Air Force Civil Engineer Center

FORMER
WILLIAMS AIR FORCE BASE

Site ST012

Former Liquid Fuel Storage Area

BCT Conference Call

15 February 2019

Battle Ready…Built Right!

ED_005025_00011227-00001

Site ST012 Outline

- Summary of activities since Jan BCT call
- Update on SVE system
- LNAPL monitoring/removal update
- Pilot study extraction/injection update
- Path forward

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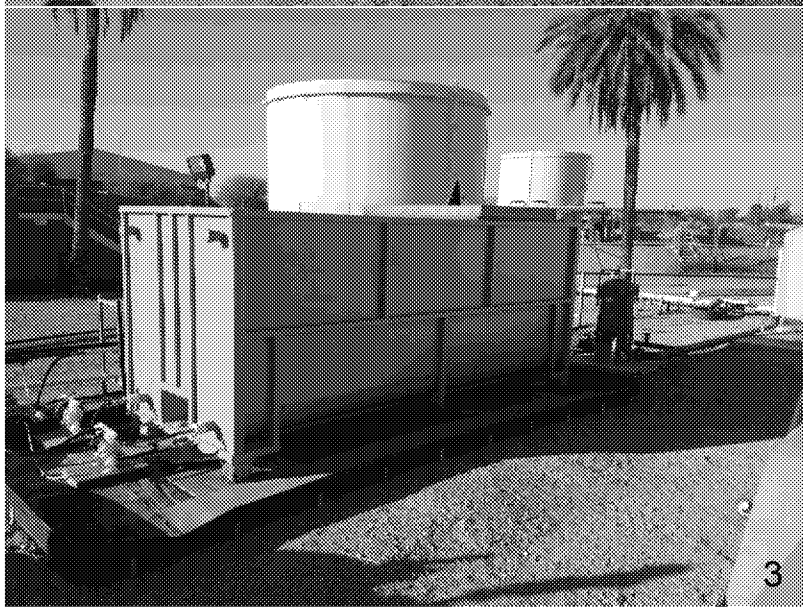
Site ST012 Activities Since January

- Continued SVE operation
- Continued LNAPL screening in accessible wells
- Operation of Extraction and Treatment
  - Pump repairs
    - CZ07 repaired discharge pipe joint
    - UWBZ27, motor replaced
  - New VFD on Catalytic Oxidizer
  - High moisture from air stripper at winter temperatures – catalytic oxidizer shut down
- Sodium sulfate injections (detail on later slides)
- Oxidizer moved from ST035 on 1 Feb (changeover of SVE from flameox to thermal oxidizer in process)



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SVE Update

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ST012 SVE System Update

- **Oct – Dec 2018**
  - **SVE ran on flameox**
  - **In parts of Nov/Dec Flameox also handled air stripper off gas**
  - **95.9% operational uptime Flameox**
    - Thermox down due to motor & VFD failures (motor installed on 12/18/18 & VFD installed on 1/23/19)
  - **Total petroleum hydrocarbon (TPH) removed – 11,030 pounds or 1,679 gallons**

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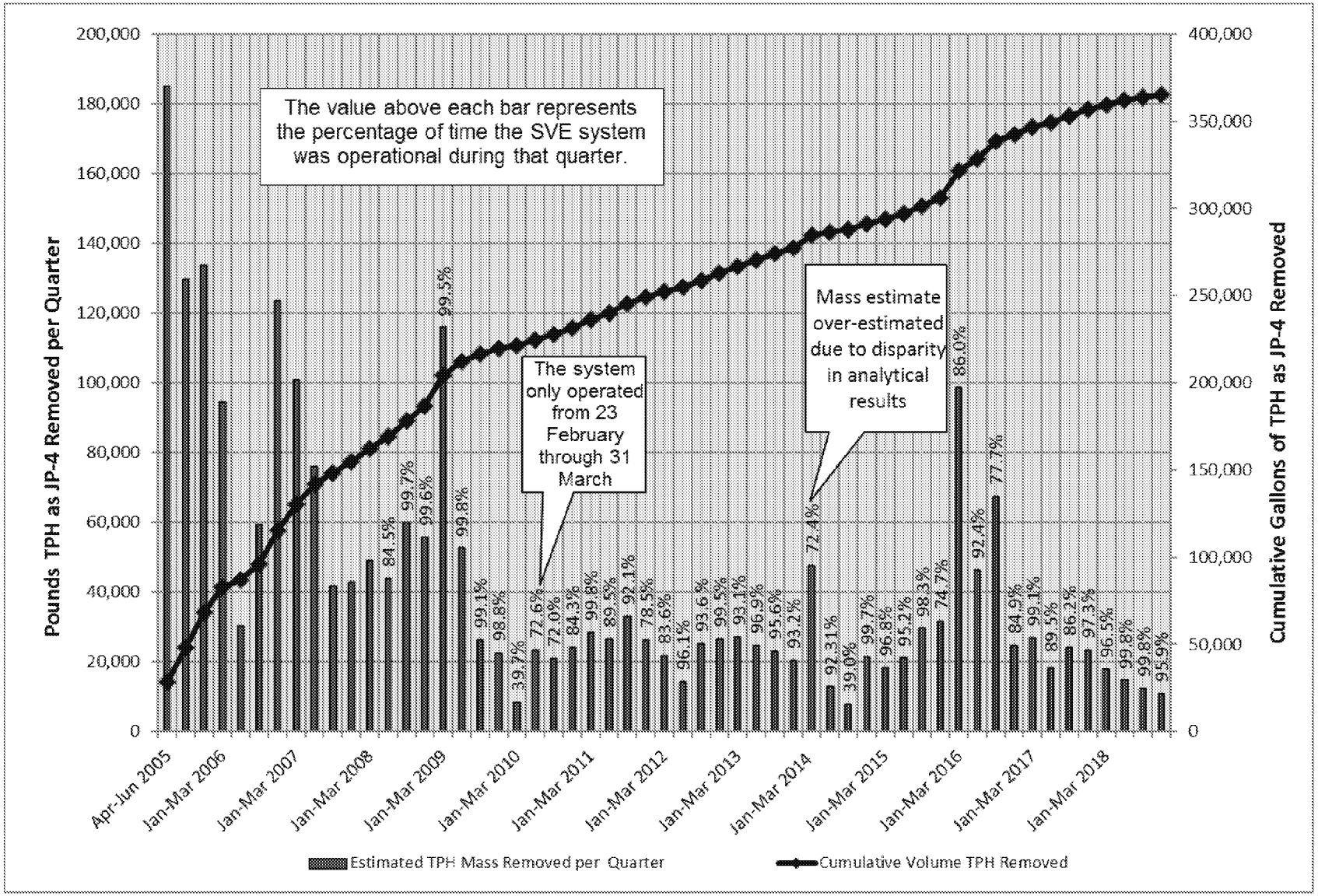
Site ST012 SVE System Performance



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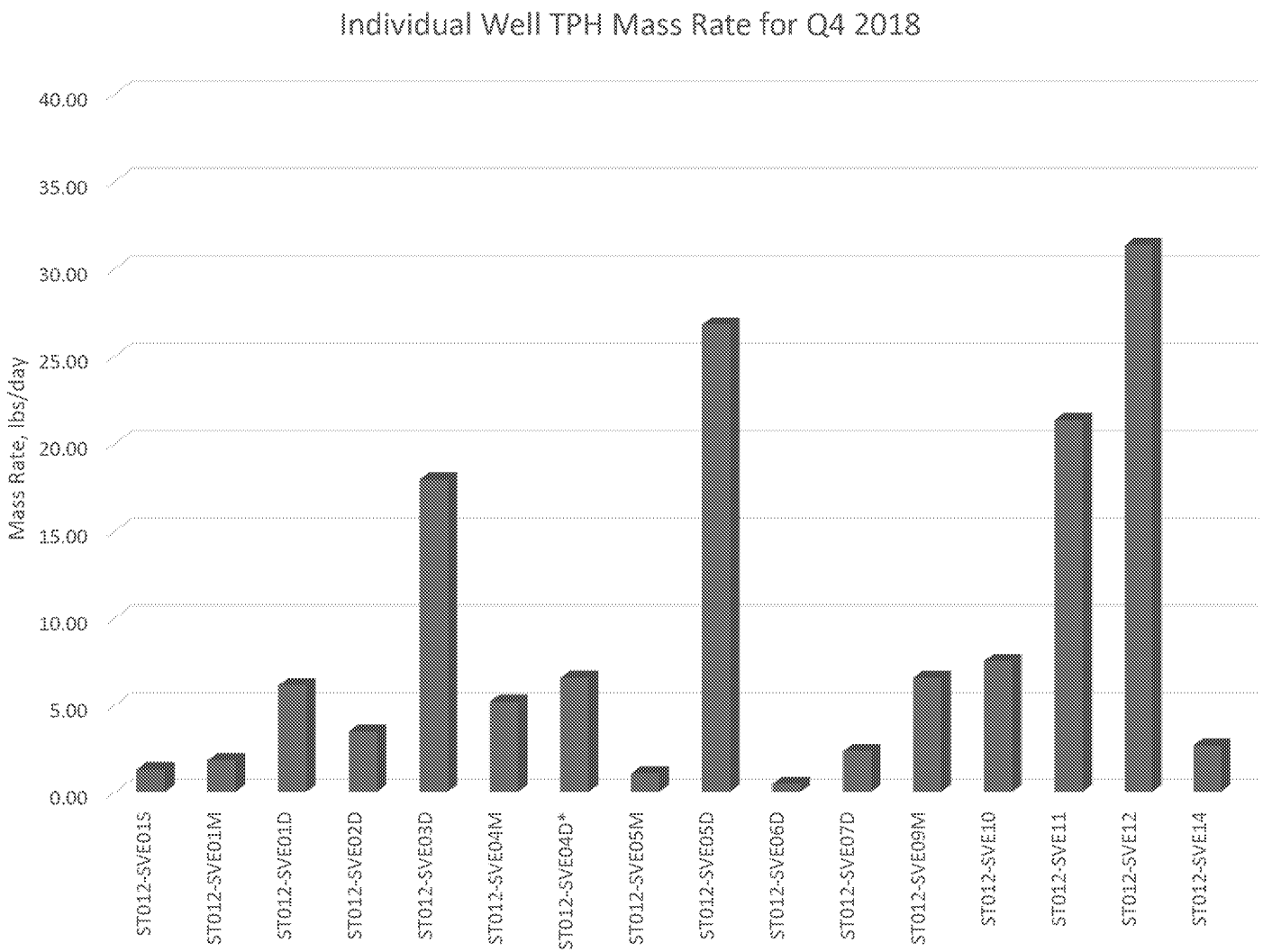
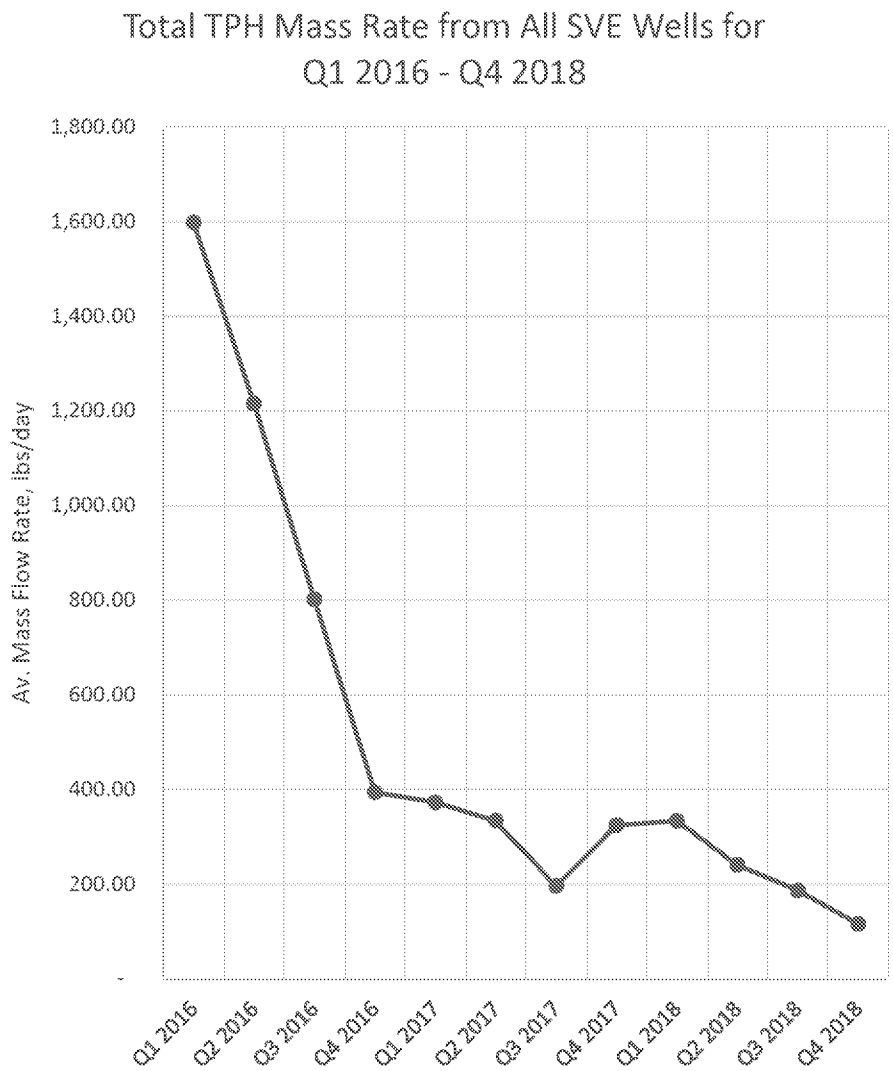
Site ST012 SVE System Performance



*Injection pipe installed in SVE04D. Flow rate averaged based on wellhead vacuum.

Site ST012 SVE System Performance



Site ST012 SVE System Performance

Mass removal rates generally highest in center of site from middle and deep intervals

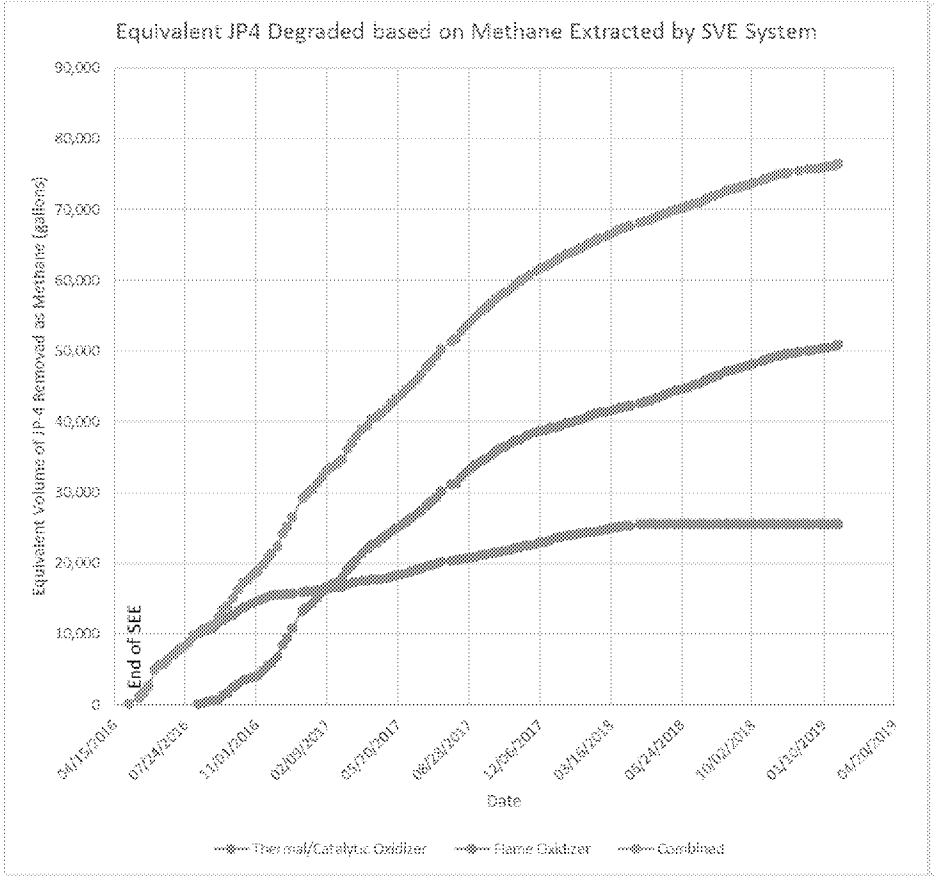
Isolated high mass removal rate in close proximity to a low concentration (closed) well

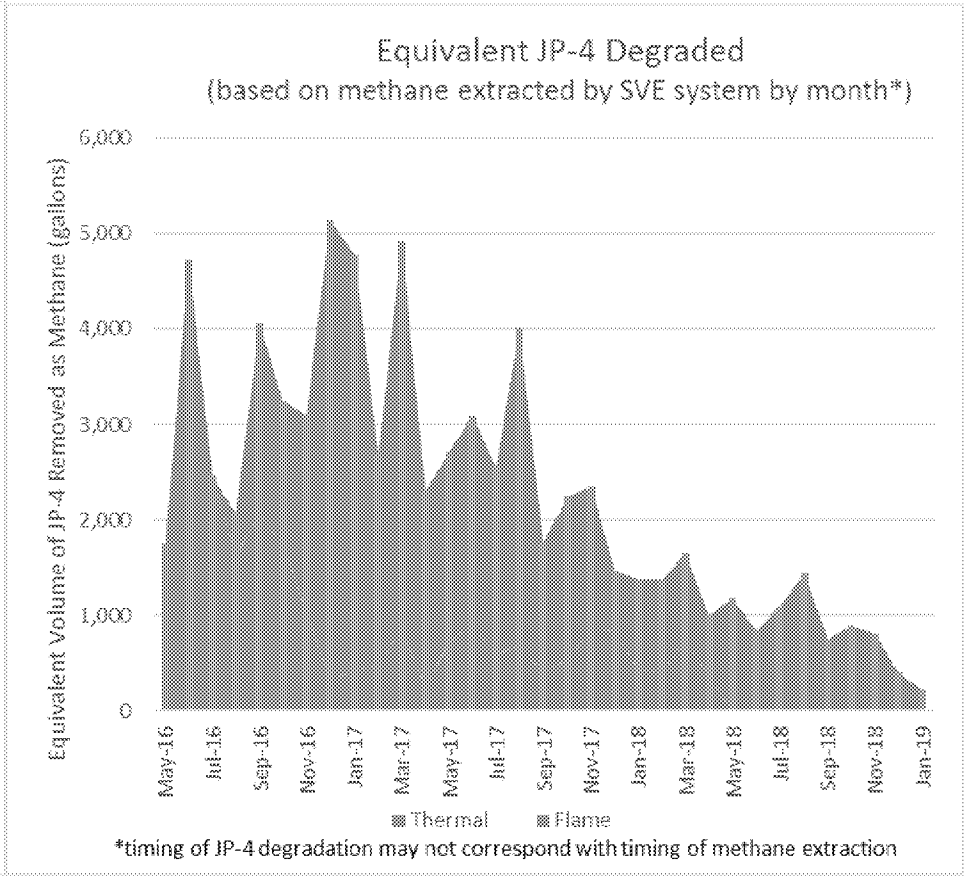
X/X/X
X/6.57/X
X/5.18/6.57
X/X/17.93
2.67
21.3
7.52
1.31/1.82/6.11
X/X/3.47
X/1.06/26.8
X/X/2.34
31.4
X
X/X/0.46

Legend

- Soil Vapor Extraction Well Location (Installed in 2013/2014)
- Nested Soil Vapor Extraction Well Location
- Decommissioned Nested Vapor Monitoring Point Location
- Groundwater Monitoring Well Location
- Decommissioned Groundwater Monitoring Well Location
- Fence Line
- ST012 Site Boundary
- S/M/D — Average Mass Flow Rate (lbs/d) in shallow/medium/deep intervals
- X — Interval Closed Throughout the Period

Site ST012 SVE System Equivalent JP-4 Degradation Based on Methane Removed





- Estimates through 31 Jan 2019.
- Estimated JP-4 degradation as methane is in addition to JP-4 removal reported for SVE
- Thermal oxidizer changed from SVE to groundwater treatment end of Apr
- Flame oxidizer treating combined SVE and air stripper intermittently since 12 Nov 2018, which may be reducing methane extraction
- Recent equivalent JP-4 degraded ~1,500 pounds per month (~225 gallons per month)

LNAPL Monitoring Update (through 25 Jan)

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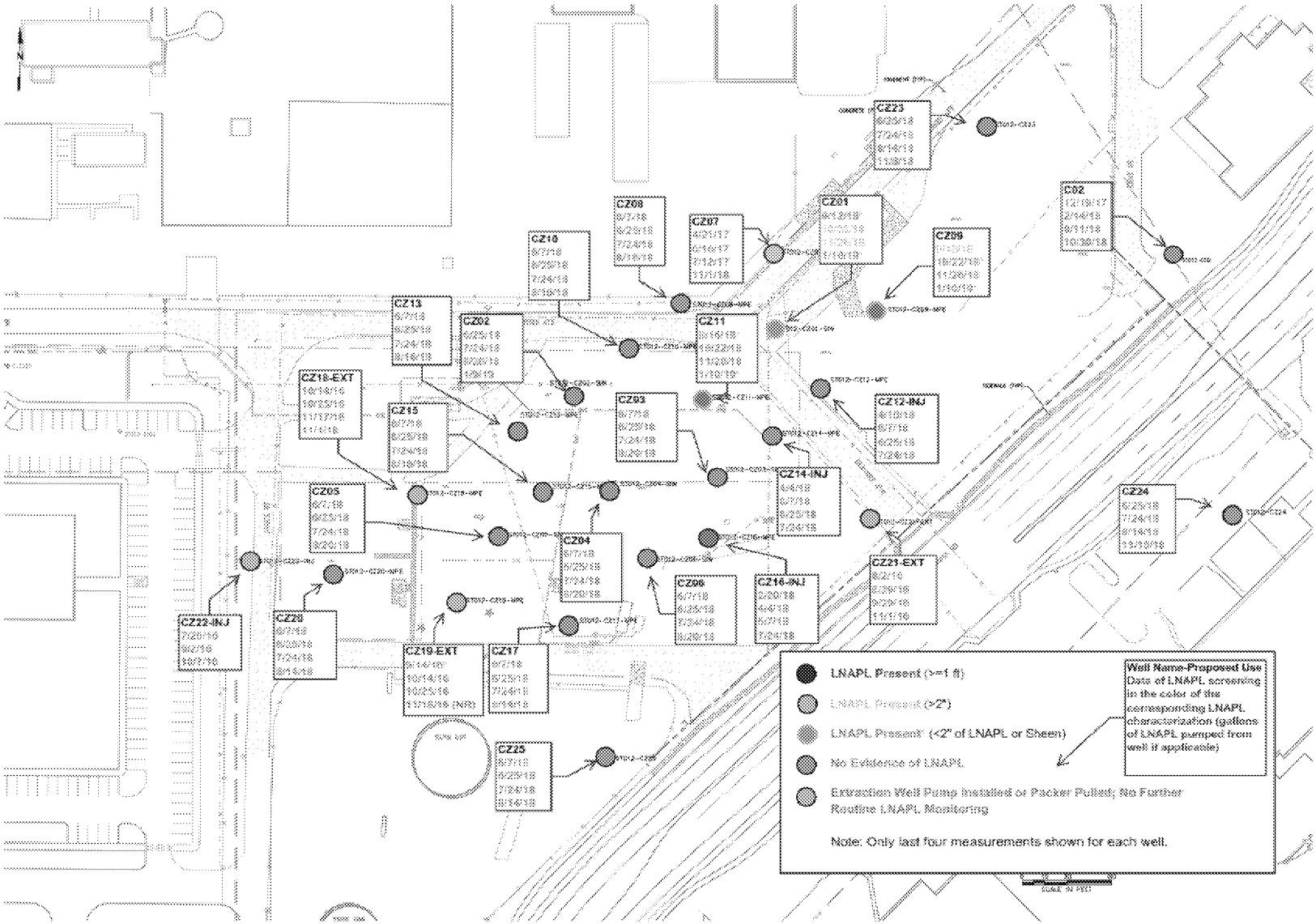
LNAPL Monitoring/Removal Status
Cobble Zone



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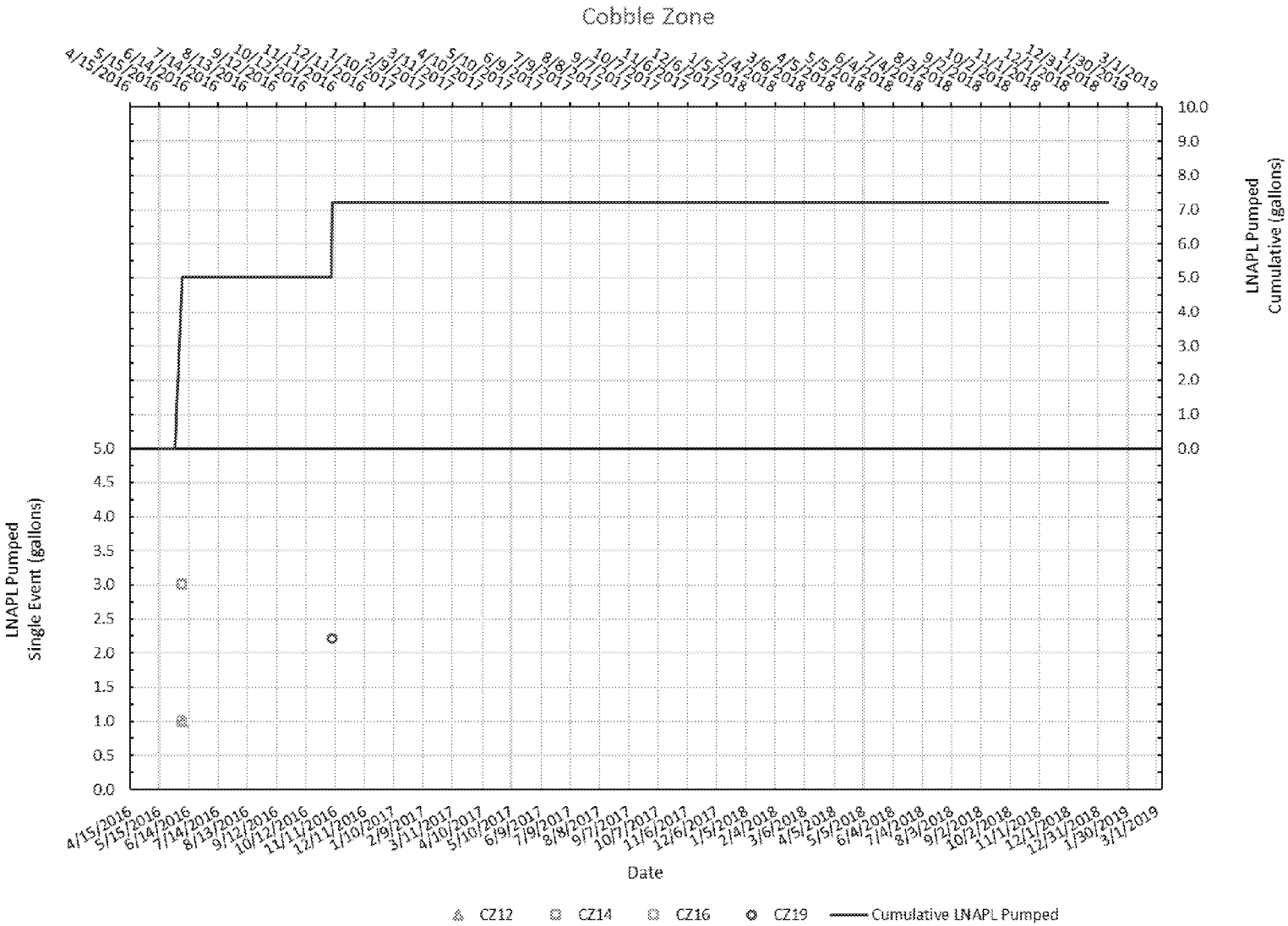
LNAPL Monitoring/Removal Status
Cobble Zone



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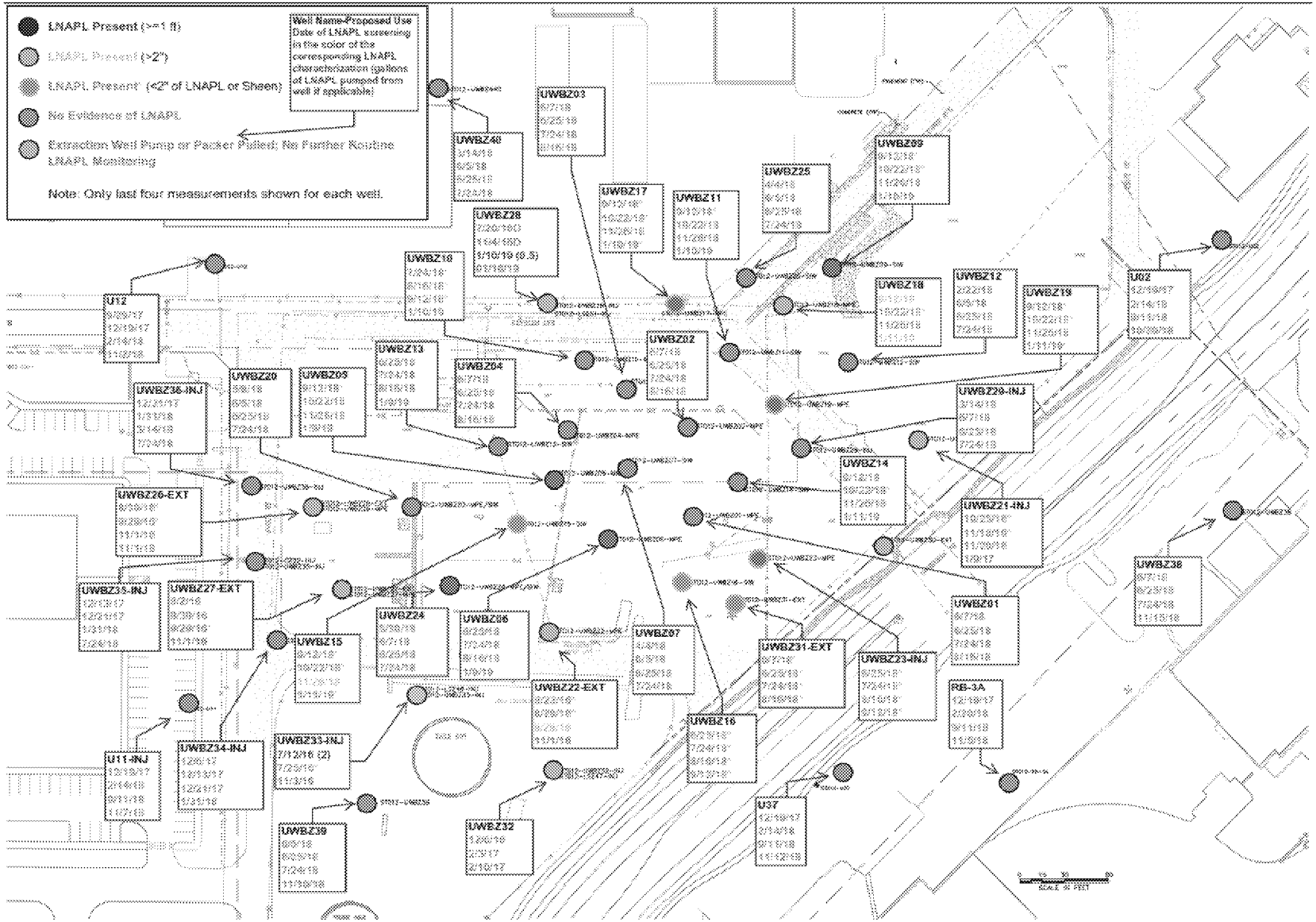
LNAPL Monitoring/Removal Status
Upper Water Bearing Zone



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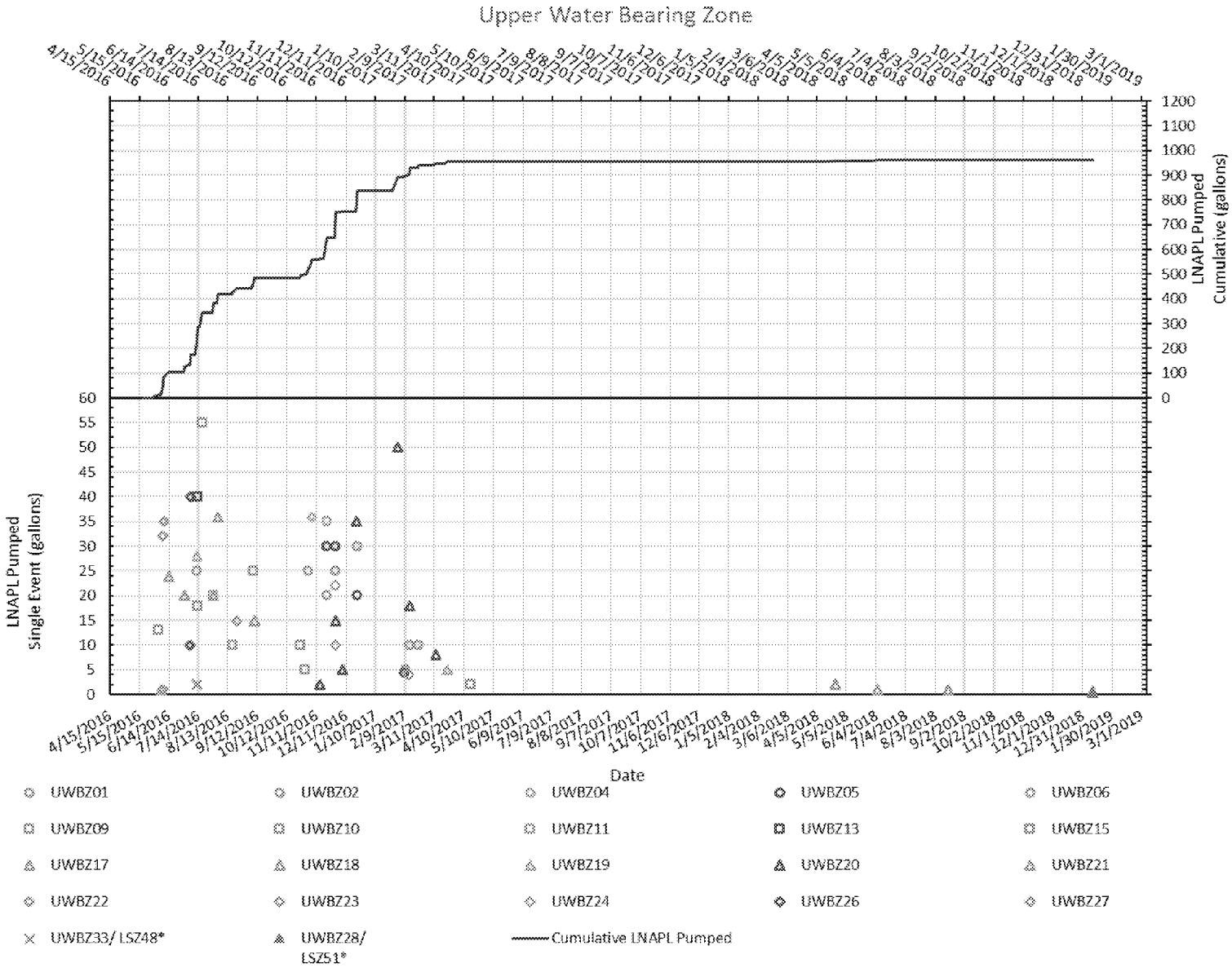
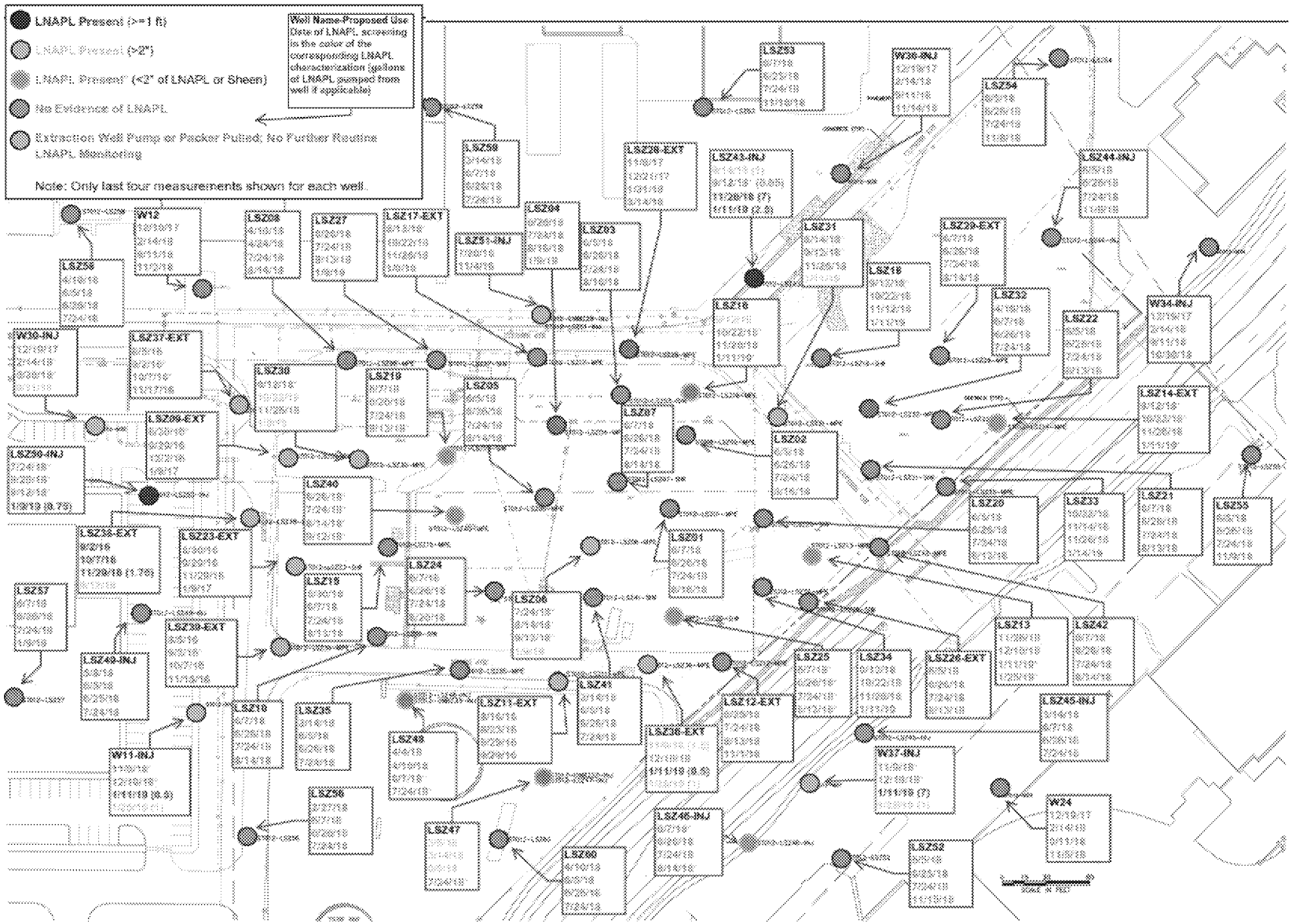
LNAPL Monitoring/Removal Status Upper Water Bearing Zone



LNAPL Monitoring/Removal Status
Lower Saturated Zone



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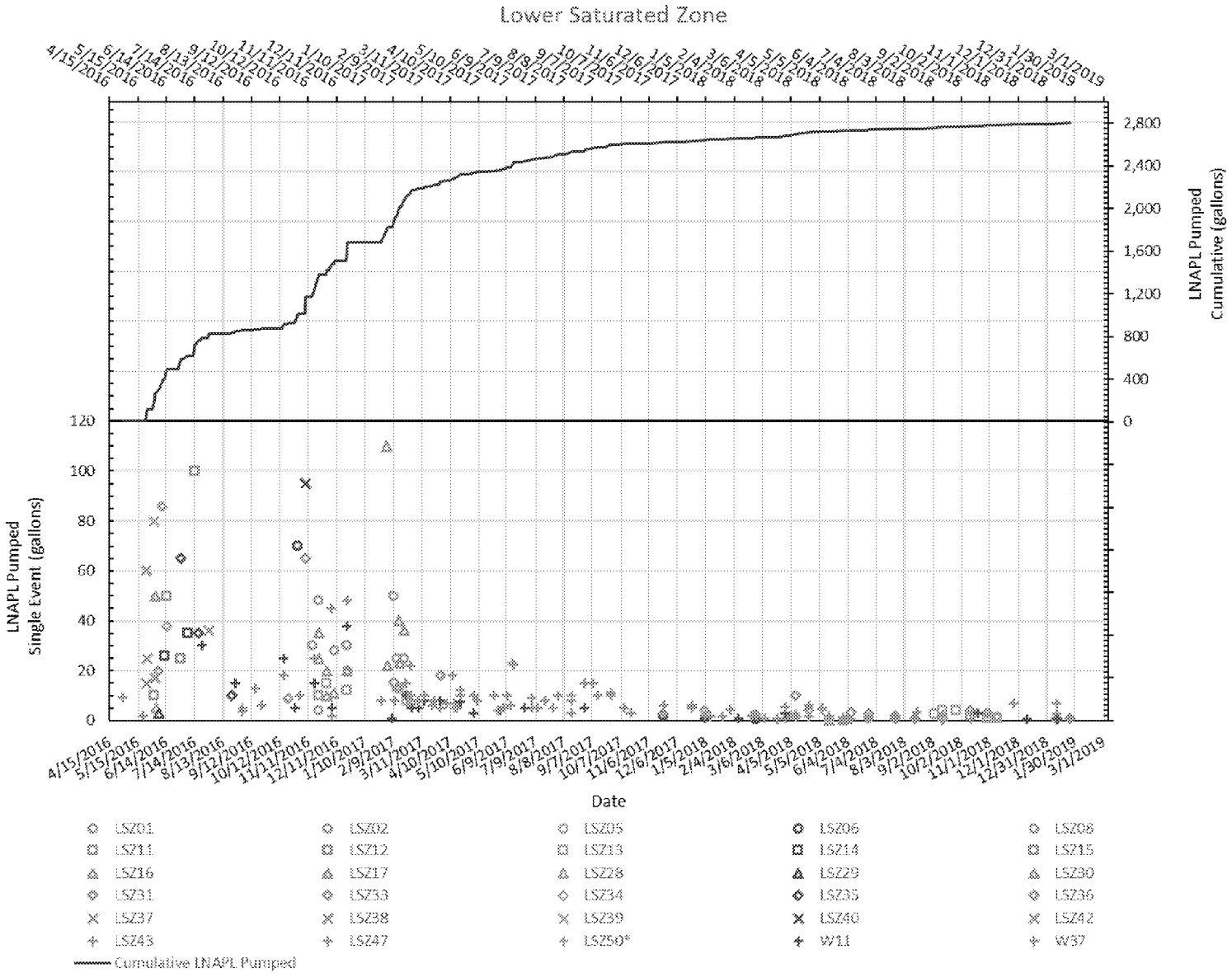
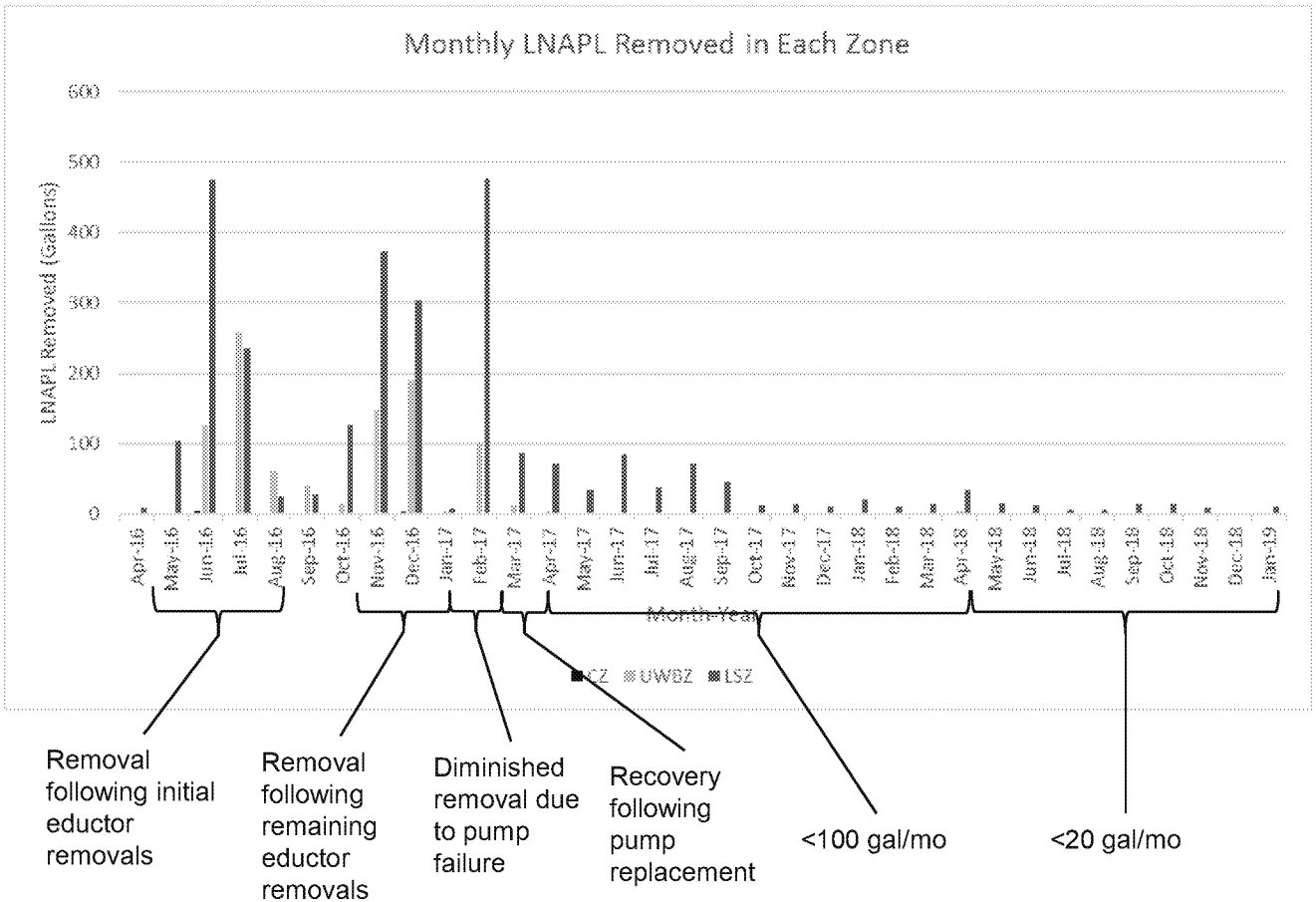
LNAPL Monitoring/Removal Status
Lower Saturated Zone



2/14/2019

ST012 LNAPL Monitoring/Removal Summary

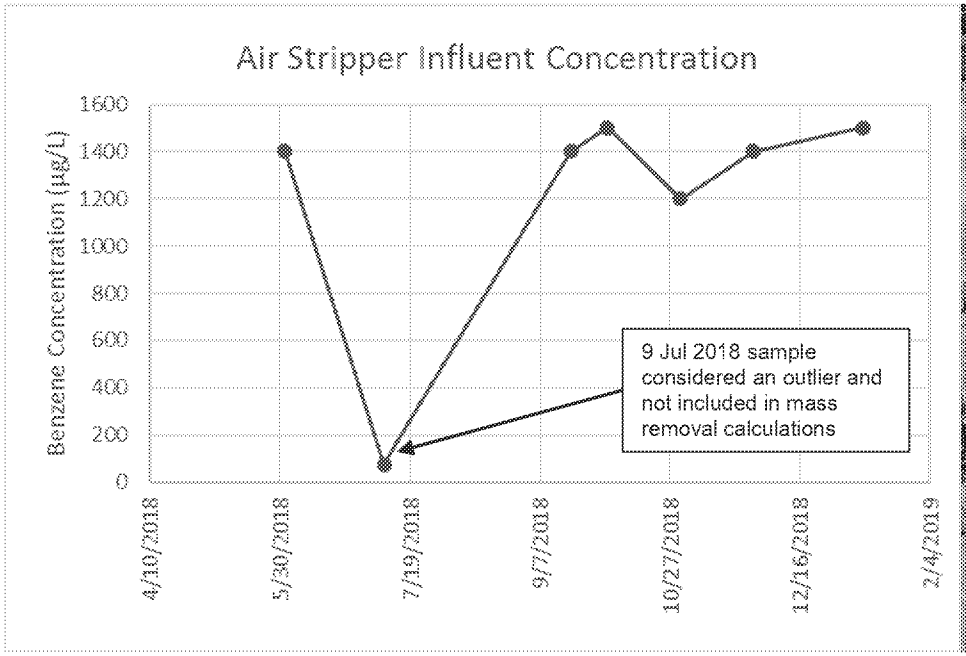
- CZ – 7 gallons of LNAPL removed. None since Nov 2016
- UWBZ - 963 gallons of LNAPL removed. None since Jan update
- LSZ - 2,803 gallons of LNAPL removed. 3 gallons removed since Jan update (W11, W37, LSZ36).

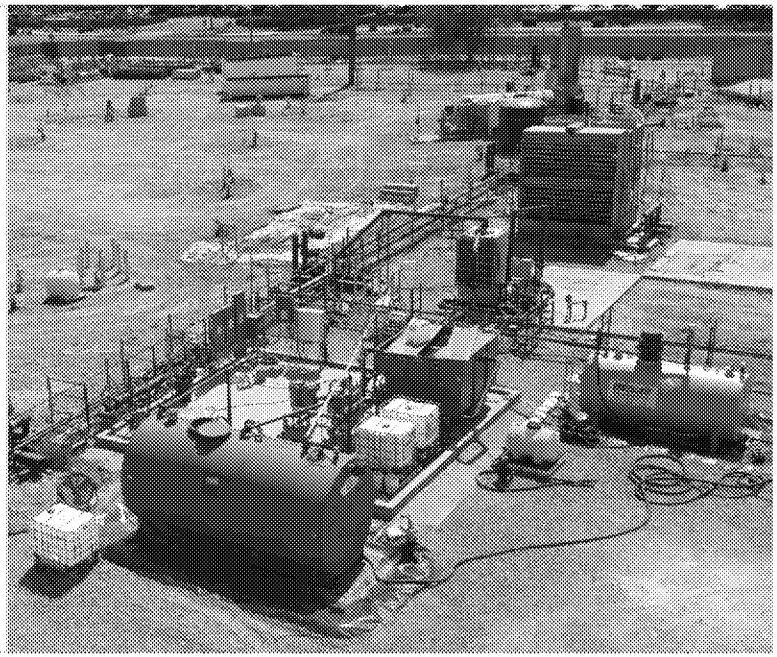


Pilot Study Injection/Extraction Update

Site ST012 Extraction System Performance

- No LNAPL has been recovered since extraction started up
- CZ07 and UWBZ27 were temporarily down (repaired and operating now)
- Benzene air stripper influent stabilized at ~1,400 µg/L





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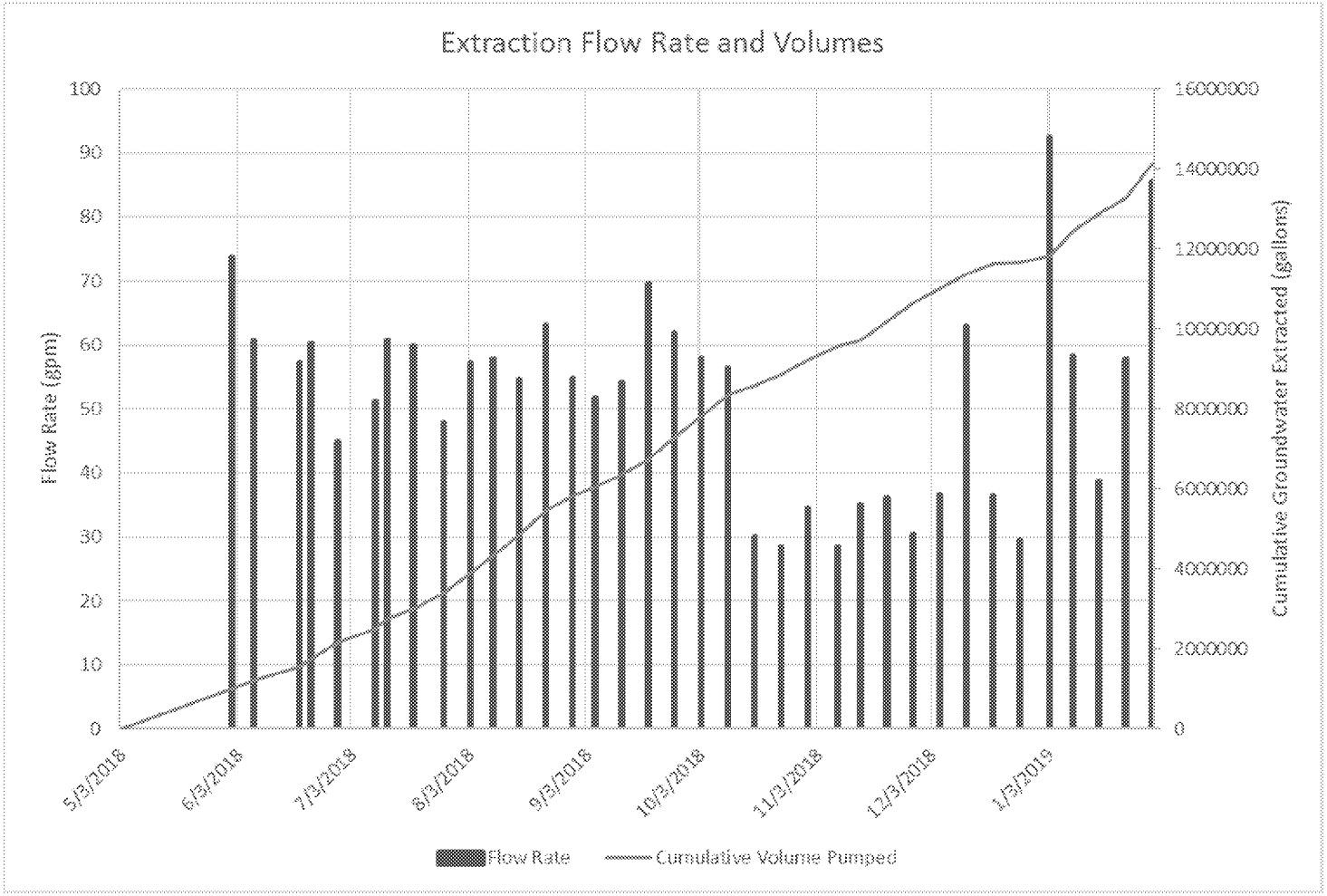
Site ST012 Extraction System Performance

- **Overall Extraction Rates and Cumulative Volume Extracted**



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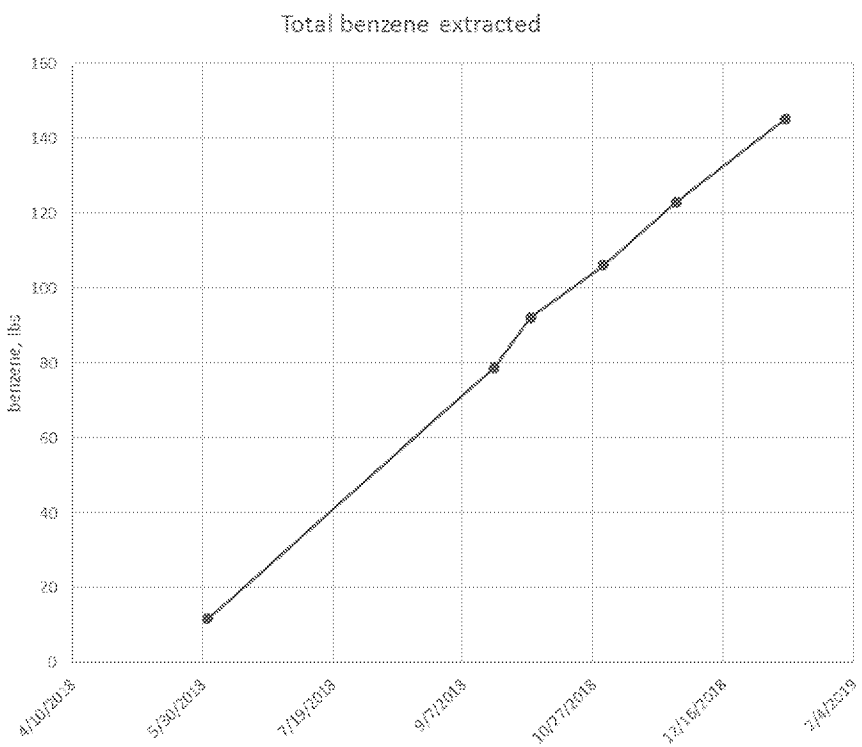
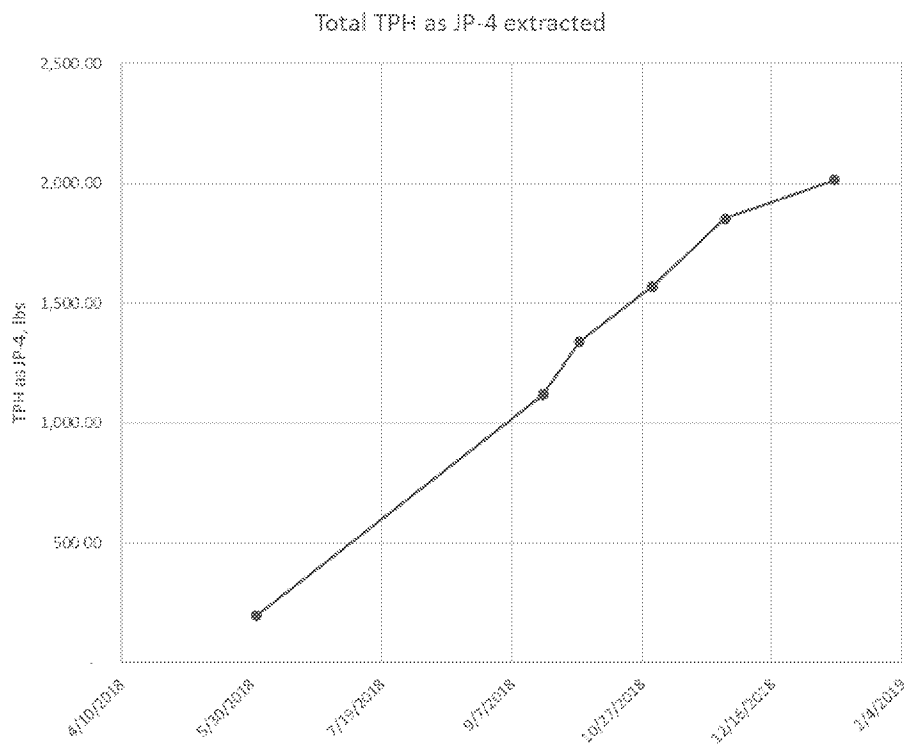
Site ST012 Extraction System Performance

- **Estimated Mass Removal by Extraction**





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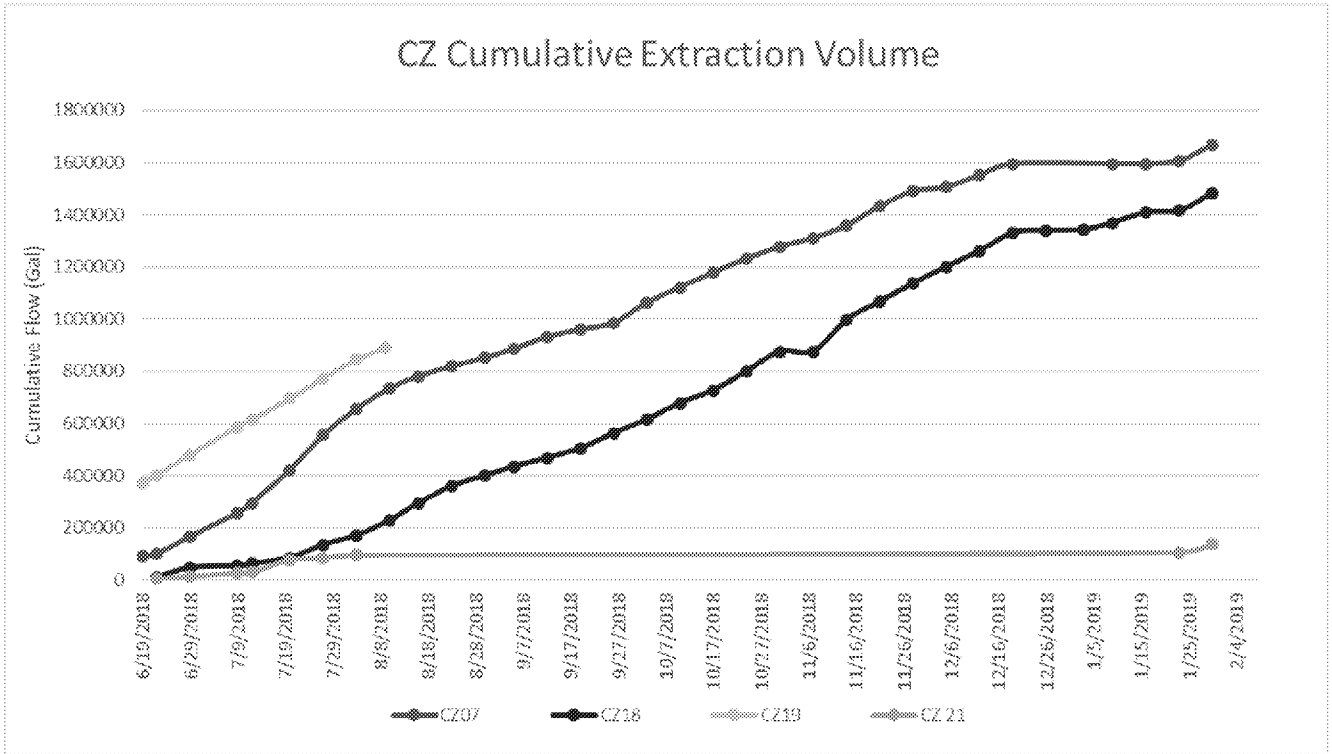
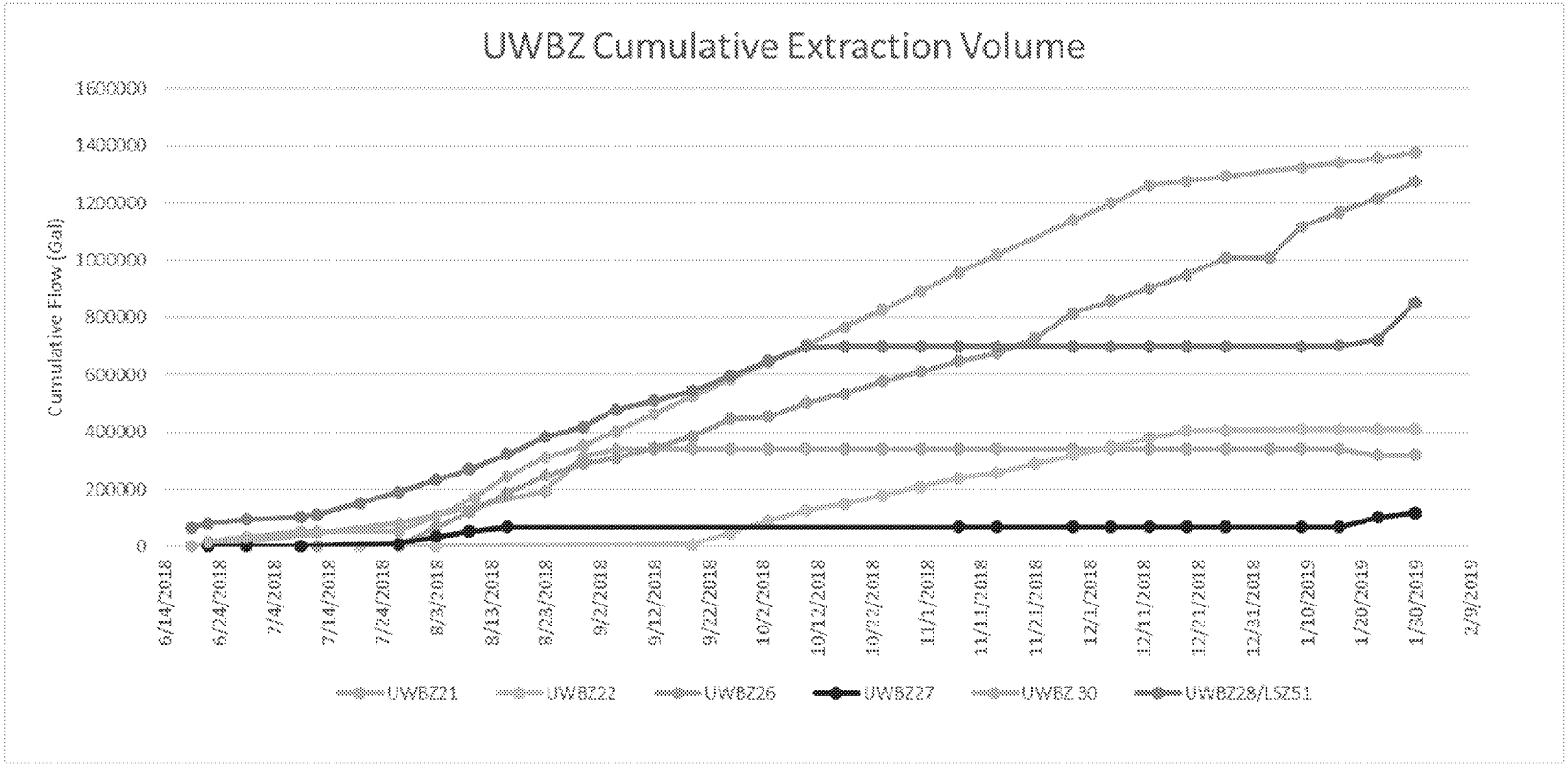
Cumulative Extraction Volume and Analytical Data by Well - Cobble Zone



Well ID	Date Sampled	Benzene Concentration, µg/L
ST012-CZ07	4/30/2018	230
	11/1/2018	600
ST012-CZ18	4/3/2018	1200
	11/1/2018	260
ST012-CZ19	5/9/2018	3.1
ST012-CZ21	4/12/2018	680

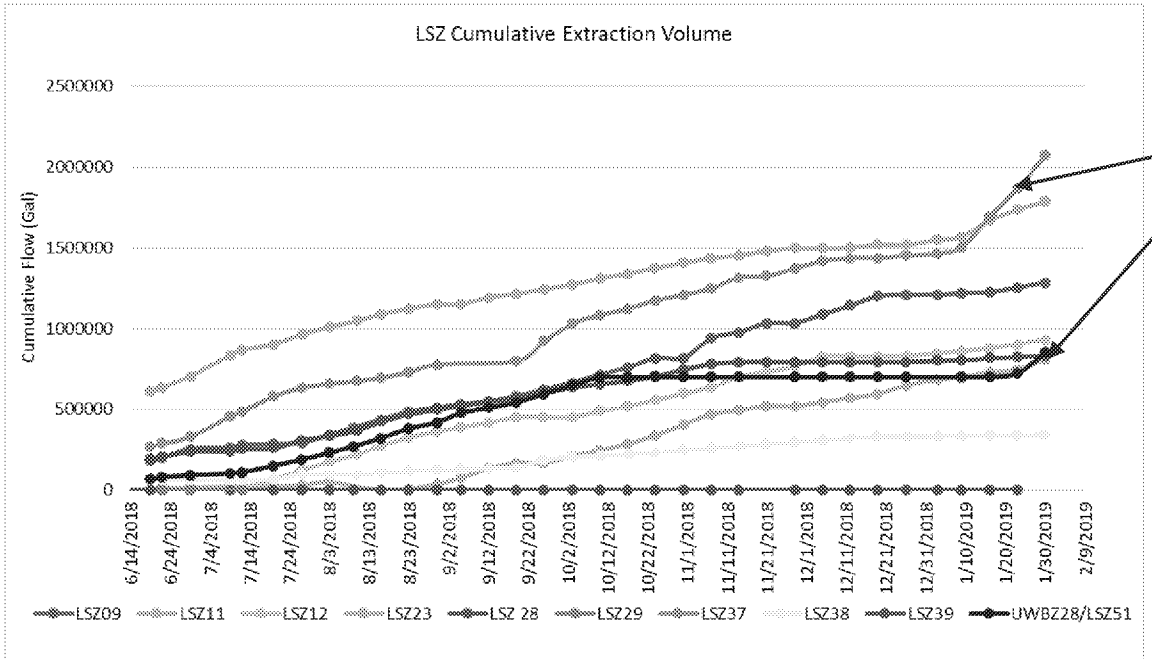
- Most recent baseline and operating (when available) benzene analytical result listed
- Many extraction wells have only had one sample analyzed for the re-baseline event
- Individual well concentrations may be reduced with pumping
- Mass removal estimates by well using the available analytical data overestimates benzene removal compared to overall estimates at the air stripper influent

Cumulative Extraction Volume and Analytical Data by Well - Upper Water Bearing Zone



Well ID	Date Sampled	Benzene Concentration, µg/L
ST012-UWBZ21	8/9/2017	3400
ST012-UWBZ22	5/9/2018	1900
ST012-UWBZ26	4/3/2018	3500
	4/3/2018	3700
ST012-UWBZ27	4/3/2018	1500
ST012-UWBZ28/LSZ51	5/9/2018	1700
ST012-UWBZ30	5/9/2018	6000

Cumulative Extraction Volume and Analytical Data by Well - Lower Saturated Zone



Flow meter at LSZ37 and LSZ39 being investigated. Recent readings may be erroneous.

Well ID	Date Sampled	Benzene Concentration, µg/L
ST012-LSZ09	4/3/2018	2100
ST012-LSZ11	5/9/2018	2100
ST012-LSZ12	5/9/2018	1400
	11/1/2018	420
ST012-LSZ23	4/3/2018	1600
ST012-LSZ28	12/1/2016	110
ST012-LSZ29	4/10/2018	2.1
ST012-LSZ37	4/12/2018	2700
ST012-LSZ38	4/3/2018	3000
	11/1/2018	1300
ST012-LSZ39	4/12/2018	3100
ST012-LSZ39	4/12/2018	5500
ST012-UWBZ28/LSZ51	5/9/2018	1700

Site ST012 Injection Progress

- **Injections continued in Jan-Feb**

Date	Volume (gallons)	Number of Bags of Sulfate Added	Calculated Na2SO4 Conc. g/L	Calculated SO4 Conc. g/L	Location
11/12/2018	10,000	6	144	97	UWBZ33
12/4/2016	10,000	4	96	65	UWBZ33
1/9/2019	10,000	4	96	65	UWBZ33
1/16/2019	10,000	5	120	81	UWBZ33
1/24/2019	10,000	4	96	65	UWBZ33
1/29/2019	5000	2	96	65	UWBZ36
2/5/2019	7500	3	96	65	UWBZ33
2/6/2019	7500	3	96	65	UWBZ33

- **Cold weather practical limit has been ~96 g/L of sodium sulfate (~65 g/L of sulfate)**
- **Initial injections in UWBZ33 complete**
- **Fresh delivery of sodium sulfate from supplier has significantly less caking**
- **Will be initiating multi-well injections**

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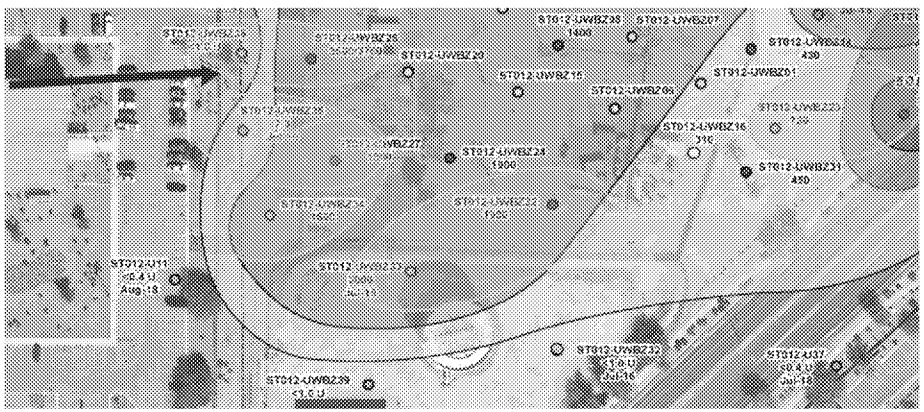
Site ST012 Sulfate Field Screening

- **Estimated travel times (from work plan, App F figures)**
  - **UWBZ33 to UWBZ22 (130 ft): up to 10 months**
  - **UWBZ33 to UWBZ27 (115 ft): up to 15 months**
  - **UWBZ36 to UWBZ26 (60 ft): 1-2 months**
- **Model predicts sulfate concentrations would increase at extraction locations for several months before decreasing**
- **Sulfate field tests completed weekly in wells in proximity to injections**
- **Sporadic increases, but no significant trend or sustained increases demonstrating sulfate migration to extraction wells to date**
- **Extraction may be pulling in water with higher sulfate at UWBZ26**

Injection Point	Extraction Well	Date	Sulfate (mg/L)
UWBZ-33	UWBZ-22 (average pre-injection laboratory sulfate = 11 mg/L)	12/17/2018	*30*
		12/21/2018	*45*
		12/26/2018	146
		1/15/2019	45
		1/18/2019	40
		1/21/2019	38
		1/24/2019	41
		1/25/2019	250
		1/28/2019	10
		1/29/2019	35
		1/31/2019	89
		2/1/2019	57
		2/5/2019	37
	UWBZ-27 (average pre-injection laboratory sulfate = 108 mg/L)	12/17/2018	*15*
		12/21/2018	*30*
		12/26/2018	>150
		1/15/2019	71
		1/18/2019	57
		1/21/2019	66
		1/24/2019	48
		1/25/2019	50
		1/28/2019	pump down
		1/29/2019	pump down
		1/31/2019	pump down
		2/1/2019	pump down
		2/5/2019	pump down
UWBZ-36	UWBZ-26 (average pre-injection sulfate = 3.6 mg/L)	1/31/2019	22
		2/1/2019	9
		2/5/2019	25

Site ST012 Path Forward Feb-Mar

- **Continued SVE operation**
- **Pilot Study Implementation**
  - **Continue mixing sulfate batches and inject according to plan (FVM7) Feb – Mar (continuing injection of batches in UWBZ36 this week)**
  - **Quarterly sampling starting this week**
    - Extraction wells, perimeter wells, and injection/monitoring wells in areas of completed injections
  - **Next planned injection wells UWBZ35, UWBZ34 with simultaneous injections**



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