Air Force Civil Engineer Center

FORMER
WILLIAMS AIR FORCE BASE

Site ST012

Former Liquid Fuel Storage Area

BCT Conference Call

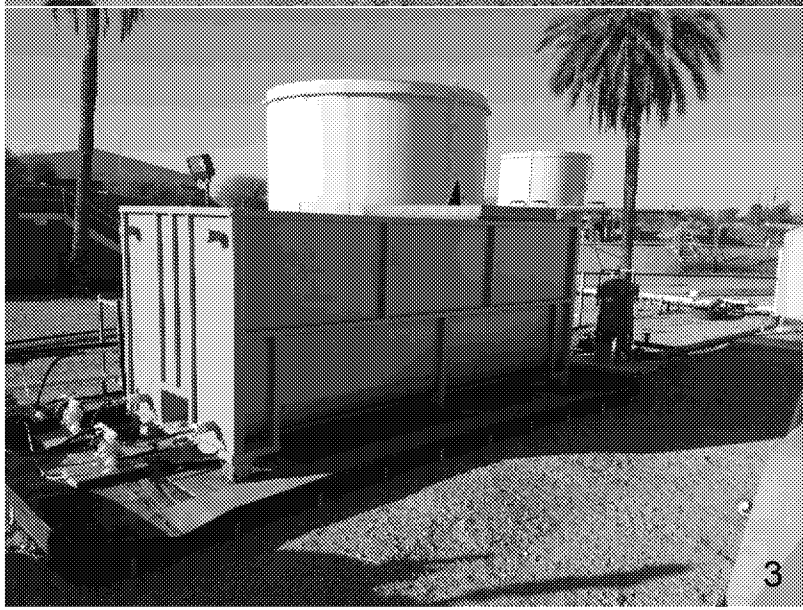
13 December 2018

Site ST012 Outline

- Summary of activities since Nov BCT call
- Update on SVE system (JP-4 equivalent of methane)
- LNAPL monitoring/removal update
- Update on regression analysis for BTEX compounds
- Summary of November groundwater monitoring benzene results
- Pilot study extraction/injection update
- Path forward

Site ST012 Activities Since November

- **Continued SVE operation**
- **Continued LNAPL screening in accessible wells**
- **Annual groundwater sampling event (plus select perimeter wells)**
- **Operation of Extraction and Treatment**
  - **Perform pump maintenance and repair as needed**
    - One new pneumatic pump installed
    - One new pneumatic pump hose repaired
    - One replacement electrical submersible pump installed (still down on electrical error)
  - **Four additional pumps on order**



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JP-4 Degradation Based on Methane Removed with SVE (through 6 Dec)

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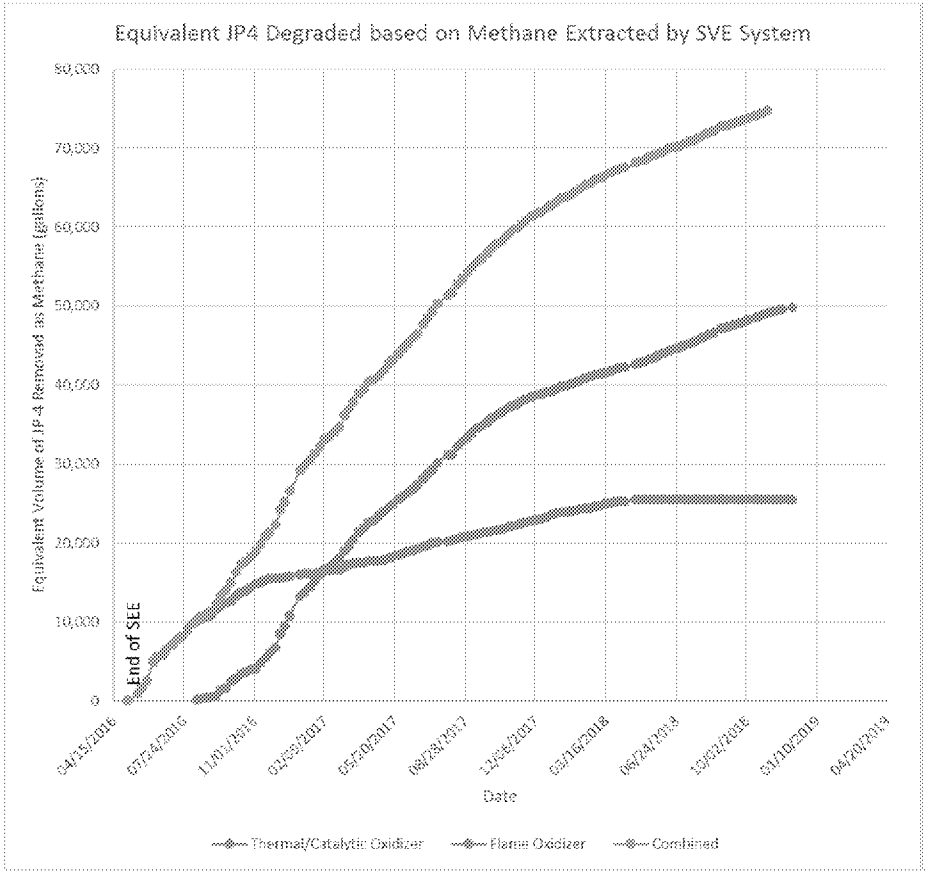
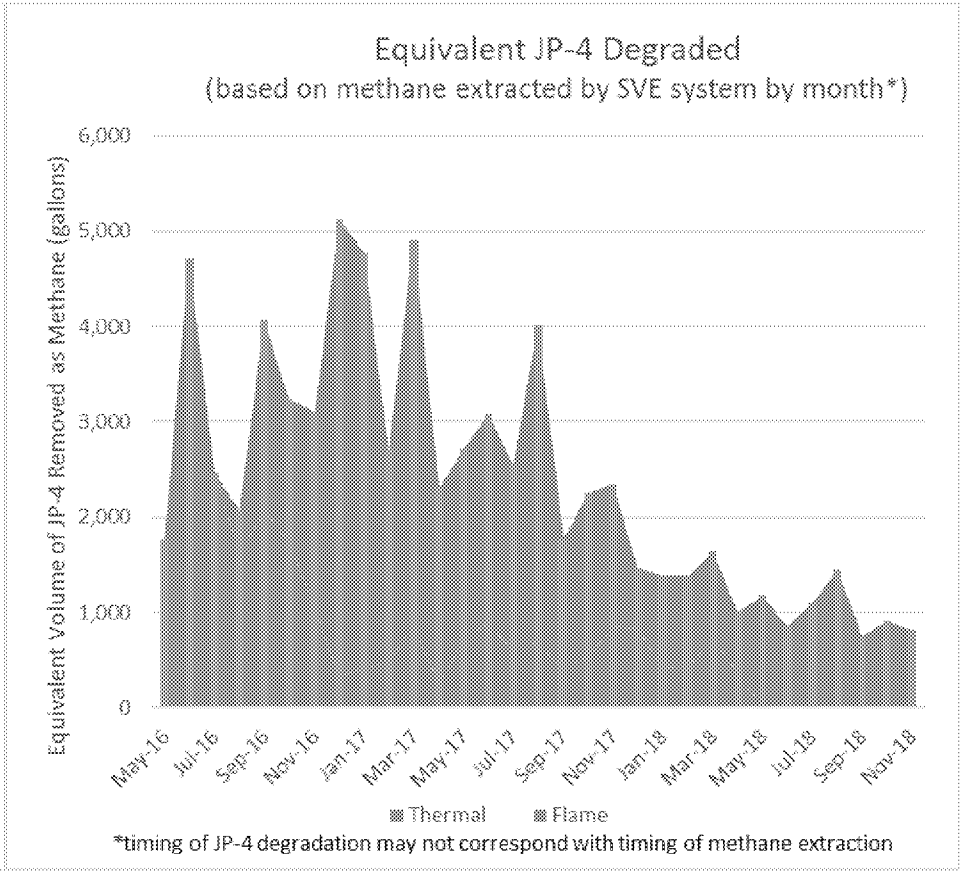
Site ST012 SVE System Equivalent JP-4 Degradation Based on Methane Removed





- Estimates revised down from previous reports due to change in formula used for SVE flow rates at oxidizers (will affect previously presented TPH summaries as well)
- Estimates through 6 Dec 2018.
- 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
- Recent equivalent JP-4 degraded ~7,000 pounds per month (~1,000 gallons per month)

LNAPL Monitoring Update (through 10 Dec)

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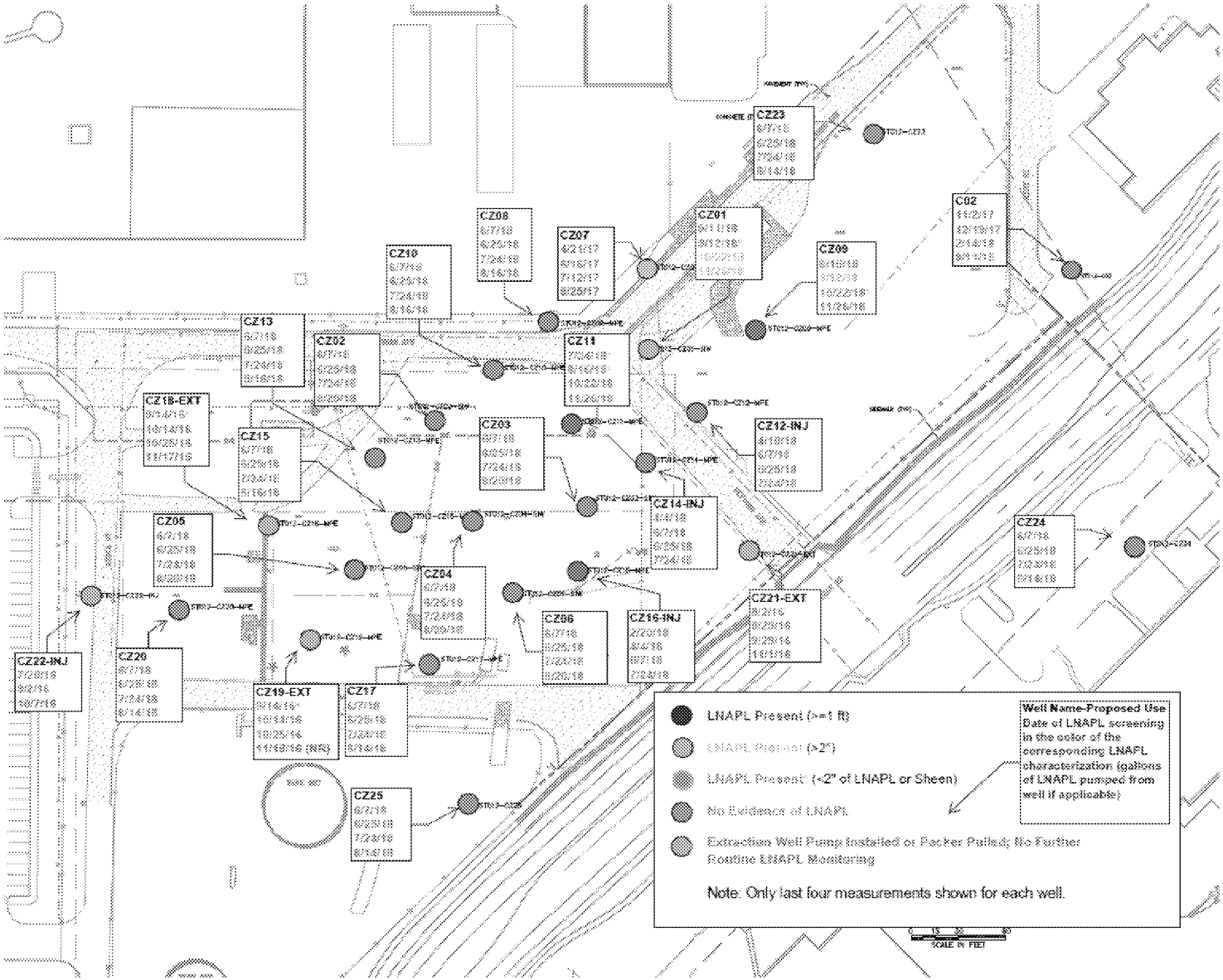
LNAPL Monitoring/Removal Status
Cobble Zone



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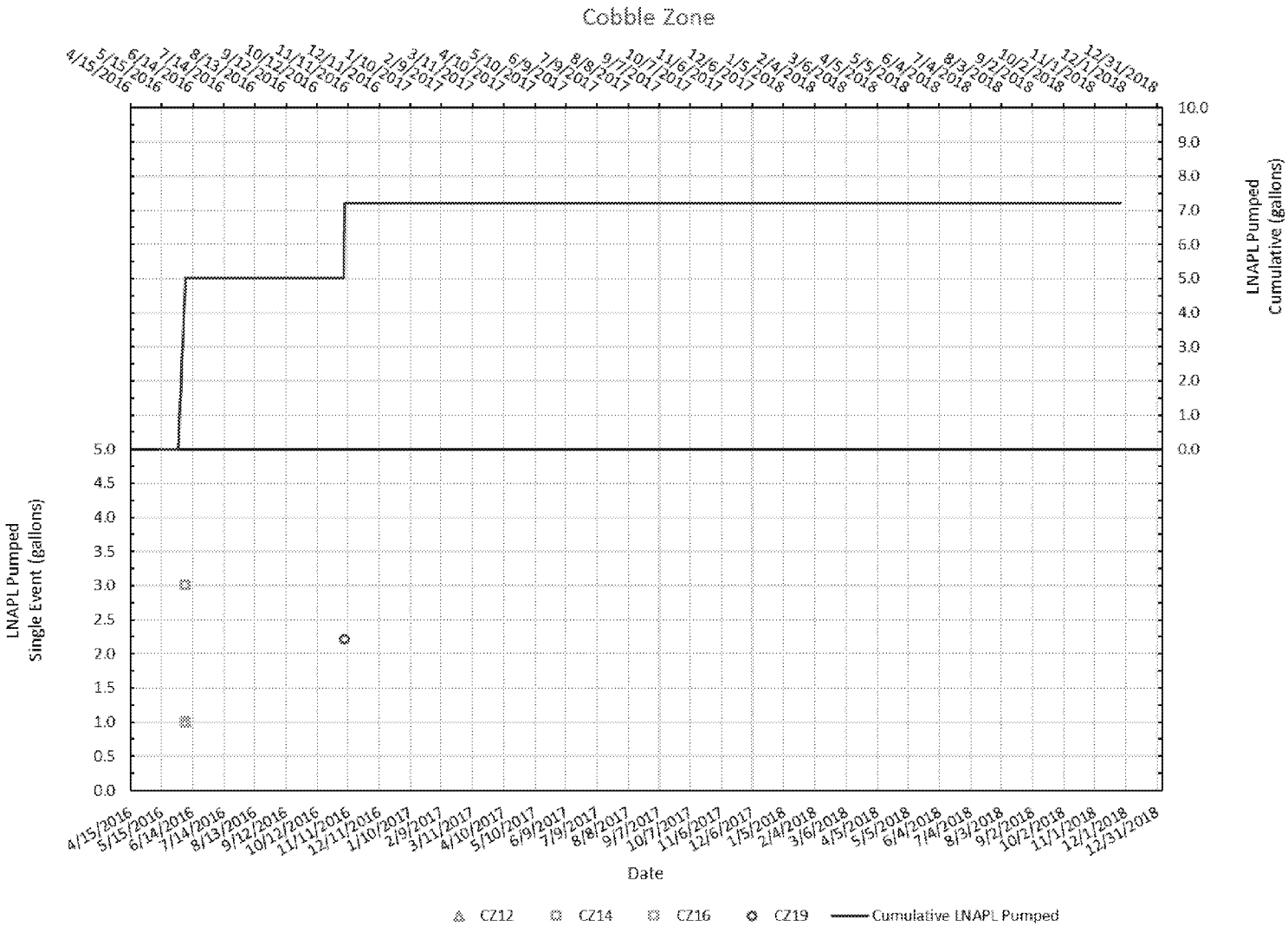
LNAPL Monitoring/Removal Status
Cobble Zone



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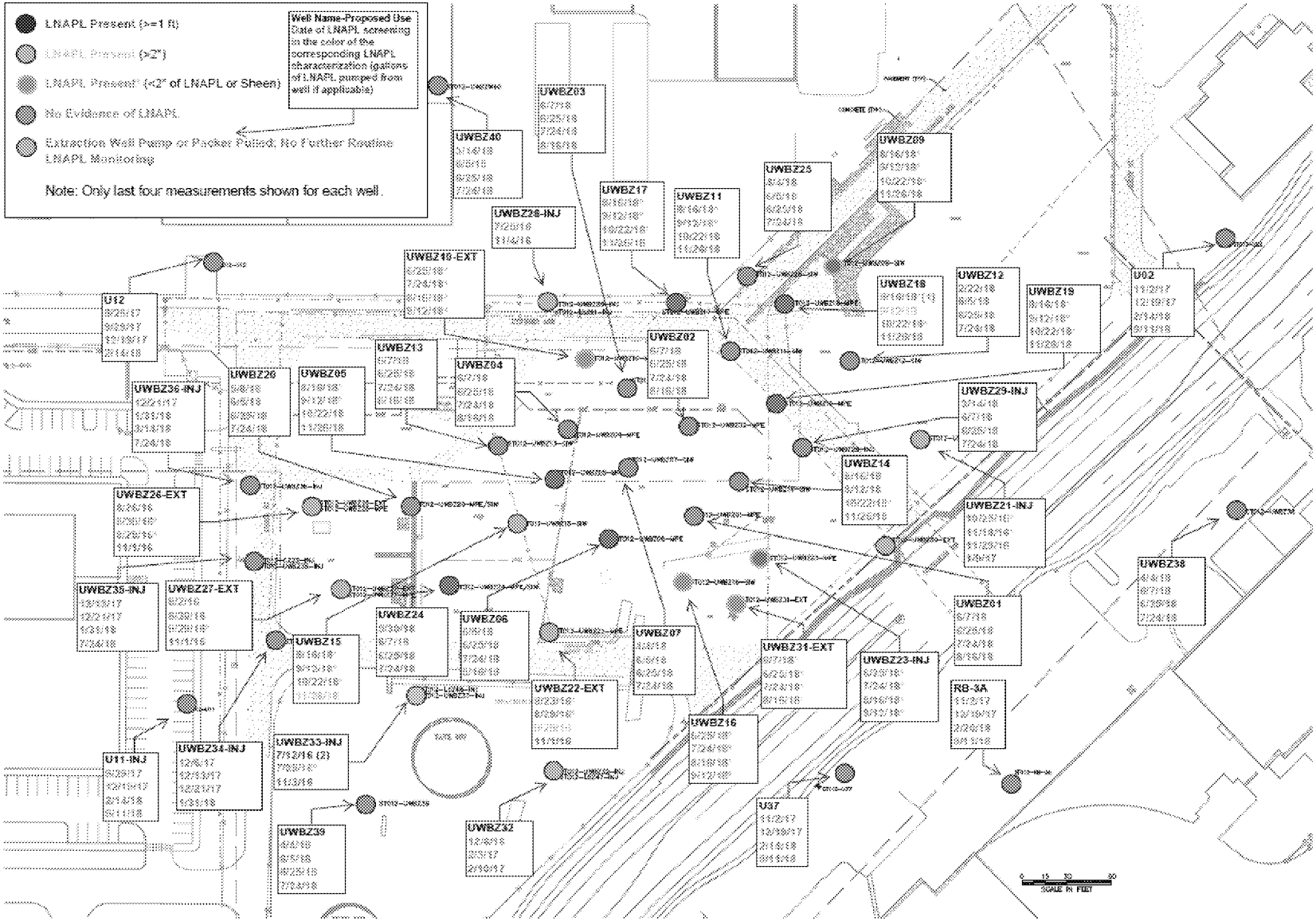
LNAPL Monitoring/Removal Status
Upper Water Bearing Zone



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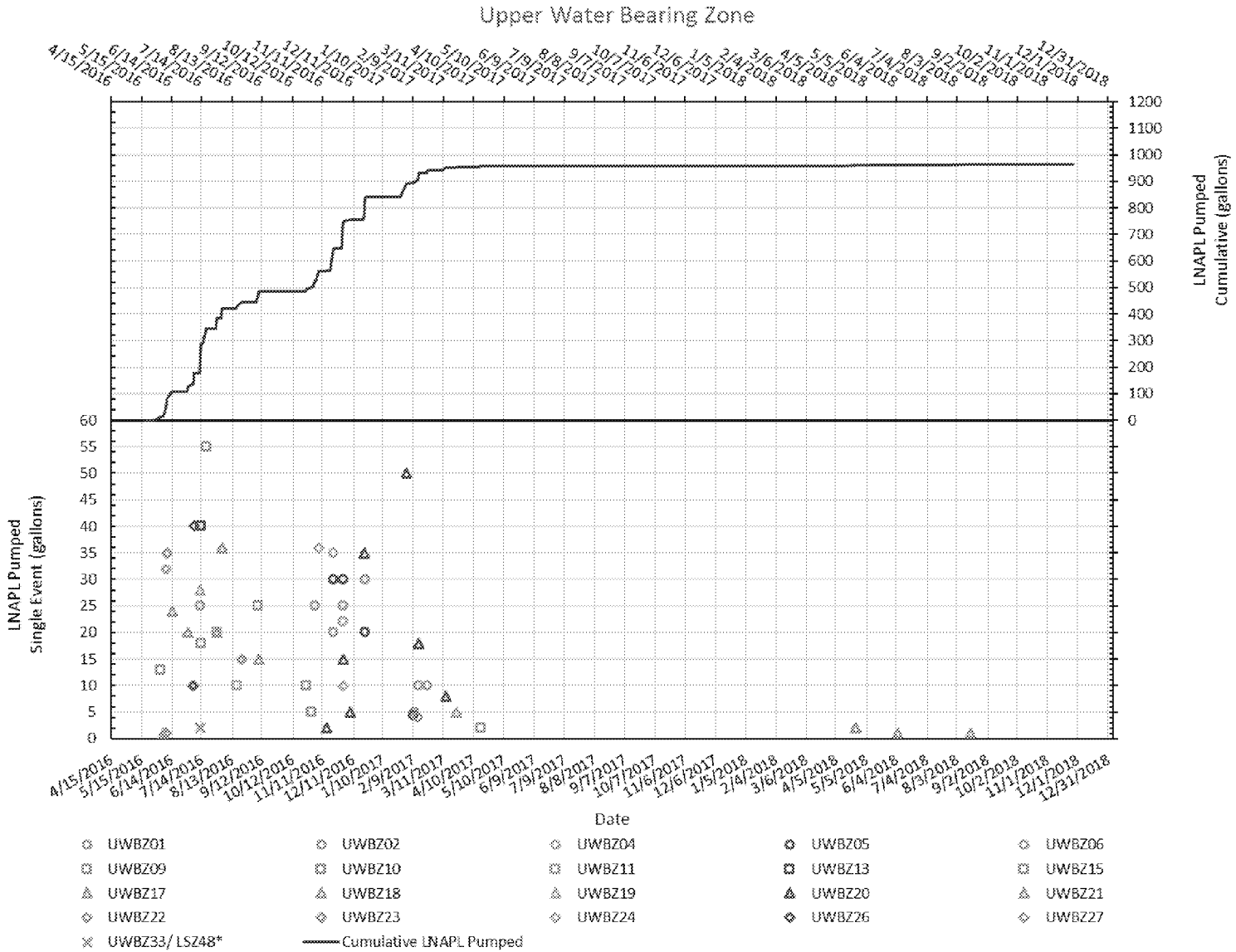
LNAPL Monitoring/Removal Status
Upper Water Bearing Zone



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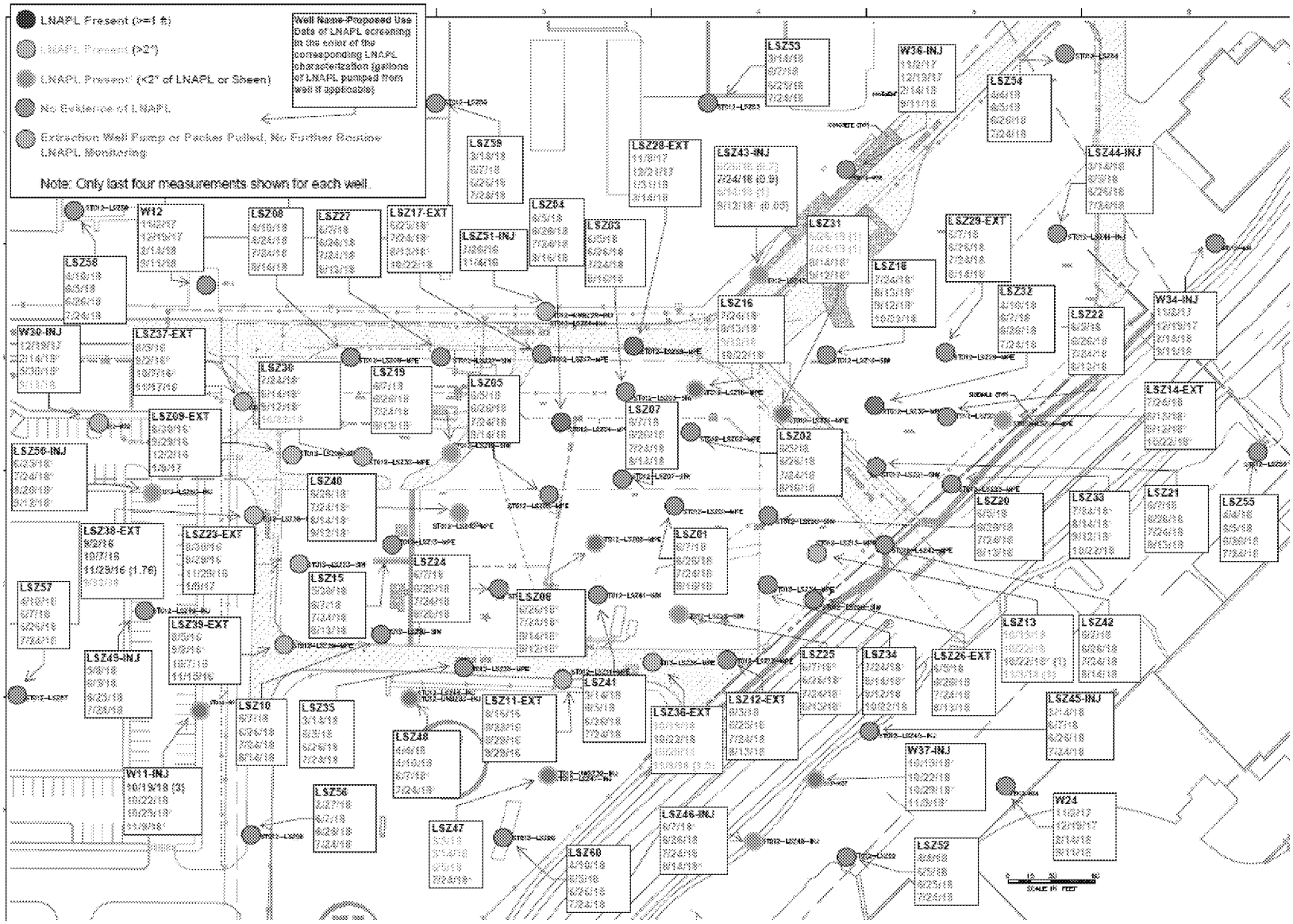
LNAPL Monitoring/Removal Status
Lower Saturated Zone



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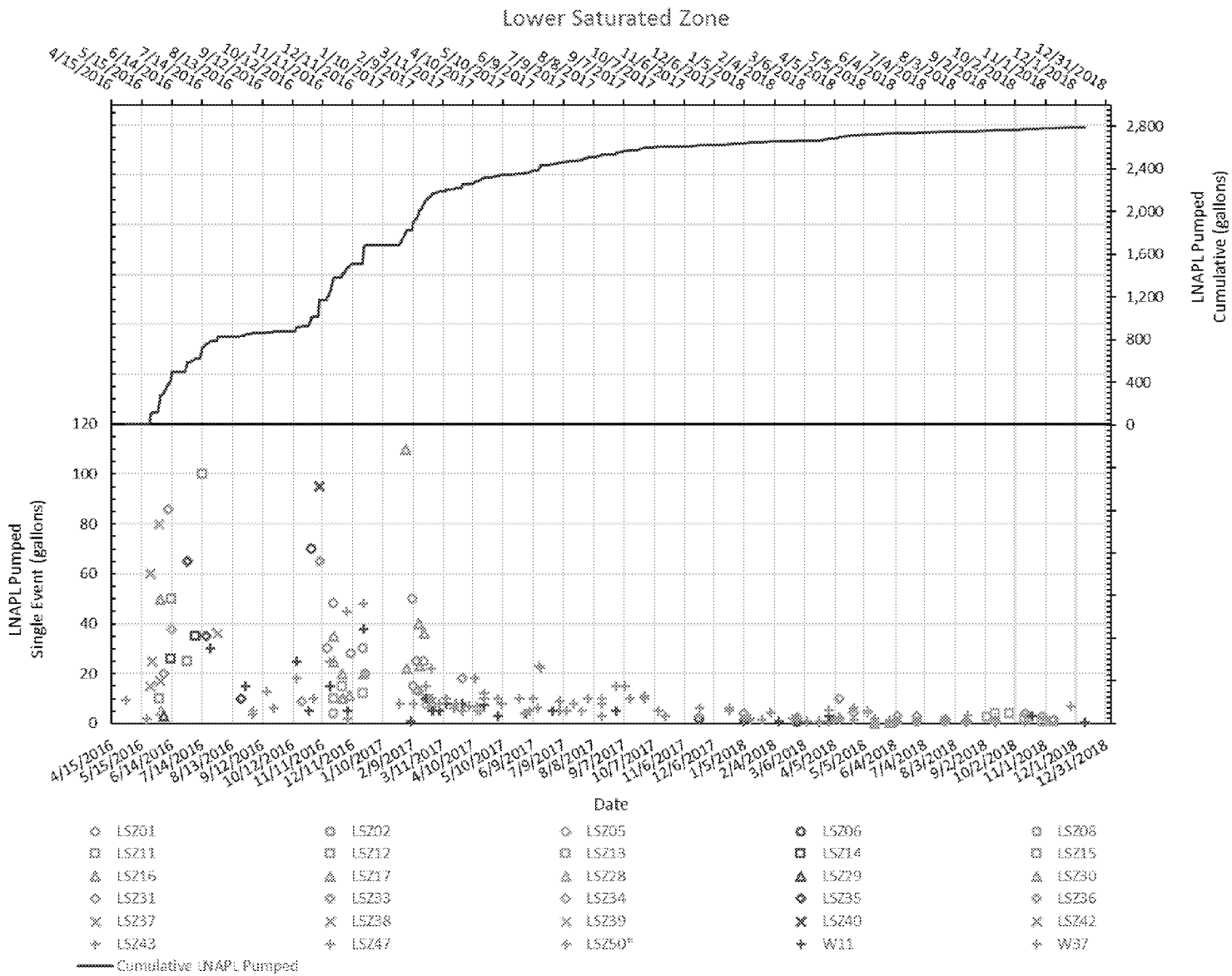
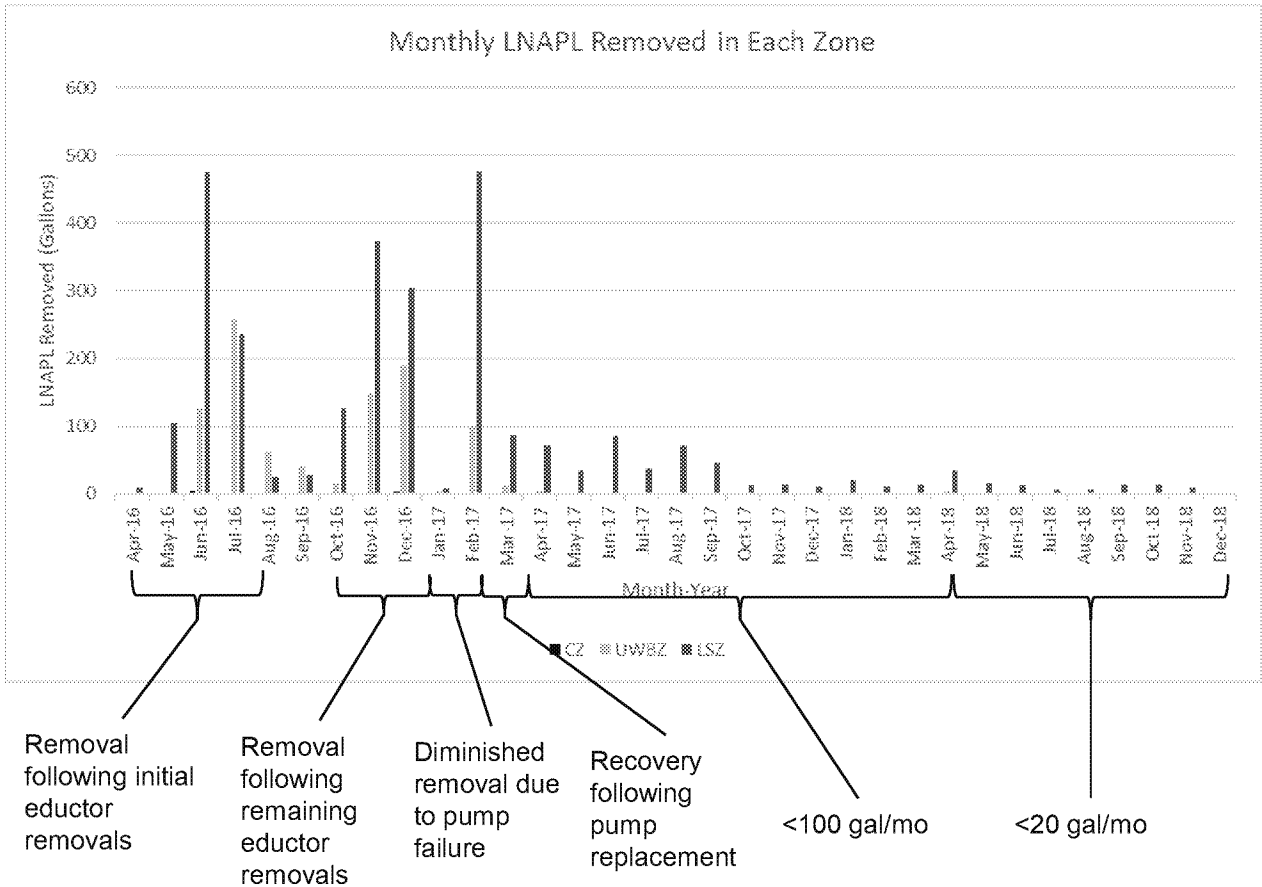
LNAPL Monitoring/Removal Status
Lower Saturated Zone



ST012 LNAPL Monitoring/Removal Summary

- CZ – 7 gallons of LNAPL removed. None since Nov 2016
- UWBZ - 962 gallons of LNAPL removed. None removed since Sep update
- LSZ - 2,789 gallons of LNAPL removed. 8 gallons removed since Nov update (W11, LSZ43).



Update on Statistical Correlation Evaluation for BTEX and TEAs

Statistical Correlation Update

- Statistical correlation presented in Oct for nitrate-benzene and sulfate-benzene
- This update adds the other BTEX compounds (toluene, ethylbenzene, and xylenes)
- Included groundwater data for perimeter wells since Jan 2015 and interior wells since SEE through August 2018

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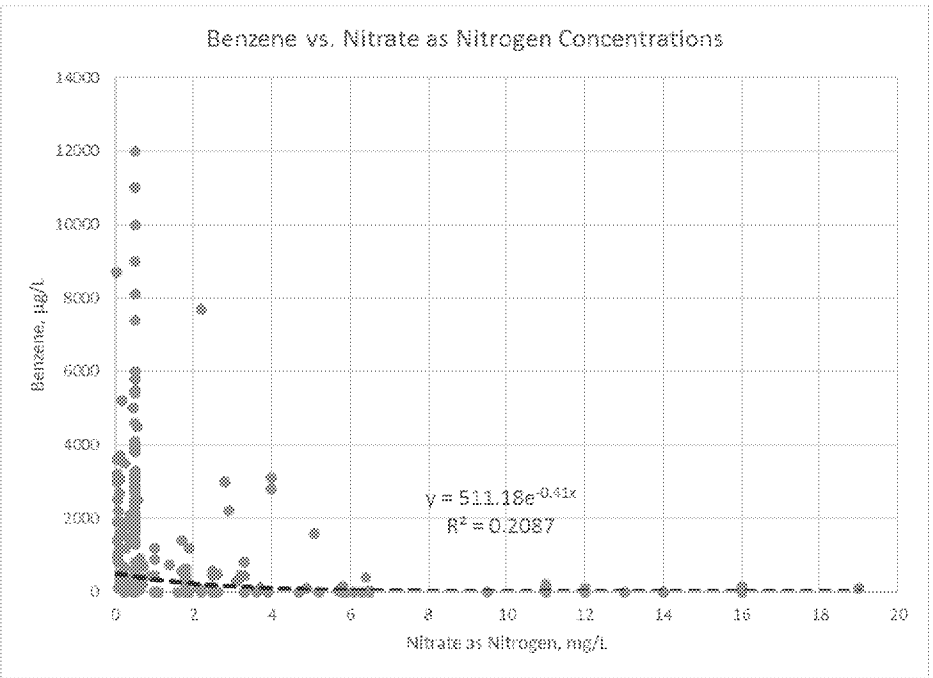
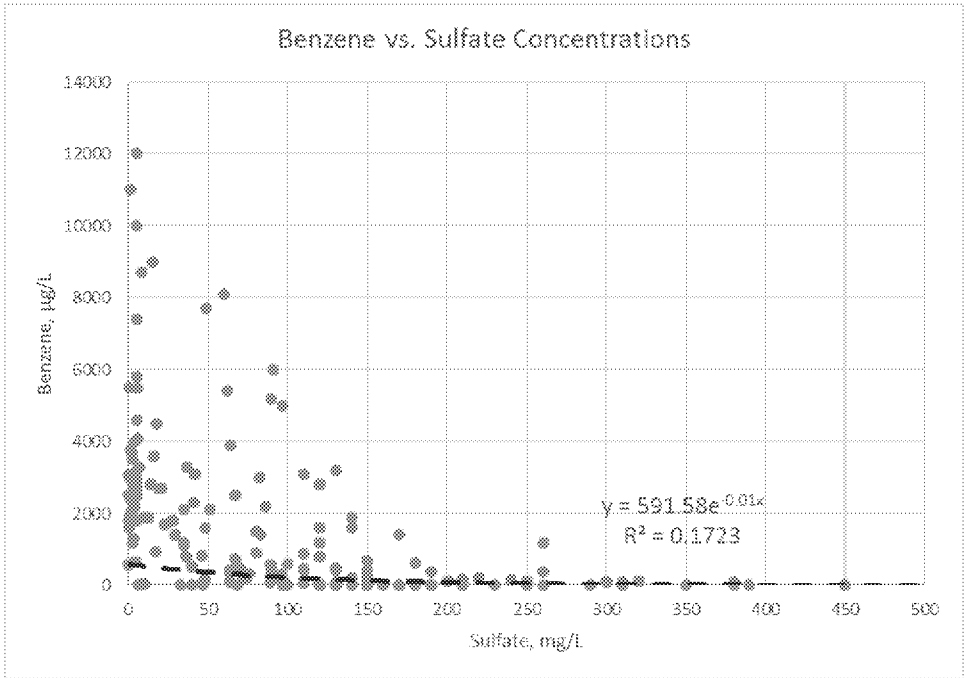
Site ST012 Regression Analysis Benzene

- **Overall nitrate and sulfate concentrations are statistically inversely correlated with benzene concentrations**
- **P values, a measure of correlation, are < 0.00003 (i.e., >99.997% probability that parameters are correlated; 95% [P<0.05] is typically considered significant correlation)**
- **R^2 values (0.21 and 0.17) , a measure of how well variability in the data is explained by the trendline equation, indicate variability (R^2=1 is ideal prediction)**





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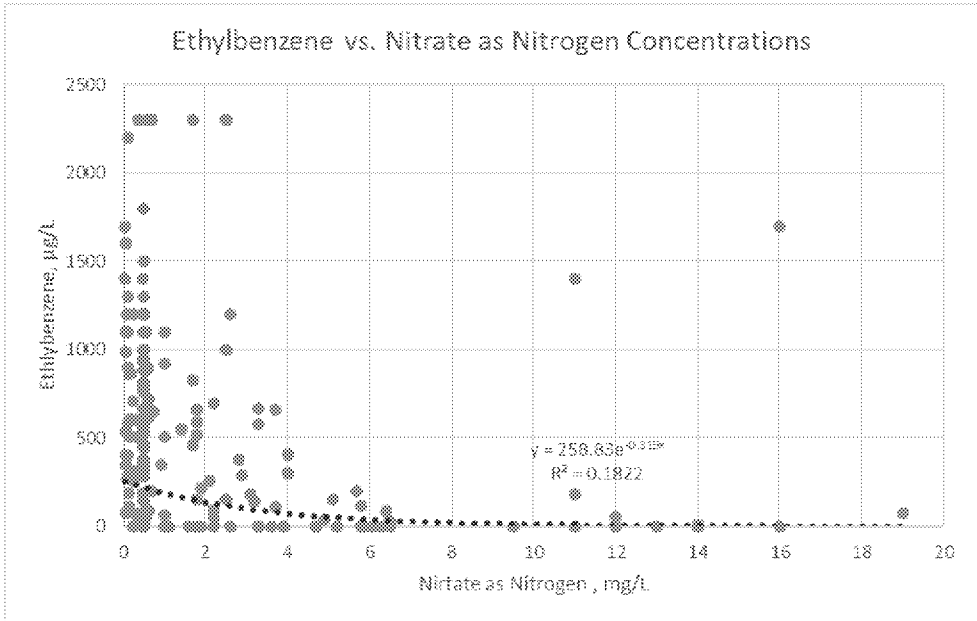
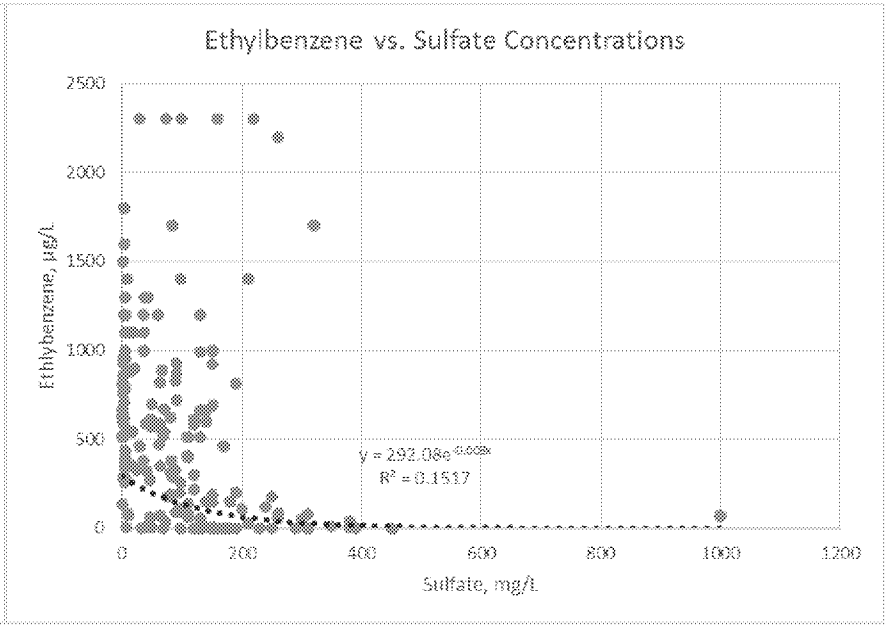
Site ST012 Regression Analysis Ethylbenzene

- **Overall nitrate and sulfate concentrations are statistically inversely correlated with ethylbenzene concentrations**
- **P values are < 0.0004 (i.e., >99.96% probability that parameters are correlated)**
- **R^2 values (0.18 and 0.15) indicate variability (R^2=1 is ideal prediction)**
- **Total iron is also statistically correlated (graph not shown) (p=0.0067)**





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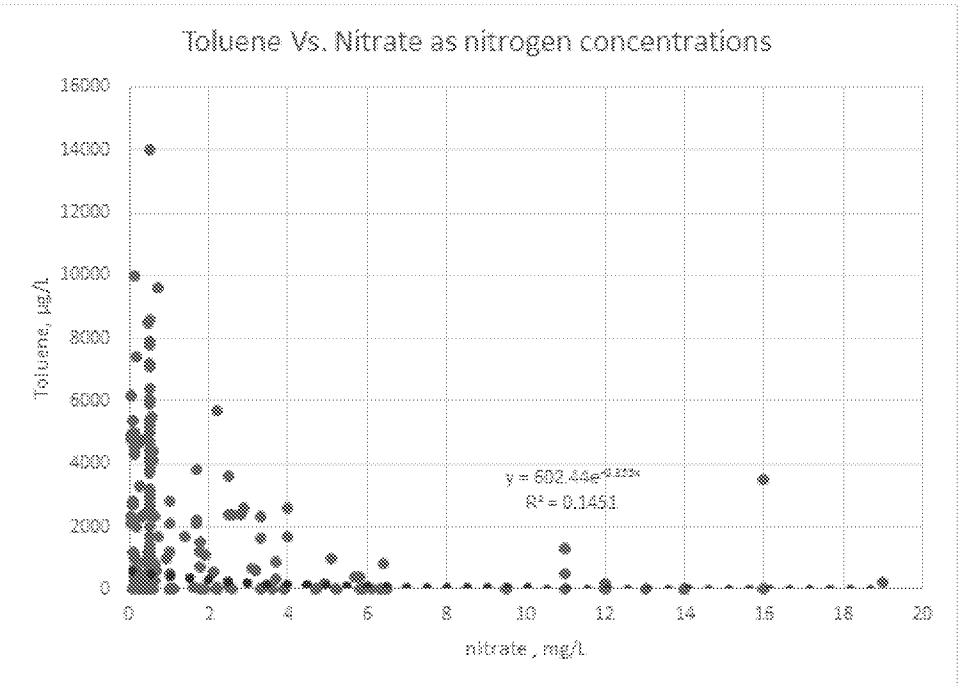
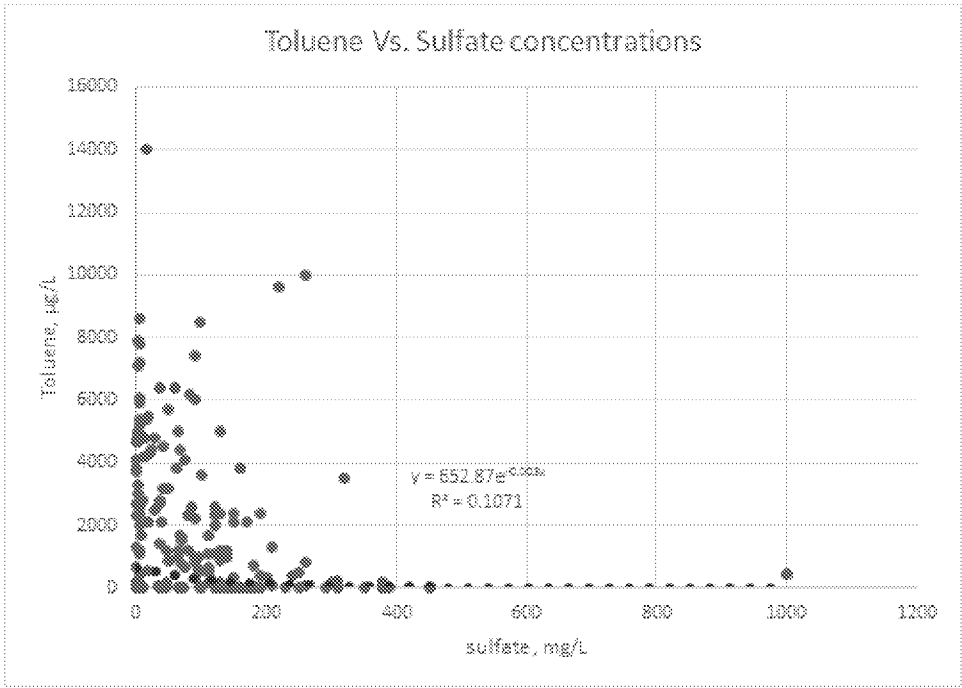
Site ST012 Regression Analysis Toluene

- **Overall nitrate and sulfate concentrations are statistically inversely correlated with toluene concentrations**
- **P values are < 0.00003 (i.e., >99.997% probability that parameters are correlated)**
- **R^2 values (0.15 and 0.11) indicate variability (R^2=1 is ideal prediction)**





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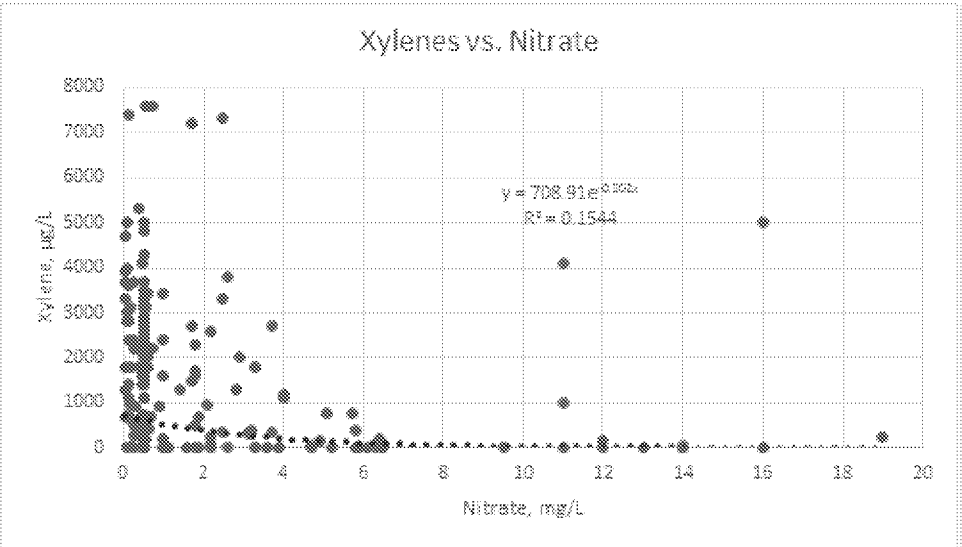
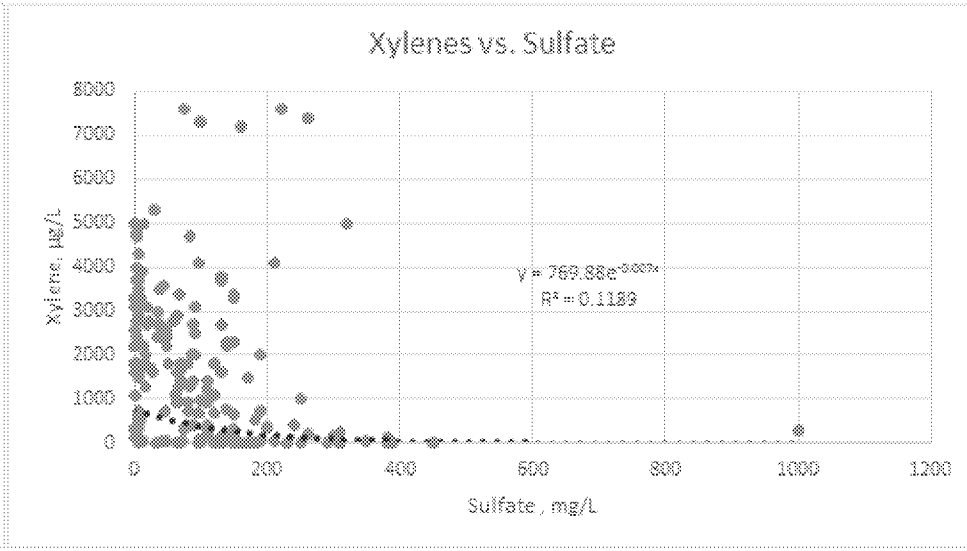
Site ST012 Regression Analysis Xylenes

- Overall nitrate and sulfate concentrations are statistically inversely correlated with total xylenes concentrations
- P values are < 0.0006 (i.e., >99.94% probability that parameters are correlated)
- R^2 values (0.15 and 0.12) indicate variability (R^2=1 is ideal prediction)
- Total iron is also statistically correlated (graph not shown) (p=0.01)





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Preliminary November Groundwater Sampling Results

November Sampling Summary

- **Sampling included:**
  - **Annual groundwater sampling locations**
  - **Quarterly pilot test groundwater sampling locations (those not already covered by annual locations)**
  - **Additional supplemental interior locations (extra samples that were not part of pilot study implementation work plan)**
    - To check for changes in magnitude of benzene concentrations in select interior locations
- **General Observations**
  - **No change in estimated 5 µg/L benzene contours**
  - **Most interior sample concentrations are reduced from previous result**

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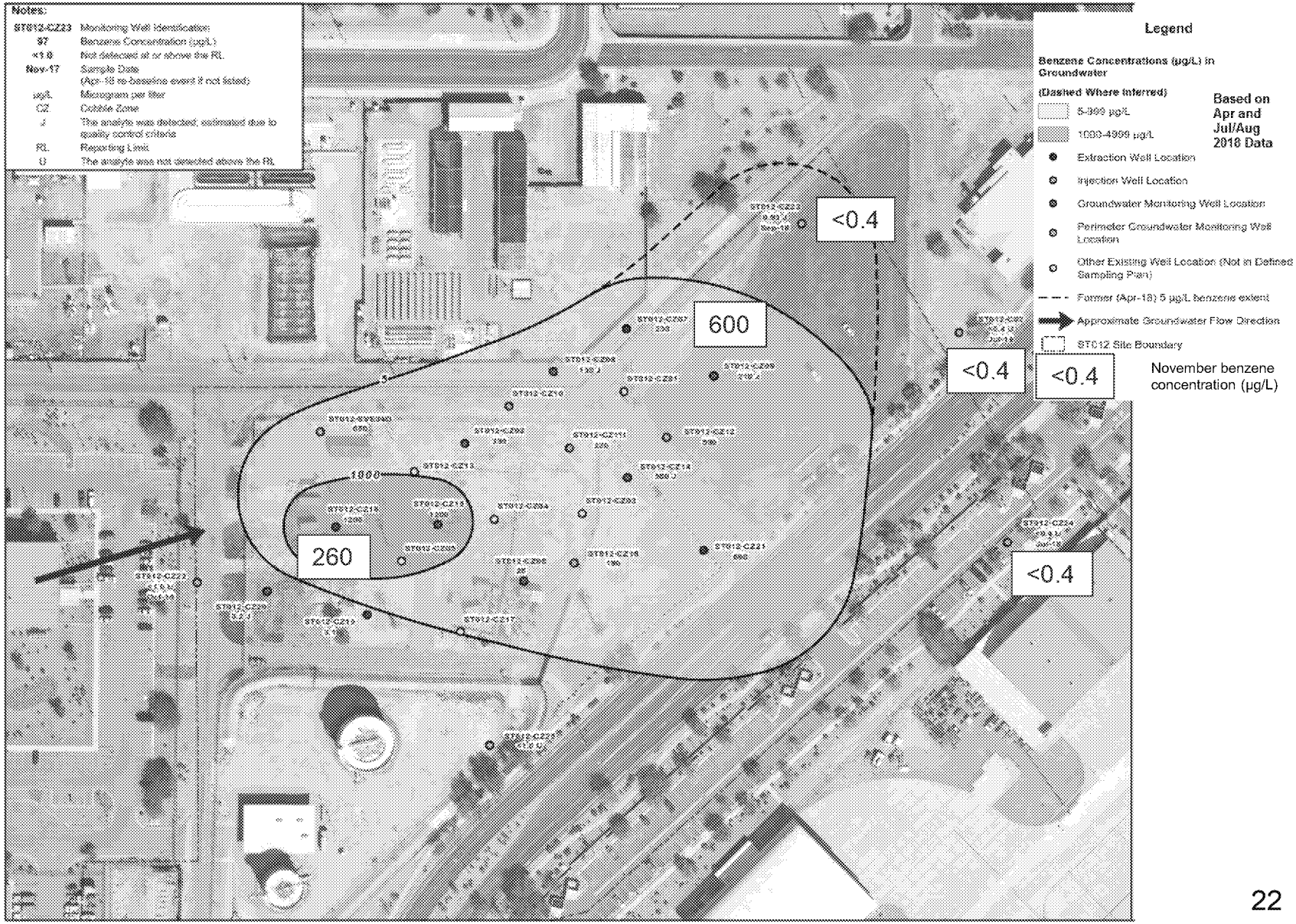
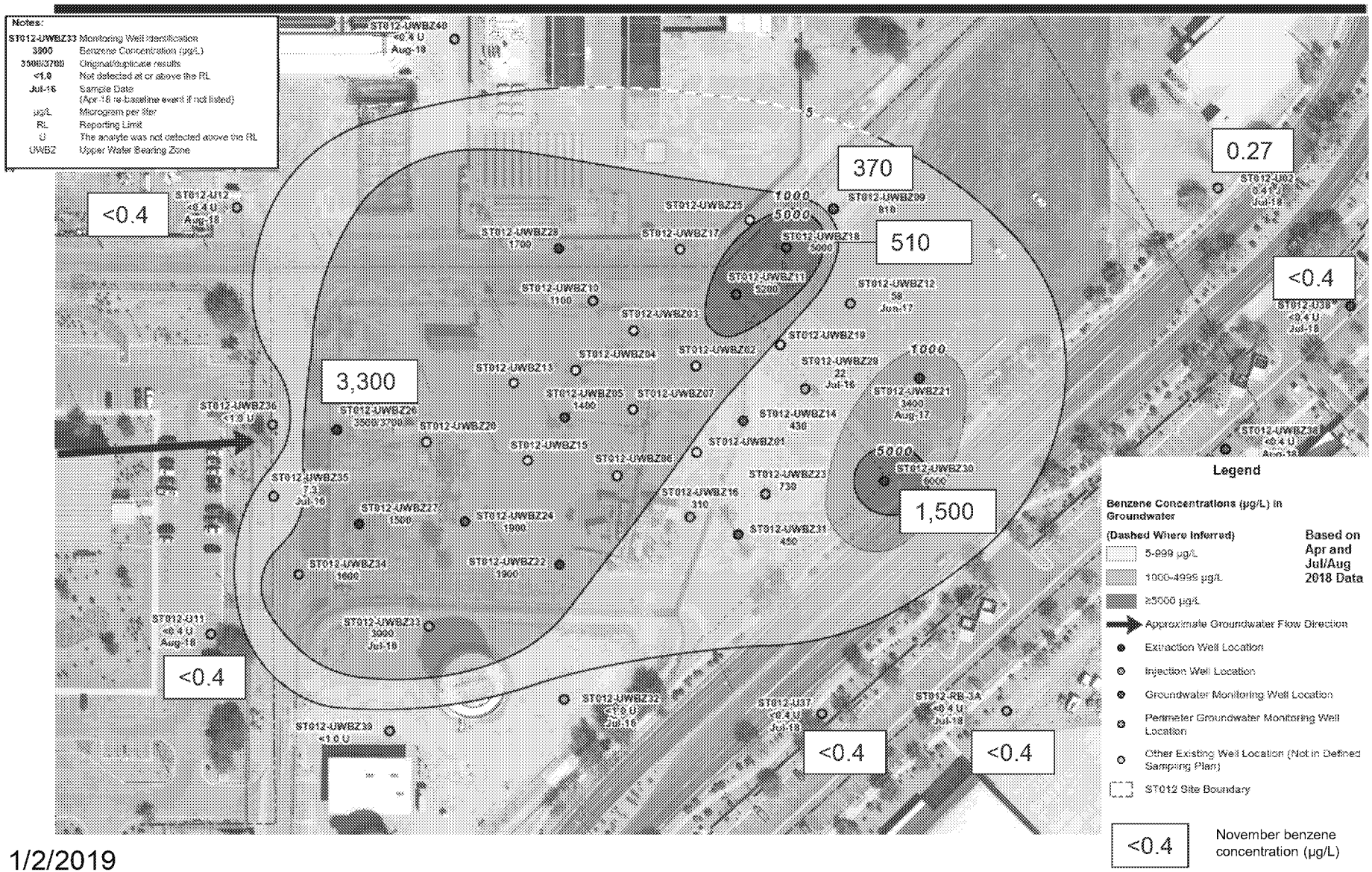
Site ST012 Annual Benzene (µg/L) in CZ (previous contours for reference)

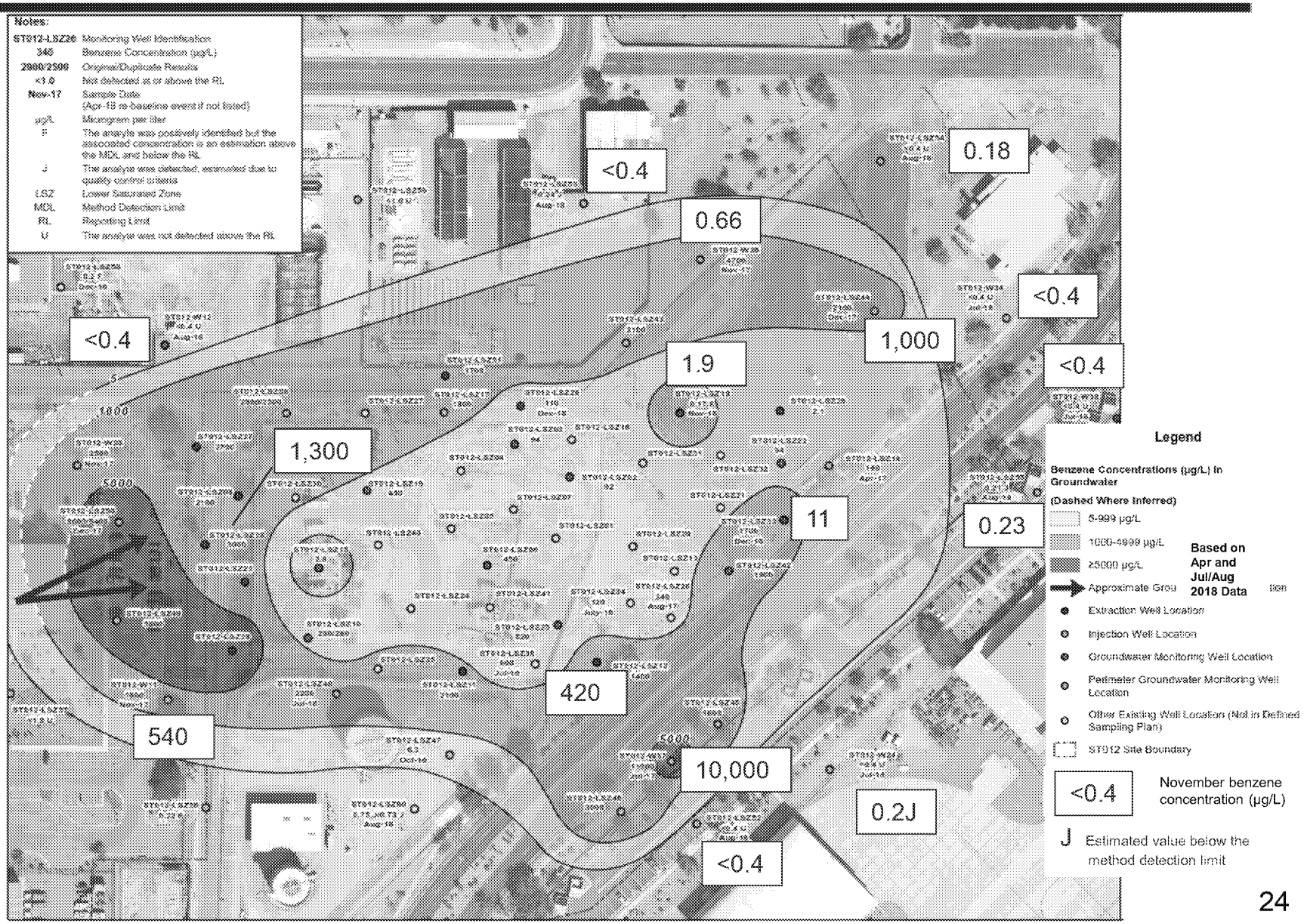


Site ST012 Annual Benzene (µg/L) in UWBZ (previous contours for reference)



1/2/2019

Site ST012 Annual Benzene (µg/L) in LSZ (previous contours for reference)



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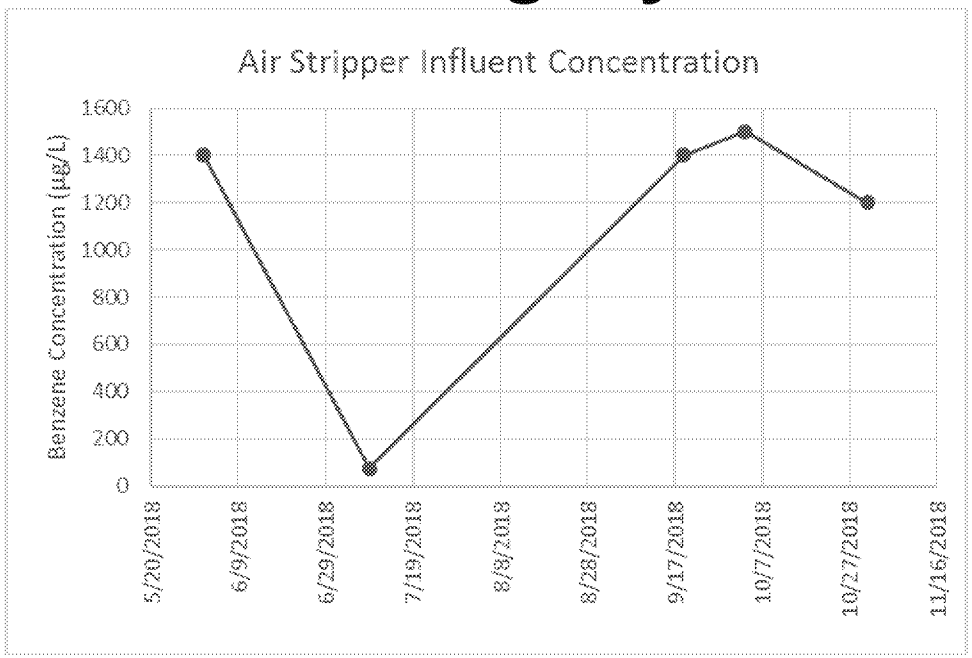
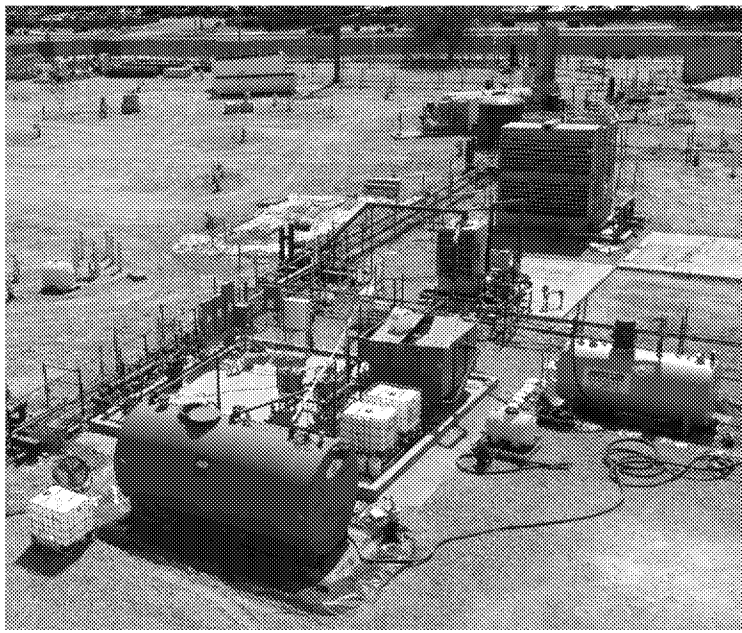
Pilot Study Injection/Extraction Update

Site ST012 Extraction System Performance

- **No LNAPL has been recovered since extraction started up**
- **Benzene air stripper influent decreased slightly**





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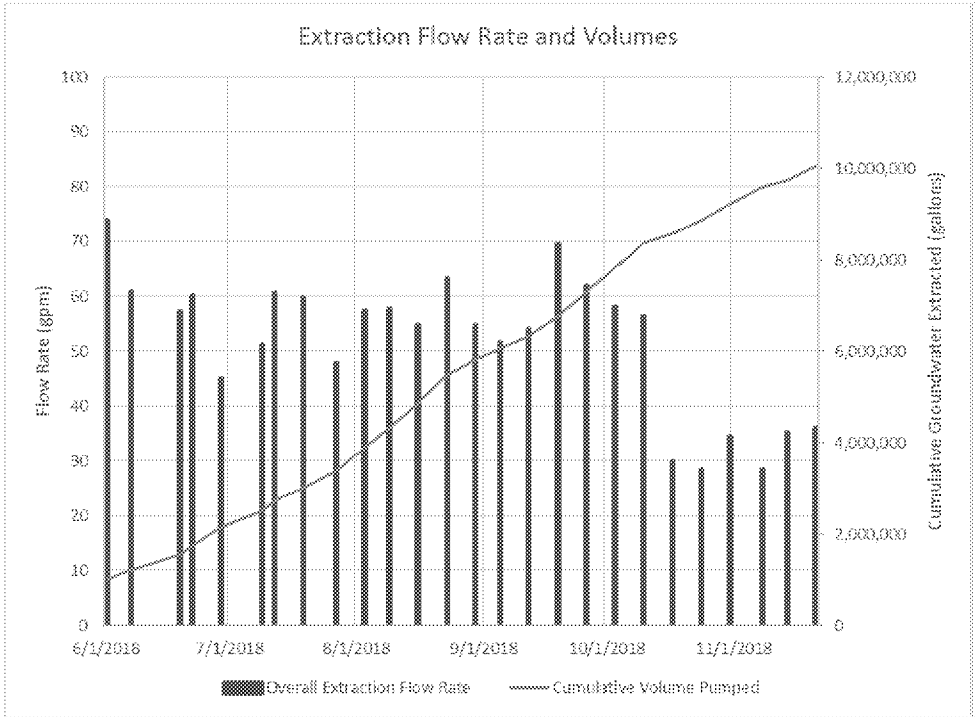
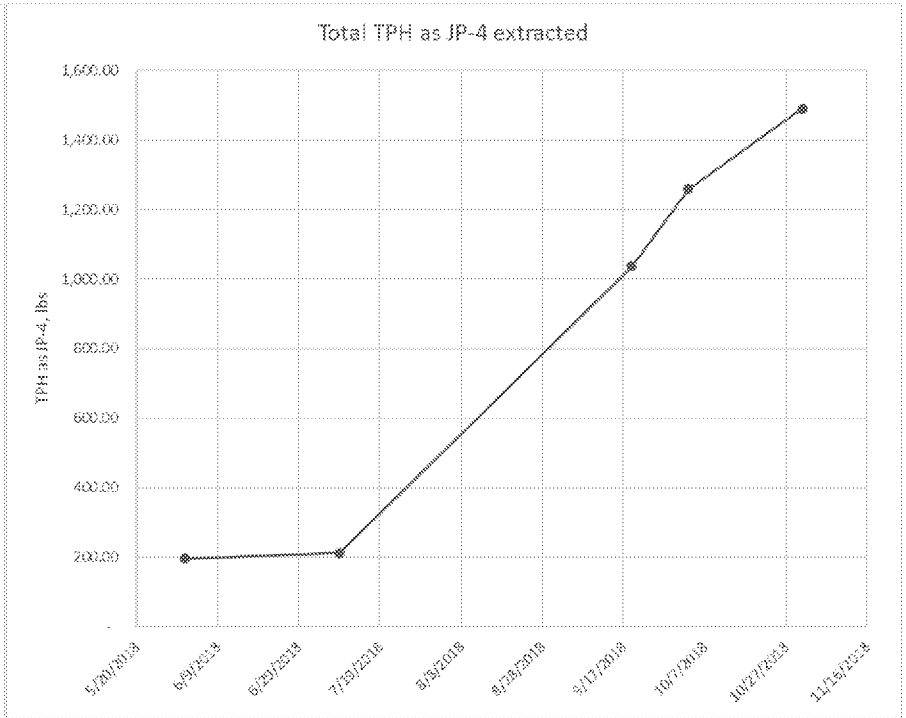
Site ST012 Extraction System Performance

- **Overall Extraction Rates and Estimated Mass Removal by Extraction**





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Site ST012 Injection Progress

- **First sodium sulfate batch mixed**
  - **Material was caked/solidified due to storage**
  - **Pre-mix tank required structural improvements**
  - **Upgraded recirculation pumps for more robust mixing**
- **Injected first batch in ST012-UWBZ33**
  - **4 Dec through 11 Dec**
  - **Injected at lower concentration(~50g/L)/higher volume due to caking/solubility but the planned sulfate mass injected**
  - **Approximate 8-10 gpm injection rate**
    - Initially estimated from drop in frac tank
    - Turbine flow meters were erratic due to the pulsing action of the pneumatic injection pump
    - Replaced turbine flow meter with positive displacement totalizing water meter (similar to residential water meter)

Site ST012 Path Forward Dec-Jan

- Continued SVE operation
- Replace flame oxidizer with oxidizer from ST035 for SVE from 14 Dec – 19 Dec
- Install replacement pumps week of 17 Dec
- Reduce CZ23 sampling frequency to quarterly
- Pilot Study Implementation
  - Continue mixing sulfate batches and inject according to plan (FVM7) Dec – Mar (continuing injection of batches in UWBZ33 mid next week, subject to working around oxidizer and pump replacement activities)

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