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Customer Success Is Our Mission

Remediation Status Update Former Raytheon Facility Wayland, Massachusetts

Integrated Defense Systems
Jonathan Hone

December 3, 2014

Outline

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- Team Introductions
  - John Drobinski, LSP, Environmental Resources Management
  - Dr. Sami Fam, Innovative Engineering Solutions
  - Lyndsey Colburn, PM, Environmental Resources Management
- Site Overview
- 2014 Site Activities
  - Site-Wide Activities
  - Southern Area
  - Northern Area Bioremediation
- Q&A

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Locus Plan

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Site Overview

- Radar testing and development (1957-1995)
- Contamination discovered in 1996
- Regulated by the Massachusetts DEP
- Historic Site Contaminants
  - PCE, TCE, 1,4-Dioxane, PCBs, metals
- Extensive Site Investigation (ongoing)
- 2 Primary Areas of Current Activity
  - Northern Area- Bioremediation
  - Southern Area – Chemical Oxidation
- 2 large soil removals & wetland restoration
- Activity & Use Limitations (AUL) have been implemented at the site
- Groundwater flow is generally to the west
- Located within drinking water zone
  - Baldwin Pond Wells
- Ongoing site redevelopment since 2009
  - Wayland Commons
  - Wayland Town Center
  - River Trail Place

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Wayland Site Plan

2014 Activities

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- Remedy Operation Status (ROS) Reports submitted in May & November
  - Available online and at the Town repository

- Groundwater quality monitoring
  - Cow Commons sampling
  - Southern Area Groundwater Sampling
  - Pending Groundwater Investigation

- Northern Area Bioremediation System
  - Bioremediation System Operation, Maintenance & Monitoring
    - Groundwater monitoring
    - Injection and recirculation of Amended Groundwater

Cow Common/Sentinel Wells

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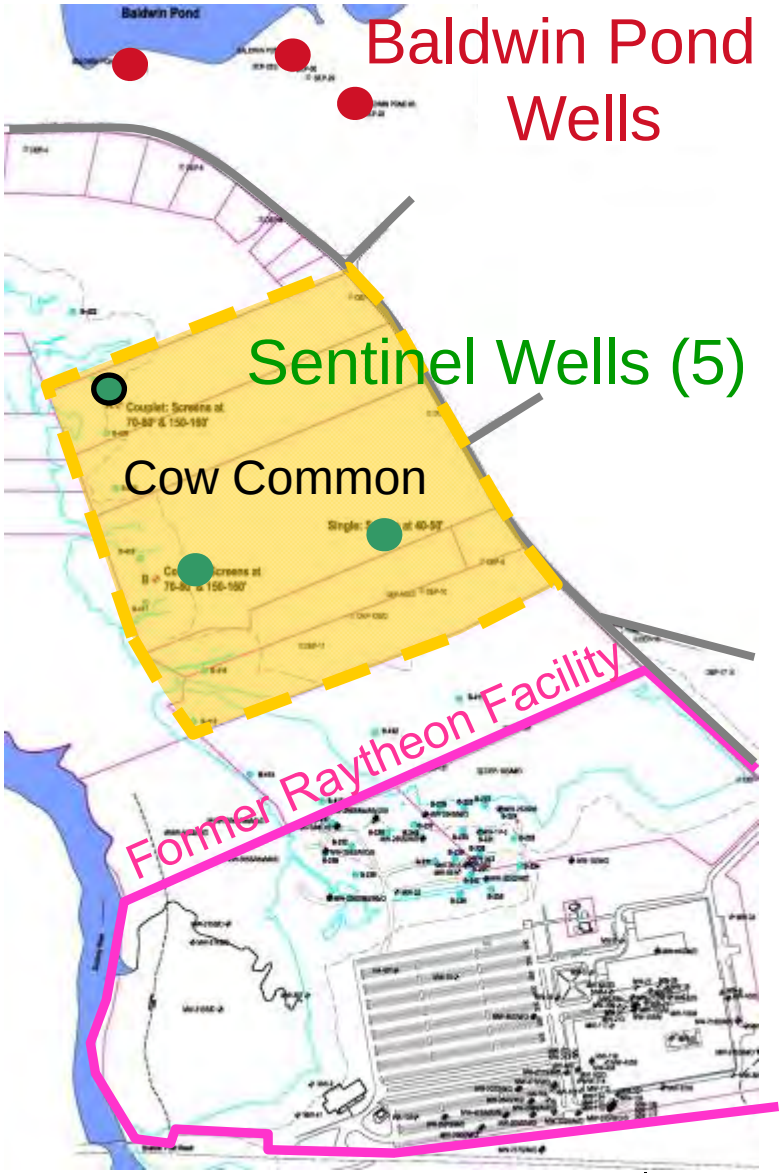
- Groundwater samples collected from wells in September 2014
  - Analyzed for VOCs by Method 8260B
- All samples were Not Detected above the laboratory detection limit (ND)
  - SEN-1 was not sampled due to a Wasp infestation
- No detections of previously identified compounds: carbon disulfide, chloroform, ethyl-tert-butyl ether, toluene



Southern Area

September TCE concentrations

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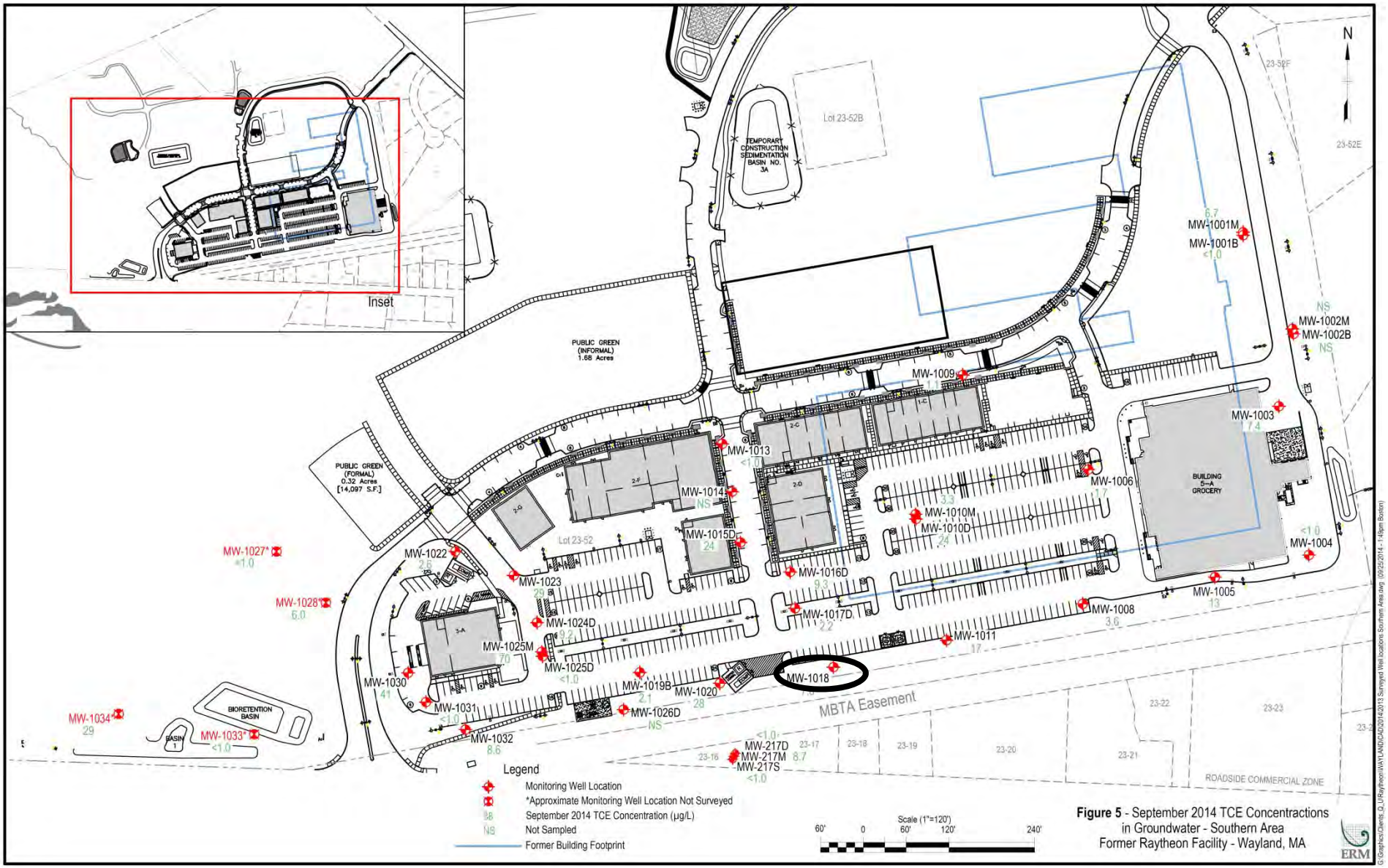

Figure 5 - September 2014 TCE Concentrations in Groundwater - Southern Area
Former Raytheon Facility - Wayland, MA

TCE concentrations in MW-1018 since installation (2013)

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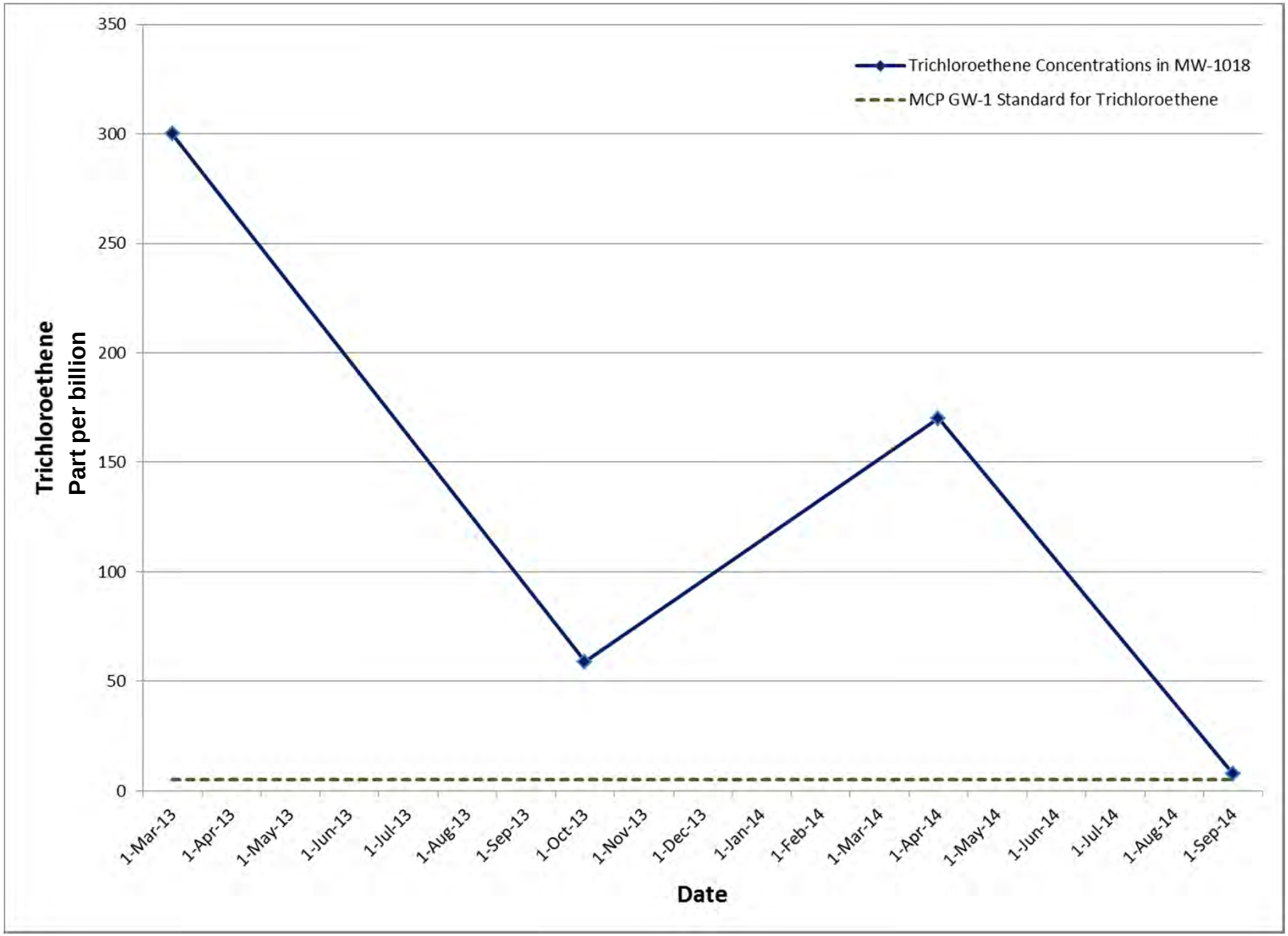

Groundwater Investigation (pending MBTA approval)

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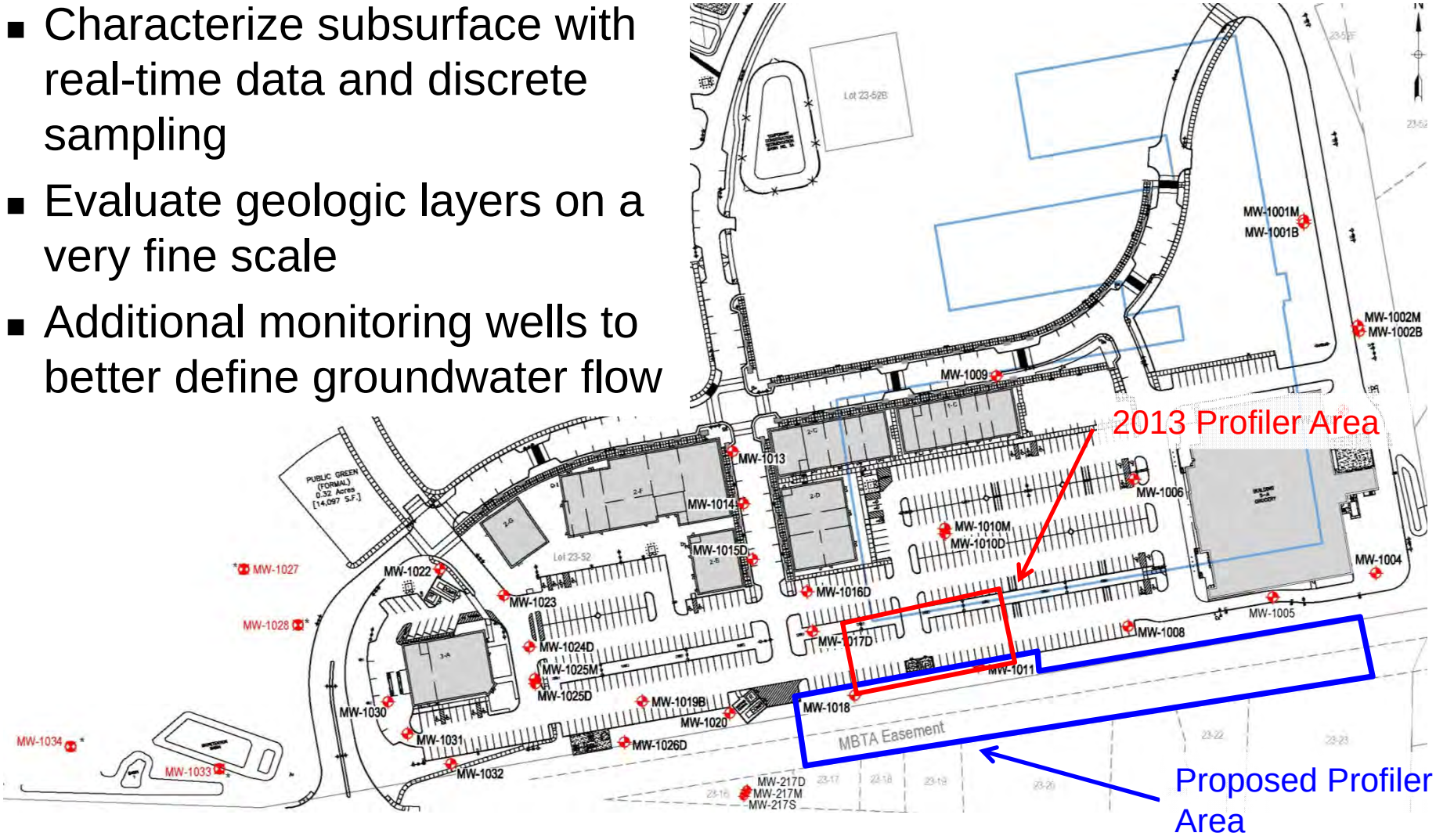
- Characterize subsurface with real-time data and discrete sampling
- Evaluate geologic layers on a very fine scale
- Additional monitoring wells to better define groundwater flow



Advanced Profiling System™ Waterloo Profiler

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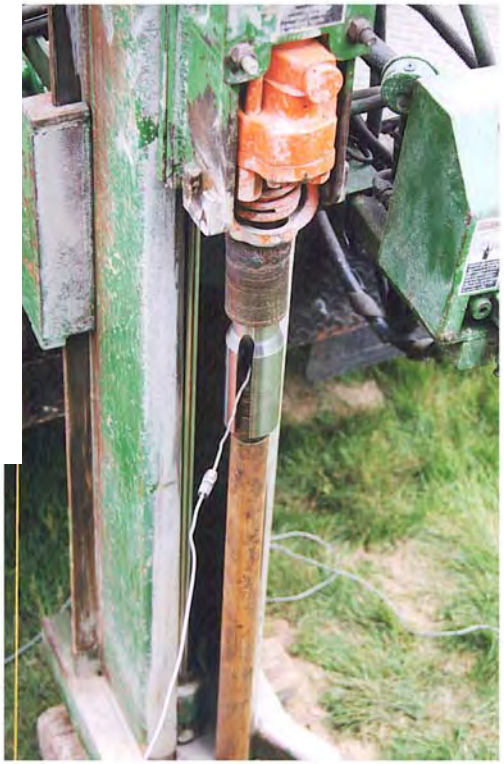
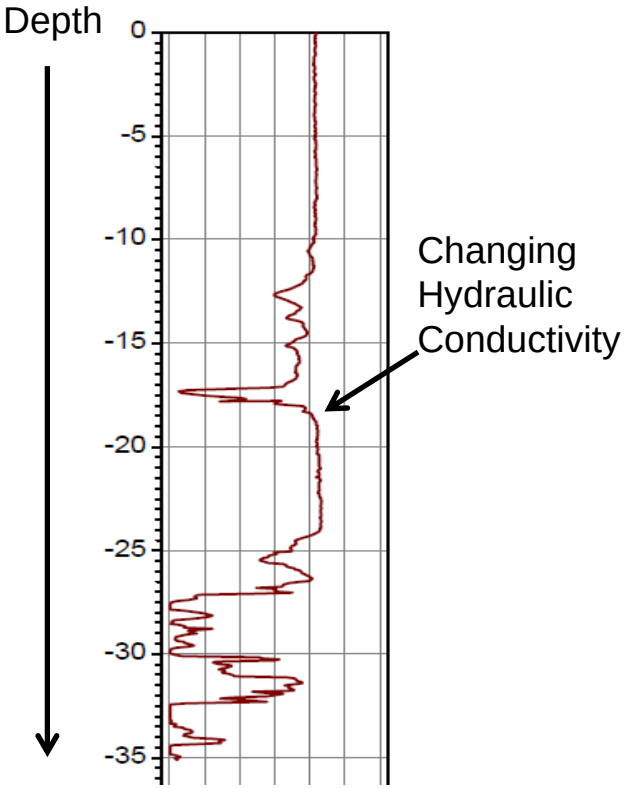
- Direct-push drilling rig advances instruments
- Collect real-time groundwater and geologic data in subsurface conditions



Example APS Log



Northern Area

Northern Area (Bioremediation)

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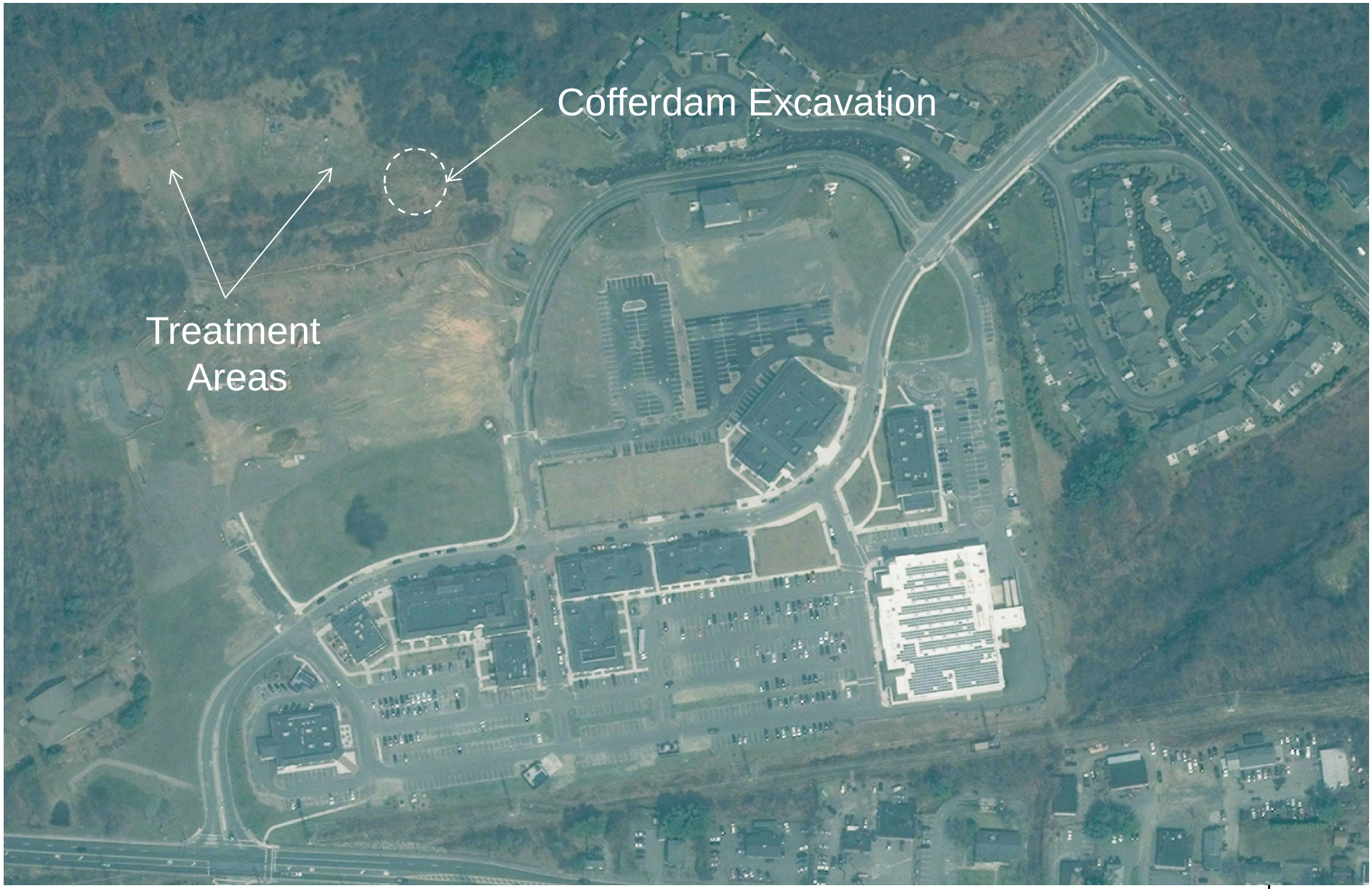

Recirculation System Overview

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- The program involves recirculation of groundwater within a area to distribute the added amendment (carbon source, “food”, electron donor)
  - Methanol (WFD permitted storage), nutrients, pH buffers, cultures
- Increases subsurface mixing by injection (upgradient) and extraction (downgradient) of amended groundwater
- Extraction wells are fitted with submersible pumps and control equipment to monitor flow, minimize possibility of leaks, and prevent damage to system
- Solar powered pumps and controls extract groundwater continuously at approximately ~3 gallons per minute (gpm)

Recirculation System Photos

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Enhanced Anaerobic Dechlorination

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- A carbon source or amendment has been introduced to the naturally occurring microbes to Enhance metabolic processes in an Anaerobic subsurface/environment

- Dechlorination is a process by which a consortia of microbes remove chlorine atoms from chlorinated solvents until all that is left is basic ethene

- "Parent" compound degrade into "Daughter" products

Tetrachloroethene (PCE)
→ **Trichloroethene (TCE)**
→ **cis-1,2-Dichloroethene (cDCE)**
→ **Vinyl Chloride (VC)**
→ **Ethene**

Recirculation System Timeline

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- October 2010: System initial start up
- 2011 expansion included the installation of 3 extraction wells near 2007 Cofferdam excavation & 3rd Solar array
- 2012 expansion included the installation of 6 injection wells, 9 extraction wells, 1 monitoring well, 12 solar panels, & incorporation of the “IW” series wells
- 2014 Activities
  - System running at full capacity
  - Recirculated approximately ~2.5 million gallons of groundwater in 2014 (~9 million gallons since the program began)

As-built & Operational History

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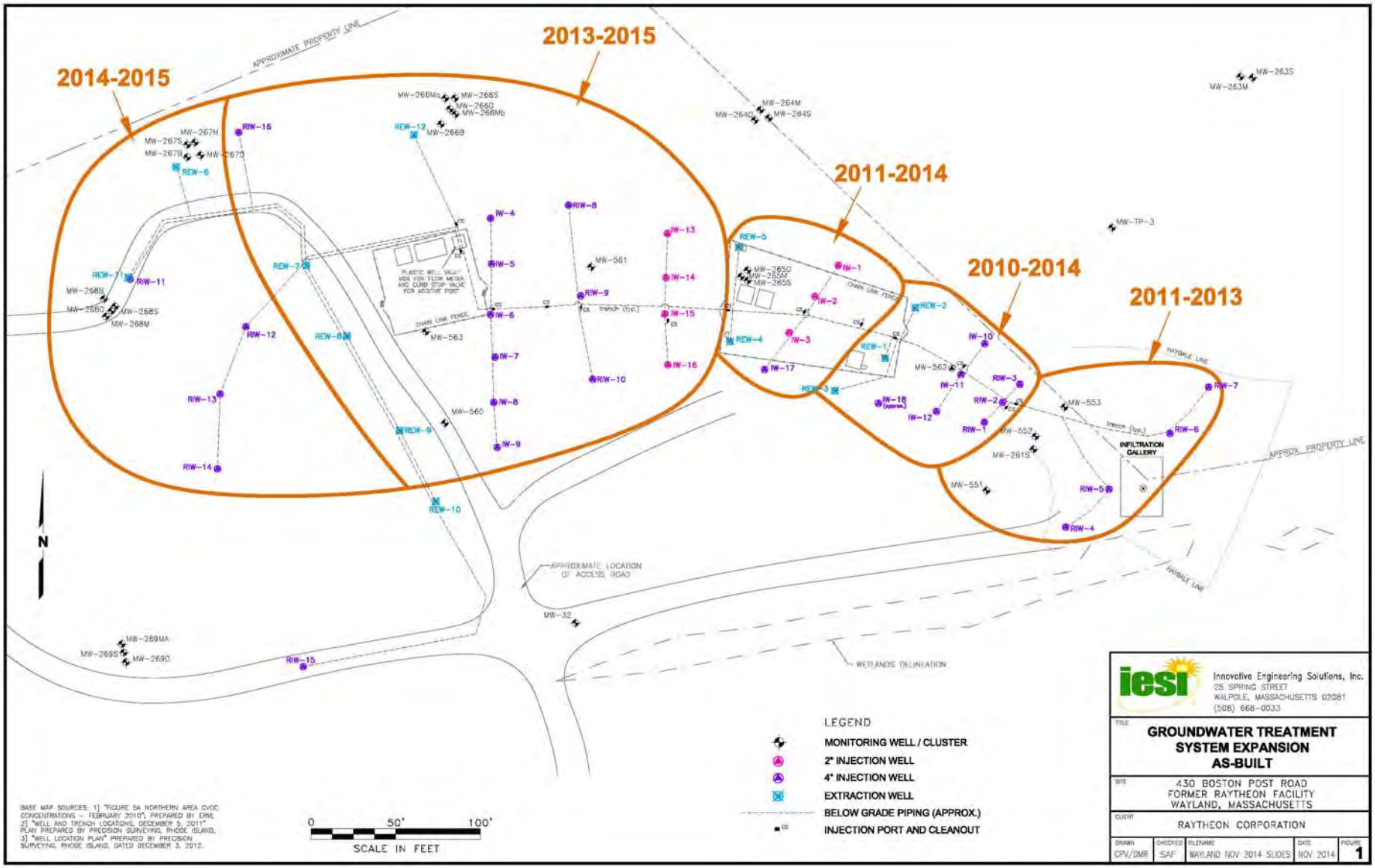
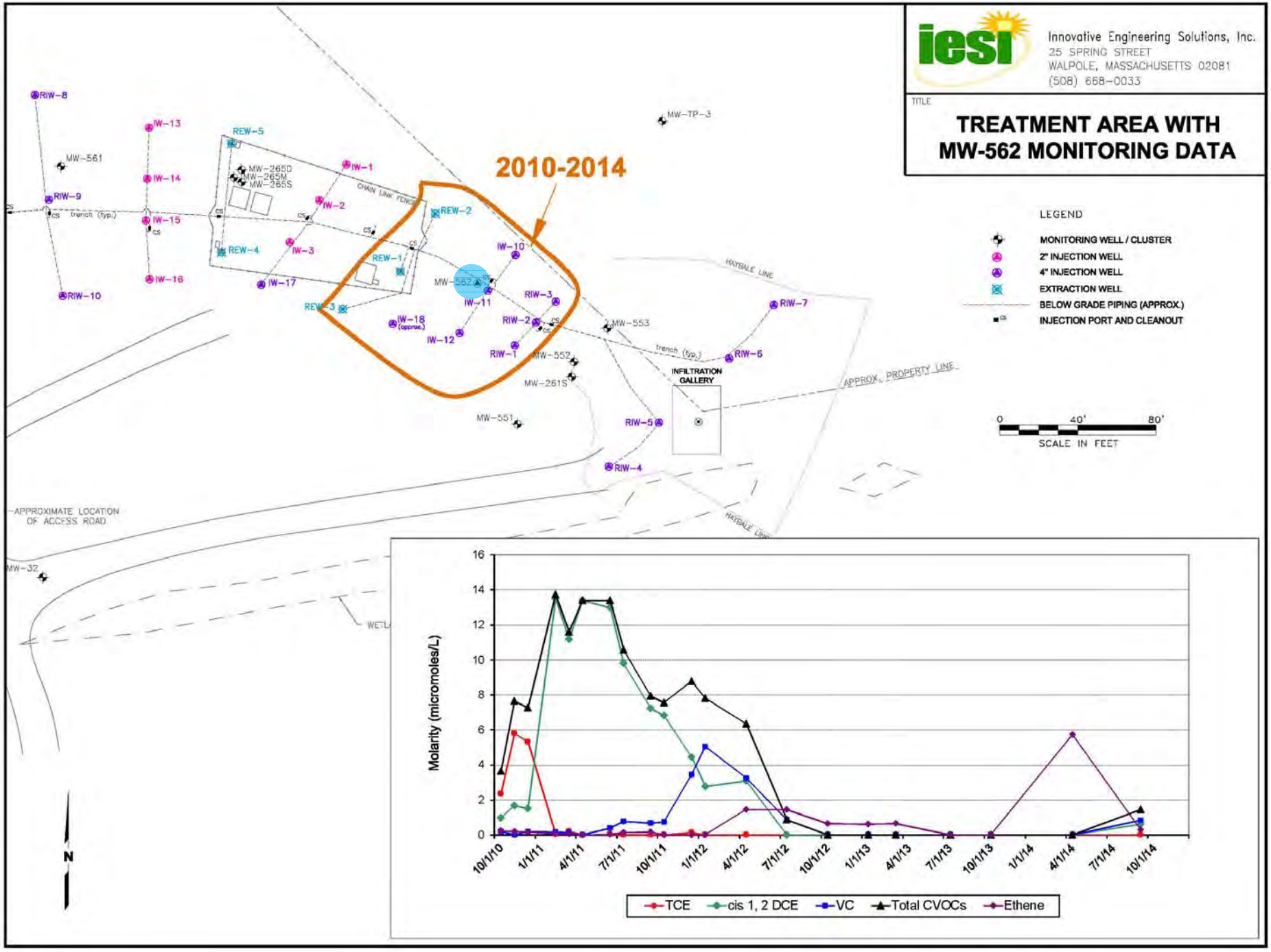


Innovative Engineering Solutions, Inc.
25 SPRING STREET
WALPOLE, MASSACHUSETTS 02081
(508) 668-0033

TITLE

TREATMENT AREA WITH MW-562 MONITORING DATA



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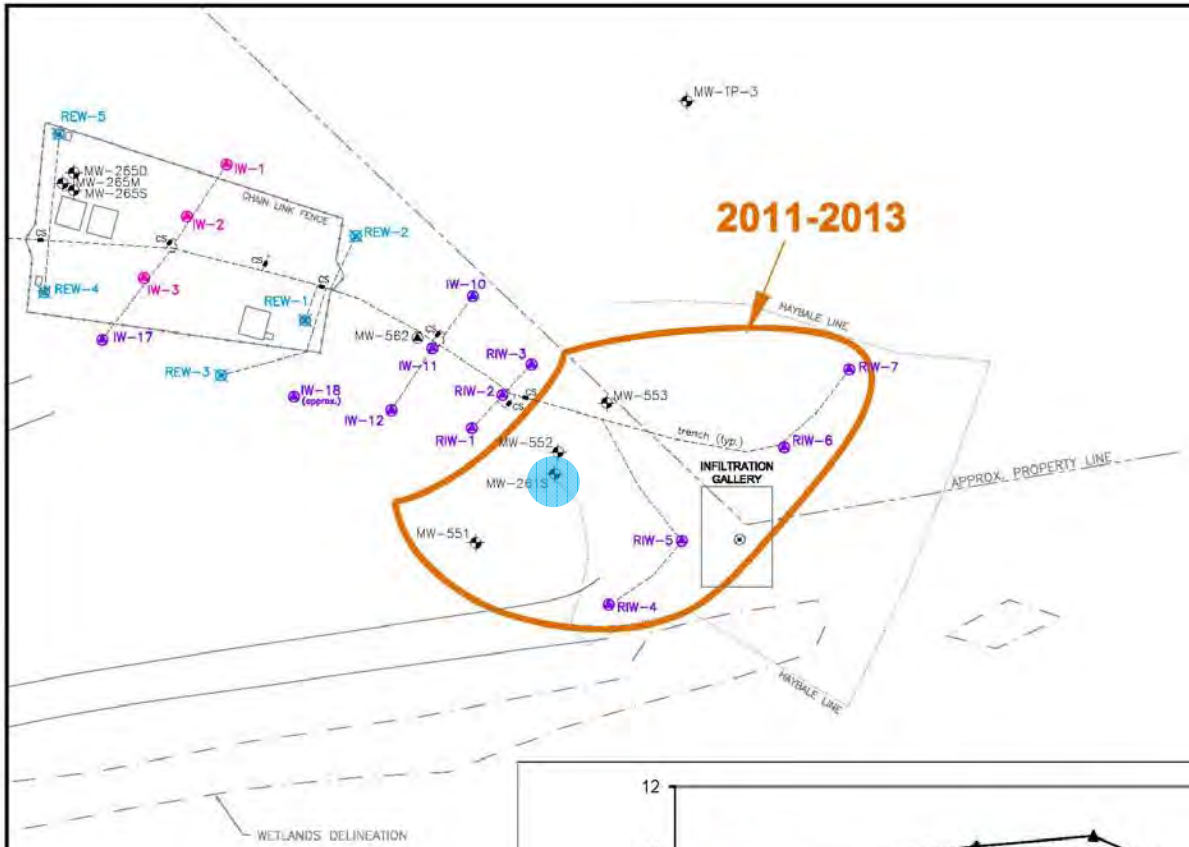
TITLE

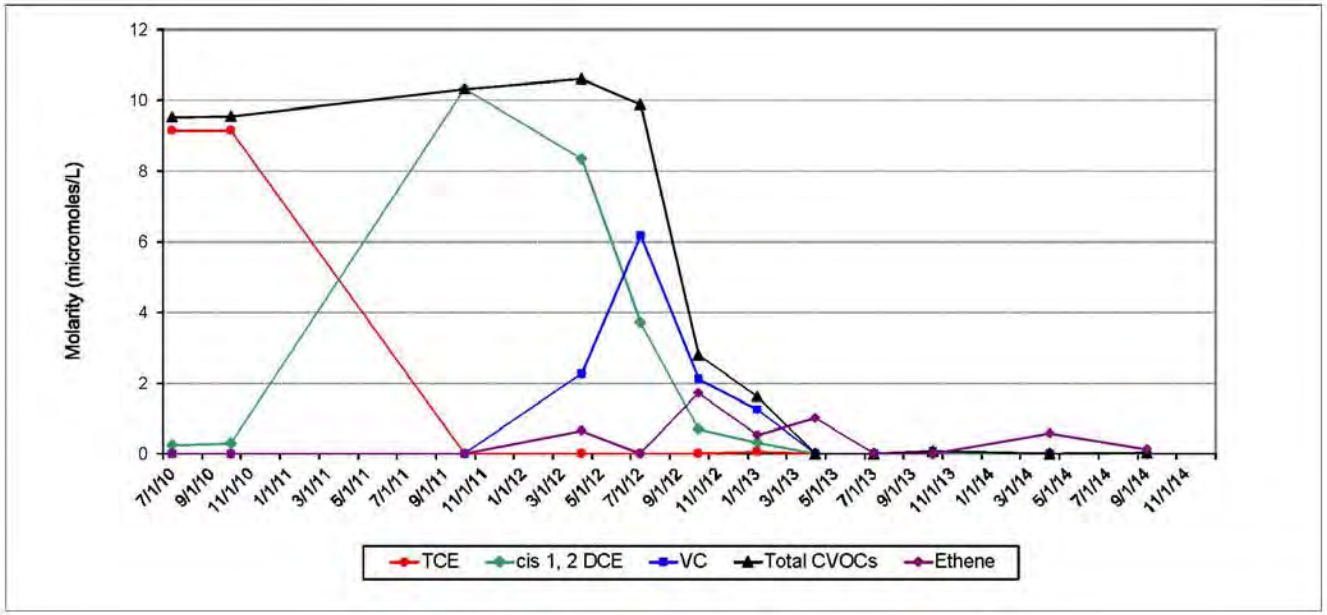
TREATMENT AREA WITH MW-261S MONITORING DATA



LEGEND

- MONITORING WELL / CLUSTER
- 2" INJECTION WELL
- 4" INJECTION WELL
- EXTRACTION WELL
- BELOW GRADE PIPING (APPROX.)
- INJECTION PORT AND CLEANOUT

0 40' 80'
SCALE IN FEET



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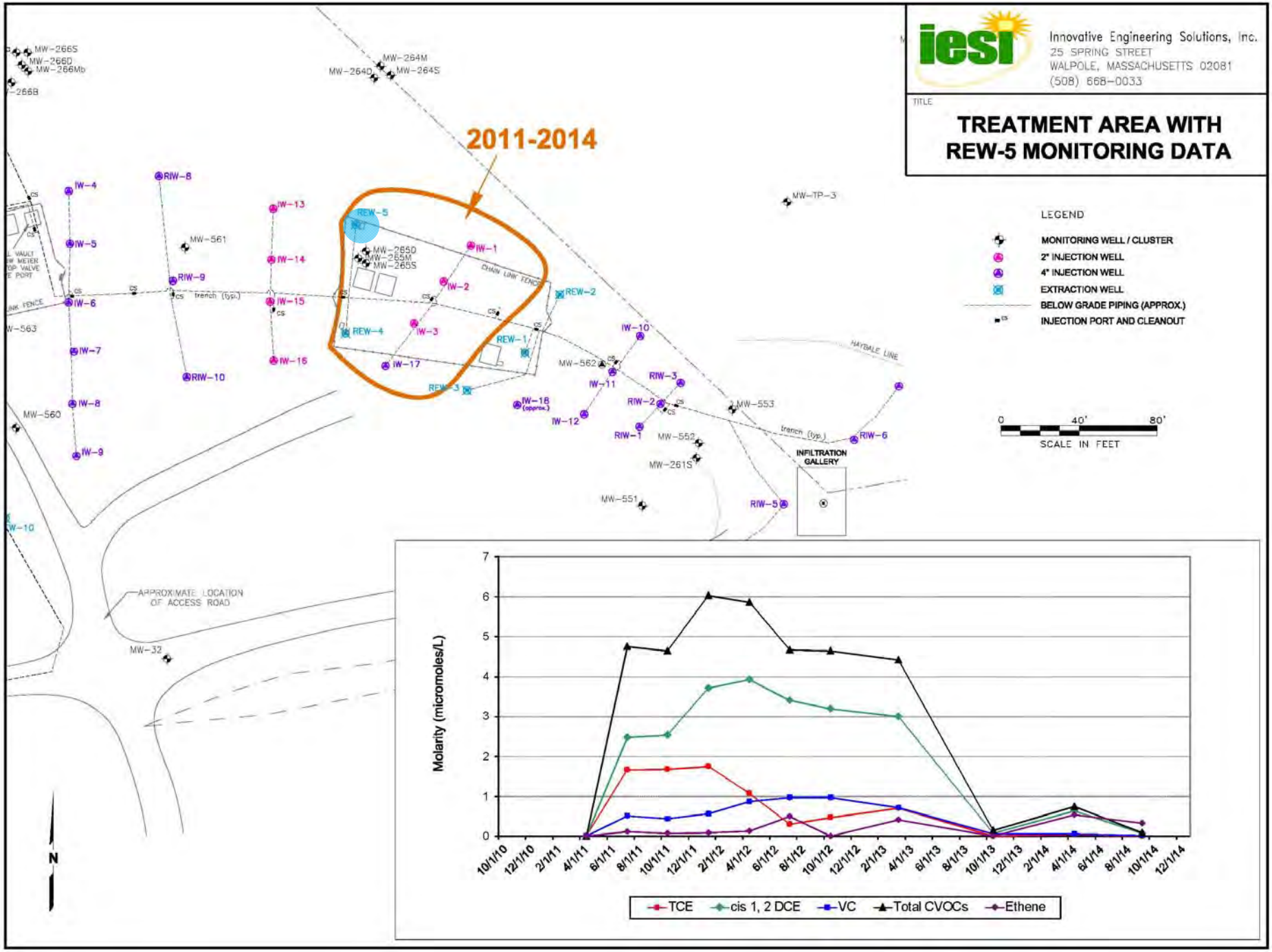
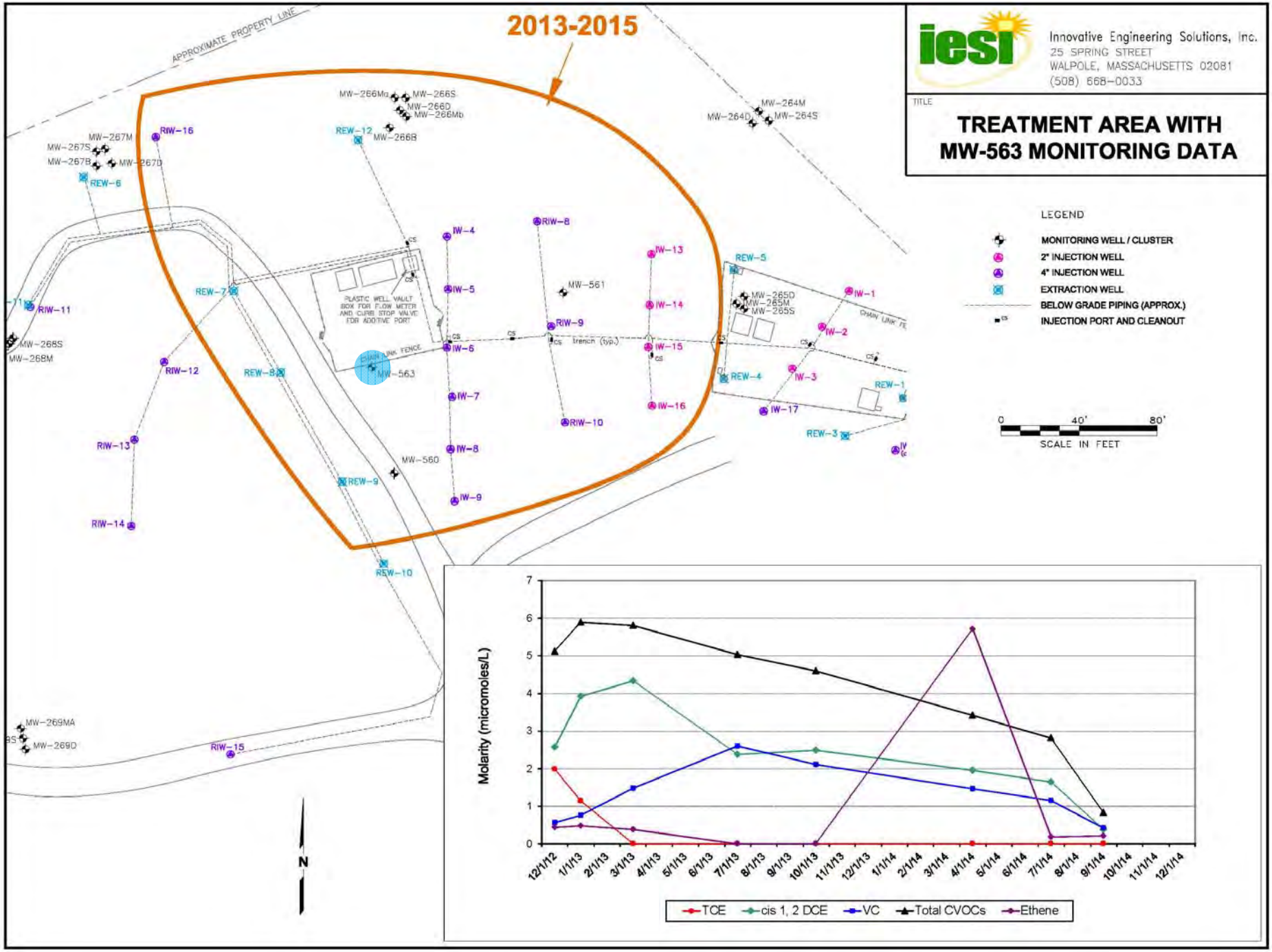
TITLE

TREATMENT AREA WITH REW-5 MONITORING DATA





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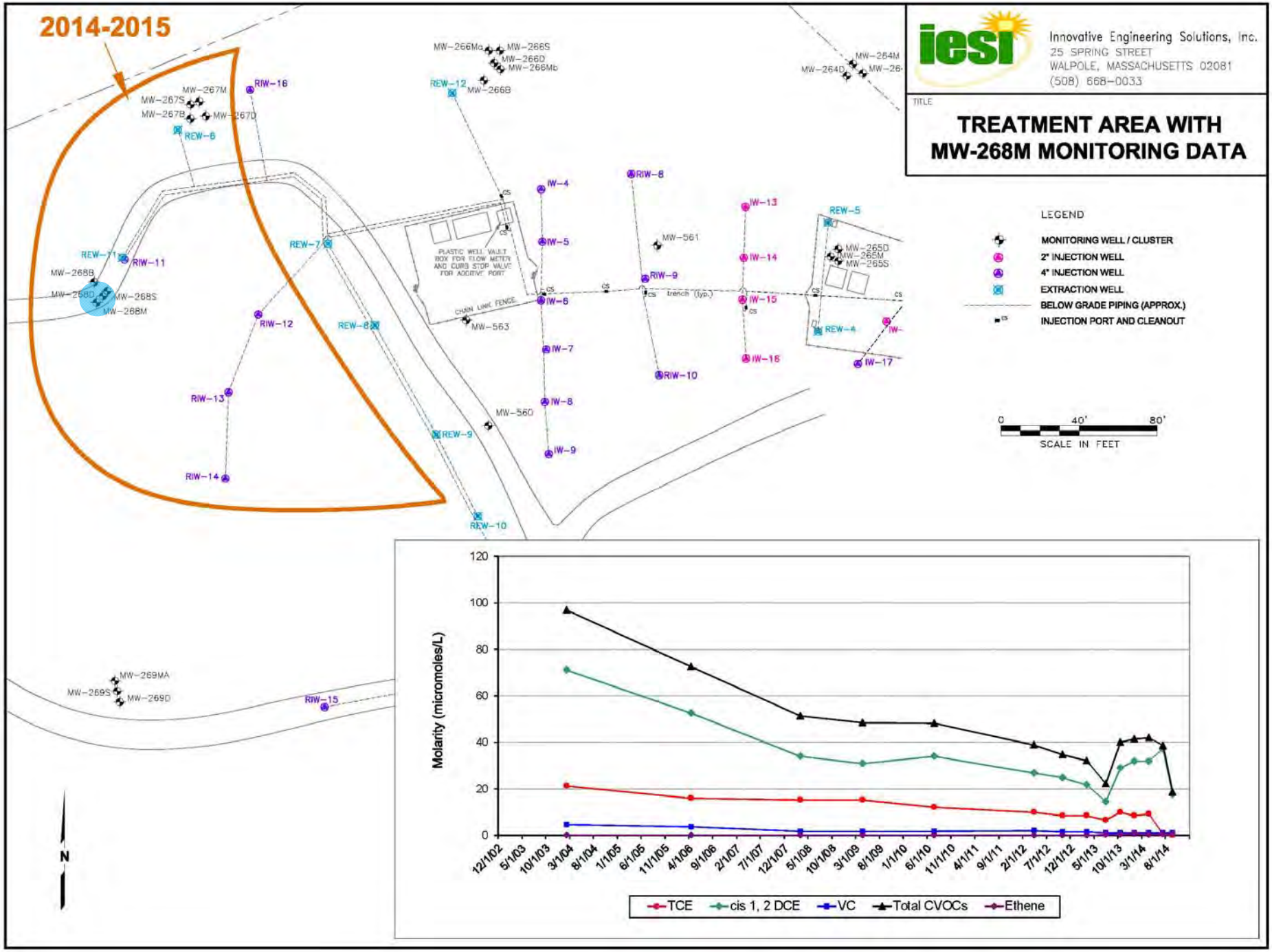
(508) 668-0033

TITLE

TREATMENT AREA WITH MW-563 MONITORING DATA


2014-2015
Innovative Engineering Solutions, Inc.
25 SPRING STREET
WALPOLE, MASSACHUSETTS 02081
(508) 668-0033
TITLE
TREATMENT AREA WITH MW-268M MONITORING DATA
LEGEND
MONITORING WELL / CLUSTER
2" INJECTION WELL
4" INJECTION WELL
EXTRACTION WELL
BELOW GRADE PIPING (APPROX.)
INJECTION PORT AND CLEANOUT
0 40' 80'
SCALE IN FEET
N
MW-266Ma
MW-266S
MW-266D
MW-266Mb
MW-266B
REW-12
MW-264M
MW-264D
MW-267M
MW-267S
MW-267B
MW-267D
REW-6
RIW-16
REW-7
REW-11
RIW-11
MW-268B
MW-268D
MW-268S
MW-268M
RIW-12
REW-8
RIW-13
RIW-14
REW-9
REW-10
MW-269MA
MW-269S
MW-269D
RIW-15
IW-4
IW-5
IW-6
IW-7
IW-8
IW-9
RIW-8
MW-561
RIW-9
RIW-10
MW-563
MW-560
IW-13
IW-14
IW-15
IW-16
REW-5
MW-265D
MW-265M
MW-265S
REW-4
IW-17
PLASTIC WELL VAULT BOX FOR FLOW METER AND CURB STOP VALVE FOR ADDITIVE PORT
CHAIN LINK FENCE
trench (typ.)
cs
Molarity (micromoles/L)
120
100
80
60
40
20
0
12/1/02
5/1/03
10/1/03
3/1/04
8/1/04
1/1/05
6/1/05
11/1/05
4/1/06
9/1/06
2/1/07
7/1/07
12/1/07
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3/1/14
8/1/14
TCE
cis 1, 2 DCE
VC
Total CVOCs
Ethene

TCE Concentration Contours

Pre-recirculation

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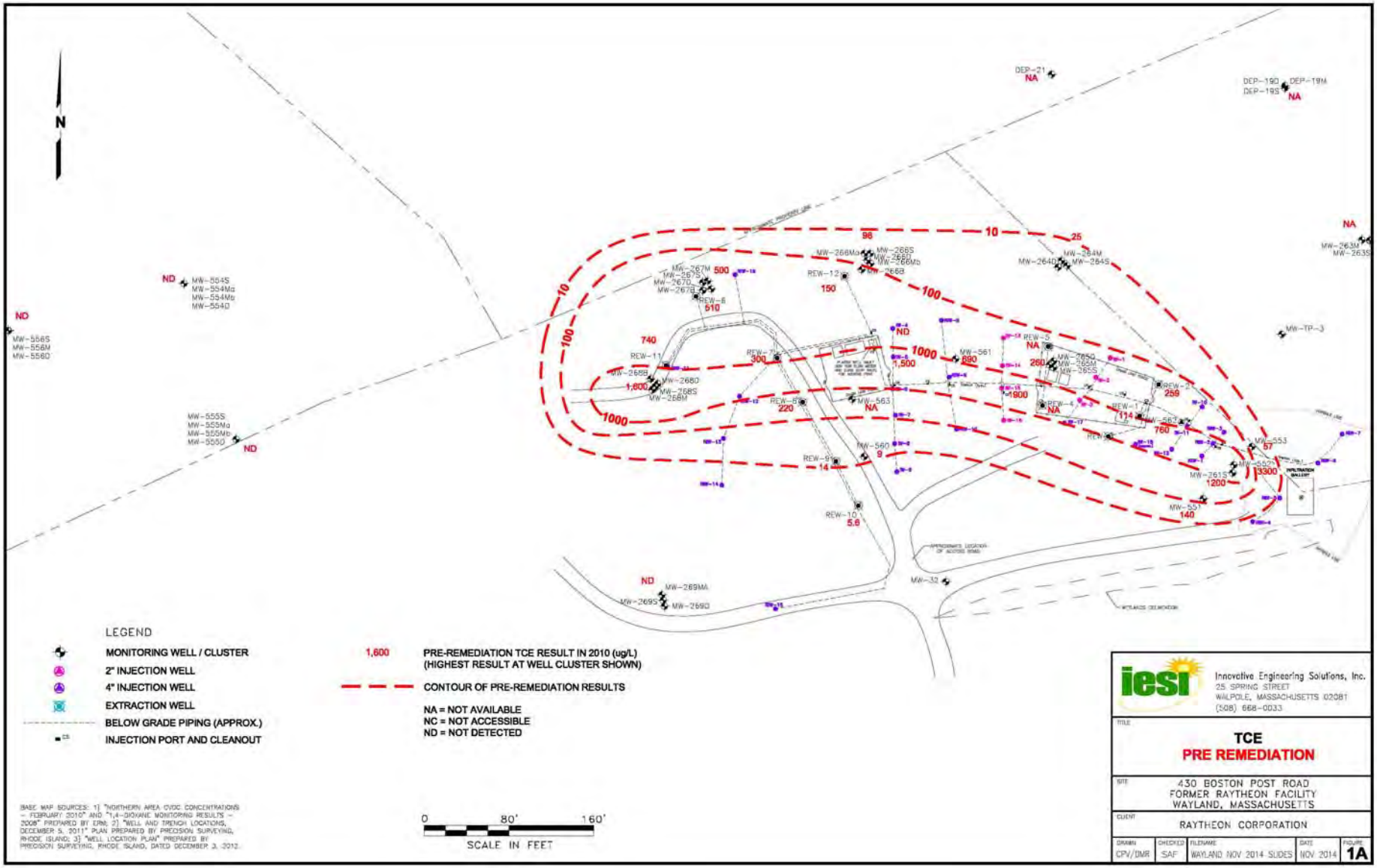

TCE Concentration Contours

Current Conditions

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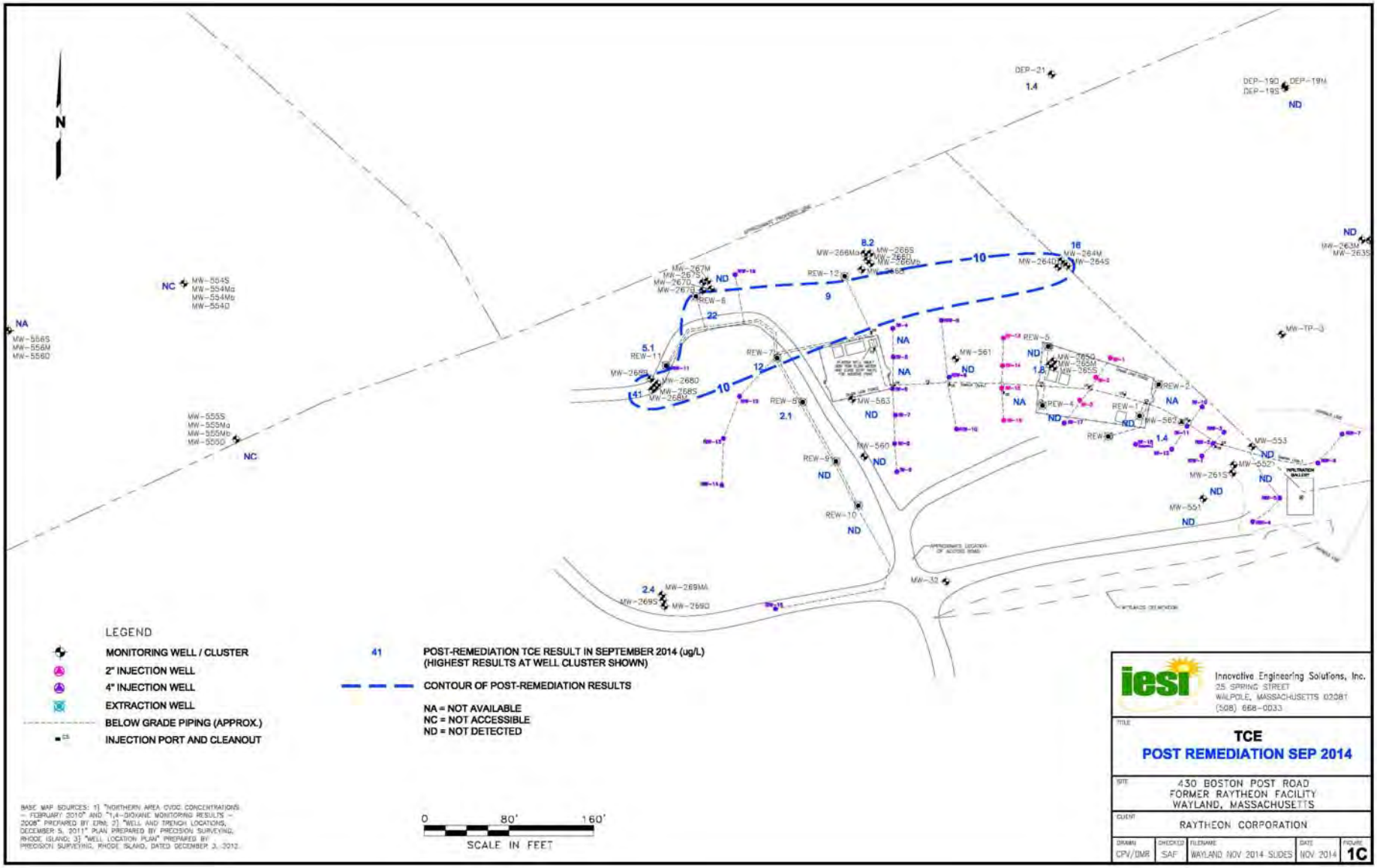

TCE Concentration Contours

Pre-recirculation vs. *Current Conditions*

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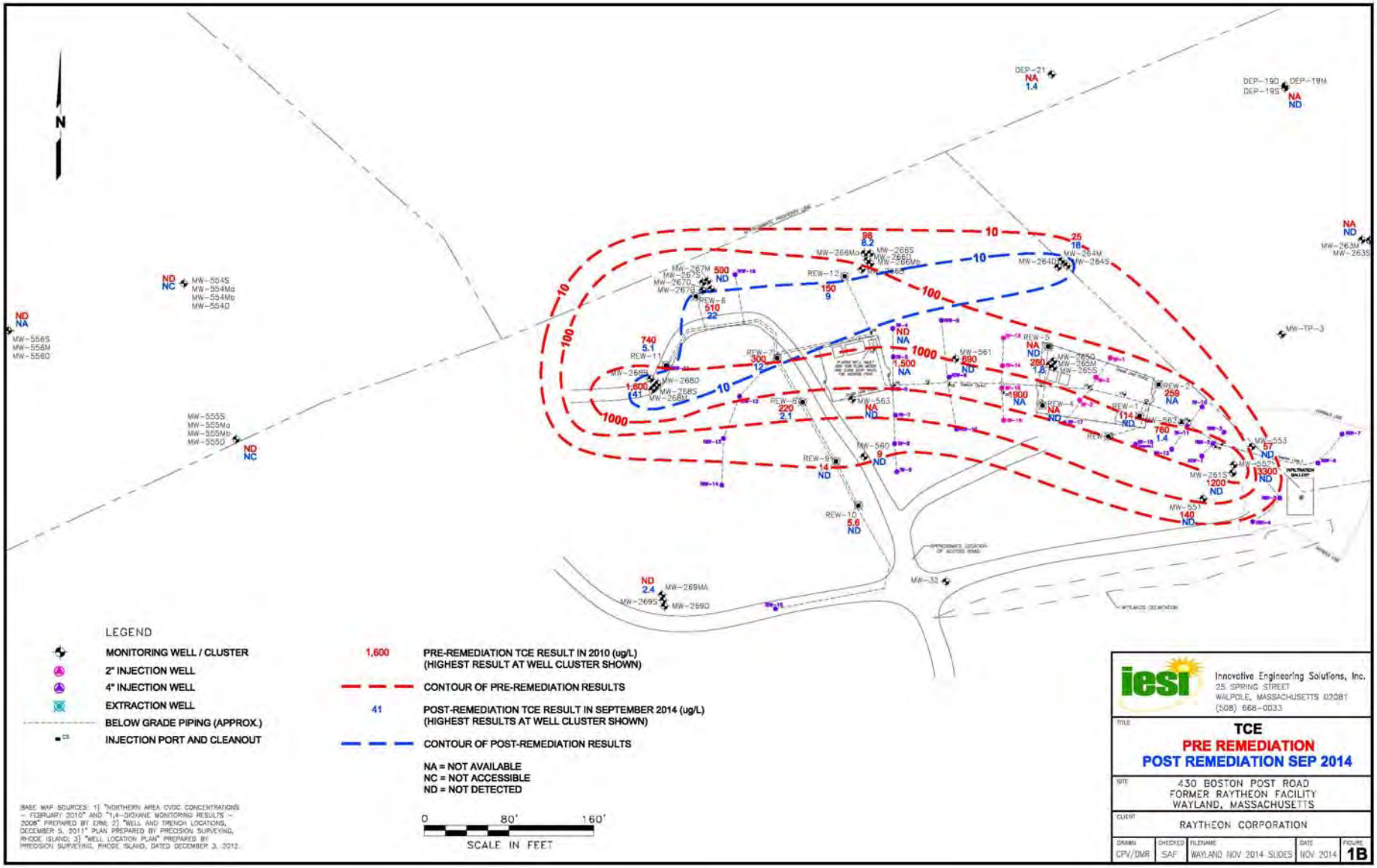

Project Summary

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- No detections of VOC concentrations in groundwater in the Cow Commons wells.
- Proposed groundwater profiling investigation delayed due to the issuance of an MBTA permit
  - Data will be evaluated in conjunction with historic data sets.
- 4 new wells to be installed outside of the MBTA ROW
- All portions of the Northern Area system are active and anticipated to continue into 2015.
- Northern Area groundwater monitoring data is positive and encouraging.
- Groundwater sampling and reporting will continue on a biannual basis in 2015.

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Questions?

- Raytheon will continue to make documents available at the information repository Wayland Board of Health and extranet web site

http://raytheon.erm.com