

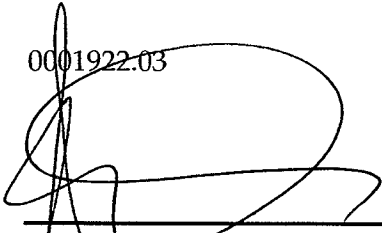
Raytheon Company

Phase I Initial Site Investigation
Former Raytheon Facility
430 Boston Post Road
Wayland, Massachusetts

RTN 3-22408

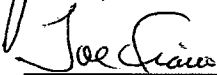
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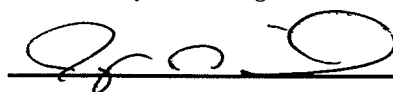
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TABLE OF CONTENTS

| | |
|--|-------------|
| TABLE OF CONTENTS | I |
| LIST OF TABLES | IV |
| LIST OF FIGURES | V |
| APPENDICES | VII |
| EXECUTIVE SUMMARY | ES-I |
| 1.0 INTRODUCTION | 1 |
| 1.1 BACKGROUND | 1 |
| 1.2 PURPOSE AND SCOPE | 2 |
| 2.0 GENERAL DISPOSAL SITE INFORMATION | 4 |
| 2.1 DEP RELEASE TRACKING NUMBERS | 4 |
| 2.2 ADDRESS AND GEOGRAPHICAL LOCATION | 5 |
| 2.2.1 Address | 5 |
| 2.2.2 Geographic Location | 5 |
| 2.3 DISPOSAL SITE LOCUS MAP & TOPOGRAPHY | 5 |
| 2.4 ESTIMATED NUMBER OF ON-SITE WORKERS AT THE DISPOSAL SITE | 6 |
| 2.5 ESTIMATED RESIDENTIAL POPULATION WITHIN A ½ MILE RADIUS OF THE SITE | 6 |
| 2.6 GENERAL DESCRIPTION OF LAND USES SURROUNDING THE DISPOSAL SITE | 7 |
| 2.7 NUMBER OF INSTITUTIONS WITHIN 500 FEET OF THE DISPOSAL SITE | 7 |
| 2.8 NATURAL RESOURCE AREAS LOCATED WITHIN 500 FEET OF THE DISPOSAL SITE | 7 |

| | | |
|-------------|---|-----------|
| 2.9 | DISPOSAL SITE MAPS | 8 |
| 2.10 | SITE REPORTING CATEGORIES | 9 |
| 2.10.1 | Overview | 9 |
| 2.10.2 | Soil | 9 |
| 2.10.3 | Groundwater | 10 |
| 3.0 | DISPOSAL SITE HISTORY | 11 |
| 3.1 | OWNER / OPERATOR AND OPERATIONS HISTORY | 11 |
| 3.1.1 | Current and Relevant Previous Disposal Site Owners and Operators | 11 |
| 3.1.2 | Current and Historical Site Uses | 11 |
| 3.2 | RELEASE HISTORY | 12 |
| 3.3 | OIL AND/OR HAZARDOUS MATERIAL USE AND STORAGE HISTORY | 12 |
| 3.3.1 | OHM Types, Uses, Quantities, Periods of Use & Storage | 12 |
| 3.3.2 | Underground Storage Tanks (USTs) | 13 |
| 3.3.3 | Aboveground Storage Tanks (ASTs) | 13 |
| 3.3.4 | Lagoons, Pits & Piles | 14 |
| 3.4 | WASTE MANAGEMENT HISTORY | 14 |
| 3.4.1 | Land Disposal | 14 |
| 3.4.2 | Subsurface Disposal | 15 |
| 3.4.3 | Surface Water Discharges | 15 |
| 3.4.4 | Discharges to Wastewater Treatment Plants | 16 |
| 3.4.5 | Other Means of Disposal or Treatment | 16 |
| 3.5 | ENVIRONMENTAL PERMITS AND COMPLIANCE HISTORY | 16 |
| 3.5.1 | Permits for M.G.L. c. 21E Response Actions | 16 |
| 3.5.2 | Oil and/or Hazardous Material Storage Permits | 17 |
| 3.5.3 | Wastewater Discharge Permits | 17 |
| 3.5.4 | Groundwater Discharge Permits | 17 |
| 3.5.5 | Air Quality Discharge Permits | 17 |
| 3.5.6 | Wetlands Alteration Permits | 18 |
| 3.5.7 | Resource Conservation and Recovery Act (RCRA) Permits | 18 |
| 3.5.8 | National Pollutant Discharge Elimination System (NPDES) Permits | 18 |
| 3.5.9 | Other Local, State and Federal Environmental Permits, OHM Storage Permits, and Permit Violation Information | 19 |
| 4.0 | METHODS | 20 |
| 4.1 | OVERVIEW | 20 |

| | | |
|------------|---|-----------|
| 4.2 | GAUGE AND SAMPLE WELLS | 21 |
| 4.3 | DELINEATE WETLANDS | 22 |
| 4.4 | GEOPHYSICAL SURVEYS | 22 |
| 5.0 | RESULTS | 23 |
| 5.1 | OVERVIEW | 23 |
| 5.2 | SITE GEOLOGY | 24 |
| 5.3 | SITE HYDROGEOLOGY | 26 |
| 5.4 | NATURE AND EXTENT OF CONTAMINATION | 27 |
| 5.4.1 | <i>Evidence of Release</i> | 27 |
| 5.4.2 | <i>Names, Concentrations and Volumes of OHM Released</i> | 32 |
| 5.4.3 | <i>Impacts to Soil</i> | 35 |
| 5.4.4 | <i>Impacts to Groundwater</i> | 35 |
| 5.4.5 | <i>Conceptual Site Models</i> | 35 |
| 5.5 | MIGRATION PATHWAYS AND EXPOSURE POTENTIAL | 38 |
| 5.5.1 | <i>Migration Pathways</i> | 38 |
| 5.5.2 | <i>Known and Potential Human Exposure</i> | 39 |
| 5.5.3 | <i>Known and Potential Impacts to Environmental Receptors</i> | 40 |
| 5.6 | EVALUATION OF NEED FOR IMMEDIATE RESPONSE ACTIONS | 40 |
| 6.0 | PHASE II CONCEPTUAL SCOPE OF WORK | 41 |
| 7.0 | TIER CLASSIFICATION | 43 |
| 7.1 | NRS SCORESHEET | 43 |
| 8.0 | CONCLUSIONS | 44 |
| 9.0 | REFERENCES | 46 |

LIST OF TABLES

TABLE 1: MONITORING WELL CONSTRUCTION SUMMARY

TABLE 2: SUMMARY OF GROUNDWATER GAUGING DATA

TABLE 3: SUMMARY OF VERTICAL HYDRAULIC GRADIENT DATA

TABLE 4: SUMMARY OF SOIL ANALYTICAL RESULTS - VOCS

TABLE 5: CVOC GROUNDWATER SCREENING DATA

TABLE 6: SUMMARY OF GROUNDWATER FIELD PARAMETER MEASUREMENTS

**TABLE 7: SUMMARY OF GROUNDWATER ANALYTICAL RESULTS - VOCS -
NORTHERN AREA**

**TABLE 8: SUMMARY OF GROUNDWATER ANALYTICAL RESULTS -
MISCELLANEOUS PARAMETERS - NORTHERN AREA**

**TABLE 9: SUMMARY OF GROUNDWATER ANALYTICAL RESULTS - DIOXINS -
NORTHERN AREA**

**TABLE 10: SUMMARY OF GROUNDWATER ANALYTICAL RESULTS - MTBE -
SOUTHERN AREA**

**TABLE 11: SUMMARY OF GROUNDWATER ANALYTICAL RESULTS - ARSENIC -
WESTERN AREA**

LIST OF FIGURES

FIGURE 1: LOCUS MAP

FIGURE 2: DISPOSAL SITE MAP

FIGURE 3: MASSGIS SITE SCORING MAP

FIGURE 4: DISPOSAL SITE LOCUS MAP – PRIVATE WELLS

FIGURE 5A: NORTHERN AREA GENERALIZED GEOLOGIC CROSS-SECTIONS

FIGURE 5B: SOUTHERN AREA GENERALIZED GEOLOGIC CROSS-SECTIONS

FIGURE 6: GEOPHYSICAL SURVEY LOCATION MAP

FIGURE 7: SEISMIC REFRACTION CROSS-SECTION

FIGURE 8A: GROUNDWATER ELEVATION CONTOUR MAP FOR WATER TABLE WELLS – APRIL 2003

FIGURE 8B: GROUNDWATER ELEVATION CONTOUR MAP FOR DEEP OVERBURDEN WELLS – APRIL 2003

FIGURE 9A: GROUNDWATER ELEVATION CONTOUR MAP FOR WATER TABLE WELLS – JULY 2003

FIGURE 9B: GROUNDWATER ELEVATION CONTOUR MAP FOR DEEP OVERBURDEN WELLS – JULY 2003

FIGURE 10A: GROUNDWATER ELEVATION CONTOUR MAP FOR WATER TABLE WELLS – OCTOBER 2003

FIGURE 10B: GROUNDWATER ELEVATION CONTOUR MAP FOR DEEP OVERBURDEN WELLS – OCTOBER 2003

FIGURE 11A: PLAN VIEW OF NORTHERN AREA CVOC CONCENTRATIONS – APRIL 2003

FIGURE 11B: NORTHERN AREA GENERALIZED GEOLOGIC CROSS-SECTION SHOWING CVOC CONCENTRATIONS – APRIL 2003

FIGURE 12A: PLAN VIEW OF NORTHERN AREA CVOC CONCENTRATIONS – OCTOBER 2003

FIGURE 12B: NORTHERN AREA GENERALIZED GEOLOGIC CROSS-SECTION SHOWING CVOC CONCENTRATIONS – OCTOBER 2003

FIGURE 13: HFA PLOTS SHOWING INTRINSIC DEGRADATION OF TCE - NORTHERN AREA

FIGURE 14: PLAN VIEW OF SOUTHERN AREA MTBE CONCENTRATIONS

FIGURE 15: PLAN VIEW OF WESTERN AREA ARSENIC CONCENTRATIONS

FIGURE 16: ORP-PH DIAGRAM FOR ARSENIC IN GROUNDWATER

APPENDICES

APPENDIX A: DEP TRANSMITTAL FORM BWSC-107

APPENDIX B: REFERENCE INFORMATION

APPENDIX C: BORING LOGS

APPENDIX D: GEOPHYSICAL SURVEY REPORT

**APPENDIX E: GRAIN SIZE ANALYSIS REPORTS AND HYDRAULIC
CONDUCTIVITY DATA**

APPENDIX F: WATERLOO PROFILER LOGS

APPENDIX G: LABORATORY ANALYTICAL REPORTS

APPENDIX H: TIER CLASSIFICATION DOCUMENTATION

EXECUTIVE SUMMARY

Background

Raytheon Company (Raytheon) retained Environmental Resources Management (ERM) to conduct a Phase I – Initial Site Investigation (Phase I) pursuant to 310 CMR 40.0480 of the Massachusetts Contingency Plan (MCP) for portions of the Former Raytheon Facility, located at 430 Boston Post Road, Wayland, Massachusetts. The Former Raytheon Facility property consists of approximately 83 acres and was operated from 1955 through 1995 as an engineering facility to support other Raytheon manufacturing facilities. Raytheon decommissioned the facility in 1996.

Comprehensive Response Actions are ongoing at the Former Raytheon Facility and have been conducted since 1996 under Release Tracking Number (RTN) 3-13302 and Tier IB Permit (No. 133939). As part of these ongoing response actions, three additional release conditions were identified during the summer of 2002. These release conditions constitute three distinct and separate “areas of concern,” based on geographic location, nature of release, and are hereafter referred to as the Northern Area, Western Area and Southern Area. The Northern and Western Areas are located in undeveloped portions of the Former Raytheon Facility property and the Southern Area is located beneath a parking lot on the property. The composite of these three “areas of concern” is referred to in this document as the “Site.”

The three release conditions were identified based on detection of the following constituents in groundwater at concentrations in excess of applicable Reportable Concentrations (RCGW-1):

- chlorinated volatile organic compounds (CVOCs) tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (cDCE), and vinyl chloride (VC) in the Northern Area;
- arsenic in the Western Area; and
- methyl tert butyl ether (MTBE) in the Southern Area.

On behalf of Raytheon, ERM submitted a Release Notification Form (RNF, BWSC-103) to the Department on 17 December 2002, pursuant to 310 CMR 40.0315(1). The Department issued a Notice of Responsibility and RTN 3-22408 on 16 January 2003 for the RNF. The two Site boundaries for RTN 3-22408 and RTN 3-13302 (Tier IB Permit No. 133939) overlap, based on

data available to date. However, the two RTNs are being treated separately under the MCP to minimize delays in response actions. This enables completion assessment activities under RTN 3-22408 without delaying ongoing remedial activities under RTN 3-13302 (Tier IB Permit No. 133939).

Purpose and Scope

The purpose of this assignment was to perform a Phase I investigation for RTN 3-22408 in accordance with 310 CMR 40.0480. The Phase I is intended to support Tier Classification of the Site and evaluate the need for Comprehensive Response Actions. The Phase I investigation included: a review of historical and current facility operation, chemical use and storage; and an extensive field investigation including geophysical surveys, characterization of the nature and extent of groundwater impacts in overburden, and evaluation of potential receptors.

Findings and Conclusions

1. Release of TCE from an unknown historical source has impacted groundwater quality in the Northern Area.

PCE, TCE, cDCE and VC were detected at concentrations exceeding Reportable Concentrations (RCs) in groundwater in the Northern Area. An apparent historical release of primarily TCE occurred in the vicinity of MW-261S and B-241. The source signature also includes significantly lower levels of PCE. Historically, the area has been filled and only transient equipment testing was known to have been conducted in the Northern Area of the Site. Therefore, the release mechanism was likely transient and no longer exists. Intrinsic biodegradation of TCE is occurring, resulting in production of cDCE and VC. CVOC impacts to groundwater are confined to a fine sand and silt unit in the Northern Area.

2. Release of MTBE from an upgradient property has impacted groundwater quality in the Southern Area.

MTBE was detected at concentrations exceeding RCs in groundwater in the Southern Area. The source of MTBE in the Southern Area was likely a gasoline release at an upgradient gasoline service station located at 365 Boston Post Road (RTN 3-17974). Pursuant to 310 CMR 40.0180, Raytheon may file a Downgradient Property Status Submittal for the Southern Area.

3. Naturally occurring arsenic has impacted groundwater quality in the Western Area.

Arsenic was detected at concentrations exceeding RCs in groundwater in the Western Area. Naturally occurring arsenic present in soil has been mobilized as a result of the natural reducing conditions in the wetlands bordering the Sudbury River. The presence of arsenic in groundwater in the Western Area likely represents a background condition.

4. Impacts to groundwater at the Site maintain a low potential to impact Site occupants or nearby receptors given current or potential future use scenarios.

Preliminary review of potential exposure pathways and receptors at or near the Site suggest a low potential for impact to human or environmental receptors based on current knowledge of Site conditions.

5. The Site has been classified as Tier IB.

Completion of the Numerical Ranking System scoresheet resulted in a Site score of 511, which scores the Site as Tier IB.

6. A Phase II Scope of Work will be prepared, pursuant to 310 CMR 40.0830.

Section 6.0 presents an outline of tasks being considered for inclusion in the Conceptual Phase II Scope of Work. A complete Phase II Scope of Work will be submitted in 2004.

1.0 INTRODUCTION

1.1 BACKGROUND

Raytheon Company (Raytheon) retained Environmental Resources Management (ERM) to conduct a Phase I – Initial Site Investigation (Phase I) pursuant to 310 CMR 40.0480 of the Massachusetts Contingency Plan (MCP) for portions of the Former Raytheon Facility located at 430 Boston Post Road, Wayland, Massachusetts (Figures 1 and 2). This report documents the results of the Phase I investigation. Because a Response Action Outcome (RAO) has not yet been achieved, the MCP requires that a Phase I and Tier Classification Submittal be filed by 17 December 2003. Massachusetts Department of Environmental Protection (Department or DEP) Bureau of Waste Site Cleanup (BWSC) Transmittal Form (BWSC-107) is presented in Appendix A.

Comprehensive Response Actions are ongoing at the approximately 83-acre Former Raytheon Facility and have been conducted since 1995 under Release Tracking Number (RTN) 3-13302 and Tier IB Permit (No. 133939). As part of these ongoing response actions, three additional release conditions were identified during Summer 2002. These release conditions constitute three distinct and separate “areas of concern,” based on geographic location, nature of release, and are hereafter referred to as the Northern Area, Western Area and Southern Area (Figure 2). The Northern and Western Areas are located in undeveloped portions of the Former Raytheon Facility property and the Southern Area is located beneath a parking lot on the property. The composite of these three “areas of concern” is hereafter referred to in this document as the “Site.”

The three release conditions were identified based on detection of the following constituents in groundwater at concentrations in excess of applicable Reportable Concentrations (RCGW-1):

- chlorinated volatile organic compounds (CVOCs) tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (cDCE), and vinyl chloride (VC) in the Northern Area;
- arsenic in the Western Area; and
- methyl tert butyl ether (MTBE) in the Southern Area.

On behalf of Raytheon, ERM submitted a Release Notification Form (RNF, BWSC-103) to the Department on 17 December 2002 (ERM, 2002a), pursuant to 310 CMR 40.0315(1). The Department issued a Notice of Responsibility and RTN 3-22408 on 16 January 2003 for the RNF (DEP, 2003). The two Site boundaries for RTN 3-22408 and RTN 3-13302 (Tier IB Permit No. 133939) overlap, based on data available to date. However, the two RTNs are being treated separately under the MCP to minimize delays in response actions. This enables completion assessment activities under RTN 3-22408 without delaying ongoing remedial activities under RTN 3-13302 (Tier IB Permit No. 133939).

1.2 PURPOSE AND SCOPE

The purpose of this assignment was to perform a Phase I investigation for RTN 3-22408 in accordance with 310 CMR 40.0480. The Phase I is intended to support Tier Classification of the Site and evaluate the need for Comprehensive Response Actions.

To satisfy the specific requirements set forth in the MCP for Phase I investigations, the scope of this investigation consisted of the following tasks:

Preliminary Assessment (including 310 CMR 40.0483(1)(a-c))

- Conduct Document Review & Site Inspection

Field Work (including 310 CMR 40.0483(1)(d-f))

- Conduct Vertical Profiling
- Advance Borings & Install Monitoring Wells
- Survey, Gauge & Sample Wells
- Perform Geophysical Surveys

Report Preparation (including 310 CMR 40.0483(1) (g&h))

- Compile & Analyze Data
- Prepare Phase I Report

Following the discovery of a reportable release condition, a series of Phase I assessment activities were conducted as described in Section 4 of this report. The investigation discussed herein was limited to the evaluation of known and suspected locations where past uses of oil and/or hazardous materials (OHM) maintain a potential to impact soil and/or groundwater quality.

2.0 GENERAL DISPOSAL SITE INFORMATION

2.1 DEP RELEASE TRACKING NUMBERS

There are currently two active RTNs associated with the Former Raytheon Facility:

- RTN 3-22408 was issued on 16 January 2003 in response to the discovery of CVOCs, arsenic and MTBE in groundwater at concentrations above the applicable Reportable Concentrations. This RTN is currently in Phase I of the MCP process. Within this document, the term “Site” will be used to reference the release conditions associated with RTN 3-22408.
- RTN 3-13302 was issued on 2 January 1996 in response to the discovery of petroleum hydrocarbons in soil and groundwater during an underground storage tank (UST) removal. This RTN is currently utilized as the primary RTN for activities related to Tier IB Permit No. 133939. The following RTNs were assigned to separate release conditions, but have been linked to RTN 3-13302:
 - 3-13574 was issued on 28 March 1996 in response to the discovery of chlorinated hydrocarbons in groundwater at concentrations above applicable Reportable Concentrations.
 - 3-14042 was issued on 25 July 1996 in response to the discovery of polychlorinated biphenyls (PCBs) in soil at concentrations above the applicable Reportable Concentration.
 - 3-19482 was issued on 9 May 2000 in response to the discovery of stunted wetland vegetation growth caused by PCBs and metals in wetland soils.
 - 3-22665 was issued on 2 April 2003 in response to the discovery of chromium in groundwater at concentrations above the applicable Reportable Concentration. The chromium in groundwater is associated with ongoing in situ chemical oxidation (ISCO) remediation activities, and is thought to be transient in nature.

An additional RTN (3-1783) was issued on 15 January 1987 per United States Environmental Protection Agency (EPA) referral and was subsequently amended to include a release of butyl cellulose to the

wastewater conveyance system. This RTN was closed on 31 July 1995 when a Licensed Site Professional (LSP) Evaluation Opinion was filed.

2.2 ADDRESS AND GEOGRAPHICAL LOCATION

2.2.1 Address

Former Raytheon Facility (currently GRM Properties II, LLC)
430 Boston Post Road
Wayland, Massachusetts 01778

2.2.2 Geographic Location

Based on a review of the appropriate United States Geologic Survey (USGS) topographic map, the approximate coordinates of the center of the Site are 42°21'53" north latitude and 71°22'13" west longitude. The approximate Universal Transverse Mercator (UTM) coordinates of the center of the Site are 4,692,780 meters north latitude and 304,820 meters east longitude (Figure 1).

2.3 DISPOSAL SITE LOCUS MAP & TOPOGRAPHY

A Disposal Site Locus Map, showing the currently defined Site boundary, and 500-foot and one-half mile radii from the Site boundary, is included in Figure 1 (compiled from portions of two USGS 7.5 x 15-minute metric series topographic maps: Framingham, Massachusetts (USGS, 1987a) and Maynard, Massachusetts (USGS, 1987b) Quadrangles (scale = 1:25,000)).

The Former Raytheon Facility property is currently designated as lots 23-52, 23-52B, 23-52C and 23-52D on map numbers 22 and 23 of the Wayland Assessors Office (Figure 2). The property has been subdivided into four parcels. The Town of Wayland owns the Sewage Treatment Plant, which is located on parcel 23-52B and is not located within the Site boundary. GRM Properties II, LLC owns parcels 23-52 and 23-52C. The Northern and Western Areas are located on parcel 23-52C and the Southern Area is located on parcel 23-52. Wayland Meadows owns parcel 23-52D; a portion of the Northern Area is located on this parcel.

The Former Raytheon Facility property consists of approximately 83 acres of land, of which approximately 16 acres is occupied by buildings and structures. The remaining land is undeveloped and comprised of grass,

woodlands and wetlands. The portions of the Former Raytheon Facility present within the Site boundary include undeveloped areas (i.e., Northern and Western Areas) and a parking lot (Southern Area). The four properties are currently zoned for Limited Commercial and Residential use. Two Activity and Use Limitations (AUL; i.e., a form of deed restriction) have been placed on portions of the properties, as shown on Figure 2. These AULs are discussed in detail in Section 3.3.2 of the Phase II – Comprehensive Site Investigation (Phase II) report for RTN 3-13302 previously submitted to the Department (ERM, 2001).

The Site is located within and adjacent to the east floodplain of the Sudbury River. Site topographic relief slopes gradually to the west, north and east. A small hill is located at the eastern margin of the Site, between the Former Raytheon Facility and Old Sudbury Road (Route 27).

2.4 ESTIMATED NUMBER OF ON-SITE WORKERS AT THE DISPOSAL SITE

There are no employees currently working within the Site boundaries.

There are employees working on the Former Raytheon Facility property, which was redeveloped as an office building. As of November 2003, the facility is occupied by one business with approximately 50 employees. GRM Properties II, LLC has approximately three building-management personnel at the facility. The Sewage Treatment Plant is typically manned by one worker. Therefore, there are currently a total of fewer than 60 workers on the property. Historically, there have been up to 2,300 workers at the property (ERM, 1996). No businesses are located on the lot owned by Wayland Meadows.

2.5 ESTIMATED RESIDENTIAL POPULATION WITHIN A ½ MILE RADIUS OF THE SITE

The EPA Enforcement and Compliance History Online (ECHO) resource tool indicated that an estimated 1,224 people live within a one-mile radius of the center of the Site, based on 2000 United States Census data (EPA, 2003a). Utilizing a ratio of people to area, an estimated 305 people are located within a one-half mile radius of the center of the Site.

2.6 GENERAL DESCRIPTION OF LAND USES SURROUNDING THE DISPOSAL SITE

Land uses surrounding the Former Raytheon Facility property are presented below.

North: Residentially-zoned woodlands about the Site to the north. The Great Meadows National Wildlife Refuge (GMNWR), which is a mixture of protected marshland and woodland along the Sudbury River, abuts the Site to the northwest.

East: Commercial and residentially-zoned undeveloped properties about the Site to the east.

South: Residential, commercial and undeveloped properties about the Site to the south. The properties are zoned Residential and Business.

West: Undeveloped wetlands and floodplains along the eastern side of the Sudbury River about the Site to the west. The properties are zoned Limited Commercial.

2.7 NUMBER OF INSTITUTIONS WITHIN 500 FEET OF THE DISPOSAL SITE

Based on a review of the Disposal Site Locus Map (Figure 1) and a visual survey conducted by ERM, there are no institutions (as defined by MCP 310 CMR 40.0006) located within 500 feet of the Site.

2.8 NATURAL RESOURCE AREAS LOCATED WITHIN 500 FEET OF THE DISPOSAL SITE

Based on a review of the Disposal Site Locus Map and a September 2003 Massachusetts Geographical Information System (MassGIS, 2003) Site Scoring Map (Figure 3), natural resource areas (as defined by MCP 310 CMR 40.0483(1)(a)8) are located within 500 feet of the Site boundary. The Sudbury River, a fish habitat, is located within 500 feet of the Western Area boundary, and is classified as a Class B Surface Water Body. Freshwater wetlands and Natural Heritage and Endangered Species Program (NHESP) Estimated Habitats of Rare Wetlands Wildlife (for use under the Wetlands Protection Act) are located on the Western Area. Site ecological

surveys conducted under RTN 3-13302 (Tier IB Permit No. 133939) indicated the presence of one rare plant species, river bullrush, on the Western Area.

The GMNWR, a federally protected open space, abuts the northwestern boundary of the Northern Area. The GMNWR contains approximately 2,900 acres of federally protected woodlands, fields, and freshwater wetlands and is designated as a high-density area for nesting wood ducks. Woodlands and freshwater wetlands owned by the Town of Wayland Conservation Commission abut the Northern Area to the north and are classified as a locally protected open space.

The entire Site is located within a DEP Approved Zone II Wellhead Protection Area for the Baldwin Pond Wellfield, which is located approximately one-half mile to the north. ERM reviewed a list of private wells provided by the Wayland Health Department, which included one well located within a 500-foot mile radius of the Site. Figure 4 displays the approximate location of the Russell's Greenhouse and Garden Center property irrigation well.

Based on a review of the MassGIS Site Scoring Map (Figure 3), none of the following natural resource areas are located within 500 feet of the Site boundaries:

- Zone A of a reservoir;
- Vernal pools;
- EPA Sole Source Aquifer;
- Potentially Productive Aquifer; or
- Area of Critical Environmental Concern.

2.9

DISPOSAL SITE MAPS

A Disposal Site Map showing the following features currently present on the Former Raytheon Facility property is included as Figure 2:

- Site boundaries, to the extent they have been defined by assessments conducted to date;
- property lines and Wayland Assessors Office lot numbers of the properties included within the disposal site boundaries;
- AULs; and

- the following features, to the extent they are located at the property: buildings, floor and storm drains, subsurface utilities serving or transecting the property, oil and/or hazardous material storage and disposal structures and/or areas, the location of any known oil and/or hazardous material releases and/or threats of release, and monitoring wells, borings, test pits, and other relevant sampling and screening points.

The portions of the Former Raytheon Facility present within the Site boundary include undeveloped areas (i.e., Northern and Western Areas) and a parking lot (Southern Area). Additional information pertinent to historical structures, features and usages of the Former Raytheon Facility outside of the Site boundary is presented in the Phase I and Phase II reports for RTN #3-13302 and Tier IB Permit No. 133939 (ERM, 1996 and 2001, respectively).

2.10 SITE REPORTING CATEGORIES

2.10.1 Overview

A release indicated by the measurement of OHM in soil and/or groundwater requires DEP notification under the provisions of 310 CMR 40.0315, if the measured concentration of one or more listed substances in 310 CMR 40.1600 is equal to or greater than the media and category-specific Reportable Concentration. The following sections identify reporting categories applicable to soil and groundwater and provide the rationale for selection of each category.

2.10.2 Soil

In accordance with 310 CMR 40.0361, Site soil is classified as RCS-1. This classification was assigned because the Site is located:

- at or within 500 feet of a residential dwelling, a residentially-zoned property, school, playground, recreational area, or park; and
- within the geographic boundaries of a groundwater resource area categorized as RCGW-1 in 310 CMR 40.0362(1)(a).

A release of OHM in soil requires notification to the DEP if the measured concentration of one or more DEP-listed substance is equal to or greater than the RCS-1 concentrations listed under 310 CMR 40.1600.

2.10.3 Groundwater

In accordance with 310 CMR 40.0362, Site groundwater is classified as RCGW-1. This classification was assigned because the Site is located within a Current Drinking Water Source Area.

A release of OHM to groundwater requires notification to the DEP if the measured concentration of one or more DEP-listed substance is equal to or greater than the RCGW-1 concentrations listed under 310 CMR 40.1600.

3.0 DISPOSAL SITE HISTORY

3.1 OWNER / OPERATOR AND OPERATIONS HISTORY

3.1.1 Current and Relevant Previous Disposal Site Owners and Operators

The current owner/operator of the Former Raytheon Facility property is GRM Properties II, LLC of New York, New York. They acquired the property on 4 December 2003. Historically, the property was owned by:

- Wayland Business Center LLC, c/o Congress Group Ventures – 1 December 1997 to 4 December 2003
- Wayland Meadows Limited Partnership – 1 October 1997 to 1 December 1997
- Continental Assurance Company – 18 June 1968 to 1 October 1997
- National Boulevard Bank – 14 July 1958 to 18 June 1968
- Norman Barnes – prior to 14 July 1958

3.1.2 Current and Historical Site Uses

Historic aerial photographs of the property from 1936 indicate the property was utilized for agricultural and residential purposes. Review of a topographic map, dated 1894, indicated that the property was undeveloped at that time. The Former Raytheon Facility operated from 1955 through 1995 as an engineering facility to support other Raytheon manufacturing facilities. Raytheon decommissioned the facility in 1996.

The Former Raytheon Facility was redeveloped during 1998 and is currently used as office space. No manufacturing or servicing of goods is conducted on the property (Congress Group, 2003).

During facility operation, Raytheon conducted research and development activities for products including:

- prototype electronic equipment,
- antennae and transmitters, and
- printed circuit boards.

Detailed discussions of historical operations at the Former Raytheon Facility are presented in the Phase I and Phase II reports for RTN 3-13302 and Tier IB Permit No. 133939 (ERM, 1996 and 2001, respectively).

3.2 RELEASE HISTORY

The Site consists of three areas of concern, each of which has a distinct and separate release condition. Little is known about the source or timing of the releases covered under RTN 3-22408. ERM's current understanding of the three releases is summarized below:

- Northern Area: Historical radar testing was conducted in this portion of the Former Raytheon Facility. Based on these activities, it is possible that an incidental release occurred during these activities in this portion of the Site.
- Southern Area: MTBE has been identified at an adjacent, upgradient gasoline station located at 365 Boston Post Road. This property is currently in Phase IV of the MCP process and is tracked under RTN 3-17974. Based on hydraulic gradient and contaminant distribution data presented in Section 5.0 of this report, it is likely that the MTBE detected in the Southern Area is attributable to the 365 Boston Post Road site.
- Western Area: ERM has not identified any evidence of historical arsenic use at the Former Raytheon Facility. The arsenic detected in groundwater at the Site is attributed to naturally occurring arsenic present in Site soil and mobilized by natural variations in geochemistry of Site groundwater.

Detailed discussions of historical releases at the Former Raytheon Facility are presented in the Phase I and Phase II reports for RTN 3-13302 and Tier IB Permit No. 133939 (ERM, 1996 and 2001, respectively). Relevant portions of these documents are presented in Appendix B.

3.3 OIL AND/OR HAZARDOUS MATERIAL USE AND STORAGE HISTORY

3.3.1 OHM Types, Uses, Quantities, Periods of Use & Storage

ERM has identified no information indicating historical or current OHM storage or generation within the Northern, Southern or Western Areas.

With respect to the facility, no indication of OHM storage or generation has been identified for the period of time from May 1996 to present. During a recent facility visit, no threats of a release of OHM were apparent. Based on discussions with Wayland Business Center personnel, no OHM is currently used at the facility (Congress Group, 2003). EPA's ECHO and Enviromapper resource tools did not identify any current hazardous waste handlers or generators on the property (EPA, 2003a; EPA, 2003b).

A summary of historical OHM use and storage during Raytheon's operation of the facility is presented in Section 4.3.1 and Table 1 of the Phase I report for RTN 3-13302 and Tier IB Permit No. 133939 (ERM, 1996). Section 4.0 and Table 1 of the 1996 Phase I report are included for reference in Appendix B.

3.3.2 *Underground Storage Tanks (USTs)*

ERM has identified no information indicating historical or current USTs within the Northern, Southern or Western Areas.

With respect to the facility, a review of the Massachusetts Department of Fire Services UST database and discussion with Wayland Business Center personnel indicated that there are no USTs present (Congress Group, 2003). A summary of the historical presence, usage, and fate of USTs located at the Former Raytheon Facility through May 1996 is presented in Section 4.3.2 and Table 1 of the Phase I report for RTN 3-13302 and Tier IB Permit No. 133939 (ERM, 1996; Appendix B). Based on review of this document, historical USTs have been closed or removed.

3.3.3 *Aboveground Storage Tanks (ASTs)*

ERM has identified no information indicating the presence of historical or current ASTs within the Northern, Southern or Western Areas.

With respect to the facility, discussions with Wayland Business Center personnel indicated that no ASTs are currently present (Congress Group, 2003). A summary of the historical presence, usage, and fate of ASTs located at the Former Raytheon Facility through May 1996 is presented in Section 4.3.3 of the Phase I report for RTN 3-13302 and Tier IB Permit No. 133939 (ERM, 1996; Appendix B). Based on review of this document, one of two historical ASTs remained in operation as of May 1996. The 500-gallon, single-wall diesel tank was installed in August 1991 within a concrete containment berm and was used to power the facility emergency

generator. This AST was subsequently removed during redevelopment of the facility in 1998.

3.3.4 Lagoons, Pits & Piles

Based on recent facility visits by ERM personnel, no lagoons currently exist at the Site. Temporary soil piles exist in the Northern Area associated with ongoing Phase IV wetlands remediation activities being conducted under RTN 3-13302 and Tier IB Permit No. 133939. Concrete-lined wastewater treatment pits are located in the Town of Wayland wastewater treatment plant. No lagoons, pits or piles are located within the Western or Southern Areas.

The presence and use of pits associated with Raytheon's historical activities are discussed in Section 4.3.4 of the Phase I report for RTN 3-13302 and Tier IB Permit No. 133939 (ERM, 1996; Appendix B). The pits noted in the 1996 Phase I document were filled during historical redevelopment of the property. No lagoons or piles were historically identified on the property.

3.4 WASTE MANAGEMENT HISTORY

3.4.1 Land Disposal

Based on a review of historic aerial photographs from 1936 through 1988, potential filling activities and potential land disposal areas were identified at the following locations and periods:

- Surface debris and disturbed land free of vegetation were observed in the Northern Area on a 1969 photograph. In a 1988 photograph, this area of the property appears to have been filled to a higher elevation and is vegetated woodland.
- Comparison of aerials from 1936 to 1957 indicates portions of the wetlands in the Western Area had been filled.
- Surface debris and land disposal were apparent in the 1988 photograph in an area located adjacent to the northwest corner of the parking lot, south of the Northern Area.

As part of Phase I (ERM, 1996) for RTN 3-13302 and Tier IB Permit No. 133939, seven test pits were excavated to visually inspect and sample subsurface soils in areas of former ground disturbances identified by a review of historic aerial photographs. Test pits were excavated to depths

ranging from five to nine feet. Total petroleum hydrocarbons (TPH) and polychlorinated biphenyls (PCBs) were detected in soil at concentrations exceeding applicable Reportable Concentrations. In response, Raytheon filed a RNF with the Department on 25 July 1996. The DEP subsequently issued RTN 3-14042, which has subsequently been linked to RTN 3-13302. Impacts to soil were remediated by excavation and off-site disposal. Post-remediation concentrations of PCBs in soil were below the applicable MCP Method 1 Cleanup Standard. One monitoring well (MW-TP-3) was installed and sampled as part of these activities. Volatile organic compounds (VOCs) were detected in groundwater at relatively low concentrations. TCE has been sporadically detected in this well at concentrations above MCP Method 1 Cleanup Standards.

Residual soil and groundwater impacts in the northern portion of the Former Raytheon Facility were addressed as part of the Phase II (ERM, 2001) for RTN 3-13302. The Phase II investigation included excavation of an additional 17 test pits, soil sampling and laboratory analyses. No further impacts to soil were identified as part of this program. One additional monitoring well (MW-32) was installed and sampled as part of Phase II. No VOCs were identified in this well.

3.4.2 *Subsurface Disposal*

ERM has identified no information indicating historical or current subsurface disposal within the Northern, Southern or Western Areas.

Based on discussions with Wayland Business Center personnel, no drywells or leachfields are currently in use at the facility (Congress Group, 2003). A history of subsurface disposal activities at the Former Raytheon Facility, including the use of drywells and leachfields, is presented in the Phase I report for RTN 3-13302 and Tier IB Permit No. 133939 (ERM, 1996; Appendix B).

3.4.3 *Surface Water Discharges*

Industrial wastewater was treated at the Former Raytheon Facility from 1972 through 1992. Industrial wastewater was discharged through a combined stormwater/non-hazardous wastewater conveyance system to the Sudbury River via a permitted National Pollutant Discharge Elimination System (NPDES) outfall. This discharge area is located in the Western Area. Additional information regarding historical wastewater treatment and sediment sampling activities conducted in the Western Area are presented in the Phase I, Phase II and Phase IV – Remedy Implementation Plan (Phase IV) reports for RTN 3-13302 and Tier IB

Permit No. 133939 (ERM, 1996, 2001 and 2002b, respectively). No surface water discharges are present in the Northern or Southern Areas.

Wayland Business Center redeveloped the Sewage Treatment Plant for treatment of sanitary wastewater and was issued a NPDES discharge permit for operation on 4 September 1998 (No. MA0039853). The Town of Wayland acquired the plant and permit from the Wayland Business Center under eminent domain on 25 October 1999. The facility treats sewage produced by the surrounding residential and commercial properties. The maximum daily permitted discharge limit is 65,000 gallons per day.

3.4.4 *Discharges to Wastewater Treatment Plants*

A discussion of on-property wastewater treatment activities is presented in Section 3.4.3. Sanitary wastewater generated by the Wayland Business Center is discharged to the on-property wastewater treatment plant. Historically, the Former Raytheon Facility discharged wastewater to the on-property wastewater treatment plant. Based on information provided by Raytheon, no wastewater was historically discharged to off-property wastewater treatment plants.

3.4.5 *Other Means of Disposal or Treatment*

The Former Raytheon Facility generated hazardous wastes, which were stored on the property in a hazardous waste storage shed, which was equipped with containment and berming. This shed was not located within the Northern, Southern or Western Areas. Hazardous waste was subsequently shipped off-property for disposal or treatment. Additional information is presented in the Phase I report for RTN 3-13302 and Tier IB Permit No. 133939 (ERM, 1996; Appendix B).

3.5 *ENVIRONMENTAL PERMITS AND COMPLIANCE HISTORY*

3.5.1 *Permits for M.G.L. c. 21E Response Actions*

A Tier IB Permit (No. 133939) was issued by the Department to Raytheon in May 1997 for RTN 3-13302. Raytheon filed a Tier IB Permit Extension for Permit No. 133939 on 15 May 2003. The Site boundary for Tier IB Permit No. 133939 encompasses portions or all of the Northern, Southern and Western Areas.

3.5.2 Oil and/or Hazardous Material Storage Permits

ERM has identified no information indicating historical or current OHM storage permits pertaining to the Northern, Southern or Western Areas. Based on discussions with Wayland Business Center personnel, the facility currently has no OHM storage permits (Congress Group, 2003). Discussion of historical OHM storage permits is presented in the Phase I report for RTN 3-13302 and Tier IB Permit No. 133939 (ERM, 1996; Appendix B).

3.5.3 Wastewater Discharge Permits

The Town of Wayland has a NPDES permit number MA0039853 for discharge of treated wastewater to the Sudbury River. The discharge area is within the Western Area. ERM has identified no information indicating historical or current wastewater discharge permits affecting the Northern or Southern Areas. Discussion of historical wastewater discharge permits is presented in the Phase I report for RTN 3-13302 and Tier IB Permit No. 133939 (ERM, 1996; Appendix B).

3.5.4 Groundwater Discharge Permits

ERM has identified no information indicating historical or current groundwater discharge permits pertaining to Northern, Southern or Western Areas.

Based on discussions with Wayland Business Center personnel, ERM did not identify any groundwater discharges or groundwater discharge permits for the Wayland Business Center (Congress Group, 2003). No historical groundwater discharges or groundwater discharge permits were identified for the Former Raytheon Facility, as presented in the Phase I report for RTN 3-13302 and Tier IB Permit No. 133939 (ERM, 1996; Appendix B).

3.5.5 Air Quality Discharge Permits

ERM has identified no information indicating historical or current air discharge permits pertaining to Northern, Southern or Western Areas.

ERM did not identify any air quality discharge permits for the Wayland Business Center. Discussion of historical air quality discharge permits is presented in the Phase I report for RTN 3-13302 and Tier IB Permit No. 133939 (ERM, 1996; Appendix B).

3.5.6 Wetlands Alteration Permits

Raytheon is currently conducting Phase IV wetlands remediation activities under RTN 3-13302 and Tier IB Permit No. 133939. These activities are being conducted within portions of the Western and Northern Areas, but do not affect the Southern Area. The wetland remediation activities required an extensive permitting process, which is discussed in Section 6.2.1 and summarized in Figure 15 of the September 2003 Revised Application for Risk-Based Disposal Approval (ERM, 2003b).

3.5.7 Resource Conservation and Recovery Act (RCRA) Permits

ERM has identified no information indicating historical or current RCRA permits pertaining to Northern, Southern or Western Areas.

Based on discussions with Wayland Business Center personnel, ERM did not identify any RCRA permits for the Wayland Business Center (Congress Group, 2003). ERM used EPA's Enviromapper and ECHO resource tools and did not identify any hazardous materials handlers or hazardous waste generators on the property (EPA, 2003a; EPA, 2003b).

The Former Raytheon Facility was licensed as a large-quantity generator of hazardous wastes and a small-quantity generator of waste oil. The Former Raytheon Facility's EPA identification number is MAD990685554. Discussion of historical RCRA permits is presented in the Phase I report for RTN 3-13302 and Tier IB Permit No. 133939 (ERM, 1996; Appendix B).

3.5.8 National Pollutant Discharge Elimination System (NPDES) Permits

ERM has identified no information indicating historical or current NPDES permits pertaining to Northern or Southern Areas. The Town of Wayland was issued NPDES permit number MA0039853 for discharge of treated wastewater to the Sudbury River. Discussion of historical wastewater discharge permits is presented in the Phase I report for RTN 3-13302 and Tier IB Permit No. 133939 (ERM, 1996; Appendix B). The outfall for current and historical NPDES permits is located within the Western Area. In November 2003, Raytheon was issued NPDES permit number MA 03I-123 associated with ongoing wetland excavation activities.

3.5.9

Other Local, State and Federal Environmental Permits, OHM Storage Permits, and Permit Violation Information

No permits related to OHM storage or any permit violation information, except as referenced above, have been identified. Local, state, and federal environmental permits related to the wetlands remediation activities are described in Section 6.2.1 of the September 2003 Revised Application for Risk-Based Disposal Approval (ERM, 2003b). These activities are being conducted within portions of the Western and Northern Areas, but do not affect the Southern Area. Figure 15 of the document displays a series of flowcharts, which illustrate the permitting process (ERM, 2003b).

4.0

METHODS

4.1

OVERVIEW

Extensive site investigation activities have been conducted at the Former Raytheon Facility property since 1995, including evaluations of soil, groundwater, sediment and surface water. These activities have focused on addressing PCB, heavy metal and polycyclic aromatic hydrocarbon (PAH) impacts to wetlands sediment in the western portion of the Former Raytheon Facility property and CVOC impacts to groundwater in the southern portion of the property. Currently, remediation of wetlands sediment and groundwater are ongoing, and are tracked under RTN 3-13302 and Tier IB Permit No. 133939.

As part of these ongoing response actions, three additional release conditions were identified during Summer 2002, which have subsequently been assigned RTN 3-22408 and are the subject of this Phase I report. As noted in Section 1.0, these release conditions have affected groundwater quality and constitute three distinct and separate areas of concern:

- CVOCs (PCE, TCE, cDCE, and VC) in the Northern Area;
- arsenic in the Western Area; and
- MTBE in the Southern Area.

Extensive groundwater investigations have been conducted under RTN 3-13302 and Tier IB Permit No. 133939 within the Western and Southern Areas. The Southern Area is located within the boundary of a TCE plume in groundwater covered under RTN 3-13302. Therefore, an extensive well network and historical data set exists in this portion of the Site. In this Phase I report, only MTBE data are reported for the Southern Area, since CVOCs in this area are currently addressed under RTN 3-13302 and Tier IB Permit No. 133939.

Beginning in Summer 2002, a vertical profiling investigation was conducted in response to the detection of CVOC impacts to groundwater in the Northern Area. Field methods conducted and results of this investigation were presented in the Phase IV report (ERM, 2002b) filed under RTN 3-13302 and Tier IB Permit No. 133939.

ERM implemented an extensive drilling and sampling program in December 2002 through January 2003 to further characterize CVOC impacts to groundwater in the Northern Area. In an effort to keep the

public and the Department informed of activities conducted and results generated during this program, Raytheon submitted a Final Scope of Work document to the Department in June 2003 (ERM, 2003a). This document was not required under the MCP, but was developed as a means to communicate the activities conducted since submission of the Phase IV report (ERM, 2002b) and to present a scope of work for additional assessment activities proposed to further characterize CVOC impacts to groundwater in the Northern Area.

Since submission of the Final Scope of Work in June 2003, ERM has conducted the following investigation activities, which are discussed further in Sections 4.2 through 4.4 of this report:

- two quarterly groundwater gauging rounds;
- one semi-annual groundwater sampling round;
- wetlands delineation; and
- surface geophysical survey.

4.2 GAUGE AND SAMPLE WELLS

The purpose of this task was to collect groundwater elevation and quality data. Prior to the sampling of each well, ERM gauged the depth to groundwater using an electronic water-level indicator. Comprehensive gauging rounds were conducted on 28 July 2003 and 29 September 2003.

Groundwater samples were collected using low-flow sampling techniques. Physico-chemical parameters (pH, temperature, specific conductance, dissolved oxygen and oxidation-reduction potential (ORP)) were monitored during purging until equilibration was achieved prior to collecting groundwater samples for laboratory analyses. Groundwater samples were collected and analyzed as detailed below:

- On 27 and 28 August 2003, ERM collected groundwater samples from Western Area well clusters MW-313, MW-314, and MW-315 for laboratory analysis of the following parameters:
 - VOCs by EPA Method 8021B (CVOCs only), and
 - arsenic by EPA Method 200.7.
- From 29 September to 03 October 2003, ERM collected groundwater samples for laboratory analysis for one or more of the following parameters as part of the semi-annual monitoring program:
 - VOCs by EPA Method 8260,
 - VOCs by EPA Method 8021B (CVOCs only),

- VOCs EPA Method 8021B (CVOCs plus MTBE),
- chloride by EPA Method 325.2, and
- arsenic by EPA Method 200.7.

4.3 ***DELINEATE WETLANDS***

The purpose of this task was to identify, locate and characterize wetlands, buffer zone substrates, and land use cover types within 200 feet of the proposed vertical profiling locations as described in the Final Scope of Work (ERM, 2003a). The survey was completed in the Northern Area as well as properties to the north of the Site. Field studies were conducted with remote sensing (GPS) techniques. Significant wetland functions and values, and unique natural features were also noted.

4.4 ***GEOPHYSICAL SURVEYS***

The purpose of this task was to gather the data necessary to design the additional subsurface investigation activities proposed in the Final Scope of Work (ERM, 2003a). ERM conducted approximately 2,500 linear feet of seismic refraction surveys to evaluate the depth to top of bedrock in the Northern Area, as well as properties to the north of the Site.

Seismic refraction is a commonly used geophysical technique to determine depth to bedrock. In seismic refraction surveys, a near-surface 'impulsive' energy source is used to create a seismic wave, which travels through the earth and is refracted along stratigraphic boundaries. This refracted energy is detected by a series of sensitive geophones deployed along the ground surface. By measuring the travel-times from the source to each geophone, the velocities of the subsurface materials and the depths to the material interfaces can be computed.

5.0 RESULTS

5.1 OVERVIEW

As noted in Section 4.1, an extensive investigation program has been conducted on the Former Raytheon Facility property since 1995. The majority of this work was conducted to characterize release conditions currently tracked under RTN 3-13302 and Tier IB Permit No. 133939. Three additional release conditions to groundwater were identified in Summer 2002 and are tracked under RTN 3-22408:

- CVOCs (PCE, TCE, cDCE, and VC) in the Northern Area;
- arsenic in the Western Area; and
- MTBE in the Southern Area.

This Phase I report is focused on presenting data related to these three release conditions. The majority of the data presented in this Phase I report was generated since Summer 2002 in response to the discovery of these release conditions. However, for the purposes of evaluating geology, hydrogeology and extents of impact to groundwater, ERM has drawn from an extensive dataset for the entire Former Raytheon Facility property that is presented in the following table.

Summary of Pertinent Investigation Activities at Former Raytheon Facility Property

| Data Type | Former Raytheon Facility property | Northern Area | Southern Area | Western Area |
|------------------------------|--|----------------------|----------------------|---------------------|
| Test Pits | 24 | 13 | 0 | 0 |
| Soil & CPT Borings | 44 | 18 | 0 | 12 |
| Vertical Profiling Locations | 26 | 21 | 2 | 0 |
| Monitoring Wells | 170 | 40 | 15 | 20 |
| Soil Screening Samples | >900 | >300 | 30 | 12 |
| Soil Analyses | ~140 | 31 | 4 | 34 |
| Groundwater Analyses | >500 | 148 | 42 | 82 |

Notes:

>: greater than
~: approximately

To enable a more complete understanding of regional geology and hydrogeology, recent and historical data from across the entire Former Raytheon Facility property were used to prepare Sections 5.2 and 5.3. Sections 5.4 through 5.7 focus on contaminant issues specific to the Northern, Southern and Western Areas.

5.2

SITE GEOLOGY

Site geology was defined using the following techniques:

- soil logging conducted during boring advancement;
- cone penetrometer (CPT) boring advancement;
- index of hydraulic conductivity (I_k) data collected using the Modified Waterloo Profiler; and
- geophysical survey.

A summary of monitoring well construction data is presented in Table 1. Monitoring well locations are shown on Figure 2. Regional surficial and bedrock geologic maps are presented in Appendix B. Soil classification,

photoionization detector (PID) field screening results and monitoring well construction details are presented on boring logs included in Appendix C.

Five general geologic units have been identified across the Former Raytheon Facility property, from top to bottom (i.e., from shallowest to deepest):

- upper, interbedded, fine to coarse sand;
- silt with some clay and fine sand interbeds;
- lower, interbedded, fine to coarse sand;
- glacial till, consisting of poorly sorted, highly compacted sediments, with a fine-grained matrix (the till layer is generally less than five feet thick and appears to be discontinuous); and
- bedrock, which is mapped as gneiss of the Claypit Hill formation and undifferentiated gabbro and diabase (USGS, 1975).

The vertical sequence, depth, and exact composition of these generalized geologic units vary across the Former Raytheon Facility property, as shown on Figures 5a and 5b. Detailed geologic information for specific locations can be obtained from boring logs (Appendix C).

Confirmed depths to bedrock vary from 60 feet (MW-33B) in the southern portion of the property to 130 feet (MW-268B) in the northwestern portion of the property. A seismic refraction survey was conducted to the north of the Former Raytheon Facility property, which indicated a maximum depth to bedrock of approximately 180 feet. Figure 6 shows the location of the seismic refraction survey and Figure 7 shows the seismic refraction cross-section. The geophysical survey report for the Northern Area is presented in Appendix D.

The geologic sequence beneath the Former Raytheon Facility property is generally reflective of a glaciolacustrine environment. That is, a deep bedrock river valley was dammed by ice or sediment after the Late Wisconsinan ice sheet receded through the area, creating a glacial lake that eventually filled with fine-grained lake bottom sediments (USGS, 1974). Consistent with this type of environment, the overburden deposits are laterally and vertically heterogeneous. The overburden deposits vary from east to west, with generally coarser deposits to the east, suggesting proximity to the former shoreline, and finer deposits to the west. The overburden deposits generally dip and thicken to the west, as the depth to bedrock increases significantly.

Groundwater, ground surface, and monitoring well elevation data are presented in Table 2. A series of comprehensive groundwater gauging rounds were conducted to evaluate groundwater flow directions across the Former Raytheon Facility property. The groundwater elevations from April, July, and September 2003 were each collected on a single day under steady atmospheric conditions. The data presented for January 2003 includes Northern Area wells only; these data were collected over a three-day period with varied atmospheric conditions.

For the purpose of evaluating groundwater flow directions across the entire Former Raytheon Facility property, ERM prepared two groundwater elevation contour maps for each gauging round representing:

- wells with screens set across the water table or with the top of the well screen located within five feet of the water table (April, July and September 2003 on Figures 8A, 9A, and 10A, respectively); and
- wells with screens set in the deep overburden (defined as the lower fine sand and silt unit in the Northern Area (Figure 5a) and the fine to medium sand unit in the Southern Area (Figure 5b) (April, July and September 2003 on Figures 8B, 9B, and 10B, respectively). It is important to note that well screens set within this unit vary significantly in depth. However, head data collected from these wells appear to represent a single hydrologic unit and therefore, represent a single piezometric surface. The lower fine sand and silt unit of the Northern Area is particularly significant because it appears to control CVOC migration in this portion of the Site.

The 2003 data sets indicate that groundwater generally flows to the west, potentially controlled by the presence of the Sudbury River.

In addition to evaluating horizontal groundwater flow, ERM calculated vertical hydraulic gradients for well clusters (i.e., two or more wells installed in close proximity to one another) located on the Former Raytheon Facility property. The vertical gradients were calculated using groundwater elevation data from the shallowest overburden well and the deepest overburden well at each location. Vertical gradients were also calculated between shallow overburden and bedrock wells, where present. Vertical gradient data are presented in Table 3 and vertical gradient calculations are presented in Appendix E.

In general, downward vertical gradients were measured in the eastern portion of the Former Raytheon Facility property. This is generally consistent with the regional hydrogeologic setting, which consists of a

local groundwater flow divide located coincident with a topographic high east of the Former Raytheon Facility property and a regional discharge boundary (i.e., the Sudbury River) located to the west. Vertical gradients are typically downward in the vicinity of a recharge boundary (e.g., area of high ground) indicating that groundwater is seeking to achieve a lower elevation, consistent with the regional water table. As groundwater flows away from the recharge boundary, vertical gradients typically become less downward and transition to upward gradients as groundwater approaches the regional discharge boundary. This transition from downward to upward vertical gradients has been observed in the central and western portions of the Former Raytheon Facility property.

Estimates of permeability rates for overburden soil samples were between 10^{-4} and 10^{-6} centimeters per second (cm/s) for the 11 soil samples submitted for analysis from the Northern Area. The laboratory reports for the grain size and estimated permeability rate testing are presented in Appendix E. Historical permeability testing results for monitoring wells located on the Former Raytheon Facility property are also presented in Appendix E.

5.4 NATURE AND EXTENT OF CONTAMINATION

5.4.1 Evidence of Release

In order to evaluate the nature and extent of contamination at the Site, the levels of contaminants detected in soil and groundwater are compared with applicable MCP Reportable Concentrations (RCs; 310 CMR 40.1600), as discussed in Section 2.10. Releases to soil and groundwater are defined based on exceedance of applicable RCs or notification criteria pursuant to 310 CMR 40.0300.

Soil

Soil field screening results (i.e., PID headspace readings) generated during borehole advancement are presented on the boring logs in Appendix C. Concentrations of contaminants detected in soil are summarized in Table 4.

Northern Area

A series of 18 soil borings was advanced in the vicinity of B-241 to evaluate the potential for a residual source of CVOCs in this area. Continuous soil samples were collected in 17 of the borings from ground surface to approximately 15 feet below ground surface (bgs), and in B-260 from ground surface to 20 feet bgs. These samples were field screened

using a PID and one sample from each location was submitted for laboratory analysis of VOCs.

Overburden borings were advanced at nine locations across the Northern Area to facilitate monitoring well installation. During boring advancement, over 100 additional soil samples were collected from the ground surface to 130 feet bgs and field screened using a PID. Nine soil samples collected from depths of 2 to 9 feet bgs (i.e., above the groundwater table) were submitted for laboratory analysis of VOCs.

PID soil screening values ranged from less than 0.1 parts per million (ppm; i.e., the instrument detection limit) to 147 ppm. In general, the highest PID readings in soil were detected within a fine sand and silt unit (Figure 5A) and are attributed to the presence of VOCs in groundwater within this unit. No VOCs were detected in 19 of the 27 soil samples collected from the unsaturated zone. No VOCs were detected in soil at concentrations above applicable RCs.

Southern Area

Four soil samples were collected from depths of 8 to 18 feet bgs (i.e., above the groundwater table) for laboratory analysis of VOCs. No VOCs were detected in these samples at concentrations above laboratory method detection limits.

Western Area

To date, no soil samples have been collected from the Western Area specific to RTN 3-22408. An extensive soil and sediment sampling program has been conducted within the wetlands, including the Western Area, as part of RTN 3-13302 and Tier IB Permit No. 133939 (ERM, 2001, 2002b, 2003b).

Groundwater

CVOC field screening data and laboratory confirmation data from the Waterloo Profiler program are presented in Table 5. Waterloo Profiler boring locations are presented in Figure 2. Waterloo Profiler I_k data, field parameter data and field laboratory sheets, and equilibrated physico-chemical properties for each sample are presented in Appendix F. Laboratory reports for the groundwater analytical results are included in Appendix G.

Groundwater quality data for the Site are presented in the following tables:

- Table 6 - Summary of Groundwater Field Parameter Measurements
- Table 7 - Summary of Groundwater Analytical Results - VOCs - Northern Area
- Table 8 - Summary of Groundwater Analytical Results - Miscellaneous Parameters - Northern Area
- Table 9 - Summary of Groundwater Analytical Results - Dioxins - Northern Area
- Table 10 - Summary of Groundwater Analytical Results - MTBE - Southern Area
- Table 11 - Summary of Groundwater Analytical Results - Arsenic - Western Area

Northern Area

Waterloo Profiler field screening data and subsequent laboratory data for groundwater collected from monitoring wells indicate that chlorinated ethenes (i.e., PCE, TCE, cDCE and VC) are the primary constituents of concern in the Northern Area. Of the chlorinated ethenes detected, cDCE was detected at the highest concentration, followed by TCE, VC and PCE. PCE, TCE, cDCE, and VC concentrations in the Northern Area for April and October 2003 are presented in plan view on Figures 11A and 12A, respectively, and in cross-sectional view on Figures 11B and 12B, respectively.

To evaluate the potential for the presence of additional contaminants of concern, a number of additional parameters were analyzed in groundwater collected from wells MW-261S and MW-TP-3. These two wells were selected for analysis of a wide array of organic and inorganic parameters because they are both located in areas of known or suspected historical releases. None of the additional parameters were detected at concentrations exceeding applicable RCs.

ERM conducted a hydrochemical facies analysis (HFA) using the January 2003 groundwater analytical data to evaluate potential source areas and fate and transport processes affecting the nature and extent of CVOC impacts in the Northern Area (Figure 13). The HFA analysis uses a trilinear diagram to evaluate relative molar ratios of three compounds and involves two steps. First, a series of "rules" are developed that predict the expected behaviors of three different constituents in groundwater (e.g., TCE, cDCE, and VC) under various fate mechanisms (e.g., biodegradation, sorption or partitioning to the vapor phase). Then, VOC concentration data from the Site are plotted and evaluated to identify the fate mechanisms occurring at the Site.

Both PCE and TCE have been detected in groundwater in the Northern Area. Both compounds are used as chlorinated solvents and could represent the “source” signature. The HFA indicates that TCE was likely the primary compound released along with significantly lesser concentrations of PCE. The TCE signature is most dominant in well MW-261S and Waterloo Profiler boring B-241. These locations also exhibited the highest TCE concentrations in the Northern Area. Therefore, the area around MW-261S and B-241 is interpreted to represent the likely area of historical release (i.e., source area).

The HFA suggests that the TCE plume degrades as it migrates to the northwest and west. This is further supported by the CVOC concentration plots (Figures 11A, 11B, 12A, and 12B) and the deep overburden groundwater elevation contour map (Figures 8B, 9B and 10B). As the plume migrates downgradient from the source area, the TCE is biologically degraded to cDCE and VC. The HFA indicates that the most downgradient well within the plume (MW-268M) exhibits a chemical signature relatively enriched in cDCE with some VC and relatively depleted in TCE.

Consistent with the Waterloo Profiler field screening data, the monitoring well installation and sampling data indicate that CVOCs are generally confined to the lower fine sand and silt unit in the Northern Area. As shown on Figure 5A, this unit is significantly deeper in the western portion of the Northern Area, reaching a maximum depth of approximately 90 feet below grade at MW-268M. To date, no CVOCs have been detected beneath the underlying gravel unit shown on Figure 5A.

Southern Area

MTBE was detected above the applicable RC (70 µg/L) in the Southern Area. Detected MTBE concentrations range from 1.8 µg/L to 170 µg/L. MTBE concentrations in groundwater are presented in plan view on Figure 14. The highest concentrations of MTBE are found within the middle well screens at three well clusters: MW-202M (28 to 33 feet bgs), MW-204M (41 to 46 feet bgs), and MW-205M (42 to 47 feet bgs). MTBE was not detected in groundwater samples collected from the shallow wells at any of these well clusters, nor was it detected in soil samples collected from above the water table at these locations. MTBE was detected in only one of the deep wells at these well clusters (MW-202D at 51 to 56 feet bgs) at a concentration of 3.4 µg/L.

MTBE is a gasoline additive used to oxygenate fuel and aid in combustion, and thus is often found within soil and groundwater where a gasoline

release to the environment has occurred (Fetter, 1999). MTBE's relatively high solubility, low sorption to soil and relatively low susceptibility to biodegradation allow the constituent to persist longer and migrate farther than other gasoline constituents. MTBE may be transported at rates nearly equal to the advective groundwater flow rate and is often detected at the leading edge of a plume prior to the detection of other gasoline constituents. In some cases, MTBE is the only compound detected at some distance from a gasoline release. Within the Southern Area, MTBE is the only constituent of gasoline that has been detected in groundwater.

MTBE has been detected in groundwater at concentrations up to 6,100 µg/L at a gasoline service station located at 365 Boston Post Road (Strata, 2002). This property is currently in Phase IV of the MCP process and is tracked under RTN 3-17974. MTBE was initially detected at this property in August 2001 and concentrations have subsequently declined (Strata, 2003), suggesting that MTBE has migrated from the source area. The highest MTBE concentration detected in groundwater on this property (i.e., 6,100 µg/L) is higher than that detected in groundwater in the Southern Area (i.e., 170 µg/L).

Based on groundwater elevation data presented in Figures 8 through 10, the service station at 365 Boston Post Road is located hydraulically upgradient of the Southern Area. As noted in Section 5.3, downward vertical hydraulic gradients exist in the eastern portion of the Former Raytheon Facility. Similar downward vertical gradients were measured on the 365 Boston Post Road site (Strata, 2003).

Collectively, these data suggest that the source of MTBE is likely located on the 365 Boston Post Road site (RTN 3-17974) and that advective groundwater transport has resulted in migration of MTBE into the Southern Area. Pursuant to 310 CMR 40.0180, Raytheon may file a Downgradient Property Status Submittal for the Southern Area.

Western Area

Arsenic was detected above the applicable RC (0.05 milligrams per liter (mg/L)) in the Western Area. Detected arsenic concentrations range from 0.010 mg/L to 0.239 mg/L. Arsenic concentrations in the Western Area are presented in plan view on Figure 15.

Arsenic is a naturally occurring element within the environment. The availability of arsenic as a dissolved species in groundwater depends on the aqueous and physical geochemistry of an aquifer system. Arsenic concentrations in the groundwater of New England are relatively high and have been the subject of scientific studies. Ayotte et al. (2003) propose

that arsenic within New England is “dominantly natural and originates from minerals in the rocks of the region,” including arsenic-bearing sulfide minerals or trace amounts of the element within rocks (Ayotte et al., 1999).

Studies show high concentrations of arsenic within many river deltas because of the high organic content and reducing geochemical conditions found there (Stronach, 2003). Dissolved-phase arsenic is also commonly found under basic pH conditions (i.e., pH greater than 7; Ayotte et al., 1999; Ayotte et al., 2003). These conditions are present in the Western Area, as described below.

The Western Area is located within and adjacent to wetlands of the Sudbury River. Wetlands, with their naturally high organic content and saturated soils, often display chemically-reduced conditions. Groundwater within the Western Area generally exhibited negative ORP measurements (Table 6C), indicative of chemically reduced conditions. Arsenic oxyanions are known to adsorb to iron hydroxides, present as coatings on sediment (Horesh, 2001). Under reduced conditions, the iron hydroxides become soluble and no longer act as sorption sites for the arsenic oxyanion (Horesh, 2001).

Figure 16 displays an ORP-pH diagram for all arsenic detections within groundwater samples collected within the Western Area. The concentration of dissolved arsenic, determined by laboratory analysis, is displayed next to each datum on the figure. Concentrations of arsenic above RCs were most frequently detected in groundwater samples having relatively low ORPs (i.e., less than 0.00 millivolts (mV)). A subset of these samples also exhibit basic pH values (i.e., greater than 7).

Based on a review of historical chemical usage at the Former Raytheon Facility (ERM, 1996) and current chemical usage at the Wayland Business Center, arsenic does not appear to have been used at the facility. Based on the absence of an apparent anthropogenic source, the abundance of naturally occurring arsenic in soil across the property and the geochemical environment of the Western Area, ERM believes that the detections of arsenic in groundwater in this portion of the Site represent a naturally occurring background condition.

5.4.2

Names, Concentrations and Volumes of OHM Released

Summary of Oil and/or Hazardous Materials (OHM) Detected in Soil and Groundwater

The volume and specific source mechanism of CVOCs, MTBE, and arsenic release to the environment are not currently known. In accordance with 310 CMR 40.0483(1)(e)2.c., the following summary tables list the minimum

and maximum concentrations of contaminants detected in soil and groundwater at the Site.

Summary of OHM Detected in Soil

| Analyte | Minimum | Maximum | RCS-1 | >RCS-1 |
|-------------------------|----------------|----------------|--------------|------------------|
| <i>Organics (mg/kg)</i> | | | | |
| PCE | ND | 99 | 500 | No |
| TCE | ND | 340 | 400 | No |
| cDCE | ND | 260 | 2,000 | No |
| Acetone | ND | 140 | 3,000 | No |

Notes:

µg/kg = micrograms per kilogram

ND = Not detected at a concentration greater than the laboratory quantitation limit.

Summary of OHM Detected in Groundwater

| Analyte | Minimum | Maximum | RCGW 1 | >RCGW-1 |
|--------------------------|---------|---------|--------|---------|
| <i>Organics (mg/L)</i> | | | | |
| PCE | ND | 90 | 5 | Yes |
| TCE | ND | 4,400 | 5 | Yes |
| cDCE | ND | 10,000 | 70 | Yes |
| tDCE | ND | 2.6 | 100 | No |
| VC | ND | 520 | 2 | Yes |
| DCA | ND | 0.94 | 70 | No |
| DCE | ND | 0.52 | 1 | No |
| 2-Butanone | ND | 10 | 400 | No |
| Toluene | ND | 24 | 1,000 | No |
| meta & para Xylenes | ND | 0.66 | 6,000 | No |
| MTBE | ND | 170 | 70 | Yes |
| 1,2,3-Trichlorobenzene | ND | 130 | NS | - |
| 1,2-Dichlorobenzene | ND | 14 | 600 | No |
| 1,4-Dichlorobenzene | ND | 4.4 | 5 | No |
| Chlorobenzene | ND | 2.1 | 100 | No |
| Chloroform | ND | 1.2 | 5 | No |
| Tetrahydrofuran | ND | 12 | 500 | No |
| Formaldehyde | ND | 140 | 1,000 | No |
| Methyl alcohol | 9,800 | 9,800 | 10,000 | No |
| 1,2,3,4,6,7,8,9-OCDD | 3.2 | 3.2 | NS | - |
| 1,2,3,4,6,7,8,9-OCDF | ND | 5.6 | NS | - |
| 1,2,3,4,7,8-HxCDF | ND | 0.98 | NS | - |
| <i>Inorganics (mg/L)</i> | | | | |
| Arsenic | ND | 0.158 | 0.05 | Yes |
| Boron | ND | 0.03 | NS | - |
| Chloride | 2.3 | 7.0 | NS | - |
| Fluoride | ND | 0.21 | NS | - |
| Nitrogen - Ammonia | ND | 0.22 | NS | - |
| Nitrogen - Nitrate | ND | 0.030 | NS | - |

Notes:

µg/L = micrograms per liter

mg/L = milligrams per liter

ND = Not detected at a concentration greater than the laboratory quantitation limit.

NS = No MCP RC

- = Not applicable

5.4.3 *Impacts to Soil*

To date, no impacts to soil above applicable RCs have been identified at the Site.

5.4.4 *Impacts to Groundwater*

Northern Area

PCE, TCE, cDCE and VC impacts to groundwater exist in the Northern Area at concentrations exceeding applicable MCP Method 1 GW-1 risk-based standards, but below MCP Method 3 Upper Concentration Limits (UCLs).

Southern Area - MTBE

MTBE impact to groundwater exists in the Southern Area at concentrations exceeding the applicable MCP Method 1 GW-1 risk-based standard, but below the MCP Method 3 UCL.

Western Area

Arsenic impact to groundwater exists in the Western Area at concentrations exceeding the applicable MCP Method 1 GW-1 risk-based standard, but below the MCP Method 3 UCL.

5.4.5 *Conceptual Site Models*

ERM has developed conceptual site models (CSMs) for impacts to groundwater in the Northern, Southern and Western Areas.

Northern Area

Based on data collected to date, ERM has developed the following CSM for the Northern Area.

- An apparent historical release of primarily TCE occurred in the vicinity of MW-261S and B-241. The source signature also includes significantly lower levels of PCE. Historically, the area has been filled and only transient radar equipment testing was known to have been conducted in this portion of the Site. Therefore, the release mechanism was likely transient and no longer exists.
- A residual source of impact to groundwater appears to be present in the low hydraulic conductivity, upper fine sand and silt unit in the vicinity of MW-261S and B-241. TCE appears to migrate via flushing by recharge events or diffusion out of the upper fine sand and silt unit

into the underlying, higher hydraulic conductivity, medium to fine sand unit. When the TCE reaches the medium to fine sand unit, it migrates via advective groundwater flow initially to the northwest and ultimately to the west.

- The medium to fine sand unit fines and dips to the west becoming the lower fine sand and silt unit in the western portion of the Northern Area. The moderate conductivity lower fine sand and silt unit is overlain by a lower conductivity silt and clay unit. The relative difference in hydraulic conductivities between the two units, combined with downward vertical hydraulic gradients, have minimized or prevented CVOC impacts to the silt and clay unit along the axis of the plume. The moderate conductivity lower fine sand and silt unit is underlain by a higher hydraulic conductivity gravel unit. This relatively higher conductivity gravel unit appears to minimize downward vertical plume migration, as evidenced by significantly lower or non-detectable CVOC concentrations in and beneath this unit.
- As the TCE migrates away from the source area and vertically downward within the lower fine sand and silt unit, intrinsic biodegradation converts TCE to cDCE and VC, resulting in enrichment of cDCE relative to TCE in the westernmost wells. Intrinsic biodegradation, along with a series of physical and chemical processes (e.g., advection, dispersion, diffusion and dilution), are collectively referred to as natural attenuation. These processes act to limit the distance over which a CVOC plume can travel by naturally reducing concentrations in groundwater until a steady state condition is achieved. Given the historical nature of the TCE release, it is anticipated that the plume has reached a steady-state condition. However, at this time, the downgradient extent of the CVOC plume has not yet been defined.
- It is currently known that the CVOC plume trends westward and appears to be migrating beneath wetlands toward the Sudbury River. The Sudbury River is the regional hydraulic discharge boundary. In theory, the plume should migrate upward and discharge to the river and/or its associated wetlands. In order to do so, the plume must migrate at least 90 feet vertically upward through the low hydraulic conductivity silt and clay unit, which is not likely. Two potential scenarios are being considered with respect to the downgradient extent of the plume:
 1. The silt and clay unit may coarsen to the west beneath the Sudbury River and/or associated wetlands allowing the plume to migrate upward and potentially discharge to the river and/or wetlands.

2. The silt and clay unit remains consistent to the west forcing the plume to remain in the lower fine sand and silt unit. Hydraulic gradients from the west side of the river prevent groundwater from flowing further westward. Because the plume is unable to discharge upward to the river and is unable to flow further to the west, it deviates to the north and follows the river valley in the downstream direction. The plume may continue to migrate within the river valley until the overlying silt and clay unit coarsens, allowing upward discharge to the river, or until natural attenuation processes decrease CVOC concentrations to non-detectable levels.

The ongoing Northern Area investigation will evaluate these two scenarios in an effort to define the nature and extent of CVOC impacts to groundwater, as required under Phase II of the MCP process.

Western Area

Based on data collected to date, ERM has developed the following CSM for the Western Area.

- Arsenic appears to be a naturally occurring element within soil across the entire Site (ERM, 2001).
- A natural reducing environment exists beneath the wetlands in the Western Area, due to high organic content in wetland sediments.
- Arsenic is soluble under reduced conditions and is detected in groundwater in the Western Area.
- The extent of arsenic in groundwater is likely constrained to the area beneath the Sudbury River and associated wetlands. Once arsenic-bearing groundwater mixes with oxygenated groundwater present to the east and west of the wetlands, the arsenic will re-precipitate onto soil grains, significantly reducing arsenic concentrations in groundwater.

Southern Area

Based on data collected to date, ERM has developed the following CSM for the Southern Area.

- A spill of oxygenated gasoline (i.e., containing MTBE) occurred at the gasoline service station located at 365 Boston Post Road.
- Advective groundwater flow transported the highly soluble MTBE to the west-northwest and downward within the aquifer.

- Because MTBE is recalcitrant to both physical and chemical degradation processes, it migrated in groundwater onto the Former Raytheon Facility property.
- Assuming that the source of release on the 365 Boston Post Road property has been controlled and therefore, is not ongoing, a slug of MTBE should continue to migrate in groundwater across the Former Raytheon Facility property toward the Sudbury River. MTBE concentrations will decrease with distance due to dilution, dispersion and diffusion.

5.5 MIGRATION PATHWAYS AND EXPOSURE POTENTIAL

5.5.1 Migration Pathways

No evidence of current exposure to Site contaminants was identified. Based on the currently known nature and extent of OHM, potential exposure pathways are evaluated below.

Air

Volatile contaminants (i.e., CVOCs and MTBE) have been detected in groundwater in the Northern and Southern Areas. There are no existing structures and/or buildings within the Site boundaries. Therefore, the potential for adverse exposure due to potential impacts to air is low.

Soil

Impacts to soil have not been detected within the Site boundaries.

Groundwater

The Site is located within the Zone II DEP Approved Wellhead Protection Area for the Baldwin Pond Wellfield, which is located approximately 3,250 feet north of the Northern and Western Areas. In general, Site groundwater flows to the west and, as noted in Section 5.4.5, may deviate to the north within the Sudbury River valley. Natural attenuation processes will likely reduce CVOC and arsenic concentrations in groundwater to non-detectable levels before they reach the Baldwin Pond Wellfield. Therefore, the potential for adverse exposure due to potential impacts to groundwater is low.

Surface Water

Impacted groundwater maintains the potential to discharge to surface water (i.e., the Sudbury River and/or associated wetlands). However, natural attenuation processes will likely reduce CVOC and arsenic concentrations in groundwater prior to discharge to surface water. In addition, dilution effects caused by discharge of small volumes of groundwater to large volumes of surface water will further reduce concentrations. Therefore, groundwater contaminants maintain a low potential to impact surface water.

Sediment

Impacted groundwater maintains the potential to discharge to surface water (i.e., the Sudbury River and/or associated wetlands), which could impact river and/or wetland sediment. As noted above, it is anticipated that natural attenuation processes will significantly reduce CVOC and arsenic concentrations prior to discharge to surface water and sediment. Therefore, groundwater contaminants maintain a low potential to impact sediment.

5.5.2 *Known and Potential Human Exposure*

No evidence of human exposure to OHM was identified. Potential exposure for current and future foreseeable uses are described below.

Inhalation

Volatile impacts to groundwater are present in undeveloped and paved areas of the Site. Low potential exists for inhalation since no buildings are currently present in contaminated areas. The potential exists for exposure to contaminants via inhalation during potential future subsurface construction work at the Site.

Dermal Contact

Impacts to groundwater are present at depth in undeveloped and paved areas of the Site. Low potential exists for dermal contact since contaminants are present in groundwater beneath the ground surface. The potential exists for exposure to contaminants via dermal contact during potential future subsurface construction work at the Site.

Ingestion

Impacts to groundwater are present at the Site. Low potential exists for ingestion since groundwater is not used for drinking water or irrigation at

the Site. The potential exists for exposure to contaminants via incidental ingestion of groundwater during potential future subsurface construction work at the Site. Site groundwater is located within a Zone II for the Baldwin Pond Wellfield.

5.5.3 *Known and Potential Impacts to Environmental Receptors*

No evidence of impact to environmental receptors has been identified.

5.6 *EVALUATION OF NEED FOR IMMEDIATE RESPONSE ACTIONS*

Based on data collected to date, ERM has not identified any Site conditions requiring Immediate Response Actions (IRA) pursuant to 310 CMR 40.0412.

Pursuant to 310 CMR 40.0510(f)2, this section constitutes a Phase II Conceptual Scope of Work. It incorporates, by reference, the previously submitted Final Scope of Work (ERM, 2003a), which was developed in an effort to keep the public and the Department informed of ongoing assessment activities at the Site. This document was not required under the MCP, but was developed as a means to document previously completed Site investigation activities conducted during late 2002 and early 2003, and to present a scope of work for additional assessment activities proposed to further characterize CVOC impacts to groundwater in the Northern Area, including:

- the potential for CVOCs from the Northern Area to impact the Baldwin Pond Wellfield; and
- the downgradient extent of Northern Area CVOC plume.

ERM submitted a Notice of Intent (NOI), dated 26 September 2003, with the Wayland Conservation Commission and the Department for activities to be conducted within wetland areas or wetland buffer zones. The Conservation Commission issued an Order of Conditions, dated 20 November 2003. Implementation of the field program is scheduled for 2004. The exact timing of the field activities is dependent upon weather and ground conditions. Data generated as part of these investigation activities will be used to develop a Phase II Scope of Work.

Pursuant to 310 CMR 40.0830, the Phase II Scope of Work will satisfy the following regulatory requirements:

- the scope and nature of investigation and sampling events that will be undertaken to characterize the source, extent, and migration pathways of OHM, and the risk of harm posed to health, safety, public welfare or the environment;
- the name and license number of the LSP representing the person conducting the Comprehensive Response Action; and
- a schedule for implementation of the Phase II – Comprehensive Site Assessment.

The Phase II Scope of Work will likely include the following field activities:

- advance soil borings and install monitoring wells;
- conduct hydraulic conductivity testing; and

- survey, gauge and sample monitoring wells.

The Phase II Scope of Work will be submitted for public review and comment following completion of the field activities proposed in the Final Scope of Work (ERM, 2003a).

Phase II activities will be conducted within the following general schedule:

- develop Phase II Scope of Work: 2004
- conduct additional investigation activities: 2004 – 2005
- submit Phase II report: by 17 December 2005

The cost of the Phase II investigation is dependent on results of the upcoming field program, which was presented in the Final Scope of Work (ERM, 2003a).

7.0 TIER CLASSIFICATION

A Tier Classification for the Site was conducted using the Numerical Ranking System (NRS) described in 310 CMR 40.1500. The NRS Scoresheet, Tier Classification submittal, BWSC 02 – Tier IB Initial Permit Application, and transmittal forms are presented in Appendix H.

7.1 NRS SCORESHEET

Pursuant to 310 CMR 40.0520(2)(a)(1), the Site is categorically classified as Tier I since “there is evidence of groundwater contamination with OHM at concentrations equal to or exceeding the applicable RCGW-1 Reportable Concentration set forth in 310 CMR 40.0360 at the time of Tier Classification, and such groundwater is located within an Interim Wellhead Protection Area or Zone II.”

Field screening groundwater analytical results (i.e., Waterloo Profiler data) were not used for scoring purposes. State-certified laboratory analytical results were used for scoring purposes. Completion of the NRS resulted in a Site score of 511, which scores the Site as Tier IB.

Based on the results of this investigation ERM makes the following conclusions:

1. Release of TCE from an unknown historical source has impacted groundwater quality in the Northern Area.

PCE, TCE, cDCE and VC were detected at concentrations exceeding RCs in groundwater in the Northern Area. An apparent historical release of primarily TCE occurred in the vicinity of MW-261S and B-241. The source signature also includes significantly lower levels of PCE. Historically, the area has been filled and only transient radar equipment testing was known to have been conducted in the Northern Area of the Site. Therefore, the release mechanism was likely transient and no longer exists. Intrinsic biodegradation of TCE is occurring, resulting in production of cDCE and VC. CVOC impacts to groundwater are confined to a fine sand and silt unit in the Northern Area.

2. Release of MTBE from an upgradient property has impacted groundwater quality in the Southern Area.

MTBE was detected at concentrations exceeding RCs in groundwater in the Southern Area. The source of MTBE in the Southern Area was likely a gasoline release at an upgradient gasoline service station located at 365 Boston Post Road (RTN 3-17974). Pursuant to 310 CMR 40.0180, Raytheon may file a Downgradient Property Status Submittal for the Southern Area.

3. Naturally occurring arsenic has impacted groundwater quality in the Western Area.

Arsenic was detected at concentrations exceeding RCs in groundwater in the Western Area. Naturally occurring arsenic present in soil has been mobilized as a result of the natural reducing conditions in the wetlands bordering the Sudbury River. The presence of arsenic in groundwater in the Western Area likely represents a background condition.

4. Impacts to groundwater at the Site maintain a low potential to impact Site occupants or nearby receptors given current or potential future use scenarios.

Preliminary review of potential exposure pathways and receptors at or near the Site suggest a low potential for impact to human or environmental receptors based on current knowledge of Site conditions.

5. *The Site has been classified as Tier IB.*

Completion of the Numerical Ranking System scoresheet resulted in a Site score of 511, which scores the Site as Tier IB.

6. *A Phase II Scope of Work will be prepared, pursuant to 310 CMR 40.0830.*

Section 6.0 presents an outline of tasks being considered for inclusion the Phase II Scope of Work. A complete Phase II Scope of Work will be submitted in 2004.

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