

In Situ Chemical Oxidation (ISCO) Pilot Test Project for Groundwater *(Feb. 25, 2015)*

The Boeing Company
Santa Susana Field Laboratory

Key Messages

■ Recent progress includes:

- Completed final (6th and 7th) ISCO injection events with higher concentration of potassium permanganate (KMnO₄)
- Continued groundwater sampling

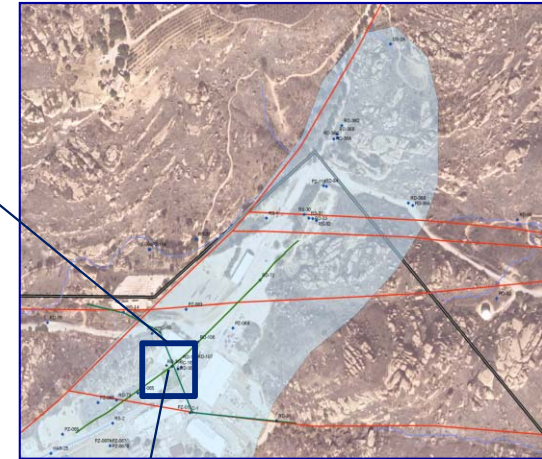
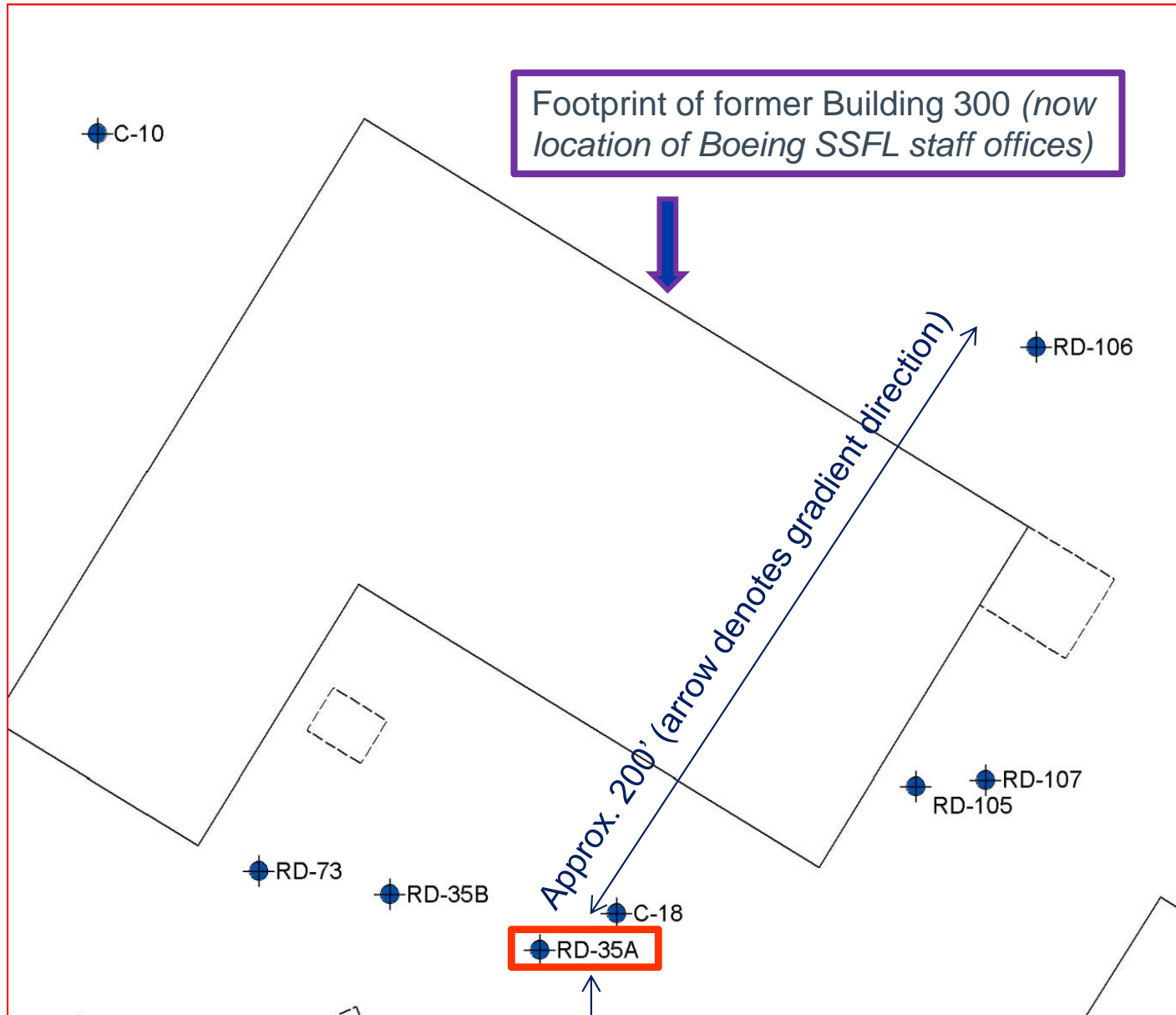
■ What did we find?

- Additional detection of KMnO₄ in 1 new port at C-18, RD-106
(in addition to prior detects of KMnO₄ at 1 port in C-18, 3 ports in RD-106)
- No visible KMnO₄ at other well/port locations

■ What are the next steps?

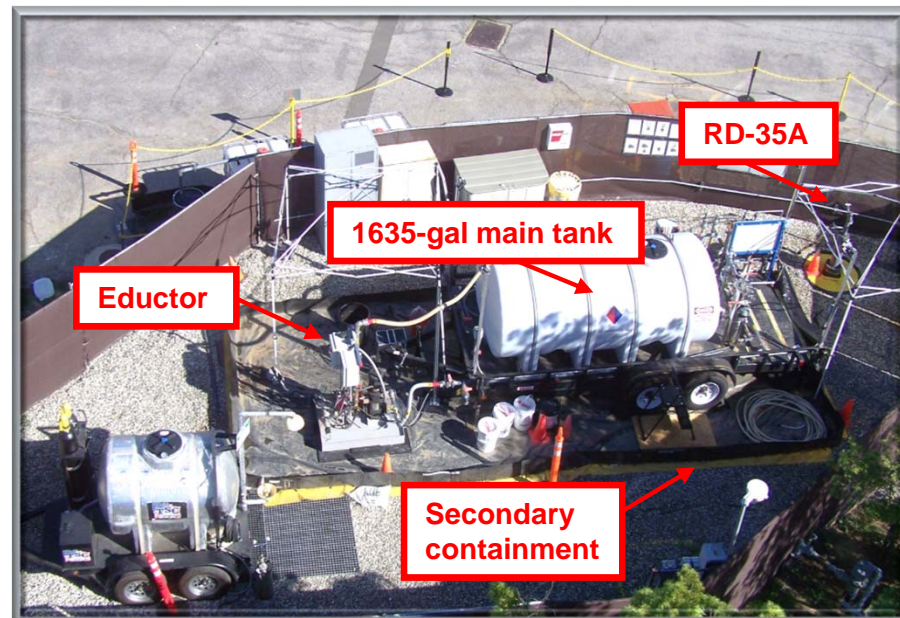
- Complete 6 months post-injection monitoring (Feb.-Aug. 2015)
- Complete two post-injection rock cores (~Aug. 2015)
- Evaluate data and issue final report (~Jan. 2016)

ISCO Pilot Test Study Area



Injection Well (open from 112' to 150' BGS)

Typical ISCO Injection



1. Use Potassium Permanganate Product

2. Mix with Hydrant Water

3. Inject
into
RD-35A



4. Sample from Monitoring Wells

Summary of ISCO Injection Events

ISCO INJECTION EVENTS COMPLETED TO DATE

EVENT	DATES	INJECTATE	FLOW (GPM)	VOLUME (GAL)	CONCENTRATION	MASS (LBS.)	MAX WL RISE (FT)	FINDINGS
ISCO #1	June 9-16, 2014	KMnO ₄ , (with KBr as tracer)	2	5,085	20 g/L (2%) KMnO ₄	771 (KBr-115)	4.48	Visible KMnO ₄ in <u>C-18</u> , (Port 3), <u>RD-106</u> (Port 8)
ISCO #2	July 14-21, 2014	KMnO ₄	2	5,158	20 g/L (2%) KMnO ₄	771	5.24	KMnO ₄ in <u>C-18</u> , (Port 3), <u>RD-106</u> (Ports 7-9)
ISCO #3	Aug. 18-25, 2014	KMnO ₄	2	5,142	20 g/L (2%) KMnO ₄	771	5.81	KMnO ₄ in <u>C-18</u> , (Port 3), <u>RD-106</u> (Ports 7-9)
ISCO #4	Sept. 22-29, 2014	KMnO ₄	2	5,199	20 g/L (2%) KMnO ₄	771	5.98	KMnO ₄ in <u>C-18</u> , (Port 3), <u>RD-106</u> (Ports 7-9)
ISCO #5	Oct. 27-Nov. 3, 2014	KMnO ₄	2	5,092	20 g/L (2%) KMnO ₄	771.	5.96	KMnO ₄ in <u>C-18</u> , (Port 3), <u>RD-106</u> (Ports 7-9)
DTSC APPROVAL FOR HIGHER DOSE INJECTIONS (DEC. 2014)								
ISCO #6	Jan. 12-19, 2015	KMnO ₄	2	5,241	30 g/L (3%) KMnO₄	1,157	5.98	KMnO ₄ in <u>C-18</u> , (Ports 3, 5), <u>RD-106</u> (Ports 6-9)
ISCO #7	Jan. 26-Feb. 2, 2015	KMnO ₄	2	5,271	30 g/L (3%) KMnO₄	1,157	6.38	KMnO ₄ in <u>C-18</u> , (Ports 3, 5), <u>RD-106</u> (Ports 6-9)

Detects of Tracers & KMnO₄

C-10				
Port	Depth (ft.)	Fluor. ppb	Br max thru Dec. 12, ppm	Maximum Colorimeter Results to Date (ppm)
1	105-135		1.1	0.6
2	155-162		3.7	0.6
3	195-205		0.54	1.0
4	240-250		0.70	1.0
5	273-283	0.14	6.1	0.7
6	342-356	0.04	1.8	0.8
7	379-390	0.04	1.7	1.9
8	411-423	0.02	1.6	0.6
9	475-485		0.8	0.8
10	520-527			0.8
11	551-560			0.9
12	575-585		0.60	0.6

C-18				
Port	Depth (ft.)	Fluor. ppb	Br max thru Dec. 12, ppm	Maximum Colorimeter Results to Date (ppm)
1	(Now dry)	1.03		
2	95-100	548	27	1.2
3	105-120	677	28	14.2 purple
4	130-135	9.22	15	0.9
5	148-168	0.01	35	5.1 pink
6	184-195	15.1	23	2.8

RD-105				
Port	Depth (ft.)	Fluor. ppb	Br max thru Dec. 12, ppm	Maximum Colorimeter Results to Date (ppm)
7	102.5		1.2	4.3
6	124		0.64	8.2
5	175.5	zone not monitored		
4	188	zone not monitored		
3	197.5			5.7
2	225			1.3
1	247.5			2.0

RD-107				
Port	Depth (ft.)	Fluor. ppb	Br max thru Dec. 12, ppm	Maximum Colorimeter Results to Date (ppm)
1	95-100		0.68	1.2
2	112-122		0.57	1.7
3	130-135		1.0	0.3
4	153-160			0.0
5	179-188			0.4
6	218-228			0.2
7	234-240			0.3

RD-106				
Port	Depth (ft.)	Fluor. ppb	Br max thru Dec. 12, ppm	Maximum Colorimeter Results to Date (ppm)
1	97.5-102.5	1.03	0.56	0.7
2	107.5-112.5	0.09	0.59	1.1
3	124-131		0.93	0.6
4	138-144		4.3	0.9
5	150-157		0.52	2.7
6	170-177	40.2	12	6.3 light pink
7	187-195	73.6	20	89 dark purple
8	205-212	131	37	83 dark purple
9	228-233	74.5	31	19.4 pinkish purple
10	242-250	1.58	3.0	4.2

Legend	
548	Fluorescein detected with max concentration shown from 2014 tracer test, lab (ppb)
27	Bromide detected with max. concentration through Dec. 2014, lab (ppm)
21.0	Visible permanganate detected, with highest concentration through Feb. 5, 2014 (field, ppm)

Note: only those bromide concentrations found at or above reporting limit (RL) of 0.50 ppm are shown.



Thank you