DES Waste Management Division
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Project Number: 0000346

OW-5/55R Area In-Situ Geochemical Stabilization Remediation Performance Evaluation Former Koppers Wood Treating Plant Hills Ferry Road, PO Box 3485 Nashua, New Hampshire

NHDES Site #:198708017
Project Type: HAZWASTE

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Report Date:
September 8, 2015

KEY ENVIRONMENTAL INCORPORATED

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September 9, 2015

Mr. Michael McCluskey, P.E.
Department of Environmental Services
Waste Management Division
29 Hazen Drive
Concord, NH 03301-6509

Re: Consent Decree, Docket No. 04-E-0151
Beazer East, Inc. Nashua, NH Site DES#198708017

Subject: OW-5/55R Area In-Situ Geochemical Stabilization Remediation Performance Evaluation Report Prepared by Tetra Tech

Dear Mr. McCluskey:

On behalf of Beazer East, Inc. (Beazer), Key Environmental, Inc. (KEY) hereby provides the New Hampshire Department of Environmental Services with the *OW-5/55R Area In-Situ Geochemical Stabilization Remediation Performance Evaluation Report* (Performance Evaluation Report). The Performance Evaluation Report has been prepared by Tetra Tech to document the short-term performance results of the In-Situ Geochemical Stabilization pilot test conducted at the Former Koppers Company Inc. Site located in Nashua, New Hampshire.

If you have any questions, or need additional information regarding this submittal, please call the undersigned at (207) 772-8100.

Sincerely,
Key Environmental, Inc.

Pete Sawchuck, P.E
Project Manager

cc: \ Mr. Michael Bollinger – Beazer
Mr. Mark Lahr – KEY
Mr. James Erickson – Tetra Tech

OW-5/55R Area In-Situ Geochemical Stabilization Remediation Performance Evaluation, Former Koppers Company, Inc. Site, Nashua, New Hampshire

Version 1
September 8, 2015

Prepared on behalf of Beazer East, Inc.

TETRA TECH

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REVISION HISTORY

Version	Date	Description
1	September 8, 2015	Initial Release

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ABBREVIATIONS AND ACRONYMS

bgs	Below Ground Surface
COI	Constituent of Interest
in.	inches
NAPL	Non-Aqueous Phase Liquid
EVS©	Environmental Visualization System
ISGS	*In-Situ* Geochemical Stabilization
amsl	Above Mean Sea Level
PID	Photoionization Detector
ROI	Radius of Influence
SBS	Sheetpile Barrier System
Site	former Kopper Company Inc. Property
SVOC	Semi-Volatile Organic Compounds
TIP	Temporary Injection Point
VOC	Volatile Organic Compounds

1.0 INTRODUCTION

This report documents the short-term performance evaluation of the *in-situ* geochemical stabilization (ISGS) pilot test designed to remediate subsurface non-aqueous phase liquids (NAPLs) at the former Koppers Company, Inc. Property (the Site) in Nashua, New Hampshire (Figure 1-1). The workplan (Tetra Tech, 2014a) describes the overall approach to the ISGS pilot test implementation and performance evaluation. The pilot test was subdivided into three phases: 1) Phase I -- OW-5/55R Characterization; 2) Phase II -- ISGS Reagent Injections; and 3) Phase III -- Performance Evaluation. Results of Phases I and II were presented in the 2014 Tetra Tech report (Tetra Tech, 2014b). This report presents the results of the Phase III – Short-Term Performance Evaluation.

The OW-5/55R pilot-test area is located approximately 100 feet west of the Merrimack River, immediately south of the Former Koppers Company, Inc Site, and represents an area with approximate dimensions of 50 feet by 80 feet (Figure 1-1). The Phase I characterization of the spatial distribution of NAPL impacts in the OW-5/55R Area was performed in 2013. The characterization consisted of installing 13 borings to establish the spatial distribution of NAPL impacts and zones to be targeted during the ISGS pilot-test injections. Eleven of these borings were converted to temporary injection points (TIPs) with open-ended, perforated PVC casing in the bottom 8 feet. The TIPs were initially intended to be used for both monitoring and reagent injections; however, flowing sands entered the casings during their installation and blocked off a portion of the NAPL zones targeted for remediation. Because of this issue, it was decided that TIPs would not be utilized for reagent injection and they would only be used for NAPL monitoring and recovery. As detailed in Section 3.3 (Phase III Performance Evaluation) of the Workplan (Tetra Tech, 2014a), NAPL recovery was performed at monitoring wells and TIPs on a biweekly basis.

In November 2014, ISGS reagent injections were performed in the OW-5/55R area, targeting previously identified zones of subsurface NAPL (Tetra Tech, 2014b). Targeted injection depths were determined by the Environmental Visualization System© (EVS©) model generated during characterization (Tetra Tech, 2014a). The EVS model is a statistical distribution of the subsurface NAPL developed based on the logs recorded during characterization. It represents the best available tool for evaluation of the extent and depths of NAPL seams in the pilot-test area. Direct-push injections were performed with a Geoprobe® rig. The direct-push injection points were initially established based on a 15-foot triangular grid pattern throughout the pilot-test area (Figure 2-1). The field locations of injection points were adjusted based on rig access and the locations of large trees; keeping the injection locations as close as possible to the proposed locations. The majority of the injection intervals were performed at depths between 25 and 35 feet below ground surface (bgs).

The Phase III Performance Evaluation is detailed in the ISGS pilot-test Workplan (Tetra Tech, 2014a). Section 2.0 presents the pre- and post-ISGS pilot test NAPL recovery results. Section 3.0 presents the reagent ROI performance evaluation results.

1.1 OVERVIEW OF ISGS TECHNOLOGY

The ISGS remediation technology consists of a permanganate-based reagent (RemOx® EC) that is injected into NAPL impacted zones for the purposes of NAPL treatment, containment/stabilization and solute flux reduction. Aluminum silicate precipitates, with minor enhanced manganese-oxyhydroxide precipitates, are deposited around NAPL ganglia and droplets following reagent injection. The precipitate that forms around the NAPL effectively isolates the free-phase NAPL from future migration and groundwater dissolution reactions. In addition to containing the free-phase NAPL, oxidation of dissolved-phase constituents results in a "hardening" or "chemical weathering" of the NAPL as it loses its more labile semi-volatile organic compounds (SVOCs). The deposition of the mineral shell also reduces the overall formation permeability in the treated area, thereby reducing the volumetric flux of upgradient groundwater into and through the impacted area. Thus, the remedy will reduce contaminant toxicity, NAPL mobility and volume through *in-situ* treatment.

1.2 OBJECTIVES AND APPROACH

The primary objective of the ISGS pilot-test injections was to determine the effectiveness of ISGS reagent performance and injection methods in order to optimally implement the full-scale ISGS remedy. The pre-demonstration ISGS injection testing (i.e. pilot test) evaluated: 1) Performance of the ISGS reagent at stabilizing free-phase NAPLs; 2) Established the radius of influence (ROI) of the injected reagent; 3) Potential for ISGS reagent discharge to river; and 4) Developed Site-specific injection parameters required for full-scale implementation of the technology at this Site.

The pilot test was performed in the OW-5/55R area targeting NAPL-impacted zones. The OW-5/55R area was chosen because the NAPL-impacted footprint is relatively small and isolated from the NAPL impacts upgradient of the Sheetpile Barrier System (SBS). The pilot-test area hydrogeology, proximity to river and NAPL impacts are representative of the proposed full-scale ISGS treatment area at this Site.

The Phase III Performance Evaluation included NAPL monitoring/recovery and the collection of geologic cores to establish the approximate ROI for the ISGS reagent. The NAPL monitoring was a continuation of the pre-pilot test injection monitoring and was used as one indicator of potential remedy success in stabilizing free-phase NAPLs. Post-injection geologic cores were collected to establish ROI and the relative success of targeting discrete NAPL impacted zones.

Continuous post-injection, geologic cores were collected from ground surface to the terminus of the borehole at an approximate depth of 40 feet using a rotasonic drilling method. Geologic cores were characterized for the following: 1) Concentrations of volatile organic vapors (VOCs) using a photo-ionization detector (PID); 2) Presence of reacted and unreacted ISGS reagent; and 3) Contact of reagent with targeted NAPL zones. The geologic deposits were not characterized during Phase III, since the Phase I characterization established detailed geologic descriptions and lateral correlation of lithologic units.

2.0 PERFORMANCE MONITORING: NAPL RECOVERY

The primary objective of the ISGS demonstration program is to contain and stabilize free-phase NAPL. The primary short-term (<1 year) performance criteria for the achievement of this objective was a significant reduction in NAPL recovery volumes in wells and TIPs completed in the OW-5/55R Area. A secondary performance criteria was the visual observation of post-injection reagent contact with NAPL impacted zones.

2.1 NAPL COLLECTION PROCEDURE

During each of the pre-injection pilot-test monitoring events, NAPL thicknesses and water levels were measured at TIP and monitoring well locations. The NAPL thicknesses were obtained with a dual-phase probe capable of differentiating between water and hydrocarbon phases. The NAPL thickness was used as an indication of potential recoverable volumes. The thickness of the NAPL in each well proved challenging to measure due to false positive readings resulting from suspended NAPL droplets in the water column. In each monitoring location, the measured thickness of NAPL was recorded, but in general the recovered NAPL volumes do not correlate with the measured thickness. Recovered NAPL volumes tend to be less than calculated volume based on the measured NAPL thickness. Because of this discrepancy, the actual NAPL thicknesses measurements are given less weight than recovered NAPL volumes for the performance evaluation.

NAPL removal from TIPs and wells was performed on a biweekly basis if the measured thickness exceeded a minimum established value. In general, NAPL removal was performed when the NAPL thickness was greater than 0.2 feet; however, during the initial pre-ISGS injection monitoring NAPL was not removed from wells and TIPs. Historically, NAPL was only removed from wells when it exceeded 0.5 feet in thickness, but this criteria was modified to 0.2 feet for the pilot-test monitoring in February 2015. During NAPL recovery, a mix of water and NAPL is pumped from the TIP/well into a graduated bucket. The water and NAPL mixture is allowed to sit undisturbed for approximately 24 hours, after which the decanted volume of NAPL is measured. The accuracy of NAPL removal volumes from monitoring wells was significantly improved over historical measurements, by allowing the NAPL to settle prior to estimating the volume.

2.2 NAPL RECOVERY

NAPL gauging was performed at three monitoring wells, five piezometers and 11 TIPs pre- and post-pilot-test reagent injections. **Appendix A** contains temporal plots of the measured NAPL thickness and NAPL recovery volumes. **Appendix B** contains temporal plots of the measured NAPL, water and sediment elevations relative to the TIP screen interval and the elevation of observed NAPL seams in cores at these locations.

Following performance of the ISGS pilot test in November 2014, each monitoring well, piezometer and TIP was also monitored for the presence of injected reagent. Monitoring was conducted using a cotton string which turned a magenta/fuchsia color in the presence of unreacted reagent. The locations of all monitoring wells, piezometers and TIPs involved in the NAPL and reagent monitoring are shown on Figure 2-1.

The following is a summary of NAPL recovery pre- and post-ISGS injections.

2.2.1 WELLS AND TIPS INSIDE PILOT-TEST AREA

Well OW-55R

OW-55R is located near the southern end of the pilot-test area. NAPL has been removed from this well on an approximately monthly basis since its installation in 2000. As part of the pre-ISGS NAPL monitoring, NAPL thickness was performed biweekly for 23 events from January 23, 2014 to November 3, 2014. NAPL was consistently observed in this monitoring well with a reported thickness between 0.1 and 2.25 feet, with a slightly declining trend. NAPL was removed from the well during 16 of these 23 monitoring events, with recovered NAPL volumes ranging from approximately 0.1 and 3 gallons per event.

There have been 20 monitoring events post-ISGS injections from November 17, 2014 to August 30, 2015. NAPL thicknesses have been highly variable fluctuating from 0 to 1.6 feet, with the eight of the 20 recorded NAPL thicknesses being less than 0.4 ft. NAPL was removed from the well during eight post-injection events, with volumes ranging from 0.2 and 0.5 gallons.

A comparison of pre-ISGS injections to post-ISGS injections indicate that the NAPL thickness and potential volume of recoverable NAPL has declined for this well. The rate of recoverable NAPL is approximately four times less post-ISGS treatment (0.13 gal/event) versus pre-ISGS treatment (0.53 gal/event).

Well OW-56

Monitoring well OW-56 is located near the center of the pilot-test area and was installed in 2014 for NAPL monitoring and recovery. The well was located in an area with historical free-phase NAPL impacts. Thin NAPL zones were identified during its drilling at depths of 28.8, 30.6 and 34.5 feet bgs. There were eight NAPL monitoring events pre-ISGS injections. Free-phase NAPL has never been detected in this well during the eight monitoring events, with the exception of sheens.

There have been 20 monitoring events post-ISGS injections. Similar to pre-ISGS injections, NAPL has never been detected in this well.

The absence of NAPL in this well demonstrates the limited volume of NAPL present in this area. Thin NAPL zones were detected during the drilling of this well; however, these NAPL zones do not always contain sufficient NAPL volumes at high enough saturation to allow migration to a recovery well.

IP13-01

TIP IP13-01 is located on the south end of the pilot-test area. Thin NAPL zones were identified during the installation of this TIP at depth intervals ranging from 25 to 38 feet bgs. There were 27 NAPL monitoring events pre-ISGS injections, with approximately 10 of the events with detectable NAPL thicknesses greater than 0.2 feet. The maximum recorded NAPL thickness was approximately 2.5 feet. There were three events pre-ISGS injections where NAPL was removed from this TIP, with volumes ranging from less than 0.005 to 0.093 gallons.

Post-ISGS injections there have been 20 monitoring events. NAPL has not been detected in this TIP since the ISGS injections. The absence of detectable NAPL in this TIP post-ISGS injections may be an indication that the free-phase NAPL has been stabilized and contained in this area; however, this cannot be established definitively for this TIP.

Flowing sands were present in this TIP shortly after it was installed. The elevation of the flowing sands remained below the elevation of NAPL impacts thought to the source of NAPL observed in the TIP (see Appendix B). Approximately 3 weeks preceding the ISGS injections, the thickness of flowing sands increased in this TIP to an elevation above the potential NAPL seam. A small amount of NAPL (10 ml) was recovered approximately 2 weeks pre-ISGS injections, after the flowing sands were above the NAPL seam elevation. There has been no NAPL detected in this TIP since the ISGS injections. Hence, the absence of NAPL in this TIP is a positive result, but it is uncertain if the presence of flowing sands prevented new NAPL from entering the TIP.

IP13-02

TIP IP13-02 is located on the east edge of the pilot-test area. A thin NAPL zone (1-in.) was identified during the installation of this TIP at a depth of 26.3 feet bgs (Elevation 94 feet amsl). There were 27 NAPL monitoring events pre-ISGS injections, with only two events with detectable NAPL thicknesses greater than 0.2 feet. The maximum recorded NAPL thickness for this TIP was approximately 0.4 feet. There has only been one event pre-ISGS injections where NAPL was recovered from this TIP. The recovered volume was less than 0.001 gallons.

Post-ISGS injections there have been 20 monitoring events. Free-phase NAPL has not been detected in this TIP since the ISGS injections. The absence of NAPL in this TIP post-ISGS injections indicate that the free-phase NAPL has been stabilized and contained in this area.

Flowing sands were present in this TIP shortly after it was installed. The elevation of the flowing sands remained below the elevation of NAPL impacts in the TIP for the first 12 events and then rose above it for the remaining 15 events leading up to the ISGS injections (see Appendix B). A small amount of NAPL (less than 1 ml) was recovered pre-ISGS injections. Post-ISGS injections, the flowing sands in this TIP dropped below the elevation of the NAPL seam. Hence, the potential blockage by flowing sands of the NAPL seam was removed. There has been no NAPL detected in this TIP since the ISGS injections. Hence, the absence of NAPL in this TIP is a positive result indicating that NAPL in the vicinity of this TIP has been stabilized.

IP13-03

TIP IP13-03 is located in the southeastern portion of the pilot-test area approximately 15 feet west of IP13-02. A thin NAPL zone (1/4-in.) was identified during the installation of this TIP at a depth of 31 feet bgs (Elevation 89.6 ft amsl). There were 27 NAPL monitoring events pre-ISGS injections, with only three events with detectable NAPL thicknesses greater than 0.2 feet. The maximum recorded NAPL thickness for this TIP was approximately 0.31 feet. NAPL was not detected in this TIP for 20 of the 27 events preceding the ISGS injections. NAPL was not removed from this TIP for the three early events that exceeded 0.2 feet.

Flowing sands entered this TIP shortly after its installation. The elevation of flowing sands was above the elevation of the NAPL seam from the start of monitoring in this TIP and remains above the NAPL seam currently. The thickness of the flowing sands increased about 1.5 to 2 feet post-ISGS injections to approximately 1 foot above the screen. The increase in sand thickness within the TIP appears to be a direct result of the pressurization of the formation during injections. The elevation of sands in this TIP may be limiting NAPL flow into the TIP

Post-ISGS injections there have been 20 monitoring events. Free-phase NAPL has not been detected in this TIP since the ISGS injections. The absence of NAPL in this TIP post-ISGS injections may be an indication that free-phase NAPLs have been stabilized and contained in this area. Alternatively, the presences of flowing sands in this TIP may be preventing free-phase NAPLs, if present, from entering the TIP.

IP13-04

TIP IP13-04 is located on the northern half of the pilot-test area, approximately 4 feet south of monitoring well OW-56. Two NAPL zones were identified during its installation at depths of 25.8 and 31.3 feet bgs (Elevations 94.3 and 88.8 ft amsl, respectively). There were 27 NAPL monitoring events pre-ISGS injections, with only nine of the 27 events with detectable NAPL thicknesses greater than 0.2 feet. The maximum reported NAPL thickness for this TIP was 3.2 feet.

There have been four events pre-ISGS injections where NAPL was recovered from this TIP. One NAPL recovery event resulted in approximately 0.1 gallon of NAPL and the remaining three NAPL recovery events resulted in approximately 0.02 gallons of NAPL, each.

Flowing sands entered this TIP shortly after its installation. The elevation of flowing sands in the TIP is above the elevation of the lowest NAPL seam, but below the upper NAPL seam. The elevation of the sands in the TIP increased 4-5 feet during the first 6 months following installation and has not changed significantly since this time. Pre-ISGS injection NAPL monitoring and recovery in this TIP is an indication that flow sands are not restricting NAPL inflows to the TIP.

Post-ISGS injections there have been 20 monitoring events. Free-phase NAPL has not been detected in this TIP since the ISGS injections. The absence of NAPL in this TIP post-ISGS injections indicate that the free-phase NAPL has been stabilized and contained in this area.

IP13-05

IP13-05 is located in the southwestern quadrant of the pilot-test area, approximately 17 feet northwest of monitoring well OW-55R. NAPL was identified in the core for the TIP at depths of approximately 26.5 to 27 and 31 feet bgs (Elevations 93.9, 93.5 and 89.4 ft amsl, respectively). There were 27 NAPL monitoring events pre-ISGS injections, with 11 events with detectable NAPL thicknesses greater than 0.2 feet. The maximum recorded NAPL thickness for this TIP was approximately 2.4 feet.

There were six events pre-ISGS injections where NAPL was removed from this TIP. Five NAPL removal events resulted in less than 0.02 gallons of NAPL per event. The largest volume of NAPL removed during an event was 0.033 gallons.

Flowing sands were present in this TIP shortly after it was installed. The elevation of the flowing sands remained below the elevation of all but one of the three NAPL seams in the TIP for the first 12 events and then rose above all three for the remaining 15 events leading up to the ISGS injections (see Appendix B). All pre-ISGS injection NAPL recovery was performed when the flowing sand elevation was above the three NAPL seams; hence, the flowing sands were not blocking NAPL inflows to this TIP. Post ISGS injections, a sand plug was pushed up the inside of the TIP casing approximately 2.5 feet. The sand plug remained there for nine monitoring events before flowing sand dropped to the approximate pre-ISGS injection elevation.

Post-ISGS injections there have been 20 monitoring events. One of the events detected NAPL thickness (1.4 feet) in excess of 0.2 feet. NAPL was removed from the TIP during one post-injection events. The volume removed was approximately 0.033 gallons.

A comparison of pre-ISGS injections to post-ISGS injections indicate that the NAPL thickness and potential volume of recoverable NAPL has declined significantly for this TIP. Recoverable NAPL appears to be declining steadily since ISGS treatment, with only one out of 20 events with recoverable NAPL. The reduced volume of NAPL in this TIP post-ISGS injections indicate that the majority of the free-phase NAPL has been stabilized and contained in this area.

IP13-06

IP13-06 is located on the western edge of the pilot-test area. During activities following installation, IP13-06 became obstructed and was rendered inaccessible. NAPL observations have not been collected at this location.

IP13-07

TIP IP13-07 is located approximately 17 feet west of monitoring well OW-56. NAPL zones were noted in the drilling log at 26 and 27 feet bgs (Elevations 94.6 and 93.6 amsl, respectively). There were 27 NAPL monitoring events pre-ISGS injections and 20 events post-ISGS injections. However, NAPL was not observed in IP13-07 in any of the NAPL monitoring events pre- and post-ISGS injections.

Flowing sands were present in this TIP shortly after it was installed. The elevation of the flowing sands remained below the elevation of one of the two NAPL seams pre-ISGS injection (see Appendix B). Hence, one of the NAPL seams was not blocked by flowing sands leading up to the ISGS injections. Post ISGS injections, the flowing sands increased slightly to the elevation of the upper NAPL seam and was above the upper NAPL seam for the past seven monitoring events.

The absence of NAPL in this TIP demonstrates the limited volume of NAPL present in this area. Thin NAPL zones were detected during the drilling of this TIP; however, these NAPL zones do not always contain sufficient NAPL volumes at high enough saturations to allow migration.

IP13-08

Located on the east side of the pilot-test area, approximately 20 feet south of PZ-34, IP13-08 was noted to have intercepted a NAPL zone at 26.3 feet bgs (Elevation 93.2 feet amsl) during drilling.

There were 18 NAPL monitoring events pre-ISGS injections, with three events with detectable NAPL thicknesses greater than 0.2 feet. However, the most recent 14 monitoring events prior to the ISGS injections did not detect any NAPL in this TIP. The maximum recorded NAPL thickness for this TIP was approximately 1.3 feet.

There was one event pre-ISGS injections where NAPL was removed from this TIP. The volume of NAPL removed during an event was 0.00013 gallons (0.5 ml).

Flowing sands were present in this TIP shortly after it was installed. The elevation of the flowing sands remained below the elevation of the NAPL seam in the TIP for the first four events and then rose above it for the remaining 14 events leading up to the ISGS injections (see Appendix B). The flowing sand elevation in this tip remained above the NAPL seam elevation post-ISGS injections.

Post-ISGS injections there have been 20 monitoring events. None of these events detected NAPL. Given the lack of significant NAPL in this TIP pre-ISGS injections, and the fact that flowing sands were above the NAPL seam, it is difficult to evaluate the performance of the ISGS at this TIP.

IP13-09

IP13-09 is located near the center of the pilot-test area, 8 feet north of OW-56. Observations made during drilling of IP13-09 indicate that NAPL zones were encountered at depths of 26.9, 30.3, 31.4, 32.1 and 32.4 feet bgs (Elevations 93.3, 89.8, 88.7 and 88.0 amsl, respectively).

There were 27 NAPL monitoring events pre-ISGS injections, with six events with detectable NAPL thicknesses greater than 0.2 feet. However, the 10 biweekly monitoring events prior to the ISGS injections did not detect NAPL in this TIP, with the exception of one event with 0.03 ft of NAPL. The maximum recorded NAPL thickness for this TIP was approximately 2.1 feet. There were no events pre-ISGS injections where NAPL was removed from this TIP.

Flowing sands were present in this TIP shortly after it was installed. The elevation of the flowing sands was above the two deepest NAPL seams for the first 12 biweekly monitoring events and rose above the two remaining upper NAPL seams for the remainder to the pre-ISGS injections. Therefore, immediately preceding the ISGS injections, the flowing sand elevation in this TIP was above all NAPL seams. The flowing sands remained above the four NAPL seams post-ISGS injections (see Appendix B). The last measurable NAPL in this TIP was immediately prior to the sand rising above the uppermost of the four NAPL seams.

Post-ISGS injections there have been 20 monitoring events. None of these events detected NAPL. NAPL has not been detected in this TIP, since ISGS injections. Given that the four NAPL seams were below the flowing sand elevations in this TIP prior to and post-ISGS injections, it is not possible to evaluate the success of the ISGS injections based on NAPL recovery.

IP13-10

IP13-10 is located approximately 15 feet west of IP13-09 in the northwestern quadrant of the pilot-test area. A single NAPL seam was observed during drilling at a depth of 25.5 feet bgs (Elevation 94.9 feet amsl).

There were 27 NAPL monitoring events pre-ISGS injections, with five events with detectable NAPL thicknesses greater than 0.2 feet. The maximum recorded NAPL thickness for this TIP was approximately 1.5 feet. There was one event pre-ISGS injections where NAPL (0.0002 gallons / 0.8 mL) was removed from this TIP. During the most-recent 14 monitoring events preceding the injection test, NAPL was only detected once, with a thickness of approximately 0.1 feet.

Flowing sands were present in this TIP shortly after it was installed. The elevation of the flowing sands increased steadily during the first 14 biweekly monitoring events and remained a few tenths of feet below the NAPL seam for the remainder of the pre-ISGS injections. Post-ISGS injections, the flowing sand elevation rose a few tenths of feet above NAPL seams. The flowing sands remained above the NAPL seam post-ISGS injections (see Appendix B).

Post-ISGS injections there have been 20 monitoring events. None of these events detected NAPL. Given that flowing sands were slightly above the NAPL seam elevation post-ISGS injections, it is difficult to evaluate the success of the ISGS based on an absence of measurable NAPL thickness.

<u>IP13-11</u>

IP13-11 is located at the northern end of the pilot-test area. During drilling slight staining associated with NAPL was observed at approximately 24.6 and 31.4 feet bgs (Elevation 95.8 and 89.0 feet amsl, respectively). NAPL has not been observed in the TIP at any time during pre- or post-ISGS injection monitoring.

2.2.2 WELLS AND PIEZOMETERS OUTSIDE OF PILOT-TEST AREA

<u>Well OW-5</u>

Monitoring well OW-5 is located northwest of the pilot-test area. During pre-injection monitoring, NAPL has been measured consistently with thicknesses varying between 0 and 0.2 feet, with one event over 0.5 feet. NAPL was recovered from OW-5 during one event with a volume of slightly over 1.2 gallons. NAPL thicknesses range between 0 and 0.1 feet, with one event where a thickness of approximately 2.3 feet was observed during the 20 monitoring events following the ISGS injections. Approximately 3.7 gallons NAPL was removed from the well during the December 2014 event. With the exception of the one event post-ISGS, free-phase NAPL is essentially non-detectible in this well. Hence, ISGS injections appear to have stabilized free-phase NAPL in this area.

<u>Piezometer PZ-33</u>

Piezometer PZ-33 is located near the northeast corner, but outside of the pilot-test area. This piezometer was installed approximately 2 week prior to the start of the ISGS injections. Two monitoring events were performed prior to ISGS injections with no detectable NAPL. Similarly, no NAPL has been detected in this piezometer in the 20 monitoring events following the ISGS injections.

<u>Piezometer PZ-34</u>

Piezometer PZ-34 is located southeast and outside of the pilot-test area. This piezometer was installed approximately 2 week prior to the start of the ISGS injections. Two monitoring events were performed prior to ISGS injections with no detectable NAPL. Similarly, no NAPL has been detected in this piezometer in the 20 monitoring events following the ISGS injections.

<u>Piezometer OSPZ-01</u>

Piezometer OSPZ-01 is located on the southern end of the lower floodplain bench between the pilot-test area and the Merrimack River. NAPL was detected during each of two monitoring events prior to the ISGS injections. The measured NAPL thicknesses for these two events were 4 feet and 0.6 feet, respectively. NAPL volumes of 1.25 and 0.25 gallons were recovered from this piezometer prior to the ISGS injections.

Post-ISGS injections, NAPL continues to be detected in this piezometer; however, NAPL thicknesses have steadily declined throughout the post-ISGS injection 20 monitoring events. The only exception is the most recent monitoring event (08/30/15) for this piezometer where a NAPL thickness of 0.71 feet was observed. Post-ISGS injections, NAPL thicknesses ranged between 0 and 1.4 feet. There have been four post-ISGS injection NAPL recovery events that recovered from 0.4 to 0.1 gallons of NAPL.

<u>Piezometer OSPZ-02</u>
Piezometer OSPZ-02 is located outside of the pilot-test area on the lower floodplain bench between the pilot-test area and the Merrimack River. No NAPL monitoring was performed prior to the ISGS injections. NAPL has not been detected during the 20 post-ISGS injections in this piezometer.

<u>Piezometer OSPZ-03</u>
Piezometer OSPZ-03 is located outside of the pilot-test area on the lower floodplain bench between the pilot-test area and the Merrimack River. No NAPL monitoring was performed prior to the ISGS injections. During post-injection monitoring, NAPL thicknesses were non-detect for the first five of 20 monitoring events and then started to increase. There have been eight monitoring events with NAPL thicknesses over 0.2 feet, with the most recent measurement of 2.3 feet. NAPL recovery volumes for these eight events ranged from approximately 0.02 to 0.06 gallons. The recent increase in NAPL observed in this piezometer may be an indication of transient conditions resulting from injections redistributing some free-phase NAPL.

This is one of the few monitoring points outside of the pilot test area that showed an increase in NAPL thickness and volume. However, NAPL thicknesses and volumes have been highly variable, with significant declines in NAPL thickness and volumes immediately following a NAPL recovery event. This is an indication that free-phase NAPL saturations are low resulting in slow recharge of NAPL to this piezometer following a recovery event.

2.2.3 SUMMARY OF NAPL MONITORING

The NAPL monitoring data contain some variability due to the low NAPL saturations and limited volume of free-phase NAPL in this area. However, the combined pre- and post-temporal results from the 18 monitoring points support the conclusion that the ISGS remedy was successful at containing and reducing the mobility of free-phase NAPLs in this area. NAPL monitoring results for both pre- and post-ISGS injections show an overall reduction in free-phase NAPL within the pilot test area. The majority of the TIPs and wells that contained NAPL prior to the ISGS injections are either nondetect or show significant reductions in free-phase NAPL. Some of the apparent reduction in observable NAPL in TIPs is due to flowing sands potentially blocking NAPL seams; however, monitoring results for the piezometers and wells are not impacted by this issue and support an overall reduction in free-phase NAPL within the pilot test area.

Piezometers and wells outside of pilot test area which contained NAPL prior to ISGS injections also shown reductions in NAPL volume. The only exception is one piezometer (OPSZ-3) which is located outside and side-gradient to the pilot test area.

The overall results of the monitoring program indicate that the short-term performance criteria were met for this pilot test. These conclusions are further supported by the post-ISGS injection core results which are discussed in Section 3.0.

3.0 POST-ISGS INJECTIONS RADIUS OF INFLUENCE EVALUATION

Nine post-ISGS geologic cores were collected in the pilot test area from land surface to a depth of 40 feet in seven boreholes and 45 feet in two boreholes (Figure 3-1). The cores were collected to evaluate the distribution of reagent and non-treated NAPL. An attempt was made to approximately center most borehole locations between injection points to evaluate the treatment radius and coverage within pilot test area. The post-treatment cores were collected approximately 6 months (June 8-10, 2015) following the completion of the ISGS injections. The following was noted in the descriptions of the cores: 1) Presence/absence of reacted and non-reacted reagent; 2) NAPL presence; 3) VOC concentrations with a PID instrument; and 4) General lithologic descriptions. The field descriptions for the logs are provided in Appendix C.

3.1 CORE EVALUATION METHODOLOGY

Coring was conducted using the rotasonic drilling technique, which employs the use of high-frequency, resonant energy to advance a core barrel and/or override casing into deposits. A mini-rotasonic drilling rig mounted on a tracked-chassis was used to access propose borehole locations due to the remote location and dense vegetation. Core samples were collected using a 6-inch override casing and a 4-inch core barrel (Figure 3-2).

A reagent neutralizing solution was pre-mixed for use in determining whether unreacted reagent was present in the soil cores. Consisting of a mixture of vinegar, 12% hydrogen peroxide, and distilled water, the neutralizer reacts with residual reagent, rendering it a combination of inert compounds including manganese hydroxides and water. The treated zones of the cores reacted with the neutralization solution when sprayed, changing from yellow-orange or brown to a pale yellow color (Figure 3-3). Where present, the natural reaction of NAPL with the subsurface lithologies and groundwater leads to reducing conditions which alter the oxidation state of subsurface iron resulting in core appearing pale yellow to light gray. The introduction of the ISGS reagent (RemOx® EC; a strong oxidizer) leads to the re-oxidation of the iron, with a corresponding change in the color of the deposits. Where neutralizing solution is sprayed on core, and its presence results in a change in the oxidation-reduction state of iron to a reduced form, the core color changes back to pale yellow.

NAPL staining was observed in thin zones in many of the cores and in contact with the reagent; however, no free-phase NAPL was observed in the cores. Application of neutralization solution to the NAPL zones treated with ISGS reagent dissolved a portion of the shell and released the encapsulated NAPL.

The distribution of the reacted ISGS reagent was established by rating the presence of reagent in the cores with a numerical rating of 1 to 3 (See Appendix C). A rating of 1 indicated that no reagent was present in the section of core. A rating of 2 indicated that reagent was thought to be present based on visual changes in colorations and a slight reaction to the neutralization solution. Similarly in several cases, the observation of light brown to orange terrace deposits adjacent to a zone of injection was determined to be consistent with the presence of reacted reagent. Application of neutralizing solution to this core resulted in no reaction as the reagent was already essentially neutralized. A reagent rating of 2 was assigned to these intervals. A rating of 3 indicated that reacted reagent was present in the core section and that it reacted strongly to the neutralization solution.

The numerical ratings for the presence and absence of ISGS reagent was entered into the EVS© model to establish the distribution within the pilot-test area. Results of the model analysis are presented in Figures 3-4a and 3-4b. The distribution of reagent is shown with a fuchsia color overlying the previously interpreted NAPL body. As shown in these figures, the ISGS reagent was successfully delivered to the majority of the targeted zones. Exceptions are areas where the ISGS injections were not performed or on the edge of the pilot test area.

3.2 CORE LOG DESCRIPTIONS

The following is a summary of NAPL observations in each of the nine boreholes advanced as part of the ROI performance evaluation. None of the cores contained visible bright purple non-reacted reagent indicating that the majority of the reagent was consumed. The color of the reacted reagent varied depending on the deposit it encountered. In general, the reacted reagent was light brown to orange in color, due to the iron content present in the Terrace Deposits.

<u>ROI-1</u>
Borehole ROI-1 is approximately 7 feet from and midway between the direct-push injection points DP-8 and DP-14. Based on NAPL observations from nearby TIP (IP13-05), NAPL zones should be present at depths of 26.6, 27 and 31 feet bgs. Reagent was injected into DP-8 from 25 to 27 and from 29 to 33 feet bgs and injected into DP-14 from 24 to 28 feet bgs.

Borehole ROI-1 was drilled on June 9, 2015 to a depth of 40 feet bgs. Thin NAPL zones (< 2 inches thick) were observed at 27.5, 28, 30.3, and 31.3 feet bgs. Indication of reagent presence was noted from 25 to 27 feet bgs, which corresponds to an ISGS reagent rating of 3. Soil core with a tan color consistent with oxidized iron were present from 27 to 28 feet bgs and 30 to 32 feet bgs. Based on the presence of oxidized iron, an EVS reagent classification of 2 was assigned to this interval consistent with the ISGS reagent numerical rating system described in Section 3.1 above.

<u>ROI-2</u>
Borehole ROI-2 was drilled between direct-push injection points DP-1 and DP-6 at an approximate distance of 7 to 8 feet from these points. Based on NAPL observations from the nearest TIP (IP13-09), NAPL zones should be present at depths of 26.9, 30.3, 31.4

and 32.1 feet bgs. Reagent was injected into DP-1 from 25 to 29 and from 30 to 32 feet bgs and injected into DP-14 from 24 to 28 and 30 to 32 feet bgs.

Borehole ROI-2 was drilled on June 10, 2015 to a depth of 40 feet bgs. No indication of NAPL was observed in the core, although an odor of naphthalene was noted from 27 to 34 feet bgs. Evidence of reagent was noted in the interval from 33.5 to 34 feet based on an observed reaction to neutralizing solution. An ISGS rating of 3 was assigned to this interval. Soil core with a tan color consistent with oxidized iron was present from 25 to 32 feet bgs. Based on the presence of oxidized iron, an EVS reagent classification of 2 was assigned to this interval consistent with the ISGS reagent numerical rating system described in Section 3.1 above.

<u>ROI-3</u>

The location for borehole ROI-3 was selected to be approximately 10 feet east of direct-push injection point DP-7. Based on NAPL observations from the nearest TIP (IP13-08), NAPL zones would be expected to be present at depths of 26.3 bgs. Reagent was injected into DP-7 from 25 to 33 feet bgs.

Borehole ROI-3 was drilled on June 10, 2015 to a depth of 40 feet bgs. Thin NAPL zones (< 1 in.) were observed at 27.5 and 28.7 ft bgs, and NAPL mottling was observed in disturbed core from 30 to 32 ft bgs. The application of reagent-neutralizing solution to the core produced visible reaction from 27.5 to 28.5 and 30-33.5 feet bgs, resulting in an ISGS reagent rating of 3. In addition, soil core with color consistent with reagent oxidation was observed at depth intervals above and below the reacted intervals.

<u>ROI-4</u>

The location for borehole ROI-4 was selected to be approximately 5 feet west of direct-push injection point DP-13 and 7 feet north of direct-push injection point DP-22. Based on NAPL observations from the nearest TIPs (IP13-07 and IP13-10), thin NAPL zones would be expected at depths of 25.5, 26 and 27 feet bgs. Reagent was injected into DP-13 from 26 to 28 and 31 to 33 feet bgs and injected into DP-22 from 26 to 30 feet bgs.

Borehole ROI-4 was drilled on June 8, 2015 to a depth of 40 feet bgs. Thin NAPL seams (<1 in.) were observed from 26 to 27 feet bgs. An oily sheen was observed in disturbed core from 30 to 32 ft bgs, which is believed to be associated with slough from overlying intervals. Evidence of reagent was not observed in the core from ROI-4, although color consistent with reagent oxidation was observed in the depth interval from 26-27 feet bgs. To be conservative, an ISGS reagent rating of 1 was assigned to the 26-27 depth interval core interval.

<u>ROI-5</u>

Borehole ROI-5 was located approximately 5 feet south of direct-push injection point DP-21, 8 feet north of DP-9, and 9 feet southwest of DP-2. Based on NAPL observations from the nearest TIP (IP13-03), a NAPL zone should be present at a depth of 31 feet bgs.

Reagent was injected into DP-2 and DP-9 from 29 to 33 feet bgs, and injected into DP-21 from 25 to 27 and 31 to 33 feet bgs.

Borehole ROI-5 was drilled on June 9, 2015 to a depth of 40 feet bgs. A thin NAPL seam (< 1 in.) was observed at 27.5 feet bgs, and sheens were observed from 30 to 31 ft bgs and from 35.5 to 36.5 feet bgs. The application of neutralizing solution to the core produced visible reaction from 25 to 27.5, 30 to 30.5 and 35.2 to 35.8 feet bgs, which corresponds to an ISGS reagent rating of 3.

<u>ROI-6</u>

Borehole ROI-6 was located approximately 3 feet southeast of direct-push injection point DP-3. Based on NAPL observations from the nearest TIP (IP13-02), a NAPL seam should be present at a depth of 26.3 feet bgs. Reagent was injected into DP-3 from 29 to 33 feet bgs.

Borehole ROI-6 was drilled on June 9, 2015 to a depth of 45 feet bgs. Thin NAPL seams (< 0.5 in.) were observed in the core at depths of 27.5 and 30.5 feet bgs. Reacted reagent was observed in the same depth intervals (27.8 and 28.3 feet bgs), as well as from 36.5 to 37.3 feet bgs. Both of these core intervals were assigned an ISGS reagent rating of 3. The interval from 37.3 to 38 was assigned an ISGS reagent rating of 2 based on a tan oxidized color.

<u>ROI-7</u>

Borehole ROI-7 was located approximately 7 feet from and midway between the direct-push injection points DP-7 and DP-13. Based on NAPL observations from the nearest TIP, IP13-09, NAPL zones should be present at depths of 26.9, 30.3, 31.4 and 32.1 feet bgs. Reagent was injected into DP-7 from 25 to 33 feet bgs and into DP-13 from 26 to 28 and 31 to 33 feet bgs.

Borehole ROI-7 was drilled on June 8, 2015 to a depth of 40 feet bgs. Thin NAPL zones (< 0.5 in.) were observed in the core at depths of 27.5 and 29 feet bgs. Additionally a sheen was observed in the core in a depth range from 30.5 to 32.5 feet bgs. The application of reagent-neutralizing solution to the core produced visible reaction at 36 feet bgs. Color consistent with reagent oxidation, but non-reactive to neutralizing solution, was observed in the depth interval from 31 to 32 feet bgs.

<u>ROI-8</u>

The location for ROI-8 was approximately 3 feet northeast of direct-push injection point DP-10 and 5 feet east of DP-20. Based on NAPL observations from the nearest TIP (IP13-01), a NAPL zone should be present at a depth of 30.6 feet bgs. Reagent was injected into DP-10 from 29 to 33 feet bgs and into DP-20 from 25 to 27, 30 to 34 and 36 to 38 feet bgs.

Borehole ROI-8 was drilled on June 8, 2015 from land surface to a depth of 45 feet bgs. Thin NAPL seams (< 1 in.) were observed from 28.3 to 28.5 and at 30 feet bgs. The application of neutralizing solution to the core produced visible reaction from 29.5 to

30.5 and 38 to 38.5 feet bgs; therefore, these zones were assigned an ISGS reagent rating of 3. Color consistent with reagent oxidation was observed in the depth interval from 25 to 29.5, 35 to 38, and 38.5 to 40 feet bgs. These depth intervals were assigned an ISGS reagent rating of 2.

ROI-9

Borehole ROI-9 was located approximately 7 feet southwest of direct-push injection point DP-5, 7 feet southeast of DP-11, and 10 feet north of DP-6. Based on NAPL observations from the nearest TIP, IP13-11, NAPL zones should be present at depths of 24.6, and 31.4 feet bgs. Reagent was injected into DP-11 from 25 to 28 feet bgs and into DP-6 from 24 to 28 and 30 to 32 feet bgs.

Borehole ROI-9 was drilled on June 10, 2015 to a depth of 40 feet bgs. Hydrocarbon odor was detected from 25 to 30 feet bgs, and a thin NAPL seam was observed at a depth of 29.5 feet bgs. The application of reagent-neutralizing solution to the core produced visible reaction in the depth range from 29 to 33.5 feet bgs and was assigned an ISGS reagent rating of 3.

3.3 Summary of Core Investigation

The post-ISGS ROI cores demonstrated that reagent was successfully delivered to the majority of the targeted NAPL zones. In the nine radius-of-influence boreholes, NAPL zones were identified in 19 depth intervals (Table 1). Evidence of reacted reagent was found to be present in 17 of these 19 intervals, or approximately 90%. In two of the 17 treated intervals, reacted reagent did not contact the entire NAPL zone. In addition to the 19 NAPL zones identified in cores, six NAPL zones were projected to be present in three boreholes which were subsequently found to contain reagent in the indicated depth interval, but had no indication of NAPL. One potential explanation for the absence of NAPL zones in these boreholes is that the NAPL zones were completely oxidized by reagent.

The pilot-test injection successfully placed the ISGS reagent in the majority of the depth intervals where NAPL seams had been previously identified. Visual observations of the core indicate that the reagent successfully contacted and reacted with the NAPL. The treated NAPL was effectively encapsulated and stabilized, thereby mitigating the potential for future NAPL mobility.

4.0 CONCLUSION

Performance evaluation of the ISGS pilot-test injection phase consisted of NAPL monitoring prior to and following ISGS injection in wells, TIPS and piezometers. NAPL monitoring and recovery was performed from November 2013 until November 2014, when the ISGS injections were performed. NAPL monitoring and recovery restarted in December 2014 and continuous to present.

In addition, soil cores were collected at nine locations in the pilot test area to evaluate the ROI and treatment. Both the NAPL monitoring and post-ISGS soil core data support the conclusion that the ISGS injections successfully delivered reagent to the majority of the targeted NAPL zones and stabilized free-phase NAPLs.

In most of the wells, piezometers and TIPs monitored as part of the NAPL collection program, NAPL recovery declined following the ISGS injections. The majority of the TIPs and wells that contained NAPL prior to the ISGS injections are either nondetect or show significant reductions in free-phase NAPL. Unfortunately, the presences of flowing sands above NAPL seam elevations in a few TIPs limited the performance evaluation. Piezometers and wells outside of pilot test area, which contained NAPL prior to ISGS injections, shown reductions in recoverable NAPL volume. The only exception is one piezometer (OPSZ-3) which is located outside and side-gradient to the pilot test area.

The post-ISGS ROI cores demonstrated that reagent was successfully delivered to the majority of the targeted NAPL zones. The pilot-test injection successfully placed the ISGS reagent in zones where NAPL impacts had been previously identified during the initial investigation phase and projected using the EVS© model 3D visualization. Visual observations of the core indicate that the reagent successfully contacted and reacted with the NAPL. The treated NAPL was effectively encapsulated and stabilized, thereby mitigating the potential for future NAPL mobility.

It is anticipated that the successful application of ISGS remediation in the pilot-test area will lead to the full-scale ISGS implementation and performance monitoring for NAPL-impacted areas located between the new cement bentonite wall and the existing SBS. The full-scale implementation will be designed based on the procedures and approaches as documented in the pre-demonstration pilot test performed in 2014 (Tetra Tech, 2014b). The major changes to this approach will be those needed to scale-up the reagent mixing and the number of simultaneous injection points to achieve higher production rates.

5.0 REFERENCES

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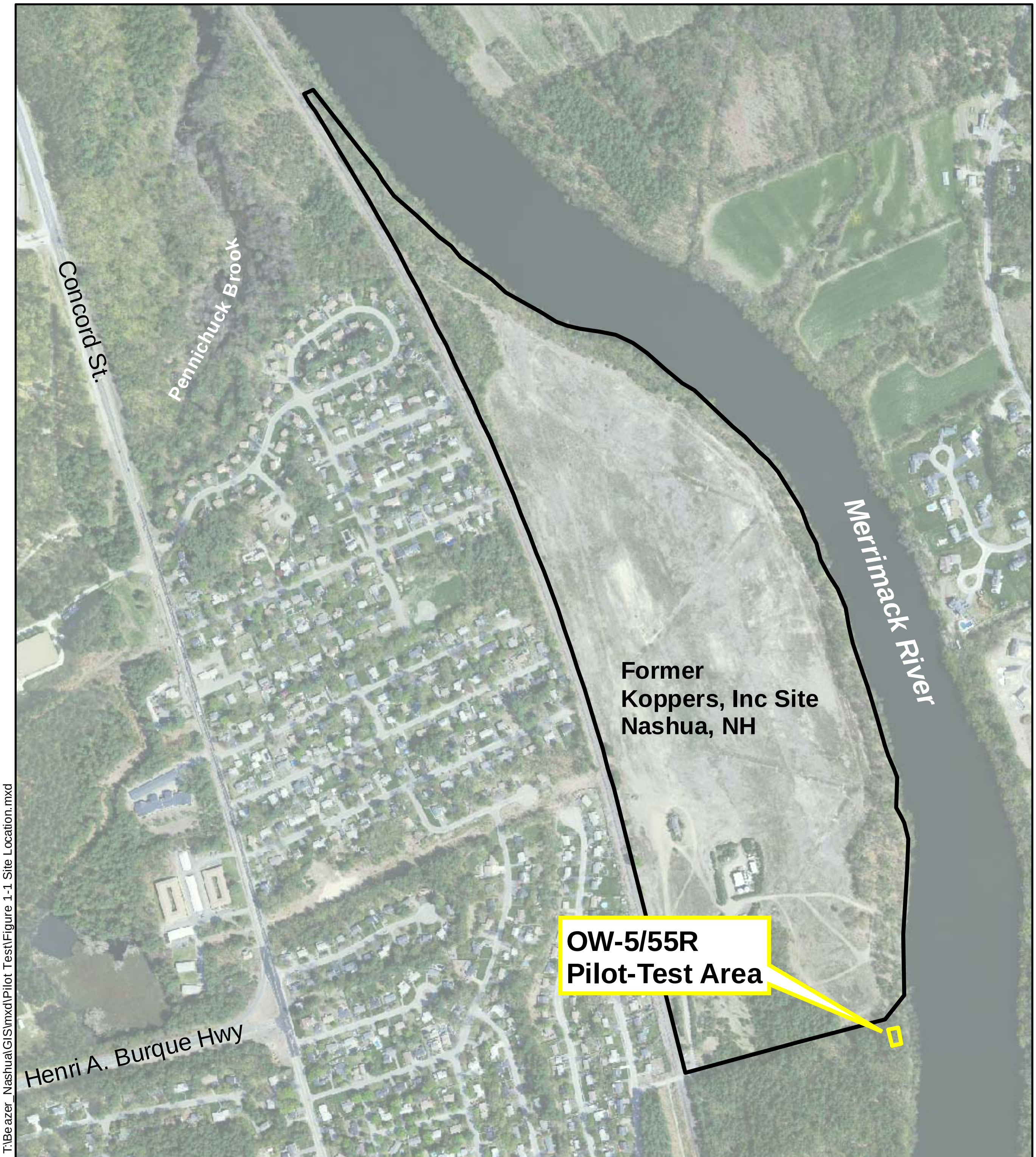
Tetra Tech, 2014b. "*OW-5/55R Area In-Situ Geochemical Stabilization Remediation Pilot Test, Former Koppers Site, Nashua New Hampshire*", December 24, 2014.

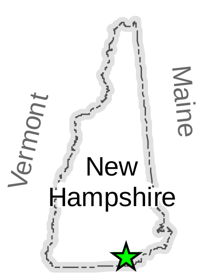
FIGURES



T:\Beazer_Nashua\GIS\mxd\Pilot Test\Figure 1-1 Site Location.mxd

0 0.05 0.1 0.2 0.3 Miles

N



TITLE:

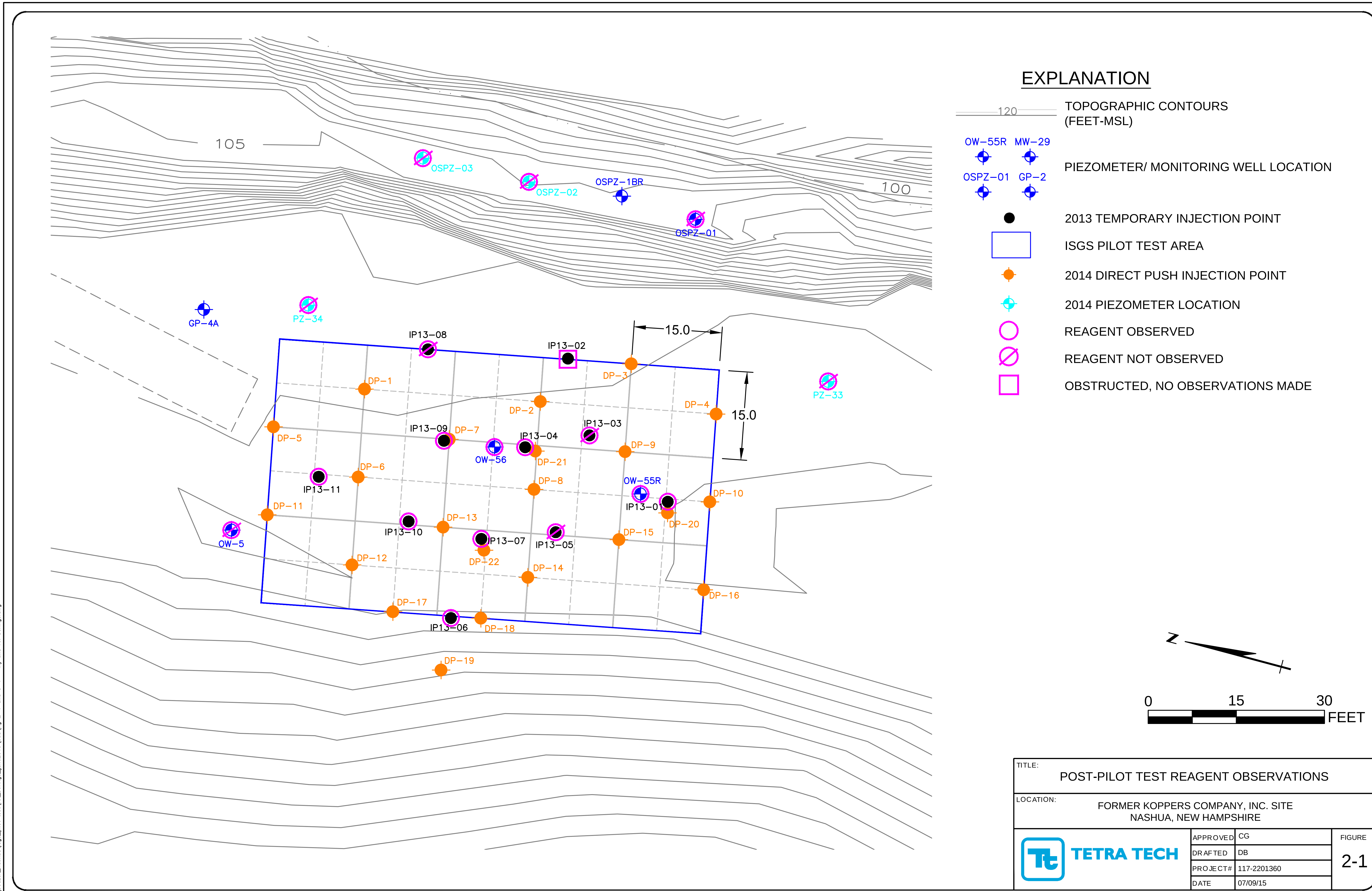
SITE LOCATION MAP

LOCATION:

Former Koppers Company, Inc. Site, Nashua, New Hampshire

TETRA TECH GEO

CHECKED	JRE	FIGURE:
DRAFTED	CKG	1-1
FILE	2201360	
DATE	7/13/2015	



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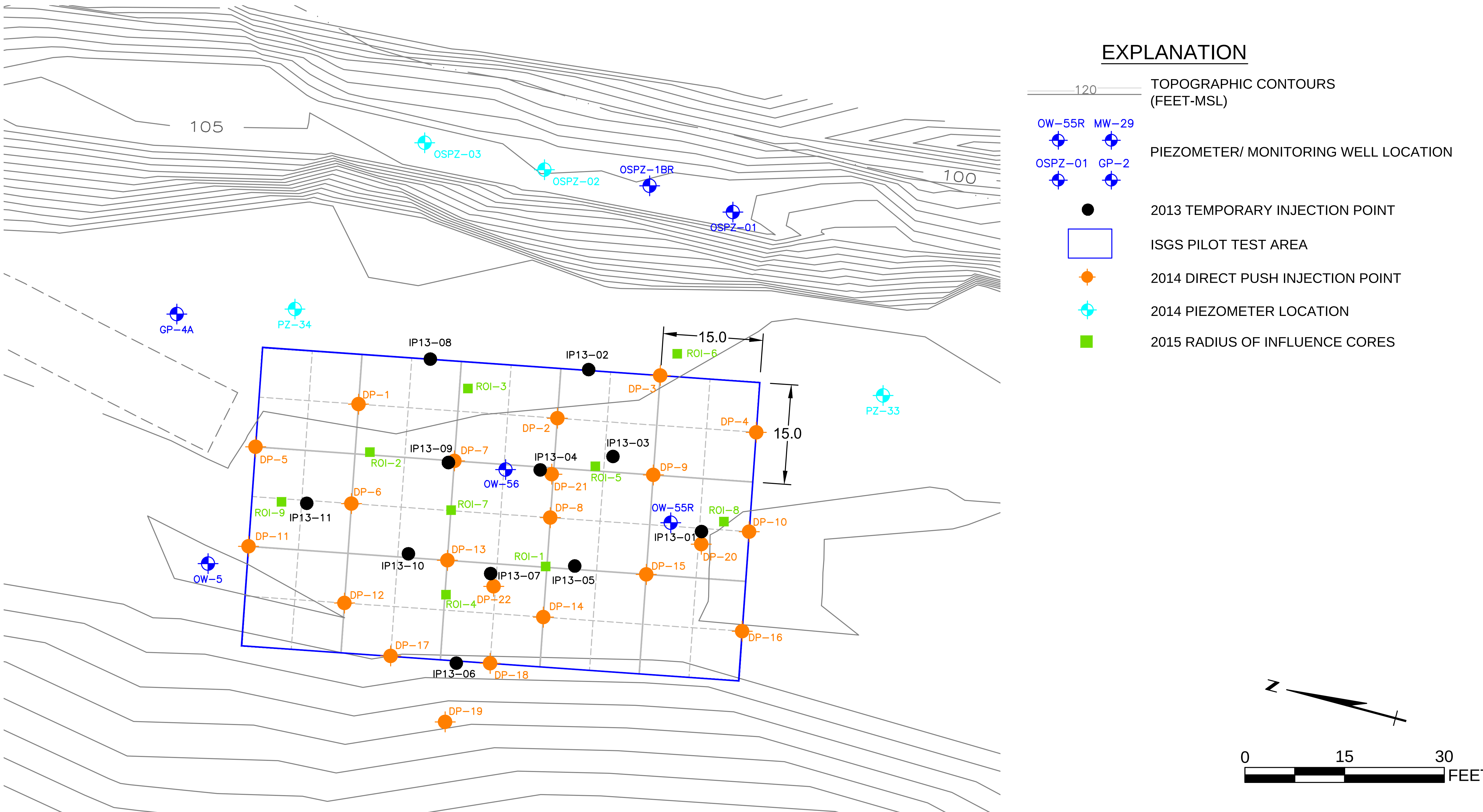
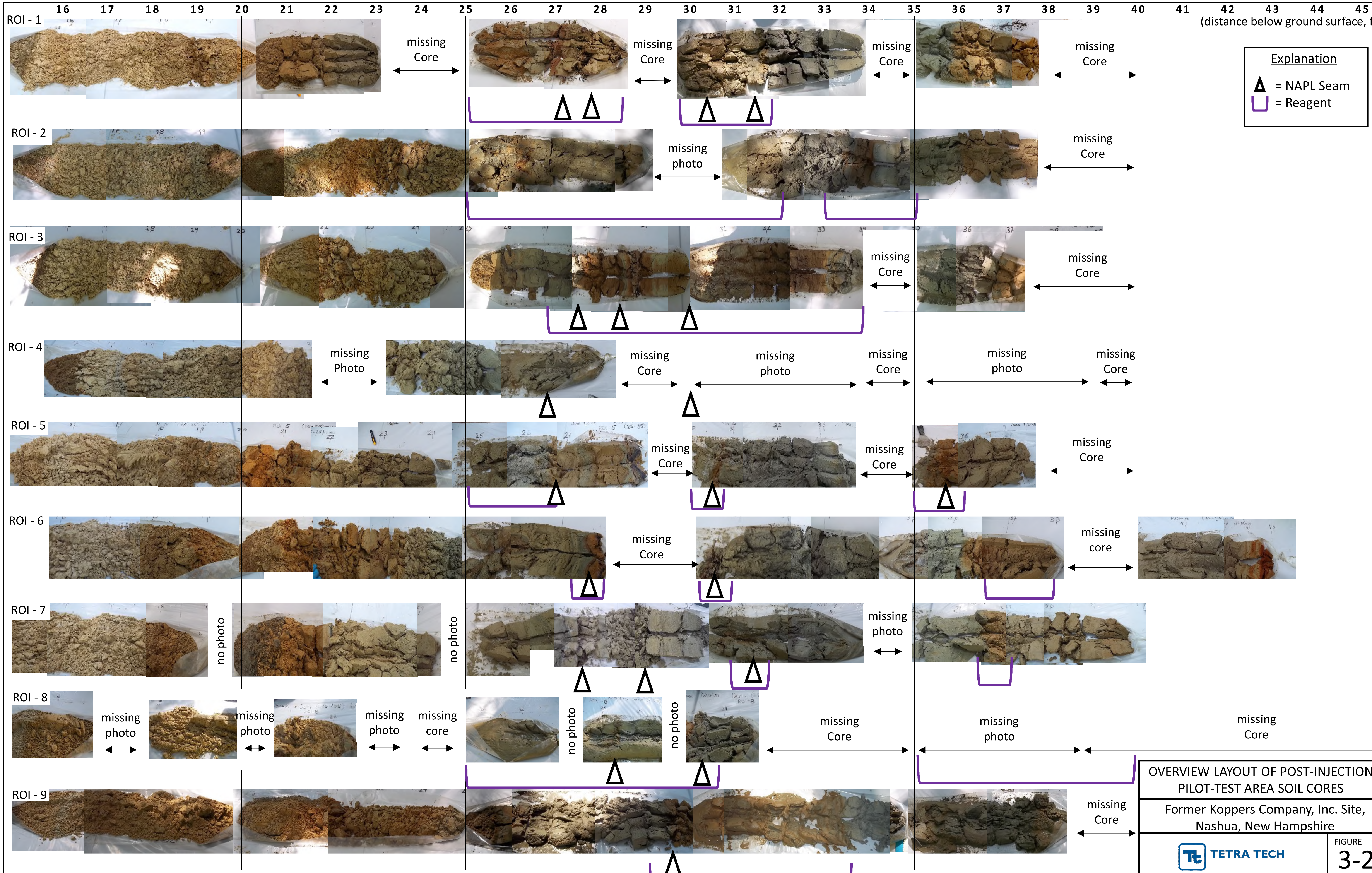


TITLE: ISGS PILOT-TEST RADIUS-OF-INFLUENCE CORE LOCATIONS

LOCATION: FORMER KOPPERS COMPANY, INC. SITE
NASHUA, NEW HAMPSHIRE

TETRA TECH

APPROVED	CG	FIGURE	
DRAFTED	DB		3-1
PROJECT#	117-2201360		
DATE	07/09/15		



OVERVIEW LAYOUT OF POST-INJECTION PILOT-TEST AREA SOIL CORES

Former Koppers Company, Inc. Site, Nashua, New Hampshire

TETRA TECH

FIGURE 3-2

ROI-3 (28 ft bgs)

Applied neutralizer

ROI-8 (29.5 ft bgs)

Applied neutralizer

ROI-5 (27 ft bgs)

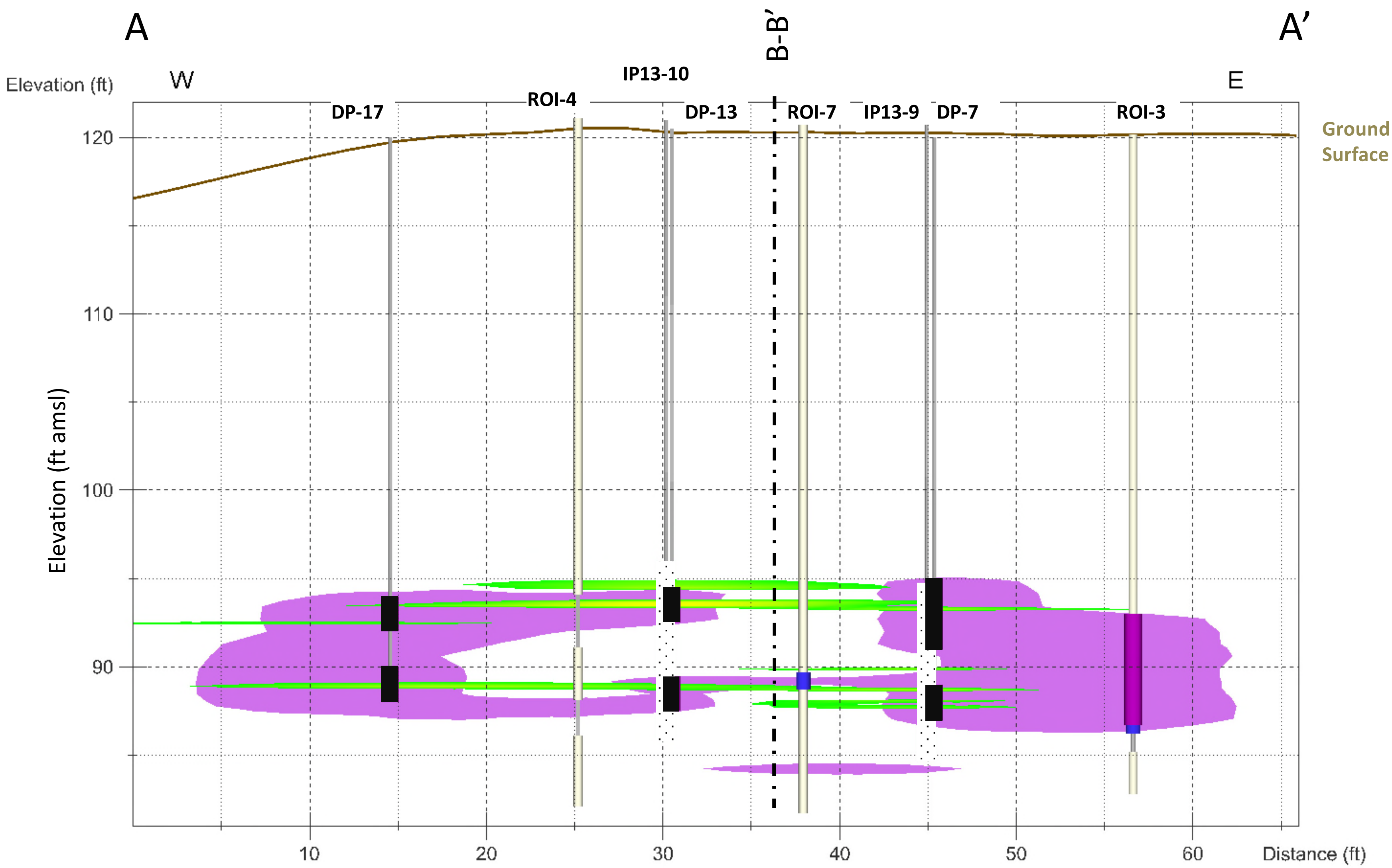
DNAPL Seam

TITLE: **DETAIL OF POST-ISGS CORE**

LOCATION: **Former Koppers Company, Inc. Site**
Nashua, New Hampshire

TETRA TECH	APPROVED	JE	FIGURE
	DRAFTED	CG	**3-3**
	PROJECT #	117-2201360	
	DATE	09-08-2015	

T:\Beazer_Nashua\ISGS_Pilot Test\ROI_Borings_June2015\Report\Figure 2-4 Core Detail.pptx



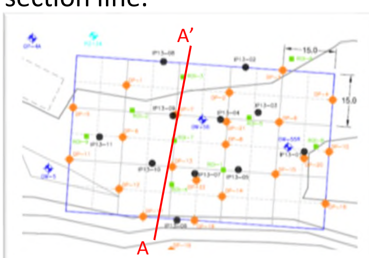
Explanation

ISGS injection intervals on section line.

NAPL Impacts

TIP Open Interval

Injected Reagent Body



TITLE:	CROSS-SECTION A-A’ WITH ISGS INJECTION INTERVALS
LOCATION:	Former Koppers Company, Inc. Site, Nashua, New Hampshire

TETRA TECH

APPROVED	JE	FIGURE
DRAFTED	CG	3-4a
PROJECT #	117-2201360	
DATE	9/08/2015	

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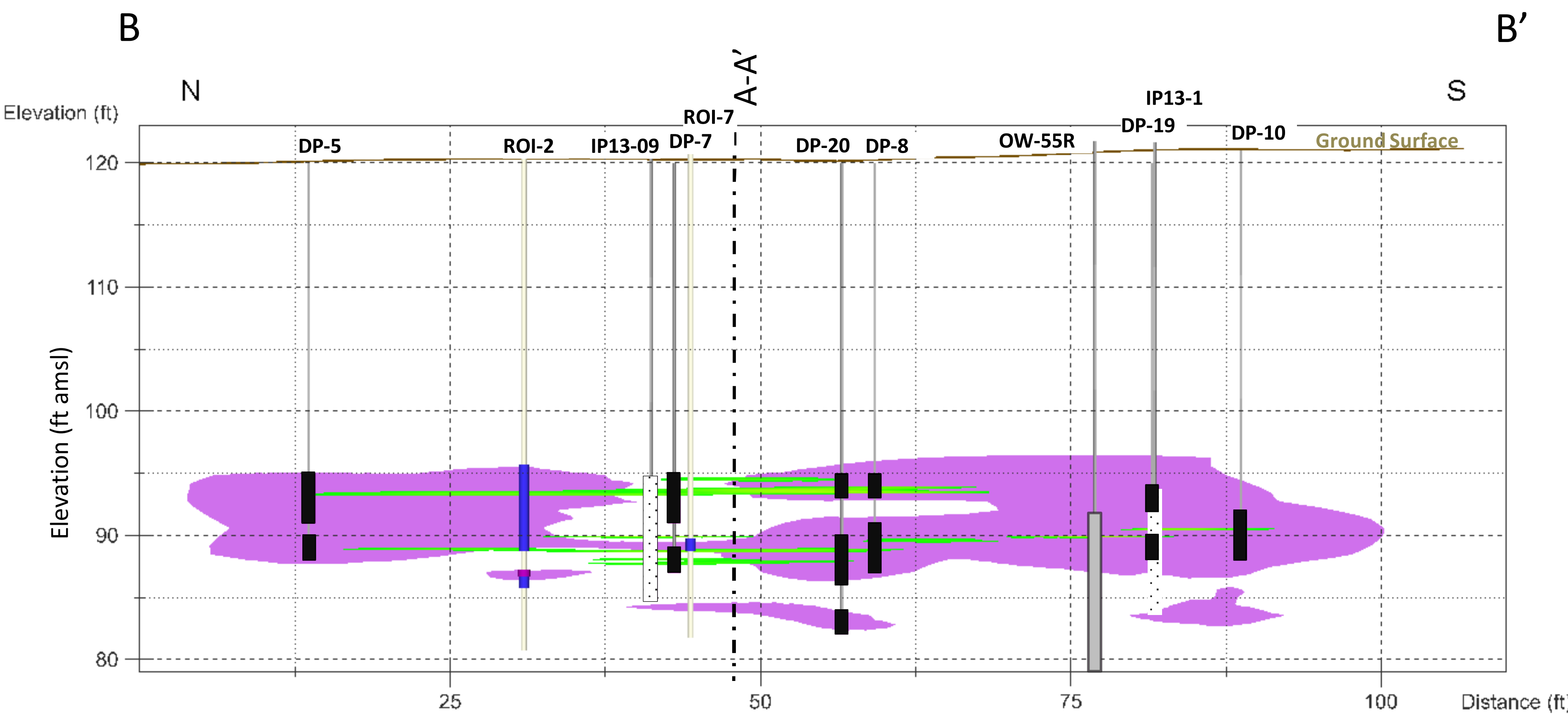


Explanation

- ISGS injection intervals on section line.
- NAPL Impacts
- TIP Open Interval
- Monitoring Well Screen
- Injected Reagent Body

TITLE: **CROSS-SECTION B-B’ WITH ISGS INJECTION INTERVALS**

LOCATION: **Former Koppers Company, Inc. Site, Nashua, New Hampshire**

TETRA TECH

APPROVED	JE	FIGURE
DRAFTED	CG	**3-4b**
PROJECT #	117-2201360	
DATE	09/08/15	

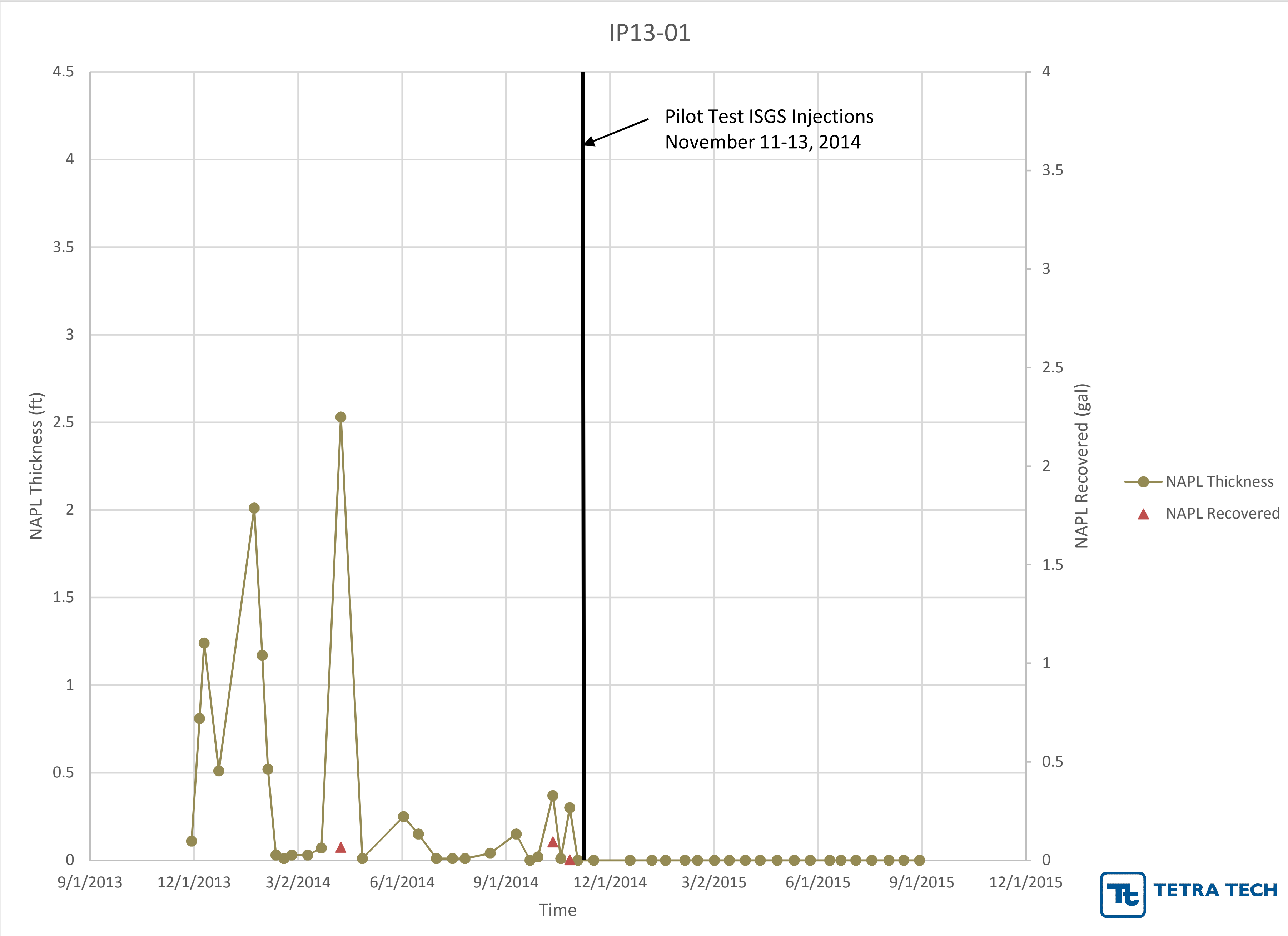
TABLES

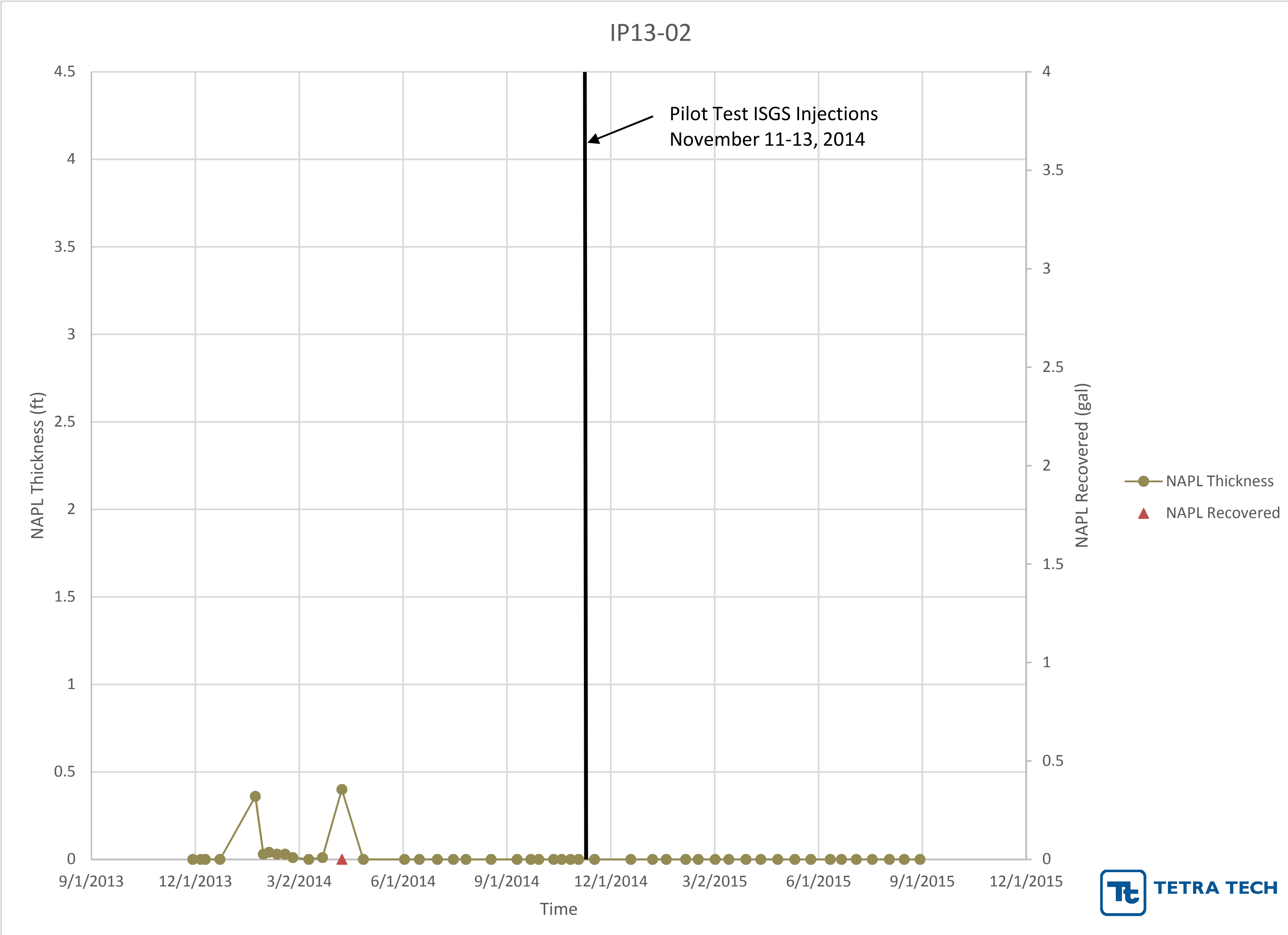
Table 1. Summary of ROI Observations

Borehole	Date	Expected NAPL Intervals (ft)	NAPL Seam Depth (ft)	Reagent Present?	Fully Oxidized Intervals (ft)
ROI-1	6/9/2015	26.6, 27, 31			26.6
			27.5	Yes	
			28	Yes	
			30.3	Yes	
			31.3	Yes	
ROI-2	6/10/2015	26.9, 30.3, 31.4, 32.1	none	25 - 32	26.9, 30.3, 31.4 and 32.1
				33.5 - 34	
ROI-3	6/10/2015	26.3, 31			
			27.5	Yes	
			28.7	No	
			30 - 32	Yes	
ROI-4	6/8/2015	25.5, 26, 27			
			26-27	Yes (no reaction)	
			30-32	No	
ROI-5	6/9/2015	31			
			27.5	Yes	
			35.5 - 36.5	Partial	
ROI-6	6/9/2015	26.3			
			27.5	Yes	
			30.5	Yes	
				26.5 - 37.5	
ROI-7	6/8/2015	26.9, 30.3, 31.4, 32.1			
			27.5	Yes	
			29	Yes	
			31-32.5	partial	
				36	
ROI-8	6/8/2015	30.6			
			28.3 - 28.5	Yes (no reaction)	
			30	Yes	
ROI-9	6/10/2015	24.6, 31.4			31.4
			29.5	Yes	

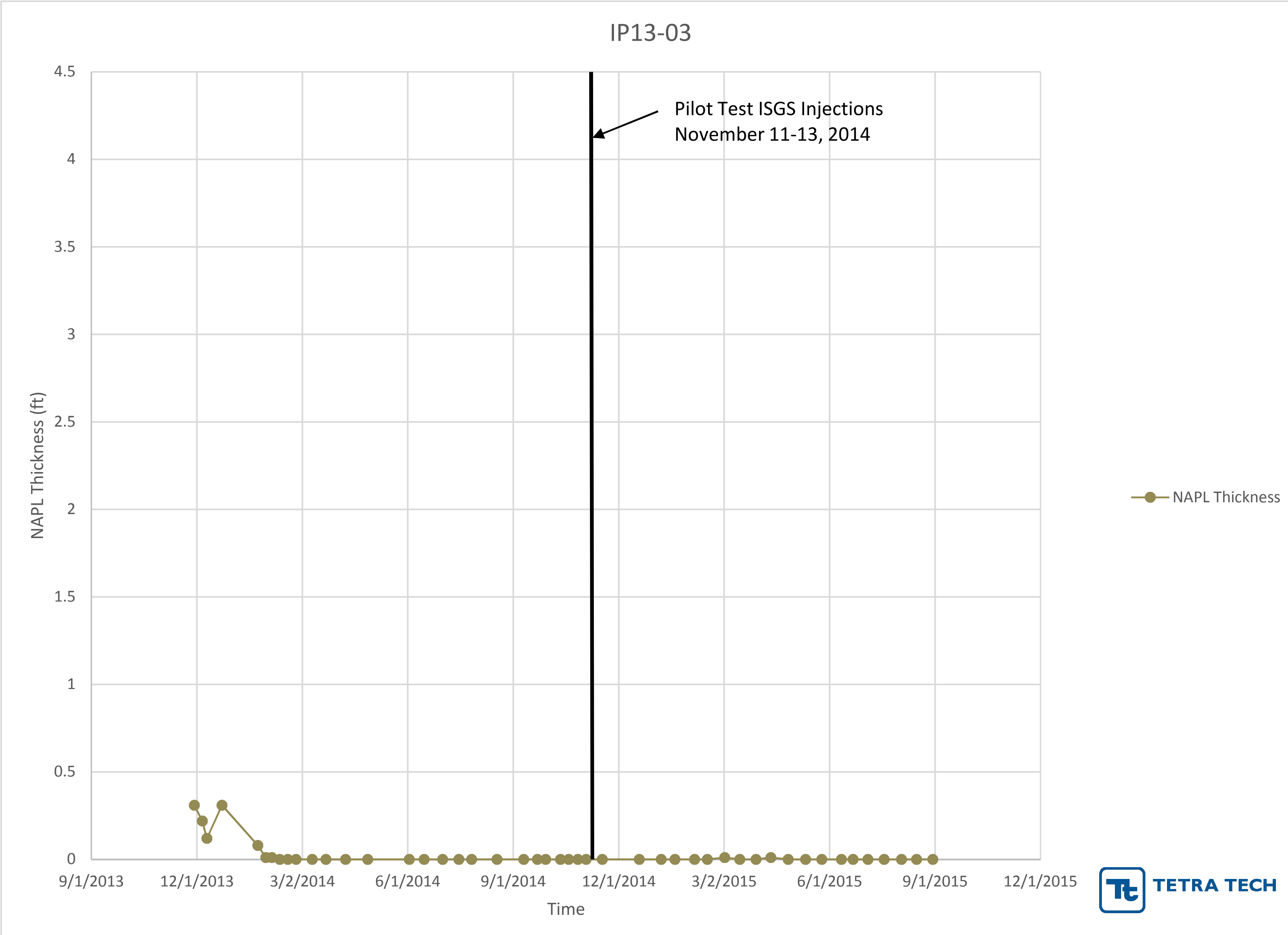
APPENDIX A

NAPL RECOVERY DATA

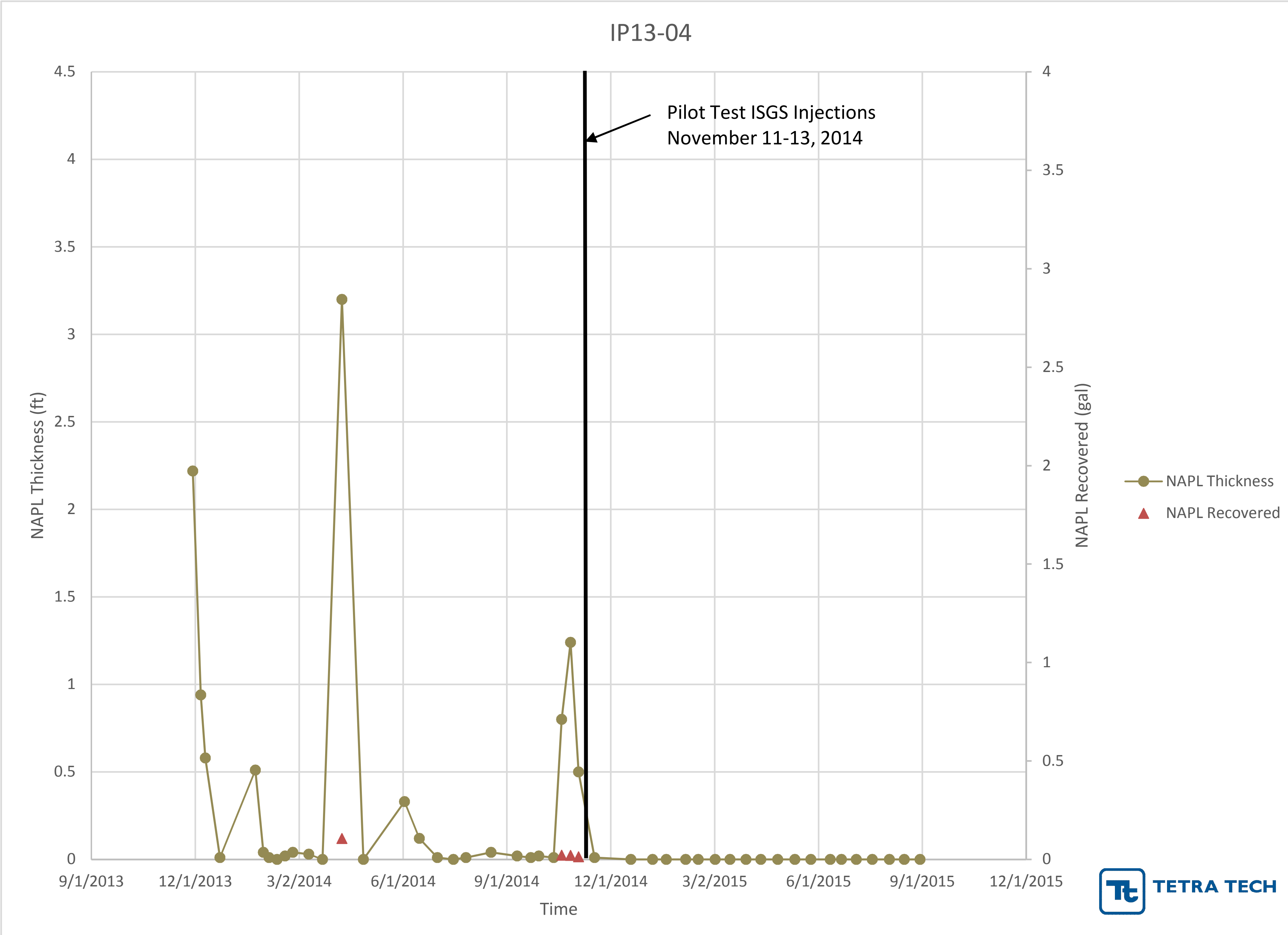

IP13-01
Pilot Test ISGS Injections
November 11-13, 2014
NAPL Thickness (ft)
NAPL Recovered (gal)
Time
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
9/1/2013
12/1/2013
3/2/2014
6/1/2014
9/1/2014
12/1/2014
3/2/2015
6/1/2015
9/1/2015
12/1/2015
NAPL Thickness
NAPL Recovered

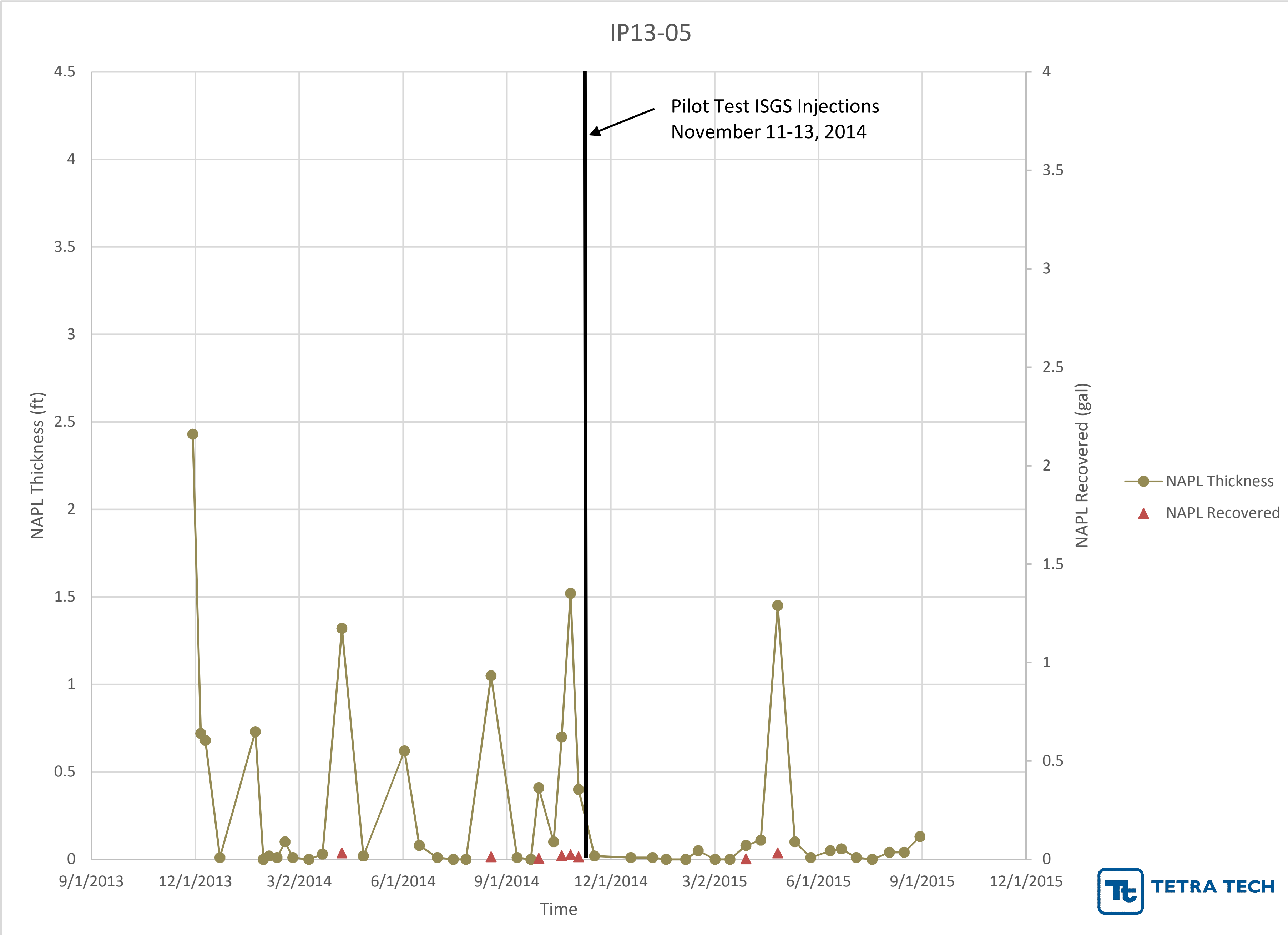


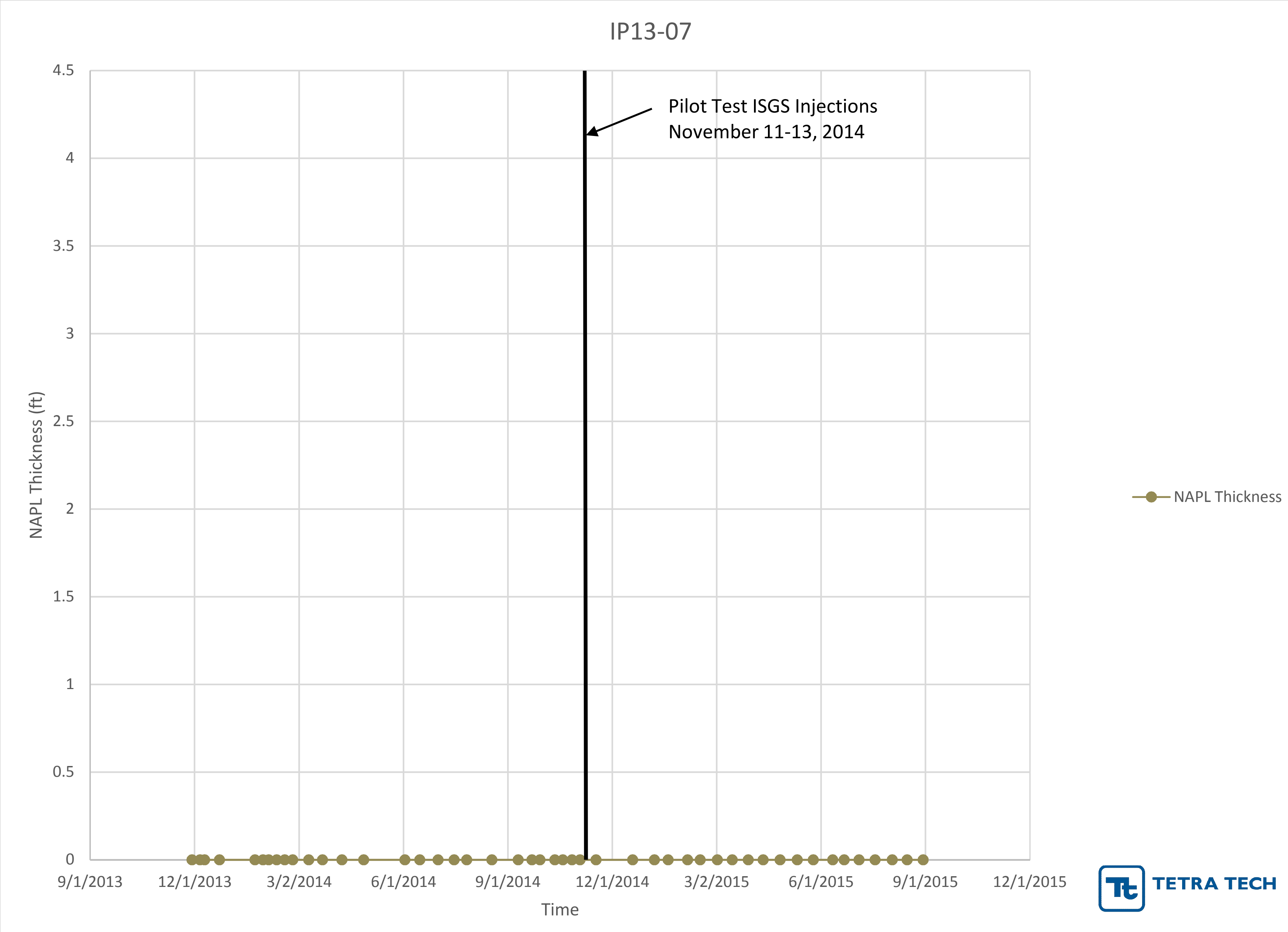
IP13-02
Pilot Test ISGS Injections
November 11-13, 2014
NAPL Thickness (ft)
NAPL Recovered (gal)
Time
NAPL Thickness
NAPL Recovered
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
9/1/2013
12/1/2013
3/2/2014
6/1/2014
9/1/2014
12/1/2014
3/2/2015
6/1/2015
9/1/2015
12/1/2015
TETRA TECH

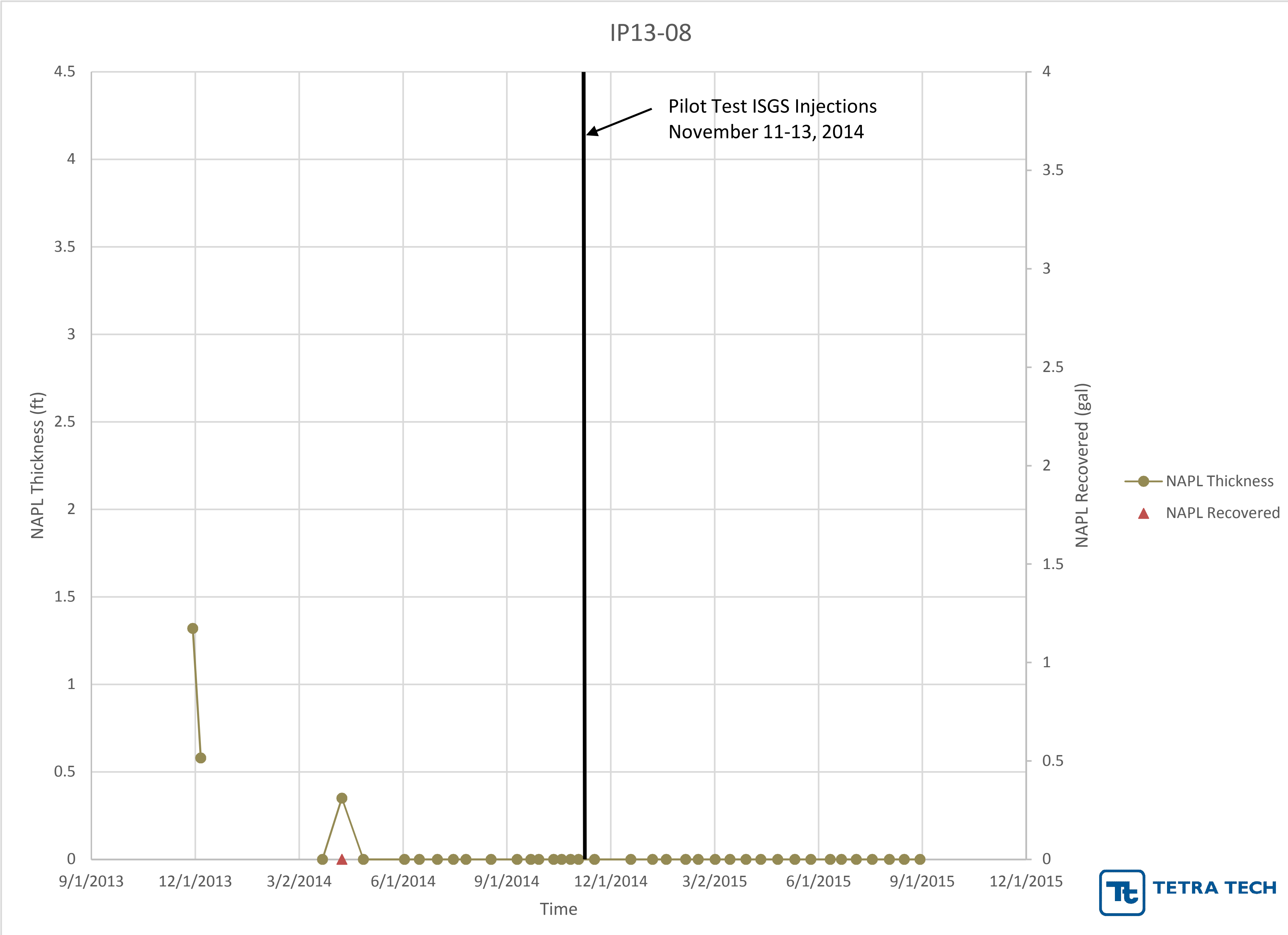


IP13-03
Pilot Test ISGS Injections
November 11-13, 2014
NAPL Thickness (ft)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
9/1/2013
12/1/2013
3/2/2014
6/1/2014
9/1/2014
12/1/2014
3/2/2015
6/1/2015
9/1/2015
12/1/2015
Time
NAPL Thickness
TETRA TECH

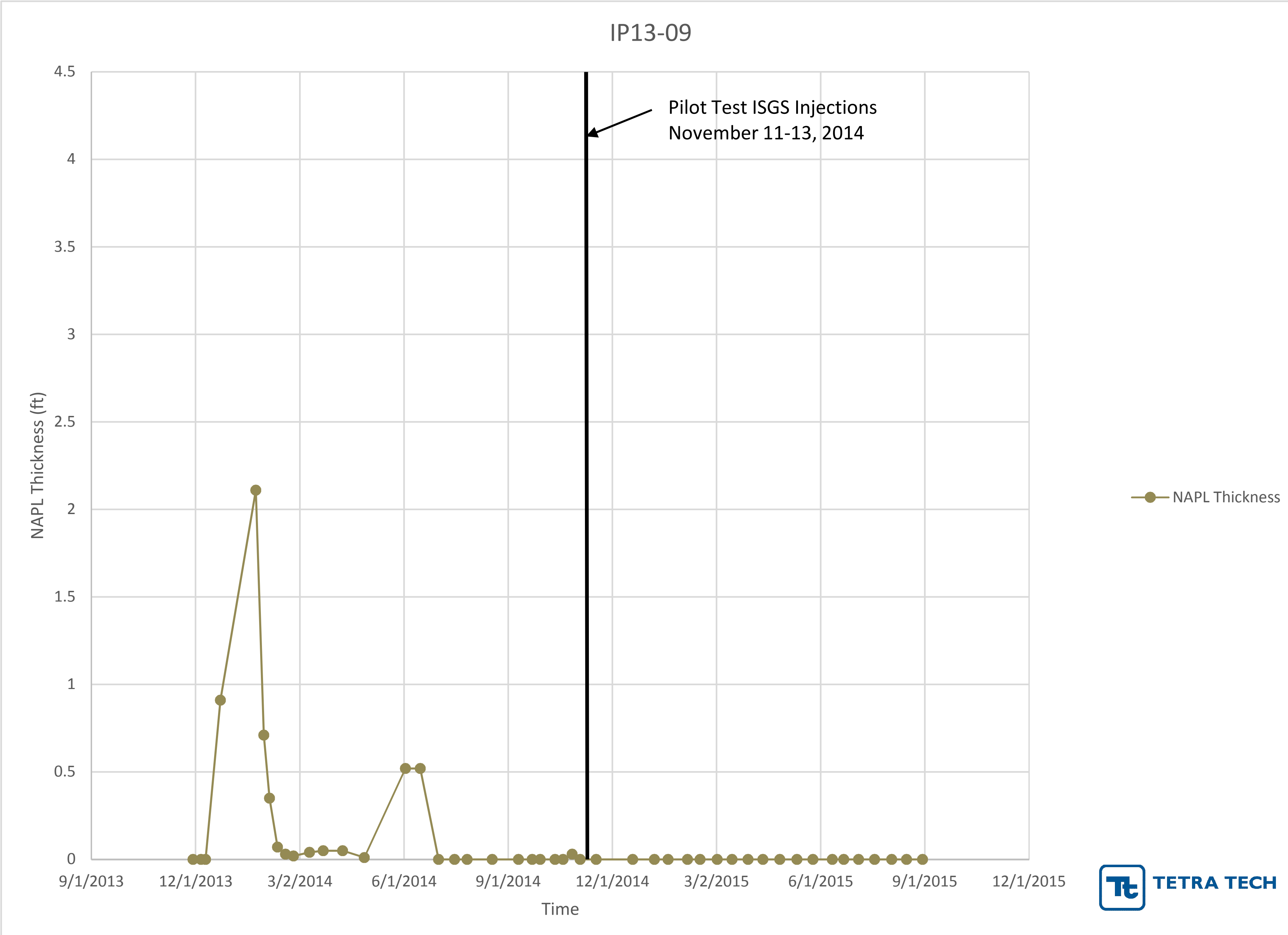

IP13-04
Pilot Test ISGS Injections
November 11-13, 2014
NAPL Thickness (ft)
NAPL Recovered (gal)
Time
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
9/1/2013
12/1/2013
3/2/2014
6/1/2014
9/1/2014
12/1/2014
3/2/2015
6/1/2015
9/1/2015
12/1/2015
NAPL Thickness
NAPL Recovered
TETRA TECH


IP13-05
Pilot Test ISGS Injections
November 11-13, 2014
NAPL Thickness (ft)
NAPL Recovered (gal)
Time
NAPL Thickness
NAPL Recovered
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
9/1/2013
12/1/2013
3/2/2014
6/1/2014
9/1/2014
12/1/2014
3/2/2015
6/1/2015
9/1/2015
12/1/2015
TETRA TECH

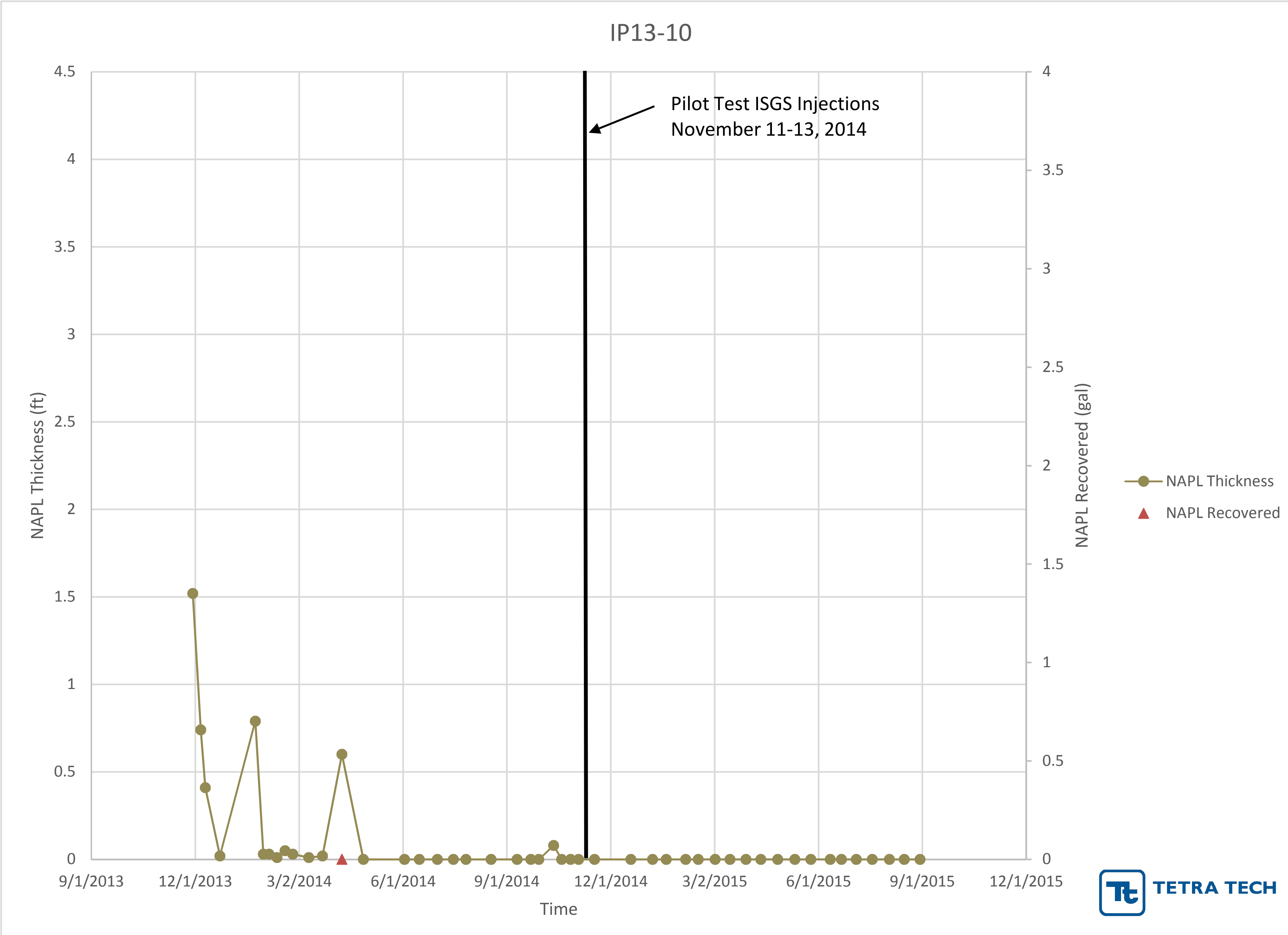

IP13-07
Pilot Test ISGS Injections
November 11-13, 2014
NAPL Thickness (ft)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
9/1/2013
12/1/2013
3/2/2014
6/1/2014
9/1/2014
12/1/2014
3/2/2015
6/1/2015
9/1/2015
12/1/2015
Time
NAPL Thickness

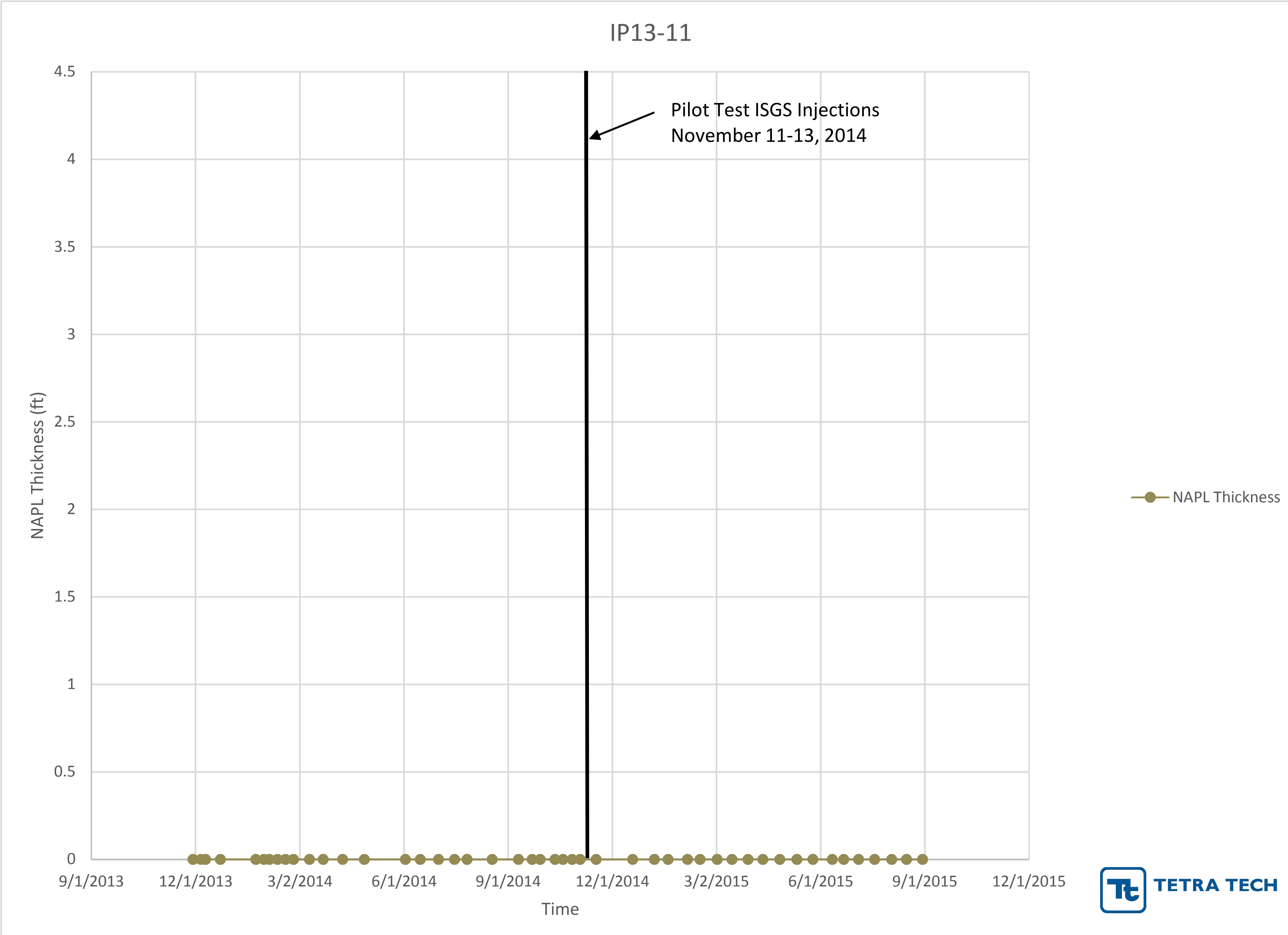


IP13-08
Pilot Test ISGS Injections
November 11-13, 2014
NAPL Thickness (ft)
NAPL Recovered (gal)
Time
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
9/1/2013
12/1/2013
3/2/2014
6/1/2014
9/1/2014
12/1/2014
3/2/2015
6/1/2015
9/1/2015
12/1/2015
NAPL Thickness
NAPL Recovered
TETRA TECH

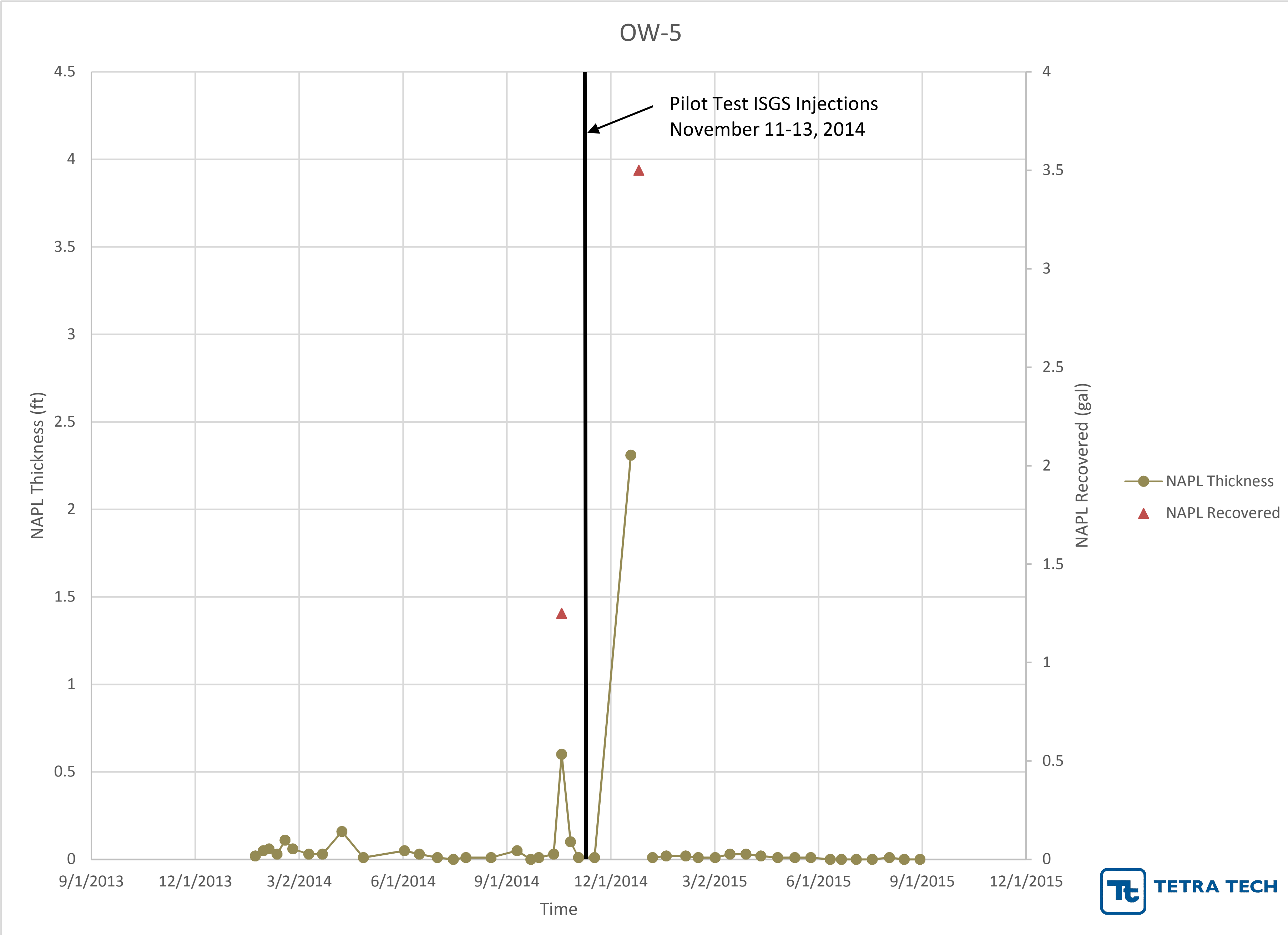


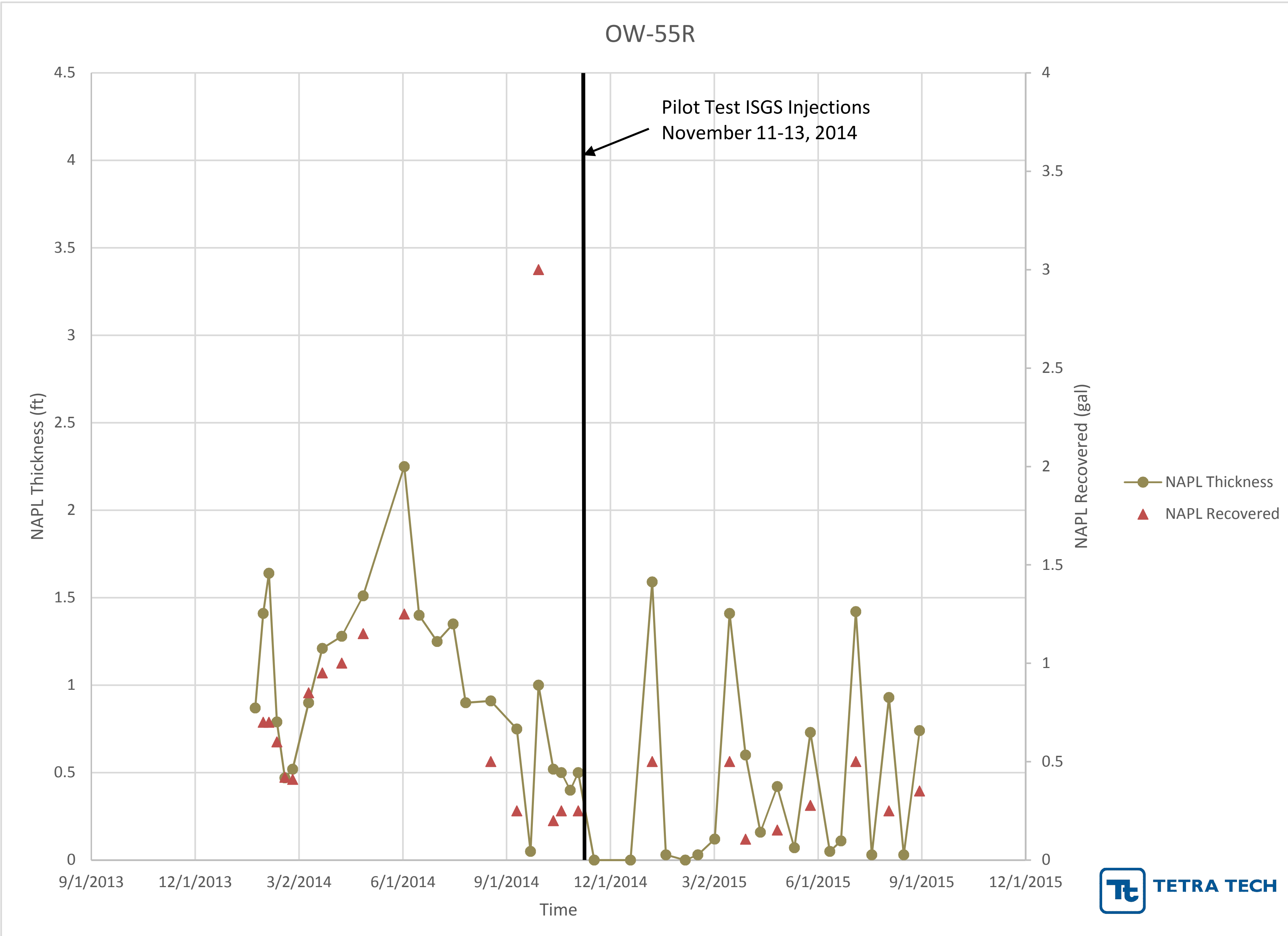
IP13-09
Pilot Test ISGS Injections
November 11-13, 2014
NAPL Thickness (ft)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
9/1/2013
12/1/2013
3/2/2014
6/1/2014
9/1/2014
12/1/2014
3/2/2015
6/1/2015
9/1/2015
12/1/2015
Time
NAPL Thickness


IP13-10
Pilot Test ISGS Injections
November 11-13, 2014
NAPL Thickness (ft)
NAPL Recovered (gal)
Time
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
9/1/2013
12/1/2013
3/2/2014
6/1/2014
9/1/2014
12/1/2014
3/2/2015
6/1/2015
9/1/2015
12/1/2015
NAPL Thickness
NAPL Recovered
TETRA TECH

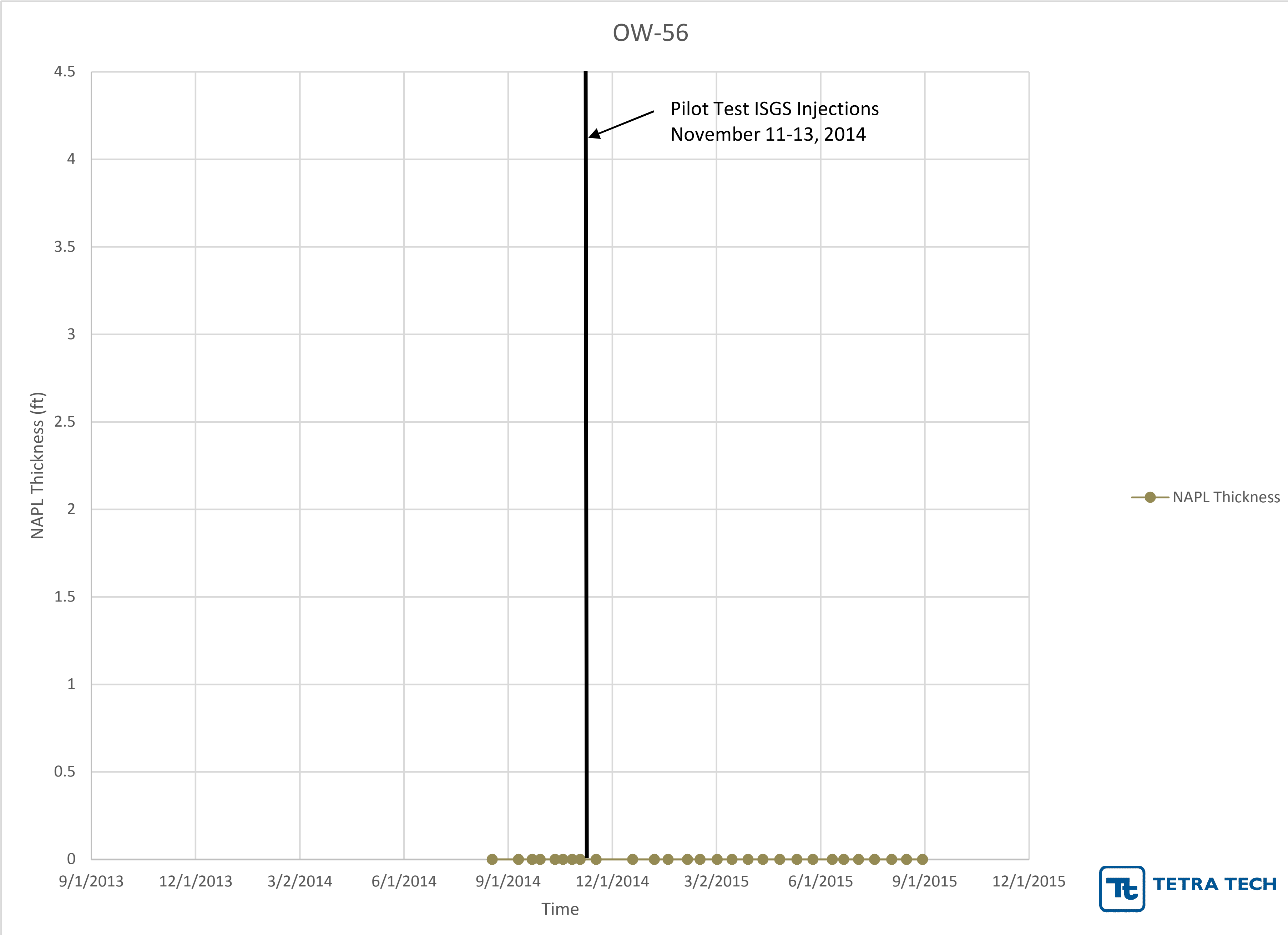


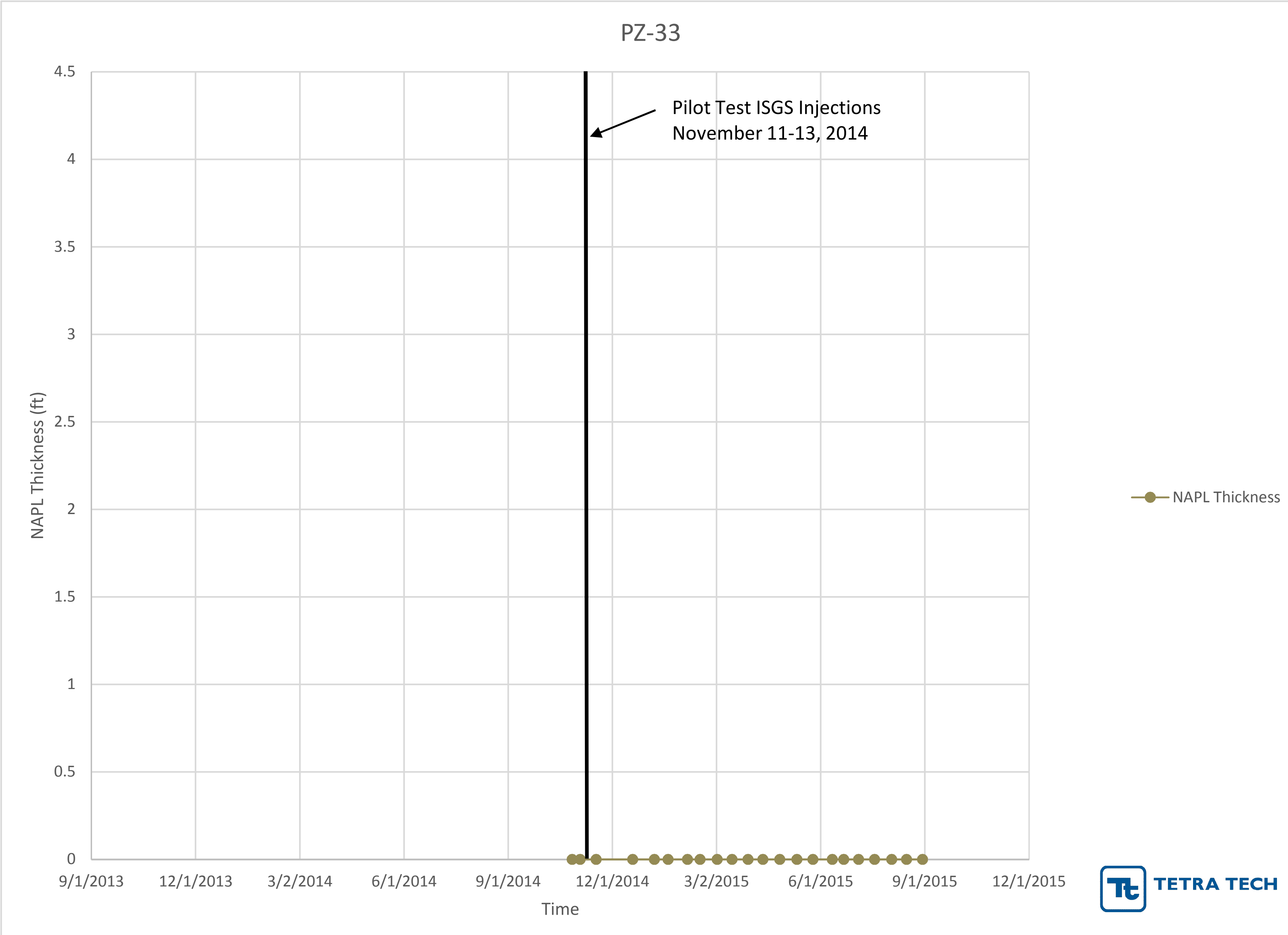
IP13-11
Pilot Test ISGS Injections
November 11-13, 2014
NAPL Thickness (ft)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
9/1/2013
12/1/2013
3/2/2014
6/1/2014
9/1/2014
12/1/2014
3/2/2015
6/1/2015
9/1/2015
12/1/2015
Time
NAPL Thickness
TETRA TECH

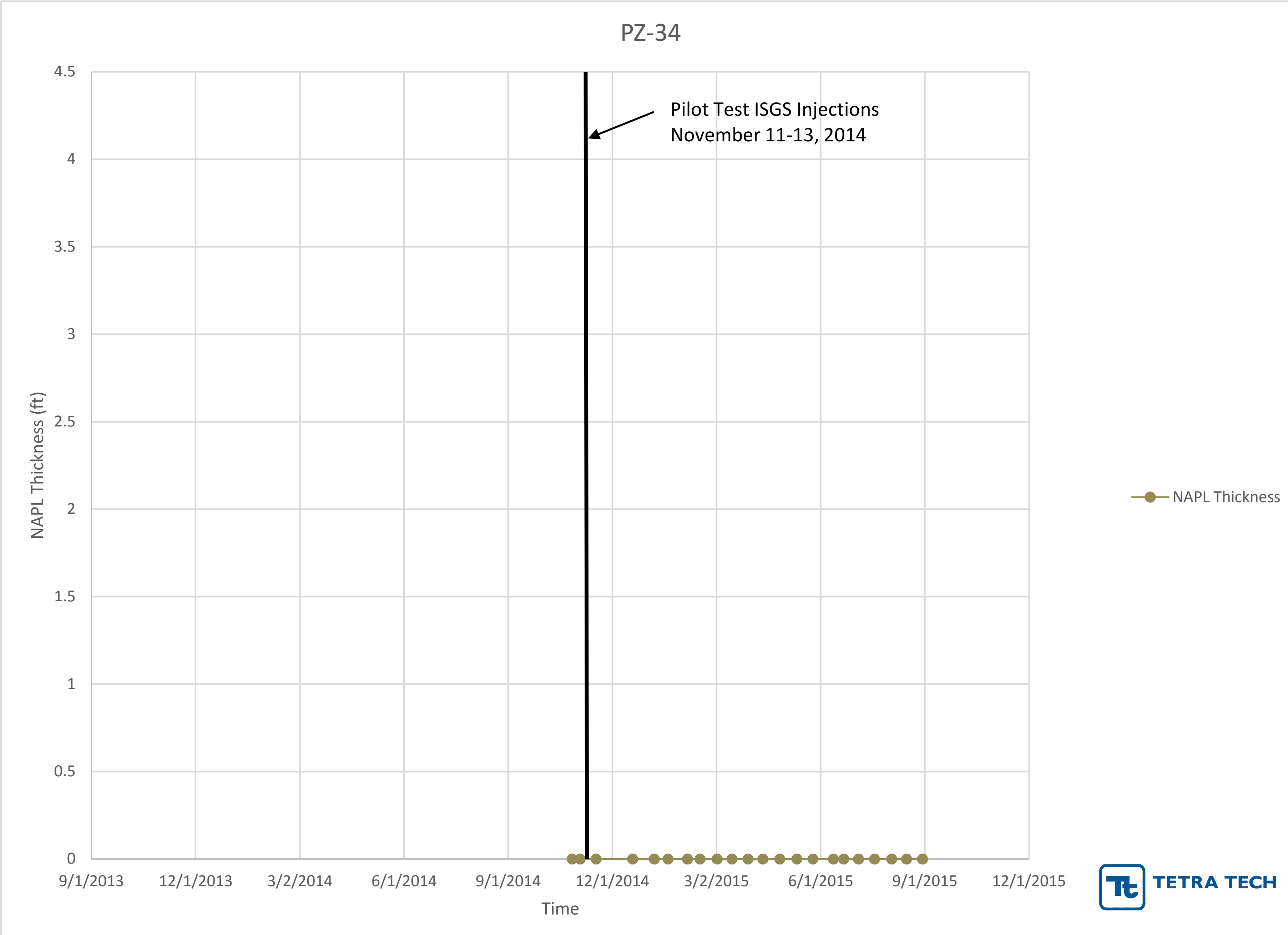

OW-5
Pilot Test ISGS Injections
November 11-13, 2014
NAPL Thickness (ft)
NAPL Recovered (gal)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
9/1/2013
12/1/2013
3/2/2014
6/1/2014
9/1/2014
12/1/2014
3/2/2015
6/1/2015
9/1/2015
12/1/2015
Time
NAPL Thickness
NAPL Recovered
TETRA TECH

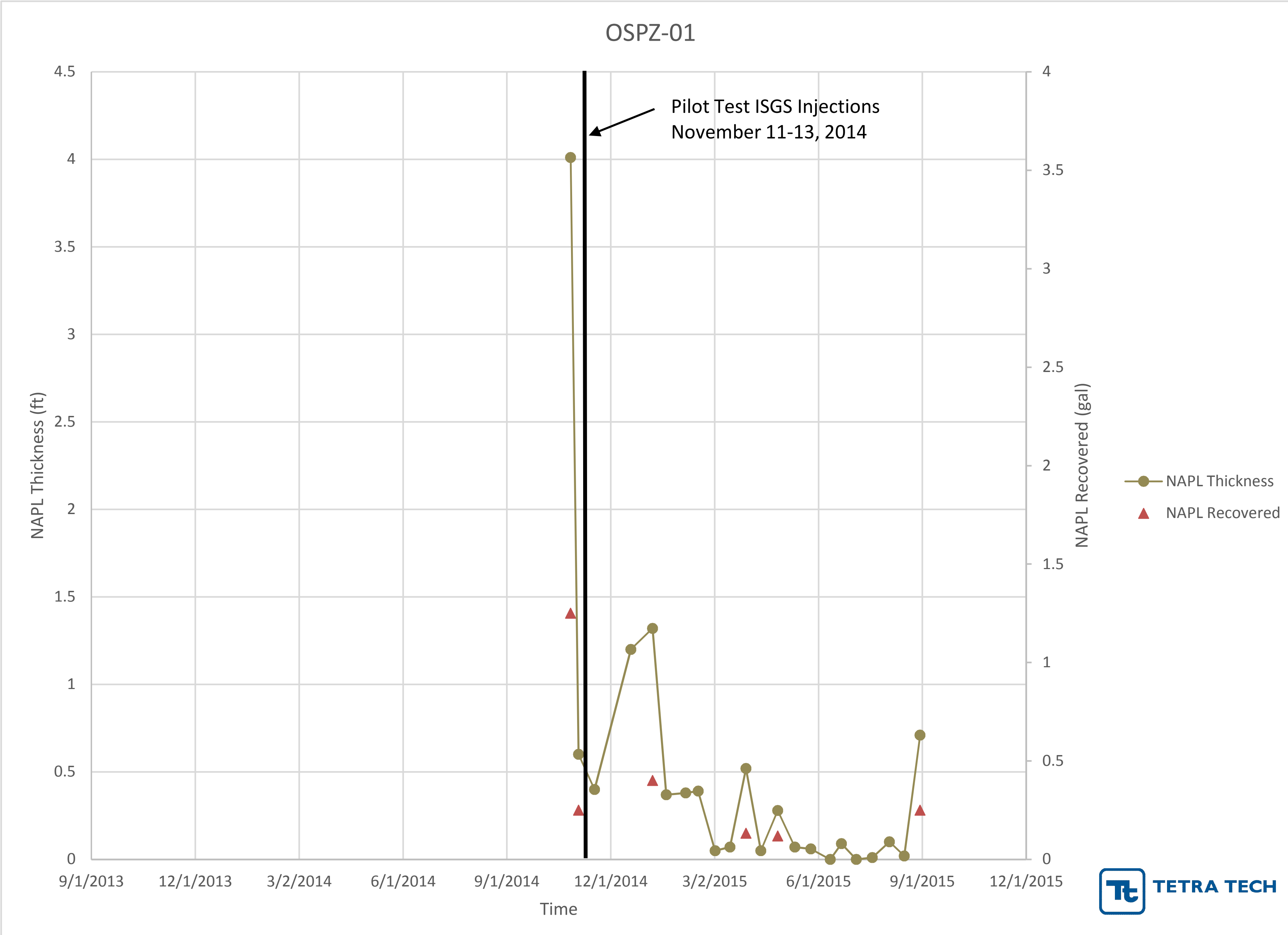


OW-55R
Pilot Test ISGS Injections
November 11-13, 2014
NAPL Thickness (ft)
NAPL Recovered (gal)
Time
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
3.5
3
2.5
2
1.5
1
0.5
0
9/1/2013
12/1/2013
3/2/2014
6/1/2014
9/1/2014
12/1/2014
3/2/2015
6/1/2015
9/1/2015
12/1/2015
NAPL Thickness
NAPL Recovered
TETRA TECH

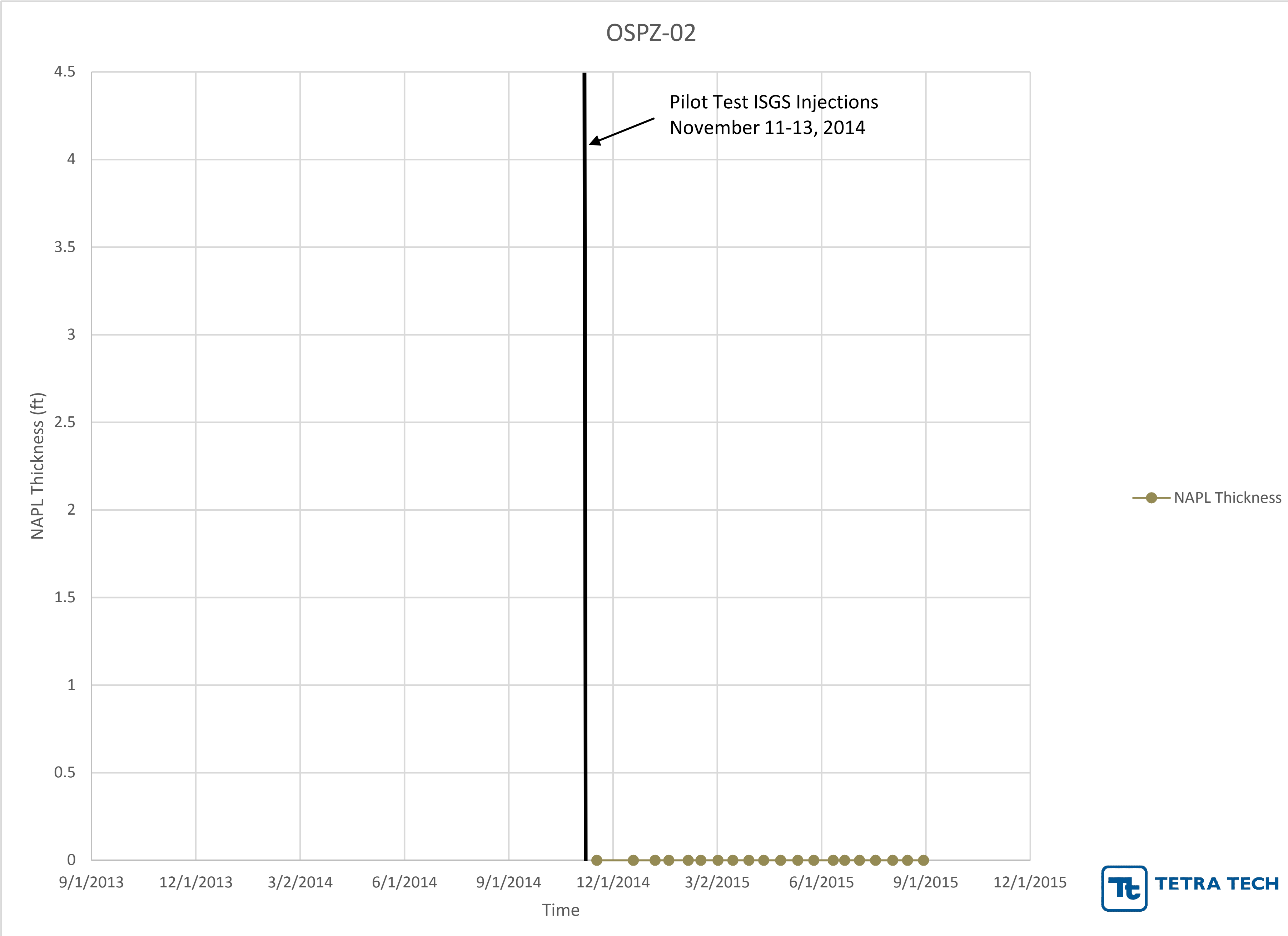

OW-56
Pilot Test ISGS Injections
November 11-13, 2014
NAPL Thickness (ft)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
9/1/2013
12/1/2013
3/2/2014
6/1/2014
9/1/2014
12/1/2014
3/2/2015
6/1/2015
9/1/2015
12/1/2015
Time
NAPL Thickness
TETRA TECH


PZ-33
Pilot Test ISGS Injections
November 11-13, 2014
NAPL Thickness (ft)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
9/1/2013
12/1/2013
3/2/2014
6/1/2014
9/1/2014
12/1/2014
3/2/2015
6/1/2015
9/1/2015
12/1/2015
Time
NAPL Thickness

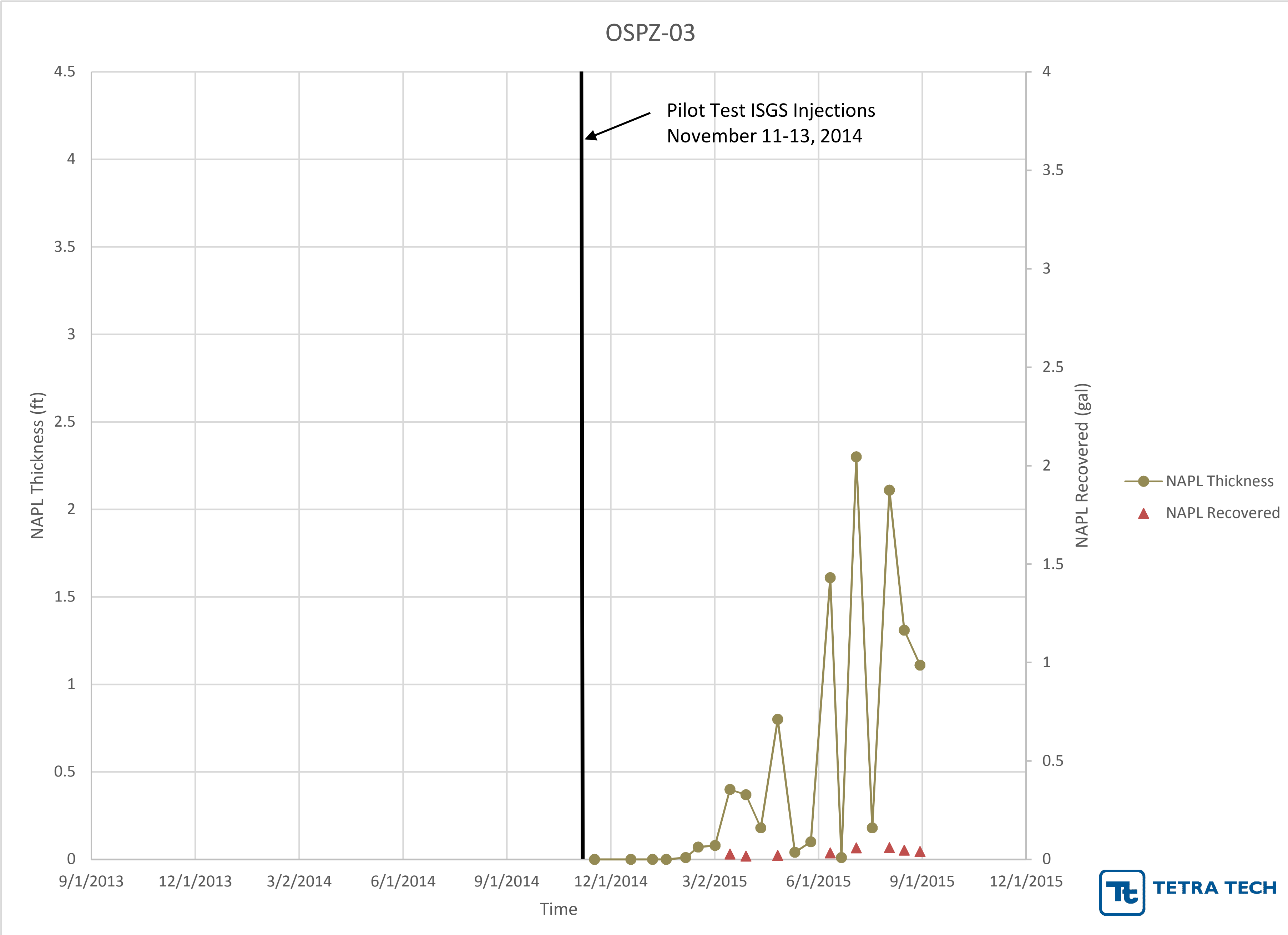

PZ-34
NAPL Thickness (ft)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
9/1/2013
12/1/2013
3/2/2014
6/1/2014
9/1/2014
12/1/2014
3/2/2015
6/1/2015
9/1/2015
12/1/2015
Time
Pilot Test ISGS Injections
November 11-13, 2014
NAPL Thickness
TETRA TECH



OSPZ-01
Pilot Test ISGS Injections
November 11-13, 2014
NAPL Thickness (ft)
NAPL Recovered (gal)
Time
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
9/1/2013
12/1/2013
3/2/2014
6/1/2014
9/1/2014
12/1/2014
3/2/2015
6/1/2015
9/1/2015
12/1/2015
NAPL Thickness
NAPL Recovered
TETRA TECH


OSPZ-02
Pilot Test ISGS Injections
November 11-13, 2014
NAPL Thickness (ft)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
9/1/2013
12/1/2013
3/2/2014
6/1/2014
9/1/2014
12/1/2014
3/2/2015
6/1/2015
9/1/2015
12/1/2015
Time
NAPL Thickness

TETRA TECH


OSPZ-03
Pilot Test ISGS Injections
November 11-13, 2014
NAPL Thickness (ft)
NAPL Recovered (gal)
Time
NAPL Thickness
NAPL Recovered
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
9/1/2013
12/1/2013
3/2/2014
6/1/2014
9/1/2014
12/1/2014
3/2/2015
6/1/2015
9/1/2015
12/1/2015
TETRA TECH

APPENDIX B

TEMPORAL PLOTS OF TIPS NAPL, WATER AND SEDIMENT DATA

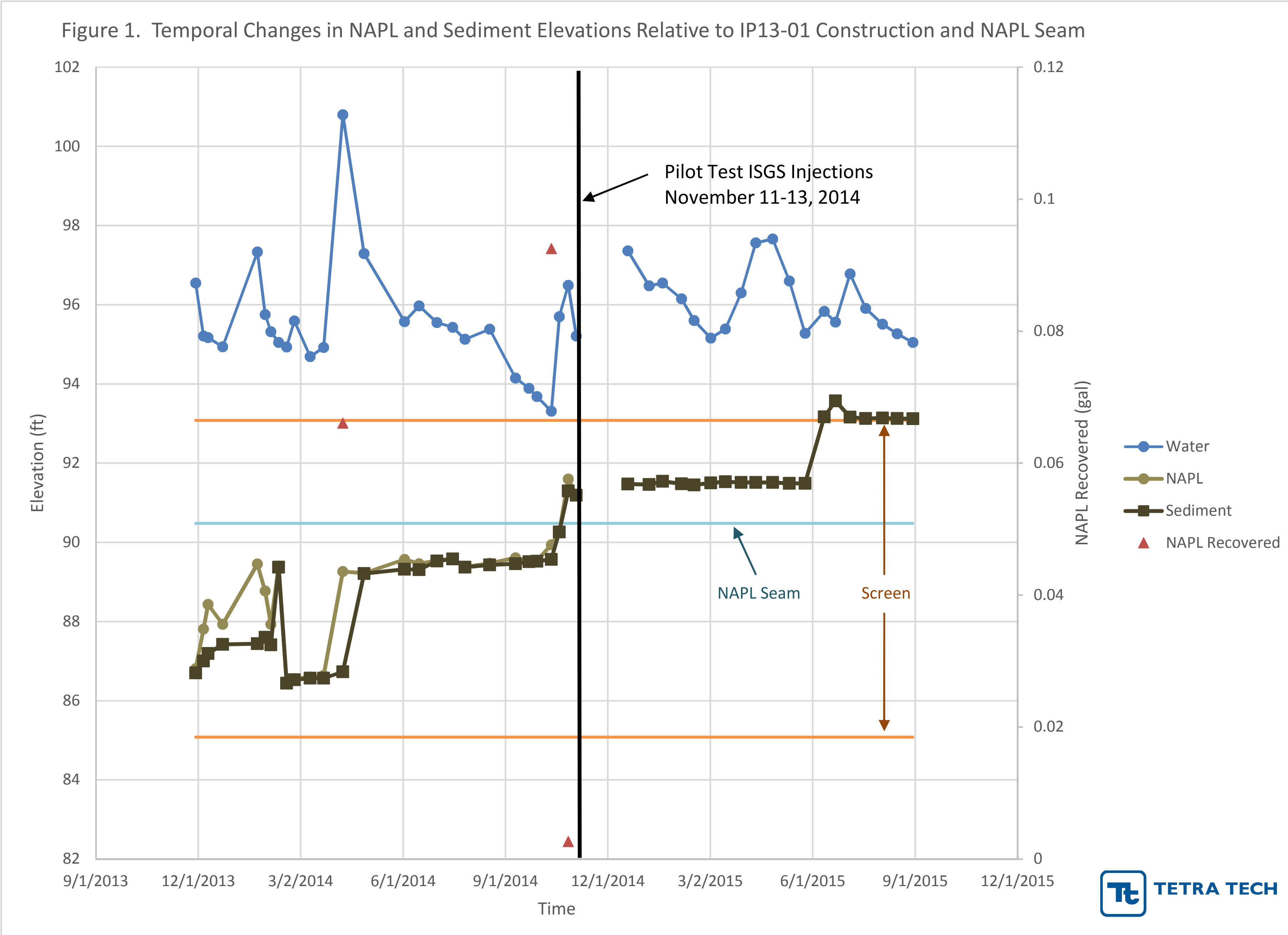


Figure 1. Temporal Changes in NAPL and Sediment Elevations Relative to IP13-01 Construction and NAPL Seam
Pilot Test ISGS Injections
November 11-13, 2014
NAPL Seam
Screen
Elevation (ft)
NAPL Recovered (gal)
Time
102
100
98
96
94
92
90
88
86
84
82
0.12
0.1
0.08
0.06
0.04
0.02
0
9/1/2013
12/1/2013
3/2/2014
6/1/2014
9/1/2014
12/1/2014
3/2/2015
6/1/2015
9/1/2015
12/1/2015
Water
NAPL
Sediment
NAPL Recovered
TETRA TECH

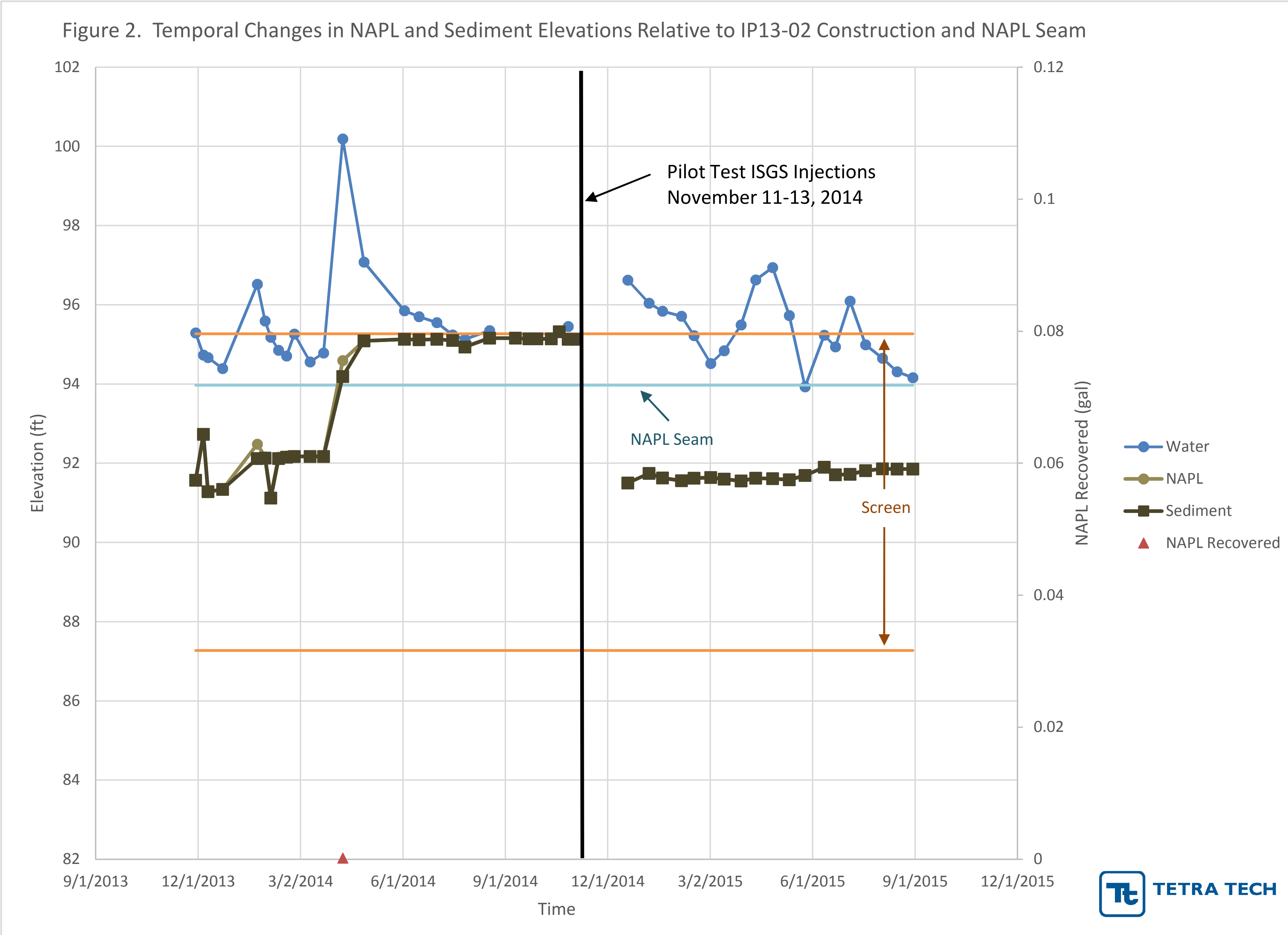
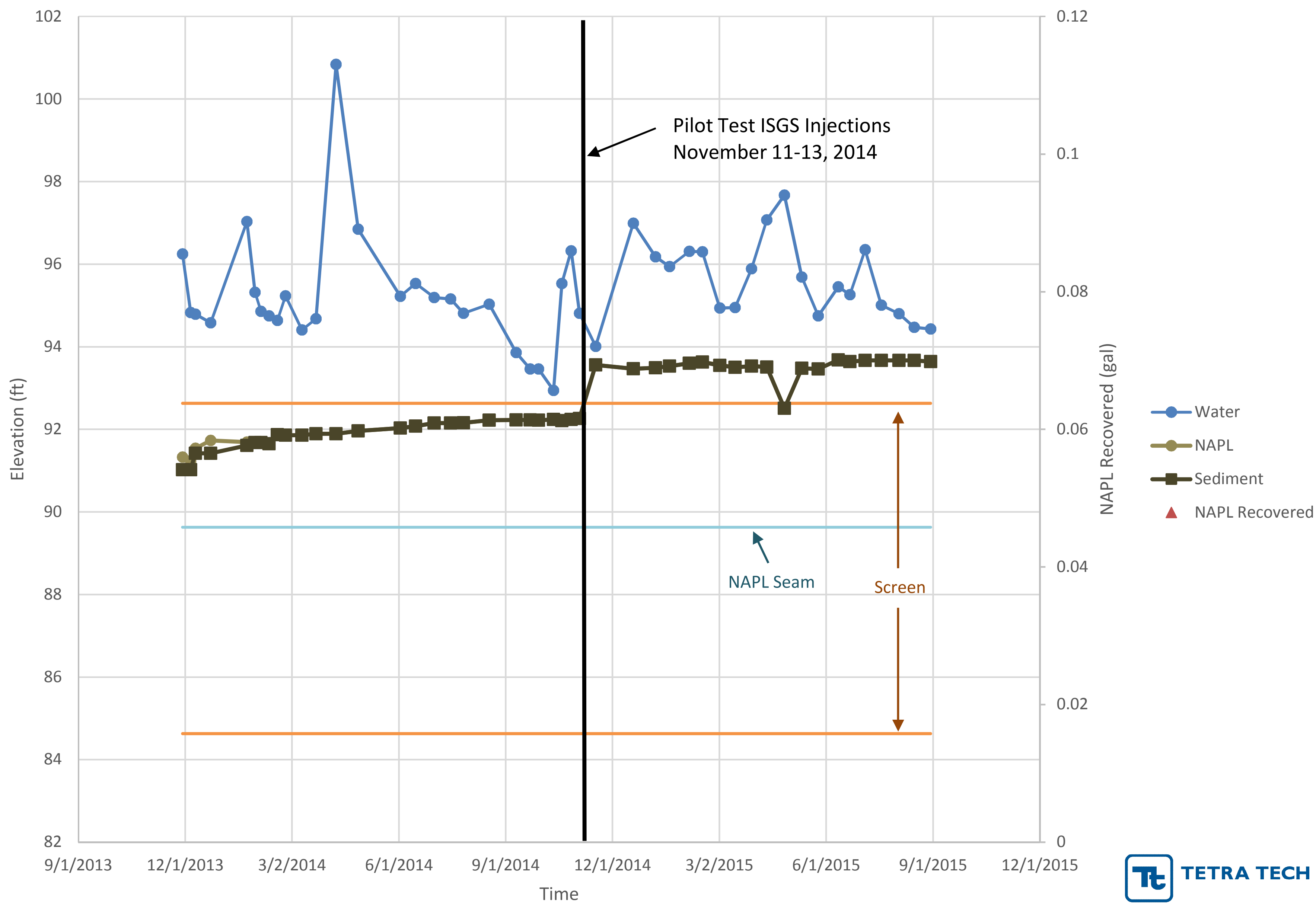


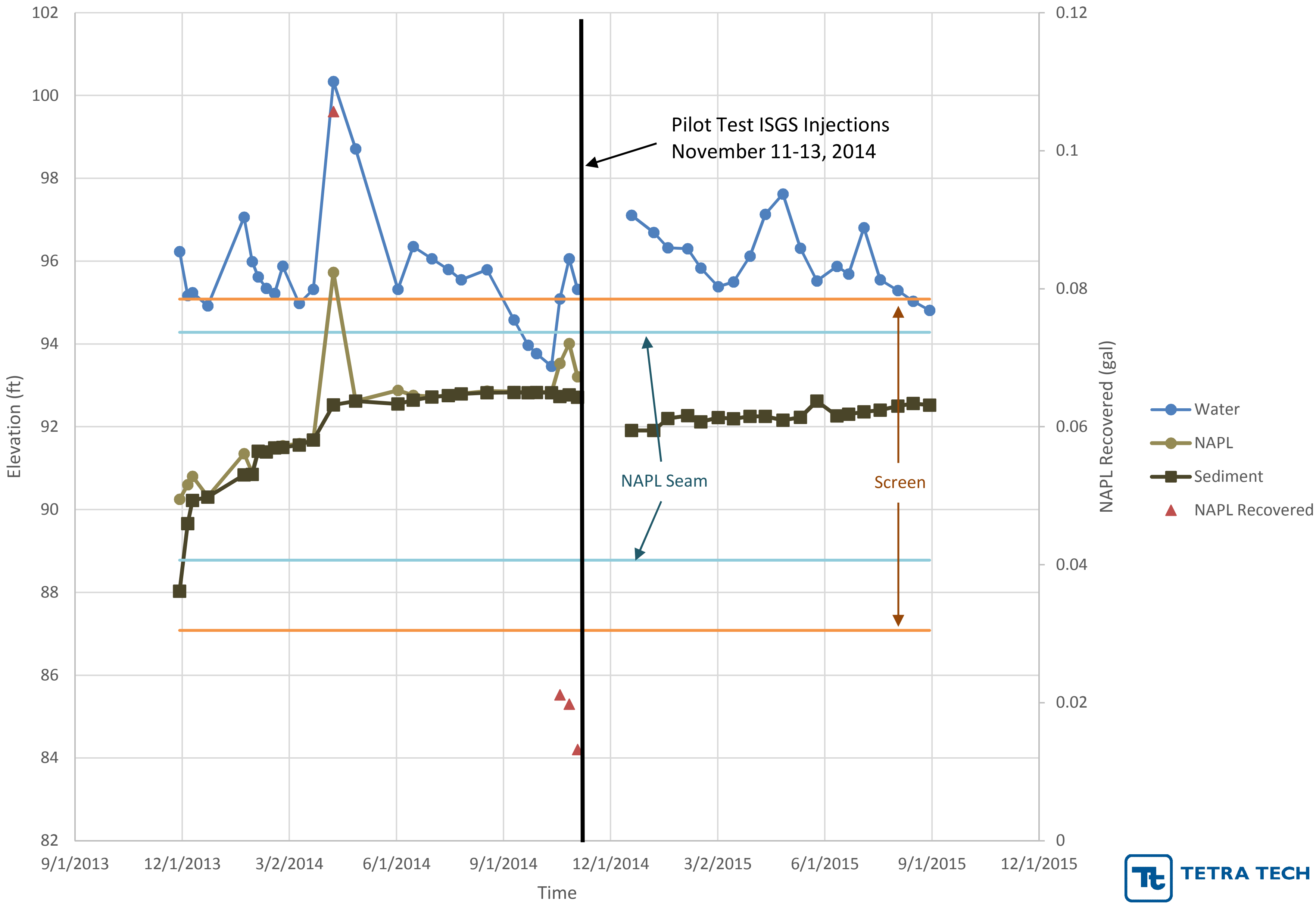
Figure 2. Temporal Changes in NAPL and Sediment Elevations Relative to IP13-02 Construction and NAPL Seam
Pilot Test ISGS Injections
November 11-13, 2014
NAPL Seam
Screen
Elevation (ft)
NAPL Recovered (gal)
Time
102
100
98
96
94
92
90
88
86
84
82
0.12
0.1
0.08
0.06
0.04
0.02
0
9/1/2013
12/1/2013
3/2/2014
6/1/2014
9/1/2014
12/1/2014
3/2/2015
6/1/2015
9/1/2015
12/1/2015
Water
NAPL
Sediment
NAPL Recovered
TETRA TECH

Figure 3. Temporal Changes in NAPL and Sediment Elevations Relative to IP13-03 Construction and NAPL Seam



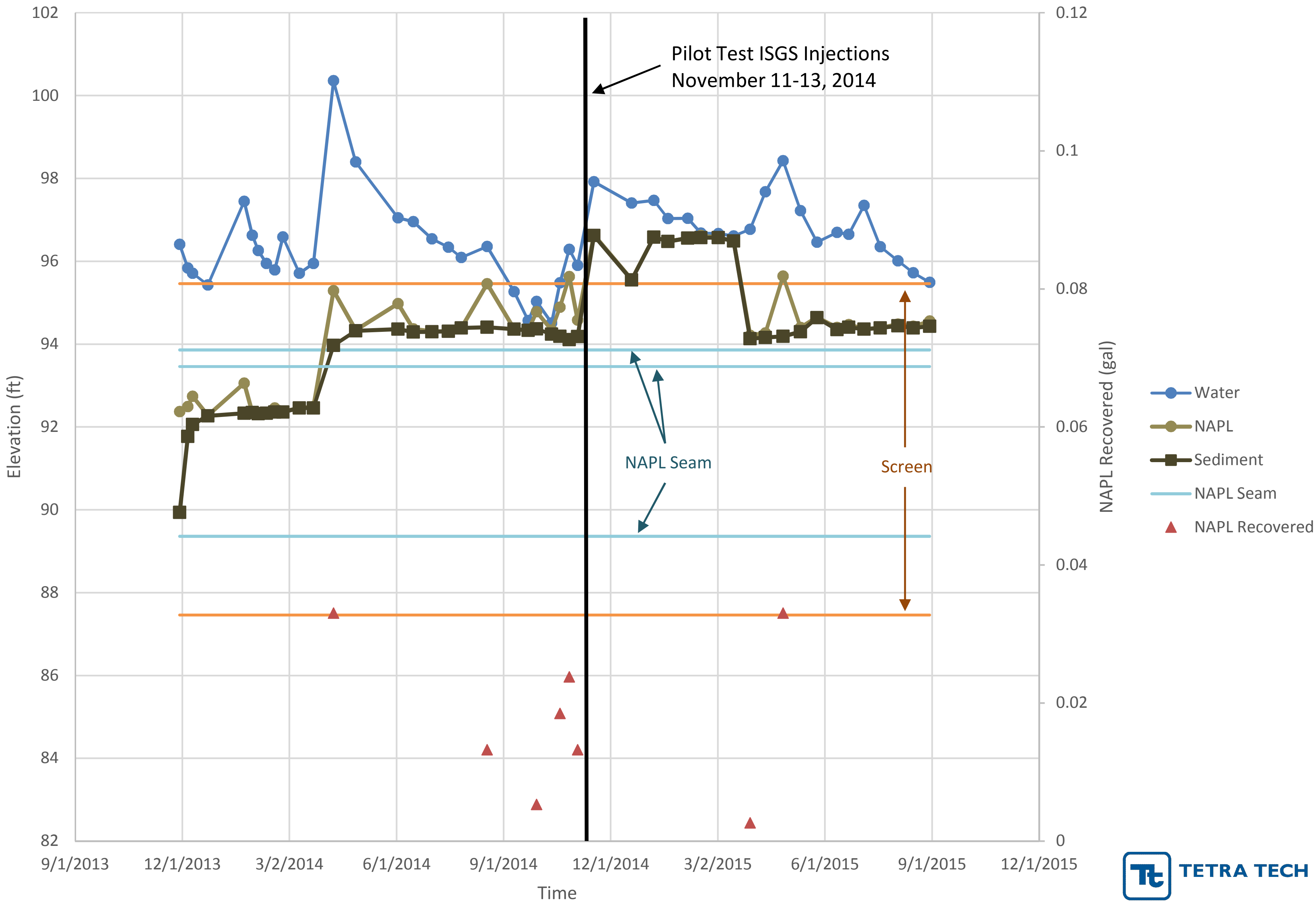
TETRA TECH

Figure 4. Temporal Changes in NAPL and Sediment Elevations Relative to IP13-04 Construction and NAPL Seam



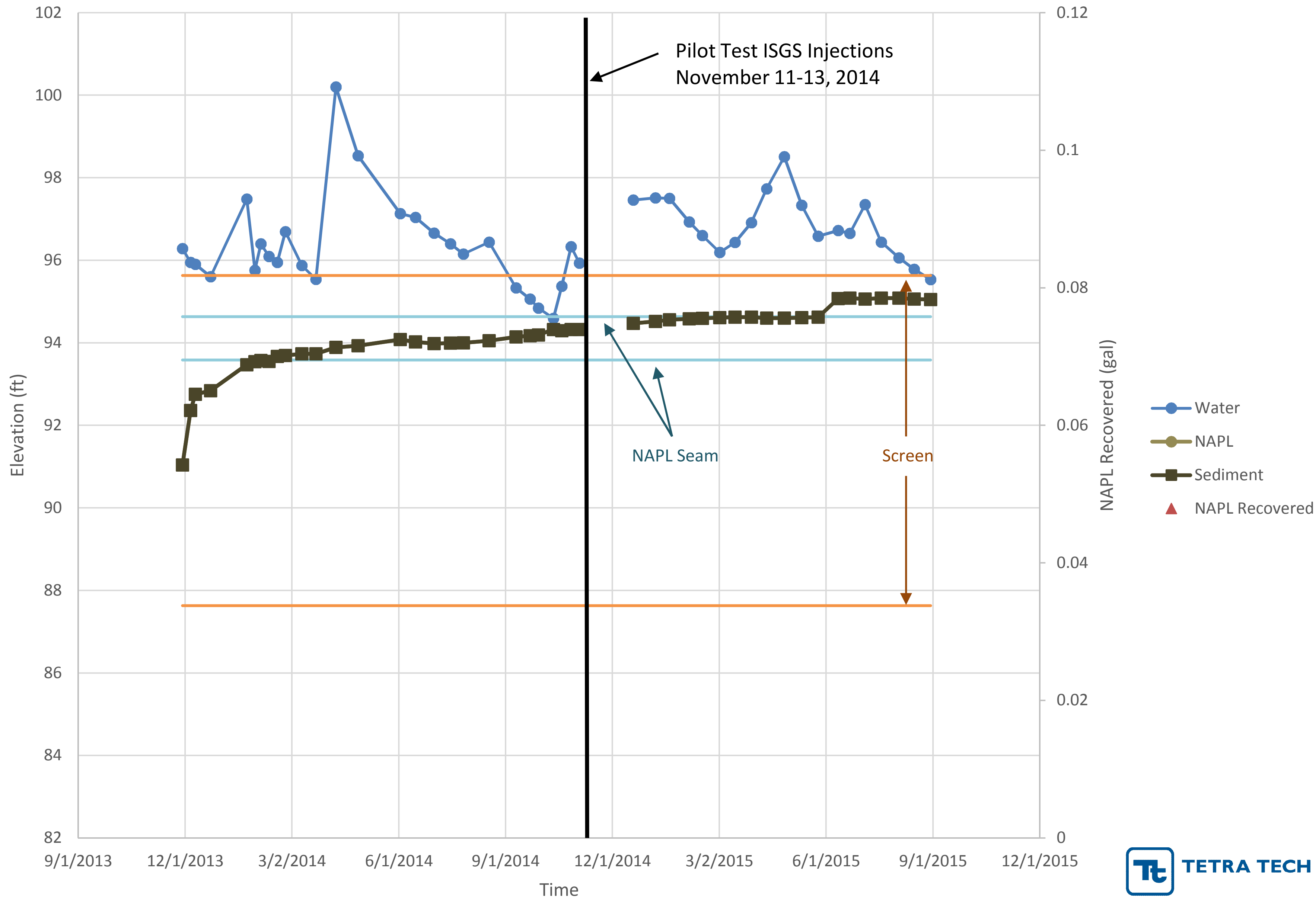
TETRA TECH

Figure 5. Temporal Changes in NAPL and Sediment Elevations Relative to IP13-05 Construction and NAPL Seam



TETRA TECH

Figure 6. Temporal Changes in NAPL and Sediment Elevations Relative to IP13-07 Construction and NAPL Seam



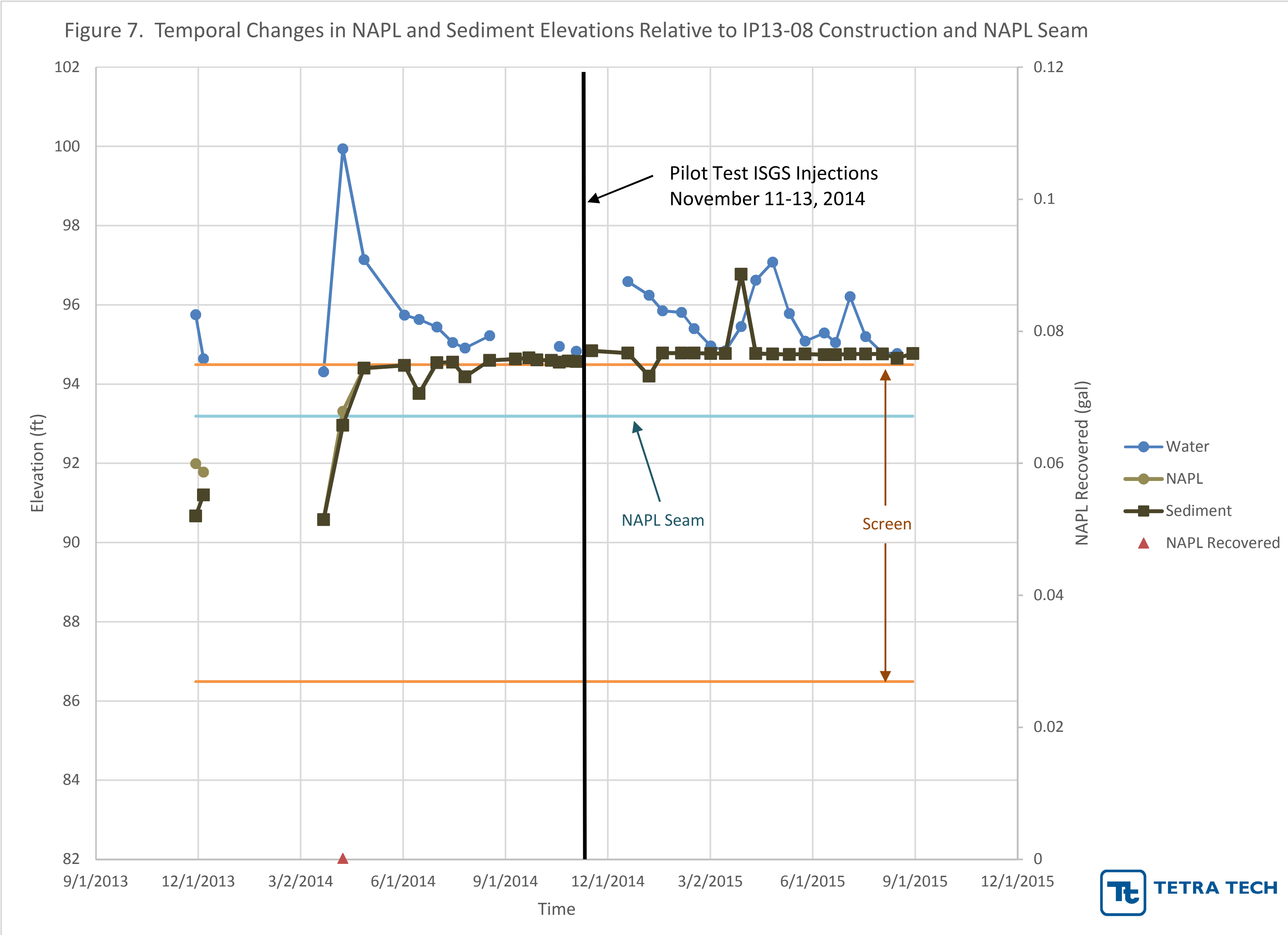
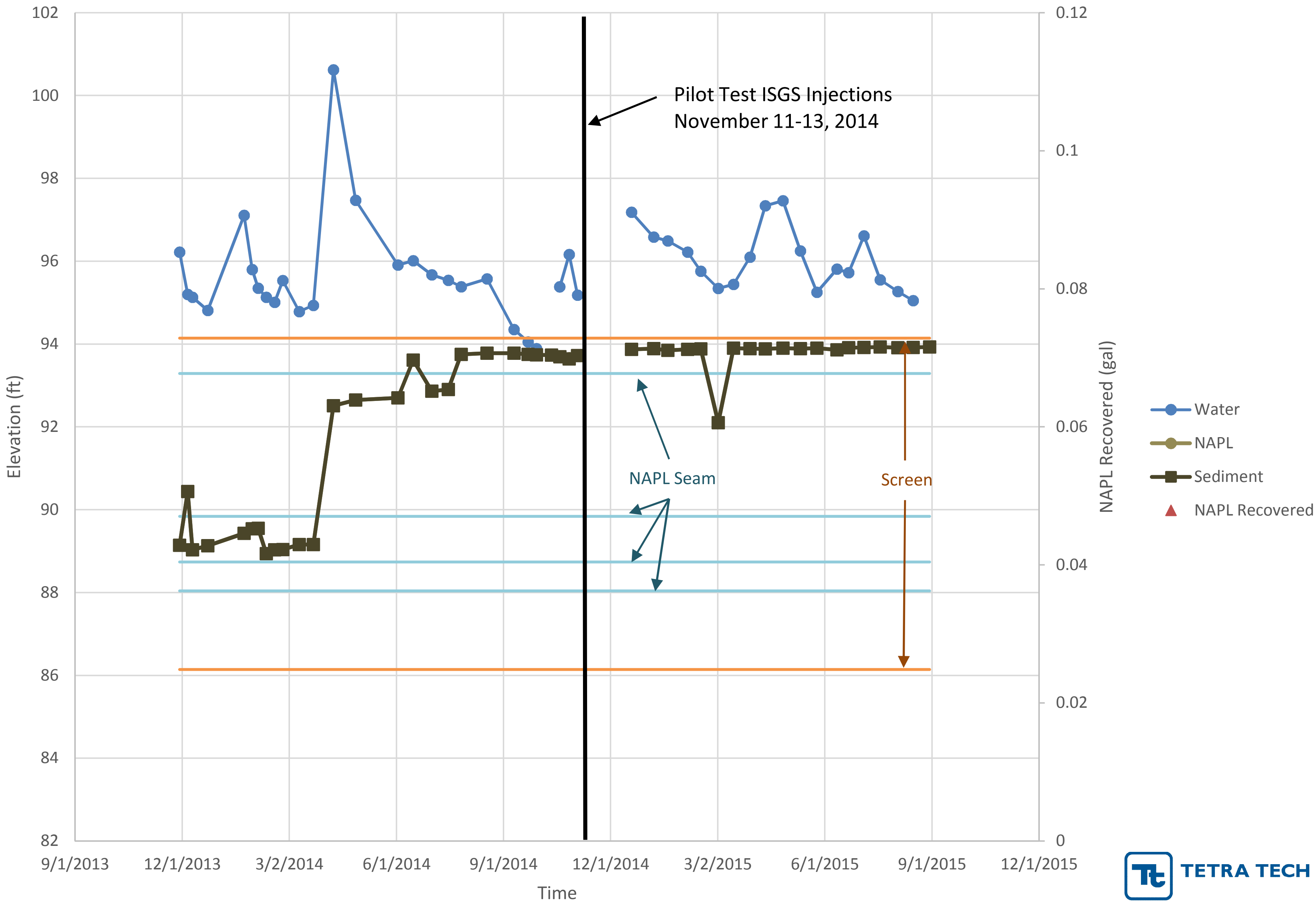


Figure 7. Temporal Changes in NAPL and Sediment Elevations Relative to IP13-08 Construction and NAPL Seam
Pilot Test ISGS Injections
November 11-13, 2014
NAPL Seam
Screen
Elevation (ft)
NAPL Recovered (gal)
Time
102
100
98
96
94
92
90
88
86
84
82
0.12
0.1
0.08
0.06
0.04
0.02
0
9/1/2013
12/1/2013
3/2/2014
6/1/2014
9/1/2014
12/1/2014
3/2/2015
6/1/2015
9/1/2015
12/1/2015
Water
NAPL
Sediment
NAPL Recovered
TETRA TECH

Figure 8. Temporal Changes in NAPL and Sediment Elevations Relative to IP13-09 Construction and NAPL Seam



TETRA TECH

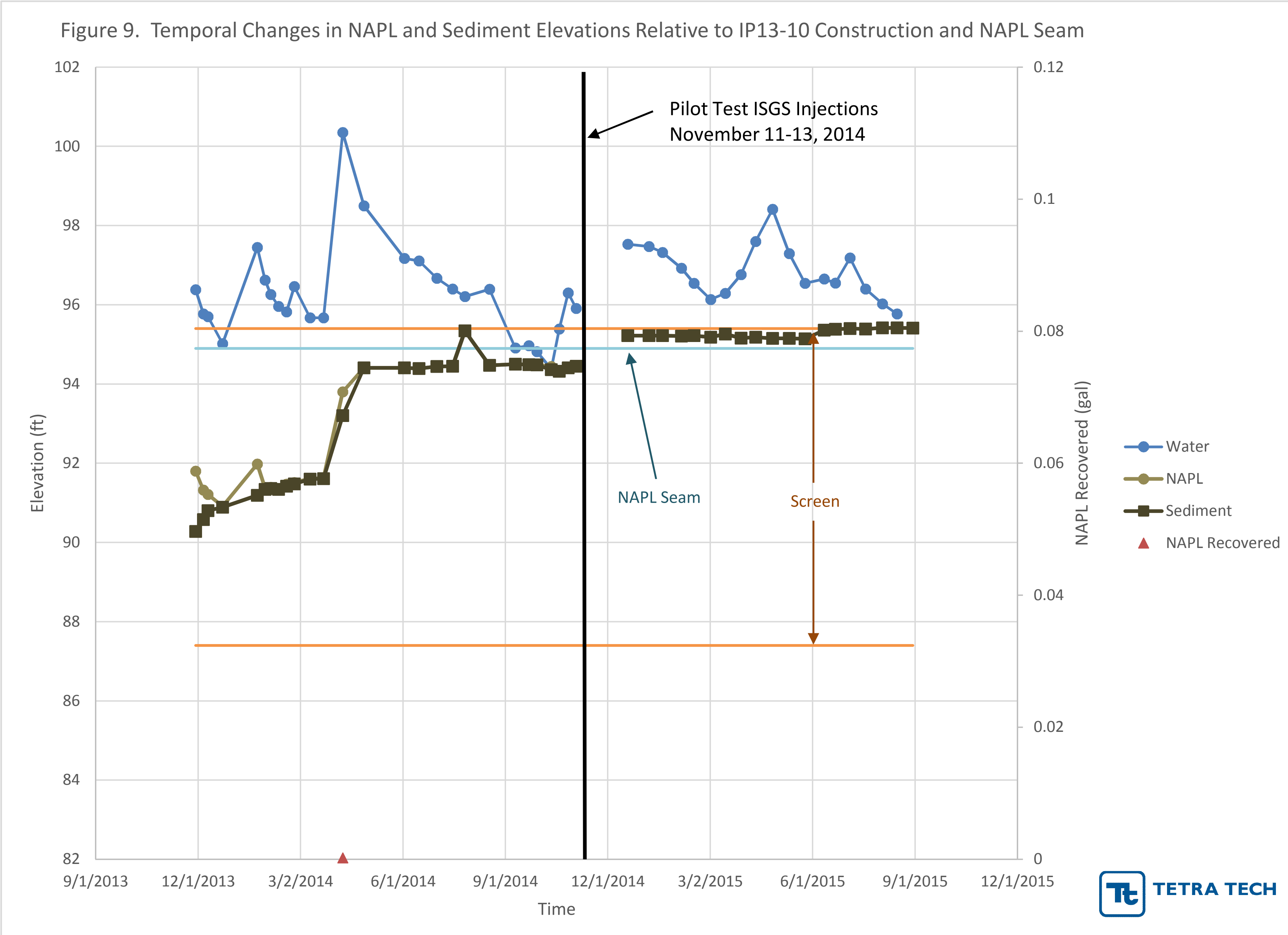


Figure 9. Temporal Changes in NAPL and Sediment Elevations Relative to IP13-10 Construction and NAPL Seam
Pilot Test ISGS Injections
November 11-13, 2014
NAPL Seam
Screen
Elevation (ft)
NAPL Recovered (gal)
Time
102
100
98
96
94
92
90
88
86
84
82
0.12
0.1
0.08
0.06
0.04
0.02
0
9/1/2013
12/1/2013
3/2/2014
6/1/2014
9/1/2014
12/1/2014
3/2/2015
6/1/2015
9/1/2015
12/1/2015
Water
NAPL
Sediment
NAPL Recovered
TETRA TECH

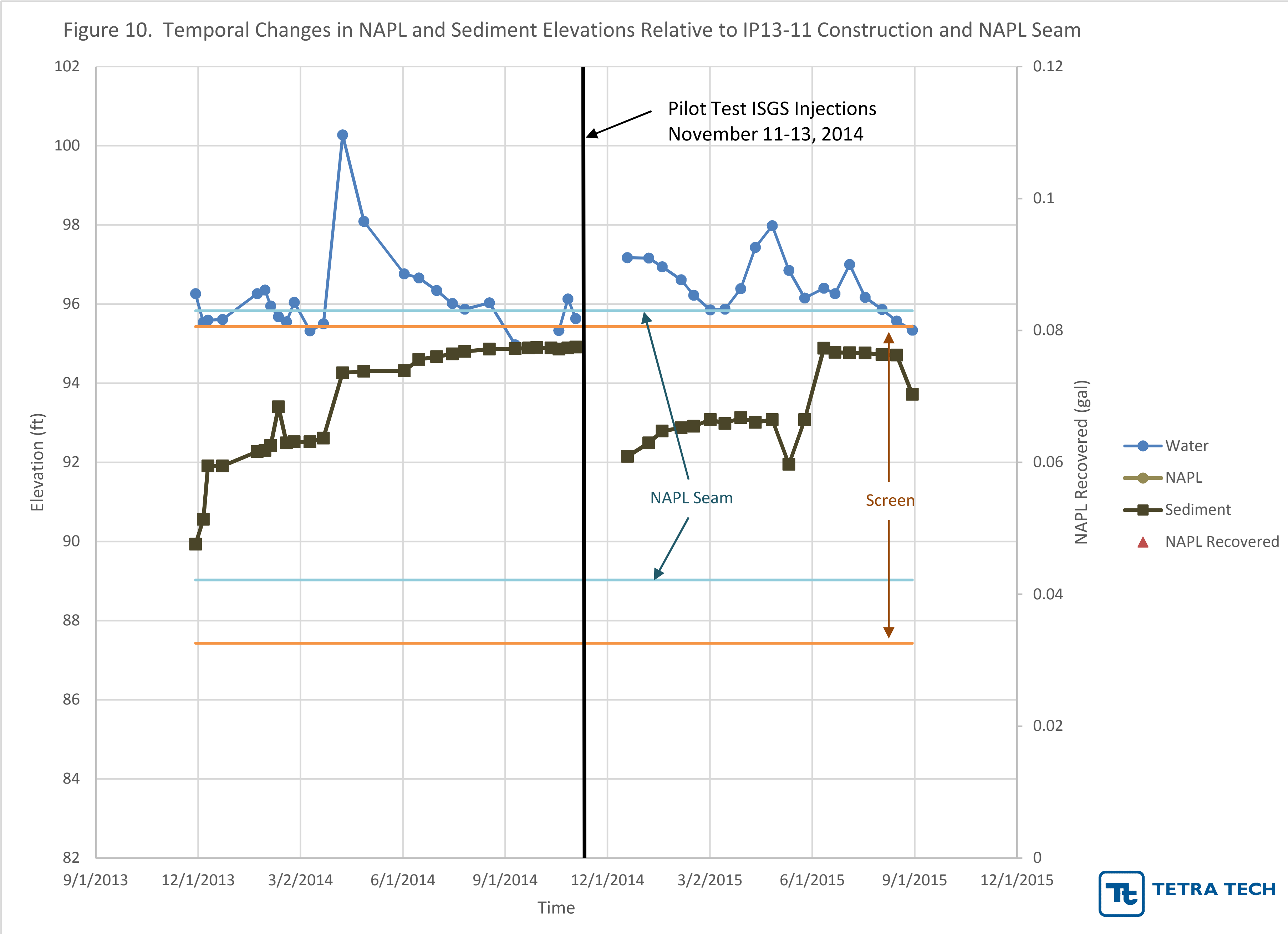


Figure 10. Temporal Changes in NAPL and Sediment Elevations Relative to IP13-11 Construction and NAPL Seam
Pilot Test ISGS Injections
November 11-13, 2014
NAPL Seam
Screen
Elevation (ft)
NAPL Recovered (gal)
Time
102
100
98
96
94
92
90
88
86
84
82
0.12
0.1
0.08
0.06
0.04
0.02
0
9/1/2013
12/1/2013
3/2/2014
6/1/2014
9/1/2014
12/1/2014
3/2/2015
6/1/2015
9/1/2015
12/1/2015
Water
NAPL
Sediment
NAPL Recovered
TETRA TECH

APPENDIX C

POST-INJECTION CORE LOGS

ISGS Reagent Rating Scale Post-ISGS Cores

The post-ISGS soil cores were logged for the presence of ISGS reagent (ISGS Reagent Present Y/N column). The Reagent numerical rating used for these cores ranged from 1 to 3 based on the following qualitative scale:

1 -- No reagent present;
2 -- Reagent present based on visual changes in colorations, and/or a slight reaction to neutralization solution; and
3 -- Reacted reagent present in core and reacts strongly to neutralization solution.

NAPL Rating Scale Post-ISGS Cores

The post-ISGS soil cores were logged for the presence of NAPL (NAPL Treated % column). The NAPL numerical rating used for these cores ranged from 1 to 5 based on the following qualitative scale:

1 -- Low PID readings, no visual NAPL staining;
2 -- Elevated PID readings, no visual NAPL staining;
3 -- Elevated PID readings, limited residual NAPL staining;
4 -- Elevated PID readings, heavy residual NAPL staining, minimal or no staining on core sleeve; and
5 -- Elevated PID readings, free-phase NAPL in core, possible free-product droplets on core sleeve.

SOIL CORE LOG FORM

OW-5/55R AREA RADIUS-OF-INFLUENCE CORE INVESTIGATION,
Beazer-Koppers, Nashua, NH Project: [illegible]-2201360

TETRA TECH

Boring ID: RCI-1	Date: 6/09/15	Casing / Core Dia. (in): 4	Core Log Sheet 1 of ____
Logger(s): cg	Start Time:	Finish Time:	Core Recovery (ft):

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
0							
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

Not Logged

SOIL CORE LOG FORM OW-5/55R AREA RADIUS-OF-INFLUENCE CORE INVESTIGATION, Beazer-Koppers, Nashua, NH Project: [illegible]-2201360

TETRA TECH

Boring ID: R01-1	Date: 6/09/15	Casing / Core Dia. (in): 4	Core Log Sheet 2 of ___
Logger(s): cg	Start Time: 1430	Finish Time: 1435	Core Recovery (ft): 5 of 5

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
10							NOT LOGGED
11							
12							
13							
14							
15	NE	N (1)	N (1)	2.5Y 7/2	none	SM	Silty sand, loose, dry, pale yellow 15-20 clay lens @ 18.7 FT moisture content increasing at bottom.
16	↓	↓	↓	↓	↓	↓	
17							
18							
19							
20							

SOIL CORE LOG FORM

OW-5/55R AREA RADIUS-OF-INFLUENCE CORE INVESTIGATION,
Beazer-Koppers, Nashua, NH Project: -2201360

TETRA TECH

Boring ID: ROH	Date: 6-09-15	Casing / Core Dia. (in): 4	Core Log Sheet 3 of ___
Logger(s): cg	Start Time: 1440 / Finish Time:		Core Recovery (ft):

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present ~~(Y/N)~~	NAPL ~~Treated (%)~~	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
20	NF	1	1	2.5Y 8/2	none	SM	Silty Sand pale yellow, fine to medium loose, moist
21	↓	↓	↓		↓	↓	
22	↓	↓	↓	2.5Y 7/1	↓	↓	SAA, gray, wet, micaceous laminations
23							
24		LOST CORE 23-25					
25	NF	3	1	2.5Y 5/6 yellow brown with 2.5Y 6/1 gray mottling	None	SM	Silty Sand, wet, fine. Reagent neutralization rxn @ 25-27 ft in iron oxy mottling
26	↓	↓	↓		↓	↓	
27	↓	2	2 / 2 / 2 / 2	2.5Y 6/1	~~NAPL~~ ~~Stain~~	↓	NAPL seam @ 27.5 ft (1 inch) and 28 FT (1 inch)
28	↓	↓	*			↓	
29	↓	↓	↓	LOST CORE 28-30		↓	
30	↓	↓	↓			↓	

SOIL CORE LOG FORM

OW-5/55R AREA RADIUS-OF-INFLUENCE CORE INVESTIGATION,
Beazer-Koppers, Nashua, NH Project: [illegible]-2201360

TETRA TECH

Boring ID: R01-1	Date: 06/09/15	Casing / Core Dia. (in): 4	Core Log Sheet 4 of ____
Logger(s): cy	Start Time: 1450	Finish Time:	Core Recovery (ft):

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
30	NF ↓ (to 40)	2 ↓	2 / 5 / 2 / 5 / 2	2.5Y 7/2 ↓	Staining and seams of napl at 30.3, 31.3	SM ↓	Silty sand. wet, fine grained. Napl seams (1-inch) at 30.3 and 31.3 ft; iron oxydation 30-32 ft; gray color 32-34 ft; micaceous laminations
32		1 ↓	1	2.5Y 7/6; 2.5Y 7/1 ↓	None ↓	ML	Clayey silty sand wet v. fine. no staining; gray color 32.6-33
33						SM ↓	Silty sand. fine to med gray, micaceous lam.
34–35	LOST CORE						
35		1 ↓	1	2.5Y 7/1	no staining	SM	Silty sand. gray fine to med, micaceous
36		1 ↓	↓	2.5Y 6/3 yellow brown	↓	↓	Silty sand yellowish brown iron oxidation; no distinct rxn to peroxide.
38–40	LOST CORE 38-40						

SOIL CORE LOG FORM

OW-5/55R AREA RADIUS-OF-INFLUENCE CORE INVESTIGATION,
Beazer-Koppers, Nashua, NH Project: [illegible]-2201360

TETRA TECH

Boring ID: R01-2	Date: 6-10-15	Casing / Core Dia. (in): 4	Core Log Sheet 1 of ___
Logger(s): cg	Start Time:	Finish Time:	Core Recovery (ft):

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
0							
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

NOT LOGGED PER JRE

SOIL CORE LOG FORM

OW-5/55R AREA RADIUS-OF-INFLUENCE CORE INVESTIGATION,
Beazer-Koppers, Nashua, NH   Project: [illegible]7-2201360

TETRA TECH

Boring ID: R01-2	Date: 6-10-15	Casing / Core Dia. (in): 4	Core Log Sheet 2 of ___
Logger(s): cg	Start Time: 1030	Finish Time: 1035	Core Recovery (ft): 5/5

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
10–15	NOT LOGGED PER SRE						
15–20	NF	N (1)	1	2.5Y 7/3 Pale Yellow	NON	SM	Fine Sand with silt, loose, dry to moist. little to no structure

SOIL CORE LOG FORM

OW-5/55R AREA RADIUS-OF-INFLUENCE CORE INVESTIGATION,
Beazer-Koppers, Nashua, NH   Project: [illegible]7-2201360

TETRA TECH

Boring ID: R01-2	Date: 4-10-15	Casing / Core Dia. (in): 4	Core Log Sheet 3 of ___
Logger(s): cg	Start Time: 1040	Finish Time:	Core Recovery (ft): 5/5, 5of5

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
20	NF	N (1)	1	2.5Y 7/3	None	SM	SILTY SAND. Loose, dry to moist fine to med grained little to no structure. no Peroxide Rxn.
21–23	↓	↓	↓	10YR 6/4	↓	↓	
23–25	↓	↓	↓	10YR 6/1	↓	↓	
25	NF	2	1	5Y 6/2	None	SM	silty sand, wet, loose. fine. no Peroxide Rxn
27	↓	↓	2	↓	↓	ML	sandy silt, wet, slightly more coherent than above. moderate naphthalene odor. no Peroxide Rxn clay stringer @27.5 (<1 cm thick)
29.5–30	↓	↓	↓	↓	↓	SM	~~silty sand~~, 10-20% fines. no Peroxide Rxn.

assume last complete foot is compressed, not lost.

SOIL C RE LOG FORM OW-5/55R AREA RADIUS-OF-INFLUEN CORE INVESTIGATION, Beazer-Koppers, Nashua, NH Project: 117-2201360

TETRA TECH

Boring ID: R01-2	Date: 6-10-15	Casing / Core Dia. (in): 4	Core Log Sheet 4 of 4	
Logger(s): cg	Start Time: 1100	Finish Time:	Core Recovery (ft):	

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
30	NF	2	2	5Y 4/3	none	SM	silty sand, loose, wet - tan - naphthalene odor
31	↓	↓	↓		↓	↓	
32		1		5Y 6/1			SAA - gray odor present
33		3		10YR 4/3	Reddish seam @33.5		fine to med sand. micaceous. odor present.
34		2	1	2.5Y 6/1	none	ML	silty, clayey sand, brown
					↓	SM	silty sand, gray salt/pepper. no odor noted.
35	NF	1	1	2.5Y 6/2	none	SM	silty sand as typ. color change gray to tan at 36 ft.
36	↓	↓	↓	2.5Y 4/4	↓	↓	no odor or sheen 35-38
37							
38							
39				LOST CORE 38-40 ft			TD 40
40							

SOIL CORE LOG FORM

OW-5/55R AREA RADIUS-OF-INFLUENCE CORE INVESTIGATION,
Beazer-Koppers, Nashua, NH Project: [illegible]-2201360

TETRA TECH

Boring ID: R01-3	Date: 6/10/15	Casing / Core Dia. (in): 4	Core Log Sheet 1 of 4
Logger(s): cg	Start Time: 0750	Finish Time: 0759	Core Recovery (ft):

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
0							
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

Not Logged Per JRE

SOIL CORE LOG FORM

OW-5/55R AREA RADIUS-OF-INFLUENCE CORE INVESTIGATION,
Beazer-Koppers, Nashua, NH Project: [illegible]-2201360

TETRA TECH

Boring ID: R01-3	Date: 6/10/15	Casing / Core Dia. (in): 4	Core Log Sheet 2 of 4
Logger(s): cg	Start Time: 0850	Finish Time: 0855	Core Recovery (ft): 5/5

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
10							
11							
12						NOT PER	LOGGED 10-15 FT JRE
13							
14							
15	NF	N (1)	1	2.5Y 3/1	NOT STAINED	SM	SILTY SAND, FINE TO MED, DRY TO MOIST PALE YELLOW
16	↓	↓	↓		↓	↓	
17							
18							
19				2.5Y 5/6		ML	SANDY SILT, LOOSE MOIST NO OBSERVED PEROXIDE RXN
20	↓	↓	↓		↓	↓	

SOIL CORE LOG FORM — OW-5/55R AREA RADIUS-OF-INFLUENCE CORE INVESTIGATION, Beazer-Koppers, Nashua, NH Project: [illegible]-2201360

TETRA TECH

Boring ID: R01-3	Date: 6/10/15	Casing / Core Dia. (in): 4	Core Log Sheet 3 of 4
Logger(s): cg	Start Time: 0825	Finish Time:	Core Recovery (ft): (5/5), (5/5)

5 ft Core Runs.

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
20	NF ↓	N ↓	1 ↓	2.5Y 7/1	None ↓	SM ↓	SILTY SAND, FINE TO MED, 10-20% Silt. clayey silty sand stringer @ 22.5 FT
21							
22				10YR 7/6			
23				2.5Y 6/1			
24							
25	NF ↓	1	↓	2.5Y 6/1	None ↓	SM ↓	SILTY SAND
26			2				
27		3 ↓	1 / 4		27.5 / 0.5 inch NAPL seam 27.5		NAPL SEAM AT 27.5 AND PEROXIDE RXN (v. clear change) 27.5-30.
28			3	2.5Y 4/4			
29			4 / 3	2.5Y 6/2	1 inch NAPL seam 28.7 / None 29-30 ↓		
30	↓	↓	2				

SOIL CORE LOG FORM

OW-5/55R AREA RADIUS-OF-INFLUENCE CORE INVESTIGATION,
Beazer-Koppers, Nashua, NH Project: -2201360

TETRA TECH

Boring ID: R01-3	Date: 4/10/15	Casing / Core Dia. (in): 4	Core Log Sheet 4 of 4
Logger(s): cg	Start Time: 0850	Finish Time: 0915	Core Recovery (ft): 4/5, 2/5

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes: 4/5
30	NF	3	5	2.5Y 4/4	Sheen in core	SM	SILTY SAND (SLOUGH) NAPL VISIBLE IN MOTTLING likely 1-inch seam, depth unclear
31	↓	↓	3	↓	Napl mottling ↓	↓	DISTINCT PEROXIDE COLOR CHG 31-33.5
32					possible thin seams		CORE COLOR 30-31 SUGGEST REAGENT PRESENT AS WELL
33	↓	↓	2	2.5Y 6/1	None	↓	
33.5		2	1				
34	LOST CORE (OR COMPRESSED 34-35)						
35	NF	1	1	2.5Y 6/1	None	SM	SILTY SAND WET, LOOSE. UPPER 2 ft of CORE IS SLOUGH (?)(SOUP)
36	↓	↓	↓		↓	↓	COLOR CHANGE AT 36.9 FROM S&P SAND TO OXIDIZED IRON BROWN. NO PEROXIDE RXN.
37				2.5Y 6/6			
38	LOST CORE 37-40						
39							
40							

SOIL CORE LOG FORM

OW-5/55R AREA RADIUS-OF-INFLUENCE CORE INVESTIGATION,
Beazer-Koppers, Nashua, NH Project: [illegible]-2201360

TETRA TECH

Boring ID: ROI-4	Date: 06/09/15	Casing / Core Dia. (in):	Core Log Sheet 1 of
Logger(s): Gutmann	Start Time: 0955	Finish Time:	Core Recovery (ft):

*2.5YR in this core should be 2.5Y. -cg

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
0	0.0	|	|		—	SM	SILTY SAND, BROWN, ORGANIC SOIL
1							2.5YR 7/3 SILTY SAND NO INDICATION OF NAPL OR REAGENT
2							
3	6.0						
4	0.6						
5							
6							
7	9.0						2.5YR 5/6 SILTY SAND NO STAINING
8							
9							
10							

SOIL C[illegible]RE LOG FORM OW-5/55R AREA RADIUS-OF-INFLUENC[illegible] CORE INVESTIGATION, Beazer-Koppers, Nashua, NH Project: [illegible]-2201360

TETRA T[illegible]H

Boring ID: R01-4	Date: 6/8/15	Casing / Core Dia. (in):	Core Log Sheet 2 of ___
Logger(s): gutman	Start Time: 1052	Finish Time:	Core Recovery (ft):

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
10	0.0 ↓	1.0 (No reagent) ↓	| ↓		NO STAINING ↓	SM/GM	FINE TO COARSE SAND w/ 0.1 to 5cm GRAVEL ROUNDED. ~5-10% FINES, LOOSE, MOIST v. pale brown to brown.
11							
12							
13							
14							
15	0.0 ↓	| ↓	| ↓	10YR 7/8 10YR 8/1	NO STAIN ↓	SM ↓	Yellow to white FINE TO COARSE SAND w/ 0.1 to 1cm gravel (10-20% FINES, LOOSE.
16				2.5YR 7/2			(lt Gray) Silty sand. 5-25% fines moist, loose
17							
18							
19							
20							

SOIL CORE LOG FORM

OW-5/55R AREA RADIUS-OF-INFLUENCE CORE INVESTIGATION, Beazer-Koppers, Nashua, NH Project: -2201360

TETRA TECH

Boring ID: R01-4	Date: 6/03/15	Casing / Core Dia. (in):	Core Log Sheet 3 of ___
Logger(s): CG	Start Time: 11:15	Finish Time:	Core Recovery (ft): 7 of 10

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL ~~Treated~~ ~~(%)~~	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
20		N	0			SM	Pale yellow silty sand, loose, moist
21							
22	0.0					ML	Pale yellow sandy silt, loose, wet ~50% fines WATER @ 22 ft
23	0.0					SM	
24	10			2.5YR 7/2			Lt gray silty sand. ~20-30% fines. wet VOC odor detected - Naphthalene
25	14		3	2.5YR 5/2	Stringers seams.	SM	silty sand, wet, loose. 0.5 cm seams of staining grayish brown.
26	30		5 (in thin stringers)		seams with dark brown, iridescent NAPL		SAA, 0.5 cm NAPL stringers, depth range uncertain iridescent, NAPL odor smelled.
27	14.3						LOST CORE. 27-30 FT
28							
29							
30							

SOIL CORE LOG FORM

OW-5/55R AREA RADIUS-OF-INFLUENCE CORE INVESTIGATION,
Beazer-Koppers, Nashua, NH Project: [illegible]-2201360

TETRA TECH

Boring ID: R01-4	Date: 6/08/15	Casing / Core Dia. (in): 4	Core Log Sheet 4 of 4
Logger(s): gutmann	Start Time: 1130	Finish Time:	Core Recovery (ft): 3 of 5 / 4 of 5

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL ~~Treated~~ ~~(%)~~	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
30	1.0	↓	4 ↓	2.5YR 7/1 ↓	Staining in loose non-intact core. Sheen on core	SM ↓	SAND, FINE WITH ~10% SILT, LT GREY. NAPL sheen in loose core, wet. Micaceous in seams
30.5	3.0						
32	0.0		2 ↓	2.5YR 5/1 ↓	no staining		
32.5	0.0						Silty sand, 20-40% silt, wet. no visible staining. grey brown
33–35	LOST CORE						LOST CORE
35	0.0	↓	↓	2.5YR 5/1	-	ML	SANDY SILT, SOFT, WET, GREY ~30% fine sand
37.5	0.0			2.5YR 6/4	-	SM	SAND w/ 30% silt. soft wet yellowish brown
39–40							LOST 39-40 Core

SOIL CORE LOG FORM

OW-5/55R AREA RADIUS-OF-INFLUENCE CORE INVESTIGATION,
Beazer-Koppers, Nashua, NH Project: [illegible]-2201360

TETRA T[illegible]H

Boring ID: R01-5	Date: 6/09/15	Casing / Core Dia. (in): 4	Core Log Sheet 1 of 4
Logger(s): CJ	Start Time:	Finish Time:	Core Recovery (ft):

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
0							
1							
2							
3					NOT LOGGED		
4						PER	JRE
5							
6							
7							
8							
9							
10							

SOIL CORE LOG FORM

OW-5/55R AREA RADIUS-OF-INFLUENCE CORE INVESTIGATION,
Beazer-Koppers, Nashua, NH Project: [illegible]-2201360

TETRA TECH

Boring ID: R01-5	Date: 6/09/15	Casing / Core Dia. (in): 4	Core Log Sheet 2 of 4
Logger(s): cg	Start Time:	Finish Time:	Core Recovery (ft):

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
10–15	NOT LOGGED PER JZE						
15–19	NF	N	N	2.5Y 7/2	None	SM	Silty sand, loose. silt (10-20%) pale yellow,
19–20	↓			10YR 5/6		↓	Silty sand - as above. shows heavier iron ox. reaction w/ neutralizer by clay seam @ 19 ft (no reaction to vinegar (water alone))

NF: NOT FUNCTIONING

SOIL CORE LOG FORM

OW-5/55R AREA RADIUS-OF-INFLUENCE CORE INVESTIGATION,
Beazer-Koppers, Nashua, NH   Project: [illegible]-2201360

TETRA TECH

Boring ID: R01-5	Date: 6/09/15	Casing / Core Dia. (in): 4	Core Log Sheet 3 of 4
Logger(s): cg	Start Time: 1210	Finish Time:	Core Recovery (ft): 5/5 / ~~5/5~~ 3/5

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
20	NF	1	1	10YR 5/6	None	SM	SILTY SAND, fine to med. iron ox 20-21. clay lens @ 21 ft. no reaction noted to neutralizer
21	↓	↓	↓	2.5Y 6/4	↓	↓	SAA, gray color.
22							
23							
24				↓			
25	NF	3	2	10YR 4/6	NO napl staining		silty sand, slough 25-26.5 in photo #1 moved core.
26	↓	↓			↓		
27			5	~~10YR 4/6~~ ↓	napl seam	↓	silty sand, reddish brown (see color) Rxn @ 27' reaction noted in core ~~25~~ - ~~28~~ 27
28							lost ~28-30
29							
30							

SOIL CORE LOG FORM

OW-5/55R AREA RADIUS-OF-INFLUENCE CORE INVESTIGATION,
Beazer-Koppers, Nashua, NH Project: [illegible]-2201360

TETRA TECH

Boring ID: R01-5	Date: 6/09/15	Casing / Core Dia. (in): 4	Core Log Sheet 4 of 4
Logger(s): cg	Start Time: 1230	Finish Time:	Core Recovery (ft):

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
30	NF	3	4	10YR4/6	Sheen 30-30.5	SM	SILTY SAND, TYP. Fine, wet 10-20% silt.
31	↓	↓	↓	2.5Y6/1	none	↓	SAA, gray color. no rxn to neutralizer below 32
32							
33						ML	Clayey silty sand.
34	LOST ~2FT CORE						
35	NF	~~3~~	~~4~~	2.5Y 6/1	sheen	SM	SILTY SAND. gray in upper 6 inches, no reaction,
36	↓	↓	↓	10YR4/6		↓	35.5-36.5 sheen present w/ reagent rxn. 36.5-37.5 no rxn. Silty sand, no sheen, wet.
37							
38	LOST CORE 37.5-40						(note in photo I'm thrown away upper 6-inches of gray core, thinking slough)
39							TD=40
40							

SOIL C[illegible]RE LOG FORM

OW-5/55R AREA RADIUS-OF-INFLUENCE CORE INVESTIGATION,
Beazer-Koppers, Nashua, NH Project: [illegible]-2201360

TETRA T[illegible]H

Boring ID: R01-6	Date: 6/09/15	Casing / Core Dia. (in): 4	Core Log Sheet 1 of ___
Logger(s): cg	Start Time: 0900	Finish Time:	Core Recovery (ft):

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
0							
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

NOT LOGGED PER JRE.

SOIL CORE LOG FORM

OW-5/55R AREA RADIUS-OF-INFLUENCE CORE INVESTIGATION,
Beazer-Koppers, Nashua, NH Project: [illegible]-2201360

TETRA TECH

Boring ID: R01-6	Date: 6/09/15	Casing / Core Dia. (in): 4	Core Log Sheet 2 of ___
Logger(s): cg	Start Time: 0900	Finish Time: 0920	Core Recovery (ft): 5/5

* unless noted, 2.5YR colors in this core should be 2.5Y (cg)

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
10–15	NOT LOGGED PER JRE						
15	0.0	N	N	2.5YR 3/2	No staining	SM	Silty sand, loose, dry to moist. Iron staining in bottom 2ft (18-19.5)
16	↓	↓	↓	↓	↓	↓	
17	↓	↓	↓	↓	↓	↓	
18	↓	↓	↓	2.5YR 5/2	↓	↓	
19	↓	↓	↓	↓	↓	↓	Reaction w/ Neutralizer @ 19 ft. Effervescent.
20	↓	↓	↓	↓	↓	↓	

SOIL CORE LOG FORM

OW-5/55R AREA RADIUS-OF-INFLUENCE CORE INVESTIGATION,
Beazer-Koppers, Nashua, NH   Project: -2201360

TETRA TECH

Boring ID: R01-6	Date: 6/09/15	Casing / Core Dia. (in): 4		Core Log Sheet 3 of ____
Logger(s): cg	Start Time: 0920	Finish Time:		Core Recovery (ft): 5/5, 3/5

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
20	0.0	N		2.5YR 6/4	N/A	SM	SILTY SAND, LOOSE, YELLOW, DRY
21	↓	↓	↓	↓	↓		
22							FINE CLAYEY SILT LENS @ 22 FT
23							
▽				2.5YR 5/1	yellow ox Fe change to reduced at W.T.		SILTY SAND, WET. COLOR CHANGE AT W.T. (REDUCING FE?) Water @ 23.5
24	3.0						
	1.8	↓	↓	↓			
25	4	N	1	2.5YR 5/1	N/A	SM	SILTY SAND, GRAY, WET
26	2.7		1				
27			1				
28	8.5 27.8	Y 3	5	10YR 5/6	NAPL sheen w/ Reagent	↓	@27.8, SILTY SAND, Yellow (oxygdized Fe) NAPL sheen on OR, Reagent rxn. Strong Naphthalene odor
29		LOST CORE 28-30					
30							

SOIL C[illegible]RE LOG FORM

OW-5/55R AREA RADIUS-OF-INFLUENC[illegible] CORE INVESTIGATION,
Beazer-Koppers, Nashua, NH Project: [illegible]-2201360

TETRA T[illegible]H

Boring ID: R01-6	Date: 6/09/15	Casing / Core Dia. (in): 4	Core Log Sheet ___ of ___
Logger(s): cg	Start Time: 0950	Finish Time: 1000	Core Recovery (ft): 5/5 (30-35) 3.5/5 (35-40)

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
30		Y 3	5	2.5YR 6/4	Stained ~30-30.5	SM	SM SILTY SAND, FINE TO MED w/ fine silt laminations. CORE COMPRESSED 30-35, in Plastic.
31	7.4	1	↓	↑	No stain	↓	Upper 0.5 ft is slough, but contains NAPL & REAGENT. (DEPTH SOMEWHAT UNCERTAIN)
32	4	↓	1	2.5YR 6/1	↓	↓	OXYDATION ~30-32 FT, THEN SALT & PEPPER FROM 32-35 FT.
33	3	↓	↓	↓	↓	↓	
34	5.4	↓	↓	↓	↓	↓	
35	32.6	1	N	2.5YR 6/1	sheen in slough 32.5	SM	SM - SILTY SAND, fine to medium, wet. Salt & Pepper color from 35-36.5. Oxydized iron 36.5-38.5. ~~Not clear if~~ oxydation is due to reagent, ~~or not~~ at least 36.5-37.5
36	3	↓	↓	↓	NONE	↓	
37	1.2	3	↓	2.5YR 6/4	↓	↓	
		2	↓	↓	↓	↓	
38							LOST CORE ~38.5 (?) to 40 ft
39							~~TD=40 ft~~ (cg) drilled additional 5-ft run, to 45'
40							

SOIL CORE LOG FORM

OW-5/55R AREA RADIUS-OF-INFLUENCE CORE INVESTIGATION,
Beazer-Koppers, Nashua, NH   Project: [illegible]-2201360

TETRA TECH

Boring ID: R01-6	Date: 6/09/15	Casing / Core Dia. (in): 4	Core Log Sheet 5 of ___
Logger(s): cy	Start Time: 1025	Finish Time:	Core Recovery (ft):

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
40	N/A ↓	1 ↓	1 ↓	2.5Y 7/2	None ↓	SM ↓	SM ↓ SILTY SAND, fine to med wet. slough at top. (flowing sands)
41							
42				interlayered. 2.5YR4/6 Red			Oxydized iron (non-reactive w/ neutralizer) from 42-43.5
43							
44							LOST CORE 43.5-45
45							TD=45'
46							
47							
48							
49							
50							

SOIL CORE LOG FORM

OW-5/55R AREA RADIUS-OF-INFLUENCE CORE INVESTIGATION,
Beazer-Koppers, Nashua, NH Project: [illegible]-2201360

TETRA TECH

Boring ID: ROI-7	Date: 6/09/15	Casing / Core Dia. (in):		Core Log Sheet 1 of ____	
Logger(s): cg	Start Time: 1400	Finish Time: 1410		Core Recovery (ft): 2/5, 5/5	

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes: *2.5YR colors are actually 2.5Y. (cg) in this core
0	0.0	|	|	2.5YR 4/3	NO STAIN	ML	SILTY SAND (~30% fines) loose, dry, brown.
1	0.0	↓	↓	2.5YR 4/8	↓	SM	SILTY SAND (~10% fines) loose dry yellow
2							
3	LOST CORE						
4							
5	0.0	|	|	2.5YR ~~4/3~~ 7/4	SAA	SM	silty sand (~10% fines) No odor or staining
6	↓	↓	↓		↓		
7							
8							
9				2.5YR 4/3 brown		GM	Sandy Gravel (~40% gravel (0.5-3cm) few fines (<5%)
10	↓	↓	↓		↓		

SOIL C[illegible]RE LOG FORM

OW-5/55R AREA RADIUS-OF-INFLUENC[illegible]CORE INVESTIGATION,
Beazer-Koppers, Nashua, NH Project: [illegible]-2201360

TETRA T[illegible]H

Boring ID: R01-7	Date: 6/08/15	Casing / Core Dia. (in): 4	Core Log Sheet 2 of ___
Logger(s): cg / JE	Start Time: 1410	Finish Time: 1430	Core Recovery (ft):

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
10	0.0	(1)	(1)	2.5YR 4/3	no Staining	GM	GRAVELLY SAND, LOOSE, dry. gravel 0.5-10 cm brown.
11	0.8	↓	↓		↓		
12				7.5YR 4/8		SM	silty sand, yellow
13				2.5YR 7/2		SM	silty sand, pale yellow. loose, dry. no odor
14	0.0					↓	
15							
16	0.0						
17							
18	0.6						
19							
20		↓	↓		↓	↓	

SOIL CORE LOG FORM OW-5/55R AREA RADIUS-OF-INFLUENCE CORE INVESTIGATION, Beazer-Koppers, Nashua, NH Project: [illegible]-2201360

TETRA TECH

Boring ID: R01-7	Date: 6/08/15	Casing / Core Dia. (in): 4	Core Log Sheet 3 of ___
Logger(s): CG/JC	Start Time: 1435	Finish Time: 1445	Core Recovery (ft): 10

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
20	0.0	1	1	5/1	No stain	SM	sand, fine loose, dry gray
				2.5YR 7/3		SM	silty-clayey sand, higher fines, form laminations of gray (clay seam?) oxidized iron color bands
21							
						ML	
22				2.5YR 5/1		SM	silty sand, fine grained, micaceous. moist
23							
24							
25	0.0						
26							
27	25		2				
			2				
			5		Napl	SM	fine sand, 10-20% fines. grey
28	14		1		no visible stain.		
			2				
			1				
29	5		5		Napl stain		
30			2				

SOIL CORE LOG FORM OW-5/55R AREA RADIUS-OF-INFLUENCE CORE INVESTIGATION, Beazer-Koppers, Nashua, NH Project: [illegible]-2201360 TETRA TECH

Boring ID: RO1-7	Date: 6/08/15	Casing / Core Dia. (in): 4	Core Log Sheet 4 of 4
Logger(s): cg	Start Time: 1500	Finish Time: 1510	Core Recovery (ft):

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
30	0	1	1	2.5YR 5/1	~~2.5YR 5/1~~	SM	Silty sand, fine w/ 10-20% silt fines. thin laminations of micaceous zones.
31	0.5	2 cg ②	4		sheen visible		oxidized iron banding 31-32 → likely evidence of iron oxydation from reagent → Reagent cat ② cg
32	0.5	① cg					
33	0		1		no staining		
34	1.4	① cg					
35	0						
36		maybe 2? (?)		7.5 5/4 / 2.5YR 4/3	~~2.5YR 4/3~~		color change to yellow-brown otherwise SAA. oxidized iron in patches 35.5 — 39 → adjacent to nodule @ 36 (37 ft in photo) JRE noted change in color w/ neutralizer soln.
37		① cg					
38							
39							Lost bottom core
40							

SOIL CORE LOG FORM

OW-5/55R AREA RADIUS-OF-INFLUENCE CORE INVESTIGATION,
Beazer-Koppers, Nashua, NH Project: [illegible]-2201360

TETRA TECH

Boring ID: R01-8	Date: 06-08-15	Casing / Core Dia. (in): 4	Core Log Sheet 1 of ___
Logger(s): cy	Start Time: 1600	Finish Time:	Core Recovery (ft):

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
0							
1							
2							
3							
4							NOT LOGGED PER JRE
5							
6							
7							
8							
9							
10							

SOIL C RE LOG FORM

OW-5/55R AREA RADIUS-OF-INFLUENC CORE INVESTIGATION,
Beazer-Koppers, Nashua, NH Project: -2201360

TETRA T H

Boring ID: R01-8	Date: 6-08-15	Casing / Core Dia. (in): 4	Core Log Sheet 2 of ____
Logger(s): cg	Start Time: 1605	Finish Time:	Core Recovery (ft):

*2.5YR colors in this core should be 2.5Y. (cg)

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
10–15	NOT LOGGED						
15	0.0	1	1	2.5YR 7/3	No stain	SM	Silty sand, fine, loose dry to moist
16–20	↓	↓	↓	↓	↓		

SOIL C[illegible]RE LOG FORM

OW-5/55R AREA RADIUS-OF-INFLUENC[illegible] CORE INVESTIGATION,
Beazer-Koppers, Nashua, NH Project: [illegible]-2201360

TETRA T[illegible]H

Boring ID: R01-8	Date: ~~[illegible]~~ 06-08-15 cg	Casing / Core Dia. (in): 4	Core Log Sheet 3 of ___
Logger(s): cg	Start Time: 1620	Finish Time: 1638	Core Recovery (ft): 8.5 of 10

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL ~~Treated~~ ~~(%)~~	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
20	6.0	1	1	2.5YR 7/2	No stain	SM	Silty sand, fine, loose, moist.
21	↓	↓	↓	↓	↓		
22							
23							
24	LOST CORE →						
25		2	1	2.5YR 6/3	No stain	SM	silty sand wet, loose (cohesive where fines are higher)
26		↓			↓	↓	
27							
28			28				
			2				
			28.3				
			5				
29		2	2	28.5			
30		3		29.7			

SOIL CORE LOG FORM

OW-5/55R AREA RADIUS-OF-INFLUENCE CORE INVESTIGATION,
Beazer-Koppers, Nashua, NH Project: [illegible]-2201360

TETRA T[illegible]H

Boring ID: R01-8	Date: 6-08-15	Casing / Core Dia. (in): 4	Core Log Sheet 4 of ___
Logger(s): cg	Start Time: 1640	Finish Time: 1710	Core Recovery (ft):

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
30		3	4	2.5YR 4/4	stain,	SM	silty sand. fines 10% - 30% wet
		1	2	2.5YR 7/2	↑	↓	
31					none		
		|	1	↓	↓	↓	
32							
33–34	LOST CORE 32.5-35						
35	0.0		1	2.5YR 5/1	reddish-yellow color possibly from reagent	SM	fine sand, loose, runny, wet.
36		2	~~[illegible]~~ 1 from 35-40				
37							reaction to ~~reagent~~ Peroxide (cg) 38-38.5 ft
38		3	~~[illegible]~~	2.5YR 7/6			
39		2	~~[illegible]~~		↓	↓	NOTE: CORE RUN TO 45' either lost core 41-45 or core ~~should~~ stretched
40	↓						
41	↓	↓	↓			↓	

SOIL CORE LOG FORM

OW-5/55R AREA RADIUS-OF-INFLUENCE CORE INVESTIGATION,
Beazer-Koppers, Nashua, NH   Project: [illegible]-2201360

TETRA TECH

Boring ID: R01-9	Date: 6-10-15	Casing / Core Dia. (in): 4	Core Log Sheet 1 of ___
Logger(s): cg	Start Time: ~1240	Finish Time:	Core Recovery (ft):

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
0							
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

NOT LOGGED PER JRE

SOIL CORE LOG FORM — OW-5/55R AREA RADIUS-OF-INFLUENCE CORE INVESTIGATION, Beazer-Koppers, Nashua, NH Project: [illegible]-2201360 — TETRA TECH

Boring ID: R01-9	Date: 6-10-15	Casing / Core Dia. (in): 4	Core Log Sheet 2 of ___
Logger(s): cy	Start Time: 1340	Finish Time: 1400	Core Recovery (ft): 5/5

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
10	NOT LOGGED PER JRE						
11							
12							
13							
14							
15	NR	N(1)	N(1)	2.5Y 7/3	none	SM	Silty Sand, fine to med sand, dry to moist loose. no odor. Pale Yellow. lens of clayey silty sand at 19 ft (1-inch)
16	↓	↓	↓	↓	↓	↓	
17							
18							
19							
20							

SOIL CORE LOG FORM

OW-5/55R AREA RADIUS-OF-INFLUENCE CORE INVESTIGATION,
Beazer-Koppers, Nashua, NH Project: [illegible]-2201360

TETRA TECH

Boring ID: RO1-9	Date: 6-10-15	Casing / Core Dia. (in): 4	Core Log Sheet 3 of ___
Logger(s): cg	Start Time: 1403	Finish Time:	Core Recovery (ft): 5/5, 5/5

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
20	NF	N(1)	N(1)	2.5Y 7/3	none	SM	silty sand (typ) loose, moist yellow.
21	↓	↓	↓	↓	↓	↓	
22				10YR 4/6			SAA - reddish zone. thin gray clay laminations 21.8-22.2
23			2 odor	2.5Y 7/3			silty sand, loose moist yellow.
24		↓	↓	↓	↓	↓	
25				2.5Y 7/1			gray color.
25	NF	N(1)	2 (odor)	2.5Y 4/4	none	SM	Silty sand fine to medium, olive yellow, no peroxide RXN
26	↓						
27				2.5Y 5/3			SAA, grayish brown no RXN
28		↓			↓		
29		3	4	2.5Y 6/4	dark seam		SAA, olive yellow. thin brown lamination at 29.5 ft effervesced peroxide. Possible oxidized NAPL seam (<0.5 cm thick)
30		↓	↓			↓	

SOIL CORE LOG FORM

OW-5/55R AREA RADIUS-OF-INFLUENCE CORE INVESTIGATION,
Beazer-Koppers, Nashua, NH Project: [illegible]-2201360

TETRA TECH

Boring ID: R01-9	Date: 6-10-15	Casing / Core Dia. (in): 4	Core Log Sheet 4 of 4
Logger(s): cy	Start Time: 1440	Finish Time: 1445	Core Recovery (ft): 5/5

Core Interval (feet BGS)	PID screen (ppm) internal core	ISGS Reagent Present (Y/N)	NAPL Treated (%)	Color, Hue, Chroma (wet)	Percent Discoloration	USCS Classification	Notes:
30	NF	3	1	2.5Y 5/4	none	SM	Silty sand, tan, reactive to Peroxide. No visible Napl indication. brown color
31							
32							
33							
34				2.5Y 7/1			Silty sand salt and pepper gray color. no indication of Napl or Reagent.
35							SAA
36							
37							
38				2.5Y 6/3			Tan color at bottom (oxydized iron) no Rxn.
39			LOST CORE	38-40			
40							