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EPA Superfund
Record of Decision:

ROSE HILL REGIONAL LANDFILL
EPA ID: RID980521025
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SOUTH KINGSTOWN, RI
12/20/1999

U.S. ENVIRONMENTAL PROTECTION AGENCY
Region I, New England

RECORD OF DECISION
First Operable Unit--Source Control

ROSE HILL REGIONAL LANDFILL SUPERFUND SITE
SOUTH KINGSTOWN, RHODE ISLAND
EPA ID # RID980521025

December, 1999

DECLARATION

ROSE HILL REGIONAL LANDFILL SUPERFUND SITE
SOUTH KINGSTOWN, RHODE ISLAND
EPA ID # RID980521025

STATEMENT OF BASIS AND PURPOSE

This decision document presents the Selected Remedy for the Rose Hill Regional Landfill Superfund Site, in South Kingstown, Rhode Island, which was chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Contingency Plan (NCP). This decision document represents the first operable unit of a phased approach to remediate the environmental contamination caused by the Site. The first operable unit is a source control remedy which is intended to prevent or minimize the continued release of hazardous substances, pollutants or contaminants to the environment. The first operable unit will collect data to assess the effectiveness of the source control remedy, assess the need for taking any further response actions under a second operable unit, and assist the State with TMDL predictions for Site-related contaminant concentrations affecting local water bodies. Management of the migration of contaminants to surface or ground water will be based on data obtained from monitoring conducted under the first operable unit and any additional studies that are deemed necessary to further assess Site impacts, characterize the extent of contamination, and assess the need to develop and evaluate alternatives for future actions.

This decision is based on the Administrative Record which has been developed in accordance with Section 113(k) of CERCLA and which is available for public review at the South Kingstown Public Library in Peace Dale, Rhode Island and at the USEPA Region I -New England, Office of Site Remediation and Restoration Records Center in Boston, Massachusetts. The Administrative Record Index identifies each of the items comprising the Administrative Record upon which the selection of the remedial action is based. The Administrative Record Index is Appendix B of this Record of Decision (ROD).

The Rhode Island Department of Environmental Management has reviewed the various alternatives and has indicated its support for the selected remedy. The State has also reviewed the Remedial Investigation, Risk Assessment and Feasibility Study to determine if the selected remedy is in compliance with applicable or relevant and appropriate State Environmental laws and regulations. The State of Rhode Island concurs with the selected remedy for the Rose Hill Regional Landfill Superfund Site.

ASSESSMENT OF THE SITE

The response action selected in this ROD is necessary to protect the public health, welfare, or the

environment. The human health and ecological risk assessments identified unacceptable risks posed by actual or threatened releases of hazardous substances from this Site which if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment. Groundwater (through the use of institutional controls), air (through the collection and treatment of landfill gas) and leachate (through excavation and consolidation) are the media of focus for this operable unit response.

DESCRIPTION OF THE SELECTED REMEDY

The Selected Remedy is Alternative 4B, modified to take into account its role as the first operable unit of a phased approach to remediate the environmental contamination caused by the Site. The Selected Remedy consists of the following activities:

! **Alternative 4B**: *Consolidation of the Bulky Waste Area onto the Solid Waste Area, Containment, Leachate Collection and Treatment (during consolidation), and Landfill Gas Treatment (Solid Waste Area)*

1. Excavate and consolidate the Bulky Waste Area landfill materials onto the Solid Waste Area landfill;

2. Collect and effectively manage leachate and waters collected from runoff and dewatering operations during the excavation of the Bulky Waste Area;

3. Construct a multi-layer hazardous waste cap using innovative and cost efficient cover materials, as may be appropriate and as further defined in design, over the extent of the Solid Waste Area landfill and consolidated Bulky Waste Area materials;

4. Inspect and monitor the integrity and performance of the landfill cap over time;

5. Assess, control, collect, and treat landfill gas emissions by an active internal and perimeter gas collection system and thermal treatment of such gasses through the use of an enclosed flare and continue monitoring landfill gas concentrations to assess the need to modify the landfill gas collection treatment system as necessary;

6. Implement access restrictions and Institutional Controls (land title restrictions including, but not limited to, easements and restrictive covenants) on land use and the use of, or hydraulic alteration of, groundwater where Preliminary Remediation Goals (PRGs) (based on MCLs, MCLGs) and/or other health based standards are exceeded.

7. Install a chain link fence and/or other physical barriers where necessary to prevent

Site access, injury and/or exposure;

8. Long-term monitoring of surface water, groundwater, air and leachate emergence;

9. Perform operation and maintenance activities throughout the life of the remedy;

10. Conduct statutory five year reviews as required.

Estimated Time for Design and Construction:	*2 years*
Estimated Time of Operation:	*< 15 years for LFG; >30 years GW/Leachate*
Estimated Capital Cost:	*$11,360,000*
Estimated Operations and Maintenance Costs (net present worth):	*$6,680,000*
Estimated Total Cost (net present worth):	*$18,040,000*

STATUTORY DETERMINATIONS

The remedial action selected for implementation at the Rose Hill Regional Landfill Superfund Site is consistent with CERCLA and the NCP. The Selected Remedy is protective of human health and the environment, attains ARARs and is cost effective. The Selected Remedy partially satisfies the statutory preference for treatment which permanently and significantly reduces the mobility, toxicity or volume of hazardous substances as a principal element and utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable. The remedy uses treatment to address landfill gas emissions and includes excavation of the Bulky Waste Area to reduce mobility of hazardous substances. Consistent with EPA's presumptive remedy for municipal landfills, capping of the consolidated Bulky and Solid Waste Areas was selected given the volume of material and the cost to treat such volume.

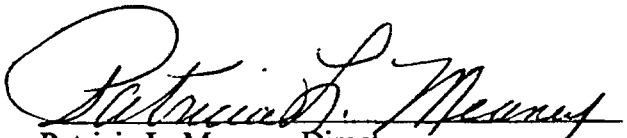
Because this remedy will result in hazardous substances remaining on-site above levels that allow for unlimited use and unrestricted exposure, a review will be conducted within five years after initiation of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

ROD DATA CERTIFICATION CHECKLIST

See attached ROD data certification checklist.

AUTHORIZING SIGNATURE

12/20/99
Date



Patricia L. Meaney, Director
Office of Site Remediation and Restoration
EPA - New England

ROSE HILL REGIONAL LANDFILL
SUPERFUND SITE ROD DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section of this Record of Decision. Additional information can be found in the Administrative Record file of this Site.

- **!** Chemicals of concern and their respective concentrations.
- **!** Baseline risk represented by the chemicals of concern.
- **!** Cleanup levels established for chemicals of concern and the basis for these levels.*
- **!** How source materials constituting principal threats are addressed.
- **!** Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of ground water used in the baseline risk assessment and ROD.
- **!** Potential land and ground-water use that will be available at the site as a result of the Selected Remedy.
- **!** Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected.
- **!** Key factor(s) that led to selecting the remedy (i.e., describe how the Selected Remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision).

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*NOTE: The selected remedy is a source control remedy which is intended to prevent or minimize the continued release of hazardous substances, pollutants or contaminants to the environment. This decision is also the first operable unit remedy of a phased clean up approach. As such, no cleanup levels are established under this remedy; instead the remedy will meet the performance standards set out in the ROD. The first operable unit remedy will meet all ARARs including those for Site air emissions, landfill closure, and process water discharge or reinjection. Management of the migration of contaminants from the Site will be addressed in a future decision document, based upon data obtained from monitoring conducted under the first operable unit, and any additional studies that are deemed necessary to further assess Site impacts, characterize the extent of contamination, and to assess the need to develop and evaluate alternatives for future actions.

RECORD OF DECISION
First Operable Unit--Source Control

ROSE HILL REGIONAL LANDFILL SUPERFUND SITE
SOUTH KINGSTOWN, RHODE ISLAND
EPA ID # RID980521025

Table of Contents

ROSE HILL REGIONAL LANDFILL
SOUTH KINGSTOWN, RI

I. SITE NAME, LOCATION AND DESCRIPTION

The Rose Hill Regional Landfill Superfund Site (the Site) is located within the town of South Kingstown, Rhode Island, in the village of Peace Dale (Figure 1) within Washington County. It lies about 5 miles inland from Narragansett Bay and 2 miles north of Wakefield, Rhode Island. The Site is bordered by Rose Hill Road to the west, the Saugatucket River to the east, and residential private property to the north and south. Remedial response activities including this Remedial Investigation and Feasibility Study were conducted under a United States Environmental Protection Agency (EPA) lead with the State of Rhode Island Department of Environmental Management (RIDEM) remaining active throughout as the support agency.

The Site is located in an abandoned sand and gravel quarry and encompasses approximately 70 acres. As shown in Figure 1, the Site consists of three separate and inactive disposal areas or landfills, referred to herein as the Solid Waste Area (SWA), the Bulky Waste Area (BWA), and the Sewage Sludge Area (SSA). An active transfer station, south of the disposal areas, is also located on the Site (Figure 2).

Two primary surface water bodies flow through the Site: Saugatucket River and Mitchell Brook. An unnamed brook, west of the Site, flows into the Saugatucket River and an unnamed tributary, in the northern portion of the Site, flows into Mitchell Brook. The Saugatucket River is classified by the State of Rhode Island as a Class B water body that is suitable for fishing and swimming. Wetland and flood plain habitats are also found adjacent to the disposal areas and are subject to runoff and contamination from the disposal areas. An open excavated area approximately 400 feet north of the disposal areas is currently used for target and skeet shooting. Approximately 200 feet west of the disposal areas, sand and gravel operators excavate sand, gravel and loam for resale to the public.

Groundwater is used within a 3-mile radius of the Site for the following purposes:

- Private residential supplies (no alternate supply available)
- Municipal public water supply

Residents in South Kingstown obtain water from both public and private wells. Private wells within a 3-mile radius of the Site consist of overburden or bedrock wells. Three supply wells for the University of Rhode Island are located 2.7 miles northwest of the Site. Two municipal supply wells for the Kingston District are located 2.9 miles northwest of the Site. The University and the District utilize each other's systems as water supply back-up.

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

A. Land Use

Prior to 1941, the Site was used for agriculture. Sand and gravel excavation operations were conducted at the Site from at least 1948 through 1963. The Rose Hill Site began operation as a landfill in 1967 in the area previously used for sand and gravel excavation. The landfill was operated by the Town of South Kingstown under a state permit from RIDEM which was renewable annually. For approximately 16 years, it received domestic and industrial wastes from residents and industries in South Kingstown and Narragansett. In October 1983, the landfill reached its state-permitted maximum capacity and active landfilling operations ceased. For the past fifty years, the Site owner has conducted organized small game hunts, the boarding, breeding, training, and showing of hunting dogs, skeet and target shooting, and stocking and periodic release of small game birds throughout the Site.

Facility Operations and Waste Disposal Practices. Table 1 provides a chronology of activities affecting the landfill operations.

Landfills in the three disposal areas (the Solid Waste, Bulky Waste, and Sewage Sludge Areas), began operations in 1967, 1978, and 1977, respectively. The Solid Waste Area landfill was closed in 1982 and the Bulky Waste and Sewage Sludge Area landfills were closed in 1983. During 1983, a transfer station for municipal refuse was located south of the Bulky Waste Area. The transfer station is currently active. At the station, refuse is unloaded from collection trucks and transferred to vehicles that transport it off site to the Johnston landfill. Figure 1 shows the three disposal areas and the transfer station at the Site.

Waste handling procedures for the Rose Hill Regional Landfill were set by state regulations and town ordinance. The waste handling practices conducted at the landfill consisted of the disposal of municipal refuse and industrial refuse including the disposal of industrial wastes. Through its investigation, EPA has acquired some information regarding the disposal and approximate location of these industrial wastes but the exact quantity and location(s) of hazardous substances disposed of on the Site throughout the landfill's operation are predominantly unknown. Information regarding the total volume of solid waste placed in the landfill is available through studies conducted for the Town of South Kingstown by C.E. Maguire.

In 1967, when activity at the landfill officially commenced, a court order prohibited the disposal of combustibles at Rose Hill. In 1978, the order was amended to allow the disposal of combustibles in the Bulky Waste Area. In 1979, the State of Rhode Island ordered cities and towns to establish facilities for the collection of waste oil. It is reported that a waste oil collection facility at the Rose Hill Site was established during this time.

A known waste handling problem concerns the disposal of liquid waste from the Peacedale Processing Company, specifically a urethane adhesive. A letter dated January 8, 1970, transmitted from an engineer of the State Division of Solid Waste Management to the South Kingstown Director of Public Works, put into writing an agreement on the disposal method for liquid waste from the Peacedale Processing Company. The two authorities came to an understanding that the drummed waste would be disposed of daily by dumping it onto other wastes that had been deposited each day. The purpose of this was to take advantage of the absorptive characteristics of the waste materials as the urethane adhesive was disposed.

A year later, on March 16, 1971, correspondence sent from the same state office notified the South Kingstown Town Manager that liquid waste from Peacedale Processing was being improperly disposed of at the Rose Hill Solid Waste landfill. The communication reiterated that the liquid waste should be spread over the surface of the landfill to allow it to be absorbed by the fill, if acceptance of such waste were to continue.

In 1979, a resident observed and reported to RIDEM the dumping of a number of barrels, with the lids intact, on the Solid Waste landfill slope within a few feet of Rose Hill Road. The truck transporting these drums on this occasion was reported to be labeled "Peacedale Processing." The resident further reported at least one barrel was labeled "slop glue." The drums were buried intact with the exception of one. One of these barrels was also observed to be at least part liquid. RIDEM investigated this report and found a drum labeled "DALTOSLEX 535" and "DRANO 21." Daltoslex is a polyurethane fabric coating dissolved in trichloroethylene (TCE), dimethyl formamide (*N*,*N*-DMF), and cellosolve solvent. Cellosolve is the trademark for mono- and dialkyl ethers of ethylene glycol and their derivatives (Sax and Lewis 1987). Analysis of samples collected from these drums identified hexane, 2-butanone (MEK), TCE, and toluene as components of the liquid. All of these chemicals are widely used industrial solvents. Dimethyl formamide and cellosolve cannot be detected by the common methods used to analyze for volatile organic compounds.

On December 6, 1979, the State Division of Solid Waste Management wrote to Kenyon Piece Dyeworks (a subsidiary of Peacedale Processing) to confirm an analysis of the waste adhesive procured from the Peacedale plant on November 19, 1979. The analysis revealed that the sample contained trichloroethylene at 29,000 parts per billion (ppb), toluene at 400 ppb, and tetrachloroethylene at 4 ppb. An analysis of the waste itself revealed that it contained trichloroethylene in the amount of 0.35%. Based upon the analyses, the waste adhesive produced at the plant was deemed not hazardous [as a solid], as defined by Rhode Island regulations, and could be disposed of at any licensed solid waste management facility. The State added that the waste adhesive was to be in a solid form when taken to the landfill and exposed to the air for at least a week prior to its disposal. Within the same time frame, Kenyon Piece Dyeworks notified the State that the company had suspended shipment of the above-mentioned waste adhesive to the Rose Hill landfill pending further investigation of its environmental reactivity.

Peacedale Processing notified the United States Environmental Protection Agency (EPA), Region I, in 1981 that the company had disposed of laminating adhesive at the Rose Hill Landfill from 1971 to 1979. Although other volatile organics, inorganics, and phthalate compounds have been detected at the Site study area, little is known about the disposal practices associated with these contaminants.

Landfill Disposal Areas. The Solid Waste Area (SWA) operated from 1967 until 1982. The exact depth of deposited solid waste materials is unknown but estimated during studies conducted for the Town of South Kingstown to be to bedrock in some places. Refuse was also reportedly deposited in areas above, below, and at the water table. Areal photographs of the disposal area compiled June 1991 by EPA's Environmental Monitoring Systems Laboratory indicate that the sand and gravel pit was filled in with refuse material starting in the southern portion and progressing north. By 1988, waste materials were present throughout the pit, and all remnants of the original sand and gravel pit were gone. Several possible leachate seeps (rust-colored staining as evidenced in November 5, 1988 photography) are observed in the northern, eastern and southern portions of the disposal area. The thickness of solid waste deposited throughout the landfill prior to 1977 is unknown. However it was estimated that from 1977 to 1982 between 10 and 14 feet of solid waste were deposited. Upon closure, the SWA was reported to have been covered with 0.5 to 2 feet of sandy soil and subsoil. Recent information indicates that only a portion of this area may have been properly covered. Natural vegetation is observed throughout most of this Area; however some spotty, less vegetated sites and occasional exposed debris is apparent where lesser amounts of cover materials were used or subsequently were eroded.

The Sewage Sludge Area (SSA) is located in the northeast section of the Site, between Mitchell Brook and the Saugatucket River. This area operated from 1977 to 1983. Its predominant use was to receive sludge from the South Kingstown wastewater treatment plant. The sludge was deposited in trenches. Aerial photographs taken in 1981 show that the northern section of a large north-to-south-orientated trench, running the entire length of this area, as well as two smaller trenches in the northern section, already contained sludge material. Three unfilled trenches were also visible at that time. The depth of each excavation and the number of trenches are unknown. Reported problems with the high moisture content of the sludge prompted the Town of South Kingstown to initiate the hauling of the sludge to the Johnston landfill. Vegetative cover in this area is less prevalent here than in the Solid Waste Area. In a letter dated July 15, 1993 from RIDEM, Division of Water Resources to the Utilities Director of the Town of South Kingstown, the Department writes: " This Department is thus in a position to confirm that this site has been properly closed, poses no threat to public health as long as the area is not excavated...", and "We [the Department) also take this opportunity to close Order of Approval No. 490 issued for the sludge disposal area."

The Bulky Waste Area (BWA), understood by reference and inference from historic Town records to have been used primarily for the disposal of large "bulky" materials such as appliances, tree stumps, and other debris, is an 11-acre area located east of the SWA and southwest of the

SSA (Figure 1). This area is approximately 200 feet east of Mitchell Brook and 250 feet west of the Saugatucket River. Disposal of materials in this Area began in 1978. Solid waste was also reportedly disposed of in the period between closure of the Solid Waste Area and construction of the transfer station (May 1982 through October 1983). Recent investigative information presented to EPA by the Town of South Kingstown in 1999 offers additional evidence that the BWA is comprised of a far greater amount of municipal solid waste than had been previously reported (see the April 1999 GZA report, in Section 11.10 of Administrative Record). Vegetation, primarily grasses overlying natural fill materials, provides a natural cover for this area.

Property Ownership. Edward L. Frisella, Sr. (deceased) and Pearl F. Frisella are owners of record of the property within which the landfill facility is located. The gravel quarry area, located adjacent to and north of the landfill, is owned by the Estate of Edward L. Frisella, Sr. In 1967, the Town of South Kingstown entered into a lease with Mr. Frisella for the operation of a Solid Waste landfill. After the establishment of the landfill, in February 1973, the Town of Narragansett entered into an agreement with the Town of South Kingstown for joint use and operation of the landfill. In 1977, Edward L. Frisella, Sr., and the Town of South Kingstown reached an agreement upon the continued use of the property as a landfill facility. This amendment to the lease provided additional land for expansion of the landfill facility (i.e., the Sewage Sludge and Bulky Waste Areas). In 1982, the Town of South Kingstown purchased 15.03 acres from Mr. Frisella for the location of the town's transfer station.

B. Response Activity

Several supporting studies have been conducted from 1975 through1994 at the Rose Hill Site prior to and during the Remedial Investigation and Feasibility Study (RI/FS). These studies have generated reports and maps concerning the Rose Hill Landfill Site. The studies are documented in the Administrative Record Index (Appendix E of this document) and many are summarized and/or referenced in either or both of the Remedial Investigation (May, 1994) and Feasibility Study (November, 1998) Reports.

Preliminary Assessment/Site Inspection. The Preliminary Assessment Report for the Rose Hill Regional Landfill Site was completed in January, 1983 followed by a Site Inspection Report completed in September, 1985. The Site was proposed for inclusion on the National Priority List (NPL) on June 24, 1988. Upon review of the Site Investigation and comments received from the proposed listing, EPA chose to conduct an Expanded Site Investigation to further characterize the Site in anticipation of final NPL listing. This effort consisted of more detailed inspection, sampling and surveying of the Site and a final report was submitted in January 1989. On October 4, 1989, the Site qualified for a final listing on the NPL.

In 1985, the Town of South Kingstown provided a municipal water line extension to adjacent residences located on Rose Hill Road and those dwellings abutting the immediate northern portion of the Site. The municipal water line extends as far north as the Site owner's driveway

(across from 349 Rose Hill Road and marked by a terminal hydrant). Hookups to the waterline were voluntary. One resident who initially refused the service was subsequently provided municipal water. By 1989, water service was provided to Broad Rock Road. Generally, residences along Rose Hill Road directly west and south of the Site use municipal water. A number of residences on Saugatucket Road and Broad Rock Road are not connected to municipal water and continue to use private wells, as do residents north of the Site on Rose Hill Road.

Removal Action. The Remedial Investigation (RI) and Feasibility Study (FS), conducted by EPA, began in 1990 with field work commencing in the Spring of 1991. In June 1991, Metcalf and Eddy (M&E), as EPA's remedial response contractor for performance of the RI/FS, installed permanent soil gas sampling wells on the three landfill disposal areas and along the perimeter of the Site. Initial results of sampling from the soil gas wells indicated the presence of explosive levels of combustible gases in the vicinity of residential dwellings abutting the landfill. As a result of M&E's soil gas results, the EPA Remedial Project Manager requested assistance from the EPA Emergency Planning and Response Branch (EPRB) to perform a removal assessment of nearby residential dwellings to ensure that the structures were free of migrating gases. The following paragraphs discuss the removal response actions conducted by EPA and a summary of the resultant conclusions. A complete history of this work, monitoring results, and reports on the removal be found in Section 2 of the Administrative Record under Removal Response.

On November 8, 1991 personnel from the United States Environmental Protection Agency Emergency Planning and Response Branch (EPRB), Waste Management Division (WMD; now known as the Office of Site Remediation and Response (OSRR)), the South Kingstown Fire Department and Technical Assistance Team (TAT) monitored 12 dwellings in proximity to the Solid Waste Area landfill for the presence of combustible gases. The results of this survey indicated that the dwellings were free of detectable concentrations of combustible gases. These results are found in a document entitled: *Methane Gas Investigation for Rose Hill Landfill, South Kingstown, Rhode Island, December 1991*, prepared by TAT.

In December 1991, the Agency for Toxic Substances and Disease Registry (ATSDR) issued a health evaluation based on analytical data generated by M&E as well as the residential survey performed in November 1991. At that time, ATSDR stated "..the data did not indicate any public health concerns, but EPA should continue periodic monitoring of the houses". As a result, EPRB requested that TAT monitor the residential dwellings on a monthly basis for the next four months. From December 1991 through March 1992, TAT monitored eight residential basements for combustible gases in ambient air using an organic vapor analyzer (OVA), a combustible gas indicator (CGI), and a photoionization detector (PID). During this time, OVA readings above background levels were observed in several residential basements, with the residential basement at 220 Rose Hill Road containing concentrations significantly above the background level (240-1,000 units). PID readings in this residential basement were not above the background readings, indicating that the gas was methane, a common landfill by-product, which is detected by the OVA but not the PID.

In July 1992, ATSDR issued another health consultation based on the monthly monitoring data and a sample collected from a soil gas well located along the foundation of 220 Rose Hill Road. Methane was detected at 18,000 parts per million (ppm) at this soil gas well.

ATSDR recommended that "a methane monitor/alarm be installed in the residence which had the 37% lower explosive level (LEL) at its external foundation". ATSDR recommended that periodic monitoring be performed on other residences.

In July 1992, EPA requested that TAT begin a biweekly monitoring program designed to monitor residential basements and the soil gas wells (installed by M&E) using a CGI, an OVA equipped with a charcoal filter (to eliminate all organic compounds except methane, ethane, and propane), and a PID (to verify that the gases detected with the OVA were methane). From July through September 1992, elevated levels of gases were detected in soil gas wells, but no significant concentration of gases were detected in any of the residential basements, including 220 Rose Hill Road. A summary of the residential basement sampling and the soil gas well sampling performed by TAT from December 1991 through September 1992 can be found in the report entitled: *Air Monitoring Data Tables, Rose Hill Regional Landfill Site, South Kingstown, Rhode Island, December 1991- September 1992*, prepared by TAT.

On September 2, 1992, EPA and TAT collected soil gas samples in Summa canisters at three soil gas wells and submitted the samples to the EPA New England Regional Laboratory (NERL) for VOC analyses. The results of the Summa samples indicated the presence of vinyl chloride in soil gas well LFGR-8 at a concentration of 4,000 ppm. The remaining two Summa samples contained other VOCs at low levels but no vinyl chloride. The presence of vinyl chloride in soil gas well LFGR-8 was verified by TAT on September 16, 1992, using a vinyl chloride Drager Chemical Detector Tube.

In October 1992, ATSDR issued another health consultation based on the September 2, 1992 Summa canister sampling results. ATSDR stated, "The presence of high levels of vinyl chloride in soil gas (4000 ppm) would justify additional characterization to determine the extent (if any) of the contaminant migration from the landfill. Additional air monitoring should include ambient air, both from the landfill property and the adjacent residential area."

On October 14, 1992, EPA Deputy Regional Administrator Paul Keough signed an Action Memorandum for Regional Administrator Julie Belaga, authorizing $1,920,000 to mitigate the threat to public health or to the environment resulting from the actual or potential exposure to nearby human populations from the migration of the landfill gases.

On October 19-20, 1992, an air and soil gas sampling survey was conducted by personnel from EPRB, the EPA Environmental Response Team (ERT), the Roy F. Weston, Inc. Response Engineering and Analytical Contract (REAC) Team and TAT. Based on the results obtained from this survey, REAC prepared two reports. The first report, entitled: *Final Emission Modeling*

Report, Rose Hill Regional Landfill, South Kingstown, Rhode Island, December 1992, estimated that the landfill would generate 800 megagrams per year (Mg/year) of methane for the next few years, and also generate 7 Mg/year of nonmethane organic compounds (NMOC). The second REAC report, entitled: *Final Air Quality Modeling Report, Rose Hill Regional Landfill, South Kingstown, Rhode Island, December 1992*, estimated that the residences around the landfill would be exposed to an average 10.7 parts per billion, volume to volume (ppb/v) vinyl chloride. Since these were models, actual data were needed to verify the estimates. Therefore two additional surveys were scheduled for the Site by EPA. In January 1993, EPRB issued a work assignment to M&E to prepare a report evaluating options for an expedited response action to mitigate the subsurface migration of landfill gases toward the residential dwellings.

The first survey was conducted by EPRB and TAT from February through March 1993, when the Site was covered by snow, and the subsurface migration of landfill gases was thought to be at the annual maximum. This survey found that only one residential dwelling (220 Rose Hill Road) had significant concentrations of methane (up to 2500 ppm) and vinyl chloride (up to 22 ppb/v). Based on the vinyl chloride result, ATSDR stated that an increased cancer risk may exist if the exposure of these levels of vinyl chloride was greater than 1.45 years. Based on the maximum vinyl chloride concentration (1.78 ppb/v) found in the other residential basements sampled and the outside ambient air, ATSDR stated that no adverse health affects were expected to occur (for the same interval of time). A summary of the results of the survey can be found in the report entitled: *Rose Hill Regional Landfill Site, Indoor Residential Air Survey Results, South Kingstown, Rhode Island, February 1993 - March 1993*, prepared by TAT.

The second survey was conducted by ERT and REAC from May 24-28, 1993, when the surface of the landfill was permeable, and the vertical migration of the gases through the surface of the landfill was thought to be at the annual maximum. Based on the results from this survey, REAC predicted the residences around the landfill would be exposed to an average 0.008 ppb/v vinyl chloride. A summary of the results can be found in the reports entitled: *Observed Ambient Air Impact Report, Rose Hill Regional Landfill, South Kingstown, Rhode Island, July 1993* and *Air Quality Modeling Final Report, Rose Hill Regional Landfill, South Kingstown, Rhode Island, August 1993*, both prepared by REAC.

The report recommended the installation of a landfill gas mitigation system consisting of a series of perimeter gas extraction wells, a gas collection system and an enclosed flare to burn the off-gases. M&E estimated the capital cost of this action at $3,770,000 and a yearly Operation and Maintenance cost of $350,000. Based upon sampling results and cost benefit analyses, an interim response action consisting of landfill gas sensors equipped with alarms for three residences and a landfill gas ventilation system for one dwelling was recommended by EPRB. A unilateral order was issued to the Town of South Kingstown in March 1993 with the above mentioned requirements (see Enforcement History below). A week later, EPRB approved the Town's Work Plan in response to the issued order requiring gas sensors, alarms, and one ventilation system to be installed at the residents' properties. By May 1993, the Town placed gas sensors and alarms at

two residences and initiated discussions with the property owner of 220 Rose Hill Road about installing a ventilation system or, alternatively, razing the dwelling. The March 1993 M&E report was used extensively as support documentation for the Feasibility Study and the remedial (long-term) response action.

On April 12, 1993, ATSDR issued a health evaluation for the samples collected in February and March 1993. ATSDR concluded that the exposure to a concentration of 21 ppb vinyl chloride at 220 Rose Hill Road may result in an increased cancer risk if the exposure were to exceed 1.45 years. ATSDR recommended that actions be taken at this residential property to prevent long term exposure. ATSDR reviewed the vinyl chloride data for the other residential dwellings and the ambient air sample results collected in February and March of the same year and concluded that "no significant risk is expected as a result of exposure to this level of vinyl chloride (a concentration range reported from non-detect to 0.99 ppb at the other residential dwellings) within the time frame that remedial action is expected to be in place (approximately 10 years)".

In June 1993, the Town of South Kingstown by agreement with the property owner and under order by EPA razed the building located at 220 Rose Hill Road and prohibited any future housing on the property.

Shortly after ERT and REAC submitted their July 1993 report entitled *Observed Ambient Air Impact Report* and the August 1993 *Air Quality Modeling Final Report* for samples gathered from May 24-28, 1993 from the residences and at the landfill, ATSDR prepared a health consult for EPA which concluded: "The maximum detected vinyl chloride [and benzene] concentration (1.6 ppb [23.4 ppb for benzene]) is below levels shown to produce adverse, non-carcinogenic health effects in animals or humans. However, long term exposure to this concentration of vinyl chloride [and benzene] in air could cause an increased risk of cancer". The health consult also contained the following recommendation: "Implement appropriate remedial actions to reduce risks associated with chronic exposure to benzene and vinyl chloride in air."

The final reports also indicated a possible "upwind" (westerly) source for these contaminants, in addition to the Rose Hill Landfill. Based on subsequent peer review of the report and additional RI data, this conclusion is thought to be erroneous. No substantiated documentation on the use, storage or disposal of any hazardous substances, including but not limited to, benzene or vinyl chloride, are known to exist with respect to the properties along Rose Hill Road and adjacent to the landfill. The report indicated that the wind velocity and direction was quite variable and at times calm. The PAL dispersion model used for this study cannot readily predict concentrations under these conditions. Therefore, the model may seriously under-predict the concentration for vinyl chloride when compared to concentrations as measured at the residential receptors. This suggests that the model results have substantial uncertainty for vinyl chloride (and for other compounds). The possible reasons for under-predicting contaminant concentrations are: 1) emission is underestimated, 2) dispersion is overestimated, and 3) that the conceptual model may be inadequate. For example, emissions may be underestimated if the flux chambers do not

represent the actual flux of landfill gas across the entire landfill surface or if laboratory recovery of vinyl chloride was low; dispersion may be overestimated if the PAL model does not adequately account for near-calm conditions; the conceptual model may be inadequate if landfill gas migrates below the ground surface to the vicinity of residential receptors. Benzene is a fairly ubiquitous contaminant and, although found to be present at the landfill, was not found in substantial concentrations in samples of landfill gas. It may be reasonable therefore to suspect that off site sources may contribute to the recorded measurements of benzene. However, vinyl chloride was found in substantial concentrations in landfill gas. This compound is not ubiquitous and is known to be a substantial degradation byproduct of chlorinated compounds found in quantity at the landfill. Since both ambient measurement results and modeled concentrations are subject to significant uncertainty, it is entirely speculative to attribute vinyl chloride at receptor locations adjacent to the Rose Hill Landfill to unknown off-site sources. The continued remedial work, including but not limited to the RI, FS, and the human health risk assessment, also took these factors into account and more advanced modeling concepts were sought in support of the continued remedial response.

In early 1994, the Town installed a bentonite clay dam around the town water line feeding the resident at 278 Rose Hill Road to prevent landfill gases from entering the residence. The Town also moved the sensor from against the outside basement wall to inside the basement to record methane concentrations inside the dwelling. The Town continues to maintain the equipment and submit data reports to EPA.

Preliminary Natural Resource Survey. On June 24 1994, the National Oceanic and Atmospheric Administration (NOAA) submitted a Preliminary Natural Resource Survey (PNRS) for the Site. The findings presented in the PNRS are based upon results documented in the EPA RI report and in a preliminary screening study entitled *An Evaluation of Saugatucket Pond Sediment, South Kingstown, Rhode Island, Final Report* (NOAA, 1994). These latter reports can be found in their entirety in Section 16 of the Administrative Record.

The findings of the PNRS indicate that the Rose Hill Regional Landfill Site is located in the Saugatucket River basin, adjacent to the Saugatucket River and Mitchell Brook, a tributary to the river. Fish passage facilities have been installed on the Saugatucket River to allow for upstream migration of anadromous fish species. The river now provides significant spawning and nursery habitat for alewife and blueback herring. Contamination from the Rose Hill Landfill may pose a threat to natural resources, including NOAA trust resources utilizing Mitchell Brook, the Saugatucket River, and Saugatucket Pond. The primary pathways of contaminant migration from the Site are groundwater discharge and surface water runoff. Iron and several trace elements were detected at elevated concentrations in surface water and sediment during the RI. The leachate seeps located on the perimeter of both the Bulky Waste and Solid Waste Areas appear to be a source of contamination to surface water bodies. A floc sample collected from Mitchell Brook contained substantial amounts of iron. In addition, iron was present at high concentrations in sediment collected as far downstream as Saugatucket Pond. Flocculent material that accumulates

near the Site may be a source of iron in sediments of the pond. Results suggest that sediment and floc transported from the vicinity of the Site contains concentrations of iron and possibly other trace element contaminants that may adversely effect blueback herring and alewife inhabiting Saugatucket Pond during sensitive life stages. While the results of the PNRS and sediment study were not unequivocal, they provided sufficient evidence to justify further study and analysis of the relationship between Site releases and adverse biological responses downstream in Saugatucket Pond.

C. Enforcement History

In April and June of 1989, EPA sent general notice letters to eight Potentially Responsible Parties (PRPs). EPA met with the PRPs in June 1989 and in June 1990, EPA sent out special notice letters to the PRPs to undertake an RI/FS. After failed attempts at negotiations, EPA requested and received funding from the Superfund trust fund to begin the RI/FS at Rose Hill.

Actual field work for the Remedial Investigation (RI) began in the Spring of 1991. Shortly after the initiation of the RI, it became apparent that the Site owner's continued use of the property (including, hunting, sport and target shooting, dog training, and other related activities) presented an unreasonable and unacceptable risk to EPA and its contractors and placed operational restrictions upon EPA in conducting the necessary field activities. On August 21, 1991, EPA issued an Administrative Order for Property Access to the property owner. An amendment to the Administrative Order for Property Access was issued on March 27, 1992 which allowed the limited use of a ten acre parcel for his business-related activities.

In March 1989, the Agency received notice of a bankruptcy proceeding and filed a proof of claim seeking reimbursement of response costs against Coated Sales and its wholly-owned subsidiary, Kenyon Industries, Inc. The Coated Sales bankruptcy proceeding involved six related corporate entities. EPA had claims against two of them, Coated Sales, Inc. ("CSI"), and Kenyon Industries, Inc. ("Kenyon"), a Rhode Island corporation and subsidiary of CSI. The bankruptcy proceeding presented EPA with its only opportunity to resolve its claims for response costs under CERCLA against CSI and Kenyon, corporate affiliates of Peacedale Processing Company, Inc., a known hazardous waste generator at the Site. In June 1994, the case was settled with EPA recovering a portion of its response costs.

On March 26, 1993, as an enforcement component to the Removal Action, EPA issued a Unilateral Administrative Order (RCRA Docket 1-93-1055) (the Order), directing the Towns of Narragansett and South Kingstown to install methane gas sensors/alarms outside the foundations and in the basements of 278 Rose Hill Road and 349 Rose Hill Road. The Order also directed the Towns to install a methane gas ventilation system and a gas sensor/alarm in the basement of 220 Rose Hill Road. As an alternative to the second directive, the Towns relocated the residents of 220 Rose Hill Road and razed the building on June 4, 1993. The alarms at 278 and 349 Rose Hill Road were installed on May 18, 1993. A summary of the alarm installation activities can be

found in the report entitled: *Completion of Work Report for Environmental Protection Agency, Administrative Order 1-93-1055, February 9, 1994,* prepared by Geological Field Services (the Town of South Kingstown's consultant). The Town is required to perform maintenance and monitoring activities and report a summary of the collected data to EPA annually.

Further information regarding the above described enforcement activities be found in Section 10 of the Administrative Record.

III. COMMUNITY PARTICIPATION

Throughout the Site's history, community concern and involvement has been moderate. EPA has kept the community and other interested parties apprized of the Site activities through informational meetings, fact sheets, press releases and public meetings.

In June 1991, EPA released a community relations plan which outlined a program to address community concerns and keep citizens informed about and involved in activities during remedial activities. On June 18, 1991, EPA held an informational meeting in South Kingstown, RI to describe the plans for the Remedial Investigation and Feasibility Study. On June 23, 1994, EPA held an open house in South Kingstown, RI to discuss the results of the Remedial Investigation.

During the removal activities, meetings were held with the residents of Rose Hill Road on January 20 and April 29, 1993 to inform the residents of monitoring results, ongoing work and proposed actions.

EPA published a notice and brief analysis of the FS and Proposed Plan in the Providence Journal on January 29, 1999 and made the plan available to the public at South Kingstown Public Library. On February 1, 1999, EPA made the Administrative Record available for public review at EPA's offices in Boston and at South Kingstown Public Library.

On February 2, 1999, EPA held an informational meeting to discuss the results of the Remedial Investigation and the cleanup alternatives presented in the Feasibility Study and to present the Agency's Proposed Plan. Also during this meeting, the Agency answered questions from the public. A joint letter from the Towns of South Kingstown and Narragansett was received on January 27, 1999 which contained a formal request to extend the 30 day public comment period by sixty days. In response to this request, the Agency held a 90-day public comment period from February 3 to May 3, 1999 to accept public comment on the alternatives presented in the Feasibility Study and the Proposed Plan and on any other documents previously released to the public. On February 18, 1999, the Agency held a public hearing to discuss the Proposed Plan and to accept any oral comments. A transcript of the hearing, the comments, and the Agency's response to comments are included in Appendix C (Responsiveness Summary) of this ROD.

Throughout the time in which the RI/FS was conducted, EPA solicited views from the Site owner, neighboring property owners, the State, the Town, and local citizen groups on the current and reasonably anticipated future land uses, and current and potential future groundwater use and value within the Site boundary and in adjacent areas. Section VI of this ROD contains a brief summary of that information.

IV. SCOPE AND ROLE OF THE FIRST OPERABLE UNIT RESPONSE ACTION

The Feasibility Study (FS) analyzed source control and management of migration alternatives for the Site. Upon extensive review and consideration of new information and comments presented during the public comment, EPA believes that additional data is needed to properly assess and evaluate management of migration options for groundwater and its impact on surface water after the source control remedy is implemented. Instituting a well designed source control remedy at the present time will minimize the migration of contaminants to groundwater. Accordingly, a more cost effective and potentially less extensive management of migration remedy can be realized through a phased approach.

The selected remedy is the first operable unit of a phased approach to remediate the environmental contamination caused by the Site. The first operable unit is a source control remedy which is intended to prevent or minimize the continued release of hazardous substances, pollutants or contaminants to the environment. Source control alternatives rely on the prevention of exposure for the protection of human health and the environment.

The first operable unit will control the sources of contamination at the Site by limiting percolation and infiltration from precipitation through waste materials thereby controlling an otherwise continued release of hazardous substances to the air and ground water. The first operable unit remedy will minimize the further migration of hazardous substances, pollutants and contaminants to groundwater and surface water. Future management of the migration of contaminants to surface and ground water will be based on data obtained from the first operable unit monitoring and any additional studies that are deemed necessary in order to further assess Site impacts, characterize the extent of contamination, and assess the need to develop and evaluate alternatives for future actions, should it be found necessary to do so.

The first operable unit remedy consists of the following components: Consolidate the Bulky Waste Area landfill onto the Solid Waste Area landfill; collect and manage leachate and waters collected from runoff and de-watering operations during the excavation and consolidation of the Bulky Waste Area; apply a protective cover (hazardous waste cap) to the Solid Waste Area landfill; assess, collect and treat landfill gases via an enclosed flare; inspect and monitor the integrity and performance of the cap over time; monitor groundwater, surface water, leachate emergence, and landfill gas emissions over the duration of the remedial action; implement deed restrictions (in form of easements and covenants) on groundwater and land use and prevent access onto the portions of the Site where remediation activities warrant this restriction; provide data to

assess the need for taking any further response actions after the cap is in place and functional; operation and maintenance of the remedy; and plan for and conduct statutory five-year reviews to ensure protectiveness. Site monitoring will furnish data to assess the effectiveness of the source control remedy and assist the State with TMDL predictions for Site-related contaminant concentrations affecting local water bodies. The Sewage Sludge Area meets minimal State requirements for sewage sludge landfill closure, and poses no significant health threat as closed. The source control remedy includes continued monitoring of this area.

The exposure to and inhalation of landfill gas and the exposure to and ingestion of contaminated groundwater are principle threats to human health posed by the Site. Leachate production poses an ecological threat to the Saugatucket River and Mitchell Brook. Consolidating and capping the landfill wastes coupled with controlling landfill gas emissions will minimize these threats by containing and treating these contaminants on-site. Once the sources are consolidated, the role of the landfill cap is to 1) effectively contain the source, 2) contain and control landfill gas emissions, 3) minimize any further migration of contaminants from the source to the groundwater, and 4) minimize the migration of the contaminated groundwater plume. Ecological risks associated with leachates reaching and impacting nearby surface water bodies are also substantially reduced through 1) removing one source in immediate proximity to the Saugatucket River, 2) consolidating the source areas to one location away from the Saugatucket River, and 3) effectively containing the combined source area, using a multi-layer hazardous waste cap. Long-term environmental monitoring coupled with deed restrictions to prevent the use of, or hydraulic alteration of, groundwater throughout the Site will ensure that the selected remedy remains protective of human health and the environment. Further assessment of the groundwater and surface water impacts as a component of the long-term environmental monitoring will be conducted after the cap is in place and functional to ensure remedy integrity and protectiveness and to support any future remedial actions that may be necessary in response to those risks posed by the Site.

V. SUMMARY OF SITE CHARACTERISTICS

Sections 1.2, 1.3 and 1.4 of the Feasibility Study (FS) contain background information including an overview of the Remedial Investigation (RI). The significant findings of the RI are summarized below. The RI/FS support documentation can be found in the Administrative Record under Section 3.0 and 4.0, respectively.

The Site study area is situated in the southwest comer of Rhode Island about five miles inland from Narragansett Bay, approximately two miles north of Wakefield, Rhode Island and located within Peace Dale; a small village of the Town of South Kingstown. The topography of the area is typical for coastal lowlands of the northeastern United States, generally flat with gently rolling hills. Elevations range from 50 to 260 feet above mean sea level with slopes of generally less than three percent.

Several geologic features that impact the movement of groundwater across the Site were identified. The behavior of groundwater in the bedrock was found to be influenced by bedrock topography, with recharge and discharge occurring at bedrock high and low areas, respectively. The predominant flow of groundwater in bedrock is to the southeast along regional fractures. Weathered and fractured bedrock (Scituate Gneiss, USGS 1956) south and west of the Solid Waste Area appears to facilitate interconnection of the overburden and bedrock flow systems.

The three major constituents of the overburden are ablation till, glacial lacustrine deposits, and glacial outwash sediments. The till and glacial outwash permit unconfined groundwater flow in a south-southeast direction. Although the groundwater flow is predominantly to the south-southeast, mounding of groundwater in the northwest corner of the Solid Waste Area may facilitate radial flow to the north, east, and west. Lacustrine deposits, encountered in the south-southeastern portion of the Site, act as a confining layer between the till and outwash. A combination of the rise in the surface elevation of the bedrock and the presence of thick lacustrine deposits along the Saugatucket River plays a significant role in the increased horizontal gradient and strong upward gradients observed south of the Bulky Waste Area.

Due to the composition and condition of existing cover materials, infiltration of precipitation through these materials is expected to be high. Groundwater interactions with the Saugatucket River and Mitchell Brook most likely play an important role in the transport of contaminants. The Saugatucket River was observed to gain water from the shallow and deep overburden and the bedrock flow systems along the western side of the river. Mitchell Brook was observed to lose water to groundwater in its upper reaches and gain groundwater in its lower reaches.

Significant ecological habitats within the Site include the Saugatucket River and Mitchell Brook, their associated tributaries and forested wetlands, and the adjacent forested and old field upland habitats. Rare plant species known to occur within the Site include a species of state interest, tickseed sunflower *(Bidens coronata)*, and a species of state concern, bloodroot *(Sanguinaria canadensis)*. A probable sighting of an avian species of state concern, red-bellied woodpecker *(Melanerpes carolinus)*, also occurred within the Site. Two avian species of state interest, glossy ibis *(Plegadis falcinellus)* and great egret *(Casmerodius albus)*, were also observed within the Site. However, the state designation applies only to breeding sites for these two species, and suitable breeding habitat does not exist within the Site, except possibly along the Saugatucket River.

As indicated by a single, reconnaissance-level survey, the Site is utilized by a variety of terrestrial species. Avian species observed on the Site were generally typical of those expected based upon geographical location, habitat present, and surrounding land uses. The extensive running of dogs and hunting on the Site have influenced the use of the Site by mammalian species. Reptiles and amphibians utilizing the Site are likely to be confined largely to terrestrial species, as Mitchell Brook does not appear to support large numbers of these organisms or other prey species, such as fish. However, the Saugatucket River likely supports a more diverse assemblage of wildlife and

aquatic species.

The macroinvertebrate species composition in the sediments of the Saugatucket River appears to be affected by the disposal areas. The species composition (in terms of the relative abundance of dominant organisms) adjacent to the disposal areas appears to be different from the species composition in upstream and downstream locations. The area adjacent to the Bulky Waste Area has the most contaminated sediments and pollution-tolerant taxa did occur in relatively high numbers in the sediments compared to the taxa in sediments in upstream and downstream locations.

Organisms in the water column of the Saugatucket River also appear to be more directly influenced by the disposal areas and leachate seeps. Total densities of organisms in the water column downstream of the disposal areas and leachate seeps are significantly lower than at upstream locations. The occurrence of pollution-sensitive invertebrate taxa in the water column also decreased from upstream to downstream locations. There also appears to be a scarcity of fish in this section of the river, where resident and migratory fish would be expected to occur.

The benthic macroinvertebrate community in Mitchell Brook does not appear to be as diverse as that of the Saugatucket River. In general, the macroinvertebrates in Mitchell Brook sediments and surface waters showed a pattern of decreasing densities from upstream to downstream locations. Species density and diversity were especially low adjacent to the disposal areas. Additionally, the occurrence of pollution-sensitive species decreased from upstream to downstream locations. In the Brook, as in the Saugatucket River, few fish were observed.

Historical sampling data gathered in support of the Preliminary Assessment and Site Investigation indicated the presence of contaminants in groundwater, landfill leachate, surface water, and sediments within the vicinity of the Site. The contamination information was summarized in the Preliminary Health Assessment written by ATSDR in 1990 and presented as follows:

- Historical contaminant concentrations in ground water collected from on-site wells were variable.

- Surface water quality data from Mitchell Brook collected in 1982 revealed the presence of 1,1,1-trichloroethane (2 ppb), methylene chloride (1 ppb), 1,2-dichloroethylene (11 ppb), 1,1-dichloroethane (1 ppb), and toluene (2 ppb).

- Off site residential wells have also intermittently revealed the presence of contaminants reportedly attributable to the Site. These contaminants included trans-1,2-dichloroethylene (27 ppb), trichloroethylene (6 ppb), di-n-butyl phthalate (20 ppb), and diethyl phthalate (20 ppb).

- In leachate, primarily from the Solid Waste Landfill, 1,1-dichloroethylene (5 ppb), trans-1,2-dichloroethylene (10 ppb), cis-1,2 dichloroethylene (2,260 ppb), benzene (15 ppb), toluene (385 ppb), ethylbenzene (35 ppb), and m-xylene (50 ppb) were reported.

- Surface water and soil samples collected in November 1987 and March 1988 revealed several volatile and extractable organic compounds; however, sampling and analytical problems precluded further use of this data.

Based upon, and in response to, the preliminary studies, the RI field work was initiated in 1991 and completed in 1994. Chemical data for surface soil, subsurface soil, groundwater, surface water, sediment, leachate, and landfill gas derived from the RI field investigation are presented below. The nature and extent of contamination in the Site study area was evaluated using analytical data generated during the RI field investigation. The results of the field investigation and information on the historical activities associated with the Site study area were used to provide an understanding of contamination and Site condition. A chronology of the RI field investigation activities is found in Table 2. To more effectively present the analytical data for the Site, sampling locations are grouped according to geographical location, disposal area or water body. Table 3 presents, by media, the different groupings used in this section.

A. Soil

Thirteen surface soil samples (SS-01 to SS-13), from 0 to 6 inches in depth, were collected in September/October 1991. In April 1992, 11 additional samples (SS-14 to SS-24) were collected from depths of 0 to 12 inches.

Three background locations (SS-01, SS-02, and SS-14) were selected and sampled. Three samples were located on the Sewage Sludge Area (SS-11, SS-12, and SS-15), three on the Bulky Waste Area (SS-09, SS-10, and SS-24), six on the Solid Waste Area (SS-03, SS-04, SS-05, SS-13, SS-16, and SS-17), and nine in non-disposal areas (SS-06, SS-07, SS-08, SS-18, SS-19, SS-20, SS-21, SS-22, and SS-23). Surface soil sampling locations are shown in Figure 3. Samples were analyzed for the following parameters:

- Volatile organics
- Semivolatile organics
- Pesticides and PCBs
- Metals
- Cyanide
- Total combustible organics (TCO; September 1991 only)
- Grain size (September 1991 only)

In addition, fourteen subsurface soil samples were collected from seven soil borings (two from each boring). Each of the borings was advanced to a depth of 20 feet. One background boring, BH-05, was drilled. Four borings were advanced in the Sewage Sludge Area (BH-01 through 04), one boring was advanced in the Bulky Waste Area (BH-06), and one was advanced in the Solid Waste Area (BH-07). Two samples from each boring were also analyzed for the above listed parameters. The analytes detected in surface soils are presented in Tables 4 and 5. The analytes detected in subsurface soils are presented in Table 6.

Surface Soil Results Summary. The presence of organic compounds in the surface soils were largely related to location (proximity to waste disposal areas). Volatile organics were the most prevalent organic compounds detected, and chlorinated and aromatic compounds and ketones were detected most frequently and in the highest concentrations. Refuse and landfill gas were the primary sources of volatile organics in surface soil. Elevated iron concentrations were found in samples near leachate seeps; and elevated lead was found throughout the Site.

Background Results. Three background samples (SS-01, SS-02, and SS-14) were collected north of the disposal areas. The locations selected were in areas that are upgradient of disposal areas and appear undisturbed by landfill operations. Samples were collected from topsoil materials and did not exhibit any signs of recent disturbance. As a result, the samples collected are considered to be representative of background conditions for surface soil.

Five organic compounds were detected infrequently at concentrations below sample quantitation limits in the background samples. Acetone was detected at 480 µg/kg in SS-14. Two phthalates, diethylphthalate and butylbenzylphthalate, were each detected at SS-02 (31 µg/kg) and SS-01 (41 µg/kg), respectively. Phthalates are widely distributed in residential as well as commercial areas because they are components in many plastics, pesticides, hydraulic oils, and lubricants. Since much of the Site study area has been used for multiple purposes, such as farming and residential use, the detection of phthalates was not unexpected.

Two polycyclic aromatic hydrocarbons (PAHs), fluoranthene (25 µg/kg) and pyrene (29 µg/kg), were also detected in SS-01, which is located approximately 20 feet away from a dirt road, and are most likely attributable to vehicular activities. Four pesticides were found in SS-01 and SS-14 at concentrations ranging from 0.6 to 1.2 µg/kg: 4,4'-DDT, 4,4'-DDE, aldrin, and endrin ketone. This family of chlorinated pesticides has been regularly used for insect control in both residential and agricultural applications from the early 1900s to the 1980s. The concentrations detected are most likely residual pesticides that were applied in the past to areas in or surrounding the Site study area. PCBs were not found in any of the background samples.

With the exception of sodium, major-metal ions (aluminum, iron, calcium, magnesium, and potassium) were detected in the three background samples at concentrations higher than those for other metals. Aluminum ranged from 12,200 to 16,600 mg/kg, iron ranged from 12,300 to 18,100 mg/kg, and basic cations (calcium, magnesium, and potassium) ranged from 213 to

1,360 mg/kg. Sodium was not reported as discussed in section 2.6. Other metals detected in the background samples include barium (15.4 to 37.8 mg/kg) and 12 heavy metals:

arsenic	2.1 to 2.8 mg/kg
chromium	11.2 to 17.5 mg/kg
cobalt	3 to 3.6 mg/kg
copper	3.5 to 5.3 mg/kg
lead	11.1 to 30.1 mg/kg
manganese	82 to 267 mg/kg
mercury	0.17 mg/kg
nickel	4.1 to 5.5 mg/kg
thallium	0.28 mg/kg
vanadium	16 to 25.7 mg/kg
zinc	21 to 30.1 mg/kg

These metals are present in other soil samples in the eastern United States and Rhode Island, with the exception of thallium, which was not analyzed for, and beryllium, which was not detected in the literature samples. Barium, beryllium, chromium, cobalt, copper, lead, manganese, mercury, vanadium, and zinc were also found in background subsurface soil samples collected in the Site study area. Aluminum, lead, and mercury were found at concentrations within the ranges listed for the eastern United States and at concentrations less than those reported in the Rhode Island sample. Lead and beryllium were found at concentrations above those reported for the Rhode Island sample but within the range reported for the eastern United States. Since metals are naturally occurring in soils and can vary within a small area, it was not possible to determine the significance of differences between literature values and concentrations detected in these samples. However, lead concentrations may be elevated throughout the Site study area because of bullets (or pellets, shot) used in the shooting of game birds, skeet shooting, and target practice, in recent years.

Cyanide was not detected in any of the background samples. The organic content of the samples was measured as 6.8 and 7.5% at SS-01 and SS-02, respectively, which indicate low organic content in the soils.

Sewage Sludge Area Results. Surface soil samples were collected at three locations (SS-11, SS-12, and SS-15) in the Sewage Sludge Area. Topsoil/fill material was encountered at thicknesses of 2 to 5 feet (based on boring activities) in several locations in the Sewage Sludge Area. The origin and thickness of fill overlying the Sewage Sludge Area is not entirely known. The fill is reportedly from a combination of off site sources and sand and gravel excavated from areas north of the disposal areas (Figure 4). There was no evidence of sludge material in any of the surface soil samples. In addition, vegetation was not present in the immediate vicinity of SS-11.

The analytes detected are presented in Tables 4 and 5. Figures 5 and 6 present a summary of the organic compounds detected.

A few organic compounds, including several volatile and semivolatile organics and pesticides, were identified in two of the surface soil samples (SS-11 and SS-12), but were not detected in SS-15 (Tables 4 and 5). PCBs were not detected in any of the samples.

Acetone was detected in SS-11 (23 µg/kg) and SS-12 (14 µg/kg), and 2-butanone (MEK) was detected in SS-12 (4 µg/kg). Diethylphthalate was also detected at a concentration less than sample quantitation limits (29 Fg/kg) in SS-12. A similar concentration was found in a background surface soil sample. Tetrachloroethene and pyrene were detected in SS-11 at concentrations below sample quantitation limits (2 µg/kg and 26 µg/kg, respectively). Pyrene was also detected in the background surface soil.

In addition, 4-chloroaniline, dieldrin, and *alpha*-chlordane were detected in SS-11 at 490, 4.5, and 3.7 µg/kg, respectively. The source of these compounds is not clear. The immediate area from which SS-11 was collected is characterized by the absence of vegetation. While there was no physical evidence of sludge material at this location, similar compounds were detected in subsurface media investigated in this area. *alpha*-Chlordane was detected from 2 to 8 feet in BH-01, located in the southern portion of the disposal area, and 4-chloroaniline was also found in groundwater from MW-II, in the central portion of the Sewage Sludge Area. Both the boring and well are in contact with sludge material.

If present in buried sludge, limited partitioning of pesticides from the sludge material upwards into the cover material would be expected because of strong adsorption and low volatility characteristics of pesticides in soils. Dieldrin is a photo- and biodegradation product of aldrin, which was found in background surface soil. In addition, chloroanilines are formed from the degradation of some pesticides and can be produced during wastewater treatment. For these reasons, these compounds may be attributed to the underlying sludge material. However, 4-chloroaniline is also used in agricultural chemicals.

Of the 20 metals detected in surface soil samples, major-metal ions (aluminum, iron, calcium, magnesium, and potassium) were detected in each of the samples and at higher concentrations than those for other metals. Concentrations ranged from 3,450 to 6,740 mg/kg for aluminum, from 7,190 to 10,400 mg/kg for iron, and from 263 to 1,300 mg/kg for basic cations. Sodium would also be expected to be detected, but was not reported, as described in section 2.6.2. Besides major-metal ions, barium, lead (2.6 to 11.8 mg/kg), manganese (96.4 to 135 mg/kg), and zinc (19.9 to 56.5 mg/kg) were detected in the three surface soil samples. Other heavy metals, consisting of arsenic (0.52 to 0.86 mg/kg), chromium (5.3 to 9.8 mg/kg), cobalt (3 to 3.6 mg/kg), and nickel (3.9 to 5.4 mg/kg), were found in SS-11 and SS-12 (both were collected in September/October 1991 from depths of 0 to 6 inches), while copper (9.9 to 99.3 mg/kg) and vanadium (12 mg/kg) were detected at SS-11 and SS-15, which was collected in April 1992 from

depths of 0 to 12 inches. Antimony, mercury, and silver were detected in SS-11 at 78.8, 0.28, and 1.6 mg/kg, respectively. Thallium (0.25 mg/kg) was found in SS-12. Beryllium (0.4 mg/kg) was detected at SS-15. Generally, more heavy metals and higher metal concentrations were measured in SS-11 relative to the other two samples.

With the exception of antimony, all of the metals detected in these surface soil samples were also found in background surface soils. In comparison to the largest metal concentrations detected in background samples, concentrations were less than two times greater than background for barium, manganese, and zinc, but were as much as 20 times greater for copper. Copper was the only metal that was significantly higher in concentration in the Sewage Sludge Area than in the background samples. All of the other metals detected in the surface soil samples were within or below the range detected in the background samples.

Cyanide was not detected in any of the samples. The organic content of the samples was measured at 0.9 and 2.8% in SS-12 and SS-11, respectively.

Bulky Waste Area Results. Three surface soil samples (SS-09, SS-10, and SS-24) were collected from the Bulky Waste Area. The sample located at SS-09 was selected because of the detection of elevated volatile organics in landfill gas at this location. The other sample locations were chosen to characterize the area. During installation of landfill settlement platforms, 2 to 4 feet of fill was encountered at ground surface in this area, whereas refuse was found at ground surface at the eastern perimeter during boring activities (BH-06). This indicates that fill/soil material does not continuously cover the area.

The surface soil samples collected consisted predominantly of topsoil and sand or sand/gravel material. Refuse was not visible, although organic vapors and methane (CH_4) were measured during sampling. Vegetative cover in the area generally consisted of tall grass (section 3.4 of the RI).

Organic compounds were detected at SS-09 and SS-10 but were not detected at SS-24. The types of organic compounds found included chlorinated and aromatic volatiles, ketones, and one phthalate. Acetone, MEK, and PCE were the only compounds detected at concentrations above sample quantitation limits. Pesticides and PCBs were not detected in any of the samples.

Two ketones, acetone (45,000 µg/kg) and MEK (1,400 µg/kg), were detected at SS-09. Acetone was also detected at SS-10 (37 µg/kg). Acetone is commonly found in municipal and industrial landfills from the disposal of solvents or industrial materials, and MEK was identified in industrial waste disposed of in the Solid Waste Area. In addition, production of acetone during degradation processes results in releases to subsurface media.

Chlorinated organics detected at SS-09 include PCE (24 µg/kg) as well as 1,2-DCE, chloroform, and TCE at concentrations less than the sample quantitation limit (8, 2, and 2 µg/kg, respectively).

Tetrachloroethene was also found at SS-10 (3 µg/kg). Three aromatic volatiles consisting of toluene, ethylbenzene, and xylene were also detected at concentrations up to 10 µg/kg at SS-09. Butylbenzylphthalate, which was also found in background surface soil, was detected in SS-10 at a concentration less than the sample quantitation limit (120 µg/kg). These organic compounds are known to have been disposed of during landfill operations, and are typically found in municipal wastes.

Of the 13 metals detected in the surface soil samples, major-metal ions (aluminum, iron, calcium, magnesium, and potassium) were detected at the highest concentrations in all of the samples. Aluminum ranged from 6,500 to 8,940 mg/kg, iron from 9,240 to 11,650 mg/kg and basic cations from 442 to 1,270 mg/kg. Sodium was also detected at similar concentrations, but was not reported. Barium (14.4 to 16.5 mg/kg), manganese (105 to 154 mg/kg), lead (4.3 to 5.6 mg/kg), vanadium (10.2 to 15 mg/kg), and zinc (19.3 to 36 mg/kg) were also found at all three locations. In addition, beryllium and copper (0.52 and 5.6 mg/kg, respectively) were detected at SS-24. Arsenic, chromium, cobalt, and nickel were detected at concentrations from 1.05 to 0.8 mg/kg at SS-09 and SS-10. All of these metals were also found in background surface soil. Concentrations measured in the three bulky waste samples were near (less than two times greater) or within the range found in background surface soil. Cyanide was not detected in any of the surface soil samples. The organic content of the samples ranged from 1.9 to 2.9%.

Solid Waste Area Results. Six surface soil samples were collected from the Solid Waste Area. Surface soil sampling points SS-03, SS-04, and SS-05 were located to evaluate areas where volatile organics were detected in landfill gas. Locations for SS-16 and SS-17 were chosen to further characterize the area, and SS-l3 was located near exposed glue-like waste.

During walkovers of the Solid Waste Area many places of exposed refuse were observed. Many of these areas are located near the perimeters of the disposal area, although other exposed areas are also within the boundaries of the disposal area. Two of the samples (SS-03 and SS-05) were collected in areas where there was little topsoil or fill material, and outcrops of exposed refuse occurred. Elevated levels of organic vapors were measured during excavation of these samples. The sample collected at SS-03 consisted of sandy soil intermixed with decomposing refuse and spongy glue-like waste material, while the sample collected at SS-05 was composed of topsoil and refuse. At SS-04, 3 inches of brown weathered sand underlain by a darkly stained sand was sampled. Elevated readings were detected at this location with the FID but not the PID. Similar measurements were made at SS-13, where organic-enriched topsoil, sand, and spongy glue-like waste were collected. A chunk of this waste removed from near SS-13 was analyzed and found to consist of methyl methacrylate, a component of laminants and adhesives (section 4.1 of the RI). Again elevated FID readings were measured, although no PID readings occurred at this location. The other two samples (SS-16 and SS-17) were collected from locations where topsoil and vegetative cover were present. These samples consisted of compacted sand and silt intermixed with pebbles and organic-enriched soil, respectively. There was no visible evidence of refuse in these samples.

Similar findings were also noted during boring and excavation (installation of landfill settlement platforms) activities, as fill material at the ground surface ranged in thickness from 0 to 1.5 feet. In addition, grey or dark-stained soil that was similar to the material collected at SS-04 was also noted at about 0.5 feet below the ground surface at several locations.

The types of volatile organics detected in the surface soils consisted of chlorinated and aromatic volatiles and ketones. Semivolatile organics found include PAHs and phthalates. Pesticides were also detected. PCBs were not detected in any of the samples.

Volatile organics were detected in all of the surface soil samples except at SS-17. Eight of the volatile organics (including 1,1-DCA, 1,2-DCE, toluene, ethylbenzene, xylenes, acetone, and MEK) were generally found in higher concentrations and more often than other volatile organics. Other volatile organics (including PCE, 1,1,1-TCA, 1,1-DCE, chloroform, benzene, 4-methyl-2-pentanone (MIBK), and 2-hexanone were found at concentrations less than sample quantitation limits. Vinyl chloride was also detected.

The majority of chlorinated volatiles were detected in SS-03 and SS-13. Total concentrations at SS-13 were 2,700 µg/kg and at SS-03 were 1,000 µg/kg. As previously mentioned, these samples were collected near refuse and glue-like waste. Chlorinated volatiles were also detected in SS-05 and SS-04. These locations were also sampled near refuse or in discolored fill, respectively. Tetrachloroethene was detected at concentrations below sample quantitation limits (2 to 5 µg/kg) in SS-03, SS-04, and SS-13. 1,1,1-Trichloroethane was also found at 8 µg/kg in SS-03. 1,2-Dichloroethene was found at the highest concentrations in SS-03 (970 µg/kg) and SS-13 (2,400 µg/kg). 1,1-Dichloroethane was also detected in SS-03 (25 µg/kg), while 1,1-DCE was detected in SS-13 (4 µg/kg). Vinyl chloride was also detected at SS-13 (250 µg/kg) and at SS-03 (4 µg/kg). Dichlorinated volatiles and vinyl chloride are common degradation products. In addition, up to 3 µg/kg of chloroform was found at SS-05 and SS-03.

Aromatic volatiles consisting of benzene, toluene, ethylbenzene, and xylenes (BTEX compounds) were present at three of the surface soil samples (SS-03, SS-04, and SS-13). Toluene (58 to 110 µg/kg), ethylbenzene (11 to 21 µg/kg), and xylenes (20 to 84 µg/kg) were found in all three samples. In addition, benzene was detected at 6 µg/kg in SS-03 and SS-13. The highest total BTEX concentrations (220 µg/kg) occurred at SS-13.

The ketones detected in surface soils in this area include acetone, MEK, 2-hexanone, and MIBK. Ketones were detected more often and in the highest total concentrations at SS-04 (160,000 µg/kg), and were also found in SS-03, SS-05, SS-13, and SS-16 at concentrations ranging from 24 to 4,000 µg/kg. Acetone was detected at an elevated concentration (160,000 µg/kg) in SS-04. Acetone concentrations at other locations were lower (75 µg/kg in SS-05 to 4,000 µg/kg in SS-16). 2-Butanone was detected in SS-03, SS-04, and SS-13. 2-Hexanone and MIBK were each detected once at SS-04 at concentrations below sample quantitation limits (3 and 6 µg/kg, respectively).

Isopropanol (IPA) was also detected as a tentatively identified compound (TIC) in SS-04 at a relatively high estimated concentration. Since this was an isolated occurrence at elevated concentrations, it is not suspected of being an artifact from field procedures. In addition, IPA was potentially disposed of in the Solid Waste Area (Kenyon Piece Dyeworks 1979). The other volatile organics are all commonly found in municipal waste, and some of these compounds (MEK, PCE, TCE, and toluene) were components of industrial wastes deposited in this area.

Phthalates and PAHs were detected in several samples at concentrations below sample quantitation limits. Butylbenzylphthalate (41 µg/kg) was detected at SS-03, and diethylphthalate (29 µg/kg) was detected at SS-13. Similar concentrations were also detected in background samples. Ten different PAHs were each detected in SS-04, SS-05, and SS-17 at concentrations ranging from 19 to 170 µg/kg. Two of the PAHs, pyrene (38 µg/kg) and fluoranthene (33 µg/kg), were also detected in SS-13. The detection of PAHs in surface soils in urban areas is common. Debris from fires or ash from boilers or fireplaces may contain PAHs. In the past, used oils were typically applied to the surface of dirt roads or the shoulders of paved roads to reduce airborne dust. Also, fuel oil, asphalt, tar, or heavier fractions of petroleum products contain PAHs, which can be released to the environment either directly or by combustion (i.e., automobile fumes). These PAHs may also be attributed to wastes disposed of in the Solid Waste Area.

The DDT family of pesticides was detected at SS-04, SS-13, SS-16, and SS-17. Except for 4,4'-DDE, concentrations were less than sample quantitation limits. 4,4'-DDT was detected at SS-04 (4.7 µg/kg) and SS-17 (0.9 µg/kg). 4,4'-DDD was detected at SS-13 (5.2 µg/kg) and SS-16 (0.24 µg/kg), and 4,4'-DDE was detected at SS-13 (7.6 µg/kg) and SS-17 (0.33 µg/kg). 4,4'-DDE and 4,4'-DDT were also detected in background surface soil samples. The concentrations found in the Solid Waste Area, however, were generally greater than those in the background samples. The disposal of insecticides, rodenticides, or herbicides in municipal solid waste landfills was not regulated until the mid-1980s. Until then, these chemicals were regularly disposed of by the public. Hence, it is likely that these contaminants would be present in the Site study area.

Major-metals ions (aluminum, iron, calcium, magnesium, and potassium) were detected at concentrations greater than other metals. Sodium was also detected at similar concentrations, but was qualified as nondetected. Barium (15.5 to 20.3 mg/kg), manganese (92.1 to 138 mg/kg), and four heavy metals (copper, lead, vanadium, and zinc at concentrations ranging from 5.4 to 253 mg/kg) were also detected in all of the samples. Arsenic, chromium, copper, and nickel were detected at concentrations from 0.81 to 12.8 mg/kg in the four samples collected from 0 to 6 inches (SS-03, SS-04, SS-05, and SS-13). In addition, beryllium was found at SS-16 and SS-17, while silver was detected at SS-03 and SS-13, and thallium was found at SS-03. Except for silver, all of the metals detected in the Solid Waste Area were also found in background surface soil. The highest concentrations tended to occur at SS-13 or SS-03. Of the metals detected, copper concentrations were as much as 50 times greater than found in background surface soils. However, based on the available data, no statistical difference was evident between the metal concentrations, including copper, and concentrations in background surface soil

(Appendix D of the RI).

Cyanide was not reported in any of the surface soil samples. The organic content of the soil ranged from 2.3 to 9.4%.

Non-disposal Areas Results. Nine sampling locations were selected outside of the disposal area boundaries. Two surface soil samples, SS-07 and SS-08, were collected on residential property to evaluate volatile organics detected in soil gas. Samples collected from these locations consisted of roots and organic-enriched soil with sand. Organic vapors were measured at SS-07. Locations for SS-18, north of the Solid Waste Area, and SS-22 and SS-23, between the Bulky Waste Area and Saugatucket River, were positioned near leachate outbreaks. Samples from these locations were characterized by dark organic matter intermixed with sand, silt, and roots. An orange leachate outbreak was observed about 3 feet from SS-23. Surface soil samples SS-19 and SS-20 were collected south of the Solid Waste Area, in a wooded area near Mitchell Brook. Samples consisted of decomposing organic matter intermixed with sand and silt. In an open area, approximately 150 feet south of the Transfer Station Road, SS-06 was collected. SS-21 was collected in a low-lying drainage area next to the eastern perimeter of the Solid Waste Area. The sample was collected from a 4-by-25-foot area with little to no vegetation and orange-stained sand that was presumed to be a dried-up leachate seep since a drainage swale was identified near this location (Figure 7). Orange-stained sandy soil was collected at this location.

Volatile organics (chlorinated and aromatic volatiles and ketones) were detected at five locations. Chlorinated volatiles were detected at concentrations below sample quantitation limits in three locations. Tetrachloroethene was found at 4 µg/kg in SS-08, while 1,1-DCA and 1,2-DCE were found in SS-07 at 2 (field duplicate only) and 6 µg/kg, respectively. SS-07 was collected near an area where leachate seeps were observed in past years by the residents and elevated volatile organic concentrations were measured in landfill gas a few feet away. Chloroform was detected in SS-06 (2 µg/kg), which is less than 100 feet from where landfill gas was detected. Concentrations of BTEX compounds ranged from 2 to 12 µg/kg. Ethylbenzene, toluene, and xylene were detected at SS-22, and toluene was found at SS-23. These compounds were also detected in a nearby leachate seep (section 4.2.3 of the RI). Acetone and MEK were found in SS-06, SS-07 (in field duplicate), SS-08, and SS-22 at concentrations ranging from 15 to 4,400 µg/kg and 23 to 33 µg/kg, respectively. Volatile organics were not detected at three locations: SS-19, SS-20, and SS-21.

Diethylphthalate (27 to 42 µg/kg) was detected in SS-20 and SS-22 at concentrations similar to those found in background surface soil. Ten individual PAHs, at concentrations ranging from 31 to 100 µg/kg, were detected at SS-07. While individual concentrations were below sample quantitation limits, total concentrations equaled 560 µg/kg. At this location, these compounds have likely resulted from runoff from Rose Hill Road, approximately 10 feet away. Several PAHs were also found in background surface soil at similar concentrations.

Other PAHs were detected in SS-08, SS-22, and SS-23 at concentrations ranging from 23 to 120 µg/kg. Two pesticides, 4,4'-DDT (0.38 to 5.2 µg/kg) and 4,4'-DDE (0.38 to 11 µg/kg), were found in SS-07, SS-18, SS-22, and SS-23. Endrin ketone was found at a concentration of 2.3 µg/kg in SS-08. These pesticides were also found in background surface soil, although at lower concentrations. PCBs were not detected in any of the samples. SS-22 and SS-23 are located downslope and downgradient of the Bulky Waste Area, near large leachate outbreaks. SS-18 is located downslope of the Solid Waste Area, and SS-08 is located on residential property.

Major-metal ions (aluminum, iron, calcium, magnesium, and potassium), barium (3.1 to 3.5 mg/kg), lead (2.8 to 6.3 mg/kg) manganese (12.9 to 6,120 mg/kg), vanadium (3.2 to 27.2 mg/kg), and zinc (10.3 to 37.4 mg/kg) were detected in each of the samples. Other metals detected include beryllium (0.37 to 0.88 mg/kg), arsenic (3.1 to 3.5 mg/kg), chromium (3.2 to 13.9 mg/kg), cobalt (3.8 to 12.8 mg/kg), copper (2.8 to 6.3 mg/kg), mercury (0.2 to 4.1 mg/kg), nickel (6.2 to 10 mg/kg), and selenium (5.9 mg/kg). Concentrations of major-metal ions were larger than those of the other metals detected: aluminum was 1,740 to 14,400 mg/kg, iron was 4,090 to 149,000 mg/kg, and basic cations were 106 to 1,710 mg/kg. The number of metals as well as concentrations tended to be higher in surface soil collected near leachate seeps (SS-18, SS-22, and SS-23). In particular, iron concentrations (15,100 to 149,000 mg/kg) at these locations were elevated in relation to background surface soil. Elevated iron concentrations were also found at SS-21 (40,500 mg/kg), collected from a large area of orange-stained soil to the east of the Solid Waste Area, presumed to be a dried-up leachate seep or drainage area.

Cyanide was not detected in any of the surface soil samples. The organic content of soils analyzed for TCO ranged from 3.2 to 12.6%.

Subsurface Soils Results Summary. Within the disposal areas, seven soil boring locations, including one background, four located in the Sewage Sludge Area, and one each in the Bulky and Solid Waste Areas, were drilled to collect subsurface soils. Fourteen samples were collected from the seven borings (two from each boring). The chemicals detected included typical municipal and industrial wastes: ketones, toluene, PAHs, phthalates, phenols, pesticides, and dichlorobenzenes. These compounds were similar to the types of compounds detected in surface soils and landfill gas. Although several metals were detected, most were not significantly elevated compared to background soils. Buried waste provides an active source for the release of contaminants to subsurface soils.

Background Results. The background boring, BH-05, was located in a wooded area just northwest of the Sewage Sludge Area. Trees in the area appear to be at least 20 to 30 years old. In addition, aerial photographs taken from 1941 to 1988 (United States Environmental Protection Agency 1987a, 1991a) indicate that excavation has not occurred and that this location has remained largely undisturbed during landfill operations. Glacial outwash was present throughout the boring. For these reasons, the samples collected from BH-05 are considered to be representative of background conditions in subsurface soils.

Volatile organics, pesticides, and PCBs were not identified in either of the samples from BH-05. The only semivolatile organics detected in samples from this boring were two phthalates, at concentrations less than sample quantitation limits. Di-n-butylphthalate was detected at 62 µg/kg from 0 to 2 feet, and di-n-octylphthalate was detected at 19 µg/kg from 10 to 16 feet but was not detected in the field duplicate for this sample.

Major-metal ions (aluminum, iron, magnesium, and potassium) were detected in both samples at concentrations that were higher than those for other metals. Concentrations ranged from 3,955 to 11,800 mg/kg for aluminum, from 6,415 to 12,800 mg/kg for iron, and from 415 to 1,350 mg/kg for magnesium and potassium. Calcium and sodium were also detected, but were not reported because of qualifications during validation. Beryllium (0.47 to 0.59 mg/kg) and seven heavy metals including chromium (3.8 to 9.2 mg/kg), cobalt (3.1 to 5.4 mg/kg), copper (3.4 to 3.5 mg/kg), lead (2.6 to 12.6 mg/kg), manganese (125 to 148 mg/kg), vanadium (6.2 to 19.3 mg/kg), and zinc (12.1 to 20 mg/kg) were also detected in each of the samples. In addition, barium (19.1 mg/kg) and mercury (0.15 mg/kg) were each detected in only one sample. All of these metals were also detected in background surface soils. With the exception of beryllium and cobalt, which were as much as two times greater, concentrations of the metals detected were within the range found in background surface soil. Aluminum concentrations were higher than those reported for soils in the eastern United States, but were lower than those reported for Rhode Island (Table 7).

Cyanide was not detected in either of the background subsurface soils. An organic content of 0.7% was measured in BH-01 (10 to 16 feet). The grain-size distribution shows that the outwash material is predominately composed of sand (51.1%), with some silt and small quantities of clay and gravel present (39.4, 3.1, and 6.5%, respectively).

Sewage Sludge Area Results. Four borings (BH-01 to BH-04) were advanced in the Sewage Sludge Area. Soil borings BH-01, BH-03, and BH-04 were located to evaluate minor landfill gas readings, while BH-02 was advanced to help define the western perimeter of the disposal area boundary. Between 2 and 6 feet of topsoil and fill material were encountered at the top of each borehole. At BH-02 and BH-04, the remainder of the borehole consisted of glacial outwash material. Although no odors, staining, or sludge material were observed in these borings, organic vapors were measured in BH-04. Sludge material and sewage odors were evident during advancement at BH-01 and BH-03. Elevated organic vapor levels were also measured in these borings.

The analytes detected are summarized in Table 6. The organic compounds detected are shown on Figure 8. Volatile organics, phenols, phthalates, and pesticides were detected in several subsurface soil samples. PCBs were not found in any of the samples.

No volatile organics were detected in the shallow sample at BH-03 (2 to 4 feet) or in either of the samples collected at BH-02 and BH-04. Sludge material and sewage odors were observed in the

samples in which volatile organics were found. Toluene was detected in one sample, BH-03 (16 to 20 feet). Acetone and MEK were each found in samples from BH-01 (2 to 8 feet and 10 to 16 feet) and in BH-03 (16 to 20 feet). Concentrations ranged from 84 to 740 µg/kg for acetone and 73 to 340 µg/kg for MEK. Acetone was also found in landfill gas at a depth of 12 feet in this area (section 4.2.8). The highest concentrations for both these chemicals occurred in BH-01 (2 to 8 feet).

Phenol, PAHs, and phthalates were found in BH-01, BH-02, and BH-03. One PAH, 2-methylnaphthalene was detected at 27 and 140 µg/kg in the two samples from BH-01 (0 to 8 feet and 8 to 10 feet, respectively). Likewise, 4-methylphenol (2,200 and 5,600 µg/kg) was found in the two samples from BH-01 (2 to 8 feet and 8 to 10 feet), respectively. Phenol (240 µg/kg) was also detected in the shallow sample (2 to 8 feet). Concentrations of these compounds tended to be higher in the sample from 2 to 8 feet than in the deeper sample from 8 to 10 feet. Another phenol, 2-methylphenol (700 µg/kg), was detected from 16 to 20 feet at BH-03.

Phthalates, which are ubiquitous in the environment, were found in all of the borings in this area and in background subsurface soil. Two phthalates were detected at concentrations less than the sample quantitation limit. Di-n-butylphthalate was detected at concentrations ranging from 40 to 120 µg/kg in four samples: BH-02 (8 to 10 and 16 to 18 feet), BH-03 (16 to 20 feet), and BH-04 (8 to 10 feet). Di-n-octylphthalate was detected in BH-02 (16 to 18 feet) and BH-03 (16 to 20 feet) at concentrations of 26 to 86 µg/kg, respectively. Although BH-02 and BH-04 were composed of glacial outwash, it is likely that the material was disturbed because of the extensive excavation throughout the disposal area.

Two chlordane pesticides (*alpha* at 6.2 mg/kg and *gamma* at 7.5 mg/kg) were detected in one sample, BH-01 (2 to 8 feet). *alpha*-Chlordane was also detected in surface soil and is typically found in Sewage Sludge Landfills.

Of the 15 metals detected in the subsurface soils in this area, major-metal ions (aluminum, iron, magnesium, and potassium) were detected at the highest concentrations (367 to 8,635 mg/kg). Aluminum concentrations ranged from 3,705 to 6,000 mg/kg, iron ranged from 3,400 to 8,635 mg/kg, and magnesium and potassium ranged from 367 to 1,700 mg/kg. Beryllium (0.35 to 0.71 mg/kg) and six heavy metals, including chromium (1.6 to 8.9 mg/kg), cobalt (1 to 6.3 mg/kg), copper (4.2 to 79.2 mg/kg), lead (2.3 to 8.8 mg/kg), vanadium (5.7 to 11.4 mg/kg), and zinc (16.5 to 188 mg/kg), were reported in at least seven of the samples (Table 4-8). Barium (10.1 to 54.3 mg/kg), antimony (5.4 to 16.8 mg/kg), manganese (106 to 213 mg/kg), and mercury (0.13 to 0.47 mg/kg) were detected less often.

Generally, the highest concentrations were found in one of the two samples from BH-01. Except for antimony, all of the metals detected were also found in background surface soils. Most of the metal concentrations were near (less than two times greater) or within the range detected in background subsurface soils. Barium and manganese were as much as two to three times higher,

while zinc was as much as nine times higher, and copper was as much as 20 times higher than the concentration detected in background surface soil.

As shown in Table 8, elevated metal concentrations typically occur in sewage sludge landfills. The highest metal concentrations tended to occur in samples collected from BH-01 and BH-03, where sludge was observed. Even though large differences in concentrations were evident for some metals, none of the differences were found to be significantly higher for samples associated with sludge material from this area in comparison to background subsurface soil (Appendix D of the RI).

Cyanide was not detected in any of the samples. The organic content in samples from BH-01 (2 to 8 feet) and BH-03 (16 to 20 feet) was 3.0 and 0.5%, respectively. Grain-size distribution for these samples shows that sand is the predominant fraction (61.4 to 79.9%), with some silt (14.1 to 29.4%), and only small percentages of gravel and clay (5.5 to 6.8% and 0.4 to 2.3%, respectively).

Bulky Waste Area Results. One soil boring (BH-06) was located in the Bulky Waste Area. During drilling, a large amount of refuse was encountered from 0 to 6 feet, which was underlain by glacial outwash from 6 to 20 feet. The types of refuse identified included nylons, paper, bottles, wire, and black organic (decomposed) material. Two samples were collected: one from 2 to 4 feet and a second from 6 to 10 feet.

One volatile organic (acetone) and one pesticide (4,4'DDE) were detected at this boring. No semivolatile organics or PCBs were found at either of the depths. A summary of the organic compounds is presented in Figure 8.

Acetone was detected at concentrations of 350 and 48 µg/kg at 2 to 4 feet and 6 to 10 feet, respectively. This compound was also found in landfill gas at other portions of this disposal area. 4,4'-DDE was detected at 4.6 µg/kg in the 2-to-4-foot sample. The detection of this pesticide is most likely attributed to the materials disposed of in the Bulky Waste Area, although 4,4'-DDE was also found in background surface soil at a lower concentration.

Major-metal ions (aluminum, iron, magnesium, and potassium) were detected in both samples at the highest concentrations (401 to 9,530 mg/kg). Barium, beryllium, and seven heavy metals [chromium (3 to 6.3 mg/kg), cobalt (3.5 mg/kg), copper (3.3 to 4.1 mg/kg), lead (4.5 to 61.4 mg/kg), mercury (0.2 to 0.24 mg/kg), vanadium (6.7 to 11.3 mg/kg), and zinc (18.9 to 95.9 mg/kg)] were also detected in both samples. In addition, antimony was found at 6.0 mg/kg from 6 to 10 feet, and manganese was found at 116 mg/kg from 2 to 4 feet. Concentrations of individual metals were usually near or within the range detected in background samples. Concentrations of mercury were less than two times greater, and lead and zinc were as much as five times higher than those in the background. Even though some of these metal concentrations were elevated, it cannot be demonstrated that there is any significant difference between concentrations in these subsurface soil samples compared to those in background subsurface soil

(Appendix D of the RI).

Cyanide was not detected in either sample. The grain-size distribution and TCO analysis conducted on BH-06 (6 to 10 feet) indicate that sand (59.8%) was the largest fraction present, followed by silt (29.8%), gravel (8.8%), and clay (5.5%). An organic content of 1.0% was also measured.

Solid Waste Area Results. One soil boring (BH-07) was drilled at the southern end of the Solid Waste Area. A strong refuse odor was present during drilling activities, and organic vapors ranging from 30 to 300 ppm occurred. Assorted refuse, including household garbage, milk cartons, plastic, and paper, was encountered throughout the entire 20 feet of the boring. Both samples (4 to 8 feet and 14 to 18 feet) collected from this boring contained refuse material.

Volatile organics were not detected in either sample collected from BH-07 because of elevated detection limits that may have masked detectable concentrations. This was discussed in more detail in section 2.6.2 of the RI. However, semivolatile organics, pesticides, and PCBs were detected.

Even though volatile organics were not identified in subsurface soil, landfill gas (section 4.2.8 of the RI) and surface soil data indicate that aromatic and chlorinated volatiles were present in a large range of concentrations throughout most of the Solid Waste Area. Ketones were also identified in these media.

Semivolatile organics (PAHs, phthalates, dichlorobenzenes, and phenols) were found in the two samples collected at BH-07. Seven different PAHs (naphthalene, 2-methylnaphthalene, phenanthrene, fluoranthene, pyrene, benzo(a)anthracene, and chrysene) were detected from 4 to 8 feet. Three PAHs (naphthalene, 2-methylnaphthalene, and phenanthrene) were also found in the sample collected from 14 to 18 feet. When detected, individual PAH concentrations were higher at the 14 to 18 foot depth.

Two dichlorobenzenes (1,2-dichlorobenzene and 1,4-dichlorobenzene) were found from 4 to 8 feet at 240 and 97 µg/kg, respectively. Two phenols, consisting of 2-methylphenol and 4-methylphenol, were detected from 4 to 8 feet at 260 µg/kg and from 14 to 18 feet at 4,000 µg/kg, respectively. Dichlorobenzenes and methylphenols (creosols) have many uses including uses as disinfectants, moth control agents, synthetic resins, and wood preservatives. A variety of mixtures containing methylphenols include degreasers and cutting oils. Dichlorobenzenes are also used in pesticides, waxes, and agricultural chemicals. Because of the various uses of these chemicals, municipal or industrial disposal to this area is probably the dominant source.

Five different phthalate compounds (diethylphthalate, di-n-butylphthalate, bis(2-ethylhexyl)phthalate, di-n-octylphthalate, and butylbenzylphthalate) were found in both

samples from BH-07 at concentrations ranging from 96 to 18,000 µg/kg. Total phthalate concentrations were generally higher in the sample collected from 14 to 18 feet (25,000 µg/kg) than in the sample collected from 4 to 8 feet (2,556 µg/kg). Given that phthalate concentrations were higher in the subsurface soil than in other soils in the study area, coupled with the types of refuse found, these phthalates may be attributed to the materials deposited in this disposal area.

Five pesticides detected from 14 to 18 feet included 4,4'-DDD (26 µg/kg), 4,4'-DDE (12 µg/kg), dieldrin (14 µg/kg), *alpha*-chlordane (17 µg/kg), and *gamma*-chlordane (15 µg/kg). Only 4,4'-DDE was found from 4 to 8 feet (12 µg/kg). Although these pesticides have been found in other surface and subsurface soils in the Site study area, it is likely that they are associated with the buried refuse in the Solid Waste Area.

Two PCB aroclors, 1242 and 1254, were detected in samples from BH-07. Aroclor-1242 was detected at 310 µg/kg in the sample collected from 14 to 18 feet, while aroclor-1254 was detected at 270 µg/kg in the sample collected from 4 to 8 feet. PCBs were also detected in monitoring wells MW-08-01, MW-08-02, and MW-05-01 (section 4.2.4 of the RI), although a different aroclor was identified. The primary use of PCBs is in capacitors and transformers. Aroclor-1242 was also used in light ballasts, and aroclor-1254 was also used in small appliances. Because disposal of PCBs was not regulated until 1978, it is possible that materials containing PCBs could have been disposed of during landfill operations.

In addition to the organic compounds, major-metal ions (aluminum, iron, magnesium, and potassium), barium (16 to 22.9 mg/kg), beryllium (0.39 to 0.7 mg/kg), chromium (5.5 mg/kg), cobalt (1.8 to 3.3 mg/kg), copper (7.4 to 18.9 mg/kg), lead (19.4 to 20.2 mg/kg), mercury (0.18 to 0.39 mg/kg), vanadium (5.5 to 9.3 mg/kg), and zinc (45.5 to 68.2 mg/kg) were detected in both the samples. Concentrations ranged from 3,620 to 5,250 mg/kg for aluminum, 4,800 to 7,540 mg/kg for iron, and 618 to 1,090 mg/kg for basic cations. Antimony was also detected from 4 to 8 feet (6 mg/kg). In comparison to background subsurface soil concentrations, mercury and lead concentrations were about two times greater, zinc was about three times greater, and copper was about five times greater. These differences, however, were not found to be statistically significant in relation to background surface soil. The sample analyzed for grain size and TCO was predominantly sand (60.7%) with 27.6% silt, 8.1% gravel, and 3.5% clay. The organic content of this sample was 3.8%.

B. Groundwater

Groundwater was collected from shallow and deep overburden and bedrock monitoring wells along with residential wells in the vicinity of the Site study area. Eight existing monitoring wells and nine residential wells were sampled during June 1991. M&E installed 28 additional monitoring wells from July to September 1991. These were selectively sampled along with existing monitoring wells and nine residential wells during September/October 1991, January/February 1992, and April 1992. Samples submitted during these four rounds of sampling

were analyzed for the following parameters:

- Volatile organics
- Semivolatile organics
- Water-soluble organics (only September/October 1991, January/February 1992, and April 1992)
- Pesticides and PCBs
- Metals (unfiltered and filtered)
- Cyanide
- Sulfide (only June 1991, September/October 1991, and January/February 1992)
- Ammonia (only April 1992)
- Total organic carbon (TOC)
- Biochemical oxygen demand (BOD)

Four wells sampled during this investigation were known to be in waste material in one of the disposal areas. Three of the wells are located in the Solid Waste Area (MW-14-01, OW-25, and OW-27); the fourth well, MW-02-01, is located in the Sewage Sludge Area. A fifth well, MW-V, appears to be located within the boundaries of the Bulky Waste Area; however, drilling logs for this well were not available to confirm this. For this reason, MW-V is not considered to be in waste material. All of the other monitoring wells were installed outside of the disposal area boundaries for further characterization of the potential migration contaminants and ground water flow paths.

Summary of Groundwater Findings. Numerous organic compounds were detected in the different groundwater flow zones. The types of compounds ranged from volatile organics to compounds that were less volatile and soluble (semivolatiles, pesticides, PCBs) to compounds that were more soluble (water-soluble organics). Of these compounds, volatile organics, primarily chlorinated and aromatic volatiles, were frequently and consistently detected in groundwater throughout the study period.

The aerial and vertical extent of volatile organics in groundwater is shown in Figures 9 and 10. More elevated concentrations generally occurred in the vicinity of the Solid Waste Area. Less elevated concentrations occurred in the vicinity of the Bulky Waste Area, and even lower concentrations occurred in the vicinity of the Sewage Sludge Area. The predominant groundwater flow direction through the Site study area is toward the south and southeast. Immediately downgradient of the Solid Waste Area, volatile organics were present in elevated concentrations. Further downgradient, and east of Mitchell Brook, concentrations tended to decrease. Volatile organics were still present, though at lower concentrations, south of the transfer station road. However, further south towards Saugatucket Road, volatile organics were not found in the residential well (Resident #6).

Volatile organics also occurred to the north of the Solid Waste Area as well as to the northeast in two residential wells. These compounds were also found to the west of Rose Hill Road near the northern portion of the Solid Waste Area, but not to the northwest in the vicinity of Resident #11. West of Rose Hill Road, near the southern portion of the Solid Waste Area, volatile organics were not found. To the north, volatile organics were found as far north as the north side of Mitchell Brook, but were not detected in the most northern residential well (Resident #1).

East of the Bulky Waste Area, concentrations decreased even more, and south of the Bulky Waste Area, one compound was found at a low concentration during only one sampling round.

In comparison to concentrations measured in wells located in the Solid Waste Area, volatile organic concentrations found in the Sewage Sludge Area were relatively low. East of the Sewage Sludge Area, volatiles were found at slightly higher concentrations, but this was not consistent.

East of the Saugatucket River, volatile organics were not detected in the lower overburden groundwater, but were found infrequently in residential wells at relatively low concentrations. The source of the volatiles in the residential wells, however, is not entirely clear.

Throughout the Site study area, the chlorinated volatiles detected most often and in the highest concentrations were 1,1-DCA (range of 1 to 220 ug/L), 1,2-DCE (3 to 730 ug/L), vinyl chloride (3 to 690 ug/L), and chloroethane (4 to 86 ug/L). In comparison, the lower concentrations of the more chlorinated volatiles (i.e., TCE, PCE, 1,1,1-TCA) suggests that degradation processes are active. While this is very likely because of degradation of landfill wastes, it is also possible that these compounds were disposed of in industrial and municipal wastes, given the elevated concentrations detected. These compounds are components of consumable products but are used in larger quantities as solvents in industrial applications. Aromatic volatiles, primarily BTEX compounds, were also found in most of the wells. Tables 9 through 16 summarize the chemicals detected in ground water.

Although prevalent, volatile concentrations appear to have decreased to some extent since landfill operations ceased. During previous studies, the highest concentrations were measured between 1981 and 1982, and by 1984 concentrations had decreased by as much as several orders of magnitude. Concentrations detected during this investigation varied depending upon location within the Site study area. During RI, the highest concentrations detected for the organic compounds listed in the historical data set were generally well below the concentrations detected up to 1982, but in many wells, concentrations were higher than found in 1984.

Although variations in volatile organic concentrations occurred over the study period, specific trends were not evident with the available data. This is not unexpected, since the source of these compounds is wastes from within the disposal areas. Given the nature of landfills, with their heterogeneous deposits of wastes and decomposition and biological transformations, the types of and concentrations of compounds released to groundwater are expected to vary to some degree.

Since landfill operations stopped in 1983, the decreases that have occurred are likely related to the slower release of contaminants from source materials (landfill contents).

The detection of *N,N*-DMF in wells west of Rose Hill Road and north of Mitchell Brook confirms that movement of groundwater in these directions is occurring. This compound and acrylamide were also found in several wells directly in and immediately downgradient of the Solid Waste Area, where disposal of industrial wastes, primarily solvents and adhesive glue wastes, have been documented. An explanation for presence of *N,N*-DMF in Residence #8 during one sampling round is not apparent. However, the concentration detected was well below the method detection limit.

The predominant metals detected in groundwater, regardless of flow zone or location, were aluminum, iron, basic cations (calcium, magnesium, sodium, and potassium), barium, and manganese. For the most part, the more soluble forms of these metals were found in higher concentrations than insoluble forms. The types of metals and concentrations detected were similar between the shallow and deep overburden groundwater. Heavy metals found at least once in these flow zones include antimony, arsenic, cadmium, chromium, cobalt, copper, lead, nickel, mercury, vanadium, and zinc. Beryllium was also detected. The number of metals and concentrations were significantly lower in bedrock groundwater. In this flow zone, major-metal ions along with barium and manganese were typically the only metals detected. A few heavy metals (zinc, nickel, copper) were occasionally found.

In shallow overburden groundwater in and immediately downgradient of the Sewage Sludge Area, metals that exceeded concentrations compared to background wells were generally basic cations, iron, barium, and manganese. Occasionally other heavy metals (arsenic, lead, nickel, vanadium, and zinc) were found in higher concentrations than background. Elevated metal concentrations were also found downgradient of the Solid Waste Area, west of Mitchell Brook. However, none of these exceedances were found to be statistically significant based on the available data. In deep overburden groundwater, elevated concentrations and a larger number of heavy metals were exhibited by groundwater directly in and west of the Solid Waste Area.

In bedrock groundwater, significantly elevated concentrations of basic cations, aluminum, barium, and manganese were found in relation to background groundwater. In addition, a few heavy metals (chromium, nickel, vanadium, and zinc) that were not detected in background groundwater were found. In several residential wells (overburden and bedrock) particularly to the north and northeast of the Solid Waste Area, and east of the Saugatucket River, manganese was the metal that most often exceeded background concentrations.

C. Surface Water

Eighteen surface water locations were sampled during the study period. This includes surface water from Mitchell Brook, the Saugatucket River, the unnamed brook, and an unnamed tributary

to Mitchell Brook. The unnamed brook was sampled west of Rose Hill Road at SW-10. Located north of the disposal areas, SW-01 was sampled in an unnamed tributary that feeds into Mitchell Brook. Along Mitchell Brook, seven locations were sampled: SW-07, SW-09, SW-12, SW-13, SW-14, SW-15, and SW-16. In the Saugatucket River nine locations were sampled: SW-02, SW-03, SW-04, SW-05, SW-06, SW-08, SW-11, SW-17, and SW-18. Surface water sampling locations are shown in Figure 11. Surface water samples were analyzed for the following parameters:

- Volatile organics
- Semivolatile organics
- Water-soluble organics (only September/October 1991, January/February 1992 and April 1992)
- Pesticides and PCBs
- Metals (unfiltered and filtered)
- Cyanide
- Sulfide (only June 1991, September/October 1991, and January/February 1992)
- Ammonia (only April 1992 and May 1992)
- Total organic carbon (TOC)
- Biochemical oxygen demand (BOD)

Other water quality parameters measured during field activities include dissolved oxygen, conductivity, and pH.

The analytes detected in surface water are presented in Tables 17 through 21. A summary of the organic compounds and metals detected in surface water samples is presented in Figures 12 and 13.

Surface Water Results Summary. A few organic compounds were infrequently detected in low concentrations in the three surface water bodies: Mitchell Brook, the Saugatucket River, and the unnamed brook. Volatile organic compounds, primarily carbon disulfide and chlorinated and aromatic VOCs, were the major contaminants found. A few SVOCs and pesticides and a water-soluble organic, acrylamide, were also detected. Several surface water locations that were adjacent to leachate seeps and downgradient of the Solid Waste Area exhibited high metal concentrations.

Unnamed Brook. One location in the unnamed brook was sampled in June and September/October 1991 and January/February 1992 (Figure 11). The unnamed brook was not sampled during the other two rounds, April and May 1992. The sampling location (SW-10) is west of Rose Hill Road and southwest of the Solid Waste Area. An active sand and gravel operation is located directly upstream of this location.

The only organic compounds detected at this location during the study period were one volatile organic, carbon disulfide, at 6 Fg/L in January/February 1992 and one pesticide, *gamma*-BHC, at

0.002 Fg/L in September/October 1991. Both of these concentrations were less than sample quantitation limits. Semivolatile organics, water-soluble organics, and PCBs were not detected.

During the study period, major-metal ions as well as barium and manganese were generally the only metals detected. While concentrations of these metals varied slightly, a large fraction of the concentrations was associated with the more soluble forms of these metals. Aluminum was not detected in filtered samples and was reported once at 160 µg/L in unfiltered samples. In unfiltered samples, iron concentrations ranged from 5,140 to 6,160 µg/L, basic cation concentrations ranged from 2,060 to 11,100 µg/L, barium concentrations ranged from 24.9 to 31.6 µg/L, and manganese concentrations ranged from 905 to 1,690 mg/L. Concentrations in filtered samples ranged from 3,325 to 3,660 µg/L for iron, from 2,800 to 12,100 µg/L for basic cations, from 22.7 to 30.2 µg/L for barium, and from 789 to 1,740 µg/L for manganese. In addition, zinc was found in January/February 1992 at 17.2 Fg/L in the unfiltered sample and at 14.9 Fg/L in the filtered sample.

Cyanide was not detected, while sulfide was measured at 1.9 mg/1 in June 1991. Total organic carbon and BOD were not detected. Conductivities ranged from 26 to 146 Fmhos/cm, pH values ranged from 5.9 to 7.2, and DO ranged from not detected to 8.4 mg/L during the study period.

As discussed above, different pesticides (such as *gamma*-BHC) that are not necessarily related to the disposal areas were detected at low concentrations. This brook is not expected to be affected by the disposal areas, since it is upgradient and was found to be consistently losing water to groundwater during the study period. However, there is a strong likelihood that alterations of metal concentrations are occurring because of the disturbance from the nearby sand and gravel operations, which are still active. Weathering of newly exposed soil and bedrock would result in increased releases of metals (including iron and aluminum) that would enter the brook. This is important, since this brook runs through the sand and gravel operations upstream of the sampling location, and new cuts in the sand bank reveal visually apparent, iron rich sands of natural origin.

Mitchell Brook. Along Mitchell Brook, seven locations were sampled from June 1991 to May 1992. Six of the locations were sampled in June and September/October 1991 and include SW-07, SW-09, SW-12, SW-13, SW-14, and SW-15. In addition, SW-01, which is located on the unnamed tributary that feeds into Mitchell Brook upstream of the disposal areas, was sampled during these rounds. In May 1992, only SW-07, SW-09, SW-12, and a new location established as SW-16 were sampled. The location on the unnamed tributary (SW-01) was not sampled in May 1992.

No organic compounds were found in the background location (SW-01) on the unnamed tributary, yet a few organic compounds were detected infrequently and at low concentrations (usually less than 10 Fg/L) in Mitchell Brook. Carbon disulfide was detected more frequently than other compounds at concentrations below 10 Fg/L. All of the other compounds detected were found in only one location during one sampling round; and consist of chlorinated (1,2-DCE and

chloroethane) and aromatic (BTEX compounds and chlorobenzene) organics, and three phthalates [bis(2-ethylhexyl)phthalate, diethylphthalate, and di-n-butylphthalate]. In addition, acrylamide was found at 272 Fg/L in SW-12. All of these compounds have also been found in different media in the vicinity of the disposal areas.

Most of the organic compounds were detected at SW-12, which is the most downstream location on Mitchell Brook, prior to its confluence with the Saugatucket River. The presence of organic compounds coincides with higher BOD levels measured at this location. In particular, acrylamide, which was also found in groundwater immediately downgradient of the Solid Waste Area and near Mitchell Brook (MW-04), was possibly disposed of with industrial waste, indicating that groundwater may be affecting water quality in this stream. Similarly, the compounds detected in SW-12 are similar to those found in MW-11, which is located near Mitchell Brook. Likewise, the xylene detected in SW-07 was similar to the types of aromatic volatiles (BTEX compounds) found at MW-11.

The predominant metals detected include major-metal ions, barium, and manganese. As shown in Figure 14, the highest concentrations of unfiltered metals were consistently found south of the transfer station road and downstream of the disposal areas, near SW-07, and increased near SW-12. This coincides with the extensive orange staining, precipitate, and floc covering of sediment in the brook south of the transfer station road. Insoluble forms of these metals were associated with these locations, whereas more soluble forms were dominant at upstream locations, north of the transfer station road. Conductivities also increased in a downstream direction. Concentrations of iron, manganese, basic cations, and conductivities were found to be significantly higher at these locations compared to the background location on the unnamed tributary. Metal concentrations and conductivity also increased, but were less pronounced, at SW-15. Other metals (zinc, antimony, copper, and lead) were occasionally found at lower concentrations in Mitchell Brook.

These trends, coupled with the organic compounds detected at SW-12, indicate that groundwater may be contributing to downgradient migration from the disposal areas to Mitchell Brook. Shallow and deep overburden groundwater exhibited elevated metal concentrations in the vicinity of the Solid Waste and Bulky Waste Areas. These flow zones discharged to Mitchell Brook throughout the study period. Overland flow to Mitchell Brook may also be occurring. The metals detected and concentrations varied over the study period, but there were no recognizable seasonal trends.

Saugatucket River. Nine locations were sampled in the Saugatucket River over five sampling rounds from June 1991 to May 1992. Six locations were sampled in June 1991: SW-02, SW-03, SW-04, SW-05, SW-06, and SW-08. Surface water location SW-11 was added in September/October 1991, and locations SW-17 and SW-18 were added in May 1992.

A few organic compounds were detected at low concentrations (less than 14 Fg/L) in the surface water locations on Saugatucket River. Besides carbon disulfide, which was detected the most

frequently, xylene and pesticides (4,4'-DDD and methoxychlor) were each detected once during the study period. Coupled with DOs above 5 mg/L and BOD values near zero, there was no indication that the disposal areas were substantially contributing organics to this river during the study period.

On the other hand, increases in metal concentrations along the course of the river appear to be influenced by the disposal areas, especially the Bulky Waste Area. For the most part, major-metal ions, manganese, and barium were the primary metals detected consistently throughout the study period. The largest fraction of these metals appears to be in a more soluble form based on comparisons of unfiltered and filtered sample concentrations.
Of these, iron and manganese as well as conductivities were found to be significantly elevated in leachate along the eastern perimeter of the Bulky Waste Area and the banks of the Saugatucket River.

Figure 15 shows the trends from upstream to downstream for unfiltered metal concentrations along the Saugatucket River. For aluminum, there was no recognizable trend, as concentrations constantly increased and decreased between sampling locations. In contrast, iron and manganese concentrations gradually increased from the background location (SW-02) toward SW-03 and SW-04, which are primarily downgradient of the Sewage Sludge and Bulky Waste Areas, respectively. Concentrations for these metals peaked at SW-05, which is downgradient of several large leachate seeps that flow into the river at this point. Downstream concentrations then decreased to a level similar to that of SW-03 and SW-04, most likely because of dilution, and then remained near the same level or slightly increased again below the confluence of Mitchell Brook. Concentrations continued to increase beyond where the river approaches and flows past Saugatucket Road. These downstream increases are more pronounced for manganese and basic cations (calcium, magnesium, sodium, and potassium) than for iron and barium. Conductivities exhibit the same patterns. Differences were statistically confirmed for calcium, manganese, magnesium, sodium, and conductivity between several downstream locations and the background location.

Elevated concentrations of similar metals were also evident, although not significantly, in shallow overburden groundwater downgradient of each of the disposal areas. Since the predominant groundwater flow direction from the disposal areas (primarily the Sewage Sludge and Bulky Waste Area) is toward the Saugatucket River, groundwater discharges along with surface runoff (overland flow) to the river are likely mechanisms that contribute to the transport of these more soluble metals from those areas.

Differences in metal concentrations also occurred between sampling rounds. Metal concentrations in June 1991 were greater than in any other round. Iron and barium concentrations were about 20 times greater in June 1991 than in September 1991. Calcium, magnesium, sodium, and manganese were also four to six times greater in June 1991 than in September. This was particularly evident at SW-05. At this location, the higher concentrations during the June 1991 sampling round corresponded with low-flow conditions in combination with elevated metal concentrations from

leachate seeps. Throughout the rest of the study period, concentrations varied, but not as substantially. Many of the mechanisms that likely contribute to these variations depend on precipitation (i.e., leachate composition, groundwater discharge, surface water volume, surface runoff).

Although the organic compounds detected in surface water in Mitchell Brook and the Saugatucket River were also found in other media in the Site study area, upstream to downstream trends were not exhibited since these compounds were seldom and inconsistently detected. However, the detection of acrylamide in Mitchell Brook, prior to its intersection with the Saugatucket River, indicates that transport of organic compounds in the Site study area is occurring at least this far south. More evident were the increases in metal concentrations in the Saugatucket River, near the large leachate seeps (along the eastern perimeter of the Bulky Waste Area), and in Mitchell Brook, south of the transfer station road. In particular, concentrations of iron, manganese, and other metals in these areas were found to be significantly elevated. Higher conductivities and the presence of orange floc were characteristic features in these areas. Below the confluence of Mitchell Brook and the Saugatucket River, metal concentrations decreased, although concentrations were higher than those found upgradient of the disposal areas.

D. Sediment

Eighteen sediment locations were sampled during the study period. This includes sediment from Mitchell Brook, the Saugatucket River, the unnamed brook, and an unnamed tributary to Mitchell Brook. The unnamed brook was sampled west of Rose Hill Road at SD-10. Located north of the disposal areas, SD-01, was sampled in an unnamed tributary that feeds into Mitchell Brook. Along Mitchell Brook seven locations were sampled: SD-07, SD-09, SD-12, SD-13, SD-14, SD-15, and SD-16. The Saugatucket River was sampled at nine locations: SD-02, SD-03, SD-04, SD-05, SD-06, SD-08, SD-11, SD-17, and SD-18. Sediment sampling locations are shown in Figure 11. Sediment sampling was conducted at the same time as surface water sampling. Sediment samples were analyzed for the following parameters:

- Volatile organics
- Semivolatile organics
- Pesticides and PCBs
- Metals
- Cyanide
- Sulfide (only June 1991 and September/October 1991)
- Ammonia (only May 1992)
- Total combustible organics (TCO)
- Grain size

The analytes detected in sediment are presented in Tables 22, 23, 24. A summary of the organic compounds and metals detected in sediment samples are presented in Figures 16 and 17. The

analytes detected in each of the different areas (Table 3) are discussed in the following sections.

4.2.7.1 Unnamed Brook. One location in the unnamed brook (SD-10) was sampled for sediments in June and September/October 1991. This location corresponds with SW-10, which was also sampled at the same time. The analytes detected during June 1991 and September/October 1991 are summarized in Table 22 and Figures 16 and 17.

During September/October 1991, one volatile organic, 4-methyl-2-pentanone, was detected at 3 Fg/kg. Seven pesticides were detected at concentrations below sample quantitation limits (0.23 to 2.6 Fg/kg): *delta*-BHC, 4,4'-DDE, 4,4'-DDT, rnethoxychlor, endosulfan II, dieldrin, and *gamma*-chlordane.

Of the metals detected, iron concentrations (113,000 mg/kg) were substantially elevated above the others. Aluminum, followed by manganese and calcium (3,210, 1,150, and 1,070 mg/kg, respectively), were the next abundant. Magnesium, sodium, and potassium concentrations ranged from 2 to 415 mg/kg. Barium (64.6 mg/kg) and four heavy metals (lead at 7.4 mg/kg, nickel at 3.0 mg/kg, vanadium at 15.2 mg/kg, and zinc at 236 mg/kg) were also detected.

Sulfide was measured at 25 mg/kg, while cyanide was not detected. The sediment consisted primarily of sand (67.7%) and was intermixed with finer silt (18.8%) and clay (10.4%) grains. The organic content was 4.7%. No organic compounds, including volatile organics, semivolatile organics, pesticides, and PCBs, were detected.

The detection of several different pesticides including *delta*-BHC in September/October 1991 in sediments coincides with the detection of *gamma*-BHC in the associated surface water sample. Since these sediments are predominantly sand with little organic material, the retention of organic compounds (if present) is expected to be limited. During this same time, substantial increases in lead concentrations and the detection of other heavy metals occurred in sediment, but were not evident in surface water. This suggests that sediment transport from upgradient sources is possibly occurring. As discussed earlier, there is no hydrogeologic indication that the disposal areas are affecting this brook, which is west of Rose Hill Road. However, as also discussed above, nearby sand and gravel operations are likely affecting metal concentrations in the brook.

Mitchell Brook. Seven locations were sampled on Mitchell Brook from June 1991 to May 1992. Six of the locations were sampled in June and September/October 1991: SD-07, SD-09, SD-12, SD-13, SD-14, and SD-15. In addition, SD-01, which is located on the unnamed tributary that feeds into Mitchell Brook and is upstream of the disposal areas, was sampled during these rounds. In May 1992 a new location established as SD-16 was sampled. The location at the unnamed tributary was not sampled in May 1992.

Two volatile organics were detected during the June 1991 sampling round at concentrations below sample quantitation limits. Xylenes were detected at SD-07 (8 Fg/kg) and at SD-09 (7 Fg/kg).

Trichloroethane (9 Fg/kg) was detected at SD-09. Semivolatile organics, pesticides, and PCBs were not detected at any location sampled. Sulfide was detected at all locations and ranged from 3.7 to 34 mg/kg, whereas cyanide was not detected at any of the locations. Sand was the predominant size fraction (57.3 to 97%). Organic content ranged from 0.8 to 7.0%.

Five volatile organics, consisting of chlorinated and aromatic volatiles and ketones, were detected at one or two locations during the September/October 1991 round of sampling. These include chloroform at SD-15 (5 Fg/kg), and PCE at SD-14 (3 Fg/kg) and SD-09 (2 Fg/kg). Benzene (1 Fg/kg) was detected at SD-12. The highest concentrations were for ketones, as acetone was detected at SD-07 and SD-09 (190 Fg/kg and 200 Fg/kg, respectively). Also detected at SD-07 was MEK (46 Fg/kg). Sulfide was detected only at SD-12 (850 mg/kg) during the September/October 1991 sampling round, and cyanide was not detected at any of the locations. Based on grain-size distributions, sand was the predominant fraction (51.2 to 97.3%), and organic content ranged from 0.8 to 7.6%.

Three semivolatile organics and two pesticides were detected at two locations during this sampling round. PCBs were not detected at any locations. Di-n-butylphthalate (650 Fg/kg) was detected at SD-09. Two PAHs, fluoranthene and pyrene, were also detected at SD-09 (34 and 40 Fg/kg, respectively). Pesticides found at this location include 4,4'-DDD (8.2 Fg/kg) and 4,4'-DDE (4.9 Fg/kg). The same PAHs and pesticides were found at SD-15: fluoranthene (34 Fg/kg), pyrene (40 Fg/kg), and 4,4'-DDE (1.6 Fg/kg).

Ammonia was also detected at SD-12 (25.6 mg/kg) and SD-16 (4.36 mg/kg) during May 1992. Cyanide was not detected at any of the locations. The predominant grain size at the locations was sand (86.5 to 95.7%). Organic content ranged from 1.1 to 1. 8%.

More types of organic compounds were detected in sediment in Mitchell Brook than in the associated surface water. Organic compounds were not found at the background location on the unnamed tributary (SD-01). Ketones (acetone and MEK) and chlorinated volatiles (TCE, PCE, 1,2-DCE, and chloroform) and BTEX compounds were the primary types of volatile organics. Found more often and in higher concentrations were PAHs, phthalates, and pesticides (4,4'-DDE, 4,4'-DDD, and *delta*-BHC), since these compounds are less soluble and more strongly adsorb to sediment and organic material. All of these compounds were also found in other media near the disposal areas. Surface runoff (overland flow) and groundwater discharges to the brook are evident. With the exception of PAHs, which were found in several locations near roads and other areas of vehicular activity, there were no recognizable patterns of distribution.

On the other hand, metals exhibited several trends, from upstream to downstream as shown in Figure 18. For the most part, concentrations were not found to be significantly elevated compared to the background location on the unnamed tributary. For example, concentrations for aluminum and lead were highest at the most upgradient location, SD-13, which is upstream of the northern portion of the Solid Waste Area. Concentrations steadily decreased toward SD-16 and then

increased at SD-07, which is south of the transfer station road, before decreasing a short distance downstream at SD-12. Barium exhibited a somewhat similar trend as aluminum and lead. On the other hand, iron and manganese concentrations were relatively similar along the length of brook from SD-13 to SD-09. Iron concentrations began to increase at SD-16. Iron concentrations continued to increase at SD-07, as did manganese. Lower concentrations for both these metals occurred further downstream at SD-12. Elevated concentrations south of the transfer station road correspond with elevated metal concentrations in surface water in this area as well as the presence of large amounts of orange floc and precipitate that cover the sediment.

Saugatucket River. Nine locations were sampled in the Saugatucket River from June 1991 to May 1992. Six locations were sampled in June 1991: SD-02, SD-03, SD-04, SD-05, SD-06, and SD-08. Sediment location SD-11 was added in September/October 1991, and locations SD-17 and SD-18 were added in May 1992.

Five volatile organics, consisting of chlorinated (TCE and 1,2-DCE) and aromatic volatiles (ethylbenzene and xylenes) and carbon disulfide, were detected at three locations during the June 1991 sampling round. Trichloroethene was detected at 7 Fg/kg in SD-04 and increased downstream to 10 Fg/kg at SD-06 and 150 Fg/kg at SD-08, which is downstream of Saugatucket Road. Also detected at SD-08 was 1,2-DCE (5 Fg/kg) and ethylbenzene and xylene (8 and 67 Fg/kg, respectively). Xylene was also detected at 10 Fg/kg in SD-03. Carbon disulfide was found at SD-08 (9 Fg/kg). No volatile organics were detected at SD-02, the background location, or SD-05, which is downstream of SD-04.

Seven PAHs were detected at SD-08 (Table 22) at a total concentration of 1,410 Fg/kg. This location is downstream of the Saugatucket Road. Another semivolatile organic, butylbenzylphthalate was detected at SD-06, also below the sample quantitation limit. Pesticides and PCBs were not detected.

Aluminum, iron, manganese, and barium were detected at all of the locations. At all of the downstream locations, concentrations of these metals were higher than in the background location, SD-02. Concentrations for aluminum ranged from 749 to 6,280 mg/kg. Iron ranged from 780 to 1,600 mg/kg, and barium and manganese ranged from 2.7 to 26.2 mg/kg and 13.5 to 193 mg/kg, respectively. Basic cation concentrations ranged from 115 to 1,270 mg/kg. The highest concentrations for these metals usually occurred at SD-04 and SD-05.

Also detected in downstream locations were arsenic (0.79 to 2.1 mg/kg) at SD-04, SD-05, and SD-08 and chromium (1.9 to 8.7 mg/kg) and cobalt (3.4 to 4.2 mg/kg) at SD-04, SD-05, and SD-06. Higher concentrations corresponded with SD-04 and SD-05. In addition, lead and zinc were detected at SD-06 (10.9 and 20.5 mg/kg, respectively), while selenium was found at SD-05 (2.1 mg/kg). Beryllium and nickel were detected at almost all locations at concentrations ranging from 0.4 to 2 mg/kg and 1.4 to 9.5 mg/kg, respectively. With the exception of beryllium and zinc, these metals were also detected at the background location, SW-02, at least once during the study

period.

Sulfide was detected in all locations while cyanide was not found at any. Sulfide ranged from 15 to 129 mg/kg and was highest at SD-06. At SD-04 and SD-05, sediments largely consisted of sand (37.7 and 54.5%, respectively) and silt (48.5 and 42.5%, respectively). At other locations, the percentage of silt decreased and sand increased. Organic content ranged from 1.0 to 14.7%.

Volatile organics were also detected during the September/October 1991 sampling round, but the compounds were somewhat different from those found in June 1991. Aromatic volatiles, ethylbenzene (3 Fg/kg), and xylene (8 Fg/kg) were found at SD-05. Acetone was detected at two locations: SD-03 (210 Fg/kg) and SD-08 (215 Fg/kg). Three other volatile organics were found at SD-08: MEK (28 Fg/kg), PCE (4 Fg/kg), and carbon disulfide (22 Fg/kg). In addition, pyrene was detected in SD-03 at 39 Fg/kg. Pesticides and PCBs were not detected at any of the locations.

During this sampling round, major-metal ions, manganese, and barium were detected at higher concentrations downstream of the background location. In the background location, SD-01, concentrations of aluminum were 8,650 mg/kg, iron were 1,500 mg/kg, basic cations were 350 to 373 mg/kg, and barium and manganese were 21.5 and 113 mg/kg, respectively. The iron concentration at SD-06 was 8,940 mg/kg, and iron and aluminum concentrations at SD-04 (6,780 and 16,400 mg/kg, respectively) and SD-05 (8,420 and 6,170 mg/kg, respectively) were more elevated than those at the other locations (1,260 to 3,080 and 1,020 to 2,590 mg/kg, respectively). Basic cation concentrations ranged from 242 to 2,560 mg/kg, barium ranged from 3.1 to 30.5 mg/kg, and manganese ranged from 41.1 to 422 mg/kg. Concentration ranges for these metals were slightly higher than ranges in June 1991.

Other metals detected include arsenic (0.43 to 1.2 mg/kg), (chromium 11.4 to 18.1 mg/kg), cobalt (1.9 to 6.5 mg/kg), lead 4.3 to 24.2 mg/kg), nickel (12.8 to 20.5 mg/kg), selenium (0.37 to 1.3 mg/kg), vanadium (2 to 17.7 mg/kg), and zinc (43.6 to 49.8 mg/kg). Beryllium (2.3 mg/kg) was detected at SD-04. Four of these metals were also detected at SD-02: lead at 7.2 mg/kg, selenium at 0.52 mg/kg, and vanadium at 2 mg/kg. Higher concentrations of these metals were found in at least one location downstream.

Four PAHs (phenanthrene, anthracene, fluoranthene, and pyrene) were detected at a total concentration of 241 Fg/kg in SD-11 during the May 1992 sampling round. Three pesticides were also detected in the sediments during this sampling round. The one detected most frequently was *delta*-BHC, which was found in all six of the downstream locations (0.46 to 1.3 Fg/kg), but was not detected in the background location, SD-02. Detected at higher concentrations were 4,4'-DDE at 4.3 Fg/kg and 4,4'-DDD at 8.0 Fg/kg in SD-11, the location with PAHs. 4,4'-DDE was also detected at SD-18 at 1.2 Fg/kg.

Major-metal ions were the predominant metals found during the May 1992 sampling round. Concentrations of aluminum were 836 to 1,860 mg/kg. The most elevated iron concentrations

detected during this round were at SD-05 (25,900 mg/kg) and SD-06 (12,500 mg/kg). Iron ranged from 885 to 25,900 mg/kg. Basic cation (258 to 555 mg/kg), barium (2.9 to 13.7 mg/kg), and manganese (22.6 to 200 mg/kg) concentrations were similar to those detected during June 1991. Chromium and lead were detected at all locations from 1.1 to 2.5 and 3.7 to 13.5 mg/kg, respectively. Arsenic (2 to 6.1 mg/kg), cobalt (0.91 to 1.4 mg/kg), and selenium (0.43 to 0.58 mg/kg) were also found, but less frequently (two to four locations). Nickel was detected in SD-06 at 4.7 mg/kg, while vanadium and zinc were detected at 3.4 and 11.2 mg/kg, respectively, in SD-05.

During the May 1992 sampling round, cyanide was not found at any locations. Ammonia was detected in three locations with the maximum at SD-05 at 3.17 mg/kg. Sand was the predominant size fraction (64.6 to 95.8%) in sediment at each location, and organic content continued to be relatively low (1.3 to 5.6%).

The types of organic compounds detected in Saugatucket River sediment were also detected in the disposal areas and other media during the study period and include chlorinated and aromatic volatiles, ketones, carbon disulfide, PAHs, and pesticides. Most notably, TCE was detected at several locations along the river. The less soluble organics, like PAHs and pesticides, as well as volatile organics were detected more often in sediments than in the associated surface water.

When detected, organic compounds were predominantly found at SD-08 and SD-11. Both of these locations are near Saugatucket Road and were sampled in areas where the river widens and current is slower. As a result, suspended sediment tends to settle out here. In June 1991, volatile organics were primarily found along with PAHs at SD-08, which is located downstream of Saugatucket Road. This suggests that organic compounds and metals detected in this section of the River are probably more related to the road than to other sources.

For the most part, all of the metals detected in sediment were also found in the background location during the study period. Iron and aluminum were the predominant metals. As shown on Figure 19, the concentrations were generally consistently higher at SD-04 and SD-5, and coincided with higher concentrations in surface water at these locations. Both are immediately downgradient of the large leachate seeps east of the Bulky Waste Area. Orange floc and precipitate covering the sediment in this area were also present. Concentrations for these metals were also elevated at SD-06, below the confluence of Mitchell Brook, although surface water concentrations at this location were not. Lead, on the other hand, was lower at these locations and in general did not exhibit any discernable pattern. In relation to background concentrations, concentrations of lead, barium, manganese, and iron were significantly elevated at most of the downstream locations (SD-04, SD-05, SD-06, SD-08, SD-11). Iron and manganese concentrations at SD-03 were also found to be significantly higher. As discussed above, elevated metal concentrations near Saugatucket Road (SD-08 and SD-11) can be attributed to the road.

All metals were generally at the highest concentrations in September/October 1991. This corresponds with higher concentrations in surface water during the same period and may be somewhat related to seasonal variations. Following drier summer periods, metal concentrations generally increased during lower flow periods, when groundwater discharge accounts for a larger portion of a stream's volume.

E. Leachate

During the study period, leachate seeps were observed around the Solid Waste and Bulky Waste Areas. Leachate was collected from six locations at which seeps were present. Five of the leachate seeps (LE-02 to LE-06) were located between the Bulky Waste Area and the Saugatucket River. The other seep (LE-01) was just north of the Solid Waste Area, near Mitchell Brook. Leachate locations are presented on Figure 20. Historically, leachate seeps have been identified at the disposal areas by aerial photographs (United States Environmental Protection Agency 1987a, 1991a). In the past, a resident has reportedly observed leachate seeps with sulfur odors and varying colors and quantities west of Rose Hill Road, near the northern portion of the Solid Waste Area. At the Bulky Waste Area, a trench filled with crushed stone was reportedly dug to drain water to the Saugatucket River (RIDEM 1992a). During the field investigation a crushed-stone trench running vertically along the eastern bank of the Bulky Waste Area toward the Saugatucket River was observed. In addition, colored leachate originating from the hill slope near the Bulky Waste Area has been observed.

All six leachate locations (LE-01 to LE-06) were sampled during June 1991. Three additional composite samples were collected from the seep at LE-05 during April 1992, to supplement ecological toxicity testing. Samples were analyzed for the following parameters:

- Volatile organics
- Semivolatile organics
- Water-soluble organics (April 1992 only)
- Pesticides and PCBs
- Metals (unfiltered and filtered)
- Cyanide
- Sulfide (June 1991 only)
- Ammonia (April 1992 only)
- Total organic carbon (TOC)
- Biochemical oxygen demand (BOD)

The analytes detected in leachate are presented in Tables 25 and 26. A summary of the organic compounds and metals detected in leachate samples is presented in Figures 21 and 22. The analytes detected in each of the different areas (Table 3) are discussed in the following sections.

Saugatucket River. Five leachate seeps (LE-02 through LE-06) were sampled along the western bank of the Saugatucket River. Several large outbreaks of leachate were obvious because of orange-colored puddles of water and orange-stained soil and vegetation. The size of the seeps varied, with LE-03, LE-05, and LE-06 comprising the largest areas. Large clumps of orange floc were also observed near the seeps. It was reported that gravel-filled trenches were embedded along the eastern perimeter of the Bulky Waste Area to facilitate drainage from this disposal area.

In the June 1991 sampling effort, chlorinated and aromatic volatiles were detected in three of the five leachates seeps near the Bulky Waste Area. Chlorinated volatiles, 1,1-DCA and chloroethane, were each found at LE-03, LE-04, and LE-05 at concentrations below sample quantitation limits (2 to 8 µg/L). Aromatic volatiles, toluene, and chlorobenzene were also detected in these samples, although toluene was the only chemical detected above sample quantitation limits (27 to 50 µg/L). The highest toluene concentration occurred at LE-03. Each of these leachate seeps was approximately 50 feet downgradient of the Bulky Waste Area and within a few feet of the Saugatucket River. Although volatile organic concentrations were relatively low in leachate, elevated concentrations of chlorinated and aromatic volatiles were found in landfill gas in the Bulky Waste Area. Similar types of volatile organics have also been detected in soil and groundwater downgradient of this disposal area.

Carbon disulfide was the only organic detected in LE-02 (3 µg/L), located south of LE-05 and the Bulky Waste Area. The most northern leachate sampling location, LE-06, had no detectable concentrations of volatile organics, yet bis(2-ethylhexyl)phthalate was detected at 230 µg/L. Organic compounds, at similar concentrations, were found periodically in surface water and sediment in the Saugatucket River during the study period.

Metals detected in the highest concentrations in unfiltered samples were the major-metal ions [aluminum (184 to 9,220 µg/L), iron (15,200 to 1,370,000 µg/L), calcium (10,000 to 59,000 µg/L), magnesium (2,420 to 16,100 µg/L), sodium (5,560 to 55,400 µg/L), and potassium (2,000 to 44,800 µg/L)]. Other metals detected in all of the samples consist of barium (22.2 to 2,120 µg/L) and manganese (2,490 to 14,700 µg/L). Cobalt (5.6 to 295 µg/L) was detected in four samples (LE-02, LE-04, LE-05, and LE-06). Vanadium (22.2 to 65.2 µg/L) and zinc (34.4 to 133 µg/L) were each found in two samples (LE-02 and LE-05, and LE-02 and LE-03, respectively). Beryllium and lead were detected in only one sample, LE-02, at 8.7 and 174 µg/L, respectively. Metals were usually detected more often and at higher concentrations at LE-02 than in any of the other unfiltered leachate samples. This sample was collected in an orange-stained muddy area along seismic line S-5.

Fewer metals were detected in filtered samples. Again major-metal ions were found in all samples in the highest concentrations. Barium and manganese were also detected, and cobalt was found at LE-04. Because of the smaller number of metals and the lower concentrations found in filtered samples, the largest fraction of the metals are likely adsorbed onto soil or other particles, are in a colloidal phase or floc, or are present in less soluble or insoluble forms.

Cyanide was detected in the most northern (LE-06) and the most southern (LE-02) leachate seeps at 41.7 and 36.1 µg/L, respectively. Sulfides were not found in any samples. Biochemical oxygen demand was measured in LE-06 and LE-02 at 7.5 and 51 mg/L, respectively. High BOD indicates organic contamination. The BOD measured in these samples is consistent with the levels of organics found.

In April 1992, the leachate seep at LE-05 was sampled on three consecutive days to supplement ecological toxicity testing. The analytes detected in April 1992 are summarized in Table 26. Water-soluble organics, pesticides, and PCBs were not detected at this location. Although slightly different sampling methods were used to collect samples during this round, analytical data between the two rounds were fairly similar and are therefore comparable.

The types of organic compounds detected during this sampling round were similar to those found at LE-05 in June 1991. Ethylbenzene (1 to 2 µg/L) was found on all three days and xylenes on two days (2 to 3 µg/L). Chloroethane and 1,2-DCE were each detected once at 2 and 1 µg/L, respectively. Naphthalene and diethylphthalate were each detected on all three days at concentrations ranging from 0.7 to 0.9 µg/L and 4 to 11 µg/L, respectively.

In unfiltered samples, major-metal ions consisting of aluminum (239 to 623 µg/L), iron (49,000 to 283,000 µg/L), calcium (16,700 to 23,000 µg/L), magnesium (5,710 to 7,220 µg/L), sodium (20,800 to 24,700 µg/L), and potassium (12,000 to 15,200 µg/L) were found, all three days, at concentrations elevated above other metals. Barium (97.4 to 293 µg/L) and manganese (1,490 to 2,410 µg/L) were also detected each day. Chromium, lead, mercury, and zinc were each detected once at 5, 10.5, 0.2, and 8.1 µg/L, respectively. In filtered samples, major-metal ions, barium, and manganese were also detected daily. Concentrations were generally highest on the second day of sampling. In addition, vanadium and cobalt were not detected during this sampling round, though they were found at this leachate location in June 1991.

Cyanide was not found. Ammonia was detected from 5.06 to 22.6 µg/L. Total organic carbon ranged from 30.9 to 49.9 mg/L, levels that were higher than in June 1991. Likewise, BOD values ranged from 1.5 to 4.2 mg/L, though BOD wasn't detected in June 1991. A pH of 6.5 and conductivity of 412 were recorded, and hardness varied between 65 and 87 mg/L $CaCO_3$. Differences in chemical composition of leachate from June 1991 to April 1992 are evident, but for the most part, these differences appeared to be minor. Chlorinated and aromatic volatiles and phthalates were detected in both sampling rounds, although the individual chemicals sometimes varied. Similar types of metals were generally found, and there was no noticeably consistent difference in concentrations. In contrast, the physical character of the seeps varied. In June 1991, large quantities of floc and water volume emerging from the seeps were evident in the Saugatucket River area. In April 1992, this was less evident. This could have resulted from changes in precipitation, as groundwater and surface water levels were higher in April 1992 than in June 1991.

Mitchell Brook. A small leachate seep, LE-01, located along the northern slope of the Solid Waste Area, was sampled in June 1991. Orange-staining of ground material was present at the sampling location.

Four chlorinated volatiles were detected: 1,2-DCE (44 µg/L), TCE (4 µg/L), and vinyl chloride (1 µg/L). Carbon disulfide was also detected at 12 µg/L. Semivolatile organics, pesticides, and PCBs were not found at LE-01.

In the unfiltered sample, all of the major-metal ions (aluminum, iron, calcium, magnesium, sodium, and potassium) were detected. Aluminum and iron concentrations were 60,500 and 133,000 µg/L. Basic cations ranged from 3,620 to 14,900 µg/L. Barium, beryllium (328 and 11.2 µg/L, respectively), and eight heavy metals were detected. Concentrations ranged from 3.7 to 49.8 µg/L for beryllium, arsenic, chromium, copper, nickel, and vanadium. For lead, manganese, and zinc, concentrations ranged from 150 to 814 µg/L. In the filtered samples, all major-metal ions except for aluminum were detected, as were barium and manganese. All of these metals, with the exception of arsenic, were found in groundwater from the shallow overburden background well. In comparison, concentrations were as much as three times greater for barium and beryllium, five times greater for aluminum, 10 times greater for iron, and 30 times greater for lead.

Ammonia, sulfide, cyanide, and BOD were not detected. Total organic content was measured at 8.4 mg/L. A conductivity of 100 µmhos/cm and a pH of 5.4 were measured.

Summary of Leachate Findings. As indicated by subsurface soil and landfill gas data, the Bulky Waste and Solid Waste Areas still serve as a viable source of organic compounds and metals. The same types of chlorinated and aromatic volatile organics were found at relatively low concentrations in leachate as in other media in the vicinity of the disposal areas. The leachate seeps were also characterized by large amounts of orange floc and stained ground cover, which is indicative of metals (i.e., iron), precipitating/coagulating such as iron hydroxide under oxidizing conditions. Concentrations of several metals, including barium, lead, manganese, and iron, were found to be significantly elevated in leachate in comparison to levels in the shallow overburden groundwater at the background well. This is important since surface water bodies (Mitchell Brook and Saugatucket River) are within a few feet of the seeps.

F. Landfill Gas

Landfill gas samples were collected from each of the disposal areas and from permanent off-site monitoring points in June and July 1991 as part of the Site reconnaissance activities. The off-site monitoring points were again measured in September 1991. Percent carbon dioxide (CO_2), methane (CH_4), oxygen (O_2), and percent of the lower explosive limit (LEL) were measured, and nearly all of the points were analyzed using a field GC equipped with a PID.

In December 1991, additional points were sampled offsite to define the areal extent of landfill gas migration and its proximity to adjacent residences. At this time, 16 additional permanent monitoring points were installed. Eight were located near homes, and eight were located along the furthest known extent of the landfill gas plume (Figure 23). Each of the eight points near adjacent homes and selected other permanent points were monitored monthly from January through April 1992. Approximately 24 of the 48 permanent points were measured during each of these monthly sampling rounds.

In May 1992, six points were sampled using SUMMA passivated canisters for laboratory analysis of volatile organics by method TO-14 (Figure 24). At the same time, impingers were used to collect and analyze samples for reduced sulfur, consisting of hydrogen sulfide and mercaptan sulfur in the landfill gas, using ASTM method D 2385-81. The impingers were analyzed in an on-site laboratory. Samples from these locations were also analyzed using the field GC. A detailed discussion of analytical methodologies, sample collection procedures, and data use is presented in section 2.5.8 of the RI report.

Sewage Sludge Area. Twenty-two points were sampled in the sewage sludge area in June 1991. These points were located using a 100-foot-by-100-foot grid and are shown on Figure 25. Many of the grid points were omitted because volatile organics were not detected in adjacent samples and concentrations of methane and carbon dioxide were much lower than in the other disposal areas. One point [SS(08+000)] was resampled in May 1992 for SUMMA canister and reduced sulfur analysis, as shown on Figure 26.

Carbon dioxide was the primary component of landfill gas throughout the Sewage Sludge Area. Methane was detected at one point SS(08+000) at a concentration above the LEL. The concentrations of these compounds, as discussed in the following sections, were much lower than were detected in other disposal areas. Carbon dioxide and methane in landfill gas result from the biological degradation of organic materials placed into a landfill. Digested sewage sludge disposed of in this area was previously degraded during primary and secondary treatment. This material would not be expected to consume as much oxygen or produce as much methane or carbon dioxide as untreated municipal waste.

The only volatile organic detected above the quantitation limit in either the field GC or the SUMMA canister analysis was acetone at SS(08+000). Volatile organic data for soil (sections 4.2.1 and 4.2.2 of the RI) from this area are consistent with this finding. Acetone was detected at two of the surface soil locations (SS-11 and SS-12) and in three of the subsurface soils (BH-01 from 4 to 6 feet and 8 to 10 feet; BH-03 from 18 to 20 feet). 2-Butanone was also detected in all of these samples except SS-11. Toluene was detected in one of the soil samples (BH-03 from 18 to 20-feet), and TCE was detected at a concentration below its sample quantitation limit in SS-11.

In addition to acetone, several other volatile organics (methylene chloride, ethylbenzene, *m*,*p*-xylene, *o*-xylene, 1,3,5-trimethylbenzene, and 1,2,4-trimethylbenzene) were detected in the SUMMA canister sample at concentrations below the sample quantitation limit.

Bulky Waste Area. Twenty-nine points, shown on Figure 25, were sampled in the Bulky Waste Area in July 1991. These were located using a 100-foot-by-100-foot grid. Many of the grid points were omitted because the landfill gas was found to contain similar concentrations of the same compounds from point to point. Two points [BW(04+100) and BW(05+500)] were resampled in May 1992 for volatile organics using a SUMMA canister and also for reduced sulfur analysis, as shown on Figure 26.

Carbon dioxide and methane concentrations were greater than 25% throughout most of the Bulky Waste Area and were measured as high as 49% for carbon dioxide and 57% for methane. Oxygen concentrations were generally depressed from ambient air concentrations to as low as 1%.

Volatile organics were present throughout the disposal area but had elevated concentrations at some hot spots such as BW(05+400), BW(05+500), BW(04+100) and BW(01+300). The relative concentrations of different volatile organic compounds in the landfill gas also varies. Toluene, *cis*-1,2-DCE, and TCE were the primary compounds detected during the field GC analysis.

Toluene had the highest concentration of any component identified during the analysis of SUMMA canister samples collected from BW(04+100) and BW(05+500). Other aromatic compounds were also detected in each of these samples.

Chlorinated compounds were present in greater quantities in BW(04+100) than in BW(05+500). Vinyl chloride and *cis*-1,2-DCE had the highest concentrations of the chlorinated compounds in BW(04+100). The compounds 1,1-DCA, chloroethane, *trans*-1,2-DCE, 1,1,1-TCA, methylene chloride, PCE and TCE were also detected.

In BW(04+100), the ketone MEK was detected in both of the SUMMA samples, while acetone was the only ketone detected.

Dichlorodifluoromethane was detected at a higher concentration in BW(05+500) than in BW(04+100). Trichlorofluoromethane was detected in both samples, while Freon 113 was only detected in BW(04+100).

Hydrogen sulfide was detected at both BW(04+100) and BW(05+500), while mercaptans were not detected at either point.

Solid Waste Area. Eighty-five points were sampled in the Solid Waste Area in June and July 1991. These points were located using a 100-foot-by-100-foot grid. The actual sampling locations are shown on Figure 25. Three points [SW(03+300), SW(11+500) and SW(13+300)] were

resampled in May 1992 for SUMMA canister and reduced sulfur analysis, as shown on Figure 26. Permeation of the landfill gas through the cover material of the Solid Waste Area was measured using two flux boxes installed in February 1992.

Carbon dioxide and methane concentration were greater than 35% throughout most of the Solid Waste Area and ranged as high as 62% for carbon dioxide and 60% for methane. Oxygen concentrations were generally depressed from ambient air concentration to as low as 1%.

Volatile organics were present throughout the disposal area but appear to have elevated concentrations at SW(11+500) and SW(13+200). The relative concentrations of different volatile organic compounds in the landfill gas also appear to vary. Toluene, *cis*-1,2-DCE, and TCE were the primary compounds detected during the field GC analysis. For the SUMMA canister data, *cis*-1,2-DCE had the highest concentration of any volatile organic in the Solid Waste Area. Vinyl chloride had the second highest concentration at SW(13+300) and SW(11+500). Chloromethane, chloroethane, 1,1-DCE, methylene chloride, *trans*-1,2-DCE, 1,1-DCA, 1,1,1-TCA, TCE, and PCE were all detected at these two points.

At SW(03+300), aromatic compounds were the primary volatile organics present in the SUMMA canisters. Although most of the same chlorinated compounds are present, the concentrations of toluene, ethylbenzene, *p*-xylene, and *o*-xylene are higher than those of any of the chlorinated compounds.

Of the Freon compounds, dichlorofluoromethane was present in all of the Solid Waste Area SUMMA canisters. Freon 114 and 113 and trichlorofluoromethane were present periodically.

2-Butanone was the only ketone detected, and it was present at a much lower concentration relative to other volatile organics.

Carbon disulfide was present in two of the four samples, and bromoform was found in only one of the four samples from the Solid Waste Area. These compounds were present at concentrations much less than those of other volatile compounds detected in these samples.

Reduced sulfur analysis indicated hydrogen sulfide results ranging from 1.0 to 6.3 mg/m^3. No mercaptan sulfur was detected.

Of the two flux boxes installed on the Solid Waste Area, FLUXEAST indicates that landfill gas is readily passing through the landfill cover material. Concentrations of methane, carbon dioxide, and volatile organic compounds appeared similar to concentrations of these compounds in landfill gas detected in the same area.

Delineation of Off-Site Landfill Gas Plume. In June and July 1991, 32 permanent landfill gas sampling points were installed around the perimeter of the Solid Waste Area. Nine points, spaced

at approximately 100-foot intervals, were placed at the north end of the Solid Waste Area along the driveway at the northern boundary. Eighteen points were placed along the west side of Rose Hill Road also at approximately 100-foot intervals. Five points were placed at the southern perimeter of the Solid Waste Area, just inside the fence that divides the Solid Waste Area from the transfer station road, again at approximately 100-foot intervals.

These sampling points are shown on Figure 27. Permanent sampling points along the driveway north of this disposal area are designated LFGF. Permanent sampling points west of the Solid Waste Area along Rose Hill Road are designated LFGR. Points south of the Solid Waste Area along the transfer station road are designated LFGT.

Sampling of the perimeter landfill gas monitoring points in July and September 1991 indicated that landfill gas was migrating from the Solid Waste Area to the north, west, and south. Elevated methane, carbon dioxide, and total volatile organics were identified at LFGF-03 to the north of the Site. *cis*-1,2-dichloroethene and vinyl chloride were the primary volatile components identified at this point. TCE, toluene, ethylbenzene, and xylenes were also identified.

The largest area of landfill gas migration was along the western perimeter of the Site. The highest landfill gas concentrations were at LFGR-08. Methane and carbon dioxide concentrations at this point were consistently high. *cis*-1,2-dichloroethene and vinyl chloride were the primary volatile components identified at this point. Trichloroethene, toluene, ethylbenzene, and xylenes were also identified. Although LFGR-08 had the highest concentrations of off-site landfill gas, this plume appeared to extend from LFGR-07 as far south as LFGR-14. Although the landfill gas plume leaving the western perimeter of the Solid Waste Area was about 700 feet wide, it appeared to extend only about 200 feet west from the landfill.

South of the Solid Waste Area, methane, carbon dioxide, and volatiles were found to migrate south of the transfer station road. This plume extended the width of the southern end of the Solid Waste Area and approximately 100 feet south of the transfer station road. The volatile organic compounds detected south of the solid waste area varied from those detected to the north and west. The high concentrations of *cis*-1,2-DCE and vinyl chloride exhibited in the landfill gas north and west of the Solid Waste Area were not present south of the disposal area.

Volatile organics were detected at three permanent residential sampling locations (LFG-LHR, LFG-GT, and LFG-AD). Methane was detected at only one of these (LFG-LHR).

G. Contaminant Fate and Transport

Predominant transport processes for contaminants identified at the Site are leachate runoff, landfill gas migration, groundwater flow through overburden and bedrock, and surface water and sediment movement. Landfill gas migration, groundwater, and leachate are the primary contaminant transport mechanisms in the unsaturated zone. Venting of landfill gas was evident where soil/fill

cover material was thin or absent; however, movement of gas into surface soil may decrease volatilization to the atmosphere. In areas of high landfill gas contamination, groundwater quality was affected.

Highest contaminant concentrations in groundwater were found in wells adjacent to the disposal areas and decreased with distance from these areas. The predominant groundwater flow direction is south-southeast in the overburden and southeast in the bedrock, although mounding effects in the northwest portion of the Solid Waste Area facilitate radial migration of contaminants towards the west, north, and northeast. Mitchell Brook intercepts contamination in the shallow and deep overburden, while the Saugatucket River is a receptor for shallow and deep overburden and bedrock contamination. Glacial lacustrine deposits restrict the vertical movement of contaminants from deep to shallow overburden in the southern portion of the Site. Bedrock fractures provide pathways for contaminant transport in groundwater from overburden to bedrock.

Transport of contaminants via leachate has impacted surface soil, surface water, and sediment quality near the disposal areas. However, downgradient in the Saugatucket River, surface water and sediment contamination decreased. Likewise, in Mitchell Brook, contamination increased south of the Solid Waste Area but decreased after the confluence with the Saugatucket River. This trend indicates dilution of contaminated surface water by uncontaminated surface water and/or sediment retention of contamination.

VI CURRENT AND FUTURE SITE AND RESOURCE USES

A. Current Land Use

Current land use is varied within the Site. The landfills are and will remain inactive. The Solid Waste Area landfill is posted and partially fenced along Rose Hill Road and the transfer station road to restrict access. The properties within the Site boundary include residential and commercial uses. North and east of the Sewage Sludge Area, the Site owner conducts his business of sport, target and archery ranges, dog training, birding and exercising. A kennel is located on the northern portion of the Site, west of the Sewage Sludge Area. Sporting ranges are located north and east of the kennel. An active Town-operated regional transfer station and recycling center reside on the southeast corner of the Site. Saugatucket and Broadrock Roads, and a portion of Rose Hill Road (south and up to the Site), are serviced with public water; connections to the waterline were voluntary. Some residents located west and north of the Site along Rose Hill Road and along Broadrock Road are not connected to public water and use private wells. New housing developments, all of which are connected to municipal water, have been constructed southwest of the Site, on the west side of Rose Hill Road, northeast of the Site, across the River on Broadrock Road and southwest of the Site along Saugatucket Road. Across from the landfill on Rose Hill Road, small commercial excavation businesses and sand and gravel operations are conducted. A family-owned farm is located west-northwest of the Site, along Rose Hill Road.

B. Future Land Use

The Town of South Kingstown has indicated an interest in expanding the recycling operations in the vicinity of the transfer station. The Site owner has also shown interest in maintaining sporting and kennel operations within the Site boundary. The Town informed EPA and the State that it has had discussions with the Site owner's family members and abutters concerning certain real property acquisitions; however, EPA has not been involved in these discussions.

A 29- unit housing development (known as South Woods) is proposed north of the Site and south of Rte 138; this development will be connected to municipal water. Further, there are discussions among certain residents on Rose Hill Road and a local developer of a future proposal for a golf course within the footprint of the existing sand and gravel operations on Rose Hill Road.

Consolidation of the wastes from the Bulky Waste Area landfill onto the Solid Waste Area landfill may allow for more future, albeit restricted, uses on portions of the Site. Based on current zoning, it is reasonable to expect that the future land use will be similar to that which is currently in the immediate vicinity of the Site (i.e. rural residential with intespersed commercial real estate along Rose Hill Road and rural residential along Broadrock and Saugatucket Road.

C. Current and Future Surface Water Use

The River in the vicinity of the Site is classified by the State as a Class B waterway meaning that the River is not of drinking water quality but is presumed to have a good aesthetic, recreational, and ecological value. As documented in the RI/FS and the Preliminary Natural Resource Survey (PNRS), leachate production and groundwater flow from the landfill result in impacts to aquatic life and water quality in the Saugatucket River, Mitchell Brook (and, according to the PNRS, to the Saugatucket Pond). These waters are listed for biodiversity impacts on the State's 1998 list of impaired waters. Under Section 303 of the Federal Clean Water Act, the State is required to develop a total Maximum Daily Load (TMDL) program for bringing impaired waters into compliance with state water quality standards and supporting all designated uses. Rhode Island has stated that development of TMDLs for the aforementioned waterbodies will begin in the year 2000. The selected remedy will be consistent with the State's TMDL's goal.

The Saugatucket River Heritage Corridor Coalition has adapted a goal of maintaining swimmable/fishable water quality conditions in the watershed. Regionally, plans are being drawn to develop a protective greenway and bike trail to follow portions of the Saugatucket River in Wakefield and surrounding communities.

D. Current and Future Groundwater Use

Rhode Island does not have an EPA-endorsed Comprehensive State Ground Water Protection Program (CSGWPP) - EPA's process for groundwater decisionmaking by states. Therefore,

Superfund guidance requires EPA to follow the NCP for federal groundwater classification in states without a CSGWPP and to coordinate with the States during remediation activities. The federal classification for this Site groundwater is Class II-B, defined as a potential drinking water source and water having other beneficial uses. Local area groundwater surrounding the Site is classified as Class II-A which is defined as a current drinking water source and water having other beneficial uses.[1]

Although Rhode Island does not have an endorsed CSGWPP, RIDEM did submit correspondence in December 1996 setting forth its opinion on the use and value of groundwater aquifer underlying the Site as medium use (designates a flexible approach to groundwater remediation). Ultimately, all of the aquifer, except that underlying the footprint of the disposal area, would be restored to GA (suitable for public or private drinking water use without treatment); the aquifer under the disposal area would be restored to GB (degraded-not suitable for public or private drinking water). The State also noted some small GA-NA (non-attainment areas with pollutant concentrations greater than those suitable for public or private drinking water without treatment). Restoration for GA-NA areas is to drinking water standards with some flexibility on time for attaining those standards.

EPA believes that its remediation plans for this Site are consistent with both the federal and state classifications for use and value of the groundwater aquifer. Source control measures will prevent further migration of contaminant into the groundwater as well as prevent further leachate from entering the groundwater and surface water. Excavation and consolidation of the Bulky Waste Area, a portion of which currently sits in the groundwater table, also eliminates a significant source of contamination to groundwater. It is also possible that capping will, over time, eliminate any possible mounding effects of groundwater in the Solid Waste Disposal area. Once the source control remedy has been implemented, additional data produced during long-term monitoring will indicate whether or not further response actions are necessary to bring groundwater to appropriate use and value standards.

VII. SUMMARY OF SITE RISKS

A baseline risk assessment was performed to estimate the probability and magnitude of potential adverse human health and environmental effects from exposure to contaminants associated with the Site assuming no remedial action was taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial

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[1]Groundwater Use and Value Determination Guidance, EPA Region 1-New England, (April 3, 1996); EPA Office of Solid Waste and Emergency Response (OSWER) Dir. 9283.1-09, April 4, 1997; EPA's Groundwater Protection Strategy (Office of Groundwater Protection, August 1984); and Guidelines for Groundwater Classification under the EPA Groundwater Protection Strategy (Final Draft, Office of Groundwater Protection, November 1986).

action. The public health risk assessment followed a four step process: 1) contaminant identification, which identified those hazardous substances which, given the specifics of the Site were of significant concern; 2) exposure assessment, which identified actual or potential exposure pathways, characterized the potentially exposed populations, and determined the extent of possible exposure; 3) toxicity assessment, which considered the types and magnitude of adverse health effects associated with exposure to hazardous substances, and 4) risk characterization, which integrated the three earlier steps to summarize the potential and actual risks posed by hazardous substances at the Site, including carcinogenic and non-carcinogenic risks. A summary of those aspects of the human health risk assessment which support the need for remedial action is discussed below followed by a summary of the environmental risk assessment.

A. Human Health Risk Assessment

Only groundwater, at the three landfill areas and at nearby residences, and air, at the Solid Waste Area (i.e., landfill gas) and nearby residences, present a Reasonable Maximum Exposure (RME) cancer risk greater than 10-4 or an HI >1. Forty-three contaminants of concern (listed in Tables 27 through 34 for groundwater, and Tables 35, 36, 37 through 42, 43, and 44 for air) of more than 50 contaminants detected at the Site were selected for evaluation in the human health risk assessment. The contaminants of concern for groundwater and for air from the Final Supplemental Human Health Risk Assessment (November 1998) were selected to represent potential Site related hazards based on toxicity, concentration, frequency of detection, and mobility and persistence in the environment. They represent a subset of all the compounds evaluated in the baseline risk assessment. Tables 28, 30, 32, and 34 for ground water, and 36, 38, 40, and 44 for air, from the Final Supplemental Human Health Risk Assessment also contain the exposure point concentrations used to evaluate the RME in the baseline risk assessment. Estimates of average or central tendency exposure concentrations can be found in the Final Supplemental Human Health Risk Assessment. Tables 45 and 46 from the Final Supplemental Human Health Risk Assessment and Table 47 (for air) as well as Tables 48 through 50 and 51 (for groundwater) from the Final RI Report (May 1994) provide a summary of the range of detected concentrations and frequency of detection for the compounds of concern in both media.

Potential human health effects associated with exposure to the contaminants of concern were estimated quantitatively or qualitatively through the development of several hypothetical exposure pathways. These pathways were developed to reflect the potential for exposure to hazardous substances based on the present uses, potential future uses, and location of the Site. The following is a brief summary of just the exposure pathways that were found to present a significant risk. A more thorough description of all exposure pathways evaluated in the risk assessment including estimates for an average exposure scenario, can be found in Section 7.0 of the Final Supplemental Human Health Risk Assessment, November, 1998.

For the inhalation of contaminated ambient and indoor air, both measured and modeled concentrations were evaluated. For modeling, measured landfill gas concentrations were used and

adjusted using emission and dispersion modeling. Exposures to ambient air at the Solid Waste Area surface were assumed to occur for an adult Site visitor 4 hr/day, 150 days/year, for 30 years. At the nearby residences, adult inhalation exposures were assumed to occur 24 hr/day, 350 days/year, for 30 years.

Excess lifetime cancer risks were determined for each exposure pathway by multiplying a daily intake level with the chemical specific cancer potency factor. Cancer potency factors have been developed by EPA from epidemiological or animal studies to reflect a conservative "upper bound" of the risk posed by potentially carcinogenic compounds. That is, the true risk is unlikely to be greater than the risk predicted. The resulting risk estimates are expressed in scientific notation as a probability (e.g. 1×10^{-6} for 1/1,000,000) and indicate (using this example), that an average individual is not likely to have greater that a one in a million chance of developing cancer over 70 years as a result of site-related exposure (as defined) to the compound at the stated concentration. All risks estimated represent an "excess lifetime cancer risk" or the additional cancer risk on top or that which we all face from other causes such as cigarette smoke or exposure to ultraviolet radiation from the sun. The chance of an individual developing cancer from all other (non-site related) causes has been estimated to be as high as one in three. EPA's generally acceptable risk range for site related exposure is 10^{-4} to 10^{-6}. Current EPA practice considers carcinogenic risks to be additive when assessing exposure to a mixture of hazardous substances.

In assessing the potential for adverse effects other than cancer, a hazard quotient (HQ) is calculated by dividing the daily intake level by the reference dose (RfD) or other suitable benchmark. Reference doses have been developed by EPA and they represent a level to which an individual may be exposed that is not expected to result in any deleterious effect. RfDs are derived from epidemiological or animal studies and incorporate uncertainty factors to help ensure that adverse health effects will not occur. A HQ<1 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic noncarcinogenic effects from that chemical are unlikely. The Hazard Index (HI) is generated by adding the HQs for all chemical(s) of concern that affect the same target organ (e.g. liver) within or across all media to which a given individual may reasonably be exposed. A HI <1 indicates that toxic noncarcinogenic effects are unlikely.

The scope of the first operable unit response for this Site is a source control action as part of a phased clean up approach. Groundwater and the risks posed by contaminants in groundwater will be further assessed using monitoring data collected during the implementation of the first operable unit and any additional studies deemed necessary and addressed under a second operable unit response action. However, based on the findings of the RI, EPA acknowledges that the cumulative excess RME cancer risk posed by present and potential future ingestion of groundwater as a drinking water source is outside of EPA's acceptable risk range for Site related exposures. Tables 52 through 55 depict the carcinogenic and non-carcinogenic risk summary for the contaminants of concern in groundwater evaluated to reflect present and potential future adult residential ingestion of Site groundwater as drinking water corresponding to the reasonable maximum exposure (RME) scenario. As such, the risk posed by this exposure route justifies the use of institutional controls as

part of the remedy for this first operable unit response.

Tables 56 through 60 depict the carcinogenic and non-carcinogenic risk summary for the contaminants of concern in air evaluated to reflect present and potential future inhalation of ambient air by Solid Waste Area visitors and ambient/indoor air by area residents corresponding to the reasonable maximum exposure (RME) scenario. Only those exposure pathways deemed relevant to the remedy being proposed are presented in this ROD. In addition, only those compounds contributing an RME cancer risk in excess of 10^{-6} or an HQ>1 have been presented. Readers are referred to Section 7.0 of the Final Supplemental Human Health Risk Assessment for a more comprehensive risk summary of all exposure pathways and for estimates of the central tendency risk. Toxicity information used for the risk calculations can be found in Tables 61 and 62 of the final Supplemental Human Health Risk Assessment.

For the air pathway, benzene, 1,1-dichloroethene, 1,1,2,2-tetrachloroethane, and vinyl chloride contribute significantly to carcinogenic and non-carcinogenic risk. The cumulative excess RME cancer risks posed by the inhalation of measured outdoor air concentrations at the Solid Waste Area and measured ambient air concentrations at the nearby residences are 4.4×10^{-4} and 5×10^{-4}, respectively. Using modeled concentrations, the cumulative excess RME cancer risks posed by the inhalation of ambient air at the Solid Waste Area and ambient/indoor air at the nearby residences are 4.4×10^{-4} and 4.6×10^{-4}, respectively. Using measured indoor air concentrations at 220 Rose Hill Road, the cumulative excess RME cancer risk posed by the inhalation of air is 1.9×10^{-3}. The non-carcinogenic hazards posed by the inhalation of measured and modeled ambient air concentrations at the nearby residences are both 12 times the EPA safe level indicating that adverse blood effects are possible as a result of chronic exposure to benzene.

Limitations and uncertainties in the risk assessment include adequacy of site characterization and sampling, quality of analytical data, accuracy of exposure assumptions, use of modeling to develop EPCs, and development of toxicity values. Most important for this risk assessment, conservative exposure assumptions were used for exposure concentrations (i.e., maximum detected concentrations) and for frequency and duration of exposure. These conservative assumptions can potentially result in an overestimate of risk to human receptors. In addition, exposure point concentrations derived by modeling have considerable uncertainty since the modeled concentrations are based on: (1) limited sampling; (2) predicted, rather than measured landfill gas generation rates; and (3) conservative assumptions for specific input parameters. Each of these uncertainties may result in an over-, or under-estimate of receptor risk.

Further detail concerning the Human Health Risk Assessment can be found in Section 3.6 of the Administrative Record.

B. Ecological Risk Assessment

The major objective of the baseline ecological risk assessment was to evaluate potential adverse effects to ecological resources from exposure to Site contaminants. The baseline ecological risk assessment provides quantitative risk estimates for aquatic communities since information on the nature and extent of contamination suggested that potential impacts to ecological resources were most likely to occur in aquatic areas; thus, data (e.g., quantitative benthic surveys and toxicity testing) were collected to support a full quantitative assessment. The baseline ecological risk assessment provides a qualitative evaluation for terrestrial communities since risks were expected to be small and data collection to support a quantitative assessment was thus not considered necessary. The baseline ecological risk assessment was conducted consistent with applicable United States Environmental Protection Agency guidance documents on ecological assessments and ecological risk assessments.

Contaminant Identification

Risks were evaluated through the development of media-specific ecological effect levels, which are defined as the concentration of a particular contaminant in a particular medium below which no adverse effects to ecological receptors are likely to occur. Ecological effect levels were developed based on established numerical criteria (e.g., United State Environmental Protection Agency and RIDEM ambient water quality criteria) or on information obtained from the literature. These effect levels can be used to assess baseline risks to ecological receptors by comparing the effect levels to existing contaminant levels in the on-site media. In addition, toxicity testing with on-site sediments and leachate served to more fully define baseline risks to aquatic receptors.

Media that were investigated as part of this remedial investigation included surface water, groundwater, leachate, surface sediment, surface soil, subsurface soil, and landfill gas. Based on likely exposure pathways (see section 7.3 of the RI) for species observed or expected to occur on Site, the following exposure pathways were identified for further evaluation under the baseline ecological risk assessment as potential concerns to ecological resources:

- Surface water in the Saugatucket River and Mitchell Brook, as well as in downgradient surface waters fed by these water bodies
- Leachate from landfill seeps
- Surface sediment in the Saugatucket River and Mitchell Brook
- Surface soil, especially in the three disposal areas
- Landfill gas, especially in the Solid Waste Area

Groundwater and subsurface soils (soils at depths greater than two feet) were eliminated as media of ecological concern since organisms on Site have limited direct contact with these media.

Tables 63 through 67 summarize the occurrence of chemicals detected in surface water, leachate, surface sediment, and surface soils samples collected within the Site study area. In summary, chemicals of ecological concern for surface water are aluminum, iron and manganese (Table 68). For leachate, aluminum, iron, lead and manganese are the chemicals of ecological concern while aluminum and iron are of ecological concern in the surface sediments. Copper, lead and manganese were identified as the chemicals of concern for surface soils. No compounds are of ecological concern in landfill gas.

Exposure Assessment

Within exposure assessment, the potential exposure pathways for various species groups such as plants, benthic invertebrates, fish, amphibians, reptiles, mammals and birds were directly or indirectly evaluated to determine those considered to be at risk of significant exposure from Site contaminants.

Table 69 lists the assessment and measurement endpoints for selected species groups for which a potential exposure risk has been identified and for which quantitative data exist. Since only the aquatic system was studied in detail, assessment and measurement endpoints are established only for benthic invertebrates and fish. Terrestrial and semiaquatic taxa were qualitatively evaluated.

Information on the toxicity of the five chemicals of ecological concern (iron, aluminum, manganese, copper, and lead) to ecological receptors was summarized in the toxicity assessment of the ecological risk assessment. In addition, the correlation between the abundance and diversity of species within the benthic community and contaminant concentrations was also presented. Because of the potential synergistic effects of contaminants in sediments and the overall lack of existing sediment toxicity information in the literature, toxicity tests were conducted on sediment samples from three locations at the Site as described in section 2.5.7.6 of the Remedial Investigation. Additionally, toxicity testing was conducted for water column organisms on leachate samples from the Site.

In summary, the results of the correlation analyses indicate that, at least in the water column, total species densities and community structure (occurrence of dominant species) are directly correlated to iron concentration in the Saugatucket River. Total densities and densities of dominant species decrease with increasing iron concentration in the Saugatucket River. This indicates that iron in the water column, although not acutely toxic, is resulting in decreased productivity. The concentration of aluminum does not appear to negatively affect the macrobenthic community.

Toxicity tests were conducted on sediments using two aquatic invertebrates, *Hyalella azteca* and *Ceriodaphnia dubia* and on the fathead minnow, *Pimephales promelas*. Composite leachate

samples were collected from the Site and toxicity tests performed using the test organisms, *C. dubia and P. promelas*. The methodologies used in the toxicity testing are described in detail in sections 2.5.7.3 and 2.7.5.4 of the RI. Detailed reports of the tests can be found in Appendix F of the RI.

Table 70 summarizes the mean weight of surviving *Hyalella azteca* in the ten-day growth test. There was variability in growth among samples, but no statistically significant difference in growth was found between samples. The mean weight of surviving organisms in the Saugatucket River was lowest in samples from locations SE-05 and SE-06 (downstream of the leachate seeps), suggesting that the growth of these organisms may be adversely influenced by contamination from the seeps. Sediments from these locations also contained the highest iron concentrations. In Mitchell Brook, the mean weight of surviving organisms was lowest (although not statistically significant) at the two downstream locations (Table 70), suggesting that contamination from the disposal areas may be affecting growth in these organisms.

Percent survival of *Ceriodaphnia dubia* in the Saugatucket River was slightly lower (although not statistically significant) in the samples from locations downstream of the major leachate seep (SE-05, SE-06, SE-11; Table 71), suggesting some potential influence on survival of organisms from the leachate contaminants. In Mitchell Brook, survival was slightly higher in the samples from the two downstream locations (SE-07 and SE-12; Table 71). In general, however, it does not appear that the contamination from the Site significantly affected the survival rate of the test organisms, since mortality at all locations was very low and not statistically difference from the laboratory control samples.

In the Saugatucket River, the survival rate of *Pimephales promelas* was lowest at the most upstream sample location (SE-02) and highest at the most downstream sample location (SE-11). Survival in the intermediate locations varied (Table 72), suggesting that no distinct correlation between survival rate and contamination was associated with the disposal areas adjacent to the river for these organisms. In Mitchell Brook, the survival rate was lower in samples from the two downstream locations (Table 72), suggesting that the survival rate in the brook samples may be influenced by Site contamination. Sediments from these two locations contained higher levels of contaminants than the upstream location. As with the other two test organisms, there was no statistical difference in survival rate between the reference sample and any of the test samples.

Based on the statistical results of these tests, it was concluded that there was no significant difference between the reference and study area samples in sediment toxicity. This indicates that the sediments at the Site do not exhibit acute or chronic toxicity to representative, aquatic species.

Toxicity tests were performed using composite leachate samples from the Site and the test organisms *C. dubia* and *P. promelas*. Results from these tests are summarized in Tables 73 and 74. Test results indicate that the leachate was acutely toxic to *C. dubia* and also caused reproductive effects. Some chronic toxicity also occurred in the fathead minnow *(P. promelas)*.

Risk Characterization

As discussed in section 3.4 of the RI, the benthic community in the Saugatucket River is generally diverse. However, community composition and relative abundance of organisms appear to be influenced by the proximity to the landfill and leachate seeps. The benthic grab samples from the sediments adjacent to the largest leachate seep were distinctly different from samples at upstream and downstream locations, indicating that the community structure at this location may be the result of adaption to the chemical influence of the sediments, and thus, is different from the community structure that would be expected in the absence of the chemical influence. Concentrations of the chemicals of ecological concern in the sediments were generally higher at the two locations immediately downstream of the major leachate seep (SE-05 and SE-06) than at the most upstream (SE-02) and most downstream (SE-11) locations. This trend is especially evident for iron, where the concentration at SE-05 and SE-06 is two orders of magnitude greater than at the upstream location. This difference in iron concentration, and to a lesser degree aluminum, may be directly influencing the benthic community structure. Results of the sediment toxicity tests also indicate that contamination in the sediments may result in lower survival rates for sensitive organisms, resulting in a shift in community structure.

In the water column of the Saugatucket River, the density of macroinvertebrates appears to be directly influenced by the disposal areas. The density of organisms significantly decreases downstream of the disposal areas where contaminant concentrations in the surface water are higher. Additionally, the occurrence of pollution-sensitive taxa decreases downstream of the disposal areas, indicating that these species are less able to tolerate the more stressful environmental conditions. This increase in densities of organisms corresponds to an increase in the concentrations of the chemicals of ecological concern in surface water from upstream to downstream locations, especially with respect to iron and manganese.

In Mitchell Brook, as with the Saugatucket River, the benthic community structure associated with contaminated sediments was distinctly different from the structure at locations less influenced by the disposal area contamination. Total species densities were lower downstream of the disposal areas even though the physical characteristics of the sediments were similar. This corresponds to an increase in the concentrations of the chemicals of ecological concern immediately downstream of the disposal areas (SE-09). This indicates that chemical contamination from the disposal areas may be affecting densities. The macrobenthic community in the water column in Mitchell Brook exhibits this same trend of decreased species densities downstream of the disposal areas associated with increased concentrations of the chemicals of ecological concern.

No quantitative assessment of the fish community in the water bodies of the Site study area was conducted. However, based on the physical characteristics of the water bodies (such as water flow and sediment type), these areas would be expected to support both resident and migratory fish populations. However, based on observations made during aquatic sampling, Mitchell Brook and

the Saugatucket River do not appear to support a healthy fish community on the Site, since few fish were observed during aquatic sampling. The lack of fish may be related to chemical contamination in the water column since both aluminum and iron exceeded AWQC. AWQC are designed to protect most aquatic organisms from the toxic effects of contaminants. Additionally, results of the leachate toxicity tests indicate that this media can produce chronic toxicity in fathead minnows. Sediment toxicity tests also suggest that there may be decreased survival rates in minnows at sediment contaminant levels associated with the study area.

The *in-situ* benthic community exhibits some apparent effects from Site contamination particularly with respect to community structure (as described in sections 3.4 and 7.5.1 of the RI). However, the results of the correlation analyses suggest that there is no significant linear correlation between species densities and sediment contamination. Also, the results of the sediment toxicity tests indicate that the sediments do not produce acute or chronic toxicity in sensitive aquatic organisms. These results suggest that the effects on the benthic community are likely to be attributable to surface water contamination and not sediment contamination. This is supported by the fact that concentrations of the chemicals of ecological concern in surface water and leachate exceed AWQC and that the leachate is acutely toxic in toxicity tests.

Ecological risk from the chemicals of ecological concern in surface water and leachate can be characterized by comparing contaminant concentrations to known ecological effect levels. For iron and aluminum, the ecological effect levels were based on ambient water quality criteria for protecting aquatic life. For iron, the chronic effect level is 1,000 Fg/L in surface water, and for aluminum is 87 Fg/L. Iron was measured at up to 65 times the criteria in surface water while aluminum was measured at up to 13 times its criteria value. Concentrations of these chemicals in surface waters throughout the Site frequently exceeded criteria levels, especially in areas downstream of leachate seeps. Thus, there is a risk to aquatic organisms in the surface waters from exposure to these chemicals of ecological concern. Concentrations of iron and aluminum in leachate also exceeded AWQC by up to four orders of magnitude for iron and up to three orders of magnitude for aluminum. The risk to aquatic organisms is confirmed by results from the leachate toxicity testing, which indicated that the leachate is acutely toxic to aquatic organisms. Additionally, the correlation analysis shows significant negative correlation between iron concentration and species densities in the surface water.

In summary, baseline risk to aquatic organisms may occur as a result of exposure to the chemicals of ecological concern in the surface water and leachate. There does not appear to be an existing risk to aquatic organisms due to exposure to sediments.

In contrast, baseline risks to terrestrial and semiaquatic organisms are not likely to be significant over most of the Site study area. Areas of soil associated with leachate seeps, and the leachate itself, may pose some risks to biota. Due to the small areas affected, however, this risk is not likely to be significant. Food chain effects are not of concern, although indirect effects from reduced prey abundance in aquatic areas may be occurring. Small areas of dead trees associated with high

methane levels in soil gas are also not considered significant, due to the extremely limited areas over which these effects have been observed.

Uncertainty

There are many sources of uncertainty associated with an ecological risk assessment. Each component of an ecological risk assessment (i.e., receptor selection, toxicity assessment, and exposure assessment) has some uncertainty associated with it. The principal uncertainty associated with this analysis involves the determination of ecological effect levels. For many chemicals, especially for the terrestrial assessment, toxicity data were very limited and criteria values were omen unavailable. To compensate for this, the most conservative values were generally used to represent a reasonable worst-case scenario.

A second uncertainty involves using chemical-specific effect levels for individual compounds to assess toxicity. This approach fails to account for multiple exposure pathways, exposures to multiple chemicals, and potential additive or synergistic effects. This uncertainty is most evident for the terrestrial portion of the ecological risk assessment; the aquatic portion included toxicity testing with on-site media, which accounts for these factors.

Conclusion

The baseline human health risk assessment revealed that area adult residents and adult visitors to the Solid Waste Area potentially exposed to compounds of concern in groundwater and air via ingestion and inhalation, respectively, may present an unacceptable human health risk (e.g. cancer risk>10^{-4} or HI>1).

Results of the baseline ecological risk assessment identified concentrations of iron and aluminum in surface waters throughout the Site frequently exceeded criteria levels, especially in areas downstream of leachate seeps. Thus, there is a risk to aquatic organisms in the surface waters from exposure to these chemicals of ecological concern. Concentrations of iron and aluminum in leachate also exceeded AWQC by up to four orders of magnitude for iron and up to three orders of magnitude for aluminum. The risk to aquatic organisms is confirmed by results from the leachate toxicity testing, which indicated that the leachate is acutely toxic to aquatic organisms. Additionally, the correlation analysis between benthic community composition and chemical concentrations, show a significant negative correlation between iron concentration and species densities in the surface water.

The human health and ecological risk assessments identified unacceptable risks posed by actual or threatened releases of hazardous substances from this Site which if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment. Therefore, groundwater, air (i.e., landfill gas) and leachate are the media of focus for the remedial alternatives presented for this Site.

VIII. REMEDIAL OBJECTIVES AND DEVELOPMENT AND SCREENING OF ALTERNATIVES

A. Statutory Requirements/Response Objectives

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

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

- To reduce the potential exposure of area residents and those at the landfill to landfill gases (i.e., vinyl chloride, benzene, 1,1-dichloroethene, and 1,1,2,2-tetrachloroethane) in ambient and indoor air via inhalation that may present a human health risk in excess of the EPA target risk range of 10^{-6} to 10^{-4} for carcinogenic compounds or with a total HI>1 for noncarcinogenic compounds with similar toxic endpoints.

- To reduce the potential exposure of area residents to organic and inorganic contaminants of concern (i.e., vinyl chloride, 1,2-dichloroethene, acrylamide, benzene, pentachlorophenol, bis(2-ethylhexyl)phthalate, antimony, arsenic, cadmium, manganese, beryllium, chromium, and lead) in groundwater via ingestion that may present a human health risk in excess of the EPA target risk range of 10^{-6} to 10^{-4} for carcinogenic compounds or with a total HI>1 for noncarcinogenic compounds with similar toxic endpoints through institutional controls.

- To reduce contaminant migration via leachate to surface waters and sediments of Atitchell Brook in order to improve water quality and designated uses, including aquatic life support.

- To reduce contaminant migration via leachate to surface waters and sediments of the Saugatucket River in order to improve water quality and designated uses, including aquatic life support.

B. Technology and Alternative Development and Screening

CERCLA and the NCP set forth the process by which remedial actions are evaluated and selected. Because many CERCLA municipal landfill sites share similar characteristics, they lend themselves to remediation by similar technologies. EPA has established a number of expectations as to the types of technologies that should be considered and alternatives that should be developed; they are listed in the National Contingency Plan (NCP), 40 CFR 300.430(a)(1). For CERCLA municipal landfill sites, it is expected that;

1. The principal threats posed by a site will be treated wherever practical, such as in the case of remediation of a hot spot.

2. Engineering controls such as containment will be used for waste that poses a relatively low long-term threat or where treatment is impractical.

3. A combination of methods will be used as appropriate to achieve protection of human health and the environment. An example of combined methods for municipal landfill sites would be treatment of hot spot in conjunction with containment (capping) of the landfill contents.

4. Institutional controls such as deed restrictions will be used to supplement engineering controls, as appropriate, to prevent exposure to hazardous wastes.

5. Innovative technologies will be considered when such technologies offer the potential for superior treatment performance or lower costs for performance similar to that of demonstrated technologies.

6. Groundwater will be returned to beneficial uses whenever practical, within a reasonable time, given the particular circumstances of the Site.

In accordance with these requirements, a range of alternatives were developed for the Site.

With respect to source control, the RI/FS developed a range of alternatives in which treatment that reduces the toxicity, mobility, or volume of the hazardous substances is a principal element. This range included an alternative that removes or destroys hazardous substances to the maximum extent feasible, eliminating or minimizing to the degree possible the need for long term management. This range also included alternatives that treat the principal threats posed by the Site

but vary in the degree of treatment employed and the quantities and characteristics of the treatment residuals and untreated waste that must be managed; alternative(s) that involve little or no treatment but provide protection through engineering or institutional controls; and a no action alternative.

With respect to ground water response action, the RI/FS developed a limited number of remedial alternatives that attain site specific remediation levels within different timeframes using different technologies; and a no action alternative. However, groundwater will be addressed in a second operable unit, based on monitoring data collected during the implementation of the first operable unit and any additional studies deemed necessary, as explained in Section VII A. above.

As discussed in Section 2 of the FS, treatment technology options were identified, assessed and screened based on implementability, effectiveness, and cost. These technologies were combined into source control (SC) (no action, limited action, containment and treatment,) and management of migration (MOM) alternatives. The MOM alternatives will be evaluated as part of a second operable unit, based on monitoring data collected during the implementation of the first operable unit and any additional studies deemed necessary. Section 3 of the FS presented the remedial alternatives developed by combining the technologies identified in the previous screening process in the categories identified in Section 300.430(e) (3) of the NCP. The purpose of the initial screening was to narrow the number of potential remedial actions for further detailed analysis while preserving a range of options. Each alternative was then evaluated in detail in Sections 4 and 5 of the FS.

In summary, the no action, limited action, and four source control (containment and treatment) remedial alternatives were retained as possible options for the cleanup of the Site. These six alternatives were selected herein for detailed analysis.

IX. DESCRIPTION OF ALTERNATIVES

This Section provides a narrative summary of each alternative evaluated.

- **Alternative 1:** *No-Action*

  The Site would remain as is; there would be no remedial action of any of the contaminated media. However, long-term monitoring of existing ground water monitoring wells, landfill gas and surface water stations located throughout the Site would be monitored for at least thirty years to detect any change that would require intervention. Five-year statutory reviews to determine protectiveness would be conducted as required. A schematic of this alternative is shown in Figure 28, Appendix A.

Estimated Time for Design and Construction:	*< 1 year*
Estimated Time of Operation:	*> 30 years*
Estimated Capital Cost:	*$100,000*
*Estimated Operations and Maintenance Costs (**net present worth**):*	*$3,460,000*
*Estimated Total Cost **(net present worth):***	*$3,570,000*

- **Alternative 2:** *Limited Action*

  This alternative would include the long-term environmental monitoring and statutory five-year reviews as described above, establish institutional controls for access and for use of groundwater in the form deed restrictions including land use easements and covenants to prevent access to restricted areas of the Site and to prevent the future use, direct contact and exposure to, or hydraulic alteration of contaminated groundwater. This alternative would also provide landfill gas control contingencies for the nearby residential dwellings which are, or may be, impacted by migrating landfill gas. A schematic of this alternative is shown in Figure 29, Appendix A.

Estimated Time for Design and Construction:	*1 year*
Estimated Time of Operation:	*>30 years*
Estimated Capital Cost:	*$360,000*
*Estimated Operations and Maintenance Costs **(net present worth):***	*$3,480,000*
*Estimated Total Cost **(net present worth):***	*$3,840,000*

EPA's Preferred Alternative, as presented in the Proposed Plan, was Alternative 3A.

- **Alternative 3A:** *Containment and Landfill Gas Treatment via an Enclosed Flare*

  This alternative would include the long-term environmental monitoring, statutory five-year reviews and establishment of institutional controls as described above, apply protective (Subtitle-C or its performance equivalent), multi-layer caps onto the Solid Waste and Bulky Waste Areas, install an active perimeter and internal gas collection system on the Solid Waste Area with treatment of the gases via combustion through an enclosed flare, and install a passive landfill gas venting system on the Bulky Waste Area. In addition, EPA would collect data to assess the need for conducting any further remedial responses concerning groundwater and surface water as a component of the long-term monitoring program. A schematic of this alternative is shown in Figure 30, Appendix A.

Estimated Time for Design and Construction:	*2 years*
Estimated Time of Operation:	*<15 years for LFG; >30 years GW/Leachate*
Estimated Capital Cost:	*$6,420,000*
*Estimated Operations and Maintenance Costs **(net present worth):***	*$7,000,000*
*Estimated Total Cost **(net present worth):***	*$13,420,000*

- **Alternative 3B:** *Containment and Landfill Gas Treatment via Photocatalytic Oxidation*

  This alternative would include the long-term environmental monitoring, statutory five-year reviews, establishment of institutional controls, protective covers, installation of a passive landfill gas venting system on the Bulky Waste Area, an active perimeter and internal gas collection system on the Solid Waste Area as described above, with treatment of the gases via photocatalytic oxidation. In addition, EPA would collect data to assess the need for conducting any additional remedial responses concerning groundwater and surface water as a component of the long-term monitoring program. A schematic of this alternative is shown in Figure 31, Appendix A.

Estimated Time for Design and Construction:	2 years
Estimated Time of Operation:	<15 years for LFG; >30 years GW/Leachate
Estimated Capital Cost:	$6,560,000
Estimated Operations and Maintenance Costs **(net present worth):**	$6,630,000
Estimated Total Cost **(net present worth):**	$13,190,000

- **Alternative 4A:** *Containment, Leachate Collection and On-site Treatment, and Landfill Gas Treatment*

  This alternative would include the long-term environmental monitoring, statutory five-year reviews, establishment of institutional controls, protective covers, installation of a passive landfill gas venting system on the Bulky Waste Area, an active perimeter and internal gas collection system on the Solid Waste Area as described in 3A above. Additionally, added measures to collect and treat leachate in the Bulky Waste Area would be implemented and treated waters would be discharged on-site through injection wells. A schematic of this alternative is shown in Figure 32, Appendix A.

Estimated Time for Design and Construction:	2 years
Estimated Time of Operation:	<15 years for LFG; >30 years GW/Leachate
Estimated Capital Cost:	$7,240,000
Estimated Operations and Maintenance Costs **(net present worth):**	$8,830,000
Estimated Total Cost **(net present worth):**	$16,070,000

EPA's Selected Remedy is Alternative 4B. The NCP allows EPA to re-evaluate its remedy preference in response to new information and in consideration of comments received during the public comment period. In review of all information and comments received, EPA modified its preferred remedy to Alternative 4B.

- **Alternative 4B:** *Consolidation of the Bulky Waste Area onto the Solid Waste Area, Containment, Leachate Collection and Management (during consolidation), and Landfill Gas Collection and Treatment (Solid Waste Area)*
  This alternative would include the long-term environmental monitoring, statutory five-year reviews and establishment of institutional controls as described above. Instead of capping the Bulky Waste Area, this disposal area would be excavated and consolidated onto the Solid Waste Area which would then be capped and an active perimeter and internal landfill gas collection system installed and treatment of the gases via combustion (enclosed flare) as required to achieve ARARs. Leachate and waters collected from runoff and de-watering operations during the consolidation phase would be managed and discharged according to appropriate regulations. As with Alternative 3A, EPA would collect data to assess the need for conducting any additional remedial responses concerning groundwater and surface water as a component of the long-term monitoring program. A schematic of this alternative is shown in Figure 33, Appendix A.

Estimated Time for Design and Construction:	2 years
Estimated Time of Operation:	<15 years for LFG; >30 years GW/Leachate
Estimated Capital Cost:	$11,360,000
Estimated Operations and Maintenance Costs **(net present worth):**	$6,680,000
Estimated Total Cost **(net present worth):**	$18,040,000

X. SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

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

A detailed analysis was performed on the alternatives using the nine evaluation criteria in order to select a Site remedy. The following is a summary of the comparison of each alternative's strength and weakness with respect to the nine evaluation criteria. These criteria are summarized as follows:

Threshold Criteria

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

1. **Overall protection of human health and the environment** addresses whether or not a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced or controlled through treatment, engineering

controls, or institutional controls.

2. **Compliance with applicable or relevant and appropriate requirements (ARARs)** addresses whether or not a remedy will meet all of the ARARs of other Federal and State environmental laws and/or provide grounds for invoking a waiver.

Primary Balancing Criteria

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

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

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

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

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

7. **Cost** includes estimated capital and Operation and Maintenance (O&M) costs, as well as present-worth costs.

Modifying Criteria

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

8. **State acceptance** addresses the State's position and key concerns related to the preferred alternative and other alternatives, and the State's comments on ARARs or the proposed use of waivers.

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

A detailed tabular assessment of each alternative according to the nine criteria can be found in Table 5-1 of the Feasibility Study.

Following the detailed analysis of each individual alternative, a comparative analysis, focusing on the relative performance of each alternative against the nine criteria, was conducted. The section below presents the nine criteria and a brief narrative summary of the alternatives and the strengths and weaknesses according to the detailed and comparative analysis.

1. Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/or institutional controls.

The preamble to the NCP and EPA's Guidance for conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites, OSWER Dir. 9355.3-11 (Febuarary, 1991) identifies municipal landfills as a type of site where treatment of the waste may be impracticable because of the size and heterogeneity of the contents. EPA generally considers containment to be an appropriate response action for large municipal landfills. Because the Rose Hill Regional Landfill Site is a large municipal landfill, the alternatives evaluated consider containment of the wastes to be the appropriate response action for source control. Further, consideration of consolidation of the Bulky Waste materials onto the Solid Waste Area provides for added protectiveness to ecological receptors by removing an uncontrolled source area from the proximity of the Saugatucket River wetland and bank and consolidating these materials into a single waste area to be properly controlled and appropriately monitored. In addition, innovative cap materials will be considered when such materials offer the potential for superior performance or lower costs for performance equivalent to that of demonstrated materials.

Alternatives 1 and 2 do not meet this criterion, while Alternatives 4A and 4B would attain adequate protection of human health and the environment, with 4B offering a higher degree of environmental protectiveness through the excavation and consolidation of the bulky waste area. Alternatives 3A and 3B would attain adequate protection of human health, but would only approach adequate attainment for protection of the environment, since some amount of leachate continue to reach surface water/sediment bodies. Alternatives 3A through 4B capture and treat landfill gas emissions in protection of human health. Under 3A and 3B, additional response actions would likely be necessary for the Bulky Waste Area (BWA) since leachate would continue to be produced after the caps were installed and functioning. This is primarily due to the anticipated seasonal fluctuations of ground water elevations contacting wastes beneath the Bulky

Waste landfill cap. While reduced by the placement of a cap on the BWA, leachate breakout may continue to impact the Saugatucket River.

Human Health Protection

Alternative 1 provides no protection against human health risks and, thus, does not meet this threshold criteria. The estimated cancer risk and hazard index would continue to exceed EPA's target cancer risk range of 10^{-6} to 10^{-4} and the target non-cancer risk limit of 1 for those exposure pathways identified in the baseline risk assessment. Alternative 1 also provides no protection from potential future risks if off site migration of contamination occurs. This Alternative will not be carved through the rest of the comparative analysis, except for cost.

Alternative 2 uses institutional controls (access and ground water restrictions in the form of easements and covenants) and landfill gas control contingency measures to provide some degree of overall protection of human health by reducing the potential for human exposures to occur. Overall risks to human health at the Site may be lessened by Alternative 2. Considering the magnitude of risk posed at the Site and the geographic extent of the ground water exceedances of water quality standards and extent of landfill gas emissions, institutional controls and the contingency measures, by themselves, are inadequate to provide protectiveness at the Site over the long term. Therefore, Alternative 2, which relies solely on institutional controls and contingency measures where risk is demonstrated to be outside EPA's acceptable risk range, are less protective than alternatives 3A through 4B. Since contamination at the Site is not reduced or contained under this alternative, off-site exposures to COCs in ambient air or indoor air at nearby residences would exceed the EPA target cancer risk range. This occurs even at locations with the residential LFG control contingency since these systems are appropriate only for reducing safety risks from methane in soil gas.

Human health risks from inhalation exposures are reduced to acceptable levels by engineering controls and access restrictions for Alternatives 3A through 4B. These alternatives also use engineering controls to increase the protection of human health from inhalation exposures to COCs originating in landfill gas (cap installation, LFG collection, and treatment of LFG at the Solid Waste Area). Risks from inhalation exposures to COCs in soil gas in ambient air and indoor air at nearby residences are expected to be reduced to within EPA's target risk range under these alternatives.

Alternative 2 does not provide source reduction of existing groundwater contamination at the Site; Alternatives 3A through 4A do provide source reduction through installation of a cap in alternatives as well as provide leachate control to help reduce subsequent groundwater impacts by minimizing infiltration from precipitation. Alternative 4B adds and extra measure of protectiveness by physically moving part of the source waste out of the groundwater table and away from the Saugatucket River through excavation and consolidation of the bulky waste area. Furthermore, Alternatives 4A and 4B use a leachate collection and contaminant management

system to provide additional leachate control. For Alternatives 3A through 4B, potential future risks from groundwater ingestion at the Site would not exceed the EPA target cancer risk range as long as groundwater institutional controls are fully implemented and remain effective. Overall protection of human health from this exposure pathway for Alternatives 3A through 4B would also depend on long-term monitoring.

Ecological Protection

The no action and limited action alternatives, Alternative 1 and 2, respectively, are not protective of the environment and, thus, do not satisfy this criterion. These alternatives provide no reduction in long- or short-term risks to ecological receptors relative to baseline levels since there would be no reduction in contaminant migration via leachate and groundwater. Therefore, the documented adverse impacts to the aquatic community as were described in Section VII. B, especially to Mitchell Brook and the Saugatucket River, would persist under these two alternatives.

Under Alternatives 3A and 3B, capping of the two disposal areas would decrease ecological exposures to site-related contaminants in wetland and aquatic habitats since leachate generation and subsequent discharge to Mitchell Brook and the Saugatucket River would be reduced.

Alternatives 4A and 4B are more protective of the environment, since capping of the disposal areas, landfill consolidation and installation of leachate collection and a contaminant management system would prevent additional migration of Site-related contaminants to wetland and aquatic habitats. Leachate generation and subsequent discharge to Mitchell Brook and the Saugatucket River would be substantially controlled under Alternative 4A; and virtually eliminated under Alternative 4B. Alternative 4A would allow for collection and treatment of leachates through the duration of the response whereas Alternative 4B need only provide short-term collection and treatment of leachate during the consolidation process.

The remedial alternatives differ in the magnitude of potential impacts to ecological habitats. While the no action alternative would not disturb ecological habitats, contaminants would remain to continue their adverse effects on the habitats. For the limited action alternative, some minor, short-term impacts to small areas of wetland and upland habitats would occur due to fence installation. For Alternatives 3A, 3B, and 4A, capping the disposal areas and constructing the leachate collection and management system would result in some temporary and/or minor impacts to ecological habitat, the filling of one small emergent wetland forming in a depression within the landfill (<0.15 acres) and impacts to forested wetlands (0 to 0.5 acres). These potential impacts can be mitigated and are lowest for Alternatives 3A and 3B and highest for Alternatives 4A and 4B (due to the number and extent of remedial actions to be conducted).

For Alternatives 3A through 4B, the caps and leachate collection/management systems also have the potential to affect the hydrology of on-site wetlands, Saugatucket River and Mitchell Brook. These potential impacts are relatively low for Alternatives 3A and 3B compared to Alternatives 4A

and 4B (due to the presence of leachate collection systems). However, most impacts can be mitigated through engineering controls.

2. Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

Section 121(d) of CERCLA requires that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA section 121(d)(4).

Applicable requirements are those substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that specifically address hazardous substances, the remedial action to be implemented at the Site, the location of the Site, or other circumstances present at the Site. Relevant and appropriate requirements are those substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law which, while not applicable to the hazardous materials found at the Site, the remedial action itself, the Site location or other circumstances at the Site, nevertheless address problems or situations sufficiently similar to those encountered at the Site that their use is well-suited to the Site.

Compliance with ARARs addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements of other Federal and State environmental statutes or provides a basis for a invoking waiver.

Compliance with ARARs is met by Alternatives 3A through 4B but not attained by Alternatives 1 and 2.

The no action and limited action alternatives, Alternatives 1 and 2 respectively, fail to meet requirements for hazardous waste landfills. Alternatives 3A through 4B meet the Rhode Island and federal regulatory requirements for a hazardous waste landfill cap.

Since this Record of Decision anticipates a source control response, ground water cleanup is not addressed and cleanup goals are not set for any of the alternatives. A second operable unit response is planned to evaluate and manage the migration of contaminants that have impacted, or may continue to impact, local area groundwater. However, all alternatives will comply with those portions of the regulations which apply to installing groundwater monitoring wells and compliance monitoring. Management of the migration of contaminants to ground water will be based on data obtained from the first operable unit monitoring and any additional studies that are deemed necessary in order to further characterize the extent of contamination to ground water.

A similar approach will be taken with respect to surface water. As a source control response, surface water clean up is not addressed in this operable unit. Therefore water quality standards will be used to measure the effectiveness of the remedy with respect to cap effectiveness, leachate

production, and any other discharges to on-site surface water. Management of the migration of contaminants to surface water will be based on data obtained from the first operable unit monitoring and any additional studies for assessing any continued impact to surface water.

Landfill gas emissions controls, proposed under Alternatives 3A through 4B, would be designed, installed, and operated to meet Rhode Island Air Pollution Control Regulations and the federal Clean Air Act. Emissions from the gas treatment systems would attain RIDEM Air Pollution Control Regulation No. 7, which prohibits the emission of air contaminants detrimental to person or property. These emissions would also be expected to be below the minimum reportable quantities and acceptable ambient levels set forth in RIDEM air toxics rules, No. 22. Under this regulation, air quality modeling may be required to determine allowable emissions.

Alternatives 3A through 4B also include a condensate aboveground storage tank and condensate pump stations which are regulated as ancillary equipment to tanks. This condensate is assumed to be hazardous by characteristic and would require off-site disposal at a RCRA-compliant TSDF. The tank and pump stations would need to be installed in compliance with state and federal tank rules. Underground components would also need to comply with appropriate UST rules.

For Alternative 2, there would be no actions taken in wetlands or buffer zones. For Alternatives 3A through 4B, wetlands-related ARARs would be met through on-site mitigation (replacement of forested wetlands) and through proper hydrological design (to mitigate potential hydrological impacts to surface water bodies and wetlands due to the caps and/or the collection and treatment systems).

State ARARs relating to threatened and endangered species or their habitat, if any are found, would be met under all alternatives through consultation with the appropriate state agency. The baseline ecological risk assessment did not identify any significant exposure pathways to Site contaminants for any endangered species which could potentially occur on the Site.

For Alternatives 3A through 4B, actions must be taken during construction to protect (or mitigate unavoidable impacts to) wetlands, surface water bodies, the flood plain, and the nearby cemetery.

3. Long-term Effectiveness and Permanence

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once clean-up levels have been met. This criterion includes the consideration of residual risk and the adequacy and reliability of controls.

This section summarizes the evaluation for risks remaining at the Site after Remedial Action Objectives have been met, and risk from management of residuals.

Magnitude of Residual Risk: Human Health

Exposure pathways which exceed acceptable human health risk levels include inhalation exposures at the Site, inhalation exposures from indoor air and ambient air at off site receptors and groundwater ingestion exposures at the Site.

Alternative 2 does not provide long-term effectiveness and permanence since no source reduction or containment measures are implemented under this alternative. While this alternative reduces residual human health risks through the use of institutional controls and residential landfill gas contingencies, residual human health risks from ambient air inhalation exposures of off-site receptors may continue to exceed acceptable risk levels.

Through engineering controls and treatment, Alternatives 3A through 4B provide an increase in long-term effectiveness and permanence compared to Alternative 2 by controlling and reducing Site COCs in ambient air and soil gas. As a result, residual human health risks from inhalation exposures at off site receptors would be reduced to acceptable risk levels.

Alternatives 3A through 4B also provide increased long-term effectiveness and permanence with respect to residual human health risks from exposures to groundwater contamination over Alternative 2. Active remediation including capping, landfill gas and leachate collection and management in addition to institutional controls provide greater reductions in long-term residual human health risks from ingestion of groundwater. Alternative 4B provides the greatest long-term effectiveness and permanence with regard to site risks through the physical removal of the bulky waste source area from the groundwater table and from the proximity to the Saugatucket River.

There are some byproducts resulting from the treatment trains proposed for the various alternatives that could pose long-term risks; however, these potential risks are assumed to be minimal since they could be mitigated by using appropriate engineering controls where possible and by using proper operating and transport methods and procedures. For example, the LFG collection and treatment system proposed for Alternatives 3A through 4B will produce a condensate waste stream and combustion products at the enclosed flare. Alternatives 4A and 4B will generate byproducts from the treatment train for collected leachate. However, these waste streams and off-gasses will be properly managed and the risk is thought to be minimal.

Magnitude of Residual Risk: Ecological

The limited action Alternative 2 would not result in a quantifiable long-term reduction in risk to ecological receptors since leachate would continue to be generated and enter Mitchell Brook and the Saugatucket River. Documented adverse impacts to the aquatic communities in these water bodies would continue from exposure to this leachate.

Long-term risks to ecological receptors in wetland and aquatic habitats would be reduced under Alternatives 3A through 4A due to installation of caps on the Solid Waste and Bulky Waste Areas. Long-term risks to ecological receptors in wetland and aquatic habitats would be significantly reduced or eliminated under Alternatives 4B.

Adequacy and Reliability of Controls

Alternative 2 would not involve treatment controls for groundwater/leachate or landfill gas, but provides protection through access and ground water restrictions (easements and covenants) and the LFG control contingency. The effectiveness of these controls is based upon their ability to be readily enforced by both private parties and governmental agencies. Such controls also depend on the cooperation of adjacent property owners. Therefore institutional controls, by themselves, are not sufficient as the sole protective measures implemented at the Site. Further, these controls are dependent upon the frequency of routine monitoring. The adequacy and reliability of monitoring is, in turn, dependent upon the use of proper sampling and analytical procedures. Even if institutional controls are effective, however, protection of human health from risks posed by off-site inhalation of ambient air is not adequate under Alternative 2.

Horizontal containment (capping) proposed under Alternatives 3A through 4B would adequately reduce or eliminate the infiltration of precipitation into waste, thereby reducing the generation of leachate. The cap would require long-term maintenance to ensure that its integrity is not compromised. The cap would also reduce the groundwater mound reducing contact between in-place refuse and groundwater. This action reduces the volume of groundwater that becomes contaminated as well as the quantity of leachate produced. The caps, however, may not eliminate all leachate production. There is a high degree of confidence associated with caps in relation to their ability to reduce infiltration of precipitation and control the escape of landfill gas.

The leachate collection system proposed under Alternatives 4A and 4B would reduce the leachate production near the Saugatucket River. Fencing and/or other security measures will prevent the public from coming in contact with untreated water and management systems.

Excavation and consolidation of the Bulky Waste Area (Alternative 4B) would eliminate the future generation of leachate from the Bulky Waste Area, assuming all contaminants are removed. If removal of waste is incomplete (i.e., some wastes remain in place) in the Bulky Waste Area, additional controls (i.e., a cap and long-term leachate collection) may be necessary. Further, monitoring of the groundwater and surface water after the Bulky Waste material is excavated and consolidated under the cap, will collect data to assess the extent to which the attenuation of these residuals is occurring, so any unacceptable impact to local groundwater and surface waters can be addressed in OU 2 as required.

The reliability and adequacy of the LFG collection and treatment systems proposed under Alternatives 3A through 4B is initially dependent on the collection system. Landfill gas not

captured by the active internal collection system would be captured by the active perimeter collection system. The perimeter system and cap provide a secondary containment of landfill gas and further reduce fugitive emissions to ambient air.

Treatment by enclosed flare is proposed for Alternatives 3A, 4A and 4B. The release of untreated Site COCs exiting the enclosed flare would be very low due to the high destruction removal efficiencies that can be expected (95% minimum for all VOCs).

Alternative 3B proposes LFG treatment by photocatalytic oxidation. Because photocatalytic oxidation is an innovative technology, its reliability over years of operation has not been determined. The technology has not yet been tested on landfill gas. Therefore, alternatives 3A, 4A and 4B are considered more reliable than 3B.

Each of the alternatives would require periodic five-year reviews to examine the reliability and adequacy of the options and technologies selected. Five year reviews would be necessary to evaluate the effectiveness of any of these alternatives because hazardous substances would remain on-site in concentrations above health-based levels.

4. Reduction of Toxicity, Mobility, or Volume through Treatment

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

Treatment/Recycling Processes Utilized

Alternative 2 does not utilize any treatment processes beyond natural attenuation and therefore do not remediate source areas. In Alternative 2, utilization of the LFG control contingency would only result in negligible reduction of toxicity, mobility, and volume of the treated waste. Alternatives 3A, 4A, and 4B treat captured landfill gases by combustion in an enclosed flare, reducing the toxicity and mobility of landfill gas migrating off the Site. Similar to Alternative 3A, Alternative 3B also treats COCs in LFG, but does not destroy methane. Alternatives 4A and 4B additionally treat groundwater/leachate using precipitation, media filtration and UV/chemical oxidation.

Amount of Hazardous Materials Treated or Recycled

The total flow rate of leachate that would be managed under Alternatives 4A and 4B is approximately 5 gpm. Under Alternative 4B, the Bulky Waste Area leachate is expected to comprise all of this flow during excavation and consolidation process. During landfill excavation and consolidation the flow rate of leachate at the Bulky Waste Area may increase or fluctuate due to ground disturbances and/or dewatering processes but will be virtually eliminated once consolidation is complete.

Under Alternatives 3A, 4A, and 4B the majority of the LFG would be burned using an enclosed flare. Under Alternative 3B, the majority of the LFG would be treated using photocatalytic oxidation. Only limited quantities of landfill gas would be addressed under Alternative 2 through the residential LFG control contingency.

Degree of Expected Reductions in Toxicity, Mobility, or Volume

While none of the alternatives remove the source of LFG contamination, Alternatives 3A through 4B provide the greatest degree of reduction in COC toxicity, mobility, and volume from landfill gas through appropriate controls. Alternatives 3A, 3B, and 4A provide progressively more reduction in COC toxicity, mobility and volume for groundwater/leachate. Alternative 4B, when completed, provides the most long-term reduction in leachate COC mobility and volume than Alternatives 3A through 4A since the Bulky Waste Area landfill will be excavated and consolidated away from the Saugatucket River.

Irreversibility

Alternatives 3A through 4B are irreversible with respect to implemented treatment technologies and process options which destroy Site COCs. To a small extent, Alternative 2 (through the LFG control contingency) also irreversibly removes or destroys Site COCs.

Type and Quantity of Residuals

Alternative 3A would generate condensate from the landfill gas collection system as well as combustion by-products. Landfill gas condensate is expected to generate at a rate of 125 gal/10^6 ft^3 of extracted gas. Combustion gases would be expected to include trace nitrogen oxides, sulfur oxides, and small quantities of undestroyed COCs. Alternative 3B would also generate condensate from the LFG collection system as well as residuals such as methane and possibly small quantities of hydrogen chloride. Alternatives 4A and 4B would generate landfill gas condensate and combustion by-products (at the same rates as predicted for Alternative 3A). Drilling and construction soils from installation of the LFG collection and treatment system and filter sludges from the leachate management systems would also be generated. The sludge would be expected to contain hydroxide sludges of aluminum, iron, and manganese. Alternative 4B would generate waste, soil and scrap metal residuals during landfill excavation. There may also be minor amounts of hazardous waste encountered under this alternative. These residuals will be properly handled through appropriate waste management and disposal practices.

Further reduction in toxicity and mobility of Site COCs in groundwater would be achieved with Alternative 4B. Landfill consolidation would eliminate a waste source (Bulky Waste Area) from the immediate vicinity of the Saugatucket River and from within the water table in this area.

5. Short-term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers and the community during construction and operation of the remedy until cleanup goals are achieved.

Protection of Community and Workers During Remedial Actions

Short-term risks include any additional risks to the community or workers at the Site from exposures as a result of construction measures and implementation of remediation activities.

Alternative 2 has nominal increases of short-term risks due to installation of the residential LFG control contingency as well as fence installation.

Alternatives 3A through 4B would result in additional short-term risks to the community and workers from ingestion and inhalation exposures to soil particles in dust during preparation of disposal areas for capping and inhalation exposures to VOCs from invasive work at the Solid Waste Area. Air sampling and monitoring would be used to evaluate any potential risks from inhalation exposures, and engineering controls would be used to reduce any potential inhalation risks from invasive activities. Dust control measures would be used to mitigate potential soil ingestion or inhalation exposures. Concentrations of COCs are expected to be the highest at the Site, therefore, workers at the Site would also use appropriate PPE to mitigate any potential risks from exposures.

Alternatives 4A and 4B may present short-term risks in addition to those described for Alternatives 3A and 3B, as a result of additional invasive work required for the installation of leachate collection and management system. These short-term risks can be mitigated by a variety of measures. Air sampling and monitoring would be used to evaluate any potential risks to the community. As discussed above, engineering controls would also be used to minimize the degree of invasive work to mitigate potential risks from this exposure pathway. Workers would also wear appropriate PPE to mitigate any potential risks from increased exposures at the Site. Alternative 4B also present short-term risks due to landfill excavation and consolidation of the Bulky Waste Area landfill onto the Solid Waste Area landfill. Similar to above, these risks could be mitigated by sampling/monitoring, engineering controls and PPE.

Environmental Impacts

Minimal short-term habitat impacts would occur under Alternative 2. Short-term risks to ecological receptors are likely to increase slightly due to the mobilization of contaminants during horizontal containment operations for Alternatives 3A through 4B. These alternatives would also temporarily displace some resident organisms, and some mortality of resident organisms would occur during capping operations.

Direct, relatively short-term (1 year) habitat impacts would occur during remedial construction activities for Alternatives 3A through 4B and would affect approximately 30 acres of habitat, including one small emergent wetland and up to 0.5 acres of forested wetlands (Alternatives 4A and 4B). Most of the impacted areas occur on top of the disposal areas; the primary disturbance would occur during installation of the caps. These impacts are lowest for Alternative 3A and 3B and highest for Alternatives 4A and 4B (due to the greater extent of remedial activities), although differences among these alternatives are not substantial. Additional disturbances include construction of roadways, leachate collection systems, and installation of materials management facilities. Disturbed areas would be restored following remediation. The increase for potential erosion, run-off, and sedimentation related to invasive activities for Alternatives 4A and 4B would be mitigated with appropriate engineering controls.

Time Until Remedial Action Objectives are Achieved

The time required to meet RAOs varies depending upon the active remedial measures for these disposal areas.

For Alternative 2 the time to achieve the RAO for landfill gas and leachate will exceed 30 years since there is no active treatment; for Alternatives 3A through 4B the timeframe falls to less than 15 years for landfill gas because active treatment is part of the remedy. To achieve the RAO for leachate in Alternative 3A and 3B, the timeframe is greater than 30 years because there is no active leachate control; for Alternatives 4A and 4B the RAO is achieved much sooner given the leachate control and management system. Consolidation of the bulky waste area in Alternative 4B may accelerate the time to reach the RAO for leachate by removing a significant source from the vicinity of the River.

For groundwater, all Alternatives reach the RAO of prohibiting ingestion through institutional controls at the same time.

6. Implementability

Technical Feasibility

There are not significant differences between Alternatives 3A, 3B, and 4A with regard to ability to construct and operate the associated technologies and process options. Alternatives 4B is similar to those above except for consolidation of the BWA and SWA landfills. Since Alternative 2 only includes residential contingencies, installation and operation will be simplified in comparison to the above alternatives. Details regarding construction and operating technologies and process options are discussed below.

Gas extraction wells would be installed in the Solid Waste Area in Alternatives 3A through 4B. Installation of the wells would necessitate drilling into disposal areas. Obstructions may be encountered in the disposal areas, which may complicate the drilling operation. Installation of the

perimeter LFG collection system would be complicated by the power lines and proximity of residences along Rose Hill Road. The perimeter system should be constructed outside the limit of waste. However, this may only be possible if some perimeter wells are installed within Rose Hill Road.

Cap construction in Alternatives 3A through 4B would require stripping existing vegetation, installation and seaming of a geomembrane, backfill and compaction of the soil components of the cap, and revegetation. Installation of the geomembrane would be complicated by the numerous gas extraction wells. The top of each extraction well would penetrate the cap and the measures taken to prevent leakage around these penetrations would slow and increase the cost of the cap installation. Level B PPE may be necessary especially during invasive construction activities. This would slow the schedule and increase the cost of construction significantly.

Alternatives 4A and 4B would also involve the construction of a leachate collection and management system. Portions of the leachate collection and management system may be in disposal areas, which would cause the similar problems as mentioned above with respect to the landfill gas collection system. The leachate management system would involve building construction, connection of the different skid mounted processes, utility connection, and piping from the extraction systems.

Administrative Feasibility

Institutional controls (access and deed restrictions) are included in Alternatives 2 through 4B; therefore, administrative feasibility is the same with respect to this component. Effort required for administrative implementability will increase incrementally from Alternatives 3A through 4B because those alternatives include the construction of landfill gas collection and treatment and leachate collection and management systems. Further administrative feasibility details are described below.

Implementation of restrictive covenants in the form of property deed restrictions in Alternatives 2 through 4B would require significant long-term coordination between federal, state, local authorities, and private property owners.

Environmental monitoring programs proposed under all five alternatives would require coordination with the State of Rhode Island and the property owners of record. Long-term coordination would be required for analytical services and review and maintenance of data.

Under CERCLA, actual permits are not required for remediation activities. Compliance with the substantive requirements of the permit is, however, required. Thus, while an air permit would not be required for operation of the enclosed flare or photocatalytic oxidation unit in Alternatives 3A through 4B, designs must meet state standards. The condensate storage tank and pump stations would need to be designed and installed in compliance with state and federal rules, including appropriate UST rules.

Availability of Services and Materials

Contractors familiar with landfill gas applications would be required to install residential contingency control systems in Alternative 2. Large volumes of capping materials (topsoil, earth, sand, etc., some of which may be available locally or within the Site boundary and which could be used where appropriate) would be necessary under Alternatives 3A through 4B. Construction contractors familiar with methane safety as well as fugitive vapors/COCs would be required for Alternatives 3A through 4B. Also for those alternatives, fabrication of the LFG treatment system would take significant lead time and may be limited to specific, specialty contractors. Contractors would be necessary for construction of the extraction system, discharge wells, leachate management system, building, and piping in Alternatives 4A through 4B. OSHA-trained contractors will be required for landfill excavation, consolidation, and cap construction under Alternatives 3A through 4B. In all alternatives, consulting specialists, equipment and services are readily available to perform monitoring.

Alternatives 3A through 4B will generate a waste stream (landfill gas condensate) that may require disposal at a RCRA-compliant TSDF. Alternatives 4A and 4B may require disposal of any wastewater management system byproducts. There may also be a need for a RCRA-compliant TSDF if hazardous waste is encountered during the landfill excavation/consolidation process (Alternative 4B). Although there are no RCRA-compliant facilities in Rhode Island which would accept these RCRA wastes, availability of this service is not expected to present any difficulties.

7. Cost

A detailed summary of costs for each alternative is presented in Appendix G of the Feasibility Study (Administrative Record at Section 4.6). A revised summary of costs for alternatives 4A and 4B are also presented in the Administrative Record at Section 4.1. The total net present cost (capital plus operations and maintenance over the duration of the remedial action) for the six alternatives evaluated ranges from $3.57 million to $18.04 million. The cost summary presented in Table 5-2 of the Final Feasibility Study has been updated for the Record of Decision (see Table 75).

The cost differential between Alternatives 1 and 2 is relatively low ($0.3 million) as the major cost component for each would be annual expenditures associated with environmental monitoring. Both alternatives have a relatively low capital cost component. The costs of Alternative 3A ($13.4 million) and 3B ($13.2 million) are significantly more than the previous two alternatives. The additional costs are required principally for installation of the cap(s), and an active internal and perimeter landfill gas collection and treatment systems. The difference in costs between Alternatives 3A and 3B is due to capital costs of the two LFG treatment systems. Landfill gas collection and treatment is conducted for a 15-year duration based on estimates of LFG production. The difference in costs between Alternatives 3A ($13.42 million), 3B ($13.19 million) and that of 4A ($16.06 million) is leachate control and management predominantly for the Bulky Waste Area over the long term at an additional cost of $2.64 or $2.87 million, respectively. Alternative 4B (which includes excavation and consolidation of the Bulky Waste Area) adds an additional $2

million and allows for leachate collection and management during the excavation and consolidation of the Bulky Waste Area.

The costs presented above are estimates which may be used to compare the relative expense of each alternative. A 20% contingency is utilized to account for any inaccuracy in the costs. Based on the accuracies of the estimates, the cost differences between alternatives may not be significant. To provide a better analysis of the costs, cost sensitivities are provided as described below.

Key cost variables were tested to determine the cost sensitivity of each of the alternatives. The results of this sensitivity analysis were originally presented in Table 5-2 of the Final Feasibility Study and updated accordingly in Table 75 of this ROD. The variables tested include: discount rate (for net present worth estimation), total capital costs, total annual (e.g. O&M) costs, contingency, and O&M duration related to the landfill gas components of each alternative.

Variation of the discount rate was evaluated at 5 % and 9%. These values are estimated to be reasonable lower and upper bounds, respectively, for long-term financial performance and reflect values above the rate of inflation.

Total capital and annual costs were varied from the base case by a +50% increase and -30% decrease. This range was selected based upon the minimum accuracy of the costs required pursuant to EPA's RI/FS guidance.

Variation of the contingency costs were evaluated at 15 % and 25%. These values are estimated to be reasonable lower and upper bounds, respectively, for the degree of cost unknowns associated with these remedial alternatives.

O&M duration of the landfill gas components of each of the alternatives was varied based on the range of times possible for natural attenuation of landfill gas from the Solid Waste Area. As described in Section 4.1.2.5 of the Feasibility Study, the Solid Waste Area is expected to generate landfill gas for 5 to 15 years. Since 15 years was evaluated as the base case, lower durations were used in the cost sensitivity of 5 years (low value of range) and 10 years (midpoint of range).

In Table 5-2 of the Final Feasibility Study, "Overall" costs reflect the highest and lowest total cost of each alternative for any of the variables evaluated. Based on this, the potential sensitivity range of costs varies from a low value of $3.57 million (for Alternative 1) to a high value of $18.04 million (for Alternative 4B).

Treating the landfill gas via an enclosed flare was selected over the photocatalytic oxidation for its proven track record as a technology readily available and for an insignificant percentage increase in cost compared to photocatalytic oxidation. The significant improvement realized by selecting excavation and consolidation over capping in place (alternative 4A versus 4B) is the permanent removal of a primary source of contamination from the vicinity of the River resulting in a far

greater reduction of leachate production rather then the construction and long-term operation and maintenance of a leachate collection and management system for the Bulky Waste Area if capped in place.

8. State Acceptance

The State's comments on the Proposed Plan are provided in Appendix D, the Responsiveness Summary. In general, the State has expressed its support for Alternative 4B with modifications. The State does not believe that Alternatives 1, 2, 3A, 3B, and 4A provide adequate protection of human health and the environment. The State supports deferring the decision as to the need for groundwater treatment to sometime in the future, when the decision on ground water is based upon presumably improved conditions resulting from the source control measures taken under this response. The State believes that the remedy selection as outlined herein accurately defines, recognizes and complies with all environmental regulations promulgated by the Department of Environmental Management. The State of Rhode Island concurs with the selected remedy. The State's letter of concurrence, documenting the State's position on the selected remedy is provided in Appendix C of this ROD.

9. Community Acceptance

The comments received from the community on the RI/FS and the Proposed Plan during the public comment period and EPA's responses to these comments are summarized in the Responsiveness Summary in Appendix D.

During the public comment period, the Proposed Plan offered the alternatives evaluated here and two additional management of migration alternatives. The community expressed its support for all alternatives except alternatives 1 through 3B, which they felt to be inadequately protective. Many of the comments received from the community raised serious objections to EPA's preferred alternative presented in the Proposed Plan. There was considerable concern that merely capping the Bulky Waste Area in place and conducting further study to address leachate and groundwater would not eliminate a significant source of contaminants to the Site surface waters. As a result of these comments and in light of new information presented during the public comment period, EPA modified its remedy to actively address the Bulky Waste Area through excavation and consolidation.

XI. THE SELECTED REMEDY

The selected remedy is Alternative 4B, modified to take into account its role as the first operable unit of a phased approach to remediate the environmental contamination caused by the Site. By implementing Alternative 4B as a first operable unit, the remedy will control the sources of contamination at the Site by limiting the extent to which precipitation will percolate and infiltrate through waste materials and minimizing the further migration of the contaminated groundwater plume. Management of the migration of contaminants from the Site will be based on data obtained

from monitoring conducted under the first operable unit and any additional studies that are deemed necessary to further assess Site impacts, characterize the extent of contamination, and assess the need to develop and evaluate alternatives for future actions.

In summary, this first operable unit remedy provides the following components:

1. Excavate and consolidate the Bulky Waste Area landfill materials onto the Solid Waste Area landfill;

2. Collect and effectively manage leachate and waters collected from runoff and dewatering operations during the excavation of the Bulky Waste Area;

3. Construct a multi-layer hazardous waste cap using innovative and cost efficient cover materials, as may be appropriate and as further defined in design, over the extent of the Solid Waste Area landfill and consolidated Bulky Waste Area materials;

4. Inspect and monitor the integrity and performance of the landfill cap over time;

5. Assess, control, collect, and treat landfill gas emissions by an active internal and perimeter gas collection system and thermal treatment of such gasses through the use of an enclosed flare and continue monitoring landfill gas concentrations to assess the need to modify the landfill gas collection treatment system as necessary;

6. Implement access restrictions and institutional Controls (land title restrictions including, but not limited to, easements and restrictive covenants) on land use and the use of, or hydraulic alteration of, groundwater where Preliminary Remediation Goals (PRGs) (based on MCLs, MCLGs) and/or other health based standards are exceeded.

7. Install a chain link fence and/or other physical barriers where necessary to prevent Site access, injury and/or exposure;

8. Long-term monitoring of surface water, groundwater air and leachate emergence;

9. Perform operation and maintenance activities throughout the life of the remedy; and

10. Conduct statutory five year review as required.

The Bulky Waste Area will be excavated to the extent necessary to ensure that all municipal solid waste from the designated area is properly excavated, collected and consolidated onto the Solid Waste Area landfill. Information gathered by the Town in April 1999, indicates that a portion of the Bulky Waste deposits are in contact with the ground water table. Therefore, appropriate de-watering and leachate collection operations, including the collection and management of excavation trench

waters and runoff from the staged materials, will be necessary. Proper on-site management and disposal strategies for such waters will be developed in design and implemented during construction. Possible management options are: On-site discharge without treatment, onsite discharge with treatment by precipitation, media filtration, ultraviolet/chemical oxidation, or offsite disposal dependent upon contaminant characteristics and/or concentrations in these process waters. These collected waters will be discharged on-site either through groundwater recharge wells, in which case the substantive provisions of the Rhode Island Rules and Regulations for Groundwater Quality and Rhode Island Underground Injection Control Regulations will be met, or by discharge to surface water, in accordance with the state regulations for Water Pollution Control and Ambient Water Quality Criteria (Water Quality Regulations and Water Quality Standards). The extent to which the Bulky Waste Area is excavated will be based on past data, design assessments, repetitive visual inspection of the excavation base and side walls, bucket observations, and other methodologies developed in the design phase to assure, to the greatest practical extent, that all physical evidence of waste deposits are removed from the Bulky Waste Area, irrespective of the level of groundwater within the excavation. The goal of this source control component is to effectively remove and contain the contaminant mass so as to significantly reduce contaminant migration through leachate production to surface waters and sediments of Mitchell Brook and the Saugatucket River and to reduce migration of landfill gas.

Waste materials will be properly staged prior to consolidation onto the Solid Waste Area. The Solid Waste Area will be appropriately prepared (grubbed and dressed) such that consolidation of the waste materials is timely and without unnecessary delay. Monitoring of hazardous conditions, runoff, fugitive dust emissions, and nuisance odors will be conducted throughout the response and contingency planning. Engineering controls will be implemented if necessary to mitigate any adverse impacts.

The use of innovative cap construction materials will be evaluated in the design phase for cost effectiveness while maintaining long-term effectiveness and permanence. Additionally, the EPA-NE technical guidance concerning alternative cap design will also be consulted and considered during the design phase. The cap will be designed and constructed to meet state hazardous waste closure requirements. The use of onsite materials for cover material will be considered where appropriate. Landfill gas emissions will be extensively monitored and controlled as required through the use of an active internal and perimeter gas collection and treatment system and on-site thermal destruction of COCs using an enclosed flare. The flare's destruction removal efficiencies for COCs will meet State and Federal ambient air quality standards. Assessments of gas constituents, concentrations, flow rates, piping and flare sizing will be conducted during design to determine the most efficient system needed and enhance and detail the construction specifications of the gas collection and treatment system. Long-term monitoring of landfill gas concentrations and treatment system performance will be conducted to evaluate and determine modifications necessary for system efficiency or other changes in landfill gas treatment.

The remedy also includes a long-term monitoring program, institutional controls, and operation and maintenance.

The costs and cleanup time frames for the selected remedy are summarized as follows:

Estimated Time for Design and Construction:	*2-3 years*
Estimated Time of Operation:	*<15 years for LFG; >30 years GW/Leachate*
Estimated Capital Cost:	*$11,360,000*
*Estimated Operations and Maintenance Costs (**net present worth**):*	*$6,680,000*
*Estimated Total Cost (**net present worth**):*	*$18,040,000*

As provided in the NCP, EPA will conduct a review of the Site at least once every five years after the initiation of remedial action at the Site since hazardous substances, pollutants and contaminants will remain at the Site. This will ensure that the remedial action continues to protect human health and the environment.

An expected outcome of the selected remedy is that the Solid Waste Area will no longer present an unacceptable risk to area residents and those at the Site through the inhalation of landfill gas. Another expected outcome of the selected remedy is that ground water in the vicinity of the Site will not present an unacceptable risk to area residents through ingestion as a result of the use of institutional controls. The second operable unit will address management of migration. The selected remedy will also provide environmental and ecological benefits such as incremental improvement of a riverine and wetland ecosystem by minimizing contaminant migration into wetland habitat adjacent to the River, and by improving the resource of the upland area associated with the former Bulky Waste Area.

XII. STATUTORY DETERMINATIONS

The remedial action selected for implementation at the Rose Hill Regional Landfill Superfund Site is consistent with CERCLA and, the NCP. The selected remedy is protective of human health and the environment, attains ARARs and is cost effective., The selected remedy partially satisfies the statutory preference for treatment which permanently and significantly reduces the mobility, toxicity or volume of hazardous substances as a principal element. Additionally, the selected remedy utilizes alternate treatment technologies or resource recovery technologies to the maximum extent practicable.

A. The Selected Remedy is Protective of Human Health and the Environment

The remedy for the Rose Hill Regional Landfill will permanently reduce the risks posed to human health and the environment by controlling exposures to human and environmental receptors through treatment, engineering controls, and institutional controls. Specifically, the risk presented by this Site is the possible exposure to and ingestion of contaminated groundwater and exposure to and

inhalation of contaminated air. The selected remedy uses a combination of consolidation, capping of wastes and collecting and treating landfill gases and institutional controls to prevent or minimize the continued release of hazardous substances from the Site.

B. The Selected Remedy Attains ARARs

This remedy will attain all applicable or relevant and appropriate federal and state requirements.

Environmental laws from which ARARs for the selected remedial action are derived can be found in Table 76, in Appendix B of this Record of Decision. The table provides a brief synopsis of the ARARs and an explanation of the actions necessary to meet the ARARs. These tables also indicate whether the ARARs are applicable or relevant and appropriate to the actions to be taken at the Site. In addition to ARARs, the tables describe standards that are To-Be-Considered (TBC) with respect to remedial actions. A full description of the ARARs are also located in Section 4 Administrative Record (Feasibility Study).

The principal ARARs are also discussed below.

Principal ARARs for Groundwater

The purpose of the remedy selected in this ROD is to control the sources of contamination; therefore, no groundwater cleanup levels are established in this ROD. Since no cleanup levels are established, no chemical specific ARARs for groundwater have been identified.

The action specific ARARs for source control include groundwater requirements set out in the Rhode Island Rules and Regulations for Groundwater Quality, and the more stringent of the Rhode Island Rules and Regulations for Hazardous Waste, or the federal hazardous waste rules at 40 CFR 264 Subtitle F, and 40 CFR 258 Subtitle E. Because groundwater cleanup levels are not established in this ROD, only those provisions related to implementing a groundwater monitoring program will be complied with. In addition, maximum contaminant levels and non-zero maximum contaminant level goals (MCLs/non-zero MCLGs) in the Safe Drinking Water Act have been identified as action specific ARARs solely for the purpose of measuring the performance of the source control remedy.

If the underground injection option is selected in connection with the dewatering of the Bulky Waste during consolidation, action-specific ARARs include the substantive requirements of the RI Rules and Regulations for Underground Injection Control.

Principal ARARS for Surface Water

Chemical and action specific ARARs address the protection of surface water bodies.

If the surface water discharge option is selected in connection with the dewatering of the Bulky

Waste during consolidation, action-specific ARARs include the substantive requirements of the NPDES provisions of the Clean Water Act, and those of the RIPDES program if more stringent than the federal requirements. Additionally, the Rhode Island Water Quality Standards and Water Quality Regulations define the water quality antidegradation policy of the State. The Rhode Island Water Quality Standards are based on Federal Ambient Water Quality Criteria which set standards for surface water quality for the protection of human health and aquatic life. Any state standards which are more stringent than federal standards must be complied with if the surface water discharge option is selected. The ecological Preliminary Remediation Goals presented in Table 78 list background levels for aluminum and manganese and the AWQC concentration. Although not cleanup levels, the source control remedy will reduce surface water concentrations as close as possible to these levels.

Principal ARARs for Wetlands

State and Federal regulations for the protection of wetlands are closely linked with those for the protection of surface water bodies; however, protection of wetlands is based on location specific criteria. Generally, actions are required to minimize or prevent the destruction, degradation, alteration or net loss of wetlands, as defined by the State of Rhode Island Department of Environmental Management Freshwater Wetlands Act and Federal Protection of Wetlands Executive Order regulations.

Principal ARARs for Air Quality

Air quality protection requirements are action-specific. Federal National Ambient Air Quality Standards (NAAQS) are not ARARs but are guidelines for specific criteria pollutants for air emission sources. NAAQS define levels of air quality which the EPA judges are necessary to protect public health. The State Air Pollution Control Regulations must contain, at a minimum, the federal air quality requirements. Landfill gas controls will meet the NESHAPs for vinyl chloride and benzene. Federal air regulations also require the collection, control and monitoring of Non-Methane Organic Compounds (NMOCs) such as benzene and ethane. RCRA requirements for air emissions from thermal units, process vents and equipment leaks are also included as ARARs. The human health Preliminary Remediation Goals are presented in Table 79. Although not cleanup levels, the remedy will reduce contaminant concentrations in ambient air as close as possible to these levels.

State Air Pollution Control Regulations mandate compliance with specific standards for such parameters as particulate emissions, installation of air pollution control and monitoring equipment and adherence to the Federal NAAQS. Included in the State Air Pollution Control Regulations are the State Air Toxics Regulations. This regulation prohibits emission of specified contaminants at rates which would result in ground level concentrations greater than acceptable ambient levels set in the regulation. Acceptable ambient levels are specified as maximum contaminant concentrations contributed by a stationary air toxic source at or beyond the facility property line.

Principal Hazardous Waste ARARs

Hazardous Waste Management regulations are action-specific ARARs. Federal regulations governing the management of hazardous waste are promulgated under the Resource Conservation and Recovery Act (RCRA). The State of Rhode Island was granted final authorization by EPA in 1986 to administer its hazardous waste program in lieu of the federal government's base RCRA program. The state program is set forth at Rule 5.00 et seq. of the "Rules and Regulations for Hazardous Waste Management" (Rhode Island Hazardous Waste Rules), as amended. Thus, these state regulations govern the management of hazardous waste activities and set operational standards for hazardous waste management facilities.

Principal To Be Considered Requirements

EPA's regional guidance for the capping of hazardous waste landfills will be considered during the design phase in order to develop a cap for the Site which meets the performance standards of both the Rhode Island Hazardous Waste Rules and RCRA Subtitle C. EPA's Technical Guidance Document on Final Covers on Hazardous Waste Landfills and Surface Impoundments, which provides guidance on constructing landfill caps to meet RCRA subtitle C requirements, will also be considered during design of the cap.

C. The Selected Remedial Action is Cost-Effective

In the Agency's judgment, the selected remedy is cost effective, i.e., the remedy affords overall effectiveness proportional to its costs. In selecting this remedy, once EPA identified alternatives that are protective of human health and the environment and that attain ARARs, EPA evaluated the overall effectiveness of each alternative by assessing the relevant three criteria: Long term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short term effectiveness. The relationship of the overall effectiveness of this remedial alternative was determined to be proportional to its costs. The revised costs of this remedial alternative are summarized in Table 80 of this ROD.

EPA believes that the combination of consolidation, capping and landfill gas treatment is sufficient to: 1) prevent migration of landfill gas; 2) prevent consumption of groundwater through the use of institutional controls; 3) reduce production of leachate to prevent the further degradation of surface waters and improve aquatic life.

While it is an effective source control remedy, it is not known whether source control alone will achieve a permanent or long-term solution to all risks posed at the Site. The assessments conducted under the first operable unit will assess the effectiveness of the remedy implemented pursuant to this ROD, at which time further remedial action may be determined to be necessary to achieve a permanent solution to the risks posed by the groundwater and surface water contamination at the Site. Additional costs that would be incurred to implement a remedy designed to manage the

migration of contamination at the Site (for example, through installing a groundwater collection and treatment system) may not be necessary if the selected remedy proves sufficient as a long-term, permanent solution.

D. The Selected Remedy Utilizes Permanent Solutions and Alternative Treatment or Resource Recovery Technologies to the Maximum Extent Practicable

Once the Agency identified those alternatives that attain ARARs and that are protective of human health and the environment, EPA identified the alternative which best utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. This determination is based on balancing the following factors: 1) long-term effectiveness and permanence; 2) reduction of toxicity, mobility or volume through treatment; 3) short-term effectiveness; 4) implementability; and 5) cost. The balancing test emphasized long-term effectiveness and permanence and the reduction of toxicity, mobility and volume through treatment; and considered the preference for treatment as a principal element, the bias against off site land disposal of untreated waste, and community and state acceptance. The selected remedy provides the best balance of trade-offs among the alternatives.

E. The Selected Remedy Satisfies the Preference for Treatment Which Permanently and Significantly Reduces the Toxicity, Mobility or Volume of the Hazardous Substances as a Principal Element

CERCLA and the NCP set forth the process by which remedial actions are evaluated and selected. Because many CERCLA municipal landfill sites share similar characteristics, they lend themselves to remediation by similar technologies. EPA has established a number of expectations as to the types of technologies that should be considered and alternatives that should be developed; they are listed in the National Contingency Plan (40 CFR 300.430(a)(1)) and EPA Guidance Document "Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites" EPA/540/P-91/001. See Section VIII. B. for a detailed list of expectations for remediating municipal landfills.

Each of the above criteria has been met in selecting alternative 4B as a source control remedy. Principal threats posed by the Site include the exposure to and inhalation of landfill gas and the exposure to and ingestion of contaminated groundwater. Through the use of active landfill gas control and treatment technology, the air exposure pathway will be addressed by collecting and permanently treating the gases with an enclosed flare. Institutional controls coupled with long-term monitoring will prevent exposure to and ingestion of contaminated groundwater. Operable unit two will further address site risks from groundwater and surface water, if necessary. Engineering controls in the fast operable unit, including the excavation, consolidation of the BWA onto the SWA and construction of a protective cap, will contain and may accelerate natural attenuation of the contamination. Data produced from the monitoring programs in the first operable unit will determine the need for any future response actions at the Site.

XII. DOCUMENTATION OF SIGNIFICANT CHANGES

On February 2, 1999, EPA presented a Proposed Plan (preferred alternative) for remediation of the Site. EPA's Preferred Alternative, as presented in the Proposed Plan, was Alternative 3A.

During an extended public comment period (from February 2, 1999 to May 3, 1999) the public, State and local representatives expressed strong concerns about certain aspects of the preferred alternative, in particular the in-place capping of the Bulky Waste Area landfill. The opposition to capping the BWA was based on its close proximity to the Saugatucket River and the ecological risk to the benthic aquatic communities within the River. State and local representatives and members of the public preferred an alternative that would remove the Bulky Waste Area and consolidate and cap this waste material with that of the Solid Waste Area thereby providing an additional measure of protection for the area along the River. During the Public Comment Period, the Town of South Kingstown presented EPA with new information demonstrating that the Bulky Waste Area may be predominantly comprised of municipal solid waste, contrary to previous information supplied by the Town during the RI. This information, together with the public's desire to provide further protective measures for the River, led EPA to reevaluate its preference.

The NCP allows EPA to re-evaluate its remedy preference in response to new information and in consideration of comments received during the public comment period. After consideration of all the public comments received on the Proposed Plan, and in light of the new information as described above, EPA is of the opinion that these changes do not require the issuance of a new Proposed Plan. While EPA has selected a modified remedy from the preferred remedy described in the Proposed Plan, the remedy selected and described in the ROD is essentially the same but for two exceptions: 1) the Bulky Waste Area will be excavated and consolidated onto the Solid Waste Area instead of capped in place; and 2) a leachate collection and management system is included. This remedy was presented as Alternative 4B in the FS and Proposed Plan.

In the course of its review of public comments on the Proposed Plan, EPA noted an error in its calculation of costs concerning alternative 4B. The error was in the calculated sum concerning landfill consolidation costs relating to cost recovery of reclaimed metals. Therefore, the revised cost for this alternative based on the final FS Report assumptions are as follows: A capital cost of $8.3 million and an O&M cost of $7.1 million for a total of $15.4 million. The Proposed Plan estimated $16.9 million for the cost of alternative 4B, resulting in a difference of $1.5 million. This cost differential is inconsequential, however, in light of EPA's guidance for Feasibility Studies which permits estimates to have an accuracy of +50 percent to -30 percent. When presented with the new information from the Town of South Kingstown, EPA revised its cost estimate to reflect an increase in materials use, volume of wastes to be excavated/consolidated (minus the cost to reclaim metals), and length of time to complete the tasks. The resulting total costs are those set forth in the ROD for Alternative 4B and reflect an increase of approximately $1 million over the costs presented in the Proposed Plan, or approximately $2.6 million over the estimated costs in the revised estimate in the Administrative Record at section 4.1.

Finally, this Record of Decision clarifies EPA's position concerning its approach in assessing the need for conducting any additional remedial responses concerning groundwater and surface water as a component of the long-term monitoring program. EPA has identified this remedy as a first operable unit of a two operable unit approach to remediate the environmental contamination caused by the Site. The first operable unit will control the sources of contamination at the Site by limiting infiltration and percolation of precipitation through waste materials which are causing a continued release of hazardous substances to the air, ground water and surface water. Further migration of hazardous substances, pollutants and contaminants to groundwater and surface water will therefore be minimized. Once the source control remedy is implemented, further studies will evaluate the need to manage the migration of contaminants from the Site. Management of the migration of contaminants from the Site will be based on data obtained from the first operable unit monitoring and any additional studies that are deemed necessary in order to further assess Site impacts, characterize the extent of contamination, and assess the need to develop and evaluate alternatives for future actions should it be found necessary to do so.

XIII. STATE ROLE

The Rhode Island Department of Environmental Management has reviewed the various alternatives and has indicated its support for the selected remedy. The State has also reviewed the Remedial Investigation, Risk Assessment and Feasibility Study to determine if the selected remedy is in compliance with applicable or relevant and appropriate State Environmental laws and regulations. The State of Rhode Island concurs with the selected remedy for the Rose Hill Regional Landfill Superfund Site. A copy of the declaration of concurrence is attached as Appendix C.

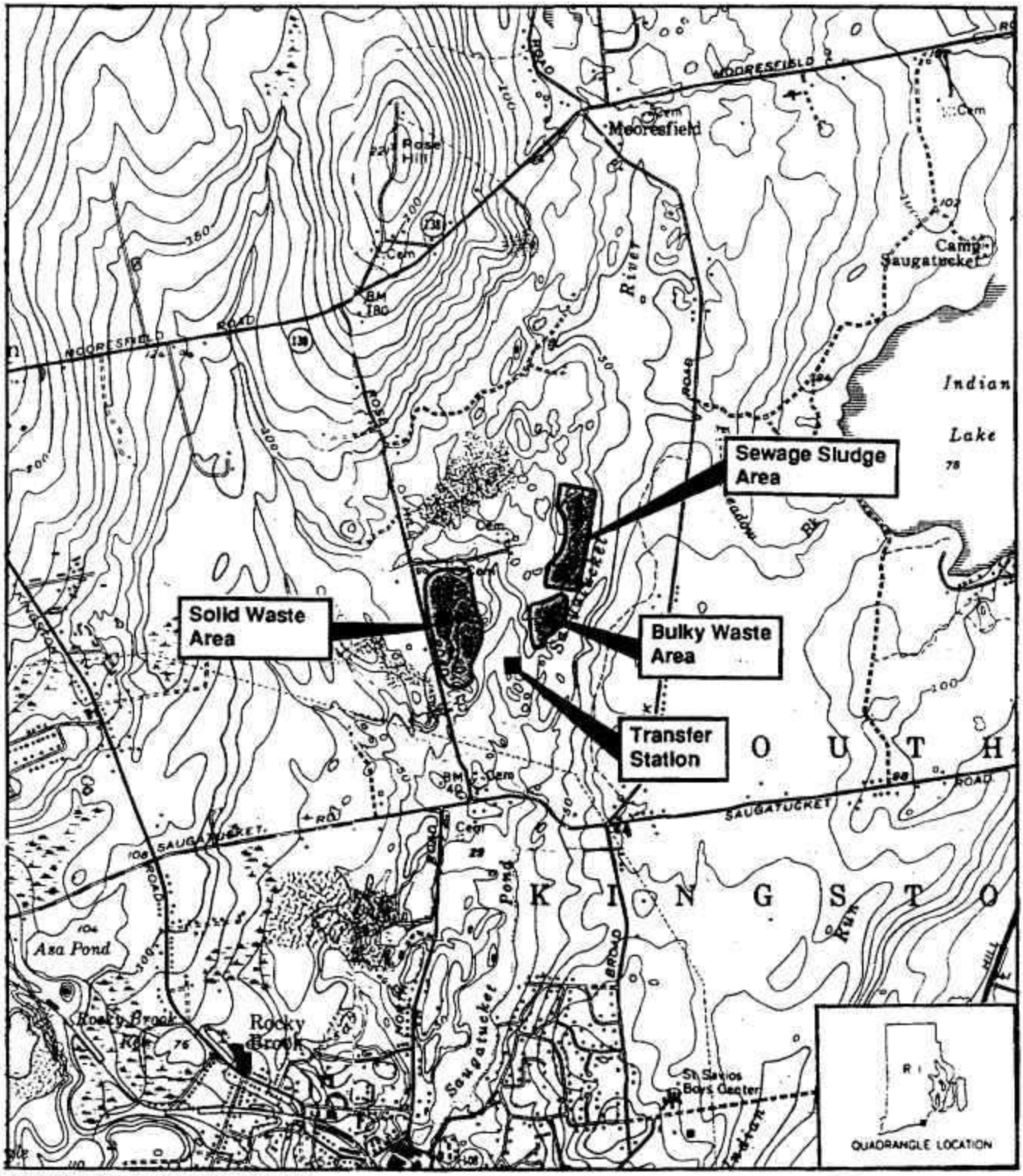
LIST OF APPENDICES

APPENDIX A

RECORD OF DECISION
Rose Hill Regional Landfill Superfund Site

LIST OF FIGURES

LIST OF FIGURES



SOURCE: USGS TOPOGRAPHIC MAPS
KINGSTON, RI, 1970
NARRGANSETT PIER, RI, 1975

FIGURE 1 **LOCATION OF THE ROSE HILL REGIONAL LANDFILL SITE**

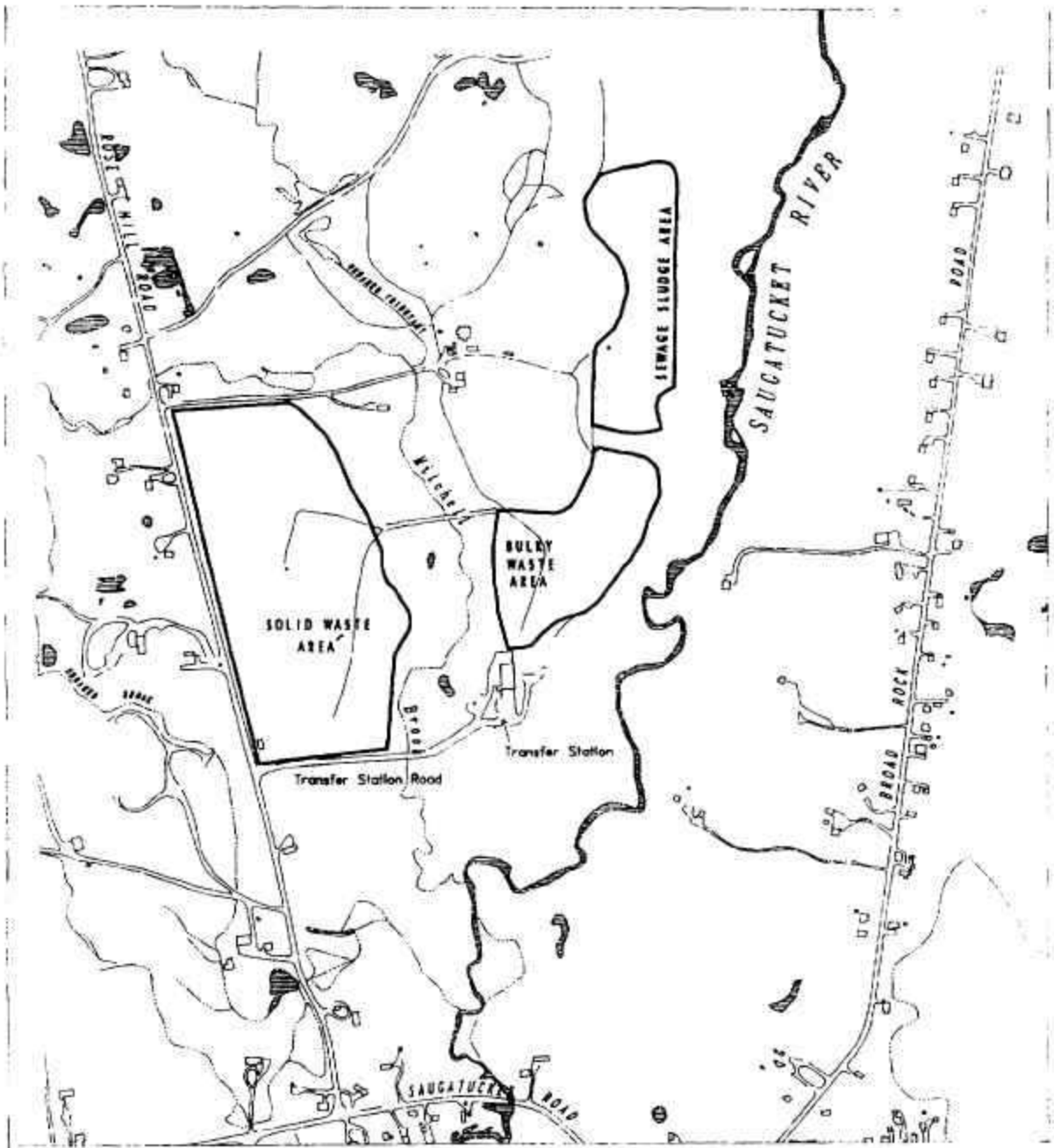
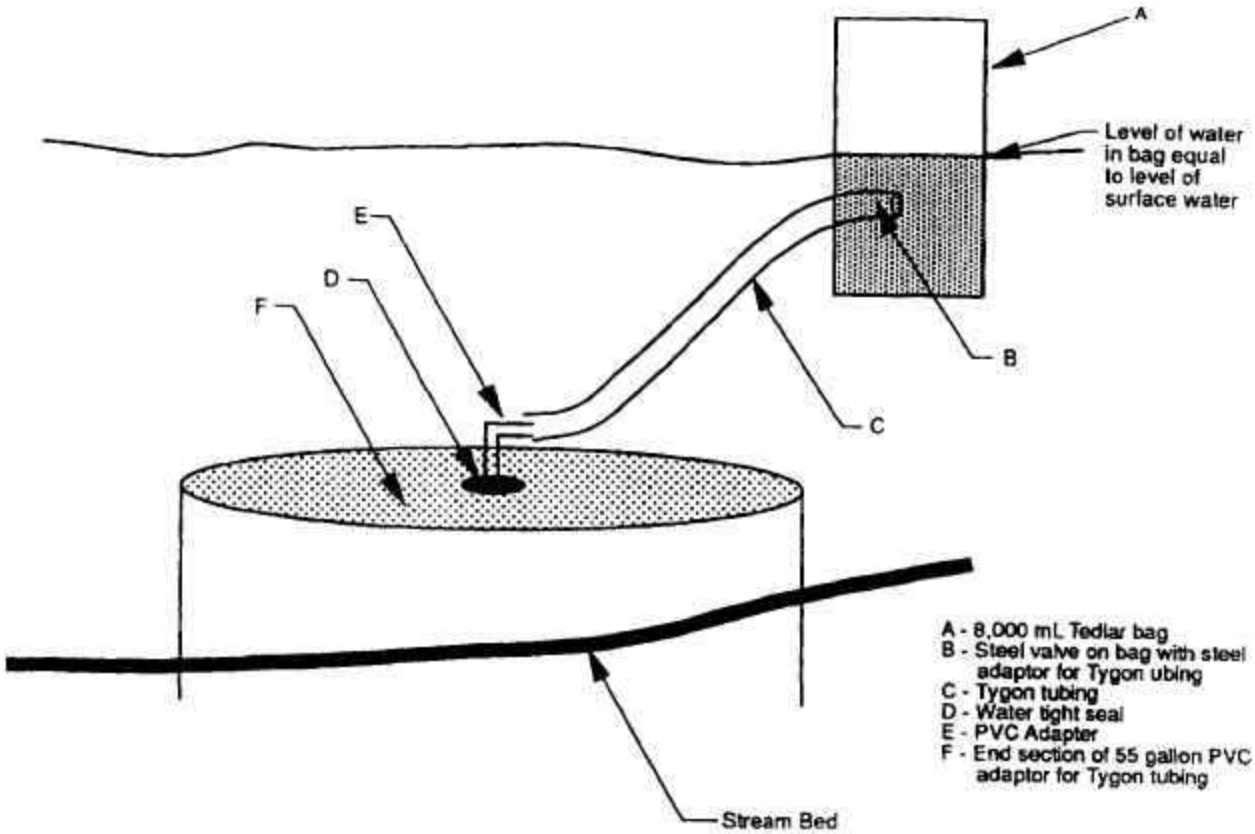


FIGURE 2

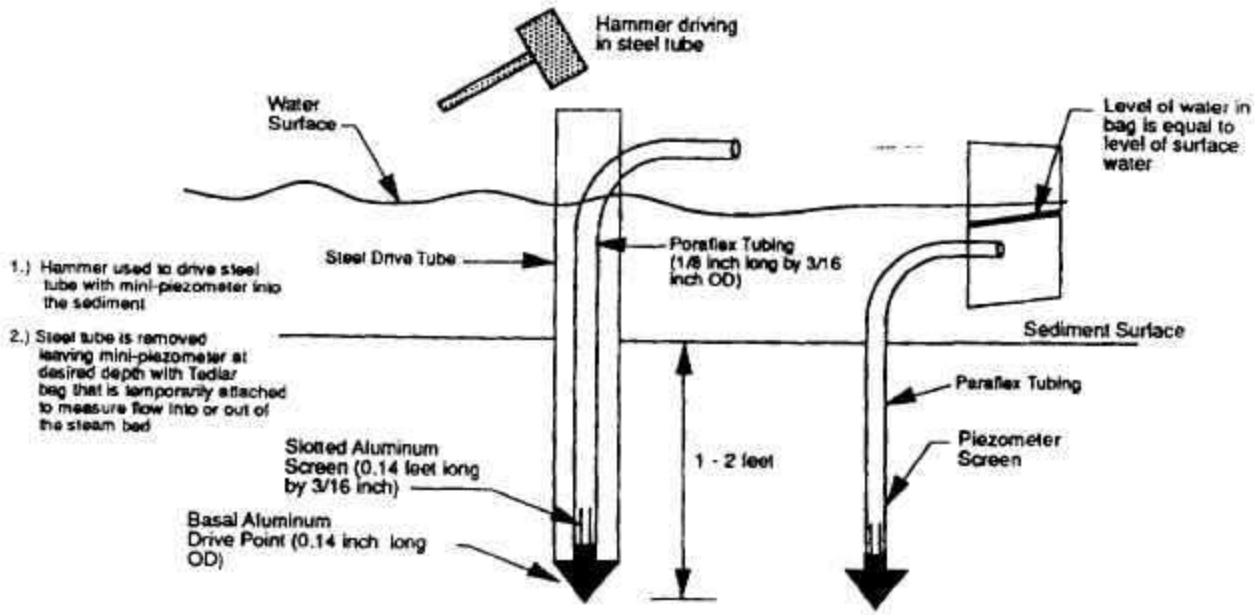
ROSE HILL SITE
STUDY AREA

ROSE HILL REGIONAL LANDFILL
SOUTH KINGSTOWN, RI

METCALF & EDDY



SEEPAGE METER



MINI-PIEZOMETER

FIGURE 3

SEEPAGE METER AND MINI-PIEZOMETER CONSTRUCTION DETAIL

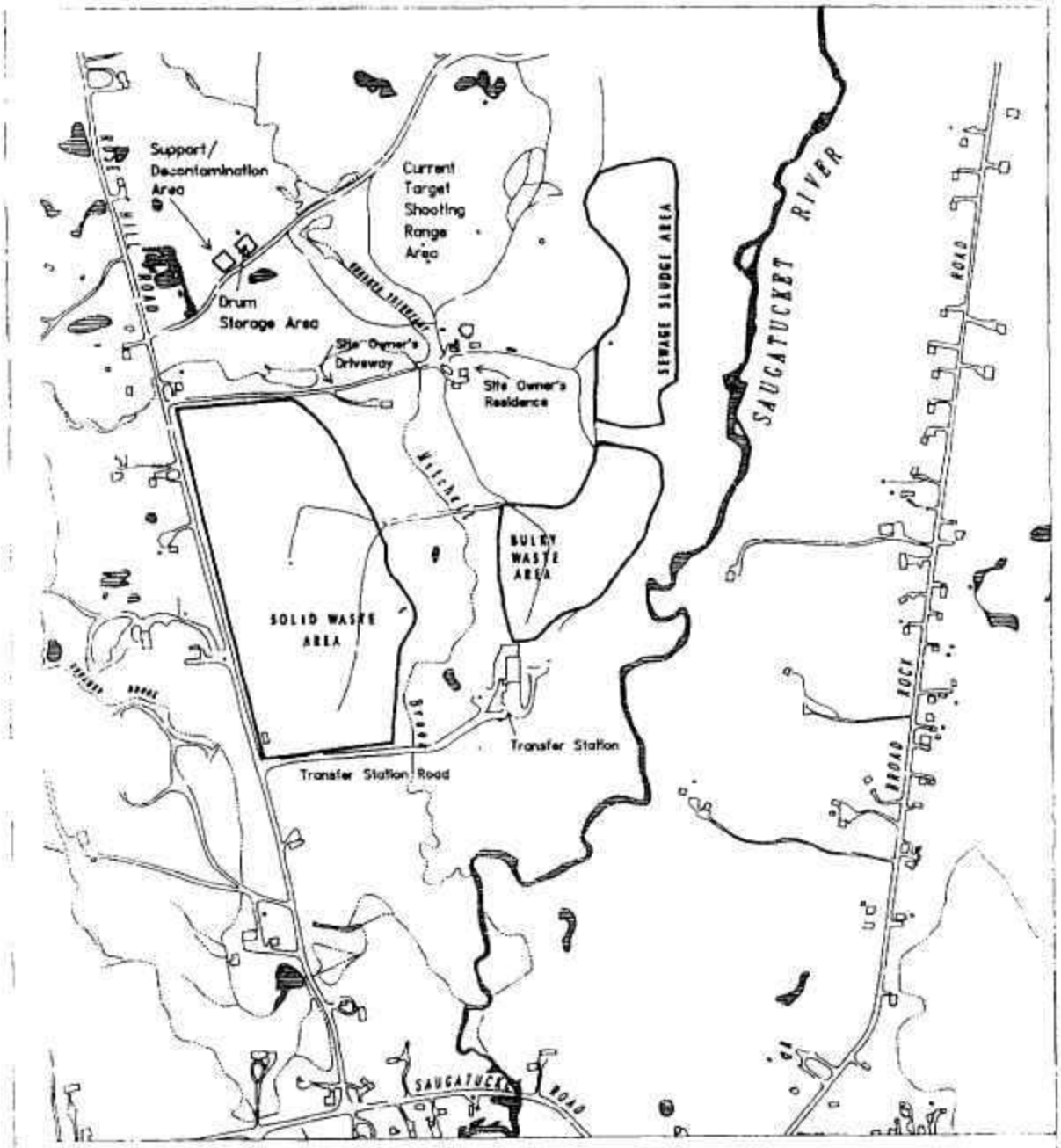


FIGURE 4

SITE MAP

ROSE HILL REGIONAL LANDFILL
SOUTH KINGSTOWN, RI

METCALF & EDDY

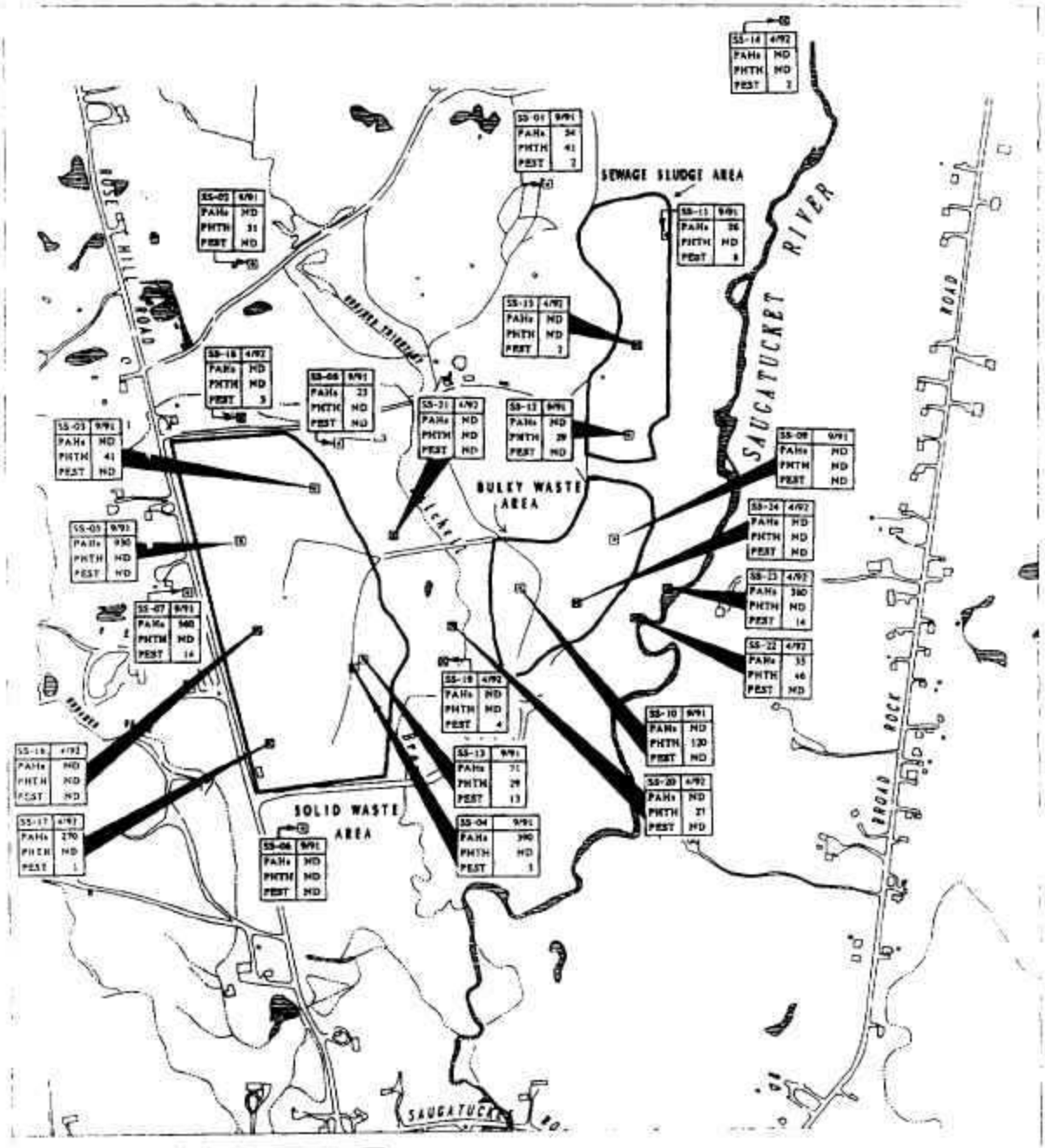


FIGURE 6 SEMIVOLATILE ORGANICS, PESTICIDES, AND PCBs DETECTED IN SURFACE SOIL

ROSE HILL REGIONAL LANDFILL
SOUTH KINGSTOWN, RI

METCALF & EDDY

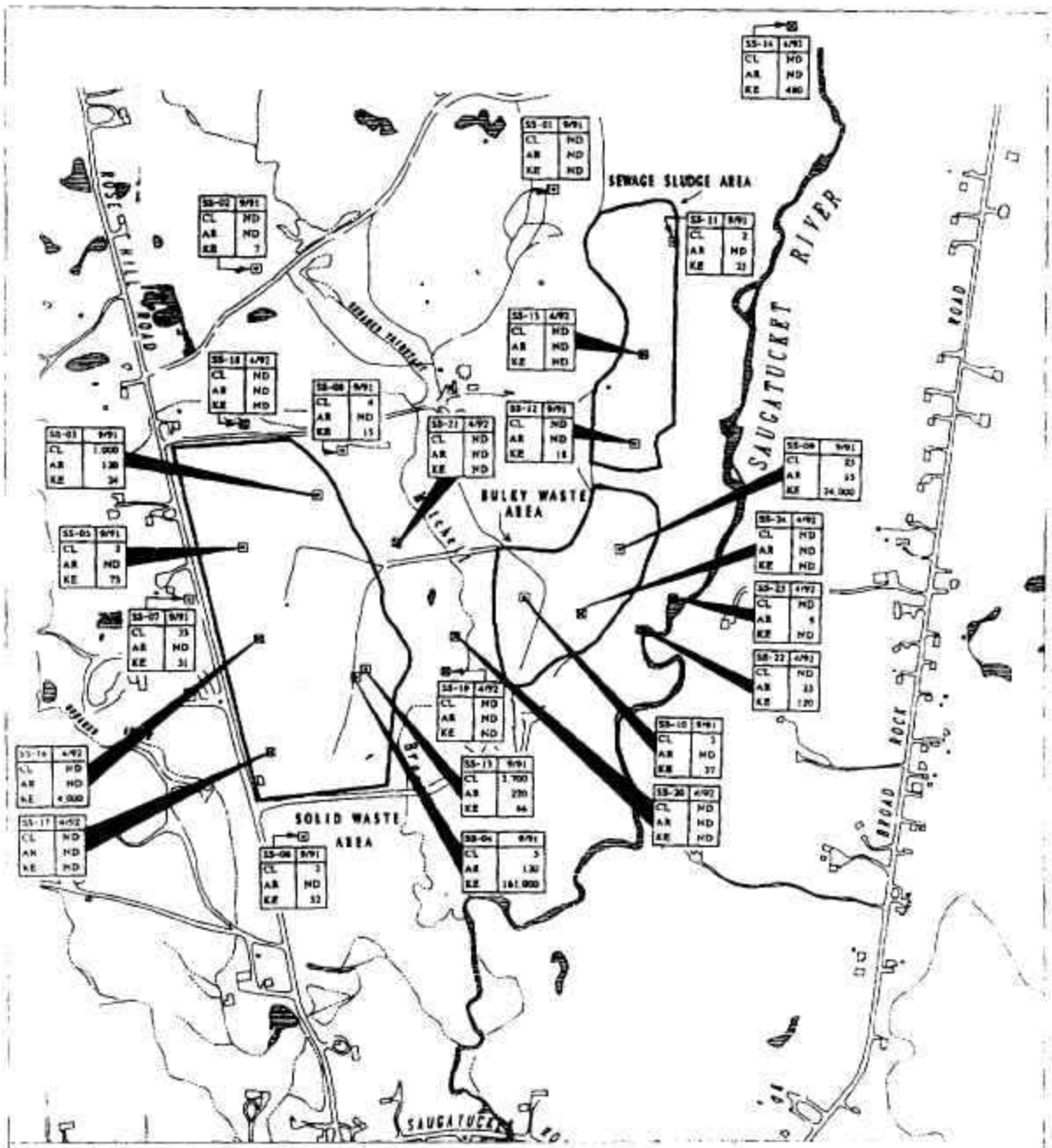


FIGURE 5 VOLATILE ORGANICS DETECTED IN SURFACE SOIL

ROSE HILL REGIONAL LANDFILL
SOUTH KINGSTOWN, RI

METCALF & EDDY

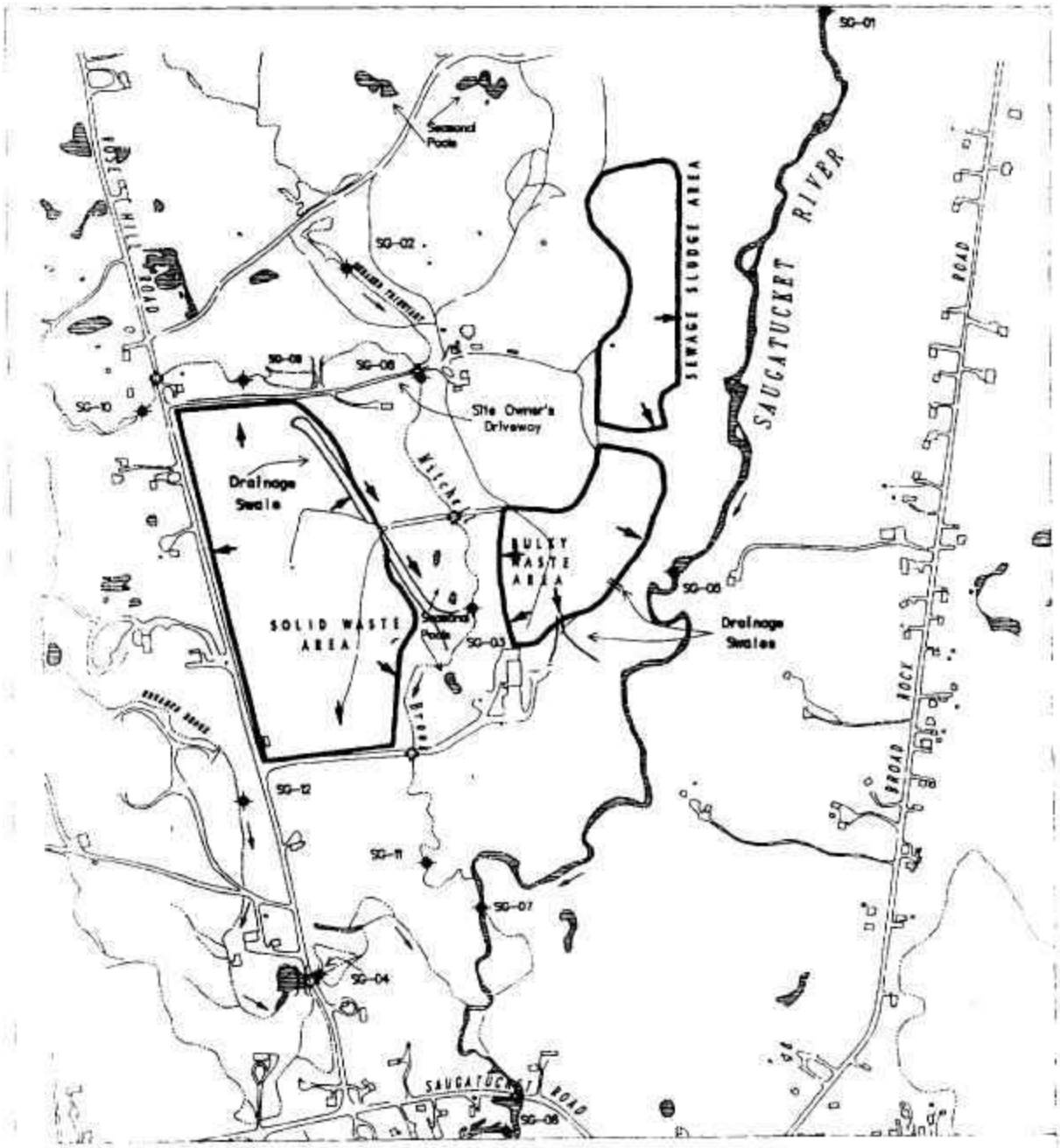


FIGURE 7
SURFACE WATER FLOW MAP

ROSE HILL REGIONAL LANDFILL
SOUTH KINGSTOWN, RI

METCALF & EDDY

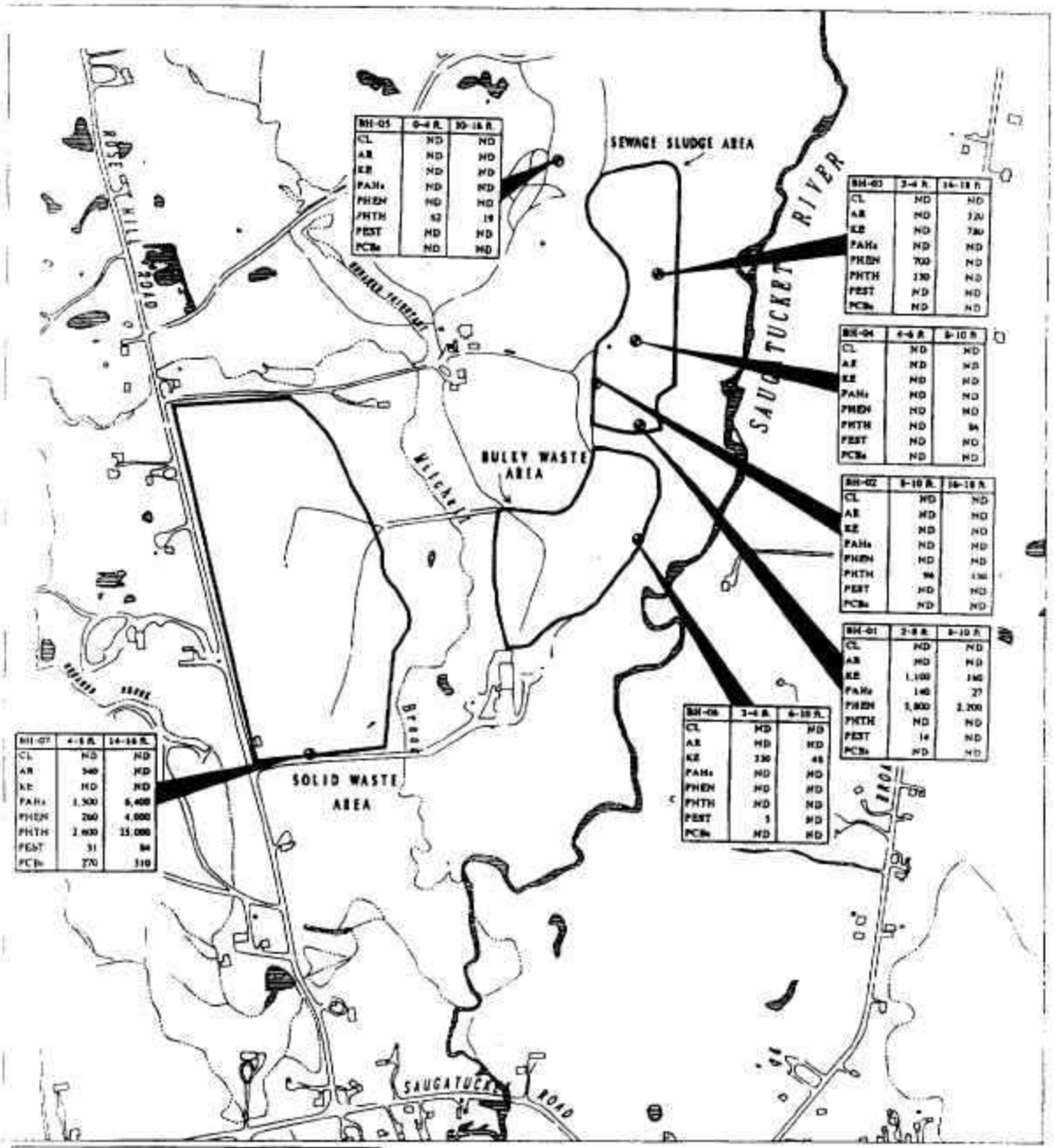


FIGURE 8 ORGANIC COMPOUNDS DETECED IN SUBSURFACE SOIL

ROSE HILL REGIONAL LANDFILL
SOUTH KINGSTOWN, RI

METCALF & EDDY

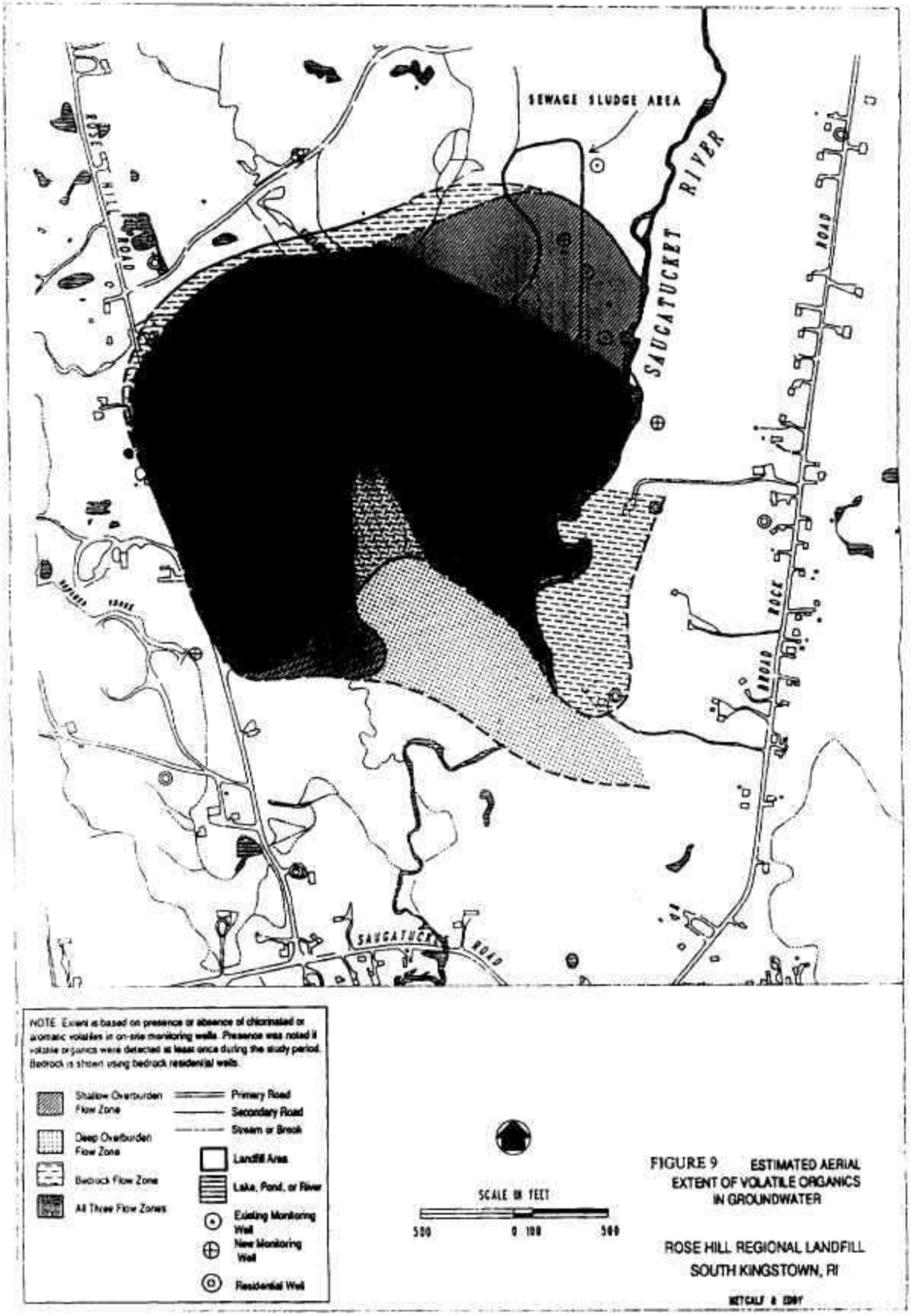
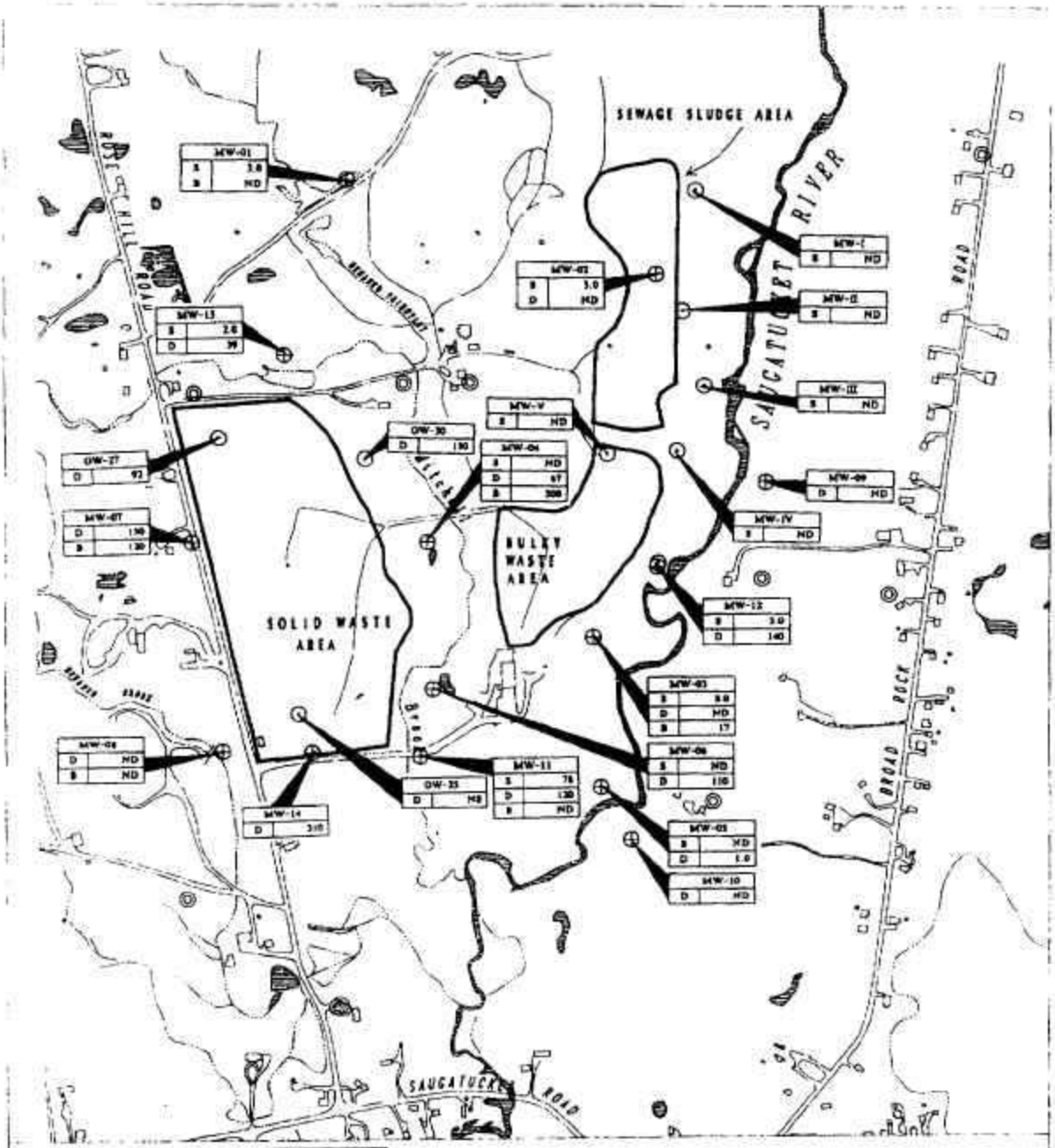


FIGURE 9 ESTIMATED AERIAL EXTENT OF VOLATILE ORGANICS IN GROUNDWATER

ROSE HILL REGIONAL LANDFILL
SOUTH KINGSTOWN, RI

METCALF & EDDY



NOTE: The total volatile organic concentrations are presented in µg/L based on data collected in September/ October 1991

S Shallow Overburden Well
D Deep Overburden Well
B Bedrock Well
ND Not Detected
NS Not Sampled

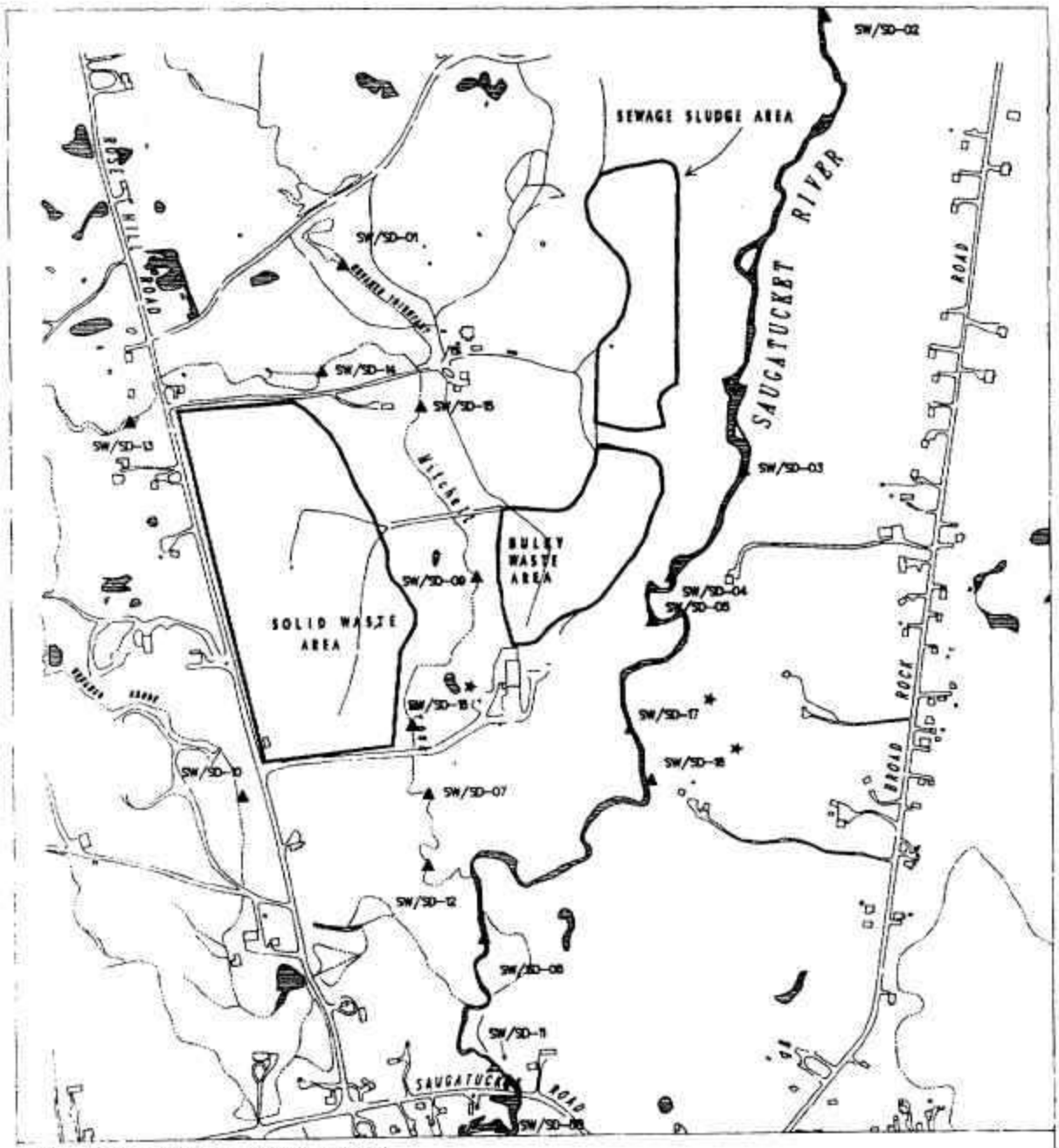
Primary Road
Secondary Road
Stream or Brook
Landfill Area
Lake, Pond, or River
Existing Monitoring Well
New Monitoring Well
Residential Well

SCALE IN FEET
500 0 500

FIGURE 10 VERTICAL DISTRIBUTION OF VOLATILE ORGANICS IN GROUNDWATER

ROSE HILL REGIONAL LANDFILL
SOUTH KINGSTOWN, RI

METCALF & EDDY



Note: * - These three locations were added in may 1982 as part of the ecological investigation.

Primary Road
Secondary Road
Stream or Brook
Landfill Area
Lake, Pond, or River
Surface Water/ Sediment Sampling Location

SCALE IN FEET
500 0 100 500

FIGURE 11

SURFACE WATER/SEDIMENT SAMPLING LOCATIONS

ROSE HILL REGIONAL LANDFILL
SOUTH KINGSTOWN, RI

METCALF & EDDY

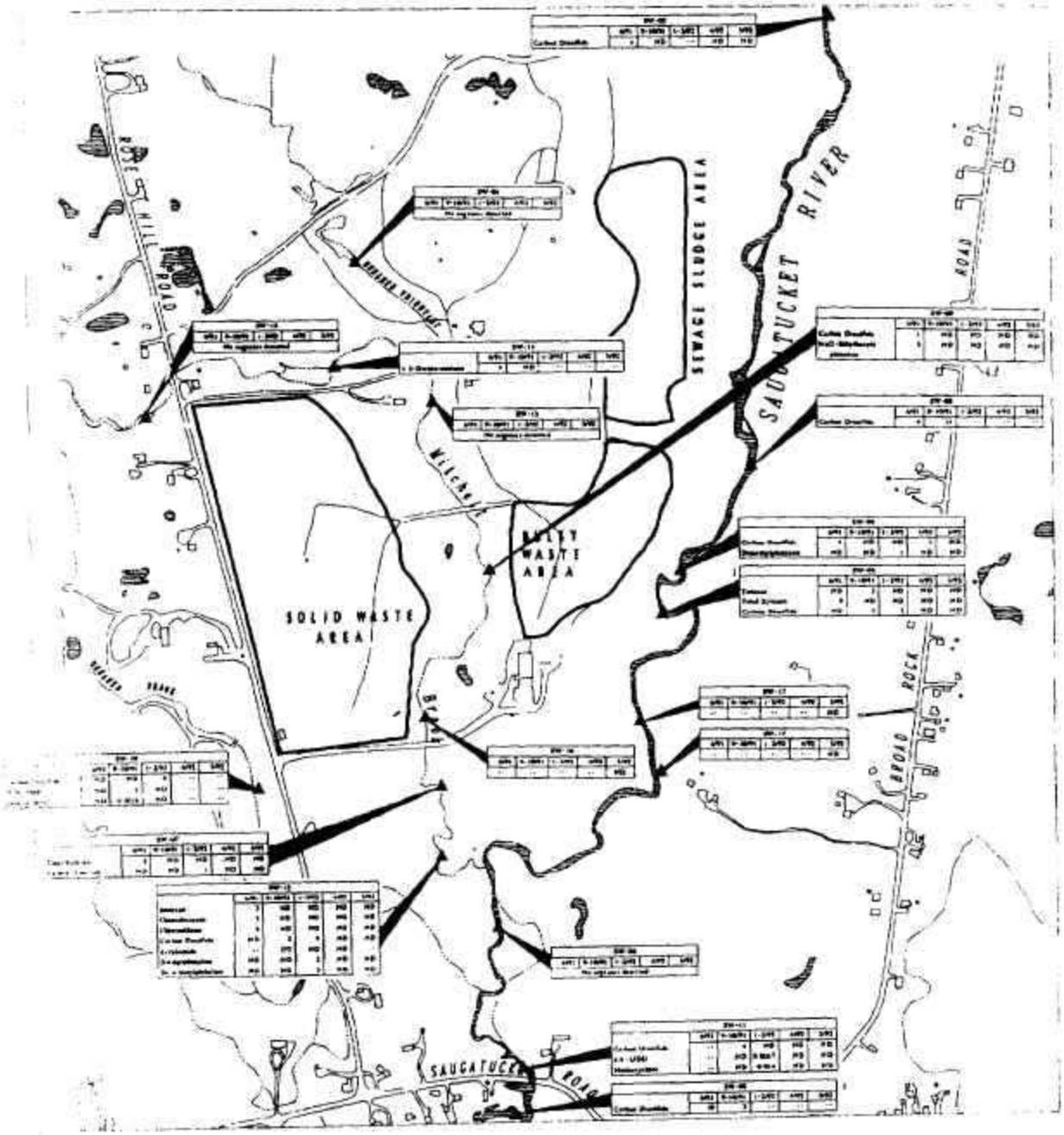


FIGURE 12 ORGANIC COMPOUNDS DETECTED IN SURFACE WATER

ROSE HILL REGIONAL LANDFILL
SOUTH KINGSTOWN, RI

METCALF & EDDY

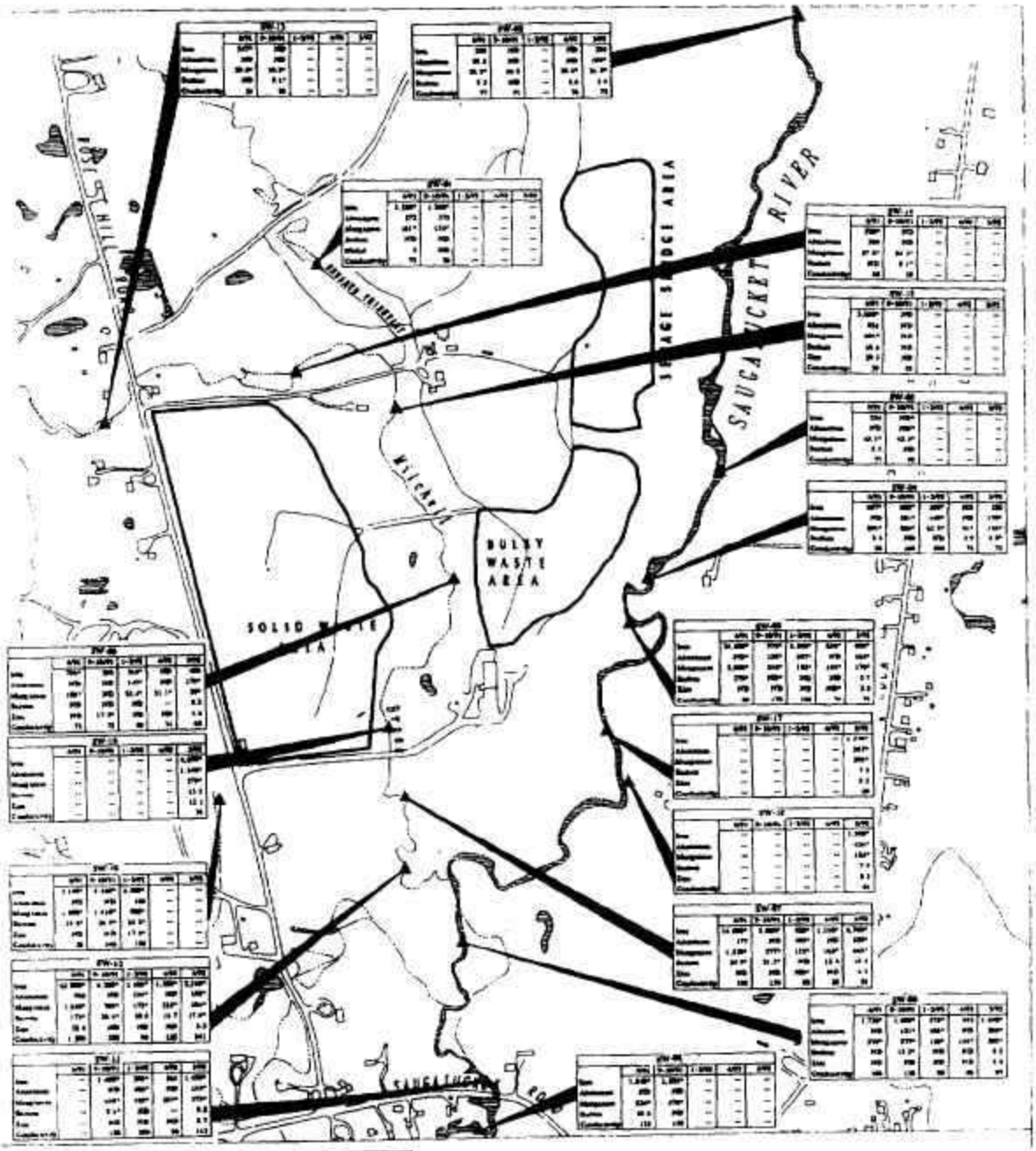


FIGURE 13 INORGANICS DETECTED IN SURFACE WATER (UNFILTERED)

ROSE HILL REGIONAL LANDFILL
SOUTH KINGSTOWN, RI

METCALF & EDDY

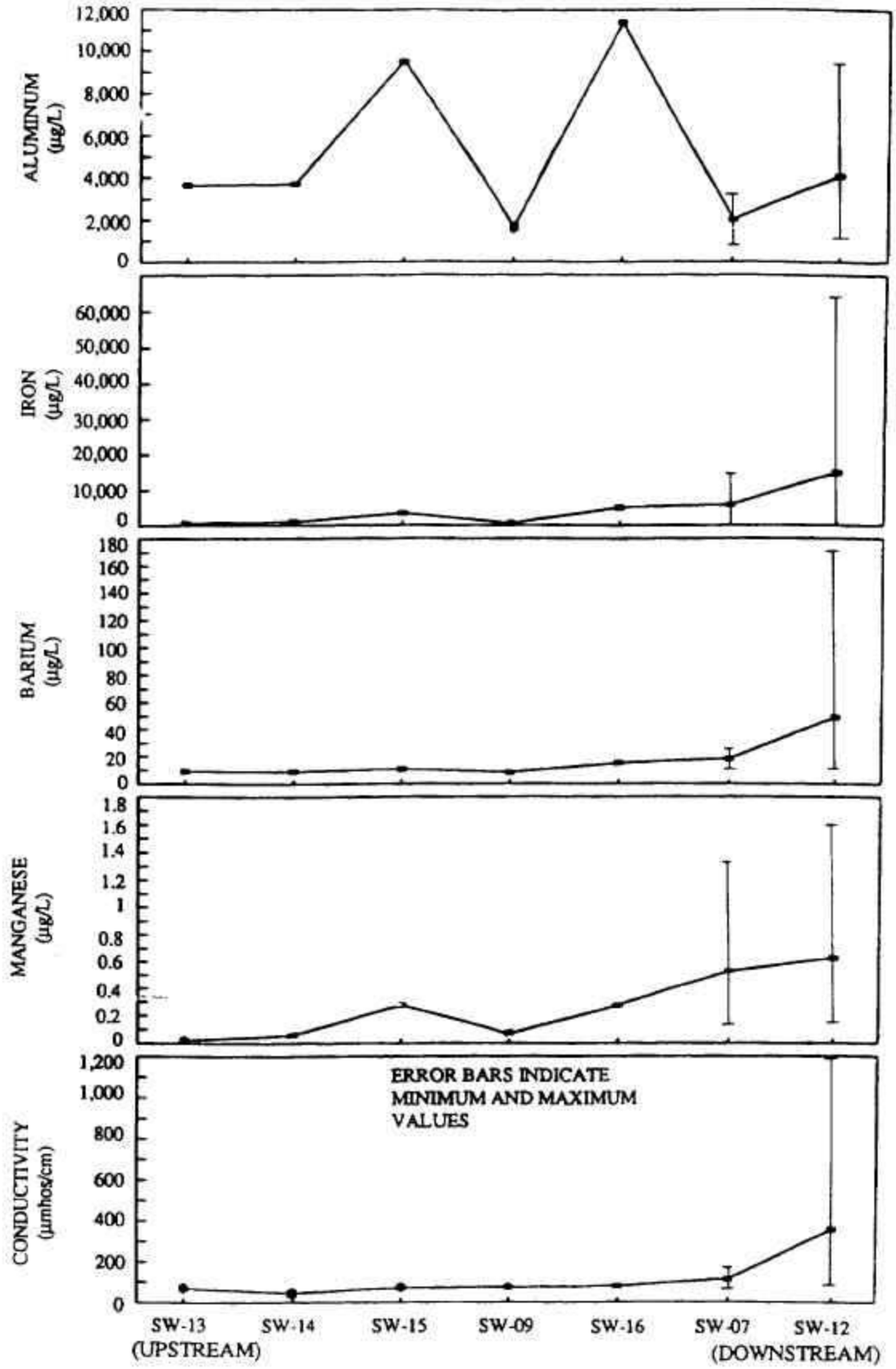


FIGURE 14

METAL TRENDS IN MITCHELL BROOK SURFACE WATER

METCALF & EDDY

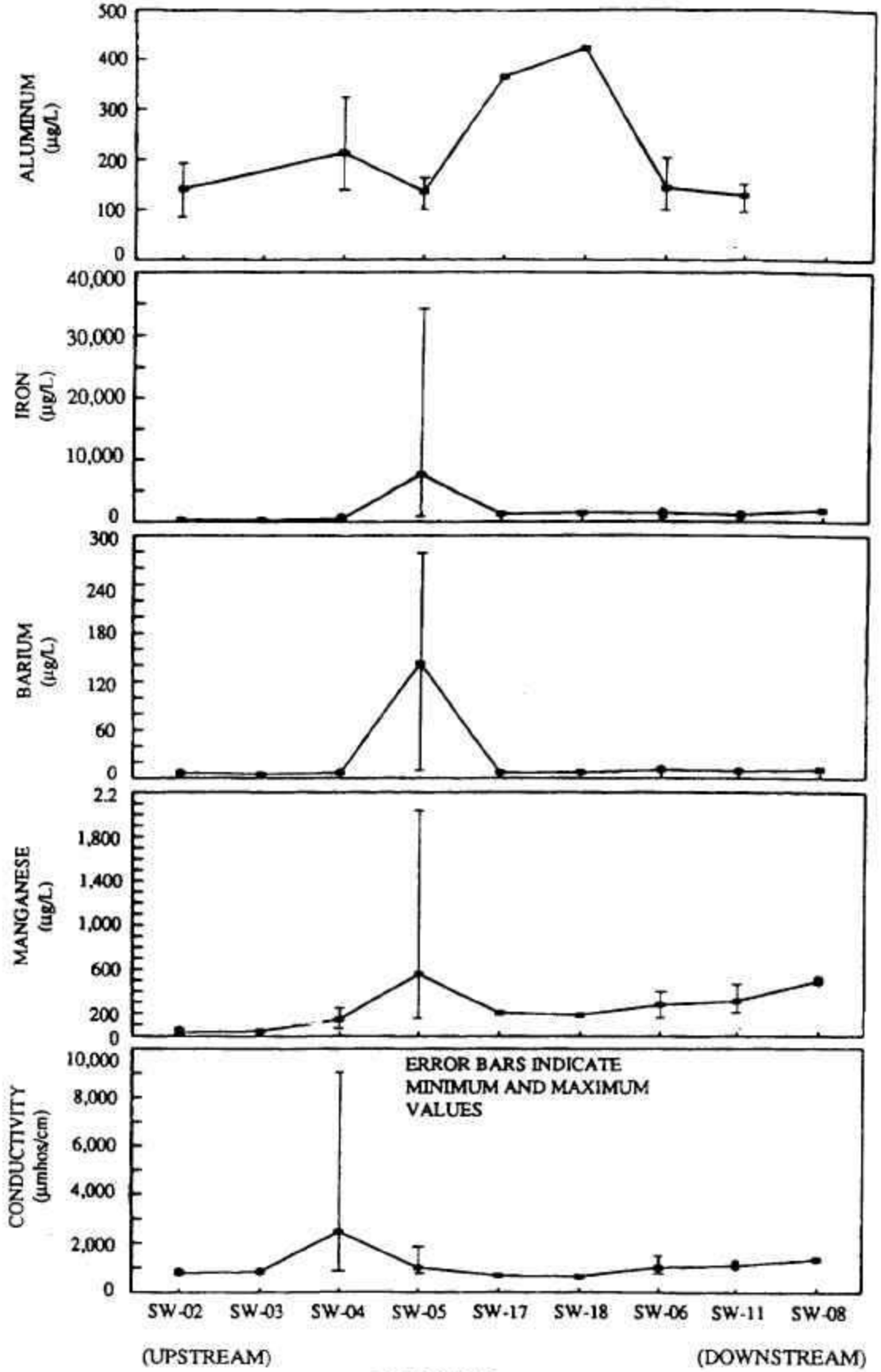


FIGURE 15

METAL TRENDS IN SAUGATUCKET RIVER SURFACE WATER

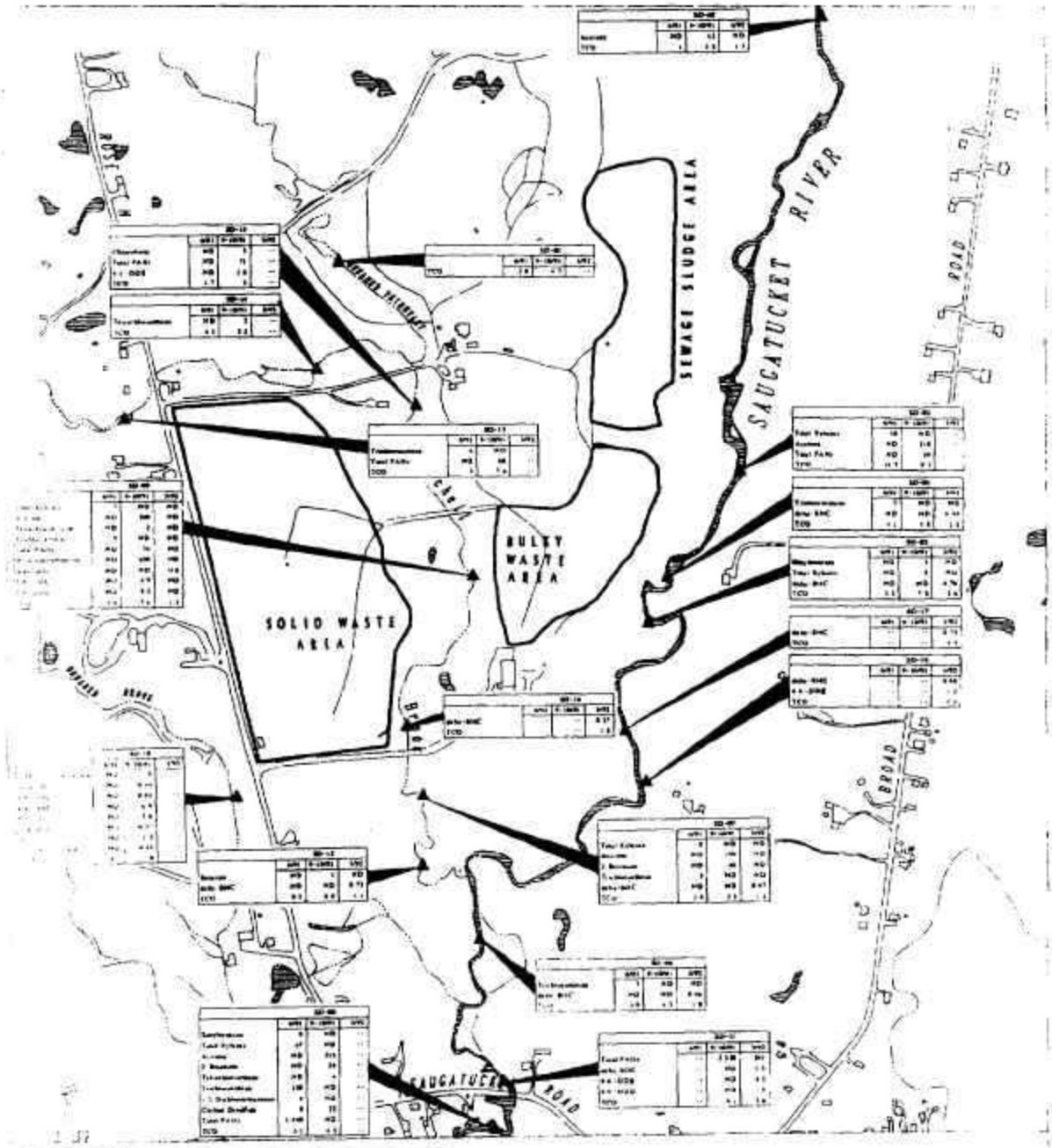


FIGURE 16 ORGANIC COMPOUNDS DETECTED IN SEDIMENT

ROSE HILL REGIONAL LANDFILL
SOUTH KINGSTOWN, RI

METCALF & EDDY

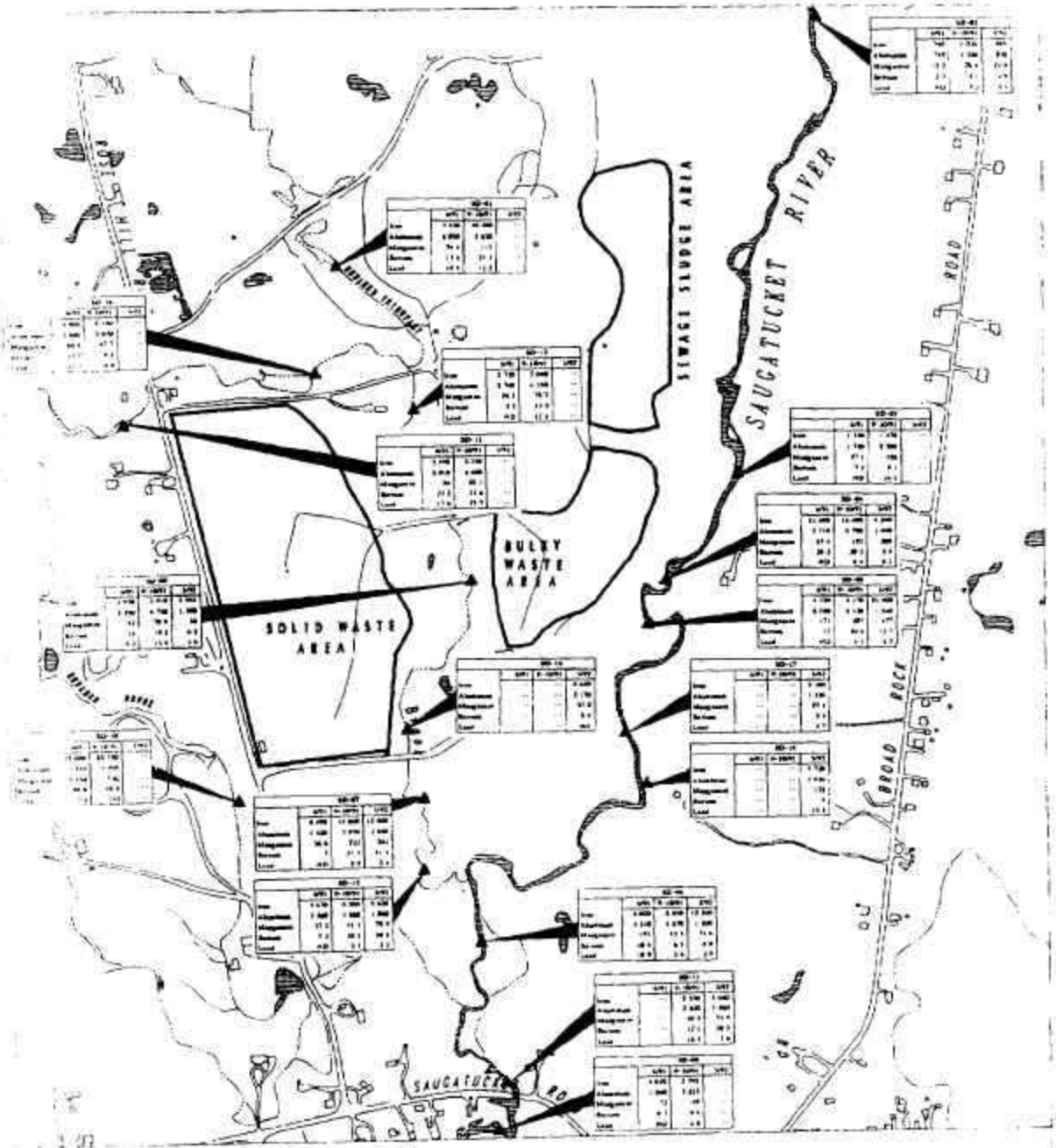


FIGURE 17 INORGANICS DETECTED IN SEDIMENT

ROSE HILL REGIONAL LANDFILL
SOUTH KINGSTOWN, RI

METCALF & EDDY

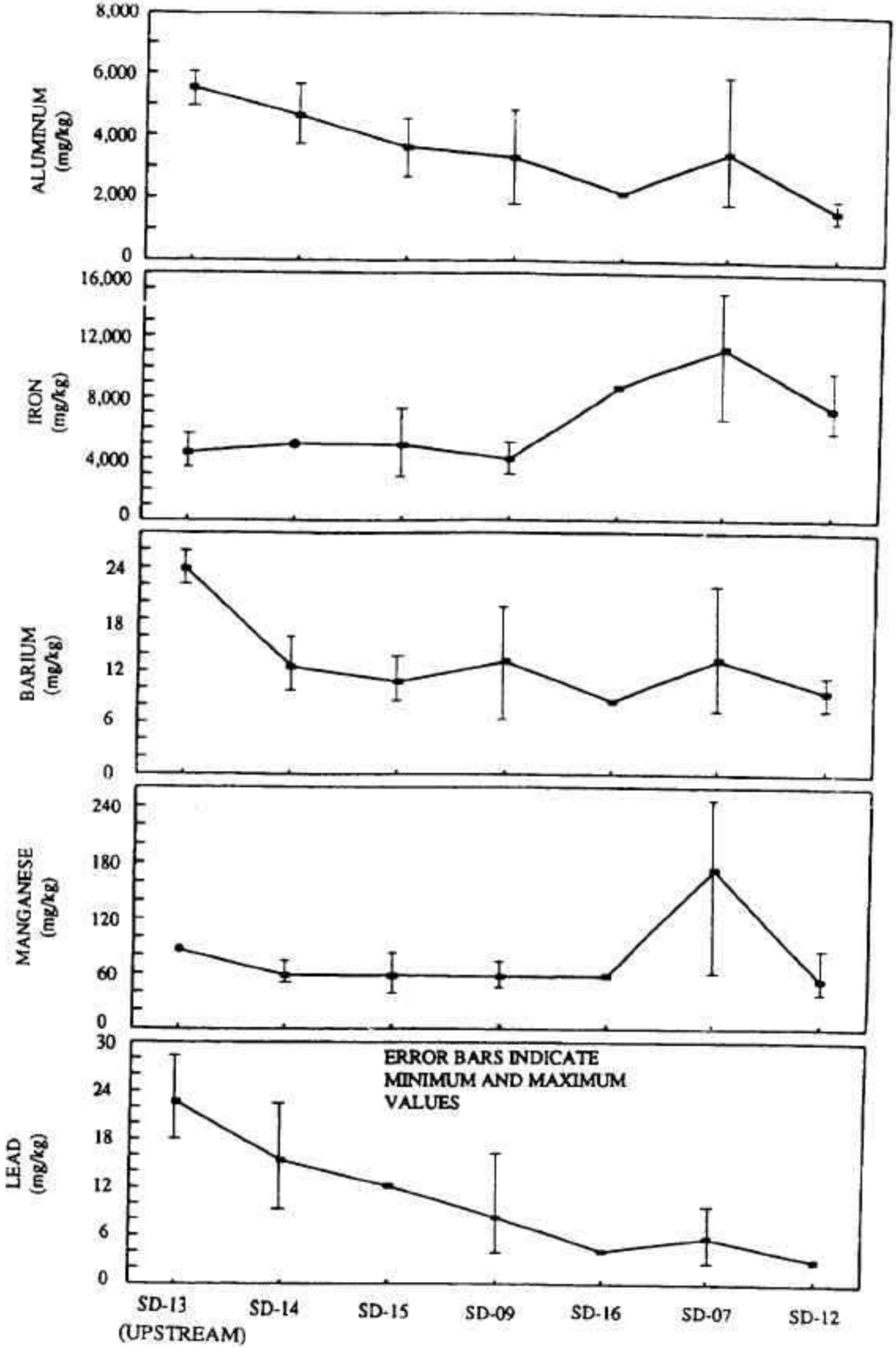


FIGURE 18
METAL TRENDS IN MITCHELL BROOK SEDIMENT

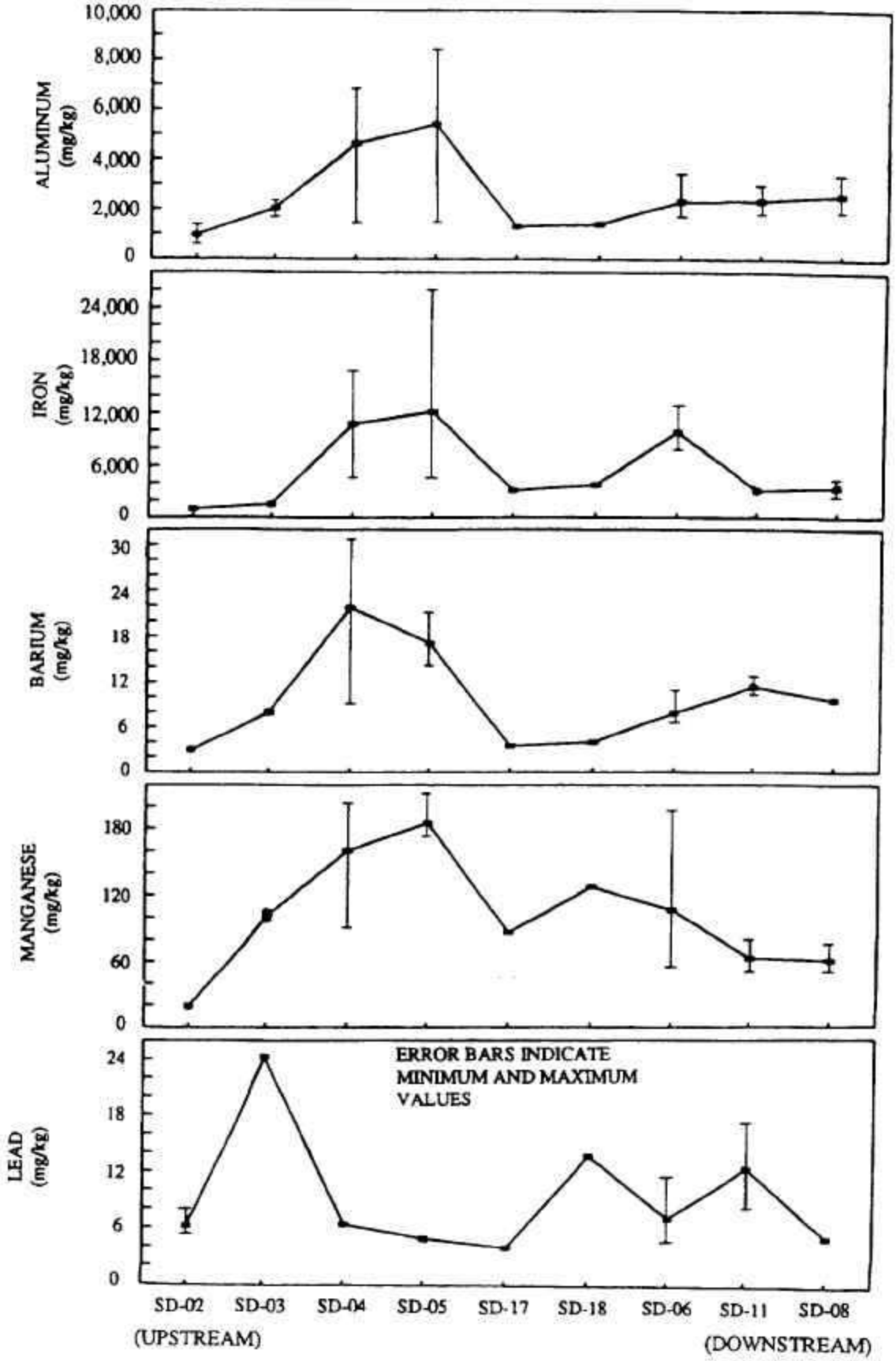


FIGURE 19
METAL TRENDS IN SAUGATUCKET RIVER SEDIMENT

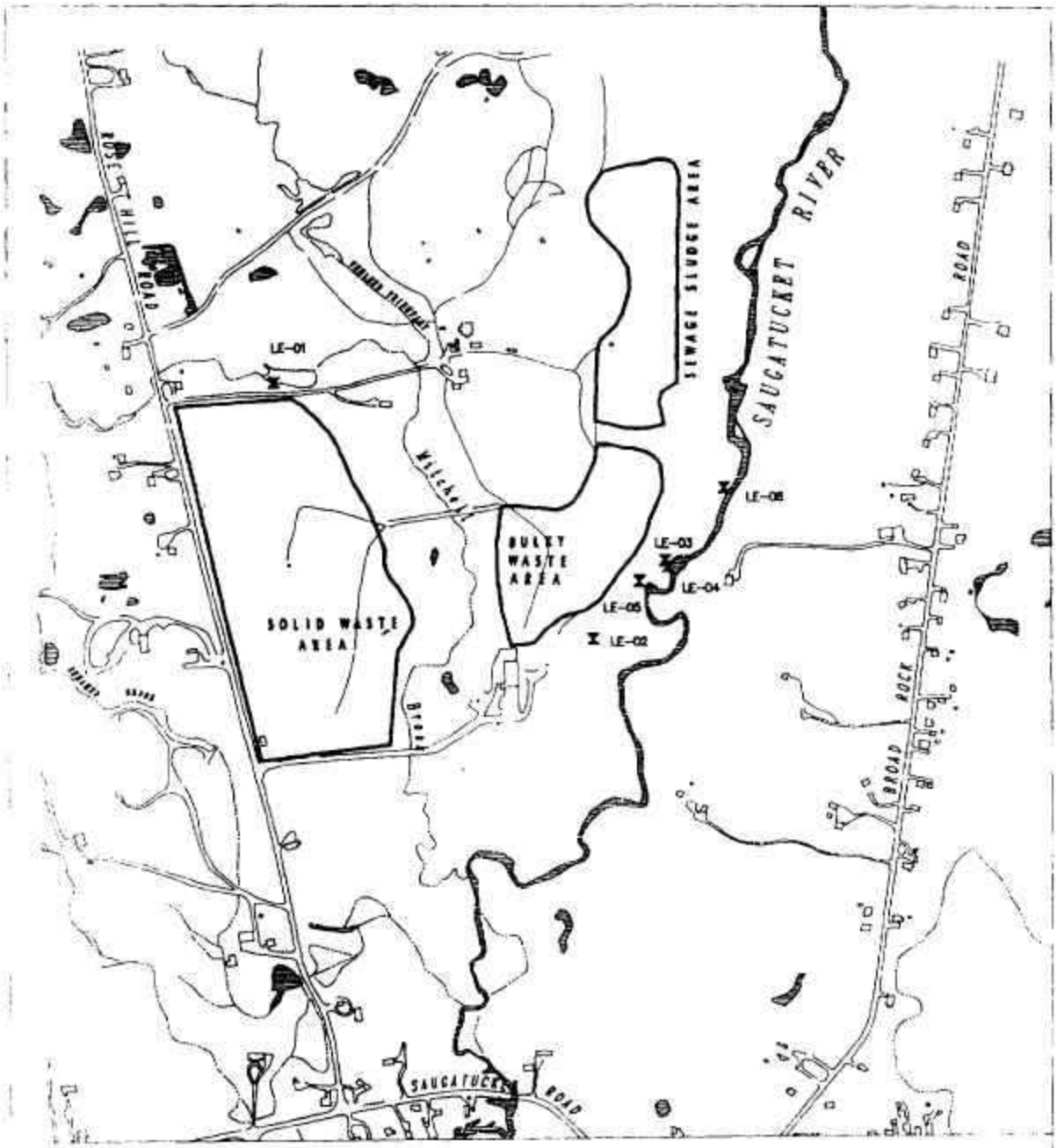


FIGURE 20

LEACHATE SAMPLING LOCATIONS

ROSE HILL REGIONAL LANDFILL
SOUTH KINGSTOWN, RI

METCALF & EDDY

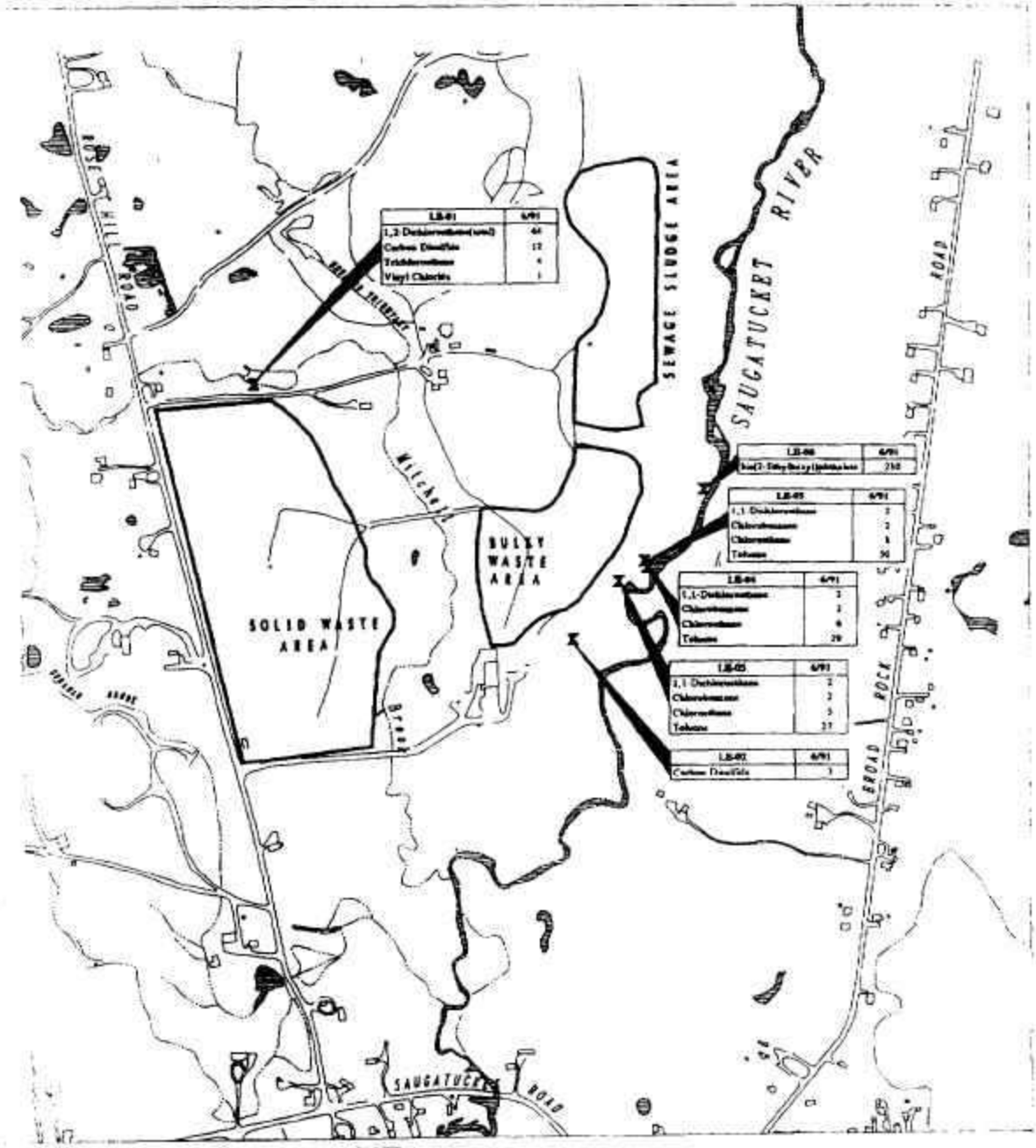


FIGURE 21 ORGANIC COMPOUNDS DETECTED IN LEACHATE

ROSE HILL REGIONAL LANDFILL
SOUTH KINGSTOWN, RI

METCALF & EDDY

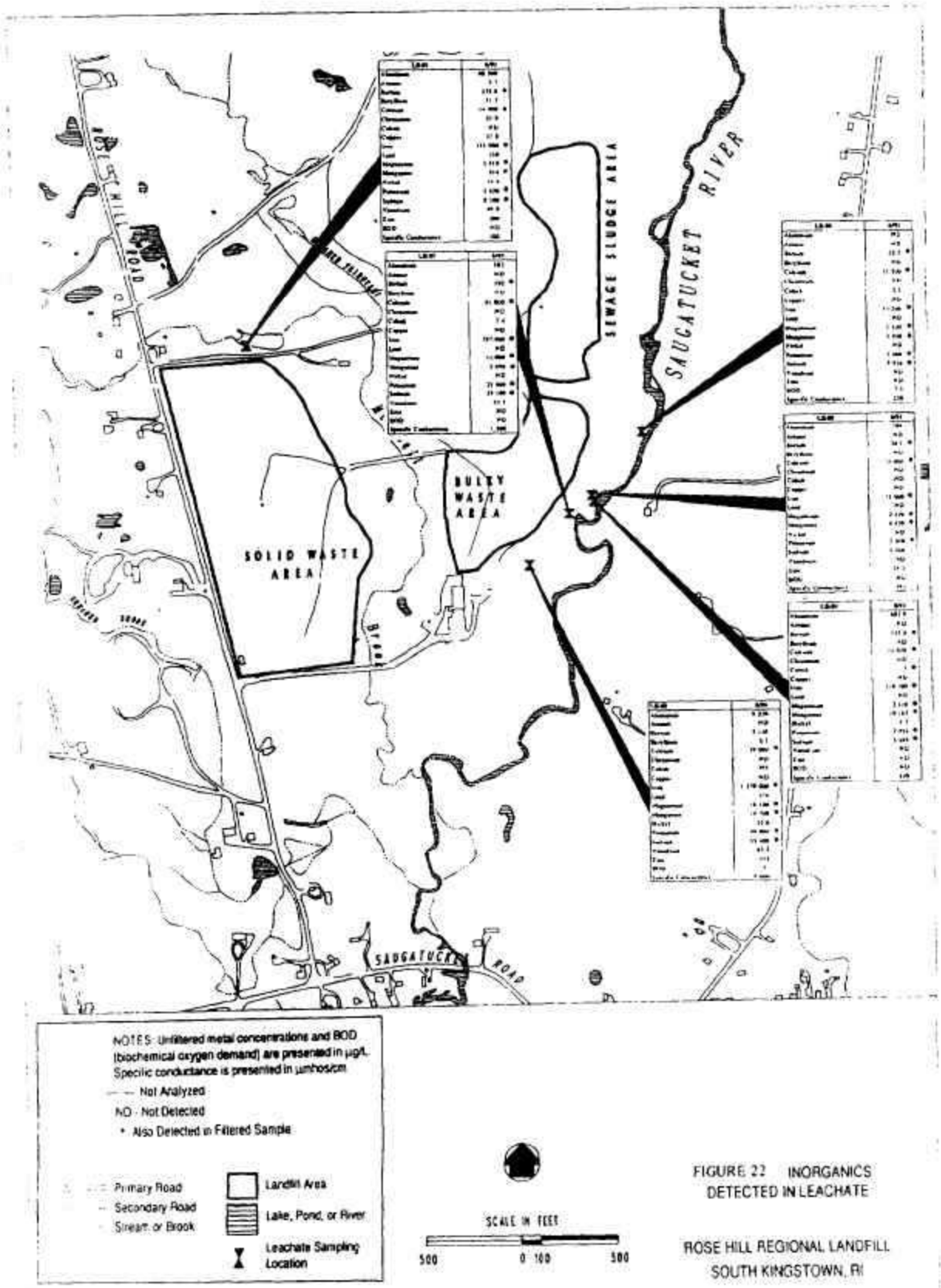
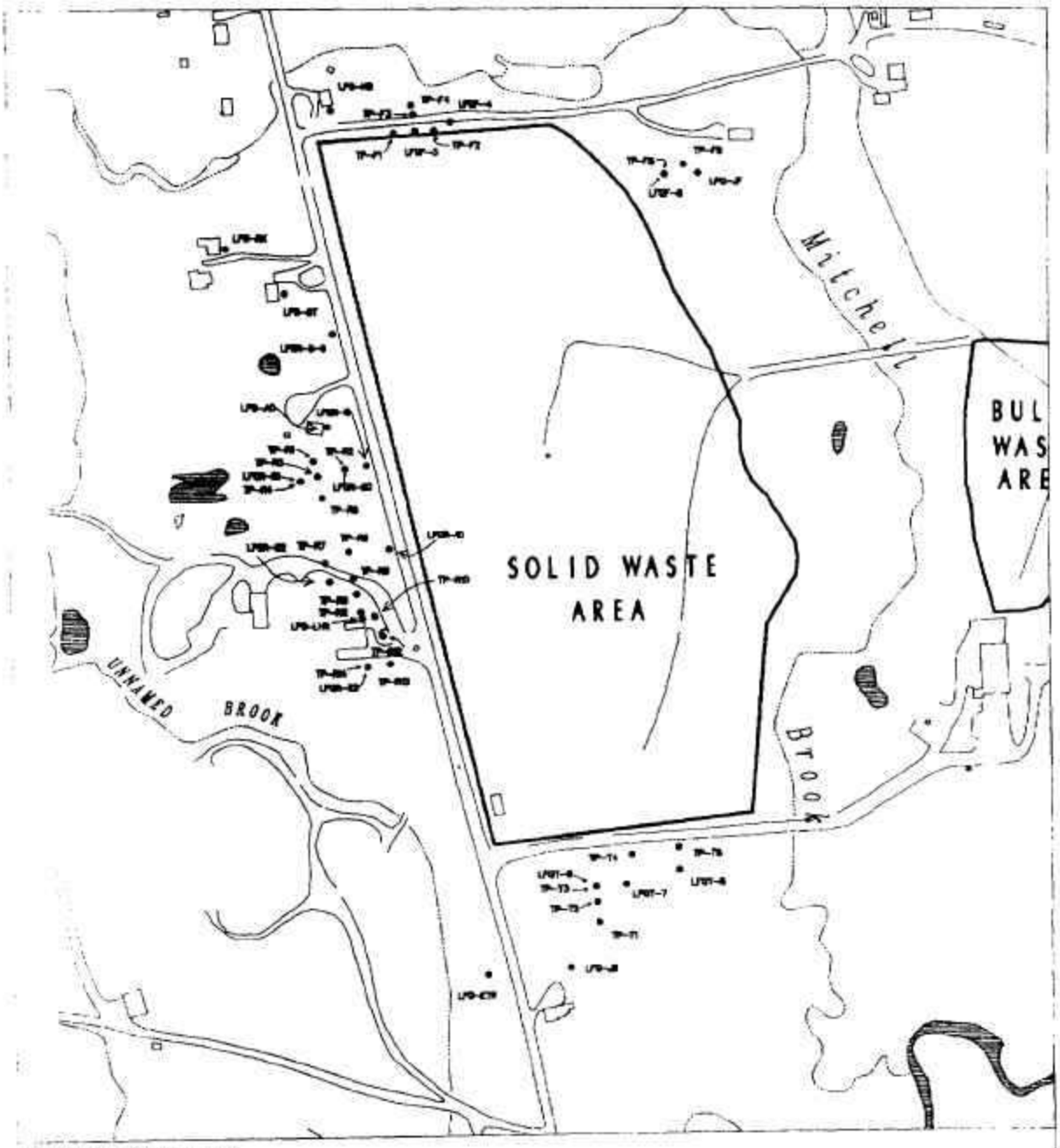


FIGURE 22 INORGANICS DETECTED IN LEACHATE

ROSE HILL REGIONAL LANDFILL
SOUTH KINGSTOWN, RI

METCALF & EDDY



NOTES: LFG - Permanent points.
TP - Temporary points sampled only in December, 1991.
Some points have both an LFG and a TP label. These points were first sampled as temporary points and then installed as permanent sampling locations.

Primary Road
Secondary Road
Stream or Brook
Landfill Area
Lake, Pond, or River
December 1991 Sampling Locations

SCALE IN FEET
250 0 100 250

FIGURE 23

LANDFILL GAS LOCATIONS SAMPLED IN DECEMBER, 1991

ROSE HILL REGIONAL LANDFILL
SOUTH KINGSTOWN, RI

METCALF & EDDY

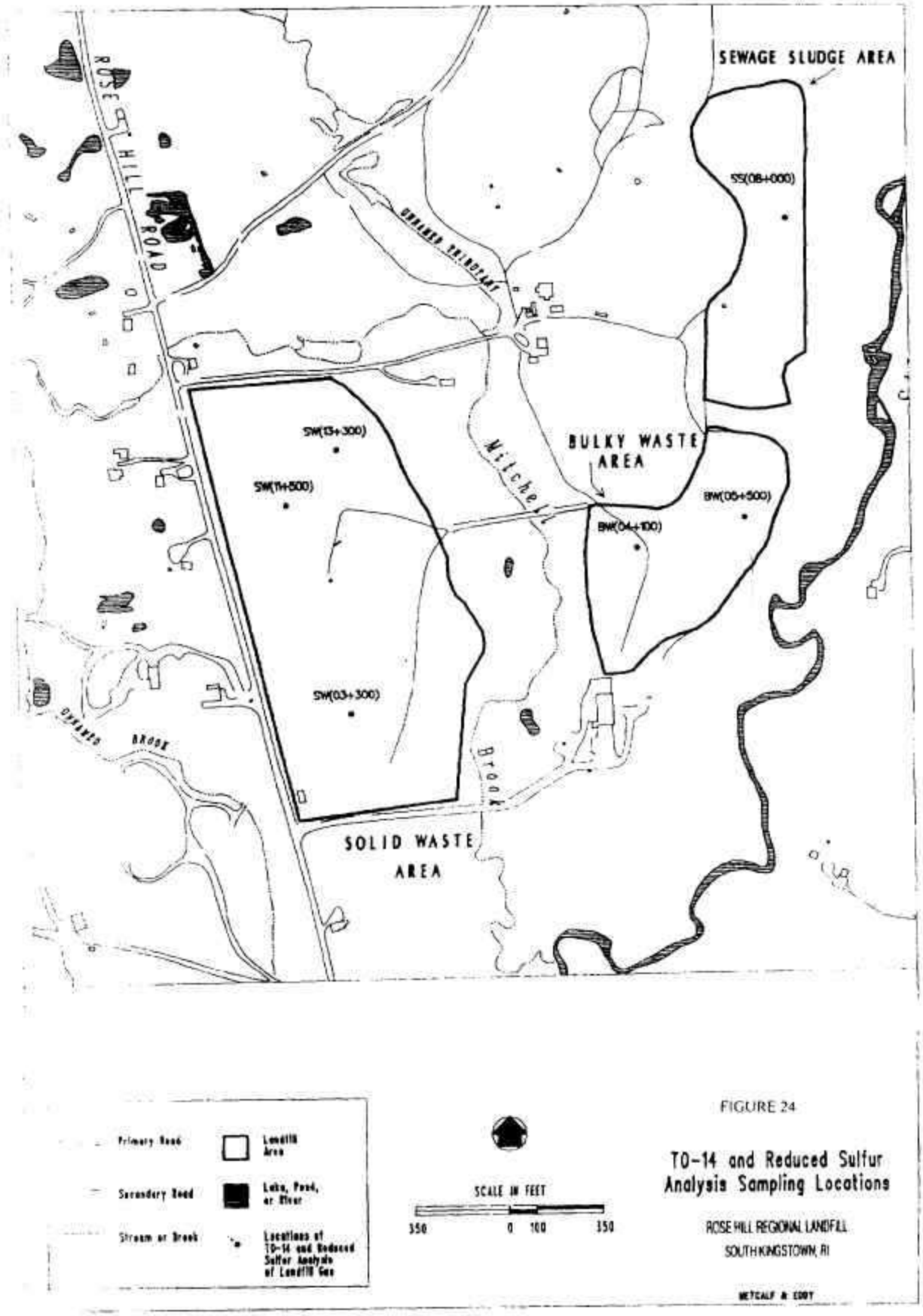


FIGURE 24

TO-14 and Reduced Sulfur Analysis Sampling Locations

ROSE HILL REGIONAL LANDFILL
SOUTH KINGSTOWN, RI

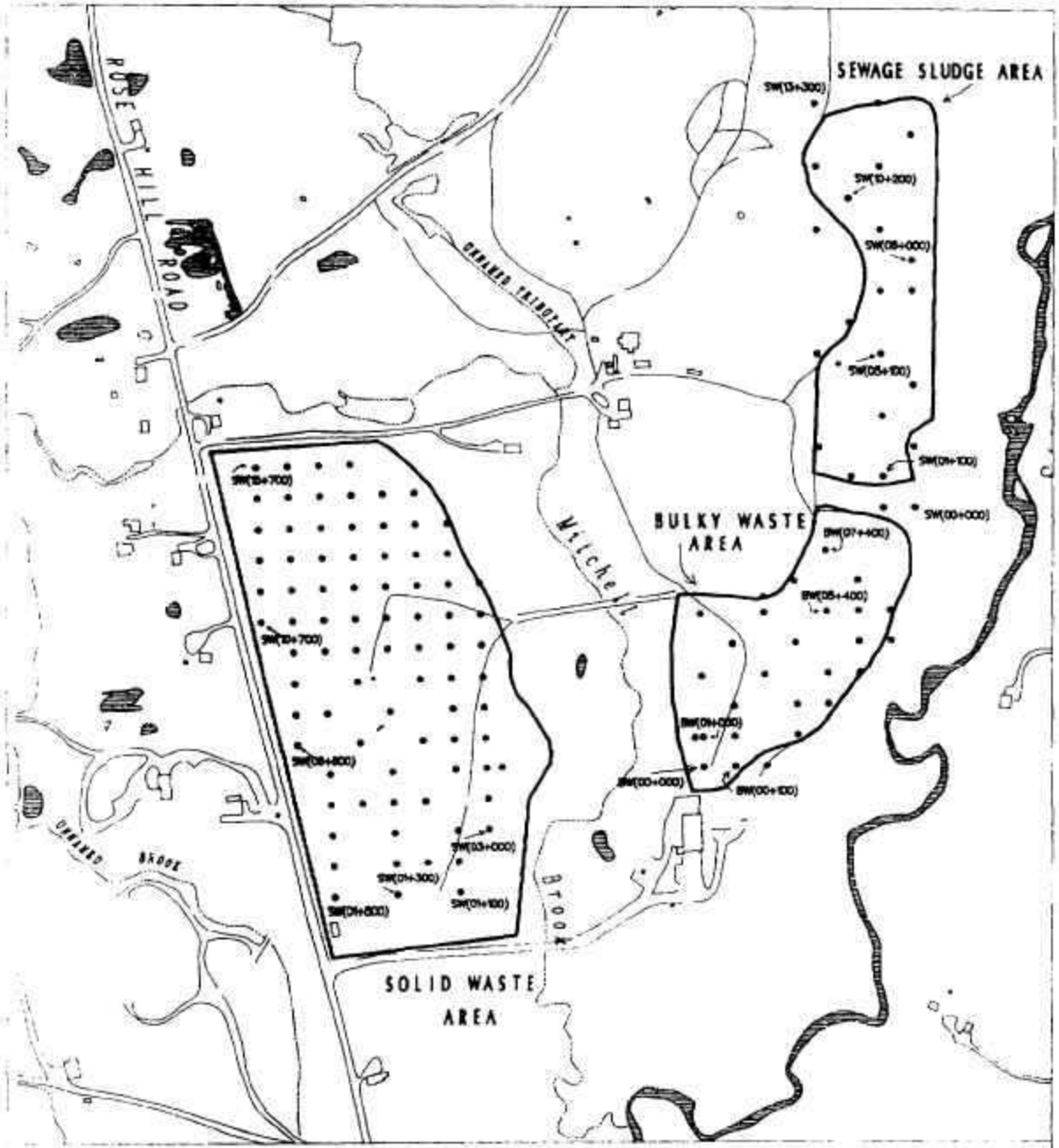


FIGURE 25

TEMPORARY LANDFILL GAS SAMPLING LOCATIONS SAMPLED IN JUNE, 1991

ROSE HILL REGIONAL LANDFILL
SOUTH KINGSTOWN, RI

METCALF & EDDY

NOTES: LFG - Permanent points.
TP - Temporary points sampled only in December, 1991.
Some points have both an LFG and a TP label. These points were first sampled as temporary points and then installed as permanent sampling locations.

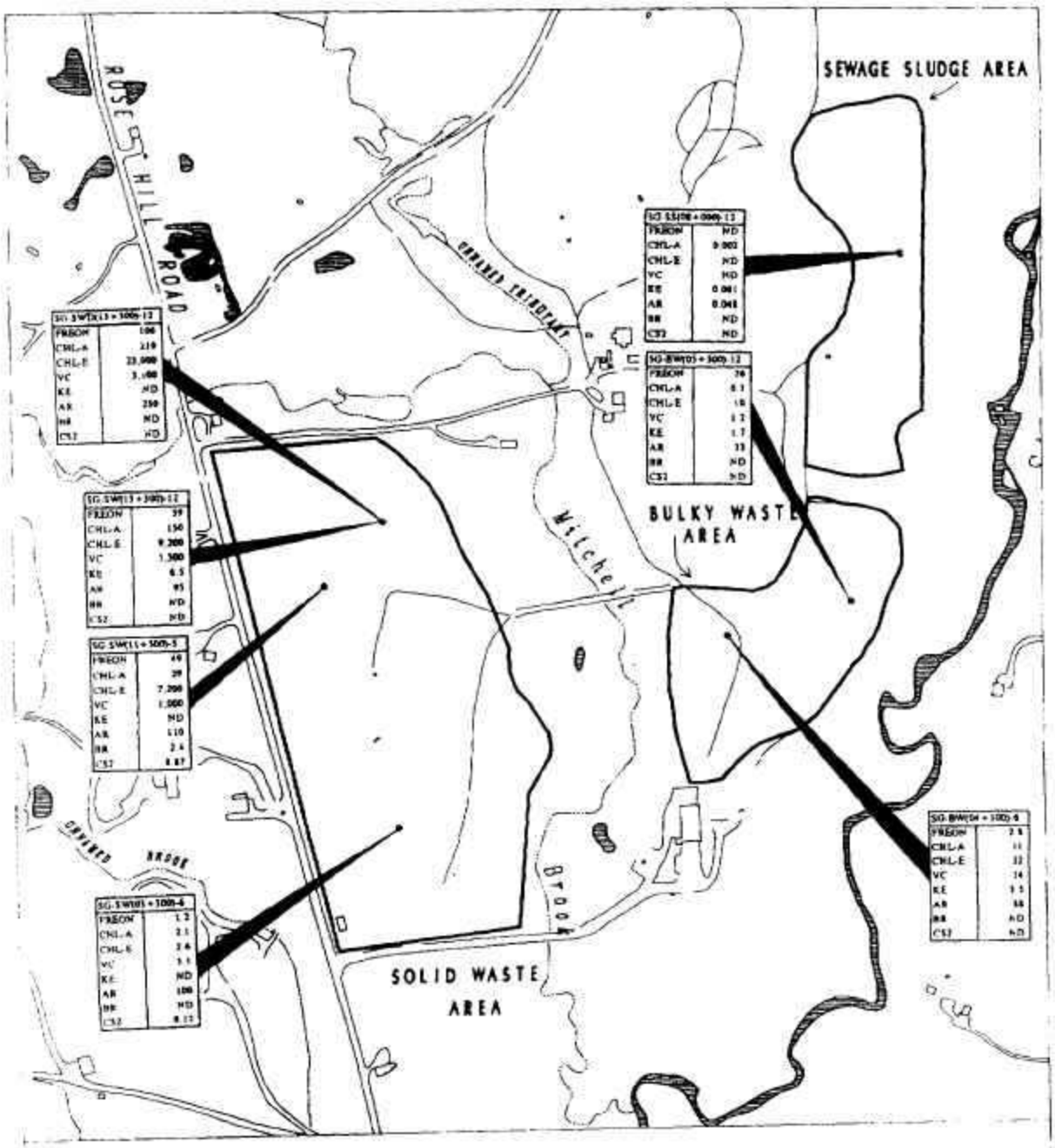
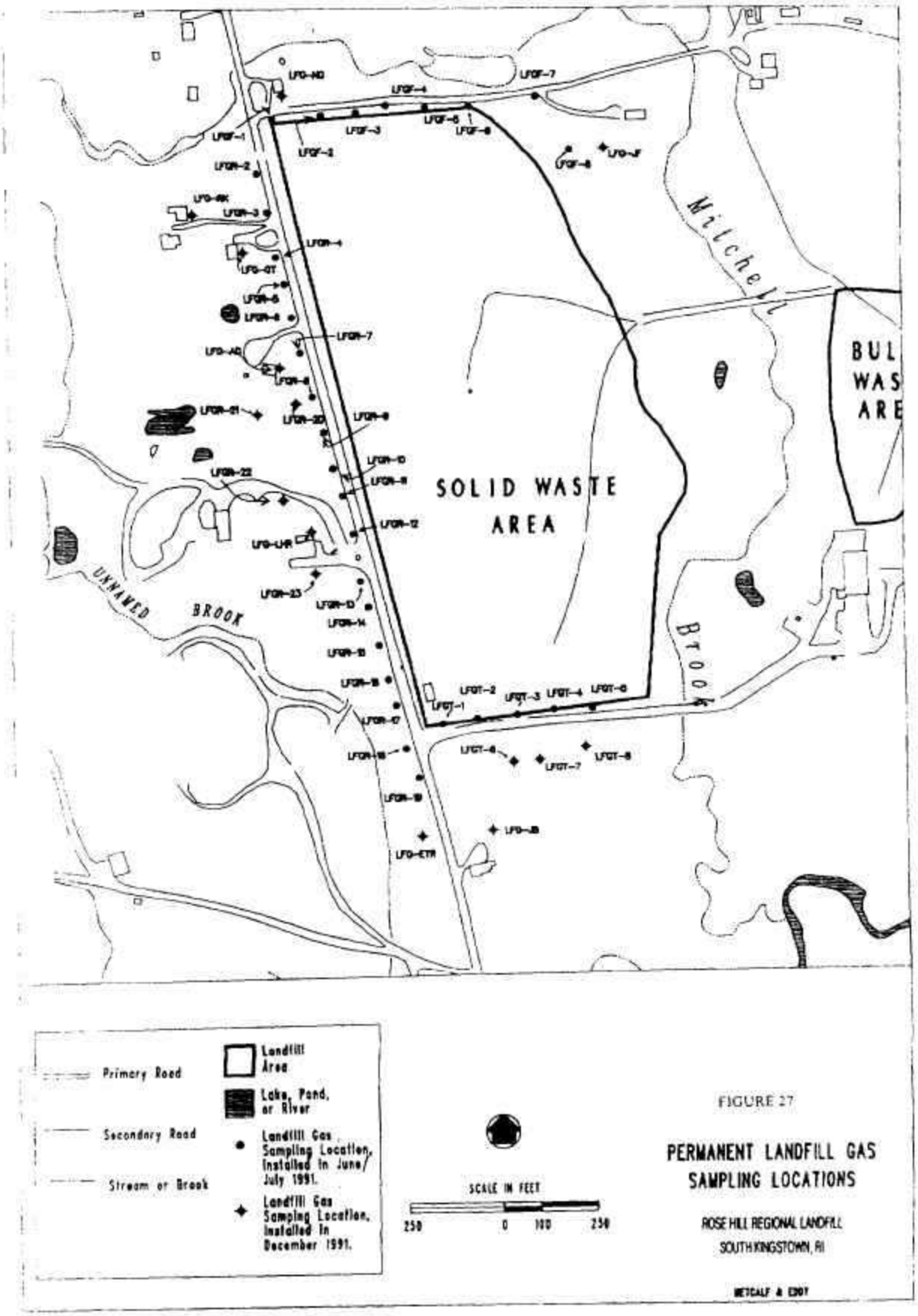


FIGURE 26
DISTRIBUTION OF ORGANIC CHEMICALS DETECTED IN LANDFILL GAS USING SUMMA CANISTERS AND TO-14 ANALYSIS

ROSE HILL REGIONAL LANDFILL
SOUTH KINGSTOWN, RI

METCALF & EDDY


SOLID WASTE AREA
UNNAMED BROOK
Mitchell
BUL
WAS
ARE
Primary Road
Secondary Road
Stream or Brook
Landfill Area
Lake, Pond, or River
Landfill Gas Sampling Location, Installed in June/July 1991.
Landfill Gas Sampling Location, Installed in December 1991.
SCALE IN FEET
250 0 100 250
FIGURE 27
PERMANENT LANDFILL GAS SAMPLING LOCATIONS
ROSE HILL REGIONAL LANDFILL
SOUTH KINGSTOWN, RI
METCALF & EDDY

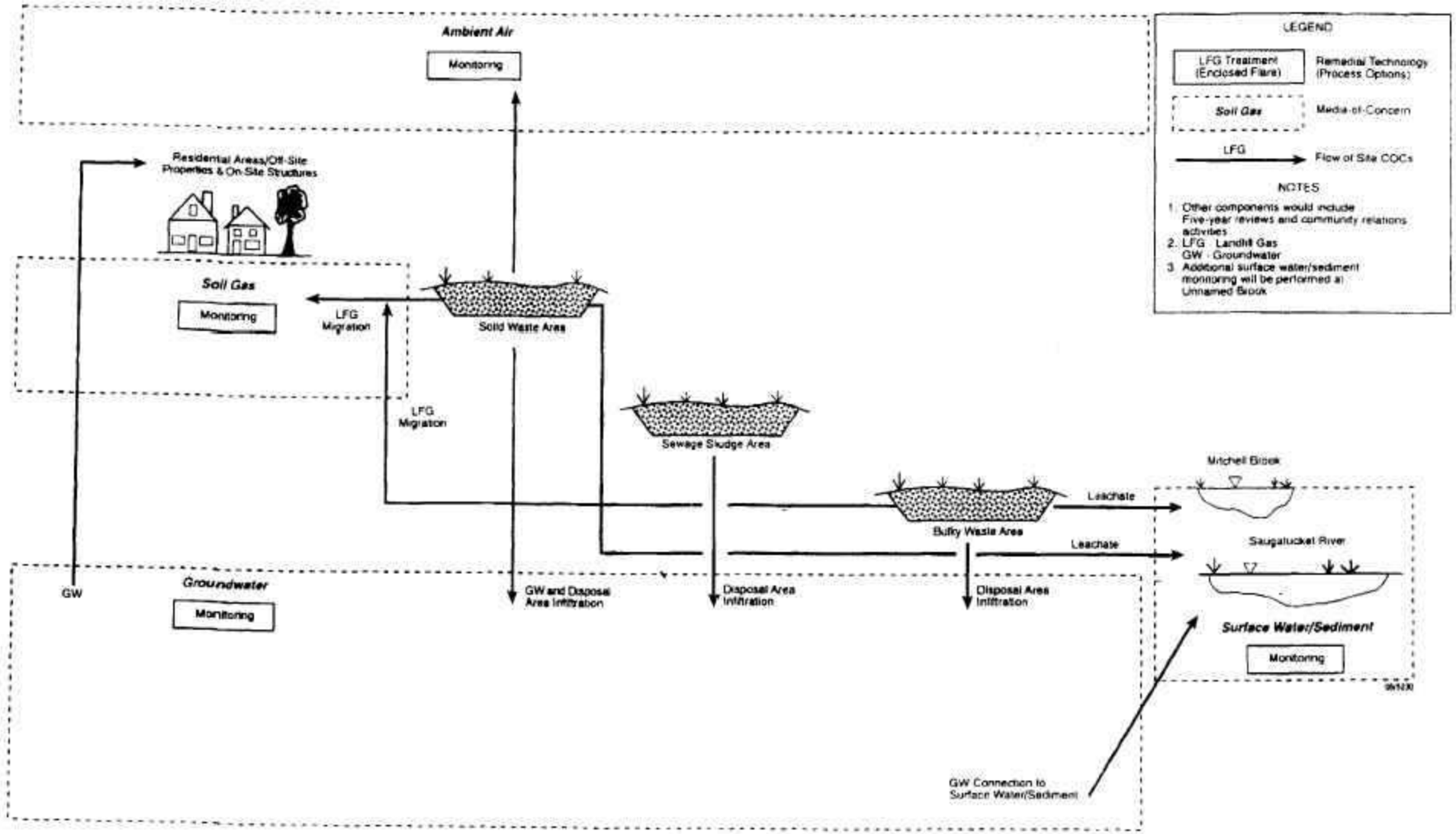


FIGURE 28

SCHEMATIC OF ALTERNATIVE #1 COMPONENTS

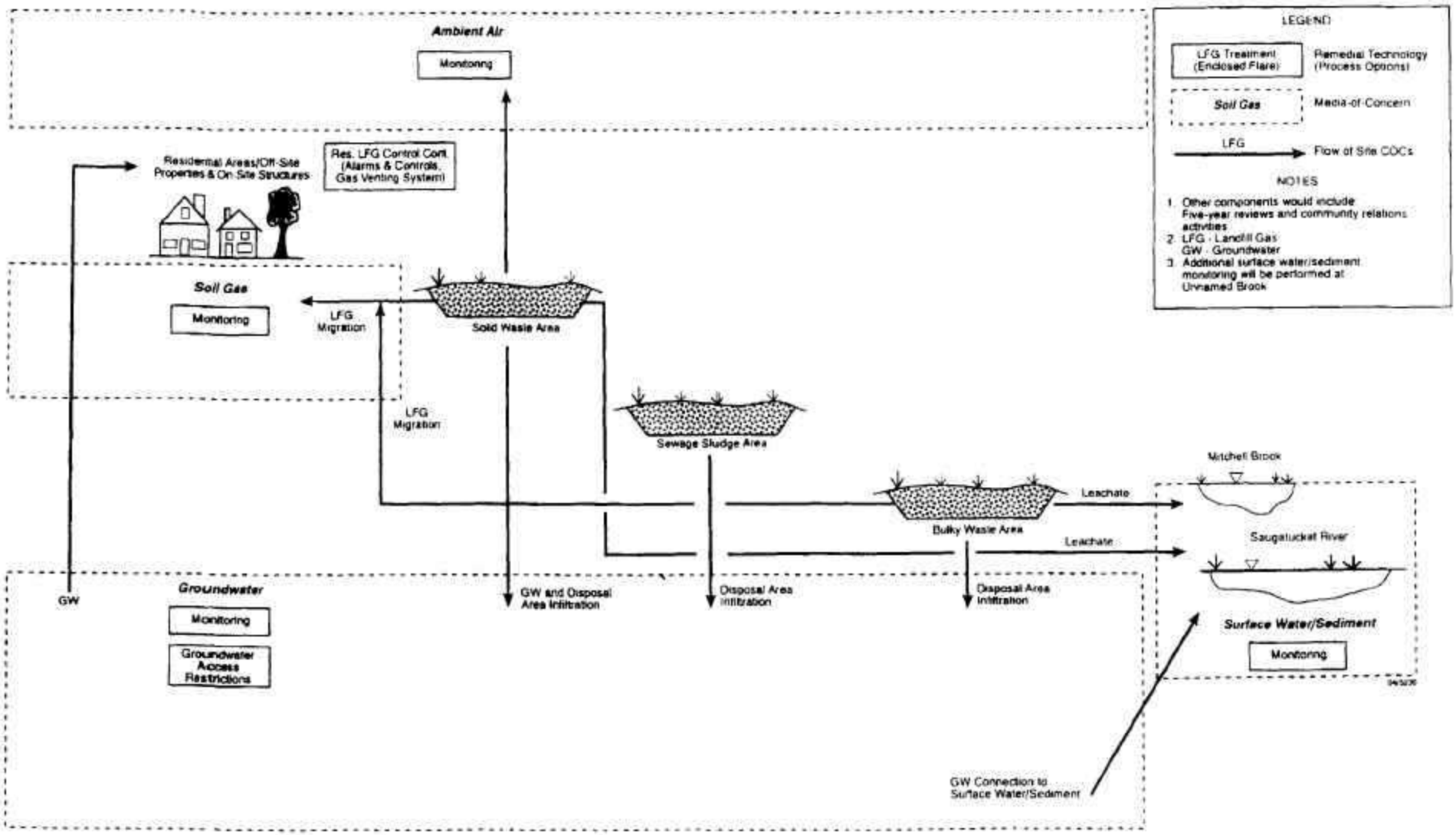


FIGURE 29

SCHEMATIC OF
ALTERNATIVE #2 COMPONENTS

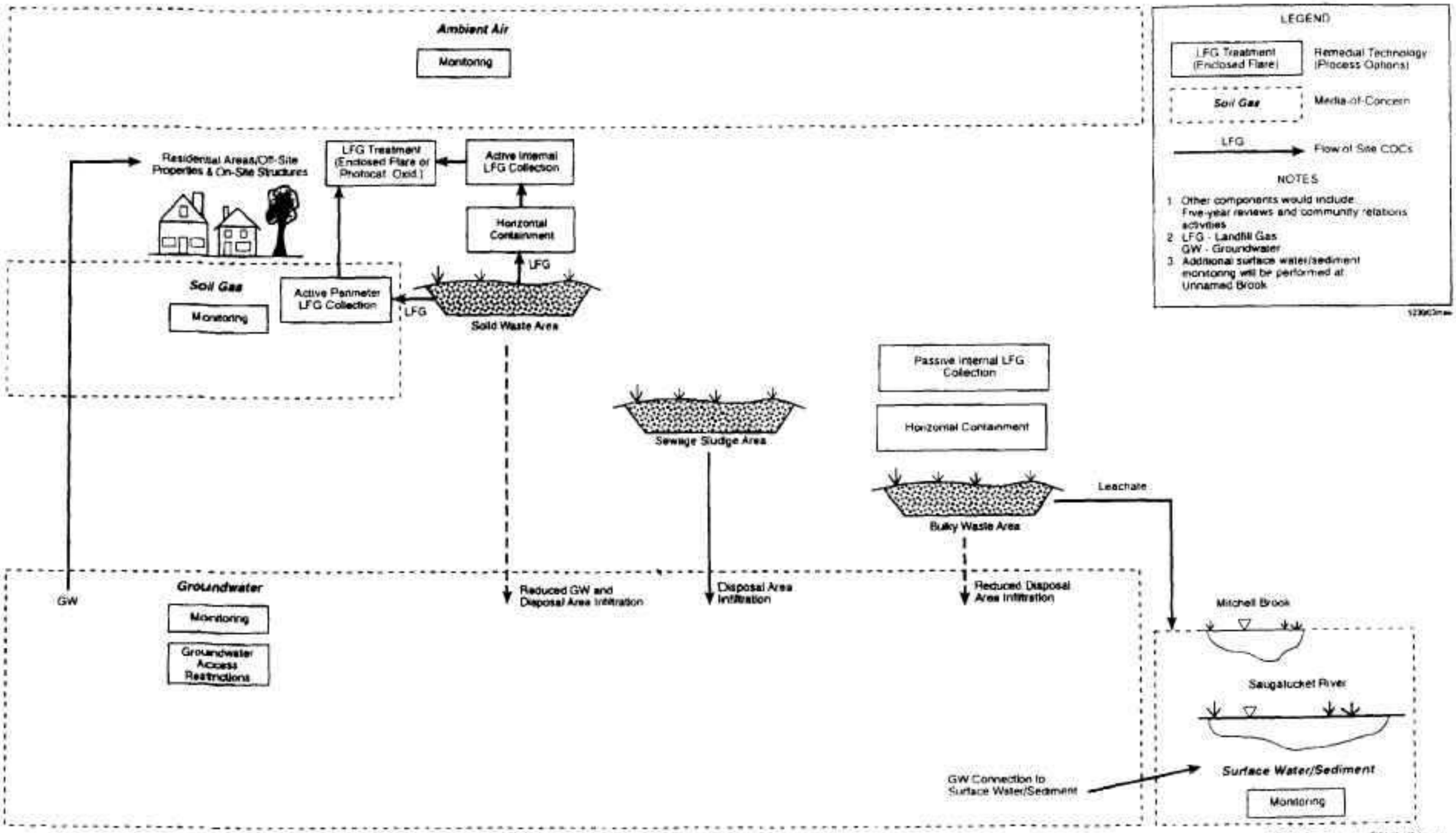


FIGURE 30 + FIGURE 31

SCHEMATIC OF ALTERNATIVES #3a and 3b COMPONENTS

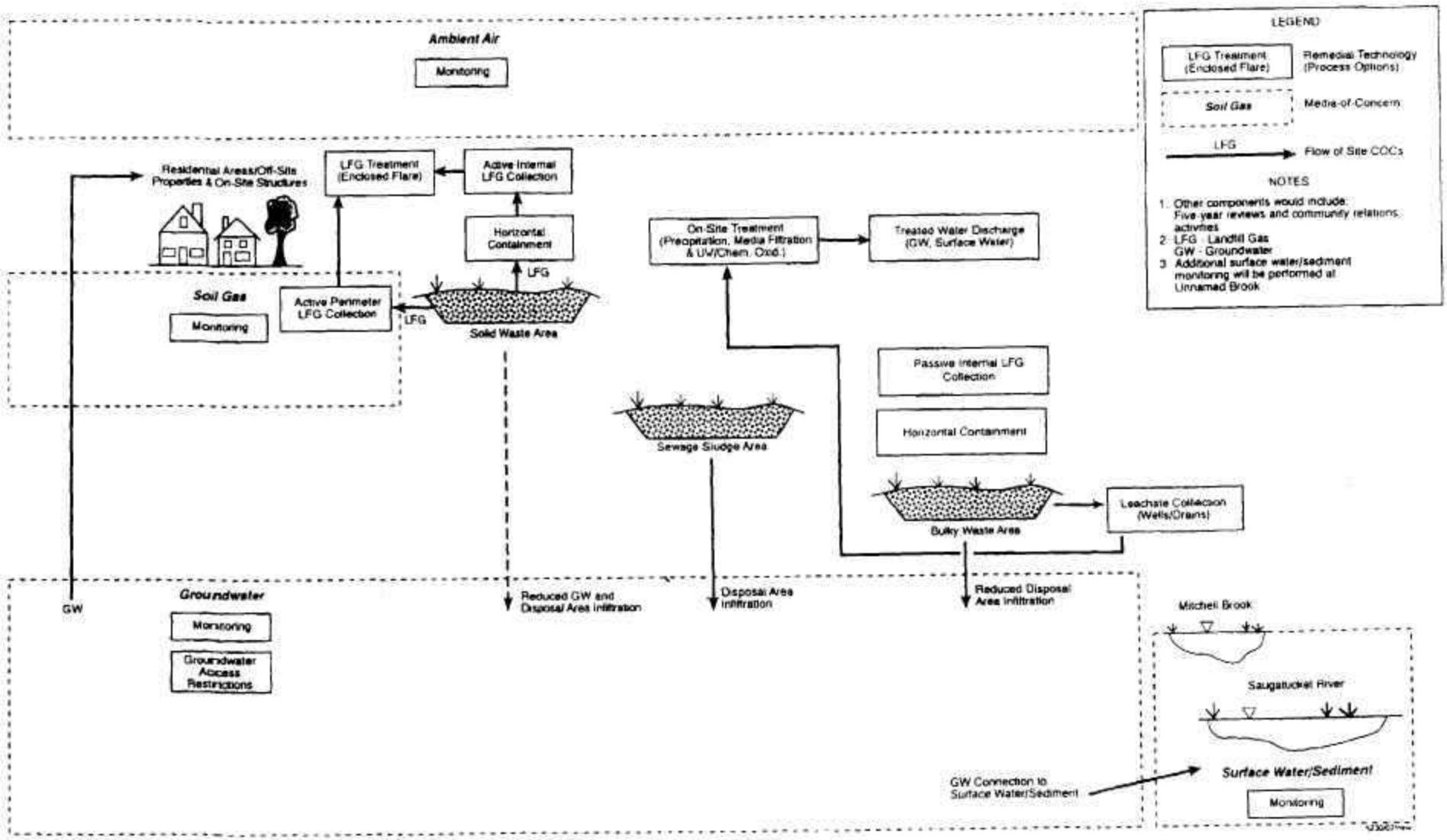


FIGURE 32
SCHEMATIC OF
ALTERNATIVE #4a COMPONENTS

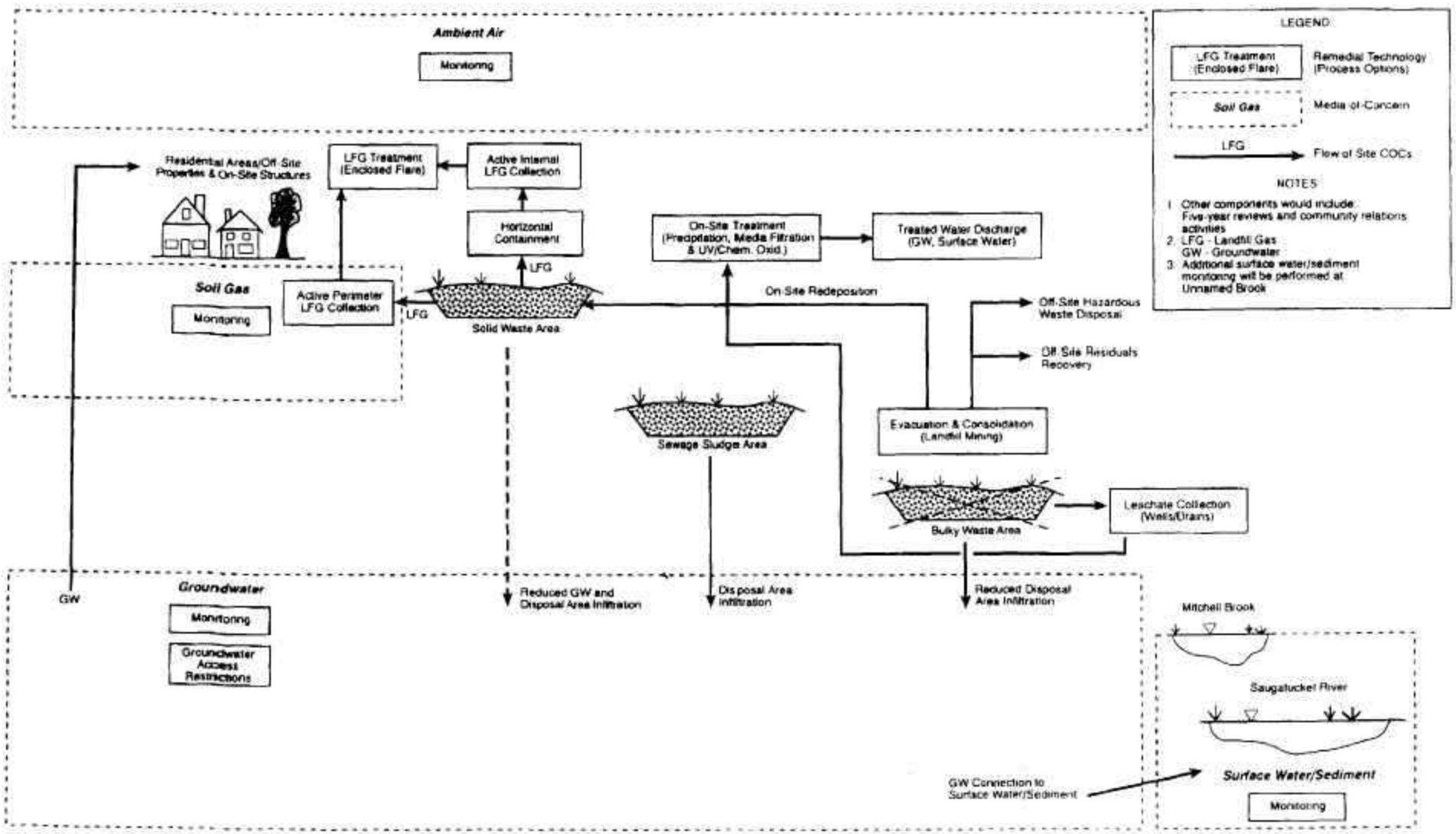


FIGURE 3

SCHEMATIC OF
ALTERNATIVE #4b COMPONENTS

APPENDIX B

RECORD OF DECISION
Rose Hill Regional Landfill Superfund Site

LIST OF TABLES

LIST OF TABLES

TABLE 1

CHRONOLOGY OF ACTIVITIES AT THE ROSE HILL REGIONAL LANDFILL

Year	Activity Affecting Landfill Operations
1967	Solid waste landfill begins operation in an abandoned gravel quarry off Rose Hill Road.
	Court order limits use of landfill by prohibiting disposal of combustibles.
1970	State Division of Solid Waste Management suggests to South Kingstown director of public works that liquid waste from Peacedale Processing be spread over the other waste if the town continued to accept Peacedale waste for disposal.
1971	State Division of Solid Waste Management notifies South Kingstown town manager that liquid waste from Peacedale Processing is improperly being disposed of; again, town is told to spread liquid waste on top of other waste if it continues to accept Peacedale waste.
1973	Town of Narragansett enters into an agreement with South Kingstown to engage in a regional landfill and disposal program concerning Rose Hill and West Kingston landfill facilities.
1975	Town of South Kingstown retains independent professional engineer to conduct groundwater study because the landfill facility has been found to be the source of objectionable groundwater in off-site private well. A new well is installed by town to this residence.
1976	South Kingstown Town Council votes to lease additional property (Lots OL16A and OL16 on Block 93A) for landfill facility from private resident.
1977	Town of South Kingstown retains engineering firm to conduct site analysis and develop operation plans for solid waste activities to comply with state regulations. Engineering report deems site suitable for bulky waste disposal and sludge landfill and recommends monitoring of water quality at four wells close to site.
	State Water Resource Board notifies State Division that site is not adequate as a landfill site; leachate formation and drainage noted as reasons for disapproval.
	Sewage sludge landfill begins operations.
	Town of South Kingstown recommends Rose Hill Regional Landfill as disposal site for refuse, bulky waste, and sewage sludge, if acceptable to state health authorities.
1978	Bulky waste disposal area opens.
	Town of South Kingstown initiates monitoring of seven residential wells in landfill area for water quality parameters.

TABLE 1 **(Continued).**
CHRONOLOGY OF ACTIVITIES AT THE ROSE HILL REGIONAL LANDFILL

Year	Activity Affecting Landfill Operations
	Monitoring well installation begins at landfill. By 1982, eleven monitoring wells have been installed.
1979	State orders cities and towns to provide for collection of waste oil.
	RIDEM collects sample from drum at landfill; analysis shows presence of trichloroethylene. The glue waste is also known to contain dimethyl formamide and cellosolve solvent. State bans glue waste from Rose Hill Regional Landfill because industrial waste should not have been dumped at refuse facility.
1980	State Department of Waste Management official is quoted in newspaper, stating that Peacedale Processing glue wastes must be exposed to air and in solid form before disposal.
1981	Peacedale Processing notifies EPA Region I that laminating adhesive containing trichloroethylene was disposed of at the Rose Hill Regional Landfill from 1971 to 1979.
	Results of sampling document high copper and zinc concentrations in sludge; this is consistent with test results of December 1978 and October 1979. Origin of source is not resolved.
1982	Solid waste landfill closes; solid waste is disposed of in bulky waste area until transfer station is completed.
	Highest concentration of volatile organic compounds is reported; 1,2-dichloroethene is substance having highest concentration level.
	Town of South Kingstown redelivers a ±6-acre parcel to private resident and votes to purchase 15.03-acre parcel from same resident.
1983	Town of South Kingstown declares zone change to accommodate transfer station.
	Court order prohibits disposal of combustibles at Rose Hill Regional Landfill.
	EPA conducts identification and preliminary assessment; potential hazards to human health through contaminated well and contaminated water supply, groundwater, and soil are identified.
	Sampling in Saugatucket River below confluence with Mitchell Brook shows presence of substance susceptible to biological and chemical oxidation, qualitatively indicating contamination.
	Bulky waste disposal area and sewage sludge landfill close.

TABLE 1 **(Continued).**
CHRONOLOGY OF ACTIVITIES AT THE ROSE HILL REGIONAL LANDFILL

Year	Activity Affecting Landfill Operations
1984	Landfill rental payments from town of South Kingstown to Frisella cease as of June 30, 1984.
	Consultant site inspection shows volatile organic compounds at detectable levels in groundwater on site, in bedrock and overburden residential wells, and in soils in bulky waste disposal area. Sampling of surface water shows no contamination from volatile organic compounds.
	Later sampling is conducted by the town for iron, phosphate, total Kjeldahl nitrogen, and chemical oxygen demand (COD); COD shows levels indicative of contamination.
1985	Town of South Kingstown extends municipal water supply line to residents on Rose Hill Road.
	Sampling analysis indicates that volatile organic compounds continue to be released to underlying groundwater on site. Compounds are not detected in Saugatucket River, Mitchell Brook, or downgradient at groundwater and surface water locations.
	Consultant recommends that monitoring of water and soil continue even though low contamination releases do not appear to adversely affect water quality.
1986	Neither heavy metals nor volatile organic compounds are detected in RIDEM monitoring wells; high conductivity appears in some groundwater monitoring wells but not in others.
1987	Volatile organic compounds are detected in breathing zone at bulky waste and solid waste disposal areas; concentrations detected higher than background levels. Low resistivity survey indicates likely contamination of overburden.
	Rose Hill Regional Landfill is ranked for inclusion on the NPL (score 38.11).
	Consulting team observes leachate pools in solid waste landfill area.
	Consultants learn that portion of landfill area has been rezoned; action may allow development of property.
	Rose Hill Regional Landfill is proposed on NPL update #7 on 6/24/88.
1989	Rose Hill Regional Landfill is placed on NPL 10/4/89.

TABLE 2 CHRONOLOGY OF THE RI FIELD INVESTIGATION AT THE ROSE HILL REGIONAL LANDFILL SITE, SOUTH KINGSTOWN, RI

DATE			ACTIVITY
4/12/91	-	4/15/91	Residential Well Field Survey
5/27/91	-	6/19/91	Mobilization Activities
	5/15/91		Clearing of Geophysical Lines
5/21/91	-	6/13/91	Geophysical Survey
5/20/91	-	5/31/91	Existing Well Survey/Development
5/28/91	-	5/31/91	Wetland Delineation
5/30/91	-	5/31/91	Wildlife Survey
6/5/91	-	6/18/91	Staff Gauge and Mini-Piezometer Installation
6/3/91	-	6/7/91	Field and Benthic Survey
	6/14/91		Residential Well Development
6/17/91	-	7/12/91	Soil Gas Survey - Landfill Temporary Points and Installation of Permanent Points
6/18/91	-	6/28/91	Round 1 - Environmental Sampling
	7/9/91		Site Surveying Began
7/21/91	-	9/9/91	Monitoring Well Installation
8/15/91	-	9/9/91	New Well Development
8/20/91	-	8/26/91	Landfill Analytical Soil Boring drilling and sampling
	8/27/91		Permeability Test Boring drilling
9/3/91	-	9/5/91	Settlement Platform Installation
	9/18/91		Settlement Platforms surveyed
9/23/91	-	10/9/91	Round 2 - Environmental Sampling
9/23/91	-	9/25/91	Soil Gas Survey - Analysis of Temporary and Permanent Points
9/30/91	-	10/2/91	Seepage Meter and Mini-Piezometer Readings
10/28/91	-	11/1/91	Slug Testing
11/4/91	-	11/6/91	Additional Geophysical Survey Activities
11/21/91	-	5/11/92	Long Term Monitoring
12/16/91	-	12/20/91	Soil Gas Survey - Installation of Residential Points and Temporary Point Analysis

TABLE 2 (Continued). CHRONOLOGY OF THE RI FIELD INVESTIGATION AT THE ROSE HILL REGIONAL LANDFILL SITE, SOUTH KINGSTOWN, RI

DATE			ACTIVITY
1/22/92	-	1/23/92	Soil Gas Survey - Residential and Permanent Point Analysis
1/27/92	-	2/5/92	Round 3 - Environmental Sampling
2/19/92	-	2/20/92	Soil Gas Survey - Residential and Permanent Point Analysis
3/20/92	-	3/24/92	Soil Gas Survey - Residential and Permanent Point Analysis
4/6/92	-	4/15/92	Round 4 - Environmental Sampling
	4/15/92		Settlement Platforms surveyed
4/21/92	-	4/24/92	Soil Gas Survey - Residential and Permanent Point Analysis
5/7/92	-	5/13/92	Soil Gas Survey - SUMMA Cannisters and Reduced Sulfur Analysis
5/20/92	-	5/23/92	Artificial Substrate Removal and Benthic Sampling
5/26/92	-	6/1/92	Round 5 - Environmental Sampling
9/21/93	-	9/23/93	Round 6 - Environmental Sampling

TABLE 3 LOCATION GROUPINGS USED IN NATURE AND EXTENT, ROSE HILL REGIONAL LANDFILL SITE

SURFACE SOIL				
Background	Sewage Sludge Area	Bulky Waste Area	Solid Waste Area	Non-Disposal Area
SS-01	SS-11	SS-09	SS-03	SS-06 (south of transfer station road
SS-02	SS-12	SS-10	SS-04	SS-07 (residential)
SS-14	SS-15	SS-24	SS-05	SS-08 (residential)
			SS-13	SS-18 (adjacent to Mitchell Brook)
			SS-16	SS-19 (near Mitchell Brook)
			SS-17	SS-20 (near Mitchell Brook)
				SS-21 (near Mitchell Brook)
				SS-22 (near Saugatucket River)
				SS-23 (near Saugatucket River)

SUBSURFACE SOIL			
Background	Sewage Sludge Area	Bulky Waste Area	Solid Waste Area
BH-05	BH-01	BH-06	BH-07 [MW-14-01]
	BH-02		
	BH-03		
	BH-04		

GROUNDWATER - MONITORING WELLS			
Background	Shallow Overburden	Deep Overburden	Bedrock
MW-01-01	MW-I	OW-25	MW-03-03
(shallow overburden)	MW-II	OW-27	MW-04-03
MW-01-02	MW-III	OW-30	MW-07-02
(bedrock)	MW-IV	MW-02-02	MW-08-02
	MW-V	MW-03-02	MW-11-03
	MW-02-01	MW-04-02	
	MW-03-01	MW-05-02	
	MW-04-01	MW-06-02	
	MW-05-01	MW-07-01	
	MW-06-01	MW-08-01	
	MW-11-01	MW-09-01	
	MW-12-01	MW-10-01	
	MW-13-01	MW-11-02	
		MW-12-02	
		MW-13-02	
		MW-14-01	

TABLE 3 (Continued). LOCATION GROUPINGS USED IN NATURE AND EXTENT, ROSE HILL REGIONAL LANDFILL SITE

RESIDENTIAL WELLS			
RES #1 – RES #10			
LEACHATE			
Saugatucket River		Mitchell Brook	
LE–02 LE–03 LE–04 LE–05 LE–06		LE–01	
SURFACE WATER			
Saugatucket River	**Mitchell Brook**	**unnamed brook**	**unnamed tributary**
SW–02 SW–03 SW–04 SW–05 SW–06 SW–08 SW–11 SW–17 SW–18	SW–07 SW–09 SW–12 SW–13 SW–14 SW–15 SW–16	SW–10	SW–01
SEDIMENT			
Saugatucket River	**Mitchell Brook**	**unnamed brook**	**unnamed tributary**
SD–02 SD–03 SD–04 SD–05 SD–06 SD–08 SD–11 SD–17 SD–18	SD–07 SD–09 SD–12 SD–13 SD–14 SD–15 SD–16	SD–10	SD–01

TABLE 4 . SUMMARY OF CHEMICALS DETECTED IN SURFACE SOIL, SEPTEMBER/OCTOBER 1991 (1)

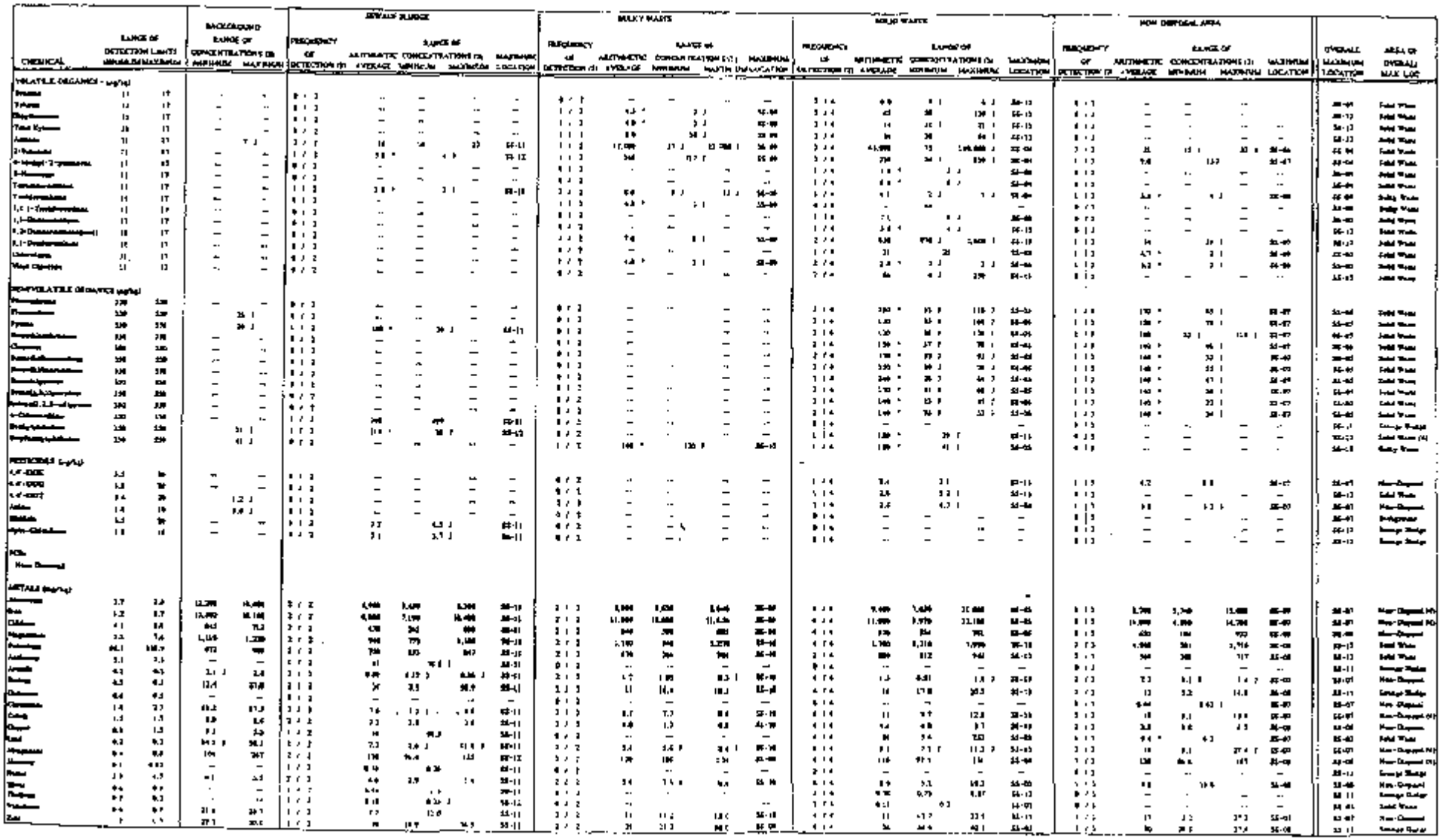


TABLE 4 (Continued). SUMMARY OF CHEMICALS DETECTED IN SURFACE SOIL, SEPTEMBER/OCTOBER 1991 (1)

CHEMICAL	RANGE OF DETECTION LIMITS MINIMUM	RANGE OF DETECTION LIMITS MAXIMUM	BACKGROUND RANGE OF CONCENTRATIONS (4) MINIMUM	BACKGROUND RANGE OF CONCENTRATIONS (4) MAXIMUM	SEWAGE SLUDGE FREQUENCY OF DETECTION (2)	SEWAGE SLUDGE ARITHMETIC AVERAGE	SEWAGE SLUDGE RANGE OF CONCENTRATIONS (3) MINIMUM	SEWAGE SLUDGE RANGE OF CONCENTRATIONS (3) MAXIMUM	SEWAGE SLUDGE MAXIMUM LOCATION	INLET WASTE FREQUENCY OF DETECTION (2)	INLET WASTE ARITHMETIC AVERAGE	INLET WASTE RANGE OF CONCENTRATIONS (3) MINIMUM	INLET WASTE RANGE OF CONCENTRATIONS (3) MAXIMUM	INLET WASTE MAXIMUM LOCATION	SOLID WASTE FREQUENCY OF DETECTION (2)	SOLID WASTE ARITHMETIC AVERAGE	SOLID WASTE RANGE OF CONCENTRATIONS (3) MINIMUM	SOLID WASTE RANGE OF CONCENTRATIONS (3) MAXIMUM	SOLID WASTE MAXIMUM LOCATION	TOP DISPOSAL AREA FREQUENCY OF DETECTION (2)	TOP DISPOSAL AREA ARITHMETIC AVERAGE	TOP DISPOSAL AREA RANGE OF CONCENTRATIONS (3) MINIMUM	TOP DISPOSAL AREA RANGE OF CONCENTRATIONS (3) MAXIMUM	TOP DISPOSAL AREA MAXIMUM LOCATION	OVERALL MAXIMUM LOCATION	AREA OF OVERALL MAX. LOC.
SOIL QUALITY PARAMETERS																										
[illegible]																										
TOTAL COMBUSTIBLE ORGANICS (%)																										
Organic Carbon	NA		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Solids Content	NA		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Sewage Sludge
Moisture Content	NA		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

NOTES:

1. [illegible]
2. [illegible]
3. [illegible]
4. [illegible]

* [illegible]

NA = Not Applicable

[illegible]

[illegible]

TABLE 5 SUMMARY OF CHEMICALS DETECTED IN SURFACE SOIL, APRIL 1992 (1)

CHEMICAL	RANGE OF DETECTION LIMITS MINIMUM	RANGE OF DETECTION LIMITS MAXIMUM	BACKGROUND CONCENTRATIONS	SEWAGE SLUDGE FREQUENCY OF DETECTION (2)	SEWAGE SLUDGE CONCENTRATIONS	SEWAGE SLUDGE LOCATION	BILEY WASTE FREQUENCY OF DETECTION (2)	BILEY WASTE CONCENTRATIONS	BILEY WASTE LOCATION	SOLID WASTE FREQUENCY OF DETECTION (2)	SOLID WASTE RANGE OF CONCENTRATIONS (3) ARITHMETIC AVERAGE	SOLID WASTE RANGE OF CONCENTRATIONS (3) MINIMUM	SOLID WASTE RANGE OF CONCENTRATIONS (3) MAXIMUM	SOLID WASTE MAXIMUM LOCATION	NON-DISPOSAL AREA FREQUENCY OF DETECTION (2)	NON-DISPOSAL AREA RANGE OF CONCENTRATIONS (3) ARITHMETIC AVERAGE	NON-DISPOSAL AREA RANGE OF CONCENTRATIONS (3) MINIMUM	NON-DISPOSAL AREA RANGE OF CONCENTRATIONS (3) MAXIMUM	NON-DISPOSAL AREA MAXIMUM LOCATION	OVERALL MAXIMUM LOCATION	AREA OF OVERALL MAX. LOC.
VOLATILE ORGANICS - (µg/kg)																					
Toluene	31	32	—	0 / 1	—	—	0 J 1	—	--	0 / 2	-	--	—	--	2 / 6	6 6	3 J	9 J	BB-25	BB-18	Non-Disposal
Ethylbenzene	31	32	—	0 / 1	--	—	0 J 1	--	--	0 / 2	--	--	—	—	1 / 6	6 6		9 J	BB-25	BB-23	Non-Disposal
Total Xylenes	63	32	—	0 / 1	--	—	0 J 1	--	--	0 / 2	--	—	—	--	1 / 6	9 5		11 5 J	BB-22	BB-22	Non-Disposal
Acetone	12	53	480	0 / 3	—	—	0 J 1	--	--	1 / 2	1,000		1,000	BB-26	5 / 6	34		98 5 J	BB-27	BB-16	Solid Waste
2-Butanone	11	32	—	0 / 3	—	—	0 J 1	--	--	0 / 2	--	--	--	—	1 / 6	11		19 J	BB-22	BB-22	Non-Disposal
SEMIVOLATILE ORGANICS (µg/kg)																					
Naphthalene	350	1,300	—	0 / 1	—	—	0 J 1	--	—	0 / 2	--	—	—	—	1 / 6	250 J		250 J	BB-23	BB-22	Non-Disposal
Phenanthrene	350	1,300	—	0 / 1	—	—	1 J 1	880 J	—	1 / 2	880 J		880 J	BB-27	1 / 6	200 J		200 J	BB-23	BB-23	Non-Disposal
Fluoranthene	350	1,300	—	0 / 1	—	—	1 J 1	130 J	—	1 / 2	130 J		130 J	BB-27	2 / 6	94 J		94 J	BB-23	BB-23	Non-Disposal
Pyrene	350	1,300	—	0 / 1	—	—	1 J 1	110 J	—	1 / 2	110 J		110 J	BB-27	1 / 6	130 J		130 J	BB-23	BB-23	Non-Disposal
Benzo(a)anthracene	350	1,300	—	0 / 1	—	—	1 J 1	100 J	—	1 / 2	100 J		100 J	BB-27	0 / 6	—	—	—	—	SS-17	Solid Waste
Chrysene	350	1,300	—	0 / 1	—	—	1 J 1	300 J	—	1 / 2	300 J		300 J	BB-27	1 / 6	100 J		100 J	BB-23	SS-23	Non-Disposal
Benzo(b)fluoranthene	350	1,300	—	0 / 1	—	—	1 J 1	280 J	—	1 / 2	280 J		280 J	BB-27	1 / 6	97 J		97 J	BB-23	BB-23	Non-Disposal
Benzo(k)fluoranthene	350	1,300	—	0 / 1	—	—	1 J 1	280 J	—	1 / 2	280 J		280 J	BB-27	0 / 6	—	—	—	—	SS-17	Solid Waste
Benzo(a)pyrene	350	1,700	—	0 / 1	—	—	0 R 1	—	—	1 / 2	180 J		180 J	BB-27	0 / 6	—	—	—	—	SS-17	Solid Waste
Benzo(g,h,i)perylene	350	1,300	—	0 / 1	—	—	0 R 1	—	—	1 / 2	180 J		180 J	BB-27	0 / 6	—	—	—	—	SS-17	Solid Waste
Dibenz(a,h)anthracene	350	1,300	—	0 / 1	—	—	0 R 1	—	—	1 / 2	180 J		180 J	BB-27	0 / 6	—	—	—	—	SS-17	Solid Waste
Indeno(1,2,3-cd)pyrene	350	1,300	—	0 / 1	—	—	0 R 1	—	—	1 / 2	180 J		180 J	BB-27	0 / 6	—	—	—	—	SS-17	Solid Waste
Diethylphthalate	350	1,300	—	0 / 3	—	—	0 R 1	—	—	0 / 2	—	—	—	—	2 / 6	220 J	27 J	48.5 J	BB-25	BB-22	Non-Disposal
PESTICIDES (µg/kg)																					
4,4'-DDE	3.5	11	0.89 B	0 / 1	--	—	0 J 1	--	--	1 / 2	9.5 J		9.5 J	BB-19	3 / 6	3.5	0.94 J	10 J	BB-23	BB-23	Non-Disposal
4,4'-DDD	3.5	11	--	0 / 1	—	—	0 J 1	—	—	1 / 2	8.9 J		8.9 J	BB-18	0 / 6	—	—	—	—	BB-18	Solid Waste
4,4'-DDT	3.5	11	1.0 J	0 / 1	—	—	0 J 1	—	—	1 / 2	14 J		14 J	BB-19	3 / 6	3.1	0.38 J	3.4 J	BB-27	BB-25	Non-Disposal
Endrin Ketone	3.5	11	0.41 J	0 / 1	—	—	0 J 1	--	--	0 / 2	--	--	--	--	1 / 6	2.5		2.5 J	BB-26	SS-18	Non-Disposal
PCBs None Detected																					
METALS (mg/kg)																					
Aluminum	4.30	13.90	10,700	1 / 3	6,740	BB-15	1 J 1	6,300	BB-24	2 / 2	3,100	1,300	5,300	SS-16	6 / 6	6,400	2,530	14,400	SS-18	SS-18	Non-Disposal
Iron	4.70	14.50	17,700	1 / 3	9,260	SS-15	1 J 1	9,340	BB-24	2 / 2	6,400	6,360	12,000	SS-16	6 / 6	10,000	6,000	149,000	SS-23	SS-23	Non-Disposal
Calcium	7.80	21.40	733	1 / 3	470	SS-15	1 J 1	447	BB-24	2 / 2	390	300	476	SS-19	6 / 6	600	346	1,570	SS-23	SS-23	Non-Disposal
Magnesium	4.30	11.90	1,340	1 / 3	1,900	BB-15	1 J 1	1,150	BB-24	2 / 2	1,000	1,050	1,000	SS-16	6 / 6	600	163	730	BB-18	SS-15	Sewage Sludge (4)
Potassium	16.80	61.70	443	1 / 3	328	BB-15	1 J 1	324	BB-24	2 / 2	300	430	766	BB-17	6 / 6	350	186	472	SS-23	SS-17	Solid Waste
Arsenic	0.43	1.30	--	0 / 3	—	—	0 J 1	--	—	0 / 2	—	—	—	—	1 / 6	1.5	3.3		SS-15	SS-15	Non-Disposal
Barium	0.21	0.63	21	1 / 3	15.6	BB-15	1 J 1	14.4	BB-24	2 / 2	15	13.5	16.9	BB-26	6 / 6	31	9.3	86.2 J	SS-25	SS-25	Non-Disposal
Beryllium	0.21	0.63	0.58	1 / 3	0.4	BB-15	1 J 1	0.52	BB-24	2 / 2	0.75	0.66	1.1	BB-26	6 / 6	0.57	0.33	0.98	SS-22	SS-16	Solid Waste
Cadmium	0.42	1.30	--	0 / 3	--	--	0 J 1	—	—	0 / 2	—	—	—	—	1 / 6	4.5	12.1 J		SS-19	SS-19	Non-Disposal
Cobalt	0.42	1.30	--	0 / 3	—	--	0 J 1	—	—	0 / 2	—	—	—	—	3 / 6	4.2	7.5	12.5	BB-23	BB-23	Non-Disposal
Copper	0.64	0.66	4.8	3 / 3	9.8	BB-15	1 J 1	5.6	BB-24	2 / 2	5.5	5.5	7.6	BB-26	3 / 6	2.8	2.8 J	5.4	BB-19	SS-15	Sewage Sludge
Lead	0.21	0.63	11.8	3 / 3	4.4	BB-15	1 J 1	4.3	BB-24	2 / 2	4.0	3.9	4.1	BB-26	6 / 6	33	6.4	156	BB-25	BB-25	Non-Disposal
Manganese	0.21	0.63	33	3 / 3	93.3	BB-15	1 J 1	105	BB-24	2 / 2	130	114	156	BB-26	6 / 6	1,100	13.9	6,280	SS-25	SS-25	Non-Disposal
Mercury	0.08	0.32	0.19	0 / 1	—	—	0 R 1	--	--	0 / 2	—	—	—	—	2 / 6	0.14	0.1	0.41	BB-25	BB-23	Non-Disposal
Nickel	0.42	0.99	—	0 / 1	—	—	0 J 1	—	—	0 / 2	—	—	—	—	1 / 5	2.4	4.3 J		BB-22	BB-22	Non-Disposal
Selenium	0.55	3.90	—	0 / 1	—	—	0 R 1	—	—	0 / 2	—	—	—	—	1 / 6	1.6	3.8 J		BB-16	BB-18	Non-Disposal
Thallium	0.21	0.64	0.26 J	0 / 1	—	—	0 R 1	—	—	0 / 2	—	—	—	—	0 / 6	—	—	—	—	SS-14	Background
Vanadium	0.43	1.30	19.5	1 / 3	19.1	BB-15	1 J 1	16.7	BB-24	2 / 2	8.6	6.9	10.3	BB-26	6 / 6	11	5.7	25.5	BB-18	BB-18	Non-Disposal
Zinc	3.40	3.90	31 J	1 / 3	22.1 J	BB-15	1 J 1	19.3 J	BB-24	2 / 2	25	18.8 J	35.7 J	BB-26	4 / 6	15	10.7 J	18.3 J	BB-20	BB-16	Solid Waste
SOIL QUALITY PARAMETERS Cyanide - Not Detected																					

NOTES:

1. Analytical data is presented in Appendix D.
2. Frequency of detection is the number of samples with positive values. Positive values include approximated values and approximated values less than sample detection limits. Number of samples include all analyzed samples for which analytical values were reported, unless the sample value was rejected as also included). A single concentration is presented when only one positive detection occurred.
3. Presents the minimum and maximum values for positive detections. Approximated values and approximated values less than sample detection limits
4. The actual highest concentration for this chemical was detected in a background sample.
5. The calculated average is greater than the maximum value.

NA = Not Applicable

J = Quantitation is approximate due to limitations identified during laboratory analysis or data validation.

— = Analyte was not detected in samples

TABLE 6 SUMMARY OF CHEMICALS DETECTED IN SUBSURFACE SOIL, AUGUST 1991 (1)

CHEMICAL	RANGE OF DETECTION LIMITS (2) MINIMUM	RANGE OF DETECTION LIMITS (2) MAXIMUM	BACKGROUND RANGE OF CONCENTRATIONS (3) MINIMUM	BACKGROUND RANGE OF CONCENTRATIONS (3) MAXIMUM	SEWAGE SLUDGE FREQUENCY OF DETECTION (4)	SEWAGE SLUDGE ARITHMETIC AVERAGE	SEWAGE SLUDGE RANGE OF CONCENTRATIONS (5) MINIMUM	SEWAGE SLUDGE RANGE OF CONCENTRATIONS (5) MAXIMUM	SEWAGE SLUDGE MAXIMUM LOCATION	BULKY WASTE FREQUENCY OF DETECTION (3)	BULKY WASTE ARITHMETIC AVERAGE	BULKY WASTE RANGE OF CONCENTRATIONS (5) MINIMUM	BULKY WASTE RANGE OF CONCENTRATIONS (5) MAXIMUM	BULKY WASTE MAXIMUM LOCATION	SOLID WASTE FREQUENCY OF DETECTION (3)	SOLID WASTE ARITHMETIC AVERAGE	SOLID WASTE RANGE OF CONCENTRATIONS (5) MINIMUM	SOLID WASTE RANGE OF CONCENTRATIONS (5) MAXIMUM	SOLID WASTE MAXIMUM LOCATION	OVERALL BACKGROUND LOCATION	AREA OF OVERALL MAX. LOC.
VOLATILE ORGANICS (µg/kg)																					
Toluene	10	3,100	--	--	1 / 8	48		330	BH-40 (18 - 20 ft)	0 / 3	--	--	--	--	0 / 2	--	--	--	--		
Acetone	10	3,100	--	--	3 / 8	730	84 J	740 J	BH-94 (6 - 14 ft)	2 / 3	200	46 J	350 J	BH-94 (2 - 4 ft)	0 / 2	--	--	--	--		
2-Butanone	10	3,100	--	--	1 / 8	83	77 J	340 J	BH-94 (14 - 16 ft)	0 / 3	--	--	--	--	0 / 2	--	--	--	--		
SEMIVOLATILE ORGANICS (µg/kg)																					
Naphthalene	340	3,600	--	--	0 / 8	--	--	--	--	0 / 3	--	--	--	--	2 / 2	1,900	300 J	3,300 J	BH-91 (14 - 16 ft)		
2-Methylnaphthalene	340	3,600	--	--	2 / 8	280 J	27 J	140 J	BH-94 (2 - 4 ft)	0 / 3	--	--	--	--	2 / 2	3,600	900	3,300 J	BH-91 (24 - 26 ft)		
Phenanthrene	340	3,600	--	--	0 / 8	--	--	--	--	0 / 3	--	--	--	--	2 / 2	540	130 J	950 J	BH-91 (14 - 16 ft)		
Fluoranthene	340	3,600	--	--	0 / 8	--	--	--	--	0 / 3	--	--	--	--	1 / 2	930 J	240 J		BH-91 (4 - 6 ft)		
Pyrene	340	3,600	--	--	0 / 8	--	--	--	--	0 / 3	--	--	--	--	1 / 2	960 J	180 J		BH-95 (4 - 6 ft)		
Benzo(a)anthracene	340	3,600	--	--	0 / 8	--	--	--	--	0 / 3	--	--	--	--	1 / 2	830 J	65 J		BH-95 (4 - 6 ft)		
Chrysene	340	3,600	--	--	0 / 8	--	--	--	--	0 / 3	--	--	--	--	1 / 2	940 J	84 J		BH-95 (4 - 6 ft)		
1,2-Dichlorobenzene	340	3,600	--	--	0 / 8	--	--	--	--	0 / 3	--	--	--	--	1 / 2	3,000 J	240 J		BH-95 (4 - 6 ft)		
1,4-Dichlorobenzene	340	3,600	--	--	0 / 8	--	--	--	--	0 / 3	--	--	--	--	1 / 2	940 J	97 J		BH-97 (4 - 6 ft)		
Phenol	340	3,600	--	--	1 / 8	130	340 J		Bkgrnd (3 - 5 ft)	0 / 3	--	--	--	--	0 / 2	--	--	--	--		
2-Methylphenol	340	3,600	--	--	1 / 8	970	700		Bkgrnd (24 - 26 ft)	0 / 3	--	--	--	--	1 / 2	2,100	4,000		BH-97 (14 - 16 ft)		
4-Methylphenol	340	3,600	--	--	2 / 8	2,500	2,200	3,400	BH-91 (2 - 4 ft)	0 / 3	--	--	--	--	1 / 2	3,800 J	380 J		BH-97 (4 - 6 ft)		
Dibenzofuran	340	3,600	--	--	0 / 8	--	--	--	--	0 / 3	--	--	--	--	2 / 2	440	140 J	780 J	BH-97 (14 - 16 ft)		
Di-n-butylphthalate	340	3,600		62 J	4 / 8	380 J	60 J	120 J	BH-97 (18 - 20 ft)	0 / 3	--	--	--	--	2 / 3	2,300	320 J	2,300 J	Bkgrnd (14 - 16 ft)		
bis(2-Ethylhexyl)phthalate	340	3,600	--	--	0 / 8	--	--	--	--	0 / 3	--	--	--	--	1 / 3	1,900	2,800		BH-95 (4 - 6 ft)		
Di-n-octylphthalate	340	3,600		19 J	3 / 8	270 J	26 J	86 J	BH-93 (14 - 16 ft)	0 / 3	--	--	--	--	1 / 3	1,800	3,400 J		Bkgrnd (14 - 16 ft)		
Butylbenzylphthalate	340	3,600	--	--	0 / 8	--	--	--	--	0 / 3	--	--	--	--	2 / 2	9,000	96 J	18,000	BH-97 (14 - 16 ft)		
PESTICIDES (µg/kg)																					
4,4'-DDD	3.4	4.0	--	--	0 / 8	--	--	--	--	1 / 3	3.2	1.6		BH-94 (2 - 4 ft)	2 / 2	22	12.0	31.0	BH-97 (4 - 6 ft)		
4,4'-DDE	3.4	4.0	--	--	0 / 8	--	--	--	--	0 / 3	--	--	--	--	1 / 2	14	28.0		BH-97 (14 - 16 ft)		
Dieldrin	3.4	4.0	--	--	0 / 8	--	--	--	--	0 / 3	--	--	--	--	1 / 2	7.9	14.0		BH-97 (14 - 16 ft)		
alpha-Chlordane	1.7	2.0	--	--	1 / 8	1.6	6.2		BH-95 (2 - 4 ft)	0 / 3	--	--	--	--	1 / 2	9.0	17.0		BH-95 (14 - 16 ft)		
gamma-Chlordane	1.7	2.0	--	--	1 / 8	1.7	7.5		BH-94 (2 - 4 ft)	0 / 3	--	--	--	--	1 / 2	6.0	13.0		BH-97 (14 - 16 ft)		
PCBs (µg/kg)																					
Aroclor-1260	34	40	--	--	0 / 8	--	--	--	--	0 / 2	--	--	--	--	1 / 2	160	340.0		BH-97 (14 - 16 ft)		
Aroclor-1254	34	40	--	--	0 / 8	--	--	--	--	0 / 2	--	--	--	--	1 / 2	340	720.0		BH-97 (4 - 6 ft)		
METALS (mg/kg)																					
Aluminum	3.42	4.34	3,910	13,800	7 / 7	4,480	3,760	6,000	BH-94 (4 - 6 ft)	2 / 2	7,850	5,100	8,910	BH-94 (2 - 4 ft)	2 / 2	4,480	3,620	5,330	BH-97 (4 - 6 ft)	BH-94 (2 - 4 ft)	Bulky Waste (5)
Iron	3.42	4.22	6,410	12,600	8 / 8	4,700	3,600	6,830	BH-94 (14 - 16 ft)	2 / 2	11,100	6,020	9,200	BH-94 (2 - 4 ft)	2 / 2	6,200	4,800	7,540	BH-97 (4 - 6 ft)	BH-94 (2 - 4 ft)	Bulky Waste (5)
Magnesium	6.83	7.74	966	1,550	8 / 8	1,000	418	1,700	BH-91 (6 - 8 ft)	2 / 2	1,055	644	1,130	BH-94 (6 - 8 ft)	2 / 2	930	720	1,090	BH-97 (4 - 6 ft)	BH-94 (6 - 8 ft)	Sewage Sludge
Potassium	39.4	54.90	495	880	5 / 5	740	467	1,490	BH-94 (6 - 8 ft)	2 / 2	880	424	963	BH-94 (6 - 8 ft)	2 / 2	700	610	790	BH-97 (4 - 6 ft)	BH-91 (8 - 10 ft)	Sewage Sludge
Antimony	9.42	3.99	--	--	4 / 8	3.8	3.4 J	10.5 J	BH-91 (2 - 4 ft)	1 / 2	4.9	6.8 J		BH-95 (6 - 8 ft)	1 / 2	4.8	6.6 J		BH-97 (4 - 6 ft)	BH-94 (2 - 4 ft)	Sewage Sludge
Barium	0.40	0.47	89.3		5 / 8	88	60.8 J	94.3	BH-94 (2 - 4 ft)	2 / 2	83	54.6	111.8	BH-95 (6 - 8 ft)	2 / 2	79	46.0	92.9	BH-97 (4 - 6 ft)	BH-91 (2 - 4 ft)	Sewage Sludge
Beryllium	0.20	0.23	0.47	0.90	8 / 8	0.53	0.33	0.71	BH-94 (8 - 10 ft)	2 / 2	0.56	0.55	0.60	BH-95 (2 - 4 ft)	2 / 2	0.54	0.38	0.7	BH-97 (4 - 6 ft)	BH-94 (8 - 10 ft)	Sewage Sludge
Chromium	1.48	1.84	3.8	9.2	8 / 8	4.8	1.6	8.9	BH-94 (6 - 8 ft)	2 / 2	4.6	3.8	6.3	BH-95 (2 - 4 ft)	2 / 2	5.5	5.5	5.5	BH-97 (4 - 6 ft)	BH-94 (6 - 8 ft)	Sewage Sludge (5)
Cobalt	0.80	0.96	3.1	5.4	8 / 8	3.3	1.8	4.3	BH-94 (4 - 6 ft)	2 / 2	3.1	3.1	3.1	BH-94 (2 - 4 ft)	2 / 2	2.6	1.8	3.3	BH-97 (4 - 6 ft)	BH-94 (4 - 6 ft)	Sewage Sludge
Copper	2.28	2.58	5.6	9.3	7 / 8	16	4.2	79.2	BH-94 (2 - 4 ft)	2 / 2	9.3	9.3	9.3	BH-94 (2 - 4 ft)	2 / 2	13	7.4	18.9	BH-97 (4 - 6 ft)	BH-91 (8 - 10 ft)	Sewage Sludge
Lead	0.39	0.47	2.6	13.6	7 / 8	4.8	3.3	8.8	BH-94 (8 - 10 ft)	2 / 2	5.3	4.3	6.4	BH-94 (2 - 4 ft)	2 / 2	20	19.4	20.2	BH-97 (4 - 6 ft)	BH-94 (2 - 4 ft)	Bulky Waste
Manganese	1.61	2.11	325	648	8 / 8	140	106	210	BH-94 (14 - 16 ft)	1 / 2	82	1.64		BH-94 (2 - 4 ft)	0 / 2	--	--	--	--	BH-97 (14 - 16 ft)	
Mercury	0.04	0.11		0.13 J	3 / 8	0.03	0.03 J	0.07 J	BH-91 (2 - 4 ft)	2 / 2	0.21	0.16 J	0.26 J	BH-95 (6 - 8 ft)	2 / 2	0.28	0.13 J	0.39 J	BH-97 (4 - 6 ft)	BH-91 (2 - 4 ft)	Sewage Sludge
Vanadium	0.80	0.96	6.2	19.3	7 / 8	7.4	5.7	10.4	BH-94 (8 - 10 ft)	2 / 2	9.8	6.7	11.3	BH-95 (2 - 4 ft)	2 / 2	7.4	5.5	9.3	BH-97 (4 - 6 ft)	BH-91 (2 - 4 ft)	Sewage Sludge (5)
Zinc	3.84	1.84	82.3 J	200 J	7 / 8	41	16.5	88	BH-91 (2 - 4 ft)	2 / 2	33	18.3	45.9	BH-94 (2 - 4 ft)	2 / 2	57	45.5	68.2	BH-97 (14 - 16 ft)	BH-91 (2 - 4 ft)	Sewage Sludge
SOIL QUALITY PARAMETERS																					
Cyanide - Not Detected																					
TOTAL COMBUSTIBLE ORGANICS (%)																					
Organic Carbon	NA			0.7	2 / 2	1.9	0.3	3.5	BH-94 (2 - 4 ft)	1 / 1	NA	1.0		BH-94 (6 - 8 ft)	1 / 1	NA	3.8		BH-97 (14 - 16 ft)	BH-91 (6 - 8 ft)	Solid Waste
Solids Content	NA			89	2 / 2	85	71.9	98.2	BH-95 (14 - 16 ft)	1 / 1	NA	91.5		BH-94 (6 - 8 ft)	1 / 1	NA	87.2		BH-97 (4 - 6 ft)	BH-91 (14 - 16 ft)	Sewage Sludge
Moisture Content	NA			11.1	2 / 2	13	5.3	20.3	BH-91 (2 - 4 ft)	1 / 1	NA	8.5		BH-94 (6 - 8 ft)	1 / 1	NA	13.0		BH-97 (4 - 6 ft)	BH-91 (2 - 4 ft)	Sewage Sludge

TABLE 7

BACKGROUND METAL CONCENTRATIONS IN SURFICIAL SOILS IN THE EASTERN U.S., AND RHODE ISLAND

	EASTERN UNITED STATES (1)		RHODE ISLAND (2)
	ARITHMETIC AVERAGE (mg/kg)	RANGE (mg/kg)	(mg/kg)
Aluminum	5.7	700 to > 10,000	> 100,000
Iron	25,000	100 to > 100,000	30,000
Calcium	6,300	100 to 280,000	11,000
Magnesium	4,600	50 to > 50,000	7,000
Potassium	15,000	50 to 37,000	15,000
Sodium	7,800	< 500 to 50,000	15,000
Barium	420	10 to 1,500	500
Beryllium	0.85	< 1 to 7	ND
Antimony	0.76	< 1 to 8.8	—
Arsenic	7.4	0.1 to 73	3.5
Cadmium	—	—	—
Chromium	52	1 to 1,000	50
Cobalt	9.2	< 0.3 to 70	10
Copper	22	< 1 to 700	15
Lead	17	< 10 to 300	15
Manganese	640	< 2 to 7,000	500
Mercury	0.12	0.01 to 3.4	0.24
Nickel	18	< 5 to 700	15
Selenium	0.45	< 0.1 to 3.9	0.9
Silver	—	—	—
Thallium	8.6	2.2 to 23	—
Vanadium	66	< 7 to 300	70
Zinc	52	< 5 to 2,900	300,000

NOTES:

— – No data available

1. Shacklette and Boerngen, 1984
2. Boerngen and Shacklette, 1981; data present for one sample

TABLE 8

SEWAGE SLUDGE CONCENTRATION STATISTICS FROM THE 1988 NATIONAL SURVEY AND THE 1980 40 CITY SURVEY

Analyte	NSSS (1)		40 City Survey	
	Mean	Standard Deviation	Mean	Standard Deviation
METALS	mg/kg	mg/kg	mg/kg	mg/kg
Arsenic	9.9	18.8	6.7	6.59
Berylium	0.37	0.34	1.63	2.1
Cadmium	6.94	11.86	69.0	252
Chromium	119	339	429	441
Copper	741	961	892	524
Lead	134	198	369	332
Mercury	5.22	15.5	2.8	2.6
Molybdenum	9.24	16.6	17.7	16.7
Nickel	42.7	94.8	135	169
Selenium	5.16	7.34	7.3	29.1
Zinc	1,200	1,550	1,590	1,760
ORGANICS **	Fg/kg	Fg/kg	Fg/kg	Fg/kg
Benzene	*	*	1,782	4,273
Benzo(a)pyrene	*	*	138	472
Bis(2–ethylhexyl)–phthalate	74,721	598,376	155,585	157,443
Trichloroethene	*	*	8,139	30,685

SOURCE: Federal Register, 1990.

NOTES: (1) – NSSS —National Sewage Sludge Survey

* - Indicates that there were not enough detected results to determine a mean or a standard deviation.

** – Only those analytes that were detected greater then 20 % of the time are listed.

TABLE 9 SUMMARY OF CHEMICALS DETECTED IN GROUNDWATER, JUNE 1991 (1)

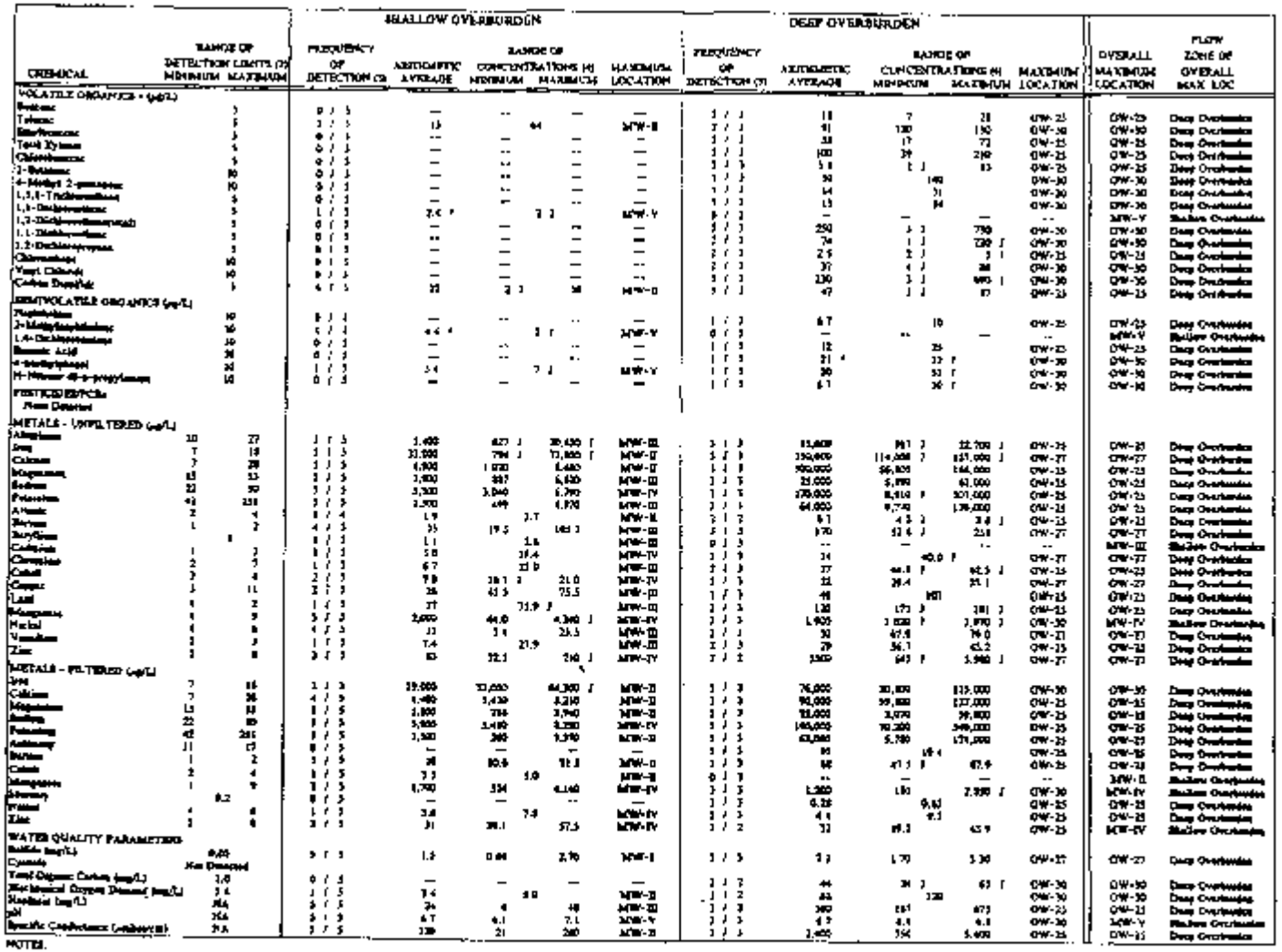


TABLE 10 SUMMARY OF CHEMICAL S DETECTED IN GROUNDWATER, SEPTEMBER/OCTOBER 1991 (1)

TABLE 10 (Continued). SUMMARY OF CHEMICAL S DETECTED IN GROUNDWATER, SEPTEMBER/OCTOBER 1991 (1)

TABLE 10 (Continued). SUMMARY OF CHEMICAL S DETECTED IN GROUNDWATER, SEPTEMBER/OCTOBER 1991 (1)

CHEMICAL	RANGE OF DETECTION LIMITS (2) MINIMUM	MAXIMUM	BACKGROUND CONCENTRATIONS OVERBURDEN	BEDROCK	SHALLOW OVERBURDEN FREQUENCY OF DETECTION (3)	ARITHMETIC AVERAGE	RANGE OF CONCENTRATIONS (4) MINIMUM	MAXIMUM	MAXIMUM LOCATION	DEEP OVERBURDEN FREQUENCY OF DETECTION (3)	ARITHMETIC AVERAGE	RANGE OF CONCENTRATIONS (4) MINIMUM	MAXIMUM	MAXIMUM LOCATION	BEDROCK FREQUENCY OF DETECTION (3)	ARITHMETIC AVERAGE	RANGE OF CONCENTRATIONS (4) MINIMUM	MAXIMUM	MAXIMUM LOCATION	OVERALL MAXIMUM LOCATION	FLOW ZONE OF OVERALL MAX. LOC.
Boron	1	2	113	—	13 / 33	740	89.5	2910	MW-11-01	13 / 15	885	36.6	4350	MW-07-01	4 / 5	39	9.6	933	MW-06-02	MW-01-01	Deep Overburden
Beryllium	1		—	—	0 / 33	—	—	—	—	2 / 15	3.5	0.5 J	10.8	MW-07-01	0 / 5	—	—	—	—	MW-01-01	
Cadmium	2		—	—	0 / 33	—	—	—	—	1 / 15	4.1	39.9		OW-27	0 / 5	—	—	—	—	OW-27	Deep Overburden
Chromium	5	6	—	—	3 / 13	35.6	22.2	54.5 J	MW-02-04	5 / 15	34	17.5	245 F	MW-07-01	3 / 5	34	9.1 J	200 J	MW-07-02	MW-07-01	Deep Overburden
Cobalt	5	8	22.7	—	2 / 13	17.7	10.2	43.0	MW-1	8 / 15	18	84.8	518	MW-07-01	0 / 5	—	—	—	—	MW-07-01	Deep Overburden
Copper	4	5	—	—	3 / 13	42.1	12.4	104	MW-05-08	8 / 15	41	11.3	310	MW-07-01	0 / 5	—	—	—	—	MW-07-01	Deep Overburden
Lead	1	2	23.6	—	5 / 13	22.3	25.1	52.6	MW-02-05	2 / 15	42	10.9	107	MW-12-02	0 / 5	—	—	—	—	MW-12-02	Deep Overburden
Manganese	2		4,080	34.5 F	33 / 33	3,000	286	9,780	MW-04-01	15 / 15	7,400	489	8,995	MW-12-02	4 / 5	490	41.9 J	1,330	MW-04-02	MW-12-02	Deep Overburden
Mercury	0.2		—	—	1 / 33	0.01	0.22	MW-27		1 / 15	0.11	0.28		OW-27	0 / 5	—	—	—	—	OW-27	Deep Overburden
Nickel	9	16	33.3		6 / 13	34	18.3	71.9	MW-13-04	6 / 15	33	28.1	123	MW-07-01	0 / 5	—	—	—	—	MW-07-01	Deep Overburden
Vanadium	3	5	13.9		8 / 33	22	6.5	101.0	MW-02-04	10 / 15	27	3 J	127	MW-07-01	1 / 5	1.6	9.8	MW-07-05	MW-07-01	Deep Overburden
Zinc	6	7	—	—	8 / 33	100	13.3 J	362 J	MW-02-01	6 / 15	630	169	7,360	OW-27	1 / 5	26	38.5 J	MW-05-05	OW-27	Deep Overburden
METALS - FILTERED (µg/L)																					
Aluminum	13	27	—	361 J	0 / 15	—	—	—	—	7 / 15	33	113 J		MW-03-02	0 / 5	—	—	—	—	MW-09-02	Deep Overburden (3)
Iron	6	9	3,150 J		10 / 13	57,000	98.9 F	96,800 J	MW-11-01	11 / 15	34,000	967 J	111,000 J	MW-07-01	0 / 5	—	—	—	—	MW-07-01	Deep Overburden
Calcium	8	30	11,000	87,300	13 / 13	23,000	3,110	61,700	MW-11-01	15 / 15	33,000	6,520	90,300	MW-13-07	5 / 5	40,000	8,360 J	80,400	MW-01-02	MW-07-02	Bedrock
Magnesium	14	34	8,390	3,750	13 / 13	8,300	845	18,400	MW-11-01	15 / 15	9,500	1,460	48,900	MW-14-01	5 / 5	5,200	404	6,240	MW-04-05	MW-14-01	Deep Overburden
Potassium	33	38	85,400	8,180	9 / 13	12,000	7,800	23,800	MW-11-01	15 / 15	34,000	7,940	148,000	MW-14-01	3 / 5	50,000	28,400	56,300	MW-07-02	MW-14-01	Deep Overburden
Sodium	73	462	9,930	1,760	9 / 13	6,300	83,700	23,400	MW-11-01	9 / 15	30,000	2,780	238,000	MW-14-01	2 / 5	22,000	3,240	104,000	MW-07-02	MW-14-01	Deep Overburden
Antimony	24	25	—	—	1 / 13	12	34.3	MW-04-03		2 / 15	38	12.0 J	20.4 J	OW-30	0 / 5	—	—	—	—	MW-04-01	Shallow Overburden
Arsenic	1	2	—	—	3 / 13	0.92	0.2 J	2.8	MW-8	4 / 15	3.5	2	7.7	MW-14-01	0 / 5	—	—	—	—	MW-14-01	Deep Overburden
Barium	1		53.9	—	7 / 13	34	13.2	151	MW-13-01	10 / 15	78	35.1	367	MW-14-02	4 / 5	47	5.0	204	MW-01-02	MW-11-02	Deep Overburden
Chromium	3	8	—	—	0 / 13	—	—	—	—	0 / 15	—	—	—	—	1 / 5	21	96.5	MW-03-01	MW-07-02	Bedrock
Cobalt	2	5	12.8	—	4 / 13	5.6	0.3	21.4	MW-1V	2 / 15	4.9	1.8	8.9	MW-14-03	0 / 5	—	—	—	—	MW-1V	Shallow Overburden
Copper	2	4	—	33.6	4 / 13	8.8	7.5	30.9	MW-1V	3 / 34	5.9	20.2	88.3	MW-03-03	0 / 5	—	—	—	—	MW-1V	Shallow Overburden
Lead	5		—	—	0 / 13	—	—	—	—	1 / 15	4.88	2.3		MW-08-01	0 / 5	—	—	—	—	MW-08-01	Deep Overburden
Manganese	5	7	3,580 J	—	13 / 13	3,000	388 J	6,660	MW-04-02	14 / 15	5,800	65.8 F	13,300 J	MW-12-03	4 / 5	240	20 J	401 J	MW-04-05	MW-12-03	Deep Overburden
Nickel	5	14	—	—	8 / 13	50	30.0		MW-12-01	9 / 15	51	86.5	315	MW-08-01	1 / 5	5.2	5.0	MW-04-01	MW-13-01	Shallow Overburden
Vanadium	2	3	—	—	0 / 13	—	—	—	—	0 / 34	—	—	—	—	1 / 5	1.6	1.0	MW-07-02	MW-07-02	Bedrock
Zinc	5	6	—	—	3 / 13	22	6.7	101	MW-13-01	5 / 15	15	8.4 F	34.2 J	MW-09-03	0 / 5	—	—	—	—	MW-12-01	Shallow Overburden
WATER QUALITY PARAMETERS																					
Bromide (mg/L)	Calc.		—	—	0 / 13	—	—	—	—	8 / 33	7.9	32 F		MW-05-07	0 / 5	—	—	—	—	MW-05-02	Deep Overburden
Cyanide (µg/L)	10		—	—	1 / 13	5.9	21.1 F	MW-1V		0 / 15	—	—	—	—	0 / 5	—	—	—	—	MW-1V	Shallow Overburden
Total Organic Carbon (mg/L)	0.5		19.0 J	—	9 / 13	36	7.8	63.9	MW-02-04	13 / 15	26	13.8 J	121.5 J	MW-14-03	5 / 5	29	7.8 J	MW-04-05	MW-04-05	Deep Overburden
Biochemical Oxygen Demand (mg/L)	2.0		—	—	4 / 13	3.8	4.0 J	12.7	MW-12-01	7 / 15	9.5	7.0 J	33.0	MW-14-01	0 / 4	—	—	—	—	MW-14-01	Deep Overburden
Hardness (mg/L)	NA		54	50	13 / 13	61	34	237	MW-11-01	15 / 15	140	58	366	MW-14-01	5 / 5	165	26 F	229	MW-07-02	MW-14-01	Deep Overburden
pH	NA		6.2	7.1	13 / 13	6.7	5.8	8.2	MW-6	15 / 15	6.7	6.2	7.3	MW-03-02	5 / 5	8.1	7.5	12.5	MW-07-02	MW-01-02	Bedrock
Specific Conductance (µmhos/cm)	NA		200	130	13 / 13	190	36	440	MW-03-01	15 / 15	650	50	2,130	MW-14-01	5 / 5	440	160	1300	MW-07-02	MW-14-01	Deep Overburden

NOTES:

1. Analytical data is presented in Appendix D.
2. If all sample detection limits are the same, a single detection limit is presented.
3. Frequency of detection is the number of samples with positive values. Positive values include approximated values and approximated values less than sample detection limits. Number of samples include QA duplicate samples for which analytical values were reported, unless the sample value was rejected.
4. Presents the minimum and maximum values for positive detections. Approximated values and approximated values less than sample detection limits are also included. A single concentration is presented when only one positive detection occurred.
5. The actual highest concentration for this chemical was detected in a background sample.
6. This calculated average is greater than the maximum value.

NA = Not Applicable

J = Quantitation is approximate due to limitations identified during laboratory analysis or data validation.

-- Analyte was not detected in samples

TABLE 11. SUMMARY OF CHEMICALS DETECTED IN GROUNDWATER, JANUARY/FEBRUARY 1992 (1)

CHEMICAL	RANGE OF DETECTION LIMITS (2) MINIMUM	MAXIMUM	BACKGROUND CONCENTRATIONS SHALLOW OVERBURDEN	BEDROCK	SHALLOW OVERBURDEN FREQUENCY OF DETECTION (3)	RANGE OF CONCENTRATIONS (4) ARITHMETIC AVERAGE	MINIMUM	MAXIMUM	MAXIMUM LOCATION	DEEP OVERBURDEN FREQUENCY OF DETECTION (3)	RANGE OF CONCENTRATIONS (4) ARITHMETIC AVERAGE	MINIMUM	MAXIMUM	MAXIMUM LOCATION	BEDROCK FREQUENCY OF DETECTION (3)	RANGE OF CONCENTRATIONS (4) ARITHMETIC AVERAGE	MINIMUM	MAXIMUM	MAXIMUM LOCATION	OVERALL MAXIMUM LOCATION	FLOW ZONE OP OVERALL MAX. LOC.
VOLATILE ORGANIC (Fg/L)																					
Benzene	10		--	--	1/4	6.5		11	MW-11-01	6/8	7.6	2 J	27	MW-14-01	2/4	4.8	4 J	5 J	MW-04-03	MW-14-01	Deep Overburden
Toluene	10		--	--	1/4	4.0 *		1 J	MW-02-01	5/8	12	1 J	52	MW-14-01	1/4	5.8		8 J	MW-04-03	MW-14-01	Deep Overburden
Ethylbenzene	10		--	--	2/4	6.0	1 J	13	MW-11-01	5/8	11	2 J	75	OW-27	0/4	--	--	--	--	OW-27	Deep Overburden
Total Xylene	10		--	--	2/4	4.2	2 J	5 J	MW-11-01	6/8	24	6 J	5 J	OW-27	2/4	3.2 *	1 J	2 J	MW-04-03	OW-27	Deep Overburden
Chlorobenzene	10		--	--	2/4	3.5 *	2 J	2 J	MW-11-01	2/8	4.9	4 J	--	OW-27	0/4	--	--	--	--	OW-27	Deep Overburden
2-Benzene	10		--	--	0/4	--	--	--	--	0/8	--	--		--	1/4	41		150 J	MW-04-03	MW-04-03	Bedrock
4-Methylphenol	10		--	--	0/4	--	--	--	--	1/8	5.4		8 J	MW-13-02	0/4	--	--	--	--	MW-13-02	Deep Overburden
Trichloroethane	10		--	--	0/4	--	--	--	--	0/8	--	--	--	--	1/4	4.5 *		3 J	MW-07-02	MW-07-02	Bedrock
1,1,1-Trichloroethane	10		--	--	0/4	--	--	--	--	0/8	--	--	--	--	1/4	4.5 *		3 J	MW-07-02	MW-07-02	Bedrock
1,2- Dichloroethene (total)	10		--	--	1/4	4.2 *		2 J	MW-11-01	3/8	5.1	1 J	9 J	MW-07-01	2/4	28	7 J	97	MW-07-02	MW-07-02	Bedrock
1,1-Dichloroethene	10		--	--	1/4	4.5 *		3 J	MW-11-01	5/8	5.4	2 J	12	OW-30	2/4	10	5 J	24	MW-07-02	MW-07-02	Bedrock
1,2-Dichloroethene	10		--	--	1/4	4.0 *		1 J	MW-11-01	0/8	--	--	--	--	0/4	--	--	--	--	MW-11-01	Shallow Overburden
1,2-Dichloropropane	10		--	--	1/4	4.5 *		3 J	MW-11-01	0/8	--	--	--	--	0/4	--	--	--	--	MW-11-01	Shallow Overburden
Chloroethane	10		--	--	2/4	12	9 J	27	MW-11-01	4/8	18	11	62	MW-11-02	1/4	5.0		5 J	MW-04-03	MW-11-02	Deep Overburden
Vinyl Chloride	10		--	--	0/4	--	--	--	--	0/8	--	--	--	--	1/4	10		24	MW-07-02	MW-07-02	Bedrock
Carbon Disulfide	10		--	--	0/4	--	--	--	--	2/8	4.0 *	1 J	1 J	MW-10-01	0/4	--	--	--	--	MW-10-01	Deep Overburden
WATER SOLUBLE ORGANICS (Fg/L)																					
N,N-DMP	50		--	--	0/4	--	--	--	--	2/8	110	257 J	495	MW-14-01	2/4	490	469	1.440 J	MW-07-02	MW-07-02	Bedrock
SEMIVOLATILE ORGANICS (Fg/L)																					
Napthalene	10		--	--	1/4	4.5 *		4 J	MW-11-01	4/8	5.2	2 J	9 J	MW-14-01	0/4	--	--	--	--	MW-14-01	Deep Overburden
2-Methylnaphthalene	10		--	--	0/4	--	--	--	--	1/8	5.0		5 J	OW-27	0/4	--	--	--	--	OW-27	Deep Overburden
1,2-Dichlorobenzene	10		--	--	1/4	4.5 *		3 J	MW-11-01	1/8	4.6 *		2 J	MW-11-02	0/4	--	--	--	--	MW-11-01	Shallow Overburden
1,3-Dichlorobenzene	10		--	--	0/4	--	--	--	--	1/8	5.0		5 J	MW-14-01	0/4	--	--	--	--	MW-14-01	Deep Overburden
1,4-Dichlorobenzene	10		--	--	1/4	5.0		5 J	MW-11-01	4/8	3.5 *	1 J	3 J	MW-11-02	0/4	--	--	--	--	MW-11-01	Shallow Overburden
2-Methylphenol	10		--	--	0/4	--	--	--	--	0/8	--	--	--	--	1/4	4.2 *		2 J	MW-04-03	MW-04-03	Bedrock
4-Methylphenol	10		--	--	0/4	--	--	--	--	1/8	13		72	MW-13-02	0/4	--	--	--	--	MW-13-02	Deep Overburden
2,4-Dimethylphenol	10		--	--	0/4	--	--	--	--	2/8	4.9	3 J	6 J	MW-14-01	0/4	--	--	--	--	MW-14-01	Deep Overburden
Diethylphthalate	10		--	--	2/4	5.5	5 J	7 J	MW-03-01	5/8	6.1	1 J	16 J	OW-27	1/4	4.0 *		1 J	MW-04-03	OW-27	Deep Overburden
Di-s-butylphthalate	10		--	--	0/4	--	--	--	--	2/8	4.1 *	1 J	2 J	MW-14-01	2/4	3.8 *	2 J	3 J	MW-07-02	MW-07-02	Bedrock
Pesticides (Fg/L)																					
beta-BHC	0.05	0.056	--	--	0/4	--	--	--	--	1/8	0.03	0.094 J		MW-14-01	0/4	--	--	--	--	MW-14-01	Deep Overburden
gamma-BHC (Lindane)	0.05	0.056	--	--	0/4	--	--	--	--	1/8	0.02 *	0.0051 J		MW-07-01	1/4	0.03 *	0.0024 J		MW-07-02	MW-07-02	Bedrock
4,4'-DDD	0.10	0.11	--	--	1/4	0.04 *	0.0050 J		MW-02-01	0/8	--	--	--	–	0/4	--	--	--	--	MW-02-01	Shallow Overburden
4,4'-DDT	0.10	0.11	--	--	0/4	--	--	--	--	1/8	0.05 *	0.016 J		MW-14-01	0/4	--	--	--	--	MW-14-01	Deep Overburden
Methoxychlor	0.50	0.56	--	--	0/4	--	--	--	--	1/8	0.23 *	0.013 J		MW-11-02	0/4	--	--	--	--	MW-11-01	Deep Overburden
Heptachlor	0.05	0.056	--	0.0023 J	0/4	--	--	--	--	0/8	--	--	--	–	0/4	--	--	--	--	MW-01-02	Background
Heptachlor Epoxide	0.05	0.056	--	--	0/4	--	--	--	--	1/8	0.02 *	0.0063 J		MW-14-01	0/4	--	--	--	--	MW-14-01	Deep Overburden
Endosulfan II	0.10	0.11	--	--	0/4	--	--	--	--	1/8	0.05 *	0.0066 J		MW-14-01	1/4	0.04 *	0.0026 J		MW-04-03	MW-14-01	Deep Overburden
Aldrin	0.05	0.056	--	--	0/4	--	--	--	--	1/8	0.02 *	0.0043 J		MW-14-01	0/4	--	--	--	--	MW-14-01	Deep Overburden
Dieldrin	0.10	0.11	--	--	0/4	--	--	--	--	0/8	--	--	--	--	1/4	0.04 *	0.0034 J		MW-04-03	MW-04-03	Bedrock
Endrin Ketone	0.10	0.11	--	--	1/4	0.04 *	0.0028 J		MW-11-01	2/8	0.04 *	0.0032 J	0.0066 J	OW-27	0/4	--	--	--	--	OW-27	Deep Overburden
alpha-Chlordane	0.05	0.056	--	--	0/4	--	--	--	--	1/8	0.23 *	0.0036 J		MW-14-01	0/4	--	--	--	--	MW-14-01	Deep Overburden
PCBs																					
None Detected																					
METALS - UNFILTERED (Fg/L)																					
Aluminum	20	66	43,000	433	4/4	37,000	20,400	55,100	MW-04-01	8/8	23,000	3,050	110,000	MW-07-01	4/4	510	28.5	906	MW-07-02	MW-07-01	Deep Overburden
Iron	11	35	71,200	13,700	4/4	79,000	38,450	114,000	MW-04-01	8/8	91,000	13,000	268,000	MW-07-01	4/4	14,000	858	37,100	MW-03-03	MW-07-01	Deep Overburden
Calcium	39	92	18,700	20,600	4/4	30,000	10,190	64,300	MW-11-01	8/8	44,000	5,430	87,600	OW-27	4/4	40,000	9,670	82,500	MW-07-02	OW-27	Deep Overburden
Magnesium	49	69	7,540	1,900	4/4	12,000	6,145	21,500	MW-11-01	8/8	17,000	3,260	44,700	MW-14-01	4/4	3,000	1,650	4,080	MW-04-03	MW-14-01	Deep Overburden
Sodium	34	38	16,400	10,700	4/4	28,000	6,460	69,700	MW-11-01	8/8	40,000	6,470	106,000	MW-11-02	4/4	36,000	10,900	58,800	MW-07-02	MW-11-02	Deep Overburden
Potassium	76	130	11,700	2,250	4/4	14,000	6,375	23,700	MW-11-01	8/8	31,000	4,340	119,000	MW-14-01	4/4	21,000	1,020	76,500	MW-07-02	MW-14-01	Deep Overburden
Barium	1	4	213	12.8	4/4	270	94.4	370	MW-03-01	8/8	200	4.89	508	MW-07-01	3/4	34	7.0	87.7	MW-11-03	MW-07-01	Deep Overburden
Beryllium	1		5.1	--	4/4	5.7	2.6	9.2 J	MW-03-01	4/8	2.8	1.5 J	13.7	OW-27	0/4	--	--	--	--	MW-07-01	Deep Overburden
Cadmium	1		--	--	0/4	--	--	--	--	1/8	5.0	33.8 J		MW-07-01	0/4	--	--	--	--	OW-27	Deep Overburden
Chromium	2	4	57.5	--	2/4	24	27.8 J	51.6	MW-04-01	4/8	30	5.6 J	154	MW-07-01	1/4	4.5	13.0 J		MW-07-02	MW-07-01	Deep Overburden
Cobalt	3		101	--	4/4	22	10.0	31.6	MW-04-01	7/8	17	5.3	53.8	MW-07-01	0/4	--	--	--	--	MW-12-02	Deep Overburden(5)

TABLE 11. (Continued). SUMMARY OF CHEMICALS DETECTED IN GROUNDWATER, JANUARY/FEBRUARY 1992 (1)

			BACKGROUND		SHALLOW OVERBURDEN					DEEP OVERBURDEN					BEDROCK						
	RANG E OF DETECTION LIMITS (2)		CONCENTRATIONS		FREQUENCY	RANGE OF				FREQUENCY	RANGE OF				FREQUENCY	RANGE OF				OVERALL	FLOW ZONE OP
CHEMICAL	MINIMUM	MAXIMUM	SHALLOW OVERBURDEN	BEDROCK	OF DETECTION (3)	ARITHMETIC AVERAGE	CONCENTRATIONS (4) MINIMUM	MAXIMUM	MAXIMUM LOCATION	OF DETECTION (3)	ARITHMETIC AVERAGE	CONCENTRATIONS (4) MINIMUM	MAXIMUM	MAXIMUM LOCATION	OF DETECTION (3)	ARITHMETIC AVERAGE	CONCENTRATIONS (4) MINIMUM	MAXIMUM	MAXIMUM LOCATION	MAXIMUM LOCATION	OVERALL MAX. LOC.
Iron	11	35	71,200	13,700	4/4	79,000	38,450	114,000	MW-04-01	8/8	91,000	13,000	268,000	MW-07-01	4/4	14,000	858	37,000	MW-03-03	MW-07-01	Deep Overburden
Calcium	39	92	18,700	20,600	4/4	30,000	10,190	64,300	MW-11-01	8/8	44,000	5,430	87,600	OW-27	4/4	40,000	9,670	82,500	MW-07-02	OW-27	Deep Overburden
Magnesium	49	69	7,540	1,900	4/4	12,000	6,145	21,500	MW-11-01	8/8	17,000	3,260	44,700	MW-14-01	4/4	3,000	1,650	4,080	MW-04-03	MW-14-01	Deep Overburden
Sodium	34	38	16,400	10,700	4/4	28,000	6,460	69,700	MW-11-01	8/8	40,000	6,470	106,000	MW-11-02	4/4	36,000	10,900	58,800	MW-07-02	MW-11-02	Deep Overburden
Potassium	76	130	11,700	2,250	4/4	14,000	6,375	23,000	MW-11-01	8/8	31,000	4,340	119,000	MW-14-01	4/4	21,000	1,020	76,500	MW-07-02	MW-14-01	Deep Overburden
Barium	1	4	213	12.8	4/4	270	94.4	370	MW-03-01	8/8	200	48.9	508	MW-07-01	3/4	34	7.0	87.7	MW-11-03	MW-07-01	Deep Overburden
Beryllium	1		5.1 J	--	4/4	5.7	2.6	9.2 J	MW-03-01	4/8	2.8	1.5 J	13.7	OW-27	0/4	--	--	--	--	MW-07-01	Deep Overburden
Cadmium	1		--	--	0/4	--	--	--	--	1/8	5.0	33.8 J		MW-07-01	0/4	--	--	--	--	OW-27	Deep Overburden
Chromium	2	4	57.5	--	2/4	24	27.8 J	51.6	MW-04-01	4/8	30	5.6 J	154	MW-07-01	1/4	45	13.0 J		MW-07-02	MW-07-01	Deep Overburden
Cobalt	3		101	--	4/4	22	10.0	31.6	MW-04-01	7/8	17	5.3	53.8	MW-07-01	0/4	--	--	--	--	MW-12-02	Deep Overburden (5)
Copper	3		115	--	3/4	38	33.7 J	73.3 J	MW-04-01	5/8	67	19.5 J	367	MW-07-01	0/4	--	--	--	--	MW-07-02	Deep Overburden
Lead	1		64.4	--	3/4	29	19.3 J	53.0	MW-04-01	3/8	29	15.9	148	OW-27	0/4	--	--	--	--	OW-27	Deep Overburden
Manganese	1		1,600	113	4/4	4,600	2,510	9,130	MW-04-01	8/8	2,400	290	5,610	MW-07-01	4/4	250	22.8	651	MW-04-03	MW-04-01	Shallow Overburden
Mercury	0.2		--	--	0/3	--	--	--	--	1/8	0.13	0.29		OW-27	0/1	--	--	--	--	OW-27	Deep Overburden
Nickel	4		30.0	--	4/4	25	19.3	34.2	MW-04-01	7/8	30	6.0	99.4	MW-07-01	1/4	3.5	8.0		MW-04-03	MW-07-02	Deep Overburden
Vanadium	2	3	36.9	--	4/4	42	27.2	67.2 J	MW-04-01	8/8	90	3.7	142 J	MW-07-01	1/4	3.0	8.6		MW-07-02	MW-07-01	Deep Overburden
Zinc	4	11	139	--	4/4	140	73.5	210 J	MW-04-01	6/8	920	25.7 J	6,320	OW-27	1/4	5.6	13.2 J		MW-11-03	OW-27	Deep Overburden
METALS -FILTERED (Fg/L)																					
Aluminum	66		96.9	--	1/4	430	1,610		MW-04-01	1/8	45	131		MW-11-02	1/4	44	75.0		MW-11-03	MW-04-01	Shallow Overburden
Iron	35		251 J	45.7 J	4/4	24,000	764 J	58,000 J	MW-11-01	7/8	51,000	20,900 J	101,000 J	OW-27	4/4	200	114 J	310 J	MW-03-03	OW-27	Deep Overburden
Calcium	92		5,030	19,500	4/4	25,000	8,770	60,900	MW-11-01	8/8	41,000	4,220	81,100	MW-11-02	4/4	34,000	9,570	57,300	MW-07-02	MW-11-02	Deep Overburden
Magnesium	69		832	1,690	4/4	7,100	2,395	18,400	MW-11-01	8/8	12,000	1,550	44,200	MW-14-01	4/4	2,400	551	4,050	MW-04-03	MW-14-01	Deep Overburden
Sodium	34		12,400	9,920	4/4	28,000	5,320	68,400	MW-11-01	8/8	39,000	7,880	107,000	MW-11-02	4/4	36,000	10,600	61,300	MW-07-02	MW-11-02	Deep Overburden
Potassium	76		2,390	1,910	4/4	9,300	2,015	20,500	MW-11-01	8/8	25,000	600	116,000	MW-14-01	4/4	22,000	1,020	79,500	MW-07-02	MW-14-01	Deep Overburden
Antimony	31		--	--	0/4	--	--	--	--	1/8	18	31.5		OW-27	0/4	--	--	--	--	OW-27	Deep Overburden
Barium	1		--	--	3/4	80	39.9	222	MW-11-01	6/8	89	38.3	246	MW-11-02	2/4	26	34.0	69.0	MW-11-03	MW-11-02	Deep Overburden
Chromium	2		--	--	0/4	--	--	--	--	1/8	24	183 J		OW-27	1/4	4.9	16.6 J		MW-07-02	OW-27	Deep Overburden
Cobalt	3		--	--	1/4	5.4	9.9		MW-04-01	2/8	4.6	8.7	13.8	MW-04-01	0/4	--	--	--	--	MW-04-02	Deep Overburden
Copper	3		--	--	0/4	--	--	--	--	1/7	1.8	3.3		MW-10-01	0/4	--	--	--	--	MW-10-01	Deep Overburden
Manganese	1		159	31.2	4/4	2,800	1,335	5,290	MW-04-01	8/8	1,500	11.4	3,855	MW-13-02	3/4	190	55.2	547	MW-04-03	MW-04-01	Shallow Overburden
Mercury	0.2		--	--	0/4	--	--	--	--	0/8	--	--	--	--	2/4	0.18	0.23 J	0.29	MW-04-03	MW-04-03	Bedrock
Nickel	4		--	--	0/4	--	--	--	--	1/8	15	102 J		OW-27	0/4	--	--	--	--	OW-27	Deep Overburden
Vanadium	3		--	--	1/4	2.0	-- 3.7		MW-11-01	2/8	2.8	4.0	9.3	MW-14-01	1/4	2.6	2.8		MW-07-02	MW-14-01	Deep Overburden
Zinc	11		--	--	1/4	7.6	13.7		MW-04-01	3/7	7.7	9 J	12.0	MW-07-01	0/4	--	--	--	--	MW-04-01	Shallow Overburden
WATER QUALITY PARAMETERS																					
Sulfide (mg/L)	1		--	--	0/4	--	--	--	--	1/8	1.1	4.94		MW-14-01	0/4	--	--	--	--	MW-14-01	Deep Overburden
Cyanide	Not Detected																				
Total Organic Carbon (mg/L)	0.5		15	11	4/4	52	28	105	MW-11-01	8/8	74	10	220	MW-14-01	3/4	15	6.3	34	MW-04-03	MW-14-01	Deep Overburden
Biochemical Oxygen Demand (mg/L)	1		--	--	1/4	5.7	19 J		MW-11-01	4/8	11	8.7	39 J	MW-13-02	1/4	4.6	17		MW-04-03	MW-13-02	Deep Overburden
Hardness (mg/L)	NA		78	59	4/4	120	51	249	MW-11-01	8/8	180	35	329	MW-14-01	4/4	110	31	218	MW-07-02	MW-04-01	Deep Overburden
pH	NA		6.2	7.8	4/4	6	6	6.8	MW-04-01	8/8	6.6	6.4	6.9	MW-04-02	4/4	8.1	6.2	11.2	MW-07-02	MW-07-02	Bedrock
Specific Conductance(Fm/hos)	NA		68	150	4/4	680	280	1,300	MW-11-01	8/8	910	125	1,800	MW-11-02	4/4	600	130	1,500	MW-07-02	MW-11-02	Deep Overburden

NOTES:

1. Analytical data is presented in Appendix D.
2. If all sample detection limits are the source, a single detection limit is presented.
3. Frequency of detection is the number of samples with positive values. Positive values include approximated values and approximated values less than sample detection limits. Number of samples include all analyzed samples for which analytical values were reported, unless the sample value was rejected
4. Presents the minimum and maximum values for positive detections. Approximated values and approximated values less than sample detection limits are also included. A single concentration is presented when only one positive detection occurred.
5. The actual highest concentration for this chemical was detected in a background sample.

* The calculated average is greater than the maximum value.

NA = Not Applicable

J = Quantitation is approximate due to limitations identified during laboratory analyses or sets validation.

-- Analytic was not detected in samples.

R = All sample values were rejected.

TABLE 12. SUMMARY OF CHEMICALS DETECTED IN GROUNDWATER, APRIL 1992 (1)

			BACKGROUND		SHALLOW OVERBURDEN					DEEP OVERBURDEN					BEDROCK						
	RANGE OF DETECTION LIMITS (2)		CONCENTRATIONS		FREQUENCY	RANGE OF				FREQUENCY	RANGE OF				FREQUENCY	RANGE OF				OVERALL	FLOW ZONE OP OVERALL
			SHALLOW		OF	ARITHMETIC	CONCENTRATIONS (4)		MAXIMUM	OF	ARITHMETIC	CONCENTRATIONS (4)		MAXIMUM	OF	ARITHMETIC	CONCENTRATIONS (4)		MAXIMUM	MAXIMUM	MAX. LOC.
CHEMICAL	MINIMUM	MAXIMUM	OVERBURDEN	BEDROCK	DETECTION (3)	AVERAGE	MINIMUM	MAXIMUM	LOCATION	DETECTION (3)	AVERAGE	MINIMUM	MAXIMUM	LOCATION	DETECTION (3)	AVERAGE	MINIMUM	MAXIMUM	LOCATION	LOCATION	
VOLATILE ORGANIC - (Fg/L)																					
Benzene	10	40	--	--	1/4	4.0 *	1 J		MW-12-01	4/7	5.4	3 J	8 J	MW-06-02	1/2	5.0	5 J		MW-07-02	MW-06-02	Deep Overburden
Toluene	10	40	--	--	2/4	33	12	110	MW-II	2/7	14	26	47	MW-07-01	0/2	--	--	--	--	MW-II	Shallow Overburden
Ethylbenzene	10	40	--	--	1/4	4.5 *	3 J		MW-12-01	4/7	10	3 J	22	OW-27	0/2	--	--	--	--	OW-27	Deep Overburden
Total Xylene	10	40	--	--	1/4	6.0	9 J		MW-12-01	4/7	17	6 J	50.5	OW-27	1/2	3.5 *	2 J		MW-07-02	OW-27	Deep Overburden
Chlorobenzene	10	40	--	--	2/4	5.5	1 J	11	MW-12-01	2/7	4.8 *	4 J	4.5 J	OW-27	0/2	--	--	--	--	MW-12-01	Shallow Overburden
Styrene	10	40	--	--	0/4	--	--	--	--	1/7	5.7	10		OW-27	0/2	--	--	--	--	OW-27	Deep Overburden
Acetone	10	40	--	--	1/4	79	300		MW-II	1/7	71	470		OW-27	0/2	--	--	--	--	OW-27	Deep Overburden
Trichloroethane	10	40	--	--	0/4	--	--	--	--	0/7	--	--	--	--	1/2	8.0	11		MW-07-02	MW-07-02	Bedrock
2-Benzene	10	40			0/4	--	--	--	--	0/7	--	--	--	--	1/2	3.5 *	2		MW-07-02	MW-07-02	Bedrock
1,1,1-Trichloroethane	10	40	--	--	0/4	--	--	--	--	0/7	--	--	--	--	1/2	3.5 *	2 J		MW-07-02	MW-07-02	Bedrock
1,1-Dichloroethene	10	40			0/4	--	--	--	--	0/7	--	--	--		1/2	3.0 *	1 J		MW-07-02	MW-07-02	Bedrock
1,2- Dichloroethene (total)	10	40	--	--	0/4	--	--	--	--	5/7	35	1 J	130	MW-07-01	1/2	42	78		MW-07-02	MW-07-01	Deep Overburden
1,1-Dichloroethene	10	40	--	--	1/4	4.5 *	3 J		MW-12-01	3/7	20	2 J	100	OW-30	1/2	14	22		MW-07-02	OW-30	Deep Overburden
Chloroethane	10	40	--	--	1/4	6.0	9 J		MW-12-01	4/7	19	5.5 J	58	MW-06-02	0/2	--	--	--	--	MW-06-02	Deep Overburden
Vinyl Chloride	10	40	--	--	0/4	--	--	--	--	3/7	78	8.5 J	340	OW-30	1/2	8.5	12		MW-07-02	OW-30	Deep Overburden
Carbon Disulfide	10	40	1 J	11	1/4	4.5 *	3 J		MW-06-01	0/7	--	--	--	--	1/2	5.5 *	2 J		MW-08-02	MW-06-01	Shallow Overburden (5)
WATER SOLUBLE ORGANICS (Fg/L)																					
N,N-DMP	50		--	--	0/4	--	--	--	--	1/7	42	142		OW-30	1/2	650	1,270		MW-07-02	MW-07-02	Bedrock
SEMIVOLATILE ORGANICS - CLP (Fg/L)																					
Napthalene	10		--	--	1/4	4.0 *	0.8 J		MW-12-01	3/7	4.2 *	2 J	4 J	MW-06-02	0/2	--	--	--	--	MW-06-02	Deep Overburden
2-Methylnaphthalene	10		--	--	0/4	--	--	--	--	1/7	4.6 *	25 J		OW-27	0/2	--	--	--	--	OW-27	Deep Overburden
1,2-Dichlorobenzene	10		--	--	0/4	--	--	--	--	2/7	3.9 *	1 J		MW-06-02	0/2	--	--	--	--	MW-06-02	Deep Overburden
1,4-Dichlorobenzene	10		--	--	1/4	4.0 *	1 J		MW-12-01	2/7	4.3 *	1.5 J	3.5 J	MW-07-02	0/2	--	--	--	--	MW-07-01	Deep Overburden
4-Chlorosellene	10		--	--	1/4	4.0 *	1 J		MW-II	0/7	--	--	--	--	0/2	--	--	--	--	MW-II	Shallow Overburden
Phenol	10		--	7 J	0/4	--	--	--	--	0/7	--	--	--	--	0/2	--	--	--	--	MW-01-02	Background
2-Methylphenol	10		--	--	2/4	3.5 *	0.9 J	3 J	MW-II	0/7	--	--	--	--	0/2	--	--	--	--	MW-II	Shallow Overburden
4-Methylphenol	10		--	--	1/4	19	60		MW-II	2/7	8.1	6.5 J	25	OW-30	0/2	--	--	--	--	MW-II	Shallow Overburden
2,4-Dimethylphenol	10		--	--	0/4	--	--	--	--	2/7	4.3 *	1 J	4 J	MW-06-02	0/2	--	--	--	--	MW-06-02	Deep Overburden
4-Chloro-3methylphenol	10				0/4	--	--	--	--	2/7	4.3	0.9 J	4.5 J	OW-27	0/2	--	--	--	--	OW-27	Deep Overburden
Diethylphthalate	10		--	--	0/4	--	--	--	--	3/7	6.8	7 J	11.5 J	MW-07-01	0/2	--	--	--	--	MW-07-01	Deep Overburden
Di-s-butylphthalate	10		--	--	0/4	--	--	--	--	1/7	4.4 *	0.9 J		OW-27	0/2	--	--	--	--	OW-27	Deep Overburden
bis(2-Ethylhexyl)phthalate	10		--	--	0/4	--	--	--	--	1/7	4.4 *	0.9 J		MW-06-02	0/2	--	--	--	--	MW-06-02	Deep Overburden
Pesticides (Fg/L)	0.05		--	--	2/4	0.02 *	0.009 J	0.010 J	MW-II	1/7	0.02 *	0.006 J		MW-06-02	0/2	--	--	--	--	MW-II	Shallow Overburden
delta-BHC																					
PCBs																					
None Detected																					
METALS - UNFILTERED (Fg/L)																					
Aluminum	22		10,800	--	4/4	15,000	2,780	24,200 J	MW-II	6/7	8,600	3,460 J	25,850 J	MW-07-01	2/2	360	278 J	445 J	MW-08-02	MW-07-01	Deep Overburden
Iron	23		12,100	30,900	4/4	61,000	10,900	114,000 J	MW-II	7/7	56,000	8,830 J	114,000 J	MW-07-01	1/2	4,800	9,430 J		MW-08-02	MW-07-01	Deep Overburden
Calcium	34		11,500	14,100	4/4	10,000	6,230	14,300	MW-12-01	7/7	30,000	5,520	74,150	OW-27	2/2	33,000	25,500	40,500	MW-07-02	OW-27	Deep Overburden
Magnesium	22		2,940	1,500	4/4	4,700	2,400	7,100	MW-II	7/7	6,700	1,140	22,900	MW-06-02	2/2	2,700	1,300	4,140	MW-08-02	MW-06-02	Deep Overburden
Sodium	67		13,000	13,600	4/4	9,500	7,130 J	15,000	MW-06-01	7/7	23,000	6,730	101,000	MW-06-02	2/2	32,000	10,600	52,500	MW-07-02	MW-06-02	Deep Overburden
Potassium	82		4,370	2,590	4/4	8,700	4,330	16,500	MW-06-01	7/7	12,000	1,640	43,800	MW-06-02	2/2	36,000	4,420	67,700	MW-07-02	MW-07-02	Bedrock
Antimony	16		--	--	1/4	10	17.5		MW-05-01	0/7	--	--	--	--	0/2	--	--	--	--	MW-05-01	Shallow Overburden
Barium	1		79.8 J	18.6 J	4/4	98	60.8 J	146	MW-12-01	6/7	94	27.6	232 J	MW-06-02	2/2	72	25.8	118	MW-08-02	MW-06-02	Deep Overburden
Beryllium	1		1.4	--	3/4	2.3	2.6	3.4	MW-II	3/7	1.2	1.1	3.35	MW-07-01	0/2	--	--	--	--	MW-II	Shallow Overburden
Cadmium	2		--	--	0/4	--	--	--	--	1/7	3.7	19.55 J		OW-27	0/2	--	--	--	--	OW-27	Deep Overburden
Chromium	3		11.5	--	3/4	22	4.2	54.3 J	MW-II	3/7	13.1	18.6	33.4 J	MW-07-01	0/2	--	--	--	--	MW-II	Shallow Overburden
Cobalt	3		31.6	--	3/4	12	8.3	26.2	MW-II	4/7	7.4	3.2	22.1	OW-27	0/2	--	--	--	--	MW-II	Shallow Overburden (5)
Copper	2		24.4	--	2/4	28	43 J	55.9	MW-05-01	6/7	38	16.35 J	68.75 J	MW-07-01	0/2	--	--	--	--	MW-07-01	Deep Overburden
Lead	1	5	22.1	--	3/4	23	24 J	39.9 J	MW-II	3/7	17	7.8 J	69.85 J	OW-27	0/2	--	--	--	--	OW-27	Deep Overburden
Manganese	1		444	330	4/4	3,000	220	6,960	MW-12-01	7/7	1,000	338	1,760	MW-07-01	1/2	1,700	3,380		MW-08-02	MW-12-01	Shallow Overburden

TABLE 12. (Continued). SUMMARY OF CHEMICALS DETECTED IN GROUNDWATER, APRIL 1992 (1)

			BACKGROUND		SHALLOW OVERBURDEN					DEEP OVERBURDEN					BEDROCK						
	RANG E OF DETECTION LIMITS (2)		CONCENTRATIONS SHALLOW		FREQUENCY OF	ARITHMETIC	RANGE OF CONCENTRATIONS (4)		MAXIMUM	FREQUENCY OF	ARITHMETIC	RANGE OF CONCENTRATIONS (4)		MAXIMUM	FREQUENCY OF	ARITHMETIC	RANGE OF CONCENTRATIONS (4)		MAXIMUM	OVERALL MAXIMUM	FLOW ZONE OP OVERALL
CHEMICAL	MINIMUM	MAXIMUM	OVERBURDEN	BEDROCK	DETECTION (3)	AVERAGE	MINIMUM	MAXIMUM	LOCATION	DETECTION (3)	AVERAGE	MINIMUM	MAXIMUM	LOCATION	DETECTION (3)	AVERAGE	MINIMUM	MAXIMUM	LOCATION	LOCATION	MAX. LOC.
Mercury		0.2	--	--	0/4	--	--	--	--	1/7	0.13	0.3 J		OW-27	0/2	--	--	–	–	OW-27	Deep Overburden
Nickel		3	93	4.8	2/4	17	3.6	49.4 J	MW-II	3/7	14	15.8	40.3 J	OW-27	0/2	--	--	–	–	MW-II	Shallow Overburden
Vanadium		2	--	--	3/4	20	19.7	35.2	MW-II	2/7	9.4	17.15	31.9	MW-07-01	0/2	--	--	–	–	MW-II	Shallow Overburden
Zinc		11	28.2 J	--	3/4	81	52.6 J	192 J	MW-II	7/7	450	18.8 J	2750 J	OW-27	1/2	9.4	13.3 J		MW-07-02	OW-27	Deep Overburden
METALS - FILTERED (Fg/L)																					
Iron	23	5	--	–	3/4	39,000	3,040	80,3000	MW-II	6/7	36,000	4,740	89,850	OW-27	1/2	2,900	5,770		MW-08-02	OW-27	Deep Overburden
Calcium	28	4	4,190	14,500	4/4	9,100	5,230	14,000	MW-12-01	7/7	29,000	5,150	66,100	OW-27	2/2	29,000	20,900	36,300	MW-07-02	OW-27	Deep Overburden
Magnesium	22	5	756	1,500	4/4	2,300	1,670	2,940	MW-12-01	7/7	5,100	1,150	22,200	MW-06-02	2/2	2,000	505	3,590	MW-08-02	MW-06-02	Deep Overburden
Sodium	34	7	14,000	14,300	4/4	9,000	5,430	15,300	MW-06-01	7/7	23,000	6,860	104,000	MW-06-02	2/2	33,000	10,800	55,000	MW-07-02	MW-06-02	Deep Overburden
Potassium	82	94	1,950	2,820	4/4	6,000	747	16,400	MW-06-01	7/7	10,000	787	44,000	MW-06-02	2/2	37,000	4,340	69,400	MW-07-02	MW-07-02	Bedrock
Barium	1	5	--	--	3/4	38	29.2	76.2	MW-12-01	3/7	49	36.7	215	MW-06-02	2/2	62	28.7	95.3	MW-08-02	MW-06-02	Deep Overburden
Lead	1	5	--	--	0/4	--	--	--	--	1/7	1.4	2.3		OW-27	0/2	--	--	--	--	OW-27	Deep Overburden
Manganese		1	47.4	64.8	4/4	2,700	26.4	6,770	MW-12-01	6/7	790	416	1,340	MW-06-02	1/2	1,400	2,800		MW-08-02	MW-12-01	Shallow Overburden
Nickel	3	5	--	--	0/4	--	--	--	--	2/7	4.5	5.8	18.3	MW-12-02	0/2	--	--	--	--	MW-12-02	Deep Overburden
Zinc	8	1	--	--	1/4	9.5	23 J		MW-12-01	2/7	11	18.4 J	35.8 J	MW-12-02	0/2	--	--	--	--	MW-12-02	Deep Overburden
WATER QUALITY PARAMETERS																					
Cyanide - Not Detected																					
Ammonia (mg/L)	0.0300		--	0.0750	3/4	5.9	0.320	17.1	MW-II	6/7	9.8	0.0340	51.7	MW-06-02	2/2	0.59	0.300	0.530	MW-08-02	MW-06-02	Deep Overburden
Total Organic Carbon (mg/L)	0.50		93	12.7	4/4	31	7.9	55.0 J	MW-II	7/7	48	9.7	99.5	OW-27	2/2	87	24.0	150	MW-07-02	MW-07-02	Bedrock
Biochemical Oxygen Demand (mg/L)	1.0		--	2.2	2/3	6.3	4.9	13.4 J	MW-II	5/5	17	1.0	31.5 J	OW-30	2/2	2.6	1.6	3.7	MW-07-02	OW-30	Deep Overburden
Hardness (mg/L)	NA		41	41	4/4	44	26	62	MW-II	7/7	100	18	257	MW-06-02	2/2	94	81	106	MW-07-02	MW-06-02	Deep Overburden
pH	NA		7.7	8.4	4/4	6.3	5.9	6.6	MW-II	7/7	6.5	6.2	6.7	MW-08-01	2/2	9.4	7.1	11.7	MW-07-02	MW-06-01	Shallow Overburden
Specific Conductance (Fmhos/cm)	NA		100	150	4/4	860	78	2500	MW-06-01	7/7	360	77	730	MW-06-02	2/2	620	200	1050	MW-07-02	MW-07-02	Bedrock

NOTES:

1. Analytical data is presented in Appendix D.
2. If all sample detection limits are the name, a single detection limit is presented.
3. Frequency of detection is the number of samples with positive values. Positive values include approximated values and approximated values less than sample detection limits. Number of samples include all analyzed samples for which analytical values were reported, unless the sample value was rejected.
4. Presents the minimum and maximum values for positive detections. Approximated values and approximated values less than sample detection limits are also included. A single concentration is presented when only one positive detection occurred.
5. The actual highest concentration for this chemical was detected is a background sample.

* The calculated average is greater than the maximum value.

NA = Not Applicable

J = Quantitation is approximate due to limitations identified during laboratory analysis or data validation.

S Analyte was not detected in samples.

TABLE 13 **SUMMARY OF CHEMICAL DETECTED IN RESIDENTIAL WELLS, JUNE 1991 (1)**

CHEMICAL	RANGE OF DETECTION LIMITS (2) MINIMUM	MAXIMUM	FREQUENCY OF DETECTION (3)	ARITHMETIC AVERAGE	RANGE OF CONCENTRATIONS (4) MINIMUM		MAXIMUM		MAXIMUM LOCATION
VOLATILE ORGANICS (µg/L)									
Ethylbenzene	1.0		1 / 9	0.60	1.4				RES#3
o-Xylene	1.0		1 / 9	0.53	0.8	J			RES#3
Trichloroethene	5		1 / 9	2.0	2	J			RES#9
1,1-Dichloroethane	1.0		1 / 9	0.79	3.1				RES#3
Chloroethane	1.0		1 / 9	0.56	1.0				RES#3
Carbon Disulfide	1.0		1 / 9	1.8	12.0				RES#3
SEMIVOLATILE ORGANICS									
None Detected									
PESTICIDES/PCBs									
None Detected									
METALS - UNFILTERED (µg/L)									
Aluminum	10	27	2 / 9	100	294	J	470	J	RES#3
Iron	7	18	5 / 9	9,300	180	J	81,000	J	RES#3
Calcium	7	28	9 / 9	8,500	4,670		17,800		RES#3
Magnesium	13	33	9 / 9	2,000	1,190		4,580		RES#3
Sodium	22	30	9 / 9	12,000	5,890		31,400		RES#7
Potassium	42	251	9 / 9	2,000	619		7,470		RES#4
Barium	1	2	6 / 9	12	5.8		44.3		RES#4
Copper	3	11	2 / 9	14	11	J	58.6		RES#9
Manganese	1	9	6 / 9	1,200	21.4	J	3,100	J	RES#3
METALS - FILTERED (µg/L)									
Aluminum	10	27	1 / 9	41	175				RES#4
Iron	7	18	2 / 9	3,400	774		30,000		RES#3
Calcium	7	28	9 / 9	8,700	4,890		18,500		RES#3
Magnesium	13	33	9 / 9	2,000	1,030		4,890		RES#3
Sodium	22	30	9 / 9	13,000	5,320		32,500		RES#7
Potassium	42	251	9 / 9	2,000	491		7,420		RES#4
Antimony	11	17	3 / 9	8.2	8.6	J	14.1		RES#6
Barium	1	2	3 / 9	11	18.6		41.2		RES#4
Copper	3	11	3 / 9	8.5	7.7		29.6		RES#4
Manganese	1	9	7 / 9	1,100	11.6		3,100		RES#1
Nickel	4	6	2 / 9	3.4	6.9		8.0		RES#9
Zinc	3	8	1 / 9	13	57.3				RES#2
WATER QUALITY PARAMETERS									
Sulfide (mg/L)	0.05		9 / 9	1.6	0.45		3.70		RES#3
Cyanide	Not Detected								
Total Organic Carbon (mg/L)	1.0		1 / 9	1.1	5.6	J			RES#3
Biochemical Oxygen Demand	Not Detected								
Hardness (mg/L)	NA		9 / 9	29	17		63		RES#3
pH	NA		9 / 9	6.4	5.9		7.8		RES#7
Specific Conductance (µmhos/cm)	NA		9 / 9	240	95		520		RES#4

NOTES:

1. Analytical data is presented in Appendix D.
2. If all samples detection limits are the same, a single detection limit is presented.
3. Frequency of detection is the number of samples with positive values. Positive values include approximated values and approximated values less than sample detection limits. Number of samples include all analyzed samples for which analytical values were reported, unless the sample value was rejected.
4. Presents the minimum and maximum values for positive detections. Approximated values and approximated values less than sample detection limits are also included. A single concentration is presented when only one positive detection occurred.

* The calculated average is greater than the maximum value.

NA = Not Applicable

J = Quantitation is approximate due to limitations identified during laboratory analysis or data validation.

— Analyte was not detected in samples.

TABLE 14 **SUMMARY OF CHEMICAL DETECTED IN RESIDENTIAL WELLS, SEPTEMBER/OCTOBER 1991 (1)**

CHEMICAL	DETECTION LIMIT	FREQUENCY OF DETECTION (2)	ARITHMETIC AVERAGE	RANGE OF CONCENTRATIONS (3) MINIMUM		MAXIMUM		MAXIMUM LOCATION
VOLATILE ORGANICS - 524 (Fg/L)								
Benzene	1	1 / 9	0.53			0.8 J		RES#3
Toluene	1	2 / 9	0.91	0.6 J		4.1	J	RES#7
Ethylbenzene	1	1 / 9	0.46 *			0.1 J		RES#7
Trichloroethene	1	2 / 9	0.62	0.6 J		1.5		RES#2
trans-1,2-Dichloroethene	1	1 / 9	0.48 *			0.3 J		RES#4
1,1-Dichloroethane	1	1 / 9	0.66			1.9		RES#3
WATER SOLUBLE ORGANICS (Fg/L)								
N,N-DMF	50	2 / 9	21 *	1.9 J		14	J	RES#3
SEMIVOLATILE ORGANICS (Fg/L)								
4-Methylphenol	10	1 / 9	11			63		RES#3
PESTICIDES/PCBs								
None Detected								
METALS - UNFILTERED (Fg/L)								
Aluminum	13	1 / 9	94			552 J		RES#3
Iron	6	6 / 9	7,000	160		41,700		RES#2
Calcium	20	9 / 9	11,000	3,220		23,400		RES#4
Magnesium	26	9 / 9	2,000	708		4,520		RES#3
Sodium	13	9 / 9	11,000	7,110		17,700		RES#9
Potassium	442	1 / 9	860			4,010		RES#3
Barium	1	2 / 9	5.5	15.2		20.7		RES#5
Copper	4	2 / 9	16	51.8		58.4		RES#2
Manganese	2	7 / 9	810	2.6		3,100		RES#1
METALS - FILTERED (Fg/L)								
Iron	6	4 / 9	230	117		1,050		RES#1
Calcium	20	9 / 9	11,000	3,210		23,000		RES#4
Magnesium	26	9 / 9	2,100	757		4,550		RES#3
Sodium	13	9 / 9	11,000	6,870		16,800		RES#9
Potassium	442	1 / 9	920			3,880		RES#3
Antimony	25	2 / 9	18	28.4		32.4		RES#9
Arsenic	1	1 / 9	0.56			1.0		RES#3
Barium	1	1 / 9	3.9			19.7		RES#5
Manganese	2	6 / 9	780	8.4		3,160		RES#1
WATER QUALITY PARAMETERS								
Sulfide	Not Detected							
Cyanide	Not Detected							
Total Organic Carbon (mg/L)	0.5	7 / 9	3.5	0.8		17.7	J	RES#3
Biochemical Oxygen Demand (mg/L)	1.0	1 / 9	3.0			22.0		RES#3
Hardness (mg/L)	NA	9 / 9	35	11		67		RES#4
pH	NA	9 / 9	6.7	5.8		7.5		RES#7
Specific Conductance (Fmhos/cm)	NA	9 / 9	120	55		180		RES#3

NOTES:

1. Analytical data is presented in Appendix D.
2. Frequency of detection is the number of samples with positive values. Positive values include approximated values and approximated values less than sample detection limits. Number of samples include all analyzed samples for which analytical values were reported, unless the sample value was rejected.
3. Presents the minimum and maximum values for positive detections. Approximated values and approximated values less than sample detection limits are also included. A single concentration is presented when only one positive detection occurred.

* The calculated average is greater than the maximum value.

NA = Not Applicable

J = Quantitation is approximate due to limitations identified during laboratory analysis or data validation.

— Analyte was not detected in samples.

TABLE 15 **SUMMARY OF CHEMICAL DETECTED IN RESIDENTIAL WELLS, JANUARY/FEBRUARY 1992 (1)**

CHEMICAL	DETECTION LIMIT	FREQUENCY OF DETECTION (2)	ARITHMETIC AVERAGE	RANGE OF CONCENTRATIONS (3) MINIMUM	MAXIMUM	MAXIMUM LOCATION
VOLATILE ORGANICS - 524 (Fg/L)						
Acetone	5.0	1 / 3	1.9 *	0.6 J		RES#8
WATER SOLUBLE ORGANICS (Fg/L)						
None Detected						
SEMIVOLATILE ORGANICS (Fg/L)						
None Detected						
PESTICIDES (Fg/L)						
Dieldrin	0.10	1 / 3	0.03 *	0.002 J		RES#7
Endrin Aldehyde	0.10	1 / 3	0.07	0.10 J		RES#7
Endrin Ketone	0.10	1 / 3	0.07	0.10 J		RES#7
PCBs						
None Detected						
METALS - UNFILTERED (Fg/L)						
Aluminum	20	2 / 3	22	20.0	36.6	RES#10
Iron	11	1 / 3	260	742		RES#8
Calcium	39	3 / 3	12,000	7,390	14,400	RES#10
Magnesium	49	3 / 3	2,200	2,110	2,200	RES#10
Sodium	38	3 / 3	310,000	12,300	891,000	RES#10
Potassium	130	3 / 3	910	572	1,220	RES#8
Manganese	1	2 / 3	330	4.1	978	RES#8
Mercury	0.2	1 / 3	0.46	0.46 J		RES#10
Zinc	4	1 / 3	56	165		RES#10
METALS - FILTERED (Fg/L)						
Iron	35	2 / 3	87	94.2 J	149 J	RES#8
Calcium	92	3 / 3	12,000	7,310	15,300	RES#10
Magnesium	69	3 / 3	2,100	1,970	2,240	RES#10
Sodium	34	3 / 3	20,000	12,300	24,900	RES#7
Potassium	76	3 / 3	900	724	1,220	RES#8
Manganese	1	1 / 3	310	932		RES#8
Zinc	11	1 / 3	8.7	15.1		RES#8
WATER QUALITY PARAMETERS						
Sulfide	Not Detected					
Cyanide	Not Detected					
Total Organic Carbon (mg/L)	0.50	3 / 3	9.8	8.3	12	RES#7
Biochemical Oxygen Demand - Not Detected						
Hardness (mg/L)	NA	3 / 3	38	27	45	RES#10
pH	NA	2 / 3	7.2	6.1	8.3	RES#10
Specific Conductance (Fmhos/cm)	NA	3 / 3	190	165	220	RES#10

NOTES:

1. Analytical data is presented in Appendix D.
2. Frequency of detection is the number of samples with positive values. Positive values include approximated values and approximated values less than sample detection limits. Number of samples include all analyzed samples for which analytical values were reported, unless the sample value was rejected.
3. Presents the minimum and maximum values for positive detections. Approximated values and approximated values less than sample detection limits are also included. A single concentration is presented when only one positive detection occurred. * The calculated average is greater than the maximum value.

NA = Not Applicable

J = Quantitation is approximate due to limitations identified during laboratory analysis or data validation.

— Analyte was not detected in samples.

TABLE 16 **SUMMARY OF CHEMICAL DETECTED IN RESIDENTIAL WELLS, SEPTEMBER 1993 (1)**

CHEMICAL	DETECTION LIMIT	FREQUENCY OF DETECTION (2)	ARITHMETIC AVERAGE	RANGE OF CONCENTRATIONS (4) MINIMUM	MAXIMUM	MAXIMUM LOCATION
VOLATILE ORGANICS - 524 (Fg/L)						
Bromodichloromethane	1.0	3 / 3	1.0	1.0 J		RES#7
WATER SOLUBLE ORGANICS						
None Detected						
SEMIVOLATILE ORGANICS						
None Detected						
PESTICIDES (Fg/L)						
None Detected						
PCBs						
None Detected						
METALS - UNFILTERED (Fg/L) (4)						
Aluminum	31	1 / 7	49	90.6		RES#11
Iron	8.0	1 / 7	120	203		RES#11
Calcium	200	1 / 7	4,712 *	3,520		RES#11
Magnesium	114	1 / 7	1,124	1,450		RES#11
Sodium	183	1 / 7	7,977 *	7,030		RES#11
Potassium	796	1 / 7	708	1,140		RES#11
Barium	6.0	1 / 7	4.3	8.5		RES#11
Copper	3.0	1 / 7	34	142		RES#11
Lead	3.0	1 / 7	2.3	7.0		RES#9
Manganese	2.0	3 / 7	461	30	2,120	RES#6
Zinc	7.0	1 / 7	4.4	10.1		RES#9
METALS - FILTERED (Fg/L) (4)						
Calcium	200	1 / 7	4,770 *	3,455		RES#11
Magnesium	114	1 / 7	1,114	1,415		RES#11
Potassium	796	1 / 7	677	1,130		RES#11
Arsenic	3.0	1 / 7	1.8	3.6		RES#5
Barium	6.0	1 / 7	4.4	7.6		RES#11
Copper	3.0	1 / 7	26	116.5 J		RES#11
Manganese	2.0	3 / 7	454	30	2,070	RES#6
WATER QUALITY PARAMETERS						
pH	NA	7 / 7	6.6	5.70	8.24	RES#7
Specific Conductance (Fmhos/cm)	NA	7 / 7	108	66	150	RES#10

NOTES:

1. Analytical data is presented in Appendix D.
2. Frequency of detection is the number of samples with positive values. Positive values include approximated values and approximated values less than sample detection limits. Number of samples include all analyzed samples for which analytical values were reported, unless the sample value was rejected.
3. Presents the minimum and maximum values for positive detections. Approximated values and approximated values less than sample detection limits are also included. A single concentration is presented when only one positive detection occurred. * The calculated average is greater than the maximum value.
4. Includes analysis of antimony at lower detection limit.

NA = Not Applicable

* = The calculated average is greater than the maximum value.

J = Quantitation is approximate due to limitations identified during laboratory analysis or data validation.

TABLE 17 SUMMARY OF CHEMICALS DETECTED IN SURFACE WATER, JUNE 1991 (1)

			SAUGATUCKET RIVER					MITCHELL BROOK					UNNAMED BROOK			UNNAMED TRIBUTARY				
CHEMICAL	RANGE OF DETECTION LIMITS (2) MINIMUM	MAXIMUM	FREQUENCY OF DETECTION (3)	ARITHMETIC AVERAGE	RANGE OF CONCENTRATIONS (4) MINIMUM	MAXIMUM	MAXIMUM LOCATION	FREQUENCY OF DETECTION (3)	ARITHMETIC AVERAGE	RANGE OF CONCENTRATIONS (4) MINIMUM	MAXIMUM	MAXIMUM LOCATION	FREQUENCY OF DETECTION (3)	CONCEN-TRATIONS	LOCATION	FREQUENCY OF DETECTION (3)	CONCEN-TRATIONS	LOCATION	OVERALL MAXIMUM LOCATION	WATER BODY ASSOC. WITH OVERALL MAX. LOC.
VOLATILE ORGANICS - (Fg/L)																				
Benzene	5		0 / 6	—	—	—	—	1 / 6	2.6	3 J		SW-12	0 / 1	—	—	0 / 1	—	—	SW-12	Mitchell Brook
Total Xylenes	5		1 / 6	3.6	9		SW-05	1 / 6	3.4	8		SW-07	0 / 1	—	—	0 / 1	—	—	SW-05	Saugatucket
Chlorobenzene	5		0 / 6	—	—	—	—	1 / 6	2.4 *	2 J		SW-12	0 / 1	—	—	0 / 1	—	—	SW-12	Mitchell Brook
1,2-Dichloroethene(total)	5		0 / 6	—	—	—	—	1 / 6	2.8	4 J		SW-14	0 / 1	—	—	0 / 1	—	—	SW-14	Mitchell Brook
Chloroethane	10		0 / 6	—	—	—	—	1 / 6	5.2	6 J		SW-12	0 / 1	—	—	0 / 1	—	—	SW-12	Mitchell Brook
Carbon Disulfide	5		4 / 6	4.5	4 J	10 J	SW-08	1 / 6	2.2 *	1 J		SW-09	0 / 1	—	—	0 / 1	—	—	SW-08	Saugatucket
SEMIVOLATILE ORGANICS (Fg/L)																				
bis(2-Ethylhexyl)phthalate	10		0 / 6	—	—	—	—	1 / 6	5.5	8 J		SW-09	0 / 1	—	—	0 / 1	—	—	SW-09	Mitchell Brook
PESTICIDES/PCBs																				
None Detected																				
METALS - UNFILTERED (Fg/L)																				
Aluminum	10	27	1 / 6	39	88.5 J		SW-02	5 / 6	480	177 J	968 J	SW-12	0 / 1	—	—	1 / 1	272 J	SW-01	SW-12	Mitchell Brook
Iron	7	18	6 / 6	6,500	234	34,600	SW-05	6 / 6	14,000	547 J	65,000 J	SW-12	1 / 1	5,140 J	SW-10	1 / 1	3,250 J	SW-01	SW-12	Mitchell Brook
Calcium	7	28	6 / 6	8,500	3,950	27,100	SW-05	6 / 6	7,000	2,430	23,200	SW-12	1 / 1	11,100	SW-10	1 / 1	2,980	SW-01	SW-05	Saugatucket
Magnesium	13	33	6 / 6	3,500	1,270	12,900	SW-05	6 / 6	2,300	960	7,380	SW-12	1 / 1	2,680	SW-10	1 / 1	1,070	SW-01	SW-05	Saugatucket
Sodium	22	30	6 / 6	17,000	7,900	59,900	SW-05	6 / 6	12,000	6,550	35,300	SW-12	1 / 1	9,930	SW-10	1 / 1	6,840	SW-01	SW-05	Saugatucket
Potassium	42	251	6 / 6	8,500	777	45,000	SW-05	6 / 6	3,000	650	11,600	SW-12	1 / 1	2,970	SW-10	1 / 1	1,050	SW-01	SW-05	Saugatucket
Arsenic	2	4	1 / 6	2.2	4.1		SW-05	0 / 6	—	—	—	—	0 / 1	—	—	0 / 1	—	—	SW-05	Saugatucket
Barium	1	2	5 / 6	52	5.3	279	SW-05	3 / 6	37	10.6	173	SW-12	1 / 1	31.6	SW-10	0 / 1	—	—	SW-05	Saugatucket
Manganese	1	9	6 / 6	530	22.2 J	2,030	SW-05	6 / 6	570	29.6	1,610 J	SW-12	1 / 1	1,690	SW-10	1 / 1	161	SW-01	SW-05	Saugatucket
Nickel	4	6	0 / 6	—	—	—	—	0 / 6	—	—	—	—	0 / 1	—	—	1 / 1	5.0	SW-01	SW-01	Unnamed trib.
Zinc	3	8	0 / 6	—	—	—	—	2 / 6	11	20.5	22.8	SW-12	0 / 1	—	—	0 / 1	—	—	SW-12	Mitchell Brook
METALS - FILTERED (Fg/L)																				
Aluminum	10	27	1 / 6	41	116 J		SW-05	0 / 6	—	—	—	—	0 / 1	—	—	0 / 1	—	—	SW-05	Saugatucket
Iron	7	18	4 / 6	570	361 J	1,520 J	SW-05	6 / 6	1,500	194 J	4,890	SW-12	1 / 1	3,620 J	SW-10	1 / 1	787 J	SW-01	SW-12	Mitchell Brook
Calcium	7	28	6 / 6	5,000	4,130	7,140	SW-08	6 / 6	6,500	2,430	20,100	SW-12	1 / 1	11,300	SW-10	1 / 1	2,970	SW-01	SW-12	Mitchell Brook
Magnesium	13	33	6 / 6	1,600	1,370	2,180	SW-08	6 / 6	2,100	873	6,320	SW-12	1 / 1	2,800	SW-10	1 / 1	1,020	SW-01	SW-12	Mitchell Brook
Sodium	22	30	6 / 6	10,000	8,310	12,350	SW-08	6 / 6	13,000	8,090	31,700	SW-12	1 / 1	12,100	SW-10	1 / 1	9,010	SW-01	SW-12	Mitchell Brook
Potassium	42	251	6 / 6	1,200	859	2,025	SW-08	6 / 6	2,800	684	9,840	SW-12	1 / 1	3,170	SW-10	1 / 1	1,120	SW-01	SW-12	Mitchell Brook
Antimony	11	17	1 / 6	7.9	10.7 J		SW-08	0 / 6	—	—	—	—	0 / 1	—	—	0 / 1	—	—	SW-08	Saugatucket
Barium	1	2	1 / 6	3.9	6.6		SW-05	2 / 6	22	24.1	92.9	SW-12	1 / 1	30.2	SW-10	0 / 1	—	—	SW-12	Mitchell Brook
Lead	1	2	0 / 6	—	—	—	—	1 / 6	1.8	3.3		SW-09	0 / 1	—	—	0 / 1	—	—	SW-09	Mitchell Brook
Manganese	1	9	6 / 6	240	17.6	550	SW-08	6 / 6	520	16.4 J	1,450	SW-12	1 / 1	1,740 J	SW-10	1 / 1	134 J	SW-01	SW-10	Unnamed brook
Nickel	4	6	0 / 6	—	—	—	—	1 / 6	2.8	5.0 J		SW-09	0 / 1	—	—	0 / 1	—	—	SW-09	Mitchell Brook
Silver	2	4	1 / 6	1.6	1.8 J		SW-08	0 / 6	—	—	—	—	0 / 1	—	—	0 / 1	—	—	SW-08	Saugatucket
WATER QUALITY PARAMETERS																				
Sulfide (mg/L)	0.05		6 / 6	1.4	0.64	2.2	SW-02	6 / 6	1.4	0.32	1.90	SW-14	1 / 1	1.90	SW-10	1 / 1	0.80	SW-01	SW-02	Saugatucket
Cyanide	Not Detected																			
Total Organic Carbon	Not Detected																			
Hardness (mg/L)	NA		6 / 6	36	15.1	121	SW-05	6 / 6	27	10	88	SW-12	1 / 1	39	SW-10	1 / 1	11.8	SW-01	SW-05	Saugatucket
pH	NA		6 / 6	5.9	5.77	6.02	SW-06	6 / 6	5.8	5.52	6.18	SW-07	1 / 1	7.2	SW-10	1 / 1	5.52	SW-01	SW-10	Unnamed brook
Specific Conductance (Fmhos/cm)	NA		6 / 6	93	77	133	SW-08	6 / 6	270	55	1,200	SW-12	1 / 1	26	SW-10	1 / 1	73	SW-01	SW-12	Mitchell Brook
Dissolved Oxygen (mg/L)	NA		6 / 6	8.7	6.62	9.66	SW-03	6 / 6	6.6	185	8.40	SW-07	1 / 1	6.48	SW-10	1 / 1	1.9	SW-01	SW-03	Saugatucket
Biochemical Oxygen Demand (mg/L)	2.4		0 / 6	—	—	—	—	0 / 6	—	—	—	—	0 / 1	—	—	1 / 1	2.8 J	SW-01	SW-01	Unnamed trib.

NOTES:

1. Analytical data is presented in Appendix D.
2. If all samples detection limits are the same, a single detection limit is presented.
3. Frequency of detection is the number of samples with positive values. Positive values include approximated values and approximated values less than same detection limits. Number of samples include all analyzed samples for which analytical values were reported, unless the sample value was rejected.
4. Presents the minimum and maximum values for positive detections. Approximated values and approximated values less than sample detection limits are also included. A single concentration is presented when only one positive detection occurred.

* The calculated average is greater than the maximum value.

NA = Not Applicable

J = Quantitation is approximate due to limitations identified during laboratory analysis of data validation

--- Analyte was not detected in samples.

TABLE 18 SUMMARY OF CHEMICALS DETECTED IN SURFACE WATER, SEPTEMBER/OCTOBER 1991 (1)

			SAUGATUCKET RIVER					MITCHELL BROOK					UNNAMED BROOK			UNNAMED TRIBUTARY				
	RANGE OF DETECTION LIMITS (2)		FREQUENCY OF	ARITHMETIC	RANGE OF CONCENTRATIONS (4)		MAXIMUM	FREQUENCY OF	ARITHMETIC	RANGE OF CONCENTRATIONS (4)		MAXIMUM	FREQUENCY OF	CONCEN-		FREQUENCY OF	CONCEN-		OVERALL MAXIMUM	WATER BODY ASSOC. WITH OVERALL
CHEMICAL	MINIMUM	MAXIMUM	DETECTION (3)	AVERAGE	MINIMUM	MAXIMUM	LOCATION	DETECTION (3)	AVERAGE	MINIMUM	MAXIMUM	LOCATION	DETECTION (3)	TRATIONS	LOCATION	DETECTION (3)	TRATIONS	LOCATION	LOCATION	MAX. LOC.
VOLATILE ORGANICS - (Fg/L)																				
Toluene	10		1 / 7	4.6 *	2 J		SW-05	0 / 6	—	—		—	—	0 / 1	—	—	0 / 1	—	—	SW-05	Saugatucket
Carbon Disulfide	10		4 / 7	5.9	3 J	14	SW-03	1 / 6	4.5 *	2 J		SW-12	0 / 1	—	—	0 / 1	—	—	SW-03	Saugatucket
WATER SOLUBLE ORGANICS (Fg/L)																				
Acrylamide	200		0 / 7	—	—	—	—	1 / 6	130	272 J		SW-12	0 / 1	—	—	0 / 1	—	—	SW-12	Mitchell Brook
N,N-DMF	50		0 / 7	—	—	—	—	0 / 6	—	—	—	—	1 / 1	5 J	SW-10	0 / 1	—	—	SW-10	Unnamed brook
SEMIVOLATILE ORGANICS (Fg/L)																				
None Detected																				
PESTICIDES																				
gamma-BHC(Lindane)	0.050		0 / 7	—	—	—	—	0 / 6	—	—	—	—	1 / 1	0.002 J	SW-10	0 / 1	—	—	SW-10	Unnamed brook
PCBs																				
None Detected																				
METALS - UNFILTERED (Fg/L)																				
Aluminum	13	31	3 / 7	130	121 J	331 J	SW-04	0 / 6	—	—	—	—	0 / 1	—	—	1 / 1	573 J	SW-01	SW-01	Unnamed trib.
Iron	6	12	5 / 7	1,000	882 J	1,825 J	SW-08	3 / 6	1,600	292 J	5,000 J	SW-07	1 / 1	6,160 J	SW-10	1 / 1	1,360 J	SW-01	SW-10	Unnamed brook
Calcium	15	20	7 / 7	5,200	4,010	6,740	SW-08	6 / 6	5,200	3,650 J	10,000	SW-12	1 / 1	9,110	SW-10	1 / 1	2,500	SW-01	SW-12	Mitchell Brook
Magnesium	26	46	7 / 7	1,700	1,460	2,075	SW-08	6 / 6	1,700	1,210 J	3,260	SW-12	1 / 1	2,060	SW-10	1 / 1	975	SW-01	SW-12	Mitchell Brook
Sodium	13	57	7 / 7	11,000	9,640	12,500	SW-08	6 / 6	13,000	10,800	18,800	SW-12	1 / 1	9,545	SW-10	1 / 1	4,620	SW-01	SW-12	Mitchell Brook
Potassium	133	442	0 / 7	—	—	—	—	1 / 6	1,100	4,220		SW-12	0 / 1	—	—	0 / 1	—	—	SW-12	Mitchell Brook
Antimony	25	47	1 / 7	14	25.0		SW-04	1 / 6	15	28.8		SW-07	0 / 1	—	—	0 / 1	—	—	SW-07	Mitchell Brook
Arsenic	1	2	1 / 7	0.57	1		SW-08	0 / 6	—	—	—	—	0 / 1	—	—	0 / 1	—	—	SW-08	Saugatucket
Barium	1	2	2 / 7	6.1	9.1	13.2	SW-06	4 / 6	13	9.1	28.4	SW-12	1 / 1	24.9	SW-10	0 / 1	—	—	SW-12	Mitchell Brook
Copper	4	5	1 / 7	5.6	11.6		SW-04	0 / 6	—	—	—	—	0 / 1	—	—	0 / 1	—	—	SW-04	Saugatucket
Manganese		2	7 / 7	270	42.3	470	SW-08	4 / 6	220	10.2	708	SW-12	1 / 1	1,410	SW-10	1 / 1	155	SW-01	SW-10	Unnamed brook
Zinc	6	7	0 / 7	—	—	—	—	1 / 6	9.1	17.9 J		SW-09	0 / 1	—	—	0 / 1	—	—	SW-09	Mitchell Brook
METALS - FILTERED (Fg/L)																				
Aluminum	13	17	4 / 7	190	132 J	620	SW-03	0 / 6	—	—	—	—	0 / 1	—	—	0 / 1	—	—	SW-03	Saugatucket
Iron	6	7	6 / 7	530	241 J	997	SW-03	2 / 6	890	1,950	3,160	SW-12	1 / 1	3,325 *	SW-10	1 / 1	440	SW-01	SW-10	Unnamed brook
Calcium	8	20	7 / 7	5,600	4,390	7,170 J	SW-11	6 / 6	5,200	3,790 J	9,830	SW-12	1 / 1	9,530 *	SW-10	1 / 1	2,530	SW-01	SW-12	Mitchell Brook
Magnesium	14	26	7 / 7	1,800	1,480	2,160 J	SW-11	6 / 6	1,700	1,220 J	3,120	SW-12	1 / 1	2,430	SW-10	1 / 1	904	SW-01	SW-12	Mitchell Brook
Sodium	13	38	7 / 7	12,000	11,400	14,800	SW-11	6 / 6	14,000	10,600	20,200	SW-12	1 / 1	10,900	SW-10	0 / 1	—	—	SW-12	Mitchell Brook
Potassium	73	442	0 / 7	—	—	—	—	1 / 6	1,000	3,810		SW-12	0 / 1	—	—	0 / 1	—	—	SW-12	Mitchell Brook
Barium		1	3 / 7	7.7	8.5	13.2	SW-05	4 / 6	9.8	4.0	25.2	SW-12	1 / 1	22.7	SW-10	0 / 1	—	—	SW-12	Mitchell Brook
Chromium	2	8	2 / 7	7.0	13.1	13.5	SW-05	0 / 6	—	—	—	—	0 / 1	—	—	0 / 1	—	—	SW-05	Saugatucket
Copper	2	4	3 / 7	12	9.8	29.8	SW-05	0 / 6	—	—	—	—	0 / 1	—	—	0 / 1	—	—	SW-05	Saugatucket
Manganese	1	2	6 / 7	300	136	547	SW-03	4 / 6	200	9.4	690	SW-12	1 / 1	1,295	SW-10	1 / 1	102	SW-01	SW-10	Unnamed brook
Zinc	5	6	0 / 7	—	—	—	—	1 / 6	15	36.6 J		SW-09	0 / 1	—	—	0 / 1	—	—	SW-09	Mitchell Brook
WATER QUALITY PARAMETERS																				
Sulfide (mg/L)	Not Detected																			
Cyanide (Fg/L)	10		1 / 7	5.7	10.2 J		SW-04	0 / 6	—	—	—	—	0 / 1	—	—	0 / 1	—	—	SW-04	Saugatucket
Total Organic Carbon (mg/L)	0.5		7 / 7	5.8	4.9 J	7.2 J	SW-02	6 / 6	4.5	3.2 J	5.4 J	SW-12	1 / 1	3.4 J	SW-10	1 / 1	9.9 J	SW-01	SW-01	Unnamed trib.
Hardness (mg/L)	NA		7 / 7	20	16	25	SW-08	6 / 6	20	14 J	38.4	SW-12	1 / 1	31	SW-10	1 / 1	10	SW-01	SW-12	Mitchell Brook
pH	NA		7 / 7	6.2	5.7	6.5	SW-05	6 / 6	5.9	5.3	7.0	SW-12	1 / 1	5.9	SW-10	1 / 1	4.4	SW-01	SW-12	Mitchell Brook
Specific Conductance (Fmhos/cm)	NA		7 / 7	120	91	170	SW-05	6 / 6	100	29	222	SW-12	1 / 1	146	SW-10	1 / 1	50	SW-01	SW-12	Mitchell Brook
Dissolved Oxygen (mg/L)	NA		7 / 7	9.0	7.7	10.2	SW-02	6 / 6	9.0	8.6	9.5	SW-13	1 / 1	8.4	SW-10	1 / 1	8	SW-01	SW-02	Saugatucket
Biochemical Oxygen Demand (mg/L)	1.0		2 / 4	0.82	1.1	1.2 J	SW-08	1 / 3	0.70	1.1		SW-12	1 / 1	0.9 J	SW-10	0 / 1	—	—	SW-08	Saugatucket

NOTES:

1. Analytical data is presented in Appendix D.
2. If all samples detection limits are the same, a single detection limit is presented.
3. Frequency of detection is the number of samples with positive values. Positive values include approximated values and approximated values less than sample detection limits. Number of samples include all analyzed samples for which analytical values were reported, unless the sample value was rejected.
4. Presents the minimum and maximum values for positive detections. Approximated values and approximated values less than sample detection limits are also included. A single concentration is presented when only one positive detection occurred.

* The calculated average is greater than the maximum value.

NA = Not Applicable

J = Quantitation is approximate due to limitations identified during laboratory analysis of data validation

--- Analyte was not detected in samples.

TABLE 19 SUMMARY OF CHEMICALS DETECTED IN SURFACE WATER, JANUARY/FEBRUARY 1992 (1)

			SAUGATUCKET RIVER					MITCHELL BROOK					UNNAMED BROOK				
	RANGE OF DETECTION LIMITS (2)		FREQUENCY OF	ARITHMETIC	RANGE OF CONCENTRATIONS (4)		MAXIMUM	FREQUENCY OF	ARITHMETIC	RANGE OF CONCENTRATIONS (4)		MAXIMUM	FREQUENCY OF	CONCEN-		OVERALL MAXIMUM	WATER BODY ASSOC. WITH OVERALL
CHEMICAL	MINIMUM	MAXIMUM	DETECTION (1)	AVERAGE	MINIMUM	MAXIMUM	LOCATION	DETECTION (3)	AVERAGE	MINIMUM	MAXIMUM	LOCATION	DETECTION (3)	TRATIONS	LOCATION	LOCATION	MAX. LOC.
VOLATILE ORGANICS – (µg/L)																	
Carbon Disulfide	10		1 / 4	4.2 *	2 J		SW– 05	2 / 3	5.0	1 J	9 J	SW–12	1 / 1	6 J	SW–10	SW–12	Mitchell Brook
WATER SOLUBLE ORGANICS																	
None Detected																	
SEMIVOLATILE ORGANICS (µg/L)																	
Dimethylphthalate	10	250	1 / 4	34 *	1 J		SW– 04	0 / 3	—	—	—	—	0 / 1	—	—	SW–04	Saugatucket
Diethylpthalate	10	250	0 / 4	—	—	—	—	1 / 3	4.0 *	2 J		SW–12	0 / 1	—	—	SW–12	Mitchell Brook
Di-n-butylphthalate	10	250	0 / 4	—	—	—	—	1 / 3	4.3 *	3 J		SW–12	0 / 1	—	—	SW–12	Mitchell Brook
PESTICIDES (µg/L)																	
4,4'-DDD	0.10		1 / 4	0.04 *	0.00 J		SW–11	0 / 3	—	—	—	—	0 / 1	—	—	SW–11	Saugatucket
Methoxychlor	0.50		1 / 4	0.19 *	0.001 J		SW–11	0 / 3	—	—	—	—	0 / 1	—	—	SW–11	Saugatucket
PCBs																	
None Detected																	
METALS – UNFILTERED (µg/L)																	
Aluminum	66		4 / 4	110	105	140	SW–04	3 / 3	130	109	147	SW–09	1 / 1	160	SW–10	SW–10	Unnamed brook
Iron	35		4 / 4	660	108	1360	SW–05	3 / 3	740	280	1,105	SW–12	1 / 1	6,500	SW–10	SW–10	Unnamed brook
Calcium	92		4 / 4	3,600	3,030	4,060	SW–11	3 / 3	3,200	2,810	3,660	SW–12	1 / 1	8,110	SW–10	SW–10	Unnamed brook
Magnesium	69		4 / 4	1,400	1,250	1,510	SW–11	3 / 3	1,200	1,070	1,335	SW–12	1 / 1	2,160	SW–10	SW–10	Unnamed brook
Sodium	34		4 / 4	9,500	9,290	10,100	SW–11	3 / 3	8,700	8,080	9,330	SW–12	1 / 1	7,910	SW–10	SW–11	Saugatucket
Potassium	76		4 / 4	870	612	1,090	SW–11	3 / 3	680	472	889	SW–12	1 / 1	2,350	SW–10	SW–10	Unnamed brook
Barium	1		0 / 4	—	—	—	—	1 / 3	6.9	10.8		SW–12	1 / 1	25.2	SW–10	SW–10	Unnamed brook
Manganese	1		4 / 4	150	62.5 J	195	SW–05	3 / 3	120	53.4 J	173	SW–12	1 / 1	905	SW–10	SW–10	Unnamed brook
Zinc	11		0 / 4	—	—	—	—	0 / 3	—	—	—	—	1 / 1	17.2 J	SW–10	SW–10	Unnamed brook
METALS – FILTERED (µg/L)																	
Aluminum	66		4 / 4	95	89.2	102	SW–06	3 / 3	120	114	126	SW–09	0 / 1	—	—	SW–09	Mitchell Brook
Iron	35		4 / 4	430	82.1 J	702 J	SW–05	3 / 3	620	232 J	940 J	SW–12	1 / 1	3,660 J	SW–10	SW–10	Unnamed brook
Calcium	92		4 / 4	3,700	3,270	4,210	SW–11	3 / 3	3,500	3,160	3,770	SW–12	1 / 1	7,850	SW–10	SW–10	Unnamed brook
Magnesium	69		4 / 4	1,300	1,240	1,460	SW–11	3 / 3	1,200	1,100	1,325	SW–12	1 / 1	2,080	SW–10	SW–10	Unnamed brook
Sodium	34		4 / 4	11,000	10,700	11,300	SW–11	3 / 3	11,000	10,100	11,500	SW–07	1 / 1	7,490	SW–10	SW–07	Mitchell Brook
Potassium	76		4 / 4	910	701	1,130	SW–11	3 / 3	830	603	999	SW–12	1 / 1	2,140	SW–10	SW–10	Unnamed brook
Barium	1		0 / 4	—	—	—	—	0 / 3	—	—	—	—	1 / 1	24.7	SW–10	SW–10	Unnamed brook
Manganese	1		4 / 4	130	56.0	172	SW–11	3 / 3	110	52.7	166	SW–12	1 / 1	789	SW–10	SW–10	Unnamed brook
Zinc	11		0 / 4	—	—	—	—	1 / 3	9.6	17.9		SW–07	1 / 1	14.9	SW–10	SW–07	Mitchell Brook
WATER QUALITY PARAMETERS																	
Sulfide	Not Detected																
Cyanide	Not Detected																
Total Organic Carbon (mg/L)	0.5		4 / 4	6.0	5.0	7.0	SW–11	3 / 3	4.5	3.3	5.7	SW–12	1 / 1	11	SW–10	SW–10	Unnamed brook
Hardness (mg/L)	NA		4 / 4	15	13	16	SW–11	3 / 3	13	11	15	SW–12	1 / 1	29	SW–10	SW–10	Unnamed brook
pH	NA		4 / 4	6.2	6.0	6.5	SW–06	3 / 3	6.0	5.4	6.4	SW–12	1 / 1	6.4	SW–10	SW–06	Saugatucket
Specific Conductance (µmhos/cm)	NA		4 / 4	300	90	900	SW–04	3 / 3	83	80	90	SW–12	1 / 1	130	SW–10	SW–04	Saugatucket
Dissolved Oxygen (mg/L)	NA		2 / 2	13	12.5	13.2	SW–05	NA	—	—	—	—	NA	—	—	SW–05	Saugatucket
Biochemical Oxygen Demand																	
Not Detected																	

NOTES:

1. Analytical data is presented in Appendix D.

2. If all sample detection limits are the same, a single detection limit is presented.

3. Frequency of detection is the number of samples with positive values. Positive values include approximated values and approximated values less than sample detection limits. Number of samples include all analyzed samples for which analytical values were reported, unless the sample value was rejected.

4. Presents the minimum and maximum values for positive detections. Approximated values and approximated values less than the sample detect on limits are also included. A single concentration is presented when only one positive detection occurred.

* The calculated average is greater than the maximum value.

NA = Not Applicable

J = Quantitation is approximate due to limitations identified during laboratory analysis or data validation.

— Analyte was not detected in samples.

TABLE 20 SUMMARY OF CHEMICALS DETECTED IN SURFACE WATER, APRIL 1992 (1)

			SAUGATUCKET RIVER					MITCHELL BROOK						
	RANGE OF DETECTION LIMITS (2)		FREQUENCY OF	ARITHMETIC	RANGE OF CONCENTRATIONS (4)		MAXIMUM	FREQUENCY OF	ARITHMETIC	RANGE OF CONCENTRATIONS (4)		MAXIMUM	OVERALL MAXIMUM	WATER BODY ASSOC. WITH OVERALL
CHEMICAL	MINIMUM	MAXIMUM	DETECTION (1)	AVERAGE	MINIMUM	MAXIMUM	LOCATION	DETECTION (3)	AVERAGE	MINIMUM	MAXIMUM	LOCATION	LOCATION	MAX. LOC.
VOLATILE ORGANICS – (µg/L)														
Carbon Disulfide	10		1 / 5	4.2 *	1 J		SW–04	0 / 3	—	—	—	—	SW–04	Saugatucket
WATER SOLUBLE ORGANICS														
None Detected														
SEMIVOLATILE ORGANICS														
None Detected														
PESTICIDE/PCBs														
None Detected														
METALS – UNFILTERED (µg/L)														
Iron	23		3 / 5	500	636 J	861 J	SW–11	2 / 3	920	1,300	1,310	SW–07	SW–07	Mitchell Brook
Calcium	34		5 / 5	3,700	3,240	4,690	SW–11	3 / 3	3,500	2,870	4,260	SW–12	SW–11	Saugatucket
Magnesium	22		5 / 5	1,300	1,210	1,590	SW–11	3 / 3	1,300	1,050	1,500	SW–12	SW–11	Saugatucket
Sodium	67		5 / 5	8,800	8,285	9,790	SW–11	3 / 3	9,200	8,150	10,400	SW–12	SW–12	Mitchell Brook
Potassium	82		5 / 5	860	624	1,190	SW–11	3 / 3	910	590	1,320	SW–12	SW–12	Mitchell Brook
Antimony	16		1 / 5	10	19.8		SW–11	1 / 3	14	24.8		SW–09	SW–09	Mitchell Brook
Barium	1		2 / 5	5.8	8.6 J	8.85	SW–04	2 / 3	11	12.6 J	15.7 J	SW–12	SW–12	Mitchell Brook
Chromium	3		0 / 5	—	—	—	—	1 / 3	2.1	3.2		SW–12	SW–12	Mitchell Brook
Manganese	1		5 / 5	140	20.6	237	SW–11	3 / 3	140	51.1	212	SW–12	SW–11	Saugatucket
METALS – FILTERED (µg/L)														
Iron	23	25	1 / 5	310	866		SW–05	2 / 3	790	1,050	1,170	SW–07	SW–07	Mitchell Brook
Calcium	28	34	5 / 5	4,100	3,510	5,050	SW–11	2 / 3	3,200	3,300	4,570	SW–12	SW–11	Saugatucket
Magnesium	22	55	5 / 5	1,400	1,250	1,640	SW–11	3 / 3	1,300	1,100	1,540	SW–12	SW–11	Saugatucket
Sodium	34	67	5 / 5	10,000	9,380	10,500	SW–06	3 / 3	11,000	9,070	12,500	SW–12	SW–12	Mitchell Brook
Potassium	82	194	5 / 5	980	729	1,320	SW–11	3 / 3	970	654	1,350	SW–12	SW–12	Mitchell Brook
Manganese	1		5 / 5	140	20.2	245	SW–11	3 / 3	140	52.8	207	SW–12	SW–11	Saugatucket
Zinc	8	11	1 / 5	10	31.3 J		SW–05	0 / 3	—	—	—	—	SW–05	Saugatucket
WATER QUALITY PARAMETERS														
Cyanide	Not Detected													
Ammonia (mg/L)	0.0300		5 / 5	0.32	0.042	0.640	SW–06	2 / 3	0.23	0.220	0.460	SW–12	SW–06	Saugatucket
Total Organic Carbon (mg/L)	0.50		5 / 5	6.2	5.4	7.9	SW–11	3 / 3	5.0	4.5	5.7	SW–12	SW–11	Saugatucket
Hardness (mg/L)	NA		5 / 5	15	13	18	SW–11	3 / 3	14	11	17	SW–12	SW–11	Saugatucket
pH	NA		5 / 5	6.0	5.7	6.08	SW–11	3 / 3	6.0	5.75	6.25	SW–12	SW–12	Mitchell Brook
Specific Conductance (µmhos/cm)	NA		5 / 5	83	74	98	SW–11	3 / 3	95	74	125	SW–12	SW–12	Mitchell Brook
Dissolved Oxygen (mg/L)	NA		5 / 5	11	10.21	11.45	SW–11	3 / 3	11	10.42	11.38	SW–07	SW–04	Saugatucket
Biochemical Oxygen Demand	1.0		2 / 2	1.3	1.1	1.5	SW–02	2 / 2	1.4	1.0 J	1.7 J	SW–12	SW–12	Mitchell Brook

NOTES:

1. Analytical data is presented in Appendix D.

2. If all sample detection limits are the same, a single detection limit is presented.

3. Frequency of detection is the number of samples with positive values. Positive values include approximated values and approximated values less than sample detection limits. Number of samples include all analyzed samples for which analytical values were reported, unless the sample value was rejected.

4. Presents the minimum and maximum values for positive detections. Approximated values and approximated values less than the sample detection limits are also included. A single concentration is presented when only one positive detection occurred.

* The calculated average is greater than the maximum value.

NA = Not Applicable

J = Quantitation is approximate due to limitations identified during laboratory analysis or data validation.

— Analyte was not detected in samples.

TABLE 21 SUMMARY OF CHEMICALS DETECTED IN SURFACE WATER, MAY 1992 (1)

CHEMICAL	RANGE OF DETECTION LIMITS MINIMUM	RANGE OF DETECTION LIMITS MAXIMUM	SAUGATUCKET RIVER FREQUENCY OF DETECTION (2)	SAUGATUCKET RIVER ARITHMETIC AVERAGE	SAUGATUCKET RIVER RANGE OF CONCENTRATIONS (3) MINIMUM	SAUGATUCKET RIVER RANGE OF CONCENTRATIONS (3) MAXIMUM	SAUGATUCKET RIVER MAXIMUM LOCATION	MITCHELL BROOK FREQUENCY OF DETECTION (2)	MITCHELL BROOK ARITHMETIC AVERAGE	MITCHELL BROOK RANGE OF CONCENTRATIONS (3) MINIMUM	MITCHELL BROOK RANGE OF CONCENTRATIONS (3) MAXIMUM	MITCHELL BROOK MAXIMUM LOCATION	WATER BODY OVERALL MAXIMUM LOCATION	WATER BODY ASSOC. WITH OVERALL MAX. LOC.
VOLATILE ORGANICS														
None Detected														
SEMIVOLATILE ORGANICS														
None Detected														
PESTICIDE/PCBs														
None Detected														
METALS – UNFILTERED (µg/L)														
Aluminum	100	100	7 / 7	240	153	424	SW-18	4 / 4	440	132	1,140	SW–16	SW–16	Mitchell Brook
Iron	10	10	7 / 7	980	234	1,640	SW–06	4 / 4	3,600	403	6,760	SW–07	SW–07	Mitchell Brook
Calcium	20	20	7 / 7	4,200	3,230	5,950	SW–11	4 / 4	4,400	2,990	6,330	SW–12	SW–12	Mitchell Brook
Magnesium	20	20	7 / 7	1,400	1,110	1,920	SW–11	4 / 4	1,500	1,100	2,170	SW–12	SW–12	Mitchell Brook
Sodium	300	300	7 / 7	8,600	7,040	10,800	SW–11	4 / 4	9,700	7,905	12,500	SW–12	SW–12	Mitchell Brook
Barium	1	1	7 / 7	7.0	4.9	9.9	SW–11	4 / 4	14	8.2	17.4	SW–12	SW–12	Mitchell Brook
Copper	2	2	2 / 7	1.3	2.1	2.1	SW–02	3 / 4	2.0	2.2	2.5	SW–07	SW–07	Mitchell Brook
Lead	2	2	0 / 7	—	—	—	—	1 / 4	1.7	3.7		SW–16	SW–16	Mitchell Brook
Manganese	1	1	7 / 7	200	21.2	373	SW–11	4 / 4	300	58.65	443	SW–07	SW–07	Mitchell Brook
Zinc	2	2	7 / 7	4.5	2.8	8.2	SW–18	4 / 4	6.3	3.2	12.1	SW–16	SW–16	Mitchell Brook
METALS – FILTERED (µg/L)														
Aluminum	100	100	7 / 7	190	120	348	SW–18	4 / 4	200	104	437	SW–16	SW–16	Mitchell Brook
Iron	10	10	5 / 7	460	356	830	SW–11	3 / 4	970	662	1,710	SW–12	SW–12	Mitchell Brook
Calcium	20	20	7 / 7	4,300	3,460	6,050	SW–11	4 / 4	4,400	2,950	6,310	SW–12	SW–12	Mitchell Brook
Magnesium	20	20	7 / 7	1,400	1,120	1,910	SW–11	4 / 4	1,400	1,060	2,130	SW–12	SW–12	Mitchell Brook
Sodium	300	300	0 / 7	—	—	—	—	1 / 4	6,900	13,000		SW–12	SW–12	Mitchell Brook
Barium	1	1	1 / 7	3.5	5.0		SW–04	1 / 4	8.5	16.9		SW–16	SW–12	Mitchell Brook
Lead	1	1	0 / 7	—	—	—	—	1 / 4	0.68	1.2		SW–12	SW–16	Mitchell Brook
Manganese	1	1	7 / 7	170	19.0	369	SW–11	4 / 4	260	54.2	417	SW–09	SW–12	Mitchell Brook
Mercury	0.1	0.1	0 / 7	—	—	—	—	1 / 4	0.07	0.115 J			SW–09	Mitchell Brook
WATER QUALITY PARAMETERS														
Cyanide (µg/L)	10	10	0 / 7	—	—	—	—	2 / 4	61	25 J	210 J	SW–07	SW–07	Mitchell Brook
Ammonia (mg/L)	0.0300	0.0300	6 / 7	0.36	0.0700	1.43	SW–11	4 / 4	1.2	0.033	3.53	SW–12	SW–12	Mitchell Brook
Hardness (mg/L)		NA	7 / 7	16	12	23	SW–11	4 / 4	17	12	25	SW–12	SW–12	Mitchell Brook
pH		NA	7 / 7	5.8	5.56	6.35	SW–11	4 / 4	6.1	5.72	6.27	SW–12	SW–11	Saugatucket
Specific Conductance (µmhos/cm)		NA	7 / 7	81	64	112	SW–11	4 / 4	95	68	141	SW–12	SW–12	Mitchell Brook
Dissolved Oxygen (mg/L)		NA	7 / 7	9.3	8.93	10.21	SW–02	4 / 4	9.6	8.93	9.97	SW–09	SW–02	Saugatucket

NOTES:

1. Analytical data is presented in Appendix D.

2. Frequency of detection is the number of samples with positive values. Positive values include approximated values and approximated values less than sample detection limits. Number of samples include all analyzed samples for which analytical values were reported, unless the sample value was rejected.

3. Presents the minimum and maximum values for positive detections. Approximated values and approximated values less than the sample detection limits are also included. A single concentration is presented when only one positive detection occurred.

* The calculated average is greater than the maximum value.

NA = Not Applicable

J = Quantitation is approximate due to limitations identified during laboratory analysis or data validation.

— Analyte was not detected in samples.

TABLE 22 SUMMARY OF CHEMICALS DETECTED IN SEDIMENT, JUNE 1991 (1)

CHEMICAL	RANGE OF DETECTION LIMITS MINIMUM	RANGE OF DETECTION LIMITS MAXIMUM	SAUGATUCKET RIVER FREQUENCY OF DETECTION (2)	SAUGATUCKET RIVER ARITHMETIC AVERAGE	SAUGATUCKET RIVER RANGE OF CONCENTRATIONS (3) MINIMUM	SAUGATUCKET RIVER RANGE OF CONCENTRATIONS (3) MAXIMUM	SAUGATUCKET RIVER MAXIMUM LOCATION	MITCHELL BROOK FREQUENCY OF DETECTION (2)	MITCHELL BROOK ARITHMETIC AVERAGE	MITCHELL BROOK RANGE OF CONCENTRATIONS (3) MINIMUM	MITCHELL BROOK RANGE OF CONCENTRATIONS (3) MAXIMUM	MITCHELL BROOK MAXIMUM LOCATION	UNNAMED BROOK FREQUENCY OF DETECTION (2)	UNNAMED BROOK CONCEN-TRATIONS	UNNAMED BROOK LOCATION	UNNAMED TRIBUTARY FREQUENCY OF DETECTION (2)	UNNAMED TRIBUTARY CONCEN-TRATIONS	UNNAMED TRIBUTARY LOCATION	WATER BODY ASSOC. WITH OVERALL OVERALL MAXIMUM LOCATION	WATER BODY ASSOC. WITH OVERALL MAX. LOC.
VOLATILE ORGANICS – (µg/kg)																					
Ethylbenzene	6	10	1/6	4.8	8 J		SD–08	0/6	—	—	—	—	0/1	—	—	0/1	—	—	SD–08	Saugatucket
Total Xylenes	6	10	2/6	16	10 J	67 J	SD–08	2/6	4.9	7 J	8	SD–07	0/1	—	—	0/1	—	—	SD–08	Saugatucket
Trichloroethene	6	10	3/6	30	7 J	150 J	SD–08	3/6	5.4	6 J	9 J	SD–09	0/1	—	—	0/1	—	—	SD–08	Saugatucket
1,2-Dichloroethene(total)	6	10	1/6	4.3	5 J		SD–08	0/6	—	—	—	—	0/1	—	—	0/1	—	—	SD–08	Saugatucket
Carbon Disulfide	6	10	1/6	5.0	9 J		SD–08	0/6	—	—	—	—	0/1	—	—	0/1	—	—	SD–08	Saugatucket
SEMIVOLATILE ORGANICS (µg/kg)																					
Phenanthrene	820	1,400	1/6	500 *	220 J		SD–08	0/6	—	—	—	—	0/1	—	—	0/1	—	—	SD–08	Saugatucket
Fluoranthene	820	1,400	1/6	520 *	330 J		SD–08	0/6	—	—	—	—	0/1	—	—	0/1	—	—	SD–08	Saugatucket
Pyrene	820	1,400	1/6	510 *	280 J		SD–08	0/6	—	—	—	—	0/1	—	—	0/1	—	—	SD–08	Saugatucket
Chrysene	820	1,400	1/6	500 *	180 J		SD–08	0/6	—	—	—	—	0/1	—	—	0/1	—	—	SD–08	Saugatucket
Benzo(b)fluoranthene	820	1,400	1/6	490 *	130 J		SD–08	0/6	—	—	—	—	0/1	—	—	0/1	—	—	SD–08	Saugatucket
Benzo(k)fluoranthene	820	1,400	1/6	490 *	130 J		SD–08	0/6	—	—	—	—	0/1	—	—	0/1	—	—	SD–08	Saugatucket
Benzo(a)pyrene	820	1,400	1/6	490 *	140 J		SD–08	0/6	—	—	—	—	0/1	—	—	0/1	—	—	SD–08	Saugatucket
Butylbenzylphthalate	820	1,400	1/6	530 *	440 J		SD–06	0/6	—	—	—	—	0/1	—	—	0/1	—	—	SD–06	Saugatucket
PESTICIDES/PCBs																					
None Detected																					
METALS (mg/kg)																					
Aluminum	2.26	10.64	6/6	3,300	749	6,280	SD–05	6/6	3,300	1,360	5,640	SD–14	1/1	3,210	SD–10	1/1	6,050	SD–01	SD–05	Saugatucket
Iron	1.58	7.09	6/6	5,000	780	1,600	SD–04	6/6	4,400	2,750	6,490	SD–07	1/1	113,000	SD–10	1/1	7,530	SD–01	SD–10	Unnamed brook
Calcium	1.58	11.03	4/6	640	547	1,270	SD–03	3/6	350	339	921	SD–13	1/1	1,070	SD–10	1/1	378	SD–01	SD–03	Saugatucket
Magnesium	2.94	13.00	3/6	490	488	1,040	SD–05	4/6	470	506	764	SD–14	1/1	597	SD–10	1/1	1,100	SD–01	SD–01	Unnamed trib.
Sodium	4.98	11.82	1/6	44	115		SD–06	3/6	40	38.1	82.3	SD–13	1/1	84.6	SD–10	1/1	47.1	SD–01	SD–06	Saugatucket
Potassium	9.50	98.91	1/6	96	191		SD–06	3/6	170	191	308	SD–14	1/1	415	SD–10	1/1	549	SD–01	SD–01	Unnamed trib.
Arsenic	0.47	1.46	3/6	0.97	0.79	2.1	SD–05	2/6	0.60	0.52	1.1	SD–07	1/1	2.0	SD–10	0/1	—	—	SD–05	Saugatucket
Barium	0.23	0.79	6/6	12	2.7	26.2	SD–04	6/6	12	7.0	22.2	SD–13	1/1	64.6	SD–10	1/1	13.6	SD–01	SD–10	Unnamed brook
Beryllium	0.23	0.39	5/6	0.78	0.40	2.0	SD–04	5/6	0.59	0.29	1.3	SD–14	1/1	1.2	SD–10	0/1	—	—	SD–04	Saugatucket
Chromium	0.45	2.76	3/6	3.9	1.9 J	8.7	SD–04	3/6	2.1	2.5	3.6	SD–14	0/1	—	—	1/1	4.4	SD–01	SD–04	Saugatucket
Cobalt	0.45	1.58	3/6	2.2	3.4 J	4.2	SD–05	0/6	—	—	—	—	0/1	—	—	0/1	—	—	SD–05	Saugatucket
Copper	0.68	4.33	0/6	—	—	—	—	1/6	2.2	4.2		SD–14	0/1	—	—	1/1	3.3	SD–01	SD–14	Mitchell Brook
Lead	0.24	0.39	1/6	5.1	10.9		SD–06	3/6	8.6	5.2	21.7	SD–14	1/1	7.4	SD–10	1/1	10.8	SD–01	SD–14	Mitchell Brook
Manganese	0.23	3.55	6/6	110	13.5	193	SD–06	6/6	54	36.3	84.0	SD–13	1/1	1,150 J	SD–10	1/1	74.4	SD–01	SD–10	Unnamed brook
Nickel	0.90	2.36	5/6	3.5	1.4	9.5	SD–05	6/6	2.2	1.4 J	3.0	SD–14	1/1	3.0	SD–10	1/1	4.1	SD–01	SD–05	Saugatucket
Selenium	0.95	1.55	1/6	0.85	2.1 J		SD–05	0/6	—	—	—	—	0/1	—	—	0/1	—	—	SD–05	Saugatucket
Vanadium	0.45	1.18	5/6	7.7	4.1	14.2	SD–05	5/6	4.7	3.5	7.6	SD–13	1/1	15.2	SD–10	1/1	10.8	SD–01	SD–10	Unnamed brook
Zinc	0.68	3.15	1/6	14	20.5		SD–06	3/6	16	17.3	30.6	SD–13	1/1	236	SD–10	1/1	25.2	SD–01	SD–10	Unnamed brook
SOIL QUALITY PARAMETERS																					
Sulfide (mg/kg)	0.04	0.07	6/6	48	15.0	129.0	SD–06	6/6	19	3.70	34.0	SD–07	1/1	25.00	SD–10	1/1	8.70	SD–01	SD–06	Saugatucket
Cyanide – Not Detected																					
TOTAL COMBUSTIBLE ORGANICS (%)																					
Organic Content	NA		6/6	5.5	1.0	14.7	SD–03	6/6	3.4	0.8	7.0	SD–13	1/1	4.7	SD–10	1/1	2.8	SD–01	SD–03	Saugatucket
Solids Content	NA		6/6	56	33.6	74.1	SD–02	6/6	67	54.1	80.5	SD–12	1/1	53.2	SD–10	1/1	68.1	SD–01	SD–12	Mitchell Brook
Moisture Content	NA		6/6	44	25.9	66.3	SD–03	6/6	29	15.6	45.9	SD–13	1/1	46.7	SD–10	1/1	31.9	SD–01	SD–03	Saugatucket
GRAIN SIZE (%)																					
Clay	NA		6/6	4.1	0.4	11.8	SD–04	6/6	1.4	0	3.6	SD–14	1/1	10.4	SD–10	1/1	2.9	SD–01	SD–04	Saugatucket
Gravel	NA		6/6	1.7	0.3	2.9	SD–05	6/6	5.6	1	13.8	SD–13	1/1	3	SD–10	1/1	6.6	SD–01	SD–13	Mitchell Brook
Sand	NA		6/6	72	37.7	95	SD–02	6/6	79	57.3	97	SD–12	1/1	67.7	SD–10	1/1	56.9	SD–01	SD–12	Mitchell Brook
Silt	NA		6/6	22	3.8	48.5	SD–04	6/6	14	1.6	26.5	SD–13	1/1	18.8	SD–10	1/1	33.5	SD–01	SD–04	Saugatucket

NOTES:

1. Analytical data is presented in Appendix D.

2. Frequency of detection is the number of samples with positive values. Positive values include approximated values and approximated values less than sample detection limits. Number of samples include all analyzed samples for which analytical values were reported, unless the sample value was rejected.

3. Presents the minimum and maximum values for positive detections. Approximated values and approximated values less than the sample detection limits are also included. A single concentration is presented when only one positive detection occurred.

* The calculated average is greater than the maximum value.

NA = Not Applicable

J = Quantitation is approximate due to limitations identified during laboratory analysis or data validation.

— Analyte was not detected in samples.

TABLE 23 SUMMARY OF CHEMICALS DETECTED IN SEDIMENT, SEPTEMBER 1991 (1)

CHEMICAL	RANGE OF DETECTION LIMITS MINIMUM	RANGE OF DETECTION LIMITS MAXIMUM	SAUGATUCKET RIVER FREQUENCY OF DETECTION (2)	SAUGATUCKET RIVER ARITHMETIC AVERAGE	SAUGATUCKET RIVER RANGE OF CONCENTRATIONS (3) MINIMUM	SAUGATUCKET RIVER RANGE OF CONCENTRATIONS (3) MAXIMUM	SAUGATUCKET RIVER MAXIMUM LOCATION	MITCHELL BROOK FREQUENCY OF DETECTION (2)	MITCHELL BROOK ARITHMETIC AVERAGE	MITCHELL BROOK RANGE OF CONCENTRATIONS (3) MINIMUM	MITCHELL BROOK RANGE OF CONCENTRATIONS (3) MAXIMUM	MITCHELL BROOK MAXIMUM LOCATION	UNNAMED BROOK FREQUENCY OF DETECTION (2)	UNNAMED BROOK CONCEN-TRATIONS	UNNAMED BROOK LOCATION	UNNAMED TRIBUTARY FREQUENCY OF DETECTION (2)	UNNAMED TRIBUTARY CONCEN-TRATIONS	UNNAMED TRIBUTARY LOCATION	OVERALL MAXIMUM LOCATION	WATER BODY ASSOC. WITH OVERALL MAX. LOC.
VOLATILE ORGANICS – (µg/kg)																					
Benzene	12	24	0/7	—	—	—	—	1/5	7.2*	1 J		SD–12	0/1	—	—	0/1	—	—	SD–12	Mitchell Brook
Ethylbenzene	12	24	1/7	7.9*	3 J		SD–05	0/6	—	—	—	—	0/1	—	—	0/1	—	—	SD–05	Saugatucket
Total Xylenes	12	24	1/7	8.6*	8 J		SD–05	0/6	—	—	—	—	0/1	—	—	0/1	—	—	SD–05	Saugatucket
Acetone	12	24	3/7	92	42 J	215 J	SD–08	2/6	73	190	200	SD–09	0/1	—	—	0/1	—	—	SD–08	Saugatucket
2-Butanone	12	24	1/7	12	28 J		SD–08	1/6	16	46		SD–07	0/1	—	—	0/1	—	—	SD–07	Mitchell Brook
4-Methyl-2-pentanone	12	24	0/7	—	—	—	—	0/6	—	—	—	—	1/1	3 J	SD–10	0/1	—	—	SD–10	Unnamed brook
Tetrachloroethene	12	24	1/7	8.3*	4 J		SD–08	2/6	5.8*	2 J	3 J	SD–14	0/1	—	—	0/1	—	—	SD–08	Saugatucket
Chloroform	12	24	0/7	—	—	—	—	1/6	7.8*	5 J		SD–15	0/1	—	—	0/1	—	—	SD–15	Mitchell Brook
Carbon Disulfide	12	24	1/7	11	22 J		SD–08	0/6	—	—	—	—	0/1	—	—	0/1	—	—	SD–08	Saugatucket
SEMIVOLATILE ORGANICS (µg/kg)																					
Fluoranthene	400	800	0/7	—	—	—	—	3/6	140*	31 J	34 J	SD–09	NA	R		0/1	—	—	SD–09	Mitchell Brook
Pyrene	400	800	1/7	260*	39 J		SD–03	3/6	150*	35 J	40 J	SD–15	NA	R		0/1	—	—	SD–15	Mitchell Brook
Di-n-butylphthalate	400	800	0/7	—	—	—	—	1/6	330	650 J		SD–09	NA	R		0/1	—	—	SD–09	Mitchell Brook
PESTICIDES (µg/kg)																					
delta-BHC	2.1	3.7	0/4	—	—	—	—	0/6	—	—	—	—	1/1	0.5 J	SD–10	0/1	—	—	SD–10	Unnamed brook
4,4'-DDE	4.0	7.1	0/4	—	—	—	—	2/6	2.8	1.6 J	4.9 J	SD–09	1/1	0.65 J	SD–10	0/1	—	—	SD–09	Mitchell Brook
4,4'-DDD	4.0	7.1	0/4	—	—	—	—	1/6	3.6	8.2		SD–09	0/1	—	—	0/1	—	—	SD–09	Mitchell Brook
4,4'-DDT	4.0	7.1	0/4	—	—	—	—	0/6	—	—	—	—	1/1	0.90J	SD–10	0/1	—	—	SD–10	Unnamed brook
Methoxychlor	21.0	37	0/4	—	—	—	—	0/6	—	—	—	—	1/1	2.6J	SD–10	0/1	—	—	SD–10	Unnamed brook
Endosulfan II	4.0	7.1	0/4	—	—	—	—	0/6	—	—	—	—	1/1	0.31J	SD–10	0/1	—	—	SD–10	Unnamed brook
Dieldrin	4.0	7.1	0/4	—	—	—	—	0/6	—	—	—	—	1/1	1.3J	SD–10	0/1	—	—	SD–10	Unnamed brook
gamma-Chlordane	2.1	3.7	0/4	—	—	—	—	0/6	—	—	—	—	1/1	0.23J	SD–10	0/1	—	—	SD–10	Unnamed brook
PCBs																					
None Detected																					
METALS (mg/kg)																					
Aluminum	3.1	12.08	7/7	3,800	1,260	8,420	SD–05	6/6	4,400	1,660	6,080	SD–13	1/1	4,000	SD–10	1/1	8,650	SD–01	SD–01	Unnamed brook
Iron	1.4	4.68	7/7	5,600	1,020	16,400	SD–04	6/6	7,300	5,010	14,600	SD–07	1/1	85,500	SD–10	1/1	10,500	SD–01	SD–10	Unnamed brook
Calcium	4.8	11.3	7/7	910	350 J	1,760 J	SD–03	6/6	580	290	949	SD–07	1/1	1,125	SD–10	1/1	751 J	SD–01	SD–03	Saugatucket
Magnesium	6.2	17.93	7/7	980	362	2,560	SD–06	6/6	700	350	933	SD–07	1/1	816	SD–10	1/1	1,550	SD–01	SD–06	Saugatucket
Sodium	3.1	22.22	2/7	41	59.6	63.2	SD–08	5/6	49	31.5	67.4	SD–07	0/1	—	—	0/1	—	—	SD–07	Mitchell Brook
Potassium	51.8	250	4/7	200	111 J	488	SD–05	6/6	340	230	583	SD–07	1/1	654	SD–10	1/1	775	SD–01	SD–01	Unnamed trib.
Antimony	6.0	18.32	0/7	—	—	—	—	0/6	—	—	—	—	1/1	62.1J	SD–10	0/1	—	—	SD–10	Unnamed brook
Arsenic	0.24	0.75	3/7	0.47	0.43	1.2	SD–05	4/6	0.44	0.35 J	0.7	SD–09	1/1	4.6	SD–10	1/1	1.2	SD–01	SD–10	Unnamed brook
Barium	0.24	0.78	7/7	13	3.1	30.5	SD–04	6/6	17	9.3	25.6	SD–13	1/1	46.8J	SD–10	1/1	21.5	SD–01	SD–10	Unnamed brook
Beryllium	0.24	0.56	1/7	0.56	2.3		SD–04	0/6	—	—	—	—	1/1	1.2	SD–10	0/1	—	—	SD–04	Saugatucket
Cadmium	0.72	1.7	0/7	—	—	—	—	1/6	0.60	1.3 J		SD–13	0/1	—	—	0/1	—	—	SD–13	Mitchell Brook
Chromium	1.9	4.5	4/7	8.5	11.4	18.1	SD–06	0/6	—	—	—	—	0/1	—	—	1/1	11.1	SD–01	SD–06	Saugatucket
Cobalt	1.4	3.4	4/7	2.9	1.9	6.5	SD–05	4/6	2.3	2.0	4.4	SD–13	1/1	5.7	SD–10	1/1	5.0	SD–01	SD–05	Saugatucket
Copper	1.0	2.3	0/7	—	—	—	—	0/6	—	—	—	—	1/1	56.1 J	SD–10	0/1	—	—	SD–10	Unnamed brook
Lead	0.24	0.75	7/7	9.8	4.3 J	24.2 J	SD–03	6/6	13	3.5 J	27.7 J	SD–13	1/1	243.4 J	SD–10	1/1	12.2 J	SD–01	SD–10	Unnamed brook
Manganese	0.48	1.1	7/7	97	20.4	207	SD–05	6/6	91	41.1	222	SD–07	1/1	530 J	SD–10	1/1	113	SD–01	SD–10	Unnamed brook
Nickel	3.51	9.0	2/7	6.9	12.8	20.5	SD–06	0/6	—	—	—	—	1/1	3.4	SD–10	1/1	7.3	SD–01	SD–06	Saugatucket
Selenium	0.24	1.5	3/7	0.46	0.37 J	1.3 J	SD–05	0/6	—	—	—	—	0/1	—	—	0/1	—	—	SD–05	Saugatucket
Thallium	0.24	0.56	0/7	—	—	—	—	2/6	0.22	0.37	0.37	SD–15	0/1	—	—	0/1	—	—	SD–15	Mitchell Brook
Vanadium	0.72	1.95	7/7	8.3	2.0	17.7	SD–05	5/6	7.7	6.0	11.5	SD–13	1/1	12.4	SD–10	1/1	16.8	SD–01	SD–05	Saugatucket
Zinc	1.4	3.4	2/7	20	43.6	49.8	SD–05	2/6	20	33.6 J	43.9 J	SD–15	1/1	229 J	SD–10	1/1	33.7	SD–01	SD–10	Unnamed brook
SOIL QUALITY PARAMETERS																					
Sulfide (mg/kg)	10	17	0/7	—	—	—	—	1/6	150	850 J		SD–12	0/1	—	—	0/1	—	—	SD–12	Mitchell Brook
Cyanide – Not Detected																					
TOTAL COMBUSTIBLE ORGANICS (%)																					
Organic Content	NA		7/7	5.6	1.8	9.3	SD–03	6/6	4.2	0.8	7.6	SD–13	1/1	6.0	SD–10	1/1	4.7	SD–01	SD–03	Saugatucket
Solids Content	NA		7/7	57	43.2	68.9	SD–04	6/6	68	53.3	81.8	SD–12	1/1	52.3	SD–10	1/1	62.9	SD–01	SD–12	Mitchell Brook
Moisture Content	NA		7/7	43	31.0	56.7	SD–11	6/6	32	18.2	46.6	SD–09	1/1	47.8	SD–10	1/1	37.2	SD–01	SD–11	Saugatucket
GRAIN SIZE (%)																					
Clay	NA		7/7	4.0	0	11.6	SD–04	6/6	1.1	0	3.2	SD–13	1/1	7.8	SD–10	1/1	7.5	SD–01	SD–04	Saugatucket
Gravel	NA		7/7	1.7	0.1	4.2	SD–05	6/6	7.0	0.2	12.9	SD–14	1/1	0.9	SD–10	1/1	1.8	SD–01	SD–14	Mitchell Brook
Sand	NA		7/7	71	31.1	93.4	SD–06	6/6	76	57	97.3	SD–12	1/1	64.0	SD–10	1/1	51.2	SD–01	SD–12	Mitchell Brook
Silt	NA		7/7	23	5	54.2	SD–04	6/6	16	2.2	29.1	SD–13	1/1	27.4	SD–10	1/1	39.5	SD–01	SD–04	Saugatucket

NOTES:

1. Analytical data is presented in Appendix D.

2. Frequency of detection is the number of samples with positive values. Positive values include approximated values and approximated values less than sample detection limits. Number of samples include all analyzed samples for which analytical values were reported, unless the sample value was rejected.

3. Presents the minimum and maximum values for positive detections. Approximated values and approximated values less than the sample detection limits are also included. A single concentration is presented when only one positive detection occurred.

* The calculated average is greater than the maximum value.

NA = Not Applicable

J = Quantitation is approximate due to limitations identified during laboratory analysis or data validation.

R = All sample values were rejected.

— Analyte was not detected in samples.

TABLE 24 SUMMARY OF CHEMICALS DETECTED IN SEDIMENT, MAY 1992 (1)

			SAUGATUCKET RIVER					MITCHELL BROOK						
	RANGE OF DETECTION LIMITS		FREQUENCY OF	ARITHMETIC	RANGE OF CONCENTRATIONS (3)		MAXIMUM	FREQUENCY OF	ARITHMETIC	RANGE OF CONCENTRATIONS (3)		MAXIMUM	OVERALL MAXIMUM	WATER BODY ASSOC. WITH OVERALL
CHEMICAL	MINIMUM	MAXIMUM	DETECTION (2)	AVERAGE	MINIMUM	MAXIMUM	LOCATION	DETECTION (2)	AVERAGE	MINIMUM	MAXIMUM	LOCATION	LOCATION	MAX. LOC.
VOLATILE ORGANICS – (µg/kg)														
None Detected														
SEMIVOLATILE ORGANICS (µg/kg)														
Phenanthrene	350	500	1 / 7	180 *	57 J		SD–11	0 / 4	—	—	—	—	SD–11	Saugatucket
Anthracene	350	500	1 / 7	190 *	64 J		SD–11	0 / 4	—	—	—	—	SD–11	Saugatucket
Fluoranthene	350	500	1 / 7	190 *	81 J		SD–11	0 / 4	—	—	—	—	SD–11	Saugatucket
Pyrene	350	500	1 / 7	180 *	39 J		SD–11	0 / 4	—	—	—	—	SD–11	Saugatucket
PESTICIDES (µg/kg)														
delta-BHC	1.9	2.7	6 / 7	0.78	0.46 J	1.3 J	SD–11	4 / 4	0.64	0.57 J	0.73 J	SD–12	SD–11	Saugatucket
4,4'-DDE	3.6	5.3	2 / 7	2.2	1.2 J	4.3 J	SD–11	0 / 4	—	—	—	—	SD–11	Saugatucket
4,4'-DDD	3.6	5.3	1 / 7	2.9	8.0		SD–11	0 / 4	—	—	—	—	SD–11	Saugatucket
PCBs														
None Detected														
METALS (mg/kg)														
Aluminum	10.9	18.8	7 / 7	1,500	836	1,860	SD–11	4 / 4	2,100	1,860	2,640	SD–07	SD–07	Mitchell Brook
Iron	1.1	1.9	7 / 7	7,700	885	25,900	SD–05	4 / 4	8,700	3,985	12,400	SD–07	SD–05	Saugatucket
Calcium	2.2	3.8	5 / 7	280	258	555	SD–11	4 / 4	210	176.5	242	SD–16	SD–11	Saugatucket
Magnesium	2.2	3.8	7 / 7	260	114	489	SD–17	4 / 4	490	388	613	SD–07	SD–07	Mitchell Brook
Arsenic	0.19	0.41	2 / 7	1.2	2.0 J	6.1	SD–05	4 / 4	0.72	0.31 J	1.1	SD–12	SD–05	Saugatucket
Barium	0.11	0.19	7 / 7	7.2	2.9	13.7 J	SD–05	4 / 4	9.2	6.2	11.5	SD–07	SD–05	Saugatucket
Beryllium	0.11	0.19	2 / 7	0.20	0.25	0.79	SD–06	3 / 4	0.25	0.27	0.42	SD–07	SD–06	Saugatucket
Chromium	0.44	0.75	7 / 7	1.7	1.1	2.5	SD–18	4 / 4	1.9	1.35	2.5	SD–07	SD–07	Mitchell Brook
Cobalt	0.33	0.56	4 / 7	0.76	0.91	1.4	SD–06	4 / 4	1.1	0.59 J	1.8	SD–07	SD–07	Mitchell Brook
Lead	0.09	0.21	7 / 7	6.5	3.7	13.5	SD–18	4 / 4	3.1	2.3	4.1	SD–16	SD–18	Saugatucket
Manganese	0.11	0.19	7 / 7	110	22.6	200	SD–04	4 / 4	110	57.8	241	SD–07	SD–07	Mitchell Brook
Nickel	2.2	3.8	1 / 7	1.8	4.7		SD–06	1 / 4	1.8	3.8		SD–12	SD–06	Saugatucket
Selenium	0.19	0.41	2 / 7	0.24	0.43	0.58	SD–18	0 / 4	—	—	—	—	SD–18	Saugatucket
Vanadium	0.22	0.38	1 / 7	1.9	3.4 J		SD–05	1 / 4	3.2	6.4		SD–07	SD–07	Mitchell Brook
Zinc	0.22	0.38	1 / 7	5.9	11.2		SD–05	0 / 4	—	—	—	—	SD–05	Saugatucket
SOIL QUALITY PARAMETERS														
Cyanide - Not Detected														
Ammonia (mg/kg)	0.980	1.37	3 / 7	1.4	2.01	3.17	SD–05	2 / 4	7.7	4.36	25.6	SD–12	SD–12	Mitchell Brook
TOTAL COMBUSTIBLE ORGANICS (%)														
Organic Content	NA		7 / 7	2.4	1.3	5.6	SD–11	4 / 4	1.3	1.1	1.8	SD–16	SD–11	Saugatucket
Solids Content	NA		7 / 7	71	50.5	78.3	SD–04	4 / 4	80	76.05	85.5	SD–12	SD–12	Mitchell Brook
Moisture Content	NA		7 / 7	43	27.7	97.9	SD–11	4 / 4	25	16.9	31.5	SD–09	SD–11	Saugatucket
GRAIN SIZE (%)														
Clay	NA		7 / 7	0	0	0	SD–11	4 / 4	0	0	0	SD–12	SD–12	Mitchell Brook
Gravel	NA		7 / 7	14	0.7	33.2	SD–05	4 / 4	6.8	0.9	10.65	SD–09	SD–05	Saugatucket
Sand	NA		7 / 7	82	64.6	95.8	SD–06	4 / 4	91	86.45	95.7	SD–16	SD–06	Saugatucket
Silt	NA		7 / 7	3.9	1.8	6.2	SD–11	4 / 4	2.4	1.5	3.4	SD–16	SD–11	Saugatucket

NOTES:

1. Analytical data is presented in Appendix D.
2. Frequency of detection is the number of samples with positive values. Positive values include approximated values and approximated values less than sample detection limits. Number of samples include all analyzed samples for which analytical values were reported, unless the sample value was rejected.
3. Presents the minimum and maximum values for positive detections. Approximated values and approximated values less than the sample detection limits are also included. A single concentration is presented when only one positive detection occurred.

* The calculated average is greater than the maximum value.

NA = Not Applicable

J = Quantitation is approximate due to limitations identified during laboratory analysis or data validation.

— Analyte was not detected in samples.

TABLE 25 SUMMARY OF CHEMICALS DETECTED IN LEACHATE, JUNE 1991 (1)

			SAUGATUCKET RIVER				MITCHELL BROOK			
	RANGE OF DETECTION LIMITS (2)		FREQUENCY OF	ARITHMETIC	RANGE OF CONCENTRATIONS (4)		FREQUENCY OF		OVERALL MAXIMUM	WATER BODY ASSOC. WITH OVERALL
CHEMICAL	MINIMUM	MAXIMUM	DETECTION (3)	AVERAGE	MINIMUM	MAXIMUM	MAXIMUM LOCATION	DETECTION (3)	CONCENTRATION	LOCATION	MAX. LOC.
VOLATILE ORGANICS – (Fg/L)											
Toluene		5	3 / 5	22	27 J	50	LE–03	0 / 1	—	LE–03	Saugatucket
Chlorobenzene		5	3 / 5	2.2 *	2 J	2 J	LE–03	0 / 1	—	LE–03	Saugatucket
Trichloroethene		5	0 / 4	—	—	—	—	1 / 1	4 J	LE–01	Mitchell Brook
1,2-Dichloroethene(total)		5	0 / 4	—	—	—	—	1 / 1	44	LE–01	Mitchell Brook
1,1-Dichloroethane		5	3 / 5	2.2 *	2 J	2 J	LE–03	0 / 1	—	LE–03	Saugatucket
Chloroethane		10	3 / 5	5.8	5 J	8 J	LE–03	0 / 1	—	LE–03	Saugatucket
Vinyl Chloride		10	0 / 4	—	—	—	—	1 / 1	1 J	LE–01	Mitchell Brook
Carbon Disulfide		5	1 / 4	2.6	3 J		LE–02	1 / 1	12	LE–01	Mitchell Brook
SEMIVOLATILE ORGANICS (Fg/L)											
bis(2-Ethylhexyl)phthalate		10	1 / 5	50	230 J		LE–06	0 / 1	—	LE–06	Saugatucket
PESTICIDES/PCBs											
None Detected											
METALS – UNFILTERED (Fg/L)											
Aluminum	10	27	4 / 5	2,100	184 J	9,220 J	LE–02	1 / 1	60,500 J	LE–01	Mitchell Brook
Iron	7	18	5 / 5	370,000	15,200	1,370,000 J	LE–02	1 / 1	133,000 J	LE–02	Saugatucket
Calcium	7	28	5 / 5	27,000	10,000	59,000	LE–02	1 / 1	14,900	LE–02	Saugatucket
Magnesium	13	33	5 / 5	7,500	2,420	16,100	LE–02	1 / 1	5,610	LE–02	Saugatucket
Sodium	22	30	5 / 5	23,000	5,560	55,400	LE–02	1 / 1	9,300 J	LE–02	Saugatucket
Potassium	42	251	5 / 5	16,000	2,000	44,800	LE–02	1 / 1	3,620	LE–02	Saugatucket
Arsenic	2	4	0 / 4	—	—	—	—	1 / 1	3.7	LE–01	Mitchell Brook
Barium	1	2	5 / 5	550	22.2	2,120	LE–02	1 / 1	328 J	LE–02	Saugatucket
Beryllium		1	1 / 5	2.3	8.7		LE–02	1 / 1	11.2	LE–01	Mitchell Brook
Chromium	2	7	0 / 5	—	—	—	—	1 / 1	23.9	LE–01	Mitchell Brook
Cobalt	2	4	4 / 5	63	5.6	295	LE–02	0 / 1	—	LE–02	Saugatucket
Copper	3	11	0 / 5	—	—	—	—	1 / 1	37.8	LE-01	Mitchell Brook
Lead	1	2	1 / 5	37	174 J		LE-02	1 / 1	150	LE-02	Saugatucket
Manganese	1	9	5 / 5	8,300	2,490 J	14,700 J	LE–02	1 / 1	814	LE–02	Saugatucket
Nickel	4	6	2 / 5	5.3	4 j	13.6	LE-02	1 / 1	15.8	LE–01	Mitchell Brook
Vanadium	2	3	2 / 5	18	22.2	65.2	LE–02	1 / 1	49.8	LE–02	Saugatucket
Zinc	3	8	2 / 4	260 *	34.3	133 J	LE–02	1 / 1	209 J	LE–01	Mitchell Brook
METALS – FILTERED (µg/L)											
Iron	7	18	5 / 5	29,000	743	64,100 J	LE–03	1 / 1	1,260 J	LE–03	Saugatucket
Calcium	7	28	5 / 5	16,000	4,500	41,500	LE–05	1 / 1	4,400	LE–05	Saugatucket
Magnesium	13	33	5 / 5	4,800	1,420	11,500	LE–05	1 / 1	1,360	LE–05	Saugatucket
Sodium	22	30	5 / 5	16,000	7,095	42,600	LE–05	1 / 1	11,600	LE–05	Saugatucket
Potassium	42	251	5 / 5	7,200	1,000	26,700	LE–05	1 / 1	1,440	LE–05	Saugatucket
Barium	1	2	4 / 5	57	22.5	143	LE–05	1 / 1	21.5	LE–05	Saugatucket
Cobalt	2	4	1 / 5	2.5	3.5 J		LE–04	0 / 1	—	LE–04	Saugatucket
Manganese	1	9	5 / 5	5,100	246	9,700 J	LE–03	1 / 1	184 J	LE–03	Saugatucket
WATER QUALITY PARAMETERS											
Cyanide (mg/L)		2	2 / 5	19	36.1	41.7	LE–06	0 / 1	—	LE–06	Saugatucket
Total Organic Carbon (mg/L)		1.0	3 / 5	18	18 J	48 J	LE–02	1 / 1	8.4 J	LE–02	Saugatucket
Biochemical Oxygen Demand (mg/L)		2.4	2 / 5	15	7.5	51	LE–02	0 / 1	—	LE–02	Saugatucket
Hardness (mg/L)		NA	5 / 5	99	35	214	LE–02	1 / 1	60	LE–02	Saugatucket
pH		NA	5 / 5	6.5	6.2	7.1	LE–02	1 / 1	5.4	LE–02	Saugatucket
Specific Conductance (Fmhos/cm)		NA	5 / 5	750	250	1,800	LE–05	1 / 1	100	LE–05	Saugatucket

NOTES:

1. Analytical data is presented in Appendix D.
2. If all sample detection limits are the same, a single detection limit is presented.
3. Frequency of detection is the number of samples with positive values. Positive values include approximated values and approximated values less than sample detection limits. Number of samples include all analyzed samples for which analytical values were reported, unless the sample value was rejected.
4. Presents the minimum and maximum values for positive detections. Approximated values and approximated values less than the sample detection limits are also included. A single concentration is presented when only one positive detection occurred.

* The calculated average is greater than the maximum value.

NA = Not Applicable

J = Quantitation is approximate due to limitations identified during laboratory analysis or data validation.

— Analyte was not detected in samples.

TABLE 26 **SUMMARY OF CHEMICALS DETECTED IN LEACHATE, APRIL 1992 (1)**

			SAUGATUCKET RIVER			
	RANGE OF DETECTION LIMITS		FREQUENCY OF	ARITHMETIC	RANGE OF CONCENTRATIONS (3)	
CHEMICAL	MINIMUM	MAXIMUM	DETECTION (2)	AVERAGE	MINIMUM	MAXIMUM
VOLATILE ORGANICS – (µg/L)						
Ethylbenzene		10	3 / 3	1.7	1 J	2 J
Total Xylenes		10	2 / 3	3.3 *	2 J	3 J
1,2–Dichloroethene(total)		10	1 / 3	3.7 *	1 J	
Chloroethane		10	1 / 3	4.0 *	2 J	
WATER SOLUBLE ORGANICS						
None Detected						
SEMIVOLATILE ORGANICS (µg/L)						
Napthalene		10	3 / 3	0.77	0.7 J	0.9 J
Diethylphthalate		10	3 / 3	6.3	4 J	11
PESTICIDES/PCBs						
None Detected						
METALS – UNFILTERED (µg/L)						
Aluminum	21	22	2 / 3	310	238.75 J	623
Iron	23	25	3 / 3	140,000	49,800	283,000
Calcium	28	34	3 / 3	20,000	16,700	23,000
Magnesium	22	55	3 / 3	6,600	5,710	7,220
Sodium	34	67	3 / 3	23,000	20,800	24,700
Potassium	82	194	3 / 3	14,000	12,000	15,200
Barium	1	5	3 / 3	180	97.4 J	293 J
Chromium	3	5	1 / 3	2.6	4.85 J	
Lead	1		1 / 3	5.0	10.5 J	
Manganese	1		3 / 3	1,900	1,490	2,410
Mercury	0.2		1 / 3	0.13	0.2	
Zinc	8	11	1 / 2	6.8	8.1 J	
METALS – FILTERED (µg/L)						
Iron	23	25	3 / 3	20,000	13,800	27,500
Calcium	28	34	3 / 3	20,000	17,100	21,800
Magnesium	22	55	3 / 3	6,800	5,730	7,530
Sodium	34	67	3 / 3	25,000	22,900	27,700
Potassium	82	194	3 / 3	15,000	12,200	16,100
Barium	1	5	3 / 3	81	80.3	82.5
Manganese	1		3 / 3	1,500	1,410	1,570
WATER QUALITY PARAMETERS						
Cyanide	Not Detected					
Ammonia (mg/L)	0.0300		3 / 3	13	5.06	21.75
Total Organic Carbon (mg/L)	0.5		3 / 3	41	30.9	49.9
Biochemical Oxygen Demand (mg/L)	1.0		3 / 3	3.2	1.5	4.1 J
Hardness (mg/L)	NA		3 / 3	78	65	87
pH	NA		1 / 1	NA	6.5	
Specific Conductance (µmhos/cm)	NA		1 / 1	NA	412	

NOTES:

1. Analytical data is presented in Appendix D. Data is summarized for one sample, LE–05, collected on three consecutive days.
2. If all sample detection limits are the same, a single detection limit is presented.
3. Frequency of detection is the number of samples with positive values. Positive values include approximated values and approximated values less than sample detection limits. Number of samples include all analyzed samples for which analytical values were reported, unless the sample value was rejected.
4. Presents the minimum and maximum values for positive detections. Approximated values and approximated values less than sample detection limits are also included. A single concentration is presented when only one positive detection occurred.

* The calculated average is greater than the maximum value.

NA = Not Applicable

J = Quantitation is approximate due to limitations identified during laboratory analysis or data validataion.

— Analyte was not detected in samples.

TABLE 27

POTENTIAL RISK FROM INGESTION OF SITE GROUNDWATER WITHIN THE SOLID WASTE AREA (AS DRINKING WATER)
AVERAGE CONCENTRATIONS USED FOR AN ADULT EXPOSURE (a)

Analyte	Average Concentration (ug/L)	Exposure Dose Chronic (b) (mg/kg/day)	Oral Reference Dose (RfD) (mg/kg/day)	Hazard Quotient (c)		Exposure Dose Lifetime (b) (mg/kg/day)	Oral Slope Factor /(mg/kg/day)	Cancer Risk (d)
Benzene	11	3.0E-04	na	—		1.3E-04	0.029	3.7E-06
1,1-Dichloroethane	14	3.8E-04	0.1	3.8E-03		1.6E-04	na	—
1,2-Dichloroethene (e)	34	9.3E-04	0.01	9.3E-02		4.0E-04	na	—
Vinyl Chloride	34	9.3E-04	na	—		4.0E-04	1.9	7.6E-04
Pentachlorophenol	3	8.2E-05	0.03	2.7E-03		3.5E-05	0.12	4.2E-06
bis(2-Ethylhexyl)phthalate	5.6	1.5E-04	0.02	7.7E-03		6.6E-05	0.014	9.2E-07
Acrylamide	160	4.4E-03	0.0002	2.2E+01		1.9E-03	4.5	8.5E-03
N,N-DMF	200	5.5E-03	0.1	5.5E-02		2.3E-03	na	—
Antimony	nd	—	0.0004	—		—	na	—
Arsenic	2.7	7.4E-05	0.0003	2.5E-01		3.2E-05	1.5	4.8E-05
Barium	170	4.7E-03	0.07	6.7E-02		2.0E-03	na	—
Beryllium	1.7	4.7E-05	0.002	2.3E-02		2.0E-05	na	—
Cadmium (f)	4.4	1.2E-04	0.0005	2.4E-01		5.2E-05	na	—
Chromium (e)	24	6.6E-04	0.005	1.3E-01		2.8E-04	na	—
Manganese (h)	1900	5.2E-02	0.024	2.2E+00		2.2E-02	na	—
Nickel	26	7.1E-04	0.02	3.6E-02		3.1E-04	na	—
Vanadium	21	5.8E-04	0.007	8.2E-02		2.5E-04	na	—
Zinc	680	1.9E-02	0.3	6.2E-02		8.0E-03	na	—
		Total Hazard Index =		2.5E+01		Total Risk =		9.3E-03
		Hazard Index (liver toxins)=		0.07				
		Hazard index (nervous system toxins)=		24.09				
		Hazard Index (kidney toxins)=		0.24				
		Hazard Index (red blood cell effects)=		0.16				

NOTES:

(a) This table does not include groundwater chemicals of concern for which no reference dose or slope factor exists.
(chloroethane,2-methylnapthalene, 4-chloro-3-methylphenol, aluminum, cobalt, copper, lead, sulfide and ammonia)

(b) Calculation for exposure dose :

INGESTION EXPOSURE	–	Conc. x	Ingestion Rate	x Exposure Frequency	x Exposure Duration	/ Body Weight	Averaging Time	x	Conversion Factor
DOSE		Conc.	2 L/day	350 days/yr	30 years	70 kg	(g) years		365 x 1E+03 days/year ug/mg

(c) Hazard quotient = chronic exposure dose / RfD

(d) Cancer Risk = lifetime exposure dose x slope factor

(e) Dose-response data for cis-1,2-dochloroethene and chromium VI were used.

(f) Reference Dose for cadmium in water was used.

(g) Averaging times of 30 years for chronic doses and 70 years for lifetime doses were used.

(h) The reference dose for manganese is based on total allowable intake (10 mg/day) minus the background intake (5 mg/day).

The remaining intake (5 mg/day) was normalized for body weight (70 kg) and an additional uncertainty factor of 3 applied for water exposures.

nd = chemical not detected

na = toxicity value not available

— = not calculated due to absence of data

TABLE 28

POTENTIAL RISK FROM INGESTION OF SITE GROUNDWATER WITHIN THE SOLID WASTE AREA (AS DRINKING WATER)
MAXIMUM CONCENTRATIONS USED FOR AN ADULT EXPOSURE (a)

Analyte	Maximum Concentration (ug/L)	Exposure Dose Chronic (b) (mg/kg/day)	Oral Reference Dose (RfD) (mg/kg/day)	Hazard Quotient (c)		Exposure Dose Lifetime (b) (mg/kg/day)	Oral Slope Factor /(mg/kg/day)	Cancer Risk (d)
Benzene	31	8.5E-04	na	—		3.6E-04	0.029	1.1E-05
1,1-Dichloroethane	220	6.0E-03	0.1	—		2.6E-03	na	—
1,2-Dichloroethene (e)	730	2.0E-02	0.01	2.0E+00		8.6E-03	na	—
Vinyl Chloride	690	1.9E-02	na	—		8.1E-03	1.9	1.5E-02
Pentachlorophenol	3	8.2E-05	0.03	2.7E-03		3.5E-05	0.12	4.2E-06
bis(2-Ethylhexyl)phthalate	36	9.9E-04	0.02	4.9E-02		4.2E-04	0.014	5.9E-06
Acrylamide	229	6.3E-03	0.0002	3.1E+01		2.7E-03	4.5	1.2E-02
N,N-DMF	1440	3.9E-02	0.1	3.9E-01		1.7E-02	na	—
Antimony	nd	—	0.0004	—		—	na	—
Arsenic	9.7	2.7E-04	0.0003	8.9E-01		1.1E-04	1.5	1.7E-04
Barium	508	1.4E-02	0.07	2.0E-01		6.0E-03	na	—
Beryllium	13.7	3.8E-04	0.002	1.9E-01		1.6E-04	na	—
Cadmium (f)	40	1.1E-03	0.0005	2.2E+00		4.7E-04	na	—
Chromium (e)	154	4.2E-03	0.005	8.4E-01		1.8E-03	na	—
Manganese (h)	9790	2.7E-01	0.024	1.1E+01		1.1E-01	na	—
Nickel	125	3.4E-03	0.02	1.7E-01		1.5E-03	na	—
Vanadium	142	3.9E-03	0.007	5.6E-01		1.7E-03	na	—
Zinc	7360	2.0E-01	0.3	6.7E-01		8.6E-02	na	—
		Total Hazard Index =		5.1E+01		Total Risk =		2.8E-02
		Hazard Index (liver toxins)=		0.45				
		Hazard index (nervous system toxins)=		42.55				
		Hazard Index (kidney toxins)=		2.19				
		Hazard Index (red blood cell effects)=		2.67				

NOTES:

(a) This table does not include groundwater chemicals of concern for which no reference dose or slope factor exists.
(chloroethane,2-methylnapthalene, 4-chloro-3-methylphenol, aluminum, cobalt, copper, lead, sulfide and ammonia)

(b) Calculation for exposure dose :

INGESTION EXPOSURE	–	Conc.	x	Ingestion Rate	x Exposure Frequency	x Exposure Duration	/ Body Weight	Averaging Time	x Conversion Factor
DOSE		Conc.		2 L/day	350 days/yr	30 years	70 kg	(g) years	365 x 1E+03 days/year ug/mg

(c) Hazard quotient = chronic exposure dose / RfD

(d) Cancer Risk = lifetime exposure dose x slope factor

(e) Dose-response data for cis-1,2-dochloroethene and chromium VI were used.

(f) Reference Dose for cadmium in water was used.

(g) Averaging times of 30 years for chronic doses and 70 years for lifetime doses were used.

(h) The reference dose for manganese is based on total allowable intake (10 mg/day) minus the background intake (5 mg/day).
The remaining intake (5 mg/day) was normalized for body weight (70 kg) and an additional uncertainty factor of 3 applied for water exposures.

nd = chemical not detected

na = toxicity value not available

— = not calculated due to absence of data

TABLE 29

POTENTIAL RISK OF INGESTION OF SITE GROUNDWATER WITHIN THE BULKY WASTE AREA (AS DRINKING WATER)
AVERAGE CONCENTRATIONS USED FOR AN ADULT EXPOSURE (a)

Analyte	Average Concentration (ug/L)	Exposure Dose Chronic (b) (mg/kg/day)	Oral Reference Dose (RfD) (mg/kg/day)	Hazard Quotient (c)		Exposure Dose Lifetime (b) (mg/kg/day)	Oral Slope Factor /(mg/kg/day)	Cancer Risk (d)
Benzene	1	2.7E-05	na	---		1.2E-05	0.029	3.4E-07
1,1-Dichloroethane	5	1.4E-04	0.1	1.4E-03		5.9E-05	na	—
1,2-Dichloroethene (e)	5	1.4E-04	0.01	1.4E-02		5.9E-05	na	—
Vinyl Chloride	nd	—	na	—		—	1.9	---
Pentachlorophenol	nd	—	0.03	---		---	0.12	---
bis(2-Ethylhexyl)phthalate	nd	—	0.02	---		---	0.014	---
Acrylamide	nd	—	0.0002	---		---	4.5	---
N,N-DMF	33	9.0E-04	0.1	9.0E-03		3.9E-04	na	—
Antimony	19	5.2E-04	0.0004	1.3E+00		2.2E-04	na	—
Arsenic	0.84	2.3E-05	0.0003	7.7E-02		9.9E-06	1.5	1.5E-05
Barium	81	2.2E-03	0.07	---		9.5E-04	na	—
Beryllium	2	5.5E-05	0.002	2.7E-02		2.3E-05	na	—
Cadmium (f)	nd	—	0.0005	---		---	na	—
Chromium (e)	9.9	2.7E-04	0.005	5.4E-02		1.2E-04	na	—
Manganese (h)	1600	4.4E-02	0.024	1.8E+00		1.9E-02	na	—
Nickel	13	3.6E-04	0.02	1.8E-02		1.5E-04	na	—
Vanadium	15	4.1E-04	0.007	5.9E-02		1.8E-04	na	—
Zinc	61	1.7E-03	0.3	5.6E-03		7.2E-04	na	—
		Total Hazard Index =		3.4E+00		Total Risk =		1.5E-05
		Hazard Index (liver toxins)=		0.01				
		Hazard Index (nervous system toxins)=		1.83				
		Hazard Index (kidney toxins)=		0.00				
		Hazard Index (red blood cell effects)=		0.02				
		Hazard Index (longevity)=		1.30				

NOTES:

(a) This table does not include groundwater chemicals of concern for which no reference dose or slope factor exists.
(chloroehtane,2-methylnapthalene, 4-chloro-3-methylphenol, aluminum, cobalt, copper, lead, sulfide and ammonia)

(b) Calculation for exposure dose:

INGESTION EXPOSURE DOSE	= Conc. x Conc.	Ingestion Rate	x Exposure Frequency	x Exposure Duration	/ Body Weight	Averaging Time	x	Conversion Factor
		2	350	30	70	(g)		365 x 1E+03
		L/day	days/yr	years	kg	years		days/year ug/mg

(c) Hazard quotient = chronic exposure dose / RfD

(d) Cancer Risk = lifetime exposure dose x slope factor

(e) Dose-response data for cis-1,2-dichloroethene and chromium VI were used.

(f) Reference Dose for cadmium in water was used.

(g) Averaging times of 30 years for chronic doses and 70 years for lifetime doses were used.

(h) The reference dose for manganese is based on total allowable intake (10 mg/day) minus the background intake (5 mg/day).
The remaining intake (5 mg/day) was normalized for body weight (70 kg) and an additional uncertainty factor of 3 applied for water exposures.

nd = chemical not detected

na = toxicity value not available

--- = not calculated due to absence of data

TABLE 30

POTENTIAL RISK OF INGESTION OF SITE GROUNDWATER WITHIN THE BULKY WASTE AREA (AS DRINKING WATER)
MAXIMUM CONCENTRATIONS USED FOR AN ADULT EXPOSURE (a)

Analyte	Maximum Concentration (ug/L)	Exposure Dose Chronic (b) (mg/kg/day)	Oral Reference Dose (RfD) (mg/kg/day)	Hazard Quotient (c)		Exposure Dose Lifetime (b) (mg/kg/day)	Oral Slope Factor /(mg/kg/day)	Cancer Risk (d)
Benzene	1	2.7E-05	na	---		1.2E-05	0.029	3.4E-07
1,1-Dichloroethane	5	1.4E-04	0.1	1.4E-03		5.9E-05	na	—
1,2-Dichloroethene (e)	5	1.4E-04	0.01	1.4E-02		5.9E-05	na	—
Vinyl Chloride	nd	—	na	—		—	1.9	---
Pentachlorophenol	nd	—	0.03	---		---	0.12	---
bis(2-Ethylhexyl)phthalate	nd	—	0.02	---		---	0.014	---
Acrylamide	nd	—	0.0002	---		---	4.5	---
N,N-DMF	183	5.0E-03	0.1	5.0E-02		2.1E-03	na	—
Antimony	104.9	2.9E-05	0.0004	7.2E+00		1.2E-03	na	—
Arsenic	2.3	6.3E-05	0.0003	2.1E01		2.7E-05	1.5	4.1E-05
Barium	430	1.2E-02	0.07	---		5.0E-03	na	—
Beryllium	10.5	2.9E-04	0.002	1.4E-01		1.2E-04	na	—
Cadmium (f)	nd	---	0.0005	---		---	na	—
Chromium (e)	66.6	1.8E-03	0.005	36E-01		7.8E-04	na	—
Manganese (h)	9995	2.7E-01	0.024	1.1E+01		1.2E-01	na	—
Nickel	71.3	2.0E-03	0.02	9.8E-02		8.4E-04	na	—
Vanadium	91	2.5E-03	0.007	3.6E-01		1.1E-03	na	—
Zinc	215	5.9E-03	0.3	2.0E-02		2.5E-03	na	—
		Total Hazard Index =		2.0E+01		Total Risk =		4.1E-05
		Hazard Index (liver toxins)=		0.05				
		Hazard Index (nervous system toxins)=		11.41				
		Hazard Index (kidney toxins)=		0.00				
		Hazard Index (red blood cell effects)=		0.03				
		Hazard Index (longevity)=		7.18				

NOTES:

(a) This table does not include groundwater chemicals of concern for which no reference dose or slope factor exists.
(chloroehtane,2-methylnapthalene, 4-chloro-3-methylphenol, aluminum, cobalt, copper, lead, sulfide and ammonia)

(b) Calculation for exposure dose:

INGESTION	= Conc. x	Ingestion	x Exposure	x Exposure	/ Body	Averaging	x	Conversion
EXPOSURE		Rate	Frequency	Duration	Weight	Time		Factor
DOSE	Conc.	2	350	30	70	(g)		365 x 1E+03
		L/day	days/yr	years	kg	years		days/year ug/mg

(c) Hazard quotient = chronic exposure dose / RfD

(d) Cancer Risk = lifetime exposure dose x slope factor

(e) Dose-response data for cis-1,2-dichloroethene and chromium VI were used.

(f) Reference Dose for cadmium in water was used.

(g) Averaging times of 30 years for chronic doses and 70 years for lifetime doses were used.

(h) The reference dose for manganese is based on total allowable intake (10 mg/day) minus the background intake (5 mg/day).
The remaining intake (5 mg/day) was normalized for body weight (70 kg) and an additional uncertainty factor of 3 applied for water exposures.

nd = chemical not detected

na =toxicity value not available

--- = not calculated due to absence of data

TABLE 31

POTENTIAL RISK OF INGESTION OF SITE GROUNDWATER WITHIN THE SEWAGE SLUDGE AREA (AS DRINKING WATER)
AVERAGE CONCENTRATIONS USED FOR AN ADULT EXPOSURE (a)

Analyte	Average Concentration (ug/L)	Exposure Dose Chronic (b) (mg/kg/day)	Oral Reference Dose (RfD) (mg/kg/day)	Hazard Quotient (c)		Exposure Dose Lifetime (b) (mg/kg/day)	Oral Slope Factor /(mg/kg/day)	Cancer Risk (d)
Benzene	nd	---	na	—		—	0.029	---
1,1-Dichloroethane	nd	---	0.1	---		---	na	—
1,2-Dichloroethene (e)	nd	---	0.01	---		---	na	—
Vinyl Chloride	nd	—	na	—		—	1.9	---
Pentachlorophenol	nd	---	0.03	---		---	0.12	---
bis(2-Ethylhexyl)phthalate	nd	---	0.02	---		---	0.014	---
Acrylamide	nd	---	0.0002	---		---	4.5	---
N,N-DMF	nd	---	0.1	---		---	na	—
Antimony	17	4.7E-04	0.0004	1.2E+00		2.0E-04	na	—
Arsenic	1.8	4.9E-05	0.0003	1.6E-01		2.1E-05	1.5	3.2E-05
Barium	97	2.7E-03	0.07	---		1.1E-03	na	—
Beryllium	1.7	4.7E-05	0.002	2.3E-02		2.0E-05	na	—
Cadmium (f)	3.3	9.0E-05	0.0005	1.8E-01		3.9E-05	na	—
Chromium (e)	14	3.8E-04	0.005	7.7E-02		1.6E-04	na	—
Manganese (h)	2500	6.8E-02	0.024	2.9E+00		2.9E-02	na	—
Nickel	33	9.0E-04	0.02	4.5E-02		3.9E-04	na	—
Vanadium	22	6.0E-04	0.007	8.6E-02		2.6E-04	na	—
Zinc	140	3.8E-03	0.3	1.3E-02		1.6E-03	na	—
		Total Hazard Index =		4.6E+00		Total Risk =		3.2E-05
		Hazard Index (liver toxins)=		0.00				
		Hazard Index (nervous system toxins)=		2.85				
		Hazard Index (kidney toxins)=		0.18				
		Hazard Index (red blood cell effects)=		0.01				
		Hazard Index (longevity)=		1.16				

NOTES:

(a) This table does not include groundwater chemicals of concern for which no reference dose or slope factor exists.
(chloroehtane,2-methylnapthalene, 4-chloro-3-methylphenol, aluminum, cobalt, copper, lead, sulfide and ammonia)

(b) Calculation for exposure dose:

INGESTION	= Conc. x	Ingestion	x Exposure	x Exposure	/ Body	Averaging	x	Conversion
EXPOSURE		Rate	Frequency	Duration	Weight	Time		Factor
DOSE	Conc.	2	350	30	70	(g)		365 x 1E+03
		L/day	days/yr	years	kg	years		days/year ug/mg

(c) Hazard quotient = chronic exposure dose / RfD

(d) Cancer Risk = lifetime exposure dose x slope factor

(e) Dose-response data for cis-1,2-dichloroethene and chromium VI were used.

(f) Reference Dose for cadmium in water was used.

(g) Averaging times of 30 years for chronic doses and 70 years for lifetime doses were used.

(h) The reference dose for manganese is based on total allowable intake (10 mg/day) minus the background intake (5 mg/day).
The remaining intake (5 mg/day) was normalized for body weight (70 kg) and an additional uncertainty factor of 3 applied for water exposures.

nd = chemical not detected

na = toxicity value not available

— = not calculated due to absence of data

TABLE 32

POTENTIAL RISK OF INGESTION OF SITE GROUNDWATER WITHIN THE SEWAGE SLUDGE AREA (AS DRINKING WATER)
MAXIMUM CONCENTRATIONS USED FOR AN ADULT EXPOSURE (a)

Analyte	Maximum Concentration (Ug/L)	Exposure Dose Chronic (b) (mg/kg/day)	Oral Reference Dose (RfD) (mg/kg/day)	Hazard Quotient (c)		Exposure Dose Lifetime (b) (mg/kg/day)	Oral Slope Factor /(mg/kg/day)	Cancer Risk (d)
Benzene	nd	---	na	—		—	0.029	---
1,1-Dichloroethane	nd	—	0.1	---		---	na	—
1,2-Dichloroethene (e)	nd	—	0.01	---		---	na	—
Vinyl Chloride	nd	—	na	—		—	1.9	---
Pentachlorophenol	nd	—	0.03	---		---	0.12	---
bis(2-Ethylhexyl)phthalate	nd	—	0.02	---		---	0.014	---
Acrylamide	nd	—	0.0002	---		---	4.5	---
N,N-DMF	nd	—	0.1	---		---	na	—
Antimony	74.2	2.0E-03	0.0004	5.1E+00		8.7E-04	na	—
Arsenic	5.5	1.5E-04	0.0003	5.0E-01		6.5E-05	1.5	9.7E-05
Barium	284	7.8E-03	0.07	1.1E-01		3.3E-03	na	—
Beryllium	3.4	9.3E-05	0.002	4.7E-02		4.0E-05	na	—
Cadmium (f)	19.4	5.3E-04	0.0005	1.1E+00		2.3E-04	na	—
Chromium (e)	54.5	1.5E-03	0.005	3.0E-01		6.4E-04	na	—
Manganese (h)	6230	1.7E-01	0.024	7.1E+00		7.3E-02	na	—
Nickel	76.6	2.1E-03	0.02	1.0E-01		9.0E-04	na	—
Vanadium	101	2.8E-03	0.007	4.0E-01		1.2E-03	na	—
Zinc	362	9.9E-03	0.3	3.3E-02		4.3E-03	na	—
		Total Hazard Index =		1.5E+01		Total Risk =		9.7E-05
		Hazard Index (liver toxins)=		0.00				
		Hazard Index (nervous system toxins)=		7.11				
		Hazard Index (kidney toxins)=		1.06				
		Hazard Index (red blood cell effects)=		0.03				
		Hazard Index (longevity)=		5.08				

NOTES:

(a) This table does not include groundwater chemicals of concern for which no reference dose or slope factor exists.
(chloroehtane,2-methylnapthalene, 4-chloro-3-methylphenol, aluminum, cobalt, copper, lead, sulfide and ammonia)

(b) Calculation for exposure dose:

INGESTION	= Conc.	x	Ingestion	x Exposure	x Exposure	/ Body	Averaging	x	Conversion
EXPOSURE			Rate	Frequency	Duration	Weight	Time		Factor
DOSE	Conc.		2	350	30	70	(g)		365 x 1E+03
			L/day	days/yr	years	kg	years		days/year ug/mg

(c) Hazard quotient = chronic exposure dose / RfD

(d) Cancer Risk = lifetime exposure dose x slope factor

(e) Dose-response data for cis-1,2-dichloroethene and chromium VI were used.

(f) Reference Dose for cadmium in water was used.

(g) Averaging times of 30 years for chronic doses and 70 years for lifetime doses were used.

(h) The reference dose for manganese is based on total allowable intake (10 mg/day) minus the background intake (5 mg/day).
The remaining intake (5 mg/day) was normalized for body weight (70 kg) and an additional uncertainty factor of 3 applied for water exposures.

nd = chemical not detected

na = toxicity value not available

--- = not calculated ue to absence of data

TABLE 33

POTENTIAL RISK FROM INGESTION OF GROUNDWATER FROM RESIDENTIAL WELLS

AVERAGE CONCENTRATIONS USED FOR AN ADULT EXPOSURE

Analyte	Average Concentration (ug/L)	Exposure Dose Chronic (a) (mg/kg/day)	Oral Reference Dose (RfD) (mg/kg/day)	Hazard Quotient (b)		Exposure Dose Lifetime (a) (mg/kg/day)	Oral Slope Factor /(mg/kg/day)	Cancer Risk (c)
Benzene	0.52	1.4E-05	na	—		6.1E-06	0.029	1.8E-07
Chloroethane	0.53	1.5E-05	na	—		6.2E-06	na	—
Trichloroethene	0.56	1.5E-05	na	—		6.6E-06	0.011	7.2E-08
4-Methylphenol	7.9	2.2E-04	0.005	4.3E-02		9.3E-05	na	—
N,N-DMF	14	3.8E-04	0.1	3.8E-03		1.6E-04	na	—
Dieldrin	0.0024	6.6E-08	0.00005	1.3E-03		2.8E-08	16	4.5E-07
Aluminum	90	2.5E-03	na	—		1.1E-03	na	—
Barium	8.3	2.3E-04	0.07	3.2E-03		9.7E-05	na	—
Copper	14	3.8E-04	na	—		1.6E-04	na	—
Manganese (d)	890	2.4E-02	0.024	1.0E+00		1.0E-02	na	—
Mercury	0.14	3.8E-06	0.0003	1.3E-02		1.6E-06	na	—
Zinc	24	6.6E-04	0.3	2.2E-03		2.8E-04	na	—
Sulfide	1600	4.4E-02	na	—		1.9E-02	na	—
		Total Hazard Index =		1.1E+00		Total Risk =		7.0E-07
		Hazard Index (liver toxins) =		0.01				
		Hazard Index (nervous system toxins) =		1.06				

NOTES:

(a) Calculation for exposure dose:

INGESTION	= Conc. x	Ingestion	x Exposure	x Exposure	/ Body	Averaging	x	Conversion
EXPOSURE		Rate	Frequency	Duration	Weight	Time		Factor
DOSE	Conc.	2	350	30	70	(e)		365 x 1E+03
		L/day	days/yr	years	kg	years		days/year ug/mg

(b) Hazard quotient = chronic exposure dose / RfD

(c) Cancer Risk = lifetime exposure dose x slope factor

(d) The reference dose for manganese is based on total allowable intake (10 mg/day) minus the background intake (5 mg/day). The remaining intake (5 mg/day) was normalized for body weight (70 kg) and an additional uncertainty factor of 3 applied for water exposures.

(e) Averaging times of 30 years for chronic doses and 70 years for lifetime doses were used.

nd = chemical not detected

na = toxicity value not available

--- = not calculated due to absence of data

TABLE 34

POTENTIAL RISK FROM INGESTION OF GROUNDWATER FROM RESIDENTIAL WELLS
MAXIMUM CONCENTRATIONS USED FOR AN ADULT EXPOSURE

Analyte	Maximum Concentration (ug/L)	Exposure Dose Chronic (a) (mg/kg/day)	Oral Reference Dose (RfD) (mg/kg/day)	Hazard Quotient (b)		Exposure Dose Lifetime (a) (mg/kg/day)	Oral Slope Factor /(mg/kg/day)	Cancer Risk (c)
Benzene	0.8	2.2E-05	na	---		9.4E-06	0.029	2.7E-07
Chloroethane	1	2.7E-05	na	---		1.2E-05	na	---
Trichloroethene	2	5.5E-05	na	---		2.3E-05	0.011	2.6E-07
4-Methylphenol	63	1.7E-03	0.005	3.5E-01		7.4E-04	na	---
N,N-DMF	14	3.8E-04	0.1	3.8E-03		1.6E-04	na	---
Dieldrin	0.0024	6.6E-08	0.00005	1.3E-03		2.8E-08	16	4.5E-07
Aluminum	522	1.5E-02	na	---		6.5E-03	na	---
Barium	44.3	1.2E-03	0.07	1.7E-02		5.2E-04	na	---
Copper	58.6	1.6E-03	na	---		6.9E-04	na	---
Manganese (d)	3100	8.5E-02	0.024	3.5E+00		3.6E-02	na	---
Mercury	0.46	1.3E-05	0.0003	4.2E-02		5.4E-06	na	---
Zinc	165	4.5E-03	0.3	1.5E-02		1.9E-03	na	---
Sulfide	3700	1.0E-01	na	---		4.3E-02	na	---
		Total Hazard Index =		4.0E+00		Total Risk =		9.8E-07
		Hazard Index (liver toxins) =		0.01				
		Hazard Index (nervous system toxins) =		3.88				

NOTES:

(a) Calculation for exposure dose:

INGESTION	= Conc. x	Ingestion	x Exposure	x Exposure	/ Body	Averaging	x	Conversion
EXPOSURE		Rate	Frequency	Duration	Weight	Time		Factor
DOSE	Conc.	2	350	30	70	(e)		365 x 1E+03
		L/day	days/yr	years	kg	years		days/year ug/mg

(b) Hazard quotient = chronic exposure dose / RfD

(c) Cancer Risk = lifetime exposure dose x slope factor

(d) The reference dose for manganese is based on total allowable intake (10 mg/day) minus the background intake (5 mg/day). The remaining intake (5 mg/day) was normalized for body weight (70 kg) and an additional uncertainty factor of 3 applied for water exposures.

(e) Averaging times of 30 years for chronic doses and 70 years for lifetime doses were used.

nd = chemical not detected

na = toxicity value not available

--- = not calculated due to absence of data

TABLE 35

POTENTIAL RISK FROM INHALATION OF OUTDOOR AIR BY ADULTS IN THE SOLID WASTE AREA
AVERAGE CONCENTRATIONS USED BASED ON SOIL GAS CONTAMINATION COLLECTED BY SUMMA CANISTERS

ANALYTE	Avg. Soil Gas Conc. (mg/m^3)	Estimated Emission Rate (mg/sec)(a)	Modeled Air Concentration (mg/m^3)(b)	Annualized Avg. Conc. (mg/m^3)(c)	Inhalation RfC (mg/m^3)	Inhalation Unit Risk /(ug/m^3)	Hazard Quotient (d)	Cancer Risk (e)
Acetone	0	0	0	0	na	na	na	---
Benzene	8.0	0.23	4.6E-04	3.1E-05	0.006	8.3E-06	5.2E-03	1.1E-07
Carbon Disulfide	0.87	0.02	5.0E-05	3.4E-06	0.7	na	4.9E-06	---
1,1-Dichloroethane	61	1.72	3.5E-03	2.4E-04	0.5	nd	4.8E-04	---
1,1-Dichloroethene	17	0.48	9.7E-04	6.7E-05	na	5.0E-05	na	1.4E-06
cis-1,2-Dichloroethene	9800	276.36	5.6E-01	3.8E-02	na	na	na	---
trans-1,2-Dichloroethene	11	0.31	6.3E-04	4.3E-05	na	nd	na	---
Dichlorodifluoromethane	51	1.44	2.9E-03	2.0E-04	0.2	nd	1.0E-03	---
Ethylbenzene	25	0.71	1.4E-03	9.8E-05	1	na	9.8E-05	---
4-Methylene-2-pentanone	6.5	0.18	3.7E-04	2.5E-05	0.08	nd	3.2E-04	---
Methylene Chloride	26	0.73	1.5E-03	1.0E-04	3	4.7E-07	3.4E-05	2.1E-08
Toluene	100	2.82	5.7E-03	3.9E-04	0.4	na	9.8E-04	---
1,2,4-Trichlorobenzene	0	0	0	0	0.2	na	---	---
1,2,4-Trimethylbenzene	2	0.06	1.1E-04	7.8E-06	0.006	na	1.3E-03	---
1,3,5-Trimethylbenzene	4.3	0.12	2.5E-04	1.7E-05	0.006	na	2.8E-03	---
Trichloroethane	31	0.87	1.8E-03	1.2E-04	na	1.7E-06	na	8.8E-08
Vinyl Chloride	1400	39.48	8.0E-02	5.5E-03	na	8.4E-05	na	2.0E-04
m,p-Xylene	41	1.16	2.3E-03	1.6E-04	na	nd	na	---
					Total Hazard Index =		1.2E-02	
						Total Cancer Risk =		2.0E-04

NOTES:

(a) Soil gas concentration x gas generation rate (60 cfm, or 0.0282 m^3/sec, calculated in M&E FS, 1998)

(b) Emission rate x Disposal area length in prevailing wind direction (NW)/Surface area x Breathing zone height x Windspeed
[(Emission rate x 450 m)/ (110950 m^2 x 2 m x 1 m/sec)]

(c) Annualized Air Concentration = Modeled Air Concentration (mg/m^3) x 4 hrs/24 hrs x 150 days / 365 days

(d) Hazard quotient = Annualized Air Concentration / RfC

(e) Cancer Risk = Annualized Air Concentration (mg/m^3) x 1000 ug/mg x Unit Risk (m^3/ug) x 30 yrs / 70 yrs

na - not available
nd - not determined
--- - not calculated due to absence of data

TABLE 36

POTENTIAL RISK FROM INHALATION OF OUTDOOR AIR BY ADULTS IN THE SOLID WASTE AREA
MAXIMUM CONCENTRATIONS USED BASED ON SOIL GAS CONTAMINATION COLLECTED BY SUMMA CANISTERS

ANALYTE	Max. Soil Gas Conc. (mg/m^3)	Estimated Emission Rate (mg/sec)(a)	Modeled Air Concentration (mg/m^3)(b)	Annualized Avg. Conc. (mg/m^3)(c)	Inhalation RfC (mg/m^3)	Inhalation Unit Risk /(ug/m^3)	Hazard Quotient (d)	Cancer Risk (e)
Acetone	0	0	0	0	na	na	na	---
Benzene	8.0	0.23	4.6E-04	3.1E-05	0.006	8.3E-06	5.2E-03	1.1E-07
Carbon Disulfide	0.87	0.02	5.0E-05	3.4E-06	0.7	nd	4.9E-06	---
1,1-Dichloroethane	140	3.95	8.0E-03	5.5E-04	0.5	nd	1.1E-03	---
1,1-Dichloroethene	32	0.90	1.8E-03	1.3E-04	na	5.0E-05	na	2.7E-06
cis-1,2-Dichloroethene	23000	648.60	1.3E+00	9.0E-02	na	na	na	---
trans-1,2-Dichloroethene	27	0.76	1.5E-03	1.1E-04	na	nd	na	---
Dichlorodifluoromethane	100	2.82	5.7E-03	3.9E-04	0.2	nd	2.0E-03	---
Ethylbenzene	25	0.71	1.4E-03	9.8E-05	1	na	9.8E-05	---
4-Methylene-2-pentanone	6.5	0.18	3.7E-04	2.5E-05	0.08	nd	3.2E-04	---
Methylene Chloride	66	1.86	3.8E-03	2.6E-04	3	4.7E-07	8.6E-05	5.2E-08
Toluene	230	6.49	1.3E-02	9.0E-04	0.4	na	2.3E-03	---
1,2,4-Trichlorobenzene	0	0	0	0	0.2	na	---	---
1,2,4-Trimethylbenzene	2	0.06	1.1E-04	7.8E-06	0.006	na	1.3E-03	---
1,3,5-Trimethylbenzene	4.3	0.12	2.5E-04	1.7E-06	0.006	na	2.8E-03	---
Trichloroethane	31	0.87	1.8E-03	1.2E-04	na	1.7E-06	na	8.8E-08
Vinyl Chloride	3100	87.42	1.8E-01	1.2E-02	na	8.4E-05	na	4.4E-04
m,p-Xylene	41	1.16	2.3E-03	1.6E-04	na	nd	na	---
					Total Hazard Index =		1.5E-02	
						Total Cancer Risk =		4.4E-04

NOTES:

(a) Soil gas concentration x gas generation rate (60 cfm, or 0.0282 m^3/sec, calculated in M&E FS, 1998)

(b) Emission rate x Disposal area length in prevailing wind direction (NW)/Surface area x Breathing zone height x Windspeed.
[(Emission rate x 450 m)/ (110950 m^2 x 2 m x 1 m/sec)]

(c) Annualized Air Concentration = Modeled Air Concentration (mg/m^3) x 4 hrs/24 hrs x 150 days / 365 days

(d) Hazard quotient = Annualized Air Concentration / RfC

(e) Cancer Risk = Annualized Air Concentration (mg/m^3) x 1000 ug/mg x Unit Risk (ug/m^3) x 30 yrs / 70 yrs

na - not available
nd - not determined
--- - not calculated due to absence of data

TABLE 37

POTENTIAL RISK FROM INHALATION OF AMBIENT AIR BY NEARBY RESIDENTS
AVERAGE CONCENTRATIONS USED FOR AN ADULT EXPOSURE

ANALYTE	Ambient Air Concentration (mg/m^3)	Annualized Avg. Conc. (mg/m^3)(a)	Inhalation RfC (mg/m^3)	Inhalation Unit Risk /(ug/m^3)	Hazard Quotient (b)	Cancer Risk (c)
Benzene	2.4E-02	2.3E-02	0.006	8.3E-06	3.8E+00	8.2E-05
Ethylbenzene	2.0E-03	1.9E-03	1	na	1.9E-03	na
Methylene Chloride	1.0E-03	9.6E-04	3	4.7E-07	3.2E-04	1.9E-07
1,1,2,2-Tetrachloroethane	4.0E-03	3.8E-03	na	5.8E-05	na	9.5E-05
Toluene	1.0E-03	9.6E-04	0.4	na	2.4E-03	na
1,1,1-Trichloroethane	2.0E-03	1.9E-03	1	na	1.9E-03	na
Vinyl Chloride	1.0E-03	9.6E-04	na	8.4E-05	na	3.5E-05
m,p-Xylene	4.0E-03	3.8E-03	na	na	na	na
o-Xylene	5.0E-03	4.8E-03	na	na	na	na
			Total Hazard Index =		3.8E+00	
				Total Cancer Risk =		2.1E-04

NOTES:

(a) Annualized Air Concentration = Ambient Air Concentration (mg/m^3) x 350 days / 365 days

(b) Hazard quotient = Annualized Air Concentration / RfC

(c) Cancer Risk = Annualized Air Concentration (mg/m^3) x 1000 ug/mg x Unit Risk /(ug/m^3) x 30 yrs / 70 yrs

na - not available

nd - not determined

TABLE 38

POTENTIAL RISK FROM INHALATION OF AMBIENT AIR BY NEARBY RESIDENTS
MAXIMUM CONCENTRATIONS USED FOR AN ADULT EXPOSURE

ANALYTE	Ambient Air Concentration (mg/m^3)	Annualized Avg. Conc. (mg/m^3)(a)	RfC (mg/m^3)	Inhalation Unit Risk /(ug/m^3)	Hazard Quotient (b)	Cancer Risk (c)
Benzene	7.5E-02	7.2E-02	0.006	8.3E-06	1.2E+01	2.6E-04
Ethylbenzene	2.0E-03	1.9E-03	1	na	1.9E-03	na
Methylene Chloride	1.0E-03	9.6E-04	3	4.7E-07	3.2E-04	1.9E-07
1,1,2,2-Tetrachloroethane	4.0E-03	3.8E-03	na	5.8E-05	na	9.5E-05
Toluene	2.0E-03	1.9E-03	0.4	na	4.8E-03	na
1,1,1-Trichloroethane	2.0E-03	1.9E-03	1	na	1.9E-03	na
Vinyl Chloride	4.0E-03	3.8E-03	na	8.4E-05	na	1.4E-04
m,p-Xylene	7.0E-03	6.7E-03	na	na	na	na
o-Xylene	7.0E-03	6.7E-03	na	na	na	na
			Total Hazard Index =		1.2E+01	
				Total Cancer Risk =		4.9E-04

NOTES:

(a) Annualized Air Concentration = Ambient Air Concentration (mg/m^3) x 350 days / 365 days

(b) Hazard quotient = Annualized Air Concentration / RfC

(c) Cancer Risk = Annualized Air Concentration (mg/m^3) x 1000 ug/mg x Unit Risk /(ug/m^3) x 30 yrs / 70 yrs

na - not available

nd - not determined

TABLE 39

POTENTIAL FUTURE RISK FROM INHALATION OF INDOOR AIR BY NEARBY RESIDENTS
AVERAGE CONCENTRATION OF VINYL CHLORIDE USED FOR AN ADULT EXPOSURE

ANALYTE	Indoor Air Concentration (Mg/m^3)	Annualized Avg. Conc. (mg/m^3)(a)	Inhalation RfC (mg/m^3)	Inhalation Unit Risk /(ug/m^3)	Hazard Quotient (b)	Cancer Risk (c)
Vinyl Chloride	2.3E-02	2.2E-02	na	8.4E-05	na	7.9E-04
			Total Hazard Index =		na	
				Total Cancer Risk =		7.9E-04

NOTES:

(a) Annualized Air Concentration = Indoor Air Concentration (mg/m^3) x 350 days / 365 days

(b) Hazard quotient = Annualized Air Concentration / RfC

(c) Cancer Risk = Annualized Air Concentration (mg/m^3) x 1000 ug/mg x Unit Risk /(ug/m^3) x 30 yrs / 70 yrs

na - not available

nd - not determined

TABLE 40

POTENTIAL FUTURE RISK FROM INHALATION OF INDOOR AIR BY NEARBY RESIDENTS
MAXIMUM CONCENTRATION OF VINYL CHLORIDE USED FOR AN ADULT EXPOSURE

ANALYTE	Indoor Air Concentration (mg/m^3)	Annualized Avg. Conc. (mg/m^3)(a)	RfC (mg/m^3)	Inhalation Unit Risk /(ug/m^3)	Hazard Quotient (b)	Cancer Risk (c)
Vinyl Chloride	5.6E-02	5.4E-02	na	8.4E-05	na	1.9E-03
			Total Hazard Index =		na	
				Total Cancer Risk =		1.9E-03

NOTES:

(a) Annualized Air Concentration = Indoor Air Concentration (mg/m^3) x 350 days / 365 days

(b) Hazard quotient = Annualized Air Concentration / RfC

(c) Cancer Risk = Annualized Air Concentration (mg/m^3) x 1000 ug/mg x Unit Risk /(ug/m^3) x 30 yrs / 70 yrs

na - not available

nd - not determined

TABLE 41

POTENTIAL CENTRAL TENDENCY RISKS FOR A CURRENT/FUTURE SITE VISITOR TO THE SOLID WASTE AREA, FROM INHALATION OF AMBIENT AIR, ESTIMATED FROM SUMMA CANISTER SAMPLES OF LANDFILL GAS AND BOX DISPERSION MODEL

ANALYTE	Avg. Landfill Gas Conc. (mg/m^3)(a)	Estimated Emission Rate (mg/sec)(b)	Modeled Air Concentration (mg/m^3)(c)	Annualized Avg. Conc. (mg/m^3)(d)	Inhalation RfC (mg/m^3)	Inhalation Unit Risk /(ug/m^3)	Hazard Quotient (e)	Cancer Risk (f)
Acetone	nd	nd	nd	nd	na	na	nd	—
Benzene	4.2	0.12	2.4E-04	1.7E-05	0.006	8.3E-06	2.8E-03	5.9E-08
Carbon disulfide	0.87	0.02	5.0E-05	3.4E-06	0.7	na	4.9E-06	---
Dichlorodifluoromethane	44	1.24	2.5E-03	1.7E-04	0.2	nd	8.7E-04	nd
1,1-Dichloroethane	43	1.21	2.5E-03	1.7E-04	0.5	nd	3.4E-04	nd
1,1-Dichloroethene	14	0.39	8.1E-04	5.5E-05	na	5.0E-05	nd	1.2E-06
cis-1,2-Dichloroethene	7800	220	4.5E-01	3.1E-02	na	na	nd	—
trans-1,2-Dichloroethene	8.2	0.23	4.7E-04	3.2E-05	na	nd	nd	—
Ethylbenzene	25	0.71	1.4E-03	9.9E-05	1	na	9.9E-05	---
4-Methylene-2-pentanone	3.5	0.10	2.0E-04	1.4E-05	0.08	na	1.7E-04	---
Methylene chloride	19	0.54	1.1E-03	7.5E-05	3	4.7E-07	2.5E-05	1.5E-08
1,1,2,2-Tetrachloroethane	nd	nd	nd	nd	na	5.8E-05	nd	---
Toluene	83	2.34	4.8E-03	3.3E-04	0.4	na	8.2E-04	---
1,2,4-Trichlorobenzene	nd	nd	nd	nd	0.2	na	nd	---
1,1,1-Trichloroethane	4.0	0.11	2.3E-04	1.6E-05	1	na	1.6E-05	---
Trichloroethene	15	0.42	8.6E-04	5.9E-05	na	1.7E-06	nd	4.3E-08
1,2,4-Trimethylbenzene	2.5	0.07	1.4E-04	9.9E-06	0.006	na	1.6E-03	---
1,3,5-Trimethylbenzene	2.0	0.06	1.2E-04	7.9E-06	0.006	NA	1.3E-03	---
Vinyl chloride	1100	31	6.3E-02	4.3E-03	na	8.4E-05	nd	1.6E-04
m,p-Xylene	41	1.16	2.4E-03	1.6E-04	na	na	nd	---
o-Xylene	11	0.31	6.3E-04	4.3E-05	na	na	nd	—
						Total Hazard Index =	8.1E-03	
							Total Cancer Risk =	1.6E-04

NOTES:

(a) Average concentration among three SUMMA canister locations, substitute value, as specified in Table 5

(b) Soil gas concentration x gas generation rate (0.0282 m^3/sec, calculated in FS: M&E, 1998)

(c) Emission rate x Disposal area length in prevailing wind direction (NW)/Surface area x Breathing zone height x Windspeed
[(Emission rate x 370 m)/ (90,580 m^2 x 2 m x 1 m/sec)]

(d) Annualized Air Concentration = Modeled Air Concentration (mg/m^3) x 4 hrs/24 hrs x 150 days / 365 days

(e) Hazard quotient = Annualized Air Concentration (mg/m^3) / Chronic RfC (mg/m^3)

(f) Cancer Risk = Annualized Air Concentration (mg/m^3) x 1000 ug/mg x Unit Risk (m^3/ug) x 30 yrs / 70 yrs

na not available or not applicable

nd not detected or not determined

--- minimal risk from compounds that were not detected or that are not considered carcinogenic

TABLE 42

POTENTIAL RME RISKS FOR A CURRENT/FUTURE SITE VISITOR TO THE SOLID WASTE AREA, FROM INHALATION OF AMBIENT AIR, ESTIMATED FROM SUMMA CANISTER SAMPLES OF LANDFILL GAS AND BOX DISPERSION MODEL

ANALYTE	Max. Landfill Gas Conc. (mg/m^3)(a)	Estimated Emission Rate (mg/sec)(b)	Modeled Air Concentration (mg/m^3)(c)	Annualized Avg. Conc. (mg/m^3)(d)	Inhalation RfC (mg/m^3)	Inhalation Unit Risk /(ug/m^3)	Hazard Quotient (e)	Cancer Risk (f)
Acetone	nd	nd	nd	nd	na	na	nd	---
Benzene	8.0	0.23	4.6E-04	3.2E-05	0.006	8.3E-06	5.3E-03	1.1E-07
Carbon disulfide	0.87	0.02	5.0E-05	3.4E-06	0.7	na	4.9E-06	---
Dichlorodifluoromethane	110	3.10	6.3E-03	4.3E-04	0.2	nd	2.2E-03	nd
1,1-Dichloroethane	140	3.95	8.1E-03	5.5E-04	0.5	nd	1.1E-03	nd
1,1-Dichloroethene	32	0.90	1.8E-03	1.3E-04	na	5.0E-05	nd	2.7E-06
cis-1,2-Dichloroethene	23000	649	1.3E+00	9.1E-02	na	na	nd	---
trans-1,2-Dichloroethene	27	0.76	1.6E-03	1.1E-04	na	nd	nd	---
Ethylbenzene	25	0.71	1.4E-03	9.9E-05	1	na	9.9E-05	---
4-Methylene-2-pentanone	6.6	0.19	3.8E-04	2.6E-05	0.08	na	3.3E-04	---
Methylene chloride	66	1.86	3.8E-03	2.6E-04	3	4.7E-07	8.7E-05	5.2E-08
1,1,2,2-Tetrachloroethane	nd	nd	nd	nd	na	5.8E-05	nd	---
Toluene	230	6.49	1.3E-02	9.1E-04	0.4	na	2.3E-03	---
1,2,4-Trichlorobenzene	nd	nd	nd	nd	0.2	na	nd	—
1,1,1-Trichloroethane	10	0.28	5.8E-04	3.9E-05	1	na	3.9E-05	---
Trichloroethene	31	0.87	1.8E-03	1.2E-04	na	1.7E-06	nd	8.9E-08
1,2,4-Trimethylbenzene	2.5	0.07	1.4E-04	9.9E-06	0.006	na	1.6E-03	---
1,3,5-Trimethylbenzene	4.3	0.12	2.5E-04	1.7E-05	0.006	NA	2.8E-03	---
Vinyl chloride	3100	87	1.8E-01	1.2E-02	na	8.4E-05	nd	4.4E-04
m,p-Xylene	41	1.16	2.4E-03	1.6E-04	na	na	nd	---
o-Xylene	11	0.31	6.3E-04	4.3E-05	na	na	nd	---
						Total Hazard Index =	1.6E-02	
						Total Cancer Risk =		4.4E-04

NOTES:

(a) Maximum concentration among three SUMMA canister locations, substitute value, as specified in Table 5

(b) Soil gas concentration x gas generation rate (0.0282 m^3/sec, calculated in FS; M&E, 1998)

(c) Emission rate x Disposal area length in prevailing wind direction (NW)/Surface area x Breathing zone height x Windspeed

[(Emission rate x 370 m)/ (90,580 m^2 x 2 m x 1 m/sec)]

(d) Annualized Air Concentration = Modeled Air Concentration (mg/m^3) x 4 hrs/24 hrs x 150 days / 365 days

(e) Hazard quotient = Annualized Air Concentration (mg/m^3) / Chronic RfC (mg/m^3)

(f) Cancer Risk = Annualized Air Concentration (mg/m^3) x 1000 ug/mg x Unit Risk (m^3/ug) x 30 yrs / 70 yrs

na not available or not applicable

nd not detected or not determined

--- minimal risk from compounds that were not detected or that are not considered carcinogenic

TABLE 43

POTENTIAL CENTRAL TENDENCY RISKS FOR A CURRENT/FUTURE RESIDENT, FROM INHALATION OF AMBIENT AND INDOOR AIR, ESTIMATED FROM SUMMA CANISTER SAMPLES OF RESIDENTIAL AREA AMBIENT AIR

ANALYTE	Measured Air Concentration (mg/m^3)(a)	Annualized Avg. Conc. (mg/m^3)(b)	Inhalation RfC (mg/m^3)	Inhalation Unit Risk /(ug/m^3)	Hazard Quotient (c)	Cancer Risk (d)
Benzene	0.024	2.3E-02	0.006	8.3E-06	3.8E+00	8.2E-05
Ethylbenzene	0.0017	1.6E-03	1	na	1.6E-03	---
Methylene chloride	0.0010	9.6E-04	3	4.7E-07	3.2E-04	1.9E-07
1,1,2-Tetrachloroethane	0.0021	2.0E-03	na	5.8E-05	nd	5.0E-05
Toluene	0.0011	1.1E-03	0.4	na	2.6E-03	---
1,1,1-Trichloroethane	0.0014	1.3E-03	1	na	1.3E-03	---
Vinyl chloride	0.0011	1.1E-03	na	8.4E-05	nd	3.8E-05
m,p-Xylene	0.0045	4.3E-03	na	na	nd	---
o-Xylene	0.0055	5.3E-03	na	na	nd	---
			Total Hazard Index =		3.8E+00	
				Total Cancer Risk =		1.7E-04

NOTES:

(a) Average concentration among valid outdoor SUMMA canister samples, as specified in Table 6

(b) Annualized Air Concentration = Modeled Air Concentration (mg/m^3) x 24 hrs/24 hrs x 350 days / 365 days

(c) Hazard quotient = Annualized Air Concentration (mg/m^3) / Chronic RfC (mg/m^3)

(d) Cancer Risk = Annualized Air Concentration (mg/m^3) x Unit Risk (m^3/ug) x 1000 ug/mg x 30 yrs / 70 yrs

na not available or not applicable

nd not detected or not determined

--- minimal risk from compounds that were not detected or that are not considered carcinogenic

TABLE 44

POTENTIAL RME RISKS FOR A CURRENT/FUTURE RESIDENT, FROM INHALATION OF AMBIENT AND INDOOR AIR, ESTIMATED FROM SUMMA CANISTER SAMPLES OF RESIDENTIAL AREA AMBIENT AIR

ANALYTE	Measured Air Concentration (mg/m^3)(a)	Annualized Avg. Conc. (mg/m^3)(b)	Inhalation RfC (mg/m^3)	Inhalation Unit Risk /(ug/m^3)	Hazard Quotient (c)	Cancer Risk (d)
Benzene	0.075	7.2E-02	0.006	8.3E-06	1.2E+01	2.6E-04
Ethylbenzene	0.0017	1.6E-03	1	na	1.6E-03	---
Methylene chloride	0.0014	1.3E-03	3	4.7E-07	4.5E-04	2.7E-07
1,1,2,2-Tetrachloroethane	0.0021	2.0E-03	na	5.8E-05	nd	5.0E-05
Toluene	0.0015	1.4E-03	0.4	na	3.6E-03	---
1,1,1-Trichloroethane	0.0016	1.5E-03	1	na	1.5E-03	---
Vinyl chloride	0.0043	4.1E-03	na	8.4E-05	nd	1.5E-04
m,p-Xylene	0.0069	6.6E-03	na	na	nd	---
o-Xylene	0.0069	6.6E-03	na	na	nd	---
			Total Hazard Index =		1.2E+01	
				Total Cancer Risk =		4.5E-04

NOTES:

(a) Maximum concentration among valid outdoor SUMMA canister samples, as specified in Table 6

(b) Annualized Air Concentration = Modeled Air Concentration (mg/m^3) x 24 hrs/24 hrs x 350 days / 365 days

(c) Hazard quotient = Annualized Air Concentration (mg/m^3) / Chronic RfC (mg/m^3)

(d) Cancer Risk = Annualized Air Concentration (mg/m^3) x Unit Risk (m^3/ug) x 1000 ug/mg x 30 yrs / 70 yrs

na not available or not applicable

nd not detected or not determined

--- minimal risk from compounds that were not detected or that are not considered carcinogenic

TABLE 45

SUMMARY STATISTICS FOR SOLID WASTE AREA LANDFILL GAS

(Units: mg/m^3)

Ambient Air Chemical of Concern	Frequency of Detection, per Sample (a)	Frequency of Detection, per Location (b)	Range of Detection Limits (c)	Range of Detected Concentrations (d)	Calculated Arithmetic Mean (e)	Selected Landfill Gas Concentrations	
						RME Case (f)	Average Case (g)
Acetone	0 / 4	0 / 3	0.4 - 300	ND	ND	ND	ND
Benzene	3 / 4	3 / 3	400	2.0 - 8.0	4.20	8.0	4.2
Carbon disulfide	2 / 4	2 / 3	100 - 400	0.12 - 0.87	21.08	0.87	0.87
Dichlorodifluoromethane	4 / 4	3 / 3	-	1.0 - 110	43.53	110	44
1,1-Dichloroethane	4 / 4	3 / 3	-	0.21 - 140	43.13	140	43
1,1-Dichloroethene	4 / 4	3 / 3	-	0.040 - 32	14.10	32	14
cis-1,2-Dichloroethane	4 / 4	3 / 3	-	1.5 - 23000	7803	23000	7800
trans-1,2-Dichloroethane	4 / 4	3 / 3	-	0.087 - 27	8.16	27	8.2
Ethylbenzene	2 / 4	2 / 3	200 - 600	13 - 25	41.70	25	25
4-Methyl-2-pentanone	1 / 4	1 / 3	0.7 - 600	6.6	3.52	6.6	3.5
Methylene Chloride	4 / 4	3 / 3	-	0.69 - 66	18.64	66	19
1,1,2,2-Tetrachloroethane	0 / 4	0 / 3	1 - 1000	ND	ND	ND	ND
Toluene	4 / 4	3 / 3	-	21 - 230	83.50	230	83
1,2,4-Trichloroethene	0 / 4	0 / 3	1 - 1000	ND	ND	ND	ND
1,1,1-Trichloroethane	2 / 4	2 / 3	0.9 - 800	1.3 - 10	4.02	10	4.0
Trichloroethene	3 / 4	3 / 3	800	0.45 - 31	15.20	31	15
1,2,4-Trimethylbenzene	2 / 4	2 / 3	200 - 700	1.1 - 2.5	33.95	2.5	2.5
1,3,5-Trimethylbenzene	3 / 4	3 / 3	700	0.74 - 4.3	2.02	4.3	2.0
Vinyl Chloride	4 / 4	3 / 3	-	3.1 - 3100	1062	3100	1100
m,p-Xylene	2 / 4	2 / 3	200 - 600	24 - 41	50.67	41	41
o-Xylene	2 / 4	2 / 3	200 - 600	4.3 - 11	34.02	11	11

NOTES:

Units converted from reported units of ppbv, using molecular weights and a conversion factor of 24.45 liters/mole (moler volume at 1 atm, 25 C)

a. This is the ratio of the number of samples in which the chemical was detected to the total number of valid samples, among SUMMA canister samples of Solid Waste Area land

b. This is the ratio of the number of locations where the chemical was detected to the total number of locations with valid samples.

c. Range of detection limits among non-detected samples

d. Range of concentrations among detected samples

e. The arithmetic mean among three locations is listed. The two samples from sampling location SW(03+300) are considered together, for averaging purposes. The mean was calculated using 1/2 of the detection limit for samples that were non-detect for a specific analyte, if the analyte was detected at other locations.

f. The landfill gas concentration used to derive the exposure point concentration for "Reasonable Maximum Exposure" is the maximum detected among four samples.

g. The landfill gas concentration used to derive average case exposure point concentrations is the arithmetic mean (note e) or the maximum detected (note f), whichever is lower.

SOURCE: REMEDIAL INVESTIGATION FINAL REPORT (M&E, May 1994)

TABLE 46

SUMMARY STATISTICS, AMBIENT AIR MEASUREMENTS NEAR RESIDENCES

(Units: mg/m^3)

Chemical Detected in Residential Area Ambient Air	Frequency of Detection, per Sample (a)		Frequency of Detection, per Location (b)		Detection Limit (c)	Range of Detected Concentrations (d)			Calculated Arithmetic Mean (e)	Selected Ambient Air Concentration Based on Direct Measurements	
										RME Case (f)	Average Case (g)
Benzene (h)	4 /	4	4 /	4	-	0.0029	-	0.075	0.024	0.075	0.024
Ethylbenzene (h)	1 /	1	1 /	1	-	0.0017			0.0017	0.0017	0.0017
Methylene Chloride (h)	4 /	4	4 /	4	-	0.0007	-	0.0014	0.0010	0.0014	0.0010
1,1,2,2-Tetrachloroethane (h)	1 /	4	1 /	4	0.007	0.0021	-	0.0021	0.0031	0.0021	0.0021
Toluene (h)	4 /	4	4 /	4	-	0.0008	-	0.0015	0.0011	0.0015	0.0011
1,1,1-Trichloroethane (h)	4 /	4	4 /	4	-	0.0005	-	0.0016	0.0014	0.0016	0.0014
Vinyl Chloride (i)	6 /	11	3 /	4	0.0005	0.0007	-	0.0043	0.0011	0.0043	0.0011
m,p-Xylene (h)	4 /	4	4 /	4	-	0.0013	-	0.0069	0.0045	0.0069	0.0045
o-Xylene (h)	3 /	3	3 /	3	-	0.0043	-	0.0069	0.0055	0.0069	0.0055

NOTES:

Units converted from reported units of ppbv, using molecular weights and a conversion factor of 24.45 liters/mole (molar volume at 1 atm, 25 C)

a. This is the ratio of the number of samples in which the chemical was detected to the total number of valid samples. The total number of samples varies between chemicals due to rejected values and, in the case of vinyl chloride, reliance on a different set of data (see notes h and i).

b. This is the ratio of the number of locations where the chemical was detected to the total number of locations with valid samples; samples flagged “B” considered invalid.

c. Detection limit reported for non-detected samples only

d. Range of concentrations among detected samples

e. Arithmetic mean among all valid samples

f. The maximum detected is selected as the “Reasonable Maximum Exposure” case concentration based on direct measurements.

g. The arithmetic mean (note e) or maximum detected (note f), whichever is lower, is selected to represent the average case ambient air concentration based on direct measurements

h. Statistics for chemicals other than vinyl chloride are the 24-hour period ending 5/27/93.

i. Statistics for vinyl chloride are from outdoor samples in residential areas collected in February and March 1993.

SOURCE: AIR QUALITY MODELING FINAL REPORT, Appendix E, Table 4 (EPA, August 1993)

TABLE 47 **SUMMARY STATISTICS FOR INDOOR AIR FROM 220 ROSE HILL ROAD**

(Units: mg/m3)

Chemical	Frequency of Detection/Location (1)	Frequency of Detection/Samples (2)	Detection Limit	Range of Concentrations	Calculated Arithmetic Mean (3)	Selected Ambient Air Concentrations RME Case (4)	Selected Ambient Air Concentrations Average Case (5)
Vinyl Chloride	1 / 1	8 / 8	0.001	0.004 – 0.056	0.023	0.056	0.023

NOTES:

1. This value represents the number of locations which had detected concentrations per the number of locations sampled.
   The number of locations sampled varies due to rejected values and locations not sampled.
2. This value represents the number of detected concentrations per the total sum of samples collected at all locations in the specific area.
   The total number of samples collected varies due to rejected values and locations not sampled.
3. When an analyte was not detected, the mean was calculated using ½ of the detection limit for that sample.
   Refer to section 6.1.3 for a detailed discussion of averaging.
4. Maximum detected is defined as the exposure point concentration for “Reasonable Maximum Exposure”
5. Exposure point concentration is maximum detected or arithmetic mean, whichever is lower.

gwsola

TABLE 48 SUMMARY STATISTICS FOR GROUNDWATER FROM THE SOLID WASTE AREA

(Units: µg/L)

Chemical	Frequency of Detection/Location (1)	Frequency of Detection/Samples (2)	Range of Detection Limit	Range of Concentrations	Calculated Arithmetic Mean (3)	Selected Exposure Point Concentrations RME Case (4)	Selected Exposure Point Concentrations Average Case (5)
Benzene	9 / 10	25 / 40	5 - 40	2 - 31	10.575	31	11
Chloroethane	6 / 10	21 / 40	10 - 40	2 - 86	16.954	86	17
1,1-Dichloroethane	7 / 10	24 / 40	5 - 40	1 - 220	13.650	220	14
1,2-Dichloroethene(total)	8 / 10	21 / 40	5 - 40	1 - 730	33.767	730	34
Vinyl Chloride	5 / 10	11 / 40	10 - 40	3 - 690	34.154	690	34
Acrylamide	1 / 9	1 / 17	200 - 2000	229	160.556	229	160
N,N-DMF	5 / 9	12 / 37	50 - 500	50 - 1140	199.259	1440	200
4-Chloro-3-methylphenol	3 / 10	5 / 39	10	0.9 - 5	4.702	5	4.7
bis(2-Ethylhexyl)phthalate	2 / 10	2 / 40	10	0.9 - 36	5.581	36	5.6
2-Methylnaphthalene	2 / 10	4 / 40	10	1 - 5	4.796	5	4.8
Pentachlorophenol	1 / 10	1 / 39	25 - 50	3	13.746	3	3
Aluminum	10 / 10	37 / 40	13 - 66	228 - 110000	13886.190	110000	14000
Antimony	0 / 10	0 / 40	8 - 47	--	0.000	0	0
Arsenic	8 / 10	11 / 39	1 - 4	1.1 - 9.7	2.718	9.7	2.7
Barium	10 / 10	39 / 40	1 - 4	7.0 - 508	165.200	508	170
Beryllium	7 / 10	10 / 40	1	1.1 - 13.7	1.669	13.7	1.7
Cadmium	1 / 10	4 / 40	1 - 3	19.6 - 40.0	4.448	40.0	4.4
Chromium	7 / 10	17 / 40	2 - 8	4.2 - 154	23.967	154	24
Cobalt	9 / 10	21 / 40	3 - 8	3.2 - 53.8	14.587	53.8	15
Copper	8 / 10	15 / 40	2 - 11	16 - 367	41.675	367	42
Lead	9 / 10	14 / 40	1 - 5	7.8 - 181	39.773	181	40
Manganese	10 / 10	38 / 40	1 - 9	22.8 - 9790	1923.843	9790	1900
Nickel	9 / 10	21 / 40	3 - 16	3.6 - 125	26.202	125	26
Vanadium	8 / 10	22 / 40	2 - 5	3 - 142	21.273	142	21
Zinc	9 / 10	21 / 39	4 - 11	13.2 - 7360	680.242	7360	680
Ammonia	5 / 5	8 / 8	30.0	34.0 - 51700	8094.000	51700	8100
Sulfide	4 / 10	4 / 32	50 - 1000	1700 - 4940	815.000	4940	820

NOTES:

1. This value represents the number of locations which had detected concentrations per the number of locations sampled.
   The number of locations sampled varies due to rejected values and locations not sampled.
2. This value represents the number of detected concentrations per the total sum of samples collected at all locations in the specific area.
   The total number of samples collected varies due to rejected values and locations not sampled.
3. When an analyte was not detected, the mean was calculated using ½ of the detection limit for that sample.
   Refer to section 6.1.3 for a detailed discussion of averaging.
4. Maximum detected is defined as the exposure point concentration for “Reasonable Maximum Exposure”
5. Exposure point concentration is maximum detected or arithmetic mean, whichever is lower.

gwbulka TABLE 49 **SUMMARY STATISTICS FOR GROUNDWATER FROM THE BULKY WASTE AREA**

(Units: Fg/L)

Chemical	Frequency or Detection/Location (1)	Frequency of Detection/Sample (2)	Range of Detection Limits	Range of Concentration	Calculated Arithmetic Mean (3)	Selected Exposure Point Concentrations RME Case (4)	Selected Exposure Point Concentrations Average Case (5)
Benzene	1 / 5	1 / 17	5 - 50	1	6.550	1	1
Chloroethane	1 / 5	2 / 17	10 - 50	9 - 16	7.750	16	7.8
1,1-Dichloroethane	2 / 5	3 / 17	5 - 50	1 - 5	6.490	5	5
1,2-Dichloroethene(total)	2 / 5	4 / 17	5 - 50	1 - 5	6.225	5	5
Vinyl Chloride	0 / 5	0 / 17	10 - 50	--	0.000		0
Acrylamide	0 / 5	0 / 9	200	--	0.000	0	0
N,N-DMF	1 / 5	1 / 16	50	183	32.900	183	33
4-Chloro-3-methylphenol	0 / 5	0 / 17	10 - 20	--	0.000	0	0
bis(2-Ethylhexyl)phthalate	0 / 5	0 / 17	10 - 20	--	0.000	0	0
2-Methylnapthalene	1 / 5	1 / 17	10 - 20	2	4.950	2	2
Pentachlorophenol	0 / 5	0 / 17	25 - 50	--	0.000	0	0
Aluminum	5 / 5	15 / 17	13 - 66	28.5 - 61000	12318.738	61000	12000
Antimony	2 / 5	2 / 17	8 - 47	17.5 - 104.9	18.663	104.9	19
Arsenic	1 / 5	2 / 16	1 - 2	1 - 2.3	0.837	2.3	0.84
Barium	5 / 5	14 / 17	1 - 4	9.1 - 430	81.428	430	81
Beryllium	3 / 5	4 / 17	1	2.6 - 10.5	1.988	10.5	2.0
Cadmium	0 / 5	0 / 17	1 - 3	--	0.000	0	0
Chromium	3 / 5	5 / 17	2 - 8	8.1 - 66.6	9.877	66.6	9.9
Cobalt	4 / 5	6 / 17	3 - 8	3.7 - 27.2	7.149	27.2	7.1
Copper	5 / 5	11 / 17	2 - 11	12.4 - 104	32.813	104	33
Lead	3 / 5	5 / 17	1 - 2	24 - 307	23.188	307	23
Manganese	5 / 5	17 / 17	1 - 9	43.3 - 9995	1637.850	9995	1600
Nickel	2 / 5	3 / 17	3 - 16	24.8 - 71.3	12.923	71.3	13
Vanadium	4 / 5	10 / 17	2 - 5	6.5 - 91.0	14.746	91.0	15
Zinc	4 / 5	9 / 16	4 - 11	48.4 - 215	60.713	215	61
Ammonia	1 / 2	2 / 4	30.0	500 - 6030	1640.000	6030	1600
Sulfide	2 / 5	2 / 13	50 - 1000	2400 - 3200	3670.000	32000	3700

NOTES:

1. This value represents the number of locations which had detected concentrations per the number of locations sampled.
   The number of locations sampled varies due to rejected values and locations not sampled.
2. This value represents the number of detected concentrations per the total sum of samples collected at all locations in the specific area.
   The total number of samples collected varies due to rejected values and locations not sampled.
3. When an analyte was not detected, the mean was calculated using ½ of the detection limit for that sample.
   Refer to section 6.1.3 for a detailed discussion of averaging.
4. Maximum detected is defined as the exposure point concentration for "Reasonable Maximum Exposure"
5. Exposure point concentration is maximum detected or arithmetic mean, whichever is lower.

gwsewa TABLE 50 **SUMMARY STATISTICS FOR GROUNDWATER FROM THE SEWAGE SLUDGE AREA**

(Units: Fg/L)

Chemical	Frequency or Detection/Location(1)	Frequency of Detection/Sample (2)	Range of Detection Limits	Range of Concentration	Calculated Arithmetic Mean (3)	Selected Exposure Point Concentrations RME Case (4)	Average Case (5)
Benzene	0 / 6	0 / 13	5 - 10	--	0.000	0	0
Chloroethane	0 / 6	0 / 13	10	--	0.000	0	0
1,1-Dichloroethane	0 / 6	0 / 13	5 - 10	--	0.000	0	0
1,2-Dichloroethene(total)	0 / 6	0 / 13	5 - 10	--	0.000	0	0
Vinyl Chloride	0 / 6	0 / 13	10	--	0.000	0	0
Acrylamide	0 / 6	0 / 6	200	--	0.000	0	0
N,N-DMF	0 / 6	0 / 9	50	--	0.000	0	0
4-Chloro-3-methylphenol	0 / 6	0 / 13	10	--	0.000	0	0
bis(2-Ethylhexyl)phthalate	0 / 6	0 / 13	10	--	0.000	0	0
2-Methylnapthalene	0 / 6	0 / 13	10	--	0.000	0	0
Pentachlorophenol	0 / 6	0 / 13	25 - 50	--	0.000	0	0
Aluminum	6 / 6	13 / 13	10 - 66	627 - 55600	16422.306	55600	16000
Antimony	1 / 6	1 / 13	11 - 47	74.2	17.097	74.2	17
Arsenic	2 / 6	3 / 13	1 - 4	2.7 - 5.5	1.800	5.5	1.8
Barium	6 / 6	11 / 13	1 - 2	19.3 - 284	97.497	284	97
Beryllium	3 / 6	3 / 13	1	2.6 - 3.4	1.701	3.4	1.7
Cadmium	1 / 6	1 / 13	1 - 3	19.4	3.325	19.4	3.3
Chromium	3 / 6	3 / 13	2 - 8	23.0 - 54.5	14.451	54.5	14
Cobalt	5 / 6	8 / 13	2 - 8	10.0 - 45.0	20.560	45.0	21
Copper	5 / 6	9 / 13	2 - 11	15.3 - 123	58.178	123	58
Lead	5 / 6	8 / 13	1 - 2	10.9 - 82.4	26.542	82.4	27
Manganese	6 / 6	13 / 13	1 - 9	44.0 - 6230	2541.444	6230	2500
Nickel	6 / 6	11 / 13	3 - 16	5.4 - 76.6	32.851	76.6	33
Vanadium	5 / 6	8 / 13	2 - 5	6.5 - 101.0	22.019	101.0	22
Zinc	6 / 6	9 / 13	3 - 11	32.5 - 362	137.426	362	140
Ammonia	1 / 1	1 / 1	30.0	17100	17100.000	17100	17000
Sulfide	4 / 6	4 / 12	50 - 1000	640 - 2700	565.000	2700	560

NOTES:

1. This value represents the number of locations which had detected concentrations per the number of locations sampled.
   The number of locations sampled varies due to rejected values and locations not sampled.
2. This value represents the number of detected concentrations per the total sum of samples collected at all locations in the specific area.
   The total number of samples collected varies due to rejected values and locations not sampled.
3. When an analyte was not detected, the mean was calculated using ½ of the detection limit for that sample.
   Refer to section 6.1.3 for a detailed discussion of averaging.
4. Maximum detected is defined as the exposure point concentration for "Reasonable Maximum Exposure"
5. Exposure point concentration is maximum detected or arithmetic mean, whichever is lower.

gwres TABLE 51 **SUMMARY STATISTICS FOR GROUNDWATER FROM RESIDENTIAL WELLS**

(Units: Fg/L)

Chemical	Frequency or Detection/Location(1)	Frequency of Detection/Sample (2)	Range of Detection Limits	Range of Concentration	Calculated Arithmetic Mean (3)	Selected Exposure Point Concentrations RME Case (4)	Selected Exposure Point Concentrations Average Case (5)
Benzene	1 / 10	1 / 21	1	0.8 - 0.8	0.515	0.8	0.52
Chloroethane	1 / 10	1 / 21	1	1.0 - 1.0	0.525	1.0	0.53
Trichloroethene	2 / 10	2 / 21	1	0.6 - 2*	0.555	2*	0.56
N,N-DMF	2 / 10	2 / 12	50	1.9 - 14	22.745	14	14
4-Methylphenol	1 / 10	1 / 19	10	63	7.900	63	7.9
Dieldrin	1 / 10	1 / 21	0.10	0.0024	0.048	0.0024	0.0024
Aluminum	4 / 10	5 / 21	10 - 27	20.0 - 552	90.475	552	90
Barium	6 / 10	8 / 21	1 - 4	5.8 - 44.3	8.273	44.3	8.3
Copper	3 / 10	4 / 21	3 - 11	11 - 58.6	13.503	58.6	14
Manganese	9 / 10	15 / 21	1 - 9	2.6 - 3100	887.830	3100	890
Mercury	1 / 10	1 / 19	0.2	0.46	0.136	0.46	0.14
Zinc	1 / 10	1 / 21	3 - 8	165	24.204	165	24
Sulfide	9 / 10	9 / 21	50 - 1000	450 - 3700	1571.000	3700	1600

NOTES:

1. This value represents the number of locations which had detected concentrations per the number of locations sampled.
   The number of locations sampled varies due to rejected values and locations not sampled.
2. This value represents the number of detected concentrations per the total sum of samples collected at all locations in the specific area.
   The total number of samples collected varies due to rejected values and locations not sampled.
3. When an analyte was not detected, the mean was calculated using ½ of the detection limit for that sample.
   Refer to section 6.1.3 for a detailed discussion of averaging.
4. Maximum detected is defined as the exposure point concentration for "Reasonable Maximum Exposure"
5. Exposure point concentration is maximum detected or arithmetic mean, whichever is lower.

TABLE 52

RISK ASSESSMENT SUMMARY
REASONABLE MAXIMUM EXPOSURE

ROSE HILL REGIONAL LANDFILL SUPERFUND SITE

Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Drinking Water	Solid Waste Area	Benzene	1.1E-05	- -	- -	1.1E-05	1,2-Dichloroethene	Liver	2.0E+00	- -	- -	2.0E+00
			Vinyl Chloride	1.5E-02	- -	- -	1.5E-02	Acrylamide	Nervous System	3.1E+01	- -	- -	3.1E+01
			Pentachlorophenol	4.2E-06	- -	- -	4.2E-06	Cadmium	Kidney	2.2E+00	- -	- -	2.2E+00
			bis(2-Ethylhexyl)phthalate	5.9E-06	- -	- -	5.9E-06	Manganese	Nervous System	1.1E+01	- -	- -	1.1E+01
			Acrylamide	1.2E-02	- -	- -	1.2E-02						
			Arsenic	1.7E-04	- -	- -	1.7E-02						
			(Total)	2.7E-02	- -	- -	2.7E-02	(Total)		4.6E+01	- -	- -	4.6E+01

- - Not Evaluated

Total Risk Across All Media and All Exposure Routes: 2.7E-02

Total Hazard Index Across All Media and All Exposure Routes: 4.6E+01

Total Liver HI =	2.0E+00
Total Nervous System HI =	4.2E+01
Total Kidney HI =	2.2E+00

TABLE 53

RISK ASSESSMENT SUMMARY
REASONABLE MAXIMUM EXPOSURE

ROSE HILL REGIONAL LANDFILL SUPERFUND SITE

Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Drinking Water	Sewage Sludge Area						Antimony	Blood	5.1E+00	- -	- -	5.1E+00
								Cadmium	Kidney	1.1E+00	- -	- -	1.1E+00
								Manganese	Nervous System	7.1E+00	- -	- -	7.1E+00
								(Total)		1.3E+01	- -	- -	1.3E+01

- - Not Evaluated

Total Risk Across All Media and All Exposure Routes: N/A

Total Hazard Index Across All Media and All Exposure Routes: 1.3E+01

Total Blood HI = 5.1E+00

Total Kidney HI = 1.1E+00

Total Nervous System HI = 7.1E+00

TABLE 54

RISK ASSESSMENT SUMMARY
REASONABLE MAXIMUM EXPOSURE

ROSE HILL REGIONAL LANDFILL SUPERFUND SITE

Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Drinking Water	Bulky Waste Area						Antimony	Blood	7.2E+00	- -	- -	7.2E+00
								Manganese	Nervous System	1.1E+01	- -	- -	1.1E+01
								(Total)		1.8E+01	- -	- -	1.8E+01

- - Not Evaluated

Total Risk Across All Media and All Exposure Routes: N/A

Total Hazard Index Across All Media and All Exposure Routes: 1.8E+01

Total Blood HI = 7.2E+00
Total Nervous System HI = 1.1E+01

TABLE 55

RISK ASSESSMENT SUMMARY
REASONABLE MAXIMUM EXPOSURE

ROSE HILL REGIONAL LANDFILL SUPERFUND SITE

Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Drinking Water	Residential Wells						Manganese	Nervous System	3.5E+00	- -	- -	3.5E+00
								(Total)		3.5E+00	- -	- -	3.5E+00

- - Not Evaluated

Total Risk Across All Media and All Exposure Routes: N/A

Total Hazard Index Across All Media and All Exposure Routes: 3.5E+00

Total Nervous System HI = 3.5E+00

TABLE 56

RISK ASSESSMENT SUMMARY
REASONABLE MAXIMUM EXPOSURE

ROSE HILL REGIONAL LANDFILL SUPERFUND SITE

Scenario Timeframe: Current/Future
Receptor Population: Visitor
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Air	Outdoor Air (1)	Solid Waste Area	1,1-Dichloroethene	- -	2.7E-06	- -	2.7E-06						
			Vinyl Chloride	- -	4.4E-04	- -	4.4E-04						
			(Total)	- -	4.4E-04	- -	4.4E-04						

- - Not Evaluated

Total Risk Across All Media and All Exposure Routes: 4.4E-04

Total Hazard Index Across All Media and All Exposure Routes: N/A

(1) Measured by SUMMA canister

TABLE 57

RISK ASSESSMENT SUMMARY
REASONABLE MAXIMUM EXPOSURE

ROSE HILL REGIONAL LANDFILL SUPERFUND SITE

Scenario Timeframe: Current/Future
Receptor Population: Nearby Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Air	Ambient Air (1)	Nearby Residences	Benzene	- -	2.8E-04	- -	2.8E-04	Benzene	Blood	- -	1.2E+01	- -	1.2E+01
			1,1,2,2-Tetrachloroethane	- -	9.5E-05	- -	9.5E-05						
			Vinyl Chloride	- -	1.4E-04	- -	1.4E-04						
			(Total)	- -	5.0E-04	- -	5.0E-04	(Total)		- -	1.2E+01	- -	1.2E+01

- - Not Evaluated

Total Risk Across All Media and All Exposure Routes: 5.0E-04

Total Hazard Index Across All Media and All Exposure Routes: 1.2E+01

(1) Measured by SUMMA canister

Total Blood HI = 1.2E+01

TABLE 58

RISK ASSESSMENT SUMMARY
REASONABLE MAXIMUM EXPOSURE

ROSE HILL REGIONAL LANDFILL SUPERFUND SITE

Scenario Timeframe: Current/Future
Receptor Population: Visitor
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Air	Ambient Air (1)	Solid Waste Area	1,1-Dichloroethene	- -	2.7E-06	- -	2.7E-06						
			Vinyl Chloride	- -	4.4E-04	- -	4.4E-04						
			(Total)	- -	4.4E-04	- -	4.4E-04						

- - Not Evaluated

Total Risk Across All Media and All Exposure Routes: 4.4E-04

Total Hazard Index Across All Media and All Exposure Routes: N/A

(1) Concentrations based on landfill gas concentrations, a landfill gas emissions rate, and simple box dispersion modeling.

TABLE 59

RISK ASSESSMENT SUMMARY
REASONABLE MAXIMUM EXPOSURE

ROSE HILL REGIONAL LANDFILL SUPERFUND SITE

Scenario Timeframe: Current/Future
Receptor Population: Nearby Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Air	Ambient and Indoor Air (1)	Nearby Residences	Benzene	- -	2.8E-04	- -	2.8E-04	Benzene	Blood	- -	1.2E+01	- -	1.2E+01
			1,1,2,2-Tetrachloroethane	- -	5.0E-05	- -	5.0E-05						
			Vinyl Chloride4	- -	1.5E-04	- -	1.5E-04						
			(Total)	- -	4.8E-04	- -	4.8E-04	(Total)		- -	1.2E+01	- -	1.2E+01

- - Not Evaluated

Total Risk Across All Media and All Exposure Routes: 4.8E-04

Total Hazard Index Across All Media and All Exposure Routes: 1.2E+01

(1) Concentrations based on landfill gas concentrations, a landfill gas emission rate, and ISC8T3 dispersion modeling.

Total Blood HI = 1.2E+01

TABLE 60

RISK ASSESSMENT SUMMARY
REASONABLE MAXIMUM EXPOSURE

ROSE HILL REGIONAL LANDFILL SUPERFUND SITE

Scenario Timeframe: Future
Receptor Population: Nearby Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Air	Indoor Air (1)	Nearby Residences	Vinyl Chloride	- -	1.9E-03	- -	1.9E-03						
			(Total)	- -	1.9E-03	- -	1.9E -03						
- - Not Evaluated			Total Risk Across All Media and All Exposure Routes				1.9E-03	Total Hazard Index Across All Media and All Exposure Routes					N/A

(1) Measured concentrations at 220 Rose Hill Road

TABLE 61

ORAL DOSE-RESPONSE VALUES FOR CHEMICALS OF CONCERN

CHEMICAL (a)	CHRONIC RfD (mg/kg)	CRITICAL EFFECTS	ORAL RfD CONFIDENCE	REFERENCE FOR RfD	ORAL SLOPE FACTOR /(mg/kg/day)	WEIGHT OF EVIDENCE	REFERENCE FOR SLOPE FACTOR	NOTES
VOLATILE ORGANIC COMPOUNDS								
Acetone	0.10	increased liver weight	Low	IRIS 8/98	NA	NA	NA	
Benzene	NA	NA	NA	NA	2.9E-02	A	IRIS 8/98	
Chloroethane	NA	NA	NA	NA	NA	NA	NA	
1,1-Dichloroethane	0.10	kidney damage	Low	HEAST '97	NA	C	IRIS 8/98	
1,2-Dichloroethene	0.01	liver lesions	Low	HEAST '97	NA	NA	NA	
Trichloroethene	NA	NA	NA	NA	1.1E-02	B2 or C	NCEA	
Vinyl chloride	NA	NA	NA	NA	1.9E+00	A	HEAST '97	
Pentachlorophenol	0.03	liver/kidney damage	Med.	IRIS 8/98	1.2E-01	B2	IRIS 8/98	
bis(2-Ethylhexyl)phthalate	0.02	NOEL	Med.	IRIS 8/98	1.4E-02	B2	IRIS 8/98	
Acrylamide	0.0002	nerve damage	Med.	IRIS 8/98	4.5E+00	B2	IRIS 8/98	
4-Methylphenol	0.005	central nervous system	Low	HEAST '97	NA	NA	NA	
N,N-Dimethylformamide	0.10	liver effects	Med.	HEAST '97	NA	NA	NA	
Benzo(a)anthracene	NA	NA	NA	NA	7.3E-01	B2	IRIS 8/98	
Benzo(a)pyrene	NA	NA	NA	NA	7.3E+00	B2	IRIS 8/98	
Benzo(b)flouranthene	NA	NA	NA	NA	7.3E-01	B2	IRIS 8/98	
Benzo(k)flouranthene	NA	NA	NA	NA	7.3E-02	B2	IRIS 8/98	
Chrysene	NA	NA	NA	NA	7.3E-03	B2	IRIS 8/98	
Indeno(1,2,3-c,d)pyrene	NA	NA	NA	NA	7.3E-01	B2	IRIS 8/98	
Dieldrin	0.00005	liver effects	Med.	IRIS 8/98	1.6E+01	B2	IRIS 8/98	

TABLE 61

(continued).
ORAL DOSE-RESPONSE VALUES
FOR CHEMICALS OF CONCERN

CHEMICAL (a)	CHRONIC RfD (mg/kg)	CRITICAL EFFECTS	ORAL RfD CONFIDENCE	REFERENCE FOR RfD	ORAL SLOPE FACTOR /(mg/kg/day)	WEIGHT OF EVIDENCE	REFERENCE FOR SLOPE FACTOR	NOTES
Aluminum	NA	NA	NA	NA	NA	NA	NA	
Antimony	0.0004	blood	Low	IRIS 8/98	NA	NA	NA	
Arsenic	0.0003	skin	Med.	IRIS 8/98	1.5	A	IRIS 8/98	
Barium	0.07	vascular	Med.	IRIS 8/98	NA	NA	IRIS 8/98	
Beryllium	0.002	NOEL	Med.	IRIS 8/98	NA	NA	IRIS 8/98	
Cadmium	0.0005	kidney damage	High	IRIS 8/98	NA	B1	IRIS 8/98	
Chromium	0.005	NOEL	Low	IRIS 8/98	NA	A	IRIS 8/98	b
Cobalt	NA	NA	NA	NA	NA	NA	NA	
Copper	NA	NA	NA	NA	NA	NA	NA	
Lead	NA	NA	NA	NA	NA	B2	IRIS 8/98	
Manganese	0.07	nervous system	Med.	IRIS 8/98	NA	D	IRIS 8/98	
Mercury	0.0003	nervous system	High	IRIS 8/98	NA	D	IRIS 8/98	
Nickel	0.02	decreased body/organ weights	Low	IRIS 8/98	NA	NA	NA	
Thallium	0.00008	NOEL	Med.	IRIS 8/98	NA	D	IRIS 8/98	
Vanadium	0.007	NOEL	Med.	HEAST '97	NA	D	IRIS 8/98	
Zinc	0.30	blood	High	IRIS 8/98	NA	D	IRIS 8/98	

FOOTNOTES:
a. This table includes chemicals detected in soil, sludge, leachate, and groundwater.
b. The RfD for Chromium VI was used.

REFERENCES:
IRIS. USEPA, 1998. Integrated Risk Information System. Database searched August 1998.
HEAST. USEPA, 1997. Health Effects Assessment Summary Tables, FY-1997 Annual.
NCEA. USEPA, 1996. National Center for Environmental Assessment, Superfund Health Risk Technical Support Center. Attachments to 21 August 1996 letter to D. Newton.

ABBREVIATIONS:
NA = Not available
NOEL=No Observed Effect Level
RfD = Reference concentration

TABLE 62

INHALATION DOSE-RESPONSE VALUES FOR AIR CHEMICALS OF CONCERN

CHEMICAL (a)	CHRONIC RfC (mg/m^3)	CRITICAL EFFECTS	INHALATION RfC CONFIDENCE	REFERENCE FOR RfC	INHALATION UNIT RISK /(ug/m^3)	WEIGHT OF EVIDENCE	REFERENCE FOR UNIT RISK	NOTES
VOLATILE ORGANIC COMPOUNDS								
Acetone	NA							
Benzene	0.006	damage to hematopoietic progenitor cells	medium	NCEA 3/96	8.3E-06	A	IRIS 8/98	b
Carbon disulfide	0.70	peripheral nervous system dysfunction	medium	IRIS 8/98				
Dichlorodifluoromethane	0.20	liver lesions		HEAST '97				c
1,1-Dichloroethane	0.50	kidney damage		HEAST '97		C	IRIS 8/98	c
1,1-Dichloroethene	NA				5.0E-05	C	IRIS 8/98	
cis-1,2-Dichloroethene	NA					D	IRIS 8/98	
trans-1,2-Dichloroethene	NA							
Ethylbenzene	1.0	developmental toxicity	low	IRIS 8/98		D	IRIS 8/98	
4-Methyl-2-pentanone (MIBK)	0.08	increased liver weight, kidney effects		HEAST '97				c
Methylene chloride	3.0	liver toxicity		HEAST '97	4.7E-07	B2	IRIS 8/98	
1,1,2,2-Tetrachloroethane	NA				5.8E-05	C	IRIS 8/98	

TABLE 62 **(continued).**

INHALATION DOSE-RESPONSE VALUES
FOR AMBIENT AIR CHEMICALS OF CONCERN

CHEMICAL (a)	CHRONIC RfC (mg/m^3)	CRITICAL EFFECTS	INHALATION RfC CONFIDENCE	REFERENCE FOR RfC	INHALATION UNIT RISK /(ug/m^3)	WEIGHT OF EVIDENCE	REFERENCE FOR UNIT RISK	NOTES
Toluene	0.40	neurological effects		IRIS 8/98		D	IRIS 8/98	
1,2,4-Trichlorobenzene	0.20	non-adverse weight changes		HEAST '97		D	IRIS 8/98	
1,1,1-Trichloroethane	1.00	brain damage	medium	NCEA 8/96		D	IRIS 8/98	b
Trichloroethene	NA				1.7E-06	B2 or C	NCEA	d
1,2,4-Trimethylbenzene	0.006	neurotoxicity, decreased body weight gain, testicular atrophy	low	NCEA 3/96				b
1,3,5-Trimethylbenzene	0.006	neurotoxicity, decreased body weight gain, testicular atrophy	low	NCEA 3/96				b
Vinyl chloride	NA				8.4E-05		HEAST '97	
m,p-Xylene	NA					D	IRIS 8/98	d
o-Xylene	NA					D	IRIS 8/98	d

FOOTNOTES:

a. This table includes chemicals selected in the RI as chemicals of concern in landfill gas that were detected in the solid waste landfill plus chemicals detected in residential area ambient air sampling in 1993.
b. The value listed as a chronic RfC is a draft, provisional value.
c. Chronic RfC is from the "Alternate Methods Table" of HEAST FY-1997.
d. RfCs for xylenes and the inhalation unit risk for trichloroethene were available on HEAST until 1991 but have since been withdrawn.

REFERENCES:

IRIS. USEPA, 1998. Integrated Risk Information System, Database searched August 1998.
HEAST. USEPA, 1997. Health Effects Assessment Summary Tables, FY-1997 Annual.
NCEA. USEPA, 1996. National Center for Environmental Assessment, Superfund Health Risk Technical Support Center. Attachments to 21 August 1996 letter to D. Newton.

ABBREVIATIONS:

NA = Not available
RfC = Reference concentration

TABLE 63 **ROSE HILL REGIONAL LANDFILL ECOLOGICAL RISK ASSESSMENT – SURFACE WATER CONTAMINANT SCREENING**

Compound	Frequency of Detection	Site Concentration Maximum	Mean 6/91	9/91	1/92	4/92	5/92	AWQC Chronic Criteria	AWQC Acute Criteria	Background Range
Volatile organics										
Benzene	1/56	3	2.5	---	---	---	---	5.9	265	U
Toluene	1/56	2	---	***	---	---	---	14	635	U
Total Xylenes	2/56	9	3.4	---	---	---	---	ND	ND	U
Chlorobenzene	1/56	2	***	---	---	---	---	18	795	U
1,2-Dichloroethene(total)	1/56	4	2.6	---	---	---	---	ND	ND	U
Chloroethane	1/56	6	5.1	---	---	---	---	ND	ND	U
Carbon Disulfide	15/56	14	3.2	5.2	4.8	***	---	ND	ND	4
Water soluble organics										
Acrylamide	1/15	272	NA	110	NA	---	NA	ND	ND	U
N,N-DMF	1/31	5	NA	***	---	---	NA	ND	ND	U
Semivolatile organics										
bis(2-ethylhexyl)phthalate	1/56	8	5.2	---	---	---	---	12	555	U
Diethylphthalate	2/56	2	---	***	***	---	---	58	2,605	U
Dimethylphthalate	1/56	1	---	---	***	---	---	37	1,650	U
Di-n-butylphthalate	1/56	3	---	---	***	---	---	ND	ND	U
Pesticides										
gamma-BHC(Lindane)	1/56	0.002	---	***	---	---	---	ND	ND	U
4,4'-DDD	1/56	0.0047	---	---	***	---	---	ND	ND	U
Methoxychlor	1/56	0.014	---	---	***	---	---	0.03	ND	U
Inorganics										
Aluminum	30/56	1,140	250	130	120	---	310	87	750	88.5 – 194
Antimony	4/56	28.8	---	15	---	12	---	10	450	U
Arsenic	2/56	4.1	1.7	0.57	---	---	---	1.2	52	U
Barium	33/56	279	40	10	7.8	7.7	9.5	ND	ND	U – 8.6
Calcium	56/56	27,100	7,700	5,300	4,000	3,700	4,300	ND	ND	3,240 – 4,070
Chromium	1/56	3.2	---	---	---	1.7	---	11	16	U
Copper	6/56	11.6	---	5.8	---	---	1.6	13.9 *	21.2 *	U – 2.1
Iron	48/56	65,000	9,500	1,600	1,400	660	1,900	1,000	ND	U – 250
Lead	1/56	3.7	---	---	---	---	1.2	4.0 *	104 *	U
Magnesium	56/56	12,900	2,700	1,700	1,400	1,300	1,500	ND	ND	1,210 – 1,460
Manganese	54/56	2,030	610	320	230	140	240	ND	ND	20.6 – 68
Nickel	1/56	5.0	2.7	---	---	---	---	185 *	1,664 *	U
Potassium	31/56	45,000	5,200	870	980	880	---	ND	ND	U – 777
Sodium	56/56	59,900	14,000	11,000	9,000	9,000	9,000	ND	ND	7,900 – 9,720
Zinc	15/56	22.8	8.3	9.4	7.0	---	5.2	124 *	137 *	U – 3.9
Ammonia	17/19	3.53	NA	NA	NA	0.29	0.65	2.2	24	U – 0.15
Cyanide	3/56	210	---	5.3	---	---	25	5.2	22	U
Sulfide	14/37	2.20	1.4	---	---	NA	NA	ND	ND	U – 2.20

NOTES

All concentrations in Fg/L except ammonia and sulfide, which are in mg/L.

--- Analyte was not detected in this round.

*** The calculated mean is greater than the maximum detect.

NA Analyte was not analyzed for is this round or all values were rejected.

ND Data not available.

* Criterion was calculated using the maximum value of unfiltered hardness (120.8 mg/L).

U This analyte was not detected in any of the background samples, or the non-detected value is the lowest concentration.

TABLE 64 **ROSE HILL REGIONAL LANDFILL ECOLOGICAL RISK ASSESSMENT – LEACHATE CONTAMINANT SCREENING**

Compound	Frequency of Detection	Site Concentration Maximum	Site Concentration Mean 6/91	Site Concentration Mean 4/92	AWQC Chronic Criteria	AWQC Acute Criteria
Volatile organics						
Toluene	3/9	50	19	---	14	635
Ethylbenzene	3/8	2	---	1.7	36	1,600
Total Xylenes	2/8	3	---	***	ND	ND
Chlorobenzene	3/9	2	***	---	18	795
Trichloroethene	1/8	4	2.8	---	43	1,950
1,2-Dichloroethene(total)	2/8	44	10.8	***	ND	ND
1,1-Dichloroethane	3/9	2	***	---	ND	ND
Chloroethane	4/9	8	5.7	***	ND	ND
Vinyl Chloride	1/8	1	***	---	ND	ND
Carbon Disulfide	2/8	12	4.5	---	ND	ND
Semivolatile organics						
Naphthalene	3/9	0.9	---	0.77	2.6	115
Diethylphthalate	3/9	11	---	6.3	58	2,605
bis(2-Ethylhexyl)phthalate	1/9	230	42.5	---	12	555
Inorganics						
Aluminum	7/9	60,500	12,000	310	87	750
Arsenic	1/8	3.7	1.9	---	1.2	52
Barium	9/9	2,120	510	180	ND	ND
Beryllium	2/9	11.2	3.8	---	0.17	7.5
Calcium	9/9	59,000	25,000	20,000	ND	ND
Chromium	2/9	23.9	6.1	2.6	11	16
Cobalt	4/9	295	53	---	ND	ND
Copper	1/9	37.8	9.6	---	22.6 *	36.2 *
Iron	9/9	1,370,000	330,000	140,000	1,000	ND
Lead	3/9	174	56	5.0	8.4 *	214 *
Manganese	9/9	14,700	7,100	1,900	ND	ND
Magnesium	9/9	16,100	7,200	6,600	ND	ND
Mercury	1/9	0.2	---	0.13	0.012	2.4
Nickel	3/8	15.8	7.0	---	300 *	2,700 *
Potassium	9/9	44,800	14,000	14,000	ND	ND
Sodium	9/9	55,400	21,000	23,000	ND	ND
Vanadium	3/9	65.2	23	---	ND	ND
Zinc	4/7	209	***	6.8	202 *	223 *
Ammonia	3/3	21.75	NA	13	2.2	24
Cyanide	2/9	41.7	16	---	5.2	22

NOTES

All concentrations in Fg/L except ammonia, which is in mg/L.

--- Analyte was not detected in this round.

*** The calculated mean is greater than the maximum detect.

NA Analyte was not analyzed for in this round or all values were rejected.

ND Data not available.

* The criterion is calculated using the maximum value of the unfiltered hardness (213.6 mg/L).

TABLE 65 **ROSE HILL REGIONAL LANDFILL ECOLOGICAL RISK ASSESSMENT: SEDIMENT CONTAMINANT SCREENING**

Compound	Frequency of Detection	Site Concentration Maximum	Mean 6/91	Mean 9/91	Mean 5/92	Sediment Criteria ERL-L	ERL-M	EPA	NYSDEC	Background Range
Volatile organics (µg/kg)										
Benzene	1/39	1	---	***	---	ND	ND	ND	ND	U
Ethylbenzene	2/40	8	4.1	***	---	ND	ND	ND	ND	U
Total Xylenes	5/40	67	9.3	***	---	ND	ND	ND	ND	U
Acetone	5/40	215	---	97	---	ND	ND	ND	ND	U – 42
2-Butanone	2/40	46	---	13	---	ND	ND	ND	ND	U
4-Methyl-2-pentanone	1/40	3	---	***	---	ND	ND	ND	ND	U
Tetrachloroethene	3/40	4	---	***	---	ND	ND	ND	ND	U
Trichloroethene	6/39	150	16	---	---	ND	ND	ND	ND	U
1,2-Dichloroethene(total)	1/40	5	3.9	---	---	ND	ND	ND	ND	U
Chloroform	1/40	5	---	***	---	ND	ND	ND	ND	U
Carbon Disulfide	2/40	22	4.2	9.5	---	ND	ND	ND	ND	U
Semivolatile organics (µg/kg)										
Phenanthrene	2/39	220	***	---	***	225	1380	ND	ND	U
Anthracene	1/39	64	---	---	***	85	960	ND	ND	U
Fluoranthene	5/39	330	***	***	***	600	3600	ND	ND	U
Pyrene	6/39	280	***	***	***	350	2200	ND	ND	U
Chrysene	1/39	180	***	---	---	400	2800	ND	ND	U
Benzo(b)fluoranthene	1/39	130	***	---	---	ND	ND	ND	ND	U
Benzo(k)fluoranthene	1/39	130	***	---	---	ND	ND	ND	ND	U
Benzo(a)pyrene	1/39	140	***	---	---	400	2500	ND	ND	U
Di-n-butylphthalate	1/39	650	---	310	---	ND	ND	ND	ND	U
Butylbenzylphthalate	1/39	440	***	---	---	ND	ND	ND	ND	U
Pesticides (µg/kg)										
delta-BHC	11/37	1.3	---	***	0.73	ND	ND	ND	ND	U
4,4'-DDE	5/37	4.9	---	2.6	2.1	2	15	ND	ND	U
4,4'-DDD	2/37	8.2	---	3.1	2.6	2	20	ND	ND	U
4,4-DDT	1/37	0.9	---	***	---	1	7	ND	ND	U
Methoxychlor	1/37	2.6	---	***	---	ND	ND	ND	ND	U
Endosulfan II	1/37	0.31	---	***	---	ND	ND	ND	ND	U
Dieldrin	1/37	1.3	---	***	---	0.02	8	ND	ND	U
gamma-Chlordane	1/37	0.23	---	***	---	0.5	6	ND	ND	U
Inorganics (mg/kg)										
Aluminum	40/40	8650	3500	4400	1700	ND	ND	ND	ND	749 – 1260
Antimony	1/40	62.1	---	8.1	---	2	25	ND	ND	U
Arsenic	21/40	6.1	0.85	0.78	1.1	33	85	3	5	U
Barium	40/40	64.6	16	17	7.9	ND	ND	20	ND	2.7 – 3.1
Beryllium	18/40	2.3	0.71	0.54	0.22	ND	ND	ND	ND	U
Cadmium	1/40	1.3	---	0.56	---	5	9	ND	0.8	U
Calcium	33/40	1760	530	780	260	ND	ND	ND	ND	U – 350
Chromium	23/40	18.1	3	5.7	1.7	80	145	25	26	U – 1.6
Cobalt	21/40	6.5	1.5	3	0.9	ND	ND	ND	ND	U
Copper	3/39	56.1	2.4	6.3	---	70	390	25	19	U
Iron	40/40	113000	13000	12000	8100	ND	ND	17000	24000	780 – 1020
Lead	32/40	243.4	7.2	27	5.2	35	110	40	27	U – 7.2
Magnesium	35/40	2560	530	890	340	ND	ND	ND	ND	U – 373

TABLE 65 **(Continued). ROSE HILL REGIONAL LANDFILL ECOLOGICAL RISK ASSESSMENT – SEDIMENT CONTAMINANT SCREENING**

Compound	Frequency of Detection	Site Concentration				Sediment Criteria				Background Range		
		Maximum	Mean 6/91	Mean 9/91	Mean 5/92	ERL-L	ERL-M	EPA	NYSDEC			
Manganese	40/40	1,150	160	120	110	ND	ND	300	428	13.5	–	22.6
Nickel	19/40	20.5	2.9	5.0	1.8	30	50	20	22	U	–	1.4
Potassium	18/40	775	180	320	---	ND	ND	ND	ND		U	
Selenium	6/40	2.1	0.68	0.34	0.20	ND	ND	ND	ND	U	–	0.52
Sodium	13/39	115	45	44	---	ND	ND	ND	ND		U	
Thallium	2/40	0.37	---	0.20	---	ND	ND	ND	ND		U	
Vanadium	28/40	17.7	7.2	8.9	2.3	ND	ND	ND	ND	U	–	2.0
Zinc	13/40	236	31	35	6.0	120	270	90	85		U	
Ammonia	5/11	25.6	NA	NA	3.7	ND	ND	75	ND		U	
Sulfide	15/29	850	31	63	---	ND	ND	ND	ND	U	–	22.0

NOTES
--- Analyte was not detected in this round.
*** The calculated mean is greater than the maximum detect.
NA Analyte was not analyzed for in this round.
ND Data is not available.
U This analyte was not detected in any of the background samples, or the non-detected value is the lowest concentration.
ER–L/ER–M Values presented by Long and Morgan (1990)
EPA Values presented by USEPA (1977)
NYSDEC Draft sediment criteria (NYSDEC 1989)

TABLE 66 **ECOLOGICAL RISK ASSESSMENT - SURFACE SOIL CONTAMINANT SCREENING**

Compound	Frequency of Detection	Site Concentration			Effect Level	Screening Status Code[2]
		Maximum	Mean[1]			
			9/91	4/92		
Volatile Organics - µg/kg						
1,1,1-Trichloroethane	1/24	8	6.8	---	100,000	SE
1,1-Dichloroethene	1/24	4	***	---	Unknown	SM
1,1-Dichloroethane	2/24	25	7.7	---	100,000	SE
1,2-Dichloroethene	4/24	2,400	266.7	---	100,000	SE
2-Butanone	7/24	830	130.8	8.5	10,000	SE
2-Hexanone	1/24	6	***	---	Unknown	SM
4-Methyl-2-Pentanone	1/24	3	***	---	Unknown	SM
Acetone	15/24	160,000	15,917	428.8	10,000,000	SE
Benzene	2/24	6	***	---	300	SE
Chloroform	4/24	3	***	---	100,000	SE
Ethylbenzene	5/24	21	8.5	7.6	1,000	SE
Tetrachloroethene	7/24	13	5.5	---	10,000	SE
Toluene	6/24	110	24.3	6.3	300	SE
Trichloroethene	1/24	2	***	---	Unknown	SM
Vinyl Chloride	2/24	250	25.0	---	10,000	SE
Total Xylenes	5/24	84	16.7	7.8	1,000	SE
Semivolatile Organics - µg/kg						
4-Chloroanaline	1/24	490	229.6	---	Unknown	SM

TABLE 66 **(Continued). ECOLOGICAL RISK ASSESSMENT - SURFACE SOIL CONTAMINANT SCREENING**

Compound	Frequency of Detection	Site Concentration			Effect Level	Screening Status Code[2]
		Maximum	Mean[1]			
			9/91	4/92		
Benzo(a)anthracene	4/24	78	***	***	1,000	SE
Benzo(a)pyrene	4/24	68	***	***	20	SM
Benzo(b)fluoranthene	5/24	76	***	***	19,000	SE
Benzo(k)fluoranthene	4/24	64	***	***	19,000	SE
Benzo(g,h,i)perylene	4/24	57	***	***	1,000	SE
Butylbenzylphthalate	3/24	120	***	---	10,000	SE
Chrysene	5/24	95	***	***	5,000	SE
Diethylphthalate	5/24	46	***	***	60	SE
Fluoranthene	7/24	160	149.2	***	10,000	SE
Indeno(1,2,3-cd)pyrene	3/24	52	***	---	1,000	SE
Naphthalene	1/24	35	---	***	5,000	SE
Phenanthrene	5/24	110	***	***	5,000	SE
Pyrene	9/24	170	126.5	***	10,000	SE
Pesticides - µg/kg						
Aldrin	1/24	0.6	***	---	Unknown	SM
alpha-Chlordane	1/24	3.7	1.3	---	Unknown	SM
Dieldrin	1/24	4.5	2.3	---	Unknown	SM
Endrin ketone	2/24	2.3	---	2.3	100	SE

TABLE 66 **(Continued). ECOLOGICAL RISK ASSESSMENT - SURFACE SOIL CONTAMINANT SCREENING**

Compound	Frequency of Detection	Site Concentration			Effect Level	Screening Status Code[2]
		Maximum	Mean[1]			
			9/91	4/92		
4,4-DDE	7/24	11.0	3.6	2.4	100	SE
4,4-DDD	2/24	5.2	2.9	***	100	SE
4.4-DDT	8/24	5.2	3.1	1.8	100	SE
Inorganics - mg/kg						
Aluminum	24/24	16,600	9,219	6,592	Unknown	SB
Antimony	1/24	79	9	---	8	SM
Arsenic	13/24	3.5	1.6	1.1	3.4	SM
Barium	24/24	86	20	24	400	SE
Beryllium	11/24	1.1	---	0.6	2.2	SE
Cadmium	1/24	0.6	0.4	---	3	SE
Calcium	24/24	1,870	626	502	Unknown	SB
Chromium	14/24	18	10	4	120	SE
Cobalt	14/24	12.8	3.9	3.3	25	SE
Copper	15/22	253	32	5	20	CC
Iron	24/24	149,000	11,285	26,124	Unknown	SM
Lead	24/24	124	11	21	20	CC
Magnesium	24/24	1,990	1,241	802	8,660	SB/SE

TABLE 66 **(Continued). ECOLOGICAL RISK ASSESSMENT - SURFACE SOIL CONTAMINANT SCREENING**

Compound	Frequency of Detection	Site Concentration			Effect Level	Screening Status Code[2]
		Maximum	Mean[1]			
			9/91	4/92		
Manganese	24/24	6,120	130	666	300	CC
Mercury	4/24	0.41	0.10	0.11	0.5	SE
Nickel	12/23	10.6	5.8	2.5	32	SE
Potassium	23/24	944	680	394	4,320	SB/SE
Selenium	1/24	5.9	---	1.1	2	SM
Silver	3/24	1.6	0.5	---	10	SE
Thallium	2/24	0.4	0.2	0.2	Unknown	SB
Vanadium	23/24	27	16	11	150	SE
Zinc	22/22	57	32	19	100	SE

[1] Only calculated for compounds with at least one detection. Half of the detection limit was used at locations where a compound was below the detection limit when calculating means. The symbol *** indicates that the calculated mean exceeded the maximum value.

[2] SB - Screened Out: Background Concentrations Only; SE - Screened Out: Media Concentration Below Effect/Criteria Level; SM - Screened Out: Miscellaneous (see text); CC - Chemical of Concern.

References for effect levels: USEPA (1985a), Eisler (1985; 1986; 1987a; 1987b; 1988a; 1988b), Bysshe (1988), Fitchko (1989), Beyer (1990), M&E (1992c), and Kappleman (1993).

TABLE 67 **ECOLOGICAL RISK ASSESSMENT - UNITED STATES SURFACE SOIL BACKGROUND LEVEL FOR METALS (MG/KG)**

Compound	Mean	Typical Range	Minimum	Maximum
Aluminum	66,000	30,000-100,000	700	>100,000
Antimony	ND	ND	ND	ND
Arsenic	6	1-12	0.1	50
Barium	554	200-1,000	15	5,000
Beryllium	1	1-3	<1	7
Cadmium	3.5	0.2-8.9	0.01	9
Calcium	24,000	8,000-18,000	<150	400,000
Chromium	53	4-1,000	1	3,000
Cobalt	10	3-10	<3	70
Copper	25	2-100	<1	300
Iron	25,000	20,000-50,000	100	550,000
Lead	20	2-100	2	700
Magnesium	9,200	3,000-10,000	50	100,000
Manganese	560	500-700	<1	7,000
Mercury	0.15	0.01-0.61	0.01	15
Nickel	20	1.5-28	<5	5,000
Potassium	23,000	9,500-25,000	50	70,000
Selenium	0.5	0.1-2.0	0.1	38
Silver	ND	0.1-1.0	0.1	1.0

TABLE 67 **(Continued). ECOLOGICAL RISK ASSESSMENT - UNITED STATES**
SURFACE SOIL BACKGROUND LEVEL FOR METALS (MG/KG)

Compound	Mean	Typical Range	Minimum	Maximum
Thallium	ND	0.5-2.0	0.5	2.0
Vanadium	76	30-70	< 7	500
Zinc	54	10-300	< 5	2,000

From: Bysshe (1988), Fitchko (1989), Beyer (1990), and M&E (1992c).
ND = No data.

TABLE 68 **SUMMARY OF THE ECOLOGICAL CHEMICALS OF CONCERN**

Compound	Surface Soil	Surface Water	Leachate	Surface Sediment
Aluminum		X	X	X
Copper	X			
Iron		X	X	X
Lead	X		X	
Manganese	X	X	X	

TABLE 69 **ASSESSMENT AND MEASUREMENT ENDPOINTS FOR SELECTED SPECIES GROUPS**

Species Group	Assessment Endpoint	Measurement Endpoint
Benthic Organisms	Abundance/Diversity	Comparison With Upstream Location, Toxicity Tests
Fish	Presence	Observed Use of Site, Water Quality Criteria, Toxicity Tests

TABLE 70 **SUMMARY OF THE WEIGHT OF SURVIVING ORGANISMS IN 10-DAY *HYALELLA AZTECA* SEDIMENT TOXICITY TESTS**

Location	Mean Weight of Surviving Organisms (mg)
Lexington Pond Reference	0.107
Laboratory Control Water	0.078
Saugatucket River	
SE-02	0.129
SE-04	0.103
SE-05	0.086
SE-06	0.071
SE-11	0.130
Mitchell Brook	
SE-09	0.101
SE-07	0.074
SE-12	0.080

Note: No statistical difference in mean weight of surviving organisms was found between test samples and reference samples.

TABLE 71 **SURVIVAL RATE OF *CERIODAPHNIA DUBIA* IN 7-DAY STATIC RENEWAL SEDIMENT TOXICITY TESTS**

Location	Percent Survival	
	Day 2	Day 7
Lexington Pond Reference	100	70
Laboratory Control Water	100	100
Saugatucket River		
SE-02	100	80
SE-04	100	100
SE-05	90	90
SE-06	90	80
SE-11	90	90
Mitchell Brook		
SE-09	90	80
SE-07	100	90
SE-12	90	90

TABLE 72 **SURVIVAL RATE OF *PIMEPHALES PROMELAS* IN 96-HOUR CHRONIC SEDIMENT TOXICITY TESTS**

Location	Percent Survival	
	48 hours	96 hours
Lexington Pond Reference	87.5	85
Saugatucket River		
SE-02	80.0	65.0
SE-04	97.5	90.0
SE-05	97.5	92.5
SE-06	87.5	85.0
SE-11	100	100
Mitchell Brook		
SE-09	97.5	92.5
SE-07	90.0	85.0
SE-12	90.0	75

Note: No significant statistical difference was found between the reference sample and any 48-hour or 96-hour test samples.

TABLE 73 **SUMMARY OF LEACHATE TOXICITY TESTS**

Measurement Endpoint	*Ceriodaphnia dubia*	*Pimephales promelas*
Acute Test:		
48 hour LC_{50}	67.8%[a]	no samples with >50% observed mortality
NOAEL	25%	50%
Chronic Test:		
7-day LC_{50}	could not be determined	58.1% [b]
Survival NOEC	no effects observed	50%
Survival LOEC	no effects observed	100%
Reproductive NOEC	50%	–
Reproductive LOEC	100%	- -
Growth NOEL	--	25%
Growth LOEC	--	50%
7-day IC_{25}-growth	--	33.8%
7-day IC_{50}-growth	--	56.8%

- indicates value not calculated for this test

(a) 95% confidence interval 101.0% to 45.5%

(b) 95% confidence interval 71.7% to 47.1%

TABLE 74 **SUMMARY OF SURVIVAL RATES IN LEACHATE TOXICITY TESTS**

Concentration of Leachate	Percent Survival			
	Ceriodaphnia dubia		*Pimephales promelas*	
	48-hour	7-day	48-hour	7-day
Control (0%)	100	100	100	82.5
3.125%	100	90	100	80
6.25%	80	80	100	85
12.5%	90	90	97	82.5
25%	80	80	100	80
50%	70	60	100	72.5
100%	0	0	83	2.5

TABLE 75. COST SENSITIVITY ANALYSIS SUMMARY

VARIABLE		TOTAL ALTERNATIVE COSTS (in $1,000's)					
	ALT #	1	2	3a	3b	4a	4b
Discount Rate	5%	4,517	4,798	14,939	14,643	18,101	19,441
	7%	**3,568**	**3,845**	**13,425**	**13,187**	**16,064**	**18,041**
	9%	2,900	3,175	12,303	12,111	14,577	16,999
Total	-30%	3,534	3,736	11,499	11,220	13,893	14,633
Capital Cost	**0%**	**3,568**	**3,845**	**13,425**	**13,187**	**16,064**	**18,041**
	+50%	3,623	4,027	16,635	16,464	19,682	23,721
Total	-30%	2,531	2,801	11,324	11,197	13,415	16,037
Annual Cost	**0%**	**3,568**	**3,845**	**13,425**	**13,187**	**16,064**	**18,041**
	+50%	5,296	5,587	16,928	16,502	20,478	21,382
Contingency	15%	3,419	3,685	12,866	12,637	15,395	17,289
	20%	**3,568**	**3,845**	**13,425**	**13,187**	**16,064**	**18,041**
	25%	3,716	4,006	13,985	13,736	16,733	18,793
LFG Operation/	5 years	3,374	3,636	11,219	11,206	13,858	15,862
Air/Soil Gas	**10 years**	**3,480**	**3,750**	**12,427**	**12,290**	**15,066**	**17,055**
Monitoring	**15 years**	**3,568**	**3,845**	**13,425**	**13,187**	**16,064**	**18,041**
	Low	2,531	2,801	11,219	11,197	13,415	14,633
Overall	**Baseline**	**3,568**	**3,845**	**13,425**	**13,187**	**16,064**	**18,041**
	High	5,296	5,587	16,928	16,502	20,478	23,721

Notes:

Boldface indicates base case conditions for the alternative

TABLE 76 **ACTION-SPECIFIC ARARS, CRITERIA AND GUIDANCE: ALTERNATIVE #4B**

Regulation	Status	Requirement	Action to be taken to attain ARARs
ACTION-SPECIFIC			
GROUNDWATER			
RCRA Groundwater Protection (40 CFR 264, Subpart F)	Implemented through RI regulations	Establishes requirements for solid waste management units (SWMUs) at RCRA regulated sites. Regulations include groundwater protection standard requirements for groundwater monitoring, detection monitoring and compliance monitoring and the corrective action program.	Because this is a source control remedy, groundwater cleanup will not be addressed and cleanup goals are not set; however, all alternatives will comply with the portions of the regulations which apply to installing groundwater monitoring wells and compliance monitoring.
Rhode Island Rules and Regulations for Hazardous Waste Management, RIDEM 4/92, Section 9.03	Applicable	Regulation outlines operation requirements for treatment, storage and disposal facilities, including a groundwater monitoring program.	Although this is a source control remedy which does not address groundwater, this alternative will comply with the regulations with respect to installation of groundwater monitoring wells and compliance monitoring.
RI Rules and Regs for Groundwater Quality, RIDEM 7/93, Sections 12.02 and 12.03.	Applicable	Regulations are designed to protect and restore the quality of the state's groundwater and include a groundwater monitoring program.	Although this is a source control remedy which does not address groundwater, this alternative will comply with the regulations with respect to installation of groundwater monitoring wells.

TABLE 76 **ACTION-SPECIFIC ARABS, CRITERIA AND GUIDANCE: ALTERNATIVE #4B**

Regulation	Status	Requirement	Action to be taken to attain ARARs
RI Rules and Regs for Underground Injection Control Program	Applicable	Regulations are designed to assure proper location, design, construction, maintenance and operation of injection wells and other subsurface disposal systems to prevent GW contamination.	The portions of this alternative which include on-site treatment of leachate, requiring discharge of treated water to GW recharge wells, will comply with UICP requirements.
Rhode Island Regs for Underground Storage Facilities used for Petroleum Products & Hazardous Material (USTs) (12-190-017)	Applicable	Establishes procedures & requirements for preventing, assessing and remediating releases from USTs.	Underground components of condensate collection system from flares will be installed and maintained in accordance with these requirements.
Draft Interim Final OSWER Monitored Natural Attenuation Policy (OSWER Dir.9200.4-17)(12/1/97)	To Be Considered	Provides guidance on how EPA will implement national policy on use of monitored natural attenuation.	Decisions on use and efficacy of monitored natural attenuation will be consistent with guidance.
<u>HAZARDOUS WASTE</u>			
RCRA-Hazardous Waste Identification, 40 CFR Part 261.	Implemented through RI regulations	Defines solid wastes that are subject to regulation as hazardous waste under 40 CFR Parts 262-265.	Requirements define RCRA regulated wastes. Acceptable management approaches for listed and characteristic hazardous waste will be met for this alternative.
RCRA-Closure and Post-Closure, 40 CFR Part 264, Subpart G	Implemented through RI regulations	Outlines the requirements for closure and post-closure care of hazardous waste management facilities.	Closure and post-closure care of the landfill will comply with these requirements.

TABLE 76 **ACTION-SPECIFIC ARARS, CRITERIA AND GUIDANCE: ALTERNATIVE #4B**

Regulation	Status	Requirement	Action to be taken to attain ARARs
RCRA Tank Systems Requirements, 40 CFR Part 264 Subpart J	Implemented through RI regulations	Sets standards for storage and treatment of hazardous waste in tanks, including pipes and ancillary equipment.	On-site treatment of leachate will comply with these standards.
RCRA-Standards for Permitted TSDFs; Thermal Treatment, 40 CFR Part 264, Subpart AA	Relevant & Appropriate	Air emission standards for process vents, closed vent systems and control devices at facilities that treat, store or dispose of hazardous wastes.	Alternatives which include on-site thermal treatment (enclosed flares) will meet these requirements.
EPA Technical Guidance for Final Covers on HW Landfills and Surface Impoundments, EPA/530-SW-047 (7/89)	To Be Considered	Guidance for landfill covers. Presents recommended technical specifications for multilayer landfill cover design.	Cap construction will be protective in accordance with the guidance.
EPA Technical Guidance memorandum regarding Alternative Cap Design for Unlined, Hazardous Waste Landfills in EPA Region 1, From Dennis P. Gagne & Yoon-Jean Choi to OSRR, 9/30/97	To Be Considered	Guidance for landfill covers in EPA Region 1. Presents recommended technical specifications for multilayer landfill cover design.	Cap construction will be protective in accordance with the guidance
EPA Technical Guidance on Management of Investigation-Derived Waste: Final covers on HW Landfills and surface Impoundments (EPA/530-SW-89-047)	To Be Considered	Guidance for landfill covers, recommending technical specifications for multi-layer landfill cover design.	Waste derived from cap construction will be managed in accordance with these standards.
RI Rules and Regs for HW Management, Section 8, RIDEM 4/92.	Applicable	Outlines requirements for treatment, disposal and storage of hazardous waste by TSDFs.	Management and treatment of on-site treatment residues and waste derived from cap construction will comply with these regulations.

TABLE 76 **ACTION-SPECIFIC ARARS, CRITERIA AND GUIDANCE: ALTERNATIVE #4B**

Regulation	Status	Requirement	Action to be taken to attain ARARs
RI Rules and Regs for HW Management, Sections 9 and 10.02, RIDEM 4/92.	Applicable	Outlines requirements for general waste analysis, security procedures, and management of hazardous waste. Sets design, construction and operational requirements for containers and tanks and closure requirements for hazardous waste facilities.	Identification and handling of hazardous waste and closure of hazardous waste landfill will comply with these requirements.
RI Guidelines on the Management of Investigation-Derived Waste	To Be Considered	Guidance on management and disposal of materials generated during environmental investigations. Specifies action levels for soils and liquids below which investigation-derived waste may be disposed of on-site.	All sampling activities performed on-site will comply with this guidance.
SURFACE WATER			
RI PDES Regulations (12-190-003) and RI Water Quality Regs for Water Pollution Control (12-190-001)	Relevant & Appropriate	Sets AWQC standards for water discharged to surface waters.	Because this is a source control remedy, surface water cleanup will not be addressed; AWQC standards will be used to measure effectiveness of remedy with respect to leachate outbreaks to streams and other discharges to onsite surface water.

TABLE 76 **ACTION-SPECIFIC ARARS, CRITERIA AND GUIDANCE: ALTERNATIVE #4B**

Regulation	Status	Requirement	Action to be taken to attain ARARs
CWA Ambient Water Quality Criteria (AWQC), 40 CFR 122.44	Relevant & Appropriate	Non-enforceable guidance used by states in conjunction with a designated use for a stream effluent to establish water quality standards. WQC levels for protection of human health from consuming fish and aquatic organisms have been developed for several contaminants. The standards are RA if there is no more stringent state rules for particular contaminants.	Because this is a source control remedy, surface water cleanup will not be addressed; WQC standards will be used to measure effectiveness of remedy with respect to leachate outbreaks to streams and other discharges to onsite surface water.
Proposed CWA Ambient Water Quality Criteria (AWQC), 40 CFR Part 120	To Be Considered	Remedial actions involving contaminated surface water or groundwater must consider the uses of the water and circumstances of release or threatened release.	Proposed AWQC for compounds detected onsite (Fe) were compared to observed concentrations in groundwater and used in developing PRGs for surface water; standards will be used to measure effectiveness of remedy with respect to leachate outbreaks to streams and other discharges to onsite surface water.
<u>AIR</u>			
Air Pollution Control Regs, RI Dept of Health, Div of Air Pollution Control, eff. 8/2/67, amended 5/20/91--Regulation No. 1 Visible Emissions	Applicable	Prohibits contaminant emissions for periods of more than 3 minutes in any one hour which are greater or equal to 20% opacity.	Air emissions from remedial actions will meet emission levels in regulations.
RI Air Pollution Control Reg No. 5--Fugitive Dust	Applicable	Requires reasonable precautions to prevent particulate matter from becoming airborne.	Operations will be performed in acc. with these rules.

TABLE 76 **ACTION-SPECIFIC ARARS, CRITERIA AND GUIDANCE: ALTERNATIVE #4B**

Regulation	Status	Requirement	Action to be taken to attain ARARs
RI Air Pollution Control Reg No. 7.1 and 7.2--Emission of Air Contaminants Detrimental to Person or Property	Applicable	Prohibits the emission of any contaminant which may be injurious to human, plant or animal life, or cause damage to property or interferes with the enjoyment of property.	Air emissions will meet all applicable standards, as set forth in RI Reg No. 22 and CAA NESHAPs, 40 CFR Part 61.
RI Air Pollution Control Reg No. 9--Permits	Applicable	Requires permitting for air pollution control systems and any new stationary sources which create an increase in pollutant emissions.	Air pollution control systems will be designed to meet all applicable standards, as set forth in RI Reg No. 22 and CAA NESHAPs, 40 CFR Part 61.
RI Air Pollution Control Reg No. 16--Operation of Air Pollution Control Systems	Applicable	Requires operation of air pollution control systems according to design specifications and defines malfunction reporting requirements.	Air pollution control systems will be operated and maintained in accordance with Operation and Maintenance Plan.
RI Air Pollution Control Reg No. 22--Air Toxics	Applicable	Prohibits the emission of specified contaminants at rates which would result in ground level concentrations greater than acceptable ambient levels in the reg.	Ambient air quality levels will be met for all technologies which emit air contaminants.
RI Guidance for Air Quality/Air Toxics Substances	To Be Considered	Provides guidelines for models and modeling procedures.	Guidance will be considered when modeling emissions from the LFG combustion stack.
CAA National Emissions Standards for Hazardous Air Pollutants (NESHAP) (40 CFR Part 61).	Relevant & Appropriate	Establishes emission levels for certain hazardous air pollutants, including vinyl chloride and benzene.	This remedy will attain NESHAP emission limits for hazardous air pollutants that result from treatment processes.

TABLE 76 **ACTION-SPECIFIC ARARS, CRITERIA AND GUIDANCE: ALTERNATIVE #4B**

Regulation	Status	Requirement	Action to be taken to attain ARARs
CAA Standards of Performance for Municipal Solid Waste Landfills (40 CFR Part 60, Subpart WWW).	Relevant & Appropriate	Establishes air emission limits for municipal solid waste landfills (MSWLF) and standards of performance for MSWLF gas collection and control systems.	Landfill gas collection and control systems will meet relevant and applicable performance standards.
CHEMICAL-SPECIFIC			
EPA Human Health Assessment Cancer Slope Factors (CSFs)	To Be Considered	CSFs are developed by EPA for health effects assessments or evaluation by the Human Health Assessment Group.	The values present the most up-to-date cancer risk potency information. CSFs will be used to compute the individual cancer risk resulting from exposure to contaminants.
LOCATION-SPECIFIC			
CWA Section 404(b)(1); Guidelines for Specification of Disposal Sites for Dredged or Fill Material (40 CFR Parts 230, 231)	Applicable	No activity that adversely affects a wetland is permitted if a practicable alternative with lesser effects is available. Controls discharges of dredged or fill material to protect aquatic ecosystems.	During the identification, screening and evaluation of the systems, the effects on wetlands will be considered, and no activity which adversely affects a wetland will be undertaken if a practicable alternative with lesser effects is available.
Executive Order 11990; Statement of Procedures on Wetlands Protection (40 CFR Part 6, App.A)	Applicable	Action to avoid, whenever possible, the long and short-term impacts on wetlands and to preserve and enhance wetlands. Plans for action in wetlands must be submitted for public review.	All practicable means will be used to minimize harm to the wetlands. Wetlands disturbed by remedial activities will be mitigated in accordance with requirements if no practicable alternative exists.

TABLE 76 **ACTION-SPECIFIC ARARS, CRITERIA AND GUIDANCE: ALTERNATIVE #4B**

Regulation	Status	Requirement	Action to be taken to attain ARARs
Fish and Wildlife Coordination Act; 16 U.S.C. 661, 40 CFR Section 6.302	Applicable	Any modification of a body of water requires consultation with US Fish and Wildlife Service and appropriate state wildlife agency to develop measures to prevent, mitigate or compensate for losses of fish and wildlife. This requirement is addressed under CWA Section 404 requirements.	Requires federal and state coordination on fish and wildlife matters. Will consult as required.
Executive Order 11988; Statement of Procedures on Floodplain Management (40 CFR Part 6, App. A)	Applicable	Action should avoid, whenever possible, the long and short-term impacts associated with occupancy and modifications of floodplains development, wherever there is a practicable alternative. Promotes preservation and restoration of floodplains so that their natural and beneficial value can be realized.	Remedial actions that involve construction in the floodplain areas will include all practicable means to minimize harm to and preserve beneficial values of floodplains. Floodplains disturbed by excavation will be restored to original conditions and utility.
Rules and Regulations governing administration and enforcement of Freshwater Wetlands Act (12-100-003)(8/90)	Applicable	Identifies and protects significant wetlands and their values and functions with the goal of no net loss.	Remedial actions will includes measures to mitigate adverse impacts on protected functions and achieve no net loss.
An Act Relating to Historic Cemeteries	Applicable	Restrictions on altering land within 25 feet of historical human cemeteries.	Plat 35 is a historic cemetery; actions must be coordinated with appropriate agencies such as RI Cemeteries Commission, town offices, and Historical Preservation Commission.

TABLE 76 **ACTION-SPECIFIC ARARS, CRITERIA AND GUIDANCE: ALTERNATIVE #4B**

Regulation	Status	Requirement	Action to be taken to attain ARARs
RI Endangered Species Act	Applicable	Actions must conserve identified local endangered or threatened species.	Consultation with RIDEM will ensure that remedial actions do not jeopardize the existence of endangered or threatened species or adversely modify or destroy critical habitat.

Note 1: Because the remedy is source control only, Safe Drinking Water Act, Maximum Contaminant Level Goals (MCLGs), 40 CFR Part 141, which are health goals for public water systems, are not ARARs for the alternative remedies at this site. Rather, they are used to measure performance of groundwater containment alternatives. The alternatives are expected to contain groundwater exceeding non-zero MCLGs within the compliance boundaries.

Note 2: RI Air Pollution Control Reg No. 17-Odors. RI Regulation No. 17, which prohibits emissions of air contaminants that create an objectionable odor beyond the property line, does not fall within the definition of an ARAR as set forth in the NCP, in EPA's view, because it falls within the category of nuisance laws rather than environmental cleanup or control standards. Therefore, it is not listed as an ARAR for this site. However, EPA views this rule to be a regulation which, like those promulgated under OSHA, must nonetheless be complied with in the performance of any remedy.

TABLE 77 **HUMAN HEALTH PRELIMINARY REMEDIATION GOALS FOR GROUNDWATER**

Analyte Exceeding Preliminary Remediation Goal (PRG)	PRG (Fg/L)	Basis
SOLID WASTE AREA [a]		
Benzene	5	Final MCL
1,2-Dichloroethene	70	Final MCL [b]
Vinyl chloride	2	Final MCL
Pentachlorophenol	1	Final MCL
bis(2-Ethylhexyl)phthalate	6	Final MCL
Acrylamide	0.02	Human Health Risk-Based
Beryllium	4	Final MCL
Cadmium	5	Final MCL
Chromium	100	Final MCL
Lead [c]	15	SDWA Action Level
Manganese [d]	840	Human Health Risk-Based
BULKY WASTE AREA		
Antimony [e]	6	Final MCL
Beryllium	4	Final MCL
Lead [c]	15	SDWA Action Level
Manganese [d]	840	Human Health Risk-Based
SEWAGE SLUDGE AREA		
Antimony [e]	6	Final MCL
Cadmium	5	Final MCL
Manganese [d]	840	Human Health Risk-Based

Note: These PRGs are determined for baseline conditions, which include an assumption of direct consumption of groundwater.

MCL: Maximum Contaminant Level under the Federal Safe Drinking Water Act (SDWA, U.S. EPA, 1996MCL).

Footnotes:

[a] Arsenic, which is listed on Table 2-1A, is not an anlyte exceeding the PRG since it was detected at concentrations lower than the SDWA MCL.

[b] The MCL for cis-1,2-DCE, 70 µg/L is selected; the MCL for trans-1,2-DCE is higher, 100 µg/L.

[c] The average concentration at a background location (MW-01-01) was 36.7 µg/L.

[d] The average concentration at a background location (MW-01-01) was 2,041 µg/L.

[e] There was one detection of antimony at a background location (RES#9) during the RI.

TABLE 78 **ECOLOGICAL PRELIMINARY REMEDIATION GOALS FOR SURFACE WATER**

Analyte Exceeding Preliminary Remediation Goal (PRG)	PRG (µg/l)	Basis
MITCHELL BROOK		
Aluminum	140	Background
Iron	1.000	AWQC
Manganese	45	Background
SAUGATUCKET RIVER		
Aluminum	140	Background
Iron	1,000	AWQC
Manganese	45	Background

TABLE 79 **HUMAN HEALTH PRELIMINARY REMEDIATION GOALS FOR AMBIENT AIR**

Analyte Exceeding Preliminary Remediation Goal (PRG)	PRG ($\mu g/m^3$)	Basis
SOLID WASTE AREA		
Vinyl chloride	0.2	Human Health Risk-Based
1,1-Dichloroethene	0.05	Human Health Risk-Based
RESIDENTIAL AREA		
Benzene	0.1	Rhode Island AAL [(1)]
1,1,2,2-Tetrachloroethane	0.04	Human Health Risk-Based
Vinyl chloride	0.03	Human Health Risk-Based

Notes:
[(1)] AAL - Acceptable Ambient Level as defined in Air Pollution Control Regulation No. 22

TABLE 80. COMPARISON OF COSTS FOR ALTERNATIVES #4a & #4b (OLD & CURRENT), ROSE HILL REGIONAL LANDFILL

May 12, 1999

CAPITAL COSTS (in $1,000's)			4a	Old 4b	Current 4b
1.0	GRADING & SITE PREP.: SOLID WASTE AREA		100	100	100
2.0	CAPPING: SOLID WASTE AREA		2,442	2,686	2,686
3.0	GRADING & SITE PREP.: BULKY WASTE AREA		48	46	46
4.0	CAPPING: BULKY WASTE AREA		864	0	0
5.0	LANDFILL MINING		0	1,452	3,812
6.0	PERIMETER WETLANDS MITIGATION		40	40	40
7.0	INTERNAL LF GAS COLLECTION SYSTEM		681	681	734
8.0	PERIMETER LF GAS COLLECTION SYSTEM		338	338	338
9.0	LF GAS TREATMENT PLANT		338	338	338
10.0	GW DEPRESSION SYSTEM: COLLECTION		0	0	0
11.0	LEACHATE COLLECTION SYSTEM		99	99	99
12.0	50 GPM WATER TREATMENT PLANT		0	0	0
13.0	5 GPM WATER TREATMENT PLANT		507	507	507
14.0	ENVIRONMENTAL MONITORING: CAPITAL COST		94	94	94
15.0	DECONTAMINATION AREA - TREATMENT PLANT AREA		50	50	50
16.0	INSTITUTIONAL CONTROLS	+	88	88	88
	TOTAL DIRECT CAPITAL COST		5,689	6,517	8,930
	REMEDIAL DESIGN ALLOWANCE		341	391	536
	CONTINGENCY	+	1,206	1,382	1,893
	TOTAL CAPITAL COSTS		$7,236	$8,290	$11,359
ANNUAL COSTS (Present Value in $1,000's)					
17.0	ENVIRONMENTAL MONITORING: ANNUAL		3,051	3,051	2,698
18.0	LANDFILL GAS COLLECTION AND TREATMENT		2,787	2,787	2,787
19.0	GW/LEACHATE COLLECTION & TREATMENT: 50 GPM		0	0	0
20.0	LEACHATE COLLECTION & TREATMENT: 5 GPM		1,519	83	83
21.0	INSTITUTIONAL CONTROLS: ANNUAL COSTS	+	0	0	0
	TOTAL DIRECT ANNUAL COST		7,357	5,921	5,568
	CONTINGENCY		1,471	1,184	1,114
TOTAL ANNUAL COSTS			$8,828	$7,105	$6,682
TOTAL COST OF ALTERNATIVE (in $1,000's)			$16,064	$15,395	$18,041

* Landfill mining costs are different than those presented in the FS and Proposed Plan due to a calculation correction.

Note that Old 4b and Current 4b estimates have the same dewatering allowance ($50,000). Further evaluation should be made to determine any increased costs for dewatering.

APPENDIX C

RECORD OF DECISION
Rose Hill Regional Landfill Superfund Site

STATE OF RHODE ISLAND CONCURRENCE LETTER

RHODE ISLAND
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

235 Promenade Street, Providence, RI 02908-5767 TDD 401-831-5508

13 December 1999

Ms. Patricia Meaney, Director
Office of Site Remediation and Restoration
USEPA – Region I
1 Congress Street, Suite 1100
Boston, MA 02114-2023

RE: Record of Decision for Rose Hill Regional Landfill Superfund Site

Dear Ms. Meaney:

The Department of Environmental Management (Department) has completed its review of the Record of Decision (ROD) for the Rose Hill Regional Landfill Superfund Site (Rose Hill Site). As you are aware, earlier drafts of the ROD along with the Proposed Plan presented to then public in January discussed a comprehensive approach to site cleanup, not a formalized operable unit approach as presented in more recent versions. This presented some concerns to us that were conveyed in previous correspondence and communications. This letter is to advise you that we are satisfied with the changes EPA has made to address our concerns and, as a result, the Department concurs with the US Environmental Protection Agency's (EPA's) selection of Alternative 4B.

The Department wishes to emphasize the following aspects of the ROD:

- This ROD represents a source control remedy and the first operable unit of a phased approach. Under this action, monitoring data will be collected to assess the effectiveness of the source control remedy and also assess the need to take further response action under a management of migration operable unit for groundwater and surface water. As indicated in the Department's comments of 8 November 1999, the determination to take additional action may be based upon the monitoring data collected alone, and may not require that additional studies be conducted. Additionally the management of migration operable unit ROD may include a no further action determination if deemed appropriate.

- The Department does not believe that the need for active perimeter and internal landfill gas collection and treatment should be mandated in the ROD based upon data collected over 5 years ago. The specifics of the landfill gas collection and treatment system should be determined in the design phase of the remedial design, based upon current conditions.

- As stated in the Department's comments of 8 November 1999, the ROD correctly states that current groundwater classification is GA (Suitable for public or private drinking water use without treatment) and that this groundwater use is not expected to change. The Department believes that, based upon recent development

approvals, the reasonable anticipated potential future groundwater use has changed. The two most recent developments (South Woods residential house development and Associated of Rose Hill, LLC/Golf Course) will not utilize local groundwater, but will be supplied by public water. Additionally, the Town of South Kingstown intends to connect all private residences not currently connected to public water. This trend is likely to continue into the future and should be considered when evaluating groundwater use and value under the management of migration determination.

- As we have stated historically, it is important to note that RIDEM's participation in this decision-making process has been as a regulatory authority and Natural Resource Damage Trustee. In our capacity as trustee, we have long argued to EPA to consider the natural resource damage component in evaluating alternatives. EPA has listened to our concerns and this ROD has been modified from the original Proposed Plan to address our concerns.

- The remedy as proposed and implemented must ensure compliance with all applicable or relevant and appropriate State and Federal statutes, regulations and policies.

- The remedy must identify institutional controls that are appropriate for each specific area of concern, are applicable throughout the remedial action, and which are protective of human health. Also, in the event that the remedial risk goals cannot be achieved, long-term controls (applicable after the remedy is terminated) must be instituted to prevent unacceptable risk to human health and the environment.

Finally, I urge EPA to make every effort to work in a cooperative manner with the local communities to assure that this remedy is implemented in a manner that allows them maximum participation in the process.

Thank you for providing us with an opportunity to review and concur with this important Record of Decision.

Sincerely,

Jan H. Reitsma
Director

cc: Geri Guardino, Deputy Chief of Staff, Governors. Office
Stephen Alfred, Town Manager, Town of South Kingstown
Maurice J. Loontjens, Jr, Town Administrator, Town of Narragansett

APPENDIX D

RECORD OF DECISION
Rose Hill Regional Landfill Superfund Site

RESPONSIVENESS SUMMARY

United States
Environmental Protection Agency
Region I-New England

S U P E R F U N D

Responsiveness Summary
Rose Hill Regional
Landfill

December 1999

TABLE OF CONTENTS

Acknowledgment: The selected pencil drawings appearing on the Front Cover were sent in during the Public Comment Period by members of Girl Scout Troop 31, South Kingstown, Rhode Island.

INTRODUCTION

The U.S. Environmental Protection Agency (EPA) held a 90-day public comment period from February 3, 1999 to May 3, 1999 to provide an opportunity for interested parties to comment on the Proposed Plan, the Remedial Investigation/Feasibility Study (RI/FS) and other documentation included in the Administrative Record developed to address a portion of the contamination at the Rose Hill Regional Landfill Superfund Site (the Site) in South Kingstown, Rhode Island. The proposed plan specifically addresses contamination and risks associated with two of three waste disposal areas, known as the Solid Waste Area and Bulky Waste Area of the Site. The third waste disposal area, known as the Sewage Sludge Area, was found to meet minimum State requirements for sewage sludge closure, and currently poses no significant health threat. The Sewage Sludge Area therefore does not require a source control response conducted under CERCLA authority at this time. Site-wide groundwater, including that which is beneath the Sewage Sludge Area, remains a human health threat that is addressed in this Record of Decision through institutional controls.

The FS examined and evaluated various options, called remedial alternatives, to address contaminants of concern and remedy options for the Site. EPA identified its preferred alternative for the Site in the Proposed Plan issued in January 1999. As described in the Proposed Plan, EPA's preferred alternative was Alternative 3A, Containment and Landfill Gas Treatment via Combustion. In response to public comment, however, EPA has re-evaluated its preferred alternative. As indicated in the Record of Decision, the selected alternative is Alternative 4B, the major components of which are: Consolidation (Bulky Waste Area), Containment (Solid Waste Area), Landfill Gas Treatment via Combustion, and Leachate Collection with On-site Treatment (during consolidation). The supporting documentation for the decision regarding the Site is placed in the Administrative Record for review. The Administrative Record is a collection of all the documents considered by EPA in choosing the remedy for the Site. It was made available at the EPA Records Center, at 90 Canal Street, in Boston, MA, and at the South Kingstown Public Library, located at 1057 Kingstown Road, Peace Dale, Rhode Island. An index to the Administrative Record for the Site is provided as Appendix E to the Record of Decision.

The Purpose of this Responsiveness Summary is to document EPA responses to the questions and comments raised during the public comment period on the RI/FS, Proposed Plan, and other documents in the Administrative Record. EPA reviewed and considered the comments prior to selecting the remedy for the Site. This remedy, and the basis for its selection, is further documented in the Record of Decision.

The Responsiveness Summary is organized into the following sections:

I. ***Overview of Remedial Alternatives Considered in the Feasibility Study, Including the Selected Remedy*** **-** This section briefly outlines the remedial alternatives evaluated in the Feasibility Study (FS) and the Proposed Plan, including EPA's selected remedy.

II. ***Background on Community Involvement*** **-** This section provides a brief history of community involvement and EPA initiatives in apprising the community of Site activities.

III. ***Summary of Comments Received During the Public Comment Period and EPA Responses*** **-** This section summarizes the oral and written comments received from the public during the public comment period and sets forth EPA's responses to those comments. Part A contains the comments received from citizens and interested parties. Part B contains comments received from the Towns of South Kingstown and Narragansett. Part C summarizes comments received from the State of Rhode Island. Part D summarizes comments received from other Federal Agencies.

I. Overview of Remedial Alternatives Considered in the Feasibility Study Including the Selected Remedy

This Section summarizes each of the remedial alternatives evaluated in the FS and the Proposed Plan.

! **Alternative 1:** *No Action*

The Site would remain as is; there would be no remedial action of any of the contaminated media. However, long-term monitoring of existing ground water monitoring wells, landfill gas and surface water stations located throughout the Site would be monitored for at least thirty years to detect any change that would require intervention. Five-year statutory reviews to determine protectiveness would be conducted as required.

Estimated Time for Design and Construction:	*<1 year*
Estimated Time of Operation:	*> 30 years*
Estimated Capital Cost:	*$100,000*
*Estimated Operations and Maintenance Costs (**net present worth**):*	*$3,460,000*
*Estimated Total Cost (**net present worth**):*	*$3,570,000*

- **Alternative 2:** *Limited Action*
  This alternative would include the long-term environmental monitoring and statutory five-year reviews as described above, establish institutional controls for access and for use of groundwater in the form deed restrictions including land use easements and covenants to prevent access to restricted areas of the Site and to prevent the future use, direct contact and exposure to, or hydraulic alteration of contaminated groundwater. This alternative would also provide landfill gas control contingencies for the nearby residential dwellings which are, or may be, impacted by migrating landfill gas.

Estimated Time for Design and Construction:	*1 year*
Estimated Time of Operation:	*>30 years*
Estimated Capital Cost:	*$360,000*
*Estimated Operations and Maintenance Costs (**net present worth**):*	*$3,480,000*
*Estimated Total Cost (**net present worth**):*	*$3,840,000*

EPA's Preferred Alternative, as presented in the Proposed Plan, was Alternative 3A.

- **Alternative 3A:** *Containment and Landfill Gas Treatment via an Enclosed Flare*
  This alternative would include the long-term environmental monitoring, statutory five-year reviews and establishment of institutional controls as described above, apply protective (Subtitle-C or its performance equivalent), multi-layer caps onto the Solid Waste and Bulky Waste Areas, install an active perimeter and internal gas collection system on the Solid Waste Area with treatment of the gases via combustion through an enclosed flare, and install a passive landfill gas venting system on the Bulky Waste Area. In addition, EPA would collect data to assess the need for conducting any further remedial responses concerning groundwater and surface water as a component of the long-term monitoring program.

Estimated Time for Design and Construction:	*2 years*
Estimated Time of Operation:	*<15 years for LFG; >30 years GW/Leachate*
Estimated Capital Cost:	*$6,420,000*
*Estimated Operations and Maintenance Costs (**net present worth**):*	*$7,000,000*
*Estimated Total Cost (**net present worth**):*	*$13,420,000*

- **Alternative 3B:** *Containment and Landfill Gas Treatment via Photocatalytic Oxidation*
  This alternative would include the long-term environmental monitoring, statutory five-year reviews, establishment of institutional controls, protective covers, installation of a passive landfill gas venting system on the Bulky Waste Area, an active perimeter and internal gas collection system on the Solid Waste Area as

described above, with treatment of the gases via photcatalytic oxidation. In addition, EPA would collect data to assess the need for conducting any additional remedial responses concerning groundwater and surface water as a component of the long-term monitoring program.

Estimated Time for Design and Construction: *2 years*
Estimated Time of Operation: *<15 years for LFG; >30 years GW/Leachate*
Estimated Capital Cost: *$6,560,000*
*Estimated Operations and Maintenance Costs (**net present worth**):* *$6,630,000*
*Estimated Total Cost (**net present worth**):* *$13,190,000*

! **Alternative 4A:** *Containment, Leachate Collection and On-site Treatment, and Landfill Gas Treatment*

This alternative would include the long-term environmental monitoring, statutory five-year reviews, establishment of institutional controls, protective covers, installation of a passive landfill gas venting system on the Bulky Waste Area, an active perimeter and internal gas collection system on the Solid Waste Area as described in 3A above. Additionally, added measures to collect and treat leachate in the Bulky Waste Area would be implemented and treated waters would be discharged on-site through injection wells.

Estimated Time for Design and Construction: *2 years*
Estimated Time of Operation: *<15 years for LFG; >30 years GW/Leachate*
Estimated Capital Cost: *$7,240,000*
*Estimated Operations and Maintenance Costs (**net present worth**):* *$8,830,000*
*Estimated Total Cost (**net present worth**):* *$16,070,000*

EPA's Selected Remedy is Alternative 4B. The NCP allows EPA to re-evaluate its remedy preference in response to new information and in consideration of comments received during the public comment period. In review of all information and comments received, EPA revised its preferred remedy to Alternative 4B.

! **Alternative 4B:** *Consolidation of the Bulky Waste Area onto the Solid Waste Area, Containment, Leachate Collection and Treatment (during consolidation), and Landfill Gas Treatment (Solid Waste Area)*

This alternative would include the long-term environmental monitoring, statutory five-year reviews and establishment of institutional controls as described above. Instead of capping the Bulky Waste Area, this disposal area would be excavated and consolidated onto the Solid Waste Area which would then be capped and an active perimeter and internal landfill gas collection system installed and treatment of the gases via combustion (enclosed flare) as required to achieve ARARs.

Leachate and waters collected from runoff and de-watering operations during the consolidation phase would be managed and discharged according to appropriate regulations. As with Alternative 3A, EPA would collect data to assess the need for conducting any additional remedial responses concerning groundwater and surface water as a component of the long-term monitoring program.

Estimated Time for Design and Construction: *2 years*
Estimated Time of Operation: *<15 years for LFG; >30 years GW/Leachate*
Estimated Capital Cost: *$11,360,000*
*Estimated Operations and Maintenance Costs (**net present worth**):* *$6,680,000*
*Estimated Total Cost (**net present worth**):* *$18,040,000*

The Proposed Plan also included two management of migration alternatives for groundwater. These options, while evaluated in the Feasibility Study and presented to the public, are not presented in the Record of Decision. Upon extensive review and consideration of new information and comments presented during the public comment, EPA believes that additional data is needed to properly assess and evaluate management of migration options for groundwater and its impact on surface water after the source control remedy is implemented. Instituting a well designed source control remedy at the present time will minimize the migration of contaminants to groundwater. Accordingly, a more cost effective and potentially less extensive management of migration remedy can be realized through a phased approach. Nonetheless, these two alternatives are presented herein as they relate to the comments received during the public comment period.

- **Alternative 5A:** *Containment, Gas Collection/Treatment, Leachate Collection/Treatment, Groundwater Collection/Treatment*
  This Alternative is similar to 4A with the addition of a groundwater collection/depression system in the Solid Waste Area to further mitigate potential future migration of contaminated groundwater.

  Estimated Time for Design and Construction: *2 years*
  Estimated Time of Operation: *<15 years for LFG; >30 years GW/Leachate*
  Estimated Capital Cost: *$8,430,000*
  *Estimated Operations and Maintenance Costs (**net present worth**):* *$11,810,000*
  *Estimated Total Cost (**net present worth**):* *$20,240,000*

- **Alternative 5B:** *Consolidation, Containment, Landfill Gas Collection/Treatment, Leachate Collection/Treatment, Groundwater Collection/Treatment*
  This Alternative is similar to 4B with the addition of a groundwater collection/depression system in the Solid Waste Area to further mitigate potential future migration of contaminated groundwater.

Estimated Time for Design and Construction:	*2 years*
Estimated Time of Operation:	*< 15 years for LFG; 1 year for Leachate >30 years GW*
Estimated Capital Cost:	*$12,550,000*
*Estimated Operations and Maintenance Costs (**net present worth**):*	*$11,390,000*
*Estimated Total Cost (**net present worth**):*	*$23,940,000*

II. Background on Community Involvement

Throughout the Site's history, community concern and involvement has been moderate. EPA has kept the community and other interested parties apprised of Site activities through informational meetings, fact sheets, press releases and public meetings.

In June 1991, EPA released a community relations plan which outlined a program to address community concerns and keep citizens informed and involved in the process during remedial activities. On June 18, 1991, EPA held an informational meeting at the South Kingstown Public Library to describe the plans for the Remedial Investigation and Feasibility Study.

During the removal activities, EPA held informational meetings with the residents of Rose Hill Road and other interested parties (January 20, 1993 and April 29, 1993) to inform residents of the monitoring results, ongoing work and proposed actions.

On June 23, 1994, EPA held an open house at the South Kingstown elementary school to discuss the results of the Remedial Investigation, Risk Assessment, and Ecological Assessment and opportunities for public involvement. A fact sheet was also issued to area residents and other interested parties.

EPA issued a public notice and brief analysis of the Proposed Plan in The Providence Journal on January 29, 1999 and made EPA's Proposed Plan available to the public at the South Kingstown public library. On February 1, 1999, EPA made the administrative record available for public review at EPA's offices in Boston and at the above-referenced local information repository.

Also on February 1, 1999, EPA held an informational meeting to discuss the results of the Remedial Investigation and the cleanup alternatives presented in the Feasibility Study and to present the Agency's Proposed Plan. The Agency answered questions from members of the public in attendance. In a joint letter from the Towns of South Kingstown and Narragansett received earlier in the week, a formal request was made to extend the thirty-day public comment period by an additional sixty days. EPA granted this request and allowed a ninety-day public comment period from February 2, 1999 to May 3, 1999 to accept comments on the alternatives presented in the Feasibility Study, the Proposed Plan, and any other documents presented in the administrative record.

On February 18, 1999, the Agency held a public hearing to discuss the Proposed Plan and accept oral comments. A transcript of the comments received at this hearing and EPA responses to the comments are included in this responsiveness summary. Tom Gibson, Deputy Staff Director for the Senate Committee on Environmental Public Works, from Senator Chaffee's Office, Warren Angell, Supervisory Engineer from the Rhode Island Department of Environmental Management Office of Waste Management, Stephen Alfred, Town Manager of the Town of South Kingstown, and five area residents offered oral comments at the public hearing. Numerous written comment was also submitted throughout the public comment period. EPA's responses to the comments received during the public comment period are set forth below.

III. Summary of Comments Received During the Public Comment Period and EPA Responses

A. Citizen and Interested Party Comments

As many as twenty-one area residents attended the public hearing on February 18, 1999. Of these, five area residents presented their comments orally to EPA at the public hearing. Additionally, as many as eleven interested individuals responded in writing to EPA's Proposed Plan, including the four junior girl scouts from Troop 31 in South Kingstown. Below is a summary of the comments received and EPA's responses.

Comment A-1: A number of residents voiced their general opinion on observed problems with surface water and risks from air attributable to the landfill, and asked for appropriate monitoring and a quick response to Site-related risks.

EPA Response: EPA's selected remedy for this Site is alternative 4B, modified to allow for a phased clean up approach. The first operable unit is a source control remedy which will control the sources of contamination at the Site by limiting the extent to which precipitation will percolate and infiltrate through waste materials and minimizing the further migration of the contaminated groundwater plume. Management of the migration of contaminants from the Site that have impacted, or may continue to impact, local area ground water and the biological integrity of surface waters will be addressed after the source control measures are implemented and will rely on data obtained from monitoring conducted under the first operable unit and any additional studies that are deemed necessary to further assess Site impacts, characterize the extent of contamination, and assess the need to develop and evaluate alternatives for future actions.

The selected source control remedy includes excavation and consolidation of the Bulky Waste Area onto the Solid Waste Area to reduce contaminant migration via leachate to surface waters and sediments of Mitchell Brook, thereby improving water quality and state designated uses, including aquatic life support. The remedy also includes capping the consolidated waste and

installing landfill gas controls on the Solid Waste Area to reduce the potential exposure of area residents and Site visitors to uncontrolled releases in ambient and indoor air which present an unacceptable human health risk. Capping will also contain the wastes, limit the extent to which precipitation will percolate and infiltrate through waste materials and minimize the further migration of the contaminated groundwater plume. Risks posed by contaminated groundwater are addressed in this operable unit through the use of institutional controls. Comprehensive long-term monitoring will be implemented to collect data to assess the effectiveness of the source control remedy and assist the State with TMDL predictions for Site-related contaminant concentrations affecting local water bodies.

Comment A-2: A member of the public asked if any consideration has been given to relocating some of the nearby residents who are subject to some of the higher health risks, as opposed to implementing a gas collection combustion system.

EPA Response: Under the NCP (40 CFR section 300.430(a)), the national goal of the remedy selection process is to "select remedies that are protective of human health and the environment, that maintain protection over time, and that minimize untreated waste." The NCP defines a process where nine criteria (40 CFR section 300.430(e)(9)(iii)(A)-(I)) are to be used to analyze remedial alternatives to ensure that selected remedies meet the program's goals. EPA's OSWER Directive: 9355.0-71P, "Interim Policy on the Use of Permanent Relocations as Part of Superfund Remedial Actions" ("the Relocation Policy"), reiterates that EPA's preferred approach at Superfund sites is to address the risks posed by the contamination by using well-designed methods of cleanup so people can remain safely in their homes and businesses.

Because permanent relocation is considered a remedial action, it is selected for use at a Superfund site only when it has been evaluated through the RI/FS process and determined to be the best overall remedy for the Site. The Rose Hill Feasibility Study did not consider relocation of residents as an alternative to actively treating the air that poses a risk to those residents, since the alternatives proposed in the FS contained engineering technologies that were thought to be feasible and implementable for mitigating these risks at the source. Moreover, the selected remedy has been found to be both protective and implementable. Thus relocation was not evaluated and could not now be determined by the Agency to be the best overall remedy for the Site without further study.

The Relocation Policy sets out limited cases where permanent relocation may be a part of a remedial action. Generally, the primary reasons for conducting a permanent relocation would be to address an immediate risk to human health (where an engineering solution is not readily available) or where the structures (e.g., homes or businesses) are an impediment to implementing a protective cleanup. Examples from the Relocation Policy of how the NCP's nine criteria could be applied and lead to consideration of permanent relocation as an appropriate option are:

- Permanent relocation may be considered in situations where EPA has determined that structures must be destroyed because they physically block or otherwise interfere with a cleanup, and methods for lifting or moving the structures safely or conducting cleanup around the structures are not implementable from an engineering perspective.

- Permanent relocation may be considered in situations where EPA has determined that structures cannot be decontaminated to levels that are protective of human health for their intended use, such that a decontamination alternative may not be implementable.

- Permanent relocation may be considered when EPA determines that potential treatment or other response options would require the imposition of unreasonable use restrictions to maintain protectiveness (e.g., typical activities, such as children playing in their yards, would have to be prohibited or severely limited). Such options may not be effective in the long-term, nor are those options likely to be acceptable to the community.

- Permanent relocation may be considered when an alternative under evaluation includes a temporary relocation expected to last longer than one year. A lengthy temporary relocation may not be acceptable to the community or cost-effective. Additionally, a shortage of available long-term rentals within the immediate area may make any potential temporary relocation extremely difficult to implement.

The circumstances at Rose Hill do not fall into any of the foregoing scenarios. First, the residences that might be relocated do not affect the implementability of the selected remedy. The residences will not physically interfere with implementation of the gas collection system, and the gas collection system is expected to remove the risk to the residents that is posed by contaminated air from the Landfill. In addition, the use restrictions to be imposed by the selected remedy are related only to use of the groundwater. Such use restrictions can be circumvented through connecting the homes to the municipal water supply, a not unreasonable, long-term solution.

Finally, it should be noted that EPA's relocation policy affects the Agency's decision-making process during alternative screening and remedy selection; it does not apply to compensatory actions that may be taken independently by potentially responsible parties (PRPs) at a Site. PRPs may agree independently with residents (or business owners) to relocate them, as long as the relocation neither compromises nor interferes with EPA's actions at the Site.

Comment A-3: A member of the public stated that, rather than waiting five years to assess groundwater contamination at the Site (as proposed in Alternative 3A), one may be able to establish what kind of clean up needs are required now and implement those using today's dollars.

EPA Response: Even with EPA's selection of Alternative 4B, there still remain a number of site-specific circumstances that compel the Agency to phase the clean up response at Rose Hill, with the latter phase addressing groundwater and surface water. By instituting a phased decision process, the gathering of groundwater and surface water data during and after the consolidation phase is complete will enable EPA to more accurately evaluate the future groundwater/surface water conditions at the Site. This monitoring and evaluation will provide a more accurate representation of the groundwater flow pattern, probable clean-up time frames, contaminant concentrations, and assessment for the need for future actions concerning the potential management of migration of contaminants from the Site.

Further, the State and the Town of South Kingstown expressed concern about actions that would result in long-term operation and maintenance costs which are not economically practical. The data gathering to be implemented under Alternative 4B, which includes evaluations to monitor the effectiveness of the source control remedy upon ground water and surface water, will help to determine if any additional remedial measures are necessary. If it is found that additional active remedial measures are necessary, the decision (based upon an evaluation of alternatives under a second OU) to implement these measures would be predicated upon the effectiveness of actions taken under OU 1 and the measure of improved Site conditions arising from those actions, resulting in a more defined and cost effective cleanup approach and reduced long-term operation and maintenance expenditures.

Comment A-4: A member of the public stated that for those living in close proximity to the landfill for many years, something should be done for immediately rather than waiting and seeing.

EPA Response: EPA believes that by phasing the cleanup approach (as discussed in Comment A-1 above), active measures will be taken to protect local area residents. Capping, gas control/treatment, and institutional controls for access and groundwater are measures that will be implemented to control Site risks under the first operable unit response.

Comment A-5: A member of the public stated that he believes the leachate is beyond the dump itself and just capping the dump does not seem to be all that is needed.

EPA Response: As stated above in Comment A-1, EPA will implement a phased cleanup approach. Management of the migration of contaminants from the Site that have impacted, or may continue to impact, local area groundwater and surface waters will be addressed in a future decision document.

Comment A-6: A member of the public asked how it is that EPA can a make an informed decision for the local community and would wish to see the Agency follow the State's or Town's recommendations more closely.

EPA Response: The National Contingency Plan (40 C.F.R. Part 300), requires EPA to ensure public involvement throughout the Superfund process. EPA solicits and takes into consideration public input into all Superfund remedy decisions. EPA solicits public comment by notifying community members of the activities taking place at the Site, including the proposed remedy, through direct mail, local media and legal notice, holding a 30-day public comment period, and hosting a formal hearing so community members can provide oral comment.

For the Rose Hill Landfill Superfund Site remedy selection, EPA mailed out a proposed plan to the community in January 1999, held an informational public meeting on February 2, 1999 and a formal hearing on February 18, 1999. The purpose of the formal hearing was to provide an opportunity for community members to give oral comment. In addition, at the Towns' request, EPA extended the public comment an additional 60 days. EPA accepted comments from February 3, 1999 to May 3, 1999.

As with all Superfund site remedy selections, EPA has taken community comments, including those from the Towns and the State into consideration in selecting the Rose Hill remedy. In this particular case, EPA elected to revise its approach on the preferred cleanup alternative. To address the concerns expressed by RIDEM, the Towns, and local citizens about iron contamination of surface waters at the Site, EPA has selected Alternative 4B, which includes consolidation (Bulky Waste Area), along with containment (Solid Waste Area), landfill gas treatment with an enclosed flare, and leachate collection with on-site treatment (during consolidation). Further, EPA will phase its clean-up approach in order to assess and further evaulate future groundwater and surface water impacts and to ensure protectiveness of human health and the environment. Consolidation of the Bulky Waste Area was advocated in numerous comments as a means of providing protection to the Saugatucket River and Mitchell Brook, specifically with respect to future iron contamination caused by leachate from the Site.

Comment A-7: A member of the public asked if the cap will alter the course of groundwater, how much waste is in the water table, and whether the water table elevations will be lowered or depressed after installation of the cap.

EPA Response: A protective cap placed on the Solid Waste Area is not expected to alter the natural direction of groundwater flow. However, reduced infiltration to the waste is expected to ultimately eliminate any radial flow existing in the northern portion of the Solid Waste Area due to topography. The water table beneath the Site is also expected to decrease 0.5 to 1.0 feet due to placement of a cap (Appendix C-2 of the Final FS Report, November 1998). Figures 7 and 10 of Appendix C-2 present approximate existing conditions and future capped conditions. These figures show that waste exists one to two feet below groundwater in a small area of the Solid Waste Area. Placement of a cap was modeled and shown to remove a significant volume of the waste from within the groundwater. The model results will be confirmed following cap placement as part of routine monitoring incorporated into the selected remedy.

Comment A-8: A member of the public asked where the Rose Hill Landfill fits on the exponentially decreasing curve for leachate generation and where the human receptors to leachate were located.

EPA Response: While leachate at the Rose Hill Site contains contaminants which may be decreasing and do not pose a direct contact risk to human receptors, the metals currently leaching from the Bulky Waste Area are impacting the environment. The selected Alternative 4B involves excavating the waste from the Bulky Waste Area and consolidating this waste onto the Solid Waste Area. It is anticipated that leachate generation from the Bulky Waste Area will decrease substantially following the waste removal. It is anticipated that leachate collection will be necessary during the excavation and that this effort, while necessary for the excavation operation, may also provide additional benefit to the immediately adjacent wetland and shallow overburden aquifer in terms of contaminant reduction in this vicinity.

Comment A-9: A member of the public asked how long leachate collection and treatment would be necessary and how that compared to natural attenuation.

EPA Response: The selected remedy is Alternative 4B and involves excavation of the waste in the Bulky Waste Area and consolidation onto the Solid Waste Area. This remedy will only require leachate and de-watering fluids to be managed and discharged on-site through the conclusion of the excavation and consolidation process. The Site will be monitored over the long term to assure that the measures that are implemented remain effective and protective. Such periodic monitoring will include ground water, surface water/leachate and air and will also include cap integrity and operation and maintenance activities as required. A statutory five-year review process will be implemented to evaluate whether the response action remains protective of public health and the environment. Monitored natural attenuation and/or other cleanup processes will be among the options considered in future evaluatations on the management of migration of Site contaminants in groundwater and surface water.

Comment A-10: A member of the public asked about the exponentially decreasing gas generation related to the Rose Hill Landfill and what contaminant levels would be acceptable to cease operation of the flare.

EPA Response: Projected gas generation rates have been presented in Appendix E-1 of the Final FS Report dated November 1998. Actual gas generation rates will be determined as part of system start-up after construction. Dispersion modeling will then be performed to calculate the maximum concentrations of contaminants in the feed gas that will be allowed to be released without treatment. This calculation involves use of the Preliminary Remediation Goals presented in Table 2-4 of the Final FS Report.

Comment A-11: A comment states: "Since this is a closed municipal landfill and wastes contained therein were placed prior to the passage of RCRA regulations, Subtitle C does not apply and the RI/FS has failed to demonstrate the relevancy and appropriateness of an impermeable cap at this landfill."

EPA Response: EPA disagrees with the comment. The Rose Hill Landfill began operation in 1967 and ceased operation in 1983. The RI/FS identified hazardous substances that are posing environmental and health risks at the site. RCRA Subtitle C is "applicable" when there is RCRA listed or characteristic hazardous waste disposed in the facility after 1980. RCRA Subtitle C is "Relevant and Appropriate" to hazardous waste disposed of prior to 1980 or if there are wastes similar to RCRA waste disposed of after that date. Since hazardous waste has been identified in the Solid Waste Area, and some of that waste was disposed of after 1980, a cap meeting the performance standards of a "RCRA Subtitle C cap" is appropriate in order to be protective of human health and the environment. Notwithstanding the foregoing, RCRA is not listed as an ARAR at the Site because RI has a hazardous waste regulatory program that has been approved by EPA and is therefore applicable in lieu of the federal program. Thus the standards that apply to substances remaining in the landfill under RCRA are being implemented at Rose Hill through the RI Hazardous Waste Management Regulations. Therefore, the cap will be designed and constructed to meet state hazardous waste landfill closure requirements.

Comment A-12: Several comments noted that natural resource damage is not addressed by the Proposed Plan.

EPA Response: EPA's full response to this comment appears below in Section B, comment B-1. Where comments suggest that the selected remedy is not sufficiently protective of the environment, EPA has addressed those comments through the public comment process and its reevaluation and selection of Alternative 4B, based upon public comment and new information.

Comment A-13: A member of the public requests that consideration be made of the ecology in place currently at the Site and asks that as little as possible be done to disturb the natural setting.

EPA Response: Some short term disturbances to fauna and flora located at the Site are expected to occur in order to implement the remedy. Critical habitat (such as wetland and flood plain) would be protected throughout the implementation of the remedy. The consolidation and installation of the cap is expected to significantly reduce the impact to natural resources and aquatic organisms utilizing Mitchell Brook, the Saugatucket River, and Saugatucket Pond. The selected remedy will ensure that certain plant life and terrestrial species continue to flourish once the cap is in place by providing appropriate plantings and seed mixes that will both protect the cap and also attract and maintain those inhabiting species.

Comment A-14: A comment suggests that the fears generated by EPA, RIDEM and the media have been over-exaggerated considering the large acreage of land involved and the low number of

homes in the immediate vicinity of the Site.

EPA Response: EPA disagrees. Based upon its findings in the Baseline Human Health and Ecological Risk Assessments, EPA identified unacceptable risks posed by actual or threatened releases of hazardous substances from this Site which, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment. In making this finding, EPA, through its Site investigation and calculation of risks, took into account appropriate Site-specific facts enumerated in the comment.

Comment A-15: A comment notes that if the Bulky Waste Area is causing problems to the River, then a cover applied to that section with gas control and five year reviews may be adequate.

EPA Response: In light of the new information and comments presented to EPA during the public comment period, EPA believes that capping and passively venting the Bulky Waste Area landfill in place would not be effective in controlling the source because a portion of the Bulky Waste Area landfill is known to be in contact with groundwater. Capping, without the installation of leachate control and management systems operating over the long term, will do little to reduce the impact caused by leachate reaching the River. Leachate control and management systems installed at the base of the landfill may be effective in controlling the leachate over time, but the operation and maintenance of such a system over time may be cost prohibitive. In its reassessment of the alternatives, EPA believes long-term risks to ecological receptors in wetland and aquatic habitats would be significantly reduced or eliminated under Alternative 4B. Alternative 4B utilizes landfill consolidation with leachate control and management (during excavation and consolidation) to remove source impacts from the Bulky Waste Area to the Saugatucket River. This remedy is more protective of the environment than the comment's suggested remedy since the Bulky Waste Area landfill will be excavated and consolidated onto the Solid Waste Area landfill and properly capped and controlled in an upland area further removed from the River. Thus, leachate production and subsequent discharge to the Saugatucket River would be prevented or substantially reduced through a more cost-efficient approach that may preclude costly long-term operation and maintenance for the Bulky Waste Area.

Comment A-16: A comment notes that the safety of a local resident's family has been jeopardized (with serious water problems and dangerous air) and that the Town should come up with a satisfactory solution (such as buying the house and property) to resolve the problem.

EPA Response: As discussed in more detail under Comment A-2, EPA has established an interim policy concerning relocation. EPA's OSWER Directive: 9355.0-71P, "Interim Policy on the Use of Permanent Relocations as Part of Superfund Remedial Actions" ("the Relocation Policy"), reiterates that EPA's preferred approach at Superfund sites is to address the risks posed by the contamination by using well-designed methods of cleanup so people can remain safely in

their homes and businesses. This policy affects the Agency's decision making process during alternative screening and remedy selection. However, this policy does not apply to the actions of a potentially responsible party (PRP), and PRPs may agree independently with residents or business owners to relocate them so long as the relocation neither compromises nor interferes with EPA's actions at a Site.

Comment A-17: A comment notes that the Site is now abundant with plant species and home to many species of animals. To the commenter's knowledge, there are no physical or observed signs of diminishment of terrestrial species. While in the past many trees along Rose Hill Road perished, plant life is improving.

EPA Response: EPA generally concurs with the comment. The Ecological Risk Assessment notes that baseline risks to terrestrial and semiaquatic organisms are not likely to be significant over most of the Site study area. Areas of soil associated with leachate seeps, and the leachate itself, may pose some risks to biota. Due to the small areas affected, however, this risk is not likely to be significant. Food chain effects are not of concern, although indirect effects from reduced prey abundance in aquatic areas may be occurring. The baseline risk to aquatic organisms may occur as a result of exposure to the chemicals of ecological concern in the surface water and leachate, however, and from the studies conducted in the RI, there does not appear to be an existing risk to aquatic organisms due to exposure to sediments.

Studies conducted by NOAA and others concluded that contamination from the Rose Hill Landfill may pose a threat to natural resources, including NOAA trust resources utilizing Mitchell Brook, the Saugatucket River, and Saugatucket Pond. The primary pathways of contaminant migration from the Site are groundwater discharge and surface water runoff. Iron and several trace elements were detected at elevated concentrations in surface water and sediment during the RI. The leachate seeps located on the perimeter of both the Bulky Waste and Solid Waste Areas appear to be a source of contamination to surface water bodies. A floc sample collected from Mitchell Brook contained substantial amounts of iron. In addition, iron was present at high concentrations in sediment collected as far downstream as Saugatucket Pond. Flocculent material that accumulates near the Site may be a source of iron in sediments of the pond. Results suggest a strong possibility that sediment and floc transported from the vicinity of the Site contain concentrations of iron and possibly other trace element contaminants that may adversely effect blueback herring and alewife inhabiting Saugatucket Pond during sensitive life stages.

Small areas of dead trees were observed during the RI. These areas, believed to be associated with high methane levels in soil gas, are also not considered significant due to the extremely limited areas at which these effects have been observed.

Some short term disturbances to fauna and flora located at the Site are expected to occur in order to implement the remedy. Critical habitat (such as wetland/flood plain and buffer areas) would be protected throughout the implementation of the remedy. The consolidation and installation of the

cap is expected to significantly reduce the impact to natural resources and aquatic organisms utilizing Mitchell Brook, the Saugatucket River, and Saugatucket Pond. The selected remedy will ensure that certain plant life and terrestrial species continue to flourish once the cap is in place by providing appropriate plantings and seed mixes that will both protect the cap and also attract and maintain those inhabiting species.

Comment A-18: A comment notes that there are written references in the EPA Proposed Plan about harm coming to children and adult visitors to the Site and that it was not understood why people would "trespass" onto this privately owned property.

EPA Response: For the development of risk scenarios, the term "trespasser or "visitor" is viewed as having the same meaning. The Human Health Risk Assessment based its estimation of risk from exposures to ambient air at the Solid Waste Area, assuming an adult Site visitor frequenting the site 4 hr/day, 150 days/year, for 30 years. While most visitors (or trespassers) to the Site may choose to avoid the Solid Waste Area, there are no protective measures in place that would prevent an individual from gaining access to the Solid waste Area and possibly being exposed to contamination. The exposure assumptions were based upon known occurrences of land use at the Solid Waste Area when sampling for the RI was conducted. Hunting dog training and exercising, use of the connecting foot path between the Solid and Bulky Waste Areas, and motorized travel onto the Solid Waste Area prior to the recent washout of the Mitchell Brook culvert, took place frequently. The Site is only partially fenced, allowing for reasonably unobstructed access to take place.

Comment A-19: A member of the public states that Alternative 2–Limited Action/Institutional Controls is a preferred choice.

EPA Response: EPA disagrees. Alternative 2 does not provide any appreciable measure of source reduction. Considering the magnitude of risk posed at the Site, the geographic extent of the ground water exceedances of water quality standards, and extent of landfill gas emissions, institutional controls and the contingency measures, by themselves, are inadequate to provide protectiveness at the Site over the long term. For these reasons, alternative 2 is not effective nor protective.

Comment A-20: A comment outlines the following concerns to EPA: 1) groundwater contamination, 2) effects (from the Site) on the pond in the local neighborhood and others in the area, 3) contamination of the River which is not addressed, 4) a plan for monitoring private wells which fall with the Site boundary, and 5) a desire to see some removal of contaminants from the Site.

EPA Response: Under this first operable unit approach, the sources of contamination will be controlled by consolidating and placing a protective cap over the wastes, which will reduce the

percolation and infiltration of precipitation through the wastes thus limiting any future migration of contaminants to groundwater. Groundwater that is impacted by Site contaminants exceeding health-based standards will be addressed through institutional controls. By selecting Alternative 4B, impacts to the River are being addressed by excavating and consolidating the Bulky Waste Area onto the Solid Waste Area, thereby removing a primary source of contamination to the River. Landfill gas and treatment controls will be implemented to capture and destroy contaminants that are posing an unacceptable risk to human health. Comprehensive monitoring will be implemented to obtain data to assess the effectiveness of the source control remedy, support a future decision document addressing groundwater and surface water, and assist the State with TMDL predictions for Site-related contaminant concentrations affecting local water bodies. Finally, EPA and RI Department of Health (DOH) strongly recommend that any resident concerned about the quality of drinking water drawn from a privately owned well have the water tested periodically and keep a record of these tests for future reference (see Comment A-21 below).

Comment A-21: A member of the public expresses concern about the author's drinking water well located less than a quarter mile south of the Site.

EPA Response: Figure 2-2 of the Final Feasibility Study, which can be found in Section 4 of the Administrative Record, generally delineated impacted areas studied during the Remedial Investigation. The areal extent of the ground water Preliminary Remediation Goal (PRG) exceedance is also shown. Based on the findings of the RI, site-derived contaminants are not expected to be found beyond the area depicted on this map. However, the selected remedy (Alternative 4B) calls for long-term monitoring of ground water. Under this strategy, further delineation of the ground water plume will be conducted and an additional network of monitoring wells will be established and sampled periodically to monitor the progress of the clean up and verify the areas impacted by the Site. If the long-term monitoring program shows appreciable changes to the size and/or concentration of the plume, further response actions will be taken to ensure protectiveness.

The writer is correct to be concerned about his private drinking water supply, if not with regard to contaminants coming from the Site, then from other potential sources of contamination that may be found in proximity to the private drinking well. Wherever located, if the drinking water does come from a private well, the land owner has primary responsibility for making sure the water derived from the well is safe to drink. While not so required by law, EPA and RI Department of Health (DOH) strongly recommend that any party with a private water well have his water tested periodically and that a record of these tests be kept for future reference. The DOH can recommend certified, local, commercial water testing labs and also offers water testing services for a fee. Sample bottles are available from the DOH lab in Providence or from the Cooperative Extension Education Center located at the University of RI in Kingston, RI. All completed samples must be taken to the lab in Providence. For more information on this program you may

call the DOH's Division of Drinking Water Quality at (401) 222-3336 or (401) 222-3436. For additional information on health effects, you may contact the Rhode Island Department of Health (DOH) at (401) 222-4948. For additional information regarding the Site's ground water, proposed monitoring or other questions related to the Site's clean up, you may contact Cynthia Gianfrancesco of the DEM's Office of Waste Management at (401) 222-2797, extension 7126, or David Newton, RPM, US Environmental Protection Agency at (617) 918-1243.

Comment A-22: A member of the public suggests that EPA should select photocatalytic treatment, (Alternative 3B) rather than the "burning process" (enclosed flare) outlined in Alternative 4A. The Comment is concerned with the release of carbon dioxide, the emissions of toxic compounds, and increased costs associated with the selection of Alternative 4A.

EPA Response: Although the chief combustion products from the enclosed flare are carbon dioxide and water, EPA is concerned with the emission of large quantities of methane, which will not be destroyed by the photocatalytic treatment system. In addition, the destruction removal efficiencies of toxic compounds for the enclosed flare and the photocatalytic treatment process are expected to be similar. Methane, itself a fuel source, will be used to supplement the fuel necessary for combustion using the enclosed flare technology. Therefore, EPA believes that the removal "of all but a fraction-of-a-percent of toxic compounds," as well as using, not venting, the methane, are key factors that outweigh the increased costs for the enclosed flare. Thus, the enclosed flare is preferred over the photocatalytic treatment technology.

Comment A-23: The comment notes that the selection of Alternative 4A is inadequate for managing the migration of contaminants in the vicinity of the Saugatucket River near the Bulky Waste Area and suggests that Alternative 4B be selected for a more permanent solution to the release of "rust-colored" leachate to the river.

EPA Response: EPA agrees with the comment and has selected Alternative 4B, which includes excavation of the Bulky Waste Area. Thus, leachate production in the Bulky Waste Area and along the east bank of the Saugatucket River will be greatly diminished due to the removal of the wastes from the immediate vicinity of the River. However, it should be noted that the first operable unit does not address management of the migration of contaminants from the Site, only the control of the sources of that contamination.

Comment A-24: A member of the public is concerned with potential groundwater contamination migrating under the Saugatucket River to residential wells and suggests that Alternative 5B (active groundwater treatment) be selected as the preferred alternative.

EPA Response: EPA is implementing a phased approach to groundwater. Under the first operable unit, a comprehensive monitoring program, including periodic groundwater sampling, will be conducted. Also, the risks that are posed by contaminated groundwater exceeding health-

based standards will be addressed through institutional controls. Management of the migration of contaminants from the Site with respect to their impact on groundwater and surface water will be based on data obtained from monitoring conducted under the first operable unit and any additional studies that are deemed necessary to further assess Site impacts, characterize the extent of contamination, and assess the need to develop and evaluate alternatives for future actions.

Comment A-25: A member of the public asked how long it would take this landfill to complete the cleaning process (that nature has started) if left alone. The landfill is not a health hazard now, a health hazard may be created by working on it, and, if the cleaning process is not significantly shortened by a significant amount of time, it's money wasted.

EPA Response: EPA disagrees with the comment that there are no human health risks posed at the Site. Groundwater, at the three landfill areas and at nearby residences, and air, at the Solid Waste Area (i.e., landfill gas) and nearby residences, present a Reasonable Maximum Exposure (RME) cancer risk that exceeds EPA's acceptable risk range. Under this operable unit response approach, the selected remedy addresses ground water risks through the use of institutional controls.

For the air pathway, risks posed from inhalation exceed EPA's acceptable risk range. The cumulative excess RME cancer risks posed by the inhalation of measured outdoor air concentrations at the Solid Waste Area and measured ambient air concentrations at the nearby residences are 4.4×10^{-4} and 5×10^{-4}, respectively. Using modeled concentrations, the cumulative excess RME cancer risks posed by the inhalation of ambient air at the Solid Waste Area and ambient/indoor air at the nearby residences are 4.4×10^{-4} and 4.6×10^{-4}, respectively. Using measured indoor air concentrations at 220 Rose Hill Road, the cumulative excess RME cancer risk posed by the inhalation of air is 1.9×10^{-3}. The non-carcinogenic hazards posed by the inhalation of measured and modeled ambient air concentrations at the nearby residences are both 12 times the EPA safe level, indicating that adverse blood effects are possible as a result of chronic exposure to benzene.

While leachate at the Rose Hill Site contains contaminants which do not pose a direct contact risk to human receptors and may be decreasing, the metals currently leaching from the Bulky Waste Area are having an impact on the environment. The ecological risk assessment indicates that risk to aquatic organisms may occur as a result of exposure to the chemicals of ecological concern in the surface water and leachate. The selected Alternative 4B involves excavating the waste from the Bulky Waste Area and consolidating this waste onto the Solid Waste Area. It is anticipated that leachate generation from the Bulky Waste Area will decrease substantially following the waste removal. It is also anticipated that leachate collection will be necessary during the excavation and that this effort, while necessary for the excavation operation, may also provide additional benefit to the immediately adjacent wetland and shallow overburden aquifer in terms of contaminant reduction.

The human health and ecological risk assessments identified unacceptable risks and actual or threatened releases of hazardous substances from this Site which, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

The selected remedy (Alternative 4B) is the preferred approach by which to mitigate or reduce these risks. This remedy was determined by the feasibility study to be implementable, cost effective, and protective of human health and the environment. The remedy will reduce the risks posed to human health and the environment by controlling exposures to human and environmental receptors through treatment, engineering controls and institutional controls.

Short-term risks during construction have also been evaluated in the Feasibility Study and summarized for each alternative in the ROD. For the selected remedy, short-term risks are posed by invasive work required for the excavation/consolidation work and remedial components such as the landfill gas controls, the protective cap, and leachate collection and management systems. These short-term risks can be mitigated by a variety of measures. Air sampling and monitoring will be used to evaluate any potential risks to the community. Engineering controls will be used to minimize invasive work and thereby mitigate potential risks from this exposure pathway. Workers will also wear appropriate Personnel Protective Equipment (PPE) to mitigate any potential risks from increased exposures at the Site.

Comment A-27: A junior girl scout leader who discussed the clean up plan with her scouts submitted a comment. A number of the scouts also passed along comments and submitted drawings depicting their concerns and thoughts. These are addressed immediately below. The leader's comment notes that the EPA plan seems adequate for the Site but that it may be limited insofar as it does not comprise surrounding areas. She hopes that the monitoring is adequate to determine if more needs to be done. The comment urges EPA to make certain that the cleanup goes far enough in protecting the lands and water bodies surrounding the landfill.

EPA Response: The Agency expresses its appreciation for the time spent and commitment shown by discussing this cleanup plan with the junior girl scouts and encourages continuation of this practice. Upon request, EPA can make available certain educational materials which may help with your endeavors. You may contact the Remedial Project Manager for this Site directly or call Sarah White, the EPA Community Involvement Coordinator at (617) 918-1026 for more information on what materials may be available.

After reviewing the information and comments received during the public comment period, EPA elected to revise its preference from alternative 3A to that of alternative 4B. The National Oil and Hazardous Substances Pollution Contingency Plan, 40 C.F.R. Part 300, allows EPA to re-evaluate its preferred remedy in response to new information and comments received during the public comment period. With the selection of Alternative 4B, EPA has initiated a phased approach to remediating the Site. As discussed in responses to comment A-1 and others above, a phased clean

up approach will be implemented to first control sources of contamination at the Site. Once the source control remedy is implemented, the management of the migration of contaminants from the Site with respect to their impact on groundwater and surface water will be based on data obtained from monitoring conducted under the first clean up phase and any additional studies that are deemed necessary to further assess Site impacts, characterize the extent of contamination, and assess the need to develop and evaluate alternatives for future actions.

Comment A-28: Four junior girl scouts from Troop 31 in South Kingstown, RI expressed their concerns for the Site in writing and in pictures. In sum, they each stress the need for a quick response due to chemical releases to the environment.

EPA Response: EPA concurs with their comments. With the writing of this Record of Decision, EPA is prepared to seek a binding agreement and obligation with those responsible and initiate the design and construction of the remedy. Once the agreements with the parties are reached, EPA anticipates approximately one year to design and two years to construct the remedy. Once constructed, the remedy will be monitored over time to ensure that the remedy is protective of human health and environment.

EPA is appreciative of the junior girl scouts' art work and has chosen two examples for the cover of this Responsiveness Summary note the Site's ecological setting and future outcomes. As with all comments received, these are included in EPA's Administrative Record for the Site. A copy is located at the designated Site Repository in the South Kingstown Public Library.

Comment A-29: A meteorologist and air monitoring professional requested that EPA consider use of open-path fourier transform infra-red technology (op-FTIR) for purposes of monitoring air emissions to protect workers and the community during implementation or construction of the preferred alternative.

EPA Response: The preferred alternative includes a generalized approach for air monitoring but leaves the specifics of its means and methods to be determined during the remedial design phase. Air monitoring work plans will be developed by the Potentially Responsible Parties and reviewed and approved by EPA/RIDEM prior to the start of work. In initiating the design for the first operable unit, EPA will encourage the design engineer to consider and evaluate appropriate air monitoring technologies, which may include op-FTIR technology.

B. Towns of South Kingstown and Narragansett Comments

The Towns of South Kingstown and Narragansett (the Towns) are identified as Potentially Responsible Parties (PRPs) based on the Towns' having co-operated the Site as a regional municipal solid waste facility. Because the Site is located within South Kingstown, the Town of South Kingstown also has certain jurisdictional and community service powers. The Towns have

worked cooperatively with one another and with EPA and RIDEM throughout the RI/FS process. Stephen Alfred, Town Manager for South Kingstown, offered oral comments on behalf of the two Towns at the public hearing and, on April 30, 1999, EPA received a joint letter of comment from the Towns. Mr. Alfred's remarks and the Towns' comments are summarized and a response to each is provided below.

Comment B-1: In his oral remarks at the public meeting, Mr. Alfred requested that Natural Resource Damage claims be resolved as a component of the remedy selected by EPA.

EPA Response: Since EPA is not a natural resource damage trustee, resolving natural resource damage claims is not within its authority, and the Feasibility Study and Record of Decision are not the appropriate vehicles for addressing those claims. Resolution of natural resource damage claims is pursued through enforcement actions. Where comments suggest that the selected remedy is not sufficiently protective of the environment, EPA responded to those comments through modification of the selected remedy, as discussed above. Some of the remediation activities, specifically, the excavation and consolidation of the Bulky Waste Area, will address a portion of the natural resource damage that has occurred by removing materials that may have contributed to the damage.

Comment B-2: In his oral comments at the public meeting, Mr. Alfred asked that EPA consider the inclusion of institutional controls, including groundwater reclassification and implementation of the Environmental Land Usage Restrictions, in the drafting of the Record of Decision. In a letter dated April 30, 1999, Mr. Alfred stated that all property designated a "Superfund Site" in the Town will have been re-zoned as of May 10, 1999 as "Governmental/Institutional"property, where residential uses are prohibited. Based on this zoning classification and other possible institutional controls, Mr. Alfred requested that EPA's Human Health Risk Assessment be modified in accordance with EPA's guidance document, "Land Use in the CERCLA Remedy Selection Process," Directive No. 9355.7-04 (May 1995).

EPA Response: The proposed plan included the possible future utilization of such institutional controls as easements and covenants to restrict access to the Site and to prevent the future use, contact or exposure to, or hydraulic alteration of, contaminated groundwater. The selected remedy uses a combination of consolidation, capping of wastes, collecting and treating of landfill gases, and institutional controls to prevent or minimize the continued release of hazardous substances from the Site. Groundwater and the risks posed by contaminants in groundwater will be further assessed and addressed in a future decision document. Based on the findings of the RI, EPA acknowledges that the cumulative excess RME cancer risk posed by present and potential future ingestion of groundwater as a drinking water source is outside EPA's acceptable risk range for Site related exposures. Institutional controls will be used as part of the first operable unit remedy to supplement engineering controls, as appropriate,, to prevent exposure to hazardous substances. This broad category of institutional controls may include the Town's recommendations of

implementing ELURs, such as changes in zoning. However, considering the magnitude of risk posed at the Site and the geographic extent of the ground water exceedances of water quality standards, institutional controls by themselves are inadequate to provide protectiveness at the Site over the long term. As part of the work to be implemented at the Site during Remedial Design, EPA will review and consider these and other such controls to be implemented at the Site to ensure protectiveness over the long term.

Comment B-3: In both his letter dated April 30, 1999 and oral comments at the public meeting , Mr. Alfred requested that EPA consider the liability of other PRPs at the Site and settle municipal liability under the Municipal Settlement Policy.

EPA Response: Discussion of how the liability of a potentially liable party will be resolved at this Site is not a proper subject for this response to public comments, which address only the appropriateness of the remedy selected by EPA for the Site. Issues relating to the municipalities' and other parties' liability for cleaning up the Site will be addressed in the context of private negotiations between those parties and EPA.

Comment B-4: The Town of South Kingstown is concerned that the computer models, exposure assumptions, and limited field measurements used in the risk assessment may be overestimating human health and environmental risk.

EPA Response: EPA does not believe that the risks presented for the Rose Hill Site are over-estimations. It should be noted that the human health risk assessment conducted for the Site was a baseline evaluation. This means that the risk assessment evaluated all current and potential future exposure pathways, assuming no measures to clean up the Site are taken. Due to uncertainties inherent in the risk assessment process, health risks calculated in a risk assessment should be viewed as estimates that may over- or under-predict actual human health risk. The selection of certain exposure assumptions may tend to result in an overestimate of risk while the use of non-representative or limited data may result in an underestimate of risk.

The exposure assumptions used in the risk assessment were selected to represent then-current (1994) exposures and best predict potential future exposures. Even though, in general, our society may be increasingly mobile and transient, the sub-population living in the vicinity of the Site does not appear to follow the national trend. Therefore, the exposure assumptions used may be more appropriate than they appear.

The measured indoor air concentrations at the former 220 Rose Hill Road residence were evaluated in the risk assessment to assess worst-case future residential risks in the vicinity of the Site. Newer construction may include a concrete foundation or slab-on-grade construction. However, the presence of features allowing preferential migration pathways (e.g., sump pumps, foundation cracks, sub-grade utility and conduit connections) could result in elevated migration of

volatile compounds to indoor air at nearby residences. The evaluation of the 220 Rose Hill Road indoor air data allowed for the estimation of an upper bound risk for the residential indoor air pathway.

In general, it is EPA's policy to evaluate all groundwater as a potential source of potable water. At the time the risk assessment was performed, many private drinking water wells existed in the vicinity of the Site. To date, not all private wells in the vicinity of the Site have been decommissioned. The risk estimates in the risk assessment were developed assuming use of groundwater as a future drinking water source in the absence of remediation.

Not all of the bulleted uncertainties should be considered conservative, resulting in an overestimate of risk. The limited availability of sampling data may, in fact, have resulted in an underestimate of risk. The use of ambient air data to represent indoor air concentrations also likely underestimates risk since volatiles tend to concentrate in indoor air due to limited dilution and dispersion. The air transport model did not include the subsurface vapor migration pathway which, if significant, would result in an underestimate of risk. No risk assessment methodology allows for the determination of actual risks at a site. Risk assessment should be viewed as a tool, in conjunction with site characterization and risk management, to assist in making remedial decisions at a site.

Comment B-5: The Towns are concerned that there is historical evidence that a stump dump existed on the west side of Rose Hill Road and that this has never been factored into EPA's studies. The Town of South Kingstown is also concerned that EPA never responded to the Town's request to investigate the stump dump as a possible source of methane.

EPA Response: It is EPA's position that certain investigations relating to the stump dump and the concern for methane found across Rose Hill Road to the west did indeed take place as part of the combined Removal and RI field work conducted at the Site. Temporary and permanent soil gas points were measured for VOCs and methane in the vicinity of the stump dump area monthly from December 1991 through the spring of 1992. This information, presented in Figures 4-38, 4-39, 4-40, 4-41 and 4-42 of the Remedial Investigation, illustrates that the highest VOC and methane concentrations in the vicinity of the stump dump are closest to the Solid Waste Area and decrease to zero as one proceeds west of Rose Hill Road. Therefore, it was concluded that the stump dump only provides a better pathway for methane and volatile contaminants to migrate due to the loosely compacted materials such as rock, soil, and bituminous concrete aggregate observed at this location. The Remedial Investigation did not document the presence of sufficient volumes of carbon-based material to have significantly contributed to the methane concentrations measured during the RI.

Starting in the fall of 1998, the Town of South Kingstown employed Goldberg, Zoino and Associates, Inc. (GZA) to provide technical assistance and limited environmental field work and

assessments to the Town regarding the Rose Hill Regional Landfill. GZA produced a report entitled, "Rose Hill Landfill Feasibility Study" (April 1999)(the GZA Report), which is referenced in Mr. Alfred's letter comment letter to EPA. The following provides responses to specific technical information provided in the GZA report.

Comment B-5: (referring to the GZA Report, 4/99, Page 2 of 29, bullet 2) This comment describes results of the Rose Hill Site Investigation Report of February 1999, also prepared by GZA for the Town of South Kingstown, relating to decreased methane generation rates in the Solid Waste Landfill.

EPA Response: The conclusion that there has been a decrease in landfill gas (LFG) generation in one area of the landfill should be reevaluated. In general, this conclusion can only be reached after reviewing operating data from an active landfill gas extraction system rather than static grab sample data. All but one of the GZA locations presented in the February 1999 report showed similar results to those of the Final Remedial Investigation Report of May 1994. Four out of the remaining five actually had increases in methane concentrations. The fifth was lower by only 6.7% (48% versus 41.3%). One single sampling location apparently went from 50.7% to 0.0% when the others either stayed similar or increased. The reported oxygen concentration of 19.8% (up from 1.1% in the RI) suggests that the sample analyzed may have been only air and not representative of the actual LFG in that area.

Comment B-6: (referring to the GZA Report, 4/99, Page 2 of 29, last paragraph) The author suggests that the human health risk may be overestimated based upon current EPA guidance.

EPA Response: The human health risk assessment for the Site was completed in 1994 using EPA guidance current at the time. The intent of the supplemental risk assessment (M&E, 1998) was to update the 1994 risk assessment to include more recent air data and toxicity value information. Neither the approach nor the assumptions used in the 1994 evaluation were altered, as clearly stated in the supplemental human health risk assessment. The more recent EPA guidance (August 1994) was released after the finalization of the Final RI Report in May 1994. However, it is unlikely that the use of the August 1994 guidance would have significantly altered the conclusions of the risk assessment since, for most exposure scenarios, the maximum detected concentration would have been used for the RME scenario rather than the 95% UCL due to the small size of the data set. For small data sets, the 95% UCL typically exceeds the maximum detected concentration. Inherent in the risk assessment process are a number of uncertainties, some of which underestimate risk and some of which overestimate risk, and these are described in further detail in the risk assessment documentation. It is impossible to state with certainty whether, overall, human health risk has been over- or under-estimated.

Comment B-7: (referring to the GZA Report 4/99, Page 3 of 29, paragraph 3) It is stated that the Final FS Report of November 1998 is "too prescriptive." It is suggested that the Record of Decision "establish performance criteria rather than mandating specifics of a technology" to allow for "advances in technologies" during design.

EPA Response: EPA agrees that establishing performance criteria in the ROD is a good method to allow flexibility with design options. However, the FS is designed to screen and evaluate a wide variety of technologies in accordance with CERCLA FS guidance. Of the options available during report preparation, those determined to be the most feasible are evaluated. EPA notes that an appropriate mix of technologies was evaluated during the FS. While new technology options may be developed following the FS release and prior to remedy implementation, these too must undergo evaluation in a manner equal to what was performed in the FS to show that they are equivalent to or better than the technologies evaluated in the FS. If such a technology were identified during the course of design which was 1) appropriately screened and evaluated in accordance with CERCLA FS guidance and the nine criteria, and 2) shown to be equally preferable to or more beneficial than the technologies outlined in the FS, the Superfund process allows the ROD to be modified, subject to public review and comment, to accommodate such a circumstance.

Comment B-8: (referring to the GZA Report 4/99, Page 4 of 29, paragraphs 1 & 2) The comment states the belief that unreasonable exposure assumptions were used in the human health risk assessment for the Site in May 1994 as part of the Final RI Report and suggests the use of updated EPA August 1994 risk guidance to evaluate human health risk at the Site.

EPA Response: See response to Comment B-6.

Comment B-9: (referring to the GZA Report 4/99, Page 5 of 29, paragraphs 1 & 2) The comment expresses concern that the selection of exposure factors for the Solid Waste Area may be too conservative.

EPA Response: While most visitors are unlikely to travel beyond the perimeter of the Solid Waste Area, there is no protective measure in place to prevent anyone from going further. The exposure assumptions were based upon known occurrences of land use at the Solid Waste Area. This was not an overestimation when sampling for the RI was conducted. Hunting dog training and exercising, use of the connecting foot path between the Solid and Bulky Waste Areas, and motorized travel onto the Solid Waste Area took place frequently. The Site is only partially fenced, allowing reasonably unobstructed access to take place. Therefore, exposure assumptions are based on reasonable factors supporting this risk scenario and were selected to evaluate exposures known to occur at the time of the risk assessment. EPA is not convinced that those factors have changed appreciably since the writing of the risk assessment.

Comment B-10: (referring to the GZA Report 4/99, Page 5 of 29, paragraph 3) The author was concerned that conservative assumptions were used to calculate air risk to human health.

EPA Response: Not all of the bulleted uncertainties should be considered conservative, i.e., resulting in an overestimate of risk. The limited availability of sampling data may, in fact, have resulted in an underestimate of risk. In addition, the use of ambient air data to represent indoor air concentrations likely underestimates risk since volatiles tend to concentrate in indoor air due to limited dilution and dispersion. The air transport model did not include the subsurface vapor migration pathway which, if significant, would result in higher off-site ambient concentrations than predicted and also would have resulted in an underestimate of risk. (See also response to Comment B-4.)

Comment B-11: (referring to the GZA Report 4/99, Page 6 of 29, bullet 1) Since the modeled ambient air concentrations and associated risks were 10 times lower than measured data, the author suspects a problem with the model or the ambient air testing.

EPA Response: M&E used modeled data beginning with soil gas data rather than actual samples at receptor locations. The air transport model used included only overland migration pathways. The contribution of any subsurface volatile migration pathways was not included. If the subsurface migration pathway is significant at the Site, measured off-site concentrations would be expected to be higher than modeled concentrations.

Comment B-12: (referring to the GZA Report 4/99, Page 6 of 29, bullet 2) The author suggests that the inhalation exposure assumptions for a resident be revised in accordance with EPA's Revised Exposure Factors Handbook (EPA, August 1997).

EPA Response: The human health risk assessment was completed in May 1994 using current EPA guidance. The approach and assumptions used in the risk assessment have not been updated to reflect EPA guidance published more recently than May 1994. However, based on information provided by local residents near the Site, the exposure assumptions are representative of actual inhalation exposures occurring near the Site.

Comment B-13: (referring to the GZA Report 4/99, Page 6 of 29, paragraph 2) The author is concerned with the use of the former (demolished) residence at 220 Rose Hill Road for the evaluation of "potential future" residential risks associated with inhalation of contaminants in indoor air.

EPA Response: The measured indoor air concentrations at the former 220 Rose Hill Road residence were utilized in the risk assessment to assess worst-case future residential risks. Even though it is likely that new construction would include a concrete foundation or slab-on-grade construction, the presence of features allowing for preferential migration pathways (e.g., sump

pumps, sub-slab utilities and conduit connections, and foundation cracks) may result in elevated migration of volatile compounds to indoor air.

Comment B-14: (referring to the GZA Report 4/99, Page 6 of 29, paragraph 3) The author is concerned that the groundwater beneath the Site was evaluated for drinking purposes, although "use of on-site groundwater is unlikely."

EPA Response: In general, it is the policy of EPA to evaluate all groundwater as a potential source of potable water. At the present time, and at the time the risk assessment was performed, private drinking water wells exist in the vicinity of the Site. To date, not all private wells in the vicinity of the Site have been decommissioned. The drinking water ingestion pathway was evaluated using EPA guidance which rely on current designations of groundwater. Contaminant concentrations in groundwater exceeding primary drinking water standards are known to exist beyond the footprint of the disposal areas. Information was gathered on the current and future potential use of groundwater in the vicinity of the Site. (See Section VI of the ROD for further detail.) EPA notes that its remediation plans for this Site are consistent with both the federal and state classifications for use and value of the groundwater aquifer.

Comment B-15: (referring to the GZA Report 4/99, Page 6 of 29, last paragraph) The author believes that a new risk assessment should be prepared which evaluates both central tendency and RME exposures for key scenarios.The author also believes that this new risk assessment would permit better evaluation of the appropriate remedial actions for the Site.

EPA Response: Remedial decisions are based on RME risk estimates. It is unlikely that reevaluation of site risks would result in a significant reduction in the RME risk estimates since RME exposure assumptions and exposure point concentrations for the air pathway would be similar to those used in the 1994 risk assessment. If a central tendency scenario were to be included, a decrease in risk estimates would be likely. However, the central tendency risk estimates are not used by EPA for remedial decision making.

Comment B-16: (referring to the GZA Report 4/99, Page 8 of 29, paragraph 2) The author is concerned that combining the perimeter gas with the internal gas stream will contribute to the need for supplemental fuel.

EPA Response: EPA acknowledges the potential cost impact mentioned by the author. However, contaminants of concern (volatile organics) in the migrating perimeter gas dictate treatment to address human health risks and to address remedial action objectives. An in-depth analysis of this issue is warranted as part of the remedial design phase in order to minimize treatment costs. In the Final FS Report of November 1998, the perimeter gas stream was to be kept separate and used as "combustion air" in the enclosed flare. The interior gas stream requires supplemental fuel due to the low volume of LFG being generated.

Comment B-17: (referring to the GZA Report 4/99, Page 8 of 29, paragraph 5) The author questions the stump dump east of Rose Hill Road as a source of methane.

EPA Response: Temporary and permanent soil gas points were measured for VOCs and methane in the vicinity of the stump dump area monthly from December 1991 through the spring of 1992. This information, presented in Figures 4-38, 4-39, 4-40, 4-41 and 4-42 of the RI, illustrates that the highest VOC and methane concentrations in the vicinity of the stump dump are closest to the Solid Waste landfill and decrease to zero as one proceeds east of Rose Hill Road. Therefore, it was concluded that the stump dump only provides a better pathway for methane and volatile contaminants to migrate due to the loosely compacted materials such as rock, soil, and bituminous concrete aggregate present at this location. The Remedial Investigation did not document the presence of sufficient volumes of carbon-based material to have significantly contributed to the methane concentrations measured during the RI.

Comment B-18: (referring to the GZA Report 4/99, Page 8 of 29, paragraph 6) The author did not find the groundwater contour maps of the Site and suggested the preparation of such maps during long-term monitoring.

EPA Response: The Final RI Report of May 1994, Volume III contains large maps for the shallow overburden, deep overburden and bedrock aquifers (Plates 2, 3, and 4). The RI also discusses wet and dry weather conditions. The Administrative Record contains the RI report in its entirety. For further assistance, the author may contact the EPA-NE Record Center (phone number: 1-617-918-1440) located at 1 Congress Street, Suite 1100, Boston MA, 02114-2023. As a component of the long-term monitoring plan and implementation of this plan, contaminant concentration maps and ground water contour maps would be expected to be drafted, refined, and used as one of the many presentation and reporting tools required for demonstrating cleanup progress and compliance.

Comment B-19: (referring to the GZA Report 4/99, Page 8 of 29, paragraph 7) The author is concerned that detailed topographic data was not presented in the Final FS Report, which may affect cap design and construction.

EPA Response: Comment noted. The RI/FS does not require the topographic detail that is required for design and construction. A detailed topographic survey of the Site will be required as part of the remedial design phase and would be performed by the Site design engineer. Final “as-built” surveys will also be required. The estimated costs in the FS are based on many assumptions regarding topography and, in accordance with EPA guidance, have an accuracy of +50% to -30%. These costs are for relative comparison purposes only. More accurate design cost information and topographic detail will be developed during the design and construction phase of the remedial action.

Comment B-20: (referring to the GZA Report 4/99, Page 9 of 29, paragraph 1) The author notes that a perimeter landfill gas collection system may not be necessary since perched water within the Solid Waste Area may be acting like a horizontal containment, thereby causing lateral landfill gas migration.

EPA Response. Elimination of the perimeter landfill gas migration control component of the preferred alternative is not possible at this point in the process. Data in the Final RI Report of May 1994 documented elevated levels of methane in offsite soil gas from migrating landfill gas. While we acknowledge that the presence of perched water could exacerbate the existing gas migration problem, there is a lack of data to support the author's theory that elimination of the perched water problem alone would solve the migration problem. The landfill gas migration measured during the RI exceeds ARAR standards and poses a human health risk. The preferred alternative appropriately provides for a direct remedial action (e.g. installation of an active perimeter system) as a means to mitigate this situation and to meet the required objectives.

Comment B-21: (referring to the GZA Report 4/99, Page 9 of 29, paragraph 3) The author stated that MCLs and MCLGs will not be relevant and appropriate for the GB buffer area.

EPA Response: While establishment of a GB buffer zone around the waste areas would affect the need for and extent of future groundwater remediation, there has been no apparent progress in establishing this buffer zone. Further, it is not known if such a buffer zone would cover the entire extent of impacted groundwater as identified in the RI/FS and depicted on Figure 2-2 of the FS. However, such determinations could be made after the issuance of the ROD and finalized as a part of the overall institutional control implementation process for the first operable unit. Groundwater monitoring and the assessment of monitoring data with respect to MCLs and MCLGs will be used to determine the need for establishing a buffer zone under State regulations, and/or further actions concerning groundwater.

Comment B-22: (referring to the GZA Report 4/99, Page 11 of 29, paragraph 4) The author stated that since there is no documentation the Solid Waste Area or Bulky Waste Area received hazardous waste, only a RCRA Subtitle D or RIDEM cap will be required.

EPA Response: EPA disagrees that there is no documentation which indicates the disposal of hazardous waste at the Rose Hill Site. The term "hazardous waste" is defined by Section 1004(5) of RCRA as a solid waste or combination of solid wastes which, because of its quantity, concentration, or physical, chemical, or infectious characteristics, may (a) cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. The RI determined that conditions at the Site support a finding that hazardous waste was disposed of at the Site. Sampling conducted at the Site indicated that RCRA characteristic hazardous waste

exists at the Site. Further, in accordance with Section 103(c) of CERCLA, Peacedale Processing notified EPA of a known waste handling problem concerning the disposal of certain liquid waste, specifically, a urethane adhesive, from the Peacedale Processing Company. This adhesive was investigated and found to contain hazardous substances including, but not limited to, trichloroethylene, toluene, dimethyl formamide and tetrachloroethylene. Other hazardous substances which are contaminants of concern were also found at the Site. Therefore, EPA believes that there is sufficient evidence to support a finding that hazardous wastes and wastes containing hazardous substances were co-disposed with municipal solid waste at the Site. These wastes contain contaminants of concern that have been found to pose a significant present and potential future threat to human health and the environment. As discussed in our response to Comment A-11, the standards set forth in the RI Hazardous Waste Management Regulations apply to hazardous wastes and hazardous substances remaining at the Site after the remedial action is completed. Therefore, the cap will be designed and constructed to meet state hazardous waste landfill closure requirements.

Comment B-23: (referring to the GZA Report 4/99, Page 12 of 29, paragraph 5 and Page 13 of 29, paragraph 1) The author asked why the slope stability analysis in Appendix B-4 and the HELP model evaluation presented in Appendix C-1 of the Final FS Report of November 1998 do not match the composition of the cap as presented in the text on page 3-7 of the Final FS Report.

EPA Response: Comment noted. The slope stability analysis included in Appendix B-4 of the Final FS was drawn from an earlier capping scenario presented in the Draft FS (1994). Future capping scenarios did not contain assumptions which varied significantly from the earlier scenario, so further slope stability evaluations were not performed. It is expected that slope stability analysis will be performed during the actual design phase.

While much of the HELP model evaluation presented in Appendix C-1 of the Final FS Report, November 1998 is based on older capping scenarios (from earlier versions of the FS), the first four pages cover evaluation of the most current protective capping scenario.

Comment B-24: (referring to the GZA Report 4/99, Page 13 of 29, paragraph 4) The author questions the need for a fence around the Solid Waste and Bulky Waste Areas.

EPA Response: A fence around the waste cells is included in order to comply with ARARs. Institutional control strategies, when fully implemented in accordance with the ROD and in combination with other remedy components, may allow for a modification or revision to the amount of fence required to comply with ARARs. For costing purposes, it was simply assumed to be the cumulative diameter of the two waste areas.

Comment B-25: (referring to the GZA Report 4/99, Page 15 of 29, paragraph 3) The author asks for the basis of the statement, “Active perimeter systems were found to be the most feasible

based in M&E's prior evaluation of landfill gas migration barrier systems."

EPA Response: Use of a perimeter barrier to control LFG migration was previously evaluated in *Evaluation of Landfill Gas Migration Barrier Systems For Removal Action, Rose Hill Regional Landfill Superfund Site, South Kingstown, Rhode Island, May 1993*. The active perimeter system was found to be the better option at the Rose Hill Site. This report is part of the Site Administrative Record. In general, EPA agrees that additional design testing is required before any appropriate LFG collection and treatment system can be constructed. Systems presented in the Final FS Report of November 1998 were used for comparative analysis and should not be considered as complete and final for the purpose of RD/RA.

Comment B-26: (referring to the GZA Report 4/99, Pages 14 through 17 of 29) The author has made several technical comments related to conceptual sizing and other design criteria with respect to a wide range of remedial technologies/process options described in the Final FS report of November 1998.

EPA Response. EPA acknowledges the value of the specific, technical comments by GZA, which will be considered during the remedial design phase for the selected remedy. None of the comments, however, affects the ultimate feasibility of remedial technologies/process options included as part of the preferred alternative.

Comment B-27: (referring to the GZA Report 4/99, Page 18 of 29, Bullet #1) The author discusses the potential to control off-site landfill gas migration using a combination of passive perimeter barriers in conjunction with the active internal gas collection system. The passive perimeter barriers would be utilized in place of the active, perimeter gas control system included in the preferred alternative.

EPA Response. EPA acknowledges the potential for cost savings with the author's alternative approach. However, protection of human health from immediate explosion hazards associated with subsurface methane and compliance with regulatory requirements for minimizing off-site landfill gas migration is a <u>necessity</u> for the selected remedy. Substantial off-site migration of subsurface methane was clearly demonstrated in the Final RI Report of May 1994. In addition, it is expected that excavation and consolidation of Bulky Waste Area refuse at the Solid Waste Area will increase landfill gas production from current levels and exacerbate the off-site landfill gas migration problem. EPA will continue to require an active perimeter gas control system as the best demonstrated remedial technology to control and minimize the gas migration hazards to off-Site residents. As landfill gas production declines over time, the operation of the perimeter system may be modified if engineering studies and field testing demonstrate continued protectiveness and effectiveness.

Comment B-28: (referring to the GZA Report 4/99, Page 18 of 29, Bullet #2, Appendix E-1) The author discusses the use of alternative parameter values other than the regulatory default values for calculating landfill gas production rates from the Solid Waste Area. The author discusses using more appropriate "regional" parameter values for calculating landfill gas production rates from the Solid Waste Area, which would result in lower rates than those used in the Final FS Report of November 1998.

EPA Response. Deviation from the regulatory "default" values for landfill gas production should be supported by comprehensive regional or site-specific field studies. Such studies or field investigations may be undertaken as part of the remedial design phase. In the absence of such studies, the regulatory "default" values were used to estimate landfill gas production in the Final FS Report of November 1998. EPA notes that the author did not discuss the potential for increased landfill gas production from the Solid Waste Area as a result of excavation and placement of refuse from the Bulky Waste Area. Recent investigations have determined that refuse from the Bulky Waste Area includes a significant portion of putrescible wastes that would generate landfill gas. Consolidation of Bulky Waste Area refuse at the Solid Waste Area may cause more landfill gas production than calculated in the Final FS Report of November 1998. EPA's preferred alternative includes an active landfill gas collection and treatment system to address this possibility.

Comment B-29: (referring to the GZA Report 4/99, Pages 18 through 21 of 29, 3.32.2 Cost Issues) The author has provided an assessment and check of costs associated with various remedial technologies /process options presented in the Final FS Report of November 1998.

EPA Response. The author has provided an estimate of costs for the various remedial technologies on a preliminary, remedial design level-of-accuracy. EPA acknowledges the value of these comments in calculating accurate cost estimates for future remedial design and remedial action phases. In general, however, the cost checks discussed by the author confirm the accuracy (+50% to -30%) required by EPA guidance of the costs contained in the Final FS Report of November 1998.

Comment B-30: (referring to the GZA Report 4/99, Pages 21 through 25 of 29, 3.33 Bulky Waste Area Landfill Mining/Consolidation) The author has provided a critique of technical and cost issues discussed in the final FS Report of November 1998 with regard to the feasibility of Bulky Waste Area landfill mining/consolidation.

EPA Response. The new preferred alternative includes excavation and consolidation of the Bulky Waste Area refuse at the Solid Waste Area. This addresses the author's overall concerns to consider this remedial technology/process option as a feasible part of the preferred alternative.

Comment B-31: (referring to the GZA Report 4/99, Pages 25 through 29 of 29, 4.00 Remedial Alternative Evaluation) The author has provided a critique of the preferred alternative with regard to technical effectiveness, implementability and cost.

EPA Response. Comments with regard to the alternatives evaluation are noted. It should be emphasized that the new preferred alternative is Alternative 4B, which addresses the author's overall concerns with regard to the selected remedy.

C. State Comments

Warren Angell, Supervisory Engineer for the Office of Waste Management, Rhode Island Department of Environmental Management (RIDEM), provided oral and written comments at the public hearing on behalf of the Department. RIDEM later submitted more detailed comments in correspondence dated February 18, 1999 and April 5, 1999. RIDEM's comments and EPA's responses are summarized below.

Comment C-1: In its February 18, 1999 letter, RIDEM states that the proposed remedy is not protective of the environment and fails to adequately address ongoing damage to natural resources, specifically, the Saugatucket River, caused by the Site.

EPA Response: To address the concern, expressed by RIDEM and others, about iron contamination of surface waters at the Site, EPA has selected alternative 4B, including a phased clean up approach. This source control remedy includes excavation and consolidation of the Bulky Waste Area onto the Solid waste Area to reduce contaminant migration via leachate to surface waters and sediments of Mitchell Brook in order to improve State water quality and designated uses, including aquatic life support. A future decision document will address the management of migration of Site contaminants to groundwater and surface water. Instituting a well designed source control remedy at the present time will minimize the migration of contaminants to groundwater, thereby leading to a more cost effective and potentially less extensive management of migration remedy in the future.

Comment C-2: RIDEM states that the future use scenario described in the FS should include the ELURs and groundwater reclassification that will prevent any future use of site groundwater as a drinking water source.

EPA Response: EPA generally concurs. The selected remedy requires the use of institutional controls, including those for groundwater. As stated in comment response B-2 above, EPA will review and consider these and other such controls to be implemented at the Site to ensure protectiveness over the long term.

Comment C-3: RIDEM states that RI Air Pollution Control Regulation No. 17–Odors ("Odor Regulation) should be included as an ARAR because it has been included at other sites in RI.

EPA Response: EPA's position on the regulation governing odors is that it does not constitute a "promulgated standard, requirement, criteria or limitation under a State environmental or facility siting law," that would thereby apply to any hazardous substance, pollutant or contaminant remaining on Site, as required by CERCLA § 121(d)(2)(A)(ii). However, although not an ARAR pursuant to CERCLA § 121(d)(2)(A)(ii), the RI Odor regulation would nonetheless be applicable to any work performed at the Site, as with other construction sites in the State.

Comment C-4: RIDEM states that the RI Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases ("Remediation Regulations") are ARARs and should be complied with at Superfund sites, despite Rule 4.02 which states, "Sites listed on the National Priorities List shall comply with the requirements of the National Contingency Plan (40 C.F.R. Part 300) in lieu of these regulations."

EPA Response: Since the Remediation Regulations are primarily procedural, not substantive, in nature, they do not meet the definition of ARARs set out in Section 121(d)(2)(A)(ii) of CERCLA. The Site will comply with the requirements of the National Contingency Plan. Furthermore, since the remedial action is a source control remedy, the clean up standards set forth in the substantive portions of the Remediation Regulations are not relevant. Instead, the remedy will meet the performance standards set out in the ROD.

Comment C-5: RIDEM does not consider active treatment of the landfill gas to be necessary to protect human health. A phased approach is suggested to collect the gas and test it to determine the need for landfill gas treatment.

EPA Response: The human health risk assessment shows that there is risk from the Solid Waste Area landfill gas. Appendix F of the Final FS Report of November 1998 contains area source modeling from this assessment showing impacts above Preliminary Risk Goals (PRGs) between 0.9 and 2.5 miles from a point just east of the Solid Waste Area. The remedial action objectives (RAOs - Table 2-7) are to prevent inhalation of Site-related contaminants. The screening of technologies (Table 2-15) resulted in treatment as the effective general response method to meet the RAOs.

Section 4.3b.1.1 of the Final Feasibility Report discusses results of dispersion modeling for treatment of landfill gas using a non-combustion technology. This method of treatment provides minimal lift out of a stack since heat is not being added to the gas. The exiting gas would perform (disperse) similar to gas which is simply vented without treatment. Results presented in both Section 4.3.b.1.1 and Appendix F show that PRGs are met in this case through use of a 30-foot stack and a vinyl chloride destruction removal efficiency of 98%. Without treatment of the landfill gas, human health cancer risk would still exist.

Comment C-6: The comment noted, based on information provided in the RI/FS report, that placement of a cap over the Solid Waste Area will prevent infiltration of precipitation but will also lower the water table to a level below the vertical limits of waste. The comment further stated that the cap, combined with landfill gas treatment, is expected to improve water quality of Mitchell Brook and the Saugatucket River and adequately address ecological impacts.

EPA Response. Placement of the cap over the Solid Waste Area will reduce infiltration of precipitation and is ultimately expected to lower the water table to some degree. However, at this point in the remediation process, it is not clear if the water table will be lowered to a point below the vertical extent of waste. In the absence of direct investigative work on this issue (e.g. no borings, wells or piezometers were installed directly within the Solid Waste Area for water level purposes), the Final FS Report of November 1998 has incorporated theoretical estimates with regard to current water table elevations. These elevations are expected to be confirmed during the remedial design process. Because of uncertainty as to how fast the landfill will be dewatered, changes in water levels after the cap is installed can best be determined by post-cap investigations and periodic monitoring rather than by current projections. The selected remedy includes a monitoring program which incorporates water level measurements over time in the Solid Waste Area. This monitoring program will also measure changes in water quality in Mitchell Brook and the Saugatucket River and confirm progress toward meeting the remedial action objectives set forth in the ROD.

Comment C-7: The Department is concerned that capping the Bulky Waste Area will not effectively reduce the amount of leachate discharge to the Saugatucket River.

EPA Response: Comment noted. However, EPA's preferred alternative has been changed to Alternative 4B. The Bulky Waste Area will be excavated and consolidated in the Solid Waste Area.

Comment C-8: The Department is concerned that the proposed alternative for the Bulky Waste Area will result in continued leachate generation and ecological impacts upon the Saugatucket River.

EPA Response: EPA's preferred alternative has been changed to Alternative 4B, including excavation and consolidation of the Bulky Waste Area at the Solid Waste Area. Alternative 4B is therefore expected to significantly reduce the generation of leachate produced from the Bulky Waste Area landfill.

Comment C-9: The Department is concerned that the proposed alternative (Alternative 3A, as presented in the Proposed Plan) will result in higher costs for future remedial actions and long term operation and maintenance, as well as Natural Resource Damage restoration and compensation.

EPA Response: As previously stated above, EPA has revised its preference to that of Alternative 4B as a source control response, with a future decision document to address management of migration. Under 3A, two separate landfills would be capped. The integrity and performance of the two caps would be monitored and further study of the groundwater and surface water would be made to assess the need for any additional response actions as required. Under 4B, the Bulky Waste Area will be excavated and consolidated onto the Solid Waste Area. The added cost of consolidation and leachate control during excavation under 4B may be equal to or greater than that of the capping under Alternative 3A. In both cases, Institutional Controls (in the form of easements and covenants) will be placed on properties where groundwater contaminant levels pose a unacceptable risk to human health or the environment. In both cases, evaluations of the long-term monitoring will dictate whether any further actions concerning groundwater and surface water impacts are necessary. Future evaluations based on monitoring data from OU1 will determine the need to conduct any future actions, and the nature of those actions, in order to achieve and assure protectiveness under CERCLA and State authorities over the long term. EPA concurs with the State that, under this selected remedy, the decision to take any additional actions will be based upon improved conditions resulting from OU1, which may result in an overall reduction in long-term operation and maintenance costs.

Comment C-10: The Department requests that consolidation be considered, assuming that little material will be separated out for recycling and that the volume of material in the Bulky Waste Area is substantially greater than assumed in the Final FS Report.

EPA Response: A technical memorandum has been prepared to provide an estimate of the costs for the new preferred alternative based on current information from the GZA field investigation conducted in early 1999. No recycling of metals and the higher volume of waste (190,000 cu yds) was assumed in this recent technical memorandum. This information is included in the Responsiveness Summary at section 4.1.

Comment C-11: The comment states that some dewatering will be necessary to remove all the waste from the Bulky Waste Area before consolidation onto the Solid Waste Area.

EPA Response: A technical memorandum (July 1999) updating the costs includes the assumption that all of the Bulky Waste Area will be removed and consolidated onto the Solid Waste Area. The amount of dewatering necessary is still questionable, as the GZA report of February 1999 only confirms an area with perched water and a small amount of waste below the water table. However, some de-watering of the excavation is expected and the extent of de-watering will be determined during the design phase.

Comment C-12: The comment notes that the cost benefit of the elimination of long-term operations and maintenance far outweigh the increased costs for capping.

EPA Response: EPA agrees that reduction of long-term operations and maintenance is desirable. However, with any of the alternatives evaluated, there will remain an appreciable component of operation and maintenance and the costs associated with this component. Again, this comment has been addressed with the selection of Alternative 4B.

Comment C-13: The Department recommends that a non-specific alternative for the landfill gas treatment be included in the ROD and that a phased approach be implemented, such as collecting and monitoring the gas emissions prior to determining the need and method of treatment.

EPA Response: EPA is not in full agreement with this approach. Landfill gas is noted as a principal threat for this Site. The ROD provides the basis for the remedial action that will be taken. When possible, the ROD should adequately and clearly address those measures that will be taken to address the principal theat(s) present at the Site. For landfill gas treatment, there are well-known technologies available which EPA has evaluated in applications in Rhode Island and throughout the Region. In keeping with usual practice, the FS evaluated the enclosed flare technology against other treatment options and, based on the research conducted in the FS, found it to be an appropriate means of addressing the threat posed by the landfill gas. EPA's experience has been that where a ROD fails to specify a treatment technology, treatment pilot studies are subsequently necessary to evaluate each of the suggested technologies in the field, thereby increasing the cost of implementation. In the case of landfill gas treatment, actual performance data collected at other Superfund sites shows that the enclosed flare is the most efficient technology to control landfill gas emissions at the Site and meet ARARs, including the RI Air Pollution Control Regulation # 22-Air Toxics. Thus EPA has selected the enclosed flare technology as a primary component of the remedy. Sampling and analyzing the landfill gas during the remedial design will prove useful in determining the design specifications, materials, fuel needs and other requirements for constructing the flare.

Comment C-14: The Department is concerned that the proposed alternative must address the continued ecological impacts to the Bulky Waste Area and failure to do so now will result in continued damages to a valuable resource and increase the potential for natural resource damage (NRD) claims against Responsible Parties in the future. Therefore, consolidation of the Bulky Waste Area should be reconsidered.

EPA Response: As stated in comment response A-1 and elsewhere, EPA has selected alternative 4B as a phased clean-up approach for this Site. Also, comment response B-1 discusses EPA's position concerning NRD.

Comment C-15 : The Department requests that EPA remain flexible with respect to the use of innovative technologies and alternative cap component materials in ROD.

EPA Response: EPA concurs with this comment. EPA has specified a design for a protective cap that meets state hazardous waste closure requirements. Alternative 4B calls for the use of innovative technology in excavating, de-watering and consolidating the bulky waste materials onto the solid waste unit. This consolidation approach will require certain strategies and material usage that must be further evaluated and developed during the design phase. Moreover, certain alternative cap component materials may be identified in design that will be more cost-effective and preferable to those material(s) commonly described for closure requirements. In these cases, the alternative cap component materials will be evaluated on a case by case by the design engineer for their performance in meeting the overall equivalency of the state's hazardous waste closure requirements.

Comment C-16: The Department is concerned that results of the *Rose Hill Landfill Superfund Site Field Investigation Report* (GZA, 1999) contradict information provided in the Final FS Report of November 1998. The GZA report indicated that "no white goods" were disposed of and the thickness and volume of waste in the Bulky Waste Area was underestimated in the FS.

EPA Response: FS waste assumptions were based on the two C.E. Maguire reports, *Phase I Preliminary Design and Hydrogeological Investigations* and *Phase II Site Evaluation and Operational Plan for Municipal Sanitary Landfill Rose Hill Road*, which were prepared for the Town of South Kingstown in 1977. The cost estimate for landfill excavation and consolidation has been updated based on the latest field information provided in the GZA Report of February 1999.

Comment C-17: The Department is concerned that the landfill gas (LFG) generation rate for the Bulky Waste Area may have been underestimated due to the underestimation of the volume of waste in the Final FS Report and suggests the need for additional modeling.

EPA Response: EPA agrees that a larger volume of municipal waste in the Bulky Waste Area would likely result in a higher LFG generation rate than originally estimated. However, the selected Alternative 4B eliminates the need for further modeling of LFG generation rates in this area, since landfill excavation and consolidation is expected to eliminate the Bulky Waste area as a source for landfill gas. Consolidation of this Bulky Waste material onto the Solid Waste Area is expected to incrementally increase the amount of landfill gas generated at the Solid Waste Area. Active landfill gas mitigation as identified in Alternative 4B will control this expected increase in total landfill gas production at the Site.

Comment C-18: The comment noted that the cap design for the Solid Waste Area should consider minimizing the manageable unit to the practical extent possible.

EPA Response. Section 3.1.2.1, page 3-7, paragraph 3 of the Final FS Report contains statements about using cut and fill methods to reduce capping costs. The FS presents a

generalized design concept for the cap only and the comment applies to the remedial design phase. By selecting Alternative 4B, EPA recognizes that the Solid Waste Area cap will be extended to meet the needs for the additional placement of Bulky Waste Area materials. A thorough evaluation of the required extent of the cap and its associated costs will be conducted as part of the remedial design process with the goal of meeting the remedial action objectives in a cost-effective manner.

Comment C-19: The Department is concerned that information presented in the GZA Report of February 1999 regarding the Bulky Waste Area, such as composition, thickness and volume of the waste as well as depth to groundwater, are in contrast to information presented in the Final FS Report of November 1998. In light of this new information, the comment inquired whether the affected criteria such as leachate generation, landfill gas generation, or cap size could be adequately addressed during the design phase.

EPA Response: With the selection of Alternative 4B, the calculations discussed in the comment will not be necessary.

Comment C-20: The Department requested that EPA reduce the size of the manageable unit to the extent practicable utilizing cut and fill methods to reduce leachate generation, comply with the 100-year flood plain ARAR, and reduce impacts to the wetland buffer zone.

EPA Response: The horizontal containment option for the Bulky Waste Area is no longer being considered since Alternative 4B is now the selected remedy. However, in the unlikely event that a considerable amount of waste is found encroaching into the wetland buffer zone, protective measures will need to be implemented during the remedial design and remedial action phases regarding excavation operations.

Comment C-21: The comment states that information provided in the GZA Report of February 1999 regarding the Bulky Waste Area indicated only a small percentage of recyclable material and that some waste was below the water table. However, the comment would like landfill mining to be reconsidered as a feasible option for the Bulky Waste Area.

EPA Response: Based on the findings presented in the GZA Report, it is unlikely that sufficient amounts of recyclables are available for cost-effective “mining” from the excavated materials. However, the cost estimate for Alternative 4B does include certain materials-handling contingencies which can be further refined in the design phase.

Comment C-22: The Department requested that EPA consider upgradient reinjection or off-Site treatment of leachate during the excavation of the Bulky Waste Area rather than construction of an on-site treatment facility, for economic reasons. Also, the comment stated that it may be necessary to continue leachate collection for a period of time after removal of the Bulky Waste

Area, until the area is stabilized.

EPA Response: Previous discussions with RIDEM Underground Injection Control personnel indicated that treatment may be needed. Therefore, a temporary treatment system was included in Alternative 4B as a conservative assumption. If RIDEM determines that upgradient reinjection without treatment is allowed, EPA agrees that this would be economically superior to treatment prior to discharge. However, some filtering may be required to remove the products of metal oxidation. Off-Site treatment may also be considered during the design phase if it is found to be more practical or economical. EPA has estimated leachate collection for one year for costing purposes in the FS. Therefore, cost estimates in the Final FS Report of November 1998 included operation of leachate collection and treatment for a time period that may be slightly longer than the actual time needed for excavation and consolidation of the Bulky Waste Area but allows for contingency.

Comment C-23: The Department asked for a comparison using the HELP model between the composite and single barrier cap in lowering the groundwater table after the first few years and whether the composite cap was more protective.

EPA Response: The impact of a cap to groundwater levels after a few years will be determined through future water level monitoring. HELP model results in Appendix C of the FS show that the protective composite cap will reduce precipitation infiltration 100%. A single barrier cap on the Solid Waste Area was shown to reduce infiltration 90%. Other considerations include the fact that a composite cap can accommodate construction imperfections and severe weather to a larger degree than a single barrier cap. The selected remedy calls for a multi-layer cap as a best available technology for containment of the source while limiting to the greatest extent practical future impacts to groundwater.

Comment C-24: The Department requested that the HELP model be rerun based on new information introduced in the GZA Report of February 1999 regarding waste thickness and submerged waste to determine the effect of capping the Bulky Waste Area on the water table.

EPA Response: Capping of the Bulky Waste Area is no longer a consideration as the selected remedy calls for excavation and consolidation of the Bulky Waste Area onto the Solid Waste Area. Therefore, it will be unnecessary to rerun the HELP model using the new information presented in the GZA Report.

Comment C-25: The Department would like the number of piezometers in the Solid Waste and Bulky Waste Areas to be reconsidered and suggested that additional technologies be evaluated to control leachate generation.

EPA Response: EPA agrees that the number of piezometers installed in the Solid Waste Area should be re-evaluated during the remedial design phase to determine the most appropriate numbers and locations. Capping of the Bulky Waste Area is not included in the selected remedy. Therefore, piezometers for the purpose of monitoring cap performance will not be necessary in this area. The evaluation of additional technologies to control leachate will be unnecessary, since the Bulky Waste Area will be excavated and consolidated onto the Solid Waste Area.

Comment C-26: The Department inquired whether the selected treatment option will remove ammonia to acceptable limits prior to discharge. If groundwater/leachate collection and treatment is implemented, RIDEM proposes passive remedial technologies such as passive Reactive Barrier/Trench System, Constructed Wetlands, and Upgradient Hydraulic Control.

EPA Response: Statements in Section 3.1.6.4 (page 3-22) of the Final FS Report of November 1998 indicate that all discharge limitations must be met. The design will incorporate necessary treatment options to meet these discharge standards.

Since the removal of the Bulky Waste Area is included in Alternative 4B, there will no longer be the need for long-term, active leachate treatment. However, selection of the most effective short-term leachate treatment system will be evaluated as part of the design phase.

Comment C-27: The Department requested that the potential for increased leachate generation and the need for leachate collection during capping or excavation of the Bulky Waste landfill be addressed.

EPA Response: Capping of the Bulky Waste Area is not included in the selected remedy, which is now Alternative 4B. There is potential for increased leachate generation during excavation and consolidation due to disturbance of waste materials and removal of cover soils. Both of these improve the contact between waste and water (precipitation and /or groundwater). Under Alternative 4B, leachate collection and treatment will be conducted during excavation in the Bulky Waste Area until the excavation and consolidation is complete. The actual length of time for leachate collection and treatment will be determined in the design phase and will be modified accordingly during the excavation phase of the cleanup.

Comment C-28: The Department requested that EPA reevaluate the costs based upon the new information presented in the GZA Report of February 1999 related to the thickness and volume of the waste, waste present in groundwater, and increased LFG generation.

EPA Response: Costs for Alternative 4B have been reevaluated based on current information from the GZA investigation. A technical memorandum has been prepared to provide a revised estimate of the costs for Alternative 4B. This technical memorandum is included in the Administrative Record under section 4.1 and presented in summary in the ROD.

Comment C-29: The Department questioned why the ambient air and soil gas monitoring costs for Alternatives 4A, 4B, 5A, and 5B are the same, since the Bulky Waste Area will be excavated in Alternatives 4B and 5B.

EPA Response: The ambient air and soil gas monitoring costs were the same for the alternatives with landfill mining 4B and 5B versus Alternatives 4A and 5A (without landfill mining) due to the assumptions presented in Table 4-3 and Appendix G. Quarterly sampling of all locations, including the Bulky Waste Area, Solid Waste Area and perimeter/offsite locations, would occur during the first year of the remedy, with or without landfill excavation. If excavation and consolidation were occurring during the first year of the remedy, this monitoring would provide information regarding any migration of air contaminants. After the first year, the number of locations requiring sampling was assumed to be reduced by a percentage. The actual locations were not selected. Sampling results, as well as remedy needs, should be used to determine which locations would no longer require sampling.

Comment C-30: The Department states that Alternative 4B should be the preferred alternative, the cap design for the Solid Waste Area should remain flexible, a phased approach should be used in determining the need for landfill gas treatment of the Solid Waste Area, and landfill excavation of the Bulky Waste Area and consolidation onto the Solid Waste Area be considered.

EPA Response: EPA concurs with the comment and EPA has concluded that Alternative 4B is the selected remedy. This addresses concerns set forth by the comment regarding the landfill excavation of the Bulky Waste Area. The capping approach for the Solid Waste Area is outlined in general in the ROD and will be finalized during the design phase. A phased approach for the landfill gas (e.g. passive discharge without treatment) is not feasible due to the human health risk from volatile organic compounds in the landfill gas and the increased methane production anticipated from the consolidation.

D. Other Federal Agencies

In a letter dated February 4, 1999, Dr. Kenneth Finkelstein of the National Oceanic and Atmospheric Administration of the Department of Commerce (NOAA) presented a number of comments regarding the Agency's Proposed Plan. EPA also received a letter from Dr. Finkelstein on March 26, 1999 concerning EPA's decision to change its preferred alternative based on new information and public comments received during the Public Comment Period. Below are EPA's summation of the comments received from NOAA and EPA's response to those comments.

Comment D-1: The comment stated that the Ambient Water Quality Criteria (AWQC) for iron must be met "because it is a State of Rhode Island water quality criteria." The comment states further that iron, although not a hazardous substance as defined in CERCLA, must be addressed

by the selected remedy because, under CERCLA § 104(a)(1)(B), iron is a "pollutant/contaminant that presents an imminent and substantial danger to the public health or welfare," where welfare as defined in the Federal Water Pollution Control Act (FWPCA) § 304(a)(1)(A) includes "plankton, fish, shellfish, wildlife, plant life, shorelines, beaches, esthetics, and recreation."

EPA Response: The selected remedy is a source control remedy which does not address migration of contamination, nor does it include treatment of surface water. Therefore, since cleanup goals for surface water will not be set, achievement of those standards is not required, and AWQC are not ARARs at the Site. AWQC standards will, however, be used to measure the effectiveness of OU1, with monitoring data used to assess the need for conducting additional remedial responses regarding groundwater and surface water.

Comment D-2: NOAA is concerned that capping of the landfills will not appreciably slow leachate discharge to surface water and no leachate treatment is planned.

EPA Response: The preferred alternative has been changed such that the Bulky Waste Area will be excavated and consolidated onto the Solid Waste Area. Leachate collection will be performed until such time as the landfill excavation and consolidation processes are complete.

Comment D-3: NOAA requests that EPA show consistency in its remedies for sites in Rhode Island. For NETC Site in Newport, RI, RIDEM has suggested that they will require that the sediment pore waters meet AWQC. If approved for use at NETC, then this clean up requirement should be implemented at Rose Hill.

EPA Response: EPA will take this comment under advisement when developing a long-term monitoring plan for the Site. Pore water, as a specific environmental medium, is not presently regulated. As stated above in Comment A-1, Rose Hill's remedy is a source control remedy whereby the treatment of surface water (or pore water from sediments in contact with the River) is not addressed. Therefore, since cleanup goals for surface water will not be set, achievement of those standards is not required, and AWQC standards will be used to measure the effectiveness of the remedy with respect to leachate outbreaks to streams and other discharges to on-site surface water.

Comment D-4: The comment expresses uncertainty as to whether Alternative 4B includes leachate collection during and after excavation of the Bulky Waste Area to mitigate impacts to surface water.

EPA Response: Section 4.4b.1 of the Final FS Report of November 1998 discusses that leachate control is implemented during the excavation and consolidation process. Cost assumptions (Appendix G) included operation for one year, assuming that the excavation and consolidation of the Bulky Waste Area could be performed within that time frame. Actual length of operation

should be determined during design and modified as necessary during the implementation of the excavation and consolidation.

Comment D-5: The comment asks if leachate collection is included in Alternative 4B. Ground water that has moved past the Bulky Waste Area is presently carrying contaminants. How would this issue be addressed through this remedy and how will EPA monitor the success of the clean up?

EPA Response: The selected remedy is the first operable unit of a phased clean up approach to remediate the environmental contamination caused by the Site. The first operable unit is a source control remedy which is intended to prevent or minimize the continued release of hazardous substances, pollutants or contaminants to the environment. Under this remedy, leachate controls will be implemented during the excavation and consolidation of the Bulky Waste Area landfill onto the Solid Waste Are landfill. The extent to which the Bulky Waste Area is excavated will be based on past data, design assessments, repetitive visual inspection of the excavation base and side walls, bucket observations, and other methodologies developed in the design phase to assure, to the greatest practical extent, that all physical evidence of waste deposits is removed from the Bulky Waste Area, irrespective of the level of groundwater within the excavation.

A goal for this source control component is to effectively remove and contain the contaminant mass so as to significantly reduce contaminant migration through leachate production to surface waters and sediments of Mitchell Brook and the Saugatucket River. A comprehensive Site monitoring program will be implemented under the first operable unit to collect data to assess the effectiveness of the source control remedy, assess the need for taking any further response actions, and assist the State with TMDL predictions for Site-related contaminant concentrations affecting local water bodies. Management of the migration of contaminants to ground water and surface water will rely on data obtained from the first operable unit's monitoring and any additional studies that are deemed necessary in order to further assess Site impacts, characterize the extent of contamination, and assess the need to develop and evaluate alternatives for any future actions concerning groundwater and surface water.

ATTACHMENT A

PUBLIC HEARING TRANSCRIPT

PAGES 1-25

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IN RE: PROPOSED CLEANUP PLAN FOR)
THE ROSE HILL REGIONAL)
LANDFILL SUPERFUND SITE)
SOUTH KINGSTOWN, RHODE ISLAND)
)
-)

PUBLIC HEARING

SOUTH KINGSTOWN TOWN HALL

180 HIGH STREET

WAKEFIELD, RHODE ISLAND

FEBRUARY 18, 1999

MR. BOYNTON: I'd like to open the comments by asking the federal, state, and local officials for their comments first beginning with Tom Gibson of Senator Chafee's office.

MR. GIBSON: Good evening. My name is Tom Gibson. I'm the deputy staff director for Senate Committee on Environmental Public Works.

Senator Chafee is the chairman of that committee. And I'm also the Superfund counsel.

My work address is the Jerickson Senate Office Building, United States Senate, Washington D.C.

I'm appearing tonight on behalf of Senator Chafee. I'm not here, really, to offer any technical comments on the proposed plan.

I did want to make several observations, though, on Senator Chafee's behalf.

First, the Superfund Plan, over the past two years, has undergone a large number of improvements and administrative

changes in an attempt to make the plan work better. And the senator and the committee have taken note of the changes.

And one thing the senator wants to do is encourage EPA and encourage Region 1 as they implement the remedy at that site to incorporate the changes to the extent they can in the remedy.

A couple of these changes I'd want to note are changes to the Ecological Risk Assessment Caucus and changes to the Municipal Liability Caucus.

The second thing I want to say is it's jumping the gun a little bit to be hearing from the rest of the state and local representatives, as we do hope that the remedy at hand does represent a consensus between the federal family and between the EPA and the cities and towns.

And that's all I have to say. Thank you.

MR. BOYNTON: Thank you, Mr. Gibson. Now I'd like to ask the Rhode Island Department of Environmental

Management to make a statement.

MR. ANGELL: Thanks. My name is Warren Angell, and I'm supervising engineer for the Department of Environmental Management Office of Waste Management. And that's at 235 Promenade Street in Providence, Rhode Island 02908.

The purpose of my statement tonight is to provide a brief overview of the DEM's comments and concerns with EPA's Proposed Plan for the Rose Hill Superfund Site.

I have made available copies of a letter from Terrence Gray, chief of the Office of Waste Management, to EPA that provides a more comprehensive representation of the DEM's position.

I am requesting that EPA enter that letter, along with my statement this evening, into the formal record.

As stated in that letter, we will also be providing EPA with more detailed technical comments on the Feasibility Study and Proposed Plan. And we'll do that in the next few weeks.

As these documents become finalized, we will make them available on the web site. I have provided information on how to locate that site on the information table.

The DEM has closely reviewed the FS and Proposed Plan to determine the effectiveness of the remedy recommended by EPA.

Based upon this review and factors to be discussed shortly, the Department does not concur with EPA's preferred alternative that is designated as Alternative 3a.

I will briefly outline our general concerns with Alternative 3a and provide supporting argument for our preferred remedy that is labeled as Alternative 4b.

Both alternatives address the Solid Waste area in the same manner but differ with respect to the Bulky Waste Area.

In short, Alternative 4b provides a more aggressive remedy and

therefore more protective remedy than 3a does.

It's important to note that we reviewed the plan in the role of both the state regulatory authority and the state designated Natural Resource Trustee.

While we understand that EPA is not a trustee, we have historically urged them to consider the Natural Resource Damage component in evaluating alternatives.

In our view, EPA has failed to adequately consider this issue in the remedy selection process and, as a result, the preferred alternative does not sufficiently address the ongoing damages to the Saugatucket River.

Before proceeding further, let me first state that both the EPA's preferred alternative and DEM's preferred alternative are equally protective of human health - it is in the protectiveness of the environment that our opinions differ.

I will now briefly discuss specific components of the preferred

alternative. With regard to the Solid Waste Area, in general, DEM concurs with this component of the preferred alternative.

The proposal to install an impermeable cap, manage landfill gas, and then monitor the effectiveness of the cap upon groundwater contamination and leachate generation is an environmentally sound approach.

If monitoring reveals at a later date that additional groundwater remediation is necessary in the future, it will be based upon improved conditions resulting in reduced long-term operation and maintenance.

We would, however, like to make the following clarification and recommendations.

First, we are concerned that the human health risk assessment could be misinterpreted. We want to clarify that there is no imminent threat to human health at or near the Rose Hill Landfill based upon the current site conditions and use of

the property.

Second, the proposed remedy assumes that active landfill gas treatment is necessary in order to reduce the potential human health risk to acceptable levels; however, the FS failed to determine if active treatment is necessary in order to accomplish this.

The Department recommends that landfill gas treatment be implemented in a phased approach by first installing collection pipe as part of cap construction and then collecting and testing landfill gas prior to determining the need and method of landfill gas treatment.

This phased approach was approved by the EPA in the preferred alternative for the McAllister Point Landfill located in Newport.

Additionally, we recommend that EPA draft a Record of Decision that is flexible enough to allow for consideration of innovative technologies and alternative cap component materials during the remedial design phase.

With regard to the Bulky Waste Area, the portion of Alternative 3a that addresses this area of the site causes the Department and the other Natural Resource Trustees the greatest amount of concern.

We have historically expressed concern to EPA regarding the effectiveness of capping the Bulky Waste Area.

We were and continue to be concerned that capping this area will not effectively reduce the amount of leachate discharged to the Saugatucket River and that we are simply postponing an inevitable decision to treat the leachate at a later date.

While the Department frequently advocates such an operable unit or phased approach, as we did for the Solid Waste Area, we believe that in this instance, where there will be ongoing damages to a valuable resource, such an approach is inappropriate.

Our concerns are further supported by new information provided by

the towns of South Kingstown and Narragansett through their consultant, GZA, that indicate certain assumptions made in the FS were determined to be inaccurate.

Leachate impact on the Saugatucket River is having an adverse ecological impact and must be effectively addressed now.

Under EPA's preferred alternative, the impact would not be further evaluated until five years after the cap is in place.

Such an approach will result in dramatically higher costs due to future remedial actions needed to provide the necessary ecological protection and long-term operation and maintenance, as well as natural resource restoration and, potentially, compensation.

The Department does not believe the EPA has fairly evaluated the long-term ecological and economic benefits of consolidation, and as a result, we are urging EPA to reconsider the consolidation alternative in 4b.

This remedy would eliminate the source of ecological impact to Mitchell Brook and the Saugatucket River and would also eliminate the need for a long-term treatment and monitoring system with indefinite associated costs.

In closing, the Department recommends that EPA utilize the 60-day extension period to review the additional information presented in the GZA Report, the comments presented by DEM, the local communities, and the Trustees.

After reviewing this information, the DEM is urging EPA to select Alternative 4b with the modifications mentioned and present a revised Proposed Plan to the public, along with a subsequent public comment period for the community and the towns.

Finally, I am formally requesting that the DEM be provided with a copy of the hearing transcripts as soon as they become available. Thank you.

MR. BOYNTON: Thank you. Now I'd like to ask Mr. Stephen Alfred, Town

Manager, Town of South Kingstown, to make comments.

MR. ALFRED: For the record, my name is Stephen Alfred, Town Manager, Town of South Kingstown. I'm appearing here tonight on behalf of the towns of South Kingstown and Narragansett.

Geo-Environmental, Inc., or GZA, was hired on behalf of the towns of South Kingstown and Narragansett to review the Remediation Investigation Feasibility Study and the Final Supplemental Human Health Risk Assessment prepared by Metcalf and Eddy in order to identify potential issues that could affect the appropriateness of EPA's Preferred Alternatives.

As a result of that review, two major issues have been identified that I'd like to address this evening.

One is the risk assessment appears to be overly conservative in predicted risks, particularly from landfill gas emissions, resulting in portions of the Preferred Alternative potentially not being necessary.

We believe that a number of erroneous and inappropriate conservative assumptions have been made in the risk analysis, which when compounded with the inclusion of potential non-site related risks cannot be relied upon to accurately estimate the true range of potential site related risks.

Adjustment of those parameters and preparation of a risk assessment which evaluates both central tendency and reasonable maximum exposures for key scenarios would better permit evaluation of appropriate remedial actions for our site.

Specifically, this reevaluation could demonstrate that there is a no risk-based reason for thermal destruction of the landfill gases.

The second issue that we'd like to present is that the Preferred Alternative for the Bulky Waste Area may not be effective in reducing the impacts of the Bulky Waste Area on groundwater and the Saugatucket River.

The Preferred Alternative, 3a, does not fully address identified conditions which may have an adverse effect on groundwater quality.

Rather, it appears that EPA intends to address these conditions with a separate and subsequent Remediation Investigation Feasibility Study.

This approach has direct implications on the proposed approach for remediating the Bulky Waste Site. It is not in anyone's best interest to perform another RIFS on this site.

Sufficient information should be available to determine what an appropriate remedy should be while Operative Unit No. 1 is being considered in its remedial design.

We believe that by delaying appropriate remedial action, leachate generation and adverse environmental impact on the Saugatucket River will continue unabated for, at minimum, an additional five-year period after the time that this initial landfill cap were installed on the

Bulky Waste Site. We think that this issue has to be addressed now rather than later. There is no reason for us to not address the leachate issue at this time.

The existing FS appears to have also significantly overestimated the mining costs and underestimated capping costs associated with this waste cell.

Based on GZA's preliminary evaluation, it appears that some wastes may be submerged perennially, or at minimum seasonally, and recovery of metals from this area would not be a viable option.

Thus, stripping the soil and simply relocating the waste to the Solid Waste Area may be a more cost-effecient alternative if submerged waste present and necessitate long-term groundwater collection and remediation actions.

The outstanding issue of Natural Resource Damage claims and the need to resolve these claims as a component of the cleanup solution warrant further Agency evaluation before an approved remediation

action can be adopted for this Bulky Waste Area.

It's noted that the towns request EPA also give strong consideration to the value of institutional controls, those which may include groundwater reclassification and the implementation of Environmental Land Usage Restrictions in the drafting of its Record of Decision.

It's equally important that the Agency provide engineering design flexibility during the remediation design process to allow for the use of innovative technologies and potential for inserting of alternative cap component materials.

In closing, please be advised that South Kingstown and Narragansett appreciate the Agency's approval of the 60-day extension.

We will be submitting formal comments and the report from GZA, which we hope will be of assistance to you in your deliberations.

The towns of South Kingstown and Narragansett have also formally requested

consideration as PRPs at this site to settle any municipal liability with the Agency under the municipal settlement policy.

And we will be anticipating a formal response from the Agency on that outstanding request. That will conclude my remarks.

MR. BOYNTON: Thank you, Mr. Alfred. Now Mr. Russell Koza of Wakefield, Rhode Island. It's K-O-Z-A, isn't it?

MR. KOZA: Koza, K-O-Z-A correct. I do have this written for the record so that your secretary doesn't have to take minutes.

Excuse me. I have a little problem with my voice. But I'd just like to read this into the record.

Some of the comments I have here are anecdotal, but I'm very concerned about some of the problems that were just raised earlier.

First of all, I'm an abutter to Saugatucket Pond, which is where the water

comes down through. I live on 163 Oakwoods Drive and my address is right there.

One thing that is anecdotal evidence -- and I'll show you where I'm going here -- we moved here in 1977 from Denver, Colorado -- and we had all kinds of problems with pollution there -- and came to this area and it was a very pleasant area.

The pond, which is the pond dammed up by Mr. Gariello, is a dam at Saugatucket River.

In the early days my children couldn't swim in that particular pond because of pollution. They would get rashes.

As I pointed out in my letter and on record here, my wife and I and the children used to go canoeing through there.

We even went up to Rose Hill dump through the river there, and the situation was really intolerable in terms of what was leaching out of the dump and everything else and the waterfowl, no fish.

I'm a hunter, fisherman, as well as nature conservancy. That kind of person. And that whole area has been devastated by that.

Now, I must admit back in the old days I used to dump things in that dump because we didn't know any better.

On Item No. 4 in the letter is I'm very concerned what was raised by the two previous gentlemen about the downstream effects.

We have in our town here something called the Saugatucket Waterway Project which is going on, and I'm very concerned that there is a monitoring of the groundwater from that site to make sure that we don't pollute downstream all the way to Salt Pond.

And I think that has to be very critically examined by whatever process is used by your agency.

I appreciate your presence here this evening so we can make these kind of comments. Other than that, I think all of us should work together to try to protect

the environment. And that's my message.

MR. BOYNTON: Thank you, Mr. Koza. The next I'd like to call Russell Morgan.

MR. MORGAN: Rustle Morgan. 139 Little Rest Road. I'd like to also point out that I also am an employee of GZA, the firm hired to look at this for the town, and I'm coming up as a resident.

I guess two issues that I'd just like to bring up. As this study is all driven by risks, we have an extensive gas collection and combustion treatment system being proposed.

Has any consideration been given to taking out some of the nearby residents that have some of these higher risks as opposed to implementing a gas collection combustion system?

My second comment is with regard to groundwater. Rather than taking a wait-and-see attitude of five years from now putting a cap on the site and seeing what kind of concentrations we still have in the groundwater, my comment is let's

take a look at it today, establish what kind of cleanup needs to be done and also what kind of cost the town is going to have to pay in today's dollars. That's it.

MR. BOYNTON: Thank you, Mr. Morgan. Next would either Myron or Alice Duffin like to make a comment?

MR. DUFFIN: Myron Duffin. I live at 278 Rose Hill Road. I'd just like to say they're talking about a 30-year scenario.

I mean, we've been living right there for 20, so our scenario is ten years. So I think something should be done a lot quicker than waiting. I mean, our kids have lived all their lives and we've been there for 20.

So I just want everybody to know I think that something should be done now for the people in the immediate area, not wait and see. Thanks.

MR. BOYNTON: Thank you, sir. Next would be -- I believe it's Michael Boisclair.

MR. BOISCLAIR: Boisclair.

MR. BOYNTON: B-O-E-S-C-L --

MR. BOISCLAIR: It's B-O-I-S-C-L-A-I-R. My family has property next door to the Duffins across the street within 250 feet of this landfill.

I think the leachate is way beyond the dump itself. I've seen it myself come through the ground into the Rose Hill Road, and just capping doesn't seem to be the way we're going to stop all this. It's way beyond capping.

So I'd just like to see it get cleaned up a little bit different and better way, especially with all the people that are living around there now. That's all.

MR. BOYNTON: Thank you very much. Would anyone else like to make a comment? Yes, ma'am. Come forward, please.

MS. ALLAIRE: My name is Michelle Allaire, A-L-L-A-I-R-E. My husband and I moved our family up to the Rose Hill area within the past 12 months with the understanding that we believed it was under

control. Recent articles in the newspaper about airborne carcinogens and everything have us very confused and feeling quite upset.

We're trying to start a small farm. We have animals we plan on raising, slaughtering, and eating.

And I'd just like to know if you people could decide something and make it known to us quickly what the plan is that's going to happen.

I'd like to commend the town and the state on their ideas that go further than what the EPA's is.

And I'd like to know how the EPA is going to make a decision for people that live here when they don't live here and have no clue of what we're going through and what we're worried about and what our futures are going to be.

I'd like to see either the state or the town's recommendations followed more because we actually really live here. Thank you.

MR. BOYNTON: Thank you very

much. Are there other comments for the record, oral comments? All right.

If there are no further oral comments, I'd just like to remind everyone that in the back of our proposed plan there is a sheet that you can use to submit with the comments.

And it's on the very back page. It's two pages. You can fill it in in hand and just fold it in half and mail it to David Newton and your comments will go into the record.

So if there are no other further comments, I'm going to close this hearing. This hearing is now closed.

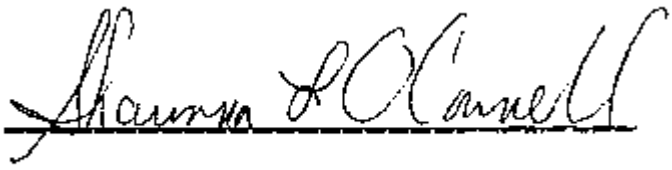
(Proceedings concluded.)

C E R T I F I C A T E

COMMONWEALTH OF MASSACHUSETTS

BRISTOL, SS.

I, Shaunna L. O'Connell, a Registered Professional Reporter for the County of Bristol, do hereby certify that the foregoing record, Pages 1 through 25, is a true and accurate transcript of the proceedings as taken by me on February 18, 1999, in the matter of ROSE HILL REGIONAL LANDFILL SUPERFUND SITE.



Shaunna L. O'Connell, RPR
and Notary Public

APPENDIX E

RECORD OF DECISION
Rose Hill Regional Landfill Superfund Site

ADMINISTRATIVE RECORD INDEX

Rose Hill Regional Landfill

Administrative Record

Index

Compiled: January 28, 1999

Prepared by EPA- New England
Office of Site Remediation and Restoration

with assistance from
ads
2070 Chain Bridge Road
Vienna, VA

INTRODUCTION

This document is the index to the Administrative Record compiled for the release of the Proposed Plan for the Rose Hill Regional Landfill Superfund Site. The index cites site-specific documents that were relied upon in formulating the selected remedy for this operable unit.

The Administrative Record, consisting of 17 three-ring binders of the documents listed herein, is available for public review, by appointment, at the EPA Region I OSRR Records Center, Boston, MA, (617-918-1440) and at the South Kingstown Public Library, 1057 Kingstown Road, Peacedale, RI 02883.

Questions concerning this Administrative Record should be addressed to the EPA Region I site manager.

An Administrative Record is required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA).

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for the

Rose Hill Regional Landfill NPL Site

1.0 Pre-Remedial

1.2 Preliminary Assessment

1. "Identification and Preliminary Assessment," EPA Region I (January 20, 1983).

1.3 Site Inspection

1. "Final Site Inspection Report," NUS Corporation (September 20, 1985).
2. "Final Scope of Work, Expanded Site Inspection" NUS Corporation (July 20, 1987).

Maps associated with entry number 3 are oversized and may be reviewed, by appointment only, at the EPA Region I OSRR Records Center in Boston, Massachusetts.

3. "Final Summary Report- Expanded Site Inspection," NUS Corporation (January 27, 1989).
4. "Final Task Report - Surface Water and Sediment Sampling," NUS Corporation (January 27, 1989).
5. "Final Task Report - Geophysical Survey," NUS Corporation (January 27, 1989).
6. "Final Task Report - Soil Sampling," NUS Corporation (January 27, 1989).
7. "Final Task Report - Leachate Sampling," NUS Corporation (January 27, 1989).
8. "Final Task Report - Stream Gauging," NUS Corporation (January 27, 1989).

Comments

9. Comment Dated October 8, 1985 from David A. Webster, Town of South Kingstown on the September 20, 1985 "Final Site Inspection Report," NUS Corporation.

1.6 Hazard Ranking System (HRS)

1. "HMS Score Sheets," including list of references (Headquarters EPA quality assurance [QA]) (October, 14, 1987).

The remainder of the "HRS Draft Documentation Package-Volumes I & II", NUS Corporation (July 29, 1987) may be reviewed, by appointment only, at the EPA Region I OSRR Records Center in Boston, Massachusetts.

1.7 Correspondence Related to Proposal of a Site to the NPL

1. Letter from Keith E. Warner, YWC, Inc. to Stephen A. Alfred, Town of South Kingstown (August 4, 1988). Concerning review of the HRS ranking.
2. Letter from Stephen A. Alfred, Town of South Kingstown to Steven Lingle, EPA Headquarters (August 12, 1988). Concerning proposed placement on the NPL.
3. Letter from Claiborne Pell, U.S. Senate to Steven Lingle, EPA Headquarters (August 18, 1988). Concerning removal of the site from the NPL.
4. List of Commenters (1988).

1.10 HRS Narrative Summary

1. "National Priorities List - Rose Hill Regional Landfill," EPA Region I (August 1989).

1.17 FIT Progress Reports

Progress Reports

1. ESI Status Report for November 1987, NUS Corporation (December 23, 1987).
2. ESI Status Report for January 1988, NUS Corporation (February 22, 1988).
3. ESI Status Report for February/March 1988, NUS Corporation (April 13, 1988).
4. Task Report /Geophysical Survey, NUS Corporation (April 25, 1988).
5. ESI Status Report for April 1988, NUS Corporation (May 12, 1988).

Trip Reports

6. Trip Report on a visit to Rose Hill Regional Landfill Site, Barbara Felitti, Kenneth Leach and Anthony Kurpaska, NUS Corporation (December 17, 1987). Concerning stream gauging measurements.
7. Trip Report on a visit to Rose Hill Regional Landfill Site, Ira Grossman, Steve Miller and Lisa Pimenta, NUS Corporation (December 30, 1987). Concerning soil sampling.
8. Trip Report on a visit to Rose Mill Regional Landfill Site, Dieter Geithner, Ira Grossman, Mark Jonnet and Sherri Kasten, NUS Corporation (January 8, 1988) with attached maps and data tables. Concerning water and sediment sampling.
9. Trip Report on a visit to Rose Hill Regional Landfill Site, Shirley Danke, Steve Miller and John McTigue, NUS Corporation (January 11, 1988) with attached maps and data tables. Concerning VLF electromagnetic resistivity surveying.
10. Trip Report on a visit to Rose Hill Regional Landfill Site, Kayleen Jalkut, Sherri Kasten and Anthony Kurpaska, NUS Corporation (April 19, 1988). Concerning second round of stream gauging measurements.
11. Trip Report on a visit to Rose Hill Regional Landfill Site, Barbara Felitti, Ira Grossman and Lisa Kulju, NUS Corporation (April 20, 1988) with attached map and data table. Concerning leachate sampling. Removal Response

2.1 Correspondence

1. Memorandum from Dean Tagliaferro, EPA Region I to Ted Bazenas, U.S. Agency for Toxic Substances and Disease Registry (ATSDR)(Not Dated). Concerning vinyl chloride indoor air action levels.
2. Memorandum from David J. Newton, EPA Region I to Dennis Huebner, EPA Region I (November 1, 1991). Concerning a request for an expedited assessment by the Environmental Services Division.
3. Memorandum from Mary Beth Smuts, EPA Region I to David J. Newton, EPA Region I (November 4, 1991). Concerning an assessment of landfill gas emissions from the Rose Hill NPL site.
4. Letter from A. David Hall, Union Fire District of South Kingstown to Stephen Alfred, Town Manager concerning the November 8 air sampling of eleven homes located on Rose Hill Road (November 12, 1991).
5. Letter from David J. Newton, EPA Region I to Louis R. Houston (January 13, 1992). Concerning methane gas air monitoring results at 220 Rose Hill Road.
6. Memorandum from David J. Newton, EPA Region I to Donald Berger, EPA Region I (June 8, 1992). Concerning a request for further evaluation of existing data and a possible removal action at the Rose Hill Landfill.
7. Memorandum from Yoon-Jean Choi, EPA Region I to David J. Newton, EPA Region I (June 19, 1992). Concerning landfill gas controls at the Rose Hill Landfill.
8. Letter from Paul R. Groulx, EPA Region I to Residents of the Town of South Kingstown (October 15, 1992). Concerning investigations of migrating landfill gas and the need for access to property.
9. Letter from Paul R. Groulx, EPA Region I to Stephen A. Alfred, Town of South Kingstown (October 19, 1992). Concerning request for access to town property.

Records cited in entry number 10 may be reviewed by appointment only at the EPA Records Center in Boston.

10. Memorandum from David J. Newton, EPA Region I to Paul Groulx, EPA Region I concerning request for information regarding glue waste and landfill engineering plans (November 3, 1992).
11. Letter from Paul R. Groulx, EPA Region I to Stephen A. Alfred, Town of South Kingstown (November 9, 1992). Concerning transmittal of reports related to an emergency removal action.
12. Memorandum from Molly Elder, Roy F. Weston, Inc. to Site File concerning research on sites in other EPA Regions similar to Rise Hill Landfill (November 11, 1992).
13. **Cross-reference:** Letter from Stephen A. Alfred, Town of South Kingstown and Jeffery Ceasrine, Town of Narragansett to Mark Lowe, EPA Region I (November 24, 1992). Concerning the Towns' response to Notice Letters relative to planned removal activities. ***[Filed and cited as entry number 17 in the February 5, 1993 Removal Action Administrative Record.]***

2.1 Correspondence (correspondence)

14. Memorandum from Thomas H. Pritchett, EPA Environmental Response Team to Paul R. Groulx, EPA Region I (December 4, 1992) with attached specification sheet. Concerning specifications for fixed station methane monitors for selected homes adjacent to site.
15. Letter Report from Thomas H. Pritchett, EPA Environmental Response Team to Paul R. Groulx, EPA Region I (December 11, 1992) with attached tables. Concerning explanation of the preliminary emission and air dispersion modeling reports conducted in support of the site assessment.
16. **Cross-Reference:** Memorandum from Thomas H. Pritchett, EPA Environmental Response Team to Paul R. Groulx, EPA Region I (December 11, 1992). Concerning table of data for summa canister samples ***[Filed and cited as entry number 6 in the February 5, 1993 Removal Action Administrative Record].***
17. Letter from Paul R. Groulx, EPA Region I to Mark M. Dennen, Rhode Island Dept. of Environmental Management (RIDEM) (December 12, 1992). Concerning transmittal of Letter Report of a field trip for soil gas monitoring.
18. Letter from Paul R. Groulx, EPA Region I to Stephen Alfred, Town of South Kingstown (December 12, 1992). Concerning transmittal of Letter Report of a field trip for soil gas monitoring.
19. Letter from Paul R. Groulx, EPA Region I to Stephen Alfred, Town of South Kingstown concerning transmittal of the Action Memorandum dated October 10, 1992 (December 16, 1992).
20. Letter from Paul R. Groulx, EPA Region I to Stephen A. Alfred, Town of South Kingstown (December 23, 1992). Concerning transmittal of three reports.
21. Letter from Paul R. Groulx, EPA Region I to Mark M. Dennen, RIDEM (December 23, 1992). Concerning transmittal of three reports.
22. Letter from Paul R. Groulx, EPA Region I to Ted Bazenas, ATSDR (December 23, 1992). Concerning transmittal of three reports.
23. Letter from Paul R. Groulx, EPA Region I to Stephen A. Alfred, Town of South Kingstown (December 24, 1992). Concerning transmittal of EPA Air Monitoring Data with cover letter for Individual Residences.
24. Letter from Paul R. Groulx, EPA Region I to Mark M. Dennen, RIDEM (December 24, 1992). Concerning transmittal of EPA Air Monitoring Data with cover letter for Individual Residences.
25. Letter from Paul R. Groulx, EPA Region I to Stephen A. Alfred, Town of South Kingstown and Jeffery Ceasrine, Town of Narragansett (January 16, 1993). Concerning Rose Hill Regional Landfill Removal Activity.
26. Letter from Paul Groulx, EPA Region I to Stephen Alfred, Town of South Kingstown with attached Site Visit Trip Report from Roy F. Weston for January 21, 1993 (January 25, 1993).
27. Letter from Jeffery Ceasrine, Town of Narragansett to Paul R. Groulx, EPA Region I (January 27, 1993). Concerning referral of all future correspondence to the new Town Manager.

2.1 Correspondence (correspondence)

28. Letter from Mark Dennen, RI DEM to Deborah Simone, Metcalf & Eddy transmitting RIDEM'S Environmental Management Rules and Regulations for Hazardous Waste Management which are filed and cited as number1 in break 2.11 (January 29, 1993).
29. Letter from Paul R. Groulx, EPA Region I to Stephen Alfred, Town of South Kingstown concerning transmittal of documents (January 29, 1993).
30. Memorandum from Paul R. Groulx, EPA Region I to David Newton, EPA Region I (January 30, 1993). Concerning notification of change in On-Scene Coordinator.
31. Letters from Paul R. Groulx, EPA Region I to Mark M. Dennen RIDEM and Stephen Alfred, Town of South Kingstown concerning transmittal of January 1993 Removal Action Administrative Record (February 3, 1993)
32. Letter from David J. Newton, EPA Region I to Mark Dennen, Rhode Island Department of Environmental Management (February 5, 1993). Concerning identification of ARARs and reassignment of personnel.
33. Letter from Dean Tagliaferro, EPA Region I to Stephen Alfred, Town of South Kingstown with attached Weston's Site Visit trip Report for February 3, 1993 (February 8, 1993).
34. Record of Telephone Conversation between Paul Killian, Roy F. Weston and Bret Moxley, EPA Region 9 with suggestions concerning indoor air sampling at the Rose Hill Regional Landfill (February 9, 1993).
35. Memorandum from Thomas H. Pritchett, EPA Region I to Dean Tagliaferro and David Newton, EPA Region I concerning the effect of incorporating Metcalf & Eddy's additional Summa Canister Data into the Air Dispersion Output (February 12, 1993).
36. Letter from Dean Tagliaferro, EPA Region I to Stephen A. Alfred, Town of South Kingstown (March 1, 1993). Concerning transmittal of Site Visit Trip Report, Roy F. Weston, Inc., February 17-18, 1993.
37. Letter from Dean Tagliaferro, EPA Region I to Mark Dennen, Rhode Island Division of Air and Hazardous Materials (March 9, 1993). Updating the Removal Program's intentions and transmitting "Evaluation of Landfill Gas Migration Barrier Systems," Metcalf & Eddy (March 1, 1993).
38. Letter from Dean Tagliaferro, EPA Region I to Stephen Alfred, Town of South Kingstown transmitting Site Visit Report (March 15, 1993).
39. Letter from Dean Tagliaferro, EPA Region I to Stephen Alfred, Town of South Kingstown with attached Weston's Site Visit Trip Report for March 17 - 18, 1993 (March 30, 1993).
40. Letter from Dean Tagliaferro, EPA Region I to Stephen A. Alfred, Town of South Kingstown (April 27, 1993). Concerning transmittal of Site Visit Trip Report, Roy F. Weston, Inc., April 15, 1993.
41. Letter from Dean Tagliaferro, EPA Region I to Stephen Alfred, Town of South Kingstown transmitting a site visit report (May 17, 1993).
42. Letter from Jon R. Schock, Town of South Kingstown to Dean Tagliaferro, EPA Region I (June 4, 1993). Concerning activities at 220 Rose Hill Road.

2.1 Correspondence (correspondence)

43. Letter from Dean Tagliaferro, EPA Region I to Stephen A. Alfred, Town of South Kingstown (June 7, 1993). Concerning attached site visit report.
44. Letter from Luke A. Fabbri, Geological Field Services, Inc. to John Fiedler, PEMCO concerning equipment problems with gas monitoring system bought by Town of South Kingstown (June 7, 1993).
45. Letter from Dean Tagliaferro, EPA Region I to Stephen A. Alfred, Town of South Kingstown (June 28, 1993). Concerning update on residential indoor air report.
46. Letter from Dean Tagliaferro, EPA Region I to Stephen A. Alfred, Town of South Kingstown and Scott Hancock, Town of Narragansett (July 2, 1993). Concerning status report on administrative order compliance.
47. Letter from Dean Tagliaferro, EPA Region I to Stephen A. Alfred, Town of South Kingstown transmitting February - March 1993 Indoor Air Survey Results (July 20, 1993).
48. Letter from Dean Tagliaferro, EPA Region I to Stephen A. Alfred, Town of South Kingstown and Scott Hancock, Town of Narragansett (August 4, 1993). Concerning extension of due date for deliverables.
49. Letter from Luke A. Fabbri, Geological Field Services to Dean Tagliaferro, EPA Region I (August 19, 1993). Concerning installation of methane gas detection system.
50. Letter from Dean Tagliaferro, EPA Region I to Stephen A. Alfred, Town of South Kingstown and Scott Hancock, Town of Narragansett (September 3, 1993). Concerning conditional approval of the installation plan for alarms and gas migration system.
51. Letter from Luke A. Fabbri, Geological Field Services to Dean Tagliaferro, EPA Region I (September 7, 1993). Concerning defective controller in site alarm system.
52. Letter from Luke A. Fabbri, Geological Field Services, Inc. to Dean Tagliaferro, EPA Region I concerning revised work plan and a certification for the soil gas monitoring system installed at 349 Rose Hill Road (September 9, 1993).
53. Letter from Dean Tagliaferro, EPA Region I to Stephen A. Alfred, Town of South Kingstown and Scott Hancock, Town of Narragansett (September 13, 1993). Concerning status report on administrative order compliance.
54. Letter from Dean Tagliaferro, EPA Region I to Ted Bazenas, U.S. Public Health Service Agency for Toxic Substances and Disease Registry (ATSDR) (September 13, 1993), concerning request for a health consult.
55. Memorandum from Andy Raubvogel, EPA Region I to Gregory Kennan et al., EPA Region I (September 14, 1993) with attached guidance document. Concerning methane releases at Superfund sites.
56. Letter from Jon R. Schock, Town of South Kingstown to Dean Tagliaferro, EPA Region I (September 29, 1993). Concerning revised work plan for methane alarm system;

2.1 Correspondence (correspondence)

57. Letter from Dean Tagliaferro, EPA Region I to Stephen A. Alfred, Town of South Kingstown (October 8, 1993). Concerning results of impending health consult for possible additional removal activities.
58. Memorandum from Thomas H. Pritchett, EPA Environmental Response Team to Dean Tagliaferro, EPA Region I concerning review of vinyl chloride results, with attached TAT Standard Operations Procedures #13, 1.0, 10/22/92 (November 1, 1993).
59. Memorandum from Dean Tagliaferro, EPA Region I to Thomas H. Pritchett, EPA Environmental Response Team (November 16, 1993). Concerning information request on ambient air sample collection.
60. Memorandum from Dean Tagliaferro, EPA Region I to Thomas H. Pritchett, EPA Environmental Response Team (December 6, 1993). Concerning invitation to attend the December 15, 1993 meeting.
61. Memorandum from Dean Tagliaferro, EPA Region I to Rose Hill Site File containing a trip report for the inspection of alarms installed under the Administrative Order (December 20, 1993).
62. Letter from Dean Tagliaferro, EPA Region I to Stephen Alfred, Town of South Kingstown and Scott Hancock, Town of Narragansett completion of required work in Section II of the Scope of Work (December 21, 1993).
63. Letter from Paul R. Groulx, EPA Region I to Thomas H. Pritchett, EPA Environmental Response Team (January 7, 1994). Concerning opportunity to review information before the January 18, 1994 meeting.
64. Memorandum from Thomas H. Pritchett, EPA Environmental Response Team to Paul Groulx, EPA Region I (January 13, 1994). Concerning response to Region I ESD questions regarding the Environmental Response Team's Rose Hill Ambient Air Data.
65. Memorandum from Paul Groulx, EPA Region I to T. Bazenas, D. Newton, D. Tagliaferro, etc. EPA Region I concerning a meeting scheduled for January 28, 1994 to discuss the Rose Hill Removal status and update, with attached agenda (January 24, 1994).
66. Letter from Jon R. Schock, Town of South Kingstown to Paul R. Groulx, EPA Region I (April 13, 1994). Concerning Bentonite Dam for Duffin Water Service Line.
67. Letter from Luke A. Fabbri, Geological Field Services, Inc. to Paul Groulx, EPA Region I concerning alarm repairs at residences (April 24, 1994).
68. Letter from Paul R. Groulx, EPA Region I to Stephen Alfred, Town of South Kingstown (May 5, 1994) with attached:
    A. Memorandum from Philip R. Campagna, EPA Environmental Response Team to Paul R Groulx, EPA Region I (April 11, 1994). Concerning recommendations for handling methane monitoring alarms.
    B. Memorandum from Paul F. Killian, Roy F. Weston, Inc. to File (April 25, 1994). Concerning March 22, 1994 meeting minutes and site chronology.

2.1 Correspondence (correspondence)

69. Letter from A. Harry Cesario, Attorney for Alice & Myron Duffin, Jr. to Dean Tagliaferro, EPA Region I (October 6, 1994). Concerning methane gas monitoring alarms and installation of a blower system.
70. Letter from Paul R. Groulx, EPA, Region I to A. Harry Cesario, Attorney for Alice & Myron Duffin, Jr. (October 26, 1994). Concerning work plan for the design and installation of a sub-slab ventilation system.
71. Letter from Paul Groulx, EPA Region I to Mark M. Dennen, RI DEM requesting a review, and comments on the work plan for the sub-slab ventilation system for the residence at 278 Rose Hill Road (October 27, 1994).
72. Letter from Mark M. Dennen, RI DEM to Paul Groulx, EPA Region I concerning the Work Plan prepared by Geological Field Services dated October 14, 1994 (November 23, 1994).
73. Letter from A. Harry A. Cesario, Attorney for the Duffins to Stephen A. Alfred, Town of South Kingstown (January 12, 1995). Concerning sub-slab ventilation system for the Duffin Residence.
74. Telefacsimile transmittal sent February 1, 1995, from Mark M. Dennen, RIDEM to David J. Newton, EPA Region I concerning transmittal of attached:
    A. Letter from Jon R. Schock, Town of South Kingstown, to Paul R. Groulx, EPA Region I (January 27, 1995). Concerning methane abatement status.
    B. Letter from Luke A. Fabbri, Geological Field Services, Inc. to Jon R. Schock, Town of South Kingstown (January 26, 1995).
75. Memorandum from David J. Newton, EPA Region I to Paul Groulx, EPA Region I concerning South Kingstown's letter of January 27, 1995 (February 3, 1995).
76. Letter from Paul Groulx, EPA Region I to Jon Schock, Town of South Kingstown transmitting a copy of the Indoor Residential Air Survey Results for February - March 1993 (April 4, 1995).
77. Letter from Mark M. Dennen, RIDEM to David J. Newton, EPA Region I concerning Landfill Gas Modeling (July 24, 1995).

2.2 Removal Response Reports

Reports

Some Agency for Toxic Substances and Disease Registry (ATSDR) documents are related to the Remedial Investigation (RI) and are filed and cited in 3.9 "Health Assessments."

1. Memorandum front David J. Newton, EPA Region I to File (November 15, 1991). Concerning methane gas air monitoring in residential dwellings adjacent to the site.
2. "Methane Gas Investigation for Rose Hill Landfill, South Kingstown, Rhode Island," Roy F. Weston, Inc. for EPA Region I (December 1991)

2.2 Removal Response Reports (continued)

3. Letter from Margaret A. Shaw and Mark J. McDuffee, Roy F. Weston, Inc. to John M. Carlson, EPA Region I (December 6, 1991). Concerning methane gas investigation.
4. Memorandum from Margaret Shaw, Roy F. Weston, Inc. to File (January 10, 1992). Concerning chronology of events for methane gas air monitoring of basements in the proximity of Rose Hill Regional Landfill December 21 and 23, 1991.
5. Memorandum from Margaret Shaw, Roy F. Weston, Inc. to File (February 5, 1992). Concerning summary of events for methane gas air monitoring of basements in the proximity of Rose Hill Regional Landfill January 21 and 22, 1992.
6. Memorandum from Margaret A. Shaw, Roy F. Weston, Inc. to File (February 21, 1992). Concerning summary of events for methane gas air monitoring of basements.
7. Memorandum from Margaret A. Shaw, Roy F. Weston, Inc. to File (April 1, 1992). Concerning summary of events for methane gas air monitoring of basements.
8. **Cross-Reference:** ATSDR Record of Activity, U.S. Public Health Service Agency for Toxic Substances and Disease Registry (July 9, 1992) ***[Filed and cited as entry number 1 in the February 5, 1993 Removal Action Administrative Record].***
9. **Cross-Reference:** ATSDR Record of Activity, U.S. Public Health Service Agency for Toxic Substances and Disease Registry (October 1, 1992) ***[Filed and cited as entry number 3 in the February 5, 1993 Removal Action Administrative Record].***
10. "Micromonitor Field Report", REAC, (October 1992).
11. Memorandum from Thomas H. Pritchett, EPA Environmental Response Team to Paul Groulx, EPA Region I concerning preliminary report of the field sampling performed at the Rose Hill Landfill on October 19, & 20, 1992 (October 28, 1992).
12. Memorandum from Thomas H. Pritchett, EPA Environmental Response Team to Paul R. Groulx, EPA Region I (November 13, 1992). Concerning the attached reports:
    A. "Remote Methane Monitoring System – Status Report," Roy F. Weston, Inc. (November 9, 1992)
    B. "Design of Methane Mitigation System – Status Report," Roy F. Weston, Inc. (November 9, 1992).
13. **Cross-Reference:** "Air Monitoring Data Tables – December 1991 – September 1992," Roy F. Weston, Inc. (November 1992) ***[Filed and cited as entry number 5 in the February 5, 1993 Removal Action Administrative Record].***
14. "Air and Soil Gas Sampling Survey – October 19-20, 1992," Roy F. Weston, Inc. (November 1992).
15. "Air Quality Modeling Report," Roy F. Weston, Inc. (November 1992).
16. "Revised Emission Modeling Report," Roy F. Weston, Inc. (November 1992).

2.2 Removal Response Reports (continued)

17. "Final Emission Modeling Report," Roy F. Weston, Inc. (December 1992).
18. "Final Air Quality Modeling Report," Roy F. Weston, Inc. (December 1992).
19. Memorandum from Paul F. Killian, Roy F. Weston to Rose Hill Regional Landfill Site File concerning the January 7 - 8, 1993 Site Visit Report (January 19, 1993).
20. "Emission Modeling Report – Summa Canister Sampling – May 1992," Roy F. Weston, Inc. (February 1993).
21. Memorandum from Thomas H. Pritchett, EPA Environmental Response Team to Dean Tagliaferro, EPA Region I concerning preliminary results for the second round of Summa Canisters in the vicinity of the Rose Hill Landfill, with attached chain of custody forms, (February 12, 1993).
22. Memorandum from Paul F. Killian, Roy F. Weston to Rose Hill Regional Landfill Site File concerning the February 17-18, 1993 Site Visit Report (February 26, 1993).
23. "Evaluation of Landfill Gas Migration Barrier Systems," Metcalf & Eddy (March 1, 1993), with transmittal letter from Deborah M. Simone, Metcalf & Eddy to Dean Tagliaferro, EPA Region I.
24. Memorandum from Paul F. Killian, Roy F. Weston to Rose Hill Regional Landfill Site File concerning the February 24 - 25, 1993 Site Visit Report (March 5, 1993).
25. Memorandum from Paul F. Killian, Roy F. Weston, Inc. to Rose Hill Regional Landfill Site File concerning the March 3 - 4, 1993 Site Visit Report (March 10, 1993).
26. Memorandum from Paul F. Killian, Roy F. Weston to Rose Hill Regional Landfill Site File concerning the March 10 - 11, 1993 Site Visit Report (March 22, 1993).
27. Memorandum from Paul F. Killian, Roy F. Weston to Rose Hill Regional Landfill Site File concerning the March 24 - 25, 1993 Site Visit Report (March 31, 1993).
28. Memorandum from Paul F. Killian, Roy F. Weston to Rose Hill Regional Landfill Site File concerning the March 31, 1993 Site Visit Report (April 9, 1993).
29. Memorandum from Paul F. Killian, Roy F. Weston to Rose Hill Regional Landfill Site File concerning the April 4, 1993 Site Visit Report (April 20, 1993).
30. "Evaluation of Landfill Gas Migration Barrier System, Final Report," Metcalf & Eddy (May 1993).
31. Memorandum from Paul F. Killian, Roy F. Weston to Rose Hill Regional Landfill Site File concerning the April 28, 1993 Site Visit Report (May 11, 1993).
32. Letter from Jon R Schock, Town of South Kingstown to Dean Tagliaferro, EPA Region I concerning activation of methane alarm at residence (278 Rose Hill Road) with attachments (May 19, 1993).

2.2 Removal Response Reports (continued)

33. Letter from Stephen A. Alfred, Town of South Kingstown to Dean Tagliaferro, EPA Region I concerning activation of methane alarm at residence (278 Rose Hill Road) on May 15, 1993 with attachments (May 28, 1993).
34. Memorandum from Paul F. Killian, Roy F. Weston to Rose Hill Regional Landfill Site File concerning the May 18, 1993 Site Visit Report (June 2, 1993).
35. "Observed Ambient Air Impact Report," Roy F. Weston, Inc. (July 1993).
36. "Air Quality Modeling Final Report," Roy F. Weston, Inc. (August 1993).
37. Letter from Dean Tagliaferro, EPA Region I to Stephen A. Alfred, Town of South Kingstown (August 19, 1993) transmitting the attached:
    A. Site Visit Report, Roy F. Weston, Inc., Technical Assistance Team (August 6, 1993).
    B. Site Visit Report, "REAC Ambient Air Survey," Roy F. Weston, Inc., Technical Assistance Team (August 9, 1993).
38. "Indoor Residential Air Survey Results – February 1993-March 1993, "Roy F. Weston, Inc. (September 1993).
39. Letter from Luke A. Fabbri, Geological Field Services, Inc. to Jon Schock, Town of South Kingstown concerning the alarm incident at 278 Rose Hill Road on January 18, 1994, with attachments (January 20, 1994).
40. Letter from Jon R. Schock, Town of South Kingstown to Paul Groulx, EPA Region I concerning methane alarm event at 278 Rose Hill Road on March 10, 1994, with attachments (March 11, 1994).
41. Letter from Jon R. Schock, Town of South Kingstown to Paul R. Groulx, EPA Region I (March 16, 1994). Concerning methane alarm events with attached "Incidence Response Sheets", and chronological summary memoranda.
42. Letter from John J. Carney, Union Fire District of South Kingstown to Jon R. Schock, Town of South Kingstown concerning response to gas alarm at 278 Rose Hill Road on March 17, 1994, with attachments (March 17, 1994).
43. Letter from Jon R. Schock, Town of South Kingstown to Paul R. Groulx, EPA Region I (March 25, 1994). Concerning responsible party actions in responding to methane alarm events with attached:
    A. Partial revised methane alarm response protocol.
    B. Revised "Incident Response Sheet."
44. Letter from Jon R. Schock, Town of South Kingstown to Paul R. Groulx, EPA Region I (April 4, 1994). Concerning revised methane alarm response protocol.
45. Letter from Luke A. Fabbri, Geological Field Services, Inc. to Jon Schock, Town of South Kingstown concerning the alarm incident at 278 Rose Hill Road on April 23, 1994, with attachments (April 29, 1994).

2.2 Removal Response Reports (continued)

46. Letter from Jon R. Schock, Town of South Kingstown to Paul R. Groulx, EPA Region I (June 8, 1994). Concerning methane response corrective actions with attached:
    A. Letter from Jon R. Schock, Town of South Kingstown to Luke Fabbri, Geological Field Services, Inc. (May 16, 1994). Concerning installation of vapor abatement collection systems.
    B. Memorandum from Paul F. Killian, Roy F. Weston, Inc. to File (April 25, 1994). Concerning March 22, 1994 meeting minutes and site chronology.
    C. Memorandum from Peter Bates, Town of South Kingstown to Jon R. Schock, Town of South Kingstown (May 13, 1994). Concerning recalibrating the portable Gas Tech combustible gas meter.
47. Letter from Jon R. Schock, Town of South Kingstown to Paul Groulx, EPA Region I (August 31, 1994). Concerning methane alarm events at the residence with attached:
    A. Letter from Andre Boisvert, Union Fire District of South Kingstown to Jon Schock, Town of South Kingstown (August 29, 1994). Concerning response to a methane gas alarm on August 27, 1994.
    B. Incident Response Report (August 27, 1994).
    C. Memorandum from Peter Bates, Town of South Kingstown to Jon Schock, Town of South Kingstown (August 30, 1994). Concerning the summary of events of the methane alarm level 1 at the residence on August 27, 1994.
48. Letter from Jon R. Schock, Town of South Kingstown to Pal Groulx, EPA Region I concerning methane alarm events at 278 Rose Hill Road on September 23, 1994, with attachments (September 28, 1994).
49. Letter from Jon R. Schock, Town of South Kingstown to Paul Groulx, EPA Region I concerning methane alarm events at 278 Rose Hill Road on September 28, 1994, with attachments (September 29, 1994).
50. Letter from Jon R. Schock, Town of South Kingstown to Paul Groulx, EPA Region I concerning methane alarm events at 278 Rose Hill Road on October 4, 1994, with attachments (October 6, 1994).
51. Letter from Jon R. Schock, Town of South Kingstown to David J. Newton, EPA Region I (May 2, 1995), concerning attached reports on subsurface soil gas testing for 278 Rose Hill Road.
52. Memorandum from Paul F. Killian, Roy F. Weston, Inc. to Rose Hill Regional landfill Site File containing a review of the of the methane alarm systems at 278 Rose Hill Road and 349 Rose Hill Road residences (June 30, 1995).

Comments

53. Memorandum from Thomas H. Pritchett, EPA Environmental Response Team to Paul R. Groulx, EPA Region I (December 18, 1992) with attached tables. Concerning explanations of the final emission air dispersion modeling reports conducted in support of the site assessment.

2.2 Removal Response Reports (continued)

54. Comments dated March 2, 1993 from Mary Beth Smuts, EPA Region I on the December 1992 "Final Emission Modeling Report," and "Final Air Quality Modeling Report," Roy F. Weston, Inc.
55. Letter from Dean Tagliaferro, EPA Region I to Mark Dennen, Rhode Island Department of Environmental Management (May 25, 1993). Concerning "Final Report, Evaluation of Landfill Gas Migration Barrier Systems for Removal Action," May 1993 with attached:
    A. Comments Dated April 1, 1993 from Mark M. Dennen, Rhode Island Department of Environmental Management on the March 1, 1993 "Evaluation of Landfill Gas Migration Barrier Systems," Metcalf & Eddy.
    B. Comments dated April 22, 1993 from Dean Tagliaferro, EPA Region I on the March 1, 1993 "Evaluation of Landfill Gas Migration Barrier Systems," Metcalf & Eddy.
    C. Response dated May 7, 1993 from Deborah M. Simone, Metcalf & Eddy to the April 1, 1993 Comment from Mark M. Dennen, and the April 22, 1993 Comment from Dean Tagliaferro.
56. Comments dated August 20, 1993 from Thomas H. Pritchett, EPA Environmental Response Team to Dean Tagliaferro, EPA Region I on the July 1993 "Observed Ambient Air Impact Report," Roy F. Weston, Inc.
57. Comments dated September 8, 1993 from Thomas H. Pritchett, EPA Environmental Response Team to Dean Tagliaferro, EPA Region I on the August 1993 "Air Quality Modeling Final Report", Roy F. Weston, Inc.

2.3 Sampling and Analysis Data

1. Letter Report from Deborah M. Simone, Metcalf & Eddy to David Newton, EPA Region I (January 10, 1992). Concerning additional soil gas monitoring results with attached:
    A. "Rose Hill Soil Gas Data", Metcalf & Eddy, December 16-20, 1991.
    B. Map: "Locations of Additional Soil Gas Points," Metcalf & Eddy.
2. Memorandum from Peter R. Kahn, EPA Region I to Paul Groulx, EPA Region I (November 10, 1992). Concerning results of indoor air investigation with attached, "Residential Basement Air Sampling Results", EPA Region I (November 1992).

Additional Sampling and Analysis Data for the Removal Response and Hazardous Waste Sheets may be reviewed by appointment only, at the EPA Region I OSRR Records Center in Boston, Massachusetts.

2.4 Pollution Reports (POLREPS)

1. POLREP 1, EPA Region I (November 25, 1992).
2. POLREP 2, EPA Region I (April 12, 1993).
3. POLREP 3, EPA Region I (June 9, 1993).
4. POLREP 4, EPA Region I (October 8, 1993).
5. Letter from Mark Dennen, RI DEM to Dean Tagliaferro, EPA Region I commenting on the POLREP dated October 8, 1993 (October 28, 1993).
6. POLREP 5, Final , EPA Region 1 (May 28, 1996) with cover letter from Paul Groulx, EPA Region I to Stephen Alfred, Town of South Kingstown and Scott Hancock, Town of Narragansett (August 9, 1996), and attached After Action Report, prepared by Roy F. Weston (May 1996).

2.6 Work Plans and Progress Reports

Work Plans

1. Letter from Deborah M. Simone, Metcalf & Eddy to David J. Newton, EPA Region I (December 12, 1991). Concerning a proposed scope of work to conduct additional soil gas surveys, with attached site diagram Weston (November 1991).
2. Memorandum from Paul F. Killian, Roy F. Weston, Inc. to Rose Hill Regional Landfill Site File with attached site chronology for activities since the October 14, 1992 Action Memorandum (January 29, 1993).
3. "Work Plan for Installation of Alarms and Gas Mitigation System, Operation and Maintenance and Emergency Contingency Plan," Ground Water Consultants, Inc. (March 31, 1993).
4. "Work Plan for Installation of Alarms and Gas Mitigation System, Operation and Maintenance and Emergency Contingency Plan," Ground Water Consultants, Inc. (Revised: August 20, 1993).
5. "Work Plan for Installation of Alarms and Gas Mitigation System, Operation and Maintenance and Emergency Contingency Plan," Ground Water Consultants, Inc. (Revised: September 7, 1993).
6. "Work Plan for the Installation of a Radon Styled Sub-Slab Ventilation System, Basement Sealing and Gas Detection System," Geological Field Services, Inc. (October 14, 1994)
7. Comments dated November 7, 1994 from David J. Newton, EPA Region I to Paul Groulx, EPA Region I on the October 1994 Geological Field Services, Inc., Work Plan for the Installation of a Radon Styled Sub-Slab Ventilation and Gas Detection System.
8. Memorandum from Paul F. Killian, Roy F. Weston, Inc, to the Rose Fill Regional Landfill Site File concerning a review of the PRP's Work plan for the Gas Migration System (November 11, 1994).
9. Memorandum from Philip R. Campagna, EPA Environmental Response Team to Paul Groulx, EPA Region I commenting on the Sub-slab Ventilation System for Rose Hill Site (November 14, 1994).

2.6 Work Plans and Progress Reports (continued)

10. Letter from Paul R. Groulx, EPA Region I to Stephen A. Alfred, Town of South Kingstown (November 17, 1994). Concerning Landfill Gas Migration System with attached:
    A. Letter from Paul R. Groulx, EPA Region I to Stephen A. Alfred, Town of South Kingstown and Jeffery Ceasrine, Town of Narragansett (January 16, 1993). Concerning Rose Hill Regional Landfill Removal Activity.
    B. Radon Contractor Proficiency Program list of participants offering services in Rhode Island (undated)

Progress Reports

11. Photodocumentation Log for work done at Rose Hill Regional Landfill Site in October 1992, Roy F. Weston, Inc., (December 1992).
12. Quarterly Report, Geological Field Services, Inc., (August 19, 1993).
13. Quarterly Report, Geological Field Services, Inc., (November 22, 1993).
14. Letter from Luke A. Fabbri, Geological Field Services, Inc., to Paul Groulx, EPA Region I (February 9, 1994) with attached "Completion of Work Report" for the installation of the gas monitoring systems, Geological Field Services, Inc., (February 9, 1994).
15. Quarterly Report, Geological Field Services, Inc., (February 22, 1994).
16. Quarterly Report, Geological Field Services, Inc., (June 7, 1994).
17. Quarterly Report, Geological Field Services, Inc., (August 29, 1994).
18. Quarterly Report, Geological Field Services, Inc., (December 5, 1994).
19. Quarterly Report, Geological Field Services, Inc., (February 21, 1995).
20. Quarterly Report, Geological Field Services, Inc., (May 30, 1995).
21. Quarterly Report, Geological Field Services, Inc., (August 24, 1995).
22. Quarterly Report, Geological Field Services, Inc., (November 21, 1995).
23. Quarterly Report, Geological Field Services, Inc., (February 29, 1996).
24. Quarterly Report, Geological Field Services, Inc., (May 31, 1996).
25. Letter from Luke Fabbri, Geological Field Services, Inc. to David Newton, EPA Region I (March 9, 1998) concerning summary of events and attached maintenance and calibrations sheets for 278 Rose Hill Road and 349 Rose Hill Road, covering the period from January 1, 1997 to December 31, 1997.

2.8 Scopes of Work

1. "Statement of Work for Design Development of Landfill Gas Migration Abatement System," EPA Region I (January 7, 1993).
2. Scope of Work for the Residential Indoor Air Study at Rose Hill Landfill (undated).

2.9 Action Memoranda

1. **Cross-Reference:** Memorandum from Paul R. Groulx, EPA Region I to Julie Belaga, EPA Region I (October 9, 1992). Concerning request for a removal action at the site ***[Filed and cited as entry number 7 in the February 5, 1993 Removal Action Administrative Record].***
2. **Cross Reference:** The Unilateral Administrative Order, together with all applicable correspondence. ***[Filed and cited in break 10.7 EPA Administrative Orders].***

2.11 Applicable or Relevant and Appropriate Requirements (ARARS)

ARARs for Removal Actions may be reviewed, by appointment only, at the EPA Region I OSRR Records Center in Boston, Massachusetts.

2.13 Daily Work Reports

Daily work reports from Roy F. Weston, Inc. dated December 1991 through June 1995 may be reviewed by appointment only at the EPA Region I OSRR Records Center in Boston, MA.

3.0 Remedial Investigation (RI)

3.1 Correspondence

1. Letter of transmittal from Deborah Simone, Metcalf & Eddy to David Newton, EPA Region I (January 29, 1991). Concerning proposed use of liners with attached:
   A. "HAZWRAP Position Paper: Use of Liners in Subsurface Soil Sampling" (January 28, 1991).
   B. Excerpt from, "Preparation of Soil Sampling Protocol: Techniques and Strategies," Benjamin J. Mason, Ethura (August 1983).
   C. Liners price list and specifications, Diedrich Drill, Inc. (January 29, 1991).
   D. "EM Field Data (EM-34)." Concerning actual site data demonstrating EM-34 measurements at greater depth.
   E. Excerpt from, "Electromagnetic Terrain Conductivity Measurement at Low Induction Numbers," J.D. McNeil, Geonics Limited (October 1980).
2. Memorandum from J. Best/P. Gwinn, Metcalf & Eddy to D. Simone, Metcalf & Eddy (July 16, 1991). Concerning Rose Hill Soil Gas
3. Letter from Mark A. Lowe, EPA Region I to Al Curnow, Town of Wakefield, RI (July 25, 1991). Concerning EPA's investigation to determine the extent of contamination at and around the site.
4. Letter from David J. Newton, EPA Region I to Al Curnow, Town of Wakefield, RI (July 30, 1991). Concerning location of monitoring stations along Rose Hill Road with attached diagrams.

3.1 Correspondence (continued)

5. Letter from David J. Newton, EPA Region I to Stephen A. Alfred, Town of Wakefield, RI (August 28, 1991). Concerning Town Observation Well OW-A.
6. Letter from Deborah M. Simone, Metcalf & Eddy to David J. Newton, EPA Region I (September 20, 1991). Concerning proposed surface soil locations with attached "Surface Soil Sampling Points."
7. Letter from Deborah M. Simone, Metcalf & Eddy to David Newton, EPA Region I with attached memo dated January 8, 1991, outlining the rationale, proposed scope and order of magnitude costs associated with additional ecological work which may be conducted as part of the Rose Hill RI/FS (January 10, 1992).
8. Letter from Deborah M. Simone, Metcalf & Eddy to David J. Newton, EPA Region I (February 6, 1992). Concerning the use of a flux chamber to measure the flow of landfill gas.
9. Letter from David J. Newton, EPA Region I to Stephen A. Alfred, Town of Wakefield, RI (February 12, 1992). Concerning EPA's request for the sampling results of the Town of South Kingstown's quarterly monitoring of the landfill.
10. Letter from Deborah M. Simone, Metcalf & Eddy to David J. Newton, EPA Region I (March 27, 1992). Concerning problems with sulfide analyses.
11. Letter from David J. Lang, Ground Water Consultants, Inc.(GWC) to David J. Newton, EPA Region I (May 12, 1992). Concerning the selection of GWC by the PRP Committee to assist during the RI/FS implementation, and GWC's request to review data validation packages.
12. Letter from Deborah M. Simone, Metcalf & Eddy to David J. Newton, EPA Region I (June 3, 1992). Concerning treatment of analytical data and its presentation in the RI Report with attached:
    A. Table of contents for the RI Report.
    B. List of Appendices.
13. Letter from Deborah M. Simone, Metcalf & Eddy to David J. Newton, EPA Region I (June 10, 1992). Concerning site demobilization activities.
14. Letter from David J. Lang, (GWC) to David J. Newton, EPA Region I (October 20, 1992). Concerning request for more active involvement by GWC in future activities at the site.
15. Letter from Wayne Westbrook, PES, Inc. to David J. Newton, EPA Region I requesting general information on the site (November 17, 1992) with attached response dated December 9, 1992.
16. Letter from Deborah M. Simone, Metcalf & Eddy to Stephen A. Alfred, Town of South Kingstown [1993]. Concerning tax abatement for Field Support Area.
17. Letter from Deborah M Simone, Metcalf & Eddy to David J. Newton, EPA Region I, (February 5, 1993) concerning need for Risk Assessment input.
18. Memorandum from J. Young, Metcalf & Eddy to D. Simone, Metcalf & Eddy (February 17, 1993). Concerning criterion for vinyl chloride in ambient air with attached Memorandum from Bret Moxley, U.S. EPA Region IX to Nancy Lindsay, U.S. EPA Region IX dated October 7, 1992. Concerning vinyl chloride air action levels: Operating Industries, Inc. (0II).

3.1 Correspondence (continued)

19. Letter from Deborah M. Simone, Metcalf & Eddy to David J. Newton, EPA Region I (May 7, 1993). Concerning attached results of iron precipitation in the Saugatucket River.
20. Letter from Deborah M. Simone, Metcalf & Eddy to David J. Newton, EPA Region I (May 20, 1993). Concerning notification of waste disposal with attached copies of Manifests, Shipping Form and Customer Notification and Certification Form.
21. Letter from Stephen A. Alfred, Town of South Kingstown to David J. Newton, EPA Region I (May 26, 1993). Concerning request for a copy of the remedial investigation report.
22. Letter from Deborah M. Simone, Metcalf & Eddy to David J. Newton, EPA Region I (June 3, 1993) with attached analysis. Concerning antimony in background groundwater.
23. Memorandum from David J. Newton, EPA Region I to Ted Bazenas, U.S. Public Health Service Agency for Toxic Substances and Disease Registry (ATSDR) (June 7, 1993). Concerning request for consult regarding the results of resident well testing.
24. Letter from Deborah M. Simone, Metcalf & Eddy to David J. Newton, EPA Region I (September 17, 1993). Concerning low concentration antimony SAS summary of events.
25. Memorandum from D. Murray, Metcalf & Eddy to D. Simone, Metcalf & Eddy (November 2, 1993). Concerning "Data Usability of Ambient Air SUMMA Canister Samples at the Rose Hill Landfill Site and of Filtered Antimony Data."
26. Memorandum from David J. Newton, EPA Region I to Richard Boynton, EPA Region I (November 8, 1993). Concerning ambient air risk issues.
27. Letter from Deborah M. Simone, Metcalf & Eddy to David J. Newton, EPA Region I (December 3, 1993). Concerning questions addressing ambient air risk for the Final RI report with attached:
    A. Internal Memorandum from D. Murray, J. Young and J. Best, Metcalf & Eddy, "Data Usability of Ambient Air SUMMA Canister Samples at the Rose Hill Landfill Site" (November 2, 1993).
    B. "Soil Vapor Emissions Calculations" (Appendix E-5 to the Draft RI Report).
28. Memorandum from Thomas H. Pritchett, EPA Environmental Response Team to Paul Groulx, EPA Region I (January 25, 1994). Responding to Metcalf & Eddy's questions regarding the "ERTs flux and air quality studies at the Rose Hill Landfill (December 3, 1993)" with attached:
    A. Table: "Summary of TAGA Results from Analyses of the Flux Control Location."

3.1 Correspondence (continued)

28. Memorandum from Thomas H. Pritchett, EPA Environmental Response Team to Paul Groulx, EPA Region I (January 25, 1994). Responding to Metcalf & Eddy's questions regarding the "ERT's flux and air quality studies at the Rose Hill Landfill (December 3, 1993)" with attached:
    B. Memorandum from Gregory M. Zarus, Roy F. Weston, Inc. to Thomas H. Pritchett, EPA Environmental Response Team (January 7, 1994). Regarding EPA's concerns about the sampling and modeling procedures used to evaluate the impact of emissions at the Rose Hill Landfill with attached Standard Operating Procedure (SOP) "Emission Isolation Flux Chamber Sampling" (October 12, 1993).
29. Memorandum from David J. Newton, EPA Region I to Rod Turpin, EPA Environmental Response Team (January 31, 1994). Concerning emission modeling data comparisons with attached:
    A. Transmittal Letter from Deborah M. Simone, Metcalf & Eddy to David J. Newton, EPA Region I (January 28, 1993).
    B. Internal memorandum From Dan Peters and Dave Carbonneau, Metcalf & Eddy to Deborah Simone (January 27, 1994). Concerning applicability of EPA - ERT studies to the Final FS Report: comparison of landfill gas generation rates and emission modeling.
30. Memorandum from David J. Newton, EPA Region I to Nancy Barmakian, EPA Region I (February 4, 1994). Concerning a request for continued Data Validation for the Summa Canister screening.
31. Memorandum from Moira M. Lataille, EPA Region I to Paul Groulx, EPA Region I (February 14, 1994). Concerning usability of Summa Canister Data from REAC.
32. Letter from Deborah M. Simone, Metcalf & Eddy to David J. Newton, EPA Region I (February 17, 1994). Concerning use of ISC2 Model and Landfill Gas Generation Calculations with attached:
    A. Memorandum from S. Czarniecki, Metcalf & Eddy to Deborah Simone, Metcalf & Eddy (February 17, 1994). Concerning use of the ISC2 Model to calculate vinyl chloride emissions at residential receptors.
    B. Memorandum from Dan Peters, Metcalf & Eddy to Deborah Simone, Metcalf & Eddy (February 17, 1994). Concerning the review of landfill gas generation rate calculations.
    C. "Bibliography of Argonne National Laboratory/U.S. Department of Energy Publications on Landfill Gas Recovery and Utilization" (January 1991).
33. Memorandum from David J. Newton, EPA Region I to Rod Turpin, EPA Environmental Response Team (February 18, 1994). Concerning the transmittal of documents that are individually cited elsewhere in this Administrative Record.
34. Memorandum from Moira M. Lataille, EPA Region I to David J. Newton, EPA Region I (March 23, 1994). Concerning an addendum to memorandum, "Usability of Summa Canister Data from REAC Work Assignment No. 4-694, Rose Hill Landfill."

3.1 Correspondence (continued)

35. Letter from David J. Newton, EPA Region I to Stephen A. Alfred, Town of South Kingstown transmitting the Remedial Investigation Report, Volumes I - IV, and the proposed meeting to discuss the findings (June 8, 1994).
36. Letter from David J. Newton, EPA Region I to Stephen A. Alfred, Town of South Kingstown transmitting copies of letters sent to residents concerning residential well sampling and results (June 17, 1994).
37. Letter from David J. Newton, EPA Region I to Stephen A. Alfred, Town of South Kingstown transmitting the Preliminary Natural Resource Survey (July 20, 1994).

3.2 Sampling and Analysis Data

Sampling and Analysis Data for the Remedial Investigation (RI) may be reviewed, by appointment only, at the EPA Region I OSRR Records Center in Boston, Massachusetts.

3.4 Interim Deliverables

Reports

1. "Site Reconnaissance Technical Memorandum for Remedial Investigation/Feasibility Study" Metcalf& Eddy (October 1991).

Records cited in entry number 2 are oversized and may be reviewed, by appointment only at the EPA Region I OSRR Records Center in Boston, Massachusetts.

2. "Hydrogeologic Assessment Technical Memorandum - Volumes I & II," Metcalf & Eddy (January 1992).
3. "Quality Assurance and Quality Control Procedures for the Rose Hill Regional Landfill Ecological Studies" Metcalf & Eddy (May 11, 1992).
4. Letter from Deborah M. Simone, Metcalf & Eddy to David J. Newton, EPA Region I (July 12, 1995), with attached Air Dispersion Modeling results.
5. Memorandum from David J. Newton, EPA Region I to Dennis Huebner, EPA Region I (July 17, 1995). Concerning distribution of additional Ambient Air Monitoring Data. [***Filed and cited document number 1 in break 4.4].***

Comments

6. Comments Dated December 24, 1991 from Edward L. Reiner, EPA Region I on the November 1991 "Ecological Assessment Technical Memorandum for RI/FS".

3.4 Interim Deliverables (continued)

7. Comments Dated March 10, 1992 from Mark M. Dennen, Rhode Island Department of Environmental Management on the January 1992 "Hydrogeologic Assessment Technical Memorandum – Volumes I & II," Metcalf & Eddy and the November 1991 Ecological Assessment.
8. Comments Dated June 29, 1992 from David J. Newton, EPA Region I on the January 1992 "Hydrogeologic Assessment Technical Memorandum - Volumes I & II," Metcalf & Eddy.

3.6.0 Remedial Investigation (RI) Reports

1. "Remedial Investigation Final Report," Volumes I - V, Metcalf & Eddy (May 1994).
2. "Final Supplemental Human Health Risk Assessment", Metcalf & Eddy (November 1998).

Comments

3. Letter from Stephen A. Alfred, Rose Hill. Landfill PRP Group to Richard C. Boynton, EPA Region I (August 29, 1994), with attached review of the remedial investigation report.
4. Letter from Richard Boynton, EPA Region I to Stephen A. Alfred, Town of South Kingstown acknowledging the receipt of the PRP Group's comments on the Remedial Investigation Report (September 7, 1994).

3.7 Work Plans and Progress Reports

1. "Final Work Plan," Metcalf & Eddy (March 1991).
2. "Final Health & Safety Plan," Metcalf & Eddy (March 1991).
3. "Final Field Sampling Plan," Metcalf & Eddy (May 1991).
4. "Final Quality Assurance Project Plan," Metcalf & Eddy (May 1991).
5. "Addendum to Sampling & Analysis Plan," Metcalf & Eddy (September 1993).

3.9 Health Assessments

Some Agency for Toxic Substances and Disease Registry (ATSDR) documents are related to Removal Actions, and arefilled and cited in 2.2 "Removal Response Reports."

1. "Preliminary Health Assessment for Rose Hill Regional Landfill," U.S. Public Health Service Agency for Toxic Substances and Disease Registry (ATSDR) (July 18, 1990).
2. ATSDR Record of Activity, U.S. Public Health Service Agency for Toxic Substances and Disease Registry (December 3, 1991).

3.9 Health Assessments (continued)

3. ATSDR Record of Activity, U.S. Public Health Service Agency for Toxic Substances and Disease Registry (March 15, 1993).
4. ATSDR Record of Activity, U.S. Public Health Service Agency for Toxic Substances and Disease Registry (April 1, 1993).
5. ATSDR Record of Activity, U.S. Public Health Service Agency for Toxic Substances and Disease Registry (April 13, 1993).
6. ATSDR Record of Activity, U.S. Public Health Service Agency for Toxic Substances and Disease Registry (June 9, 1993).
7. ATSDR Record of Activity, U.S. Public Health Service Agency for Toxic Substances and Disease Registry (September 27, 1993).
8. ATSDR Record of Activity, U.S. Public Health Service Agency for Toxic Substances and Disease Registry (December 7, 1993).
9. ATSDR Record of Activity, U.S. Public Health Service Agency for Toxic Substances and Disease Registry (November 1, 1994).

4.0 Feasibility Study (FS)

4.1 Correspondence

1. Letter from David E. Chopy, Rhode Island Department of Environmental Management to Jon R Schock, Town of South Kingstown (July 15, 1993). Concerning approval to use site as a shooting range.
2. Letter from Deborah M. Simone, Metcalf & Eddy to David J. Newton, EPA Region I (April 10, 1994). Concerning estimate for modeling of ambient air risk to residential receptors.
3. Letter from David J. Newton, EPA Region I to Deborah M. Simone, Metcalf & Eddy (May 9, 1994). Concerning consideration for complying with substantive requirements of a RIPDES permit for discharges to the Saugatucket River; Rose Hill Regional Landfill feasibility study with attached:
   A. Questions and Comments Concerning Discharge Options
   B. Letter from Paul W. Guglielmino, RIDEM to Allen Snow, Environmental and Safety Designs, Inc. (August 6, 1993). Concerning Stamina Mills Superfund Site and Order of Approval for Quarterly well monitoring.
   C. Letter from Angelo S. Liberti, RIDEM to Allen Snow, Environmental and Safety Designs, Inc. (May 21, 1993). Concerning Stamina Mills Superfund Site and RIPDES Application Requirements with enclosure.
   D. Letter from Angelo S. Liberti, RIDEM to Neil Handler, EPA Region I (April 8, 1994). Concerning discharge limitations for the Davis Liquid Waste Site with enclosure.
4. Letter from Deborah M. Simone, Metcalf & Eddy to David J. Newton, EPA Region I (June 10, 1994). Concerning Metcalf & Eddy's response to EPA's letter of May 9, 1994 – Considerations for complying with substantive requirements of a RIPDES permit for discharges to the Saugatucket River, with attached EPA questions and comments concerning discharge options.

4.1 Correspondence (continued)

5. Letter from Mark M. Dennen, Rhode Island , Department of Environmental Management to David Newton, EPA Region I (August 4, 1994). Concerning Saugatucket River discharge limits with attached:
   A. State of Rhode Island and Providence Plantations Inter-Office Memorandum from Mark M. Dennen, Division of Site Remediation to Chris Feeney, Division of Water Resources, (August 3, 1994). Concerning Saugatucket River discharge limitations for Rose Hill Regional Landfill.
   B. Charts: "Calculation of Freshwater Aquatic Life Discharge Limitations."
   C. Chart: "Calculations for Human Health Criteria" (July 21, 1994).
   D. Map of North Kingstown area: "Drainage Area for the Saugatucket River."
6. Memorandum from David J. Newton, EPA Region I to Wayne Westbrook, PES, (March 2, 1995). Concerning data pull to support RTP review with attached:
   A. "Ambient Air Data and Model Information"
   B. Metcalf & Eddy memo (March 2, 1995).
7. Memorandum from David Newton, EPA Region I to D. Boynton, EPA Region I (April 25, 1995). Concerning new developments re: Rose Hill Air Monitoring.
8. Memorandum from Sean Czarniecki, Metcalf & Eddy to Deb Simone (May 1, 1995). Concerning Rose Hill Air Modeling.
9. Letter from Deborah Simone, Metcalf & Eddy to David J. Newton, EPA Region I enclosing the minutes of the February 27, 1996 meeting held at RIDEM (March 22, 1996).
10. Letter from Greg S. Fine, RIDEM to Richard C. Boynton, EPA Region I (April 4, 1996). Concerning potential remedial responses for the site.
11. Letter from Deborah Simone, Metcalf & Eddy to David J. Newton, EPA Region I with attached Landfill Mining Memorandum (July 2, 1996).
12. Letter from Deborah M. Simone, Metcalf & Eddy to David J. Newton, EPA Region I enclosing minutes for the Second Inter-agency Planning Session held July 10, 1996. (July 17, 1996).
13. Letter from Deborah Simone, Metcalf & Eddy to David J. Newton, EPA Region I with attached Final Landfill Mining Memorandum (July 19, 1996).
14. Letter from Deborah Simone, Metcalf & Eddy to David J. Newton, EPA Region I, with attached minutes from the August 8, 1996 meeting (August 19, 1996).
15. Letter from Richard C. Boynton, EPA Region I to Warren Angell, RIDEM concerning further discussions of Landfill Mining (December 9, 1996).
16. Letter from Warren S. Angell, RIDEM to Richard C. Boynton, EPA Region I concerning issues related to the Feasibility Study, with attached specific comments (December 16, 1996).
17. Letter from Richard C. Boynton, EPA Region I to Warren Angell, RIDEM responding to comments on the Draft Feasibility Study and issues that the Office of Waste Management would like to have addressed (January 14, 1997).
18. Memorandum from D. Simone, Metcalf & Eddy to D. Newton, EPA Region I containing minutes of July 1, 1997 meeting on the approach to be taken in preparing the Revised Draft Final Feasibility Study (July 8, 1997).

4.1 Correspondence (continued)

19. Letter from Warren S. Angell II, RIDEM to David Newton, EPA Region I (September 2, 1997). Concerning RIDEMs comments on the Technical Screening Options Technical Memorandum.
20. Letter from Deborah Simone, Metcalf & Eddy to David J. Newton, EPA Region I, with attached minutes of the September 3, 1997 Feasibility Study Progress Meeting (September 17, 1997).
21. Memorandum from Dennis P. Gagne, EPA Region I to OSRR (Office of Site Remediation and Restoration) (September 30, 1997). Concerning alternative cap design guidance for unlined, hazardous waste landfills in the EPA Region I., with attachment:
    A. "The Design of Drainage Systems Over Geosynthetically Lined Slopes", Geosynthetic Research Institute, Drexell University (June 17, 1997).
22. Memorandum from S. Czarniecki, Metcalf & Eddy to D. Simone, Metcalf & Eddy (October 21, 1997). Concerning comparison of Rose Hill FS cap design with EPA Region I alternative cap design.
23. Letter from Richard C. Boynton, EPA Region 1 tp Stephen A. Alfred, Town Manager, South Kingstown, Rhode Island concerning the completion of the Feasibility Study for the Rose Hill Regional Landfill (December 1, 1998).
24. Letter from Jon R. Schock, Town of South Kingstown to David J. Newton, EPA Region I with attached meeting agenda for the January 13, 1999 meeting (January 8, 1999).

4.4 Interim Deliverables

1. Memorandum from David J. Newton, EPA Region I to Dennis Huebner EPA Region I (July 17, 1995). Concerning distribution of additional ambient air modeling data with attached:
    A. RI Risk Tables
    B. Air Dispersion Model Results

4.6 Feasibility Study (FS) Reports

1. "Feasibility Study [Task 9] Technical Memorandum", Section 1, 2, and 3, Metcalf & Eddy (May 1993). Attached to letter from Deborah M. Simone, Metcalf & Eddy to David J. Newton, EPA Region I (May 14, 1993).
2. "Technical Screening Options Technical Memorandum", Metcalf & Eddy, (June 1997).

Records cited in entry number 3 may be reviewed, by appointment only at the EPA Region I OSRR Records Center in Boston, Massachusetts.

3. "Feasibility Study Revised Draft Final Report", Volumes 1 - 3, Metcalf & Eddy, (November 1997).

4.6 Feasibility Study (FS) Reports (correspondence)

4. **Cross-reference:** Memorandum from David J, Newton, EPA Region I to Kenneth Finkelstein, NOAA (December 9, 1997). Concerning response to NOAA comments (attached) on revised draft feasibility study. ***[Filed and cited as number 4 in break 16.1].***
5. Feasibility Study Final Report, Volumes 1 - 3, Metcalf & Eddy, (November 1998).

4.9 Proposed Plan

1. Proposed Plan for the Rose Hill Regional Landfill Superfund Site (January 1999).

9.0 State Coordination

9.1 Correspondence

1. Letter from Richard C. Boynton, EPA Region I to Daniel Varian, RI Department of Administration (June 13, 1991). Concerning initiation of intergovernmental review and commencement of fund-lead RI/FS.
2. Letter from David J. Newton, EPA Region I to Kevin Nelson, RI Division of Planning (July 23, 1991). Concerning intergovernmental review with attached "Executive Order 12372", April 8, 1993.
3. Letter from Daniel W. Varian, RI Department of Administration to David Newton, EPA Region I (August 13, 1991). Concerning the State Process Recommendation for the Intergovernmental Review
4. Letter from Terrence Gray, RI Department of Environmental Management to Richard Boynton, EPA Region I (March 20, 1995). Concerning March 15th discussion with municipal officials from the Towns of Narragansett and South Kingstown and request for releasing the draft of Feasibility Study (FS) to the two towns.
5. Letter from Richard C. Boynton, EPA Region I to Terrence Gray, RI Department of Environmental Management (March 28, 1995). Concerning Rose Hill Regional Landfill, Superfund Site.
6. Letter from Mark M. Dennen, RIDEM to Jon Schock, South Kingstown Town Hall (April 11, 1995). Concerning availability of fill from Deer Island Project in Boston.
7. Letter from David J. Newton, EPA Region I to Mark Dennen, RIDEM (February 26, 1996). Concerning response to request for data files.
8. Letter from David J. Newton, EPA Region I to Gregory Fine, RIDEM (March 11, 1996). Concerning transmittal of "Draft Groundwater Use and Value Guidance".
9. Letter from David J. Newton, EPA Region I to Mark Dennen, RIDEM requesting a written response from RIDEM on EPA's modified approach to cleanup (March 14, 1996).

9.1 Correspondence (continued)

10. Letter from Mark M. Dennen, RIDEM to David Newton, EPA Region I concerning Groundwater Use and Value Determination regarding Rose Hill Regional Landfill (December 19, 1996).
11. Letter from Peter M. Zuk, Massachusetts Highway Department to Stephen A. Alfred, Town of South Kingstown concerning the availability of clay for capping landfills (January 8, 1997).
12. Letter from Warren S. Angell II, RIDEM to Richard Boynton, EPA Region I (February 4, 1997). Concerning the potential availability of clay and excavated fill from the Central Artery/Tunnel Project from the Massachusetts Highway Dept. During the next five years.
13. Letter from David J. Newton, EPA Region I to Warren Angell, RIDEM concerning EPAs comments on documents sent by RIDEM (February 24, 1997).

10.0 Enforcement

10.1 Correspondence

1. Letter from Linda M. Murphy, EPA Region I to Stephen A. Alfred, Town of South Kingstown extending an invitation to meeting (April 3, 1997).

10.2 Department of Justice (DOJ) Referral Documents

1. Memorandum from Michael R. Deland, EPA Region I to Donald A. Carr, U.S. DOJ (March 3, 1989). Concerning Bankruptcy Referral: Coated Sales, Inc., et al. With attached:
   A. Proof of Claim of the united States on Behalf of the USEPA (U.S. Bankruptcy Court Southern District of New York). No signature or date.
   B. Rhode Island Department of Health chemical results for the South Kingstown landfill.
   C. Letter from Richard W. Curtis, Peacedale Processing Co., Inc., to EPA Region I (June 2, 1981). Concerning notification of disposal of waste laminating adhesive containing trichloroethylene at the Rose Hill Landfill.
   D. Field Investigation Report from John P. Leo, Department of Environmental Management (September 19, 1979). Concerning samples of waste collected at the Rose Hill Landfill disposed of by Peacedale Processing Co., Inc., with attached photographs of samples, and handwritten notes.
   E. Industrial listings for Peacedale Processing Co., Inc. and Coated Sales, Inc.
   F. "Site inspection Report for Kenyon Piece Landfill, Charlestown, Rhode Island," Environmental Science Services (November 19, 1987).
   G. Dun & Bradstreet Report for Coated Sales, Inc., and subsidiary Kenyon Piece Dye Works, Inc. (February 6, 1989).

10.2 Department of Justice (DOJ) Referral Documents (continued)

1. Memorandum from Michael R. Deland, EPA Region I to Donald A. Carr, U.S. DOJ (March 3, 1989). Concerning Bankruptcy Referral: Coated Sales, Inc., et al. With attached:
   H. Notice of Bankruptcy Proof of Claim filing date and forms from Cornelius Blackshear, United States Bankruptcy Court, Southern District of New York to Francisco Leal, EPA Region I (January 11, 1989).
2. Federal Register Vol. 59, No. 124 (June 29, 1994). Concerning notice of lodging of stipulation pursuant to CERCLA in regards to Coated Sales, Inc. et al.

10.5 Negotiation with Multiple PRPs

1. Master of Letter from Richard C. Boynton, EPA Region I to addresses (June 7, 1989). Concerning notification of meeting on June 19, 1989, with attached:
   A. Meeting Agenda
   B. Address List
   C. Registration Form
2. Transmittal for Information to attendees of the June 19, 1989 PRP meeting consisting of the following:
   A. Record of Attendance
   B. Opening statement by Richard C. Boynton, Chief, Rhode Island Superfund Section, EPA Region I.
   C. Statements by David J. Newton, Project Manager, EPA Region I on history of the site and the planned RI/FS.
   D. Statement by Richard C. Boynton, EPA Region I on "Government Oversight of a Private Party Remedial Investigation and Feasibility Study."
   E. Statement by Elissa Tonkin, EPA Region I Office of Regional Counsel.
3. Records of attendance, Rose Hill Landfill PRP meeting, June 19, 1989. (Amended as of 12/07/89 to reflect corrections). Attached are 5 completed registration forms.
4. Special Notice Package Containing the following:
   A. Letter from Merrill S. Hohman, EPA Region I to the following addresses (June 13, 1990):
      1. David J. Brask
      2. President, Coated Sales, Inc. and Lester M. Kirshenbaum, Esq., Levin & Weintraub & Crames.
      3. Edward L. & Pearl F. Frisella
      4. President, Kenyon Industries, Inc. and Lester M. Kirshenbaum, Esq., Levin & Weintraub & Crames
      5. Vincent Izzo, Town Manager, Town of Narragansett
      6. Richard W. Curtis, President, Peacedale Processing Co., Inc.
      7. Stephen A. Alfred, Town Manager, Town of South Kingstown
      8. Jeffrey Jeep, Waste Systems, Inc.
   B. PRP address list

10.5 Negotiation with Multiple PRPs (continued)

5. Letter from David J. Newton, EPA Region I to Mark M. Dennen, RIDEM (June 13, 1990). Concerning transmittal of Special Notice Package, Rose Hill regional Landfill.
6. Meeting of PRPs under Special Notice Moratorium – Agenda and Record of Attendance (July 13, 1990).
7. Letter from Mark A. Lowe to Jo Ann Shotwell, Gadsby & Hannah (Attorney for Rose Hill PRP Group) (July 27, 1990). Concerning attached cost summary.
8. Letter from Jo Ann Shotwell, Gadsby & Hannah (Attorney for Rose Hill PRP Group) to David J. Newton, EPA Region I (August 16, 1990). Concerning naming the University of Rhode Island and the State of Rhode Island as additional PRPs with attached:
   A. Letter from John S. Quinn Jr., Rhode Island Department of Health to John E. DiPretoro, Town of South Kingstown (January 8, 1970).
   B. Letter from John S. Quinn, Jr., Rhode Island Department of Environmental Management to Marguerita C. Hindle, Kenyon Piece Dyeworks, Inc. (December 6, 1979).
   C. Letter from Paul M. DePace, University of Rhode Island to Stephen A. Alfred, Town of South Kingstown (October 10, 1980).
   D. Agreement between the University of Rhode Island and the Town of South Kingstown (November 19, 1981).
9. Letter from Jennifer W. Catlin, Kirkpatrick and Lockhart (Attorney for Rose Hill PRP Group) to David J. Newton, EPA Region I (August 20, 1990). Concerning PRP Group's Good Faith Offer to perform RI/FS with attached:
   A. Draft Appendix I to the Administrative Order: Statement of Work for the RI/FS, modified by the Rose Hill Landfill PRP Group
   B. Draft Administrative Order by Consent
   C. Draft Administrative Agreement
10. Letter from Mark A Lowe, EPA Region I to David M. Jones, Kirkpatrick & Lockhart (Attorney for Rose Hill PRP Group P (August 24, 1990). Concerning EPA's Rejection of the PRP's Good Faith Offer.
11. Letter from David M. Jones, Kirkpatrick & Lockhart (Attorney for Rose Hill PRP Group) to Merrill S. Hohman, EPA Region I (August 31, 1990). Concerning request for meeting to discuss PRP's Good Faith Offer.
12. Letter from Merrill S. Hohman, EPA Region I to David M. Jones, Kirkpatrick & Lockhart (Attorney for Rose Hill PRP Group) (September 6, 1990). Concerning EPA's decision not to meet with the PRPs.
13. Letter from James W. Fester, RIDEM to Merrill S. Hohman, EPA Region I (September 10, 1990). Concerning a request for a meeting of the PRP Group and EPA.
14. Letters from Mark A McSally, Taft & McSally, to Julie A Belaga, EPA Region I (September 13, 1990). Concerning request for intervention in the staff's decision to terminate negotiations with the PRP group.

10.5 Negotiation with Multiple PRPs (continued)

15. Letter from David M. Jones, Kirkpatrick & Lockhart (Attorney for Rose Hill PRP Group) to Merrill S. Hohman, EPA Region I (September 14, 1990). Concerning execution of administrative order similar to Shpack Landfill site.
16. Letter from Mark A. Lowe, EPA Region I to Mark A. McSally, Taft & McSally (Attorney for Rose Hill PRP Group) (October 17, 1990). Concerning EPA's decision not to have the PRP Group conduct the remedial investigation.
17. Letter from Merrill S. Hohman, EPA Region I to James W. Fester, RIDEM (October 31, 1990). Concerning EPA's decision not to have the PRP Group conduct the remedial investigation.
18. Letter from Thomas D. Getz, RI Division of Air and Hazardous Materials, to Merrill Hohman, EPA Region I (January 10, 1991). Concerning disappointment in termination of negotiations with the PRP Group, and the State's share of costs for the Remedial Investigation and Feasibility Study (RI/FS).
19. Letter from Merrill S. Hohman, EPA Region I, to Thomas F. Getz, RIDEM (February 14, 1991). Concerning RI/FS financing.

10.6 PRP-Specific Negotiations

1. Registration form of Edward L. Frisella, for PRP meeting (June 19, 1989).
2. Letter from Mark A. McSally, Taft & McSally to David J. Newton, EPA Region I (July 2, 1990). Concerning July 13, 1990 meeting with attached:
   A. Telecopier request from David J. Newton, EPA Region I to Mark Lowe, EPA Region I (July 12, 1990).
3. Letter from Jo Ann Shotwell, Gadsby & Hannah (Attorney for the Town of South Kingstown) to David J. Newton and Mark A. Lowe, EPA Region I (July 19, 1990). Concerning mixed funding arrangements for remedial actions and other matters related to negotiations.
4. Letter from Mark A. Lowe, EPA Region I to Jo Ann Shotwell, Gadsby & Hannah (Attorney for the Town of South Kingstown) (August 6, 1990). Concerning the issues of mixed funding for remedial action at the site and responses to other requests.

Documents cited as entry numbers 5 through 11 below are filed and cited as entry number 8 through 15 in the February 5, 1993 Removal Action Administrative Record.

5. Letter from Edward J. Conley, EPA Region I to David J. Brask, former President of Goditt & Boyer, Inc. (November 4, 1992). Concerning Notice of Removal Activity, Notice of Liability, and Invitation to Perform or Finance Proposed Activities.
6. Letter from Edward J. Conley, EPA Region I to Mr. & Mrs. Edward Frisella, Sr. (November 4, 1992). Concerning Notice of Removal Activity, Notice of Liability, and Invitation to Perform or Finance Proposed Activities.

10.6 PRP-Specific Negotiations (continued)

7. Letter from Edward J. Conley, EPA Region I to Lester M. Kirschenbaum, Esq., Levin & Weintraub & Crames, Attorney for Coated Sales, Inc. (November 4, 1992). Concerning Notice of Removal Activity, Notice of Liability, and Invitation to Perform or Finance Proposed Activities.
8. Letter from Edward J. Conley, EPA Region I to Lester M. Kirschenbaum, Esq., Levin & Weintraub & Crames, Attorney for Kenyon Industries, Inc. (November 4, 1992). Concerning Notice of Removal Activity, Notice of Liability, and Invitation to Perform or Finance Proposed Activities.
9. Letter from Edward J. Conley, EPA Region I to Vincent Izzo, Town of Narragansett (November 4, 1992). Concerning Notice of Removal Activity, Notice of Liability, and Invitation to Perform or Finance Proposed Activities.
10. Letter from Edward J. Conley, EPA Region I to Richard W. Curtis, Peacedale Processing Co., Inc. (November 4, 1992). Concerning Notice of Removal Activity, Notice of Liability, and Invitation to Perform or Finance Proposed Activities.
11. Letter from Edward J. Conley, EPA Region I to Stephen A. Alfred, Town of South Kingstown (November 4, 1992). Concerning Notice of Removal Activity, Notice of Liability, and Invitation to Perform or Finance Proposed Activities.
12. Letter from Edward J. Conley, EPA Region I to Jeffrey Jeep, Waste Management of North America (November 4, 1992). Concerning Notice of Removal Activity, Notice of Liability, and Invitation to Perform or Finance Proposed Activities.
13. Letter from James V. Aukerman, Kenyon and Aukerman to Mark A. Lowe, EPA Region I (November 19, 1992). Concerning Frances Frisella's desire to participate in negotiations to resolve liability.
14. Letter from Jeffrey D. Jeep, Waste Management of North America, Inc. to Mark Lowe, EPA Region I (November 23, 1992) declining EPA's invitation to perform or finance the proposed removal activity.

10.7 EPA Administrative Orders

1. Letter from Richard C. Boynton, EPA Region I to Edward Frisella, Sr. and Pearl F. Frisella, (August 21, 1991). Concerning issuance of Administrative Order for Property Access, attached.
2. Letter from Edward L. Frisella to Mark A. Lowe, EPA Region I (August 22, 1991). Concerning request for a conference.
3. Letter from Mark A. Lowe, EPA Region I to Robert B. Gates, Gardner, Sawyer, Gates & Sloan (August 29, 1991). Concerning confirmation of September 4, 1991 conference.

4. Memorandum from Robert B. Gates, Gardner, Sawyer, Gates, Sloan & Engustian, to Mark A. Lowe, EPA Region I (September 6, 1991). Concerning the use of Edward Frisella's property with attached:
   A. Statement of Edward Frisella's financial burden by Richard V. Frisella, Peacedale Shooting Preserve (Undated).
5. Letter from Mark A. Lowe, EPA Region I to Robert B. Gates, Gardner, Sawyer, Gates, Sloan & Engustian (September 20, 1991). Concerning request for additional information required for an amendment to the Administrative Order, Docket #I-91-1103.
6. Letter from Robert B. Gates, Gardner, Sawyer, Gates, Sloan & Engustian to Mark A. Lowe, EPA Region I (September 26, 1991). Concerning Administrative Order for Property Access, with attached:
   A. Letter from Richard Frisella to Robert Gates, Gardner, Sawyer, et al., (Undated). Concerning description of the 10 acre field and the training of dogs.
   B. News clipping, "Fall field trial beckons at Peace Dale Preserve," Providence Journal (September 1, 1991).
7. Letter from Mark A. Lowe, EPA Region I to Robert B. Gates, Gardner, Sawyer, et al., (November 20, 1991). Concerning request for amendment to the Administrative Order for Property Access.
8. Letter from Mark A. Lowe, EPA Region I to Robert B. Gates, Gardner, Sawyer, et al., (December 23, 1991). Concerning required response to EPA's proposal prior to amendment to the Administrative Order.
9. Letter from Robert B. Gates, Gardner, Sawyer, et al., to Mark A. Lowe, EPA Region I (December 24, 1991). Concerning agreement with the proposed amendment to the Administrative Order.
10. Letter from Robert B. Gates, Gardner, Sawyer, et al., to Mark A. Lowe, EPA Region I (March 2, 1992). Concerning EPA's violation of Administrative Order for Property Access.
11. Letter from Mark A. Lowe, EPA Region I to Robert B. Gates, Gardner, Sawyer, et al., (March 23, 1992). Concerning Mr. Frisella's violations of Administrative Order for Property Access and EPA's agreement to contact Mr. Frisella for a key to the second lock.
12. Letter from Richard C. Boynton, EPA Region I to Edward L. Frisella, Sr. and Pearl F. Frisella (March 27, 1992). Concerning the attached First Amended Administrative Order for Property Access.
13. Letter from David McIntyre, EPA Region I to Stephen A. Alfred, Town of South Kingstown and Scott A. Hancock, Town of Narragansett (March 3, 1993). Concerning an invitation for comments to the attached Draft unilateral Administrative Order for Action at the Rose Hill Landfill Superfund Site.
14. Letter from Jo Ann Shotwell, Gadsby & Hannah, Attorney for Town of South Kingstown to Mark A. Lowe, EPA Region I (March 12, 1993). Concerning comments to the Draft Unilateral Administrative Order for Action at the Rose Hill Landfill Superfund Site.

10.7 EPA Administrative Orders (continued)

15. Letter from Mark A. McSally, Kelly, Kelleher, Reilly & Simpson, Attorney for the Town of Narragansett to Mark Lowe, Esq., EPA Region I (March 15, 1993). Concerning comments on the Draft Unilateral Administrative Order.
16. Letter from Jo Ann Shotwell, Gadsby & Hannah, Attorney for Town of South Kingstown to Mark A. Lowe, EPA Region I (March 22, 1993). Concerning proposed alternative language for the Draft Unilateral Administrative Order.
17. Letter from Mark A. Lowe, EPA Region I to Jo Ann Shotwell, Gadsby & Hannah, Attorney for Town of South Kingstown (March 25, 1993). Concerning EPA's response to comments on the Draft Unilateral Administrative Order.
18. Letter from David McIntyre, EPA Region I to Stephen A. Alfred, Town of South Kingstown and Scott A. Hancock, Town of Narragansett (March 26, 1993). With attached Final Unilateral Administrative Order (RCRA Docket No. I-93-1055).
19. Letter from Dean Tagliaferro, EPA Region I to Stephen A. Alfred, Town of South Kingstown (April 6, 1993). Concerning the Status of Administrative Order RCRA Docket No. I-93-1055.
20. Temporary Easement and Restriction Agreement between Louis R. Houston & Associates, Inc. and the Town of South Kingstown, Rhode Island executed on April 26, 1993

10.9 Pleadings

1. Amended Judgment, *Alexander J Dimeo and Neida Ogden Dimeo vs. Town of South Kingstown,* Superior Court State of Rhode Island, Civil Action No. 66-248 (April 3, 1978)

11.0 Potentially Responsible Party (PRP)

11.5 Site Level – General Correspondence

1. Master Letter: Notice of Potential Liability and Request for Information from Merrill S. Hohman, EPA Region I to Addressees (April 6, 1989) with attached:
   A. Instructions.
   B. List of potentially responsible parties receiving notice of liability.
2. Master Information Request Letter from Merrill S. Hohman, EPA Region I to Addressees (April 17, 1989) with attached:
   A. List of recipients.
   B. Instructions.
3. **Cross Reference:** Letter from David J. Lang, Ground Water Consultants, Inc. to David Newton, EPA Region I requesting a more active involvement in future activities at the site (October 20, 1992). ***[Filed and cited as entry number 14 in break 3.1 Correspondence]***

11.6 Site Level - Evidence - Government Agency Documents

Rhode Island Department of Health

1. Memorandum from Robert B. Russ, Rhode Island Water Resources Board to John S. Quinn Jr., Rhode Island Department of Health (October 15, 1974). Concerning evaluation of proposed landfill with attached site description.
2. Memorandum from John S. Quinn Jr., Rhode Island Department of Health to Carleton A. Maine, Rhode Island Department of Health (January 27, 1976). Concerning transmittal of attached comments by Frank B. Stevenson, Rhode Island Department of Health on the "Investigation of Ground Water at Landfill, Rose Hill Road," by William E. Kelly for the Town of South Kingstown. ***[Dr. Kelly's report is filed and cited as entry number 6 in 17.8 State and Local Technical Records].***
3. Memorandum from Robert B. Russ, Rhode Island Water Resources Board to Frank B. Stevenson, Rhode Island Department of Health (March 3, 1976) with attached maps. Concerning description of soil at proposed landfill.
4. Letter from John S. Quinn Jr., Rhode Island Department of Health to Kenneth T. Perez and Gerald G. Pesch, South County Association for Resources (SCAR) (April 18, 1977). Concerning statements about proposed landfill.
5. Letter from Frank B. Stevenson, Rhode Island Department of Health, to Alfred J. Curnow, Town of South Kingstown (June 21, 1977), concerning comments on "Design and Development of Sanitary Landfill Operation, Town of South Kingstown, Rhode Island."
6. Memorandum from Robert B. Russ, Rhode Island Water Resources Board to Frank B. Stevenson, Rhode Island Department of Health (July 7, 1977). Concerning drainage information on new landfill.
7. Letter from Frank L. Hinckley Jr., Hinckley & Spangler (Attorney for Louis R. Houston and Leo G. Boisclair) to Rhode Island Department of Health. Concerning opposition to the site being used as a landfill.
8. Memorandum from Stephen Majkut, Rhode Island Department of Environmental Management to File (October 15, 1979) with attached maps. Concerning water samples taken from the site.
9. Memorandum from James W. Fester, Rhode Island Department of Environmental Management to John S. Quinn Jr., Rhode Island Department of Environmental Management (April 29, 1980). Concerning attached results of water samples collected from the site.
10. Memorandum from John P. Leo, Rhode Island Department of Environmental Management to File (November 26, 1982). Concerning neutralization of acid barrel at the site.
11. Landfill Field Inspection Report, Rhode Island Department of Environmental Management (February 24, 1983).

11.6 Site Level - Evidence - Government Agency Documents (continued)

12. Letter from David P. Evangelista, Lee Pare & Associates, Inc. to Frank Stevenson, RIDEM (March 7, 1983). Concerning solid waste transfer station with attached:
    A. "Warranty Deed" Edward L. Frisella and Town of South Kingstown (September 14, 1982)
    B. Minutes of meeting
13. Landfill Field Inspection Report, Rhode Island Department of Environmental Management (April 25, 1983).
14. Memorandum from Peter M. Janaros, Rhode Island Department of Environmental Management to Frank B. Stevenson, Rhode Island Department of Environmental Management (September 17, 1984). Concerning potential groundwater pollution with attached memorandum from Mr. Stevenson, to R. Daniel Prentiss, Rhode Island Department of Environmental Management dated November l, 1979.
15. Memorandum from Alicia M. Good, RIDEM to Thomas D. Getz, RIDEM (August 27, 1985). Concerning South Kingstown Regional Landfill Closure
16. Transfer Station Field Inspection Report (Reinspection), Rhode Island Department of Environmental Management (February 25, 1987).
17. Transfer Station Field Inspection Report, Rhode Island Department of Environmental Management (March 16, 1987).
18. Field Investigation Report, Rhode Island Department of Environmental Management (September 16, 1987).
19. Memorandum from Christopher M. Campbell, Rhode Island Department of Environmental Management to Jeffrey Crawford, Rhode Island Department of Environmental Management (October 23, 1987). Concerning results of water samples taken at the site.
20. Field Investigation Report, Rhode Island Department of Environmental Management (November 17, 1987).
21. Complaint Report, Rhode Island Department of Environmental Management, received from Neida Dimeo (April 12, 1988). Concerning dying trees and request for soil sampling.
22. Telephone Discussion Record between George Briggs, resident of South Kingstown, and Mark M. Dennen, RIDEM (February 26, 1992).

11.9 PRP-Specific Documents

Brask, David J.

1. Letter from Merrill S. Hohman, EPA Region 1, to David J. Brask, (formerly of Goditt & Boyer) (June 9, 1989). Concerning Notice of Potential Liability and Request for Information for the Rose Hill Landfill.
2. Letter from James J. Coogan, Coogan, Bennett, et al., Attorney for David J. Brask to David J. Newton, EPA Region I (July 13, 1989). Concerning responses to Notice Letter and Request for Information.

Frisella, Edward L.

3. Letter from Alfred J. Curnow, Town of Wakefield to Joseph E. Cannon, M.D. Rhode Island Department of Health (July 30, 1976). Concerning variance request with attached Town Council, Town of South Kingstown Land Rental Agreement, June 28, 1976.
4. Memorandum from Stephen A. Alfred, Town of South Kingstown to Robert B. Gates, Gardner, Sawyer, Gates & Sloan (Attorney for Town of South Kingstown) (October 9, 1981). Concerning the amended judgment in the Dimeo case and lease agreement between the Town and Edward L. Frisella.
5. Memorandum from Robert B. Gates, Gardner, Sawyer, Gates & Sloan (Attorney for Town of South Kingstown) to Stephen A. Alfred, Town of South Kingstown (October 14, 1981). Concerning comments on the amended judgment in the Dimeo case and lease agreement between the Town and Edward L. Frisella.
6. Memorandum from Robert B. Gates, Gardner, Sawyer, Gates & Sloan (Attorney for Town of South Kingstown) to Stephen A. Alfred, Town of South Kingstown (July 1, 1982). Concerning comments on the amended judgment in the Dimeo case and lease agreement between the Town and Edward L. Frisella.
7. Letter from Robert B. Gates, Gardner, Sawyer, Gates & Sloan (Attorney for Town of South Kingstown) to Knight Edwards, Edwards & Angell (August 10, 1982). Concerning real estate sales agreement with Edward L. Frisella with attached payment schedule.
8. Letter from Stephen A. Alfred, Town of South Kingstown to Edward L. Frisella (December 16, 1983). Concerning leased land and landfill closeout.
9. Letter from Thomas D. Getz, RIDEM to Edward L. Frisella, Sr. (February 1, 1988). Concerning announcement of potential hazardous waste sites.
10. Letter from Edward and Pearl Frisella to David J. Newton, EPA Region I (June 21, 1990). Concerning acknowledgment of receipt of notice letter.

Frisella, John

11. Memorandum from Alfred J. Curnow, Town of South Kingstown to Stephen A. Alfred, Town of South Kingstown (September 1, 1983). Concerning the relocation of John Frisella's well.

Goditt & Boyer, Inc.

12. Letter from Jeffrey D. Jeep, Waste Management of North America, Inc. to David J. Newton, EPA Region I (May 9, 1989). Concerning response to Notice of Potential Liability and Request for Information regarding the landfill.

Kenyon/Coated Sales, Inc.

Other Bankruptcy Referral, and associated documents submitted to U.S Department Justice are filed and cited in 10.2: Department of Justice (DOJ) Referral Documents

13. Letter from Annemargaret Connolly, Weil, Gotshal & Manges to David J. Newton, EPA Region I (June 28, 1989). Concerning contact person for Coated Sales Corporation.
14. Letter from Ralph M. Mellom, Ogletree, Deakins, et al. to David J. Newton, EPA Region I (June 29, 1989). Concerning representation of Kenyon Industries, Inc. and Coated Sales, Inc. and discussion relative to bankruptcy.
15. Letter from Mark A. Lowe, EPA Region I to Eric Nelson, U.S. Attorney's Office, New York (May 24, 1990). Concerning Special Notice Letter to Coated Sales, Inc. and related entities.
16. Letter from Roger S. Hayes, DOJ to Mark Lowe, EPA Region I (April 5, 1993) containing materials received from debtors relating to their contention that they are not potentially responsible parties at the Rose Hill Regional Landfill.
17. Stipulation and Order authorizing Kenyon Industries, Inc. to abandon certain real property located in Charlestown, Rhode Island, Cornelius Blackshear, U.S. Bankruptcy Court, Southern District of New York (June 30, 1993).
18. Letter from Steven B. Soll, Otterbourg, Steindler, et al., to Allan Taffet, U.S. Attorney's Office (February 9, 1994). Concerning a Joint position between Creditors Committee and Debtors regarding EPA's assertion of Section 107(a)(3) CERCLA liability against Coated Sales, Inc.
19. Letter from David J. Newton, EPA Region I to Stephen A. Alfred, Town of South Kingstown (July 18, 1994). Concerning a Notice of Lodging of Proposed Stipulation regarding Coated Sales, Inc. Bankruptcy matter with attached:
    A. Federal Register, vol.59, No.124 (June 29, 1994),
    B. Notice of Lodging of Proposed Stipulation (June 15, 1994),
    C. Stipulation (This copy lacks authorization and approval by the Bankruptcy Court).
20. United States of America's Request for Approval and Entry of Settlement Agreement and Stipulated Order Resolving Claims Filed by the Environmental Protection Agency (October 18, 1994).
21. Order Approving Stipulation Settling the Appeal Filed by the Environmental Protection Agency and Granting Related Relief, Cornelius Blackshear, U.S. Bankruptcy Court, Southern District of New York (November 9, 1994), with attached Exhibit "A" [original Stipulation as Amended by the Court.]
22. Order Dismissing Appeal and Vacating Stay, U.S. District Court Southern District of New York (December 12, 1994).

South Kingstown, Town of

23. Letter from John S. Quinn Jr., Rhode Island Department of Health to John E. DiPretoro, Town of South Kingstown (January 8, 1970). Concerning disposal of waste from Peacedale Processing.
24. Letter from James T. Spaulding, Rhode Island Department of Health to Norman Bampton, Town of South Kingstown (February 12, 1976). Concerning existing landfill as unacceptable for disposal of sludge from wastewater treatment plant.
25. Letter from W. Edward Wood, Rhode Island Department of Environmental Management to Stephen A. Alfred, Town of South Kingstown (July 5, 1979). Concerning caution when accepting waste for disposal.
26. Memorandum from Alfred J. Curnow, Town of South Kingstown to Stephen A. Alfred, Town of South Kingstown (March 25, 1980). Concerning the University of Rhode Island's fee to use landfill.
27. Letter from W. Edward Wood, Rhode Island Department of Environmental Management to Alfred J. Curnow, Town of South Kingstown (May 7, 1980). Concerning groundwater testing at solid-waste disposal sites.
28. Memorandum from Stephen A. Alfred, Town of South Kingstown to South Kingstown Town Council (September 16, 1980). Concerning attached:
    A. Letter from Neida A. Ogden Dimeo to South Kingstown Town Council (January 10, 1980)
    B. "Poisoning – Toxicology, Symptoms, Treatments," by Jay M. Arena.
29. Letter from Norman Bampton, Town of South Kingstown to James W. Fester, Rhode Island Department of Environmental Management (August 6, 1981). Concerning results of sludge sampling.
30. Letter from Frank B. Stevenson, Rhode Island Department of Environmental Management to Alfred J. Curnow, Town of South Kingstown (September 1, 1982). Concerning increased surveillance on industrial and commercial users of the landfill.
31. Letter from Anna F. Prager, Town of South Kingstown to Thomas E. Wright, Rhode Island Department of Environmental Management (October 12, 1982). Concerning request for information on waste generated by certain businesses in the area.
32. Letter from Thomas E. Wright, Rhode Island Department of Environmental Management to Anna F. Prager, Town of South Kingstown (October 18, 1982). Concerning types of waste generated by certain businesses in the area.
33. Letter from Stephen A. Alfred, Town of South Kingstown to Edward l. Frisella (December 16, 1983). Concerning the land used as a landfill.
34. Letter from Carmine J. Spinalle, Northeast Environmental Testing Laboratories to Mr. Bishop, Town of South Kingstown (January 7, 1987). Concerning analyses of samples from wastewater treatment plant.

35. Letter from Thomas D. Getz, Rhode Island Department of Environmental Management to Charles P. Kelley, Town of South Kingstown (February 23, 1987). Concerning notification that Town is in violation of state regulations with attached:
    A. Solid Waste Management Facility Notification Sheet (February 18, 1987)
    B. Transfer Station Field Inspection Report, Rhode Island Department of Environmental Management (February 18, 1987).
36. Letter from Thomas D. Getz, RIDEM to Edward L. Frisella, Sr. (February 1, 1988). Concerning announcement of potential hazardous waste sites.
37. Letter from Thomas D . Getz, Rhode Island Department of Environmental Management to Anna F. Prager, Town of South Kingstown (May 31, 1988). Concerning using the site for future development.
38. Letter from David J. Newton, EPA Region I to Stephen A. Alfred, Town of South Kingstown (October 17, 1989). Concerning transmittal of an excerpt from "Support Document for the Revised National Priorities List Final Rule," U.S. EPA (October 1989).
39. **Cross-Reference:** Letter from Paul R. Groulx, EPA Region I to Stephen A. Alfred, Town of South Kingstown and Jeffery Ceasrine, Town of Narragansett (December 15, 1992). Concerning intention to issue a unilateral administrative order for removal activity. ***[Filed and cited as entry number 18 in the February 5, 1993 Removal Action Administrative Record.]***
40. Letter from Jon R. Schock, Town of South Kingstown to David J. Newton, EPA Region I requesting comments on the attached Scope of Work for a supplemental site investigation (June 11, 1998).

Waste Management, Inc.

41. Letter from Jeff Jeep, Waste Management of North America, Inc. to David J. Newton, EPA Region I (May 9, 1989). Concerning response to notice of potential liability and request for information regarding the landfill. ***[Filed and cited as number 12 in break 11.9].***
42. Letter from Merrill S. Hohman, EPA Region I to Jeffery Jeep, Waste Management of North America, Inc. (June 9, 1989). Concerning Notice of Potential Liability.
43. Letter from Stephen T. Joyce, Waste Management, Inc., to Richard Boynton, EPA Region I (June 3, 1994). Concerning June 8, 1994 meeting and intent of working cooperatively with EPA to identify Potentially Responsible Parties (PRPS) with attached:
    A. Summary of Rose Hill PRP Investigation (June 3, 1994);
    B. Letter from Jeffery D. Jeep, Waste Management, Inc., to Mark Lowe, EPA Region I (November 23, 1992). Concerning response to EPA's notice of removal activity;
    C. Peacedale Processing Co., Inc., 1978 and 1979 waste removal costs;
    D. Facility operations and Waste disposal practices;

11.9 PRP-Specific Documents (continued)

43. Letter from Stephen T. Joyce, Waste Management, Inc., to Richard Boynton, EPA Region I (June 3, 1994). Concerning June 8, 1994 meeting and intent of working cooperatively with EPA to identify Potentially Responsible Parties (PRPS) with attached:
    E. South Kingstown list of Landfill Users (April 20, 1989);
    F. List of Hauler Permits (Garbage license Holders), Town of Narragansett;
    G. Town of South Kingstown: Entities licensed to use the site; EPA did not send Information Requests;
    H. Town of Narragansett: Entities licensed to use the site; EPA did not send Information Requests;
    I. List of entities and individuals invoiced by the Town of South Kingstown for waste disposal to whom EPA did not send Information Requests;
    J. Affidavit of Bruce Buffington (November 18, 1992);
    K. Affidavit of David J. Brask (November 19, 1992);
    L. "Rose Hill Landfill Total Waste-In Annually" (1972-1983);
    M. "Rose Hill Waste-In List" (September 9, 1993);
    N. "Rose Hill Waste-In Alpha Summary List" (June 2, 1994).
44. Letter from Richard C. Boynton, EPA Region I to Stephen T. Joyce, Waste Management Inc., (June 23, 1994). Concerning response to discussion with Waste Management relative to sharing information on field investigation efforts.
45. Letter from Michael J. Brennan, Waste Management, Inc. to Paul Groulx, EPA Region I concerning Mr. Brennan's assumption of Jeffrey Jeep's position as Environmental Counsel (December 28, 1994).

11.12 PRP Related Documents

1. Field Investigation Work Plan, Prepared for Town of South Kingstown by GZA GeoEnvironmental, Inc. (September 1998).

13.0 Community Relations

13.1 Correspondence

1. Letter from William R Adams Jr., EPA Region I to Kenneth T. Perez, South County Association for Resources (SCAR) (August 17, 1978). Concerning sludge disposal from regional wastewater treatment plant.

Maps associated with entry number 2 are oversized and may be reviewed, by appointment only, at the EPA Region I OSRR Records Center in Boston, Massachusetts

2. Letter from Hagop Boghasian, Rhode Island Department of Health to John D. Frisella (December 27, 1984). Concerning results of well water sample with attached "Water Sample Analysis Report."

13.1 Correspondence (correspondence)

3. Letter from Ronald G. Lee, Rhode Island Department of Health to Edward S. Frisella, Sr. (December 28, 1989). Concerning result of well water sample with attached report number 68233.
4. Letter from Ronald G. Lee, Rhode Island Department of Health to Norman Gagne. (December 28, 1989). Concerning result of well water sample with attached report number 68232.
5. Letter from Terrence Gray, RIDEM to David Newton, EPA Region I (April 1, 1991). Concerning the Draft Community Relations Plan and RIDEM's involvement in the Remedial Investigation.
6. Letter from James R. Sebastian, EPA Region I to Terrence Gray, RIDEM (April 18, 1991). Concerning changes to the Draft Community Relations Plan.
7. Letter from Wesley Grant III, Environment Consultants, Inc. to Planning Board, Town of South Kingstown (May 28, 1993). Concerning proposed Woodfield subdivision site narrative.
8. Letter from Wesley Grant III, Environment Consultants, Inc. to Planning Board, Town of South Kingstown (May 28, 1993). Concerning square footage of proposed Woodfield cluster subdivision.
9. Letter from David J. Newton, EPA Region I to Planning Board, Town of South Kingstown (June 8, 1993). Concerning monitoring stations with attached:
   A. Map of Locations of Surface Water Monitoring Stations
   B. "Notification of Proposed Subdivision," Town of South Kingstown.
10. Letter from Francis W. and Christine Blount to David J. Newton, EPA Region I (July 26, 1993). Concerning request for soil-testing information.
11. Letter from David J. Newton, EPA Region I to Francis W. and Christine Blount (August 9, 1993). Concerning field activities at the site with attached:
    A. Consent for Access to Property
    B. EM34-3 Horizontal Dipole Results chart
    C. EM Surface Geophysical Survey Lines map.
12. Memorandum from Tony Lachowicz, Town of South Kingstown to Planning Board, Town of South Kingstown (August 20, 1993). Concerning groundwater monitoring at the Woodfield cluster subdivision.
13. Letter from Stephen B. Kenyon, Kenyon and Aukerman (Attorney for Sterling Smith) to David J. Newton, EPA Region I (September 10, 1993). Concerning request for information regarding possible contamination of Mr. Smith's property.
14. Memorandum from Tony Lachowicz, Town of South Kingstown to the Planning Board concerning discussions with the town's groundwater consultant on the Woodfield Subdivision (June 24, 1996).
15. Letter from Dave Newton, EPA Region I to Karen Livingston concerning well water testing (January 7, 1999).

13.2 Community Relations Plans

1. "Final Draft Community Relations Plan," Metcalf & Eddy (June 1991).
2. Community Relation and Strategy Meeting (January 5, 1993).

13.3 News Clippings/Press Releases

News Clippings

1. "Haulers Plan Legal Action If SK Enacts Tonnage Fee," Narragansett Times – Wakefield, RI (January 7, 1971).
2. "EPA Joins State In Probe Of Pollution," Providence Journal – Providence, RI (January 28, 1988).
3. "EPA Puts Site On Hazardous Waste List," Evening Bulletin – Providence, RI (May 26, 1988).
4. "Town Stunned Rose Hill Landfill On EPA Priority List for Cleanup," Evening Bulletin – Providence, RI (June 22, 1988).
5. "Town Questions EPA Nomination of Former Landfill," Narragansett Times – Wakefield, RI (June 24, 1988).
6. "Firm Says EPA Overstated Potential Harm of Landfill," Narragansett Times – Wakefield, RI (August 26, 1988).
7. "EPA Orders Landfill Study," Narragansett Times – Wakefield, RI (June 23, 1989).
8. "EPA Adds Rose Fill To Superfund," Evening Bulletin – Providence, RI (September 28, 1989).
9. "EPA Tags 9th R.I. Site for Superfund Cleanup," Providence Journal – Providence, RI (September 29, 1989).
10. "Alfred Lambastes EPA Over Landfill," Providence Journal – Providence, RI (October 2, 1989).
11. "EPA Adds Rose Hill Landfill In S. Kingstown To Superfund," Providence Journal Providence, RI (October 2, 1989).
12. "A Prime Example Of Bureaucratic Stupidity'," Narragansett Times – Wakefield, RI (October 13, 1989).
13. "Consultant: EPA Errs In Listing SK Landfill," Narragansett Times – Wakefield, RI (October 18, 1989).
14. "Lally To Fight Landfill's Spot On Superfund List," Narragansett Times – Wakefield, RI (October 27, 1989).
15. "DEM targets groundwater protection," Narragansett Times – Wakefield, RI (February 7, 1990).
16. "Towns Protesting Superfund Designation," Narragansett Times – Wakefield, RI (July 13, 1990).
17. "Contaminated Dumpsters A Problem," Narragansett Times – Wakefield, RI (August 10, 1990).
18. "Towns Must Pay Part Of $1.5 Million It Will Cost To Study Rose Hill Landfill," Providence Journal – Providence, RI (August 20, 1990).

13.3 News Clippings/Press Releases (continued)

19. "Past Trash Costly Now," Narragansett Times – Wakefield, RI (August 24, 1990).
20. "Towns' Plea for Landfill Study Rejected," Providence Journal – Providence, RI (August 31, 1990).
21. "EPA Turns Down Joint Proposal for Cleanup Study," Providence Journal – Providence, RI (August 31, 1990)
22. "EPA Rejects Towns' Landfill Offer," Narragansett Times – Wakefield, RI (September 5, 1990).
23. "Towns, EPA End Talks," Narragansett Times – Wakefield, RI (November 7, 1990).
24. "EPA Schedules Tests for Rose Hill Dump Site," Providence Journal – Providence, RI (November 23, 1990).
25. "Landfill study to be costly," Narragansett Times – Wakefield, RI (June 21, 1991).
26. "S. Kingstown Man Clashes With EPA," Narragansett Times – Wakefield, RI (August 28, 1991).
27. "Rose Hill Properties Free Of Methane Gas," Narragansett Times – Wakefield, RI (November 20, 1991).
28. "Methane Gas Near Landfill," Narragansett Times – Wakefield, RI (April 14, 1993).
29. "Former dump's gases seep into house," Providence Journal – Providence, RI (April 14, 1993).
30. "Agency To Release Latest Test Results," Narragansett Times – Wakefield, RI (April 28, 1993).
31. "EPA meets tomorrow on Superfund Site," Providence Journal – Providence, RI (April 28, 1993).
32. "Kennel Cited In Complaints," Narragansett Times – Wakefield, RI (May 26, 1993).
33. "Shooting Preserve to Appeal Citation," Narragansett Times – Wakefield, RI (June 9, 1993).
34. "Towns Grapple With Cost Of Superfund Cleanup," Providence Business News, Providence, RI (June 28, 1993).
35. "Zoning Board Delays Frisella Decision," Narragansett Times – Wakefield, RI (July 30, 1993).
36. "SK Planning Board Holds Subdivision Hearing," Narragansett Times – Wakefield, RI (September 10, 1993).
37. "Board Hesitantly Passes Plan Along," Narragansett Times – Wakefield, RI (September 24, 1993).
38. "Police Training Planned," Narragansett Times – Wakefield, RI (October 29, 1993).
39. "More Growth On SK Table," Narragansett Times – Wakefield, RI (November 5, 1993).
40. "Frisella Aims To Offer Archery," Narragansett Times – Wakefield, RI (December 10, 1993).

13.3 News Clippings/Press Releases (continued)

41. "Meeting Of The Week," Narragansett Times – Wakefield, RI (December 15, 1993).
42. "Development Appeal Denied," Narragansett Times – Wakefield, RI (December 29, 1993).
43. "Methane Triggers Alarm," Narragansett Times – Wakefield, RI (January 21, 1994).
44. "EPA Finds some toxins," Narragansett Times – Wakefield, RI (June 15, 1994).
45. "Closed dump must be cleaned, EPA says," Providence Journal – Providence, RI (June 16, 1994).
46. "EPA to discuss health hazards at site of former Rose Hill Dump," Evening Bulletin – Providence, RI (June 23, 1994).
47. "Former Dump site worries its neighbors," Evening Bulletin – Providence, RI (June 24, 1994).
48. "Residents still worried about dump," Narragansett Times – Wakefield, RI (June 29, 1994).
49. "N.J. company to pay $700,000 for dump cleanup," Providence Journal – Providence, RI (July 29, 1994).
50. "Congress tries to clean up Superfund rules," Providence Journal – Providence, RI (August 2, 1994).
51. "Firm to pay dump claim," Narragansett Times – Wakefield, RI (August 3, 1994).
52. "River bacteria at high levels, Saugatucket test results surprise few," Narragansett Times – Wakefield, RI (August 24, 1994).
53. "Town: EPA misjudged landfill pollution," Providence Journal-Bulletin, Providence, RI (September 12, 1994).
54. "Town protests EPA ruling," Narragansett Times – Wakefield, RI (September 14, 1994).
55. "Input sought on Saugatucket River Heritage Corridor," Narragansett Times – Wakefield, RI (October 26, 1994).
56. "Chafee role to expand," Narragansett Times – Wakefield, RI (November 11, 1994).
57. "Critic of landfill developing lots", Narragansett Times – Wakefield, RI (December 16, 1994).
58. "River proposal drafted by class," Narragansett Times – Wakefield, RI (December 16, 1994).
59. "Superfund law overhaul has Chafee at the helm," Narragansett Times – Wakefield, RI (February 3, 1995).
60. "Meeting set on Rose Hill Estates," Narragansett Times – Wakefield, RI (March 10, 1995).
61. "Rose Hill neighbors fear for water quality," Narragansett Times – Wakefield, RI (March 17, 1995).
62. "Legal Advertisement – Town of South Kingstown 1995 Financial Town Meeting April 25, 1995, 7:00 P.M., South Kingstown High School," Narragansett Times – Wakefield, RI (April 14, 1995).

13.3 News Clippings/Press Releases (continued)

63. "Expert to study potential for contamination," Narragansett Times – Wakefield, RI (April 14, 1995).
64. "Fish climbing ladder to prosperity," Narragansett Times – Wakefield, RI (April 14, 1995).
65. "Saugatucket fish declared healthy," Narragansett Times – Wakefield, RI (May 26, 1995).
66. "Rose Hill plat approved," Narragansett Times – Wakefield, RI (June 16, 1995).
67. "Pond silting investigated by the DEM," Narragansett Times – Wakefield, RI (July 5, 1995).
68. "Zoning scenarios discussed for Saugatucket Road area," Narragansett Times – Wakefield, RI (July 26, 1995).
69. "Dock proposed for Saugatucket," Narragansett Times – Wakefield, RI (August 25, 1995).
70. "Woodfield subdivision EIS ready," Narragansett Times – Wakefield, RI (September 6, 1995).
71. "Resident tracks EPA reports missing from library to developer," Providence Journal-Bulletin (November 1, 1995).
72. "Woodfield misses deadline," Narragansett Times – Wakefield, RI (November 17, 1995).
73. "Legals – South Kingstown legals – notice of public hearing – Town of South Kingstown 1996 - 1997 to 2001 - 2002 Capital Improvement Program Notice of Public Hearing," Narragansett Times – Wakefield, RI (January 10, 1996).
74. "Woodfield Subdivision Appeal Denied by Town Board", Narragansett Times, (February 14, 1996).
75. "Neighbor Appeals Woodfield Vote", Narragansett Times, (March 1, 1996).
76. "Saugatucket Tests High for Bacteria", Narragansett Times (March 6, 1996).
77. "Town to study Rose Hill cleanup", Narragansett Times (May 1997).
78. "Frisella Case Overturned," Narragansett Times – Wakefield, RI (undated)
79. "Activists Call for Stronger Pollution Legislation", Providence Journal (August 7, 1998).
80. "Work Drags on at 12 Toxic Superfund Sites in Rhode Island", Boston Globe (August 7, 1998).
81. "EPA to pick 1 of 8 ways to cleanse Rose Hill Road dump.", Providence Journal, (December 11, 1998).
82. "EPA poised to divulge its cleanup plan for Superfund site", The Providence Journal (January 6, 1999).
83. "EPA chooses a cleanup plan for Rose Hill Road landfill", Providence Journal, (January 21, 1999).

Press Releases

84. "Environmental News – Nine Sites in Region Named to Superfund Priority List," EPA Region I (September 28, 1989).

13.3 News Clippings/Press Releases (continued)

85. "Environmental News – EPA to Fund Investigation at Rose Hill Regional Landfill," EPA Region I (November 9, 1990).
86. "Environmental News – Rose Hill Homes Free of Suspected Methane", EPA Region I (November 13, 1991).
87. "Environmental News – Change in location for Rose Hill Superfund Site Informational Meeting", EPA Region I (April 21, 1993).
88. "Superfund Week," – Rose Hill RI done (Vol. 8, No. 26, page 7, July 1, 1994).
89. "Environmental News – EPA examines health risks, cleanup options at Rose Hill Superfund Site", EPA Region I (December 7, 1998).

13.4 Public Meetings

1. Summary of the Public Information Meeting, EPA Region I (June 18, 1991).
2. Meeting Agenda – Community Update Meeting (October 19, 1992)

13.5 Fact Sheets

1. "ATSDR Public Health Statement: Vinyl Chloride," Agency for Toxic Substances and Disease Registry (August 1989).
2. "Superfund Program Fact Sheet – EPA Begins Field Investigation," EPA Region I (June 1991).
3. "Superfund Program Fact Sheet – Rose Hill Regional Landfill Site," EPA Region I (April 1993).
4. "Superfund Program Fact Sheet – Rose Hill Regional Landfill Site," EPA Region I (June 1994).

14.0 Congressional Relations

14.1 Correspondence

1. Letter from Claiborne Pell, U.S. Senate to Julie Belaga, EPA Region I (September 20, 1990). Concerning meeting request from the Towns of South Kingstown and Narragansett with attached Letter from Mark A. McSally, Taft & McSally (Attorney for Town of Narragansett) to Julie Belaga, EPA Region I dated September 13, 1990.
2. Letter from Julie Belaga, EPA Region I to Claiborne Pell, U.S. Senate (October 30, 1990). Concerning denial of town officials' meeting request.
3. Letter from Ronald K. Matchley, U.S. House of Representatives to Julie Belaga, EPA Region I (October 25, 1991) with attached news clipping. Concerning Edward Frisella's bird-hunting preserve.
4. Letter from Julie Belaga, EPA Region I to Ronald K. Matchley, Member of the U.S. house of Representatives (November 21, 1991). Concerning Mr. Ed Frisella's difficulties operating his bird-hunting preserve during field operations by EPA.

14.1 Correspondence (correspondence)

5. Letter from Claiborne Pell, U.S. Senate to Julie Belaga, EPA Region I (December 18, 1991). Concerning restrictions imposed on the Frisella business.
6. Letter from Julie Belaga, EPA Region I to Claiborne Pell, U.S. Senate (January 10, 1992). Concerning response to Senator Pell's December 18, 1991 letter.
7. Letter from Jack Reed, U.S. House to Julie Belaga, EPA Region I (February 5, 1992). Concerning restrictions imposed on the Frisella business.
8. Letter from Claiborne Pell, U.S. Senate to Julie Belaga, EPA Region I (February 24, 1992). Concerning cooperation between EPA workers and the Frisella family.
9. Letter from Julie Belaga, EPA Region I to Jack Reed, U.S. House of Representatives (February 28, 1992). Concerning EPA's accommodations to the Frisella business.
10. Letter from Julie Belaga, EPA Region I to Claiborne Pell, U.S. Senate (March 25, 1992). Concerning EPA's conflicts with the Frisella business.

16.0 Natural Resource Trustee

16.1 Correspondence

1. Letter from Kenneth Finkelstein, U.S. NOAA with comments on the Draft RI/FS Work Plan (January 9, 1990).
2. Letter report from Kenneth Finkelstein, U.S. National Oceanic and Atmospheric Administration (NOAA) to David Newton, EPA Region I (October 3, 1994). Concerning results of NOAA's visit of September 1, 1994, to the Saugatucket River to measure pH and Eh, with attached chart.
3. Letter from Stephen A Alfred, Town of South Kingstown to David J. Newton, EPA Region I (December 15, 1994). Concerning comments on a report completed by Alceon Corporation, Consultant for the Rose Hill PRP Group with attached letter from Leslie R. Bloomfield, Alceon Corporation to Stephen A. Alfred (November 17, 1994).
4. Letter from Kenneth Finkelstein, NOAA to David Newton, EPA Region I commenting on the Draft Feasibility Study (October 28, 1996) and response from David Newton, EPA Region I (December 9, 1997).

16.5 Technical Issue Papers

1. Preliminary Natural Resource Survey (PNRS), NOAA (June 24, 1994) with attached, "An Evaluation of Saugatucket Pond Sediment, South Kingstown, RI Final Report (1994).
2. Letter from Stephen A. Alfred, Town of South Kingstown to David Newton, EPA Region I (October 11, 1994). Concerning PRP Group's comments to the "Preliminary Natural Resource Survey – Final Report," with attached letter from Leslie R. Bloomfield, Alceon Corporation to Stephen A. Alfred, Town of South Kingstown (October 6, 1994).

16.5 Technical Issue Papers (correspondence)

3. Letter from David J. Newton, EPA Region I to Stephen A. Alfred, Town of South Kingstown (October 14, 1994). Concerning receipt of comments on NOAA's Preliminary Natural Resource Survey (PNRS) and Final Report.
4. Letter from Kenneth Finkelstein, U.S. National Oceanic and Atmospheric Administration (NOAA) to Stephen A. Alfred, Town of South Kingstown (October 20, 1994). Concerning responses to PRP Group's comments on the Preliminary Natural Resource Survey (PNRS) and the "Evaluation of the Saugatucket Pond Sediment" reports.

17.0 Site Management Records

17.2 Site Access

1. **Cross-Reference:** Letter from Richard C. Boynton, EPA Region I to Edward L. Frisella, Sr. And Pearl F. Frisella (August 21, 1991). Concerning issuance of Administrative Order for Property Access ***[Filed and cited as entry number 1 in 10.7 EPA Administrative Orders].***
2. **Cross-Reference:** Letter from Richard C. Boynton, EPA Region I to Edward L. Frisella, Sr. And Pearl F. Frisella (March 27,1 992). Concerning the First Amended Administrative Order for Property Access ***[Filed and cited as entry number 2 in 10.7 EPA Administrative Orders].***
3. Letter from Stephen A. Alfred, Town of South Kingstown to Paul Groulx, EPA Region I concerning attached executed Consent for Access to Property and map documenting property ownership (October 27, 1992).

Additional Access Records for adjoining properties may be reviewed, by appointment only at the EPA Region I OSRR Records Center in Boston, Massachusetts.

17.4 Site Photographs/Maps

Records cited in entry numbers 1 and 2 may be reviewed, by appointment only, at the EPA Region I OSRR Records Center in Boston, Massachusetts. Additional photographs and maps may be reviewed, by appointment only, at the EPA Region I OSRR Records Center in Boston, Massachusetts.

1. "Site Analysis Rose Hill Landfill," South Kingstown, Rhode Island, The Bionetics Corporation (December 1987) with attached transmittal memorandum from Thomas Osberg, EPA Environmental Photographic Interpretation Center (EPIC) to Ruth Leabman, EPA Region I (December 13, 1987).
2. "Site Analysis Rose Hill Landfill," South Kingstown, Rhode Island, The Bionetics Corporation (June 1991) with attached transmittal memorandum from Thomas Osberg, EPA Environmental Photographic Interpretation Center (EPIC) to Ruth Leabman, EPA Region I (June 27, 1991).

17.7 Reference Documents

Reference documents cited in entry numbers 1 through 17 may be reviewed, by appointment only, at the EPA Region I OSRR Records Center in Boston, Massachusetts.

1. "Methane on the Move: Your Landfill's Silent Partner," Intergovernmental Methane Task Force Symposium, March 21-23, 1979.
2. Memorandum from Henry L. Longest II, OSWER to Basil G. Constantelos, Region 5 concerning CERCLA Removal Actions at Methane Release Sites (January 23, 1986).
3. "Experiments on Pollutant Transport from Soil into Residential Basements by Pressure-Driven Airflow", William W. Nazaroff, Stephen R. Lewis, Suzanne M. Doyle, Barbara A. Moed, and Anthony V. Nero (1987).
4. "Mathematical Modeling of Landfill Gas Extraction", Journal of Environmental Engineering (December 1989).
5. Memorandum from Gerald F. S. Hiatt, EPA Region IX to Bret Moxley, EPA Region IX concerning Vinyl Chloride Action Levels: Fresno Landfill (October 30, 1991).
6. "Superfund and Municipal Landfills: A Blessing or a Curse?," Rhode Island Department of Administration (August 1992).
7. Memorandum from Bret Moxley, EPA Region IX to Nancy Lindsay, EPA Region IX (October 7, 1992). Concerning vinyl chloride air actions levels near the Operating Industries landfill.
8. Early Action and Long-Term Action Under SACM – Interim Guidance, OSWER, (December 1992).
9. "Establishment and Field Testing of a Rapid Bioassessment Screening of Rhode Island Freshwater Benthic Macroinvertabrates," Mark Gould, School of Science and Mathematics, Roger Williams University, Bristol, RI, December 1992.
10. "Establishment and Field Testing of a Rapid Bioassessment Screening of Rhode Island Freshwater Benthic Macroinvertabrates," Mark Gould, School of Science and Mathematics, Roger Williams University, Bristol, RI, December 1993.
11. "A River Runs Through It – But Can It Hurt Me?," Kathy Castro, November 22, 1994.
12. "Establishment and Field Testing of a Rapid Bioassessment Screening of Rhode Island Freshwater Benthic Macroinvertabrates," Mark Gould, College of Arts and Sciences, Roger Williams University, Bristol, RI, December 1994.
13. "Biological Survey of Saugatucket Pond," Anthony Brinson, University of Rhode Island, Department of Fisheries, May 23, 1995.
14. "River Herring and Fishway Assessment of the Saugatucket River, South Kingstown, Rhode Island," Neil Thompson, University of Rhode Island, Department of Fisheries, Animal and Veterinary Services, May 24, 1995.

17.7 Reference Documents (continued)

15. Letter from David J. Newton, EPA Region I to Warren Angell, RIDEM concerning information of the Use of Chipped Tires for Landfill Drainage (March 25, 1997).
    A. Letter from Jeffrey S. Hansen, Dames & Moore to Edward Hathaway, EPA Region I concerning Disposal Specialist, Inc. site North Retention Pond and Tire Chip Drainage Layer analytical results (January 3, 1995).
    B. Innovative Use of Shipped Tires for Landfill Drainage.
    C. "Chipped Tires and Low Permeability Silt Helped Put a Vermont Landfill Remediation Project on the Superfund Fast Track", Leonard Sarapas (April 1996).
    D. "Cold Regions Lab Studies Use of Tire Chips as Insulation Under Gravel Road".
    E. Letter from Gary M. Garfield and Leo Sarapas, Balsam Environmental Consultants, Inc. to Carl Woodbury, NHDES concerning Chipped Tire Leachability Protocol Results, Pelham Landfill, Pelham, New Hampshire (July 28, 1994).
16. World Resource Foundation Technical Brief: Landfill Mining (1996).
17. "Evaluation of High Concentration of VOCs in Landfill Gas: A Case Study of the Rose Hill Regional Landfill Superfund Site," Jay B. Best and Deborah M. Simone, Metcalf & Eddy, (not dated).

17.8 State and Local Technical Records

1. "Phase II Site Evaluation and Operation Plan for Municipal Sanitary Landfill Rose Hill Road," CE Maguire, Inc. for Town of South Kingstown, RI (August 1977).
2. "Assessment of Groundwater Contamination from a Municipal Landfill and Evaluation of Remedial Measures," Mark Brickell, A Thesis submitted in partial fulfillment of the requirements for the Degree of Master of Science in Civil and Environmental Engineering, University of Rhode Island (1982).
3. "Engineering and Hydrogeological Assessment of the Rose Hill Landfill," York Wastewater Consultants, Inc. for the Town of South Kingstown, RI (February 17, 1984).
4. "A Summary of the Rhode Island Wellhead Protection Program," Rhode Island Department of Environmental Management (April 1990).
5. "Water Testing", Natural Resources Facts, The University of Rhode Island, College of Resource Development. Fact Sheet No. 90-22 (July 1990).
6. "Investigation of Ground Water at Landfill, Rose Hill Road, South Kingstown, R.I.", prepared by William E. Kelly for the Town of South Kingstown (undated).
7. [Fact Sheet: Water Quality and Testing]. Rhode Island Dept. Of Health, Division of Drinking Water Quality (undated).
8. Letter from David J. Newton, EPA Region I to Raymond T. Nickerson, Town of South Kingstown (November 28, 1995) commenting on the attached environmental impact analysis for Woodfield Subdivision.

Rose Hill Regional Landfill

Administrative Record Addendum

Index

ROD Signed: December 1999

Prepared by EPA-New England
Office of Site Remediation and Restoration

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INTRODUCTION

This is the index to the Administrative Record Addendum compiled for the signing of the Record of Decision for the Rose Hill Regional Landfill Superfund Site. The index cites additional site-specific documents, received after the release of the Proposed Plan, that were relied on in formulating the selected remedy for this operable unit.

The Administrative Record, consisting of three (3) three ring binders of the documents listed herein, is available for public review, by appointment, at the EPA Region 1 OSRR Records Center, 1 Congress Street, Boston, MA (617-918-1440) and at the South Kingstown Public Library, 1057 Kingstown Road, Peacedale, RI 02883.

Questions concerning the Administrative Record should be addressed to the EPA Region 1 site manager.

An Administrative Record is required by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA).

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4.0 Feasibility Study

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1. Letter from Deborah M. Simone, Metcalf & Eddy to David J. Newton, EPA Region 1 with attached "Technical Input in Support of the Record of Decision, Revised Cost Analyses - Alternative 4B", (May 18, 1999).
2. Memorandum from J. Young, Metcalf & Eddy to Deborah M. Simone, Metcalf & Eddy commenting on the marked text faxed from Dave Newton on June 16, 1999 (June 24, 1999).
3. Transmittal Letter from Deborah M. Simone, Metcalf & Eddy to David J. Newton, EPA Region 1, with attached review of Dames & Moore Tire Chip Specification (July 26, 1999).
4. Transmittal Letter from Deborah M. Simone, Metcalf & Eddy to David J. Newton, EPA Region 1 with attached memorandum outlining cost comparison for Alternatives 4A and 4B based on review of the GZA Field Investigation Report of February 1999 (July 28, 1999).

5.0 Record of Decision

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1. Transmittal Letter from Deborah M. Simone, Metcalf & Eddy to David J. Newton, EPA Region 1, with attached Table 10 of the Technical Approach for Risk Assessment (TARA) Tables for review and use in preparing the Record of Decision (January 7, 1999).

5.3 Responsiveness Summary

Federal Agencies

1. Letter from Kenneth Finkelstein, U.S. Department of Commerce, NOAA to David Newton, EPA Region 1 commenting on the Proposed Plan (February 4, 1999).
2. Letter from Kenneth Finkelstein, U.S. Department of Commerce, NOAA to David Newton, EPA Region 1 commenting on issues pertaining to the new preferred remedial plan (March 26, 1999).
3. Memorandum from Alfred A. Basile, Office of Ecosystems Protection to David Newton, Office of Site Remediation and Restoration commenting on the Proposed Plan (April 7, 1999).

State of Rhode Island

4. Statement of Warren Angell, RIDEM (February 18, 1999).
5. Public Statement made by Stephen A. Alfred, South Kingstown Town Manager at the Public Hearing of behalf of the Towns of South Kingstown and Narragansett, Rhode Island (February 18, 1999).
6. Letter from Terrence Grey, RIDEM to Patricia Meaney, EPA Region 1 commenting on the Feasibility Study and the Proposed Plan (February 18, 1999).
7. Memorandum from Chris Turner, RIDEM Office of Water Resources to Alicia Good and Elizabeth Scott, RIDEM Office of Water Resources concerning the Feasibility Study Plan for the Rose Hill Landfill site (February 25, 1999).
8. Letter from Alicia Good, RIDEM Office of Water Resources to Robert Mendoza, EPA Region 1, Office of Ecosystems Protection Concerning the draft report summarizing water quality investigations in the Saugatucket River (February 26, 1999).
9. Letter from Cynthia M. Gianfrancesco, RIDEM to David Newton, EPA Region 1, commenting on the Feasibility Study and the Proposed Plan (April 5, 1999).

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12. Letter from Roger Duwart, EPA Region 1 to Maurice J. Loontjens, Jr., Town of Narragansett granting the 60 day extension to the public comment period (February 16, 1999).
13. Letter from Stephen A. Alfred, Town of South Kingstown and Maurice J. Loontjens, Jr., Town of Narragansett commenting on the Proposed Plan and requesting a written response (April 30, 1999).

Environmental Organizations

14. Letter from Dorothy Devine, Saugatucket River Heritage Corridor Coalition, Inc. to David Newton, EPA Region 1 commenting on the Proposed Plan for Cleanup of the Rose Hill Landfill (February 9, 1999).
15. Letter from Curt Spaulding, Save the Bay to David Newton, EPA Region 1 concerning the cleanup option chosen for the Rose Hill Regional Landfill (April 29, 1999).

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16. Letter from Gerald M. Carbone commenting on the cleanup options for the Rose Hill Landfill Superfund site (February 8, 1999).
17. Comments on the Proposed Plan by Russell C. Koza, PhD (February 18, 1999).
18. Transcript of Public Hearing for the Proposed Cleanup for the Rose Hill Regional Landfill Superfund Site (February 18, 1999).
19. Memorandum from Judith Sine to David Newton, EPA Region 1 commenting Rose Hill Regional Landfill Proposed Plan (March 16, 1999).
20. Memorandum from Jason Engle to David J. Newton, EPA Region 1 commenting on the cleanup at the Rose Hill Landfill (March 26, 1999).
21. Letter from Evelyn W. Kenyon to David Newton, EPA Region 1 commenting on the cleanup plan for Rose Hill Regional Landfill (April 17, 1999).
22. Letter from Patricia F. Gagne to Sarah White, EPA Region 1 with comments on the options being considered for the Rose Hill Landfill (April 22, 1999).
23. Memorandum from Eleanor Freda to David J. Newton, EPA Region 1 commenting on the proposed cleanup plan for the Rose Hill Landfill Superfund site (no date
24. Comments by Karen Johnson on the cleanup at Rose Hill Regional Superfund site.

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25. Comments by Donald D. And Barbara A. Allen on the Rose Hill Regional Landfill site.
26. Comments by Dorothy Devine on the Rose Hill Regional Landfill site.

5.4 Record of Decision

1. Record of Decision for Rose Hill Regional Landfill, First Operable Unit - Source Control, (December 1999).

9.0 State Coordination

9.1 Correspondence

1. Letter from Larry Brill, EPA Region 1, OSRR to Leo Hellested, RIDEM responding to RIDEM's Proposed Wording Changes to the ROD, (November 24, 1999).
2. Letter from Jan H. Reitsma, RIDEM to Patricia Meaney, EPA Region 1, OSRR concurring with EPA's selected remedy, (December 13, 1999).

11.0 Potentially Responsible Party (PRP)

11.12 PRP Related Documents

1. Field Investigation Report, prepared for the Town of South Kingstown by GZA GeoEnvironmental, Inc. (February 1999)
2. **Cross Reference:** Memorandum from Chris Turner, RIDEM to Alicia Good and Elizabeth Scott, RIDEM concerning the Feasibility Study Plan for the Rose Hill Landfill site (February 25, 1999) **[Filed and cited as #7 in 5.3 Responsiveness Summary].**
3. **Cross Reference:** Letter from Alicia Good, RIDEM Office of Water Resources to Robert Mendoza, EPA Region 1 (February 26, 1999). **[Filed and cited as #8 in break 5.3 Responsiveness Summary].**
4. Feasibility Study prepared for the Town of South Kingstown by GZA GeoEnvironmental, Inc. (April 1999).
5. Memorandum from Alfred A. Basile, EPA Region 1 to David Newton, EPA Region 1 forwarding correspondence from RIDEM, Office of Water Resources (April 7, 1999).

11.12 PRP Related Documents (continued)

6. Letter from Deborah M. Simone, Metcalf & Eddy to David J. Newton, EPA Region 1 with attached comments on the GZA Field Investigation Report of February 1999 (April 9, 1999).
7. Letter from David J. Newton, EPA Region 1 to Stephen A. Alfred, Town of South Kingstown concerning correspondence received from the RIDEM Office of Water Resources, attached (May 4, 1999).
8. Response from Joseph Unsworth, Edward Summerly and Michael Powers, GZA GeoEnvironmental, Inc. to Metcalf & Eddy's comments dated April 9, 1999 on GZA's Field Investigation Report (June 8, 1999), with transmittal letter from John D. Schock, Town of South Kingstown to David Newton, EPA Region 1 (June 16, 1999).

13.0 Community Relations

13.1 Correspondence

1. Letter from Sarah White, EPA Region 1 to Colleen Camp, Town of South Kingstown, to confirm public meeting and public hearing 11 dates to announce EPA's proposed cleanup plan for Rose Hill Landfill Superfund Site (December 22, 1998).
2. Letter from John DeVillars, EPA Region 1 to Dorothy Devine, Saugatucket River Heritage Corridor Coalition, Inc. concerning public participation and comments (March 5, 1999).

13.3 News Clippings/Press Releases

1. "EPA Warns of risk, airborne chemicals described", South County Independent, (December 31, 1998).
2. "EPA chooses a cleanup for Rose Hill Road landfill, The Providence Journal, (January 21, 1999).
3. "Landfill options selected, decision not final", South County Independent, (January 21,1999).
4. "The United States Environmental Protection Agency announces a Proposed Cleanup Plan for the Rose Hill Landfill Superfund site", The Providence Journal, (January 27, 1999).
5. "EPA to talk about dumping cleanup", The Providence Journal, (February 2, 1999).
6. Report on the public meeting held February 2, 1999, South County Independent, (February 3, 1999).
7. Letter to the editor from Myron and Alice Duffin, "Hard life near Superfund site", South County Independent, (February 18, 1999).

13.3 News Clippings/Press Releases (continued)

8. "Critics argue cleanup plan falls short", The Providence Journal, (February 22, 1999).
9. "Town officials critical of EPA's plan for Rose Hill Landfill", Narragansett Times, (February 25, 1999).
10. Untitled article concerning properties near Rose Hill Landfill, The Providence Journal, (April 2, 1999).
11. "Notice that EPA has extended the public comment period on the proposed cleanup plan for Rose Hill Regional Landfill Superfund site to May 3, 1999, The Times, (April 10, 1999).
12. "A close look at plans for Rose Hill Landfill raises concerns", The Providence Journal, (April 14, 1999).
13. "DEM endorses $17 million plan to clean up Rose Hill site", The Providence Journal, (April 16, 1999).
14. "Let Rose Hill landfill property recover on its own", South County Independent, (April 29, 1999).
15. Environmental News: EPA examines public health risks, cleanup options at Rose Hill Superfund Site (December 7, 1998).
16. Newspaper notice of Record of Decision availability (December 1999).

13.4 Public Meetings

1. Agenda and sign-in sheet for the Feasibility Study Public Meeting held February 2, 1999.
2. **Cross Reference:** The Proposed Plan Public Hearing Transcript, dated February 18, 1999. **[Filed and cited in break 5.3 Responsiveness Summary].**

13.5 Fact Sheets

1. Rhode Island DEM Fact Sheet (March 1999).

16.0 Natural Resource Trustees

16.5 Technical Issue Papers

1. Response by Kenneth Finkelstein, NOAA to Mark Dennen, RIDEM on RIDEM's comments on the preliminary biological study of the Saugatucket Pond sediment (May 31, 1994).
   A. Letter from Mark Dennen, RIDEM to David Newton, EPA Region 1 concerning the Evaluation of Saugatucket Pond Sediment (May 2, 1994).

16.5 Technical Issue Papers (continued)

2. Response by Kenneth Finkelstein, NOAA to Mark Dennen, RIDEM on RIDEM's comments on the preliminary biological study of the Saugatucket Pond sediment (May 31, 1994).
   A. Memo from Alicia M. Good, RIDEM to Terrence Gray, RIDEM commenting on An Evaluation of Saugatucket Pond Sediment (April 27, 1994).

17.0 Site Management

17.7 Reference Documents

Reference Documents cited in entries below may be reviewed by appointment only at the EPA Region 1 Superfund Records Center in Boston, Massachusetts.

1. Groundwater Protection Strategy, EPA (April 1984).
2. The State's Groundwater (April 1988)
3. Guidelines for Groundwater Classification Under EPA Groundwater Protection Strategy, EPA (June 1988).
4. Suggested ROD Language for Various Groundwater Remediation Options, OSWER Directive 9283.1-03 (October 1990).
5. Rules and Regulations Pertaining to the Treatment, Disposal, Utilization and Transportation of Wastewater Treatment Facility Sludge, RIDEM (March 1991).
6. A Guide to Principal Threat and Low Level Threat Wastes, OSWER Directive 9380.3-6FS (September 1991).
7. Use of Institutional Controls at Superfund Sites, EPA (July 27, 1992).
8. Air Pollution Controls Regulation No. 22, Air Toxics, RIDEM (March 28, 1988, Amended November 19, 1992).
9. Air Pollution Control Regulation No. 7, Emission of Air Contaminants Detrimental to Person or Property, RIDEM, (August 1967, Amended March 28, 1993).
10. Considering Wetlands at CERCLA Sites, OSWER (May 1994).
11. Underground Injection Control Program Rules and Regulations, RIDEM (May 31, 1984).
12. Regulations for Rhode Island Pollution Discharge Elimination System, RIDEM (June 1984, Amended February 9, 1993).
13. Water Quality Facts, Home Water Testing, University of Rhode Island, College of Resource Development (September 1994).
14. Review of Draft Presumptive Remedy Guidance for CERCLA Sites with Contaminated Groundwater, OSWER (September 1994).

17.7 Reference Documents (continued)

15. "Establishment and Field Testing of a Rapid Bioassessment Screening of Rhode Island Freshwater Benthic Macroinvertabrates", Mark Gould, College of Arts and Sciences, Roger Williams University, Bristol, Rhode Island (December 1994).
16. Guidelines for Management of Investigation Derived Wastes, RIDEM Policy Memo 95-01 (April 18, 1995).
17. Low Stress (Low Flow) Purging and Sampling Procedures for the Collection of Ground Water Samples from Monitoring Wells, EPA Region 1 (June 30, 1996).
18. Rules and Regulations for Groundwater Quality, RIDEM (August 1996).
19. Rules and Regulations for the Investigation of Hazardous Material Releases, RIDEM (March 1993, Amended August 1996).
20. Air Pollution Control Regulation no. 5, Fugitive Dust, RIDEM (August 1967, Amended September 16, 1996).
21. Rules and Regulations for Composting Facilities and Solid Waste Management Facilities, RIDEM (January 1997).
22. Solid Waste Regulation No. 2, Solid Waste Landfills, RIDEM (January 1997).
23. Solid Waste Regulation No. 3, Transfer Stations and Collection Stations, RIDEM (January 1997).
24. The Role of CSGWPP's in EPA Remediation Programs, OSWER Directive 9283.1-09 (April 14, 1997).
25. Revised "Landfill Surface Methane Monitoring Plan, L & RR Landfill, North Smithfield, Rhode Island", Metcalf & Eddy (January 12, 1998).
25. Guidance on Preparing Superfund Remedial Decision Documents, Final Review Draft, OERR (June 19, 1998).
26. Air Pollution Control Regulation No. 9, Air Pollution Control Permits, RIDEM (July 1998).
27. National Recommended Water Quality Criteria; Notice; Republication, Federal Register (December 10, 1998).
28. Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites, OSWER Directive 9200.4-17P (April 21, 1999).

17.8 State and Local Technical Records

1. Letter from David C. Baud, Town of South Kingstown to Robert Carr, containing the Conceptual Master Plan Decision for the South Woods Major Subdivision (February 13, 1998), with FAX transmittal to Cynthia Gianfrancesco, RIDEM, dated September 13, 1998).

17.8 State and Local Technical Records (continued)

2. Letter from Alicia Good, RIDEM to Stephen A. Alfred, Town of South Kingstown, concerning attached draft report summarizing water quality investigations in the Saugatucket River conducted by Dr. Raymond Wright of the University of Rhode Island (February 24, 1999)
   A. "Saugatucket River Water Quality Investigation - Steady State Modeling of Dissolved Oxygen and Nutrients on the Saugatucket River", Mirko Kugler and Raymond M. Wright, University of Rhode Island (July 1998).
   B. "Saugatucket River Water Quality Investigations: Water Quality Data Report", Raymond M. Wright, Mirko Kugler Mark Yeboah and Quoc Nguyen, University of Rhode Island (July 28, 1998).