Draft Supplemental Phase II/III and Revised Phase IV Remedy Implementation Plan (RIP) Release Tracking Number 3-2856

Prepared for:
Massachusetts Bay Transportation Authority
Readville 5-Yard Facility
Industrial Drive
Dedham & Readville, Massachusetts

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List of Acronyms and Definitions

ACEC	Area of Critical Environmental Concern
ACM	Asbestos Containing Material
ADD	Average Daily Dose
ADE	Average Daily Exposure
AOC	Area of Concern
AST	Above-ground Storage Tank
AUL	Activity and Use Limitation
AWQC	Ambient Water Quality Criteria
BC(L)/SS	Sample code for surface soil samples collected to test Baseline Conditions
bgs	Below Ground Surface (depth below the ground surface)
BNs	Base Neutral extractables
BOL	Bill of Lading
BP/HA	Sample code for soil samples collected to investigate a former Burn Pit (BP) in the Historical Area (HA)
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
BWSC	Bureau of Waste Site Cleanup
CA/T	Central Artery/Tunnel Project
CAM	Compendium of Analytical Methods
CDC	Center for Disease Control
CDM	Camp Dresser and McKee Consultants
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CF/GP	Sample code for soil samples collected at Clinker Fill (CF) locations by Geoprobe (GP)
CFR	Code of Federal Regulations
CL/GP	Sample code for soil samples collected at Center Line (CL) locations by Geoprobe (GP)
CMR	Code of Massachusetts Regulations
COC	Contaminants of Concern
CRA	Comprehensive Remedial Action
CSA	Comprehensive Site Assessment
CSF	Cancer Slope Factors
CSM	Conceptual Site Model
DD/HA	Sample code for soil samples collected from Drainage Ditch (DD) locations within the Historical Area
DEP	Massachusetts Department of Environmental Protection
DEQE	Massachusetts Department of Environmental Quality and Engineering (precursor to MassDEP)
DUP	Duplicate
ELCR	Excess Lifetime Cancer Risk (human health risk assessment)
EPA	Environmental Protection Agency
EPC	Exposure Point Concentration
EPH	Extractable Petroleum Hydrocarbons
EZ	Exclusion Zone
EZ/GP	Sample code for soil samples collected from the Exclusion Zone (EZ) by Geoprobe (GP)
EZ/MW	Exclusion Zone/Monitoring Well
EZ/TP	Exclusion Zone/Test Pit
FEMA	Federal Emergency Management Administration
ft/ft	Foot per foot
GIS	Geographic Information System
GPR	Ground Penetrating Radar
GPS	Global Positioning System
Group A	Human Carcinogen - sufficient evidence in epidemiological studies to support causal association between exposure and cancer in humans
Group B2	Probable Human Carcinogen

List of Acronyms and Definitions (Cont'd)

Group C	Possible Human Carcinogen - inadequate or lack of human data and limited evidence of carcinogenicity in animals
Group D	Not Classifiable - inadequate or no human and animal evidence of carcinogenicity
GW-1	Groundwater category GW-1 applies if the groundwater is located within a Current Drinking Water Source Area or Potential Drinking Water Source Area
GW-2	Groundwater category GW-2 applies within 30 feet of an existing occupied structure where the average annual depth to groundwater is 15 feet below grade or less
GW-3	Groundwater at all disposal Sites in Massachusetts is considered a potential source of discharge to surface water and is therefore categorized GW-3 at a minimum
HASP	Health and Safety Plan
HB/GP	Sample code for soil samples collected from Historical Building (HB) locations by Geoprobe (GP)
HDPE	High-density Polyethylene
HEAST	Health Effects Assessment Summary Tables
HI	Hazard Index
HMM	HMM Associates, Inc.
ICP	Inductively Coupled Plasma
IDW	Investigational Derived Waste
IEUBK	Integrated Exposure, Uptake, and Biokinetic Model
IH	Imminent Hazard
IRA	Immediate Response Action
IRIS	Integrated Risk Information System
IWPA	Interim Wellhead Protection Area
kg/day	kilogram/day
LADD	Lifetime Average Daily Dose
LADE	Lifetime Average Daily Exposure
LFR	Levine Fricke Consultants
LOAEL	Lowest-Observed-Adverse-Effect Level
LSP	Licensed Site Professional
LT/SS	Sample code for surface soil samples collected from Looping Track (LT) locations
MassDEP	Massachusetts Department of Environmental Protection
MBCR	Massachusetts Bay Commuter Rail
MBTA	Massachusetts Bay Transportation Authority
MCP	Massachusetts Contingency Plan
MCP 13	Massachusetts Contingency Plan 13 Priority Pollutant Metals
mg/kg	Milligrams per kilogram
mg/kg/day	Milligrams per kilogram/day
MW	Monitoring Well
MWRA	Massachusetts Water Resources Authority
NHRHTA	New Haven Railroad Historical and Technical Association, Inc.
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
NOAEL	No-Observed-Adverse-Effect Level
NOR	Notice Of Responsibility
NRS	Numerical Ranking System
O&M	Operations & Maintenance
OHM	Oil and/or Hazardous Materials
OL/SS	Sample code for surface soil samples collected from the Dedham Secondary/Orphan Line area
OMM	Operation, Maintenance and/or Monitoring Plan
OSHA	Occupational Safety & Health Administration (US government)
OSWER	Office of Solid Waste and Emergency Response

List of Acronyms and Definitions (Cont'd)

P/MW	Sample code for Perimeter Monitoring Wells
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated biphenyls
PID	Photoionization Detector
PIP	Public Involvement Plan
PRP	Potentially Responsible Party
RAA	Remedial Action Alternatives
RAFs	Relative Absorption Factors
RAO	Response Action Outcome
RAP	Remedial Action Plan
RAPS	Response Action Performance Standard
RBC	Risk-Based Concentration
RC	Risk Characterization
RCRA	Resource Conservation and Recovery Act
RCRA 8	Resource Conservation and Recovery Act 8 Metals
RfCs	Reference Concentrations
RfDs	Reference Doses
RIP	Remedial Implementation Plan
RP	Responsible Party
RTN	Release Tracking Number
SA/GP	Sample code for soil samples collected from the Staging Area (SA) by Geoprobe (GP)
SA/MW	Sample code for Staging Area Monitoring Wells
SA/TP	Sample code for Staging Area Test Pit samples
SOW	Scope of Work
SSCMP	Soil Stockpile Characterization and Management Plan
SVOC	Semi-Volatile Organic Compounds
SW/GP	Sample code for soil samples collected from Southwest Perimeter by Geoprobe (GP)
TCLP	Toxicity Characteristic Leachate Procedure
TPH	Total Petroleum Hydrocarbons
TSCA	Toxic Substances Control Act
TVOCs	Total Volatile Organic Compounds
UCL	Upper Confidence Level
µg/l	microgram per liter
µg/m^3	microgram per cubic meter
USCG	U.S. Coast Guard
USGS	United States Geological Survey
UST	Underground Storage Tank
UTM	Universal Transverse Mercator coordinate system
VOC	Volatile Organic Compounds
VPH	Volatile Petroleum Hydrocarbons
XRF	X-Ray Fluorescence

1.0 INTRODUCTION

1.1 General

The Readville 5 Yard facility ("the Site") is a 42-acre parcel located on Industrial Drive at the border between Dedham and Boston, Massachusetts. Sections of the Site are unpaved and the perimeter is fenced. The Site is abutted by residential properties to the north and west and by industrial properties to the south and east. The Site is owned by the Massachusetts Bay Transportation Authority (MBTA). Earth Tech, Inc. (Earth Tech) has prepared a draft Revised Phase IV Remedy Implementation Plan (RIP), on behalf of the MBTA, in accordance with 310 CMR 40.0874 of the Massachusetts Contingency Plan (MCP).

The purpose of this Draft Supplemental Phase II/III Report and Revised Phase IV RIP (Revised Phase IV RIP) is to document engineering concepts and design criteria to be used for the design and construction for the Comprehensive Remedial Action (CRA) based on commercial/industrial property end use. Secondary goals of this document are to present and analyze supplemental Site data in support of an updated Risk Characterization (RC) and Supplemental Phase II Comprehensive Site Assessment (CSA) report, as well as to present a Supplemental Phase III Remedial Action Plan (RAP).

1.2 Overview

The results of the Phase II CSA submitted on January 31, 2003 by Weston & Sampson (further discussed in Section 2.0) indicated that a condition of "No Significant Risk" of harm to human health, public welfare, and the environment does not exist under current Site conditions. For the purposes of the risk characterization and the Phase III, the 42-acre Site was divided into four separate potential exposure areas (Areas 1 through 4) based primarily on historical use, types and concentrations of contaminants, and existing zoning and access.

The four areas assessed in the risk characterization and evaluated in the Phase III study include:

- ***Area 1 – Orphan Line:*** The Orphan Line was formerly the Dedham Secondary Line and consists of an approximately 90-foot wide by 3,200–foot long section of abandoned railroad tracks along the Site's northern boundary. Previous investigations indicated the presence of elevated arsenic and lead concentrations in surficial soil within this area. This area is currently fenced.

- ***Area 2 – Western Fence Line (adjacent to Ashcroft Street):*** Area 2 is a narrow strip of land located along the southwestern Site boundary between the exclusion zone (EZ) and a wooded area followed by residential properties on Ashcroft Street. Elevated lead and arsenic concentrations were also reported in surface soil within this area. This area is currently fenced.

- ***Area 3 - Main Rail Yard:*** The Main Rail Yard is the largest area evaluated for this Site. Comprising approximately 21 acres, the area contains both active and inactive tracks. The Main Rail Yard is currently used by MBTA and Amtrak for storage of railroad materials (ties, track panels, etc.), and has a long history of use as a former railroad maintenance and storage yard. One large building was formerly located within the Main Rail Yard, and the foundation of this structure still exists in some areas. Petroleum compounds, lead and arsenic, were detected in surface and subsurface soil. Currently, the Main Rail Yard is completely fenced.

- ***Area 4 - Exclusion Zone:*** This Area is located west of the Main Rail Yard and occupies most of the western portion of the Site. Reportedly, Area 4 has been used for railroad associated materials and a historical burn pit, and has soil piles. Elevated concentrations of lead, arsenic, polycyclic aromatic hydrocarbons (PAHs) and petroleum compounds have been detected in surface and subsurface soil. Like the Main Rail Yard, the EZ area is currently completely fenced.

Site-wide Risk-Based Concentration levels (RBCs) were developed during risk characterization for four potential future general use scenarios/receptors, which include: recreational, commercial/ industrial (indoor/outdoor worker), construction, and residential. Contaminants of concern (COCs) carried through the risk characterization for the four Areas included arsenic, lead, antimony, barium, chromium, cobalt, copper, nickel, zinc, extractable petroleum hydrocarbon (EPH) parameters, and select PAHs. Specific contaminants driving the remediation of the Site include arsenic, lead, and copper.

Two lead "hot spots" were identified in surface soil based on historical data. One location is in the EZ and a second location is in the Main Rail Yard. These areas did not meet a condition of "No Significant Risk" based on a comparison of lead exposure point concentrations (EPCs) to applicable RBCs. The concentration of lead in these two areas ranged from 15,000 to 20,000 parts per million (ppm). These "hot spots" exceeded the UCL of 6,000 ppm (at the time); therefore, Weston & Sampson concluded that these "hot spots" should be remediated to achieve a condition of "No Significant Risk" for the Site.

In addition to the four areas identified and the two lead "hot spots", 15 soil and debris stockpiles are located in Area 4. A total of 33 soil samples were collected during the Phase II CSA activities from the various soil and debris piles and were analyzed for selective disposal parameters.

Materials identified in the soil and debris piles included the following: soil, creosote timbers, asphalt, wood debris, railroad ties, bricks, ash, trash, metal, burnt material, and other miscellaneous items. Based on the results of soil and debris pile sampling and characterization, the soil and debris piles were estimated by Weston & Sampson to comprise approximately 21,000 tons of material. Of this material, approximately 5,000 tons (24% of total material) were found to contain polychlorinated biphenyls (PCBs) ranging from 2.2 to 24.2 milligrams per kilogram (mg/kg), and approximately 6,000 tons (28% of total material) were found to exceed the Resource Conservation and Recovery Act (RCRA) threshold of 5.0 milligrams per liter (mg/l) for lead (i.e., Toxicity Characteristic Leachate Procedure (TCLP)).

The risk characterization, the basis for Weston & Sampson's Phase III evaluation, focused primarily on human health posed by contaminants in soil only. Based on the findings of the Phase II, contaminants were not considered to be present in groundwater and/or air at significant concentrations and neither surface water nor sediment is present at the Site. Consequently, groundwater, air, surface water and sediment were not considered as potential exposure media in the risk assessment. Under existing conditions, further response actions, either remediation of soil or implementation of engineering and institutional controls (Activity and Use Limitation (AUL)), are required to prevent exposure to surface and shallow subsurface soil to achieve a condition of "No Significant Risk" at the Site. Note that a Phase II Addendum, containing Massachusetts Department of Environmental Protection (MassDEP) comments on the Phase II CSA as well as MBTA's responses, was included as an appendix to the Final Phase II Report (see Weston & Sampson, January 2003).

As part of the Supplemental Phase II investigation conducted during June and July 2008, additional soil data were collected to supplement the original Weston & Sampson characterization. The Supplemental Phase II investigation included the following field investigations:

- Existing soil piles were sampled to gather the necessary data to estimate the quantity of soil that exceeded the revised Upper Concentration Limit (UCL) for soil lead of 3,000 mg/kg. Previous soil estimates were based on the 6,000 mg/kg lead UCL, which was applicable at the time but was since revised to 3,000 mg/kg. Up to thirty samples per 500 cubic yards of soil were collected by Earth Tech for X-Ray Fluorescence (XRF) screening in the field for lead and arsenic. Of these, one composite sample per 250 cubic yards (88 samples) was submitted for confirmatory laboratory analysis of total lead, TCLP lead, total arsenic, and EPH with target compounds (a total of 88 samples).

- Earth Tech collected 100 soil samples to evaluate the validity of the LFR, Inc. (LFR) data collected in the UCL areas in the Main Yard of the rail yard. These data were used to define the extent of the previously identified UCL areas to evaluate whether the UCL areas were overestimated based on the limited sampling data collected (e.g., one sample per fifty foot grid) and due to the poor correlation of XRF/lab data for arsenic obtained by LFR. Approximately 10% of the confirmatory samples (a total of 12 samples) were submitted for laboratory analysis of total lead and total arsenic (along with other analyses).

The results of these field activities are presented as the Supplemental Phase II Addendum in Section 2.0 of this report.

Based on the information collected during the Phase II and risk characterization, the goals of the Phase III study were to select comprehensive remedial alternatives that would:

- Eliminate UCL exceedances,
- Minimize and/or eliminate exposure to soil with contaminant concentrations above the RBCs,
- Remove surface soil hot spots in two areas, and
- Evaluate soil and debris pile soil reuse/disposal options.

Due to the unknown future use of the Site at the time, one comprehensive remedial alternative could not be selected in the Phase III evaluation. Therefore, Weston & Sampson summarized the selected potential remedial alternatives for each Risk Area (Areas 1 through 4, the soil and debris piles, and the lead hot spots) under each potential future use scenario (residential, commercial/industrial, and recreational). The selected alternatives for Areas 1 through 4 included: Alternative 4 –Soil Excavation of RBC Exceedances and Off-Site Disposal with Stabilization, and Alternative 5A – Clean Fill Cover. The selected potential alternatives for the 14,000 cubic yards of soil and debris stockpiles at the Site included: on-Site reuse within the area of concern (AOC); “hot cell” removal and disposal and on-Site reuse within the AOC; and, off-Site disposal with Stabilization. The selected potential alternative for the lead-contaminated hot spots is Alternative 2 – Soil Excavation (0-3 feet) and Off-Site Disposal with Stabilization. Since these remedial alternatives will not remediate the Site to unrestricted use, an AUL would be required after completion of the remedial activities (based on selection of alternative) to achieve a condition of “No Significant Risk”.

The Phase III Addendum was prepared to meet the requirements of the MCP Phase III criteria, to incorporate the additional Phase II data, and also to consider potential future industrial/commercial use. The future use identified in this report was for the purpose of evaluation only and should not be considered as the only option for property end use. The current and/or future property owner may consider a combination of potential future uses and/or activities evaluated in this report. This report was not prepared to identify the highest and best use of the Site. The costs presented in this report are an estimate of potential remedial costs associated with a commercial/industrial end use. The Phase III Addendum is presented in Section 3.0 of this report.

A field confirmatory investigation to support Phase IV design was completed, as described above. The Phase IV Design was based on the field confirmatory investigation performed in June and July 2008. The Phase IV design is presented in Section 4.0 of this report.

1.3 Site Background Information

1.3.1 Site Location

The Site occupies an approximately 42-acre area located on Industrial Drive and straddles the boundary between the Town of Dedham and the City of Boston (Readville), Massachusetts. Approximately 21 acres of the Site are located in Readville and 21 acres are located in the Town of Dedham. The portion of the Site located in Dedham is zoned general residential and the portion of the Site located in Readville is zoned general and light manufacturing. The geographical location for the Site is shown on the Site Locus Plan, Figure 1, and is described as follows:

UTM Coordinates:	N 4,678,253 m
	E 323,168 m
Latitude/Longitude:	42° 14' 19" N
	71° 08' 37" W

The Site is roughly an elongated teardrop shape and its perimeter is defined by a loop railroad track enclosed by an 8-foot tall chain link fence. The MBTA property extends beyond the railroad track fencing. The Site is mostly unpaved, with the exception of a driveway approximately 100 feet wide and 1,700 feet long running east-west along the northern side of the Site. The Site is owned by MBTA and is currently operated by Amtrak under contract to MBTA. Materials used for railroad maintenance (ties, track panels, etc.) are currently stored primarily within a 5-acre staging area located in the south-central area of the Site and historically at various locations throughout the central and western areas of the Site. The western portion of the property, designated as the EZ, was fenced off and posted with warning signs in October 2001 to restrict access to stockpiles containing soil and miscellaneous debris located within this area. Other significant Site features include a historical burn pit located in the EZ, a clinker fill area located between the northern loop tracks and the Orphan Line, historical site building remnants including the concrete building slab in the staging area, and a drainage ditch located along the approximate Site centerline. An aerial photograph showing Site features, including the EZ, the staging area, and property boundaries, is presented as Figure 2.

The Site is abutted by residential properties to the north, east, and west, and by industrial properties to the south. Residential and commercial properties abut the Site to the west on Ashcroft Street and to the north opposite the former Dedham Secondary rail line (a.k.a. the “Orphan Line”) on Milton/W. Milton Street. Commercial and industrial properties, including a school bus garage and storage yard and a gravel crushing operation, are located to the south, opposite Industrial Avenue. The MBTA Readville commuter rail station, including commuter parking lots and the MBTA 2-Yard facility, is located to the east.

1.3.2 Sensitive Receptors

Based on the Massachusetts Geographic Information System (MassGIS) Data Layer Map presented in Figure 3, a medium yield non-potential drinking water source area and designated Area of Critical Environmental Concern (ACEC) is located approximately 500 feet east-southeast of the Site. In addition, a designated open space, Iacono/Readville Playground, is located approximately 500 feet north northeast of the Site. A Zone II is located approximately ½-mile south of the Site.

There are no designated drinking water resources, including Zone As, Interim Wellhead Protection Areas (IWPAs), Sole Source Aquifers or Potential Drinking Water Source Areas, Threatened or Endangered Species Habitats, or Outstanding Resource Waters, within 500 feet of the Site. The nearest surface water body is Sprague Pond, located approximately 1,000 feet south/southeast of the Site.

The closest institution is the Eastwood Care Center nursing home and convalescent home, located approximately 1 mile west-southwest of the Site. The closest residence is located approximately 150 feet north of the Site. In addition, St. Ann’s School is located approximately 500 feet north of the Site.

The Town of Dedham’s municipal water supplier is the Dedham-Westwood Water District, which receives their water supply from 11 artesian wells, six of which are located in Westwood, and five of which are located in Dedham. The City of Boston receives its water supply through the Massachusetts Water Resources Authority (MWRA), from the Quabbin Reservoir located in Belchertown, Massachusetts.

1.3.3 Regional Topography and Geology

Topography in the area of the Site is characterized by small hills up to 150 feet above mean sea level in height, rising above broad level river valleys marked by wetlands and small ponds. Based on information published by the United States Geological Survey (USGS) regarding geology within the area of the Site, there are three major geologic units present at the Site. These include, in stratigraphic succession from youngest to oldest:

1) Sand and Gravel - consisting of alternating layers of medium-coarse sand & gravel, medium-fine sand & silt, and fine sand & silt.
2) Glacial Till - consisting of very compact fine sand and silt, and rock fragments.
3) Bedrock – consisting of granite.

Regional surficial deposits within the Boston Harbor Drainage Basin, one of many sedimentary basins in the western Massachusetts area, were presented in the Weston & Sampson Phase II CSA. These maps depict stratified surficial deposits and till in the vicinity of the Site.

The 1983 USGS Bedrock Geology Map of Massachusetts identifies the Site as lying within the Milford-Dedham Zone. Bedrock within this area is characterized by granite including light grayish-pink to greenish gray equigranular to slightly porphyritic, variably altered. Bedrock outcrops were not observed at the Site.

1.3.4 Regional Hydrology/Hydrogeology

The Site is located within the Neponset River Watershed. According to information published by the USGS, groundwater resources in the area of the Site are principally located within stratified sand and gravel aquifers, which in the area of the Neponset River Valley extend approximately 150 feet and yield up to 300 gallons per minute. Wells completed in bedrock or glacial till reportedly yield a few gallons per minute.

1.3.5 Groundwater and Soil Classification

1.3.5.1 Groundwater

The Site groundwater is not classified as GW-1 since it is not within a Current or Potential Public Drinking Water Source Area (see Weston & Sampson, January 2003). Groundwater is not considered to be GW-2 because although the groundwater is located at a depth of less than 15 feet from the ground surface (average depth of water at the Site is approximately 14.63 feet bgs), it is not located within 30 feet of an existing occupied structure and foreseeable Site uses do not include construction of occupied structures. Category GW-3 applies because groundwater ultimately discharges to surface water.

1.3.5.2 Soil

Impacted soils are located at depths ranging from the ground surface to depths up to approximately 15 feet bgs and/or beneath pavement/concrete. The Site is used by MBTA/MBCR/Amtrak as a storage facility for rail maintenance materials and is not typically occupied. An 8-foot tall chain link fence surrounds the Site to discourage trespassers. However, the Property is not guarded and the potential exists for nearby residents to enter the Site. Due to the presence of the locked 8-foot chain link fence, the fact that the Site is currently used by the MBTA/MBCR/Amtrak as a storage facility for rail maintenance materials and there is currently no evidence of child trespasssers, the frequency or intensity of use by children is considered low. Soils between 0 feet and 3 feet at the mostly unpaved Site are considered accessible. Soil at depths of 3 feet to 15 feet bgs in unpaved areas, and up to 15 feet bgs and under pavement, is considered potentially accessible, while soil at depths in excess of 15 feet bgs is considered isolated. Therefore for current use, the applicable soil category for the Site is S-2. As discussed above in Section 1.3.5.1, the GW-3 groundwater category applies to the Site. Therefore, the Method 1 Soil Standards that are applicable are S-2/GW-3.

1.4 Site History

1.4.1 General

A historical account of New York, New Haven and Hartford Railroad operations at the Readville Shops provided by Arthur M. Bixby, Sr., published in the July 1981 Norfolk and Western Magazine, Shoreliner, indicates the Site is located at the historic crossing of the Boston & Providence Railroad, which began operating in Readville in 1834, and the Midland Railroad, which began operating in 1853. The Midland Railroad later became the New York New England Railroad and then, in 1895, a subsidiary of the New York, New Haven and Hartford Railroad. The Readville Shop operations included repair and maintenance of locomotives and rail cars in an area that extended well beyond the 42-acre Site, based on a May 16, 1975, tracing by C. Boggs for the New Haven Railroad Historical and Technical Association, Inc., (NHRHTA) of the "Situation at Readville, Mass., circa 1929-1930". Additional plans and photographs published by the NHRHTA indicate that on-Site operations included freight and gas rail car repair. Two small buildings identified as the priming building and "sand blast" are located immediately south of the Site.

According to previous investigations regarding Site history, the Readville 5-Yard property was acquired by MBTA from the National Railroad Passenger Corporation (Amtrak) in a quitclaim deed dated November 11, 1987. Amtrak had been deeded the property from Conrail on April 1, 1976, one day after Penn Central conveyed the property to Conrail on March 30, 1976.

1.4.2 Release History

In 1989, HMM Associates, Inc., (HMM) performed a preliminary environmental assessment to support proposed redevelopment of the Site as a commuter train facility. During their review of files maintained by the Massachusetts Department of Environmental Quality and Engineering (DEQE, precursor to the MassDEP), they identified a reported release of 100–500 gallons of sulfuric acid at the Site in February 1985. Jet Line Services, Inc., (Jet Line) reportedly neutralized the spill with lime. However, "some of the acid apparently drained into the subsurface". HMM reported that MassDEP's files did not identify the exact location of the spill. During several visual inspections of the Site by HMM between March and May 1989, a large accumulation of debris was noted, approximately ½-acre in size, containing earth piles, used car parts, and railroad ties within the western area of the Site. Due to the extensive vegetative cover over this central pile, HMM believed that the earth/debris was deposited at least several years prior.

HMM also conducted a subsurface investigation that included advancement of soil borings, monitoring well installation, and surficial soil sampling. Based on detected concentrations of petroleum and metal contamination in soil and groundwater samples, HMM submitted a Waiver of Approvals application to the MassDEP, which was subsequently approved on October 10, 1990 (Site Number 3-2856). Additional assessment conducted by HMM in 1990 confirmed the presence of elevated concentrations of lead and petroleum hydrocarbons in Site soil.

On September 29, 1999, the MassDEP issued a Notice of Responsibility (NOR) and a second Release Tracking Number (RTN) for this Site (3-18777), after reviewing the files and determining that elevated lead concentrations in soil could potentially pose an Imminent Hazard (IH) condition. In accordance with the NOR, the MBTA was required to perform an Immediate Response Action (IRA) to include: an IH evaluation, fencing of the area of elevated lead in soil, and posting of warning signs. The MBTA installed a fence and warning signs in December 1999. The MassDEP installed additional fencing along the Orphan Line in January 2000.

In October 2000, Rizzo Associates, Inc., (Rizzo) conducted an IH investigation that included the collection of 48 surficial soil samples for the analysis of lead. Elevated concentrations of lead were detected in the soil samples collected across the Site. Based on these data, Rizzo conducted an IH Evaluation and concluded that an IH did not exist at the Site. On September 14, 2001, Rizzo prepared a Phase I Initial Site Investigation (ISI) and Tier Classification for the Site. The MassDEP conditionally approved the Tier IC permit in a letter dated February 7, 2002.

On July 13, 2001, the MBTA received a petition requesting designation of the Site as a Public Involvement Plan (PIP) Site. In response to the petition, the MBTA and the MassDEP designated the Site as a PIP site. A draft PIP Plan was prepared and presented at a public meeting in February 2002.

On October 12, 2001, the MBTA and the Attorney General for the Commonwealth of Massachusetts entered into a preliminary injunction agreement that identified several tasks to be expedited. These tasks included covering of the exposed stockpiles within the EZ, completion of a groundwater investigation, and preparation of a stockpile characterization plan. On November 6, 2001, Weston & Sampson completed and submitted an IRA Plan to conduct these three identified tasks.

Between October and December 2001, the MassDEP conducted an IH Evaluation that included the collection of over 3,000 surficial soil samples for XRF field screening for lead and arsenic. Based on the results of their IH Evaluation, the MassDEP concluded that IH conditions did not exist at the Site under current conditions; however, they identified several zones for additional investigation located immediately outside the Site fence to the north near Milton Street and to the west near Ashcroft Street (see Figure 2).

Weston & Sampson prepared a draft IRA Plan for additional assessment of the above-mentioned zones, which was submitted to the MassDEP and presented at the PIP meeting at the Dedham High School on February 27, 2002. The final IRA Plan was submitted to the MassDEP on March 28, 2002. On April 2, 2002, Weston & Sampson commenced sampling activities. Analytical data indicated high concentrations of arsenic along the western fence and lead at two locations along the northern fence. On May 28, 2002, Weston & Sampson conducted additional sampling to evaluate the extent of contamination. Between June 1 and 19, 2002, a new fence was installed approximately 20 feet west of the original western fence.

On June 6, 2002, Weston & Sampson held another PIP meeting at the Dedham Town Hall to present the draft Phase II Scope of Work (SOW) for public comment, and to notify the residents of IRA excavation activities outside the northern fence. On June 26, 2002, Weston & Sampson documented the IRA excavation of a total of approximately 20 cubic yards of lead-impacted soil from two locations outside the northern fence. Shortly after the close of the 21-day comment period, Weston & Sampson submitted a Final Phase II SOW to the MassDEP on July 12, 2002, and fieldwork commenced the week of July 22, 2002.

In addition, Amtrak, independent of MBTA, presented a plan to the MassDEP on December 4, 2001, for disposal of solid waste and management of reusable materials stored at the Site. In accordance with this plan, reusable materials were consolidated within the 5-acre staging area, numerous wooden rail ties were removed from the Site to a licensed incineration facility, and approximately 2,000 tons of metal material was identified and sold to a scrap dealer. During these activities, Amtrak identified wreckage of an Amtrak baggage car that had been stored at the Site for accident investigation purposes. Analysis of this wreckage indicated a thin adhesive coating/lining within the steel structure containing three percent (3%) asbestos. The asbestos containing material (ACM) was subsequently scheduled to be removed under an IRA Plan prepared by Amtrak and their consultant, Harding ESE, Inc., and presented during the June 6, 2002, public meeting. According to Amtrak, the train wreckage material and soil containing asbestos was removed from the Site during August and September 2002.

1.4.3 Previous Investigations

1.4.3.1 Preliminary Site Assessment, Phase I Limited Site Investigation, May 1989

On May 12, 1989, HMM prepared a Preliminary Site Assessment Phase I – Limited Site Investigation for the MBTA. This report summarized the results of a Site investigation conducted by HMM between March 7, 1989, and May 5, 1989, and included a detailed Site description, history, subsurface investigation, and sample analysis.

HMM conducted a Site reconnaissance during which they observed the following environmental concerns:

- A pile of metallic debris, black stained soil, and stressed vegetation within a circular area with an approximately 50- to 100-foot radius at the western border of the paved area and series of railroad tracks.
- An accumulation of debris approximately ½-acre in size including soil, used car parts, railroad ties, burned wood, trash, and miscellaneous man-made materials.
- Two 55-gallon drums, one containing a solidified yellow compound and the other containing an amber viscous substance.
- An approximately 30-foot round by 5-foot deep burn pit.
- A long drainage swale connected to storm-water drains.
- Areas of stressed vegetation and surficial debris.

To establish a Site history, HMM interviewed Mr. Walter Mark of the MBTA Railroad Operations and Mr. Eddie St. George, a long-time Readville area resident and railroad enthusiast. Based on these interviews, the Site has historically been used primarily for storage purposes. Repair and refurbishment of rail cars reportedly occurred at the former building historically located at the concrete slab (currently used as the staging area) in the south-central area of the Site. However, Mr. St. George indicated that sandblasting and painting of railcars occurred at a different location on the southern side of Industrial Drive. In addition, Mr. St. George indicated that he did not believe that underground storage tanks (USTs) were located on, or that hazardous materials had been stored at, the Site.

A review by HMM personnel of files maintained by the Northeast Region of the DEQE indicated that several spills had occurred at or near the Site, including the following:

- In February 1985, between 100 and 500 gallons of sulfuric acid were released from a tank car en-route to Fall River, Massachusetts. The exact spill location was not identified. Cleanup procedures, conducted by Jet Line, involved the neutralization of sulfuric acid puddles with lime.
- On November 21, 1982, approximately 1,000 gallons of arsenic pentoxide-copper oxide-chromic acid solution in water leaked from a pipe into an enclosed bermed area during a fire at the Gerrity Lumber Yard located to the south of the Site. The leakage was reportedly contained and subsequently pumped out by Jet Line. Groundwater samples collected from the release area and analyzed for the eight listed RCRA metals reportedly indicated insignificant concentrations of arsenic and chromium in groundwater.
- Several small spills in the vicinity of the yard in Boston and Hyde Park were identified by HMM, which concluded that none of these spills represented a significant source for widespread contamination.

- In 1982, following a complaint from a resident who alleged that oil was being spilled in the Conrail yard, The DEQE investigated and reportedly found no evidence of the spilled oil.

HMM conducted a field investigation that included soil-boring advancement, monitoring well installation, and surficial soil and groundwater sample collection and analysis to assess impact from hazardous material and/or petroleum hydrocarbon contamination. Between April 5 and 10, 1989, HMM advanced eight borings at locations selected based on surficial dumping piles, former building structures, and evidence of impact. Seven of the eight borings were completed as monitoring wells, MBTA-1 through -7 (later identified as MW-1 through MW-7). In addition, composite surficial soil samples were collected from selected areas of the Site where surficial staining or evidence of impact was observed. A total of 17 groundwater and composite surficial soil samples were submitted for laboratory analysis. Groundwater sample analytical data indicated the following:

- Of the three analyzed samples, only one sample from MBTA-2 (MW-2) indicated detected volatile organic compounds (VOCs), chloroform at 4.0 micrograms per liter (μg/l). HMM attributed this detection to laboratory contamination of the sample.

- Three samples were analyzed for total petroleum hydrocarbons (TPH), which was only detected in well MBTA-3 (MW-3) at 15 milligrams per liter (mg/l). HMM reported observing a petroleum sheen and odor during sampling of this well.

- One composite groundwater sample from wells MBTA-1 through -4 and MBTA-6 was analyzed for RCRA 8 soluble metals, acid and base neutral extractable compounds (BNs). This sample indicated a detected concentration of lead at 0.06 mg/l. No detected BNs were reported.

Composite surficial soil samples from five areas of the Site where HMM observed stained soil and analyzed for TPH, RCRA 8 soluble metals, BNs, polychlorinated biphenyls (PCBs) and pesticides indicated the following:

- Soluble lead was detected at a concentration of 43.4 mg/l in a re-composited surficial soil sample from earth and fill piles near MBTA-5 and surficial and boring samples collected at 0-2 feet and 3-5 feet at MBTA-6 (all within the current EZ area of the Site).

- Each composite area indicated detected concentrations of TPH ranging from 99 milligrams per kilogram (mg/kg) at MBTA-4 (MW-4) to 2,400 mg/kg at MBTA-6 (located near the water valve in the EZ).

- The two re-composited samples analyzed for BNs, PCBs, and pesticides reportedly indicated elevated concentrations of BNs including naphthalene, chrysene, and pyrene. The report does not indicate that PCBs or pesticides were detected.

1.4.3.2 Draft Phase III Report, Development of Remedial Alternatives, May 1990

On May 29, 1990, HMM prepared a Draft Phase III, Development of Remedial Alternatives Report for the MBTA. The Draft Phase III Report was developed using the results of a Phase II Investigation conducted by HMM to evaluate the nature and extent of soil and groundwater contamination at the Site. The Phase II Investigation reportedly included a Ground Penetrating Radar (GPR) survey to identify potential buried contaminant sources, a test pit program to evaluate subsurface anomalies identified in the GPR survey, advancement of 57 borings; installation of 14 groundwater wells, and collection and analysis of soil and groundwater samples.

The results of the GPR study indicated buried utility lines in the area of the 5-acre staging area, several possible buried tanks, a large buried dome-like structure, possible historical excavations to 8 to 15 feet deep, and highly conductive material at 4-5 feet depth. Based on the results of the confirmatory test pit investigation, only one possible tank was identified, in the central area of the Site just north of the staging area.

Based on their investigation results, HMM identified three areas with significant concentrations of PAHs, TPH, and lead detected in soil. The areas included an approximately 65,000-square foot area located within the EZ immediately south of the largest soil pile, an approximately 80,000-square foot area encompassing the 5-acre staging area, and an approximately 12,000-square foot area centrally located between the EZ and the 5-acre staging area.

1.4.3.3 Tier II Extension Submittals (1996, 1997, 1998)

On December 31, 1996, December 22, 1997, and December 30, 1998, Rizzo submitted three separate Tier II Extension submittals on behalf of MBTA for the Site. These submittals included a summary of the Site background, regulatory status, and ongoing or recently completed response actions. Rizzo's Site background summary references analytical testing by HMM which indicated a detected concentration of 134,000 milligrams per kilogram (mg/kg) of lead and 128 mg/kg of PAHs in shallow Site soil during pre-design subsurface investigations following submittal of the 1990 Phase III Report. Rizzo included a contaminant concentration map indicating that the highest detected concentrations of lead extended from the central area of the Site westward to the largest debris pile. However, no specific information, including the location and laboratory analytical data for the pre-design shallow soil samples, was provided.

1.4.3.4 Immediate Response Action Status Report and Imminent Hazard Evaluation, October 2000

Rizzo submitted an IRA Status Report and IH Evaluation to the MassDEP on October 30, 2000, in response to an NOR issued to the MBTA by the MassDEP dated September 29, 1999. The IRA included a Site visit to verify placement and maintenance of fence and warning signs and to collect 48 surficial soil samples (SS-01 to SS-48) for lead analyses. The soil samples were collected along an approximately 100-foot spaced grid to a depth of up to 0.5 feet. Soil samples were submitted to AMRO Analytical Laboratories in Merrimac, New Hampshire, for lead analysis. Using data from these samples, Rizzo conducted an IH Evaluation for exposure to lead contamination in surficial soil to railroad workers and local resident trespassers. They identified two hot spots at sampling locations SS-01 and SS-22, where detected concentrations of lead exceeded the applicable standards, which they evaluated separately from the rest of the Site. Based on their calculations, Rizzo concluded the following:

- For trespassers, concentrations of lead in Site soil did not exceed the MassDEP non-cancer risk guidelines. However, concentrations of lead in soil at each of the two hot spot areas exceeded the MassDEP non-cancer risk guidelines. Lead concentrations in soil at the Site and within the two hot spot areas did not exceed IH levels.
- For railroad workers, concentrations of lead in Site soil and at the two hot spot areas exceeded the MassDEP non-cancer risk guidelines. However, lead concentrations in soil at the Site and within the two hot spot areas did not exceed IH levels.

Therefore, a condition of "Significant Risk" was found to exist at the Site for railroad workers, public welfare, public safety, and the environment. However, IH thresholds developed by Rizzo were not exceeded.

1.4.3.5 Phase I Initial Site Investigation, September 2001

On September 14, 2001, Rizzo submitted a Phase I - Initial Site Investigation (Phase I) to the MassDEP. The Phase I investigation used the results of previous Site investigations conducted by HMM and Rizzo to support completion of a Numerical Ranking System (NRS) Scoresheet, a Tier IC Permit Application, and a Phase II SOW. The Site was Tier Classified as Tier IC with an NRS score of 413.

1.4.3.6 Immediate Response Action, Preliminary Injunction, November 2001

In November 2001, Weston & Sampson submitted an IRA Plan to the MassDEP to support completion of a series of tasks outlined in the Preliminary Injunction Agreement between the MBTA and the Massachusetts State Attorney General dated October 12, 2001, which included the following tasks:

- Covering of exposed soil stockpiles identified in the Preliminary Injunction Agreement.
- Groundwater monitoring, including installation of additional wells and gauging and sampling of seven monitoring wells.
- Preparation of a stockpile characterization plan.

On November 9, 2001, Weston & Sampson's contractor, Franklin Environmental, covered the five exposed soil stockpiles, which were identified in the October 12, 2001, Preliminary Injunction Agreement. The stockpiles were covered using 10-millimeter thick polyethylene (poly) sheeting held in place with sand bags and bermed with staked hay bales. This work was conducted in accordance with a MassDEP-approved dust mitigation plan. Two small stockpiles located at the southwestern portion of the Site were covered completely with poly sheeting and three larger stockpiles, located to the north, were partially covered. The poly sheeting ripped on occasion due to high winds. On these occasions, the poly was repaired and stakes were placed on either side of the poly seam to keep the poly sheeting in place.

Between November and December 2001, Weston & Sampson conducted a groundwater assessment. The assessment included the installation of three additional monitoring wells (MW-101 through MW-103) and development, sampling, and gauging of four existing Site monitoring wells (MW-2, MW-3, MW-4, and MW-49). The approximate well locations are shown on the Site Plan, Figure 2. Groundwater analytical data for samples collected on December 4, 2001, indicate that:

- EPH was detected in two wells, MW-3 and MW-49, at concentrations below applicable MCP Method 1 GW-3 Groundwater Standards.
- Target PAHs were detected in well MW-3 only, at concentrations below applicable MCP Method 1 GW-3 Groundwater Standards.
- Only one VOC, methyl tert-butyl ether (MTBE), was detected at a concentration below applicable MCP Method 1 GW-3 Groundwater Standards.
- Dissolved metals, including lead and arsenic, were not detected in any of the groundwater samples analyzed.

On December 17, 2001, Weston & Sampson and EST Associates (EST) prepared and submitted a Soil Stockpile Management and Characterization Plan (SSCMP) to the MassDEP. This plan detailed proposed stockpile management procedures to prevent fugitive dust, erosion controls to prevent surface run-off, event notification protocols, approach for sample collection and analysis, evaluation and selection criteria for material classification, and decontamination procedures. The MassDEP verbally approved the SSCMP in December 2001. However, the SSCMP was appended to the Phase II SOW and presented at the PIP meeting on June 6, 2002, to allow opportunity for public comment prior to implementation starting the week of July 22, 2002.

Two IRA Status Reports summarizing IRA activities and findings were submitted to the MassDEP in March and September 2002.

1.4.3.7 Imminent Hazard Evaluation, February 2002

Between October 2001 and February 2002, the MassDEP conducted an IH Evaluation that included collection of surficial soil samples along a 100-foot to 50-foot grid throughout the Site and immediately outside the fence and an assessment of exposure risks. The Site was divided into five separate exposure areas to address the various uses and activities expected to occur in different locations. These exposure areas included: the land adjacent to West Milton Street properties, land adjacent to Ashcroft Street properties, the Main Yard, the EZ, and the Orphan Line.

The MassDEP concluded that an IH condition did not exist in any of the above-listed areas of the Site under current use conditions. In addition, the MassDEP's review of their data indicated that the XRF field screening appeared to overestimate arsenic concentrations relative to standard laboratory analysis. However, based on MassDEP's XRF field screening data, elevated concentrations of arsenic and lead were detected in soil at several sampling locations within two general areas outside of the Site fence: Area 1 (Zone 1), the north side of the Site closest to West Milton Street and Area 2 (Zone 2), the west side of the Site closest to Ashcroft Street. Additional assessment was recommended within these areas. A copy of MassDEP's IH Evaluation, the MassDEP sampling grid, and the arsenic/lead XRF screening results, was provided in Appendix C of the Weston & Sampson Phase II report (see Weston & Sampson, January 2003).

1.4.3.8 Immediate Response Action, Sampling Outside Fence, March 2002

While the MassDEP concluded that IH conditions did not exist based on the average detected concentrations within the different areas of the Site, individual samples collected at locations outside of the Site fence north of the Site near Milton Street and west of the Site near Ashcroft Street indicated detected concentrations above IH thresholds. Therefore, the MassDEP requested that the MBTA conduct an IRA to further evaluate these sampling locations.

On April 1, 2002, Weston & Sampson marked out a 25-square-foot area (5 feet by 5 feet) around each of the MassDEP's IH evaluation sample locations that had indicated elevated lead and/or arsenic concentrations. There were 12 sampling locations (200, 250, 500, 600, 900, 1300, 1350, 1600, 2450, 2700, 2750, and 2800) marked out in Zone 1 and four sampling locations (100, 300, 400, and 500) marked out in Zone 2.

On April 2, 2002, Weston & Sampson conducted surficial soil sampling in Zone 1 and Zone 2. A composite surficial soil sample was collected from five discrete grab sample locations within the sixteen established grids. Each sample was marked with the corresponding grid location number as established by the MassDEP. The soil samples were analyzed for total arsenic and lead. A summary of analytical data for these samples was included in the IRA report submittals. The data analyzed from all the laboratory runs indicated that lead was detected at concentrations exceeding MassDEP-established IH thresholds at one location in Zone 1, 2700, and that arsenic was detected at concentrations exceeding the MassDEP-established IH thresholds at each of the four sampling locations in Zone 2. In Zone 1, at location 900, high lead levels were also detected. These levels were below the MassDEP-established IH thresholds but additional assessment was warranted based on the potential for variability in the sample.

On May 28, 2002, Weston & Sampson collected additional soil samples for lead analysis at grid sample locations 1300 and 2700 in Zone 1 and arsenic analysis at sample locations 0 to 550 in Zone 2. In summary, the additional soil sample data indicated that lead contamination in Zone 1 extended up to a depth of approximately 18 inches and a distance of up to 9 feet from the existing outer fence in both locations (900 and 2700). Within Zone 2, arsenic was detected above the MassDEP's IH threshold within 10 feet of the original fence, and at one location 15 feet from the original fence location. None of the Zone 2 arsenic samples collected from the deeper (i.e., 18-inch) interval exceeded the MassDEP's IH threshold. In Zone 2, a fence was installed approximately 20 feet from the existing fence as an IRA activity.

An IRA was performed in Zone 1 consisting of excavating soil up to a depth of 3 feet below grade at grid location 2700 in response to detected concentrations of lead exceeding the MassDEP's IH threshold and at grid location 900 in response to the MassDEP's stated concern regarding average detected concentrations of lead. The MassDEP was informed that the excavation would be conducted in accordance with their IRA Conditional Approval.

On June 26, 2002, Weston & Sampson excavated an estimated 20 cubic yards of lead-impacted soil from the two grid locations in Zone 1 (900 and 2700). Confirmatory post-excavation samples were collected from the sidewalls and pit bottoms at each of the excavations. Analytical data for these samples indicated that none of the samples exceeded the MassDEP's IH threshold. In addition, with the exception of two samples collected at grid location 900, from the northern and eastern excavation sidewalls, all of the samples were below applicable MCP Method 1 standards.

1.4.3.9 Amtrak Immediate Response Action Completion, December 2002

On behalf of Amtrak, Harding ESE, Inc., prepared an IRA Plan to remove a piece of railroad equipment (wreckage of a railcar) from the EZ at the Site. The railcar was placed at the Site for inspection after a rail accident in Boston. Testing conducted by Amtrak confirmed that a permanent adhesive coating on the inner skin of the railcar contained a low percentage of asbestos in a non-friable, bound matrix similar to an adhesive polymer. Amtrak's IRA was prepared to perform removal of the railcar wreckage and disposal of material and soil in the area of the wreckage. Amtrak presented the results of the IRA at a PIP meeting in December 2002. According to information presented at the meeting, the following IRA activities were conducted: the train wreckage was encapsulated with a bridging compound; approximately 1 inch of soil in the area of the wreckage was removed and confirmatory soil samples collected; large and small asbestos-containing debris was disposed off-Site; and a draft IRA Completion Report was prepared.

1.4.3.10 Phase II – Comprehensive Site Assessment, January 2003

A Phase II investigation was performed at the Site by Weston & Sampson on behalf of the MBTA between July and October 2002 and included advancement of geoprobe borings, excavation of test pits, installation of monitoring wells, collection of surficial soil samples, characterization of soil and debris piles, evaluation of groundwater flow, and collection of groundwater samples in August and October.

Based on the Phase II investigation, detected contaminants included metals (predominantly lead and arsenic), EPH, and target PAHs. Contaminant concentrations in soil were generally highest within the shallow fill identified as brown to black coarse sand, asphalt, glass, coal, brick, and wood. Contaminant concentrations decreased rapidly with depth and were generally not observed within the deeper unit identified as native material, which consisted of dense sand with varying amounts of gravel, cobbles, silt, and clay. No PCBs or herbicides were detected in the soil samples analyzed (surficial, shallow, or subsurface).

All detected contaminant concentrations in groundwater were at or near analytical method detection limits. No contaminant concentrations were detected above the applicable MCP Method 1 GW-3 standards.

A total of 33 soil samples were collected from the various soil and debris stockpiles at the Site in the EZ. Materials identified in the soil and debris piles included soil, creosote timbers, asphalt, wood debris, railroad ties, bricks, ash, trash, metal, burnt material, lead-acid batteries, white "talc-like" material (lime), and other miscellaneous items. Contaminants detected in the soil and debris stockpiles included total and leachable metals (mainly lead and arsenic), PAHs, PCBs (at concentrations below the Toxic Substances Control Act (TSCA) thresholds), and TPH.

A Method 3 RC was performed to evaluate the potential risk to human health, safety, public welfare, and the environment posed by contaminants detected at the Site. The RC focused on the risk posed by soil because, based on the findings of the Phase II investigation, contaminants were not detected at or in excess of applicable regulatory thresholds in groundwater. For risk assessment purposes, the Site was divided into four areas based on historical use and types and concentrations of contaminants. The areas included the Orphan Line (Area 1), Ashcroft Street Fence Line (Area 2), Main Rail Yard (Area 3), and the EZ (Area 4). The soil and debris piles located in Area 4 were evaluated as a separate area. Site-wide RBCs were developed for four future general use scenarios/receptors, which included: recreational, commercial/industrial, construction, and residential. COCs carried through the RC included arsenic, lead, antimony, barium, chromium, cobalt, copper, nickel, zinc, EPH parameters, and select PAHs.

Evaluation of acceptable risk for the four future general use scenarios/receptors was developed based on a comparison of the EPCs to the RBCs. EPCs less than a derived RBC signified an acceptable use; conversely, EPCs greater than a derived RBC signified a use that was not acceptable. In addition, two lead soil hot spots were identified at the Site.

The results of the RC indicated that further response actions to eliminate exposure to surface (0 to 6 inches) and subsurface (0 to 3 feet) soils are required to achieve a condition of “No Significant Risk” in all Areas under existing Site conditions for all potential Site uses except for the construction scenario. The Phase II CSA concluded that remedial activities were required to achieve a level of “No Significant Risk” and the Phase III to be prepared for the Site would evaluate potential remedial options.

Weston & Sampson prepared a draft of the Phase II Report and provided it to the MassDEP on November 26, 2002 (the “Draft Phase II Report”). In accordance with PIP, the MBTA established a public comment period for the Draft Phase II Report from December 11, 2002 to January 8, 2003. On December 9, 2002, the MassDEP provided comments on the Draft Phase II Report to Weston & Sampson and, on December 11, 2002, the report was presented at a public meeting. No additional comments from the MassDEP and no comments from the public were received during the public comment period. After the close of the public comment period on January 8, 2003, Weston & Sampson finalized the Draft Phase II Report and incorporated the MassDEP’s December 9, 2002 comments into the “Final Phase II Report”. The Final Phase II Report was submitted to the MassDEP and the information repositories on January 31, 2003. In accordance with the PIP, the 350 persons who appear on the Site’s PIP mailing list were notified by letter dated February 3, 2003 that the Final Phase II Report was available for review at the information repositories.

To accommodate the MassDEP’s additional comments on the Phase III, and to avoid confusion among the public, the MBTA responded to the MassDEP’s comments concerning the Final Phase II Report in the form of a Phase II Addendum – Response to DEP Comments on the Final Phase II Report (the “Phase II Addendum”). The Phase II Addendum was attached as Appendix F to the Final Phase III Report submitted to the MassDEP on April 30, 2003.

1.4.3.11 Phase III – Remedy and Phase II Addendum, January 2003

Weston & Sampson performed a Phase III – Identification, Evaluation, and Selection of CRA Alternatives (Phase III) for the Site on behalf of the MBTA. The purpose of the Phase III study is to identify, evaluate, and select a remedial response action(s) that can achieve a condition of “No Significant Risk” under current and future Site uses. The evaluation considered an initial screening of likely potential Remedial Action Alternatives (RAAs) and a detailed evaluation of the remedial alternatives identified in the initial screening. The evaluation was based on the data collected during the past investigations and the results of risk characterization. No additional sampling and analysis and/or pilot studies were performed as part of the Phase III study. Potentially applicable technologies were evaluated to identify technologies that are most effective as remedial alternatives. Weston & Sampson evaluated factors associated with the applicable technologies, including: effectiveness with Site contaminants, effectiveness in Site subsurface conditions, implementability, protective to human health and environment, and cost.

Based on the evaluation, the following were retained by Weston & Sampson for further evaluation: soil excavation and off-Site disposal; cover; solidification/stabilization; and implementation of an Activity and Use Limitation (AUL). These alternatives were found to be technologically feasible, effective, and readily implementable. Since an AUL is an institutional control and not a remedial technology, it was retained, but not evaluated in detail.

Due to the unknown future use of the Site, one comprehensive remedial alternative could not be selected. Therefore, Weston & Sampson summarized the selected potential remedial alternatives for each Risk Area (Areas 1 through 4, the soil and debris piles, and the lead hot spots) under each potential future use scenario (residential, commercial/industrial, and recreational). The selected alternatives for Areas 1 through 4 included: Alternative 4 –Soil Excavation of RBC Exceedances and Off-Site Disposal with Stabilization; and, Alternative 5A – Clean Fill Cover. The selected potential alternatives for the 14,000 cubic yards of soil and debris stockpiles at the Site included: on-Site reuse within the AOC; “hot cell” removal and disposal and on-Site reuse within the AOC; and, off-Site disposal. The selected potential alternative for the lead-contaminated hot spots was Alternative 2 – Soil Excavation (0-3 feet) and Off-Site Disposal with Stabilization. Since Weston & Sampson determined that these remedial alternatives would not remediate the Site to unrestricted use, they indicated that an AUL may be required after completion of the remedial activities (based on selection of alternative) to achieve a condition of “No Significant Risk”. The Phase III report was submitted to the MassDEP on April 30, 2003.

1.4.3.13 Modified IRA Plan, September 2003

A Modified IRA Plan for lead and TPH field screening of stockpiled soil was prepared by Weston & Sampson on September 22, 2003. On October 2, 2003, a Supplemental IRA Plan Modification was prepared by Weston & Sampson and submitted to the MassDEP for comment. Between October 9 and 16, 2003, Weston & Sampson oversaw the segregation and field screening of certain soil cells in stockpiles and surficial samples identified with lead and TPH MCP UCL exceedances. It was reported that 1,000 tons of soil was estimated to contain lead and/or TPH and the newly segregated stockpiles were designated as R-S 17 through R-S21 and RS-38.

1.4.3.14 Final IRA Plan Modification, February 2004

In December 2003, Weston & Sampson prepared a follow-up draft IRA Plan Modification for the removal of the lead and TPH UCL classified soil. The IRA Plan Modification was presented at a public meeting on December 11, 2003. On December 23, 2003, Weston & Sampson submitted a Final Draft IRA Plan Modification to the MassDEP for review. On January 26, 2004, MassDEP's comments were incorporated and on February 5, 2004, the MassDEP approved the IRA Plan Modification for the removal of the lead and TPH UCL soils.

1.4.3.15 IRA Completion Report, May 2004

An IRA Completion Report was prepared by Weston & Sampson in May 2004, which described the in-situ treatment and removal of soil stockpiles containing elevated concentrations of lead and petroleum above UCLs. On March 12, 2004, composite soil samples were collected from the stockpiles for analysis of disposal parameters. Total lead was detected at concentrations ranging from 3,800 to 17,000 mg/kg and TCLP lead concentrations ranged from 10 to 36 mg/L. From March 22 to 24, 2004, a phosphate-based chelating stabilization compound was applied to the stockpiles to lower leachable lead levels. Post-treatment sampling was conducted and concentrations of TCLP were below the 5 mg/L RCRA criteria for hazardous soil. On April 12, 2004, a total of 545.85 tons of treated soil was disposed of at the Turnkey Lined Landfill in New Hampshire.

1.4.3.15 LFR Subsurface Investigation, November & December 2005

LFR was retained by Readville Yards, LLC to prepare the Phase IV RIP at the subject Site for proposed residential use in the western portion and an industrial program use consistent with current zoning, but undefined in the eastern portion. As a result of the proposed single-family residential use on the western portion of the Site, additional soil sampling was conducted to assess soil impacts. The objective of LFR's subsurface investigation was to conduct a soil characterization program designed to collect soil samples in areas where insufficient analytical data existed. The soil sampling plan was also used to better define, and, potentially limit the volume of impacted soils and regions of the Site where soils exceed the Method 3 RC RBCs. The soil data obtained by LFR and previous consultants was used in the geospatial distribution of contaminant concentrations relative to the RBCs.

Prior to commencing the soil characterization program, LFR superimposed a 50-foot by 50-foot grid coordinate system over the Site based on the Massachusetts State Plane Coordinates. The center location of each grid cell was surveyed, staked, and assigned an identification number and a representative global positioning system (GPS) coordinate.

The subsurface investigation included a test pit program. Each test pit was excavated from the center of each grid to a depth to delineate the extent of impacts or fill, as most of the impacts were in the fill. Additional test pits were excavated to further delineate impacts in select grids. The investigation included the collection of soil samples for analysis of the primary COCs (arsenic and lead).

From November 23 to December 13, 2005, LFR field personnel collected and analyzed samples collected across the Site using a combination of field screening supplemented with laboratory analysis of selected samples. A total of 250 test pits were excavated on the Site and were excavated using a subcontracted backhoe and operator. The depths of each test pit varied from 3 feet to 15 feet below ground surface depending on the extent of the urban fill layer and field screening.

During test pitting activities, soils were visually classified and logged using the Burmister soil classification method. Representative surficial and shallow soil samples up to a depth of 3 feet below grade were collected with hand sampling methods and an excavator. Deeper samples were collected directly from the excavator bucket. Sampling tools were decontaminated with a laboratory-grade soap solution between each test pit location.

1.4.3.12 Phase IV –Remedial Implementation Plan, June-July 2006

As part of the Phase IV RIP dated July 18, 2006 by LFR, on behalf of the Readville Yards, LLC, additional soil sampling was performed in anticipation of proposed residential use of the western portion of the Site. The objective of the LFR investigation was to obtain soil samples in areas where insufficient data existed. Using a 50 foot by 50 foot coordinate system, LFR oversaw the excavation of 250 test pits at depths ranging 3 feet to 15 feet below ground surface (bgs) during the period from November 23 to December 13, 2005. A total of 592 soil samples were field screened for RCRA metals using a calibrated XRF and for total ionizable VOCs using a photoionization detector (PID). LRF also submitted 10% of the samples to a certified laboratory for RCRA metals analysis. As with previous investigations, elevated soil lead was observed primarily in the shallow soils and urban fill layer across the Site. Elevated arsenic was observed primarily in the vicinity of the railroad tracks and chemically treated railroad ties. In addition to the above soil investigation, LFR retained Gradient Corporation to review and update the RBCs for the Site using “updated exposure parameters and toxicity values”.

2.0 SUPPLEMENTAL PHASE II CSA

2.1 Supplemental Phase II CSA Activities

In a November 8, 2007 letter to the MassDEP, the MBTA provided a Draft Scope of Work (SOW) that detailed the tasks to be performed to finalize the Revised Phase IV RIP at the Site. For the purposes of the Draft SOW, the MBTA assumed that, at a minimum, the cleanup of the Site would include removal of some of the stockpiled soils, excavation of soil in areas exceeding the lead UCLs and either re-use of the excavated soils under an engineered barrier or off-site disposal. The MBTA indicated that the anticipated railroad operations would require the use of a 5-acre laydown area for storage of railroad-related construction materials and that the Property will be marketed for sale in the future, and therefore, the Phase IV remedy would consider potential future division of the Property but assumed a commercial/industrial property end use. The Draft SOW included a field confirmatory investigation to support the final Phase IV design.

The MassDEP provided comments to the MBTA on the above Draft SOW for the final Phase IV RIP in a letter dated December 4, 2007. In these comments, the MassDEP indicated that some of the work required in order to submit the Revised Phase IV RIP was more appropriately categorized as Phase II and/or Phase III activities. As such, the MassDEP stated that the Revised Phase IV RIP should include a supplement that updates the previously submitted Phase II and Phase III reports. The MBTA responded to the MassDEP comments to the Draft SOW for Phase IV RIP in a letter dated February 28, 2008.

Based on the above letters/submittals, Earth Tech undertook supplemental Phase II activities at the Site, as discussed below. The following sections describe the methods and materials for the field investigation effort. All field investigations were performed in accordance with Earth Tech's site-specific Health & Safety Plan (HASP) described below. The correspondence between MBTA and MassDEP is presented in the appendices of this document.

2.1.1 Field Health and Safety Plan

Earth Tech prepared a HASP that provides a general description of the levels of personal protection and safe operating guidelines expected of each employee or subcontractor associated with the environmental services being conducted at the Site. The HASP also identifies chemical and physical hazards known to be associated with the Earth Tech-managed Phase IV activities. The provisions of the HASP are mandatory for all Earth Tech personnel engaged in fieldwork associated with the environmental services being conducted at the Site.

The HASP conforms to the regulatory requirements and guidelines established in Title 29, Part 1910 of the Code of Federal Regulations (29 CFR 1910), *Occupational Safety and Health Standards* (with special attention to Section 120, *Hazardous Waste Operations and Emergency Response*); Title 29, Part 1926 of the Code of Federal Regulations (29 CFR 1926), *Safety and Health Regulations for Construction; and* National Institute for Occupational Safety and Health (NIOSH)/OSHA/U.S. Coast Guard (USCG)/EPA, *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, Publication No. 85-115, 1985.

2.1.2 Preliminary Utility Mark Out

Prior to performing any subsurface investigation activities, the proposed test pit and soil boring locations were properly marked and Dig Safe System, Inc. (Digsafe®) was contacted to mark utilities in the vicinity of the proposed boring locations.

2.1.3 Dust Monitoring and Air Sampling

Earth Tech, Inc. implemented real-time dust monitoring and air sampling procedures during soil pile sampling and maintenance activities to avoid generation of visible dust. Dust monitoring included stationing of dust meters (i.e., MIE RAM-1) within the work area and additional meters in the prevailing downwind direction at the perimeter of the “exclusion zone” area of the Site. Based on previous investigation data, action levels of 0.42 milligrams per cubic meter (mg/m^3) of total particulates within the work zone and 0.20 mg/m^3 of total particulates at the perimeter were established. When these action levels were detected, additional dust control measures were to be implemented. However, the action levels were not exceeded during the supplemental Phase II activities.

During daily operations, dust abatement measures (i.e., water spraying or misting) were employed to minimize the spread of dust contaminants, and to reduce the potential for exposure to site workers and the adjacent community. When implemented, if the additional dust control measures failed to diminish the concentration of total particulates, work was to be stopped until Site conditions allow for work to be completed within the above action limits. However, as mentioned above, no action levels were exceeded and additional dust control measures were not required.

2.1.4 Decontamination Procedure

All equipment and vehicles exiting the Site EZ, such as excavators or support trucks, traveled across a rehabilitated decontamination pad. Small equipment that has been in contact with potential or known contamination were then cleaned appropriately.

- Decontamination procedures included but are not limited to:
- Rinsing equipment with warm soapy water (green soap or alconox mixture).
- Dry brush or wipe equipment.

Where appropriate, Earth Tech utilized disposable equipment and supplies to minimize the need for decontamination. Use of disposable material also minimized the potential for cross contamination due to inadequate decontamination practices.

2.1.5 Tree and Brush Removal

In preparation for the soil pile sampling, trees and brush covering the piles were cleared on June 18, 2008 by New England Disposal Technologies, Inc. under the oversight of Earth Tech. Trees and brush embedded in the soil piles were cut approximately 12 inches above grade and brought to an area where they were chipped or stockpiled for disposal as general debris. The stumps remained in the soil for removal within the applicable waste streams.

2.1.6 Soil/Debris Stockpile Sampling

During the period from June 30, 2008 to July 3, 2008, Earth Tech sampled the existing soil piles to gather the necessary data to estimate the quantity of soil that may exceed the revised UCL for soil lead of 3,000 mg/kg. Previous soil estimates were based on the 6,000 mg/kg lead UCL, which was applicable at the time but has since been revised to 3,000 mg/kg.

Earth Tech conducted a tape survey and grid using wooden stakes with labels and site sketches to segregate the stockpiles into 500 cubic yard cells. Up to thirty samples per 500 cubic yards of soil were collected for XRF screening in the field for lead and arsenic. Samples were screened using an Innov-X Handheld XRF model alpha-4000. The unit was calibrated according to Innov-X Systems in-house calibration procedure. The calibration was verified using Soil Certified Reference Materials produced by the National Institute of Standards and Technology (NIST). One composite sample per 250 cubic yards (eighty-eight samples) were submitted to Con-Test Analytical Laboratory (Con-Test), East Long Meadow, MA for confirmatory laboratory analysis of total lead, TCLP lead, total arsenic, and EPH with target compounds. Samples were collected by hand auger and/or from the bucket of the excavator during test pit activities.

Depending upon the size of the stockpile, the following sampling protocols were utilized:

- Smaller stockpiles (less than 1,000 tons) and the sloping edges of larger stockpiles were sampled by hand auger. Samples collected by hand auger included soil from the surface of the sample location to a vertical depth of approximately three (3) feet. A minimum of five (5) sample locations were used to generate a representative composite profile for that quadrant. A total of 10 cells were sampled by this method.

- Larger stockpiles capable of supporting a small tracked vehicle were sampled from test pits using an excavator. Once control had been obtained, the stockpiles were divided into approximately 250 cubic yard sections based on stockpile size and depth. The sections were staked and flagged in the field and samples were collected using a tracked excavator. A ten point composite samples was then collected from each section with three shallow, four midlevel and three deeper samples comprising the composite sample. Samples were then homogenized in a dedicated plastic bag and subsequently aliquoted into the appropriate sample containers for laboratory analysis.

As soil was excavated, it was placed on an HDPE liner and segregated based on depth. Shallow soil was stockpiled separately form midlevel and deeper soils. Following sample collection, soils were placed back in the stockpile from the same general vertical interval it was generated from. The procedure was then repeated for each of the larger stockpile sections. A total of 20 cells were sampled by this method.

Regardless of the soil sampling method utilized, each sample submitted for laboratory analysis from the stockpiles was field screened for total VOCs (TVOCs) using a PID. Existing site data indicated elevated levels of metals and TPH. As described above, collected soil pile samples were submitted to a Massachusetts-certified laboratory. Soil samples were collected using clean utensils and placed directly into laboratory prepared glassware. The most direct method for collecting soil samples is with the use of a spade or scoop. This is most effective for collecting soil at surface or at shallow depths in stockpiles. This process was also used when collecting a sample from the bucket of a larger excavator when extended depths were sampled.

Composite soil samples were homogenized in plastic zip-top bags prior to being placed into laboratory prepared glassware. Samples were collected in such a manner as not to cause any cross-contamination. All sampling equipment was properly decontaminated between each sample.

Results of the soil laboratory analysis are summarized in Table 1. A copy of the soil sample laboratory analytical report is included in Appendix A. The PID soil screening results are provided in the soil boring/test pit logs presented in Appendix B. The XRF soil screening results are provided in Table 4.

Earth Tech then surveyed the horizontal location of each sampling location using Global Positioning System (GPS) technology. Earth Tech used the survey data in conjunction with analytical data to prepare MassGIS maps to provide better control on the locations and extent of various waste streams.

2.1.7 Confirmatory LFR Soil Sampling

Earth Tech collected 100 soil samples to evaluate the validity of the LFR data collected in the UCL areas in the Main Yard of the rail yard. These data were used to define the extent of the previously identified UCL areas to evaluate whether the UCL areas were over estimated based on the limited sampling data collected (e.g., one sample per fifty foot grid) and due to the poor correlation of XRF/lab data for arsenic obtained by LFR.

On June 11 and 12, 2008, Earth Tech conducted a tape survey and grid to divide the areas of concern into 50 foot by 50 foot cells using wooden stakes with labels. The locations of the grids were based on site sketches, aerial photos and the UTM coordinates provided on the LFR figures indicating the UCL exceedance areas.

On June 18, 2008 surface soil samples (0-6 inches) were collected by Earth Tech using a stainless steel scoop. On June 19, 2008 deeper subsurface samples were attempted to be collected using a Geoprobe. However, due to site conditions (numerous cobbles, scarp metal, and debris) the deeper subsurface samples could not be collected using a Geoprobe. As a result, deeper subsurface samples were collected using an excavator operated by Geologic, Inc. during June 20, 2008 and June 23, 2008. Tests pits were advanced to a maximum depth of 6 feet. Each sample interval (0.0-0.5 feet, 0.5-3.0 feet, and 3.0-6.0 feet) was visually inspected by Earth Tech's on-site environmental scientist. A descriptive log, based on the modified Burmister Soil Classification System, was prepared in the field for each sample interval, apparent density, moisture, color, approximate grain size distribution, structure, texture and any visible or olfactory evidence of contamination. The soil boring/test pit logs are presented in Appendix B. Samples were screened in the field using an Innov-X Handheld XRF model alpha-4000. The unit was calibrated according to Innov-X Systems in-house calibration procedure. Approximately 10% of the confirmatory samples (a total of 12 samples) were submitted to Con-Test for laboratory analysis of total lead, TCLP lead, and total arsenic, and EPH. Metals that cause interference during screening were also recorded as part of the evaluation of the screening data quality. The correlations(s) derived from comparisons of the lead and arsenic soil data are presented in Figures 5 and 6, respectively, and are further discussed in Section 2.4.1.2.

All 12 confirmatory soil samples were collected in laboratory supplied glassware and immediately placed into an ice filled cooler, and submitted under standard chain-of-custody procedures to Con-Test for total lead, total arsenic, TCLP lead, and EPH analysis. Quality assurance samples (equipment blanks, field duplicates, matrix spike and matrix spike duplicate samples) were also collected during the Supplemental Phase II investigation for the Site. Results of the soil laboratory analysis are summarized in Table 2. A copy of the soil sample laboratory analytical report is included in Appendix A. The XRF soil screening results are provided in Table 4.

2.1.8 Containerization and Disposal of Wastes

No drums of investigational derived waste (IDW) were generated during investigation activities, therefore no containerized waste was taken off-site for disposal. No excess environmental media was produced. Soil samples that were collected in plastic bags for XRF analysis and not sent to the lab were placed back in the areas from which they were removed.

2.1.9 Decontamination Procedures

In order to minimize the potential for cross-contamination of environmental samples collected for laboratory analysis and/or field testing, all non-disposable intrusive equipment was decontaminated between each usage.

The tools were sprayed with pressurized steam to remove any loose dirt and debris, scrubbed with hand brushes as needed, sprayed with a solution of Alconox® and water, and then rinsed with steam.

At the completion of all intrusive site investigation activities all equipment was decontaminated prior to mobilizing off-site.

2.1.10 Topographic Survey

Prior to preparation of the Draft Phase IV RIP, Earth Tech subcontracted with Nitsch Engineering (Nitsch) to conduct a topographic (i.e., horizontal and vertical - x, y, and z coordinates) Site survey incorporating key features of the Site. This survey was used to update the existing base map for the Site. An AutoCAD version 2006 file of the completed Site survey was used in support of the Draft Phase IV RIP. This site survey provides the foundation for the engineering design and earthwork performed in Subtasks below.

The scope of work from Nitsch Engineering (the Massachusetts Registered surveyor) included the following:

- <u>Topographic Survey (Existing Conditions)</u>: Nitsch Engineering flew the project area and compiled mapping at 1"=40' with 1' contours. Spot elevations were obtained in obscured areas. Information located included all visible surface improvements such as pavement, curbs, manholes, valves, monitoring wells and roadway improvements. Additional elevations were obtained in order to properly define the topography. Inverts of accessible drainage structures were measured in the field. Subsurface utility information was compiled from a combination of field measurements and record information. Utility information from utility companies generally does not exist outside of roadways and, therefore, records and available information were provided by the MBTA.

- <u>Property Line – Right of Way</u>: Nitsch recovered and located monuments referenced on the plan. The Property lines were established in the survey as a reference to the limits of ownership.

2.2 Site Geology and Hydrogeology

2.2.1 Site Hydrology

No surface water bodies are located on or immediately adjacent to the Site. The topography of the Site is generally flat with stormwater controlled by on-Site catch basins, which discharge to an approximately 900-foot long on-Site drainage ditch that runs roughly east to west, north of the staging area. The drainage ditch receives storm-water run off from storm drains located along the northern railroad tracks (Figure 2). This drainage ditch is typically dry during most of the year. The Site is not located within a designated 100- or 500-year floodplain, according to the Federal Emergency Management Administration (FEMA).

2.2.1.1 Groundwater Hydrology

Based on four rounds of groundwater elevation measurements collected at the Site by Weston & Sampson on December 14, 2001, August 5, 2002, September 18, 2002, and October 2, 2002, the average depth to groundwater at the Site ranges from approximately 11 feet bgs to 22 feet bgs. The highest groundwater elevations were generally observed at monitoring wells MW-2 and MW-3 in the center of the Site at depths of approximately 11 to 15 feet below grade. The lowest groundwater elevations were observed in monitoring wells MW-102, MW-107 and MW-108 in the northwestern area of the Site at depths of approximately 22 to 29 feet below grade. The average depth of water at the Site is approximately 14.63 feet below grade. A groundwater contour map was generated by Weston & Sampson using groundwater-gauging data collected on September 18, 2002. Based on these elevation data, the groundwater generally flows outward from the Site in a radial pattern, with the eastern end and northwestern corner of the Site considered downgradient.

2.2.1.2 Hydraulic Gradients

Weston & Sampson calculated an average horizontal hydraulic gradient (IAVG) of 0.006 feet per foot (ft/ft) across the Site based on the groundwater contour map, generated using data collected in September 2002. Using groundwater elevation data from August, September, and October 2002, for the two shallow and deep monitoring well clusters (MW-104 and MW-105), Weston & Sampson calculated vertical gradients between the shallow and deeper overburden. These gradients indicate a downward gradient at the MW-105 cluster located in the central area of the Site near the 5-acre staging area during August and September 2002. In October 2002, when the average depth to water was the lowest measured, the MW-105 cluster indicated an upward gradient. At the MW-104 cluster located in the west-central area of the Site in the EZ, a downward gradient was observed during all three gauging events. These gradients were generally consistent with groundwater flow direction observed at the Site extending radially from a groundwater high/recharge area located near the staging area.

2.2.1.3 Hydraulic Conductivity

Based on slug test data collected by Weston & Sampson at monitoring wells MW-104S, MW-105S, and P/MW-111 on September 18, 2002, Weston & Sampson calculated an average hydraulic conductivity of approximately 0.344, 2.04 and 0.291 feet/day, respectively.

2.2.1.4 Groundwater Velocity

Weston & Sampson indicated that the groundwater velocity across the Site calculated using Darcy's Law ranges from approximately 0.007 to 0.049 feet per day, or 2.5 to 17.9 feet per year, at wells P/MW-111 and SA/MW-105S, respectively.

2.2.2 Site Geology

During implementation of the Phase II subsurface investigation, Weston & Sampson identified three general geologic units comprising overburden at the Site including, in stratigraphic succession from youngest (shallowest) to oldest (deepest):

<u>Fill</u>: Brown to black, loose, fine to coarse sand, gravel and cobbles, asphalt, ash, glass, coal, brick and wood.

<u>Native Material Fill</u>: Tan to brown, loose, fine to coarse Sand, some gravel, some crushed cobbles and boulders, little silt.

<u>Native Material</u>: Tan to brown, dense, fine to coarse sand, varying amounts of gravel, cobbles, some silt, trace clay.

The fill unit was encountered in 25 of Weston & Sampson's 56 Phase II drilling locations, at depths up to 12 feet below grade (SA/GP-41 and EZ/MW-104D), and with an average thickness of approximately 6 feet on the eastern portion of the Site, approximately 7 feet in the central portion of the Site, and approximately 5 feet on the western portion of the Site. The fill unit was thickest in the center of the Site just north of the Staging Area, and thinned with distance to the east and west. Non-native materials observed in the fill unit included: asphalt, ash, glass, coal, brick, and wood. Headspace screening measurements by Weston & Sampson indicated high concentrations of TVOCs at only a few locations within the fill unit, including 389 parts per million by volume (ppm/v) in boring EZ/MW-104D at a depth of 8 to 12 feet below ground surface. As indicated in the Earth Tech soil boring/test pit logs presented in Appendix B, fill material was also observed in the Supplemental Phase II test pits performed in the EZ to depths of up to 6 feet below grade. The fill material was as described above and contained ash, scrap metal, brick, wood, concrete, glass, and cinders. It should be noted that Earth Tech's field soil headspace screening did not indicate elevated levels of TVOCs (refer to soil boring/test pit logs in Appendix B).

During the Phase II investigations, Weston & Sampson indicated that the native material fill unit consisted of reworked loose sand, gravel, and cobbles, and ranged in thickness from ground surface to a maximum depth of 16 feet in EZ/MW-104D located in the north-central portion of the Site. The native fill material was identified primarily based on cohesiveness measured by blow counts indicating the native fill material is "loose" and native material is "medium-dense". The native fill material was observed in 34 of Weston & Sampson's 56 drilling locations, most often in the western-most and northern areas of the Site and the centrally located Staging Area. The average thickness of this unit was approximately 5 feet on the western portion, 11 feet on the central portion, and 3 feet on the eastern portion. Weston & Sampson observed petroleum odors in the native fill unit at borings SA/GP-18 and SA/GP-44EZ at depths of 8 to 12 feet below ground surface.

Native material consisting of dense sand, gravel, cobbles and some silt were observed by Weston & Sampson in all soil borings advanced during the Phase II investigation. Weston & Sampson reported that the native material was observed at depths ranging from ground surface to end of boring in 8 borings. Petroleum odors were detected in SA/GP-46 at a depth of 8 to 10 feet bgs. No confining layers were identified at the Site during Weston & Sampson's Phase II investigation. Bedrock was not encountered during the Phase II drilling to a maximum depth of 35 feet bgs and no bedrock outcrops were observed at the Site.

During the Supplemental Phase II investigations described in Section 2.2.7, Earth Tech observed fill material in all soil test pits, to the maximum depth explored of 6 feet bgs. The fill material was as described previously by Weston & Sampson. The soil boring/test pit logs are presented in Appendix B.

The 1983 USGS Bedrock Geology Map of Massachusetts identifies the Site as lying within the Milford-Dedham Zone. Bedrock within this area is characterized by granite including light grayish-pink to greenish gray equigranular to slightly porphyritic, variably altered. Bedrock outcrops were not observed at the Site.

2.3 Representativeness Evaluation and Laboratory Data Usability Assessment

The requirement to provide a Data Usability Assessment and Representativeness Evaluation in documentation that will be used to support a Response Action Outcome (RAO) is contained in the MCP at 310 CMR 40.1056(2)(k) and cited below:

40.1056: Content of Response Action Outcome Statements

(2) Except where previously submitted, all documentation, plans and/or reports necessary to support the Response Action Outcome shall be submitted to the Department, including, without limitation, the following:

(k) for all Class A, B, or C Response Action Outcomes, a Data Usability Assessment documenting that the data relied upon is scientifically valid and defensible, and of a sufficient level of precision, accuracy, and completeness to support the RAO, and a Representativeness Evaluation, documenting the adequacy of the spatial and temporal data sets used to support the RAO.

The MCP performance standards (310 CMR 40.0017 and 310 CMR 40.0191(2)(c)) are designed to ensure that the adequacy of analytical and other environmental assessment data are applicable to the MCP response actions. As such, ongoing consideration and evaluation of data usability and representativeness are important and appropriate from the start and throughout the response action process. The intent of the MCP requirement for providing a Data Usability Assessment and Representativeness Evaluation as part of a RAO Statement is to consolidate information ***that has been generated and evaluated throughout the response action process*** in the documentation that supports key MCP milestones or endpoints.

This Supplemental Phase II report includes a Representativeness Evaluation documenting the adequacy of the spatial and temporal data sets that will likely be used to support an RAO for the Site and a Data Usability Assessment documenting that the data relied upon is scientifically valid and defensible, and of a sufficient level of precision, accuracy, and completeness to eventually support the RAO. The MassDEP guidance entitled *MCP Representativeness Evaluations and Data Usability Assessments, Policy #WSC-07-350, September 19, 2007* (the Data Usability Guidance Document) was utilized in these evaluations. It should be noted that a Data Usability Assessment and Representativeness Evaluation for the data obtained previously by Weston & Sampson as part of the Phase II and by LFR as part of the Phase IV were included in those respective reports and, therefore, were not evaluated within this Supplemental Phase II report.

2.3.1 Representativeness Evaluation

Representativeness Evaluation means a comprehensive evaluation of the adequacy of spatial and temporal data set in representing disposal site conditions and supporting environmental decision-making. As used in this definition, spatial data includes historical use, hydrogeologic and physical characteristics and similar data in addition to analytical data. The Representativeness Evaluation, pursuant to 310 CMR 40.1056(2)(k), must encompass, consider and compile the full range of data gathered over the course of the response action process (i.e., site history, conceptual site model, analytical, hydrogeological and physical data, and field observations). The rigorousness of the evaluation should be proportional to the complexity of the project and the ramifications associated with an incorrect decision.

Figures 2 and 3 shows a summary of the sampling performed at the Site and the inferred limits of contamination (disposal site boundary). Oil and/or hazardous material have been detected in soil and groundwater at the Site, although only minimal groundwater contamination has been observed.

2.3.1.1 Conceptual Site Model

Historical data indicates the Site has been impacted by lead, arsenic, and petroleum hydrocarbons. Contaminants were primarily detected in shallow soil and the soil stockpiles. Groundwater does not appear to be impacted. The Phase II assessed the extent of surficial contamination, potential impact to deeper subsurface soils, and deeper overburden groundwater, and evaluated Site background concentrations. The Phase II investigation indicated the presence of metals (predominantly lead and arsenic), EPH, and target PAHs. The concentrations of oil and/or hazardous materials (OHM) in soil were generally highest within the shallow urban fill material identified as brown to black coarse sand, asphalt, glass, coal, brick, and wood. The concentrations of OHM decreased significantly with depth and were generally not observed within the deeper unit identified as native material consisting of dense sand with varying amounts of gravel, cobbles, silt, and clay. No PCBs or herbicides were detected in the surficial or subsurface soil at the Site. The concentrations of OHM detected in groundwater were at or near analytical method detection limits and were well below the applicable MCP Method 1 GW-2 and GW-3 standards. A total of 33 soil samples were collected from the various soil stockpiles at the Site in the EZ and analyzed. Materials identified in the stockpiles in the EZ included soil, creosote timbers, asphalt, wood debris, railroad ties, bricks, ash, trash, metal, burnt material, lead-acid batteries, white “talc-like” material (lime), and other miscellaneous items. The OHM detected in the stockpiles included metals, PAHs, PCBs (at concentrations below the TSCA thresholds), and TPH. As part of the Phase IV RIP, additional soil sampling was performed in anticipation of proposed residential use of the western portion of the Site. As with previous investigations, elevated soil lead was observed primarily in the shallow soils and urban fill layer across the Site. Elevated arsenic was observed primarily in the vicinity of the railroad tracks. The Supplemental Phase II investigation involved a confirmatory investigation to support the final Phase IV design. As discussed further below, as part of the Supplemental Phase II, Earth Tech collected 134 soil samples to evaluate the validity of the LFR data collected in the UCL areas in the Main Yard of the rail yard. Samples were screened in the field for arsenic and lead using an XRF , and a total of 12 samples were submitted for confirmatory laboratory analysis of total lead, TCLP lead, and total arsenic, and EPH. The Supplemental Phase II investigations also included obtaining 944 soil samples from the existing soil piles for XRF arsenic and lead screening, and 88 samples for confirmatory laboratory analysis to gather the necessary data to estimate the quantity of soil that may exceed the revised UCL.

The Site is roughly an elongated teardrop shape, defined by a loop railroad track enclosed by an 8-foot tall chain link fence. The Property extends beyond the railroad track fencing. The Site is mostly unpaved, with the exception of a driveway approximately 100 feet wide and 1,700 feet long running east-west along the northern side of the Site. Materials used for railroad maintenance (ties, track panels, etc.) were historically stored at various locations throughout the Site. The western portion of the Site, designated as the EZ, is fenced and is posted with warning signs to restrict access to stockpiles containing soil and miscellaneous debris located within this area. Other significant Site features include a historical burn pit located in the EZ, a clinker fill area located between the northern loop tracks and the Orphan Line, historical site building remnants including the concrete building slab in the staging area, and a drainage ditch located along the approximate Site centerline.

The Site is abutted by residential properties to the north, east, and west, and by industrial properties to the south. Zoning in the area of the Site is industrial. Residential and commercial properties abut the Site to the west on Ashcroft Street and to the north opposite the former Dedham Secondary rail line (a.k.a. the “Orphan Line”) on Milton/W. Milton Street. Commercial and industrial properties, including a school bus garage and storage yard and a gravel crushing operation, are located to the south, opposite Industrial Avenue. The MBTA Readville commuter rail station, including commuter parking lots and the MBTA 2-Yard facility, is located to the east.

No surface water bodies are located near the Site. The nearest surface water body is Sprague Pond, located approximately 1,000 feet south/southeast of the Site.

Based on observations made during advancement of soil borings, three general geologic units comprising overburden at the Site. An urban fill unit was encountered at depths up to 12 feet below grade, and with an average thickness of approximately 6 feet on the eastern portion of the Site, approximately 7 feet in the central portion of the Site, and approximately 5 feet on the western portion of the Site. Non-native materials observed in the urban fill unit included: asphalt, ash, glass, coal, brick, and wood. A native material fill unit was observed consisting of reworked loose sand, gravel, and cobbles. The native fill unit ranged in thickness from ground surface to a maximum depth of 16 feet in the north-central portion of the Site. The native fill material was observed most often in the western-most and northern areas of the Site and the centrally located Staging Area. The average thickness of this unit was approximately 5 feet on the western portion, 11 feet on the central portion, and 3 feet on the eastern portion. Native material consisting of dense sand, gravel, cobbles and some silt were observed in all soil borings, at depths ranging from ground surface to to a depth of 35 feet, the maximum depth explored. Bedrock was not encountered during drilling and no bedrock outcrops were observed at the Site. However, Weston & Sampson noted that bedrock was reportedly observed at 42 feet below grade in previous Site studies.

The depth to water at the Site ranges from approximately 16 to 22 feet below grade. using groundwater-gauging data collected on September 18, 2002 (see Weston & Sampson, January 2003). Based on groundwater elevation contours generated from the September 18, 2002 gauging data, the groundwater at the Site generally flows outward from the Site in a radial pattern, with the eastern end and northwestern corner of the Site considered downgradient. A seepage velocity ranging from approximately 0.29 feet/day (106 feet/year) to 2.04 feet/day (745 feet/year) was calculated during the Phase II investigation.

Potential migration pathways include migration of contaminants via:

- Groundwater

- Ambient air;
- Indoor air;
- Soil Gas;
- Underground utilities;
- Surface water and sediments; and
- Movement of contaminated soil particles via ambient air or erosion.

Groundwater does not appear to be a significant migration pathway at the Site since OHM were only detected in groundwater at concentrations near the laboratory analytical detection limit. As the groundwater moves naturally within the subsurface, the dissolved contaminants are transported with the water. Additionally, contaminants adsorbed to fine soil particles carried by the groundwater can serve as a potential migration pathway. However, because the quantity of soil that actually moves through the subsurface is small, it is unlikely that this mode of transport has ever been or will ever be a significant migration pathway.

Ambient air does not appear to be a significant migration pathway since the concentrations of VOCs in the soil (and groundwater) generally do not appear to be high enough to result in VOC concentrations that would be detected in ambient air above background conditions. Also, background concentrations of the VOCs in ambient air are expected to be high because of the volume of vehicular traffic in the area. Indoor air is not considered a migration pathway due to migration of contaminants via soil gas based on the low concentrations of VOCs in present in soil (and groundwater) and since an occupied building is not located on the Site.

Air does not appear to be an existing or potential migration pathway due to fugitive dust based on the air monitoring performed during the Phase II and supplemental Phase II investigations. Site topography is generally flat with stormwater controlled by on-Site catchbasins, which discharge to the on-Site drainage ditch. This drainage ditch is typically dry. These Site features make erosion and transport of soil particles an unlikely pathway.

Underground utilities at the Site include electrical, water, sanitary sewer, and storm water drain. Utilities are also located along Ashcroft Street, Milton Street and Industrial Avenue. However, due to the relatively low concentrations of VPH and VOCs detected in soils (and groundwater), and based on the PID soil screening performed during the Phase II activities, potential migration of vapors along these underground utilities is not considered a significant migration pathway.

In general, the depths of the water, gas, sewer and drainage lines are estimated to be 4 to 10 feet bgs. Since groundwater was observed at a depth of approximately 16 to 22 feet below grade, the utility lines are unlikely to act as potential migration conduits.

Due to the distance to the nearest downgradient surface water body (Sprague Pond, located approximately 1,000 feet south/southeast of the Site) significant human or environmental exposures are unlikely. Only very low concentrations of OHM were detected in site groundwater and contaminant concentrations in groundwater are likely to decrease between the Site and surface water by natural processes such as dilution, dispersion, retardation, and biological activity. In addition, significant dilution of groundwater will occur once discharged into the surface water. Therefore, surface water and sediments are not considered a likely migration pathway at this time.

2.3.1.2 Field Screening

Numerous assessment activities have been performed for the Site. These investigations involved the collection of samples from various areas to determine whether a release has occurred at the Site, identify the release source(s), assess historical uses, define the hydrogeologic and physical characteristics of the Site, and the nature and extent of contamination. Field screening (visual/olfactory evidence and PID screening) was performed to help direct the investigations at the Site. In general, these field screening data correlate well with the analytical data.

The MassDEP May 2002 IH Evaluation was based on a soil data set of over 600 samples that were field screened for arsenic and lead using XRF technology. Approximately 10% of the screened soil samples were sent to a laboratory for confirmation analysis. According to the MassDEP, the XRF screening data correlated well with laboratory results for lead, but not for arsenic (the XRF overestimated the actual arsenic concentrations). These correlation findings were also confirmed by Weston & Sampson during the Phase II investigation through comparison of their IRA sampling results from the West Milton Street Fence Line (MassDEP Zone 1) and Ashcroft Street Fence Line (MassDEP Zone 2). LFR found that the XRF lead results from the Phase IV investigation were slightly higher than the corresponding laboratory results and the XRF arsenic results were consistently much higher than the corresponding laboratory results. LFR reported a coefficient of determination (R^2) of 0.92 for lead XRF results and a R^2 of 0.33 for arsenic XRF results.

During the Supplemental Phase II evaluation of the stockpiles in the EZ, up to thirty samples per 500 cubic yards of soil were collected by Earth Tech for XRF screening in the field for lead and arsenic. Of these, one composite sample per 250 cubic yards (88 samples) were submitted for confirmatory laboratory analysis of total lead and total arsenic (along with other analyses). In addition, Earth Tech re-evaluated the lead and arsenic UCL exceedances identified by LFR during the Phase IV investigation. Approximately 10% of the confirmatory samples (a total of 12 samples) were submitted for laboratory analysis of total lead and total arsenic (along with other analyses). Using the XRF, the lead levels ranged from 15 mg/kg to 80,330 mg/kg, while the lead concentrations via laboratory analysis ranged from 19.5 mg/kg to 49,100 mg/kg. The Supplemental Phase II lead and arsenic XRF and laboratory analytical results are summarized in Table 4. Comparison of the XRF lead detections to the corresponding laboratory results indicates that, in general, the XRF readings were slightly higher than the laboratory results. A comparison of the lead and arsenic XRF screening results to the laboratory analytical results is provided in Table 5. The XRF and laboratory results were in good agreement, with the exception of the highest concentrations detected by the two methods (80,330 mg/kg and 49,100 mg/kg, respectively). Therefore, Earth Tech performed a Discordance Test to determine whether this XRF reading was a statistical outlier and did not "fit" the distribution of the remainder of the data. The Discordance Test was performed using the following equation:

$$T_n = \frac{(X_n - X)}{s}$$

Where:	X_n	=	maximum value
	X	=	mean
	s	=	standard deviation

From this equation, the T_n is then compared to the T_c (critical value based on level of significance) to determine whether the maximum value is an outlier. Based on the XRF data set of 100 readings, a T_n of 9.0 was calculated. Since the T_c is between 3.02 and 4.08, the maximum XRF value is considered an outlier. As such, it was considered appropriate to exclude this data point from the data set. With the exclusion of this outlier, good correlation was observed between the lead XRF readings and the corresponding laboratory result, as presented in Figure 5.

As was found by the MassDEP and LFR in their investigations, poor correlation was observed between Earth Tech's XRF arsenic reading and the arsenic soil concentrations by laboratory analysis (refer to Figure 6). In fact, Innov-X Systems, Inc., the manufacturer of the XRF used by Earth Tech, has documented that the precision of the arsenic XRF results are affected by the presence of lead in a sample due to interference created by the overlapping of the spectral peaks for these two metals. As such, high lead concentrations can greatly affect the arsenic XRF results. Based on these considerations, the arsenic XRF data are not considered to be reliable for evaluating the nature and extent of contamination at the Site.

It should be noted that as part of LFR's draft Phase IV RIP activities, a total of 592 soil samples were screened in the field with an XRF for arsenic, chromium, lead and mercury. Of these samples, 52 were also submitted for confirmatory laboratory analysis. Earth Tech's review of these data revealed a very poor correlation between the XRF and lab results for chromium and mercury. Therefore, the chromium and mercury XRF data are not considered to be reliable for evaluating the nature and extent of contamination at the Site.

2.3.1.3 Sampling Locations

Soil boring/sampling and groundwater monitoring well installations during the preliminary assessments and the Phase I, IRA, Phase II, Phase IV and Supplemental Phase II investigations were typically in areas of the Site with the greatest potential for contamination to be present. In addition, the numerous soil and groundwater samples collected across the Property were collected in order to define the horizontal and vertical limits for potential future remedial activities.

In May 1989, a Preliminary Site Assessment Phase I – Limited Site Investigation was performed at the Site involving the advanced eight borings at locations selected based on surficial dumping piles, former building structures, and evidence of impact. Seven of the eight borings were completed as monitoring wells. In addition, composite surficial soil samples were collected from selected areas of the Site where surficial staining or evidence of impact was observed. A total of 17 groundwater and composite surficial soil samples were submitted for laboratory analysis. In October 2000, Rizzo Associates, Inc., (Rizzo) conducted an IRA investigation that included the collection of 48 surficial soil samples for the analysis of lead. Between October and December 2001, the MassDEP conducted an IH Evaluation that included the collection of approximately 600 surficial soil samples for XRF field screening for lead and arsenic. Between November and December 2001, Weston & Sampson conducted a groundwater assessment program at the Site that included the installation of three additional monitoring wells and development, sampling, and gauging of four existing Site monitoring wells. In April 2002 and May 2002, IRA sampling activities were undertaken at the Site, which indicated high concentrations of arsenic along the western fence and lead at two locations along the northern fence. The Phase II investigation activities at the Site included the advancement of 58 sub-surface soil borings, 11 shallow sub-surface soil borings, 8 test pits, and 27 surface soil locations. A total of 144 soil samples were collected from ranging depths for varying parameters. An additional 10 monitoring wells and 2 monitoring well couplets were installed as part of the Phase II investigation, and 17 monitoring wells were sampled in August and October 2002. In addition, a total of 33 soil samples were collected from the various soil stockpiles at the Site in the EZ. As part of the Phase IV investigation, 250 test pits were excavated at depths ranging 3 feet to 15 feet below ground surface (bgs). A total of 592 soil samples were field screened for RCRA metals using a calibrated XRF and for total ionizable VOCs using a PID. Approximately 10% of the samples were also submitted to a certified laboratory for RCRA metals analysis.

In all Site investigations, the borings/groundwater monitoring wells were installed either in areas of concern based on historical use information, where limited information had been collected, in areas where elevated concentrations of contaminants had been identified during previous studies, or at locations selected to verify previous sampling results. The locations were selected to further define the nature and extent of contamination present at the Site. Field duplicates and trip blanks were collected during the Phase II and Supplemental Phase II investigations. All environmental samples were properly preserved and kept in a cooler with ice after collection, and were transported to the laboratory under a chain-of-custody.

2.3.1.4 Temporal Data

Groundwater samples were collected at the Site in December 2001, August 2002 and October 2002. Very minimal groundwater impacts were observed in any of the on-site monitoring wells and, therefore, no temporal data are considered necessary to evaluate groundwater quality at the Site.

2.3.1.5 Field Completeness

A large number of soil samples and a significant number of groundwater samples have been collected at the Site. All the samples were collected from environmental media that are representative of identified routes of exposure to identified human and environmental receptors consistent with the conceptual site model, as discussed above.

All environmental sample locations were within or were used to determine the disposal site boundary, and all samples were collected utilizing methods/procedures that prevented cross-contamination between samples and were consistent with the requirements of the analytical method to be performed. Therefore, all field quality control elements ensured that the quality of the samples were intact. In addition, all soil and groundwater samples were analyzed by MassDEP Methods or MCP Analytical Methods that are detailed in the MassDEP's CAM, and that provided information that allowed for the assessment of the accuracy, precision, and sensitivity of the data. The soil and groundwater samples and sample locations are felt to adequately characterize the spatial and temporal distribution of oil and/or hazardous materials at the exposure points on the Site. Analytical results of the soil and groundwater sampling indicated detectable concentrations of metals, petroleum hydrocarbons and target PAHs in soil, with the highest concentrations generally within the shallow fill at the Site. Metals, petroleum hydrocarbons, PAHs and PCBs were present in the stockpiles at the Site. These data are considered to be acceptable to eventually support an RAO.

2.3.1.6 Data Inconsistency

With the exception of the poor correlation between the laboratory soil arsenic, chromium, and mercury data and the XRF data for arsenic, chromium, and mercury, no inconsistent data were identified. Visual observations, odors and field screening were generally well correlated. With the exception of the arsenic XRF data, the data collected are considered to adequately characterize the Site and no sources of uncertainty are considered to exist that would affect the conclusions reached in this report.

2.3.1.7 Data Not Used

As discussed above, the XRF arsenic data tends to overestimate the actual soil arsenic concentrations via laboratory analysis. Therefore, these data were not included in the Revised Phase II RC.

Based on the above considerations, the data collected is considered representative of Site conditions.

2.3.2 Data Usability Assessment

A Data Usability Assessment has an analytical and a field component. An Analytical Data Usability Assessment is used to evaluate whether analytical data points are scientifically valid and defensible, and of a sufficient level of precision, accuracy, and sensitivity to support an RAO. The Analytical Data Usability Assessment evaluates whether the analysis of "What's in the Jar" has yielded a valid result.

Analytical Data Usability Assessment means a systematic evaluation of the uncertainty associated with **analytical data points** in terms of their accuracy and precision conducted pursuant to 310 CMR 40.1056(2)(k). It determines whether an individual analytical data point is indicative of the location sampled and establishes or qualifies to what extent the analytical data for that sampling point meets applicable **Data Quality Objectives,** and are suitable to support the RAO and a **Representativeness**

Evaluation pursuant to 310 CMR 40.1056(2)(k). The Data Usability Guidance document states that the rigorousness of this Analytical Data Usability Assessment should be proportional to the complexity of the project and the ramifications associated with an incorrect decision.

Field Data Usability Assessment means an evaluation of the sampling procedure (e.g., sampling method, preservation, and hold times) and, as appropriate, field quality control elements to ensure the quality of the sample and to identify any issues of concern that may limit or qualify the use of the data.

A review of the quality and usability of the laboratory data from the Supplemental Phase II activities was conducted by Earth Tech. The laboratory data from the Phase II and Phase IV investigations was previously performed within those respective reports. The information reviewed by Earth Tech included:

- Sampling Method
- Sample Containers and Preservation
- Collection and analysis dates (Hold Time)
- Chain of Custody documentation
- Individual sample results
- Results of surrogate spikes, percent recovery, and control limits

All samples were collected utilizing methods/procedures that prevented cross-contamination between samples and were consistent with the requirements of the analytical method to be performed. Therefore, all field quality control elements ensured that the quality of the samples were intact. The soil laboratory analytical data are summarized in Table 1 and Table 2.

The issues and limitations noted with the laboratory data based on Earth Tech's evaluations are summarized in Table 3. Except as noted on Table 3, Con-Test reported that analyses met applicable quality control and quality assurance requirements. Although Presumptive Certainty was not obtained for all data as described in the CAM, no data usability issues were identified that would limit the usability of the data. The primary issues that prevented the laboratory from concluding that Presumptive Certainty status was obtained for the data included the following: 1) at Earth Tech's request, only select metals were reported (arsenic and lead); and, 2) certain field or laboratory control samples had specific analyte recoveries or reproducibility or precision parameters outside the control limits. However, these issues did not affect the overall quality of the data. In addition, all soil and groundwater samples were analyzed by MCP Analytical Methods that are detailed in the MassDEP's Compendium of Analytical Methods (CAM), and that provided information that allowed for the assessment of the accuracy, precision, reproducibility, and sensitivity of the data. None of the Organic Criteria for Rejection of Data or Inorganic Criteria for Rejection of Data presented in the Data Usability Guidance document were met. Based on these considerations, these data are considered to be of sufficient quality for this Supplemental Phase II report. Therefore, pursuant to 310 CMR 40.1056(2)(k), the validity and defensibility of the analytical data with respect to accuracy, precision, reproducibility and completeness have been satisfied.

2.4 Nature and Extent of Contamination

Numerous soil samples were collected from the Site during previous studies conducted at the Site by other consultants. As part of the Phase II investigation from July 22, 2002, through August 16, 2002, a total of 144 soil samples were collected from varying depths by Weston & Sampson. Weston & Sampson documented the advancement of 58 sub-surface soil borings, 11 shallow sub-surface soil borings, 8 test pits, and 27 surface soil locations. Groundwater samples were collected by Weston & Sampson in December 2001, August 2002, and October 2002. The groundwater samples were submitted for laboratory analysis for total dissolved metals and EPH/VPH with target VOCs/PAHs.

During the period from November 23 to December 13, 2005, LFR oversaw the excavation of 250 test pits at depths ranging 3 feet to 15 feet below ground surface (bgs) and the collection of additional soil sampling was performed by LFR as part of the Phase IV RIP. A total of 592 soil samples were field screened for RCRA metals using a calibrated XRF and for total ionizable VOCs using a PID. LFR also submitted 10% of the samples to a certified laboratory for RCRA metals analysis.

In addition to the above investigations performed at the Site by other consultants, as part of the Supplemental Phase II investigations Earth Tech collected 100 soil samples from test pit excavations to evaluate the validity of the LFR data collected in the UCL areas in the Main Yard of the rail yard during the period from June 20 to June 23, 2008. Samples were screened in the field using an XRF meter calibrated for lead and arsenic and approximately 10% of the samples (a total of 12 samples) were submitted for confirmatory laboratory analysis of total lead, TCLP lead, total arsenic, and EPH with target PAHs. The nature and extent discussion will draw upon the information gathered during the Phase II, Phase IV and Supplemental Phase II investigations efforts.

2.5 Soil Categories

The classification of soils at the Site was presented in Section 1.3.5.2. For current use, the applicable soil category for the Site is S-2. As discussed in Section 1.3.5.1, the GW-3 groundwater category applies to the Site. Therefore, the Method 1 Soil Standards that are applicable are S-2/GW-3. It should be noted that an Activity and Use Limitation (AUL, a deed restriction) may be required at sites where the S-1 standards are not met in soil less than 15 feet below the ground surface, even if the S-2 and/or S-3 standards apply.

2.6 Soil Quality

Numerous soil samples were collected from the Site during previous studies conducted at the Property by other consultants and during Earth Tech's Supplemental Phase II investigation. These studies indicated that contaminants that may be associated with historical railroad activities and areas with an industrial history have been detected in Site soil. The predominant OHM detected included the metals arsenic and lead, and PAHs (EPH has also been observed in some areas but at concentrations below the Revised RBCs discussed further in Section 2.14.2.10). In addition, as discussed in the Phase IV RIP, lead is the primary OHM of concern at the Site (followed by arsenic), and can be used as an indicator compound such that if elevated levels of lead are observed, the other OHM of concern may also be elevated. As such, arsenic, lead, and PAHs were selected to evaluate the nature and extent of contamination at the Site. Soil data obtained via field XRF screening (lead, only) and via laboratory analysis were used in this evaluation. Other contaminants that were detected infrequently and/or at low concentrations (i.e., VPH or VOCs) are not believed to significantly contribute to the overall extent of contamination at the Site. Groundwater data indicate that Site contaminants have not impacted groundwater.

2.6.1 Comparison of Earth Tech Screening Results to LFR Screening Results

During the period from June 18, 2008 through June 19, 2008, Earth Tech collected 100 soil samples to evaluate the validity of the LFR data collected in the UCL areas in the EZ and Main Yard of the rail yard. These data were used to define the extent of the previously identified UCL areas to evaluate whether the UCL areas were over estimated based on the limited sampling data collected (e.g., one sample per fifty foot grid) and due to the poor correlation of XRF/lab data for arsenic obtained by LFR. Each sample interval (0.0-0.5 feet, 0.5-3.0 feet, and 3.0-6.0 feet) was visually inspected by Earth Tech's on-site environmental scientist and was screened in the field using an XRF. A total of 12 samples were submitted to Con-Test for laboratory analysis of total lead, TCLP lead, and total arsenic, and EPH. A summary of the Supplemental Phase II lead and arsenic XRF screening results and the laboratory analytical results is provided in Table 4.

A comparison of the XRF field screening and laboratory analytical data obtained by LFR and Earth Tech is provided in Table 5. The soil arsenic concentrations from laboratory analysis of samples collected by

LFR ranged from non-detect (<11.0 mg/kg) to 41.8 mg/kg, while those collected by Earth Tech ranged from 12.2 mg/kg to 61.6 mg/kg. The soil lead concentrations from laboratory analysis of samples collected by LFR ranged from 5.26 mg/kg) to 18.4 mg/kg, while those collected by Earth Tech ranged from 107 mg/kg to 27,500 mg/kg. Comparison of the LFR and Earth Tech laboratory analytical data indicates that the arsenic results differed by 19% to 65% and the lead results varied by 20% to 96%.

The soil lead concentrations by LFR's XRF screening ranged from 21.2 mg/kg to 40,089.6 mg/kg, with an average concentration of 3,985.6 mg/kg. The soil lead concentrations by Earth Tech's XRF screening ranged from 15 mg/kg to 80,330 mg/kg, with an average concentration of 4,989 mg/kg. The soil lead XRF field screening data collected by LFR and Earth Tech varied by 1% to 100%, with an average variation of 46%.

Although the above comparisons often indicate significant variability between the LFR and Earth Tech results, the non-homogeneity of the soil samples, normal/expected instrument variability, and the fact that LFR and Earth Tech samples were not actual duplicates but were rather separate discrete soil samples, may account for the majority of these differences between the two data sets. Therefore, the Earth Tech and LFR data are both considered valid. As discussed previously in Section 2.4.1.2, LFR reported a coefficient of determination (R^2) of 0.92 for lead XRF results and a R^2 of 0.33 for arsenic XRF results. Earth Tech obtained an R^2 of 0.87 for lead XRF results and a R^2 of 0.42 for arsenic XRF results. As such, it is felt that LFR's and Earth Tech's arsenic XRF results cannot be relied upon for evaluating soil arsenic concentrations at the Site.

2.6.2 Soil Analytical Results

2.6.2.1 Previous Investigations

From July 22, 2002, through August 16, 2002, Weston & Sampson documented the advancement of 58 sub-surface soil borings, 11 shallow sub-surface soil borings, 8 test pits, and 27 surface soil locations during the Phase II investigation. A total of 144 soil samples were collected from ranging depths for varying parameters. The analytical data was included in Appendix H of the Phase II CSA (see Weston & Sampson, January 2003). The results from the Phase II soil sampling are summarized below

Potential Historical Source Areas

The historical source areas identified in the Phase II investigation consisted of the historical building locations (HB), east-west railroad centerline locations (CL/GP), perimeter clinker fill/coal ash locations (CF), railroad looping track locations (LT/SS), the drainage ditch locations (DD), and a potential UST location (SA/TP-7).

From July 24, 2002, through July 29, 2002, Weston & Sampson collected 16 subsurface soil samples, plus two field duplicate samples, from the historical building (HB/GP) locations. Samples were analyzed for EPH with target PAHs and MCP 13 metals. Elevated concentrations (i.e., above the MCP Method 1 S-1/GW-3 standards) of total lead were detected at three locations (HB/GP-15/S-1/1-3, HB/GP-16/S-1/1-3, and HB/GP-26/2-4) ranging from 350 to 590 milligrams per kilogram (mg/kg). One sample, HB/GP-24/2-4, indicated elevated concentrations of the EPH C_{19}-C_{36} aliphatics and C_{11}-C_{22} aromatics at 5,600 mg/kg and 1,190 mg/kg, respectively. Three samples (HB/GP-15/S-1/1-3, HB/GP-26/2-4, and HB/GP-46/4-8) indicated minor detected concentrations of PAHs ranging from 0.576 to 0.723 mg/kg.

From July 23, 2002, through July 29, 2002, Weston & Sampson collected 10 sub-surface soil samples, plus one field duplicate sample, from the centerline (CL/GP) locations. Samples were analyzed for EPH with target PAHs and MCP 13 Metals. According to the analytical results, total antimony and lead, as well as several EPH compounds, were detected at elevated concentrations at CL/GP-10/S-1/0-4, CL/GP-20/2-

4, CL/GP-21/2-4, and DUP-4. Arsenic was also detected above 30 mg/kg at DUP-4. Total lead results ranged from 680 to 3,800 mg/kg at CL/GP-20/2-4.

From July 24, 2002, through July 26, 2002, Weston & Sampson collected 12 sub-surface soil samples, plus one field duplicate sample, from the clinker fill (CF/GP) locations. Samples were analyzed for EPH with target analytes and MCP 13 Metals. According to the laboratory results, no samples from CF/GP locations were above the applicable MCP Method 1 standards.

On July 24 and 26, 2002, Weston & Sampson collected 20 surficial soil samples, plus two field duplicates, from the looping track (LT/SS) locations. Samples were analyzed for herbicides. No herbicides were detected in the LT/SS soil samples. See

On July 22 and 30, 2002, Weston & Sampson collected 4 shallow sub-surface soil samples, plus one field duplicate, from the drainage ditch (DD/HA) locations. Samples were analyzed for EPH with target analytes, VOCs, and MCP 13 Metals. According to the laboratory results, total antimony and lead, as well as benzo(b)fluoranthene, exceeded the applicable MCP Method 1 standard at location DD/HA-1 and DUP-3. Several other EPH compounds were detected above the applicable MCP Method 1 standard at location DD/HA-4/0-1.5. Total lead detected at location DD/HA/1 was 5,400 mg/kg.

Staging Area

The 5-acre Staging Area sampling consisted of soil borings and groundwater monitoring well borings to evaluate historical maintenance activities in this 5-acre area (i.e., samples SA/GP-17 through -19, -44, and SA/MW-105D) and borings to assess the fill material and historical detections of lead north of the staging area (samples SA/GP-39 through -42).

On July 24, 2002, and July 26, 2002, Weston & Sampson collected 20 sub-surface soil samples, plus two field duplicate samples, from the Staging Area (SA/GP) locations. Samples were analyzed for EPH with target analytes, MCP 13 Metals, and VPH with BTEX compounds. Samples SA/GP-17 through -19 (all depths) and SA/GP-44 (both depths) were also analyzed for PCBs. According to the analytical results, total antimony and lead exceeded the applicable MCP Method 1 standard in samples SA/GP-39/S-1/0-2, SA/GP-41/4-8, and SA/GP-42/S-2/4-8. Total arsenic was also slightly above the applicable MCP Method 1 standard in sample SA/GP-42/S-2/4-8 at 39 mg/kg. Sample SA/GP-44/S-3/9-11 exceeded the applicable standards for VPH C_9-C_{10} aromatics, and EPH C_9-C_{18} aliphatics and C_{11}-C_{22} aromatics. No PCBs were detected in any SA/GP soil samples.

On July 24, 2002, two sub-surface soil samples were obtained from boring SA/MW-105D (2-4 feet and 10-12 feet) and analyzed for EPH with target analytes, VOCs, and MCP 13 Metals. No compounds were detected above the applicable MCP Method 1 standard for these soil samples.

Exclusion Zone

Soil borings, groundwater monitoring well borings, shallow sub-surface borings, and test pits conducted inside the EZ during the Phase II investigation were as follows: the former burn pit area locations (EZ/GP-1 through -4, BP/HA-1 and -2, and EZ/TP-5 and -6); the utility trench locations (EZ/GP-5 through -8, and EZ/TP-4); and, soil stockpile locations (EZ/GP-9, EZ/MW-104D, and EZ/TP-1 through -3).

On July 22, 2002, July 23, 2002, and July 26, 2002, Weston & Sampson collected 19 sub-surface soil samples, plus one field duplicate, for all EZ/GP locations. The samples were analyzed for EPH with target analytes, VOCs, and MCP 13 Metals. EZ/GP-43/0-2 and 4-8 were not analyzed for VOCs. Total lead was detected in several EZ/GP soil samples above the applicable MCP Method 1 standard. Total antimony, along with several EPH compounds, were detected above the applicable MCP Method 1 standard in EZ/GP-6/S-2/4-8 feet and EZ/GP-43/0-2 feet.

On August 7, 2002, Weston & Sampson collected 9 sub-surface soil samples, plus one field duplicate, from four test pit locations (EZ/TP-1 through 4). The samples from EZ/TP-1 through -3 (all depths) were analyzed for EPH with target analytes and MCP 13 Metals. In addition, a sample from EX/TP-2 collected at a depth of 2 feet comprised of white fill material was analyzed for asbestos content and MCP 13 metals. Samples from EZ/TP-4 (both depths) were analyzed for EPH with target analytes and VPH with benzene, toluene, ethylbenzene and xylenes (BTEX). Analytical data for the test pit samples indicate that total lead was detected in several samples; the highest concentration (24,000 mg/kg) was detected at EZ/TP-2/2.5. Total antimony was detected in three samples (EZ/TP-2/2.5 feet, EZ/TP-3/2. feet, and EZ/TP-3/11.5), total arsenic in two samples (EZ/TP-2/2.5 and EZ/TP-3/2.5), and total zinc in one sample at 6,100 mg/kg (EZ/TP-2/2. feet). EPH fractions were detected in EZ/TP-4 at both depths. Asbestos was not detected in the white fill material sample collected from EZ/TP-2.

On August 16, 2002, Weston & Sampson collected four shallow sub-surface soil samples from two locations within the suspected former burn pit. The samples were analyzed for EPH with target analytes, VOCs, and MCP 13 Metals. According to the laboratory results, benzo(b)fluoranthene was detected above the applicable MCP Method 1 standard (0.7 mg/kg) in BP/HA-2/0-1 feet. No other compounds were detected above applicable MCP Method 1 standards in the BP/HA soil samples.

On July 22, 2002, two sub-surface soil samples from EZ/MW-104D (10-12 feet and 14-16 feet) and one field duplicate were collected for analysis for EPH with target PAHs, VOCs, and MCP 13 Metals analysis. According to the analytical results, total antimony (190 mg/kg), arsenic (42 mg/kg), lead (10,000 mg/kg), and zinc (7,600 mg/kg), as well as benzo(a)pyrene (7.16 mg/kg), were detected in EZ/MW-104D/10-12 feet above the applicable MCP Method 1 standard. No compounds were detected above applicable MCP Method 1 standards in EZ/MW-104D/14-16 feet.

Orphan Line

On July 30, 2002, Weston & Sampson collected 10 shallow sub-surface soil samples from five locations along the Dedham Secondary/Orphan Line (OL/SS). The samples were analyzed for EPH with target analytes, VOCs, and MCP 13 Metals. According to the laboratory results, no total metals were detected in the OL/SS samples above the applicable MCP Method 1 standard. Several EPH compounds were detected in six soil samples, with the maximum concentration of benzo(a)anthracene (6.12mg/kg) at OL/SS-2/0-1.

Perimeter Monitoring Wells

From July 23 through 25, 2002, Weston & Sampson collected six sub-surface soil samples, plus three field duplicates, from groundwater monitoring well borings around the west and north Site perimeter (P/MW-106 through 111). Samples were analyzed for EPH with target analytes and MCP 13 Metals. No compounds were detected above the applicable MCP Method 1 standard.

2.6.2.2 Supplemental Phase II Investigation

During the period from June 18, 2008 through June 19, 2008, Earth Tech collected 100 soil samples to evaluate the validity of the LFR data collected in the UCL areas in the EZ and Main Yard of the rail yard. A total of 12 samples were submitted to Con-Test for laboratory analysis of total lead, TCLP lead, and total arsenic, and EPH. These included Cell 410 (3-6 feet), Cell 637 (3-6 feet), Cell 639 (0-0.5 feet and 0.5-3 feet), Cell 692 (0.5-3 feet), Cell 694 (0.5-3 feet), Cell 742 (0.5-3 feet), Cell 906 (0-0.5 feet), Cell 1016 (0-0.5 feet), Cell 1020 (0.5-3 feet), Cell 1076 (3-6 feet) and Cell 1130 (0-0.5 feet).

Laboratory analytical data for these samples indicated elevated concentrations of lead and arsenic in soil samples Cell 637 3-6 feet (arsenic only), Cell 639 0-0.5 and 0.5-3 feet, Cell 692 0.5-3 feet, Cell 694 0.5-3 feet, and Cell 906 0-0.5 feet (lead only) above the MCP Method 1 S-1/GW-3 standards. Cell 639 0-0.5

feet also had elevated levels of EPH C_{19}-C_{36} aliphatics and C_{11}-C_{22} aromatics. Cell 639 0.5-3 also had elevated levels of a few PAHs but the detected concentrations were below the Central Artery/Tunnel Project (CA/T) 95th percentile concentrations. The soil lead concentrations in Cell 639 0-0.5 feet and 0.5-3 feet, Cell 692 0.5-3 feet, Cell 694 0.5-3 feet, and Cell 906 0-0.5 feet also exceeded the UCL of 3,000 mg/kg. These results are summarized in Table 4.

2.6.3 Extent of Soil Contamination

A summary of collected soil samples and conclusions regarding extent of contamination and potential sources as presented in the Phase II report is provided below. A summary of soil sample data was provided in Tables 5 through 16 of the Phase II report (see Weston & Sampson, January 2003).

Site Location	Sample ID/ Rationale	Results
Potential Historical Source Areas	**HB/GP**. Two samples from each geoprobe boring (most impacted and first native) to evaluate historical impacts at former Site buildings.	Lead was detected above 300 mg/kg at three locations and EPH was detected above 1,000 mg/kg at one location, indicating historical buildings are not associated with significant impact except near the staging area.
	CL/GP. Two samples from each of four geoprobe borings (most impacted and first native) to evaluate the extent of fill along an east-west centerline.	The fill unit, including a shallow fill comprised of brown to black coarse sand, asphalt, glass, coal, brick, and wood and a native fill comprised of reworked sand and gravel, ranged in thickness from 6 to 12 feet below grade, and generally did not intersect the water table.
	CF/GP. One sample at each of 12 geoprobe borings (first native) to evaluate the extent of clinker/coal ash fill just south of the Orphan Line.	No impact to underlying soil from piles of clinker/coal ash.
	LT/SS. One surficial soil sample from 20 locations to evaluate historical use of herbicides along the railroad tracks looping the Site.	No detected concentrations of herbicides.
	DD/HA. One shallow hand-augered soil sample from four locations to evaluate impacts to drainage collection areas.	Elevated concentrations of metals (antimony and lead) detected in westernmost sample indicating potential migration from EZ and staging area via storm-water runoff. elevated concentrations of PAHs; up to 2.09 mg/kg in easternmost drainage ditch sample.
Staging Area	**SA/GP**. Two soil samples from each geoprobe boring to evaluate historical high detections of lead and petroleum compounds, white-colored fill material, and potential impacts from maintenance activities at the building historically located on the concrete slab currently used for the staging area.	Elevated concentrations of metals observed in borings located immediately to north of staging area; concentrations decreased to below S-1 standards with depth. Evidence of historic petroleum impact to east of staging area (GP-44), but vertical and horizontal extent appeared limited. Groundwater samples indicate no detected concentrations above applicable
	SA/MW. Two samples from a monitoring well borehole to assess impacted soil above	

Site Location	Sample ID/ Rationale	Results
	and at the water table.	standards.
	SA/TP. Two separate test pits to evaluate the possible presence of an underground storage tank and sources for petroleum contamination; confirmatory samples as needed.	No evidence of UST observed; however, buried metal debris including sheets of metal of various sizes observed.
Western "Exclusion Zone" Area	**BP/HA**. Two samples from two hand-augered borings to evaluate historical evidence of a burn pit.	No evidence of a burn pit observed. Only one elevated concentration of PAHs detected: benzo(b)fluoranthene at 1.03 mg/kg.
	EZ/GP. Two samples from nine geoprobe borings to evaluate historic accounts of volatile soaked material, assess potential historical excavation and filling.	Surface and shallow soil impacted by metals but concentrations decrease with depth. No VOC impact observed. No evidence of significant excavation and filling with debris observed near soil piles.
	EZ/TP. Six test pits to assess references to volatile soaked material and whether the soil pile material extended below grade.	Test pits indicate high concentrations of metals (up to 24,000mg/kg lead) in soil up to 4 feet deep, but decrease with depth.
	EZ/MW. Two samples from a monitoring well borehole to assess impacted soil above and at the water table.	Elevated concentrations of metals and PAHs detected in sample from MW-104D, but decrease significantly at the water table.
Orphan Line	**OL/SS**. Five borings were hand-augered from the surface (0-1 feet) and shallow subsurface (2-3 feet) to assess the extent of Site contaminants indicated during DEP's IH evaluation.	Elevated concentrations of PAHs observed in surficial samples, decreased significantly in shallow subsurface samples. No significant concentrations of metals detected in soil.
Baseline Conditions	**BC(L)/SS**. Eight surficial soil samples to assess surface concentrations of Site contaminants in areas outside of potential source areas.	Elevated concentrations of metals (antimony, arsenic, and lead) and PAHs detected in soil, indicating potential Site-wide impact to surficial soil.
	SW/GP. Two geoprobe borings to assess subsurface concentrations of Site contaminants in areas outside of potential source areas.	No detected concentrations of contaminants in soil exceeded applicable MCP Method 1 standards.
Perimeter Monitoring Wells	**P/MW**. Two samples from six monitoring well boreholes to assess impacted soil above and at the water table.	No detected concentrations of Site contaminants in soil or groundwater exceeded applicable MCP Method 1 standards.

Weston & Sampson stated that elevated levels of arsenic were present primarily in the vicinity of the railroad tracks and chemically-treated railroad ties.

The horizontal and vertical extent of contamination at the Site was estimated by Earth Tech based on soil XRF data (lead only) and laboratory analytical data collected by the MassDEP, HMM, Rizzo and Weston & Sampson during previous Phase I, IRA, IH evaluation, Phase II and Phase IV activities, and the Supplemental Phase II Comprehensive Site Assessment activities performed by Earth Tech. It should be noted again that the arsenic XRF data were not included in this evaluation due to the poor correlation obtained with the XRF as compared to laboratory analysis. This evaluation focused on lead and arsenic since these are the primary OHM of concern. Additionally, LFR has stated that lead is the primary OHM of concern and can be used as the indicator compound where if the lead impacts are removed, the other OHM of concern are also removed.

Horizontal Extent of Impacts to Soil

The soil sampling locations demonstrating lead and/or arsenic concentrations above the CA/T 95th percentile background concentrations at depths of 0-0.5 feet, 0 to 3 feet, 3 to 8 feet and >8 feet below grade are presented in Figures 7 through 10, respectively. This comparison indicates that numerous detections of lead (and arsenic) were observed in surface soil (0 to 0.5 feet and 0 to 3 feet below grade) across the Site, with the majority of the elevated soil lead concentrations located in the western portion of the Site within the EZ and to the east of the EZ within the Main Rail Yard. Elevated levels of soil lead above the CA/T 95th percentile background concentration were also observed in several surface soil sample locations on the northern portion of the Site within Area 1. Elevated concentrations of arsenic were observed primarily in the upper 6 inches of soil within the EZ, with several locations with elevated arsenic located in the upper 6 inches of soil within the Main Rail Yard (and one location in Area 1). Concentrations of soil lead above background concentrations (and one arsenic exceedance) were also observed in soil located at 3 to 8 feet below grade in the EZ and to the immediate east of the EZ in the Main Rail Yard. An area of soil lead above background concentrations was observed in deep soil (>8 feet below grade) to the immediate east of the EZ in the central portion of the Main Rail Yard and in one sample location within the EZ. As discussed in the Phase II report, the only detection of PAHs above the CA/T 95th percentile background concentrations was in sample SA/GP-44 at 9 to 11 feet below grade located in the central portion of the Main Rail Yard.

Figures 11 through 14 present soil sampling locations with lead and/or arsenic above the respective UCLs. Numerous detections of lead above UCL concentrations were observed in surface soil (0 to 0.5 feet and 0 to 3 feet below grade) across the Site, with the large majority of the soil lead concentrations exceeding the UCL located in the western portion of the Site within the EZ and just to the east of the EZ. One shallow surface soil (0 to 0.5 feet) sample on the south-central portion of the Site (in the Main Rail Yard) also demonstrated a concentration of arsenic above the UCL. Scattered soil lead UCL exceedances were also observed in the surface soil located on the central and eastern portion of the Site within the Main Rail Yard and at several locations on the northern portion of the Site within Area 1. Soil lead UCL exceedances were also observed in soil located at 3 to 8 feet below grade in the EZ and to the immediate east of the EZ in the Main Rail Yard. An area of deep soil (>8 feet below grade) with soil lead UCL exceedances is present to the immediate east of the EZ in the central portion of the Main Rail Yard. No soil arsenic UCL exceedances are present in soil deeper than 6 inches below grade.

As discussed in Section 2.14.2.10, revised RBCs have been developed for use at the Site. The soil sampling locations demonstrating lead and/or arsenic concentrations above the revised Industrial/Commercial RBCs at depths of 0-0.5 feet, 0 to 3 feet, 3 to 8 feet and >8 feet below grade are presented in Figures 15 through 18, respectively. This comparison indicates that numerous detections of lead (and arsenic) were observed in surface soil (0 to 0.5 feet and 0 to 3 feet below grade) across the Site, with the majority of the elevated soil lead concentrations located in the western portion of the Site within the EZ and just to the east of the EZ. Small areas of revised lead and arsenic revised Industrial/Commercial RBC exceedances were also observed in surface soil located on the central and eastern portion of the Main Rail Yard, with a few revised Industrial/Commercial RBC exceedances for soil lead within Area 1. Concentrations of soil lead above the revised Industrial/Commercial RBC were also observed in soil located at 3 to 8 feet below grade in the EZ and to the immediate east of the EZ in the Main Rail Yard. An area of soil lead above the revised Industrial/Commercial RBC was observed in deep soil (>8 feet below grade) to the immediate east of the EZ in the central portion of the Main Rail Yard.

Vertical Extent of Impacts to Soil

Figures 7 through 18 indicated that the elevated concentrations of soil lead (and arsenic) are located in the top 6-inches to 3-feet of soil. The soil lead and arsenic concentrations and areas of contamination decrease with depth, and only a small area of elevated soil lead is observed at a depth >8 feet below grade. No elevated soil arsenic was observed at depths greater than 0 to 3 feet below grade. Soil lead UCL exceedances are present to a maximum depth of 13.5 feet below grade. Based on the characteristics of the detected contaminants, the most significant vertical extent of impacts to soil is likely limited to the approximate lowest water table elevation that has occurred since the materials were released/deposited. Records are not available that would indicate this depth. Based on monitoring well gauging, field screening and observations, site geology/hydrogeology and analytical results, the vertical limit of significant soil impacts is estimated to approximately 20 to 25 feet below grade.

2.7 Groundwater Categories

Three groundwater categories (GW-1, GW-2, and/or GW-3) are identified in the MCP. Groundwater at all disposal Sites in Massachusetts is considered a potential source of discharge to surface water and is therefore categorized GW-3 at a minimum. Additional standards may also apply. Category GW-1 applies if the groundwater is located within a Current Drinking Water Source Area or Potential Drinking Water Source Area. The GW-2 classification applies within 30 feet of an existing occupied structure where the average annual depth to groundwater is 15 feet below grade or less.

As discussed previously in Section 1.3.5.1, the Site groundwater is not classified as GW-1 since it is not within a Current or Potential Public Drinking Water Source Area (see Weston & Sampson, January 2003). Groundwater is not considered to be GW-2 because although the groundwater is located at a depth of less than 15 feet from the ground surface (average depth of water at the Site is approximately 14.63 feet bgs), it is not located within 30 feet of an existing occupied structure. However, if foreseeable Site uses include construction of occupied structures, groundwater would be classified as GW-2. Category GW-3 applies because groundwater ultimately discharges to surface water.

2.8 Groundwater Quality

2.8.1 Groundwater Gauging

A groundwater contour map was generated by Weston & Sampson using groundwater-gauging data collected on September 18, 2002. Based on these elevation data, the groundwater generally flows outward from the Site in a radial pattern, with the eastern end and northwestern corner of the Site considered downgradient. The average depth of water at the Site is approximately 14.63 feet below grade.

2.8.2 Groundwater Analytical Results

Groundwater samples were collected as part of the Phase II investigation in December 2001, August 2002, and October 2002. The groundwater samples were submitted for analysis for total dissolved metals and EPH/VPH with target VOCs and PAHs. In addition, monitoring wells EZ/MW-104D and SA/MW-105D were also submitted for analysis of VOCs according to EPA Method 8260B, to evaluate potential impact from chlorinated solvents. The detected concentrations of metals included arsenic ranged from not detected at 5 μg/l to 8 μg/l. As discussed in the Phase II report, none of the detected analytes exceeded applicable MCP Method 1 standards during each of the sampling events.

2.8.3 Extent of Impacts to Groundwater

No further groundwater evaluations were undertaken as part of the Supplemental Phase II investigation. As discussed in the Phase II report, groundwater analytical data collected during December 2001, August 2002, and October 2002, indicated the following.

- No dissolved lead was detected, even in wells located near the soil stockpiles where TCLP lead was detected above 5 mg/L, and soil from MW-104D indicated total lead at 9,200 mg/kg at a depth of 10-12 feet below grade.
- No contaminant concentrations were detected above the most stringent MCP Method 1 GW-1 Standards, applicable for drinking water sources or the applicable MCP Method 1 GW-2 and GW-3 standards.
- All detected contaminant concentrations were at or near analytical method detection limits.

Hydrologic data collected during groundwater gauging events conducted concurrently with the Phase II groundwater sampling events indicated the following:

- The groundwater elevation contours indicate a radial flow extending out from the south central area of the Site, suggesting recharge from storm water sheet flow from the western area of the Site channeled to the drainage ditch.
- Vertical hydraulic gradients indicate that, in general, shallow groundwater recharges to the deeper overburden in the Staging Area near south-central area of the Site. However, at the soil pile area within the EZ, an upward gradient was calculated indicating the deeper overburden recharges to the shallow overburden.

2.9 Stockpiles

As part of the Phase II, a limited number of characterization samples were collected from the piles of soil located within the EZ area of the Site and analyzed for VOCs, SVOCs, PCBs, total metals, TPH, pesticides and herbicides, and RCRA waste characteristics including reactivity, ignitibility, and toxicity. A total of 33 soil samples were collected from the stockpiles, as shown on the figure within the Stockpile Characterization Report provided in Appendix E of the Phase II report (see Weston & Sampson, January 2003). During an IRA performed at the Site between 2002 and 2004, the soils from stockpiles represented by samples R-S8-C1, R-S8-C2, R-S8-C3, R-S8-C11, R-S10-C1 and R-S10-C2 were apparently removed and properly disposed since these soils had concentrations of lead above the UCL. As such, the stockpile discussions below do not consider these samples that are no longer on the Site.

During the period from June 30, 2008 to July 3, 2008, Earth Tech sampled the existing soil piles to gather the necessary data to estimate the quantity of soil that may exceed the revised lead UCL of 3,000 mg/kg. Up to thirty samples per 500 cubic yards of soil were collected for XRF screening in the field for lead and arsenic. One composite sample per 250 cubic yards (88 samples) was submitted for confirmatory laboratory analysis of total lead, TCLP lead, total arsenic, and EPH with target compounds. The soil stockpile XRF screening and laboratory analytical results are summarized in Table 4. Based on limited and selective sampling performed during the Phase II and Supplemental Phase II investigation, detected contaminant concentrations of select parameters included the following: arsenic (3.6 – 43.5 mg/kg), lead (54 - 12,000 mg/kg), TCLP lead (0.06 – 34.4 mg/l), TPH (120 - 2,000 mg/kg), EPH (C19-C36 aliphatics 31.2 - 293 mg/kg; C11-C22 aromatics 54.2 – 2,760 mg/kg), total PAHs (11 – 1,572 mg/kg), and total PCBs (0.03 – 24.2 mg/kg).

- Concentrations of total PAHs above 100 mg/kg were observed in soil samples collected from cells R-S1-C1, R-S8-C12, R-S15-C1, S07-B-1, S07-B-2, S-07-B-3, S-10-A-1, S16-D-1, and S20-D-3. At many of these locations, creosote timbers and/or burnt pieces of wood/railroad ties were observed.

- Weston & Sampson noted that concentrations of total lead detected above 2,500 mg/kg were detected in samples collected from or adjacent to cells where lead batteries, green “lead-acid” staining, and/or white talc-like fill material was observed.

- Weston & Sampson indicated that a white talc-like fill material was noted in stockpile samples R-S8-C3, R-S8-C4, and R-S8-C6, at depths ranging from 4 to 11.5 feet. The samples collected from cells including the white talc-like fill material indicated a high pH. Sample R-S8-C3B, which contained only the white talc-like material, indicated a pH of 12.9. The only documented use of lime at the Site was in February 1985 to neutralize a spill of 100-500 gallons of sulfuric acid.

- Samples collected from the white talc-like fill material, EZ/TP-2/2, was analyzed for asbestos. Asbestos was not detected in this sample. In addition, analytical data for stockpile cell sample R-S8-C3B, comprised of the white talc-like fill material, indicated a high conductivity (7,800 micromhos per centimeter); high pH (12.9); high moisture content (53% solids); minor concentrations of metals including barium, chromium and lead; and no detected concentrations of TPH, PCBs, SVOCs, VOCs, pesticides, or herbicides.

- In general, concentrations of soluble lead extracted using TCLP detected above 5 mg/l were observed in samples with concentrations of total lead which exceeded approximately 2,500 mg/kg and were often collected from or adjacent to cells where lead batteries, green “lead-acid” staining, and/or white talc-like fill material was observed. The only exception was sample S10-B-3, which had a total lead concentration of 710 mg/kg and a TCLP lead concentration of 31.8 mg/l.

- The highest detected concentration of PCBs was associated with a soil sample (R-S8-C8) collected from a cell with a large amount of miscellaneous debris.

2.10 Background Concentrations

On July 23 and 29, 2002, Weston & Sampson collected eight surface samples from eight baseline perimeter locations (BC/SS and BL/SS). Samples were analyzed for EPH with target analytes and MCP 13 Metals. Total metals were detected in several samples, with the maximum concentration of total lead (2,900 mg/kg) in BL/SS-5/0-6″. The target PAHs benzo(a)pyrene and dibenzo(a,h)anthracene were also detected above applicable MCP Method 1 standards with benzo(a)pyrene having a maximum concentration of 3.43 mg/kg in BC/SS-2/0-6 inches and dibenzo(a,h)anthracene having a maximum concentration of 1.42 mg/kg in BL/SS-7/0-6 inches. See Table 16 of the Phase II report for the analytical results (see Weston & Sampson, January 2003).

On July 23 and 24, 2002, Weston & Sampson collected two sub-surface soil samples from two soil boring locations along the southwest perimeter (SW/GP). Both samples were analyzed for EPH with target analytes and MCP 13 Metals. SW/GP-12/S-2/4-5 feet was also analyzed for VPH with BTEX compounds. No compounds were detected above the applicable MCP Method 1 standard for these soil samples. See Table 12 of the Phase II report for the analytical results (see Weston & Sampson, January 2003).

Potential sources of lead and arsenic contamination were identified in the Phase II report and included sandblasting of railcars during refurbishment and the potential application of herbicides. Potential sources of petroleum contaminants at the Site include historical railroad maintenance and railroad operation activities.

As stated in the Phase II characterization, target PAHs and metals are typically present in urban fill due to various anthropogenic sources (car exhaust, cigarette ashes, miscellaneous trash, etc.) and their presence often is not associated with any site release(s). To evaluate if PAHs and metals other than arsenic and lead at the Site are consistent with urban fill background concentrations, the Phase II RC compared the contaminant concentrations to the Massachusetts Highway Department, CA/T background urban fill data, the results of which were presented in a draft report entitled "Background Soil Contaminant Assessment" prepared by Camp Dresser and McKee (CDM) in April 1996. Several studies have been published regarding "background" concentrations of target PAHs and metals throughout Massachusetts and New England. This particular study was selected in the Phase II for comparison with Site data because the CA/T urban background data is based on over 800 samples collected from sites in Boston and, therefore, represents similar conditions to those found at the Readville 5 Yard Site, which is also partly located within the Boston city limits.

For all PAHs and metals (except arsenic and lead, which were retained as COCs), the Phase II RC compared the 95th percentile concentrations to the corresponding 95th percentile CA/T urban background concentrations. Statistical summary tables were provided in Appendix A of the Phase II RC and an overall Site-wide comparison to background was presented in Table 1 of the Phase II RC (see Weston & Sampson, January 2003). Two PAHs (2-methylnaphthalene and acenaphthylene) in Area 3 - Main Rail Yard slightly exceeded the CA/T background concentrations as follows:

Both PAHs were detected above the laboratory detection limits in only one sample (SA/GP-44) collected at 9 to 11 feet below grade. This sample also had elevated VPH concentrations and was identified as a "hot spot" to be evaluated separately (as discussed in the Phase II Method 3 RC). Except for this location, all other PAH concentrations in Area 3 (Main Rail Yard) and Area 4 (EZ) were at or well below urban background concentrations and were not evaluated as COCs in the RC. Most of the metal concentrations in Areas 3 and 4 exceeded the urban background concentrations and were therefore retained as COCs.

There are no published urban background concentrations for EPH parameters. EPH parameters were detected relatively frequently above the laboratory detection limits in Risk Areas 3 and 4, although at low concentrations in most locations except for HB/GP-24 (Area 3), which had a total EPH concentration of 6,851 mg/kg. Similar to SA/GP-44, this location was evaluated separately as a hot spot.

During the Supplemental Phase II investigation, Earth Tech collected 12 soil samples from 11 grid locations in Area 3 (6 samples, 5 locations) and Area 4 (6 samples, 6 locations), and 88 samples from the 15 stockpiles located in Area 4. All samples were submitted for laboratory analysis of total arsenic, total lead, TCLP lead and EPH with target PAHs. Based on comparison of the laboratory results to the corresponding 95th percentile CA/T urban background concentrations, the detected PAH concentrations are consistent with the corresponding 95th percentile CA/T urban background concentrations

2.11 Contaminants of Concern

As discussed in the Phase II RC, for purposes of the RC, the Site was divided into four separate potential exposure areas (Areas 1 through 4) based primarily on historical use and types and concentrations of contaminants. These areas were generally consistent with the areas identified by the MassDEP in the IH Evaluation dated January 7, 2002. The approximate boundaries of Areas 1 through 4 were shown on Figure 2 in the Phase II report (see Weston & Sampson, January 2003) and are described below.

- ***Area 1 – Orphan Line***: The Orphan Line was formerly the Dedham Secondary Line and consists of an approximately 90-foot wide by 3,200–foot long section of abandoned railroad tracks along the Site's northern boundary. Previous investigations indicated the presence of elevated arsenic and lead concentrations in surficial soil within this Area. For the IH Evaluation conducted by the MassDEP, Area 1 was divided into two exposure areas consisting of the fenced abandoned rail line and the unfenced 30-foot wide strip that lies south of the residential properties on West Milton Street. For the purposes of the risk assessment, both exposure areas were combined based on locations within the Site.

- ***Area 2 – Ashcroft Street Fence Line:*** Area 2 is a narrow strip of land located along the southwestern Site boundary between the EZ (Area 4) and a wooded area followed by residential properties on Ashcroft Street. Currently fenced, elevated lead and arsenic concentrations were also reported in surface soil within this area.
- ***Area 3 - Main Rail Yard:*** The Main Rail Yard is the largest exposure area evaluated for this Site. Consisting of approximately 21 acres, Area 3 contains both active and inactive tracks. Many of the sub-areas described in the Conceptual Site Model (CSM) and Field Investigation sections of the Phase II report are located within Area 3 as follows: Staging Area, Historical Source Areas, Loop Track, and Perimeter Monitoring Wells.
- The Main Rail Yard is currently used by MBTA and Amtrak for storage of railroad materials (ties, track panels, etc.), and has a long history of use as a former railroad maintenance and storage yard. One large building was formerly located within the Main Rail Yard, and the foundation of this structure still exists in some areas. Currently, the Main Rail Yard is completely fenced.
- ***Area 4 - Exclusion Zone:*** The EZ is located west of the Main Rail Yard and occupies most of the western portion of the Site. The Phase II report indicated that Area 4 has been reportedly used for stockpiling of soil and railroad associated materials and a potential burn pit (see Phase II Report). Elevated concentrations of lead, arsenic, PAHs and petroleum compounds have been detected in surface and subsurface soil. Like the Main Rail Yard, the EZ area is currently completely fenced.
- Area 4 currently contains approximately 15 soil stockpiles. Soil samples from the stockpiles collected during the Phase II and Supplemental Phase II investigations were analyzed for parameters to evaluate disposal and/or reuse options. With regard to the Phase II RC, the soil stockpiles were not included as part of Area 4 and were evaluated as a separate exposure point.

The Phase II report indicated that the following COCs were retained for the risk characterization:

Risk Area	Contaminant of Concern
Risk Area 1	Arsenic, cobalt, lead, EPH parameters
Risk Area 2	Arsenic and lead only
Risk Area 3	Antimony, arsenic, barium, chromium, cobalt, copper, nickel, lead, zinc, EPH parameters 2-methylnaphthalene and acenaphthylene
Risk Area 4	Antimony, arsenic, barium, chromium, cobalt, copper, lead, EPH parameters

With the exception of lead and arsenic, the most frequently detected COCs in Areas 3 and 4 were antimony, cobalt, and the EPH parameters.

Earth Tech performed a focused soil investigation as part of the Supplemental Phase II activities. Soil samples were screened for lead and arsenic using an XRF and select soil samples were submitted for laboratory analysis of total arsenic, total lead, TCLP lead and EPH with target PAHs. Based on the results of these investigations, no additional COCs were identified at the Site.

2.12 Contaminant Fate and Transport

The fate and transport processes potentially associated with each affected medium at the Site, as well as the persistence and migration characteristics for COCs at the Site, are presented in this section. The COCs for the MBTA Readville Site include metals, EPH, and certain PAHs. The environmental fate and transport characteristics of these COCs were discussed in Section 7 of the Phase II report.

2.13 Revised Risk Characterization

<u>Phase II Risk Characterization</u>

As part of the Phase II report, Weston & Sampson prepared a Method 3 RC in general accordance with 310 CMR 40.0000 of the MCP, to evaluate the potential risk to human health, safety, public welfare, and the environment posed by contaminants detected at the Site. The analytical data used in the Phase II RC included the results of the 2002 Phase II investigation and IH evaluations by the MassDEP in 2002 and Rizzo in 2000. The Phase II RC for this Site focused primarily on human health posed by contaminants in soil only. Based on the findings of the Phase II, contaminants were not considered to be present in groundwater and/or air at significant concentrations, and surface water and/or sediment are not present at the Site. Consequently, groundwater, air, surface water and sediment were not considered as potential exposure media in the Phase II risk assessment. The details of the RC were presented in Appendix J of the Phase II report (see Weston & Sampson, January 2003).

The objective of the Phase II risk assessment was two-fold: 1) to develop Site-wide RBCs for various current and potential future activities and receptors; and, 2) to evaluate whether existing Site conditions pose a condition of No Significant Risk for existing and proposed uses. The following four general categories of human-health receptors were evaluated for the Phase II RC to cover a wide range of potential Site uses and development options:

General Use Category	Potential Activities and Use
Recreational Use	Park, playground
Construction/Utility Worker	Site development, utility repairs
Commercial/Industrial Worker	Indoor and outdoor work activities
Residential Use	Single-family homes with gardens

The Phase II Method 3 RC involved comparison of EPCs in Areas 1 through 4 to the RBCs developed for the four general Site uses (recreational, construction, commercial/industrial, and residential). The EPCs for each of the COCS identified within each Area were then compared to the RBCs developed for each of the four general use scenarios/receptors. EPCs less than a derived RBC signified an "acceptable use"; conversely, EPCs greater than a derived RBC signified a use that "<u>was not</u> acceptable". Based on the results of this comparison, Weston & Sampson created four separate matrix tables summarizing "acceptable" Site uses by area based on combinations of various remedial/response actions. All of the remedial/response actions assume removal of the two hot spot areas (one in Area 3 and one in Area 4) under future acceptable use scenarios. The various remedial/response actions included: 1) no remediation and existing soil conditions; 2) remediation of surface soil (0 to 6 inches) only (assumes removal of the two hot spot areas in Areas 3 and 4); 3) remediation of subsurface soil (0 to 3 feet) only (assumes removal of the two hot spot areas in Areas 3 and 4); and, 4) no remediation with implementation of engineering (i.e., capping) and institutional controls (i.e., Activity and Use Limitation, or AUL) on the Property (assumes removal of the two hot spot areas in Areas 3 and 4)*.* Each of these scenarios required removal of hot spots (Area SS01 in Area 4 and SS22 in Area 3).

The results of the Phase II RC indicated that further response actions to eliminate exposure to surface (0 to 6 inches) and subsurface (0 to 3 feet) soils would be required to achieve a condition of No Significant Risk in all Areas under existing Site conditions for all potential Site uses except for the construction scenario. Acceptable use of the Site can be achieved under all receptor scenarios (recreational, commercial/industrial, construction, and residential) with hot spot removal, implementation of engineering controls (i.e., cap), and an AUL. On-site reuse of soil from the stockpiles was considered in the risk assessment. Based on the concentrations of contaminants detected and the type of contaminants detected, the Phase II RC concluded that the soil from the stockpiles may be suitable for reuse in the EZ.

As discussed previously, the MBTA responded to the MassDEP's comments concerning the Final Phase II Report in the form of a Phase II Addendum. The Phase II Addendum was attached as Appendix F to the Final Phase III Report submitted to the MassDEP on April 30, 2003. Based on the Phase II Addendum, the Phase II risk assessment results did not change.

The MBTA also responded to the MassDEP's comments concerning the Final Phase II Report in an October 28, 2003 report entitled "Response to DEP's September 17, 2003 Meeting Comments". This letter prepared by Weston & Sampson formalized the comments provided by the MassDEP in the September 17, 2003 meeting and provided additional clarification on certain items contained in the Phase II and Phase III reports. The MassDEP then responded to this October 28, 2003 letter in their Memorandum dated November 20, 2003. In general, the MassDEP indicated that, with respect to the Phase II risk assessment, the majority of issues had been resolved with the exception that additional soil sampling data from areas of the Site and the stockpiles should be included in the risk characterization or an argument should be made that the newer data does not affect the results of the risk characterization, remedial plan, or selected remedial actions. All additional data collected at the Site since the submittal of the Final Phase II Report have been included in this Supplemental Phase II report contained herein.

LFR's Updated RBCs

As part of the Phase IV RIP prepared by LFR, additional soil sampling was performed in anticipation of proposed residential use of the western portion of the Site. In addition to the soil investigation, LFR retained Gradient Corporation to review and update the RBCs for the Site using "updated exposure parameters and toxicity values". A comparison of the Weston & Sampson RBCs to LFR's revised RBCs was presented in Table 2 of the Phase IV RIP (see LFR, July 2006).

Risk Assessment Update

As requested by the MassDEP in their letter to the MBTA dated December 4, 2007, Earth Tech has prepared this Updated Risk Assessment in order to incorporate additional site data collected by LFR during the Phase IV RIP and by Earth Tech during this Supplemental Phase II investigation, and also to evaluate the site risks based on changes in toxicity information for the COCs.

This Revised Method 3 RC was completed in accordance with procedures and standards for the characterization of the risk of harm to health, safety, public welfare and the environment as presented in Subpart I, Section 310 CMR 40.0900 of the MCP, and is intended to meet the Response Action Performance Standard (RAPS) specified in Section 310 CMR 40.0191. This Revised Method 3 RC report presents an evaluation of current Site conditions. Potential risks are evaluated under current land use and reasonably foreseeable future land use conditions in the absence of further remediation. As required by the MCP, use of the Site for residential purposes with unrestricted access to impacted media was also considered in this RC to evaluate whether one or more AULs would be required to achieve a condition of No Significant Risk.

The following items are typically addressed within a Method 3 RC scope of work:

- Evaluation of site history, chemical, hydrologic, demographic and other information;
- Identification of potential human and environmental receptors;
- Identification and evaluation of potential human and environmental exposure pathways through a review of data collection activities, analytical protocols, current and surrounding land use, populations-at-risk and other related data;
- Characterization of completed exposure pathways by the evaluation of chemical release sources, fate and transport, exposure (contact) points and chemical intake routes;
- Quantification and summarization of estimated potential human chemical intakes, chemical-specific risk-based criteria and potential toxic effects;
- Characterization and discussion of potential chemical-specific carcinogenic and non-carcinogenic risks to humans and their respective uncertainties;
- Characterization and discussion of potential risks to safety;
- Characterization and discussion of potential risks to public welfare; and
- Characterization and discussion of potential environmental risks.

The purpose of this RC is to provide a Method 3 evaluation of soil and groundwater conditions on the Site. The results of this Characterization of Risk were utilized to establish whether a level of "No Significant Risk," as that term is defined in the MCP, exists at the Site. As discussed previously, soil UCL exceedances have been noted at the Site. As defined in 310 CMR 40.0996(3)(b), a level of No Significant Risk of harm to public welfare and the environment does not yet exist for future conditions if the concentration of an OHM exceeds an applicable UCL.

2.13.1 Current and Reasonably Foreseeable Site Activity and Use

The MBTA Readville 5-Yard property occupies an approximately 42-acre area located on Industrial Drive and straddles the boundary between the Town of Dedham and the City of Boston (Readville), Massachusetts. The Site is roughly an elongated teardrop shape and its perimeter is defined by a loop railroad track. The Site is enclosed by an 8-foot tall chain link fence, which restricts access to the Site. The MBTA property extends beyond the railroad track fencing. The Site is mostly unpaved, with the exception of a driveway approximately 100 feet wide and 1,700 feet long running east-west along the northern side of the Site.

The Site is abutted by residential properties to the north, east, and west, and by industrial properties to the south. Zoning in the area of the Site is industrial. Residential and commercial properties abut the Site to the west on Ashcroft Street and to the north opposite the former Dedham Secondary rail line (a.k.a. the “Orphan Line”) on Milton/W. Milton Street. Commercial and industrial properties, including a school bus garage and storage yard and a gravel crushing operation, are located to the south, opposite Industrial Avenue. The MBTA Readville commuter rail station, including commuter parking lots and the MBTA 2-Yard facility, is located to the east.

Materials used for railroad maintenance (ties, track panels, etc.) are currently stored in various areas on the Site. The western portion of the Property, designated as the EZ, was fenced off and posted with warning signs in October 2001 to restrict access to stockpiles containing soil and miscellaneous debris located within this area. Other significant Site features include a historical burn pit located in the EZ, a clinker fill area located between the northern loop tracks and the Orphan Line, historical site building remnants including the concrete building slab in the staging area, and a drainage ditch located along the approximate Site centerline. It is likely these uses will continue in the foreseeable future, and activities similar to those currently conducted at the Property can be reasonably expected to continue. Excavation of soil at the Site is not planned, but could occur in the future for the purpose of utility repair, or other construction. As a conservative measure, the potential for conversion of the Site to residential purposes is also considered by this RC.

2.13.2 Characterization of the Risk of Harm to Health

This Method 3 human health risk characterization for the Site was prepared in accordance with 310 CMR 40.0993. It relies on methodologies and guidance documents recommended by the MassDEP. Numerous conservative assumptions have been made throughout the human health risk characterization. This health risk characterization considers the current and potential future uses of the Site and current and potential future exposure pathways. As presented below, the Method 3 human health risk characterization demonstrates that a condition of No Significant Risk of harm to health ***does not*** exist at the Site based on the levels of OHM in soil.

2.13.2.1 Human Exposure Receptors/Pathways/Exposure Points

The purpose of an exposure assessment is to identify pathways through which humans can be exposed under current and potential future use scenarios. As outlined in the U.S. Environmental Protection Agency's (EPA) *Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A)* (EPA/540/1-89/002, December 1989), an exposure pathway generally consists of four elements:

- A source and mechanism of chemical release;
- A retention and transport medium (media);
- A point of potential human contact with the impacted media; and
- An exposure route at the contact point.

In order for an exposure pathway to be complete, all four of the above elements must be met. The source itself (e.g., soil containing chemicals) may be an exposure point, or an impacted media may be a contaminant source for other media (e.g., impacted soil could be a source for groundwater contamination).

The exposure assessment considers the current conditions at the Site and surrounding area in determining exposure scenarios and exposure concentrations. Additionally, future uses of the Site and surrounding area are also considered. This analysis assumes that the concentrations of chemical constituents in environmental media are stable and will not change significantly over time. This is a conservative assumption, as natural attenuation is expected to reduce contaminant concentrations with time.

The Site is currently vacant and is used by the MBTA, MBCR and/or AMTRAK for the storage of railroad-related construction materials. It is likely these uses will continue in the foreseeable future, and activities similar to those currently conducted at the Property can be reasonably expected to continue. The MBTA has identified the end use of the Site as commercial/industrial, as discussed at a meeting with the MassDEP in August 2003. As a conservative measure, this RC also considered the potential for conversion of the Site to residential uses. Therefore, direct contact with contaminated soil and consumption of homegrown fruits and vegetables by future child and adult residents was considered a potential future exposure pathway. Access to the Site by non-MBTA/MBCR/AMTRAK employees is currently restricted by the presence of an 8-foot high chain link fence that is locked. However, the fence significantly restricts but does not necessarily preclude access by potential trespassers, and the fence may be removed in the future. Therefore, direct contact with soil by site employees, and trespassers was considered a complete exposure pathway. Although it is expected to be used for commercial/industrial purposes in the future, direct contact with contaminated soil during recreational use (park or playground) of the Site was also considered a potential future exposure pathway

Direct contact of construction/utility workers to contaminated soils is considered to be a complete exposure pathway. Individuals conducting subsurface work at the Site) represent potential future human receptors to site soils. Future construction workers and current/future utility workers may come into direct contact with contaminated soil through incidental ingestion, dermal absorption, and inhalation of re-suspended soil. The average depth of water at the Site is approximately 14.63 feet below grade. Therefore, dermal contact by construction/utility workers with contaminated groundwater is unlikely to be a significant potential exposure pathway. In addition, due to the relatively low levels of groundwater contamination (which will decrease with time due to biodegradation), and the expected extremely limited exposure to groundwater by construction/utility workers (i.e., short-term exposures while installing a pump during dewatering activities), direct contact with groundwater was not considered a significant exposure pathway.

The nearest surface water body is Sprague Pond, located approximately 1,000 feet south/southeast of the Site. Based on the groundwater sampling results, no contaminants above applicable standards were detected. In addition, significant attenuation/dilution is expected as groundwater migrates toward a surface water body. As such, it is unlikely that OHM will be present in nearby surface water bodies at detectable concentrations. Therefore, the surface water (and sediment) pathway is considered incomplete.

As indicated in Figure 4 (GIS Data Layer Map), the Site is located approximately 500 feet east-southeast from a medium yield non-potential drinking water source area and designated ACEC. In addition, a designated open space, Iacono/Readville Playground, is located approximately 500 feet north northeast of the Site. A Zone II (defined as the area of an aquifer which contributes water to a well under the most severe pumping and recharge conditions that can be realistically anticipated) is located approximately ½-mile south of the Site. There are no designated drinking water resources, including Zone As, IWPAs, Sole Source Aquifers or Potential Drinking Water Source Areas, Threatened or Endangered Species Habitats, or Outstanding Resource Waters, within 500 feet of the Site.

The Town of Dedham’s municipal water supplier is the Dedham-Westwood Water District, which receives their water supply from 11 artesian wells, six of which are located in Westwood, and five of which are located in Dedham. The City of Boston receives its water supply through the MWRA, from the Quabbin Reservoir located in Belchertown, Massachusetts. Based on the above considerations, potable use of groundwater in the immediate vicinity of the Site is not expected currently or in the foreseeable future.

Although, the average annual depth to groundwater is approximately 15 feet bgs, no occupied structures are located on the Site. Therefore, potential migration of volatile contaminants from soil and/or groundwater to the indoor air was not considered a significant/complete exposure pathway. Since VOCs are not considered COCs for soil and groundwater, and due to the large atmospheric dilution factor, human exposure to vapors in ambient air is also not expected.

2.13.2.2 Soil and Groundwater Categories

As discussed in Section 1.3.5.1, the Method 1 Groundwater Standards applicable at the Site are GW-3, and the Method 1 Soil Standards that are applicable at the Site are S-2/GW-3 (refer to Section 1.3.5.2). It should be noted that an Activity and Use Limitation (AUL, a deed restriction) may be required at sites where the S-1 standards are not met in soil less than 15 feet below the ground surface, even if the S-2 and/or S-3 standards apply.

2.13.2.3 Summary of Potential Human Exposures

Based on the current and potential future site uses, potential human receptors and routes of exposure may include:

- Direct contact (incidental ingestion and dermal absorption) with soils by on-site workers and contractors (adults and teenagers).
- Utility workers and future construction workers conducting potential subsurface excavation activities (adults) via direct contact with soils and the inhalation of re-suspended soils.
- Direct contact with soils by site trespassers, including nearby residents and patrons of the nearby commercial establishments (teenagers).
- Direct contact with soils by future recreational users, if the Property is developed for use as a park or playground (adults, teenagers and children).
- Direct contact with soils and consumption of homegrown fruits and vegetables by future site residents, if the Property is developed for residential use (adults, teenagers and children).

2.13.2.4 Exposure Points /Exposure Point Concentrations

Groundwater

As discussed in Section 2.14.2.1, no complete groundwater exposure pathways were identified (i.e., no Exposure Points were identified).

Soils

As described in the MassDEP's *Guidance for Disposal Site Risk Characterization*, soil Exposure Points encompass only continuous areas of contaminated soil and do not include clean soil. Therefore, the boundary of an Exposure Point is no larger than the extent of contamination at the Site. The potential Exposure Point for contact with soils is the release area itself (i.e., the entire disposal site boundary). As specified in 310 CMR 40.0926, EPCs are typically calculated by averaging the contaminant concentration measured by each sample, using one-half the reporting limit for samples with non-detected values. The MCP [310 CMR 40.0926(3)(b)(1)] further states that arithmetic averaging for EPCs should only be done if: the arithmetic average is less than or equal to the applicable standard; seventy-five percent of the data points used in the averaging do not exceed the applicable standard; and, no data point used in the averaging is ten times greater than the applicable standard.

In order to provide a “revised” risk characterization for the Site, Earth Tech considered the same Exposure Points and Areas of concern as those described previously by Weston & Sampson in the Method 3 RC included in the original Phase II report. These Exposure Points included surface soils (0-6 inches), shallow subsurface soil (0-3 feet) and deep subsurface soil (>3 feet) in the following areas of concern at the Site, as appropriate:

- Area 1 (Orphan Line) (0-6 inches and 0-3 feet).
- Area 2 (Ashcroft Street Fence Line) (0-6 inches).
- Area 3 (Main Rail Yard) (0-6 inches, 0-3 feet, and > 3 feet).
- Area 4 (EZ) (0-6 inches, 0-3 feet, and > 3 feet).

The soil stockpiles were also evaluated as a separate Exposure Point, as in the previous Method 3 RC. As discussed in the Phase II report, composite samples R-S1-C1 and R-S15-C1 had total PAH concentrations of 276 and 349 mg/kg, respectively, and these samples also reportedly contained creosote-treated timbers, burnt railroad ties, and wood debris, all of which are potential sources of PAHs. In addition, sample S20-D4 collected by Earth Tech during the Supplemental Phase II investigation had total PAH concentrations of 1,572 mg/kg. As such all three of these samples were evaluated separately from the other soil stockpiles (similar to a hot spot evaluation).

As with the previous Method 3 RC for the Site, in addition to the Weston & Sampson Phase II data, the data sets used to calculate EPCs were based primarily on the soil results from the following studies listed below. It should be noted that as discussed in Section 2.4.1.2, poor correlation was observed between MassDEP's, LFR's and Earth Tech's XRF arsenic screening results and the arsenic soil concentrations by laboratory analysis. As such, the arsenic XRF results from the studies below were not included in this Risk Assessment Update provided herein.

Rizzo, October 2000, Imminent Hazard Evaluation:

- Surface soil samples (lead analysis by EPA Method 6010 ICP) in the EZ and Main Rail Yard Areas.

MassDEP, February 2002, Imminent Hazard Evaluation:

- Surface soil samples (lead by XRF) screening data in West Milton Street Fence Line, Ashcroft Street Fence Line, Main Rail Yard, EZ, and Orphan Line.

Weston & Sampson, April/May, 2002, IRA Investigation:

- Surface and shallow subsurface soil samples (lead and arsenic by EPA Method 6010 ICP) along West Milton Street Fence Line (MassDEP Zone 1).
- Surface soil samples (lead and arsenic by EPA Method 6010 ICP) along Ashcroft Street Fence Line (MassDEP Zone 2).

Weston & Sampson, June 2002, IRA Investigation:

- Post-excavation confirmatory side-wall and pit bottom soil samples (lead by EPA Method 6010 ICP) along West Milton Street Fence Line (MassDEP Zone 1).

EST, November 2002, Draft Soil Stockpile Characterization Sampling:

- Composite soil samples from stockpiles in the EZ.

In addition, Earth Tech also incorporated the soil investigation results from the following studies:

LFR, November and December 2005, Subsurface Investigation:

- Subsurface soil samples (lead by XRF, RCRA 8 metals by EPA Method 6010/7471) from 250 test pits within the western portion of the Site.

Earth Tech, June and July 2008, Supplemental Phase II Investigation:

- Surface, shallow subsurface and deep subsurface soil samples (lead by XRF, lead by EPA Method 6010 ICP, TCLP lead by EPA Method 1311/6010, EPH with target PAHs by MassDEP Methods) from direct-push test boring locations on the western portion of the Site to confirm the LFR 2005 results.
- Composite soil samples from stockpiles in the EZ (lead by XRF, lead by EPA Method 6010 ICP, TCLP lead by EPA Method 1311/6010, EPH with target PAHs by MassDEP Methods) to confirm the LFR 2005 results.

As specified in 310 CMR 40.0926, EPCs are typically calculated by averaging the contaminant concentration measured by each sample, using one-half the reporting limit for samples with non-detected values. The MCP [310 CMR 40.0926(3)(b)(1)] further states that arithmetic averaging for EPCs should only be done if: the arithmetic average is less than or equal to the applicable standard; seventy-five percent of the data points used in the averaging do not exceed the applicable standard; and, no data point used in the averaging is ten times greater than the applicable standard. Since these criteria are not met, in accordance with 310 CMR 40.0926(3)(c) "the use of the maximum concentrations or the 95th percentile upper confidence limit on the mean, whichever is lower, shall be used to estimate an Exposure Point concentration". The 95% UCL of the mean concentration was calculated as follows:

$$95\%\ UCL = m_x + \left(t * \frac{s_x}{\sqrt{n}}\right)$$

Where: m_x = average or arithmetic mean concentration
t = t-value from the Students t-distribution with n-1 degrees of freedom (significance level or α=0.05)
s_x = standard deviation
n = number of samples collected for analysis

In accordance with the MassDEP's *Guidance for Disposal Site Risk Characterization*, the mean concentration was calculated using a value of one-half the method detection limit as a proxy concentration when an OHM was not detected in a particular sample. If an OHM was not detected in any of the samples, a value of zero was assumed in place of the method detection limit (i.e., it was assumed the OHM was not present). When a duplicate analysis was available for a particular sample, the higher detected concentration was used in the EPC calculation. Laboratory data were used in place of XRF screening data, when available. If no analytes were detected in a particular sample, the sample was not used in the calculation of EPCs.

As discussed in the MassDEP's *Guidance for Disposal Site Risk Characterization-In Support of the Massachusetts Contingency Plan,* the MCP allows averaging of soils to develop EPCs, provided that "hot spot" concentrations are not inappropriately averaged with other soil data affected. The identification of a hot spot is based on consideration of both the concentrations and spatial pattern of contamination. Knowledge of a defined source area and site-specific observations and data may also help to define the extent of a hot spot.

In terms of magnitude, hot spots exist where the concentration of an OHM is 100 times greater than the concentration in the surrounding area, and may exist where the concentration is between 10 and 100 times that of the surrounding area. However, discrete areas where the concentration difference is greater than ten, but less than 100 are not hot spots if there is no evidence that the discrete area would be associated with greater exposure potential that the surrounding area.

As with the previous Method 3 RC presented in the Phase II report, the following locations were considered "hot spots" at the Site:

- Soil sample SA/GP-44 (9 to 11 feet) was considered to be a "VPH hot-spot" and was not averaged with data collected from other locations within the Main Rail Yard. In SA/GP-44, the concentration of total VPH (unadjusted) was 694 mg/kg, and consisted of 154 mg/kg (C_9-C_{10} aromatics) and 193 mg/kg (C_9-C_{12} aliphatics, adjusted), which was 10 to 100 times greater than the VPH concentrations detected in surrounding locations (SA/GP-18, SA/GP-46 and SA/TP-8). Other COCs at SA/GP-44 included the two EPH fractions and target PAHs 2-methylnaphthalene and acenaphthylene.

- Soil sample HB/GP-24 (2 to 4 feet) was considered an "EPH hot spot" and was not averaged with data collected from other locations within the Main Rail Yard. In HB/GP-24, the concentration of total unadjusted EPH was 6,851 mg/kg and consisted of 60.6 mg/kg (C_9-C_{18} aliphatics), 5,600 mg/kg (C_{19}-C_{36} aliphatics) and 1,190 mg/kg (C_{11}-C_{22} aliphatics), which was 10 to 100 times greater than the EPH concentrations detected in surrounding locations (HA/GP-40 and HA/GP-42).

- During the IH Evaluation in 2000, Rizzo identified two surface soil sample locations as "lead hot spots". Lead was detected at 20,000 mg/kg in surface soil sample SS01 (0-6") in the EZ (Area 4) and at 15,000 mg/kg in surface soil sample SS22 (0-6") in the Main Rail Yard (Area 3). Rizzo treated these two locations as separate exposure points in the IH Evaluation because lead concentrations in these areas were significantly higher than in other adjacent samples. Similarly, for the Phase II risk assessment the Rizzo surface soil samples SS01 and SS22 were evaluated separately as hot spots and were not averaged with other soil samples (0 to 6 inches) in calculating EPCs for lead in surface soil. However, the MassDEP XRF soil screening data indicated lead concentrations between 2,563 and 3,820 mg/kg near Rizzo SS22 (15,000 mg/kg) and lead concentrations of 1,263 mg/kg near Rizzo SS01 (20,000 mg/kg). The soil data sets used in estimating EPCs in surface soil were generally large (100+ samples) and exclusion of the two Rizzo samples SS01 and SS22 as separate exposure points was considered appropriate, in the Phase II RC for evaluation of lead in surface soil. For this revised Method 3 RC, SS01 was also considered a separate exposure point for evaluating surface soil lead (Lead Hot Spot 1). Further evaluation of surface soil sample SS22 revealed that this sample is located within a cluster of soil samples with elevated lead concentrations. As such, surface sample SS22 was considered part of a larger hot spot evaluated as part of this Revised Method 3 RC (refer to Lead Hot Spot 2, below).

As part of the Supplemental Phase II investigations, Earth Tech performed test pit activities in several areas identified in the Phase IV FIR to have elevated levels of lead or arsenic. An evaluation of these data indicated that the following locations are considered "hot spots" at the Site:

- In Area 3, elevated levels of lead were observed in Cell 637 at 0-0.5 feet (20,015 mg/kg via XRF) (10,000 mg/kg via Phase IV lab analysis), Cell 639 at 0-0.5 feet (37,900 mg/kg), Cell 692 at 0.5-2 feet (49,100 mg/kg), and 694 (0.5-3 feet) (27,500 mg/kg) at concentrations above the lead UCL of 3,000 mg/kg. In addition, elevated lead concentrations were observed in adjacent Cell 693 at 0.5-3 feet (6,518.4 mg/kg) during the Phase IV lead XRF screening. Rizzo's surface soil sample SS22 is located on the northern edge of Cell 639 (in the southern edge of Cell 695) and is also considered part of this hot spot. Therefore, the area of the Site located in the Main Rail Yard defined by these sample locations was considered a separate exposure point (Lead Hot Spot 2) in this Revised Method 3 RC.

- In Area 4, an elevated concentration of lead was present in Cell 906 at 0-0.5 feet (9,520 mg/kg) above the lead UCL of 3,000 mg/kg. Lead concentrations in surrounding cells were well below the lead UCL and revised RBC. As such, this location in Area 4 was considered a separate exposure point (Lead Hot Spot 3) in this Revised Method 3 RC.

The soil EPCs for each of the hot spots discussed above, and the soil stockpile hot spots, were assumed to be the maximum detected concentration of each COC due to the small number of samples collected in each hot spot (i.e., often only one sample) and/or the small areas encompassed by each hot spot.

The soil EPC calculations are presented in Appendix C.

2.13.2.5 Quantification of Human Exposure

Six (6) potential receptors/scenarios were identified at the Site:

- Future on-site resident.
- Site workers and contractors.
- Nearby resident that may trespass on the Site.
- Future recreational user.
- Future construction worker involved in heavy construction at the Site for 6 months.
- Utility worker involved in subsurface work for 1 day.

The exposure pathways identified included:

- Incidental ingestion of soil.
- Dermal contact with soil.
- Consumption of homegrown fruits and vegetables (future resident).
- Inhalation (and ingestion) of re-suspended soil (construction/utility workers).

Potential exposures to trespassers, future park visitors, future construction workers and future on-site residents, and resultant health risks, were estimated using the MassDEP's *ShortForms for Human Health Risk Assessment under the MCP, version 4-076, April 28, 2006, revised February 1, 2007.* It should be noted that this risk assessment did not quantitatively evaluate potential exposures and resultant health risks to site soils by potential site commercial/industrial workers since the MassDEP has not developed a ShortForm for this receptor/exposure scenario. However, due to the conservative exposure assumptions and receptors used by the MassDEP in the *Short Form for Human Health Risk Assessment under the MCP, April 28, 2006, revised February 1, 2007*, it is expected that the residential exposure scenario provided a worst-case evaluation of potential human exposures and resultant health risks from chronic exposures at the Site. Likewise, the future construction worker ShortForm is expected to provide a worst-case evaluation from subchronic exposures at the Site. The MassDEP's *Guidance on Implementing Activity and Use Limitations, May 1999*, states that when evaluating emergency utility repair work it is appropriate to consider only those contaminants that may pose an acute or short-term risk through dermal contact and incidental ingestion (i.e., cyanide) and potential acute dermal reactions associated with exposure to specific metals (e.g., hexavalent chromium and nickel). In addition, the MassDEP has stated in the *Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan* document the following. "Of all the chemicals commonly detected at disposal sites, cyanide is the only one which could pose a significant health risk from a one-time exposure to concentrations that are often found in the environment. Although acute exposures to some other hazardous materials could pose a health risk at some level, the concentrations at which acute exposures are of concern are much higher than levels typically found in the environment." The OHM of concern at this site are metals, petroleum hydrocarbons and certain target PAHs, and does not include cyanide. Based on these considerations, the residential exposure scenario evaluated in this Revised Method 3 RC is considered to provide a worst-case evaluation of potential human exposures and resultant health risks at the Site.

It should be noted that the MassDEP's Risk Assessment ShortForms do not include the COCs cobalt and copper, which are considered COCs for Areas 1, 3 and 4. However, since the maximum detected concentrations of cobalt and copper in Area 1 (5.1 mg/kg and 69 mg/kg, respectively), Area 3 (12 mg/kg and 3,800 mg/kg, respectively) and Area 4 (10.0 mg/kg and 2,300 mg/kg, respectively) are well below the respective site-specific RBCs of 26,326 mg/kg and 42,690 mg/kg for residential use as revised by Gradient in LFR's Phase IV RIP, omission of these COCs is not expected to affect the conclusions of this Revised Method 3 RC.

2.13.2.6 Dose-Response Assessment

Dose-response information describes the health effects observed in humans or animals associated with particular doses of a chemical. Based on the observed effect and target organ identified, a numerical value is developed to estimate the magnitude of the health effect associated with a dose. Dose-response values are derived differently for non-carcinogenic and carcinogenic effects, as discussed below.

The toxicity information used by the MassDEP in the ShortForms were used in this Revised Method 3 RC. The primary sources of dose-response information for compounds detected at this Site were the EPA's on-line Integrated Risk Information System (IRIS) database, the EPA's Health Effects Assessment Summary Tables (HEAST) and MassDEP documents.

Threshold (Non-carcinogenic) Effects

For non-carcinogenic effects, there is believed to be a threshold level below which no adverse health effects will occur. Dose-response values for non-carcinogenic oral effects are referred to as Reference Doses (RfDs). For inhalation effects, these values are referred to as Reference Concentrations (RfCs). RfDs and RfCs represent EPA's provisional estimate (with uncertainty spanning perhaps an order of magnitude) of the threshold dose that will not pose risk of an adverse health effect to sensitive humans.

RfDs and RfCs are developed by applying uncertainty factors and modifying factors to the critical dose or concentration. This dose or concentration is usually either the Lowest-Observed-Adverse-Effect Level (LOAEL) or the No-Observed-Adverse-Effect Level (NOAEL) from toxicological studies, typically carried out on test animals.

Uncertainty factors are used to account for interspecies variability, variation in sensitivity within the human population, differences in the route of administration among tests, and other variables that may lend uncertainty to the extrapolation of test data to environmental settings.

Units for RfDs are milligrams per kilogram per day (mg/kg/day), representing a dose of chemical (in milligrams) per receptor body weight (in kilograms) per day. For inhalation exposures, the RfC value is expressed as a concentration in air in micrograms per cubic meter ($\mu g/m^3$) for continuous, 24 hour/day exposure.

Oral RfDs and inhalation RfCs for the soil COCs are incorporated into the MassDEP’s ShortForms.

Non-threshold (Carcinogenic) Effects

In accordance with MCP guidance, it has been assumed that for carcinogenic effects there is no threshold level; that is, every non-zero exposure to a carcinogen is believed to be associated with some increased incremental risk. Dose-response values derived for carcinogenic compounds are Cancer Slope Factors (CSFs). CSFs are calculated as the largest linear slope of the dose-response curve, which is generally extrapolated from the low-dose end of the curve. CSFs are expressed in $(mg/kg/day)^{-1}$, and assume that the received dose is averaged over a lifetime.

EPA's weight-of-evidence cancer classifications for each of the constituents of concern were compiled in the MassDEP ShortForms. These classifications indicate whether existing human and animal data are sufficient to confirm whether there is an association between exposure to the compound and the occurrence of cancer. The COC arsenic has a weight-of-evidence classification of Group A (i.e., Human Carcinogen - sufficient evidence in epidemiological studies to support causal association between exposure and cancer in humans). Lead has a classification of Group B2 (i.e., Probable Human Carcinogen). No COC has been given a weight-of-evidence cancer classification of Group C (Possible Human Carcinogen - inadequate or lack of human data and limited evidence of carcinogenicity in animals). The remaining COCs have been given a classification of D (i.e., Not Classifiable - inadequate or no human and animal evidence of carcinogenicity) or a classification is not available.

Carcinogenic values for inhalation exposures, called unit risks, are calculated by dividing the slope factor by the body weight (70 kg) and multiplying by the air inhalation rate (20 m^3) for risk associated with unit concentration in air. Multiplication by 10^{-3} is necessary to convert mg (milligrams) to µg (micrograms).

Dose-response information for carcinogenic effects associated with the soil COCs are incorporated into the MassDEP's ShortForms.

Relative Absorption Factors

Relative absorption factors (RAFs) are used to account for the differences in absorption likely to occur between exposures under Site conditions and those that occurred under the experimental conditions that form the basis of the toxicity values. Absorption differences may result from matrix effects (e.g., doses absorbed from soil versus water) as well as from routes of administration (e.g., oral versus dermal exposure). RAFs adjust the calculated Site dose to make it comparable to the available toxicity information.

RAFs used in this risk assessment are incorporated into the MassDEP's ShortForms.

2.13.2.7 Health Risk Characterization

Risk characterization is the final step in the risk assessment process. The purpose of this section is to estimate and characterize the potential for non-cancer adverse toxic effects and potential cancer risks. Risks are characterized for specific exposure pathways and for exposed hypothetical reference populations and to exhibit maximum chemical sensitivities. Reasonable maximum exposures are defined for all exposure pathways. The noncarcinogenic and carcinogenic risks that were characterized were dependent upon numerous assumptions made throughout each stage of the risk assessment process. The presentation of these risks considered the attendant scientific uncertainties and limitations of the available data.

As discussed previously, potential trespasser, future recreational user (park visitor), future construction worker, and future residential exposures to soil at the Site were evaluated using the MassDEP's *ShortForm for Human Health Risk Assessment under the MCP, version 4-06, April 28, 2006, revised February 1, 2007.* This risk assessment did not quantitatively evaluate potential exposures and resultant health risks to site soils by potential site commercial/industrial workers since the MassDEP has not developed a ShortForm for this receptor/exposure scenario. However, due to the conservative exposure assumptions and receptors used by the MassDEP in the *Short Form for Human Health Risk Assessment under the MCP, April 28, 2006, revised February 1, 2007*, it is expected that the residential exposure scenario provided a worst-case evaluation of potential human exposures and resultant health risks from chronic exposures at the Site, and the future construction worker exposure scenario provided a worst-case evaluaion of potential subchronic adult human exposures and resultant health risks.

Non-Cancer Risk

The indicator used to describe the potential for non-carcinogenic health effects is the Hazard Index (HI). For a given chemical, the HI is the ratio of a receptor's exposure level (or dose) to the level of exposure considered to be safe. In this risk characterization, a safe level of exposure is represented by the RfD or RfC for each compound. An HI that does not exceed 1 indicates the receptor's exposure to that compound is without risk of adverse health effect.

$$\text{Hazard Index} = \text{ADD/RfD or}$$
$$\text{Hazard Index} = \text{ADE/RfC}$$

When the Hazard Indices for each of the compounds of concern at the Site are summed for each receptor, the result is a total Site Hazard Index. This total Site Hazard Index is referred to as a screening HI because it does not segregate different compounds of concern based on their mode of toxicological activity.

Thus, when used as an indicator of total Site non-carcinogenic risk, the screening HI is likely to overstate the actual level of non-carcinogenic risk. If the screening level HI is not greater than 1, this indicates there is no significant non-carcinogenic health risk associated with Site exposures. In this case, there is no need to refine the assessment by segregating constituent-specific HIs by critical effect.

Cancer Risk

The potential for carcinogenic health effects is estimated as the Incremental Excess Lifetime Cancer Risk (ELCR). The ELCR represents the incremental probability of an exposed individual developing cancer over a lifetime as a result of exposure. For each chemical, the ELCR is the product of the Lifetime Average Daily Dose (LADD) or Lifetime Average Daily Exposure (LADE) and that compound's carcinogenic potency. The indicator of carcinogenic potency used in this risk characterization is the EPA Cancer Slope Factor (CSF) or Unit Risk.

$$ELCR = LADD \times CSF \text{ or}$$
$$ELCR = LADE \times \text{Unit Risk}$$

As in the case of non-cancer risk, the ELCRs for each of the different compounds and pathways are summed to produce a receptor-specific cumulative ELCR. This cumulative ELCR is compared to the risk management criterion of 1×10^{-5} (one in one hundred thousand). A cumulative ELCR that does not exceed 1×10^{-5} indicates that no significant carcinogenic risk is present due to OHM at the Site. A cumulative ELCR greater than 1×10^{-5} indicates a potential for significant cancer risk is present as defined by the MCP.

The estimated HI and ELCR from exposure to COCs in soil in Area 1 (Orphan Line) at depths of 0 to 0.5 feet below grade and 0.5 to 3 feet below grade, respectively, by the potential trespasser, future recreational user (park visitor), future construction worker (also via inhalation), and future residential scenarios, respectively, from the MassDEP's *ShortForms* are presented in Appendix D as Tables D-1 through D-8. The potential noncarcinogenic hazards and cancer risk posed by exposure to COCs in soil in Area 2 (Ashcroft Street Fence Line) at depths of 0 to 0.5 feet below grade by the potential trespasser, future recreational user (park visitor), future construction worker (also via inhalation), and future residential scenarios, respectively, from the MassDEP's *ShortForms* are presented in Appendix D as Tables D-9 through D-12. The potential noncarcinogenic hazards and cancer risk posed by exposure to COCs in soil in Area 3 (Main Rail Yard) at depths of 0 to 0.5 feet below grade, 0.5 to 3 feet below grade and >3 feet below grade, respectively, by the potential trespasser, future recreational user (park visitor), future construction worker (also via inhalation), and future residential scenarios, respectively, from the MassDEP's *ShortForms* are presented in Appendix D as Tables D-13 through D-24. The potential noncarcinogenic hazards and cancer risk posed by exposure to COCs in soil in Area 4 (EZ) at depths of 0 to 0.5 feet below grade, 0.5 to 3 feet below grade and >3 feet below grade, respectively, by the potential trespasser, future recreational user (park visitor), future construction worker (also via inhalation), and future residential scenarios, respectively, from the MassDEP's *ShortForms* are presented in Appendix D as Tables D-25 through D-36.

The estimated HI and ELCR from exposure to COCs in soil in the VPH Hot Spot (sample SA/GP-44 9-ll feet), EPH Hot Spot (HB/GP-24 2-4 feet), Lead Hot Spot 1 (SS1 0-0.5), Lead Hot Spot 2 (HB/GP-24 0-0.5 feet), Lead Hot Spot 3 (Cell 637 0-0.5 feet and 0.5-3 feet, Cell 639 0-0.5 feet, Cell 692 0.5-2 feet, Cell 693 0.5-3 feet and Cell 694 0.5-3 feet) and Lead Hot Spot 4 (Cell 906 0-0.5 feet), respectively, by the potential trespasser, future recreational user (park visitor), future construction worker (also via inhalation), and future residential scenarios, respectively, from the MassDEP's *ShortForms* are presented in Appendix D Tables D-37 through D-40 (VPH Hot Spot), Tables D-41 through D-44 (EPH Hot Spot), Tables D-45 through D-48 (Lead Hot Spot 1), Tables D-49 through D-52 (Lead Hot Spot 2), Tables D-53 through D-60 (Lead Hot Spot 3) and Tables D-61 through D-64 (Lead Hot Spot 4).

Area 1 (Orphan Line)

The potential noncarcinogenic hazards and cancer risk posed by exposure to COCs in soil in Area 1 (Orphan Line) at depths of 0 to 0.5 feet below grade and 0.5-3 feet below grade by the potential trespasser, future recreational user (park visitor), future construction worker (also via inhalation), and future residential scenarios are summarized in Table 7. These values for the trespasser and future construction worker scenarios are below the MassDEP's target HI level of 1.0 indicating a condition of No Significant Risk exists for non-cancer effects to these receptors. However, the subchronic HIs for the future recreational and future resident scenarios are above the MassDEP's target HI level of 1.0 indicating a condition of No Significant Risk does not exist for non-cancer effects to these receptors. The MassDEP's *ShortForms* results presented in Appendix D as Tables D-1 through D-8 indicate that the potential noncarcinogenic health risk under the future recreational and future resident scenarios is primarily due to the presence of arsenic and lead in soil at depths of 0 to 0.5 feet and 0 to 3 feet below grade.

The potential Excess Lifetime Cancer Risk (ELCR) carcinogenic risk posed by exposure to COCs in soil in Area 1 (Orphan Line) at depths of 0 to 0.5 feet below grade and 0.5-3 feet below grade by the potential trespasser, future recreational user (park visitor), future construction worker (also via inhalation), and future residential scenarios are summarized in Table 7. The calculated ELCRs for the trespasser and future construction worker scenarios are below the MassDEP's target risk of 1×10^{-5} indicating a condition of No Significant Risk exists for cancer risks to these receptors. However, the calculated ELCRs for the future recreational and future resident scenarios are above the MassDEP's target risk level of 1×10^{-5} indicating a condition of No Significant Risk does not exist for cancer risks to these receptors. The MassDEP's *ShortForms* results presented in Appendix D as Tables D-1 through D-8 indicate that the potential carcinogenic risk under the future recreational and future resident scenarios is due to the presence of arsenic in soil at depths of 0 to 0.5 feet and 0 to 3 feet below grade.

Area 2 (Ashcroft Street Fence Line)

The potential noncarcinogenic hazards and cancer risk posed by exposure to COCs in soil in Area 2 (Ashcroft Street Fence Line) at a depth of 0 to 0.5 feet below grade by the potential trespasser, future recreational user (park visitor), future construction worker (also via inhalation), and future residential scenarios are summarized in Table 8. These values for the trespasser scenario are below the MassDEP's target HI level of 1.0 indicating a condition of No Significant Risk exists for non-cancer effects to this receptor. However, the subchronic HIs for the future recreational, future construction worker and future resident scenarios, and the chronic HI for the future resident, are above the MassDEP's target HI level of 1.0 indicating a condition of No Significant Risk does not exist for non-cancer effects to these receptors. The MassDEP's *ShortForms* results presented in Appendix D as Tables D-9 through D-12 indicate that the potential noncarcinogenic health risk under the future recreational, future construction worker and future resident scenarios is primarily due to the presence of arsenic (and lead for the park visitor and resident child exposures) in soil at a depth of 0 to 0.5 feet below grade.

The potential Excess Lifetime Cancer Risk (ELCR) carcinogenic risk posed by exposure to COCs in soil in Area 2 (Ashcroft Street Line) at a depth of 0 to 0.5 feet below grade by the potential trespasser, future recreational user (park visitor), future construction worker (also via inhalation), and future residential scenarios are summarized in Table 8. The calculated ELCRs for the trespasser and future construction worker scenarios are below the MassDEP's target risk of 1×10^{-5} indicating a condition of No Significant

Risk exists for cancer risks to these receptors. However, the calculated ELCRs for the future recreational and future resident scenarios are above the MassDEP's target risk level of 1 x 10^{-5} indicating a condition of No Significant Risk does not exist for cancer risks to these receptors. The MassDEP's *ShortForms* results presented in Appendix D as Tables D-9 through D-12 indicate that the potential carcinogenic risk under the future recreational and future resident scenarios is due to the presence of arsenic in soil at a depth of 0 to 0.5 feet below grade.

Area 3 (Main Rail Yard)

The potential noncarcinogenic hazards and cancer risk posed by exposure to COCs in soil in Area 3 (Main Rail Yard) at depths of 0 to 0.5 feet below grade, 0.5-3 feet below grade and >3 feet below grade by the potential trespasser, future recreational user (park visitor), future construction worker (also via inhalation), and future residential scenarios are summarized in Table 9. These values for the trespasser scenario are below the MassDEP's target HI level of 1.0 indicating a condition of No Significant Risk exists for non-cancer effects to this receptor. However, the subchronic and chronic HIs for the future recreational, future construction worker and future resident scenarios are above the MassDEP's target HI level of 1.0 indicating a condition of No Significant Risk does not exist for non-cancer effects to these receptors. The MassDEP's *ShortForms* results presented in Appendix D as Tables D-13 through D-24 indicate that the potential noncarcinogenic health risk under the future recreational, future construction worker and future resident scenarios is primarily due to the presence of arsenic and lead in soil at a depth of 0 to 0.5 feet below grade.

The potential Excess Lifetime Cancer Risk (ELCR) carcinogenic risk posed by exposure to COCs in soil in Area 3 (Main Rail Yard) at depths of 0 to 0.5 feet below grade, 0.5-3 feet below grade and >3 feet below grade by the potential trespasser, future recreational user (park visitor), future construction worker (also via inhalation), and future residential scenarios are summarized in Table 9. The calculated ELCRs for the trespasser and future construction worker scenarios are below the MassDEP's target risk of 1 x 10^{-5} indicating a condition of No Significant Risk exists for cancer risks to these receptors. However, the calculated ELCRs for the future recreational (soil 0-3 feet below grade, only) and future resident (soil at all depths) scenarios are above the MassDEP's target risk level of 1 x 10^{-5} indicating a condition of No Significant Risk does not exist for cancer risks to these receptors. The MassDEP's *ShortForms* results presented in Appendix D as Tables D-13 through D-24 indicate that the potential carcinogenic risk under the trespasser, future recreational, future construction worker and future resident scenarios is due to the presence of arsenic in soil at depths of 0 to 0.5 feet, 0 to 3 feet and > 3 feet below grade.

Area 4 (Exclusion Zone)

The potential noncarcinogenic hazards and cancer risk posed by exposure to COCs in soil in Area 4 (EZ) at depths of 0 to 0.5 feet below grade, 0.5-3 feet below grade and >3 feet below grade by the potential trespasser, future recreational user (park visitor), future construction worker (also via inhalation), and future residential scenarios are summarized in Table 10. These values for the trespasser scenarios are below the MassDEP's target HI level of 1.0 indicating a condition of No Significant Risk exists for non-cancer effects to this receptor. However, the subchronic and/or chronic HIs for the future recreational, future construction worker and future resident scenarios are above the MassDEP's target HI level of 1.0 indicating a condition of No Significant Risk does not exist for non-cancer effects to these receptors. The MassDEP's *ShortForms* results presented in Appendix D as Tables D-25 through D-36 indicate that the potential noncarcinogenic health risk under the trespasser, future recreational, future construction worker and future resident scenarios is primarily due to the presence of lead in soil at depths of 0 to 0.5 feet, 0 to 3 feet and > 3 feet below grade, and arsenic in surface soil (0-3 feet).

The potential Excess Lifetime Cancer Risk (ELCR) carcinogenic risk posed by exposure to COCs in soil in Area 4 (EZ) at depths of 0 to 0.5 feet below grade, 0.5-3 feet below grade and >3 feet below grade by the potential trespasser, future recreational user (park visitor), future construction worker (also via inhalation), and future residential scenarios are summarized in Table 10. The calculated ELCRs for the trespasser and future construction worker scenarios are below the MassDEP's target risk of 1 x 10^{-5} indicating a condition of No Significant Risk exists for cancer risks to these receptors. However, the calculated ELCRs for the future recreational (soil at 0 to 0.5 feet below grade, only) and future resident scenarios (soil at 0 to 3 feet below grade) are above the MassDEP's target risk level of 1 x 10^{-5} indicating a condition of No Significant Risk does not exist for cancer risks to these receptors. The MassDEP's *ShortForms* results presented in Appendix D as Tables D-25 through D-36 indicate that the potential carcinogenic risk under the future recreational and future resident scenarios is due to the presence of arsenic in soil at depths of 0 to 0.5 feet and 0 to 3 feet below grade.

VPH Hot Spot

The potential noncarcinogenic hazards and cancer risk posed by exposure to COCs in the VPH Hot Spot (sample SA/GP-44) at a depth of 9 to 11 feet below grade in Area 3 (Main Rail Yard) by the potential future trespasser, future recreational user (park visitor), future construction worker (also via inhalation), and future residential scenarios are summarized in Table 11. These values for all scenarios are below the MassDEP's target HI level of 1.0 indicating a condition of No Significant Risk exists for non-cancer effects to these future receptors. The MassDEP's *ShortForms* results are presented in Appendix D as Tables D-37 through D-40.

The potential Excess Lifetime Cancer Risk (ELCR) carcinogenic risk posed by exposure to COCs in soil in the VPH Hot Spot (sample SA/GP-44) at a depth of 9 to 11 feet below grade in Area 3 (Main Rail Yard) by the potential future trespasser, future recreational user (park visitor), future construction worker (also via inhalation), and future residential scenarios are summarized in Table 11. The MassDEP's *ShortForms* results presented in Appendix D as Tables D-37 through D-40 indicate that no carcinogenic chemicals were considered COCs for the VPH Hot Spot.

It should be noted that due to the depth of this soil (i.e., 9 to 11 feet below grade) there are no current exposures/scenarios and resultant health risks.

EPH Hot Spot

The potential noncarcinogenic hazards and cancer risk posed by exposure to COCs in the EPH Hot Spot (sample HB/GP-24) at a depth of 2 to 4 feet below grade in Area 3 (Main Rail Yard) by the potential trespasser, future recreational user (park visitor), future construction worker (also via inhalation), and future residential scenarios are summarized in Table 12. These values for all scenarios are below the MassDEP's target HI level of 1.0 indicating a condition of No Significant Risk exists for non-cancer effects to these receptors. The MassDEP's *ShortForms* results are presented in Appendix D as Tables D-41 through D-44.

The potential Excess Lifetime Cancer Risk (ELCR) carcinogenic risk posed by exposure to COCs in soil in he EPH Hot Spot (sample HB/GP-24) at a depth of 2 to 4 feet below grade in Area 3 (Main Rail Yard) by the potential trespasser, future recreational user (park visitor), future construction worker (also via inhalation), and future residential scenarios are summarized in Table 12. The MassDEP's *ShortForms* results presented in Appendix D as Tables D-41 through D-44 indicate that no carcinogenic chemicals were considered COCs for the VPH Hot Spot.

Lead Hot Spot 1

The potential noncarcinogenic hazards and cancer risk posed by exposure to COCs in Lead Hot Spot 1 (sample SS1) at a depth of 0 to 0.5 feet below grade in Area 4 (EZ) by the potential trespasser, future recreational user (park visitor), future construction worker (also via inhalation), and future residential scenarios are summarized in Table 13. The subchronic and chronic HIs for the trespasser, future recreational, future construction worker and future resident scenarios are above the MassDEP's target HI level of 1.0 indicating a condition of No Significant Risk does not exist for non-cancer effects to these receptors. The MassDEP's *ShortForms* results presented in Appendix D as Tables D-45 through D-48 indicate that the potential noncarcinogenic health risk under the trespasser, future recreational, future construction worker and future resident scenarios is due to the presence of lead in soil at a depth of 0 to 0.5 feet below grade.

The potential Excess Lifetime Cancer Risk (ELCR) carcinogenic risk posed by exposure to COCs in soil in the Lead Hot Spot 1 (sample SS1) at a depth of 0 to 0.5 feet below grade in Area 4 (EZ) by the potential trespasser, future recreational user (park visitor), future construction worker (also via inhalation), and future residential scenarios are summarized in Table 13. The MassDEP's *ShortForms* results presented in Appendix D as Tables D-45 through D-48 indicate that no carcinogenic chemicals were considered COCs for Lead Hot Spot 1.

Lead Hot Spot 2

The potential noncarcinogenic hazards and cancer risk posed by exposure to COCs in Lead Hot Spot 2 (Cell 637 0-0.5 feet and 0.5-3 feet, Cell 639 0-0.5 feet, SS22 0-0.5 feet, Cell 692 0.5-2 feet, Cell 693 0.5-3 feet and Cell 694 0.5-3 feet) in Area 3 (Main Rail Yard) by the potential trespasser, future recreational user (park visitor), future construction worker (also via inhalation), and future residential scenarios are summarized in Table 14. The subchronic and chronic HIs for the trespasser, future recreational, future construction worker and future resident scenarios are above the MassDEP's target HI level of 1.0 indicating a condition of No Significant Risk does not exist for non-cancer effects to these receptors. The MassDEP's *ShortForms* results presented in Appendix D as Tables D-49 through D-56 indicate that the potential noncarcinogenic health risk under the trespasser, future recreational, future construction worker and future resident scenarios is due to the presence of lead (and arsenic) in soil at a depth of 0 to 0.5 feet and 0 to 3 feet below grade.

The potential Excess Lifetime Cancer Risk (ELCR) carcinogenic risk posed by exposure to COCs in soil in Lead Hot Spot 2 (Cell 637 0-0.5 feet and 0.5-3 feet, Cell 639 0-0.5 feet, SS22 0-0.5 feet, Cell 692 0.5-2 feet, Cell 693 0.5-3 feet, Cell 694 0.5-3 feet) in Area 3 (Main Rail Yard) by the potential trespasser, future recreational user (park visitor), future construction worker (also via inhalation), and future residential scenarios are summarized in Table 14. The calculated ELCRs for the trespasser and future construction worker scenarios are below the MassDEP's target risk of 1×10^{-5} indicating a condition of No Significant Risk exists for cancer risks to these receptors. However, the calculated ELCRs for the future recreational and future resident scenarios are above the MassDEP's target risk level of 1×10^{-5} indicating a condition of No Significant Risk does not exist for cancer risks to these receptors. The MassDEP's *ShortForms* results presented in Appendix D as Tables D-49 through D-56 indicate that the potential carcinogenic risk under the future recreational and future resident scenarios is due to the presence of arsenic in soil at depths of 0 to 0.5 feet and 0 to 3 feet below grade.

Lead Hot Spot 3

The potential noncarcinogenic hazards and cancer risk posed by exposure to COCs in the Lead Hot Spot 3 (Cell 906) at a depth of 0 to 0.5 feet below grade in Area 4 (EZ) by the potential trespasser, future recreational user (park visitor), future construction worker (also via inhalation), and future residential scenarios are summarized in Table 15. The subchronic and chronic HIs for the trespasser (chronic, only) and future construction worker scenarios are below the MassDEP's target HI level of 1.0 indicating a condition of No Significant Risk exists for non-cancer effects to these receptors. However, the subchronic HI for the trespasser scenario and the subchronic and chronic HIs for the future recreational and future resident scenarios are above the MassDEP's target HI level of 1.0, indicating a condition of No Significant Risk does not exist for non-cancer effects to these receptors. The MassDEP's *ShortForms* results presented in Appendix D as Tables D-57 through D-60 indicate that the potential noncarcinogenic health risk under the trespasser, future recreational, future construction worker and future resident scenarios is due to the presence of lead (and arsenic) in soil at a depth of 0 to 0.5 feet below grade.

The potential Excess Lifetime Cancer Risk (ELCR) carcinogenic risk posed by exposure to COCs in soil in the Lead Hot Spot 4 (Cell 906) at a depth of 0 to 0.5 feet below grade in Area 3 (EZ) by the potential trespasser, future recreational user (park visitor), future construction worker (also via inhalation), and future residential scenarios are summarized in Table 15. The calculated ELCRs for the trespasser, future recreational and future construction worker scenarios are below the MassDEP's target risk of 1×10^{-5} indicating a condition of No Significant Risk exists for cancer risks to these receptors. However, the calculated ELCR for the future resident scenario is above the MassDEP's target risk level of 1×10^{-5} indicating a condition of No Significant Risk does not exist for cancer risks to this potential future receptor. The MassDEP's *ShortForms* results presented in Appendix D as Tables D-57 through D-60 indicate that the potential carcinogenic risk under the future resident scenario is due to the presence of arsenic in soil at a depth of 0 to 0.5 feet below grade.

Soil Stockpiles

The potential noncarcinogenic hazards and cancer risk posed by exposure to COCs in the soil stockpiles located in Area 4 (EZ) by the potential trespasser, future recreational user (park visitor), future construction worker (also via inhalation), and future residential scenarios are summarized in Table 16. The subchronic and chronic HIs for the trespasser scenario is below the MassDEP's target HI level of 1.0 indicating a condition of No Significant Risk exists for non-cancer effects to this receptor. However, the subchronic HI for the construction worker scenario and the subchronic and chronic HIs for the future recreational and future resident scenarios are above the MassDEP's target HI level of 1.0, indicating a condition of No Significant Risk does not exist for non-cancer effects to these receptors. The MassDEP's *ShortForms* results presented in Appendix D as Tables D-61 through D-64 indicate that the potential noncarcinogenic health risk under the future recreational, future construction worker and future resident scenarios is due to the presence of lead (along with arsenic and PCBs) in the stockpiles soil.

The potential Excess Lifetime Cancer Risk (ELCR) carcinogenic risk posed by exposure to COCs in the soil stockpiles located in Area 4 (EZ) by the potential trespasser, future recreational user (park visitor), future construction worker (also via inhalation), and future residential scenarios are summarized in Table 16. The calculated ELCRs for the trespasser, future recreational and future construction worker scenarios are below the MassDEP's target risk of 1×10^{-5} indicating a condition of No Significant Risk exists for cancer risks to these receptors. However, the calculated ELCR for the future resident scenario is above the MassDEP's target risk level of 1×10^{-5} indicating a condition of No Significant Risk does not exist for cancer risks to this potential future receptor. The MassDEP's *ShortForms* results presented in Appendix D as Tables D-61 through D-64 indicate that the potential carcinogenic risk under the future resident scenario is due to the presence of arsenic and PCBs in stockpile soil.

Stockpile Hot Spots

The potential noncarcinogenic hazards and cancer risk posed by exposure to COCs in the soil stockpile hot spots (R-S1-C-1, R-S15-C1 and S20-D4) located in Area 4 (EZ) by the potential trespasser, future recreational user (park visitor), future construction worker (also via inhalation), and future residential scenarios are summarized in Table 17. Note that these estimated exposures and resultant risks utilized the maximum detected concentrations as the EPCs since only three samples comprised this exposure point. The subchronic and chronic HIs for the trespasser, scenario are below the MassDEP's target HI level of 1.0 indicating a condition of No Significant Risk exists for non-cancer effects to this receptor. However, the subchronic and chronic HIs for the future construction worker. future recreational and future resident scenarios are above the MassDEP's target HI level of 1.0, indicating a condition of No Significant Risk does not exist for non-cancer effects to these receptors. The MassDEP's *ShortForms* results presented in Appendix D as Tables D-65 through D-68 indicate that the potential noncarcinogenic health risk under the future recreational and future resident scenarios is due to the presence of lead, arsenic and cadmium in the soil stockpile hot spots.

The potential Excess Lifetime Cancer Risk (ELCR) carcinogenic risk posed by exposure to COCs in the soil stockpile hot spots (R-S1-C-1, R-S15-C1 and S20D4) located in Area 4 (EZ) by the potential trespasser, future recreational user (park visitor), future construction worker (also via inhalation), and future residential scenarios are summarized in Table 17. Note that these estimated exposures and resultant risks utilized the maximum detected concentrations as the EPCs since only three samples comprised this exposure point. The calculated ELCRs for the trespasser, and future construction worker scenarios are below the MassDEP's target risk of 1×10^{-5} indicating a condition of No Significant Risk exists for cancer risks to these receptors. However, the calculated ELCR for the future recreational and future resident scenarios are above the MassDEP's target risk level of 1×10^{-5} indicating a condition of No Significant Risk does not exist for cancer risks to these potential future receptors. The MassDEP's *ShortForms* results presented in Appendix D as Tables D-65 through D-68 indicate that the potential carcinogenic risk under the future resident scenario is primarily due to the presence of arsenic and benzo(a)pyrene (and other carcinogenic PAHs) in the soil stockpile hot spots.

2.13.2.8 Identification of Applicable or Suitably Analogous Standards

Applicable or suitably analogous standards are formally promulgated standards intended to protect human health and the environment from adverse effects of hazardous agents. Such standards are media-specific.

There are no applicable or suitably analogous soil standards available for Site COCs. In accordance with MassDEP policy, the MCP Method 1 risk characterization standards are not considered to be applicable or suitably analogous standards for Method 3 risk assessments.

Federal and state drinking water standards are not applicable or suitably analogous standards for this Site, because groundwater at the Site is not classified as GW-1.

2.13.2.9 Uncertainties in the Health Risk Assessment

Scientific uncertainties are associated with site chemical characterization, estimates of exposures, dose-response relationships and risks presented in any human health evaluation. It is generally accepted in the scientific community that the degree of uncertainty associated with quantitative risk assessments cannot be stated in absolute terms.

The uncertainties in this report are unavoidable in that they depend, to a greater or lesser extent, upon many technical judgments and imperfect mathematical models of the physical, chemical and biological processes involved.

The risk assessment process uses information from a variety of sources, such as analytical data from the Site investigation and toxicity data from published research. This information is combined with assumptions regarding potential receptors and Site use. Uncertainties may be present in each of these assumptions, and may affect the outcome of the risk assessment. The risk assessment was developed to be a conservative estimate of potential adverse health effects. Its results should not be interpreted as definitive quantitative values. Uncertainties in the various portions of this risk assessment are discussed below.

Hazard Identification

The identification of constituents present in soil (and groundwater) and their distribution across the Site are dependent upon the sampling and analytical program conducted. Conservative assumptions were made in developing soil EPCs that likely lead to overestimates of actual exposure point concentrations.

EPCs were often based on detected concentrations in samples collected from higher concentration areas since sampling programs tend to focus on areas of higher concentration, resulting in a high-end estimate of the EPC.

Exposure Assessment

There is uncertainty associated with exposure assessment because the range of potential human activity is broad. Variability is associated with differences between individual receptors, such as body weight, skin surface area, and rates of soil or water ingestion. Use of the MassDEP's Risk Assessment ShortForms insured that conservative exposure assumptions were used in developing pathway exposure factors that are anticipated to err on the side of protection of health.

An uncertainty present in any risk assessment is that the EPCs utilized in the analysis are assumed representative of the entire site as a whole. Use of the 95% UCL of the arithmetic mean soil concentrations helped to ensure that the analysis provides a conservative estimate of potential human exposures. It is also assumed in the risk analysis process that the EPCs have not changed since sampling was conducted and will not change over time; i.e., that they remain constant.

Dose-Response Assessment

Toxicity information for many of the chemicals detected at the Site is associated with varying degrees of uncertainty. Sources of uncertainty for toxicity values may include:

- Using dose-response information from effects observed at high doses to predict the adverse health effects that may occur following exposure to low levels expected from human contact with the agent in the environment;
- Using dose-response information from short-term exposure to predict the effects of long-term exposures, and vice-versa;
- Using dose-response information from animal studies to predict effects in humans;
- Using dose-response information from homogeneous animal populations or healthy human populations to predict the effects likely to be observed in the general population consisting of individuals with a wide range of sensitivities.

The toxicity factors used in this Revised Method 3 RC were those utilitized by the MassDEP in the Risk Assessment ShortForms. Most of the toxicity values used in this risk characterization are EPA-verified RfDs/RfCs and slope factors. These values, as presented in IRIS, are derived using a number of safety factors and are accompanied by a statement of confidence in the value itself, the critical study, and the overall data base for RfDs/RfCs, and the weight-of-evidence classifications for slope factors. The MassDEP has derived toxicity values for VPH/EPH fractions using a reference surrogate compound approach for these complex mixtures of hydrocarbons. The method involves segregating the petroleum hydrocarbons present in mixtures into broad chemical classes and further into subgroups or fractions based upon their size, and with consideration of comparative toxicity and structure activity relationships (SARs). For each subgroup of compounds, a reference compound was initially identified to represent the toxicity of all compounds in the range. The compound was usually chosen because its toxicity was relatively well characterized. For each reference compound, an EPA published value was identified or a value was identified based on available toxicity information.

Risk Calculations

The risk calculations were performed using a deterministic methodology as required under MCP guidance. In a deterministic methodology, a single value (point estimate) is used for exposure parameters and EPCs. The result is that a single risk value is calculated for each scenario and receptor of concern. However, the use of a mix of mid-range and conservative exposure assumptions is intended to produce realistic upper-end exposure estimates, which will be protective of public health and produce risk estimates that will be valid for comparison to MCP Cumulative Risk Limits.

The use of chronic toxicity data may have affected the potential receptors evaluated in this risk assessment when evaluating subchronic risks. When possible, subchronic toxicity data were used by the MassDEP to evaluate the subchronic exposures. However, subchronic toxicity data were not available for all OHM. As such, the potential subchronic noncancer risks may be overly conservative for the scenarios evaluated.

Although quantitative estimates of risk were not estimated for the future utility worker scenario, the MassDEP has stated in the *Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan* document the following. “Of all the chemicals commonly detected at disposal sites, cyanide is the only one which could pose a significant health risk from a one-time exposure to concentrations that are often found in the environment. Although acute exposures to some other hazardous materials could pose a health risk at some level, the concentrations at which acute exposures are of concern are much higher than levels typically found in the environment.”

This risk assessment did not quantitatively evaluate potential exposures and resultant health risks to utility workers. However, the MassDEP has stated in the *Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan* document the following. “Of all the chemicals commonly detected at disposal sites, cyanide is the only one which could pose a significant health risk from a one-time exposure to concentrations that are often found in the environment. Although acute exposures to some other hazardous materials could pose a health risk at some level, the concentrations at which acute exposures are of concern are much higher than levels typically found in the environment.” The OHM of concern at this site are metals, petroleum hydrocarbons and certain target PAHs, and does not include cyanide.

As discussed previously, this risk assessment did not quantitatively evaluate potential exposures and resultant health risks to site commercial/industrial workers. However, due to the conservative exposure assumptions and receptors (e.g., young children) used by the MassDEP in the *ShortForm for Human Health Risk Assessment under the MCP, version 4-06, April 28, 2006, revised February 1, 2007*, it is expected that the future residential exposure scenario provided a worst-case evaluation of potential chronic human exposures and resultant health risks, and the future construction worker exposure scenario provided a worst-case evaluation of potential subchronic adult human exposures and resultant health risks.

The MassDEP’s Risk Assessment ShortForms do not include the COCs cobalt and copper, which are considered COCs for Areas 1, 3 and 4. However, since the maximum detected concentrations of cobalt and copper in Area 1 (5.1 mg/kg and 69 mg/kg, respectively), Area 3 (12 mg/kg and 3,800 mg/kg, respectively) and Area 4 (10.0 mg/kg and 2,300 mg/kg, respectively) are well below the respective site-specific RBCs of 26,326 mg/kg and 42,690 mg/kg for residential use as revised by Gradient in LFR’s Phase IV RIP, omission of these COCs is not expected to affect the conclusions of this Revised Method 3 RC.

Special Considerations for Lead

The EPA has stated that the current knowledge of lead pharmacokinetics indicates that risk values derived by standard procedures (i.e., a RfD approach) would not truly indicate the potential risk, because of the difficulty in accounting for pre-existing body burdens of lead (EPA’s IRIS databse). It is felt that the health effects due to lead exposures are better represented by blood lead levels. The EPA's and the Center for Disease Control’s (CDC) level of concern for blood lead levels is currently 10 micrograms per deciliter (µg/dl). The EPA has developed a computer model for exposure to lead in the environment. This model is referred to as the Integrated Exposure, Uptake, and Biokinetic Model (IEUBK). The IEUBK model utilizes a partially compartmentalized physiologic-based pharmacokinetic model that estimates potential bodily uptakes and resultant blood lead levels *in children* due to exposure to environmental lead. This model has been validated at several Superfund Sites. Using the IEUBK model, the EPA has developed a strictly health-based acceptable residential (i.e., children) lead soil screening level of 400 mg/kg for use at CERCLA and RCRA sites (*OSWER Directive #9355.4-12*). This soil lead level provides a 95% probability that a child will not have a blood lead level above the EPA and Centers for Disease Control (CDC) 10 µg/dl blood lead level of concern.

Because the IEUBK model cannot be used in evaluating potential health risks posed to adolescents and adults by lead at the Site, in addition to the RfD approach lead in soil was evaluated using the EPA's Adult Lead Methodology (*EPA-540-R-03-001, OSWER Dir #9285.7-54*). This methodology is designed for assessing risks associated with adult exposures to lead in soil/sediment by relating soil lead concentrations to blood lead concentrations in an exposed population. Using this methodology, a risk-based evaluation of adult exposures to lead in soil can be performed based on the relationship between the soil lead concentration and the blood lead concentration in the developing fetus of adult women that have site exposures prior to or during pregnancy.

Like other site COCs, lead was evaluated using the MassDEP's Risk Assessment Shortforms in order to streamline this Revised Method 3 RC. As such, lead was evaluated using the MassDEP's RfD approach. As demonstrated by Gradient as part of updating the site-specific RBCs for the Site in the Phase IV RIP, the adult blood lead model results in approximately 3-times lower RBCs for the Site under the residential, construction worker, commercial/industrial worker and recreational user scenarios than those derived by the RfD approach. Therefore, evaluating lead using a RfD approach may underestimate the resultant health risks for these receptors. Although the RfD approach creates some uncertainty with respect to the overall risk estimates for soil lead, the overall conclusions of the Revised Method 3 RC would not likely change. In addition, the site-specific RBCs for lead derived for use during potential future remediation efforts considered the use of the blood lead models and, therefore, will insure that the Site will be remediated to soil lead levels that pose a condition of No Significant Risk (1,765 mg/kg).

2.13.2.10 Revised Risk-Based Concentrations

As discussed previously, LFR retained Gradient Corporation to review and update the RBCs for the Site using "updated exposure parameters and toxicity values" as part of the Phase IV RIP. Since the Site is expected to remain a commercial/industrial property in the future, Earth Tech reviewed the updated Commercial/Industrial RBCs prepared by Gradient and is in general agreement with the updated exposure parameters and toxicity values that were used. However, it appears that Gradient derived each of the RBCs based on noncarcinogenic effects using a Hazard Quotient of 1. As such, no consideration is given for multiple chemical exposures. For this reason, Earth Tech revised these Commercial/Industrial RBCs as discussed below.

In accordance with 310 CMR 40.0984(2), MCP soil standards for OHM based upon non-cancer health risks are to be "associated with 20% of a Reference Dose". In other words, a soil standard derived using a RfD are to be divided by a factor of 5. In deriving RBCs for Area 4 as discussed in the Phase II Addendum included in the Phase III report, Weston & Sampson divided the derived standard by 5 to account for the fact that 5 COCs were contributing 99% of the risk for this area of the Site. Based on these considerations, and since the exposure assumptions and toxicity factors used by LFR were acceptable, Earth Tech adjusted LFR's noncarcinogenic Commercial/Industrial RBCs by a factor of 5 for application across the Site. However, the RBCs for arsenic and lead were developed in a different manner as dicussed below.

Since arsenic is the only carcinogenic COC at the Site, no adjustments were made to the Commercial/Industrial RBC developed by LFR. For lead, LFR derived a Commerical/Industrial RBC using the EPA's Adult Lead Model. Since no other noncarcinogenic COC is evaluated by this approach and since the toxic effect endpoint for lead is different than any other COC, LFR's Commercial/Industrial RBC for lead is appropriate for use at the Site. The Revised Commercial/Industrial RBCs are presented in Table 18.

2.13.3 Potential Risk of Harm to Safety

As required by 310 CMR 40.0960, the risk of harm to safety was also characterized based on the data presented in the Phase II, Phase IV and Supplemental Phase II reports, and the Site receptor and exposure information discussed previously. The risk to safety must be evaluated separately from the Method 1, 2, or 3 evaluation of risk of harm to health, public welfare, and the environment. The purpose of evaluating the risk of harm to safety is to identify conditions that have resulted or may result in a release of oil and/or hazardous material that will pose a threat of physical harm or bodily injury to people.

As discussed in the MassDEP's *Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan* (1995) conditions that may constitute a risk of harm to safety include:

- The threat of fire or explosion, or the presence of explosive vapors;
- Rusted or corroded drums or containers;
- Weakened berms;
- Reactive chemicals stored or disposed of in an unsafe manner;
- Unsecured pits, ponds, lagoons or other dangerous structures;
- Uncontained materials which exhibit the characteristics of corrosivity, reactivity, flammability, or are infectious;
- The presence of ionizing or non-ionizing radiation; and
- The presence of conditions unrelated to the release that may increase the risk of exposure to a receptor.

Additionally, the MCP requires that current and reasonably foreseeable disposal site conditions must be compared to applicable or suitably analogous safety standards, guidelines and policies when characterizing the risk of harm to safety.

With one exception, risks to human health, safety, public welfare or the environment not <u>directly</u> associated with the known release of petroleum were not relevant to this project, and were <u>not</u> assessed. The only exception was the evaluation of the potential for conditions unrelated to the release to increase a receptor's petroleum exposure risk.

No evidence of release-related physical hazards such as corroded storage drums or containers, weakened berms, unsecured structures, or conditions unrelated to the release which may increase the risk of exposure to a receptor were noted during site visits.

Based on the known released (non-background) materials, reactive chemicals, radiation, or infectious corrosive, or flammable materials were not anticipated. The soil concentrations of the metals, petroleum hydrocarbons and certain target PAHs determined by laboratory analysis do not suggest a risk of fire or explosion hazard. In addition, non-aqueous phase liquid is not present, and the materials are located in soil (and groundwater), where the availability of oxygen to sustain combustion is limited. Therefore, a condition of "No Significant Risk" of harm to safety, as related to the fuel oil release, exists at the Site. No applicable or suitably analogous safety standards, guidelines, or policies for characterizing the risk of harm to safety exist for the analytes present in environmental media at the Site.

2.13.4 Public Welfare Risk Characterization

The MCP defines two purposes for conducting a characterization of risk to public welfare: (a) to identify and evaluate nuisance conditions that may be localized, and (b) to identify and evaluate significant community effects. The characterization of risk to public welfare considers effects that are or may result from the presence of residual contamination or the implementation of a proposed remedial alternative (310 CMR 40.0994).

The characterization of the risk of harm to public welfare considers Site, receptor, and exposure information, as well as data collected pursuant to the response action(s) being performed. The characterization of risk of harm to public welfare also considers such factors as the existence of nuisance conditions, loss of active or passive property use(s), and any non-pecuniary effects not otherwise considered in the characterization of risk of harm to health, safety, and the environment, but which may accrue due to the degradation of public resources directly attributable to the release or threat of release of OHM or the remedial alternative (310 CMR 40.0994(2)).

The risk of harm to public welfare is characterized by comparing the concentration of each OHM to the UCLs in soil and groundwater, as defined in 310 CMR 40.0996. In addition, a level of No Significant Risk of harm to public welfare exists or has been achieved, if no nuisance conditions, such as noxious odors, persist.

2.13.4.1 Characterization of Risks to Public Welfare

As discussed below, no risks to public welfare were identified. Although often located at the ground surface, field observations and air monitoring performed during IRA, Phase II, Phase IV and Supplemental Phase II investigations indicate that the presence of these COCs does not contribute to the generation of dust, odors, or other nuisance conditions. In addition, the relatively low levels of volatile chemicals in the soil (and groundwater), and the fact that no occupied structure is located on the Site, indicate that indoor air impacts are not likely at the Site. There are no data to indicate that contamination is spreading to off-site locations at levels that could adversely impact property values and property uses in the vicinity of the Site.

The Property and surrounding areas are serviced by municipal water provided by the MWRA. There are no public or private drinking water wells/sources (e.g., reservoirs) within a 500-foot radius of the Site. Due to the distance to the nearest public or private water supply source, the direction of groundwater flow beneath the Site, and the fact that very low levels of OHM were detected in site groundwater, the municipal water supplies for the area and private wells are unlikely to be impacted by site groundwater.

The nearest surface water body is Sprague Pond, located approximately 1,000 feet south/southeast of the Site. Based on the groundwater sampling results, no contaminants above applicable standards were detected. In addition, significant attenuation/dilution is expected as groundwater migrates toward a surface water body. As such, it is unlikely that OHM will be present in nearby surface water bodies at detectable concentrations.

The foreseeable activities and uses at nearby properties include residential and commercial uses and the presence of contaminants at the Site does not inhibit those uses, or restrict, or require the restriction of, the use of the nearby properties. The presence of contamination at the Site is not expected to result in monetary or non-monetary impacts to the public welfare.

2.13.4.2 Upper Concentration Limits

The risk of harm to public welfare is also characterized by comparing the concentrations of contaminants in soil and groundwater to the UCLs, as described in the MCP. In accordance with 310 CMR 40.0996. soil or groundwater contaminant EPCs exceeding UCLs, "indicate the potential for significant risk of harm to public welfare and the environment under future conditions". The EPC for lead in Area 4 soil at a depth of > 3 feet below ground surface exceeds the UCL.

Based on the above considerations, no nuisance conditions exist or will result from the release, as defined by the following conditions described in 310 CMR 40.0994(4): the breathing zone of ambient and indoor air is currently and will in the foreseeable future remain free from persistent, noxious odors (related to the release condition); and there is accessible drinking water that is and will in the reasonably foreseeable future remain free from noxious taste and odors. In addition, no community is or will likely experience significant adverse impacts from the release. However, the requirements of 310 CMR 40.0996 concerning the UCLs have not been met since lead is present in Area 4 soil (>3 feet below grade) at concentrations above the UCL. Therefore, it is concluded that a condition of No Significant Risk to public welfare *does not* exist at the Site under future conditions.

2.13.5 Environmental Risk Characterization

The MCP specifies two components be included in an environmental risk characterization. The first step involves combining site-specific information on OHM distribution, OHM toxicity, and receptor exposure to assess the risk of harm to habitats and biota. The second step involves comparing the concentrations of OHM in environmental media, for current and reasonably foreseeable exposure pathways, to Applicable or Suitably Analogous Standards and to the UCLs specified in the MCP.

To facilitate the elimination of insignificant exposure pathways from more involved evaluations, the MCP divides the environmental risk characterization process into two stages - Stage I Environmental Screening and Stage II Environmental Risk Characterization. The Stage I Environmental Screening is used to evaluate the need for a quantitative Stage II Risk Characterization. The objective of the Stage I assessment, as stated in 310 CMR 40.0995, is to identify and document conditions which *do not* pose a significant risk of harm to site biota and habitats based upon the absence of a complete exposure pathway. A Stage I screening is used to eliminate from further evaluation those situations in which either: (1) the exposures are clearly unlikely to result in environmental harm, or (2) harm is readily apparent. Exposure pathways that are not eliminated in Stage I are carried through the quantitative Stage II Environmental Risk Characterization process. No significant Risk of harm to public welfare and the environment exists for current and future conditions if: (1) no significant exposure pathways have been identified in the Stage I screening, and (2) no concentration of OHM exceeds an Applicable or Suitably Analogous Standard and the UCLs.

As described below, no current or reasonably foreseeable future exposures were identified. Therefore, a Stage II Environmental Risk Characterization is not required. However, since the EPCs for arsenic and lead exceed the respective UCLs, a condition of No Significant Risk of harm to the Site biota and habitats does not exist under future conditions.

2.13.5.1 Stage I Environmental Screening

The Stage I Environmental Screening involves evaluating all available information to determine whether plants and/or animals are currently exposed, or could potentially be exposed, to contamination at or from the Site. In accordance with the MassDEP's *Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan*, a complete exposure pathway means that the contamination is actually reaching plants or animals, or is likely to do so in the future. If a potential exposure is not complete and is not likely to be complete in the future, hypothetical risks postulated for that pathway do not have to be considered further and do not have to be carried through the Stage II Environmental Risk Characterization process. Each complete exposure pathway is evaluated in the Stage I to determine whether it is potentially significant. Any complete exposure pathways associated with readily apparent harm are identified. Conditions that include readily apparent harm include visibly stressed biota, contaminant concentrations that exceed environmental standards, and visible oil or tar distributed over an area of soil greater than 2 acres or over an area of sediment greater than 1,000 ft^2.

The MassDEP's Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan dictates that the Stage I Screening should:

- Identify potential exposure pathways.
- For complete exposure pathways, determine whether risk of harm is readily apparent. If harm is readily apparent, a full quantitative risk characterization (Stage II) may not be necessary.
- Determine whether each pathway is or could be a complete exposure pathway, and eliminate incomplete exposure pathways from further consideration.
- For the remaining complete exposure pathways, an effects-based screening step should be conducted to determine whether the pathway clearly does not pose a significant risk.

Those pathways that do not pose a significant risk are then eliminated from further assessment.

Identification of Complete Exposure Pathways

The MBTA Readville 5-Yard property occupies an approximately 42-acre area located on Industrial Drive and straddles the boundary between the Town of Dedham and the City of Boston (Readville), Massachusetts. The Site is roughly an elongated teardrop shape and its perimeter is defined by a loop railroad track. The Site is enclosed by an 8-foot tall chain link fence, which restricts access to the Site. The Site is mostly unpaved, with the exception of a driveway approximately 100 feet wide and 1,700 feet long running east-west along the northern side of the Site. The Site is used for the storage of railroad materials. It is likely this use will continue in the foreseeable future, and activities similar to those currently conducted at the Property can be reasonably expected to continue.

According to the GIS Data Layer map, presented as Figure 4, the Site is located approximately 500 feet east-southeast from a medium yield non-potential drinking water source area and designated ACEC. In addition, a designated open space, Iacono/Readville Playground, is located approximately 500 feet north northeast of the Site. A Zone II (defined as the area of an aquifer which contributes water to a well under the most severe pumping and recharge conditions that can be realistically anticipated) is located approximately ½-mile south of the Site. There are no designated drinking water resources, including Zone A, IWPA, Sole Source Aquifers or Potential Drinking Water Source Areas, Threatened or Endangered Species Habitats, or Outstanding Resource Waters, within 500 feet of the Site. The nearest surface water body is Sprague Pond, located approximately 1,000 feet south/southeast of the Site.

Available evidence was evaluated to determine whether there are current or potential reasonably foreseeable future exposures of environmental receptors to contamination at or from the Site. Sources of such evidence included historical records, site data, field observations, and information gathered during interviews with employees. Based on our evaluations, no records exist of damage done to plant or animal populations due to the release of OHM at the Site. There is no known evidence that OHM at or from the Site has come to be located in the surface water or sediment of Sprague Pond. In addition, it is unlikely that OHM will migrate to Sprague Pond at detectable concentrations (refer to Section 2.14.4.1). Therefore, it is highly unlikely that the migration of groundwater from the Site to Sprague Pond will result in surface water concentrations exceeding the Ambient Water Quality Criteria (AWQC).

The Site is located in a mixed commercial/industrial and residential area. The Site has been historically used, and is currently used, as a rail yard and natural vegetation on the Site is limited to sporadic weeds and trees/shrubs due to Site development and an urban location. Impacted soils have been reported in soils at the ground surface. Therefore, it is possible that plants and burrowing wildlife could directly contact the impacted Site soils. In the future, if the deeper soils become uncovered and are brought to the surface, terrestrial receptors may contact these impacted soils.

A further evaluation of the presence of potentially significant exposure pathways was completed. Since no soil screening criteria are available, the terrestrial habitat has been screened on the basis of its size. For the purposes of this screening, the size of undeveloped/open land at the Site determines the specific evaluation of terrestrial environments. The MassDEP's *Guidance for Disposal Site Risk Characterization In Support of the Massachusetts Contingency Plan, Chapter 9, Method 3 Environmental Risk Characterization, Interim Final Policy, BWSC/ORS-95-141. April 1996* states that for the purposes of the screening process, undeveloped/open land is characterized by the presence of native vegetation, and does not include landscaped residential and commercial parcels.

Based on this MassDEP definition, the open space at the Site is less than 2 acres in size. Therefore, no further action to characterize ecological risk is required for sites unless:

- Contaminant transport from surface soil to an ACEC is possible, or
- State-listed threatened or endangered species, or other species of special concern are present.

According to the MassGIS map (Figure 4), the Site is not:

- Within an ACEC nor is contaminant transport from surface soil to an ACEC possible, or
- The location of state-listed threatened or endangered species, or other species of special concern.

Given the above considerations, no potential complete environmental exposure pathways exist or are likely to exist in the future.

2.13.5.2 Upper Concentration Limits

As discussed in 2.14.4.2, the EPC for lead in Area 4 soil (>3 feet) exceeds the soil UCL.

2.13.5.3 Conclusions

Based on the above evaluations, the environmental conditions at the Site indicate that:

- No physical evidence of harm to the environment exists.
- No complete environmental receptor pathways exist or are likely to exist in the future.
- The soil lead EPC in Area 4 (>3 feet) exceeds the UCL.

Therefore, a condition of No Significant Risk to the environment *does not* exist under future use conditions.

2.13.6 Conclusions of Method 3 Risk Characterization

Based on the above evaluations, the environmental conditions at the release site indicate that:

- A condition of No Significant Risk to human health does not exist at the Site.
- A condition of No Significant Risk to safety exists at the Site.
- A condition of No Significant Risk to public welfare does not exist at the Site.
- A condition of No Significant Risk to the environment does not exist at the Site.

Under current Site conditions, a condition of No Significant Risk *has not* been achieved at the Site for current and unlimited, foreseeable future Site conditions. Accordingly, further Comprehensive Response Actions are required at the Site in accordance to 310 CMR 40.800.

2.14 Supplemental Phase II CSA Conclusions

A Supplemental Phase II CSA and a Revised Method 3 RC were completed for the Site. The limits of contamination were established, and the Method 3 RC indicated a condition of "No Significant Risk" to human health, safety, public welfare and the environment does not exist for the Site, and that a Permanent Solution has not been achieved.

2.14.1 Discussion

The Supplemental Phase II CSA report was based on investigations conducted by Earth Tech and on previous investigations performed by other consultants, and was prepared in accordance with applicable requirements specified in 310 CMR 40.0000 and/or any approval conditions specified by the MassDEP. Based on the findings of the Supplemental Phase II CSA, the current knowledge of site-specific and surrounding conditions, the following is concluded:

- None of the Site conditions meet the Imminent Hazard criteria as defined in 310 CMR 40.0321. Therefore, no Imminent Hazard exists at the Site.
- The source of the release at the Site is considered to be historical use of the Site as a rail yard.
- A Revised Method 3 RC was performed by the Site. The risk assessment focused on the risk posed by soil since, based on the findings of the Phase II investigation, contaminants were not detected at significant concentrations in groundwater. Surface water and sediment are not present at the Site. As with the Phase II RC, for risk assessment purposes, the Site was divided into four areas based on historical use, types and concentrations of contaminants. The areas include: Area 1 - Orphan Line; Area 2 - Ashcroft Street Fence line; Area 3 - Main Rail Yard; and Area 4 - EZ. The stockpiles located in the EZ were evaluated separately for possible on-site re-use. Potential human exposures and resultant health risks were evaluated using the MassDEP's Risk Assessment Shortforms for resident, construction worker, park visitor (recreational) and trespasser scenarios.
- Two lead hot spots were identified in each of Area 3 and Area 4. The EPCs in these lead hot spots resulted in noncancer risks above the MassDEP acceptable risk level for all four scenarios evaluated. As such, a condition of No Significant Risk of harm to human health does not exist in these hot spots.
- Evaluation of the soil EPCs in Area 1, Area 2, Area 3, and Area 4 indicated health risks above the MassDEP acceptable risk levels for all four scenarios evaluated. As such, a condition of No Significant Risk of harm to human health does not exist at the Site.
- The EPC for soil lead in Area 4 (>3 feet) exceeds the UCL. Therefore, by definition of UCLs in the MCP, a level of No Significant Risk to public welfare and the environment cannot be achieved for the Site. Further comprehensive response actions will likely be required to eliminate the UCL exceedances.
- The Revised Method 3 RC indicated a condition of No Significant Risk of harm to safety exists for the Site.
- CRAs are necessary at the Site to achieve a level of No Significant Risk and to address remaining impacts. Since CRAs are necessary at the Site, a Supplemental Phase III RAP will be submitted to the MassDEP (see Section 3.0 of this Report).

2.14.2 Supplemental Phase II Completion Statement

As specified in 310 CMR 40.0836, a Phase II Completion Statement is submitted with this Supplemental Phase II CSA report as a separate document. A copy of the Supplemental Phase II Completion Statement is provided in Appendix E.

2.14.3 Licensed Site Professional Opinion

The LSP Certification is contained on the attached Transmittal Form (BWSC-108).

2.14.4 Public Involvement

Upon completion of any Phase reports, the Chief Municipal Officer and the Board of Health must be informed of the availability of these reports, and how to obtain a copy of the report.

On behalf of the MBTA, Earth Tech prepared letters to the municipal officials. A copy of the letters to the municipal officials is presented in Appendix F.

3.0 SUPPLEMENTAL PHASE III

3.1 Introduction

This report was prepared as an Addendum to supplement the original Phase III RAP prepared for the Readville 5-Yard facility located on Industrial Drive in Dedham and Readville, Massachusetts. The original Phase III report was prepared by Weston and Sampson Engineers, Inc. and submitted to the MassDEP in April 2003. As requested by MassDEP, this Supplemental Phase III incorporates the findings of the Supplemental Phase II, evaluates feasible alternatives to the use of a cap or engineering barrier, and evaluates the feasibility of reducing contaminant concentrations to levels at or below applicable UCLs.

The Supplemental Phase III was deemed necessary in order to further evaluate the likely effectiveness and implementation of remedy alternatives selected in the original Phase III, based on the Supplemental Phase II CSA and RC conducted for the Site. The scope, results, and conclusions of the Supplemental Phase II CSA and RC are described in detail in Section 2 of this document above. Appendix G presents the MBTA and MassDEP correspondence, specifically, MassDEP requests for additional work.

3.1.1 Objectives and Methodology

Section 310 CMR 40.0850 et seq. of the MCP sets forth the requirements for Phase III - Identification, Evaluation, and Selection of CRA Alternatives. The following Supplemental Phase III is meant to supplement the original Phase III report based upon updated Phase II information.

3.1.2 Site Regulatory Background

For a detailed account of the historical information regarding the Site regulatory background, the reader should refer to Section 1.4.2 of this report.

3.1.3 Remedial Action Plan Objectives

As detailed in 310 CMR 40.0853, the Phase III RAP has two primary objectives. First, the RAP must identify and evaluate RAAs that are "reasonably likely to achieve a level of No Significant Risk considering the oil and hazardous material present, media contaminated, and site characteristics…" It is important to note that, as defined in the MCP, this evaluation of RAAs is intended to be site-specific as well as contaminant-specific, and that this flexibility provides a means for dealing with the site hydrogeology, geochemistry, the interaction between the natural and built environments, and other factors that would affect the viability of a remedial technology or combination of technologies.

Secondly, the MCP mandates that the RAP result in the recommendation of a RAA that is "a Permanent or Temporary Solution, where a Permanent Solution includes measures that reduce, to the extent feasible, the concentrations of oil and hazardous material in the environment to levels that achieve or approach background." This provision recognizes that a Permanent Solution, while desirable, is not always feasible given site-specific conditions. However, a Temporary Solution, as defined by the MCP, must eliminate any substantial hazard presented by the site until a Permanent Solution can be achieved.

The original RAP prepared by Weston & Sampson Engineers, Inc. (W&S) in April 2003 proposed six alternatives which included the following:

- Alternative 1 – Soil Excavation (0-6 inches) and Off-Site Disposal with Stabilization: This Alternative included the excavation of soil from 0 to 6 inches, stabilization in order to minimize leachability of lead and arsenic (if necessary, based on TCLP testing), Hot Spot excavation, and off-site disposal.
- Alternative 2 – Soil Excavation (0 - up to 3 feet) and Off-Site Disposal with Stabilization: This Alternative included the excavation of soil from 0 to 3 feet, stabilization in order to minimize leachability of lead and arsenic (if necessary, based on TCLP testing), Hot Spot excavation, and off-site disposal.
- Alternative 3 - Soil Excavation (>3 feet) and Off-Site Disposal with Stabilization: This Alternative included the excavation of soil greater than 3 feet, stabilization in order to minimize leachability of lead and arsenic (if necessary, based on TCLP testing), Hot Spot excavation, and off-site disposal.
- Alternative 4 – Soil Excavation of RBC Exceedances and Off-Site Disposal with Stabilization: This Alternative included the excavation of locations where contaminants were found to exceed the applicable RBCs, stabilization in order to minimize leachability of lead and arsenic (if necessary, based on TCLP testing), Hot Spot excavation, and off-site disposal.
- Alternative 5A – Clean Fill Cover: This Alternative includes a cover of 3 feet of clean (i.e., contaminant concentrations below applicable cleanup standards) soils on top of a marker barrier.
- Alternative 5B – Asphalt Cover: This Alternative includes asphalt pavement and crushed stone as a cover over the existing soil.

These Alternatives as well as others are introduced and/or revisited in this Supplemental Phase III in order to select an effective remedy for the Site, based upon the conclusions of the Supplemental Phase II CSA and RC.

3.2 Summary of Phase III RAP Findings

3.2.1 Introduction

The development of remedial objectives is the necessary first step in the evaluation and selection of RAAs. The objectives specify that conditions on the Site shall represent No Significant Risk to human health and the environment. This original Phase III evaluation established objectives based on the results and conclusions of the Phase II RC (Section 8 of the Weston & Sampson Phase II CSA, January 2003). Based on the results of the Supplemental Phase II CSA and RC effort, Earth Tech has developed risk-based clean-up objectives that are chemical-specific and media-specific for Readville Yard Areas. These clean-up standards are protective of human health and the environment. Presented below are the remedial action risk-based objectives for the Site.

3.2.2 Risk-Based Clean-up Objectives

The remedial objective for this Site is to achieve a Permanent Solution. If a Permanent Solution cannot be achieved because it is not technologically feasible or cost-effective, then the remedial objective is to achieve a Temporary Solution. Specific remedial objectives are related to achieving a level of control for substances of concern, to accomplish risk reduction, and to approach or achieve background conditions.

The objective of the Phase II risk assessment was two-fold: 1) to develop Site-wide RBCs for various current and potential future activities and receptors; and, 2) to evaluate whether existing Site conditions pose a condition of No Significant Risk for existing and proposed uses. The Site is used for railroad operations, including the storage of railroad materials. It is likely this use will continue in the foreseeable future, and activities similar to those currently conducted at the Property can be reasonably expected to continue. Therefore, the MBTA assumes that the future use of the site will remain its current use, i.e. commercial/industrial.

As with the Phase II RC, for risk assessment purposes, the Site was divided into four areas based on historical use, types and concentrations of contaminants. The areas include: Area 1 - Orphan Line; Area 2 - Ashcroft Street Fence line; Area 3 - Main Rail Yard; and Area 4 - EZ. The stockpiles located in the EZ were evaluated separately. The original Phase III identified these areas as follows:

- Area 1 – Orphan Line: The Orphan Line was formerly the Dedham Secondary Line and consists of an approximately 90-foot wide by 3,200 foot long section of abandoned railroad tracks along the Site's northern boundary. This area is currently fenced.
- Area 2 – Western Fence Line (adjacent to Ashcroft Street): Area 2 is a narrow strip of land located along the southwestern Site boundary between the EZ and a wooded area followed by residential properties on Ashcroft Street. This area is also fenced.
- Area 3 – Main Rail Yard: The Main Rail Yard is the largest area evaluated for this Site. Consisting of approximately 21 acres, the area contains both active and inactive tracks. The Main Rail Yard is currently used by MBTA and Amtrak for storage of railroad materials (ties, track panels, etc.), and has a long history of use as a former railroad maintenance and storage yard. One large building was formerly located within the Main Rail Yard, and the foundation of this structure still exists. Currently, the Main Rail Yard is completely fenced.
- Area 4 – Exclusion Zone: This Area is located west of the Main Rail Yard and occupies most of the western portion of the Site. Reportedly, Area 4 has been used for railroad associated materials and a historical burn pit. A number of soil/debris piles are present. Like the Main Rail Yard, the EZ area is currently completely fenced.

Soils

The horizontal and vertical extent of contamination at the Site was estimated by Earth Tech based on soil data collected by the MassDEP, HMM, Rizzo, LFR, and Weston & Sampson during previous Phase I, IRA, IH evaluation, Phase II and Phase IV activities, and the Supplemental Phase II Comprehensive Site Assessment activities performed by Earth Tech.

For a detailed description of the horizontal and vertical extent of impacts to soil, the reader should refer back to Section 2.6 of this report.

The commercial/industrial RBCs for the Site soils developed by Earth Tech in the updated Risk Assessment are presented in Section 2.13 of this report.

Groundwater

Groundwater does not propose an unacceptable risk; therefore, no specific remedial objectives were developed for this report.

3.2.3 Recommended Remedial Alternatives

Sections 4 and 5 of the original Phase III RAP report provided information on the remedial technologies and RAAs to address the COCs identified in the previous section.

This section will identify the candidate remedial technologies (or combinations of remedial technologies) that have been selected for consideration at the Site, and will present the results of the technology screening process used to determine which of these technologies could become elements of the RAAs. This screening has been performed in accordance with the provisions of the MCP (310 CMR 40.0855), and represents the first stage in selection of the preferred RAAs for the Site. In the initial screening of RAAs, Earth Tech has identified remedial technologies capable of achieving the remedial objectives and has then assembled these technologies into RAAs. Each of the RAAs was then evaluated based on two criteria:

1. The ability of the RAA to achieve a Permanent or Temporary Solution as defined by the MCP (310 CMR 40.0006); and
2. The availability of individuals and resources needed to implement the RAA.

Based on the MBTA assumption that the future use of the site would remain its current use of commercial/industrial, Weston & Sampson previously selected remedial Alternative 4 (Soil Excavation of RBC Exceedances and Off-Site Disposal with Stabilization for Areas 1 through 4); On-site reuse for the MA Regulated Material and Non-TSCA PCB-Impacted material; On-Site Reuse and Stabilization with Hot Cell Removal for the Potential RCRA Characteristic Waste; and Alternative 2 (Soil excavation (0-3 feet) and Off-site disposal with Stabilization for the Area 3 Hot Spot (SS-2) and Area 4 Hot Spot.

Earth Tech has assumed that the results of the technology identification and screening process used by Weston & Sampson (Sections 4 and 5 of the original RAP) complied with the provisions of 310 CMR 40.0850 and were accepted by DEP. Therefore, based on the conclusions of the original Phase III RAP, the Supplemental Phase II CSA and RC, and the proposed continued future use of the Site as commercial/industrial, we have developed the following comprehensive RAAs to achieve a condition of “No Significant Risk” for the Site. These RAAs include the following:

- Alternative 1 – Soil Excavation (0 to >8 feet) of Site-wide RBC Exceedances and Off-Site Disposal with Stabilization.
- Alternative 2 – Soil Excavation (0 to >8 feet) of Site-wide UCL Exceedances and Off-Site Disposal with Stabilization.
- Alternative 3 – Soil Excavation (0 to >8 feet) of Limited UCL Exceedances and Off-Site Disposal with Stabilization.
- Alternative 4 – Installation of an Engineered Barrier.

Several general options have not been included in the description of the alternatives above as they are a requirement of all four alternatives. Descriptions of these general options and affected areas (Figure 19) are provided below:

- Hot Spot Removal – Hot spots of surficial lead-contaminated soils were identified in Areas 3 (SS-22) and 4 (SS-01). In addition, hot spots of VPH (SA/GP-44) and EPH (HB/GP-24) were identified in Area 3. The estimated volume of hot spot soils to be removed is approximately 1,600 cubic yards. It should be noted that hot spots previously identified within the stockpiles will be addressed separately as part of the stockpile removal.

- Stockpiles Screening and Removal – Based on limited and selective sampling performed during the Phase II and Supplemental Phase II investigation, a number of stockpiles were identified as requiring stabilization and off-site disposal for a number of reasons including UCL and/or RBC exceedances, PAH hot spots, and/or the presence of PCBs (refer to Figure 3). Prior to removal, the material would be screened and unsuitable debris would be removed and disposed off-site. The estimated total volume of these existing stockpiles to be screened, stabilized (if necessary), and disposed off-site is approximately 8,000 cubic yards.

- TCLP Soil Stabilization – Soils in which TCLP lead has been reported at more than 5 mg/l, which are not being removed from the Site, will be stabilized. The volume of soil that may require stabilization is estimated to be approximately 1,000 cubic yards.

- Activity and Use Limitation (AUL) – Deed restrictions in the form of an Activity and Use Limitation will be placed on the entire property limiting future land use and construction activities.

3.3 Re-Evaluation of Remedial Alternatives

3.3.1 Introduction

Earth Tech re-evaluated the RAAs developed by Weston & Sampson in the original Phase III utilizing the supplemental data collected by Earth Tech and others in the supplemental site investigations discussed in detail in Sections 1 and 2 of this report. All of the technologies and alternatives evaluated in the original Phase III RAP were reconsidered as part of this effort if additional data was significant. The results of the evaluation are presented in the following section.

3.3.2 Reevaluation of Remedial Action Alternatives

This section will evaluate the candidate RAAs (or combinations of remedial technologies) that have been selected for consideration at the Site. In going forward with the reevaluation of RAAs, Earth Tech has assumed that the results of the technology identification and screening process used by Weston & Sampson (Sections 4 and 5 of the original RAP) complied with the provisions of 310 CMR 40.0850 and were accepted by DEP.

All of these four remedial alternatives outlined in Section 3.2.3 are described below and assessed in terms of eight MCP criteria:

- Alternative 1 – Soil Excavation (0 to >8 feet) of Site-wide RBC Exceedances and Off-Site Disposal with Stabilization:

  This Alternative is similar to Alternative 4 of the original Phase III and includes the following components:

  - Excavation and off-site disposal of approximately 39,000 cubic yards of metals-contaminated soils across all four areas of the site where contaminant concentrations have been shown to exceed the applicable RBCs;
  - Excavation and off-site disposal of approximately 1,600 cubic yards of Hot spot soil Areas (SS-1, SS-22, cell 906).

- On-Site chemical stabilization (if necessary) of all excavated and stockpiled soils prior to off-site disposal in order to minimize leachability of lead and arsenic;
- In-Situ stabilization of approximately 1,000 cubic yards of soils within the Main Rail Yard (Area 3) for which analytical results have indicated TCLP exceedances;
- Excavation and off-site disposal of approximately 8,000 cubic yards of stockpiled soils where the contaminant concentrations have been shown to exceed either UCLs or RBC, PCBs are present, and/or hot spots have been previously identified (refer to Figure 3); and
- Deed Restrictions – Deed restrictions in the form of an Activity and Use Limitation (AUL) will be placed on the entire property limiting future land use activities.

After excavation and removal of the soils, the areas would be backfilled and/or regraded and left in a geotechnically stable condition. Confirmatory soil sampling would be conducted to ensure that an appropriate volume of soil had been removed to meet the risk-based goals of these areas.

- Alternative 2 – Soil Excavation (0 to >8 feet) of Site-wide UCL Exceedances and Off-Site Disposal with Stabilization:

  This Alternative is similar to Alternative 1 above in the following components:

  - Excavation and off-site disposal of approximately 1,600 cubic yards of Hot spot soil Areas (SS-1, SS-22, cell 906).
  - On-Site chemical stabilization (if necessary) of all excavated and stockpiled soils prior to off-site disposal in order to minimize leachability of lead and arsenic;
  - In-Situ stabilization of approximately 1,000 cubic yards of soils within the Main Rail Yard (Area 3) for which analytical results have indicated TCLP exceedances;
  - Excavation and off-site disposal of approximately 8,000 cubic yards of stockpiled soils where contaminant concentrations have been shown to exceed either UCLs or RBC, PCBs are present, and/or hot spots have been previously identified (refer to Figure 3); and
  - Deed Restrictions – Deed restrictions in the form of an Activity and Use Limitation (AUL) will be placed on the entire property limiting future land use activities.

  Alternative 2 differs from Alternative 1 in that UCL exceedances are used to determine the limits of excavation in lieu of applicable RBCs used in Alternative 1, which results in reduced volumes of soil as follows:

  - Excavation and off-site disposal of approximately 24,500 cubic yards of metals-contaminated soils across all four areas of the site where contaminant concentrations have been shown to exceed the applicable UCLs.

  Similar to Alternative 1, the areas would be backfilled and/or regraded and left in a geotechnically stable condition after excavation and removal of the soils. Confirmatory soil sampling would be conducted to ensure that an appropriate volume of soil had been removed to meet the risk-based goals of these areas.

- Alternative 3 – Soil Excavation (0 to >8 feet) of Limited UCL Exceedances and Off-Site Disposal with Stabilization:

  This Alternative is similar to Alternatives 1 & 2 above in the following components:

  - Excavation and off-site disposal of approximately 1,600 cubic yards of Hot spot soil Areas (SS-1, SS-22, cell 906).
  - On-Site chemical stabilization (if necessary) of all excavated and stockpiled soils prior to off-site disposal in order to minimize leachability of lead and arsenic;

- In-Situ stabilization of approximately 1,000 cubic yards of soils within the Main Rail Yard (Area 3) for which analytical results have indicated TCLP exceedances;
- Excavation and off-site disposal of approximately 8,000 cubic yards of stockpiled soils where contaminant concentrations have been shown to exceed either UCLs or RBC, PCBs are present, and/or hot spots have been previously identified (refer to Figure 3); and
- Deed Restrictions – Deed restrictions in the form of an Activity and Use Limitation (AUL) will be placed on the entire property limiting future land use activities.

Alternative 3 differs from Alternatives 1 & 2 in that only UCL exceedances within Area 4 are used to reduce contaminant concentrations to meet applicable EPCs, which results in reduced volumes of soil as follows:

- Excavation and off-site disposal of approximately 1,950 cubic yards of metals contaminated soils where the contaminant concentrations have been shown to exceed the applicable UCLs (refer to Figure 3).

No excavation is required in Areas 1 through 3 since EPCs are currently below RBCs.

Similar to Alternatives 1&2, the areas would be backfilled and/or regraded and left in a geotechnically stable condition after excavation and removal of the soils. Confirmatory soil sampling would be conducted to ensure that an appropriate volume of soil had been removed to meet the risk-based goals of these areas.

- Alternative 4 – Installation of an Engineered Barrier:

  Similar to the three options described above, Alternative 4 would include the following components:

  - Excavation and off-site disposal of approximately 1,600 cubic yards of Hot spot soil Areas (SS-1, SS-22, cell 906).
  - On-Site chemical stabilization (if necessary) of all excavated and stockpiled soils prior to off-site disposal in order to minimize leachability of lead and arsenic;
  - In-Situ stabilization of approximately 1,000 cubic yards of soils within the Main Rail Yard (Area 3) for which analytical results have indicated TCLP exceedances;
  - Excavation and off-site disposal of approximately 8,000 cubic yards of stockpiled soils where contaminant concentrations have been shown to exceed either UCLs or RBC, PCBs are present, and/or hot spots have been previously identified (refer to Figure 3); and
  - Deed Restrictions – Deed restrictions in the form of an Activity and Use Limitation (AUL) will be placed on the entire property limiting future land use activities.

  Alternative 4 differs from the previous three alternatives in that an engineered barrier would be installed in lieu of excavation in Area 4 in order to achieve a level of no significant risk.

3.3.3 Detailed Evaluation

Evaluation Criteria

This section presents a detailed evaluation comparison of the RAAs described above that have been formulated from the original RAAs developed for the Site by Weston & Sampson. As specified in 310 CMR 40.861(2)(b), the MCP requires the RAAs that passed the initial screening be put through a comparative analysis for the criteria outlined in 310 CMR 40.0858. The required criteria are grouped into the following categories: effectiveness, reliability, implementability, cost, risk, benefit, timeliness, and non-pecuniary interests. These criteria are described below:

- Criterion 1 – Effectiveness in terms of: achieving a Permanent or Temporary solution; reusing, destroying, detoxifying or treating at the Site; and reducing the levels of hazardous materials at the Site to concentrations that achieve or approach background.
- Criterion 2 – Short and long-term reliability in terms of: degree of certainty that the alternative will be successful; and the effectiveness of any measures required to manage residues or remaining wastes or control emissions or discharges to the environment.
- Criterion 3 – Implementability in terms of: technical complexity; ability to integrate with existing facility operations, where applicable; monitoring and site access requirements; availability, capacity of necessary off-site treatment, storage, and disposal facilities; whether the alternative meets regulatory requirements for any likely approvals, permits, or licenses issued by the DEP, other state agencies, federal or local agencies.
- Criterion 4 – Cost of the alternative in terms of capital expenditure; operation and maintenance (O & M) costs; design fee; and monitoring charges. It is important to note that the costs presented in this report are only preliminary estimates and will be refined upon completion of the engineering design for those alternatives selected as the final remedy of the Site.
- Criterion 5 – Risks in terms of: short-term on-site and off-site risks during implementation; on-site and off-site risks over the period of time required to attain applicable cleanup standards; and risks remaining after the completion of the remedial action.
- Criterion 6 – Benefits in terms of: restoring natural resource; returning the Site to productive use; avoiding costs to relocate people, businesses or water supplies.
- Criterion 7 – Timeliness of the alternative in terms of eliminating any uncontrolled release and/or achieving a level of No Significant Risk.
- Criterion 8 – Non-pecuniary affects, such as aesthetic values or other parameters that cannot be assigned a monetary value.

Detailed Evaluation

Effectiveness

All four alternatives would be effective in achieving a level of No Significant Risk and a Permanent Solution, since metals-impacted soils (to varying degrees) would be excavated and removed from the Site. These alternatives would rely on off-site management and recycling of the waste material; thus it would effectively reuse, recycle, destroy, detoxify, or treat varying quantities of the waste materials from the Site. Implementation of these alternatives would not reduce levels of untreated soils to concentrations that achieve or approach background. Stabilization is a component of all four alternatives for excavated soils prior to disposal that fail the TCLP leachability testing.

The installation of the engineered barrier under Alternative 4 would rely mainly on the elimination of exposure to the contaminated soils and minimally on soil excavation and reduction of the contaminant levels (stockpiles and hot spots only).

All four alternatives rely on institutional controls (i.e., AUL) to achieve the required risk reduction necessary to protect the future construction worker from incidental ingestion of and dermal contact with metals.

Short-term and long-term reliability

These four alternatives would be effective in maintaining No Significant Risk and a Permanent Solution by either successfully removing contaminated soil or eliminating the exposure pathway to meet risk based cleanup levels and thus ensuring long-term reliability. In the short-term, impacts from air emissions would need to be controlled.

The engineered barrier as part of Alternative 4 will require a long-term monitoring and maintenance program to ensure that the integrity of the barrier is maintained and that a condition of No Significant Risk is sustained.

Implementability

The excavation of soils around the Site is not judged to be technically complex and is implementable, but will be impacted by the pre-screening and stabilization process (if necessary) prior to off-site disposal. Public approval of these processes will be required.

Space limitations are not an issue on the property for the large area proposed for excavation by Alternatives 1 & 2, and therefore can accommodate the required additional truck loads of soil to be handled and transported from the Site. These RAAs requires only temporary equipment during excavation, stabilization, and installation of the engineered barrier (Alternative 4). There is adequate accessibility and room for staging and pretreatment areas around the Site.

This Alternative for soil remediation would not likely encounter any significant regulatory hurdles; therefore, all permits and approvals could be obtained.

Excavated and stabilized soils will need to be transported off-site under a Bill of Lading (BOL) or appropriate materials tracking documentation to an appropriate disposal facility. It is anticipated that the RAA will meet all regulatory requirements for any likely approvals, permits, or licenses issued by the DEP, other state agencies, federal or local agencies.

Cost

The costs to implement Alternatives 1, 2 and 3 are directly proportional to the quantity of contaminated soil requiring removal, stabilization, and disposal from the Site, which will depend on the actual quantity of soil that will be removed. The majority of cost for Alternative 4 is associated with the construction of the engineered barrier. In addition, the exact costs for stabilization and off-Site trucking and disposal are time- and site-dependent. However, given these uncertainties, preliminary estimates of costs for the four alternatives have been developed. These estimated preliminary order of magnitude costs for Alternatives 1 through 4, are presented in Tables 19 through 22, respectively.

Risks

All four alternatives could present the potential for both short-term and long-term risks. The potential short-term risks include:

- Worker contact with heavy-duty earthmoving equipment including excavators and trucks/trailers will need to be employed to perform the work; and
- Worker contact with soil contaminants during excavation and handling operations.

These risks can be managed by Health and Safety Plans and Soil Management Plans.

The potential long-term risks are minimal, as varying portions of the source of contamination will be removed under Alternatives 1, 2, and 3. For Alternative 4, long-term risks for construction workers during future excavation activities associated with the contaminated soils remaining in-place would be mitigated by the implementation of an AUL. Implementing an AUL would allow the reuse of the Site for productive commercial/industrial purposes in a safe and protective manner to human health and the environment.

Benefits

Implementation of these alternatives is expected to be beneficial in providing a Permanent Solution. Alternatives 1, 2 & 3 provide additional benefits by reducing the potential for exposure to contaminated soils by removing contaminated soils from the Site in varying degrees. Alternative 4 would provide a reduction in potential for exposure by implementation of the engineered barrier. All four alternatives will provide for future reuse of the Site for commercial/industrial use.

This Alternative would also provide a financial benefit to the current facility owner in terms of improving the value of the property.

Timeliness

Alternatives 1, 2, & 3 can be implemented quickly and will be effective immediately upon removal and off-site disposal of the contaminated soils. The duration is estimated to be 12 months depending upon which excavation alternative is selected. The duration of Alternative 4 is expected to require at least 12 months based upon the time needed to complete a design and acquire the necessary permits and approvals, and implement the remedy.

Non-pecuniary affects

Aesthetically, the Site would be modified and changed substantially due to the excavation and removal of the stockpiles for all alternatives. Permanent closure of the site should reduce neighborhood concerns.

3.4 Recommended Remedial Alternative

Based on the results of the detailed evaluation presented in original Phase III RAP and the re-evaluation presented in Section 3.3 above, the following RAA is recommended as the final remedy for the Readville Yard site.

- **Alternative 3 – Soil Excavation (0 to >8 feet) of Limited UCL Exceedances and Off-Site Disposal with Stabilization:** This Alternative has the greatest potential to cost-effectively attain a reduction of COCs (mainly metals) in soil to levels that achieve risk-based cleanup goals and meet a condition of No Significant Risk, and thus reach a Permanent Solution. Alternative 3 has been selected because the combined alternative provides the following advantages:
  - High level of confidence in timely achievement of Permanent Solution;
  - The availability of resources needed to implement the RAA;
  - The least amount of design, installation and maintenance, which translates into the least amount of overall foreseeable difficulties; and
  - Cost-effective remedy in comparison to other alternative.

In summary, Alternative 3 provides the best balance of contaminant removal with implementability, cost effectiveness, and risk of short-term impacts. It would protect public health and the environment by removing the most accessible contamination (stockpiles) and effectively reducing contaminant concentrations below applicable RBCs across the entire Site by selectively removing areas of high UCL exceedances.

It is expected that the implementation of Alternative 3 will result in a condition of "No Significant Risk" to health, safety, public welfare, and the environment at the Site, and a Permanent Solution will be achieved. Therefore, any further benefit concerning risk reduction that may be achieved by further reducing concentrations of COCs in soil under Alternatives 1 and 2 would be limited and would not justify the additional cost (more than 3 times the cost) associated with these alternatives. Short-term risks, in fact, may actually increase due to the increased number of trucks and other equipment required to implement Alternatives 1 and 2 as compared to Alternative 3.

The engineering controls (engineered barrier) proposed in Alternative 4, in conjunction with the proposed institutional controls, would be reliable methods of preventing human exposure to contaminants and provide similar risk benefits to Alternative 3. However, the estimated capital costs of Alternative 4 would be higher and implementation requires long-term maintenance costs to maintain the barrier, making Alternative 3 more cost-effective.

3.4.1 Operation, Maintenance, and Monitoring Requirements

A Permanent Solution will be achieved for the Site as a result of the implementation of the recommended alternative. Therefore, no on-going operation and maintenance activities are required. The implementation of an AUL for the Site is also considered to be a Permanent Solution by providing the reduction of risk to the future construction worker. However, the AUL would require that any conditions of the AUL be maintained and that any future work on the Site involving excavation of soils be performed in accordance with a Health and Safety Plan (HASP) and under the supervision of a Licensed Site Professional (LSP).

3.4.2 Health and Safety

A Health and Safety Plan (HASP) will be implemented during all site activities.

3.4.3 Implementation Schedule

The proposed remedial activities will be implemented following the submittal of the Phase IV RIP to DEP. The Phase IV RIP will include a project schedule for implementation of the remedial action. It is anticipated that the remedial activities associated with the Site will be initiated in Summer 2009. A Response Action Outcome Statement is anticipated within 18 months of initiation of excavation activities.

3.4.4 Temporary versus Permanent Solution

It is anticipated that implementation of Alternative 3 will result in concentrations of contaminants in the soil below applicable RBC standards. Excavation of selected metals-contaminated soils which exceed UCLs in Area 4, as well as the hot spots and soil stockpiles will effectively reduce metal contaminant levels in the soils. The end result is a condition of No Significant Risk, a Permanent Solution, and the reduction of metals contaminants to below acceptable RBC levels. The implementation of an AUL for the Site will also result in a condition of No Significant Risk for future Site conditions and a Permanent Solution for the Site.

3.4.5 Evaluation of Feasibility of Achieving Background

As required by the MCP (310 CMR 40.861(g)), the feasibility of achieving background conditions for each COC identified at the Site was evaluated. The feasibility of the selected RAAs to achieve background conditions at this Site was evaluated for the media of concern (contaminated soil).

3.4.5.1 Identification of Background Levels

For a detailed description of background levels for the Site COCs, the reader should refer back to Section 2.0 of this report.

3.4.5.2 Potential of Achieving or Approaching Background Conditions

An evaluation of the ability to achieve background conditions as defined in the previous section was completed for this Site. The chosen RAA (Alternative 3 - Soil Excavation (0 to >8 feet) of Limited UCL Exceedances in Area 4 Only and Off-Site Disposal with Stabilization) will likely result in a reduction of contaminant concentrations (primarily metals) in soils to levels that achieve risk-based cleanup goals and achieve a condition of No Significant Risk, but do not approach background conditions. Given that the selected RAA will achieve a condition of No Significant Risk, further reduction of contaminant levels would not provide significant benefits relative to risk reduction. In addition, the costs to implement the other feasible alternatives would be substantial and would be disproportionate to the incremental benefits additional remediation may provide. In fact, the additional costs to removal all soils above background are estimated to exceed 5 times the cost of the recommended Alternative.

4.0 PHASE IV REMEDY IMPLEMENTATION PLAN

4.1 Introduction

4.1.1 Objective

The objective of this Phase IV RIP is to address, as appropriate and pertinent, the MCP requirements under 310 CMR 40.0870 for the implementation of the CRA selected for the Site. The selection of the CRA was based on a detailed evaluation of several feasible RAAs. A detailed evaluation was presented by Weston & Sampson in the RAP submitted to MassDEP in April 2003. However, the MBTA recently gathered additional characterization data in June and July 2008 to supplement and update the Phase II CSA, including an updated Method 3 RC (see Section 2.0), and used these data to revise the detailed evaluation of RAAs in a Supplemental Phase III report (see Section 3.0).

This Phase IV RIP considers pertinent conditions at the Site necessary for the development and implementation of a remedial design, including the monitoring and identification of other contingencies, by means of soil excavation, on-site chemical stabilization and off-site disposal. The goal of the remedial activities is to reduce the impacted soil to levels below the Method 3 RBCs through limited soil removal thereby significantly reducing the contamination at the Site.

A Comprehensive Response Action Transmittal Form (BWSC-108) accompanies this submittal and a copy is presented in Appendix E.

4.1.2 Site Background

A detailed description of the Site and surrounding areas, the Site history, Site and surrounding area land use, utilities, and a summary of the COCs were presented in Section 1.3 of this Report.

4.1.3 Previous Investigations

Site history and previous investigations are presented above in Section 1.4 of this Report.

4.1.4 Phase III RAP Recommendations

Phase III RAP recommendations are presented above in Section 3.4 of this Report.

4.1.5 List of Relevant Contact Information

In accordance with 310 CMR 40.0874 (3) (a) (1) the names, addresses and telephone numbers of the RP, PRP, or Other Persons responsible for the submittal of the RIP are provided below.

Responsible Party:	Massachusetts Bay Transportation Authority
Address:	10 Park Plaza, Room 6720, Boston, Massachusetts
Contact:	Debra Darby, Site Remediation Specialist
Telephone:	617-222-3169

In accordance with 310 CMR 40.0874 (3) (a) (2) the name, address and telephone number of the LSP is provided below.

L.S.P.:	Elissa J. Brown
Address:	300 Baker Avenue, Suite 290, Concord, MA 01742
Telephone:	978-371-4000
License No.:	5371
Company:	Earth Tech AECOM

In accordance with 310 CMR 40.0874 (3) (a) (3) and 310 CMR 40.0874 (3) (d) (1) the identification of those persons who will own, operate and/or maintain the selected RAA during and following construction, and who will conduct operation, maintenance and monitoring is provided below.

Consultant:	Earth Tech AECOM
Address:	300 Baker Avenue, Suite 290, Concord, MA 01742
Telephone:	978-371-4000
Contacts:	Elissa Brown, Mark Jones

4.2 Engineering Design

4.2.1 Goals of the Remedial Action

The cleanup objective for the Site is to reduce soil COC concentrations that mitigate Site conditions such that a condition of No Significant Risk to human health or the environment exists. Specifically, excavation of selected metals-contaminated soils which exceed UCLs in Area 4, as well as the hot spots and soil stockpiles will effectively reduce contaminant levels in the soils. The end result is a condition of No Significant Risk, a Permanent Solution, and the reduction of COCs to below acceptable RBC levels. The implementation of an AUL for the Site will also result in a condition of No Significant Risk for future Site conditions and a Permanent Solution for the Site.

4.2.2 Significant Changes or New Information Related to Disposal Site Conditions

In accordance with 310 CMR 40.0874 (3) (b) (2), new information and changes (revised RBCs) related to Site conditions were updated and summarized in the Supplemental Phase II CSA and RC presented in Section 2.0 and the Supplemental Phase III RAP presented in Section 3.0 of this report.

4.2.3 Disposal Site Maps

The Disposal Site Maps depicting the existing Site features and proposed locations of activities associated with the remedial actions are attached in the Figures section of this report. Figure 1 presents the Site Locus Plan. Figure 2 presents the Site Plan depicting the portion of the Property comprising the Site, utility locations, and other site features. Figure 3 presents the soil boring, stockpile, test pit, and monitoring well locations at the Site. Figures 7 through 18 present the estimated extent of the soil contamination at the Site. Figure 19 presents a conceptual design showing areas proposed for excavation, treatment and off-site disposal.

4.2.4 Characteristics, Quantities, and Location of Contaminated Media to be Treated

4.2.4.1 Soil Contamination

A detailed summary of the soil analytical data for samples collected during the Supplemental Phase II investigation, are presented in the Supplemental Phase II CSA Report in Section 2.6.3 above. A summary of soil analytical data is presented in Tables 1 and 2. Figure 19 presents hot spot, soil, and stockpile areas that are proposed for excavation, on-site chemical stabilization and off-site disposal.

4.2.4.2 Groundwater Contamination

Groundwater does not pose an unacceptable risk; therefore, no specific remedial objectives were developed for this report.

4.2.5 Conceptual Plan

The following conceptual plan has been developed to achieve the remedial goals outlined in Section 4.2.1 above. The conceptual plan comprises soil excavation, on-site and in-situ chemical stabilization, off-site disposal, and an Activity and Use Limitation (AUL) to address the existing site conditions.

1) <u>Excavation and Off-Site Disposal</u> – Excavation and off-site disposal of approximately 1,600 cubic yards (or 2,400 tons) of hot spot soil Areas (SS-1, SS-22, cell 906). Excavation and off-site disposal of approximately 1,950 cubic yards (or 2,900 tons) of metals contaminated soils where the contaminant concentrations have been shown to exceed the applicable UCLs. Excavation and off-site disposal of approximately 8,000 cubic yards (or 12,000 tons) of stockpiled soils where contaminant concentrations have been shown to exceed either UCLs or RBC, PCBs are present, and/or hot spots have been previously identified. The approximate excavation areas are shown on Figure 19. Additional information regarding the handling and disposal of impacted soils is presented in Section 4.2.8.

2) On-Site chemical stabilization (if necessary) of all excavated and stockpiled soils (approximately 5,300 tons) prior to off-site disposal in order to minimize leachability of lead and arsenic;

3) In-Situ stabilization of approximately 1,000 cubic yards (or 1,500 tons) of soils within the Main Rail Yard (Area 3) for which analytical results have indicated TCLP exceedances; and

4) Deed Restrictions – Deed restrictions in the form of an Activity and Use Limitation (AUL) will be placed on the entire property limiting future land use activities.

The areas would be backfilled and/or regraded and left in a geotechnically stable condition after excavation and removal of the soils. Confirmatory soil sampling will be conducted to ensure that an appropriate volume of soil had been removed to meet the risk-based goals of these areas.

4.2.6 Relevant Design and Operation Parameters

4.2.6.1 Design Criteria

The key design and operations parameters for the remedial excavation include the following:

- Permitting issues will be addressed prior to initiating remediation activities in the proposed excavation area.

- The excavation area and traffic access areas will be secured with hay bales, silt fence, caution tape, or snow fence as needed or required by permit. Proposed work limits shown as Area 4 (EZ) are presented on Figure 19.
- Utilities located within the excavation area will be identified by a utility locating company, protected during construction and/or rerouted as necessary. The utilities include underground gas line, water line, and sewer line (see Figure 3).
- The soil removed from the excavation area will be placed in a stockpile staging area. Soil will be stockpiled on top of and beneath two layers of 6-mil polyethylene sheeting. The stockpile will be secured with a berm, hay bales, silt fence, caution tape or snow fence as needed.
- The approach to TCLP lead stabilization of soil residue at the site is based upon converting the existing site elemental lead compounds to more stable thermodynamic, nontoxic, natural insoluble mineral lead complexed apatite compounds, and completing the stabilization in an in-situ fashion for TCLP failed soils or on-site in small stockpiles before transport off-site for disposal, depending on the area. The compounds formed are engineered to be low leachable under TCLP and natural-leaching conditions found in landfills or waste piles. The resultant heavy metal compounds are found in natural settings, and are derived from elements common to natural surficial geology. The lead stabilization method uses a mixed apatite forming phosphate sulfuric mineral blend, which allows for an instantaneous reaction and stabilization upon mixing with soil, and thus requires no curing time. The chemical blend is applied to the surface of the waste and water activated. The anticipated chemical dose application rate of 1% to 2% and free water application of 1% will not significantly alter the character of the soil in any hardness, cohesiveness, and workability or grain size manner.
- After the excavation is completed, the excavation area will be backfilled and re-graded to its current condition. Certification that the fill is clean and acceptable for backfill will be provided by the facility supplying the fill materials.

4.2.6.2 Expected Effectiveness of the Remedial Action

The expected effectiveness of the soil excavation and removal is considered high. Post-excavation samples will be collected from the excavation sidewalls and bottom to confirm the removal of contaminants and the effectiveness of the remedy. Post-excavation soil sample results should demonstrate a condition of No Significant Risk based on EPC calculations of the soil remaining in place resulting in attainment of remedial goals.

4.2.7 Contingency Design Measures

Contaminated soil from excavation activities will be transported properly to minimize the potential for spills.

The excavation equipment to be used on-site is generally engineered to minimize the potential for accidental discharge or malfunction. Equipment operators and remediation chemical handlers will be appropriately licensed and trained, and will be supervised by Earth Tech personnel to ensure that work adheres to the specifications set forth in this RIP.

4.2.8 Management of Remediation Wastes

As discussed, impacted soils will be excavated and stockpiled. The soil stockpile area will be constructed of two layers of 0.6-millimeter polyethylene sheeting on the ground surface. The downslope perimeter of the soil stockpile area will be bermed with 6-inches of clean soil and/or hay bales. The bottom polyethylene sheeting will be placed over the berm and secured. Once the soils are placed onto the soil stockpile polyethylene sheeting, the soils will be covered with a second sheet of polyethylene sheeting.

The top polyethylene sheeting will be secured to provide protection from rainfall infiltration and generation of fugitive dust. There will be one or more soil stockpiles created for the excavation area.

Using an excavator, the soils will be excavated and placed in the designated soil stockpile area adjacent to the excavation. Once all designated soils have been excavated and stockpiled, soil from each pile will be sampled for waste characterization analysis to determine the appropriate waste disposal option for the soils. Alternatively, the soils may be pre-characterized prior to excavation in order to expedite off-site disposal and minimize on-site temporary stockpiling. The final disposal location will be selected based on the stockpile disposal characterization analyses. The analysis required for each sample will consist of TPH, VOCs, semi-volatile organic compounds (SVOCs), pH, Conductivity, Reactivity Sulfide/Cyanide, RCRA 8 Metals, Flashpoint, and PCBs. It should be noted that these parameter groups are not necessarily found in the soils based on sampling conducted to date, but are necessary to provide information to the receiving facility for determination of disposal options. Upon determining the proper disposal destination for each stockpile, the soils will be loaded into permitted transport trucks and shipped under proper BOL or Manifest.

Contaminated soil, and contaminated water if generated, will be disposed off-site at a Massachusetts-licensed recycling and/or disposal facility in accordance with state and federal laws and will be shipped under a Massachusetts BOL prepared and stamped by an Earth Tech LSP or manifest.

4.2.9 Site-Specific Characteristics Affected by CRA

Remediation activities will be coordinated with the MBTA Facility Manager for the rail yard. Particular care will be taken to ensure that utilities located within or adjacent to the proposed excavation are protected.

In accordance with 310 CMR 40.0874 (9)(a,b,c,d) there are no other site-specific characteristics which may affect or be affected by the design, construction, or operation of the selected RAA.

4.2.10 Avoidance of Environmental Impact

In accordance with 310 CMR 40.0874 (10) environmental receptors and/or natural resources on the Site are unlikely to be negatively impacted or altered during implementation of the selected RAA. The nearest surface water body is located approximately 1,000 feet from the Site and the remedial action will conducted predominantly below ground. Surface operations will be performed in such a manner to prevent or minimize standing water.

4.2.11 Inspections and Monitoring

A Phase IV Operations, Maintenance and/or Monitoring (OMM) Plan is presented as Section 4.4 of this RIP.

A DEP Phase IV Completion Statement Form will be completed and appended to the Phase IV Final Inspection Report. The Final Inspection Report will include a Plan showing the area of soil excavation, all Phase IV analytical results, and conclusions.

An Earth Tech on-site representative will document the construction and excavation operations, including: the securing of excavation stockpile areas, the excavation, on-site stabilization, stockpiling and the loading of soil to trailers for off-site disposal. The on-site representative will record construction observation notes, as-built measurements, photographic images, and related information in a daily log book form. Pursuant to 310 CMR 40.0875, an As-Built Report will be prepared if the constructed remedial alternative varies significantly from the proposed plan in this RIP.

4.3 Construction Plans and Specifications

The selected RAA does not include the installation of treatment equipment. As such, construction plans and specifications are limited only to the plans and specifications for utility protection and soil excavation. Up to 13,000 cubic yards (approximately 19,000 tons) of contaminated soil will be excavated and disposed of off site. The area requiring protection, excavation, and disposal are detailed on Figures 19.

It is anticipated that the CRA implementation will be initiated in Summer 2009. A Response Action Outcome Statement is anticipated within 18 months of initiation of excavation activities.

4.4 Operation, Maintenance, and Monitoring

The names and telephone number of the persons conducting operation, maintenance and monitoring activities under the RIP are above in Section 4.1.5. Because of the nature of the remediation, general operating procedures such as start-up, testing, maintenance, shutdown and contingency or emergency procedures are not necessary.

4.4.1 Performance Monitoring Plan

Confirmatory soil sampling will be conducted to ensure that an appropriate volume of soil had been removed to meet the risk-based goals of this area. Earth Tech will collect sidewall and bottom soil samples from the area of contamination (see Figure 19). Confirmatory samples will be determined for lead by XRF. Approximately 107 soil samples will be submitted under chain-of-custody to a Massachusetts-certified laboratory for analysis. All the samples will be analyzed for lead and arsenic, by the MCP Analytical Methods that are detailed in the MassDEP's Compendium of Analytical Methods (CAM). Sufficient post-excavation monitoring will occur to comply with 310 CMR 40.0046.

4.5 Miscellaneous Implementation Issues

4.5.1 Health and Safety Plan

Earth Tech prepared a site-specific health and safety plan (HASP) in accordance with 29 CFR 1910.120. The hazardous materials health and safety plan prepared to address oversight of remediation activities is presented in Appendix G. Contractors will be responsible for preparing a HASP to address remedial activities.

4.5.2 Necessary Federal, State, or Local Permits Required for the RIP

No permits are anticipated for completion of the excavation and off-site disposal of contaminated soils. Should permits be required, MBTA's contractor will be responsible for completion and filing of permits with support from the MBTA.

4.5.3 Property Access

The implementation of the selected RAA will be conducted, in its entirety, within the limits of the Owner's property. Therefore, in accordance with 310 CMR 40.0874 (3) (f), there are <u>no</u> property access issues, which are relevant to the implementation of the selected RAA.

4.5.4 Public Involvement Requirements

In accordance with Public Involvement Activities in Response Actions (310 CMR 10.1403) outlined in the MCP and described in the PIP prepared for the Site (dated April 2002), notice of the availability of this Revised Phase IV RIP (and Supplemental Phase II and III) report will be submitted to the Boston and Dedham Chief Municipal Officers, Municipal Boards of Health, and the PIP mailing list. Prior to submission of a final document, a draft version of the document will be placed in the public repositories in Dedham and Boston, notification made to public officials and other persons on the PIP list, and a public meeting held on November 5, 2008 to inform the public and to solicit the concerns of the public during a public comment period. Meeting summaries and responses to public comments are included, with copies of the letters to municipal officers in Appendix F. A copy of this final document, with the meeting summaries and response to comments, has been placed in the public repositories as well.

Written notice will also be provided to the Boston and Dedham Chief Municipal Officers, Municipal Boards of Health and PIP mailing list at least three days prior to undertaking field activities with notice provided concurrently to the MassDEP.

4.6 Additional Phase IV Activities

4.6.1 As-Built Construction Report

An As-Built Construction Report will be prepared and submitted to the DEP if the remedial action alternative as-constructed differs significantly from the description of the alternative described above in this RIP (310 CMR 40.0875 (1) (a), (b), or (c)). If required, the report shall include a description of construction activities conducted, tests and measurements performed, any significant modifications of the design as described above in the RIP, and as-built drawings in conformance with appropriate engineering and construction standards and practices, and regulations applicable to construction plans and activities, per 310 CMR 40.0875 (2) and (3).

4.6.2 Final Inspection Report

In accordance with 310 CMR 40.0878, a final inspection of the CRA will be performed. A Final Inspection Report will be prepared and submitted to the DEP describing the final inspection activities and findings. In addition, a Phase IV Completion Statement (310 CMR 40.00879) will be submitted along with the Final Inspection Report.

5.0 REFERENCES

HMM Associates, Inc., 1989. Preliminary Site Assessment Phase I – Limited Site Investigation, MBTA Readville Yard.

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Weston & Sampson Engineers, Inc., December 2002. Immediate Response Action Status Report, MBTA Readville 5-Yard Facility, Dedham and Readville, MA.

Weston & Sampson Engineers, Inc., January 2003. Phase II – Comprehensive Site Assessment, MBTA Readville 5-Yard Facility, Dedham and Readville, MA.

Weston & Sampson Engineers, Inc., April 2003. Phase III – Remedial Action Plan, MBTA Readville 5-Yard Facility, Dedham and Readville, MA.

Weston & Sampson Engineers, Inc., and EST Associates, Inc., December 2001. Soil Stockpile Management and Characterization Plan, MBTA Readville 5-Yard Facility, Dedham and Readville, MA.

Figures

Tables

Appendices

Appendix A

Laboratory Analytical Reports

(NOTE: THIS APPENDIX INTENTIONALLY LEFT BLANK. WILL BE PROVIDED UPON REQUEST)

Appendix B

Boring and Test Pit Logs

Appendix C

Soil Exposure Point Concentration Calculation

Appendix D

Risk Characterization Tables

Appendix E

Comprehensive Response Action Transmittal Form
&
Phase II, III, IV Completion Statements (BSWC-108)

Appendix F

Letters to Municipal Officers and PIP Participants

Appendix G

Health and Safety Plan (HASP)

The attached disk includes the following:

Figures
Tables
Appendices