

**Virgilio Cocianni**  
Remediation Manager

**Schlumberger**

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January 16, 2015

Grace Ma  
Groundwater Remediation Project Manager  
Superfund Division SFD-7-3  
EPA Region IX  
75 Hawthorne Street  
San Francisco, CA 94105

Subject: **Addendum to Final Work Plan for *In Situ* Chemical Oxidation Pilot Study**  
401 National Avenue, Former Fairchild Building 9  
Middlefield-Ellis-Whisman Area  
Mountain View, California

Dear Ms. Ma:

Enclosed with this letter is the Addendum to the Final Work Plan for *In Situ* Chemical Oxidation (ISCO) Pilot Study (Final Work Plan) at the former Fairchild Building 9, located at 401 National Avenue, Mountain View, California. The Final Work Plan was submitted to the U.S. Environmental Protection Agency (EPA) on 20 November 2014 and EPA provided conditional approval on 2 January 2015. A response to EPA's comments in the conditional approval is provided as part of this document as well as proposed revisions to the ISCO pilot study scope based on the results of recent data collection activities.

Mobilization for the first ISCO injection event is scheduled to take place on 9 February 2015, with injections beginning on 16 February 2015. We are therefore requesting approval of this addendum by 31 January 2015.

If you have any questions about the enclosed work plan, please feel free to contact me.

Very truly yours,



Virgilio Cocianni  
Remediation Manager

Enclosure

CC: MEW Distribution List  
Victor R. Fracaro, National Avenue Partners, LLC

16 January 2015

Grace Ma  
Remedial Project Manager, Superfund Division  
United States Environmental Protection Agency Region 9  
75 Hawthorne Street,  
San Francisco, California

**Subject: Addendum to Final Work Plan for In Situ Chemical Oxidation Pilot Study  
401 National Avenue, Former Fairchild Building 9  
Middlefield-Ellis-Whisman Area, Mountain View, California**

Dear Ms. Ma:

On behalf of Schlumberger Technology Corporation (STC), Geosyntec Consultants, Inc. (Geosyntec) has prepared this addendum to address comments provided in the Environmental Protection Agency's (EPA) 2 January 2015 Conditional Approval Letter for the Final Work Plan for In Situ Chemical Oxidation (ISCO) Pilot Study at the subject site (Final Work Plan).

In addition to responding to EPA's comments in the Conditional Approval Letter, this addendum includes the following updates to the Final Work Plan:

- A summary of the grab groundwater sampling activities that were proposed in the Work Plan for ISCO Pilot Study Data Collection<sup>1</sup> and completed in November 2014;
- Updated pilot study treatment areas based on the results of the November 2014 grab groundwater sampling activities;
- A description of the ISCO reagent mixture that will be used during the pilot study based on results from the recent bench-scale testing completed as part of the ISCO pilot study data collection activities;

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<sup>1</sup> Geosyntec, 2014. Work Plan for ISCO Pilot Study Data Collection, 401 National Avenue, Former Fairchild Building 9, Middlefield-Ellis-Whisman Area, Mountain View, California. 3 July.

- The location of the monitoring wells to be installed at the site; and
- The proposed monitoring schedule for the ISCO pilot study.

The above updates to the Final Work Plan are consistent with the updates recommended by Geosyntec to EPA at a meeting on 7 January 2015.

**RESPONSE TO EPA COMMENTS OUTLINED IN EPA'S CONDITIONAL APPROVAL LETTER (2 JANUARY 2015):**

**Comment 1: ISCO Injection Events.** *EPA acknowledges the increased number of planned injection events as part of the Work Plan. In order to maximize the effectiveness of the ISCO pilot study test results, efforts should be made to include a third injection event into the pilot test schedule. In addition, EPA previously requested consideration of a proposed method to deliver follow on injections after construction of the parking structure such as permanent injection wells completed below grade or via directional drilling. Please clarify why post construction ISCO injection events are infeasible and not being considered.*

**Response:** The current injection design includes three injection events as suggested by EPA. However, as stated in the Final Work Plan (November 2014, pg 33 Section 4.4.3.3), completion of the third round of injection will depend on several factors, such as:

- Potential site access limitations due to ongoing redevelopment activities; and
- An assessment of the effectiveness of the first two injection events with respect to distributing oxidant within the desired treatment zones.

Geosyntec will notify EPA of adjustments to the planned third injection event.

As we discussed in our 7 January 2015 meeting, there are several technical and logistical challenges to conducting ongoing ISCO injections past the anticipated three injections described Final Work Plan, including:

1. As requested by EPA, STC is currently evaluating a zero-valent iron (ZVI) permeable reactive barrier (PRB) technology and intends to submit a work plan for installation of a ZVI PRB at the site. Additional ISCO injections would preclude potential installation of a ZVI PRB due to potential incompatibilities between the ISCO reagents and the ZVI and

is therefore inconsistent with EPA's request for evaluating a combined ISCO-ZVI treatability study.

2. Once the planned parking structure is completed and occupied at the site, it will be infeasible to conduct multiple injections in the future. The A-zone at the site is generally comprised of fine-grained layered silts and silty sands, which limit the rate at which ISCO reagents can be injected. As a result, each of the three ISCO injection events described in the Final Work Plan will require approximately three weeks of continuous injections, which could not be conducted without significant impact to structure occupants.
3. In order to mitigate stakeholder concerns regarding potential mounding and flow of oxidant out of the slurry wall during ISCO pilot study implementation, the injection program has been designed as a "net zero" program (i.e., a volume of groundwater equivalent to the volume of oxidant solution injected will be extracted during each injection event to limit mounding). In order to manage the extracted groundwater, significant temporary aboveground infrastructure will be used on site during the injection program, which will not be possible when the parking structure is constructed and operating.

**Comment 2: EPA Notification and Emergency Procedures.** *The Work Plan needs to include specific timeframes for notifying EPA if there is a change in the field that requires EPA approval. In addition, if the 401/405 National Shared Treatment System shuts down or if an emergency occurs, EPA needs to be notified within 24 hours.*

**Response:** Geosyntec will notify EPA 48 hours prior to major changes to the ISCO injection program that would require approval by EPA. As requested by EPA, Geosyntec will provide notification within 24 hours in the event the 401/405 National Avenue Shared Treatment System is shut down or if an emergency occurs.

**Comment 3: Progress Reporting Requirements.** *Preliminary monitoring data summary tables should be provided to EPA on a monthly basis. The ISCO Pilot Study Implementation Report is due to EPA by May 29, 2015. In addition, the ISCO Pilot Study Results and Evaluation Report is due 60 days after completion of the fourth quarterly sampling event.*

**Response:** A baseline schedule for the ISCO pilot study is included as Figure 1, based on the three injection events included in the Final Work Plan pilot study design. The baseline schedule

for the pilot study is based on our current understanding of the time required to inject the stated quantities of solution and oxidant per injection event, and the time required to collect and analyze monitoring data following each injection. As requested by EPA, Geosyntec will provide summary updates of the injection program along with data summary tables on a monthly basis.

As shown in Figure 1, if a third injection is implemented, it would likely not occur until the first week of June 2015 and would be ongoing through the end of June 2015. Based on the anticipated pilot study schedule, it will not be possible to submit an ISCO Pilot Study Implementation Report documenting the three injection events (if all three are completed) to EPA by 29 May 2015. Geosyntec is committed to providing the ISCO Pilot Study Implementation Report to EPA in a timely manner and will submit the report to EPA within 45 days of completing the last injection event. Based on the baseline pilot study schedule (Figure 1), the report would be provided to EPA by 15 August 2015 if three injection events are completed.

## **SUMMARY OF 2014 ISCO PILOT STUDY DATA COLLECTION**

The following tasks were completed between October and November 2014 in accordance with the Work Plan for ISCO Pilot Study Data Collection<sup>2</sup>:

- Borings were advanced using direct-push technology to further delineate the ISCO treatment areas, including:
  - Four continuous core soil borings were advanced to log the approximate depths of coarse-grained materials within the data collection area and select depth intervals for depth-discrete groundwater samples; and
  - Depth-discrete grab groundwater samples were collected from 17 locations to evaluate TCE concentrations and finalize the extent of the pilot study implementation area. The depth-discrete samples were collected in both the upper and lower coarse-grained sands within the A-zone, and specific depths were selected based on site lithologic data.

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<sup>2</sup> Geosyntec, 2014. Work Plan for ISCO Pilot Study Data Collection, Former Fairchild Building 9 Groundwater Remediation Program, 401 National Avenue, Mountain View, California, July 3.

- A groundwater sample was collected from on-site source control and recovery well (SCRW) AE/RW-9-2, and twelve continuous core soil borings were advanced to collect soil from within the ISCO treatment areas to support the bench-scale ISCO testing program described below.
- Bench-scale testing was performed using soil and groundwater collected from the site to evaluate site-specific consumption of oxidant mixtures by chlorinated volatile organic compounds (cVOCs) and non-target compounds (e.g., soil organic matter) prior to finalizing the oxidant and dosing design for the ISCO pilot study.

The locations of the grab groundwater samples collected to delineate the ISCO treatment area are shown in Figure 2. The locations of borings advanced to collect soil for the bench scale testing program are shown in Figure 3.

The concentrations of cVOCs detected in grab groundwater samples collected to delineate the ISCO treatment areas are provided in Table 1. TCE concentrations for monitoring well and grab groundwater samples collected from both the upper and lower coarse-grained zones are shown in Figure 4. Based on the monitoring well data and grab groundwater samples collected in 2013 and 2014, the highest concentrations of TCE at the site are located in the upper coarse-grained zone (shallow zone).

### **FINAL PILOT STUDY TREATMENT AREA BASED ON NOVEMBER 2014 GRAB GROUNDWATER SAMPLING RESULTS**

The treatment area for the ISCO pilot study has been finalized based on the results of the November 2014 grab groundwater sampling and subsequent discussions with EPA on 7 January 2015. The ISCO pilot study will focus on injecting oxidant into the upper sand horizon only. Focusing injections in the upper sand will provide the following benefits:

- TCE mass removal will be maximized by treating the highest concentrations of TCE, which were detected in the upper sand;
- The duration of each injection event will be shortened, increasing the probability that a third event can be implemented within the available period for completing the injections; and
- The potential for oxidant transport outside of the slurry wall will be significantly reduced.

Figure 2 shows the original anticipated ISCO pilot study injection areas for the upper and lower coarse-grained zones and Figure 4 shows the revised ISCO pilot study injection area focused on the upper zone only.

## **FINAL OXIDANT SELECTION BASED ON BENCH-SCALE TESTING**

As described in the Work Plan for ISCO Pilot Study Data Collection, bench-scale testing was completed in December 2014 using site soil and groundwater. The objective of the bench-scale testing was to compare the effectiveness of various oxidant formulations at reducing the concentration of TCE in site soil and groundwater. Based on the bench-scale results (presented in Figure 5<sup>3</sup>), a combined oxidative approach is the most effective to reduce TCE mass in site soil and groundwater. As shown in Figure 5, a combination of sodium permanganate and sodium persulfate decreased the initial concentration of TCE from 54,000 µg/L to less than 10 µg/L in all four of the combined sodium persulfate/sodium permanganate bench-scale tests. Although sodium permanganate and iron activated sodium persulfate were effective single oxidant approaches to TCE destruction, the combined oxidative approach has the potential to utilize both mechanisms of oxidative destruction (direct and radical based pathways) that are documented in literature, thereby increasing efficacy of the ISCO pilot study within the available period for completing the injection program.

## **LOCATIONS OF PILOT STUDY MONITORING WELLS**

The Final Work Plan stated that three additional monitoring wells will be installed as part of the pilot study. Based on the final ISCO pilot study treatment area, the proposed monitoring well locations and depths have been revised, and two additional proposed monitoring wells have been added to the pilot study monitoring network. The planned locations of the monitoring wells are presented in Figure 6 and anticipated well construction details are provided in Table 2. The wells will be monitored in accordance with the monitoring program included as Tables 2 and 3.

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<sup>3</sup> A complete report of the bench scale testing results will be included in the ISCO Pilot Study Implementation Report.

Ms. Grace Ma  
16 January 2015  
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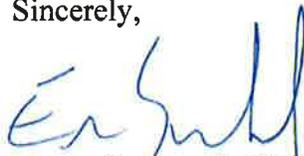
## PILOT STUDY SCHEDULE

The anticipated schedule for the ISCO pilot study is provided as Figure 1. Mobilization for the first ISCO injection event is scheduled to take place on 9 February 2015, with injections beginning on 16 February 2015. Additional injection events will follow a period of process monitoring and data evaluation. The timing of the second and third injection events may be revised based on the process monitoring results and in consultation with EPA.

## CLOSING

Please contact either of the undersigned at (510) 836-3036 if you have any further questions.

Sincerely,

  
Eric J. Suchomel, PhD, PE  
Senior Engineer



  
John Gallinatti, PG, CHG  
Principal Hydrogeologist

Attachments: Table 1 – Groundwater Analytical Results: Detected cVOCs  
Table 2 – Extraction and Monitoring Well Construction Summary  
Table 3 – Monitoring Schedule

Figure 1 – Baseline Schedule  
Figure 2 – ISCO Treatment Area Data Collection Locations  
Figure 3 – Oxidant Demand Sample Locations  
Figure 4 – Revised ISCO Treatment Area  
Figure 5 – Bench-Scale Comparative Oxidant Test Data  
Figure 6 – ISCO Pilot Study Performance Monitoring Points

Copies to: MEW Distribution List  
Victor Fracaro, National Avenue Partners

# TABLES

**Table 1**  
**Groundwater Analytical Results: Detected cVOCs**  
 401 National Avenue  
 Mountain View, California

Sample Location	Sample Date	Sample Depth (ft bgs) <sup>1</sup>	Concentration in µg/L by EPA method 8260B									
			PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	Vinyl Chloride	1,1,1-TCA	1,1-DCA	1,1-DCE	Freon 113	Total VOCs <sup>2</sup>
<b>Wells Inside Slurry Wall Enclosure</b>												
35A	9/25/2012	12-37	<0.50	220	130	1.7	1.1	<0.50	3.6	2.5	2.1	360
36A	9/18/2012	35-40	<0.50	110	270	2.1	0.7	<0.50	3.3	2.7	0.64	390
37A	10/23/2013	15-30	<0.50	72	370	3.7	49	7.6	36	8.6	1.1	550
122A	9/26/2012	28-38	<0.50/<0.50	210/230	100/100	1.6/1.6	<0.50/<0.50	<0.50/<0.50	3.0/3.0	2.1/2.1	1.0/0.97	220
137A	10/23/2013	34-36	<5.0	6,400	4,300	41	<5.0	<5.0	<5.0	11	16	11,000
AE/RW-9-1	10/17/2013	8-33	1.5	810	710	7.7	13	45	53	12	3.9	1,700
AE/RW-9-2	10/17/2013	8-37	4.6	13,000	8,800	78	260	49	84	38	190	23,000
RW-20A	10/17/2013	26.5-36.5	1.7	1,100	940	7.0	4.1	9.1	12	9.3	7.2	2,100
RW-21A	10/17/2013	21-36	4.6	410	350	5.8	1.8	1.6	5.0	5.0	9.0	800
<b>Well Upgradient of Slurry Wall Enclosure</b>												
123A	10/23/2013	28-38	<5.0	510	260	<5.0	<5.0	<5.0	<5.0	<5.0	6.2	800
<b>Wells Downgradient of Slurry Wall Enclosure</b>												
41A	10/23/2013	13-25	<5.0	580	220	<5.0	<5.0	<5.0	<5.0	<5.0	7.0	800
42A	10/23/2013	10-35	1.9/1.7	480/470	87/85	1.4/1.3	1.1/1.0	1.8/1.7	1.4/1.4	2.2/2.1	6.8/6.5	600
<b>Wells Transgradient of Slurry Wall Enclosure</b>												
43A	10/23/2013	15-27	1.5	420	96	1.2	1.5	1.4	1.3	1.8	3.5	500
44A	10/23/2013	13.5-28	1.8	330	51	0.79	<0.50	1.0	0.7	1.2	2.4	400
126A	9/25/2012	23-38	<0.50	130	110	1.0	0.59	<0.50	4.0	2.8	1.7	300
138A	10/23/2013	34-37	<0.50	340	920	6.4	16	<0.50	3.2	3.6	<50	1,300
<b>Grab Samples Inside Slurry Wall Enclosure 2013</b>												
MIP-02	9/9/2013	21-25	<1,000	560,000	59,000	<1,000	3,000	<1,000	<1,000	<1,000	7,100	630,000
MIP-02	9/9/2013	33-36	<25	100	5,300	71	86	<25	<25	<25	<25	5,600
MIP-03	9/10/2013	18-22	<50	6,600	15,000	200	56	<50	<50	<50	<50	22,000
MIP-04	9/9/2013	16-20	<50	360	11,000	79	180	<50	<50	<50	<50	12,000
MIP-04	9/9/2013	33-36	<25/<25	1,200/1,200	2,700/2,700	<25/<25	25/25	<25/<25	<25/<25	<25/<25	<25/<25	3,900
MIP-08	9/10/2013	18-22	<50	2,100	1,200	<50	<50	<50	<50	<50	64	3,400
MIP-09	9/10/2013	20-23	<50	76,000	45,000	480	570	50	210	140	410	120,000
MIP-12	9/10/2013	18-22	<25	2,300	180	<25	<25	<25	<25	<25	36	2,500
MIP-12	9/10/2013	22-26	59	120,000	55,000	280	520	<50	310	160	1,200	180,000
MIP-12	9/10/2013	33-35	<50	770	2,400	<50	<50	<50	<50	<50	<50	3,200

**Table 1**  
**Groundwater Analytical Results: Detected cVOCs**  
 401 National Avenue  
 Mountain View, California

Grab Samples Inside Slurry Wall Enclosure 2014												
HP01	11/20/2014	22-26	<5.0	270	930	12	9.2	230	260	62	<5.0	1,800
HP01	11/20/2014	33-36	<5.0	290	320	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	610
HP02	11/21/2014	22-26	<5.0	16	2,400	6.6	280	<5.0	800	51	<5.0	3,600
HP02	11/21/2014	33-36	<5.0/<5.0	3,000/2,700	6,600/6,100	39/40	71/73	<5.0/<5.0	6.6/6.6	20/20	<5.0/<5.0	9,700/8,900
HP03	11/21/2014	21-23	<5.0	11	3,900	19	180	<5.0	250	21	<5.0	4,400
HP03	11/21/2014	33.5-37.5	<5.0	1,900	7,000	37	81	<5.0	7.5	20	<5.0	9,000
HP04	11/21/2014	21-25	<5.0	<50	7,000	32	330	<5.0	66	<5.0	<5.0	7,400
HP04	11/24/2014	33-36	<50	1,600	5,500	51	95	<50	<50	<50	<50	7,200
HP05	11/24/2014	18-21	<50	1,700	440	<50	<50	270	550	200	<50	3,200
HP05	11/24/2014	32.5-35.5	<5.0	450	190	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	640
HP06	11/24/2014	20-24	<50	110	400	<50	<50	630	1,900	150	<50	3,200
HP06	11/24/2014	33-36	<2.5	220	67	<2.5	<2.5	<2.5	4.0	<2.5	<2.5	290
HP07	11/25/2014	20-24	<50	280	1,300	<50	390	3,500	4,900	750	68	11,000
HP07	11/25/2014	32-36	<10	150	970	<10	56	<10	40	11	<10	1,200
HP08	11/25/2014	19.5-23.5	<50	2,200	2,400	<50	250	280	440	220	60	5,900
HP08	11/25/2014	32-36	<5.0	280	210	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	490
HP09	11/21/2014	20-24	<5.0	36	1,800	15	69	25	1,600	190	5.3	3,700
HP09	11/21/2014	32-36	<5.0	130	2,400	7.7	<5.0	<5.0	13	12	<5.0	2,600
HP10	11/25/2014	20-24	<50	<50	4,700	<50	650	<50	<50	<50	<50	5,400
HP10	11/25/2014	31-35	<50	3,300	3,200	<50	<50	<50	<50	<50	<50	6,500
HP11	11/24/2014	19.5-23.5	<50	29,000	12,000	94	370	93	210	120	760	43,000
HP11	11/24/2014	32-36	<25	160	1,100	<25	<25	<25	<25	<25	<25	1,300
HP12	11/25/2014	32-36	<5.0	320	1,300	8.9	20	<5.0	76	23	<5.0	1,700
HP13	11/25/2014	22-26	<50/<10	<50/<10	680/610	<50/<10	73/82	<50/12	2,600/2,300	150/140	<50/<10	3,500/3,100
HP13	11/25/2014	33-36	<0.50	40	23	0.54	<0.50	<0.50	1.2	<0.50	<0.50	65
HP14	11/25/2014	17-21	<5.0	47	430	13	<5.0	280	370	110	<5.0	1,300
HP15	11/26/2014	18-22	<25	<25	160	<25	<25	99	3,600	34	<25	4,200
HP16	11/26/2014	18-22	<2.5	45	160	5.1	<2.5	66	160	30	<2.5	470
HP16	11/26/2014	26-30	<25	410	1,700	<25	<25	<25	<25	<25	<25	2,100
HP16	11/26/2014	33-37	<2.5	86	220	3.0	<2.5	<2.5	4.7	<2.5	<2.5	310
HP17	11/26/2014	18-22	<10	13	81	<10	31	<10	840	42	<10	1,100
HP17	11/26/2014	26-30	<25	56	4,000	27	430	<25	3,100	220	<25	7,800

**Notes:**

- 1. Sample depth represents screen intervals for monitoring wells or grab sample depths
  - 2. The Total VOCs values were rounded
- ft bgs = feet below ground surface  
 µg/L = micrograms per liter  
 EPA = Environmental Protection Agency  
 1,200/1,200 indicates primary and duplicate sample results  
 < indicates analyte not detected above the reported detection limit

- PCE = Tetrachloroethene
- TCE = Trichloroethene
- cis-1,2-DCE = cis-1,2-Dichloroethene
- trans-1,2-DCE = trans-1,2-Dichloroethene
- 1,1,1-TCA = 1,1,1-Trichloroethane
- 1,1-DCA = 1,1-Dichloroethane
- 1,1-DCE = 1,1-Dichloroethene

- Freon 113 = 1,1,2-Trichloro-1,2,2-trifluoroethane
- VOC = volatile organic compounds
- cVOCs = chlorinated volatile organic compounds

**Table 2**  
**Extraction and Monitoring Well Construction Summary**  
 401 National Avenue ISCO Pilot Study  
 Mountain View, California

Well ID	Reference Elevation <sup>1</sup> (ft msl)	Diameter (inches)	Total Well Depth (ft bgs)	Top of Screened Interval (ft bgs)	Bottom of Screened Interval (ft bgs)	Top of Sand Pack (ft bgs)	Bottom of Sand Pack (ft bgs)	Well Type	Included in Monitoring program	Rationale for Inclusion/Exclusion in Pilot Study Monitoring Program
<b>Current A Zone Well Located Inside Slurry Wall Enclosure</b>										
35A	42.67	2	37	12	37	12	37	Mon		Located outside of pilot study area
36A	42.32	2	40	35	40	15	40	Mon		Located outside of pilot study area
37A	43.21	2	30	15	30	12	30	Mon	X	Located adjacent to pilot study area treatment area
122A	44.23	4	38	28	38	18	39	Mon		Located outside of pilot study area
137A	43.68	4	36	34	36	32	38	Mon	X	Located in lower sand below pilot study area treatment area
AE/RW-9-1	43.15	6	33	8	33	6	36	Ext		Located outside of pilot study area
AE/RW-9-2	43.85	6	37	8	37	6	38	Ext	X	Located within pilot study treatment area
RW-20A	43.57	8	37.5	26.5	36.5	11	38	Ext		Located outside of pilot study area
RW-21A	43.16	6	37	21	36	11	38	Ext		Located outside of pilot study area
<b>Proposed Temporary A Zone Well Located Inside Slurry Wall Enclosure<sup>2</sup></b>										
B9-1A	--	2	24	17	24	16	24	Mon	X	New well to be installed within pilot study treatment area
B9-2A	--	2	24	17	24	16	24	Mon	X	New well to be installed within pilot study treatment area
B9-3A	--	2	24	17	24	16	24	Mon	X	New well to be installed within pilot study treatment area
B9-4A	--	2	24	17	24	16	24	Mon	X	New well to be installed within pilot study treatment area
B9-5A	--	2	36	31	36	30	36	Mon	X	New well to be installed below pilot study treatment area
<b>Nearby A Zone Well Located Outside Slurry Wall Enclosure</b>										
31A	43.87	2	27	14.5	27	10	27	Mon	X	Located upgradient of EX-1
39A	42.77	2	35	15	35	12	35	Mon	X	Located upgradient of EX-3 and EX-4
40A	43.44	2	27	11.5	27	12	27	Mon		Proximity to 39A, 39A will be monitored instead of 40A
41A	42.40	2	25	13	25	13	25	Mon	X	Located upgradient of 116A and GSF wells
42A	42.97	2	35	10	35	12	35	Mon		Conditions up-gradient of 116A and the GSF wells to be monitored by 41A
43A	43.38	2	27	15	27	15	27	Mon	X	Located upgradient of EX-4
44A	43.13	2	28	13.5	28	13.5	28	Mon		Downgradient of EX-1 through EX-4
69A	42.48	2	31	21	31	10	31	Mon		GSF wells to be monitored by 41A and 116A
116A	40.97	4	41	19	39	17	41	Mon <sup>3</sup>	X	Located upgradient of GSF wells
123A	44.37	4	38	28	38	18	39	Mon		Located upgradient of pilot study area
126A	42.85	4	38	23	38	18	40	Mon		Located crossgradient of pilot study area
138A	43.60	4	37	34	37	32	38	Mon	X	Located upgradient of EX-2, EX-3, and EX-4
EX-1 <sup>4</sup>	44.20	NA	29.7	9.9	28.5	8.5	29.7	Ext	X	405 National SCRW
EX-2 <sup>4</sup>	44.10	NA	29.0	9.4	27.9	8.1	29.0	Ext	X	405 National SCRW
EX-3 <sup>4</sup>	43.80	NA	30.1	9.9	29.3	8.5	30.1	Ext	X	405 National SCRW
EX-4 <sup>4</sup>	43.70	NA	31.1	10.4	28.6	8.5	31.1	Ext	X	405 National SCRW
GSF-1A	39.46	NA	35	19	34	17.0	35.0	Ext	X	Shared SCRW
<b>B1 Zone Wells</b>										
69B1	42.62	4	59	54	59	50	61	Mon	X	Monitoring conditions below the slurry wall
GSF-1B1	39.43	NA	71	63.6	70.5	61	71	Ext	X	Shared SCRW

## Notes:

- Reference Elevations are in National Geodetic Vertical Datum from 1929 (NGVD 29).
- Actual total depths and screen intervals for the individual monitoring wells may be adjusted in the field based on the subsurface conditions encountered.
- 116A is planned to be converted into an SCRW to support the STC/Vishay shared remedy.
- Wells drilled at a 45 degree angle to the east. Construction depths provided are approximate depths below ground surface. See Section 4.4 of ISCO Pilot Study Work Plan for monitoring program details (Geosyntec, November 2014).

## Abbreviations:

ft msl = feet mean sea level  
 ft bgs = feet below ground surface  
 Ext = extraction well  
 Mon = monitoring well  
 SCRW = source control recovery well

**Table 3**  
**Monitoring Schedule**  
 401 National Avenue ISCO Pilot Study  
 Mountain View, California

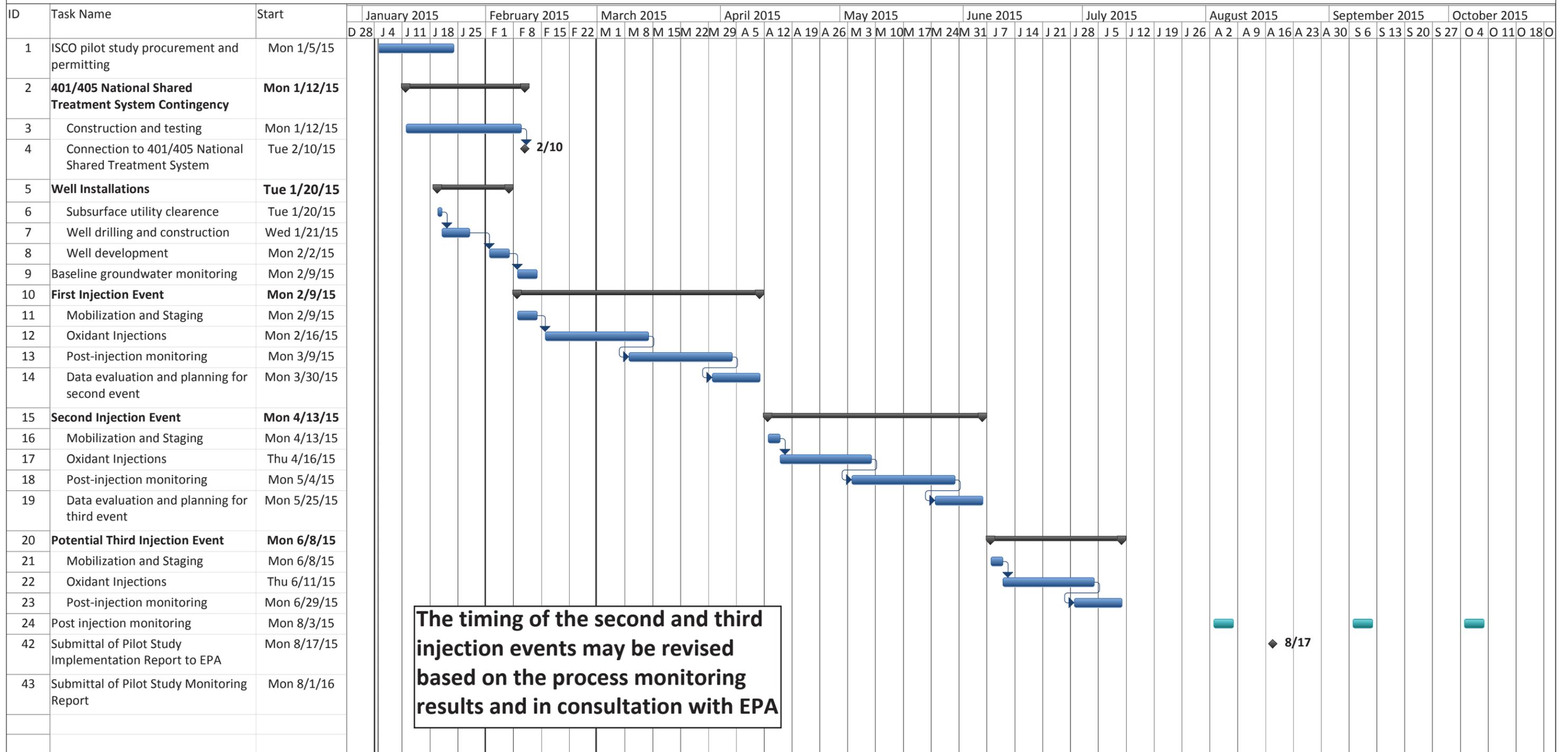
Component	Pilot Study Performance Monitoring Wells	Sentry Wells	Shared SCRWs and 405 National SCRWs	Vishay Treatment System	
Monitoring Point(s)	AE/RW-9-2, 37A, 137A, B9-1A, B9-2A, B9-3A, B9-4A, B9-5A	31A, 39A, 41A, 43A, 116A, 138A, and 69B1	EX-1, EX-2, EX-3, EX-4, 116A, GSF-1A, and GSF-1B1	Influent	Effluent
<b>Baseline Sampling</b>					
cVOCs by EPA Method 8260B	Prior to the start of injections. A minimum of 72 hours after the completion of well development.	Prior to the start of injections	Prior to the start of injections	Prior to the start of injections	Prior to the start of injections
Total dissolved solids (TDS) by Method SM 2540C					
Chloride by EPA Method 300.0					
Dissolved manganese, iron, and chromium by EPA Method 6010B					
Dissolved hexavalent chromium by EPA Method 7196					
<b>Monitoring During Injection Program</b>					
Gauging	Daily during injections	Daily during injections	--	--	--
Visual presence of oxidant	Daily during injections	Daily during injections	--	--	--
Oxidant using a commercially available field test kit	If MnO <sub>4</sub> is observed during daily monitoring	If MnO <sub>4</sub> is observed during daily monitoring	Note 2	--	--
ORP and SC	--	Daily during injections	--	--	--
Dissolved hexavalent chromium by EPA Method 7196	--	Note 2	Note 2	--	--
<b>Monitoring Following Injection Program<sup>3</sup></b>					
cVOCs by EPA Method 8260B	Quarterly for first year	Monthly for first year	Sampled in accordance with NPDES Permit	Sampled in accordance with NPDES Permit	Sampled in accordance with NPDES Permit
Oxidant using a commercially available field test kit	Monthly for first year	Monthly for first year	Monthly for first year	--	--
Dissolved hexavalent chromium by EPA Method 7196	Quarterly for first year	Monthly for first year	Monthly for first year	Sampled in accordance with NPDES Permit	Sampled in accordance with NPDES Permit
TDS by Method SM 2540C	Quarterly for first year	Monthly for first year	Monthly for first year	--	--
Chloride by EPA Method 300.0	Quarterly for first year	Monthly for first year	Monthly for first year	--	--
Dissolved total iron and manganese by EPA Method 6010B	Quarterly for first year	Monthly for first year	Monthly for first year	--	--
Dissolved total chromium by EPA Method 6010B	Quarterly for first year	Monthly for first year	Monthly for first year	Sampled in accordance with NPDES Permit	Sampled in accordance with NPDES Permit

**Notes:**

- 1) 116A is planned to be converted into an SCRW to support the STC/Vishay shared remedy.
  - 2) If oxidant is observed in the sentry wells, then the sentry wells, the shared SCRWs, and 405 National SCRWs will be sampled for oxidant and hexavalent chromium.
  - 3) After the first year, the scope and frequency of monitoring will be evaluated and modified, as appropriate.
- cVOCs - chlorinated volatile organic compounds  
 EPA - United States Environmental Protection Agency  
 ORP - oxidation-reduction potential  
 SC - specific conductance

# FIGURES

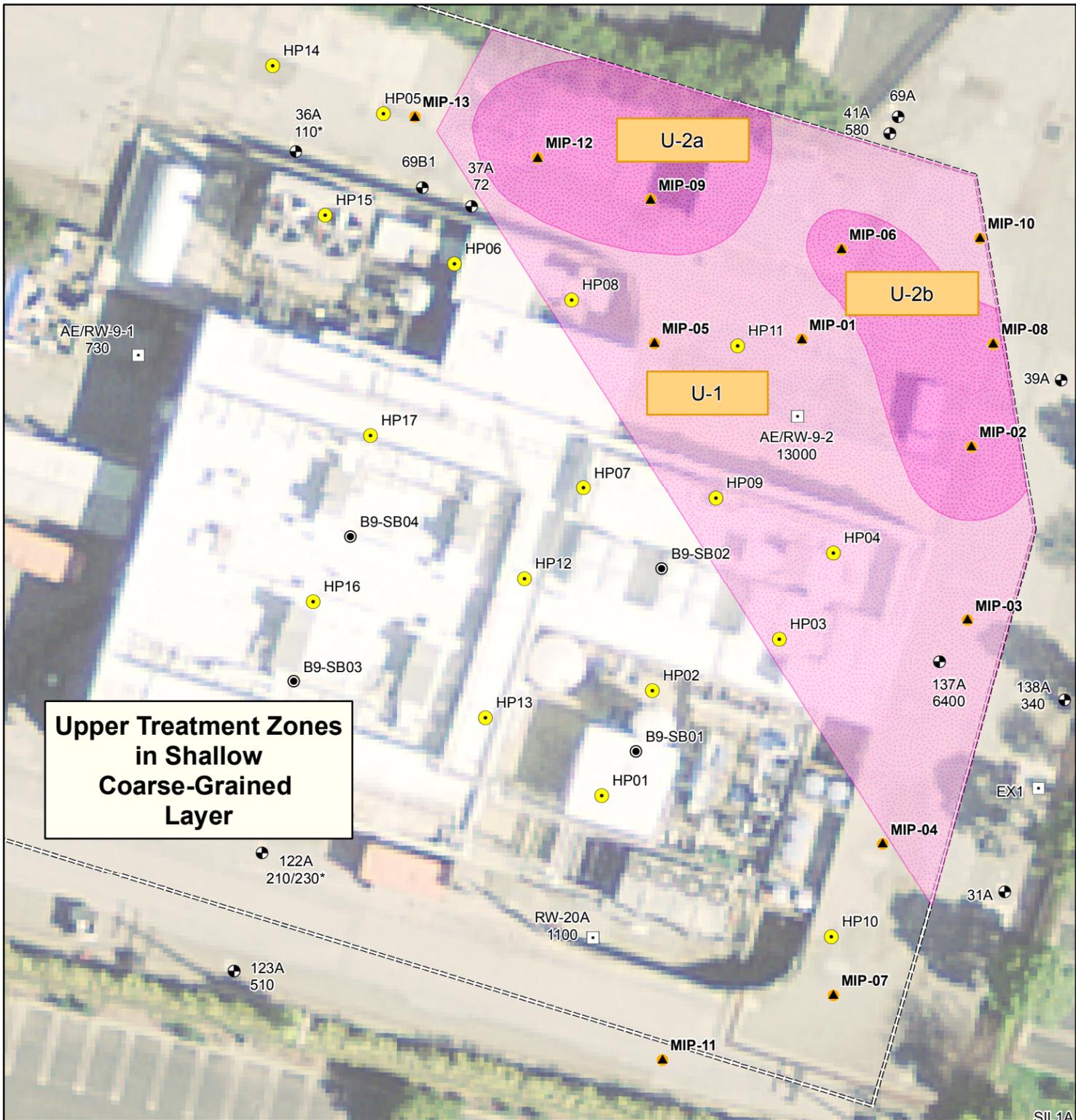
**Figure 1**  
**Baseline Schedule**  
 401 National Avenue ISCO Pilot Study  
 Mountain View, California



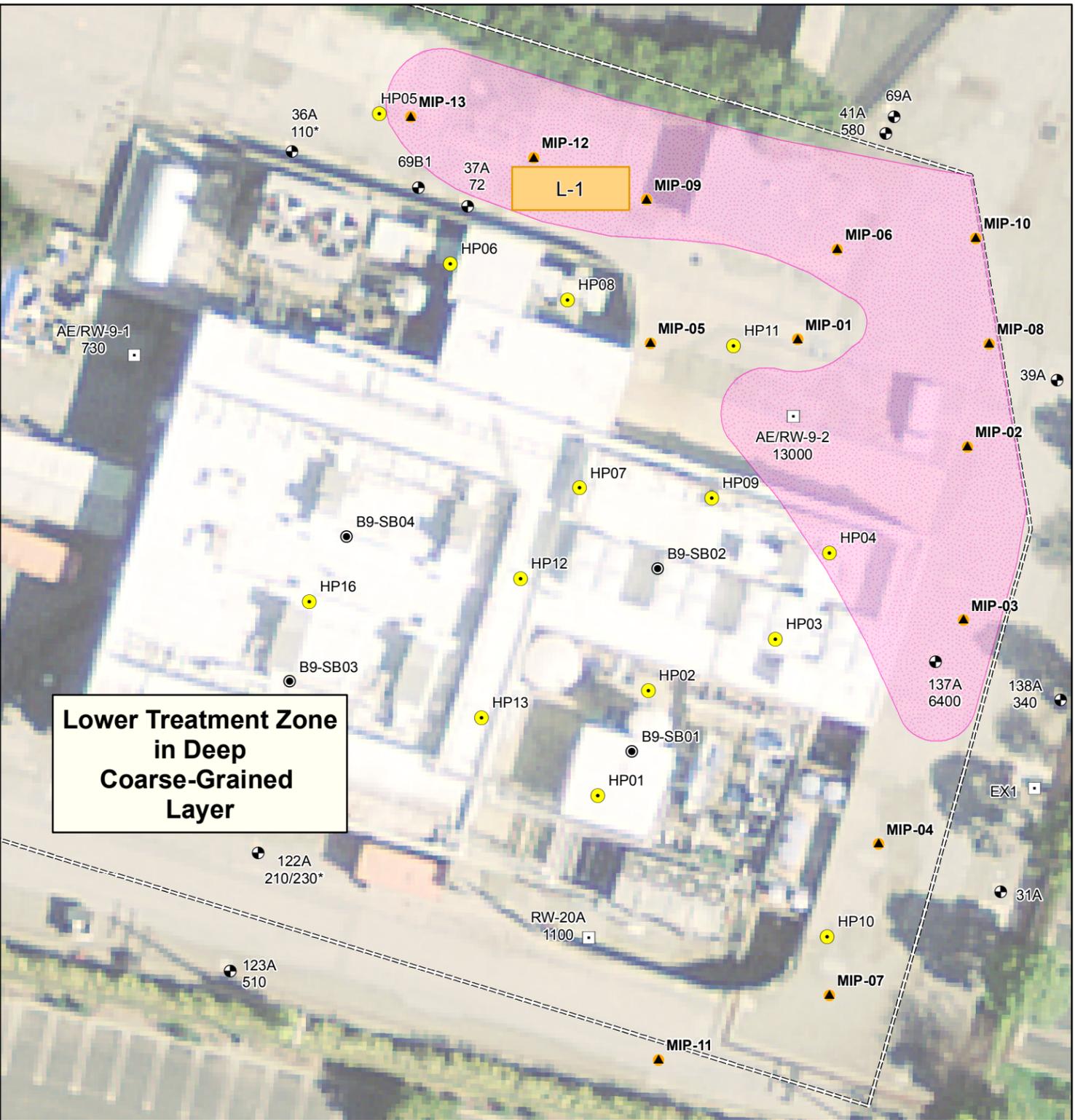
**The timing of the second and third injection events may be revised based on the process monitoring results and in consultation with EPA**

Project: Figure 1 - Schedule_prev Date: Fri 1/16/15	Task		Project Summary		Inactive Milestone		Manual Summary Rollup		Deadline	
	Split		External Tasks		Inactive Summary		Manual Summary		Progress	
	Milestone		External Milestone		Manual Task		Start-only			
	Summary		Inactive Task		Duration-only		Finish-only			





**Upper Treatment Zones  
in Shallow  
Coarse-Grained  
Layer**



**Lower Treatment Zone  
in Deep  
Coarse-Grained  
Layer**

**Legend**

- Recovery Well
- Monitoring Well
- Well ID
- TCE Concentration (ug/L)
- MIP Location (September 2013)
- Slurry Wall
- Conceptual Treatment Zones (Final Work Plan for in Situ Chemical Oxidation Pilot Study, November 2014)
- Hydropunch Location (November 2014)
- Soil Boring Location (November 2014)

**Notes:**  
 ug/L - micrograms per liter  
 MIP - membrane interface probe  
 \* Figure shows results for only those wells sampled in 2012 and 2013 for 401 National Avenue. Star indicates wells that were last sampled in 2012.

**ISCO Treatment Area Data Collection Locations**  
 401 National Avenue  
 Mountain View, California

**Geosyntec**  
 consultants

Oakland      January 2015

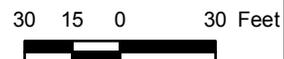
**Figure**  
**2**





**Legend**

- Oxidant Demand Sample
- ==== Slurry Wall



**Oxidant Demand Sample Locations**  
 401 National Avenue  
 Mountain View, California

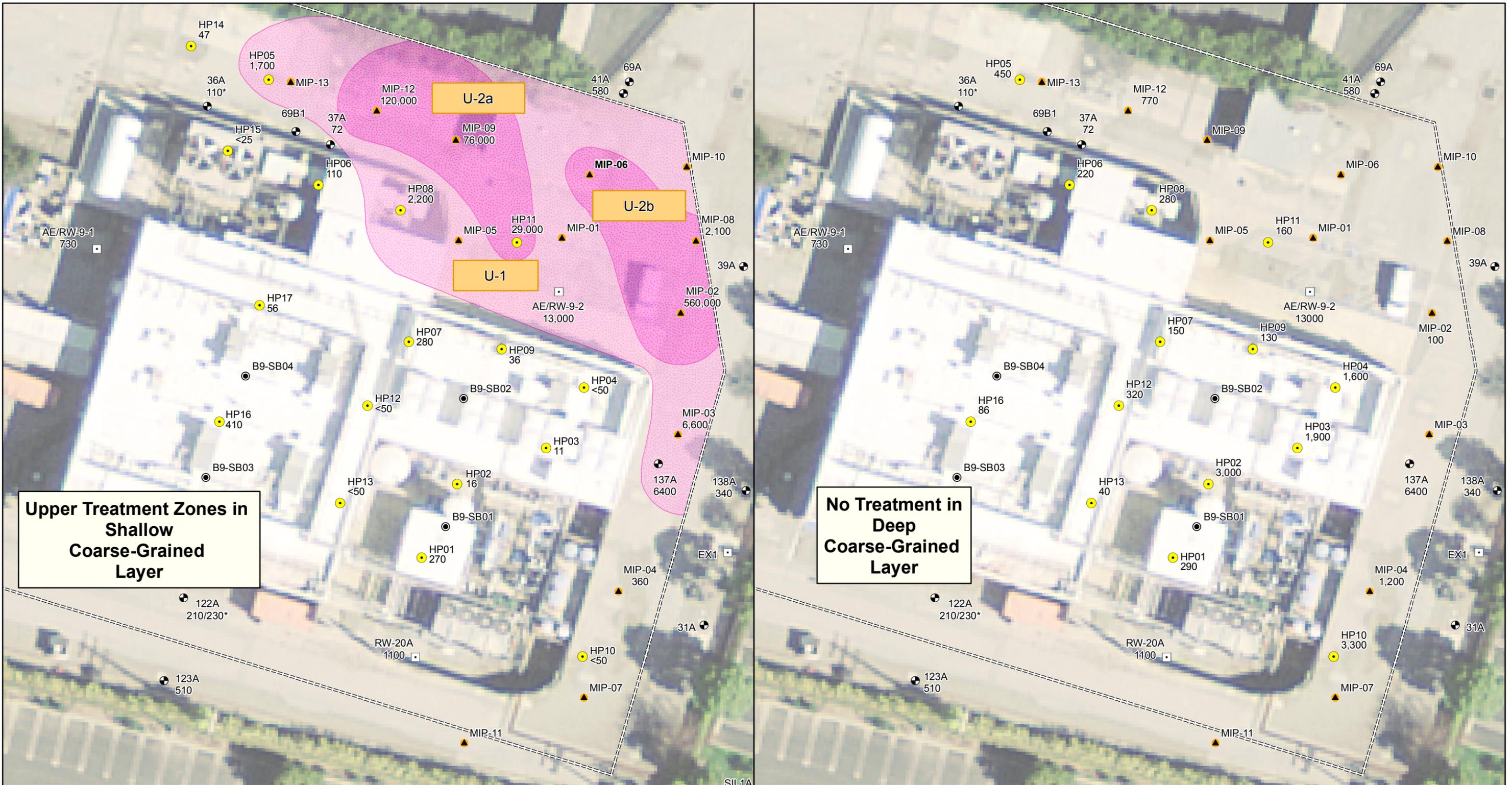
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 consultants

Figure

**3**

Oakland

January 2015



**Upper Treatment Zones in Shallow Coarse-Grained Layer**

**No Treatment in Deep Coarse-Grained Layer**

**Legend**

- Recovery Well
- Monitoring Well
- 36A 110\* Well ID  
TCE Concentration (ug/L)
- ▲ MIP Location (September 2013)
- Slurry Wall
- Proposed Treatment Zones
- Hydropunch Location (November 2014)
- Soil Boring Location (November 2014)

**Notes:**  
 ug/L - micrograms per liter  
 MIP - membrane interface probe  
 \* Figure shows results for only those wells sampled in 2012 and 2013 for 401 National Avenue. Star indicates wells that were last sampled in 2012.

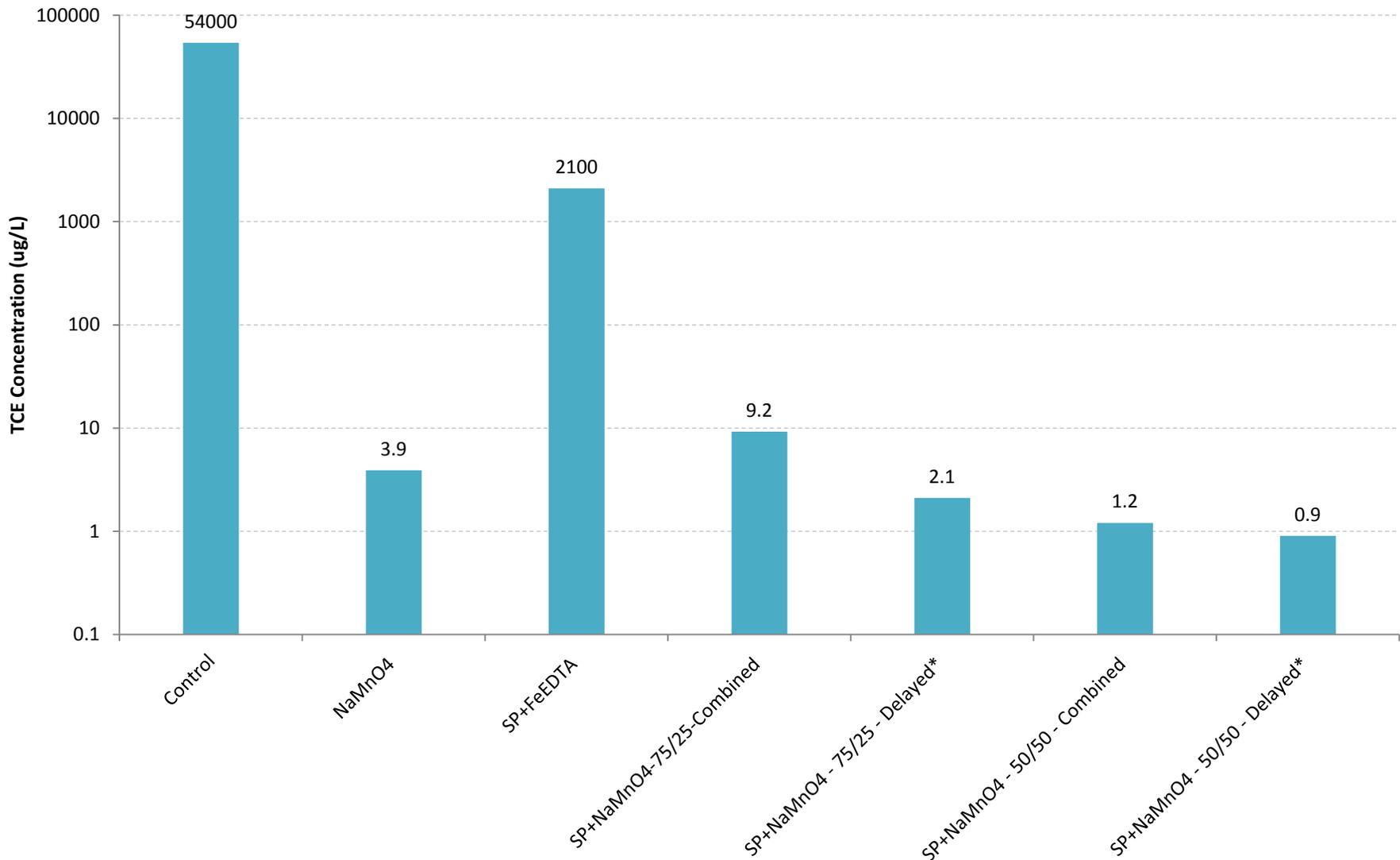
N  
 30 15 0 30 Feet

**Revised ISCO Treatment Areas**  
 401 National Avenue  
 Mountain View, California

**Geosyntec**  
 consultants

**Figure**  
**4**

Oakland      January 2015



**Note:**  
This graph represents baseline TCE concentrations in the saturated phase at day zero (control) and the various reactors amended with oxidant and measured at day 14 for TCE.

**Abbreviations:**  
 Control - No Amendment  
 FeEDTA - Chelated Iron  
 NaMnO4 - Sodium Permanganate  
 SP - Sodium Persulfate  
 TCE - Trichloroethene  
 \* - For “delayed” tests, persulfate was added to the reactors three days after permanganate addition to evaluate effects of sequencing oxidant dosing on TCE degradation.

**Bench-Scale Comparative Oxidation Test Data**

401 National Avenue  
 Mountain View, California

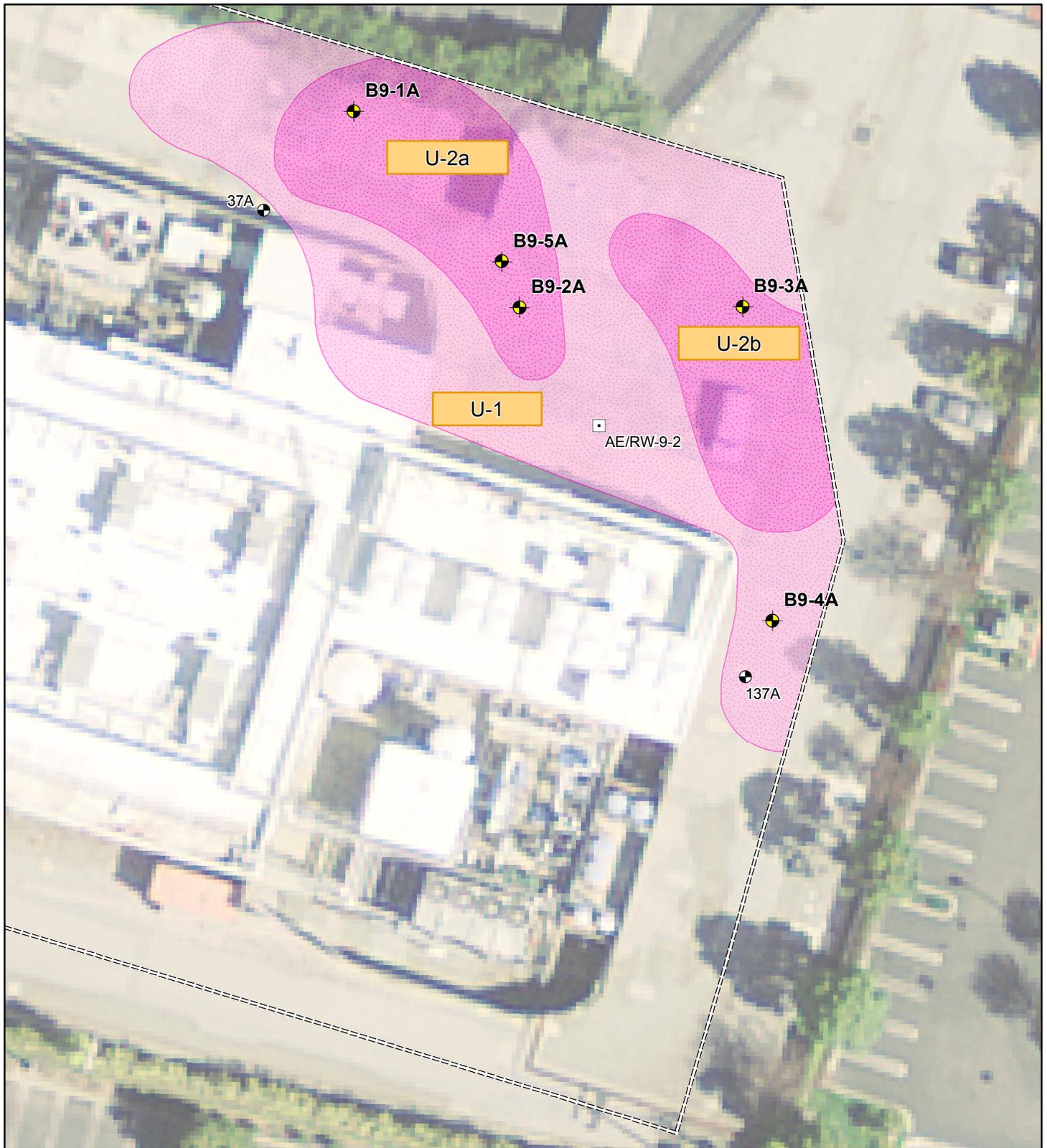


**Figure**

**5**

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**Legend**

- Recovery Well
- Monitoring Well
- Planned Monitoring Wells
- Slurry Wall
- Proposed Treatment Zones



**ISCO Pilot Study Performance Monitoring Points**  
 401 National Avenue  
 Mountain View, California

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Figure  
**6**

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January 2015