

SCANNED

REPORT ON
PARTIAL CLASS C RESPONSE ACTION OUTCOME
(RAOP) STATEMENT
FORMER MALDEN MGP SITE
MALDEN, MASSACHUSETTS
RTN 3-0362
TIER IB PERMIT 7378



by

Haley & Aldrich, Inc.
Boston, Massachusetts

for

Massachusetts Electric Company
Westborough, Massachusetts

File No. 06558-669
February 2004



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Haley & Aldrich, Inc.
465 Medford Street
Suite 2200
Boston, MA 02129-1400
Tel: 617.886.7400
Fax: 617.886.7600
www.HaleyAldrich.com



27 February 2004
File No. 06558-669

Massachusetts Department of Environmental Protection
Northeast Regional Office
One Winter Street
Boston, Massachusetts

Attention: Site Management Branch

Subject: Partial Class C Response Action Outcome (RAOP) Statement
Former Malden Manufactured Gas Plant (MGP) Site, Malden, Massachusetts
RTN 3-0362 and linked RTNs 3-03757, 3-11581, 3-12448, 3-13310,
3-13345, 3-13753, and 3-13754
Tier IB Permit Number 7378

Ladies and Gentlemen:

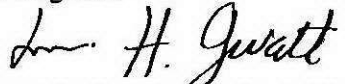
On behalf of Massachusetts Electric Company (MEC), Haley & Aldrich, Inc. (Haley & Aldrich) has prepared this partial Class C Response Action Outcome (RAOP) Statement for the terrestrial portion of the former Malden MGP Site, located in the vicinity of the intersection of Commercial and Charles Streets in Malden, Massachusetts. As detailed in the June 2003 Phase III Remedial Action Plan, the Malden River portion of the Site is addressed separately from the terrestrial portion of the Site. This RAOP Statement is transmitted with original transmittal form BWSC-104. A copy of BWSC-104 is included in Appendix A.

Please do not hesitate to contact us should you have any questions or require additional information regarding this report.

Sincerely yours,
HALEY & ALDRICH, INC.


Sean M. Carroll
Staff Engineer

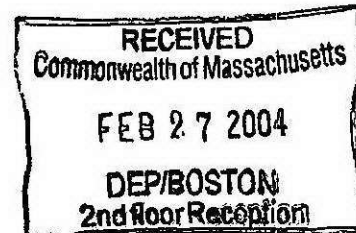

Richard J. Rago
Senior Scientist


Richard P. Standish, P.G., LSP.
Vice President, LSP of Record

FOR

cc: Massachusetts Electric Company; Michele V. Leone
KeySpan Energy Delivery; Patricia Haederle

Enclosures
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1. INTRODUCTION

This Partial Class C Response Action Outcome Statement (RAOP) is completed in accordance with 310 CMR 40.1000 on behalf of Massachusetts Electric Company (MEC) for selected parcels at the former Malden manufactured gas plant (MGP) Site (the Site), located along Commercial Street near its intersections with Charles Street and Centre Street, also known as Route 60, in Malden, Massachusetts. This RAOP pertains to the upland portion of the Site, which includes the terrestrial land parcels of the Site and excludes the Malden River portion of the Site. The Malden River portion of the Site extends from the Malden River Culvert outfall to a point approximately 1,400 ft. downstream (just north of the Medford Street Bridge) and will be addressed separately, as described in the June 2003 Phase III Remedial Action Plan (RAP) for the Site. A Site Locus is presented on Figure 1.

1.1 Site Background Information

Portions of the former Malden MGP Site have been the subject of Massachusetts Contingency Plan (MCP) 310 CMR 40.0000 compliance activities since 1988 under various Massachusetts Department of Environmental Protection (MADEP) Release Tracking Numbers (RTNs). This Class C RAOP pertains to those terrestrial portions of the former Malden MGP which have not yet received a Response Action Outcome (RAO) or a Waiver Completion Statement, and are not known to be the subject of MCP investigations by others. The Phase II - Comprehensive Site Assessment (Phase II) for the Site identified Significant Risks to human health, public welfare and the environment. The Phase III RAP evaluated Remedial Action Alternatives to address risks posed by MGP residuals to human health and the environment, and selected a Comprehensive Remedial Action for the Site.

The former Malden and Melrose Gas Light Company (MMGLC) and its successor, the Mystic Valley Gas Company (MVGC), operated an MGP which expanded over time to include approximately 16.4 acres of land in the vicinity of the intersection of Commercial and Charles Streets in Malden, Massachusetts from approximately the mid to late 1800s to the late 1960s/early 1970s. The former MGP occupied land currently referred to as Parcels A, B, C, D and E, as shown on Figure 2. Also, by 1912, the American Tar Company operated a tar refining operation on the northern portion of Parcel A and on land currently occupied by the Centre Street Right of Way. Each of these properties was re-developed following the decommissioning of the former MGP facilities in the 1970s, and are now owned and controlled by various parties. MEC does not own any of the Site parcels.

As indicated above, this Class C RAOP addresses the terrestrial portions of the former MMGLC/MVGC holdings that have not been addressed by other parties, or that have not had a Waiver Completion Statement or RAO filed at MADEP. Therefore, Parcel C (RTN 3-2066), which has a Waiver Completion Statement dated 14 September 1990, and the portion of Parcel D (i.e., Callahan Park) subject to an existing Partial Class A-3 RAO (RTN 3-13310), are not included in this RAOP. Figure 3 shows the limits of the Partial Class A-3 RAO that was filed for the Callahan Park property, and the limits of the Grant of Environmental Restriction (GER) that was placed on the Park property.

1.2 Site Description and Location

The Former Malden MGP Site boundary and parcels of the MGP that are included in this Class C RACP are identified on Figure 4 and are described below:

- Parcel A: Parcel A is a rectangular shaped parcel of approximately 2.8 acres, occupied by six buildings (51 through 109 Commercial Street) on five separate properties. The parcel is bounded by Commercial Street to the east, Charles Street to the south, a Massachusetts Bay Transit Authority (MBTA) Orange Line railroad right-of-way to the west, and Centre Street to the north. Current occupants of the buildings on Parcel A include: a dental office, a chiropractic office, a muffler shop, a retail liquor store, an automobile body shop, a rental car garage and office, a tanning/nail salon, and medical offices.
- Parcel B: Parcel B is a rectangular shape parcel of approximately 2 acres, bounded by Charles Street to the north, Commercial Street to the east, Adams Street to the south, and the MBTA Orange Line railroad right-of-way to the west. The single existing building on the parcel is located at 129 Commercial Street and is currently occupied by a commercial bakery.
- Parcel D: The portion of Parcel D that was not included in the January 1997 Partial Class A-3 RAO (RTN 3-13310) includes an area associated with the former Governor House. The Governor House was an historic MGP facility that housed equipment used to regulate the flow of manufactured gas from gas holders on Parcel D into the gas distribution system located in the Charles Street right-of-way.
- Parcel E: The 100 Commercial Street property which comprises Parcel E, is approximately 6.6 acres in size, and is bounded by Commercial Street to the west, Charles Street to the south, Centre Street to the north, and the culverted Malden River to the east. The parcel is currently owned and occupied by the Boston Gas Company d/b/a KeySpan Energy Delivery New England (KeySpan) which currently uses the property as an Operations and Vehicle Maintenance Center.
- West End Brook and Malden River Culverts: The portions of the West End Brook (WEB) and Malden River (MR) Culverts that extend from Parcel D to the Malden River outfall.

The Malden River in its reach between the Malden River Culvert outfall and a point approximately 1,400 ft. downstream of the culvert outfall is also part of the Site, as outlined in the Phase II and as shown on Figure 4. As described in the Phase III RAP, the Malden River portion of the Site has been separated from the terrestrial portion of the Site and will be the subject of a future RAO. As discussed with MADEP during a meeting held on 3 April 2003, MEC intends to address the sediments in the Malden River as a separate operable unit (OU). Additionally, the Mystic Valley Development Commission (MVDC), through the TeleCom City partnership, has formed a group of parties with interest in the Malden River. The Telecom City partnership formed due to the proposed development of a state-of-the-art telecommunications research and development park on 200 acres of land situated in Malden, Medford and Everett, located along the Malden River and downstream of the Site boundary.

The MVDC has partnered with the Army Corps of Engineers to conduct a study of ecosystem impacts and to identify potential remedial measures that may be undertaken in the area. MEC is contributing technical and financial support to this project and is participating in the study, designated the Malden River Ecosystem Restoration Study. MEC also intends to participate in discussions regarding the restoration of the Malden River, as appropriate. In light of these recent developments, evaluation of Malden River sediments associated with the former Malden MGP Site, if applicable, would be more efficient and cost-effective if conducted in conjunction with these efforts along the larger portion of the River.

The Site is located within a designated Industrial Zone, and there are no institutions located within 500 ft. There are numerous residences within 0.5 miles of the Site and it is estimated that greater than 1,000 people live within 0.5 miles of the Site. The Site is not located within 3,000 ft. of an Area of Critical Environmental Concern. Based on area groundwater use and recharge characteristics, the Site is not included within areas designated Zone I, Zone II, or Zone III. The MADEP Natural Resources Map for the Site from the Phase III report, dated May 2003, is provided on Figure 5.

1.3 Land Use and History

Earliest available information indicates that the Malden and Melrose Gas Light Company (MMGLC) erected a gas manufacturing facility in 1855. The facility, which consisted of coal storage buildings, retort houses, a gas manufacturing building, a condenser house and limited purification facilities on Parcel A, reportedly began providing street lighting by gas on 1 November 1855. The locations of historic MGP facilities are shown on Figure 6.

As the plant capacity was expanded, operations spread to Parcels B, D, and E. Parcel B was used primarily for gas purification operations, Parcel D was primarily used for storage and distribution of gas product, and Parcel E was the location of the second condenser house, a series of above-ground storage tanks, and various tar handling facilities. By 1912, the American Tar Company operated a tar refining operation on the northern portion of Parcel A and on land currently occupied by the Centre Street Right of Way. The MGP continued to operate as MMGLC through 1953. At that time, the MMGLC reorganized and became the Mystic Valley Gas Company (MVGC).

Manufactured gas production continued through the early 1960s, at which time natural gas became available and quickly became the primary gas source for MVGC. By 1963, the gas manufacturing building, the retort house, and the tar storage tanks associated with the American Tar Company on Parcel A were removed. Although pipeline natural gas had become the predominant form of gas supplied to customers by the 1960s, limited production of manufactured gas continued to supplement natural gas supplies during peak demand periods until the early 1970s. In 1973, Eastern Gas and Fuel Associates purchased MVGC's stock, and Boston Gas purchased MVGC's assets.

In the mid-1970s, remaining MGP - affiliated structures were removed from Parcel A, and the Malden Redevelopment Authority (MRA) subdivided the parcel into four properties: 51 Commercial Street, 77 Commercial Street, 99-103 Commercial Street, and 105-109 Commercial Street. Development of Parcel A took place between 1973 and 1980. Gas purification operations on Parcel B ceased in the 1960s, and in the mid to late 1970s,

previously existing structures were demolished and a two-story cinder block building, 129 Commercial Street, was constructed. Gas storage features remained on Parcel D until approximately 1975, when the gas holders, governor house and support facilities were dismantled.

Parcel E remained as the primary operational property for MVGC. In the early 1960s gas manufacturing facilities on Parcel E were replaced by an office and storage building, which was constructed on Parcel E east of the control building. In the early 1970s, several structures associated with the gasification process were still present on the parcel.

In the mid-1970s (approximately 1973-1975) remaining MGP-affiliated structures on Parcel E were razed except for the control building and the office and storage building. Following demolition of the former MGP structures in the mid-1970s, the office and storage building was expanded and extended north. This building is now known as the operations building. A maintenance garage was also constructed at this time. KeySpan Energy Delivery New England purchased the Boston Gas Company in 2000, and took ownership of Parcel E.

1.4 Historic Re-routing of Surface Water Bodies on the Site

The former Malden MGP was located in a marshy area, partially underlain by an organic peat deposit, and was transected by two meandering water bodies. The historic courses of the two surface water bodies on the Site, the Malden River and the West End Brook, are shown on Figure 6. Historically, the Malden River meandered through the Site, flowing generally from the north to south side of the Site, along the eastern Site boundary. The West End Brook, a tributary to the Malden River, flowed across the center of the Site from west to east before emptying into the Malden River. The West End Brook was straightened sometime in the mid 1900s, and in approximately 1970 - 1971, the Metropolitan District Commission (MDC) constructed a culvert to convey the West End Brook across the Parcel E portion of the Site. In 1977, the Malden River culvert was constructed. Both culverts are supported on wooden piles to provide structural support, and are underlain by a layer of crushed stone, approximately 3 ft. thick.

1.5 Nature and Extent of MGP Contamination

The former Malden MGP operated from the mid-1800s until the early 1970s. The types and levels of contaminants detected in soil, groundwater and sediment are consistent with this long industrial history. Operations at the former Malden MGP facility used coal, coke, and oils as raw feedstock for combustion in retorts and produced a number of residuals while processing the generated gas and separating impurities prior to gas distribution. MGP residuals included solid residue from the retorts, hydrocarbon/aqueous condensate from gas separator units (e.g., condensers, tar separators), and solid wastes from the purification process.

MGP residuals remaining on the former Malden MGP Site generally include tars, oils, and some inorganic contaminants. Classes of compounds most commonly observed in samples collected at the site include PAHs, VOCs, and cyanide. As described in the conceptual site models presented in the Phase II Comprehensive Site Assessment and the Phase III RAP, several different types of contamination have been identified on the Site. The interpreted

extents of the different types of contamination present based on Site investigations to date, are shown on Figure 7. The types of contamination identified include the following:

- **Tar-saturated material (TSM):** TSM refers to soil that is saturated with coal tar. Generally TSM has been observed at depths of between approximately 4 and 17.5 ft. below ground surface, on the upper surface of the organic deposits in the Site subsurface. A portion of the coal tar in TSM is fluid enough to be able to flow in the subsurface as dense non-aqueous phase liquid (DNAPL), described below. TSM on the Site is believed to exist beneath existing buildings on Parcels A and E, including the KeySpan Operations Building on Parcel E. TSM impacts observed in the WEB and MR Culverts on the 100 Commercial Street property have been the subject of previously completed response actions as described herein.
- **DNAPL:** Free-phase DNAPL (i.e., separate phase organic oils that are heavier than water and therefore migrate downward in the subsurface) has been observed in monitoring wells on the Site. DNAPL tends to collect on top of the organic deposit. The results of Site investigations to date indicate that a fraction of the DNAPL at the site is mobile and can be collected from the subsurface. Based on NAPL thickness measurements, the total volume of DNAPL present is estimated to be approximately 13,000 to 22,000 gallons. Monitoring well observations suggest that a portion of the DNAPL on the Site may be located beneath existing buildings on Parcels A and E.
- **LNAPL:** Free-phase light non-aqueous phase liquid, oils that are lighter than water and float on the water table, have been identified in some monitoring wells on Parcels A and E. Based on NAPL thickness measurements, the total LNAPL volume is estimated to be approximately 8,000 to 11,000 gallons. Monitoring well observations suggest that LNAPL may also be located beneath existing buildings on the southern portion of Parcel A.
- **BTEXSN compounds in soil and groundwater on Parcel B:** Data collected during the Phase II and subsequent investigations indicate the presence of benzene, toluene, ethylbenzene, xylenes, styrene, and naphthalene (BTEXSN) contamination in soil and groundwater beneath the 129 Commercial Street building. Elevated VOC concentrations (primarily benzene, toluene and styrene) have been detected in air inside the facility. Based on our current understanding of subsurface conditions beneath the 129 Commercial Street building, indoor air impacts appear to result from volatilization of contaminants from impacted soil and groundwater.
- **Petroleum-impacted soil on Parcel E:** Petroleum-impacted soil associated with the former tank farm is located in the vicinity of the historic above-ground petroleum and coal tar tanks on the northern half of Parcel E, just north of the WEB Culvert. The primary contamination observed in this area appears to be petroleum impacts associated with the historic fuel tanks. Generally, soils in this area are not saturated with coal tar, as is the case in the TSM-impacted areas on other portions of Parcel E. However, some soil samples in this area contained a mixture of tar-related compounds and petroleum compounds, indicating a mixture of contamination types in this area.

- BTEX contamination in soil and groundwater located south of Callahan Park: Elevated BTEX concentrations have been detected in soil and groundwater beneath the southern parking lot of Callahan Park and in Charles Street south of Callahan Park. This contamination is believed to be due to operation of the former governor house, which regulated gas flow from large gas holders to the distribution system beneath Charles Street. Contamination associated with the former governor house has been detected in soil in the eastern corner of the southern parking lot and in groundwater in monitoring wells located in the Charles Street right of way. This area includes approximately 3,670 square ft. (sf), or 0.08 acres, of the southern Callahan Park parking lot, and a 267-ft. length of Charles Street, covering an area of approximately 13,970 sf, or 0.32 acres. The Phase II Risk Characterization demonstrated a condition of No Significant Risk for this area. Furthermore, impacted soil in the Governor House area is not considered to be an ongoing source of contamination. Therefore, a Class A-3 RAO is anticipated in the near future for the Governor House portion of the Site. In addition, the Governor House portion of the Site was incorporated into the existing Grant of Environmental Restriction for Callahan Park, which specifies use restrictions (i.e., property use is maintained as a public park) and provides procedures and limitations for excavation of impacted soil.

2. CURRENT REGULATORY STATUS

Contamination present at the Site is the result of over 100 years of MGP operations, and has impacted soil, groundwater, indoor air, sediments and surface water to varying degrees. Assessment activities began on Parcel E in 1988 and have since been conducted on Parcels A, B, and D under several MADEP RTNs. Response actions have included several Release Abatement Measures (RAMs) and Immediate Response Actions (IRAs). A Phase II Comprehensive Site Assessment was submitted to MADEP on 28 December 2001, and a Phase III RAP for the terrestrial portion of the Site was submitted on 2 July 2003. Additional details regarding the site regulatory history are provided below.

2.1 Site Regulatory History and Related RTNs

Investigations began at the Site in 1988, when the presence of coal tar contamination was first confirmed through subsurface borings. The Site was initially designated a Tier II Site under the MCP and assigned Release Tracking Number (RTN) 3-0362. RTN 3-0362 has been used to manage MCP compliance activities for the former holdings of the Malden MGP facility that have not been addressed by other parties, or that have not had a Waiver Completion Statement or RAO filed at MADEP. Several RTNs that have been assigned due to releases or possible releases of contaminants associated with the former Malden MGP facility have been linked with or otherwise related to RTN 3-0362, and include the following:

- RTN 3-03757, Parcel B, 129 Commercial Street: Assessment began in 1991 by others on behalf of the property owner(s) in response to the identification of oil and hazardous materials. These investigations detected concentrations of VOC compounds (BTEX and naphthalene) in soil and groundwater greater than reportable concentrations, and detected elevated concentrations of VOCs in indoor air in the commercial building on the property. RTN 3-03757 for the 129 Commercial Street property was linked to the former Malden MGP Site RTN 3-0362 on 6 February 1997. As described below, an MCP Release Abatement Measure (RAM) is ongoing and includes the installation and maintenance of a mechanical sub-slab venting system and quarterly monitoring of indoor air. These additional response actions have resulted in a condition of No Significant Risk.
- RTN 3-11581, Diesel Fuel Piping IRA: An assessment-only IRA was conducted on Parcel E property in September 1994 in response to a failed tightness test for piping related to a diesel fuel tank. A small, "pinhole" leak was identified in the pipe and was repaired. Re-testing confirmed that the pipe was "tight," and an IRA Completion Report was filed with MADEP on 8 November 1994. Because the diesel fuel contamination was potentially commingled with MGP residuals, RTN 3-11581 was linked with RTN 3-0362 upon completion of the IRA.
- RTN 3-13310, Parcel D (William R. Callahan Park): Based on the identification of the presence of MGP residuals during Initial Site Investigations on the Callahan Park property, RTN 3-13310 was assigned, and a RAM was initiated in January 1996 as a risk reduction measure. As described above in Section 1.2, Callahan Park (Parcel D) is located on the northeast corner of Charles and Pearl Streets adjacent to the Site, and was the location of historical MGP gas holders and the governor house, which

regulated gas flow from the holders to the distribution system. RAM activities included assessment of the extent of contamination and removal of oily soil and water associated with an historical drip pot and drip valve, and removal of mercury-contaminated soils associated with the former Medford Booster House. Upon completion of these remedial actions, Callahan Park was restored through soil placement and re-grading, followed by placement of a marker barrier, drainage subgrade, loam and sod. Catch basins in the Park were repaired or replaced, a new parking area was created on the northwestern corner of the Park, and the southern parking lot was re-paved.

A Partial Class A-3 RAO was filed for Callahan Park in January 1997. A small portion of the Callahan Park southern parking lot (the southwestern section) was included in the GER, as shown in Figure 3, but is not considered part of the former Malden MGP Site, RTN 3-0362. Similarly, a small portion of the Callahan Park southern parking lot (the southeastern section or Governor House area) was included in the GER but excluded from the partial Class A-3 RAO, as shown in Figure 3.

The partial Class A-3 RAO indicated that the extent of soil and groundwater contamination identified in the vicinity of the former Governor House and Charles Street had not been fully assessed at the time and was therefore excluded from the limits of Class A-3 RAO. This portion of the Callahan Park property is included in RTN 3-0362, and in this Partial Class C RAO.

- RTN 3-13345, Charles Street IRA (linked with RTN 3-13310): This assessment-only IRA was conducted in response to the detection of elevated total VOC concentrations identified in groundwater in Charles Street just south of Callahan Park. As described above, the results of Initial Site Investigation activities on Callahan Park indicated the presence of MGP residuals (i.e., elevated PAH and VOC concentrations in soil and groundwater). A total VOC concentration of 9.72 mg/l in a monitoring well located in Charles Street (B130-MW) that was screened less than 15 ft. below ground surface and located less than 30 ft. from an occupied residence prompted the IRA. The purpose of the IRA was to assess whether the elevated VOCs detected in groundwater in Charles Street had resulted in elevated VOC concentrations in homes south of Charles Street, and if so whether the elevated VOC concentrations posed risk to the residents in the homes.

IRA activities included the necessary notifications, gauging for NAPL in wells in Charles Street, monitoring of indoor air for a 24-hour period inside 3 residential buildings, re-sampling of monitoring well B130-MW, and preparation of a Risk Characterization assessing risk due to exposure to VOCs in indoor air inside the residences. The Risk Characterization satisfied a condition of No Significant Risk to human health for carcinogenic and noncarcinogenic effects. Therefore, an IRA Completion Statement was submitted on 19 March 1996 and further actions were not conducted.

- RTN 3-13753, Gasoline Release to Soil IRA, 100 Commercial Street: This RTN was assigned to an underground storage tank (UST) removal that took place on the 100 Commercial Street Property (Parcel E) in May 1996. The removal began as a RAM

under RTN 3-0362 but was converted to an IRA and assigned RTN 3-13753 due to the detection of PID measurements in excess of 100 ppm during the UST removal. Two gasoline USTs and one diesel UST were removed, along with approximately 1053 gallons of water/gasoline mixture and 24 tons of petroleum-contaminated soil. An IRA Completion Statement for RTN 3-13753 was submitted on 12 July 1996, indicating that future response actions related to this release would be conducted under RTN 3-0362.

- RTN 3-12448 and 3-13754, WEB and MR Culvert IRAs: An IRA with RTN 3-12448 was initiated in May 1995 in response to observation of a recurring, discontinuous sheen on surface water flowing in the Malden River Culvert. IRA activities under RTN 3-12448 included deployment of absorbent booms in the culvert, a video survey of conditions in the culvert, installation of test borings and monitoring

good condition. Additionally, DNAPL was not observed in a monitoring point installed beneath the MR Culvert near its outfall. Therefore, on 12 September 2003 an IRA completion report for RTN 3-13754 was submitted to MADEP, indicating that future response actions related to this release would be conducted under RTN 3-0362.

Annual Tier II Extension Submittals were made for RTN 3-0362 from 1996 to 1999, and in August 1999, a Tier Re-Classification/Tier IA Permit Application was submitted to MADEP. In response, MADEP issued Tier IB Permit 7378, with an effective date of 28 December 1999. A Phase II Comprehensive Site Assessment was submitted to MADEP on 28 December 2001, and a Phase III RAP was submitted to MADEP on 2 July 2003. The Phase III report presented an evaluation of remedial alternatives for the terrestrial portion of the Site. The selected remedial alternative in the Phase III RAP constituted a temporary solution that included the following components:

- Extraction of DNAPL using extraction wells on Parcels A and E
- LNAPL extraction using belt-skimmers on Parcels A and E
- Installation of vertical barriers to prevent or reduce DNAPL migration between adjacent properties, if necessary
- In-situ chemical oxidation of TSM and petroleum-impacted soils (once NAPL quantity has been sufficiently reduced) on Parcels A and E
- Installation of biosparging and soil vapor extraction (SVE) systems on Parcel B, installed using HDD methods beneath the 129 Commercial Street building.
- A Site-wide groundwater monitoring program was recommended, including the sampling of approximately 20 to 25 monitoring wells on an annual basis, to ensure that site conditions remain stable during the implementation of the Temporary Solution on the Site.
- AULs may be implemented on properties located within the boundaries of the Site to mitigate potential exposure to contaminated soil. AULs may mandate the maintenance of a direct contact barrier (i.e., asphalt pavement) to prevent contact of Site employees, visitors and trespassers with contaminated soil.

2.2 Ongoing Response Actions at the Site

Currently, a RAM is ongoing at the 129 Commercial Street property. This RAM was initiated to address elevated concentrations of BTEXSN compounds detected in indoor air at 129 Commercial Street. The stated objective of the RAM Plan submitted to MADEP in July 1998 was to seal portions of the floor slab that were identified as VOC vapor migration pathways through the floor slab in order to reduce VOC concentrations in indoor air. The RAM was modified on 9 April 1999 to include the installation of a sub-slab venting system. As described in more detail in Section 3, the RAM has involved quarterly indoor air monitoring, a pilot floor-sealing program, and the installation of a pilot scale, sub-slab ventilation system.

3. SUMMARY OF RISK REDUCTION MEASURES CONDUCTED TO DATE

To date, substantial Risk Reduction Measures have been undertaken on the former Malden MGP Site. Contaminated media have been removed during four general response actions at the Site. These include: (A) removal of underground storage tanks and contaminated soil from 100 Commercial Street; (B) pilot-scale removal of LNAPL from a monitoring well located on Parcel E; (C) removal of sediments, DNAPL, and other wastes from 100 Commercial Street and the WEB and MR Culverts; and (D) reduction of VOC concentrations in indoor air at the 129 Commercial Street property. These response actions are described in more detail below.

- **Removal of USTs from the 100 Commercial Street Property:** Three USTs were removed from the 100 Commercial Street Property (Parcel E) in May 1996. The removal began as a RAM under RTN 3-0362 but was converted to an IRA and assigned RTN 3-13753 due to the detection of PID measurements in excess of 100 ppm during the UST removal. Two gasoline USTs and one diesel UST were removed, along with approximately 1063 gallons of water/gasoline mixture and 24 tons of petroleum-contaminated soil.
- **Pilot-scale LNAPL Removal, Parcel E:** As part of a RAM initiated in July 1998, a pilot-scale "siphons-without-a-pump" (SWAP) LNAPL removal system was installed in monitoring well B109A-OW, in which LNAPL had been consistently identified at thickness ranging from 0.2 ft. to 1.0 ft. The results of the test indicated that the SWAP technology was not appropriate for the LNAPL present at the Site; approximately 0.5 gallons of LNAPL were collected over a period of approximately 10 months. Therefore, the conclusion of the RAM was that alternative LNAPL removal methods should be identified.
- **WEB and MR Culvert IRAs:** Two IRAs were conducted in response to the observance of sheens on surface water flowing in the WEB and MR Culverts. Response actions conducted in the culverts and in the vicinity of the culverts between May 1995 and September 2003 included monitoring, sealing of culvert openings, sediment removal, lining of drain lines, and DNAPL removal. In total, approximately 525 tons (approx. 330 cy) of contaminated soil and sediments were removed from catch basins and the culverts and disposed of off-site. Absorbent booms were also installed in the WEB and MR Culvert, and waste and debris collected on the booms was periodically collected and disposed. Existing culvert expansion joints were sealed and culvert weep holes were grouted to prevent infiltration of DNAPL to the culverts. Catch basins and drain lines that discharge into the culverts were sealed and lined, and a grout seepage collar was installed beneath and around a discrete portion of the MR Culvert to prevent DNAPL migration beneath the culvert. A DNAPL recovery well (designated RW-1) was installed adjacent to the WEB Culvert. A total of approximately 702 gallons of DNAPL was extracted from the subsurface using this well between September 2001 and September 2003. The IRA Completion Report for RTN 3-12448, West End Brook & Malden River Culverts, was dated 3 May 1996. The IRA Completion Report for RTN 3-0362 & 3-13754, West End Brook & Malden River Culverts, was dated 12 September 2003.

- **100 Commercial Street Corrosion Protection Anode Installation URAM:** This URAM was initiated by Haley & Aldrich on 16 November 2001 on behalf of KeySpan, the current property owner. The URAM consisted of the excavation of a trench approximately 1 ft. deep, and installation of seven corrosion-protection anodes in borings created using hollow-stem augers. Pavement was replaced subsequent to completion of anode installation. The anodes were installed to provide corrosion protection for a gas pipe on the KeySpan property. URAM activities included the management of contaminated soils generated during the anode installation. Excavated soils were re-used as backfill during the URAM; therefore soils were not sent off-site for treatment or disposal. A URAM Completion Report was submitted to MADEP on 19 February 2002.

- **100 Commercial Street Sewer Pipe Installation URAM:** This URAM was initiated by Haley & Aldrich in January 2003 on behalf of KeySpan. Activities conducted under this URAM included the installation of a sewer pipe at the northwest corner of the KeySpan Operations building. Cuts were made in the concrete slab of the building and a trench was excavated to install a sewer pipe. Haley & Aldrich personnel observed mild odors and visual indications of contamination during excavation. Sewer piping was installed between 14 and 21 January 2003. Subsequently the trench was backfilled with excavated soils, compacted and concrete was poured to replace the floor slab on 24 January 2003. Less than 1 cy of soil was sent offsite for treatment to Clean Harbors of Bristol, CT on 16 April 2003. A URAM Completion Statement was filed on 13 May 2003.

- **129 Commercial Street RAM:** This RAM was initiated in November 1998 in response to the detection of elevated concentrations of benzene, toluene, ethylbenzene, xylenes, styrene and naphthalene contaminants (BTEXSN) detected during Phase II investigations in indoor air at 129 Commercial Street. Detected concentrations did not constitute an imminent hazard for workers in the building, and were less than applicable occupational standards set by the US Occupational Safety and Health Administration (OSHA). However, remedial actions were deemed necessary to reduce long-term risks due to indoor air exposure.

Initially, RAM activities included a pilot floor-sealing program in a portion of the 129 Commercial Street facility. However, testing of the sealed portion of the floor indicated that this program was not successful, and the RAM was modified to include the installation of a sub-slab venting system. A sub-slab venting system was installed in October 1999, consisting of five 2-inch diameter soil vapor extraction points installed horizontally through the foundation wall beneath the floor slab. The vapor extraction points extend approximately five ft. beneath the building. These points were connected to a 140-cfm blower that removes vapors from beneath the floor slab and directs them through a 165-lb granular activated carbon drum for treatment. The blower and carbon drum are stored in a temporary building located east of the building along Commercial Street. Treated air is emitted through a 4-inch diameter vent pipe to the atmosphere. This system has been maintained since its installation, and quarterly indoor air monitoring has been conducted in the facility. The results of monitoring indicate that the levels of VOCs in indoor air have decreased.

Spent carbon drums are sent off-site under hazardous waste manifest to Clean Harbors, Inc. of Braintree, MA or Bristol, CT. To date, 46 drums (approximately 7,590 lbs) of spent carbon have been sent off-site. The Risk Characterization included in the Phase III RAP satisfied a condition of No Significant Risk for workers inside the facility assumed to inhale indoor air. However, because the data used for the Risk Characterization included data collected while the system was operational, it is assumed that this system is required to maintain a condition of No Significant Risk at this time.

4. NO SUBSTANTIAL HAZARDS

The primary contaminants of concern at the former Malden MGP Site are PAHs, VOCs, metals and cyanide in soil and groundwater, and VOCs in indoor air at 129 Commercial Street. A Temporary Solution requires the elimination of Substantial Hazards. The Substantial Hazard Evaluation (SHE) is comprised of two components: human health and ecological evaluation. An evaluation of human health and ecological Substantial Hazards was conducted as part of the Method 3 Risk Characterization that was prepared for the former Malden MGP Site.

AMEC Earth and Environmental (AMEC) prepared two Risk Characterization documents for the Site; the first is included in the Phase II Comprehensive Site Assessment, and is entitled "Method 3 Risk Characterization for the Former Malden Manufactured Gas Plant Site". The second document, which incorporates additional Site data collected during Phase III Site work, is included in the Phase III RAP and is entitled "Amendment to Method 3 Risk Characterization and Substantial Hazard Evaluation, Portion of Former Manufactured Gas Plant Site". The aggregate results of these Risk Characterizations pertaining to the terrestrial portion of the Site are discussed in this section.

4.1 Human Health Substantial Hazard Evaluation

The human health SHE evaluates potential risk for current site use in a manner similar to the assessment of Significant Risk, except the SHE evaluates potential risk posed over a reduced exposure period. The exposure period considered for the SHE is equal to the period of time elapsed between notification to MADEP of the presence of hazardous materials at the Site and the date that the SHE is conducted, plus an additional five years. The results of the SHE are compared to the same thresholds as the assessment for Significant Risk; as a result, a risk that is considered a Substantial Hazard indicates a greater degree of risk to the exposed population than failure to demonstrate a condition of No Significant Risk. The following human health receptors were quantitatively evaluated for current site uses of the terrestrial portion of the Site:

- A utility worker who is exposed to soil and groundwater through incidental ingestion and dermal contact, inhalation of fugitive dust, and the inhalation of VOCs migrating from soil and groundwater into ambient air via a trench;
- A trespasser entering the Site during utility work who is exposed to soil through incidental ingestion and dermal contact, inhalation of fugitive dust, and inhalation of VOCs migrating from soil and groundwater into ambient air in the trench;
- An on-site commercial/industrial worker who is exposed to VOCs via inhalation of indoor air vapors that have migrated from soil and groundwater beneath the building; and
- A landscape worker who is exposed to soil through dermal contact and incidental ingestion.

1. **Property access and property use:** The Former Malden MGP Site is comprised of properties, all of which are owned by entities other than MEC. Therefore, implementation of the remedy must be coordinated with the needs of property owners. The properties located within the limits of the Site are occupied by operating businesses, which must be allowed to function during implementation of the remedy.
2. **Appropriate sequencing of remedial technologies:** On Parcels A and E, the quantity of NAPL in the subsurface must be reduced to the extent practicable prior to the remediation of TSM and soil. Remediation of TSM or soil in the presence of LNAPL or DNAPL would be ineffective.
3. **Other technical considerations:** Technical factors regarding the effectiveness of the proposed remedial components will be taken into consideration during implementation of the remedy. For example, proper location of DNAPL extraction wells is dependent upon the elevation of the organic deposit, which has been observed to be highly irregular during subsurface investigations. Based on these observations, DNAPL extraction wells may be installed in stages, such that the locations of the second stage of DNAPL extraction wells would be determined based on the results obtained in the first stage. The most efficient placement of DNAPL or LNAPL extraction wells may result in the installation of extraction wells on one property before another. The presence of utilities, utility conduits, public streets, parking lots, and buildings also present technical considerations.

5.3 AULs

This Class C RAOP is not based upon the implementation of an Activity and Use Limitation (AUL). Where a Temporary Solution is expected to be in place for a long period of time, an AUL may be useful as a means of providing notice of the residual contamination to future holders of an interest in property at the Disposal Site. As definitive and enterprising steps progress, AULs will be pursued for those parcels where it can be shown that there is a condition of No Significant Risk and no continuing sources of contamination. Implementation of AULs on these parcels could allow for the achievement of Permanent Solutions as partial RAO Statements. This will further limit the area of the Temporary Solution and bring more focus toward achieving a Permanent Solution for that remainder of the Disposal Site.

5.4 Pilot Tests and Bench-Scale Studies

The need for performance of Pilot Tests and Bench-Scale Studies is not anticipated at this time. However, the need for Pilot Tests and Bench-Scale Studies may be re-evaluated as definitive and enterprising steps are performed and as new technologies are reviewed.

5.5 Additional Technology Review

New technology developments will be reviewed to determine if implementation would result in progress toward a Permanent Solution. These will be reported during the required 5 year review, or sooner if applicable.

5.6 Review Site Uses

Pursuant to 310 CMR 40.0580, once every 5 years, site uses will be reviewed to determine if the previously evaluated technologies or new technologies can be implemented without serious disruption to property owners and user's normal daily operations.

5.7 Post-RAO Active Operation and Maintenance

Currently, ongoing Active Operation and Maintenance activities managed under the 129 Commercial Street RAM are considered to be required to maintain the conditions upon which this RAO is based. Pursuant to 310 CMR 40.1056(1)(e), Post-RAO Active Operation and Maintenance activities under 310 CMR 40.0896 will be conducted in support of Post-RAO response actions. At this time, it is anticipated that Post-RAO response actions described above will be continue to be conducted as MCP Release Abatement Measures.

A site-wide monitoring program will be conducted developed that will include gauging of selected monitoring wells for groundwater elevation and presence or thickness of NAPL, and/or groundwater sampling and testing. In addition, an annual monitoring program for the MR Culvert and the tar monitoring port that was installed in the MR Culvert near its outfall (TMP-1) will be developed and implemented.

5.8 Projected Schedule

It is anticipated that initial NAPL recovery will begin in Spring/Summer 2004 with installation of DNAPL recovery on Parcel E. A RAM Plan for NAPL recovery is currently being prepared and is anticipated to be submitted in Spring 2004. Following evaluation and assessment of DNAPL recovery on Parcel E, further NAPL recovery activity will be commenced, including DNAPL recovery on Parcel A, and LNAPL recovery Parcel A and Parcel E. SVE and biosparging on Parcel B is in the pre-design stages with ongoing activities including a detailed utility survey and additional data review. A RAM Plan Modification for Parcel B will be developed following these activities and is anticipated to be submitted in later 2004. More detailed schedules for implementation and operation and maintenance for these definitive and enterprising steps will be included in the respective RAM plans.

6. QUALITY ASSURANCE/QUALITY CONTROL AND LSP NARRATIVE

Recently, DEP has implemented a MCP Data Quality Enhancement Program (DQEP) and has issued guidance regarding this program. As of August 2003, the Department expects that analyses of all samples used to support MCP actions will address enhanced data quality objectives. To facilitate this, the Department has developed specific analytical methods and will offer a "Presumptive Certainty" option for data that are derived using these methods and that meet certain other program requirements.

The samples collected for the Partial Class C RAO Opinion described herein were collected before 1 August 2003. These samples were analyzed by approved EPA and DEP analytical methodologies. The laboratory analytical data were provided in the Phase II report, Volumes V, VI, VII, VIII, IX, X, and XII. Haley & Aldrich has reviewed the analytical laboratory data reports for the sampling and analysis conducted at the Site. Our previous review included an evaluation of field collection documentation, holding times, blanks, surrogates, matrix spikes, laboratory and field duplicates, and laboratory control samples and would be considered to satisfy current DQEP requirements. We have assessed the data herein for QA/QC parameters and conclude that the results are acceptable for incorporation into this Response Action Outcome (RAO) Statement and are suitable for the intended use.

7. CONCLUSIONS

A Partial Class C RAO has been achieved for the terrestrial portion of the former Malden MGP Site, located in Malden, Massachusetts. The Partial Class C RAO has been achieved through risk reduction measures and is based on an MCP Substantial Hazard Evaluation that concludes that a condition of No Substantial Hazard exists for the terrestrial portion of the Site.

Definitive and enterprising steps toward a Permanent Solution have been outlined in Section 5, and are anticipated to include removal of LNAPL and DNAPL from the subsurface and reduction of contaminant concentrations in soil, groundwater, and indoor air at the Site. Achievement of a Permanent Solution is not feasible at this time, because a significant portion of the LNAPL, DNAPL and impacted soils and groundwater are located beneath occupied buildings. The remedial approach for the Site at present is to reduce the quantity of LNAPL and DNAPL in the Site subsurface in accessible portions of the Site, and reduce VOC concentrations in soil and groundwater beneath the building on Parcel B to the extent practicable. The Temporary Solution for the Site will be re-evaluated within five years and reconsidered in the event that a change in Site conditions or advances in technology enable access to currently inaccessible portions of the Site.

8. LSP SEAL AND SIGNATURE

The seal and signature of the Licensed Site Professional, Richard P. Standish, LSP#2242, are provided on BWSC Form BWSC-104, which is being submitted separately along with this document. A copy of BWSC Form-104 is included in Appendix A.



REFERENCES

1. Haley & Aldrich, Inc., "Report on Phase III Remedial Action Plan, Former Malden MGP Site - Upland Portion, Malden, Massachusetts", dated June 2003
2. Haley & Aldrich, Inc., "Report on Phase II Comprehensive Site Assessment, Former Malden MGP Site, Malden, Massachusetts", dated 28 December 2001
3. Haley & Aldrich, Inc., Tier II Extension Submittals, Former Malden Manufactured Gas Plant, dated 17 February 1995, 16 April 1996, 6 February 1997, 19 February 1998, and 17 February 1999
4. Haley & Aldrich, Inc., "Tier Reclassification Submittal and Tier 1A Permit Application, Former Malden MGP, Malden, Massachusetts", dated 20 August 1999
5. Haley & Aldrich, Inc., "Release Abatement Measure Plan, Former Manufactured Gas Site, Parcel B, 129 Commercial Street, Malden, Massachusetts, RTN-3-0362 and Linked RTNs 3-3757, 3-13310, and 3-13345", dated 2 July 1998
6. Haley & Aldrich, Inc., "Modification to Release Abatement Measure Plan, Former Malden MGP Site, Parcel B, 129 Commercial Street, Malden, Massachusetts", dated 9 April 1999
7. Haley & Aldrich, Inc., "Release Abatement Measure Status Report", Nos. 1 through 11, RTN 3-0362 and linked RTN 3-3757, dated 22 January 1999 through 7 October 2003
8. Haley & Aldrich, Inc., "Immediate Response Action Status Reports, RTN 3-12448, West End Brook & Malden River Culverts", dated 1 September 1995 and 20 October 1995, and 19 February 1996.
9. Haley & Aldrich, Inc., "Immediate Response Action Completion Report, RTN 3-12448, West End Brook & Malden River Culverts", dated 3 May 1996.
10. Haley & Aldrich, Inc., "Immediate Response Action Plan, RTN 3-13754, West End Brook & Malden River Culverts", dated 12 July 1996.
11. Haley & Aldrich, Inc., "Immediate Response Action Plan Update, RTN 3-0362 & 3-13754, West End Brook & Malden River Culverts", dated 12 March 1998.
12. Haley & Aldrich, Inc., "Immediate Response Action Status Report", Nos. 1 through 14, RTN 3-0362 & 3-13754, West End Brook & Malden River Culverts, dated 11 September 1996 through 12 March 2003.
13. Haley & Aldrich, Inc., "Immediate Response Action Completion Report, RTN 3-0362 & 3-13754, West End Brook & Malden River Culverts", dated 12 September 2003.

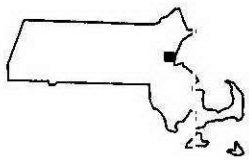
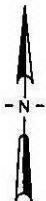
14. Haley & Aldrich, Inc., "Release Abatement Measure Plan, Former Manufactured Gas Plant, Parcel D - Callahan Park, Charles and Pearl Streets, Malden, Massachusetts, RTN 3-13310", dated January 1996.
15. Haley & Aldrich, Inc., "Immediate Response Action (IRA) Completion Report (Assessment Only), Charles Street, Malden, Massachusetts, RTN 3-13345", dated 19 March 1996.
16. Haley & Aldrich, Inc., "Data Report, Former Manufactured Gas Plant, Parcel D - William R. Callahan Memorial Park, Charles and Pearl Streets, Malden, Massachusetts, RTN 3-13310", dated 29 February 1996.
17. Haley & Aldrich, Inc., "Release Abatement Measure Completion Report, Former Manufactured Gas Plant, William R. Callahan Memorial Park, Charles and Pearl Streets, Malden, Massachusetts, RTN 3-13310", dated 27 June 1996.
18. Haley & Aldrich, Inc., "Report on Oil and Hazardous Material Site Evaluation, Boston Gas Company, Commercial and Center Streets, Malden, Massachusetts", dated 26 August 1988.
19. Haley & Aldrich, Inc., "Report on Oil and Hazardous Material Site Evaluation, Boston Gas Company, Commercial and Charles Streets, Malden, Massachusetts", dated 20 September 1988.
20. Haley & Aldrich, Inc., "Report on Oil and Hazardous Material Site Evaluation and Conceptual Remedial Recommendation, Boston Gas Company, 100 Commercial Street, Malden, Massachusetts", Volumes I through III, dated 21 September 1988.

G:\06558\Class C RAO\Malden_MGP_RAOC_final.doc





SITE COORDINATES: 42°25'25"N 71°04'27"W



U.S.G.S. QUADRANGLE: BOSTON NORTH, MA



UNDERGROUND
ENGINEERING &
ENVIRONMENTAL
SOLUTIONS

PARTIAL CLASS C RAO
FORMER MALDEN MGP SITE
MALDEN, MASSACHUSETTS

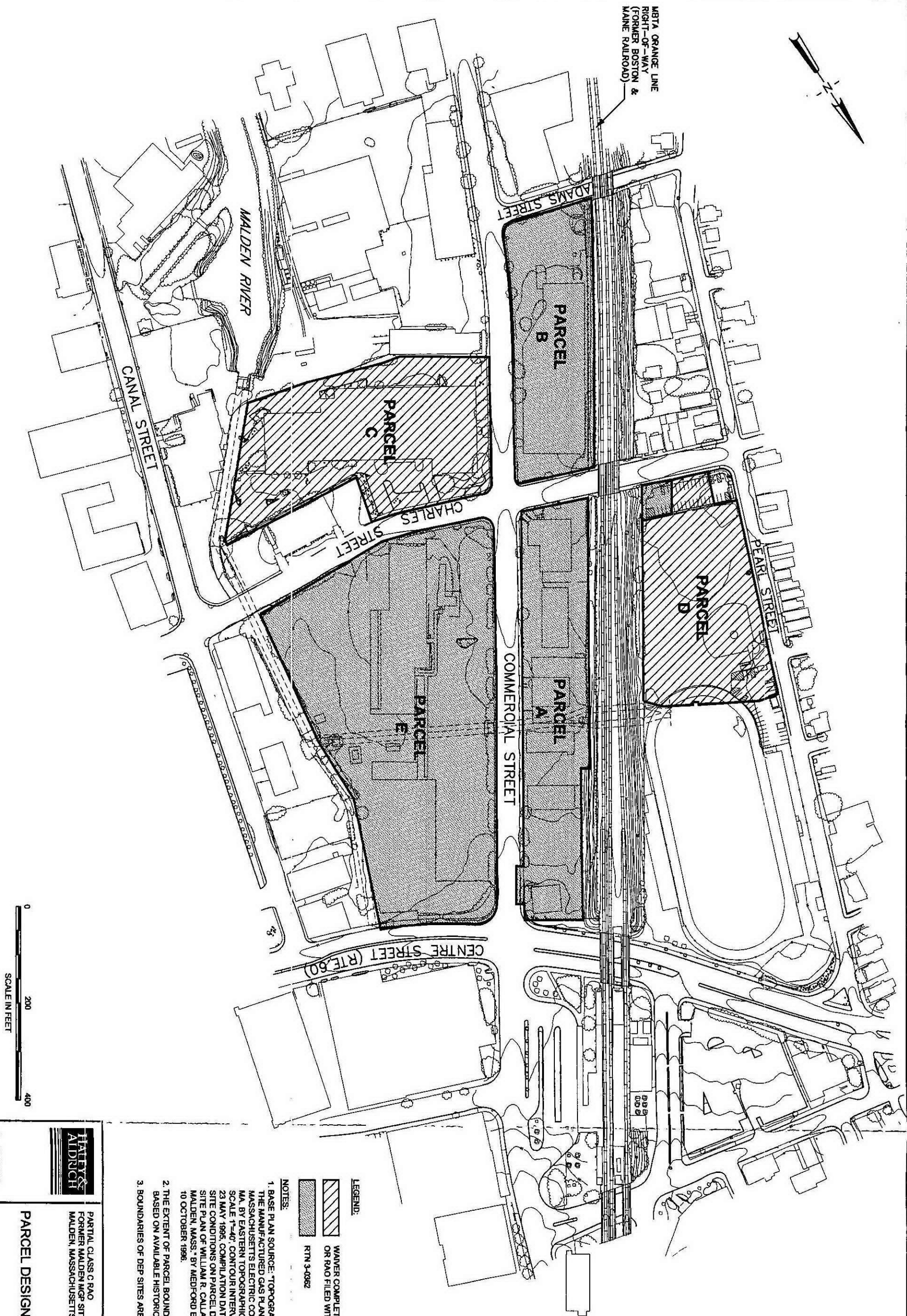
PROJECT LOCUS

APPROXIMATE SCALE: 1:25,000

FEBRUARY 2004

FIGURE 1

06558-669 A214





HATCH & ALDRICH
UNDERGROUND
ENGINEERING &
ENVIRONMENTAL
SOLUTIONS

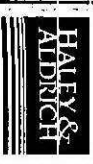
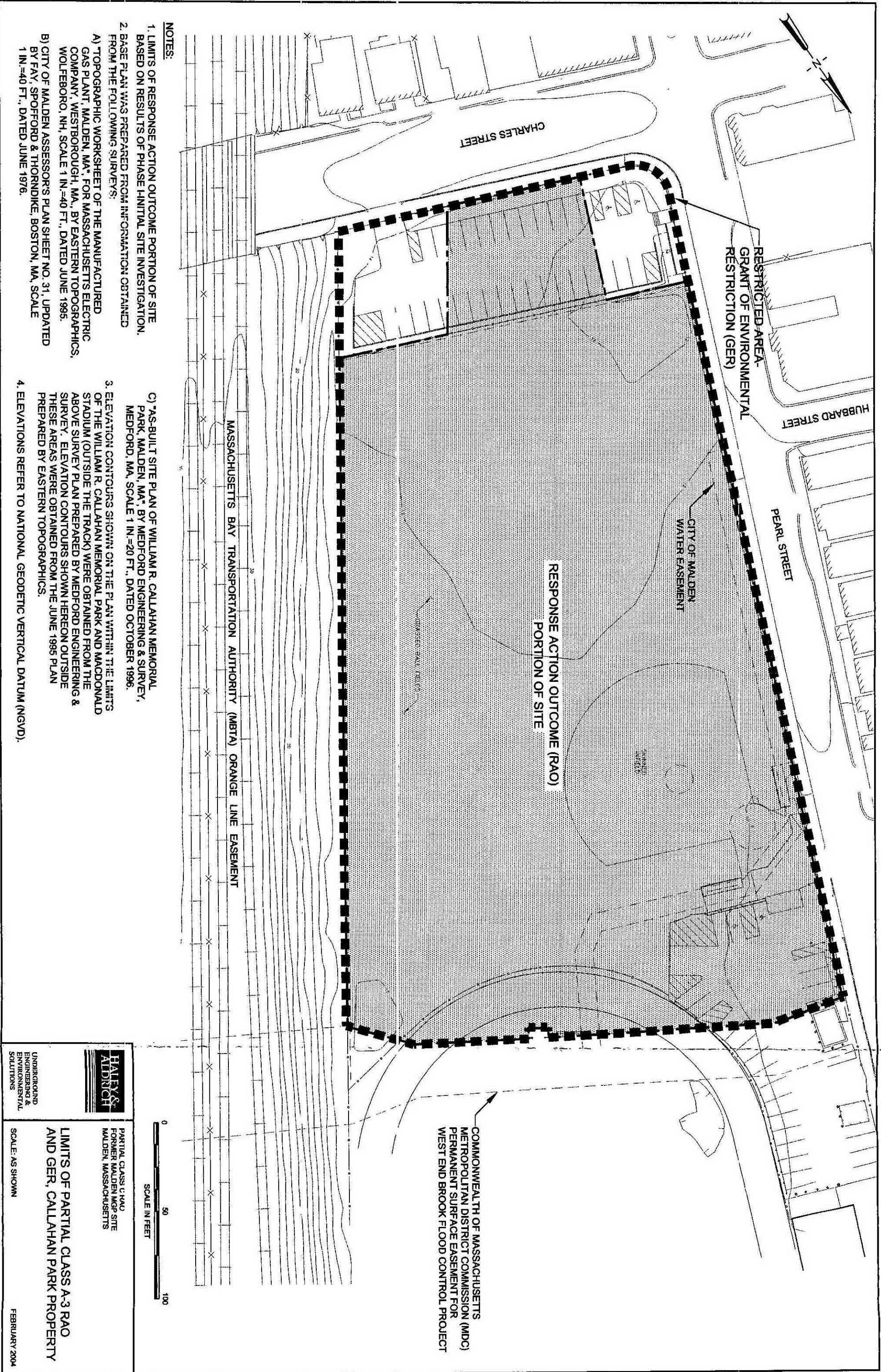
PARTIAL CLASS C RAO
FORMER MALDEN MGP SITE
MALDEN, MASSACHUSETTS

PARCEL DESIGNATIONS

SCALE: AS SHOWN

FEBRUARY 2004

FIGURE 2



PARTIAL CLASS C RAO
FORMER MALDEN MGP SITE
MALDEN, MASSACHUSETTS

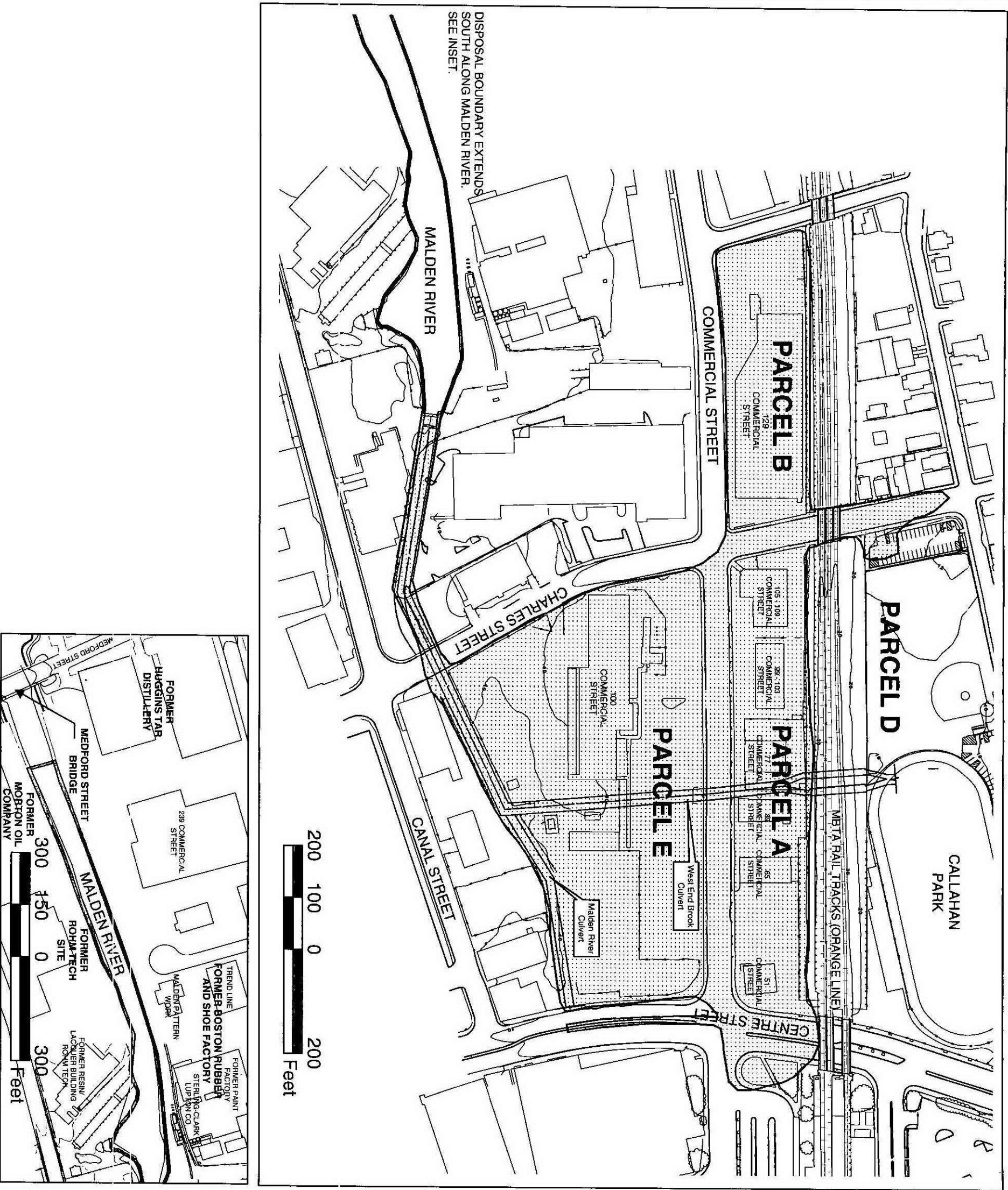
LIMITS OF PARTIAL CLASS A-3 RAO
AND GER, CALLAHAN PARK PROPERTY

SCALE: AS SHOWN

FEBRUARY 2004

UNDERGROUND
ENGINEERING &
ENVIRONMENTAL
SOLUTIONS

FIGURE 3



- LEGEND:
- FORMER MALDEN MGP DISPOSAL SITE BOUNDARY
 - PORTION OF MALDEN MGP DISPOSAL SITE SUBJECT TO PARTIAL CLASS C RAO
 - PILE-SUPPORTED CONCRETE CULVERTS INSTALLED BY MDC
 - EXISTING CHAIN LINK FENCE
 - GROUND SURFACE CONTOUR
 - RAILROAD TRACKS

NOTES:

1. BASE PLAN ADAPTED FROM "TOPOGRAPHIC WORKSHEET OF THE MANUFACTURED GAS PLANT, MALDEN, MA" FOR MASSACHUSETTS ELECTRIC COMPANY BY EASTERN TOPOGRAPIHC, JUNE 1935, AND CITY OF MALDEN ASSESSOR'S PLAN SHEETS 1 AND 2, JUNE 1935, AND SHEET NO. 53 BY FAY, SPOFFORD & THORNDIKE, INC., REVISED 30 JULY 1979.

HALEY & ADRICH

PARTIAL CLASS C RAO
FORMER MALDEN MGP SITE
MALDEN, MASSACHUSETTS

DISPOSAL SITE BOUNDARY AND
LIMITS OF PARTIAL CLASS C RAO

ENGINEERING &
ENVIRONMENTAL
SOLUTIONS

SCALE AS SHOWN

FEBRUARY 2004

FIGURE 4

MA DEP - Bureau of Waste Site Cleanup

Site Scoring Map: 500 feet & 0.5 Mile Radii

SITE NAME:

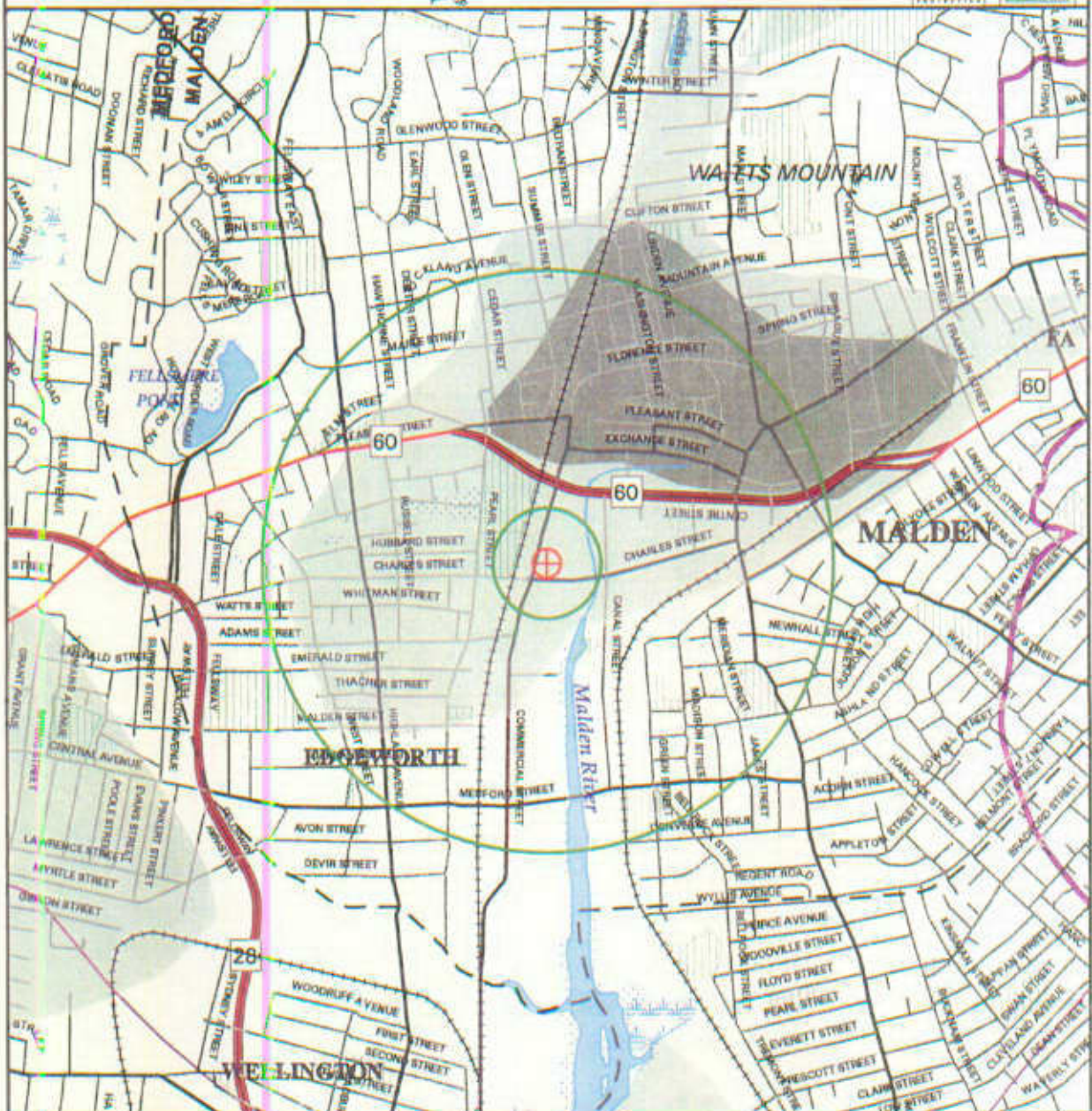
Former Malden MGP Site
Commercial and Charles Streets
MALDEN, MA
904220n 235040ew

Site Location

The information shown on this map is the best available at the date of printing. Please refer to the data source descriptive document.

MASS GIS
Massachusetts Geographic Information System
Massachusetts Executive Office of Environmental Affairs - 2004

MassGIS
Geographic Information System



Roads: Limited Access, Divided, Major Road, Connector, Street, Track, Trail
Boundaries: Town, County, DEP Region, Train, Powerline, Pipeline, Aqueduct
Bodies: Major, Sub, Stream, Potable, Intermittent, Man Made Shores, Dams
Potentially Productive Aquifers: Medium, High Yield
Non-Potential Drinking Water Source Area: Medium, High Yield

EPA Sole Source Aquifer; FEMA 100-year floodplain
Public Water Supplies: Ground, Surface, Non-Community
Approved Zone 2; NWPA; Surface Water Supply Zone A
Hydrography: Water Features, Public Surface Water Supply
Wetlands: Fresh, Salt, MHSWP Wetlands Habitat
Protected Open Space: ACEC
DEP Permitted Solid Waste Facilities; Certified Vernal Pools



SCALE 1:15000

January 13, 2004

06558-669 A217



PARTIAL CLASS C RAO
FORMER MALDEN MGP SITE
MALDEN, MASSACHUSETTS

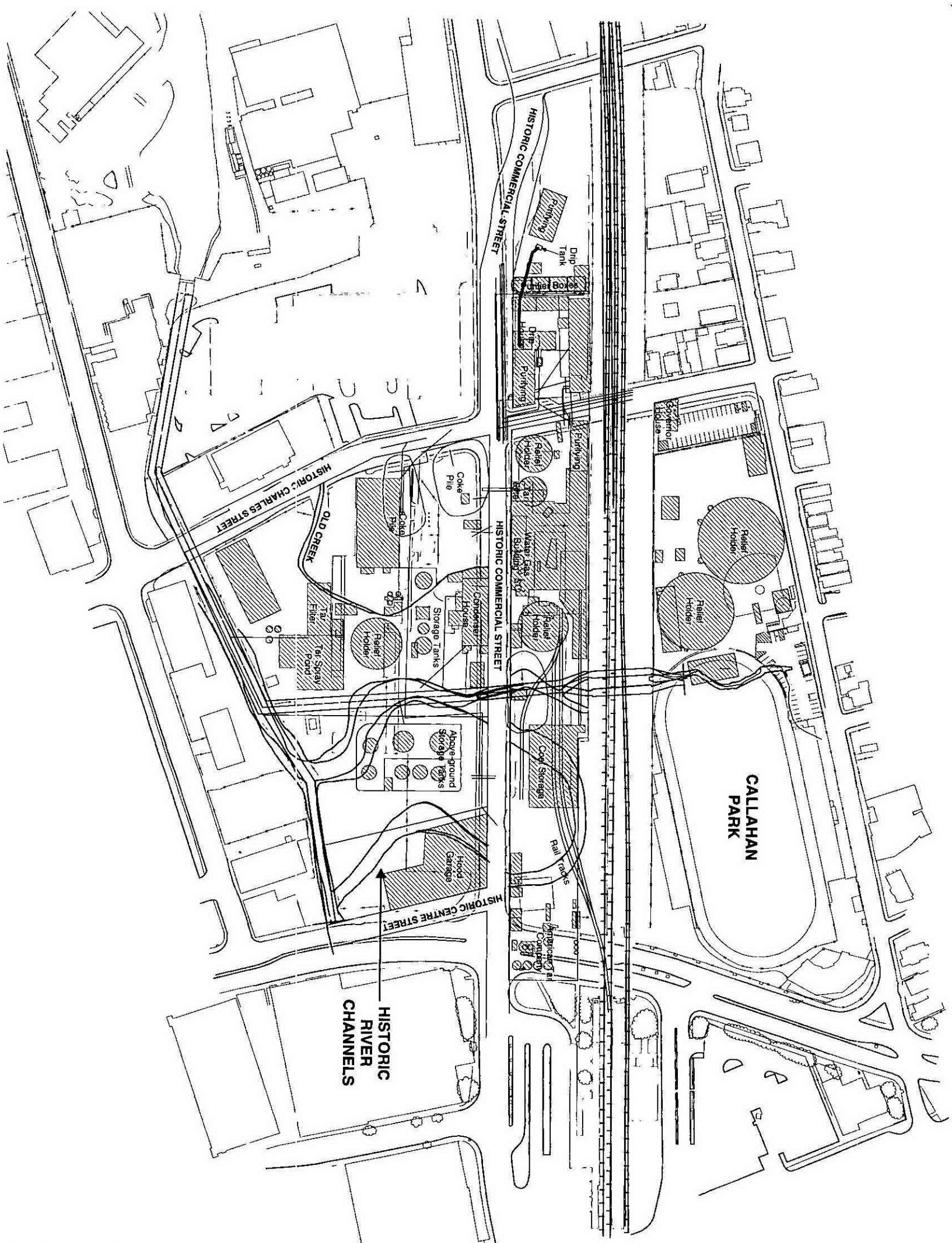
MA DEP SITE NATURAL RESOURCES MAP

UNDERGROUND
ENGINEERING &
ENVIRONMENTAL
SOLUTIONS

NOT TO SCALE

FEBRUARY 2004

FIGURE 5



LEGEND:

- HISTORIC MGP OPERATIONAL FEATURES
- APPROXIMATE LIMITS OF HISTORIC WATER FEATURES, 1907 AND 1916
- PRESENT-DAY BASEMAP FEATURES
- RAILROAD TRACKS
- EXISTING PILE-SUPPORTED CONCRETE CULVERTS (INSTALLED CIRCA 1970)

NOTES:

1. BASE PLAN ADAPTED FROM "TOPOGRAPHIC WORKSHEET OF THE MANUFACTURED GAS PLANT, MALDEN, MA" FOR MASSACHUSETTS ELECTRIC COMPANY BY EASTERN TOPOGRAPHICS, JUNE 1995, AND CITY OF MALDEN ASSESSOR'S PLAN SHEETS 1 AND 2, JUNE 1995, AND SHEET NO. 53 BY FAY, SPOFFORD & THORNDIKE, INC., UPDATED JUNE 1976 AND REVISED 30 JULY 1979.
2. HISTORIC RIVER LIMITS AND MGP STRUCTURES ESTIMATED BASED ON HISTORIC SANBORN PLANS, "MALDEN AND MELROSE GAS LIGHT CO., LAND PLAN", 1907, AND "MALDEN AND MELROSE GAS LIGHT CO., MALDEN MASS., PLAN OF WORKS", 1916.



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PARTIAL CLASS C RAO
FORMER MALDEN MGP SITE
MALDEN, MASSACHUSETTS

HISTORIC MGP
OPERATIONAL FEATURES

UNDERGROUND
ENGINEERING &
ENVIRONMENTAL
SOLUTIONS

SCALE AS SHOWN

FEBRUARY 2004

FIGURE 6

HALEY &
ALDRICH

PARTIAL CLASS C RAD
FORMER MALDEN MGP SITE
MALDEN, MASSACHUSETTS

NATURE AND EXTENT OF OBSERVED CONTAMINATION

SCALE AS SHOWN

FEBRUARY 2004

LEGEND:

- | | | |
|---|-----------------|--|
|  | B206-OW | DESIGNATION AND APPROXIMATE LOCATION OF SHALLOW MONITORING WELL AT WHICH DNAPL HAS BEEN DETECTED |
|  | B110A-OW | DESIGNATION AND APPROXIMATE LOCATION OF DEEP MONITORING WELL AT WHICH DNAPL HAS BEEN DETECTED |
|  | B109A-OW | DESIGNATION AND APPROXIMATE LOCATION OF MONITORING WELL AT WHICH LNAPL HAS BEEN DETECTED |
|  | | APPROXIMATE OBSERVED EXTENT OF TSM |
|  | | APPROXIMATE EXTENT OF PETROLEUM-IMPACTED SOIL ON PARCEL E |
|  | | APPROXIMATE EXTENT OF BTXESXN-IMPACTED SOIL AND GROUNDWATER ON PARCEL B |
|  | | APPROXIMATE OBSERVED EXTENT OF LNAPL |
|  | | APPROXIMATE EXTENT OF GOVERNOR HOUSE CONTAMINATION |
|  | | APPROXIMATE LIMITS OF FORMER MALDEN MGP DISPOSAL SITE |
|  | | PILE-SUPPORTED CONCRETE CULVERTS |
|  | | APPROXIMATE LIMITS OF HISTORIC WATER FEATURES, 1907 AND 1916 |
- NOTES:
1. BASE PLAN ADAPTED FROM "TOPOGRAPHIC WORKSHEET OF THE MANUFACTURED GAS PLANT, MALDEN, MA" FOR MASSACHUSETTS ELECTRIC COMPANY BY EASTERN TOPOGRAPHS, JUNE 1995, AND CITY OF MALDEN ASSESSOR'S PLAN SHEETS 1 AND 2, JUNE 1995, AND SHEET NO. 53 BY FAY, SPOFFORD & THORNDIKE, INC., UPDATED JUNE 1976 AND REVISED 30 JULY 1979.
 2. HISTORIC RIVER LIMITS AND MGP STRUCTURES ESTIMATED BASED ON HISTORIC SANBORN PLANS, "MALDEN AND MELROSE GAS LIGHT CO., LAND PLAN", 1907, AND "MALDEN AND MELROSE PLAN OF WORKS", 1916.

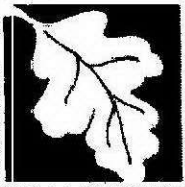
NOTES:

1. BASE PLAN ADAPTED FROM "TOPOGRAPHIC WORKSHEET OF THE MANUFACTURED GAS PLANT, MALDEN, MA" FOR MASSACHUSETTS ELECTRIC COMPANY BY EASTERN TOPOGRAPHICS, JUNE 1995, AND CITY OF MALDEN ASSESSOR'S PLAN SHEETS 1 AND 2, JUNE 1995, AND SHEET NO. 53 BY FAY, SPOFFORD & THORNDIKE, INC., UPDATED JUNE 1976 AND REVISED 30 JULY 1979.

3. HISTORIC RIVER LIMITS AND MAP STRUCTURES ESTIMATED BASED ON HISTORIC SANBORN PLANS, "MALDEN AND MELROSE GAS LIGHT CO., LAND PLAN", 1907, AND "MALDEN AND MELROSE PLAN OF WORKS", 1916

APPENDIX A

Copy of BWSC-104 Transmittal Form and Copy of Public Notices



Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BWSC104

RESPONSE ACTION OUTCOME (RAO) STATEMENT

Pursuant to 310 CMR 40.0580 (Subpart E) & 40.1056 (Subpart J)

Release Tracking Number

3 - 362

A. SITE LOCATION:

1. Site Name/Location Aid: Former Malden MGP Site

2. Street Address: Commercial and Charles Streets

3. City/Town: Malden

4. ZIP Code: _____

☐ 5. Check here if a Tier Classification Submittal has been provided to DEP for this disposal site.

☐ a. Tier 1A ☒ b. Tier 1B ☐ c. Tier 1C ☐ d. Tier 2

6. If a Tier I Permit has been issued, provide Permit Number: No. 7378, effective 12/28/1999

B. THIS FORM IS BEING USED TO: (check all that apply)

1. List Submittal Date of RAO Statement (if previously submitted): _____

mm/dd/yyyy

☒ 2. Submit a **Response Action Outcome (RAO) Statement**

☒ a. Check here if this RAO Statement covers additional Release Tracking Numbers (RTNs). RTNs that have been previously linked to a Primary Tier Classified RTN do not need to be listed here.

b. Provide additional Release Tracking Number(s) covered by this RAO Statement.

☐ - ☐ -

☐ 3. Submit a **Revised Response Action Outcome Statement**

☐ a. Check here if this Revised RAO Statement covers additional Release Tracking Numbers (RTNs), not listed on the RAO Statement or previously submitted Revised RAO Statements. RTNs that have been previously linked to a Primary Tier Classified RTN do not need to be listed here.

b. Provide additional Release Tracking Number(s) covered by this RAO Statement.

☐ - ☐ -

☒ 4. Submit a **Response Action Outcome Partial (RAO-P) Statement**

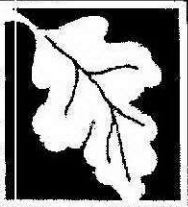
Check above box, if any Response Actions remain to be taken to address conditions associated with this disposal site having the Primary RTN listed in the header section of this transmittal form. This RAO Statement will record only an RAO-Partial Statement for that RTN. A final RAO Statement will need to be submitted that references all RAO-Partial Statements and, if applicable, covers any remaining conditions not covered by the RAO-Partial Statements.

☐ 5. Submit an optional **Phase I Completion Statement** supporting an RAO Statement

☐ 6. Submit a **Periodic Review Opinion** evaluating the status of a Temporary Solution for a Class C RAO Statement (Section E is optional)

☐ 7. Submit a **Retraction** of a previously submitted **Response Action Outcome Statement** (Sections D & E are not required)

(All sections of this transmittal form must be filled out unless otherwise noted above)



RESPONSE ACTION OUTCOME (RAO) STATEMENT

Release Tracking Number

Pursuant to 310 CMR 40.0580 (Subpart E) & 40.1056 (Subpart J)

3 - 362

C. DESCRIPTION OF RESPONSE ACTIONS: (check all that apply, for volumes list cumulative amounts)

- | | |
|---|---|
| ☐ 1. Assessment and/or Monitoring Only | ☐ 2. Temporary Covers or Caps |
| ☒ 3. Deployment of Absorbent or Containment Materials | ☐ 4. Temporary Water Supplies |
| ☒ 5. Structure Venting System | ☐ 6. Temporary Evacuation or Relocation of Residents |
| ☒ 7. Product or NAPL Recovery | ☐ 8. Fencing and Sign Posting |
| ☐ 9. Groundwater Treatment Systems | ☒ 10. Soil Vapor Extraction |
| ☐ 11. Bioremediation | ☐ 12. Air Sparging |
| ☒ 13. Removal of Contaminated Soils | |

- ☒ a. Re-use, Recycling or Treatment ☐ i. On Site Estimated volume in cubic yards _____
- ☒ ii. Off Site Estimated volume in cubic yards 345

ii. Facility Name: AMREC Town: Charlton State: MA

ii. Facility Name: ESMI Town: Louden State: NH

iii. Describe: Treatment of contaminated Sediments and soils removed from the Site.

☐ b. Landfill

☐ i. Cover Estimated volume in cubic yards _____

Facility Name: _____ Town: _____ State: _____

☐ ii. Disposal Estimated volume in cubic yards _____

Facility Name: _____ Town: _____ State: _____

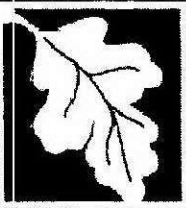
☒ 14. Removal of Drums, Tanks or Containers:

a. Describe Quantity and Amount: 3 removed gasoline and diesel tanks sent to Turner Trucking;

Drums containing oily water and sediment sent to C.H.

b. Facility Name: Turner Trucking Town: Lynn State: MA

c. Facility Name: Clean Harbors Town: Braintree State: MA



Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BWSC104

RESPONSE ACTION OUTCOME (RAO) STATEMENT

Pursuant to 310 CMR 40.0580 (Subpart E) & 40.1056 (Subpart J)

Release Tracking Number

3 - 362

C. DESCRIPTION OF RESPONSE ACTIONS (cont.): (check all that apply, for volumes list cumulative amounts)

☒ 15. Removal of Other Contaminated Media:

a. Specify Type and Volume: Coal tar removed using extraction well
PPE and other debris: refer to attachment.

b. Facility Name: Clean Harbors Town: Braintree State: MA

c. Facility Name: Town: State:

☐ 16. Other Response Actions:

Describe:

☐ 17. Use of Innovative Technologies:

Describe:

D. RESPONSE ACTION OUTCOME CLASS:

Specify the Class of Response Action Outcome that applies to the disposal site, or site of the Threat of Release.
Select **ONLY** one Class.

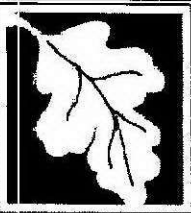
☐ 1. Class A-1 RAO: Specify one of the following:

☐ a. Contamination has been reduced to background levels. ☐ b. A Threat of Release has been eliminated.

☐ 2. Class A-2 RAO: You **MUST** provide justification that reducing contamination to or approaching background levels is infeasible.

☐ 3. Class A-3 RAO: You **MUST** provide an implemented Activity and Use Limitation (AUL) and justification that reducing contamination to or approaching background levels is infeasible.

☐ 4. Class A-4 RAO: You **MUST** provide an implemented AUL, justification that reducing contamination to or approaching background levels is infeasible, and justification that reducing contamination to less than Upper Concentration Limits (UCLs) 15 feet below ground surface or below an engineered barrier is infeasible. If the permanent solution relies upon an engineered barrier, you must also provide a Phase III report justifying the selection of the engineered barrier.



Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

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RESPONSE ACTION OUTCOME (RAO) STATEMENT

Pursuant to 310 CMR 40.0580 (Subpart E) & 40.1056 (Subpart J)

Release Tracking Number

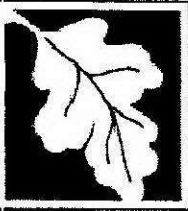
3 - 362

D. RESPONSE ACTION OUTCOME CLASS (cont.):

- ☐ 5. Class B-1 RAO: Specify one of the following:
- ☐ a. Contamination is consistent with background levels ☐ b. Contamination is **NOT** consistent with background levels.
- ☐ 6. Class B-2 RAO: You **MUST** provide an implemented AUL.
- ☐ 7. Class B-3 RAO: You **MUST** provide an implemented AUL and justification that reducing contamination to less than Upper Concentration Limits (UCLs) 15 feet below ground surface is infeasible.
- ☒ 8. Class C RAO: Specify one:
- ☐ a. Monitoring ☐ b. Passive Operation and Maintenance
- ☒ c. Active Operation and Maintenance (defined at 310 CMR 40.0006)

E. RESPONSE ACTION OUTCOME INFORMATION:

1. Specify the Risk Characterization Method(s) used to achieve the RAO described above:
- ☐ a. Method 1 ☐ b. Method 2 ☒ c. Method 3
- ☐ d. Method Not Applicable-Contamination reduced to or consistent with background, or Threat of Release abated
2. Specify all Soil and Groundwater Categories. More than one Soil Category and more than one Groundwater Category may apply at a Site. Be sure to check off all **APPLICABLE** categories.
- a. Soil Category(ies) Applicable:
- ☐ i. S-1/GW-1 ☐ iv. S-2/GW-1 ☐ vii. S-3/GW-1
- ☐ ii. S-1/GW-2 ☒ v. S-2/GW-2 ☒ viii. S-3/GW-2
- ☐ iii. S-1/GW-3 ☒ vi. S-2/GW-3 ☒ ix. S-3/GW-3
- b. Groundwater Category(ies) impacted:
- ☐ i. GW-1 ☒ ii. GW-2 ☒ iii. GW-3 ☐ iv. No Groundwater Impacted
3. Specify remediation conducted.
- ☒ a. Check here if soil remediation was conducted.
- ☐ b. Check here if groundwater remediation was conducted.
4. Estimate the number of acres this RAO Statement applies to: 14.8



Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BWSC104

RESPONSE ACTION OUTCOME (RAO) STATEMENT

Release Tracking Number

3 - 362

Pursuant to 310 CMR 40.0580 (Subpart E) & 40.1056 (Subpart J)

F. LSP SIGNATURE AND STAMP:

I attest under the pains and penalties of perjury that I have personally examined and am familiar with this transmittal form, including any and all documents accompanying this submittal. In my professional opinion and judgment based upon application of (i) the standard of care in 309 CMR 4.02(1), (ii) the applicable provisions of 309 CMR 4.02(2) and (3), and 309 CMR 4.03(2), and (iii) the provisions of 309 CMR 4.03(3) to the best of my knowledge, information and belief,

> if Section B indicates that either an RAO Statement, Phase I Completion Statement and/or Periodic Review Opinion is being provided, the response action(s) that is (are) the subject of this submittal (i) has (have) been developed and implemented in accordance with the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000, (ii) is (are) appropriate and reasonable to accomplish the purposes of such response action(s) as set forth in the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000, and (iii) comply(ies) with the identified provisions of all orders, permits, and approvals identified in this submittal.

I am aware that significant penalties may result, including, but not limited to, possible fines and imprisonment, if I submit information which I know to be false, inaccurate or materially incomplete.

1. LSP #: 2242

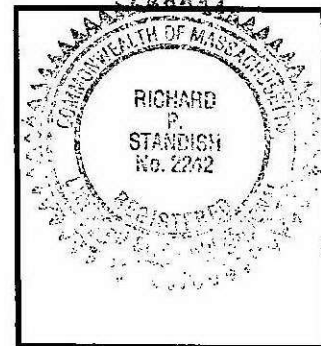
2. First Name: Richard P. 3. Last Name: Standish

4. Telephone: (860) 282-9400 5. Ext: 3150 6. FAX: (860) 282-9500

7. Signature: *Richard P. Standish*

8. Date: 02/26/2004
mm/dd/yyyy

9. LSP Stamp:



G. PERSON MAKING SUBMITTAL:

1. Check all that apply: ☐ a. change in contact name ☒ b. change of address ☐ c. change in the person undertaking response actions

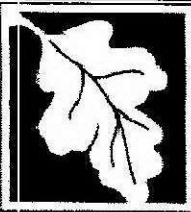
2. Name of Organization: Massachusetts Electric Company

3. Contact First Name: Michele V. 4. Last Name: Leone

5. Street: 25 Research Drive 6. Title: Senior Environmental Engineer

7. City/Town: Westborough 8. State: MA 9. ZIP Code: 01582-0000

10. Telephone: (508) 389-4296 11. Ext.: 12. FAX: (508) 389-4299



Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BWSC104

RESPONSE ACTION OUTCOME (RAO) STATEMENT

Release Tracking Number

Pursuant to 310 CMR 40.0580 (Subpart E) & 40.1056 (Subpart J)

3 - 362

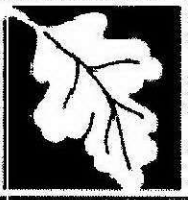
H. RELATIONSHIP TO RELEASE OR THREAT OF RELEASE OF PERSON MAKING SUBMITTAL:

- ☒ 1. RP or PRP ☐ a. Owner ☐ b. Operator ☐ c. Generator ☐ d. Transporter
☒ e. Other RP or PRP Specify: Party of Interest

- ☐ 2. Fiduciary, Secured Lender or Municipality with Exempt Status (as defined by M.G.L. c. 21E, s. 2)
☐ 3. Agency or Public Utility on a Right of Way (as defined by M.G.L. c. 21E, s. 5(j))
☐ 4. Any Other Person Making Submittal Specify Relationship: _____

I. REQUIRED ATTACHMENT AND SUBMITTALS:

- ☒ 1. Check here if the Response Action(s) on which this opinion is based, if any, are (were) subject to any order(s), permit(s) and/or approval(s) issued by DEP or EPA. If the box is checked, you MUST attach a statement identifying the applicable provisions thereof.
- ☐ 2. Check here to certify that the Chief Municipal Officer and the Local Board of Health have been notified of the submittal of an RAO Statement that relies on the public way/rail right-of-way exemption from the requirements of an AUL.
- ☒ 3. Check here to certify that the Chief Municipal Officer and the Local Board of Health have been notified of the submittal of a RAO Statement with instructions on how to obtain a full copy of the report.
- ☒ 4. Check here to certify that documentation is attached specifying the location of the Site, or the location and boundaries of the Disposal Site subject to this RAO Statement. If submitting an RAO Statement for a PORTION of a Disposal Site, you must document the location and boundaries for both the portion subject to this submittal and, to the extent defined, the entire Disposal Site.
- ☐ 5. Check here if required to submit one or more AULs. You must submit an AUL Transmittal Form (BWSC113) and a copy of each implemented AUL related to this RAO Statement. Specify the type of AUL(s) below: (required for Class A-3, A-4, B-2, B-3 RAO Statements)
- ☐ a. Notice of Activity and Use Limitation b. Number of Notices submitted: _____
☐ c. Grant of Environmental Restriction d. Number of Grants submitted: _____
- ☐ 6. If an RAO Compliance Fee is required for any of the RTNs listed on this transmittal form, check here to certify that an RAO Compliance Fee was submitted to DEP, P. O. Box 4062, Boston, MA 02211.
- ☐ 7. Check here if any non-updatable information provided on this form is incorrect, e.g. Site Address/Location Aid. Send corrections to the DEP Regional Office.
- ☒ 8. Check here to certify that the LSP Opinion containing the material facts, data, and other information is attached.



Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BWSC104

RESPONSE ACTION OUTCOME (RAO) STATEMENT

Pursuant to 310 CMR 40.0580 (Subpart E) & 40.1056 (Subpart J)

Release Tracking Number

3 - 362

J. CERTIFICATION OF PERSON MAKING SUBMITTAL:

1. I, Michele V. Leone, attest under the pains and penalties of perjury (i) that I have personally examined and am familiar with the information contained in this submittal, including any and all documents accompanying this transmittal form, (ii) that, based on my inquiry of those individuals immediately responsible for obtaining the information, the material information contained in this submittal is, to the best of my knowledge and belief, true, accurate and complete, and (iii) that I am fully authorized to make this attestation on behalf of the entity legally responsible for this submittal. I/the person or entity on whose behalf this submittal is made am/is aware that there are significant penalties, including, but not limited to, possible fines and imprisonment, for willfully submitting false, inaccurate, or incomplete information.

2. By: [Signature]
Signature

3. Title: Sr. Environmental Engineer

4. For: Massachusetts Electric Company
(Name of person or entity recorded in Section G)

5. Date: 02/25/2004
mm/dd/yyyy

☐ 6. Check here if the address of the person providing certification is different from address recorded in Section G.

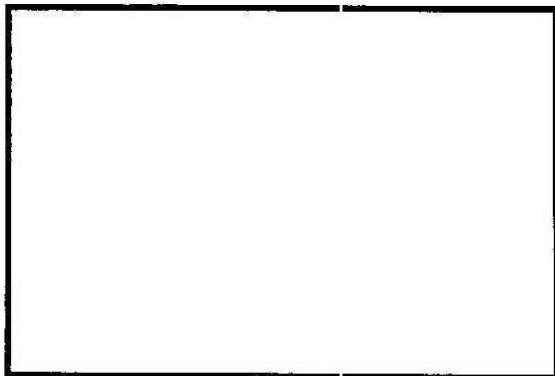
7. Street: _____

8. City/Town: _____ 9. State: _____ 10. ZIP Code: _____

11. Telephone: _____ 12. Ext.: _____ 13. FAX: _____

YOU MUST LEGIELY COMPLETE ALL RELEVANT SECTIONS OF THIS FORM OR DEP MAY
RETURN THE DOCUMENT AS INCOMPLETE. IF YOU SUBMIT AN INCOMPLETE FORM, YOU
MAY BE PENALIZED FOR MISSING A REQUIRED DEADLINE.

Date Stamp (DEP USE ONLY:)



C. DESCRIPTION OF RESPONSE ACTIONS

(Updated through 5 December 2003)

QUANTITIES OF REMEDIATION WASTE TRANSPORTED TO DATE

Remediation Waste	Quantity Received at Receiving Facility			
	AMREC	Turner Trucking	ESMI	Clean Harbors, Inc.
UST Removal IRA, RTN 3-13753				
Excavated Soils	24.40 tons	---	---	---
Water/fuel mixture from USTs	---	---	---	1063 gal
Tanks, gasoline and diesel	---	3 tanks	---	---
129 Commercial Street RAM, RTN 3-0362				
Waste soils	---	---	5 cy (3.29 tons)	---
Spent granular activated carbon drums	---	---	---	46 drums (7590 lbs)
100 Commercial Street RAM, RTN 3-0362				
LNAPL	---	---	---	0.5 gal
PPE and oily debris	---	---	---	3 drums
100 Commercial Street URAM, RTN 3-0362				
Soil	---	---	---	<1cy
WEB and MR Culvert IRA, RTN 3-13754				
Sediment	---	---	513.42 tons	---
Soil Spoil (RW-1)	---	---	12 tons	---
Oily equipment - PPE, booms, etc.	---	---	---	8 drums
Oily equipment - PPE, booms, etc.	---	---	---	4 flexbin
Oily equipment - PPE, booms, etc.	---	---	---	23.5 cubic yards
Coal tar (RW-1)	---	---	---	702 gal (28 drums)
Well Development (sediment/water)	---	---	---	3446 gal (MA01)
DNAPL	---	---	---	2506 gal (DO18)
Decon water	---	---	---	3 drums
Water - Pipe Lining	---	---	---	3035 gal (MA99)
Water - Pipe Lining	---	---	---	1 Drum (MA01)
Soil/Sediment - Pipe Lining	---	---	---	1 Flexbin (MA01)

Estimated Total Quantities:

Soil & Sediment:	554.61 tons (approx. 350 cy) sent to AMREC, ESMI and Clean Harbors
Tanks:	3 tanks sent to Turner Trucking in Lynn
Oily Water:	7744 gallons sent to Clean Harbors
Spent GAC Drums:	46 drums (approx. 7590 lbs) sent to Clean Harbors
Coal tar DNAPL:	2506 gallons sent to Clean Harbors, Inc.

I. LSP OPINION

Response Actions on which this opinion is based were subject to the Tier I Permit issued by DEP on 28 December 1999

Haley & Aldrich, Inc.
465 Medford Street
Suite 2200
Boston, MA 02129-1400
Tel: 617.886.7400
Fax: 617.886.7600
www.HaleyAldrich.com



26 February 2004
File No. 06558-669

City of Malden Office of the Mayor
200 Pleasant Street
Malden, Massachusetts 02148

Attention: Mayor Richard C. Howard

Subject: Public Notification of Availability Under 310 CMR 40.1403
Partial Class C Response Action Outcome Statement
Former Malden Manufactured Gas Plant (MGP) Site
Malden, Massachusetts
RTN 3-0362
Tier IB Permit No. 7378

Ladies and Gentlemen:

On behalf of the Massachusetts Electric Company (MEC) and in accordance with the Massachusetts Contingency Plan (MCP), 310 CMR 40.0000, Haley & Aldrich, Inc., is notifying you of the availability of the above document. This letter serves as notice of availability to the Malden Board of Health in accordance with the MCP under 310 CMR 40.1403(3)(e), of a report entitled "Report on Partial Class C Response Action Outcome Statement, Former Malden MGP Site, Malden Massachusetts, RTN 3-0362, Tier IB Permit 7378" dated 27 February 2004, and prepared by Haley & Aldrich, Inc.

A copy of this Partial Class C RAO is available for review at the Massachusetts Department of Environmental Protection, Northeast Regional Office. The File review office is located at 35 Congress Street, Salem, Massachusetts. Files are available for review on Tuesdays, Wednesdays and Thursdays from 9 AM until 12 PM by appointment only.

If you have questions concerning this letter, please contact Ms. Michele V. Leone of MEC at (508) 389-4296, or the undersigned at 617-886-7494.

Sincerely yours,
HALEY & ALDRICH, INC.

A handwritten signature in dark ink, appearing to read "Sean M. Carroll". The signature is written in a cursive, flowing style.

Sean M. Carroll
Senior Engineer

c: Massachusetts Electric Company; Attn: Ms. Michele V. Leone
KeySpan Energy Delivery New England; Attn: Ms. Patricia Haederle
City of Malden Board of Health; Attn: Mr. Walter F. Carlan

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Haley & Aldrich, Inc.
465 Medford Street
Suite 2200
Boston, MA 02129-1400
Tel: 617.886.7400
Fax: 617.886.7600
www.HaleyAldrich.com



26 February 2004
File No. 06558-669

City of Malden Board of Health
200 Pleasant Street
Malden, Massachusetts 02148

Attention: Mr. Walter F. Carlan
Director of Public Health

Subject: Public Notification of Availability Under 310 CMR 40.1403
Partial Class C Response Action Outcome Statement
Former Malden Manufactured Gas Plant (MGP) Site
Malden, Massachusetts
RTN 3-0362
Tier IB Permit No. 7378

Ladies and Gentlemen:

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Santa Barbara
California

Tucson
Arizona

Washington
District of Columbia

On behalf of the Massachusetts Electric Company (MEC) and in accordance with the Massachusetts Contingency Plan (MCP), 310 CMR 40.0000, Haley & Aldrich, Inc., is notifying you of the availability of the above document. This letter serves as notice of availability to the Malden Board of Health in accordance with the MCP under 310 CMR 40.1403(3)(f), of a report entitled "Report on Partial Class C Response Action Outcome Statement, Former Malden MGP Site, Malden, Massachusetts, RTN 3-0362, Tier IB Permit 7378" dated 27 February 2004, and prepared by Haley & Aldrich, Inc.

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Sincerely yours,
HALEY & ALDRICH, INC.

A handwritten signature in dark ink, appearing to read "Sean M. Carroll".
Sean M. Carroll
Senior Engineer

c: Massachusetts Electric Company; Attn: Ms. Michele V. Leone
KeySpan Energy Delivery New England; Attn: Ms. Patricia Haederle
City of Malden, Chief Municipal Officer; Attn: Mayor Richard C. Howard

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APPENDIX B

AMEC Risk Characterization and Substantial Hazard Evaluation

Amendment to Method 3 Risk Characterization and
Substantial Hazard Evaluation
Portion of Former Manufactured Gas Plant Site
Malden, Massachusetts

Submitted to:

Massachusetts Electric Company
Northborough, Massachusetts

Submitted by:

AMEC Earth & Environmental
Boston, Massachusetts

February, 2003

6-7037-0500

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TABLE 3 Summary of Risk Estimates--129 Commercial Street; Amendment to Method 3 Risk Characterization
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TABLE 6 Potential Hazard Quotient and Risk Following Exposure via Incidental Ingestion and Dermal Contact with Soil--51 Commercial Street; Amendment to Method 3 Risk Characterization
TABLE 7 Summary of Risk Estimates--51 Commercial Street; Amendment to Method 3 Risk Characterization
TABLE 8 Potential Hazard Quotient and Risk Following Exposure via Inhalation of Indoor Air-- 129 Commercial Street; Substantial Hazard Evaluation
TABLE 9 Summary of Risk Estimates--129 Commercial Street; Substantial Hazard Evaluation
TABLE 10 Potential Hazard Quotient and Risk Following Exposure via Incidental Ingestion and Dermal Contact with Soil--51 Commercial Street; Substantial Hazard Evaluation
TABLE 11 Summary of Risk Estimates--51 Commercial Street; Substantial Hazard Evaluation

LIST OF ATTACHMENTS

- Attachment A: Indoor Air Sampling Locations
- Attachment B: Soil Boring Locations

1.0 INTRODUCTION

A Method 3 Human Health Risk Characterization was performed in December 2001 as part of a Phase II Comprehensive Site Investigation (Haley and Aldrich, 2001) for portions of the Former Malden Manufactured Gas Plant (MGP) Site (referred to herein as "The Site"), including parcels at 100 Commercial Street, 129 Commercial Street, 99-109 Commercial Street, 89 Commercial Street, 77 Commercial Street, 65 Commercial Street, 51 Commercial Street, Charles Street and the Governor House located at the corner of Pearl and Charles Street. These parcels are collectively referred to as the Upper Site; the portion of the Site consisting of the Malden River from the Malden River culvert outfall to the Medford Street Bridge is not addressed in this evaluation.

The conclusions of that assessment indicated that a condition of No Significant Risk to human health under current Site conditions exists at 100 Commercial Street, 99-109 Commercial Street, 89 Commercial Street, 77 Commercial Street, 65 Commercial Street, Charles Street, and Governor House. At the remaining two parcels that comprise the Upper Site, the Phase II Risk Characterization concluded that a condition of No Significant Risk to human health did not exist under current conditions for the following identified current receptors and exposure pathways:

- At the 129 Commercial Street parcel: the excess risk was associated with potential exposures to a current commercial/industrial worker who is assumed to inhale contaminants of potential concern (CPCs) in indoor air. Estimated excess cancer risk estimates for the current commercial/industrial worker exceeded the risk management criterion based on an average concentration of benzene. However, the average concentration of benzene (16.5 ug/m^3) in indoor air samples (representing December 2000, March 2001, June 2001, and October 2001) was less than MADEP's published indoor air background concentration (21 ug/m^3).
- At the 51 Commercial Street parcel: the excess risk was associated with a current landscape worker who is assumed to have direct exposure to soils. No soil data from the limited landscaped area on this parcel were available when the Risk Characterization was conducted. Rather, a single surrogate soil sample from an adjacent paved area (representing a depth interval 1 to 3 feet below ground surface [fbgs]) was used to estimate potential risks.

Four indoor air sampling events have been conducted at 129 Commercial Street following submission of the Method 3 Human Health Risk Characterization in December, 2001. These occurred on January 15, April 12, June 26, and October 14, 2002 (Haley and Aldrich, 2002; 2003). Additionally, three soil borings were collected and analyzed from 51 Commercial Street in June, 2002 (Haley and Aldrich, 2002). These data were used herein to update the results of the human health risk characterization for these two parcels.

A Substantial Hazard Evaluation was also conducted to determine whether a temporary solution has been achieved at portions of the Site in support of a Class C Response Action Outcome (RAO) in accordance with the Massachusetts Contingency Plan (MCP) (310 CMR 40.0956, 310



CMR 40.1050). The Substantial Hazard Evaluation consists of evaluating possible exposures to human and environmental receptors considering current Site uses and activities. The period of exposures considered under the definition of "current" Site uses is from 1989 (the year this Site was listed with the Massachusetts Department of Environmental Protection [MADEP]) to the year 2007 (an additional five years from the date of this evaluation) (per 310 CMR 40.0956). If a condition of No Substantial Hazard to human health and the environment exists and can be maintained, then conditions at the Site have achieved the requirements for a Class C RAO (310 CMR 40.1050).

By definition, a condition of No Substantial Hazard to health and the environment exists if, for an appropriate Exposure Period, no Cumulative Receptor Cancer Risk and no Cumulative Receptor Non-cancer Risk is greater than the Cumulative Receptor Risk Limits, defined as one in one hundred thousand (10^{-5}) for carcinogenic effects and 1.0 for non-cancer health effects (310 CMR 40.0956; 310 CMR 40.0993(6)). Therefore, based on the conclusions of the Phase II Risk Characterization, a condition of No Substantial Hazard to Human Health exists at 100 Commercial Street, 99-109 Commercial Street, 89 Commercial Street, 77 Commercial Street, 65 Commercial Street, Charles Street, and Governor House. The focus of this Substantial Hazard Evaluation is the current exposures to human receptors at 129 Commercial Street and 51 Commercial Street, incorporating additional, recent data representing each of these parcels.

A revised Method 3 Risk Characterization for these two parcels, incorporating the new sampling data, is presented in Section 2.0 below. In Section 3.0, a substantial hazard evaluation on these parcels is conducted using the assumptions of current Site use (i.e., a reduced exposure period) and dose-response values (i.e., non-cancer and cancer toxicity values, relative absorption factors) presented in the Phase II Risk Characterization (AMEC, 2001). Section 4.0 contains the Ecological Substantial Hazard Evaluation for the upland portion of the Site, and Section 5.0 presents the overall conclusions of both the revised Method 3 Risk Characterization and the Substantial Hazard Evaluation.

2.0 AMENDED HUMAN HEALTH RISK CHARACTERIZATION

Below, the results from the AMEC (2001) Method 3 Risk Characterization for the 129 Commercial Street and 51 Commercial Street parcels are updated using recently collected indoor air and soil data, respectively.

2.1 129 Commercial Street

The parcel located at 129 Commercial Street is currently used as a commercial bread bakery. A single building, composed of the bakery production area (mixing and baking), freezers, packaging, storage and shipping areas, exists on the property. In the Method 3 Risk Characterization, receptors at this parcel included a trespasser, landscaper, utility worker, and site (commercial) worker. No significant risk was found for all of these receptors but the site worker (AMEC, 2001). Current site workers are assumed to be present for 8-hour shifts 24 hours per day, and potentially exposed to oil and/or hazardous materials (OHM) via inhalation of indoor air.

For this amendment to the risk characterization, exposures to OHM in indoor air were evaluated based on data collected on December 12, 2000, March 16, 2001, June 29, 2001, October 17, 2001, January 15, 2002, April 12, 2002, June 26, 2002, and October 14, 2002 (Haley and Aldrich, 2002; 2003). A summary of the OHM detected in recent indoor air samples is presented in Table 1 (see Attachment A for sampling locations). The sampling locations (sites 4, 5, 6, 7, 8, and 10) were defined to represent all possible work areas within the building (i.e., production and baking area, packaging area, freezer, storage area, loading dock). A comparison of the detected concentrations to background indoor air concentrations indicates that all compounds were below background levels on the average. However, five compounds were detected at concentrations greater than background levels in at least one individual sample: benzene, toluene, ethylbenzene, styrene, and naphthalene. Xylenes (o-, m- and p-) are considered to be consistent with background levels.

Because workers are not limited to one area of the building, the entire building is considered a single exposure point. For each volatile compound, the indoor air exposure point concentration is based on the arithmetic average concentration of the detected concentrations and values equal to one-half the laboratory reporting limit. Field duplicate samples and primary samples were averaged prior to incorporation into the exposure point concentration. The exposure point concentrations are presented in Table 1.

The algorithm used to estimate Average Daily Dose (ADD) and Lifetime Average Daily Dose (LADD) to commercial workers at 129 Commercial Street from inhalation of indoor air is presented below and in Table 2.

$$\text{LADD or ADD} = \frac{\text{CA} \times \text{IR} \times \text{AAF} \times \text{ET} \times \text{ED} \times \text{EF} \times \text{CF}}{\text{BW} \times \text{AP}}$$

where:

- LADD = Lifetime Average Daily Dose Due to Inhalation (mg/kg-day)
- ADD = Average Daily Dose Due to Inhalation (mg/kg-day)
- CA = Compound Concentration in Air (mg/m³)
- IR = Inhalation Rate (m³/day)
- AAF = Absorption Adjustment Factor (unitless)
- ET = Exposure Time (hours/day)
- ED = Exposure Duration (years)
- EF = Exposure Frequency (days/year)
- CF = Unit Conversion Factor
- BW = Body Weight (kg), and
- AP = Averaging Period (ED * 365 d/yr for noncancer; 75 yr * 365 d/yr for cancer).

All of the exposure parameters, toxicity values, and relative absorption values used in this amendment are those found in the AMEC (2001) Method 3 Risk Characterization and represent currently available information regarding potential toxicity (e.g., Environmental Protection Agency [EPA] Integrated Risk Information System [IRIS, www.epa.gov/iris], MADEP).

In order to determine whether a condition of No Significant Risk exists at this parcel, a risk characterization was conducted. The risk characterization provides quantitative estimates of the likelihood for adverse health effects (noncarcinogenic and carcinogenic) to occur based on potential current exposures to current receptors. The potential for both noncarcinogenic and carcinogenic effects was estimated for a commercial worker based on potential exposures to indoor air at 129 Commercial Street (see Table 2). An estimate of non-carcinogenic risk, or Hazard Quotient (HQ), is calculated as follows:

$$HQ = \frac{ADD}{RfD}$$

where:

HQ = Hazard Quotient (unitless)
ADD = Average Daily Dose (mg/kg-day), and
RfD = Reference Dose (mg/kg-day).

The HQs for all compounds in indoor air were summed to yield the cumulative noncarcinogenic risk, or Hazard Index (HI), for this exposure pathway and receptor. The HI for each receptor was then compared to MADEP's noncarcinogenic risk limit of 1. A total HI for a constituent that does not exceed one for a given receptor indicates that no adverse noncarcinogenic health effects are expected to occur as a result of that receptor's potential exposure to compounds in indoor air (310 CMR 40.0993(6)); see Table 2).

For compounds considered carcinogenic to humans, potential carcinogenic risk, or Excess Lifetime Cancer Risk (ELCR), is calculated as follows:

$$ELCR = LADD \times CSF$$

where:

ELCR = Excess Lifetime Cancer Risk (unitless)
LADD = Lifetime Average Daily Dose (mg/kg-day), and
CSF = Cancer Slope Factor (mg/kg-day)⁻¹.

The ELCR for each potential pathway was calculated by summing the ELCRs for each potentially carcinogenic compound. Subsequently, a cumulative ELCR was calculated by summing the pathway-specific ELCRs. The ELCR for each potential receptor was then compared to MADEP's carcinogenic risk limit of 1×10^{-5} (310 CMR 40.0993(6)). Table 2 presents the risk estimation procedures and results for current workers at 129 Commercial Street.

A condition of No Significant Risk to Human Health exists if no Cumulative Receptor Cancer Risk and no Cumulative Receptor Non-cancer Risk is greater than MADEP's Cumulative Receptor Risk Limits, defined as one in one hundred thousand (10^{-5}) for carcinogenic effects and 1 for non-cancer health effects. A summary of the risk estimates for all receptors at 129 Commercial Street is presented in Table 3. For current site workers at 129 Commercial Street



who may be exposed to volatile compounds in indoor air, the results of this Risk Characterization utilizing recent indoor air data indicate that the Cumulative Receptor Cancer Risk and Non-cancer Risk are less than the MADEP risk management criteria. The risk estimates for the utility worker, the landscape worker, and the trespasser, which represent conclusions of the Method 3 Risk Characterization (AMEC 2001) at 129 Commercial Street, are also less than the MADEP risk management criteria. Therefore, a condition of No Significant Risk to Human Health exists at 129 Commercial Street.

2.2 51 Commercial Street

The parcel located at 51 Commercial Street is currently used as an office building (dentist office and chiropractor office). A single building composed of multiple offices currently exists on the property, with landscaped areas surrounding the sides abutting Commercial and Centre Streets. Under current conditions, office workers, utility workers, trespassers, and landscapers are assumed to exist at this parcel. The complete exposure pathways for these receptors include inhalation of indoor air, incidental ingestion of soil, dermal contact with soil, incidental ingestion of groundwater, dermal contact with groundwater, inhalation of constituents in ambient air (volatilized from soil), inhalation of constituents in ambient air (volatilized from groundwater), and inhalation of particulates from soil. The conclusion of the Phase II Risk Characterization for current Site conditions was that a condition of No Significant Risk exists for the current office worker, utility worker, and the current trespasser.

For current landscapers, the basis of the exposure point concentration in the landscaped area adjacent to the building at 51 Commercial Street (soil exposure point) in the Phase II Risk Characterization was surrogate soil analytical data. The soil analytical data consisted of a single surface (0 to 3 fbs) soil sample obtained from beneath pavement located near the boundary with the parcel at 65 Commercial Street. However, this is not soil to which landscapers could actually be exposed. Therefore, in June 2002, three soil borings were installed in the landscaped area with soil samples collected from the 0.5 to 1 foot interval and 0 to 3 feet interval (Haley and Aldrich 2002; see Attachment B for locations). Soil samples collected from the 0.5 to 1 foot interval were analyzed for Volatile Petroleum Hydrocarbon fractions (VPH) and target analytes; soil samples from the 0 to 3 feet interval were analyzed for Extractable Petroleum Hydrocarbon fractions (EPH) and target analytes. A summary of the data is presented in Table 4.

The entire landscaped area is considered a single exposure point, with the three soil samples (0 to 3 fbs) considered representative of the exposure point. The results for naphthalene from the VPH analysis representing the 0.5 to 1 foot depth interval is used to represent the 0 to 3 feet depth interval because the detected concentrations were higher relative to that from the EPH analysis. For each detected compound, the soil exposure point concentration is based on the arithmetic average concentration of the detected concentrations and values equal to one-half the laboratory reporting limit. Field duplicate samples and primary samples were averaged prior to incorporation into the exposure point concentration. The soil exposure point concentrations are presented in Table 5.

The algorithm used to estimate Average Daily Dose (ADD) and Lifetime Average Daily Dose (LADD) to current landscape workers at 51 Commercial Street from direct exposures to soil is presented below and in Tables 6a (ingestion) and 6b (dermal).

$$\text{LADD or ADD} = \frac{\text{CS} \times [(\text{IR} \times \text{FI} \times \text{RAFO}) + (\text{SA} \times \text{AF} \times \text{RAFD})] \times \text{ED} \times \text{EF} \times \text{CF}}{\text{BW} \times \text{AP}}$$

where:

- ADD = Average Daily Dose Due to Potential Ingestion and Dermal Contact (mg/kg-day)
- LADD = Lifetime Average Daily Dose Due to Potential Ingestion and Dermal Contact (mg/kg-day)
- CS = Compound Concentration in Soil (mg/kg)
- IR = Soil Ingestion Rate (mg/day)
- FI = Fraction of Soil Ingested From the Site (unitless)
- RAFO = Relative Absorption Factor (Oral-Soil) (unitless)
- SA = Skin Surface Area Exposed (cm²/day)
- AF = Soil to Skin Adherence Factor (mg/cm²)
- RAFD = Relative Absorption Factor (Dermal-Soil) (unitless)
- EF = Exposure Frequency (days/year)
- ED = Exposure Duration (years)
- CF = Conversion Factor (10⁻⁶ kg/mg)
- BW = Body Weight (kg), and
- AP = Averaging Period (ED * 365 d/yr for noncancer; 75 yr * 365 d/yr for cancer).

All of the exposure parameters, toxicity values, and relative absorption values used in this amendment are those found in the AMEC (2001) Method 3 Risk Characterization.

A risk characterization was conducted for the current landscaper, and the potential for both noncarcinogenic and carcinogenic effects were estimated for a landscape worker based on potential direct exposures to surface soil at 51 Commercial Street (see Tables 6a and 6b). HQs, HIs, and ELCRs were calculated using the equations presented in Section 2.1 and are provided in Tables 6a and 6b. A summary of the risk estimates for all receptors at 51 Commercial Street parcel is presented in Table 7. For current landscape workers at 51 Commercial Street who may be exposed to compounds in surface soil, the results of this Risk Characterization utilizing recent soil data indicate that the Cumulative Receptor Cancer Risk and Non-cancer Risk are less than the MADEP risk management criteria of 10⁻⁵ and 1.0, respectively. The risk estimates for the current office worker, utility worker, and the trespasser, which represent conclusions of the Method 3 Risk Characterization (AMEC, 2001) at 51 Commercial Street, are also less than the MADEP risk management criteria. Therefore, a condition of No Significant Risk to Human Health exists at 51 Commercial Street.

3.0 HUMAN HEALTH SUBSTANTIAL HAZARD EVALUATION

Despite the fact that no significant risk was found to receptors at either 129 Commercial Street or 51 Commercial Street, a Substantial Hazard Evaluation was conducted for these two parcels. Each is described in the following sections.

3.1 129 Commercial Street

As described in Section 2.1, the parcel located at 129 Commercial Street is currently used as a commercial bread bakery. Under current conditions, utility workers, trespassers, commercial (site) workers, and landscapers are assumed to exist at this parcel. The complete exposure pathways for these receptors include incidental ingestion of soil, dermal contact with soil, incidental ingestion of groundwater, dermal contact with groundwater, inhalation of constituents in ambient air (volatilized from soil), inhalation of constituents in ambient air (volatilized from groundwater), inhalation of indoor air, and inhalation of particulates from soil. The conclusion of the Method 3 Risk Characterization for current Site conditions was that a condition of No Significant Risk exists for the current utility worker, the current landscape worker, and the current trespasser. Therefore, a condition of No Substantial Hazard to Human Health exists for these receptors at 129 Commercial Street. As such, only commercial workers are included in this Substantial Hazard Evaluation.

Commercial workers are assumed to be present at 129 Commercial Street for 8-hour shifts 24 hours per day. The identified exposure pathway for current workers to identified OHM at this Site is via inhalation of indoor air. For the current commercial worker, exposures to OHM in indoor air are evaluated in this Substantial Hazard Evaluation based on indoor air data representing current Site conditions (collected on December 12, 2000, March 16, 2001, June 29, 2001, October 17, 2001, January 15, 2002, April 12, 2002, June 26, 2002, and October 14, 2002 [Haley and Aldrich, 2002]). Exposure point concentrations for indoor air are shown in Table 1 and were derived as described in Section 2.1. This represents the only current potential exposure pathway for this receptor.

The ADD for this receptor was calculated using the equations presented in Section 2.1 above. With the exception of the exposure duration and the averaging period for non-cancer risk estimates, the algorithm represents the same equation and assumptions utilized in the Method 3 Risk Characterization (AMEC, 2001) for current commercial workers at 129 Commercial Street. For this Substantial Hazard Evaluation, the period of exposure is a total of 19 years, representing January 1989 (the date of "site notification") to September 2007 (five years from the date of this evaluation) (310 CMR 40.0956(1)(b)). The toxicity values (reference dose [RfD] and Cancer Slope Factor [CSF]) and relative absorption values used in this Substantial Hazard Evaluation (see Table 8) are the same values used in the Method 3 Risk Characterization (AMEC, 2001), and represent currently available information regarding potential toxicity.

In order to determine whether a condition of No Substantial Hazard exists at this parcel, a risk characterization was conducted. As stated in Section 1.0, a condition of No Substantial Hazard to Human Health exists if, for an appropriate Exposure Period, no Cumulative Receptor Cancer Risk and no Cumulative Receptor Non-cancer Risk is greater than the Cumulative Receptor Risk Limits, defined as one in one hundred thousand (10^{-5}) for carcinogenic effects and 1 for non-cancer health effects (MADEP Risk Management Criteria) (310 CMR 40.0956; 310 CMR



40.0993(6)). A summary of the risk estimates for all current receptors at 129 Commercial Street is presented in Table 9, including the Substantial Hazard Risk Characterization results for the current commercial workers. For current commercial workers at 129 Commercial Street who may be exposed to volatile compounds in indoor air, the results of this Substantial Hazard Risk Characterization utilizing recent indoor air data indicate that the Cumulative Receptor Cancer Risk and Non-cancer Risk are less than the MADEP risk management criteria. The risk estimates for the current utility worker, the current landscape worker, and the current trespasser, which represent conclusions of the Method 3 Risk Characterization (AMEC 2001) for current Site conditions at 129 Commercial Street, are also less than the MADEP risk management criteria. Therefore, a condition of No Substantial Hazard to Human Health exists at 129 Commercial Street.

3.2 51 Commercial Street

The parcel located at 51 Commercial Street is currently used as an office building, as described in Section 2.2 above. Under current conditions, office workers, utility workers, trespassers, and landscapers are assumed to exist at this parcel. The complete exposure pathways for these receptors include inhalation of indoor air, incidental ingestion of soil, dermal contact with soil, incidental ingestion of groundwater, dermal contact with groundwater, inhalation of constituents in ambient air (volatilized from soil), inhalation of constituents in ambient air (volatilized from groundwater), and inhalation of particulates from soil. The conclusion of the Method 3 Risk Characterization for current Site conditions was that a condition of No Significant Risk exists for the current office worker, utility worker, and the current trespasser (AMEC, 2001). Therefore, a condition of No Substantial Hazard to Human Health exists for these receptors at 51 Commercial Street.

For current landscapers, the basis of the exposure point concentration in the landscaped area adjacent to the building at 51 Commercial Street (soil exposure point) in the Phase II Risk Characterization was a surrogate soil analytical data, as described in Section 2.2. The soil data collected at the parcel in June 2002 are used in this Substantial Hazard Evaluation and are summarized in Table 4. As with the amended risk characterization in Section 2.2, the entire landscaped area is considered a single exposure point, with the three soil samples (0 to 3 fbs) considered representative of the exposure point. The soil exposure point concentrations are presented in Table 5.

The algorithms used to estimate Average Daily Dose (ADD) and Lifetime Average Daily Dose (LADD) to current landscape workers at 51 Commercial Street from direct exposures to soil are the same as those used for the Method 3 Risk Characterization update and are presented in Section 2.2. With the exception of the exposure duration and the averaging period for non-cancer risk estimates, this algorithm represents the same equation and assumptions utilized in the Phase II Risk Characterization (AMEC, 2001) for current landscapers at 51 Commercial Street. For this Substantial Hazard Evaluation, the period of exposure is a total of 19 years, representing January 1989 (the date of "site notification") to September 2007 (five years from the date of this evaluation) (310 CMR 40.0956(1)(b)). The toxicity values and relative absorption values used in this Substantial Hazard Evaluation (see Tables 10a and 10b) are the same values used in the Phase II Risk Characterization (AMEC, 2001).



In order to determine whether a condition of No Substantial Hazard exists at this parcel, a risk characterization was conducted. The potential for both noncarcinogenic and carcinogenic effects were estimated for a landscape worker based on potential direct exposures to surface soil at 51 Commercial Street (see Tables 10a and 10b). HQs, HIs, and ELCRs were calculated using the equations presented in Section 2.1 and are provided in Tables 10a and 10b.

A summary of the risk estimates for all current receptors at 51 Commercial Street parcel is presented in Table 11, including the Substantial Hazard Risk Characterization results for the current landscape workers. For current landscape workers at 51 Commercial Street who may be exposed to compounds in surface soil, the results of this Substantial Hazard Risk Characterization utilizing recent soil data indicate that the Cumulative Receptor Cancer Risk and Non-cancer Risk are less than the MADEP risk management criteria of 10^{-5} and 1.0, respectively. The risk estimates for the current office worker, utility worker, and the current trespasser, which represent conclusions of the Phase II Risk Characterization (AMEC, 2001) for current Site conditions at 51 Commercial Street, are also less than the MADEP risk management criteria. Therefore, a condition of No Substantial Hazard to Human Health exists at 51 Commercial Street.

4.0 ECOLOGICAL SUBSTANTIAL HAZARD EVALUATION

As stated in the MCP, the focus of an Ecological Substantial Hazard Evaluation is on any "environmental resource areas, such as wetlands, aquatic and terrestrial habitats, and fisheries, that exist at a site" (310 CMR 40.0956). A condition of No Substantial Hazard to the Environment exists at the Site if steps have been taken to eliminate or mitigate any of six conditions affecting environmental resources at the Site:

- Evidence of stressed biota attributable to the release at the Site (e.g., fish or wildlife kills, abiotic conditions)
- Visible presence of oil and/or hazardous materials (OHM) in soil within three feet of ground surface over an area greater than or equal to two acres
- Continuing discharge of contaminated groundwater to surface water where levels of Site-related OHM exceed Massachusetts surface water standards
- Continuing discharge of contaminated groundwater to surface water where Site-related surface water and/or sediment OHM concentrations already pose a significant risk
- Migration of OHM to additional environmental media or resource area where exposures would potentially pose a significant risk of harm in the future, or
- Ecological risk or harm such that recovery would be substantially more difficult or would require more time if the Site was not remediated for even a short period of time.

The former Malden MGP Site properties included in this Substantial Hazard Evaluation are urban, developed, industrial sites without significant habitat for important terrestrial receptors. However, the potential for migration of dense nonaqueous phase liquid (DNAPL) from the terrestrial portion of the Site to sediments in the Malden River, via the West End Brook and Malden River culverts and/or the crushed stone bedding beneath them, does exist. Mobile DNAPL has been documented at the Site and has been observed in the West End Brook and Malden River culverts in the past and in the crushed stone beneath the culverts. Haley &



Aldrich has taken steps to mitigate the migration of DNAPL through the culverts; however, little work has yet been done to mitigate DNAPL migration through the crushed stone beneath the culverts. One product recovery well has been installed to intercept the DNAPL that collects in the crushed stone beneath the West End Brook culvert. Additional mitigation steps are planned for the future.

Based on the above information, as steps are being taken to mitigate the migration of DNAPL from the upland portion of the Site to the Malden River, AMEC concludes that a condition of No Substantial Hazard to the Environment exists at the Site in accordance with the MCP.

5.0 SUMMARY AND CONCLUSIONS

Based on the updated exposure point concentrations resulting from recent data collected at 129 Commercial Street and 51 Commercial Street, the Method 3 Risk Characterization (AMEC, 2001) was revised for these two parcels of the Former Malden MGP Site. For 129 Commercial Street, risks were evaluated for the current site worker potentially exposed to constituents via inhalation of indoor air. The current landscaper at 51 Commercial Street was evaluated for potential exposure via dermal contact and incidental ingestion of surface soil. These risk evaluations determined that, as the Cumulative Receptor Cancer Risk and Non-cancer Risk are less than the MADEP risk management criteria, a condition of No Significant Risk exists to current receptors at these parcels.

A Substantial Hazard Evaluation was also conducted at a portion of the Site in order to determine whether a Substantial Hazard exists to human and environmental receptors through exposures related to current Site uses and activities. For this evaluation, "current" refers to a period of time from January 1989 to September 2007 (310 CMR 40.0956). The portion of the Site considered in this evaluation includes the parcels at: 100 Commercial Street, 129 Commercial Street, 99-109 Commercial Street, 89 Commercial Street, 77 Commercial Street, 65 Commercial Street, 51 Commercial Street, Charles Street, and the Governor House. Based on the conclusions of the Phase II Risk Characterization (AMEC, 2001), it was concluded that a condition of No Substantial Hazard to Human Health exists at the parcels located at 100 Commercial Street, 99-109 Commercial Street, 89 Commercial Street, 77 Commercial Street, 65 Commercial Street, Charles Street, and Governor House. Based on the conclusions of the Phase II Risk Characterization, a condition of No Substantial Hazard to Human Health exists for the current utility worker, the current landscape worker, and the current trespasser at the 129 Commercial Street parcel. At the 51 Commercial Street parcel, a condition of No Substantial Hazard to Human Health exists for the current office worker, utility worker, and the current trespasser.

The primary focus of this Substantial Hazard Evaluation is exposures to current commercial workers at 129 Commercial Street and current landscape workers at 51 Commercial Street, incorporating recent data obtained from each parcel (indoor air and soil data, respectively). For current commercial workers at 129 Commercial Street who may be exposed to volatile compounds in indoor air, the results of this Risk Characterization utilizing recent indoor air data indicate that the Cumulative Receptor Cancer Risk and Non-cancer Risk are less than the MADEP risk management criteria. For current landscape workers at 51 Commercial Street who



may be exposed to compounds in surface soil, the results of this Risk Characterization utilizing recent soil data indicate that the Cumulative Receptor Cancer Risk and Non-cancer Risk are less than the MADEP risk management criteria. Therefore, a condition of No Substantial Hazard to Human Health exists at 129 Commercial Street and 51 Commercial Street. Additionally, a condition of No Substantial Hazard to the environment exists at the Site.

6.0 REFERENCES

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TABLES

TABLE 1
SUMMARY OF INDOOR AIR EXPOSURE POINT CONCENTRATIONS
129 COMMERCIAL STREET
FORMER MALDEN MANUFACTURED GAS PLANT
MALDEN, MASSACHUSETTS

Constituent	No. of Detections	Total No. of Samples	Minimum Detection (mg/m ³)	Maximum Detection (mg/m ³)	Arithmetic Mean (mg/m ³)
Benzene	31	46	0.0014	0.0480	0.0132
Ethylbenzene	43	46	0.0010	0.0110	0.0025
Naphthalene	18	46	0.0013	0.0423	0.0029
Styrene	36	46	0.0012	0.0258	0.0043
Toluene	12	46	0.0068	0.0988	0.0232
m-&p-xylenes	16	46	0.0021	0.0232	0.0053
o-xylenes	10	46	0.0010	0.0070	0.0023

Note:

(1) This table presents the summary of data collected during the eight most recent monitoring events conducted on December, 2000; March 2001; June 2001; October 17, 2001, January 15, 2002, April 12, 2002, June 26, 2002, and October 14, 2002.

(2) Exposure Point concentration based on arithmetic mean concentration of detected concentrations and values equal to one-half reporting limit for non-detects.

Table 2

**Potential Hazard Quotient Following Exposure via Inhalation of Indoor Air—129 Commercial Street
Amendment to Method 3 Risk Characterization
Former Malden MGP, Malden, Massachusetts**

Receptor:

Site Worker (Adult)

$$\text{ADD (mg/kg-day)} = \frac{\text{CA} \times \text{AAF} \times \text{IR} \times \text{ET} \times \text{EF} \times \text{ED} \times \text{CF}}{\text{BW} \times \text{AP}}$$

$$\text{Hazard Quotient (HQ)} = \text{ADD (mg/kg-day)} / \text{RfD (mg/kg-day)}$$

Parameter (units)	Value
ADD = Average Daily Dose Due to Inhalation (mg/kg-day)	See Below
CA = Compound Concentration in Air (mg/m ³)	Chemical-Specific
AAF = Absorption Adjustment Factor (unitless)	Chemical-Specific
IR = Inhalation Rate (m ³ /hr)	1.2
ET = Exposure Time (hr/day)	8
EF = Exposure Frequency (days/year)	250
ED = Exposure Duration (years)	27
BW = Body Weight (kg)	70
AP = Averaging Period (days) (ED x 365 days/yr, noncancer)	9855
RfD = Reference Dose (mg/kg-day)	Chemical-Specific

Compound	Compound Concentration in Air (mg/m ³)	AAF (unitless)	ADD (mg/kg-day)	Inhalation RfD (mg/kg-day)	Inhalation HQ (unitless)
Benzene	0.0132	1	1.24E-03	0.0017	7.28E-01
Ethylbenzene	0.0025	1	2.38E-04	0.2900	8.20E-04
Naphthalene	0.0053	1	5.01E-04	0.1240	4.04E-03
Styrene	0.0029	1	2.74E-04	0.0009	3.20E-01
Toluene	0.0023	1	2.20E-04	0.1240	1.78E-03
m-&p-xylenes	0.0043	1	4.05E-04	0.2857	1.42E-03
o-xylenes	0.0232	1	2.18E-03	0.1140	1.91E-02
Total Hazard Index =					1

Table 2
Potential Carcinogenic Risk Following Exposure via Inhalation of Indoor Air--129 Commercial Street
Amendment to Method 3 Risk Characterization
Former Malden MGP, Malden, Massachusetts

Receptor: Site Worker (Adult)

$$\text{LADD (mg/kg-day)} = \frac{\text{CA} \times \text{AAF} \times \text{IR} \times \text{ET} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AP}}$$

$$\text{ELCR} = \text{LADD (mg/kg-day)} \times \text{CSF (1/mg/kg-day)}$$

Parameter (units)	Value
LADD = Lifetime Average Daily Dose Due to Inhalation (mg/kg-day)	See Below
CA = Compound Concentration in Air (mg/m ³)	Chemical-Specific
AAF = Absorption Adjustment Factor (unitless)	Chemical-Specific
IR = Inhalation Rate (m ³ /hr)	1.2
ET = Exposure Time (hr/day)	8
EF = Exposure Frequency (days/year)	250
ED = Exposure Duration (years)	27
BW = Body Weight (kg)	70
AP = Averaging Period (days) (75 years x 365 days/yr, cancer)	27375
CSF = Cancer Slope Factor (1/mg/kg-day)	Chemical-Specific
ELCR = Estimated Lifetime Cancer Risk	Calculated

Compound	Compound (mg/m ³)	AAF (unitless)	ADD (mg/kg-day)	Inhalation CSF (1/mg/kg-day)	Inhalation (unitless)
Benzene	0.0132	1	4E-04	0.0273	1E-05
Ethylbenzene	0.0025	1	9E-05	Class D	NA
Naphthalene	0.0053	1	2E-04	Class D	NA
Styrene	0.0029	1	1E-04	NA	NA
Toluene	0.0023	1	8E-05	Class D	NA
m-&p-xylenes	0.0043	1	1E-04	NA	NA
o-xylenes	0.0232	1	8E-04	Class D	NA
ELCR =					1.E-05

TABLE 3
SUMMARY OF RISK ESTIMATES
129 COMMERCIAL STREET
AMENDMENT TO METHOD 3 RISK CHARACTERIZATION
FORMER MALDEN MANUFACTURED GAS PLANT
MALDEN, MASSACHUSETTS

Receptor	Exposure Pathway	Estimated Lifetime Cancer Risk (ELCR)	Hazard Index (HI)	Exceeds MADEP Target Risk Levels*
Current	Inhalation of Indoor Air	1E-05	1E+00	No
	TOTAL RISK	1E-05	1E+00	No
Trespasser (Utility Scenario)	Incidental Ingestion of Soil	6E-09	1E-04	No
	Dermal Contact with Soil	3E-09	1E-05	No
	Inhalation of Fugitive Dust	6E-11	1E-06	No
	Inhalation of Vapors	2E-09	6E-04	No
	TOTAL RISK	1E-08	7E-04	No
Landscape	Incidental Ingestion of Soil	5E-07	3E-03	No
	Dermal Contact with Soil	4E-07	5E-04	No
	TOTAL RISK	9E-07	3E-03	No
Utility Worker	Incidental Ingestion of Soil	4E-08	2E-04	No
	Dermal Contact with Soil	3E-08	4E-05	No
	Incidental Ingestion of Groundwater	6E-09	7E-05	No
	Dermal Contact with Groundwater	9E-08	1E-03	No
	Inhalation of Fugitive Dust	3E-09	1E-05	No
	Inhalation of Vapors	2E-08	2E-03	No
	TOTAL RISK	2E-07	4E-03	No

Notes:

* = MADEP establishes a condition of No Significant Risk if the hazard index is less than or equal to one and the estimated lifetime cancer risk is less than or equal to 1E-5.

(1) Represents revised risks using recent data. All other risk estimates from Phase II Risk Characterization (AMEC 2001).

Table 4
Summary of Soil Data
51 Commercial Street
Former Malden Manufactured Gas Plant
Malden, Massachusetts

Detected Compound	Sample Id and Depth (fbgs)										Average Concentration 0.5-1 0-3	Frequency of Detect 0.5-1 0-3
	SS-101		SS-102		SS-103		SS-103		SS-103 DUP			
	0.5-1 mg/kg	0-3 mg/kg	0.5-1 mg/kg	0-3 mg/kg	0.5-1 mg/kg	0-3 mg/kg	0.5-1 mg/kg	0-3 mg/kg	0.5-1 mg/kg	0-3 mg/kg		
1-Methylnaphthalene	---	1.1 U	---	0.94	---	0.57 U	---	0.57 U	---	1.1 U	---	1 of 3
2-Methylnaphthalene	---	1.8 U	---	0.98	---	0.92 U	---	0.92 U	---	1.8 U	---	1 of 3
Acenaphthylene	---	4.2	---	2.4	---	0.57 U	---	0.57 U	---	1.1 U	---	2 of 3
Anthracene	---	3.4	---	2.6	---	0.57 U	---	0.57 U	---	1.1 U	---	2 of 3
Arsenic	---	7.6	---	9.5	---	8.9	---	8.9	---	9.5	---	3 of 3
Barium	---	72	---	53	---	62	---	62	---	65	---	3 of 3
Benzo(a)anthracene	---	8.1	---	6	---	1.1	---	1.1	---	2.4	---	3 of 3
Benzo(a)pyrene	---	8.3	---	6.2	---	1.1	---	1.1	---	2.4	---	3 of 3
Benzo(b)fluoranthene	---	7.3	---	4.9	---	0.92	---	0.92	---	1.8	---	3 of 3
Benzo(e)pyrene	---	6	---	4.2	---	0.76	---	0.76	---	1.7	---	3 of 3
Benzo(g,h,i)perylene	---	6.6	---	4.6	---	0.76	---	0.76	---	1.7	---	3 of 3
Benzo(k)fluoranthene	---	6.8	---	4.9	---	0.89	---	0.89	---	2.1	---	3 of 3
C11-C22 Aromatics	---	542	---	1730	---	191	---	191	---	127	---	3 of 3
C19-C36 Aliphatics	---	155	---	151	---	122	---	122	---	81	---	3 of 3
C9-C18 Aliphatics	---	102 U	---	65.4	---	34.5 U	---	34.5 U	---	11.5 U	---	1 of 3
Cadmium	---	0.85	---	0.46 U	---	0.47	---	0.47	---	0.51	---	2 of 3
Chromium	---	38	---	17	---	16	---	16	---	14	---	3 of 3
Chrysene	---	8.4	---	6.3	---	1.1	---	1.1	---	2.6	---	3 of 3
Cyanide, Physiologically A	---	0.87	---	1.9	---	0.4	---	0.4	---	0.45	---	3 of 3
Cyanide, Total	---	5.4	---	6.5	---	1.6	---	1.6	---	1.3	---	3 of 3
Dibenzo(a,h)anthracene	---	1.9	---	1.3	---	0.57 U	---	0.57 U	---	1.1 U	---	2 of 3
Fluoranthene	---	11	---	9.5	---	1.6	---	1.6	---	3.6	---	3 of 3
Fluorene	---	1.1 U	---	0.8	---	0.57 U	---	0.57 U	---	1.1 U	---	1 of 3
Indeno(1,2,3-cd)pyrene	---	5.8	---	4.1	---	0.71	---	0.71	---	1.5	---	3 of 3
Lead	---	300	---	340	---	300	---	300	---	330	---	3 of 3
Mercury	---	0.41	---	0.38	---	0.25	---	0.25	---	0.24	---	3 of 3
Naphthalene	---	1.1 U	---	1.4	---	0.57 U	---	0.57 U	---	1.1 U	---	1 of 3
Naphthalene (VOC)	1.3	---	1.9	---	0.89 U	---	0.86 U	---	0.86 U	---	2 of 3	---
p/m-Xylene	0.18 U	---	0.3	---	0.18 U	---	0.17 U	---	0.17 U	---	1 of 3	---
Perylene	---	2.3	---	1.7	---	0.57 U	---	0.57 U	---	1.1 U	---	2 of 3
Phenanthrene	---	4.7	---	8.4	---	0.82	---	0.82	---	2	---	3 of 3
Pyrene	---	14	---	12	---	1.8	---	1.8	---	4.4	---	3 of 3

Notes:

Data represent soil samples collected in June 2002 (Haley and Aldrich, 2002)

Average Concentration represents arithmetic average of detects and one-half laboratory reporting limit for non-detects.

"---" = Not Evaluated

Table4.xls

Table 5
Soil Exposure Point Concentrations
51 Commercial Street
Former Malden MGP, Malden, Massachusetts

Compound	Soil Data 0 to 3 ft. Arithmetic Mean (mg/kg)
1-Methylnaphthalene	0.64
2-Methylnaphthalene	0.85
Acenaphthylene	2.34
Anthracene	2.14
Arsenic	8.77
Barium	62.8
Benzo(a)anthracene	5.28
Benzo(a)pyrene	5.42
Benzo(b)fluoranthene	4.52
Benzo(e)pyrene	3.81
Benzo(g,h,i)perylene	4.14
Benzo(k)fluoranthene	4.40
C11-C22 Aromatics	810
C19-C36 Aliphatics	136
C9-C18 Aliphatics	42.6
Cadmium	0.52
Chromium	23.3
Chrysene	5.52
Cyanide, Physiologically Available	1.07
Cyanide, Total	4.45
Dibenzo(a,h)anthracene	1.21
Fluoranthene	7.70
Fluorene	0.59
Indeno(1,2,3-cd)pyrene	3.67
Lead	318
Mercury	0.35
Naphthalene (VOC)	1.22
p/m-Xylene	0.16
Perylene	1.47
Phenanthrene	4.84
Pyrene	9.70

Notes:

Data represents samples collected in June 2002.

Naphthalene data represents VPH results from samples collected in 0.5-1 foot depth interval

Table 6a

Potential Hazard Quotient and Risk Following Exposure via Incidental Ingestion of Soil - 51 Commercial Street
Amendment to Method 3 Risk Characterization
Former Malden MGP, Malden, Massachusetts

Scenario: Current Occupational Scenario (0 - 3 ft.)
Receptor: Landscaper

$$\text{Intake (mg/kg-day)} = \frac{\text{CS} \times \text{IR} \times \text{FI} \times \text{RA}_{\text{Fo}} \times \text{EF} \times \text{ED} \times \text{CF}}{\text{BW} \times \text{AT}}$$

$$\text{Hazard Quotient (HQ)} = \frac{\text{Intake (mg/kg-day)}}{\text{RfD (mg/kg-day)}}$$

$$\text{Cancer Risk (ELCR)} = \text{Intake (mg/kg-day)} \times \text{CSF [1/(mg/kg-day)]}$$

Parameter (units)	Value
ADD = Average Daily Dose Due to Ingestion (mg/kg-day)	See Below
CS = Compound Concentration in Soil (mg/kg)	Chemical-Specific
IR = Soil Ingestion Rate (mg/day)	50
FI = Fraction of Soil Ingested from the Site (unitless)	1
RA _{Fo} = Relative Absorption Factor (Oral-Soil) (unitless)	Chemical-Specific
EF = Exposure Frequency (days/year)	24
ED = Exposure Duration (years)	27
CF = Conversion Factor (kg/mg)	1E-06
BW = Body Weight (kg)	70
AT = Averaging Time (days) (ED x 365 days/yr, noncancer)	9855
AT = Averaging Time (days) (75 yr. x 365 days/yr, cancer)	27375
RfD = Reference Dose (mg/kg-day)	Chemical-Specific
CSF = Cancer Slope Factor [1/(mg/kg-day)]	Chemical-Specific

Compound	Soil Concentration (0 - 3 ft.) (mg/kg)	Noncancer Hazard Quotient				Excess Lifetime Cancer Risk			
		Oral-Soil RAF (unitless)	Intake (Noncancer) (mg/kg-day)	Chronic Oral RfD (mg/kg-day)	Soil Ingestion HQ (unitless)	Oral-Soil RAF (unitless)	Intake (Cancer) (mg/kg-day)	Oral CSF (mg/kg-day) ⁻¹	Soil Ingestion Risk (unitless)
1-Methylnaphthalene	0.64	0.43	1.3E-08	2.0E-02	6.4E-07	NA	NA	NA	NA
2-Methylnaphthalene	0.85	0.43	1.7E-08	2.0E-02	8.6E-07	NA	NA	NA	NA
Acenaphthylene	2.3	0.43	4.7E-08	6.0E-02	7.9E-07	NA	NA	Class D	NA
Anthracene	2.1	0.43	4.3E-08	3.0E-01	1.4E-07	NA	NA	Class D	NA
Arsenic	8.8	0.51	2.1E-07	3.0E-04	7.0E-04	5.1E-01	7.6E-08	1.5E+00	1.1E-07
Barium	63	1	3.0E-06	7.0E-02	4.2E-05	NA	NA	NA	NA
Benzo(a)anthracene	5.3	0.27	6.7E-08	4.0E-02	1.7E-06	2.7E-01	2.4E-08	7.3E-01	1.8E-08
Benzo(a)pyrene	5.4	0.27	6.9E-08	4.0E-02	1.7E-06	2.7E-01	2.5E-08	7.3E+00	1.8E-07
Benzo(b)fluoranthene	4.5	0.27	5.7E-08	4.0E-02	1.4E-06	2.7E-01	2.1E-08	7.3E-01	1.5E-08
Benzo(e)pyrene	3.8	0.43	7.7E-08	3.0E-02	2.6E-06	NA	NA	Class D	NA
Benzo(g,h,i)perylene	4.1	0.27	5.3E-08	4.0E-02	1.3E-06	NA	NA	Class D	NA
Benzo(k)fluoranthene	4.4	0.27	5.6E-08	4.0E-02	1.4E-06	2.7E-01	2.0E-08	7.3E-02	1.5E-09
C11-C22 Aromatics	810	0.43	1.6E-05	3.0E-02	5.5E-04	NA	NA	NA	NA
C19-C36 Aliphatics	136	0.91	5.8E-06	2.0E+00	2.9E-06	NA	NA	NA	NA
C9-C18 Aliphatics	43	0.91	1.8E-06	1.0E-01	1.8E-05	NA	NA	NA	NA
Cadmium	0.5	1	2.5E-08	1.0E-03	2.5E-05	NA	NA	NA	NA
Chromium	23	0.3	3.3E-07	3.0E-03	1.1E-04	NA	NA	NA	NA
Chrysene	5.5	0.27	7.0E-08	4.0E-02	1.7E-06	2.7E-01	2.5E-08	7.3E-03	1.8E-10
Cyanide, Physiologically Av	1.1	1	5.0E-08	2.0E-02	2.5E-06	NA	NA	Class D	NA
Cyanide, Total	4.5	0.2	4.2E-08	2.0E-02	2.1E-06	NA	NA	Class D	NA
Dibenzo(a,h)anthracene	1.2	0.27	1.5E-08	4.0E-02	3.8E-07	2.7E-01	5.5E-09	7.3E+00	4.0E-08
Fluoranthene	7.7	0.43	1.6E-07	4.0E-02	3.9E-06	NA	NA	Class D	NA
Fluorene	0.59	0.43	1.2E-08	4.0E-02	3.0E-07	NA	NA	Class D	NA
Indeno(1,2,3-cd)pyrene	3.7	0.27	4.7E-08	4.0E-02	1.2E-06	2.7E-01	1.7E-08	7.3E-01	1.2E-08
Lead	318	0.3	4.5E-06	7.5E-04	6.0E-03	NA	NA	NA	NA
Mercury	0.35	2	3.2E-08	3.0E-04	1.1E-04	NA	NA	Class D	NA
Naphthalene (VOC)	1.2	0.43	2.5E-08	2.0E-02	1.2E-06	NA	NA	NA	NA
p,m-Xylene	0.16	1	7.5E-09	2.0E+00	3.8E-09	NA	NA	Class D	NA
Perylene	1.5	0.43	3.0E-08	3.0E-02	9.9E-07	NA	NA	Class D	NA
Phenanthrene	4.8	0.43	9.8E-08	4.0E-02	2.4E-06	NA	NA	Class D	NA
Pyrene	10	0.43	2.0E-07	3.0E-02	6.5E-06	NA	NA	Class D	NA
Hazard Index:					0.008	Total Cancer Risk:			
						3.8E-07			

Notes:

Pyrene RAF, RfD, and CSF are used as a surrogate values for Benzo(e)pyrene and Perylene.

Table 6b

Potential Hazard Quotient and Risk Following Exposure via Dermal Contact with Soil - 51 Commercial Street
Amendment to Method 3 Risk Characterization
Former Malden MGP, Malden, Massachusetts

Scenario:	Current Occupational Scenario (0 - 3 ft.)
Receptor:	Landscaper

$$\text{Intake (mg/kg-day)} = \frac{\text{CS} \times \text{SA} \times \text{AF} \times \text{RAF}_d \times \text{EF} \times \text{ED} \times \text{CF}}{\text{BW} \times \text{AT}}$$

$$\text{Hazard Quotient (HQ)} = \text{Intake (mg/kg-day)} / \text{RfD (mg/kg-day)}$$

$$\text{Cancer Risk (ELCR)} = \text{Intake (mg/kg-day)} \times \text{CSF [1/(mg/kg-day)]}$$

Parameter (units)	Value
ADID = Average Daily Dose Due to Dermal Contact (mg/kg-day)	See Below
CS = Compound Concentration in Soil (mg/kg)	Chemical-Specific
SA = Skin Surface Area Exposed (cm ² /day)	3477
AF = Soil to Skin Adherence Factor (mg/cm ²)	0.19
RAF _d = Relative Absorption Factor (Dermal-Soil) (unitless)	Chemical-Specific
EF = Exposure Frequency (days/year)	24
ED = Exposure Duration (years)	27
CF = Conversion Factor (kg/mg)	1E-06
BW = Body Weight (kg)	70
AT = Averaging Time (days) (ED x 365 days/yr, noncancer)	9855
AT = Averaging Time (days) (75 yr. x 365 days/yr, cancer)	27375
RfD = Reference Dose (mg/kg-day)	Chemical-Specific
CSF = Cancer Slope Factor [1/(mg/kg-day)]	Chemical-Specific

Compound	Soil Concentration (0 - 3 ft.) (mg/kg)	Noncancer Hazard Quotient				Excess Lifetime Cancer Risk			
		Dermal-Soil RAF (unitless)	Intake (Noncancer) (mg/kg-day)	Oral RfD (mg/kg-day)	Soil Dermal HQ (unitless)	Dermal-Soil RAF (unitless)	Intake (Cancer) (mg/kg-day)	Oral CSF (mg/kg-day)	Soil Dermal Risk (unitless)
1-Methylnaphthalene	0.64	0.1	3.9E-08	2.0E-02	2.0E-06	NA	NA	NA	NA
2-Methylnaphthalene	0.85	0.1	5.3E-08	2.0E-02	2.6E-06	NA	NA	NA	NA
Acenaphthylene	2.3	0.1	1.5E-07	6.0E-02	2.4E-06	NA	NA	Class D	NA
Anthracene	2.1	0.1	1.3E-07	3.0E-01	4.4E-07	NA	NA	Class D	NA
Arsenic	8.8	0.009	4.9E-08	3.0E-04	1.6E-04	9.0E-03	1.8E-08	1.5E+00	2.6E-08
Barium	63	0.001	3.9E-08	7.0E-02	5.6E-07	NA	NA	NA	NA
Benzo(a)anthracene	5.3	0.02	6.6E-08	4.0E-02	1.6E-06	2.0E-02	2.4E-08	7.3E-01	1.7E-08
Benzo(a)pyrene	5.4	0.02	6.7E-08	4.0E-02	1.7E-06	2.0E-02	2.4E-08	7.3E+00	1.8E-07
Benzo(b)fluoranthene	4.5	0.02	5.6E-08	4.0E-02	1.4E-06	2.0E-02	2.0E-08	7.3E-01	1.5E-08
Benzo(e)pyrene	3.8	0.1	2.4E-07	3.0E-02	7.9E-06	NA	NA	Class D	NA
Benzo(g,h,i)perylene	4.1	0.02	5.1E-08	4.0E-02	1.3E-06	NA	NA	Class D	NA
Benzo(k)fluoranthene	4.4	0.02	5.5E-08	4.0E-02	1.4E-06	2.0E-02	2.0E-08	7.3E-02	1.4E-09
C11-C22 Aromatics	810	0.1	5.0E-05	3.0E-02	1.7E-03	NA	NA	NA	NA
C19-C36 Aliphatics	136	0.1	8.4E-06	2.0E+00	4.2E-06	NA	NA	NA	NA
C9-C18 Aliphatics	43	0.2	5.3E-06	1.0E-01	5.3E-05	NA	NA	NA	NA
Cadmium	0.5	0.04	1.3E-08	1.0E-03	1.3E-05	NA	NA	NA	NA
Chromium	23	0.04	5.8E-07	3.0E-03	1.9E-04	NA	NA	NA	NA
Chrysene	5.5	0.02	6.8E-08	4.0E-02	1.7E-06	2.0E-02	2.5E-08	7.3E-03	1.8E-10
Cyanide, Physiologically Ave	1.1	1	6.6E-07	2.0E-02	3.3E-05	NA	NA	Class D	NA
Cyanide, Total	4.5	0.1	2.8E-07	2.0E-02	1.4E-05	NA	NA	Class D	NA
Dibenzo(a,h)anthracene	1.2	0.02	1.5E-08	4.0E-02	3.7E-07	2.0E-02	5.4E-09	7.3E+00	3.9E-08
Fluoranthene	7.7	0.1	4.8E-07	4.0E-02	1.2E-05	NA	NA	Class D	NA
Fluorene	0.59	0.1	3.7E-08	4.0E-02	9.1E-07	NA	NA	Class D	NA
Indeno(1,2,3-cd)pyrene	3.7	0.02	4.6E-08	4.0E-02	1.1E-06	2.0E-02	1.6E-08	7.3E-01	1.2E-08
Lead	318	0.002	4.0E-07	7.5E-04	5.3E-04	NA	NA	NA	NA
Mercury	0.35	0.01	2.1E-09	3.0E-04	7.1E-06	NA	NA	Class D	NA
Naphthalene (VOC)	1.2	0.1	7.5E-08	2.0E-02	3.8E-06	NA	NA	NA	NA
p/m-Xylene	0.16	0.04	4.0E-09	2.0E+00	2.0E-09	NA	NA	Class D	NA
Perylene	1.5	0.1	9.1E-08	3.0E-02	3.0E-06	NA	NA	Class D	NA
Phenanthrene	4.8	0.1	3.0E-07	4.0E-02	7.5E-06	NA	NA	Class D	NA
Pyrene	10	0.1	6.0E-07	3.0E-02	2.0E-05	NA	NA	Class D	NA
Hazard Index:					2.8E-03	Total Cancer Risk:			
						2.9E-07			

Notes:

Pyrene RAF, RfD, and CSF are used as a surrogate values for Benzo(e)pyrene and Perylene.
Table6.xlsTable6b

TABLE 7
SUMMARY OF RISK ESTIMATES
51 COMMERCIAL STREET
AMENDMENT TO METHOD 3 RISK CHARACTERIZATION
FORMER MALDEN MANUFACTURED GAS PLANT
MALDEN, MASSACHUSETTS

Receptor	Exposure Pathway	Estimated Lifetime Cancer Risk (ELCR)	Hazard Index (HI)	Exceeds MADEP Target Risk Levels*
Current	Incidental Ingestion of Soil	4E-07	8E-03	No
	Dermal Contact with Soil	3E-07	3E-03	No
	TOTAL RISK	7E-07	1E-02	No
Trespasser (Utility Scenario)	Incidental Ingestion of Soil	1E-07	1E-04	No
	Dermal Contact with Soil	9E-08	3E-05	No
	Inhalation of Fugitive Dust	7E-10	3E-06	No
	Inhalation of Vapors	6E-09	3E-03	No
	TOTAL RISK	2E-07	3E-03	No
Utility Worker	Incidental Ingestion of Soil	1E-06	4E-04	No
	Dermal Contact with Soil	8E-07	4E-04	No
	Inhalation of Fugitive Dust	4E-08	8E-05	No
	Inhalation of Vapors	5E-08	7E-03	No
	TOTAL RISK	2E-06	8E-03	No
Site Worker	Inhalation of Indoor Air	2E-06	1E-01	No
	TOTAL RISK	2E-06	1E-01	No

Notes:

* = MADEP establishes a condition of No Significant Risk if the hazard index is less than or equal to one and the estimated lifetime cancer risk is less than or equal to 1E-5.

(1) Represents revised risks using recent data. All other risk estimates from Phase II Risk Characterization (AMEC 2001).

Table 8

Potential Hazard Quotient Following Exposure via Inhalation of Indoor Air
Substantial Hazard Evaluation
Former Malden MGP, Malden, Massachusetts

Receptor: Site Worker (Adult)

$$\text{ADD (mg/kg-day)} = \frac{\text{CA} \times \text{AAF} \times \text{IR} \times \text{ET} \times \text{EF} \times \text{ED} \times \text{CF}}{\text{BW} \times \text{AP}}$$

$$\text{Hazard Quotient (HQ)} = \text{ADD (mg/kg-day)} / \text{RfD (mg/kg-day)}$$

Parameter (units)	Value
ADD = Average Daily Dose Due to Inhalation (mg/kg-day)	See Below
CA = Compound Concentration in Air (mg/m ³)	Chemical-Specific
AAF = Absorption Adjustment Factor (unitless)	Chemical-Specific
IR = Inhalation Rate (m ³ /hr)	1.2
ET = Exposure Time (hr/day)	8
EF = Exposure Frequency (days/year)	250
ED = Exposure Duration (years)	19
BW = Body Weight (kg)	70
AP = Averaging Period (days) (ED x 365 days/yr, noncancer)	6935
RfD = Reference Dose (mg/kg-day)	Chemical-Specific

Compound	Compound Concentration in Air (mg/m ³)	AAF (unitless)	ADD (mg/kg-day)	Inhalation RfD (mg/kg-day)	Inhalation HQ (unitless)
Benzene	0.0132	1	0.001	0.0017	0.7
Ethylbenzene	0.0025	1	0.0002	0.290	0.0008
Naphthalene	0.0029	1	0.0003	0.0009	0.3
Styrene	0.0043	1	0.0004	0.286	0.001
Toluene	0.0232	1	0.002	0.114	0.02
m-&p-xylenes	0.0053	1	0.001	0.124	0.004
o-xylenes	0.0023	1	0.0002	0.124	0.002
Total Hazard Index =					1

Table 8
Potential Carcinogenic Risk Following Exposure via Inhalation of Indoor Air
Substantial Hazard Evaluation
Former Malden MGP, Malden, Massachusetts

Receptor: Site Worker (Adult)

$$\text{LADD (mg/kg-day)} = \frac{\text{CA} \times \text{AAF} \times \text{IR} \times \text{ET} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AP}}$$

$$\text{ELCR} = \text{LADD (mg/kg-day)} \times \text{CSF (1/mg/kg-day)}$$

Parameter (units)	Value
LADD = Lifetime Average Daily Dose Due to Inhalation (mg/kg-day)	See Below
CA = Compound Concentration in Air (mg/m ³)	Chemical-Specific
AAF = Absorption Adjustment Factor (unitless)	Chemical-Specific
IR = Inhalation Rate (m ³ /hr)	1.2
ET = Exposure Time (hr/day)	8
EF = Exposure Frequency (days/year)	250
ED = Exposure Duration (years)	19
BW = Body Weight (kg)	70
AP = Averaging Period (days) (75 years x 365 days/yr, cancer)	27375
CSF = Cancer Slope Factor (1/mg/kg-day)	Chemical-Specific
ELCR = Estimated Lifetime Cancer Risk	Calculated

Compound	Compound (mg/m ³)	AAF (unitless)	ADD (mg/kg-day)	Inhalation CSF (1/mg/kg-day)	Inhalation (unitless)
Benzene	0.0132	1	3E-04	0.0273	9E-06
Ethylbenzene	0.0025	1	6E-05	Class D	NA
Naphthalene	0.0029	1	7E-05	NA	NA
Styrene	0.0043	1	1E-04	NA	NA
Toluene	0.0232	1	6E-04	Class D	NA
m-&p-xylenes	0.0053	1	1E-04	Class D	NA
o-xylenes	0.0023	1	6E-05	Class D	NA
ELCR =					9.E-06

TABLE 9
SUMMARY OF RISK ESTIMATES
129 COMMERCIAL STREET
SUBSTANTIAL HAZARD EVALUATION
FORMER MALDEN MANUFACTURED GAS PLANT
MALDEN, MASSACHUSETTS

Receptor	Exposure Pathway	Estimated Lifetime Cancer Risk (ELCR)	Hazard Index (HI)	Exceeds MADEP Target Risk Levels*
Current				
Site Worker ⁽¹⁾	Inhalation of Indoor Air	9E-06	1E+00	No
	TOTAL RISK	9E-06	1E+00	No
	Incidental Ingestion of Soil	6E-09	1E-04	No
Trespasser (Utility Scenario)	Dermal Contact with Soil	3E-09	1E-05	No
	Inhalation of Fugitive Dust	6E-11	1E-06	No
	Inhalation of Vapors	2E-09	6E-04	No
	TOTAL RISK	1E-08	7E-04	No
Landscape	Incidental Ingestion of Soil	5E-07	3E-03	No
	Dermal Contact with Soil	4E-07	5E-04	No
	TOTAL RISK	9E-07	3E-03	No
Utility Worker	Incidental Ingestion of Soil	4E-08	2E-04	No
	Dermal Contact with Soil	3E-08	4E-05	No
	Incidental Ingestion of Groundwater	6E-09	7E-05	No
	Dermal Contact with Groundwater	9E-08	1E-03	No
	Inhalation of Fugitive Dust	3E-09	1E-05	No
	Inhalation of Vapors	2E-08	2E-03	No
	TOTAL RISK	2E-07	4E-03	No

Notes:

* = MADEP establishes a condition of No Significant Risk if the hazard index is less than or equal to one and the estimated lifetime cancer risk is less than or equal to 1E-5.

(1) Represents revised risks using recent data in Substantial Hazard Evaluation. All other risk estimates from Phase II Risk Characterization (AMEC 2001).

Table 10a
Potential Exposure via Incidental Ingestion of Soil - 51 Commercial Street
Substantial Hazard Evaluation
Former Malden MGP, Malden, Massachusetts

Scenario: Current Occupational Scenario (0 - 3 ft.)
 Receptor: Landscaper

$$\text{ADD/LADD (mg/kg-day)} = \frac{\text{CS} \times \text{IR} \times \text{FI} \times \text{RA} \times \text{Fo} \times \text{EF} \times \text{ED} \times \text{CF}}{\text{BW} \times \text{AT}}$$

Hazard Quotient (HQ) = ADD (mg/kg-day) / RfD (mg/kg-day)
 Cancer Risk (ELCR) = LADD (mg/kg-day) * CSF [1/(mg/kg-day)]

Parameter (units)	Value
ADD = Average Daily Dose Due to Ingestion (mg/kg-day)	See Below
LADD = Lifetime Average Daily Dose (mg/kg-day)	See Below
CS = Compound Concentration in Soil (mg/kg)	Chemical-Specific
IR = Soil Ingestion Rate (mg/day)	50
FI = Fraction of Soil Ingested from the Site (unitless)	1
RA/Fo = Relative Absorption Factor (Oral-Soil) (unitless)	Chemical-Specific
EF = Exposure Frequency (days/year)	24
ED = Exposure Duration (years)	19
CF = Conversion Factor (kg/mg)	1E-06
BW = Body Weight (kg)	70
AT = Averaging Time (days) (ED x 365 days/yr, noncancer)	6935
AT = Averaging Time (days) (75 yr. x 365 days/yr, cancer)	27375
RfD = Reference Dose (mg/kg-day)	Chemical-Specific
CSF = Cancer Slope Factor [1/(mg/kg-day)]	Chemical-Specific

Compound	Soil Concentration (0 - 3 ft.) (mg/kg)	Noncancer Hazard Quotient				Excess Lifetime Cancer Risk			
		Oral-Soil RAF (unitless)	ADD (Noncancer) (mg/kg-day)	Chronic Oral RfD (mg/kg-day)	Soil Ingestion HQ (unitless)	Oral-Soil RAF (unitless)	LADD (Cancer) (mg/kg-day)	Oral CSF (mg/kg-day) ⁻¹	Soil Ingestion Risk (unitless)
1-Methylnaphthalene	0.64	0.43	1.3E-08	0.02	6.4E-07	NA	NA	NA	NA
2-Methylnaphthalene	0.85	0.43	1.7E-08	0.02	8.6E-07	NA	NA	NA	NA
Acenaphthylene	2.34	0.43	4.7E-08	0.06	7.9E-07	NA	NA	Class D	NA
Anthracene	2.14	0.43	4.3E-08	0.3	1.4E-07	NA	NA	Class D	NA
Arsenic	8.77	0.51	2.1E-07	0.0003	7.0E-04	0.51	5.3E-08	1.5	8.0E-08
Barium	63	1	3.0E-06	0.07	4.2E-05	NA	NA	NA	NA
Benzo(a)anthracene	5	0.27	6.7E-08	0.04	1.7E-06	0.27	1.7E-08	0.73	1.2E-08
Benzo(a)pyrene	5.42	0.27	6.9E-08	0.04	1.7E-06	0.27	1.7E-08	7.3	1.3E-07
Benzo(b)fluoranthene	5	0.27	5.7E-08	0.04	1.4E-06	0.27	1.5E-08	0.73	1.1E-08
Benzo(e)pyrene	4	0.43	7.7E-08	0.03	2.6E-06	NA	NA	Class D	NA
Benzo(g,h,i)perylene	4	0.27	5.3E-08	0.04	1.3E-06	NA	NA	Class D	NA
Benzo(k)fluoranthene	4	0.27	5.6E-08	0.04	1.4E-06	0.27	1.4E-08	0.073	1.0E-09
C11-C22 Aromatics	810.33	0.43	1.6E-05	0.03	5.5E-04	NA	NA	NA	NA
C19-C36 Aliphatics	136	0.91	5.8E-06	2	2.9E-06	NA	NA	NA	NA
C9-C18 Aliphatics	43	0.91	1.8E-06	0.1	1.8E-05	NA	NA	NA	NA
Cadmium	1	1	2.5E-08	0.001	2.5E-05	NA	NA	NA	NA
Chromium	23.33	0.3	3.3E-07	0.003	1.1E-04	NA	NA	NA	NA
Chrysene	6	0.27	7.0E-08	0.04	1.7E-06	0.27	1.8E-08	0.0073	1.3E-10
Cyanide, Physiologically Av	1	1	5.0E-08	0.02	2.5E-06	NA	NA	Class D	NA
Cyanide, Total	4	0.2	4.2E-08	0.02	2.1E-06	NA	NA	Class D	NA
Dibenzo(a,h)anthracene	1	0.27	1.5E-08	0.04	3.8E-07	0.27	3.9E-09	7.3	2.8E-08
Fluoranthene	7.70	0.43	1.6E-07	0.04	3.9E-06	NA	NA	Class D	NA
Fluorene	0.59	0.43	1.2E-08	0.04	3.0E-07	NA	NA	Class D	NA
Indeno(1,2,3-cd)pyrene	4	0.27	4.7E-08	0.04	1.2E-06	0.27	1.2E-08	0.73	8.6E-09
Lead	318	0.3	4.5E-06	0.00075	6.0E-03	NA	NA	NA	NA
Mercury	0	2	3.2E-08	0.0003	1.1E-04	NA	NA	Class D	NA
Naphthalene (VOC)	1	0.43	2.5E-08	0.02	1.2E-06	NA	NA	NA	NA
p/n-Xylene	0.16	1	7.5E-09	2	3.8E-09	NA	NA	Class D	NA
Perylene	1.47	0.43	3.0E-08	0.03	9.9E-07	NA	NA	Class D	NA
Phenanthrene	4.84	0.43	9.8E-08	0.04	2.4E-06	NA	NA	Class D	NA
Pyrene	10	0.43	2.0E-07	0.03	6.5E-06	NA	NA	Class D	NA
Hazard Index:					0.008	Total Cancer Risk: 2.7E-07			

Notes:
 Toxicity information for Pyrene used as surrogate values for Benzo(e)pyrene and Perylene.

Table 10b

Potential Exposure via Dermal Contact with Soil - 51 Commercial Street
Substantial Hazard Evaluation
Former Malden MGP, Malden, Massachusetts

Scenario: Current Occupational Scenario (0 - 3 ft.)
Receptor: Landscaper

$$ADD/LADD \text{ (mg/kg-day)} = \frac{CS \times SA \times AF \times RA_{fd} \times EF \times ED \times CF}{BW \times AT}$$

$$\text{Hazard Quotient (HQ)} = \text{ADD (mg/kg-day)} / \text{RfD (mg/kg-day)}$$

$$\text{Cancer Risk (ELCR)} = \text{LADD (mg/kg-day)} \times \text{CSF [1/(mg/kg-day)]}$$

Parameter (units)	Value
ADD = Average Daily Dose Due to Dermal Contact (mg/kg-day)	See Below
LADD = Lifetime Average Daily Dose (mg/kg-day)	See Below
CS = Compound Concentration in Soil (mg/kg)	Chemical-Specific
SA = Skin Surface Area Exposed (cm ² /day)	3477
AF = Soil to Skin Adherence Factor (mg/cm ²)	0.19
RA _{fd} = Relative Absorption Factor (Dermal-Soil) (unitless)	Chemical-Specific
EF = Exposure Frequency (days/year)	24
ED = Exposure Duration (years)	19
CF = Conversion Factor (kg/mg)	1E-06
BW = Body Weight (kg)	70
AT = Averaging Time (days) (ED x 365 days/yr, noncancer)	6935
AT = Averaging Time (days) (75 yr. x 365 days/yr, cancer)	27375
RfD = Reference Dose (mg/kg-day)	Chemical-Specific
CSF = Cancer Slope Factor [1/(mg/kg-day)]	Chemical-Specific

Compound	Soil Concentration (0 - 3 ft.) (mg/kg)	Noncancer Hazard Quotient				Excess Lifetime Cancer Risk			
		Dermal-Soil RAF (unitless)	ADD (Noncancer) (mg/kg-day)	Oral RfD (mg/kg-day)	Soil Dermal HQ (unitless)	Dermal-Soil RAF (unitless)	LADD (Cancer) (mg/kg-day)	Oral CSF (mg/kg-day) ⁻¹	Soil Dermal Risk (unitless)
1-Methylnaphthalene	0.64	0.1	3.9E-08	0.02	2.0E-06	NA	NA	NA	NA
2-Methylnaphthalene	0.85	0.1	5.3E-08	0.02	2.6E-06	NA	NA	NA	NA
Acenaphthylene	2.34	0.1	1.5E-07	0.06	2.4E-06	NA	NA	Class D	NA
Anthracene	2.14	0.1	1.3E-07	0.3	4.4E-07	NA	NA	Class D	NA
Arsenic	8.77	0.009	4.9E-08	0.0003	1.6E-04	0.009	1.2E-08	1.5	1.9E-08
Barium	63	0.001	3.9E-08	0.07	5.6E-07	NA	NA	NA	NA
Benzo(a)anthracene	5	0.02	6.6E-08	0.04	1.6E-06	0.02	1.7E-08	0.73	1.2E-08
Benzo(a)pyrene	5.42	0.02	6.7E-08	0.04	1.7E-06	0.02	1.7E-08	7.3	1.2E-07
Benzo(b)fluoranthene	5	0.02	5.6E-08	0.04	1.4E-06	0.02	1.4E-08	0.73	1.0E-08
Benzo(e)pyrene	4	0.1	2.4E-07	0.03	7.9E-06	NA	NA	Class D	NA
Benzo(g,h,i)perylene	4	0.02	5.1E-08	0.04	1.3E-06	NA	NA	Class D	NA
Benzo(k)fluoranthene	4	0.02	5.5E-08	0.04	1.4E-06	0.02	1.4E-08	0.073	1.0E-09
C11-C22 Aromatics	810.33	0.1	5.0E-05	0.03	1.7E-03	NA	NA	NA	NA
C19-C36 Aliphatics	136	0.1	8.4E-06	2	4.2E-06	NA	NA	NA	NA
C9-C18 Aliphatics	43	0.2	5.3E-06	0.1	5.3E-05	NA	NA	NA	NA
Cadmium	1	0.04	1.3E-08	0.001	1.3E-05	NA	NA	NA	NA
Chromium	23.33	0.04	5.8E-07	0.003	1.9E-04	NA	NA	NA	NA
Chrysene	6	0.02	6.8E-08	0.04	1.7E-06	0.02	1.7E-08	0.0073	1.3E-10
Cyanide, Physiologically	1	1	6.6E-07	0.02	3.3E-05	NA	NA	Class D	NA
Cyanide, Total	4	0.1	2.8E-07	0.02	1.4E-05	NA	NA	Class D	NA
Dibenzo(a,h)anthracene	1	0.02	1.5E-08	0.04	3.7E-07	0.02	3.8E-09	7.3	2.8E-08
Fluoranthene	7.70	0.1	4.8E-07	0.04	1.2E-05	NA	NA	Class D	NA
Fluorene	0.59	0.1	3.7E-08	0.04	9.1E-07	NA	NA	Class D	NA
Indeno(1,2,3-cd)pyrene	4	0.02	4.6E-08	0.04	1.1E-06	0.02	1.2E-08	0.73	8.4E-09
Lead	318	0.002	4.0E-07	0.00075	5.3E-04	NA	NA	NA	NA
Mercury	0	0.01	2.1E-09	0.0003	7.1E-06	NA	NA	Class D	NA
Naphthalene (VOC)	1	0.1	7.5E-08	0.02	3.8E-06	NA	NA	NA	NA
p/m-Xylene	0.16	0.04	4.0E-09	2	2.0E-09	NA	NA	Class D	NA
Perylene	1.47	0.1	9.1E-08	0.03	3.0E-06	NA	NA	Class D	NA
Phenanthrene	4.84	0.1	3.0E-07	0.04	7.5E-06	NA	NA	Class D	NA
Pyrene	10	0.1	6.0E-07	0.03	2.0E-05	NA	NA	Class D	NA
Hazard Index:					0.003	Total Cancer Risk: 2.0E-07			

Notes:

Toxicity information for Pyrene used as surrogate values for Benzo(e)pyrene and Perylene.

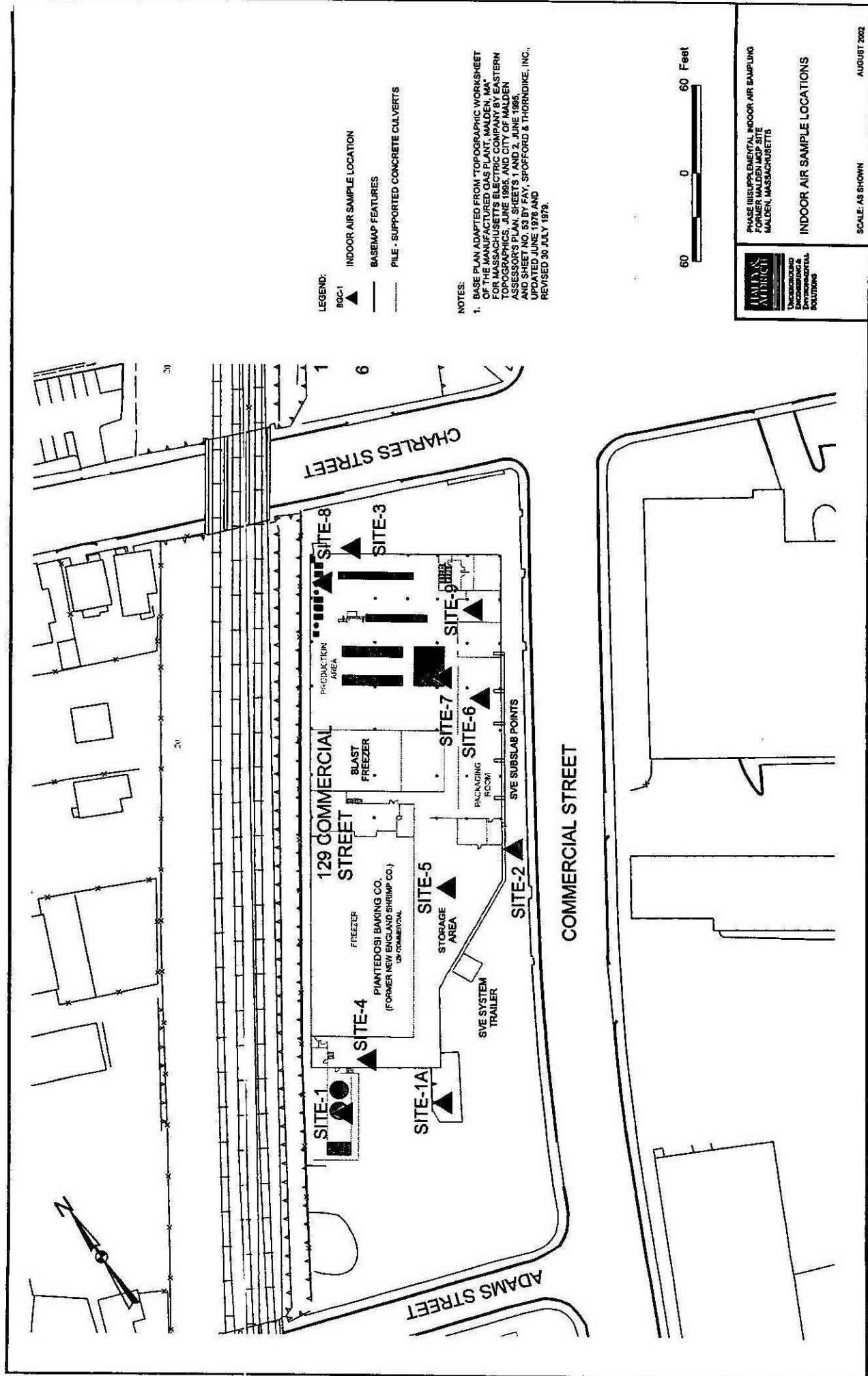
TABLE 11
SUMMARY OF RISK ESTIMATES
51 COMMERCIAL STREET
SUBSTANTIAL HAZARD EVALUATION
FORMER MALDEN MANUFACTURED GAS PLANT
MALDEN, MASSACHUSETTS

Receptor	Exposure Pathway	Estimated Lifetime Cancer Risk (ELCR)	Hazard Index (HI)	Exceeds MADEP Target Risk Levels*
Current				
Landscaper ⁽¹⁾	Incidental Ingestion of Soil	3E-07	8E-03	No
	Dermal Contact with Soil	2E-07	3E-03	No
	TOTAL RISK	5E-07	1E-02	No
Trespasser (Utility Scenario)	Incidental Ingestion of Soil	1E-07	1E-04	No
	Dermal Contact with Soil	9E-08	3E-05	No
	Inhalation of Fugitive Dust	7E-10	3E-06	No
	Inhalation of Vapors	6E-09	3E-03	No
	TOTAL RISK	2E-07	3E-03	No
Utility Worker	Incidental Ingestion of Soil	1E-06	4E-04	No
	Dermal Contact with Soil	8E-07	4E-04	No
	Inhalation of Fugitive Dust	4E-08	8E-05	No
	Inhalation of Vapors	5E-08	7E-03	No
	TOTAL RISK	2E-06	8E-03	No
Site Worker	Inhalation of Indoor Air	2E-06	1E-01	No
	TOTAL RISK	2E-06	1E-01	No

Notes:

* = MADEP establishes a condition of No Significant Risk if the hazard index is less than or equal to one and the estimated lifetime cancer risk is less than or equal to 1E-5.

(1) Represents revised risks using recent data in Substantial Hazard Evaluation. All other risk estimates from Phase II Risk Characterization (AMEC 2001).



9/06558/016/AR/CVIEW/MALDEN MGP.APR

FIGURE 25

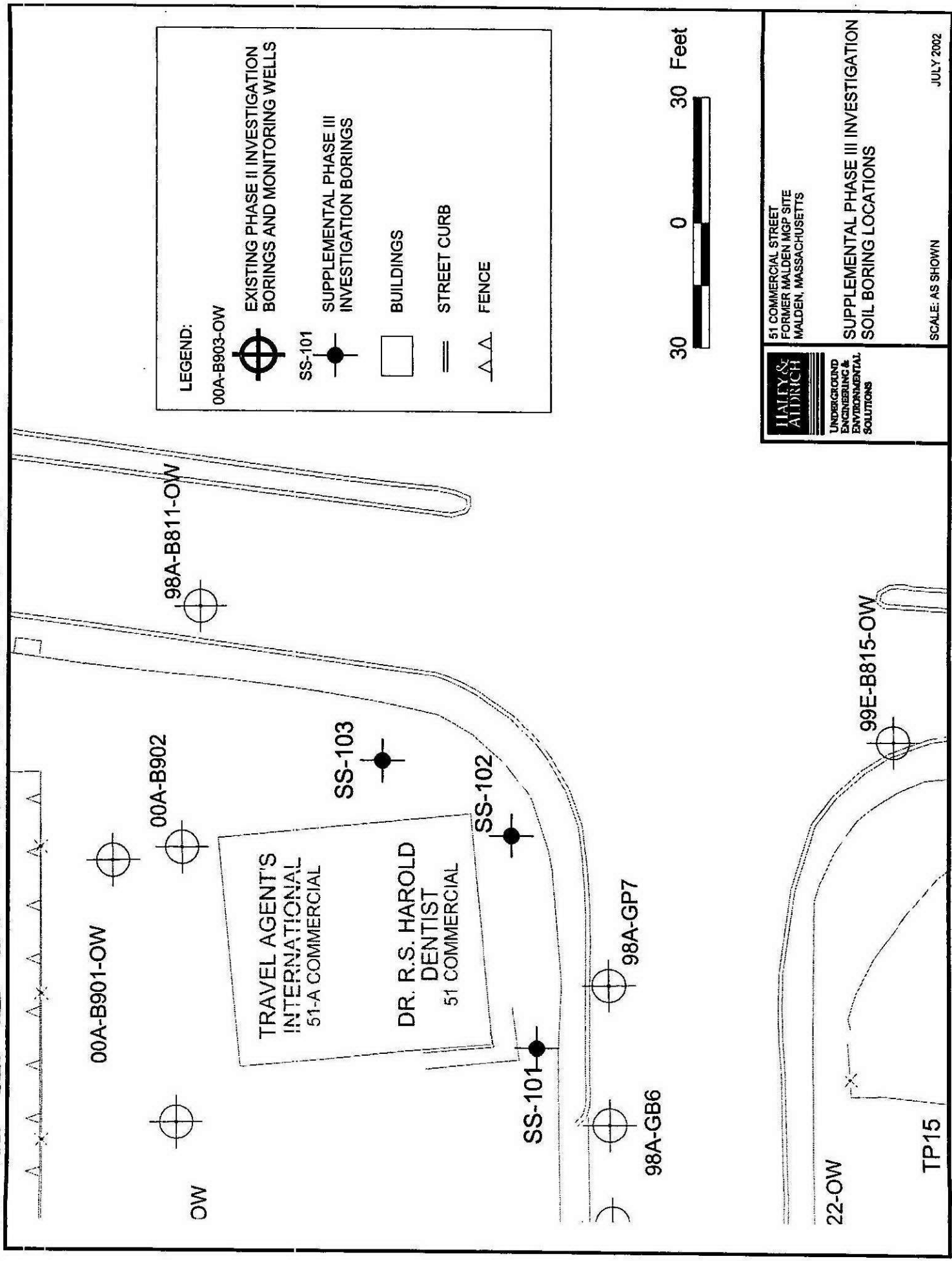


FIGURE 1