

Environmental
Resources
Management

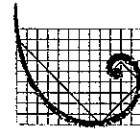
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17 December 2003
Reference: 0001922.03

COPY

Mr. Benson R. Gould
CMG Environmental, Inc.
Southbridge, MA 01550



ERM®

Re: Response to Public Comments
Draft Phase I Initial Site Investigation Report
Former Raytheon Facility
430 Boston Post Road
Wayland, Massachusetts (the "Site")
CMG ID 2002-003 RTN 3-22408

Dear Mr. Gould:

On behalf of Raytheon Company (Raytheon), Environmental Resources Management (ERM) has prepared this letter providing responses to comments prepared by CMG Environmental, Inc. (CMG), consultant to the Town of Wayland, regarding the Draft Phase I Initial Site Investigation report (Phase I), dated 12 November 2003. CMG's comment letter, dated 3 December 2003, contains 11 comments. This response letter includes relevant portions of each comment in italics and responses in plain text.

CMG's Comments:

OVERALL

It is readily apparent from review of the ISI [Initial Site Investigation] Report that there are three very different releases addressed under the single RTN of 3-22408. The 'Southern Area' is a methyl tertiary butyl ether (MTBE) release, which appears to be the direct result of gasoline release at an abutting property. The 'Western Area' is due to arsenic detected in wetlands groundwater, which appears to be a naturally-occurring phenomenon. The 'Northern Area' is a chlorinated solvent release whose origins are uncertain (but appears to have occurred during Raytheon's tenancy), which has migrated a significant distance in both the horizontal and vertical directions.

1) The Town of Wayland is concerned that keeping these three obviously separate releases grouped under the same RTN will multiply the amount of reporting required by the Massachusetts Department of Environmental Protection (DEP) under the Massachusetts Contingency Plan-(MCP, 310 CMR 40.0000), and subsequently for Wayland to review. The Town believes that the Southern Area will be best addressed through assertion of Downgradient Property Status pursuant to CMR 40.0180, and

the Western Area will likely be addressed as a background condition that has already achieved a Class B-1 Response Action Outcome (RAO). Meanwhile, it appears that the Northern Area will require a very significant investigation that will take at least two more years to proceed through MCP Phase II and III before Raytheon can determine a viable remediation strategy. Wayland recommends that Raytheon separate the three areas under separate RTNs, if DEP will accommodate this. It may be possible to submit a Partial RAO Statement to address the Western Area, but we are not aware of any similar mechanism to obtain "Partial Downgradient Property Status."

Raytheon's intent in combining the three separate release conditions under a single Release Tracking Number (RTN) was to reduce the amount of paperwork generated (e.g., if Raytheon had submitted three separate Release Notification Forms, then they would currently have to submit three separate Phase I reports, Tier Classification submissions and Tier IB Permit Applications).

ERM appreciates the Town's agreement that the Western Area will likely be addressed as a background condition. Raytheon intends to conduct additional groundwater monitoring activities to further support this assertion. If the data support that arsenic in groundwater is consistent with background in accordance with DEP guidance, two regulatory mechanisms may exist to address arsenic in groundwater at the Site:

- submission of a Class B-1 RAO - Partial if a condition of No Significant Risk is defined; or
- elimination of arsenic as a compound of concern as part of the comprehensive risk characterization for the RTN, which will be documented in the Phase II report (this alternative would generate less paperwork for the Town to review).

ERM also agrees with the Town that MTBE in groundwater in the Southern Area may represent a Downgradient Property Status (DPS) condition. Raytheon intends to conduct additional groundwater monitoring activities to further support this assertion. With respect to regulatory options for addressing this condition, ERM contacted Mr. John Fitzgerald of the DEP, who suggested that Raytheon could file a DPS for the MTBE condition without listing a RTN on the DEP Transmittal Form. The DEP would assign a RTN to the MTBE condition. ERM could then document in the Phase II report that the MTBE was being addressed under a separate RTN as a DPS condition.

Raytheon intends to address both of these conditions, consistent with MCP requirements, as part of the Phase II process. In doing so, this approach will:

- ensure that an adequate amount of data has been generated to justify both regulatory assertions; and
- minimize the amount of regulatory submissions that the Town will have to review.

2.0 GENERAL DISPOSAL SITE INFORMATION

2.4 Estimated Number of On-Site Workers at the Disposal Site

II) ERM is correct in stating "there are currently a total of fewer than 60 workers at the property." However, this appears to be a temporary population low. During the mid-1950s through the mid-1990s, Raytheon employed more than 1,000 people at the property (and possibly as many as 1,800 to 2,000). This is pertinent to the Numerical Ranking Scoresheet used for Tier Classification purposes (Appendix H of the ISI Report; see also our comment XI below). The Town recommends that you include wording briefly explaining the change in number of property workers over the past 10 years, and provide an estimated maximum number of workers potentially employed at the property building at full occupancy.

In response to this comment, ERM has amended the report text as follows:

"Historically, there have been up to 2,300 workers at the property (ERM, 1996)."

2.8 Natural Resource Areas Located within 500 feet of the Disposal Site

(III) The second paragraph on page 8 of the ISI Report reads "The southeastern boundary of the GMNWR, which abuts the northwestern boundary of the Northern Area, is a federally protected open space." The boundary of the Great Meadows National Wildlife Refuge (GMNWR) is a line, not a space. Wayland believes what ERM meant to say is that "the GMNWR, whose southeastern boundary abuts the northwestern boundary of the Northern Area, is a federally-protected open space."

In response to this comment, ERM has modified the report text as follows:

"The GMNWR, a federally protected open space, abuts the northwestern boundary of the Northern Area."

3.0 DISPOSAL SITE HISTORY

3.1 Owner/Operator and Operations History

3.1.2 Current and Historical Site Uses

IV) ERM states that "No additional information was identified regarding property use prior to 1936." On behalf of Wayland, CMG suggests that ERM research "Historic USGS Maps of New England & New York" available online from the University of New Hampshire Dimond Library Government Documents Department (<http://docs.unh.edu/nhtopos/nhtopos.htm>). We quickly located images of an 1894 topographic map of Framingham that depicts the Site

(<http://docs.unh.edu/MA/fram94ne.ipg>), a portion of which is included in Figure 1 attached to this letter. This map clearly depicts the entire property as flood plain wetlands along the Sudbury River, which we believe is significant in regards to hydrogeology at the disposal site. The 1943 topographic map of Natick from this collection (see <http://docs.unh.edu/MA/natc43nw.ipg>) depicts a pronounced hill within the property boundaries. The Town requests that ERM review information from this data source and incorporate pertinent information into the ISI Report.

In response to this comment, ERM has amended the report text as follows:

"Review of a topographic map, dated 1894, indicated that the property was undeveloped at that time."

ERM appreciates the Town's input regarding historical topographic maps. We, too, use this resource regularly and had previously reviewed the same historical topographic maps relevant to the Site, but failed to reference them in the report text.

V) ERM states on page 12 of the ISI Report that "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" (prepared in 1996). This is certainly true. However, the Town suggests that it may be beneficial to provide sufficient information in this portion of this ISI (for RTN 3-22408) to make for a stand-alone document.

Wayland recommends that ERM either include all the above information directly into the current ISI Report or include select portions of the previous (1996) Phase I report as an appendix. We also request that ERM provide specific section number references to any previous reports cited rather than generically stating "as presented in the Phase I Report for RTN 3-13302."

ERM agrees with the Town with respect to this comment and has included Section 4.0 and Table 1 of ERM's Phase I report, dated May 1996, in Appendix B. Various sections of the report have been amended to reference the incorporation of this information in Appendix B.

3.4 Waste Management History

3.4.1 Land Disposal

VI) On page 14 of the ISI Report, ERM notes that "portions of the wetlands in the Western Area had been filled" between 1936 and 1957. The Town notes that it appears the entire property was apparently wetlands in 1894, so a good deal more than just the Western Area has been filled (see Comment IV and our attached Figure 1). Although not a requirement for ISI reporting, it may prove useful to establish a chronology of property

filling.

As noted in our response to the Town's comment #IV, ERM has previously reviewed these historical topographic maps and noted inconsistencies between them. For example, in 1894 the land where the Site is located was mapped as apparent wetlands. Yet, in 1943, this same land was occupied by an approximately ½-mile long, northeast-southwest trending hill with 50 feet of vertical relief. It is ERM's opinion that this hill was not constructed between 1894 and 1943, but likely existed in 1894. A similar disparity exists in the area referred to as "Cherry Brook Station" on the 1894 map. Though these historical topographic maps are very useful for evaluating general land use (i.e., developed v. undeveloped), it is ERM's opinion that the 1894 map, in particular, is of questionable accuracy with respect to topography and wetlands delineation. Therefore, ERM has not relied upon this resource for evaluating potential filling of historical wetlands.

To further support this assertion, ERM reviewed boring logs from across the Site and determined that wetland sediments, such as organic silts and peat, have not been identified in shallow soil across the Site, as would be expected if the entire Site had once been a wetland. Therefore, Raytheon does not intend to establish a chronology of property filling activities.

5.0 RESULTS

5.4 Nature and Extent of Contamination

5.4.1 Evidence of Release

Groundwater - Western Area

VII) On page 32 of the ISI Report, ERM discusses relationships between arsenic concentrations in groundwater, pH, and oxidation-reduction potential (ORP). This discussion refers to Figure 16. ERM states that "concentrations of arsenic above RCs were most frequently detected in groundwater samples having relatively low ORPs (i.e., less than 0.00 millivolts (mV))." While this may be true, it implies a correlation between negative ORP and elevated arsenic concentrations.

We have done a statistical analysis on groundwater arsenic results presented in Table 11 of the ISI report versus ORP and pH field screening values presented in Tables 6C and 6B, respectively. (The field parameter measurements for September 2002 groundwater sampling are not given in the current ISI report - we obtained these values from Tables 3a [pH] and 3e [ORP] presented in the December 30, 2002 Phase IV report for RTN 3-22408.) Our analysis of 26 data points indicates an R2 correlation coefficient of 0.0239 for arsenic concentrations versus ORP, and an R2 value of 0.0054 for arsenic concentrations versus pH (see attached Figure 2). This indicates there is no statistical correlation between ORP and arsenic concentrations or pH and arsenic concentrations.

Wayland requests that ERM consider other possibilities to explain the observed elevated arsenic concentrations in Western Area groundwater at the Site. While their conceptual model of iron hydroxide-mediated release of arsenic oxy-anions under reducing conditions seems plausible (see also Section 5.4.5 [Western Area, page 37] of the current ISI Report), our statistical analysis suggests this may not be the actual mechanism involved.

ERM has reviewed available historical chemical usage at the Former Raytheon Facility and determined that arsenic was not used at the facility. Prior to Raytheon's occupancy of the facility in 1955, the property was undeveloped. Based on this information, ERM is not aware of an anthropogenic source of arsenic to groundwater beneath the wetlands at the Site (i.e., Western Area).

Based on data presented in ERM's Phase II – Comprehensive Site Assessment report for RTN 3-13302, dated 27 November 2001, arsenic has been detected in soil samples collected from across the Former Raytheon Facility property at an average concentration of 5.5 milligrams per kilogram (mg/kg). This average concentration is below the default background soil concentration (i.e., 20 mg/kg) published by the DEP in the May 2002 technical update "Guidance for Disposal Site Risk Characterization." Therefore, arsenic concentrations in soil at the Site are considered by DEP to be consistent with a background condition.

As noted in the Phase I report, the scientific literature strongly supports the relationship between arsenic solubility and aquifer geochemistry (i.e., arsenic is mobile in groundwater under reducing and/or basic conditions). ERM did not present an exhaustive discussion of arsenic geochemistry in the Phase I report, in an effort not to overwhelm the public. However, we have developed a more detailed discussion of arsenic geochemistry, in response to the Town's question, in an effort to clarify the data that was presented in the Phase I report.

Arsenic in its +5 valence state, As(V), is the oxidized form, which is relatively insoluble and therefore relatively immobile in water. As(V) exists in a number of forms, depending on the pH. At low pH (between 3 and 6), mono-ortho arsenate (H_2AsO_4^-) is the preferred form. Above a pH of 7, di-ortho-arsenate (HAsO_4^{2-}) predominates. The solubility of mono-ortho arsenate varies with pH, with a peak solubility at a pH of approximately 4.5. The solubility of di-ortho-arsenate peaks at a pH of approximately 9. Arsenic mobility is also sharply reduced by the presence of iron and aluminum oxides and calcium. For instance, arsenic can form insoluble iron arsenates when Fe(III) is present or precipitate as calcium arsenate. Arsenic can also absorb onto amorphous iron oxides.

Under moderately reducing conditions, As(V) is reduced to As(III; i.e., the +3 valence state), a far more soluble form of arsenic. The primary forms of As(III) are arsenic trioxide (As_2O_3) and arsenite (AsO_2^-). Under extremely low redox potentials, arsenic is stable in the form of arsine gas (AsH_3).

Because of the abundance of forms of arsenic and the complex Eh-pH relationship, one would not expect to find any sort of linear relationship between arsenic concentration and either pH or Eh. The reason for this is that different forms of arsenic, each with a pH-dependent solubility, could be mixed together in the data set. For instance, the range of oxidation-reduction potential (ORP) on Figure 16 of the Phase I report is from -160 to +275 millivolts (mV), and the range of pH is from 5.5 to 8.1. Over this range, there are at least three stable arsenic forms: mono-ortho arsenate, di-ortho arsenate and arsenite. ERM did not indicate in the report, nor does the scientific literature suggest, that there is a linear relationship between arsenic concentrations and ORP/pH, but rather indicated that arsenic was significantly more soluble under reducing (low ORP values) and basic (high pH) aquifer conditions.

ERM did not present a more detailed evaluation of this relationship in the Phase I report, because we did not deem it appropriate or necessary at this stage of the MCP process. With respect to the statistical analysis conducted on the data by the Town, ERM does not believe that linear regression is an appropriate statistical tool to evaluate the relationship between arsenic concentration and ORP and/or pH, as noted above.

Eh-pH diagrams are commonly used to evaluate relationships between metal (e.g., arsenic) solubility relative to groundwater geochemistry (i.e., ORP and pH). The form of ERM's Figure 16 is much more in keeping with the geochemical understanding of arsenic behavior. The trend of the plotted points follows the general trend of the zone of arsenite (As (III)) stability. To illustrate this, we have superimposed the Eh-pH diagram for arsenic at 25°C and 1 atm, based on the diagram published in Ferguson and Gavis (1972)¹. Clearly, all but one data point falls in the reduced zone (i.e., the region in which soluble As(III) is stable). In summary, the solubility of arsenic as a function of Site geochemistry will be evaluated in more detail during the Phase II. This evaluation will be conducted to the extent necessary to support the assertion that the arsenic in groundwater is consistent with background.

¹ Ferguson, J. F. and Gavis, J., 1972. "A review of the arsenic cycle in natural waters," *Water Research*, v. 6., pp. 1259-1274.

5.4 Conceptual Site Models

Northern Area

VIII) The Town requests that ERM postulate an approximate volume of trichloroethene released. We believe that if you can approximate the release volume, this will aid in narrowing down the possibilities of release mechanism.

Raytheon will provide the TCE mass estimation results under the Phase II - Comprehensive Site Assessment.

6.0 CONCEPTUAL SCOPE OF WORK

IX) On page 41 of the ISI Report, ERM notes that they previously submitted a Final Scope of Work to DEP. This is true. However, to avoid any confusion the Town suggests that ERM and Raytheon point out this was a Phase I Scope of Work, not a Phase II Scope of Work as set forth at 310 CMR 40.0834 of the Massachusetts Contingency Plan (MCP).

It is important to note that the Final Scope of Work document submitted to the DEP on 13 June 2003 is not a Phase I Scope of Work. Under the MCP, such a document does not exist. As noted in the Phase I, the Final Scope of Work was prepared as an interim document intended to keep the public and the DEP informed regarding work completed at the Site subsequent to submission of the Phase IV - Remedy Implementation Plan (RTN 3-13302), dated 30 December 2002, and to provide a means to inform the public as to proposed Site investigation activities.

ERM modified the text in Section 6.0 of the Phase I to further clarify the intent of the Final Scope of Work and status of the proposed field activities presented in that document.

7.0 TIER CLASSIFICATION

7.1 NRS Scoresheet

ERM numerically scored RTN 3-22408 as 516, which results in a Tier IB classification (see page 43 and Appendix H of the ISI report).

X) In Section II.B. of the NRS Scoresheet, ERM has scored groundwater 20 points for 'evidence of contamination' and 100 points for 'potential exposure pathway'. It is our understanding that the higher of these scores carries forward in the NRS scoresheet, not both values. Therefore we believe the total Section II score should be 150, not 170.

In response to this comment, ERM has edited Section II.B of the NRS Scoresheet, resulting in a total score of 100 points for Section II.B.

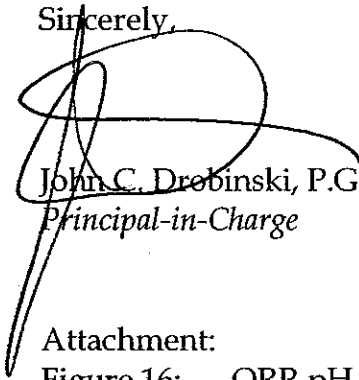
XI) Section VIA. of the NRS Scoresheet indicates the number of on-Site workers as "none," which scores 0 points. Wayland agrees that there are no workers employed at the actual 'Disposal Site' as defined in Section 1.1 of the ISI Report and illustrated on Figure 2. However, 310 CMR 40.1507(1)(a)3. clearly discusses the "presence of On-Site Workers at the property or properties comprising the disposal site." Therefore, the Town believes that ERM must consider that there is a large commercial building and small municipal wastewater treatment plant located on the 'properties which comprise the disposal site.' ERM states in Section 2.4 of the ISI Report that there are currently 'fewer than 60' workers at the property. If this remains the case for the foreseeable future, then a score of 5 points (for 1-99 on-site workers) might be valid. However, Wayland believes it is reasonably foreseeable that 1,500-2,000 employees will work at the property again, as was the case during Raytheon's occupancy of the premises. Therefore, we suggest that ERM score Section VLA. of the NRS Scoresheet as 15 points (for $\geq 1,000$ on-site workers).

These two changes lower the overall disposal site score to 511, which remains a Tier IB classification.

In response to this comment, ERM has edited Section IV.A of the NRS Scoresheet, resulting in a total score of 15 points for Section IV.A. The total Site score was adjusted from 516 to 511 as a result of these two changes. The Site is still classified as Tier IB.

If you have any questions or comments please, contact Mr. Edwin Madera of Raytheon at (978) 440-1813.

Sincerely,



John C. Drobinski, P.G., LSP
Principal-in-Charge

Joe Fiaco
R. Joseph Fiacco, Jr., P.G.
Senior Project Manager

Attachment:

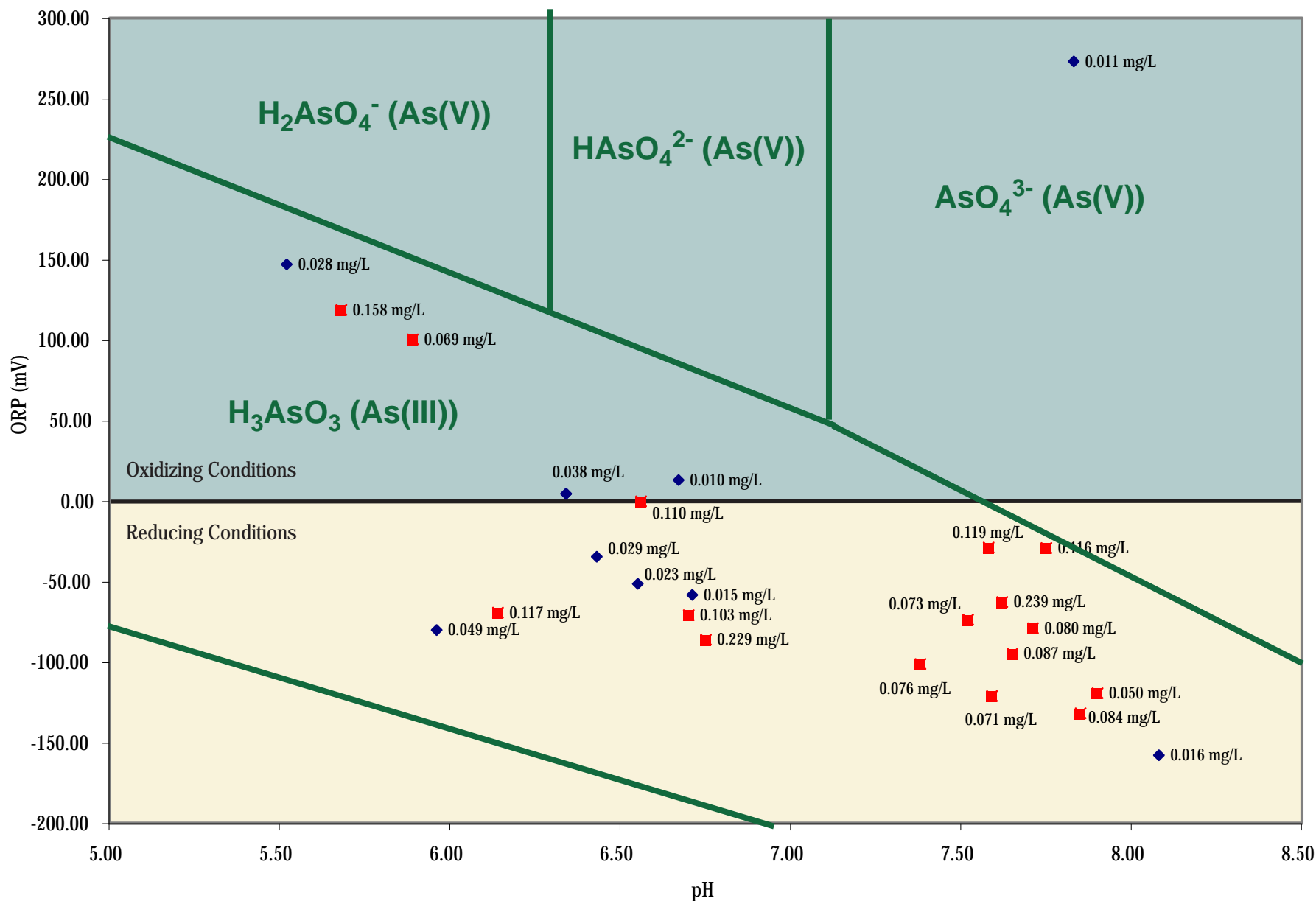
Figure 16: ORP-pH Diagram for Arsenic in Groundwater

cc: Mr. Edwin Madera, Raytheon Company, Sudbury, MA 01776

Public Repository (Primary Location), Wayland Public Library, Wayland,
MA 01778

Public Repository (Secondary Location), Board of Health Office, Wayland,
MA 01778

Ms. Karen Stromberg, Massachusetts Department of Environmental
Protection - Northeast Region, One Winter Street, Boston, MA 02108



Note: Red concentrations at or above RCGW-1 of 0.050 mg/L
 Blue concentrations below RCGW-1 of 0.050 mg/L

Figure 16 - ORP - pH Diagram for Arsenic in Groundwater
 Former Raytheon Facility - Wayland, MA

