



Albuquerque Bernalillo County
Water Utility Authority



Independent Conceptual Site Model for KAFB Bulk Fuel Facility Fuel Release

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Objectives

- Summarize INTERA support to ABCWUA
- Conceptual Site Model objectives and methods
- Key findings
- Key data gaps
- 3D visualization (time permitting)

INTERA Support

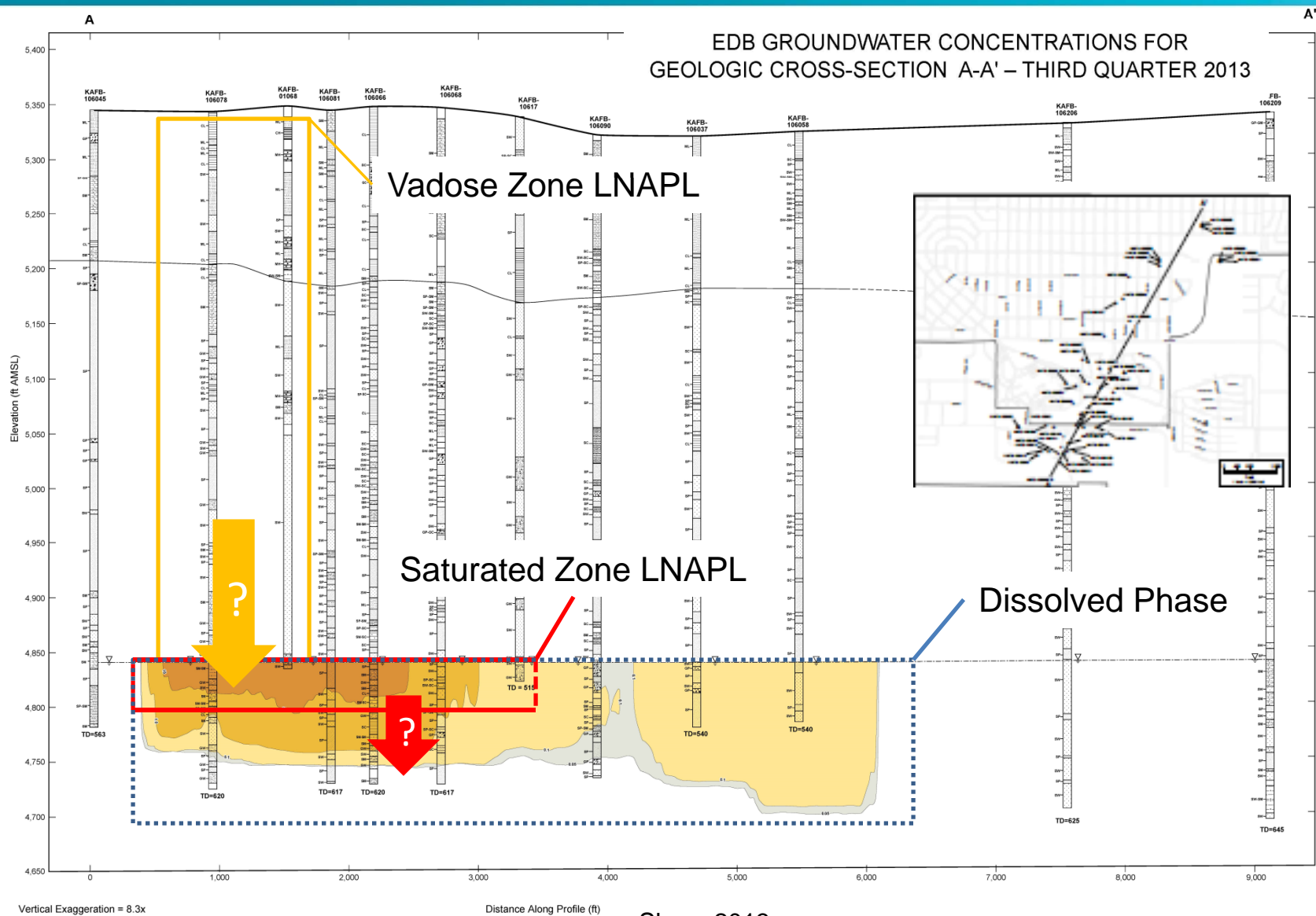
- Technical reviews
 - LNAPL interim measure work plan: Jan-11, May-11, Aug-11
 - Vadose zone work plan: Feb-11,
 - Groundwater work plan: Feb-11, May-11,
 - SVE optimization and addendum: Nov-11, Dec-11, Jan-12
 - New GW well locations: May-12
 - SVE design: Jan-13
 - In-well treatment system: Mar-13
 - Pump testing: May-11, Sep-13, Feb-14
- Field work
 - Construct and sample Trumbull well nest: from May-13
- Independent Conceptual Site Model development

CSM Objectives

- Describe features, events, and processes governing current and future migration of released fuels
- Contaminant domains
 - LNAPL and vapor in vadose zone
 - LNAPL in saturated zone
 - Dissolved phase
- Constituents of Concern (COCs):
 - EDB in AvGas only
 - 1000 gallons \rightarrow 2.27 kg EDB \rightarrow 10^{10} gallons at 0.05 $\mu\text{g/L}$ MCL
 - Little or no biodegradation
 - Benzene in AvGas, JP4, and JP8
 - MCL = 5 $\mu\text{g/L}$
 - Biodegradation occurring



CSM Objectives



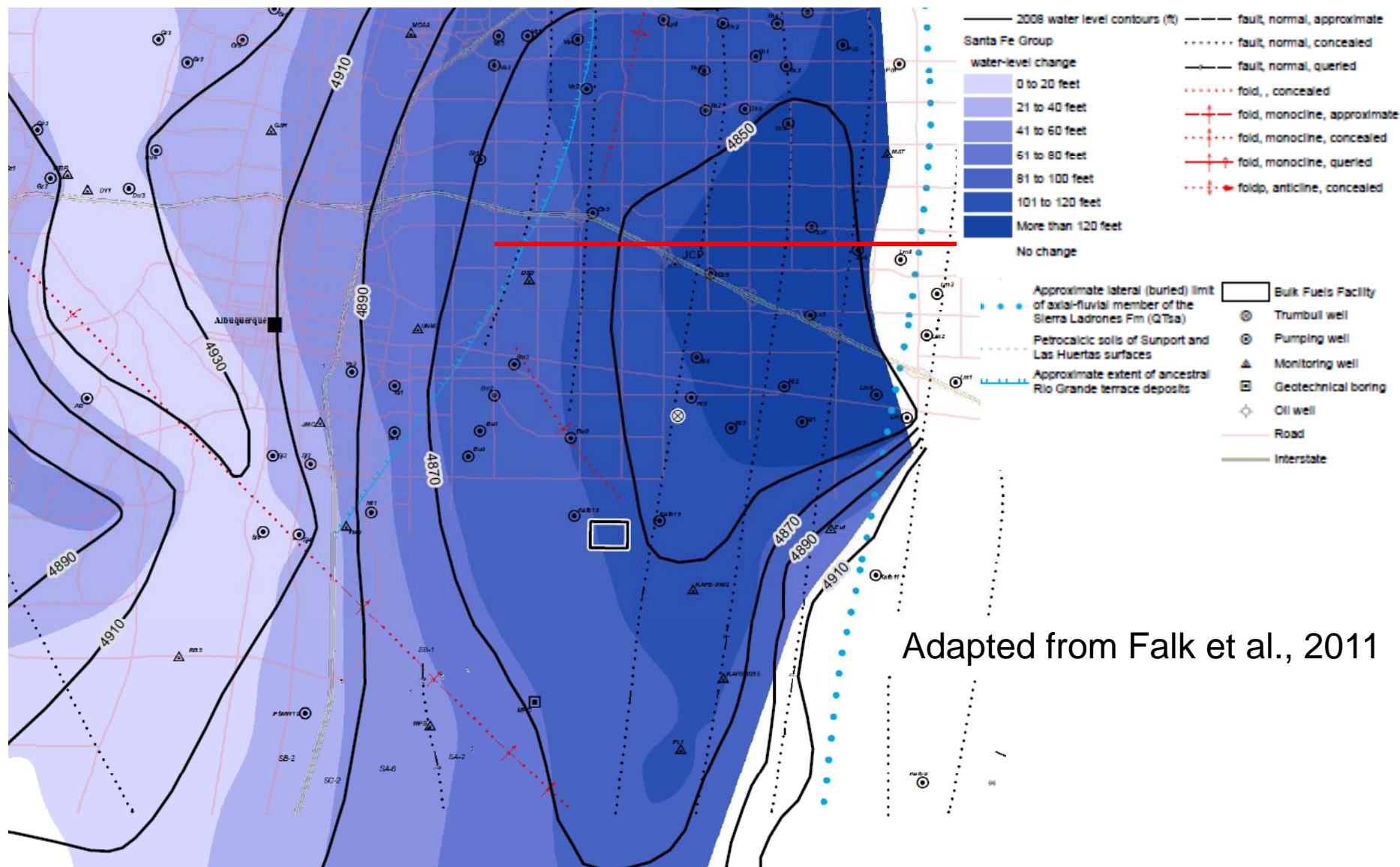


CSM Methods

- Created database using KAFB data from end of 2012
 - Contaminant data
 - Fluid levels
 - Well construction
- Demanding QA/QC
- Geology and Hydrogeology
 - Stratigraphy and aquifer parameters
- ArcGIS – linked database
 - Queries compute TVOCs, total TPH, BTEX
- Show spatial and temporal changes
- Visualize geology and COCs in 3D



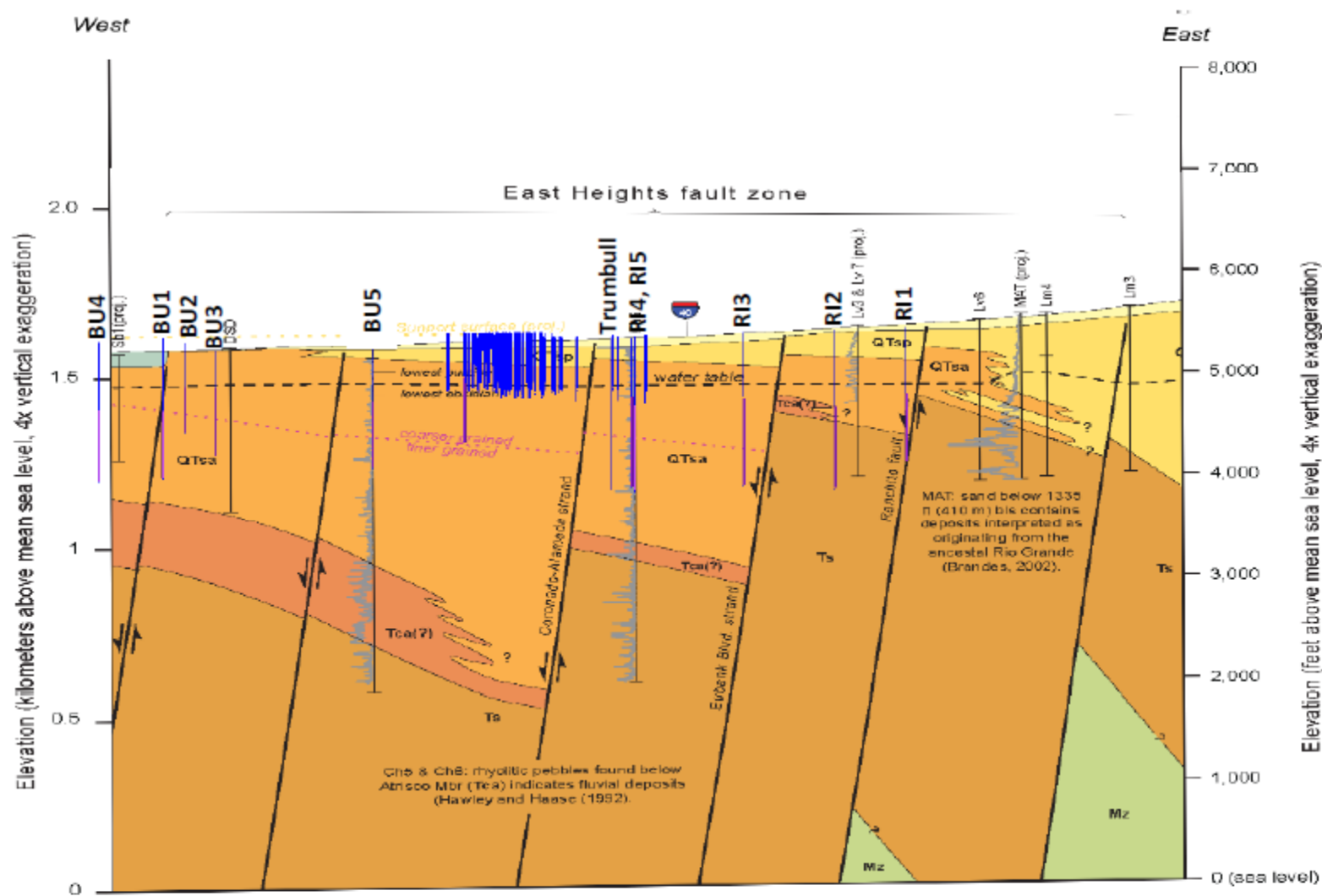
Regional Hydrogeology



Adapted from Falk et al., 2011



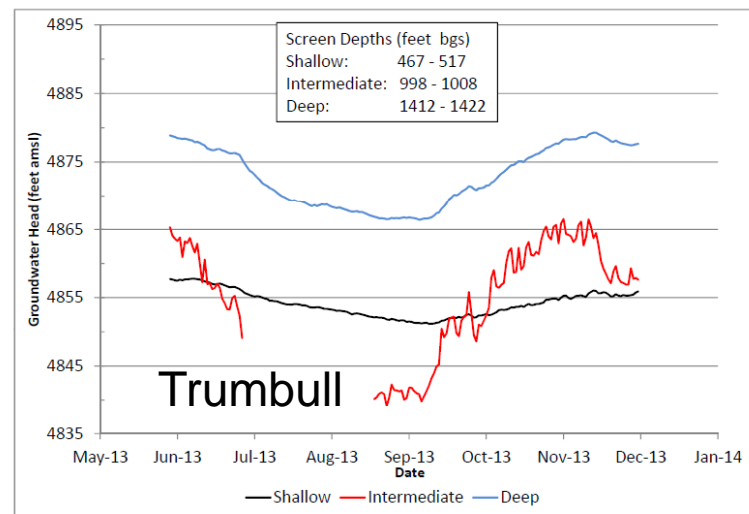
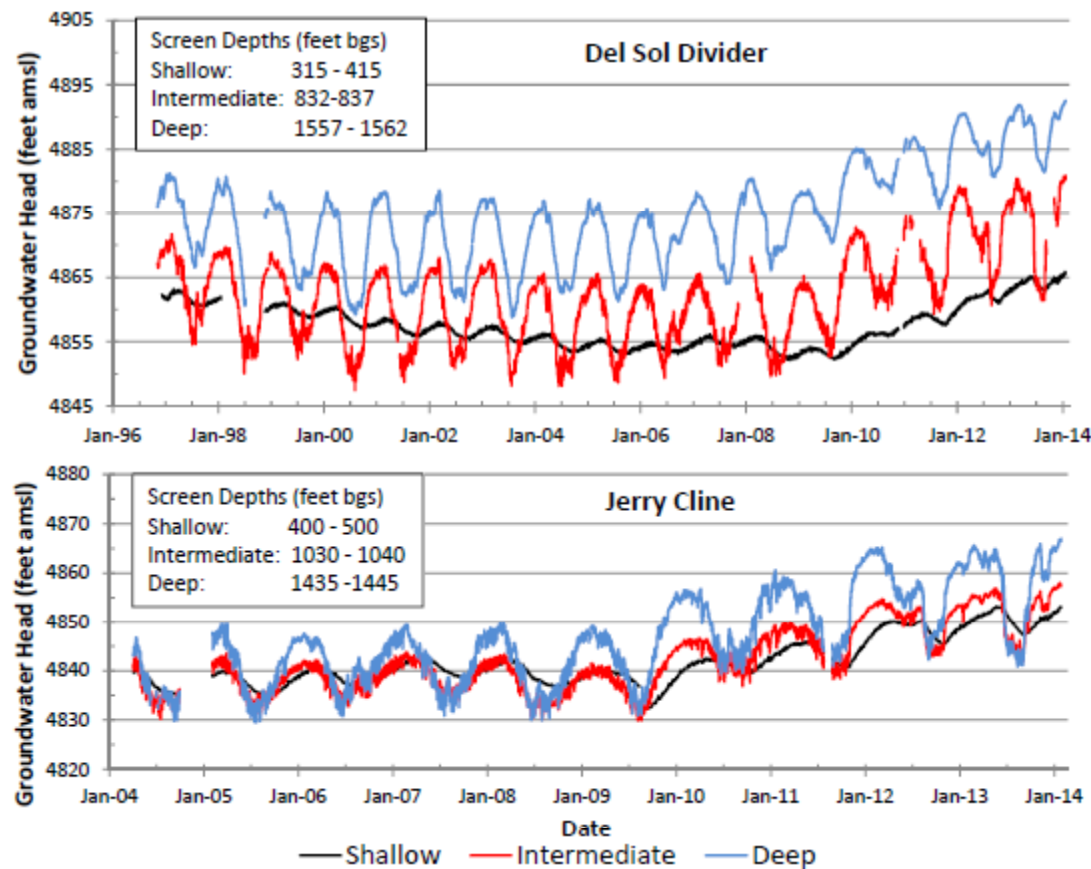
Regional Hydrogeology



Adapted from Connell, 2006



Regional Hydrogeology



- Well nests show unconfined and confined aquifers
- Rebound started in 2009

Data from USGS, 2014

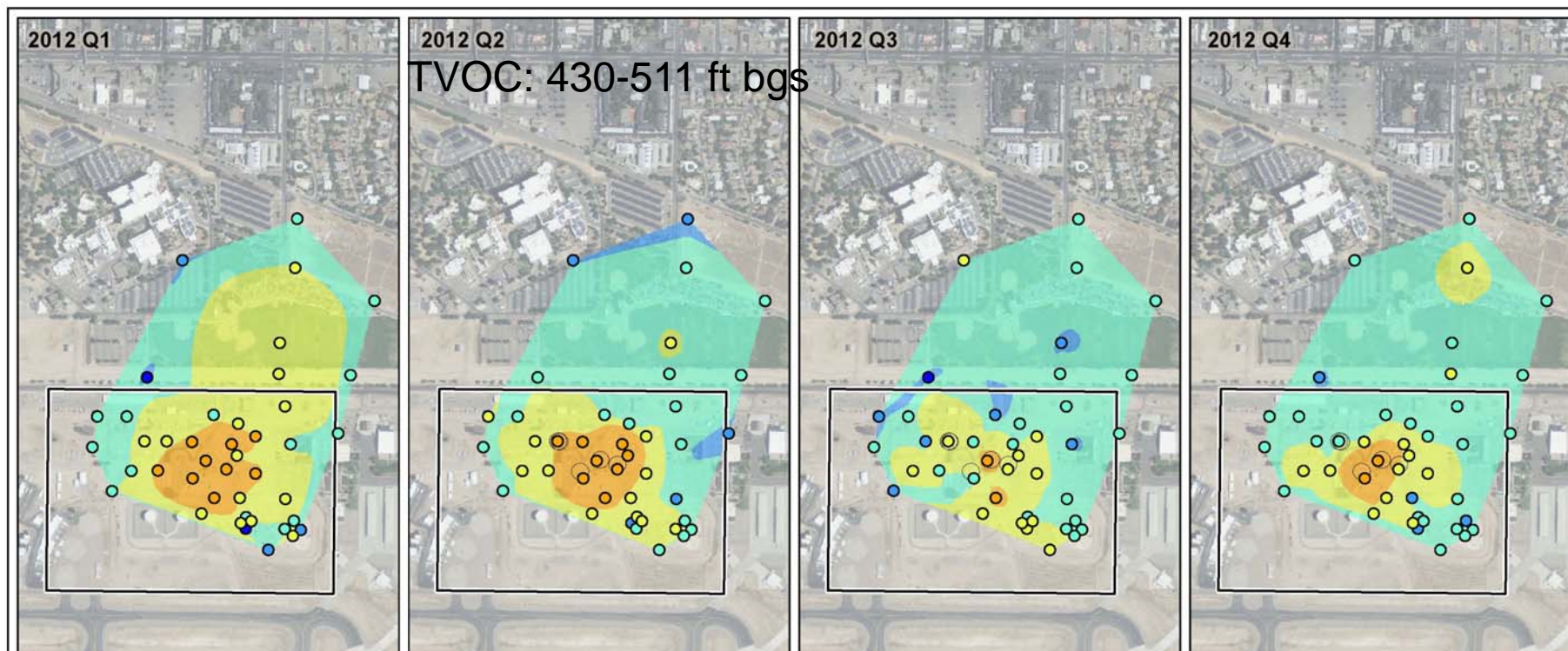


LNAPL – Vadose Zone

- What is LNAPL's spatial distribution in the thick vadose zone?
 - ~60% of total TPH samples at ~50 ft spacing
- Soil vapors monitored quarterly (TVOCs)
- Residual LNAPL saturation data
 - One sample
- SVE has removed ~543,000 gallons fuel by end of 2012



LNAPL – Vadose Zone



Total VOC (ppmv)

- 0 - 1
- 2 - 10
- 11 - 100
- 101 - 1,000
- 1,001 - 10,000
- 10,001 - 100,000

○ SVE well

▭ Bulk Fuels Facility

- Concentrations are highly variable
- Insufficient data to the south
- Two mechanisms may be affecting concentrations
 - SVE
 - Drowning of LNAPL



LNAPL – Vadose Zone

- Key Data Gaps
 - Soil data too sparse to characterize distribution or mobility
 - How much LNAPL is migrating downward?
 - No data
 - How much LNAPL mass is above water table?
 - No data
 - How much EDB in LNAPL?
 - No data

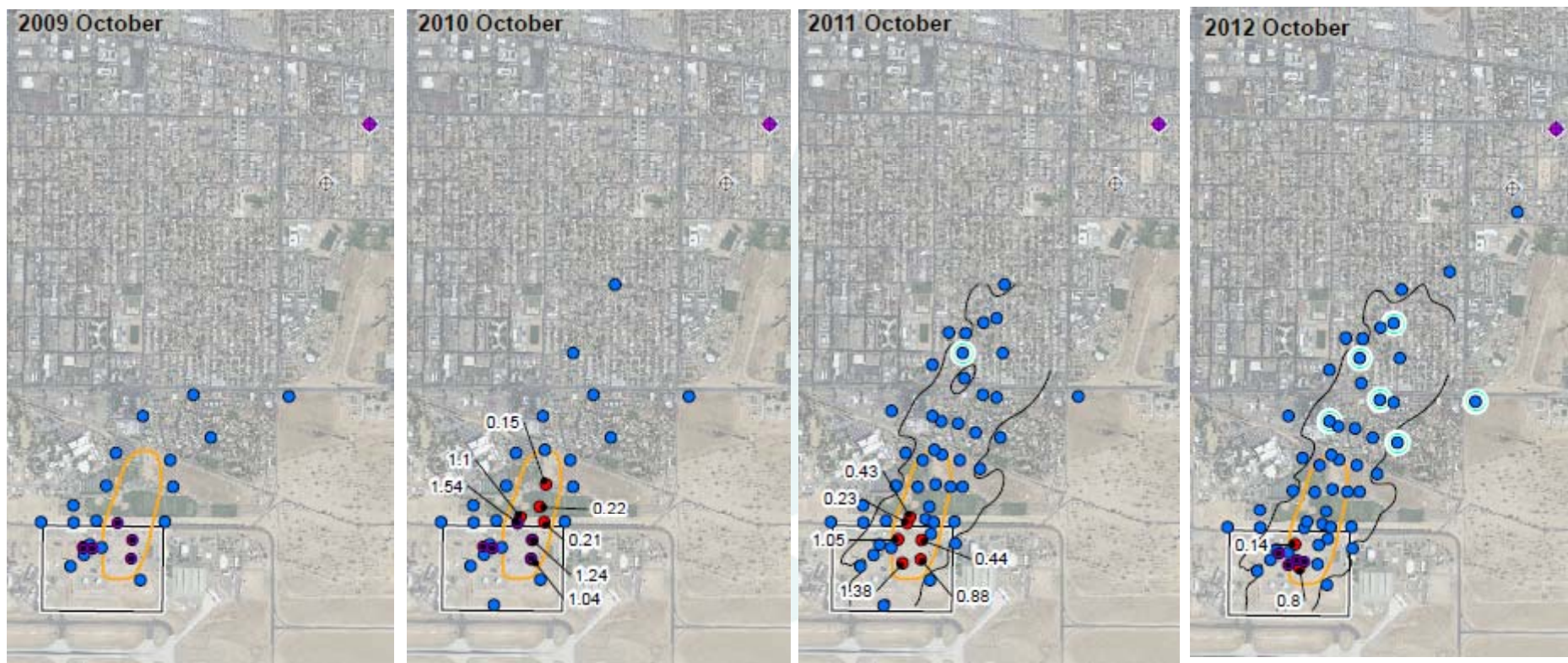


LNAPL – Saturated Zone

- Horizontal extent was fairly well known
- Vertical extent changing rapidly since 2009
 - Vertical extent prior to 2009 not defined
- Water table rose ~6 ft by end of 2012
- Mobile saturated zone LNAPL redistributed into smear zone
- Rising water table entrapping vadose zone LNAPL
 - Saturated zone LNAPL mass likely increasing
 - Annual rise of 2-3 ft expected



LNAPL – Saturated Zone



Shallow Well Location

● Detected LNAPL (thickness in feet)

● No detected LNAPL

Remediation Wells

● LNAPL skimmer

● SVE

○ Submerged wells

□ Bulk Fuels Facility

— LNAPL extent (estimated, INTERA)

~ EDB shallow 0.013 µg/L contour
by quarter

⊕ Trumbull monitoring well

◆ Ridgecrest water supply well

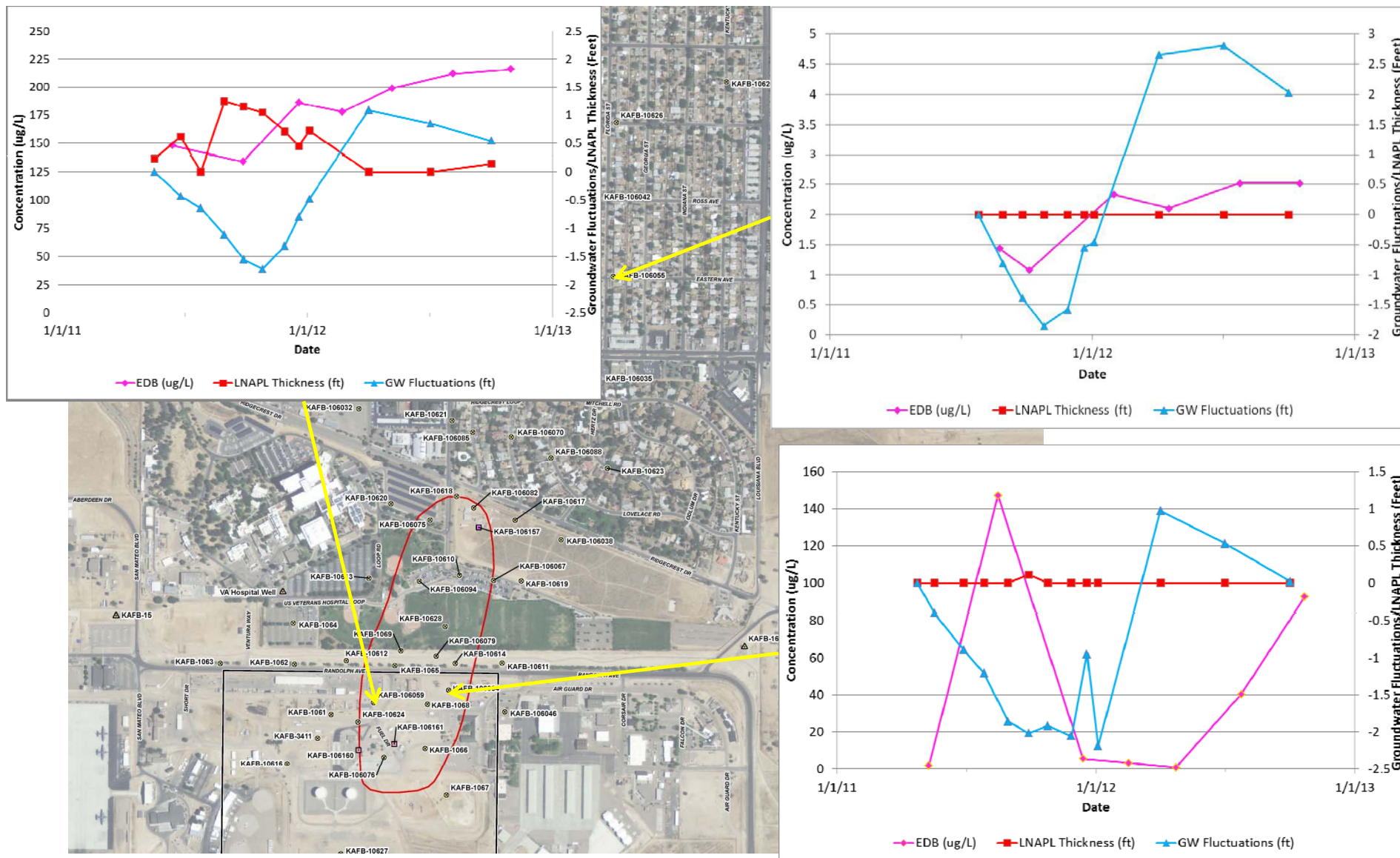


LNAPL – Saturated Zone

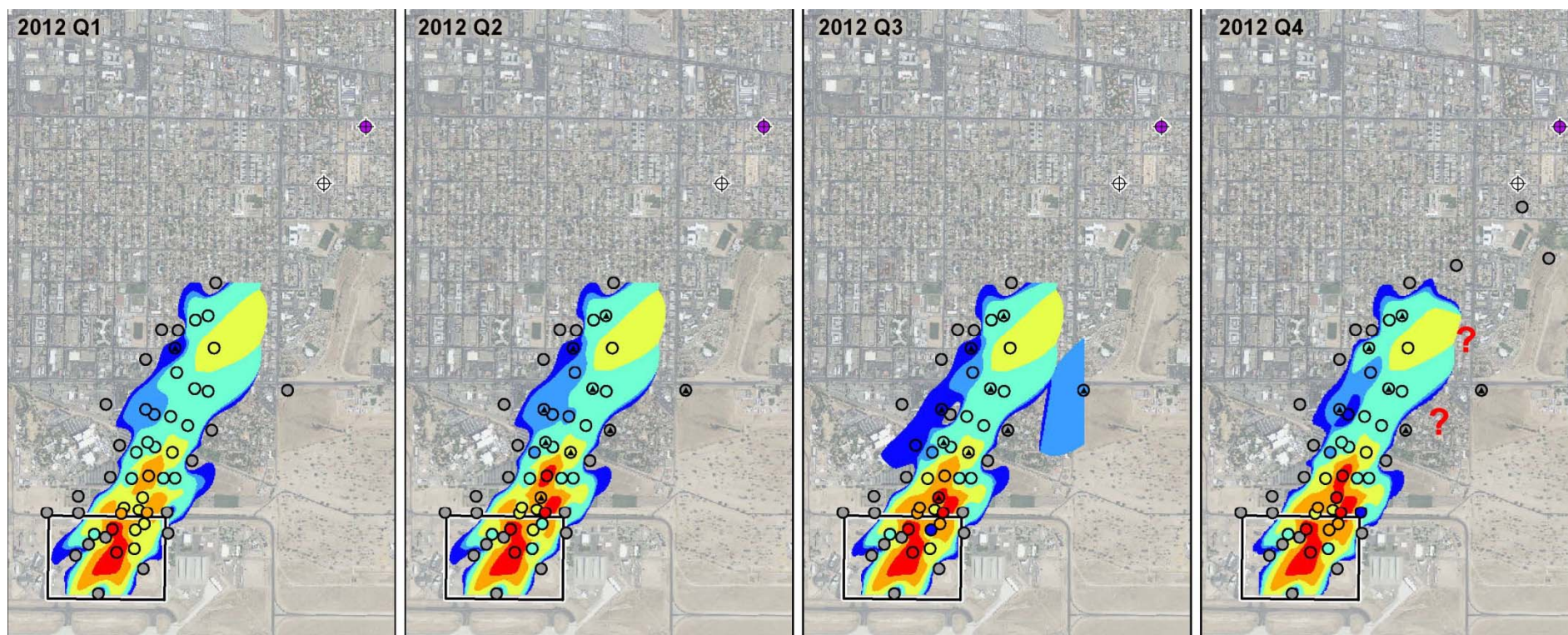
- Key Data Gaps
- How is vertical LNAPL distribution changing?
 - What is LNAPL mass in smear zone?
 - How much LNAPL mass is added to saturated zone with each foot of water table rise?
- How much EDB is in saturated zone LNAPL?



Dissolved Phase



Shallow Dissolved Phase



EDB ($\mu\text{g/L}$)

- 0.013 - 0.050
- 0.051 - 0.1
- 0.101 - 1
- 1.001 - 10
- 10.001 - 100
- 100.001 - 1,000

● Non-detect

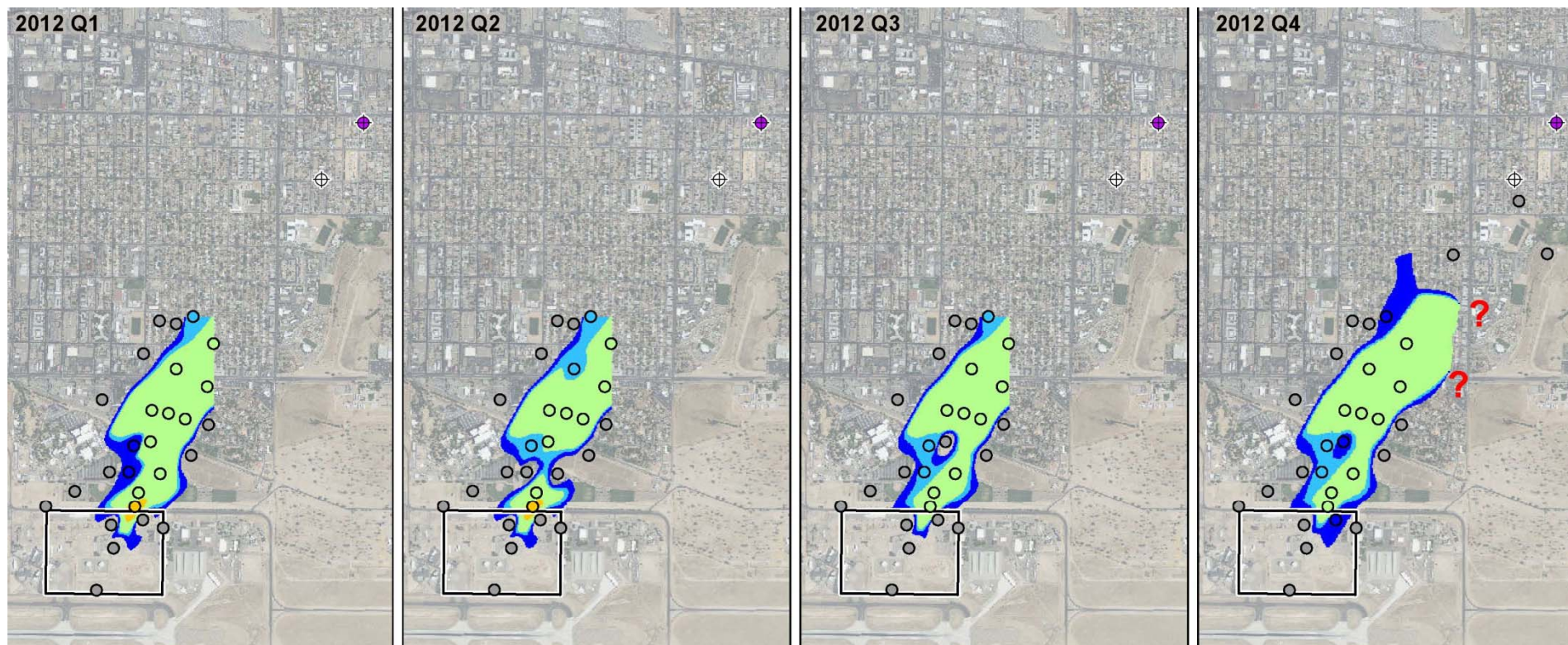
▭ Bulk Fuels Facility

⊕ Trumbull monitoring well

◆ Ridgecrest water supply well

▲ Submerged Well Sreen

Intermediate Dissolved Phase



EDB (µg/L)

- 0.011 - 0.050
- 0.051 - 0.1
- 0.101 - 1
- 1.001 - 2
- 2.001 - 2.2

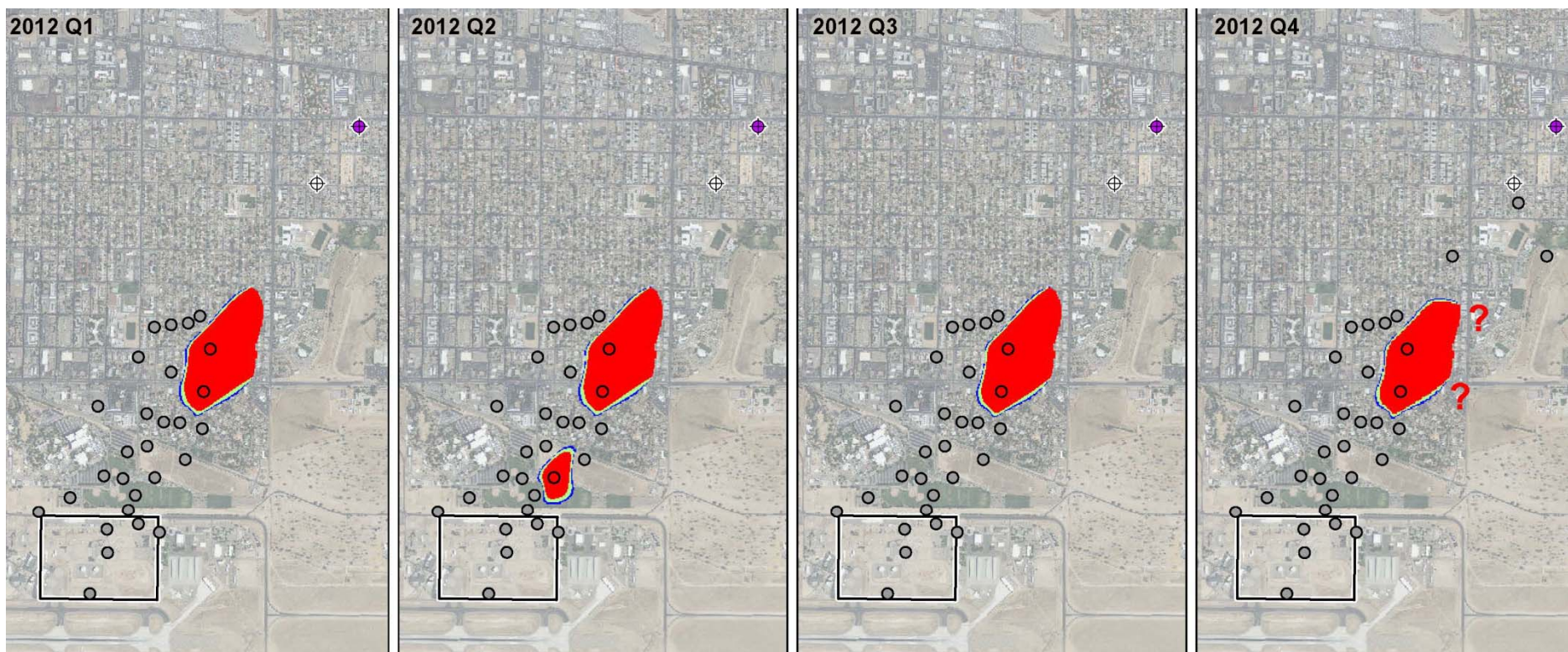
● Non-detects

▭ Bulk Fuels Facility

⊕ Trumbull monitoring well




◆ Ridgecrest water supply well

Deep Dissolved Phase







Deep Dissolved Phase

Well Zone Split

-  Deep - shallow
-  Deep - intermediate
-  Deep - deep
-  Deep

EDB (µg/L)

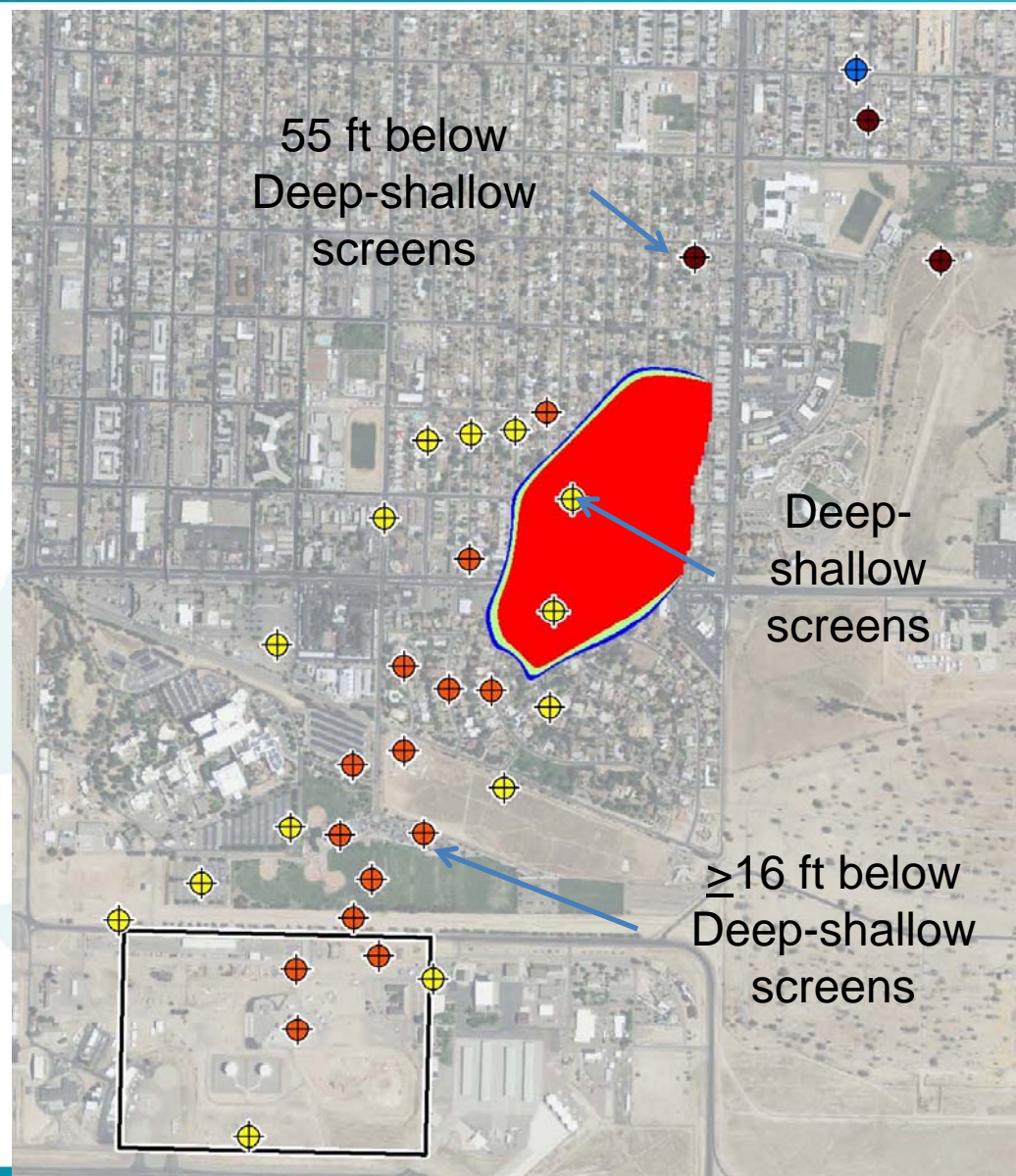
-  0.032 - 0.05
-  0.05 - 0.1
-  0.1 - 1
-  Bulk Fuels Facility

Depth (ft amsl)

4,818 - 4,797
4,781 - 4,752
4,742 - 4,721

Screen Designation

deep-shallow
deep-intermediate
deep-deep





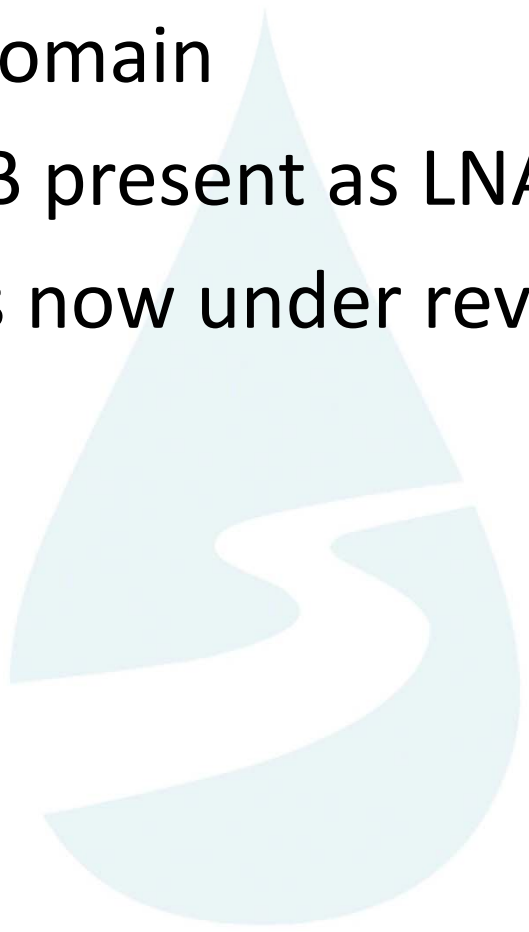
Dissolved Phase: Data Gaps

- Undefined EDB plume extents
 - Deep monitoring well network is insufficient
- Defining plume with submerged screens and elevated reporting limits (benzene)
- Dissolved phase plumes are not stable
 - Saturated zone LNAPL mass likely increasing
 - Long-term monitoring required to show plume changes
- Travel time to Ridgecrest wells?



Summary

- Important data gaps remain for each contaminant domain
- Amount of EDB present as LNAPL not known
- RFI documents now under review
- Questions?





Glossary

- $\mu\text{g/L}$ – micrograms per liter
- BTEX – benzene, toluene, ethyl benzene, xylenes
- COCs – constituents of concern
- CSM – Conceptual Site Model
- EDB – ethylene dibromide
- LNAPL – light non-aqueous phase liquid
- MCL – maximum contaminant level
- SVE – soil vapor extraction
- Total TPH – sum of gasoline and diesel range organics
- TVOCs – total volatile organic compounds