Kirtland Air Force Base Fuel Spill Cleanup

July 23, 2015

Welcome

Col. Tony Haught
Commander
U.S. Air Force
377th Mission Support Group

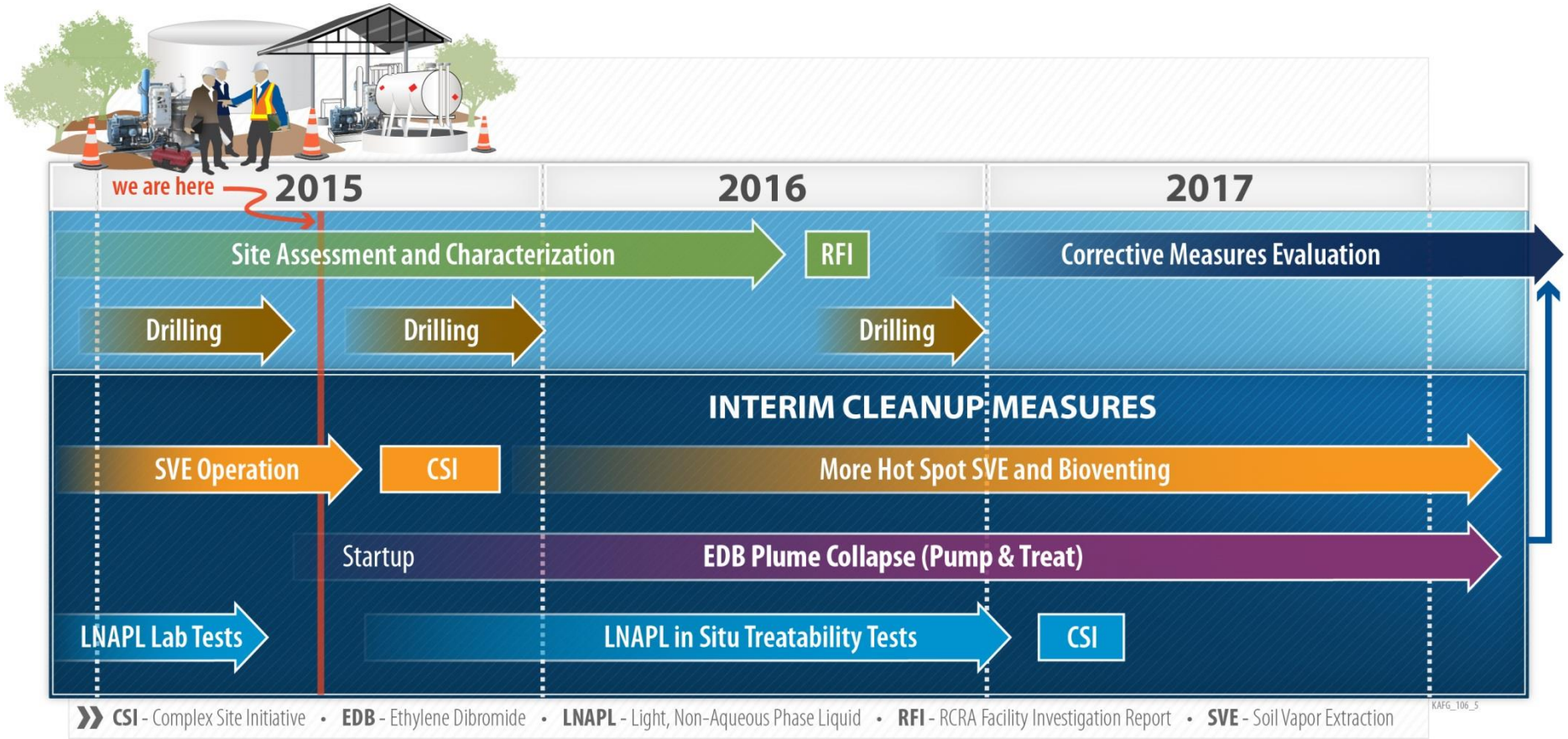
Progress Report by:

Adria Bodour, Ph.D., AFCEC Environmental Scientist
Dennis McQuillan, NMED Geologist

A Partnership for Success

A collaborative technical team is solving the complex hydrogeologic and engineering challenges posed by fuel spill

KAFB Fuel Cleanup Timeline 2015-17



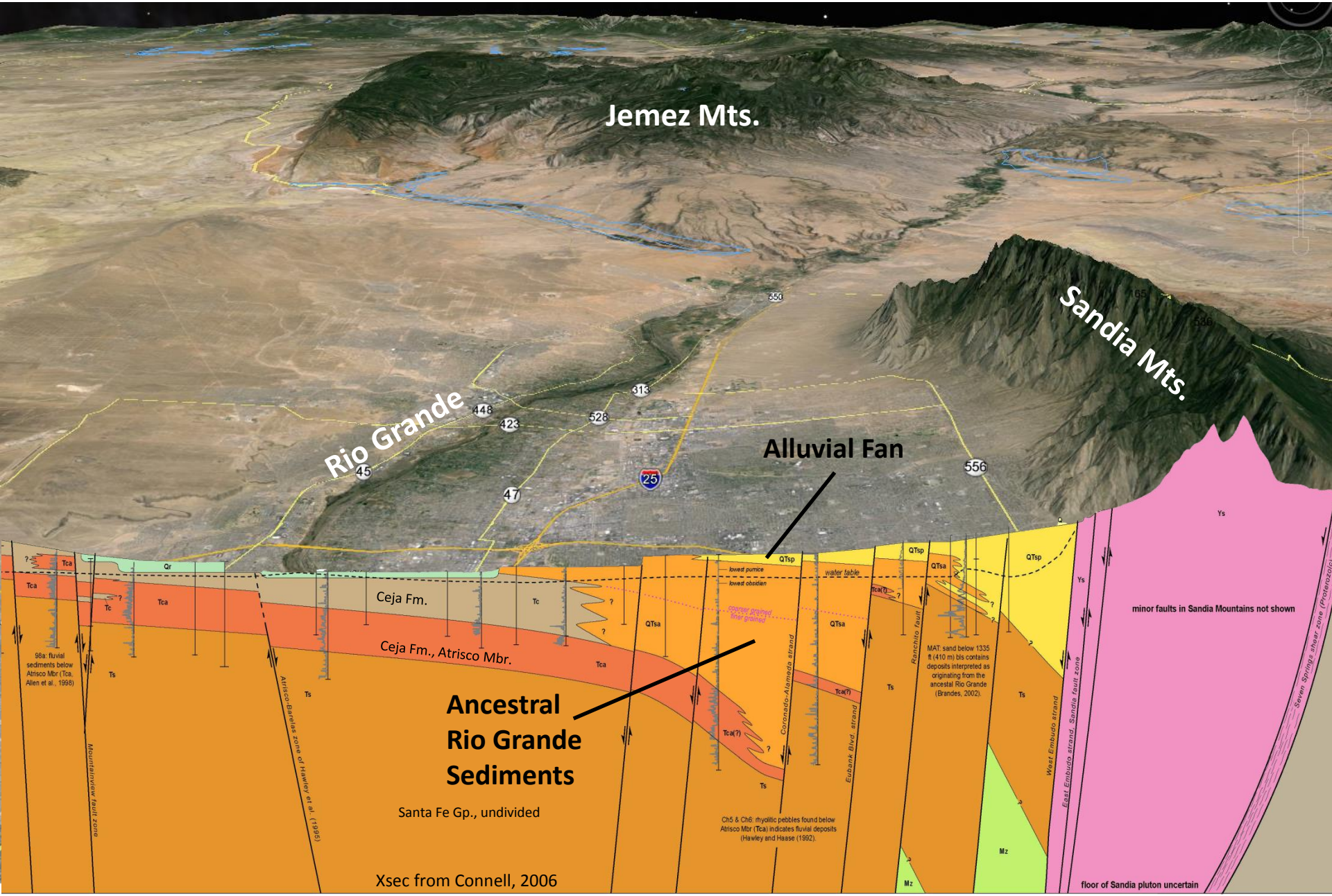
Major Progress to Report

- **Better understanding of geology influence on contaminant migration**
- **16 new groundwater monitoring wells drilled**
  - **Ethylene dibromide (EDB) not migrating towards drinking water wells KAFB-3 and Ridgecrest-3**
- **EDB plume collapse; first extraction well and treatment system are operating**
- **Soil vapor extraction (SVE) rebound and bio-respiration testing completed; evaluating data to drive decisions on continued use of SVE and suitable areas to bioventing**
- **Laboratory microcosm testing completed; anaerobic in-situ bioremediation pilot test is proposed**

Drinking Water Protection

Monthly testing of drinking water wells in the area of the plume shows no detections of fuel contaminants

Middle Rio Grande Basin

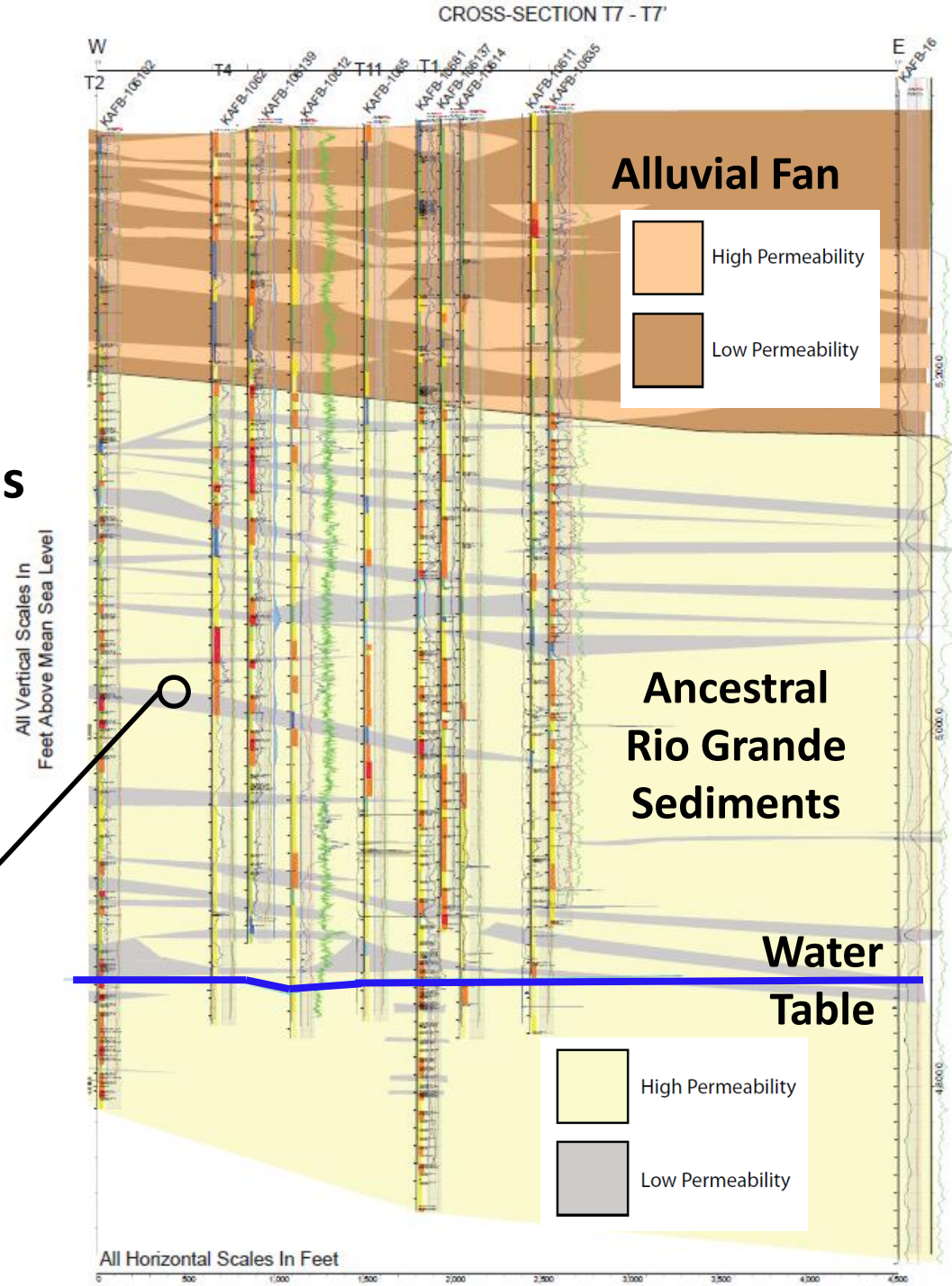


Site Geology

Interbedded Coarse and Finer Grained Sediments

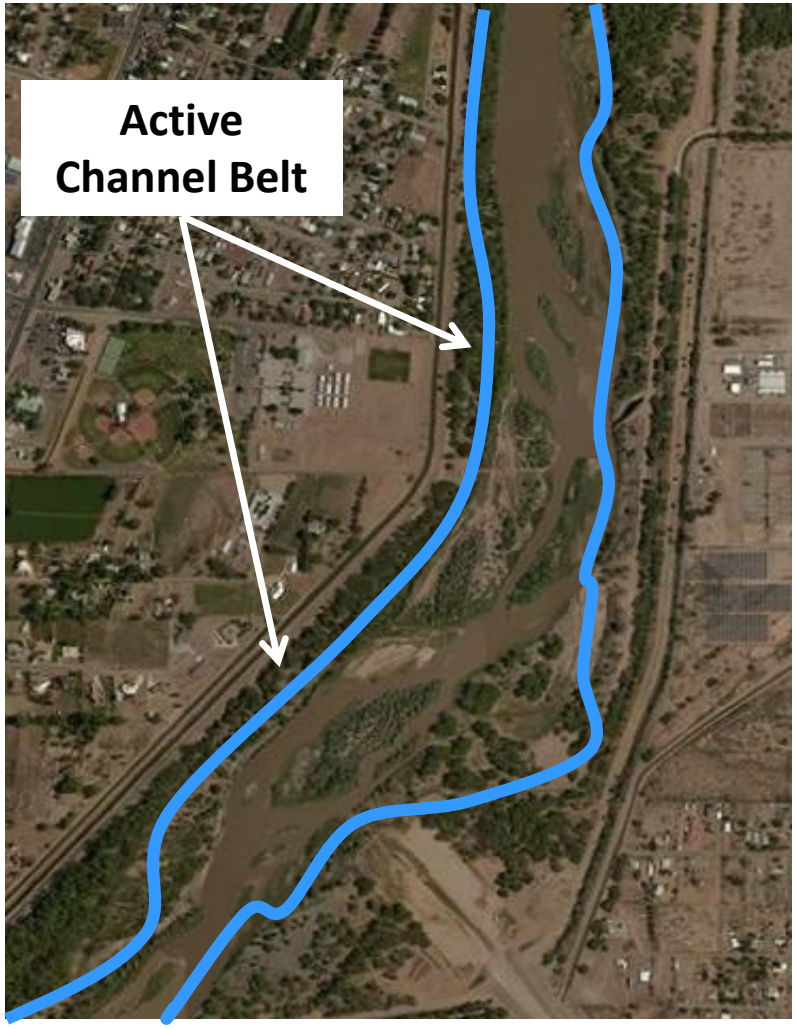
Anisotropy – Physical Properties Vary with Direction

Outcrop of sediment similar to what is at fuel spill site

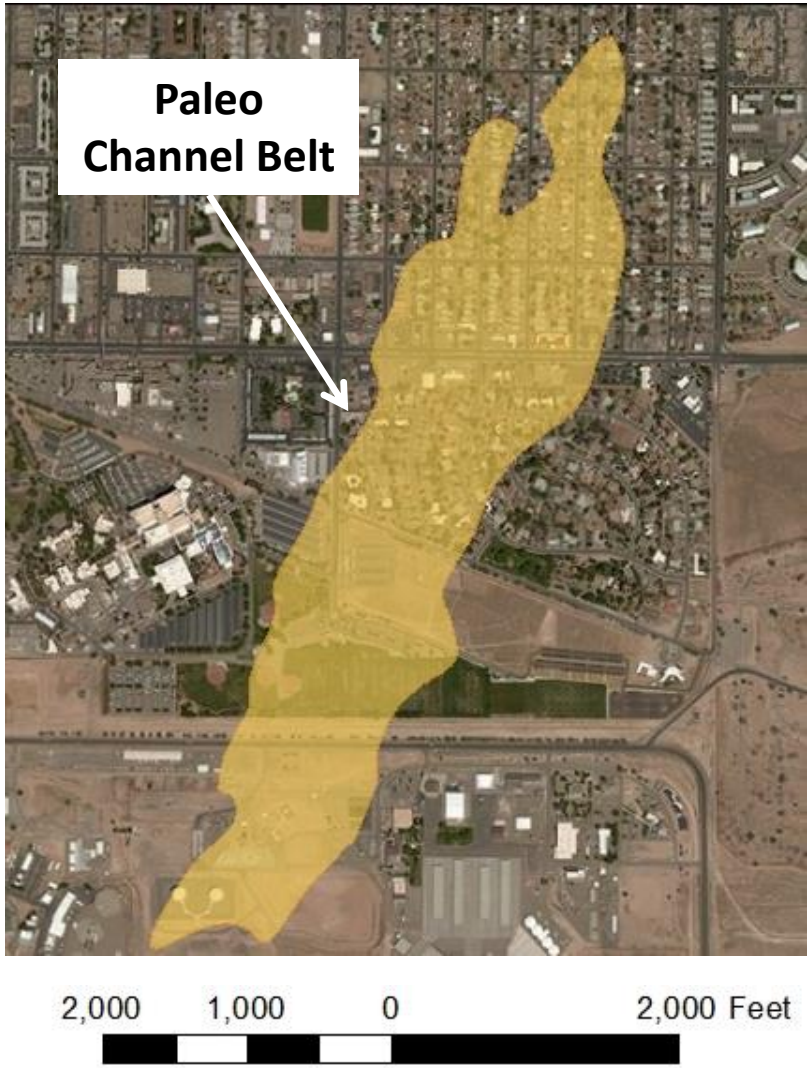


Rio Grande Braided Stream Channel Belt

Rio Grande Braided Stream In Albuquerque South Valley

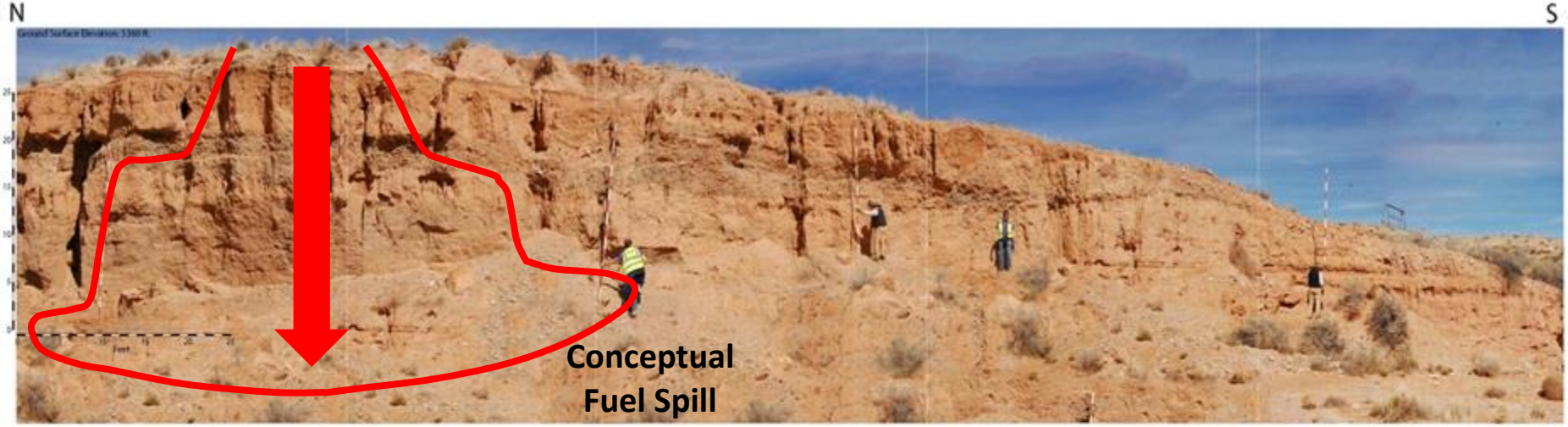


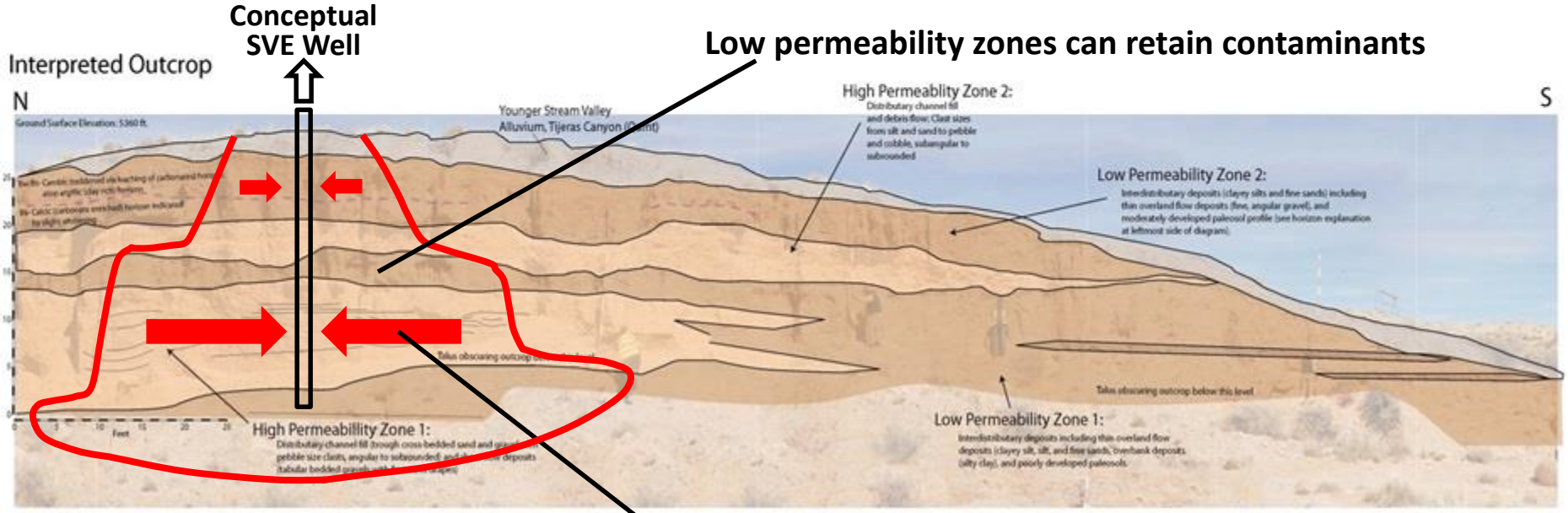
Shallow EDB Plume



Alluvial Fan

Permeability differences control the migration of fuel and the recovery of fuel vapor by SVE





Data-Driven Investigation & Cleanup

- **We have a vision and a Strategic Plan for how the investigation and cleanup will proceed**
- **We prepare work plans for specific actions**
- **We drill, construct, measure, sample and test**
- **Then, we evaluate all available data to make decisions on what the next steps should be, and prepare the next work plans**
- **This flexibility provides efficiency and cost effectiveness**

Well Drilling Update

Diane Agnew, CB&I

Thank You Neighborhoods!

The Air Force, NMED, and all the collaborating organizations sincerely thank the neighborhoods for putting up with the temporary road blocks and noise from the well drilling rigs

Drilling and Coring Methods

Air Rotary Casing Hammer (ARCH)

- **Air is circulated from the drill bit into the borehole to carry drill cuttings up to the surface; a temporary casing is driven down just behind the drill bit to keep the borehole open**
- **Used to drill 16 new data gap groundwater monitoring wells**

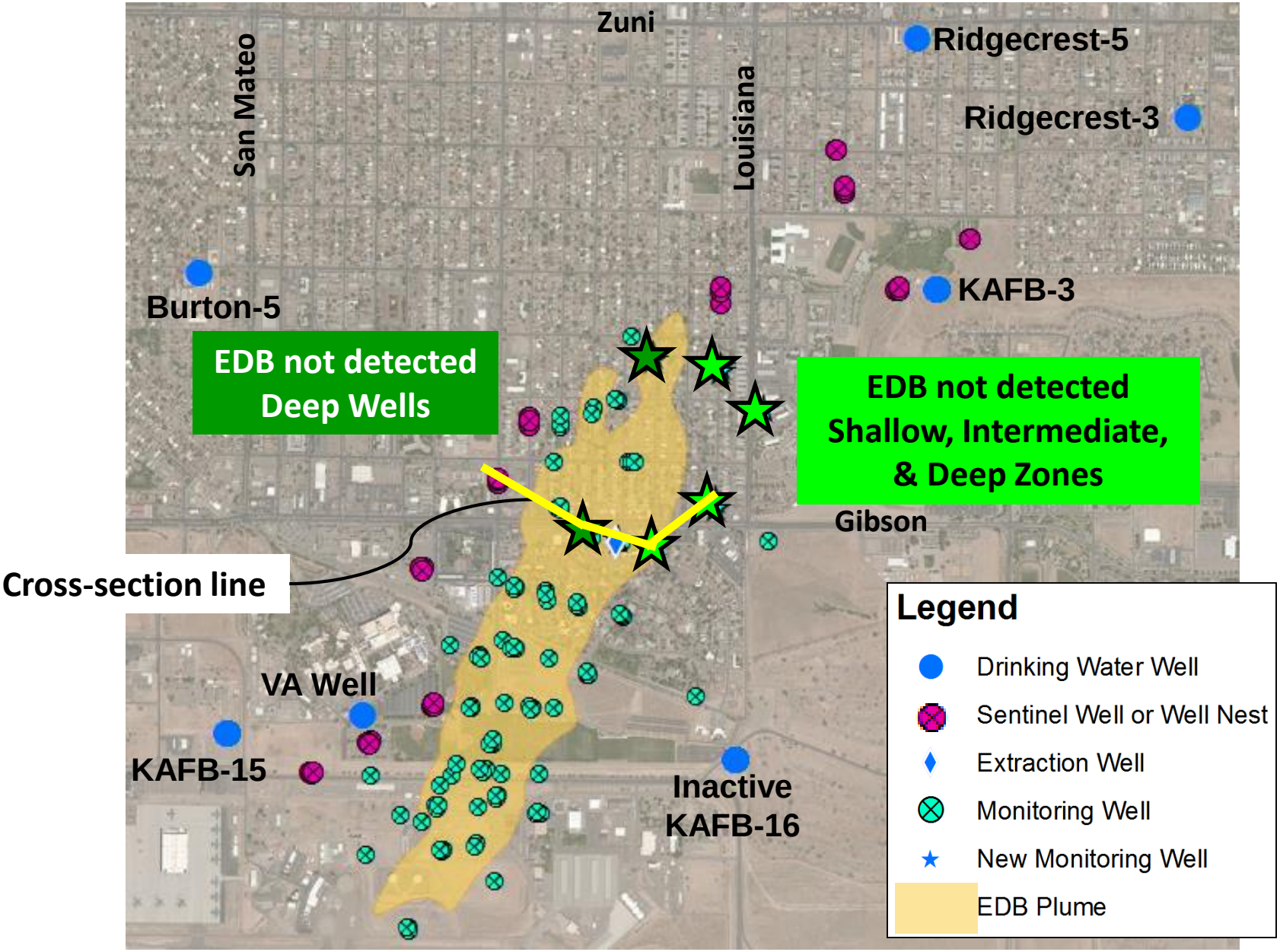
Mud Rotary

- **Mud is circulated from the drill bit into the borehole to carry drill cuttings up to the surface; mud keeps the borehole open**
- **Used to drill extraction well KAFB-106228**

Sonic

- **High frequency vibration and slow rotation advances a core barrel that is extracted and brought to surface; no mud or air is circulated**
- **Used to obtain continuous aquifer core from deep monitoring wells**

Drilling Results - Plume Definition



Cross Section West-East Along Gibson

Alluvial Fan Sediments

High Permeability

Low Permeability

Ancestral Rio Grande Sediments

High Permeability

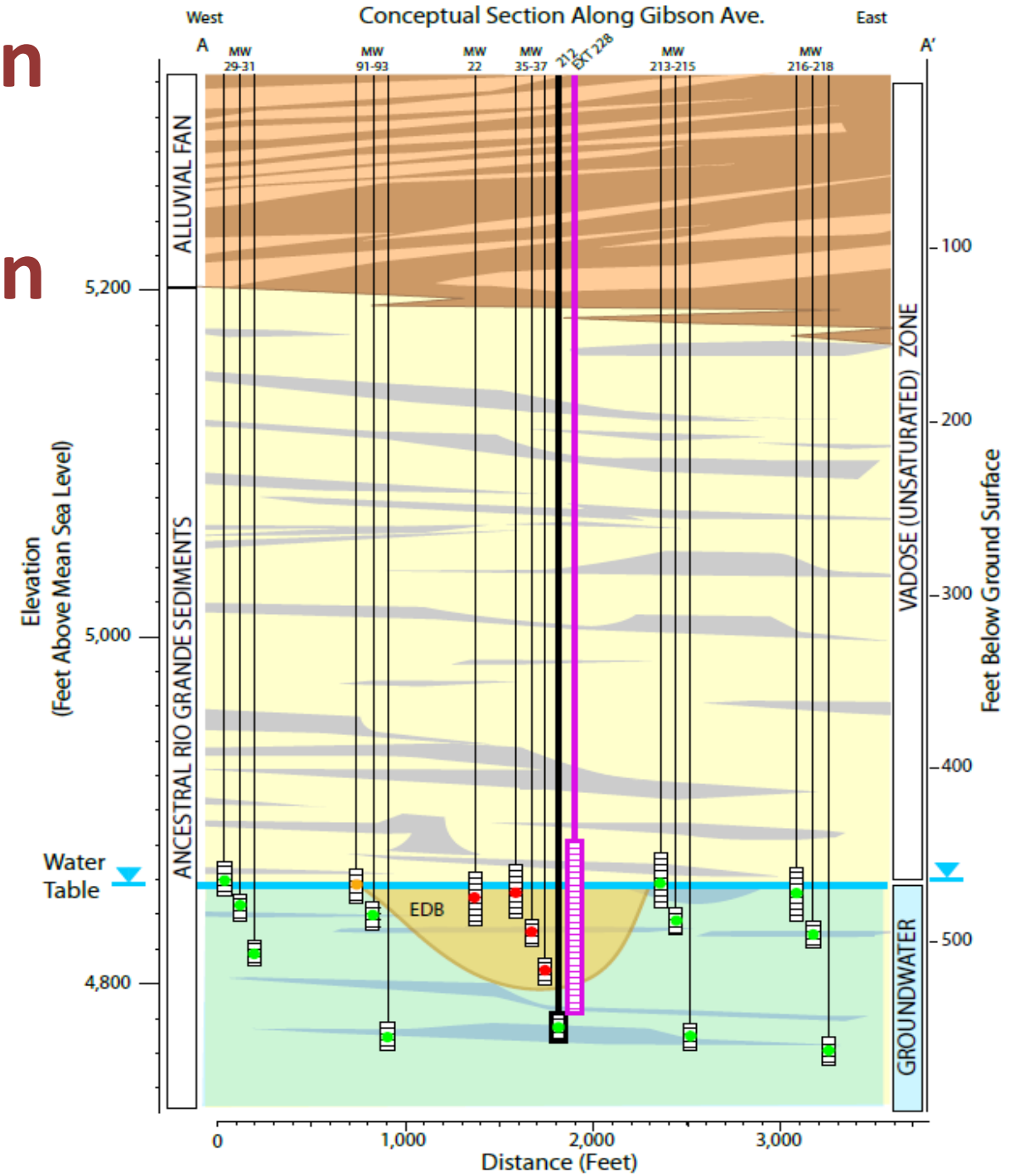
Low Permeability

EDB

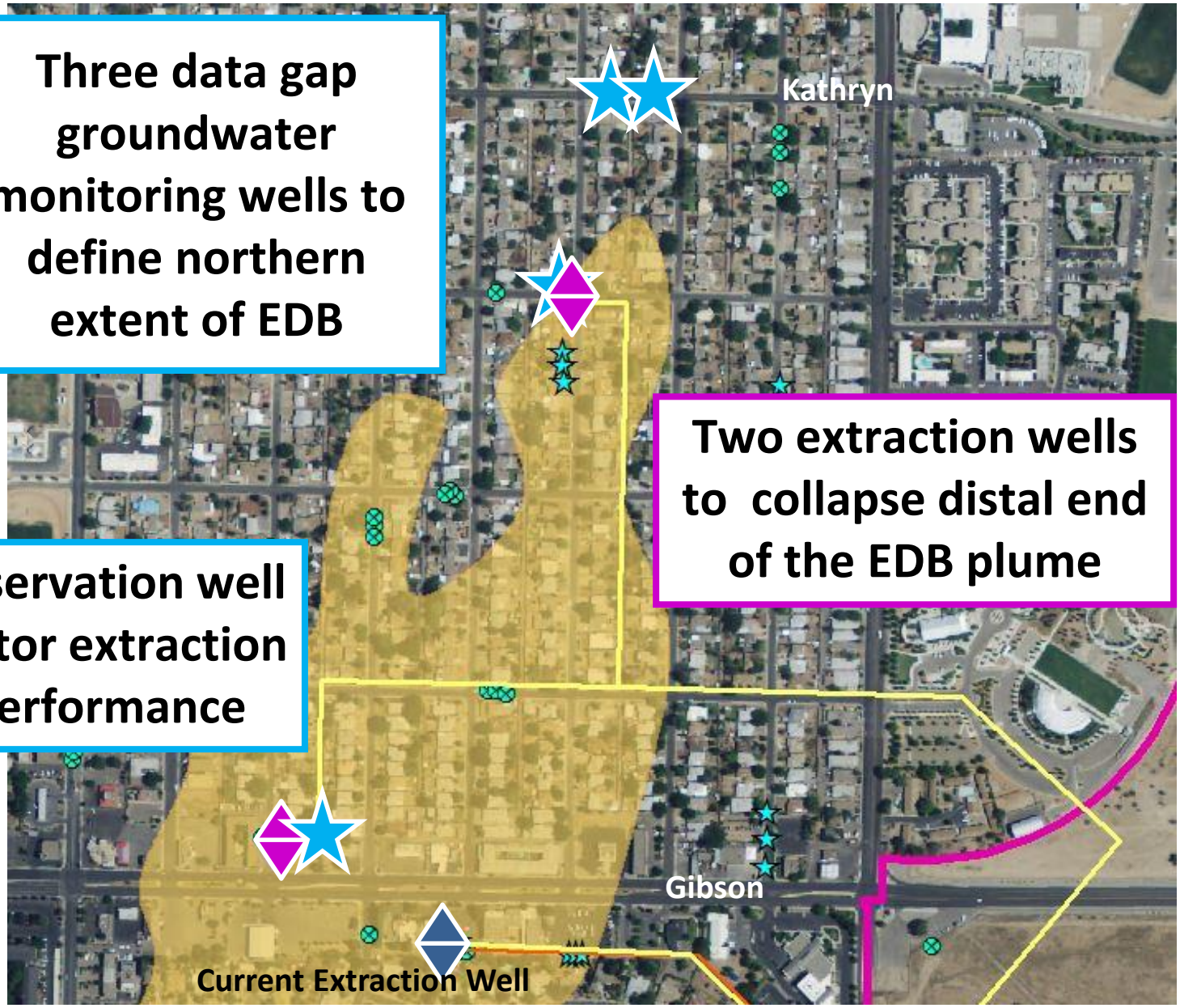
Non-Detect

Detection, Below MCL

Detection Above MCL



Additional Well Drilling (Fall 2015)



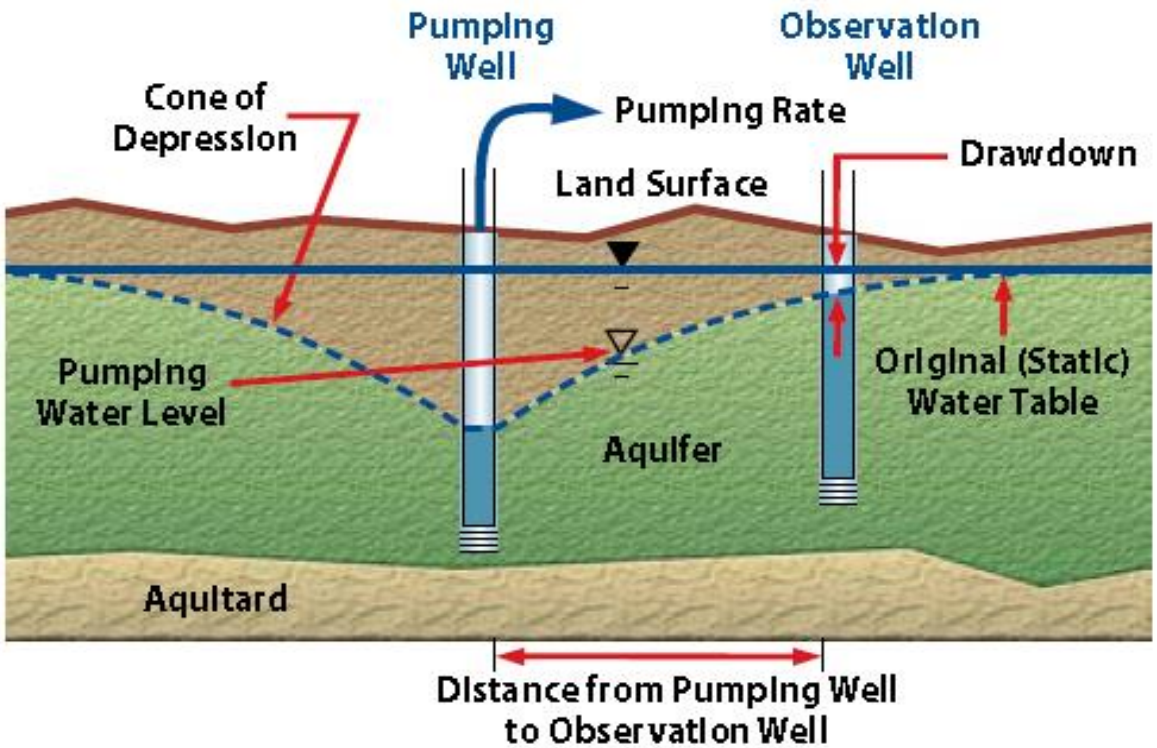
Three data gap groundwater monitoring wells to define northern extent of EDB

Two extraction wells to collapse distal end of the EDB plume

One observation well to monitor extraction well performance

Aquifer Performance Testing

- Pump the extraction well
- Measure water-level drawdown in pumping well and in observation wells
- Measure water-level recovery after pumping ends
- Use pump test data to calculate hydraulic properties of aquifer
- In progress and will be completed in early August



Groundwater Modelling

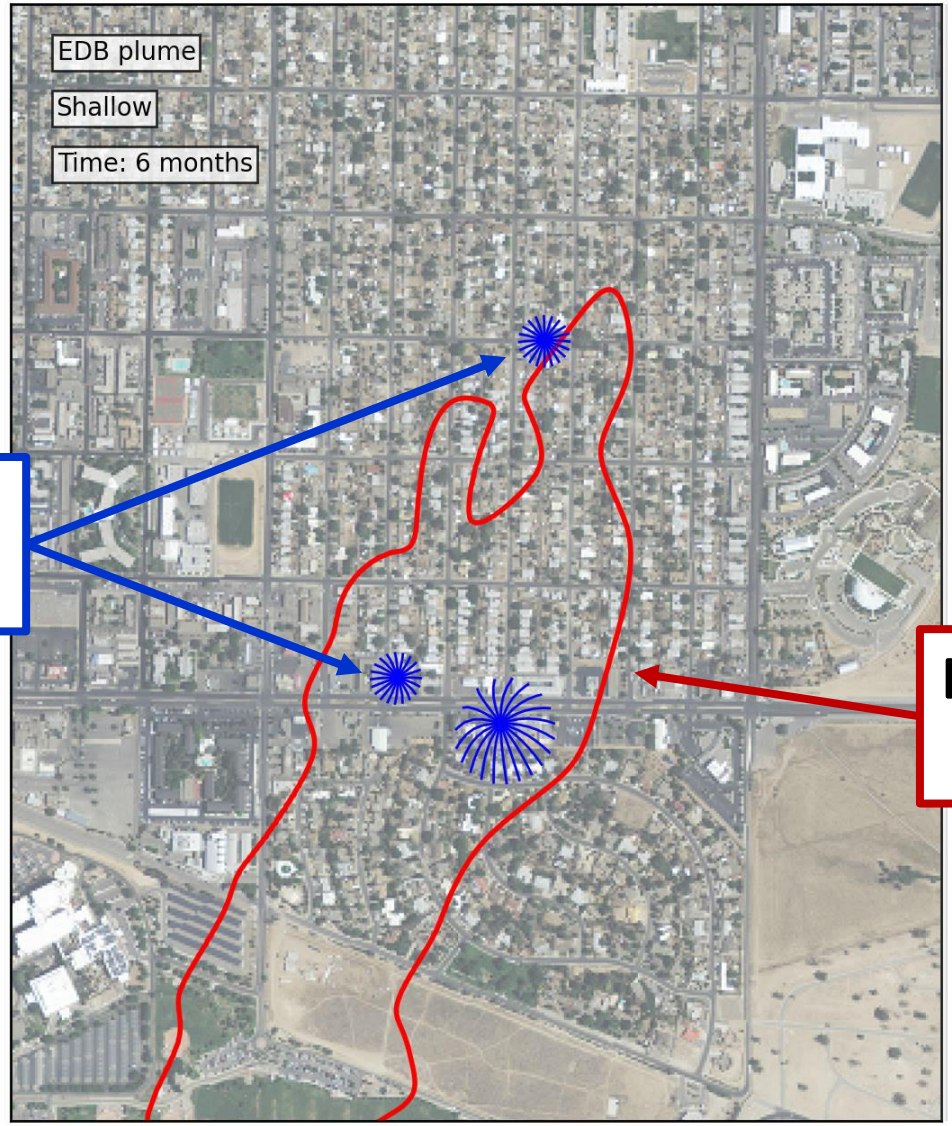
John Sigda, Intera

Two different modeling methods are being used by EPA, INTERA, and CB&I to locate the extraction wells, study the collapse of the dissolved EDB plume, and improve extraction well operation:

1. **<u>Analytic Element</u> – Calculates groundwater flow very accurately over fairly simple aquifers for a range of system components (e.g., pumping wells, rivers, boundaries, etc.)**

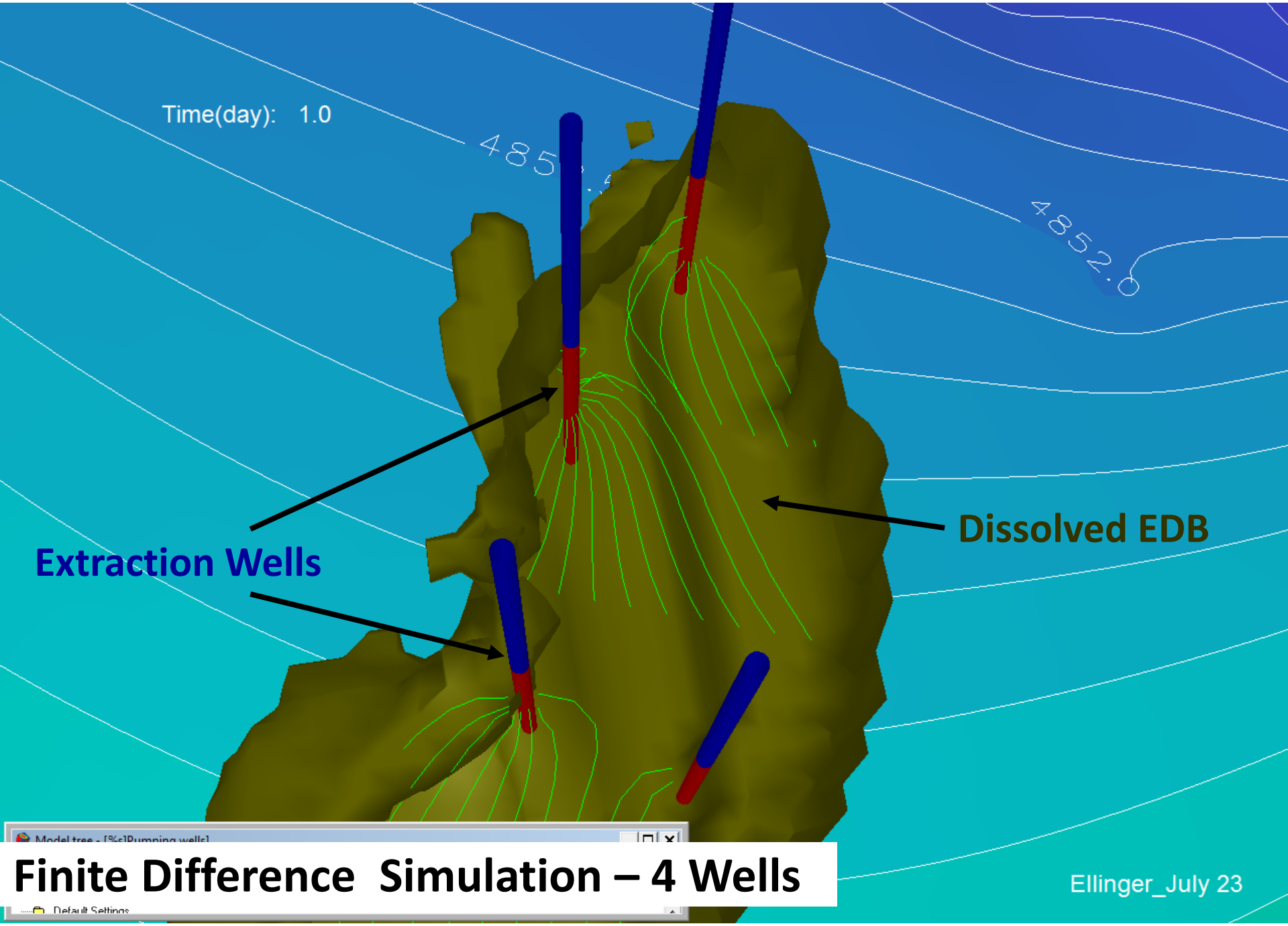
2. **<u>Finite Difference</u> – Calculates groundwater flow and transport over a simple or complex aquifer partitioned in space and time for a wide range of system components**

Analytic Element Simulation – 3 Wells



Extraction Wells

Dissolved EDB Plume Edge



Finite Difference Simulation – 4 Wells

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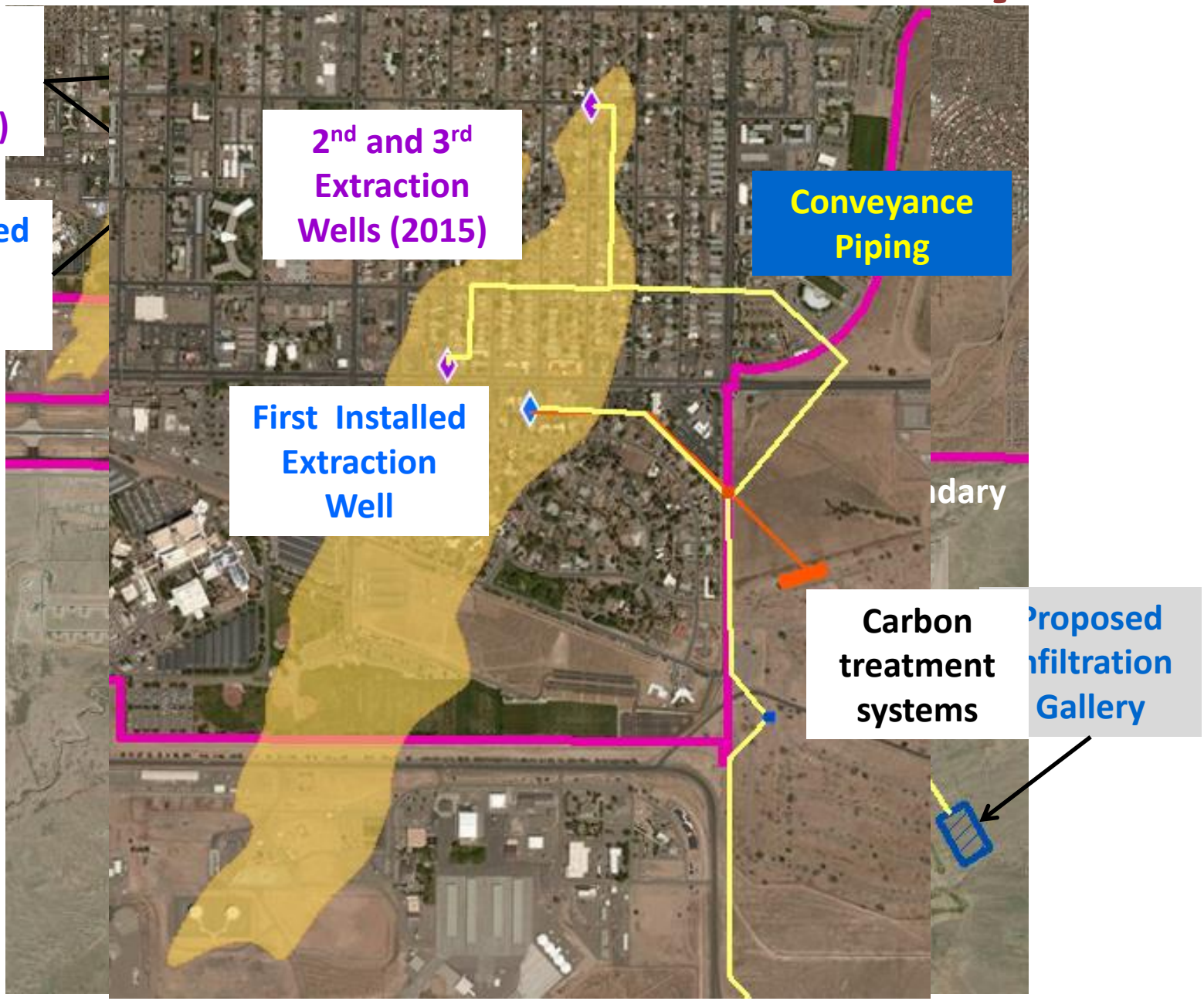
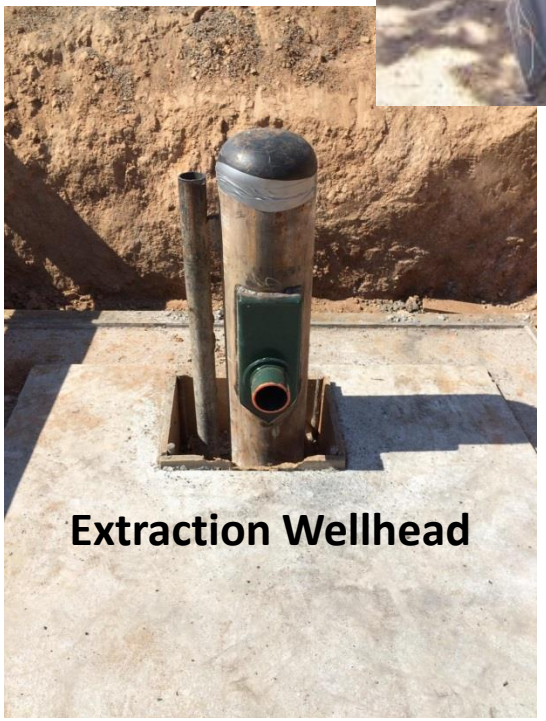
EDB Groundwater Treatment System



Groundwater Treatment System Construction

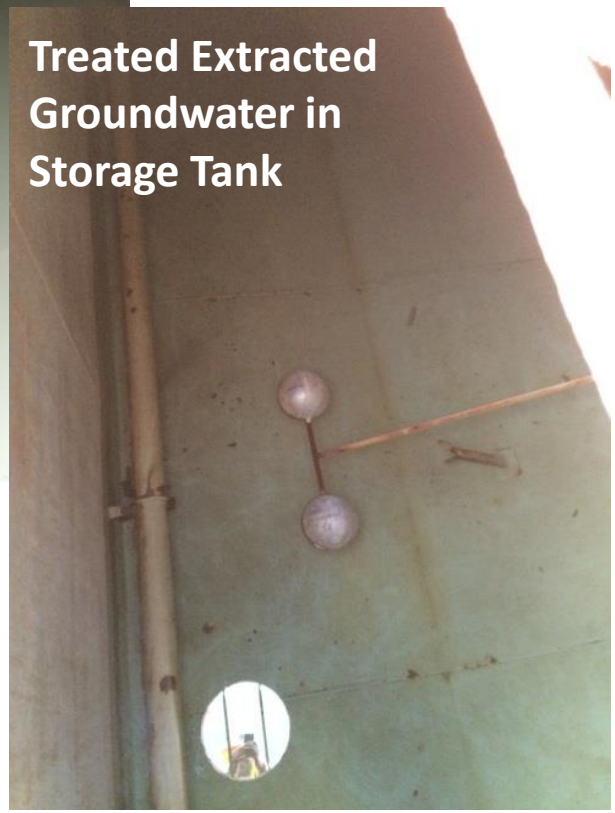
Fusing Double-Walled Groundwater Pipeline



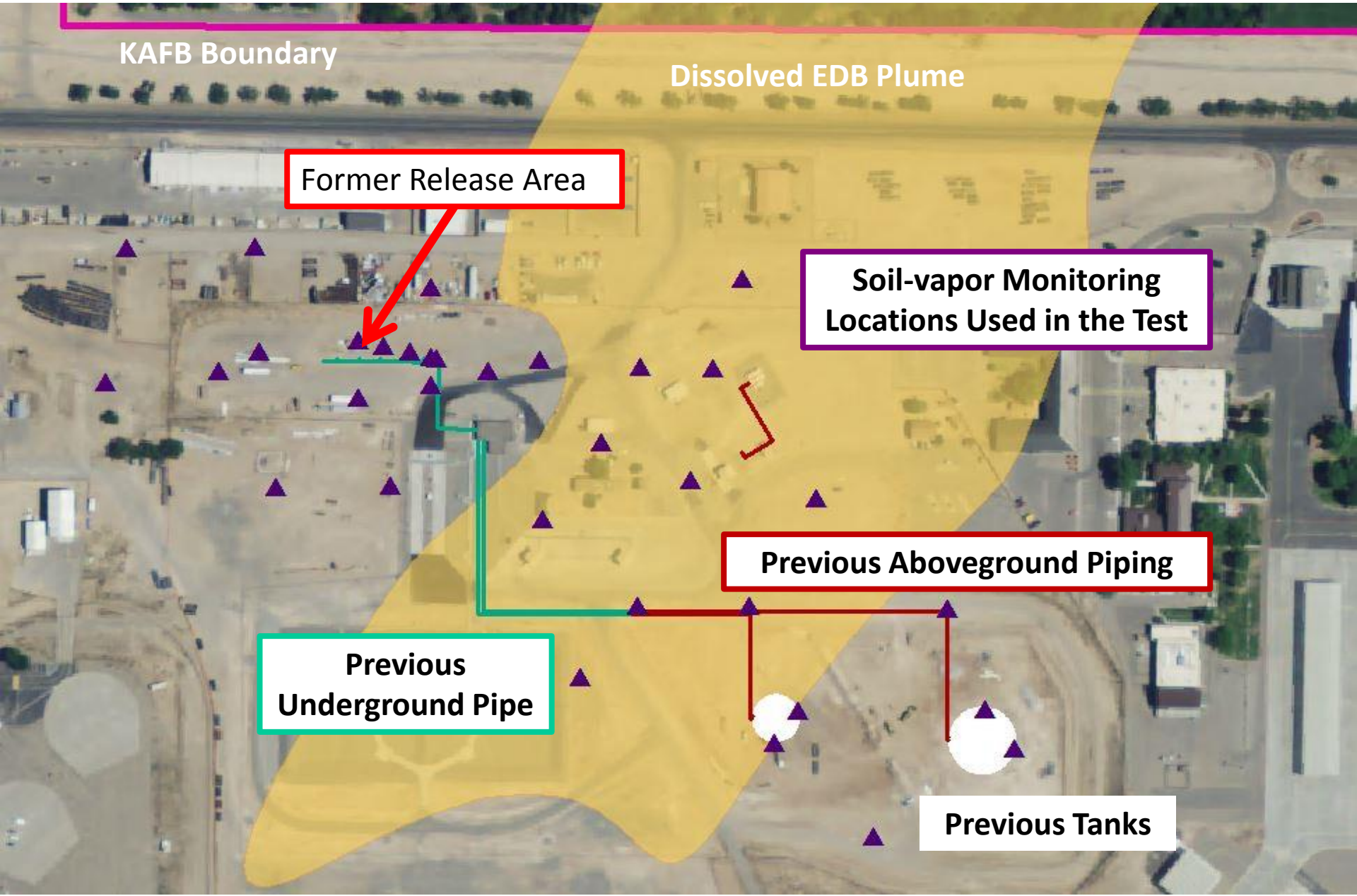
Treatment Process Tanks

Groundwater Takeaway

- First extraction well has removed 1.1 M gallons and treated 692 mg of EDB
- EDB not detected in treated water
- Clean water is being used to irrigate KAFB golf course
- Aquifer performance test underway



Source Area – Interim Measures



SVE Temporary Shutdown Test

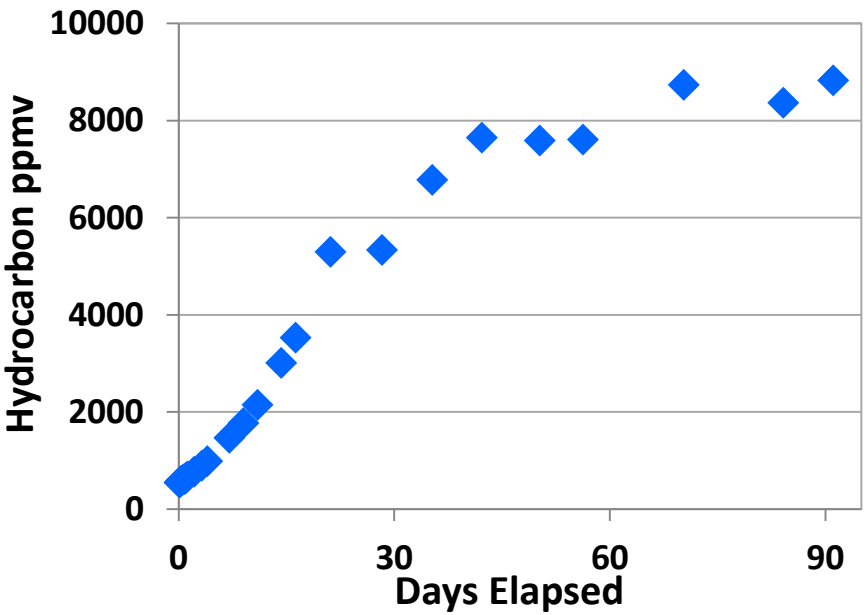
Objective: Monitor hydrocarbon rebound and in-situ respiration in the vadose zone over 3 months

<u>Soil-vapor monitoring (SVM) included</u>:

- **Baseline, time-series, and final soil-vapor sampling**
- **Laboratory and field analyses**
  - **Standard analytic methods**
  - **Horiba analyzes fuel hydrocarbons, oxygen (O_2), and carbon dioxide (CO_2)**

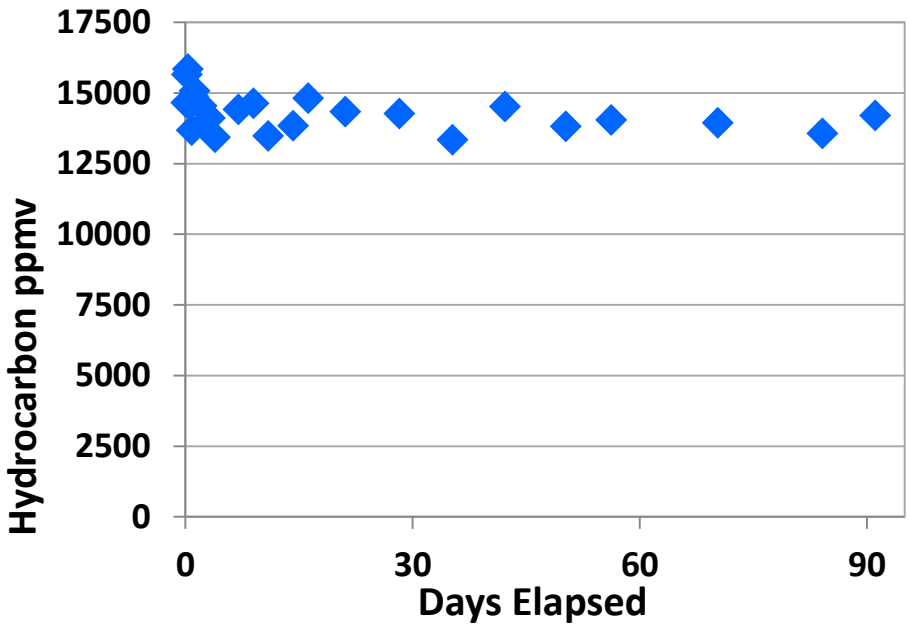
Preliminary Rebounding Examples

SVMW-03 at
250 ft below ground surface



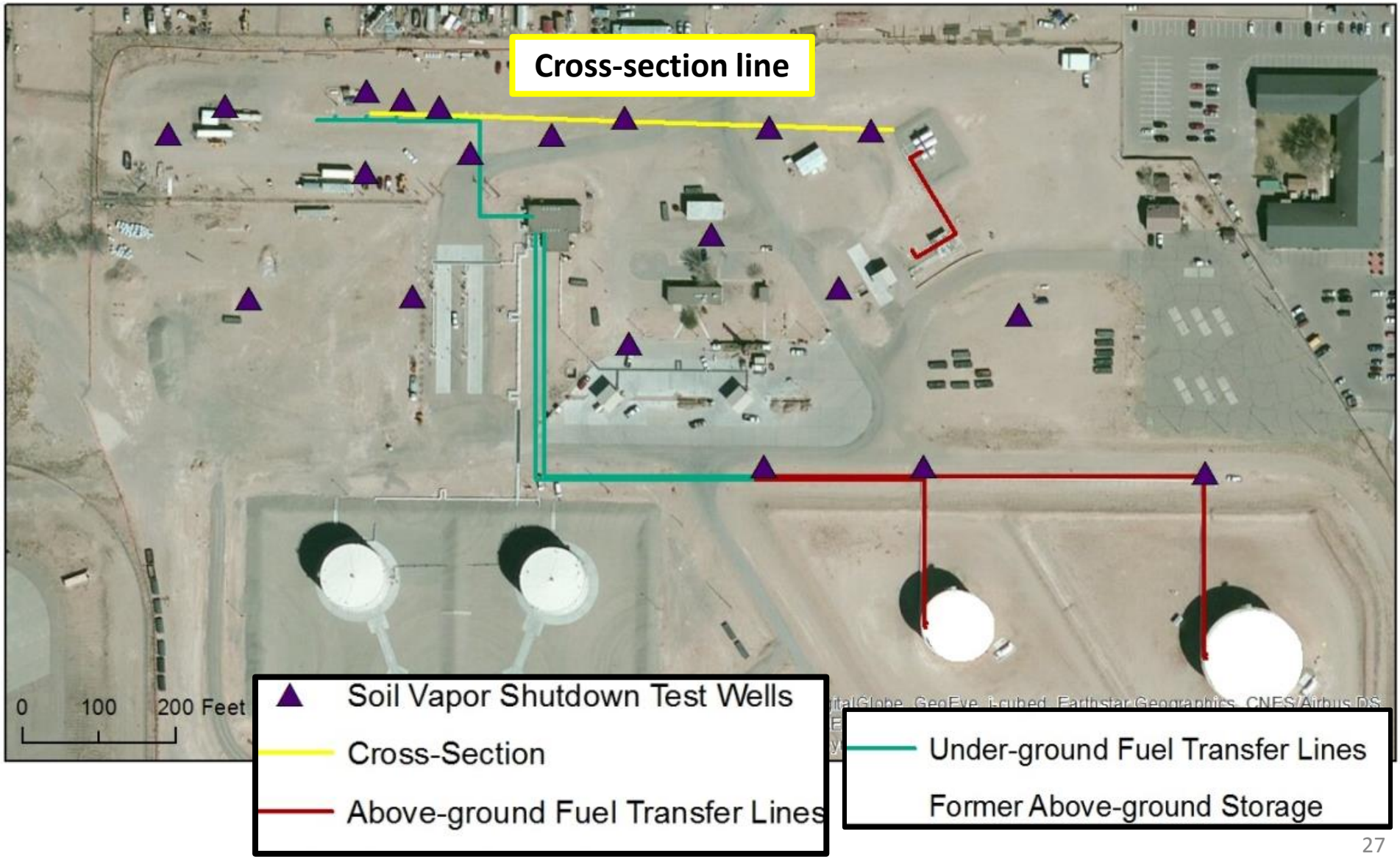
Hydrocarbon concentrations increased indicates rebounding

SVMW-03 at
300 ft below ground surface

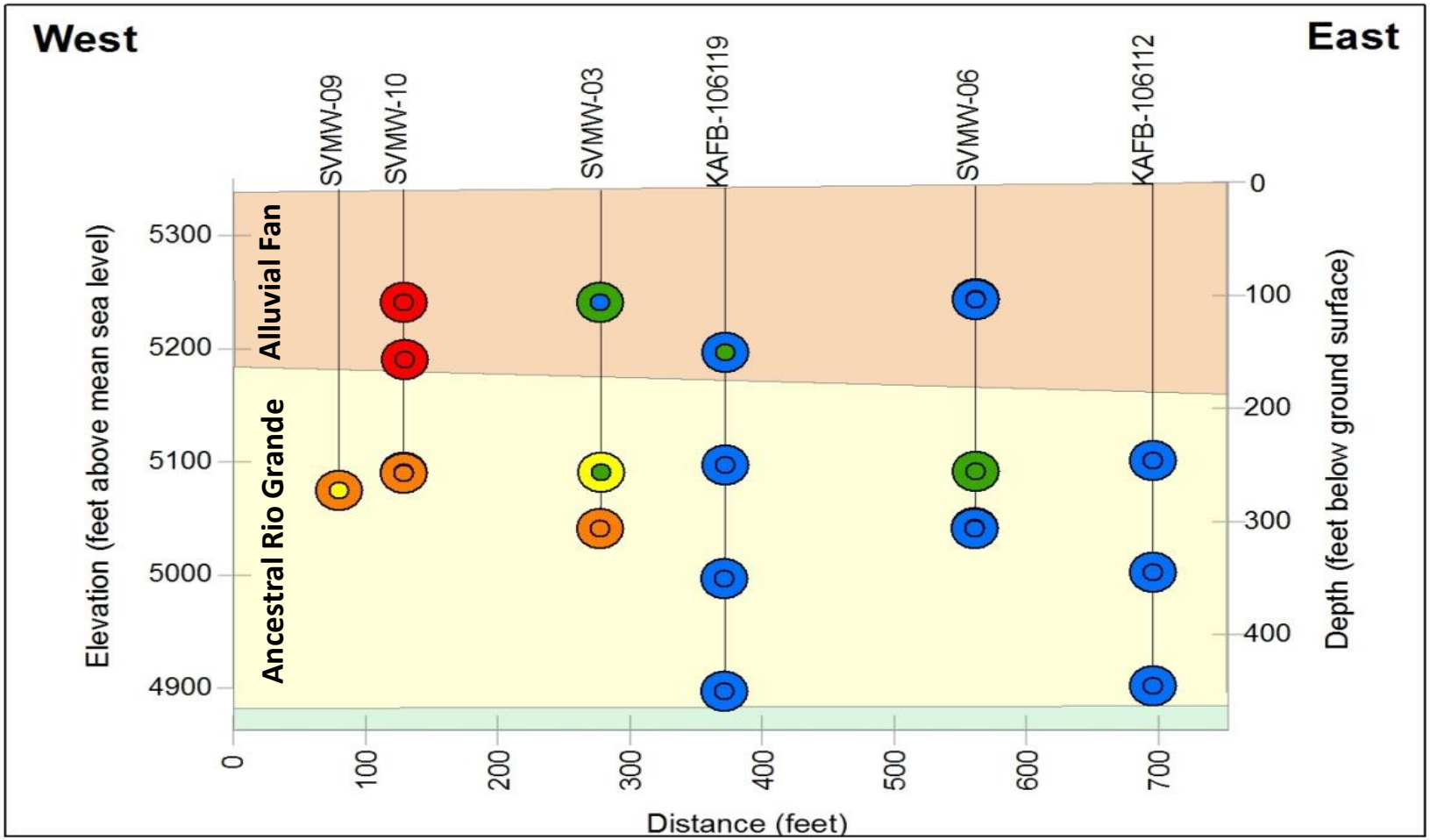


Hydrocarbon concentrations remained stable (example above) or decreased indicates no rebound

SVE Temporary Shutdown Test



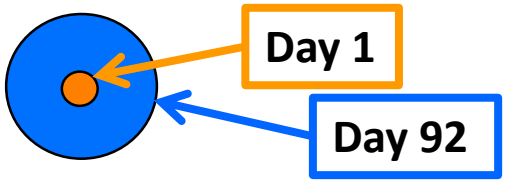
Cross Section West-East In Source Area



Hydrocarbon Concentration ppmv

- 0.0 - 450.0
- 450.1 - 3500.0
- 3500.1 - 10000.0
- 10000.1 - 20000.0
- 20000.1 - 32760.0
- SVE Well Casings

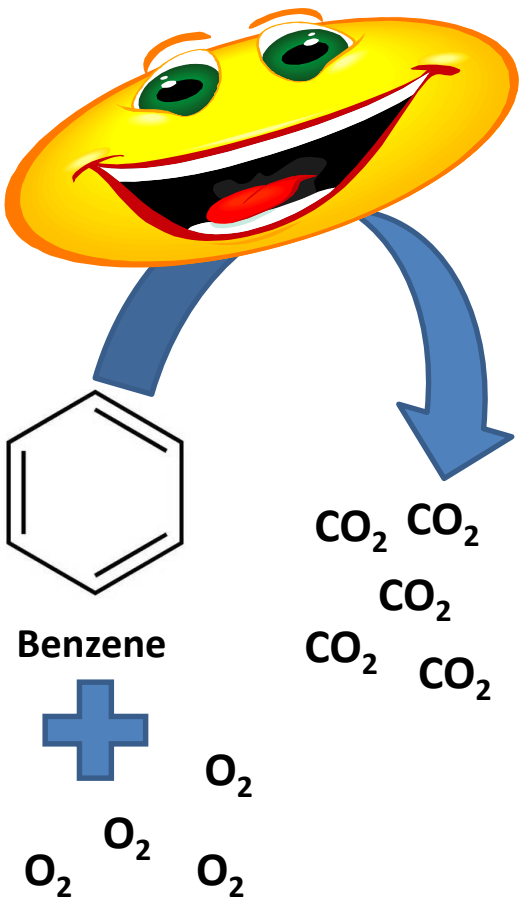
Symbol Size Corresponds to Sample Date



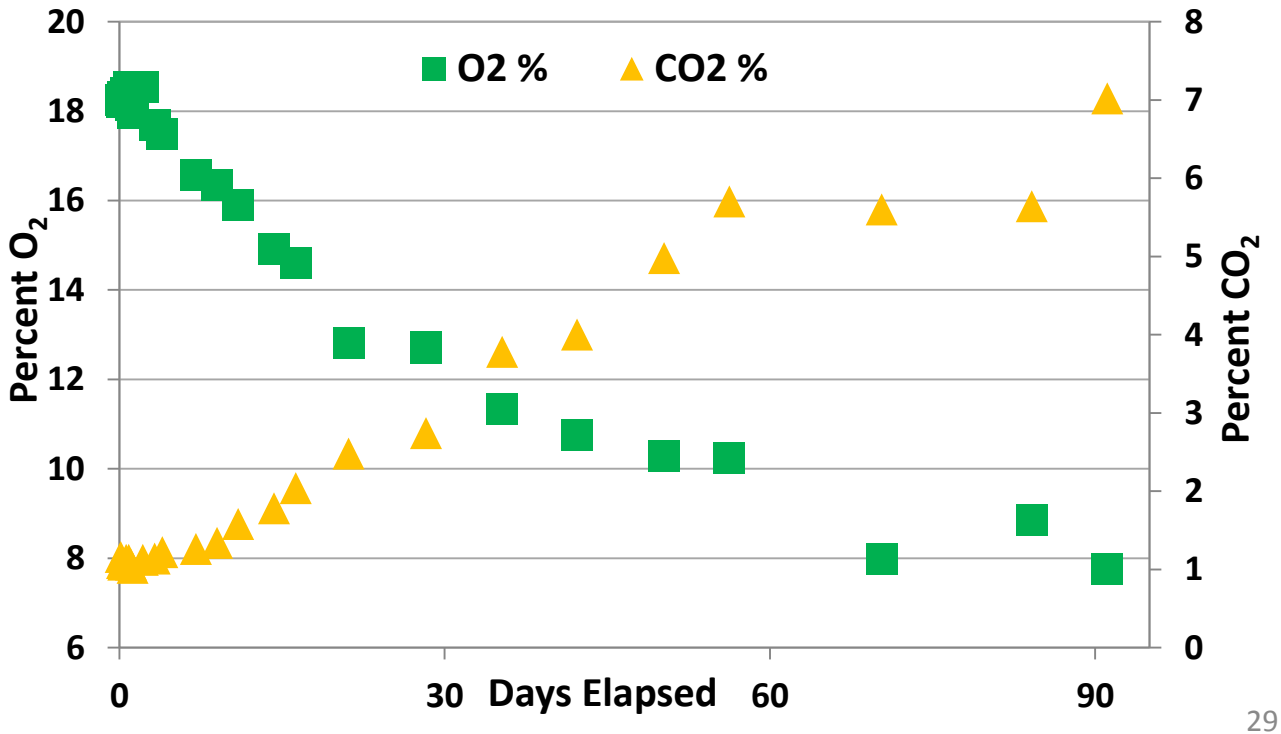
Preliminary In-situ Biorespiration Results

Naturally occurring soil bacteria are present throughout subsurface

Bacteria consume O_2, produce CO_2 as they biodegrade or "eat" fuel



SVMW-03 at 250 ft below ground surface



Soil Vapor Path Forward

Final sampling of the total SVM network is now being completed

Huge amount of data to evaluate:

1. **Areas with high rebound concentrations:**

   a) High O_2 and low CO_2 → suitable for SVE

   b) Low O_2 and high CO_2 → suitable for SVE/bioventing

2. **Areas with no rebound, low O_2, and high CO_2 suitable for SVE/bioventing**

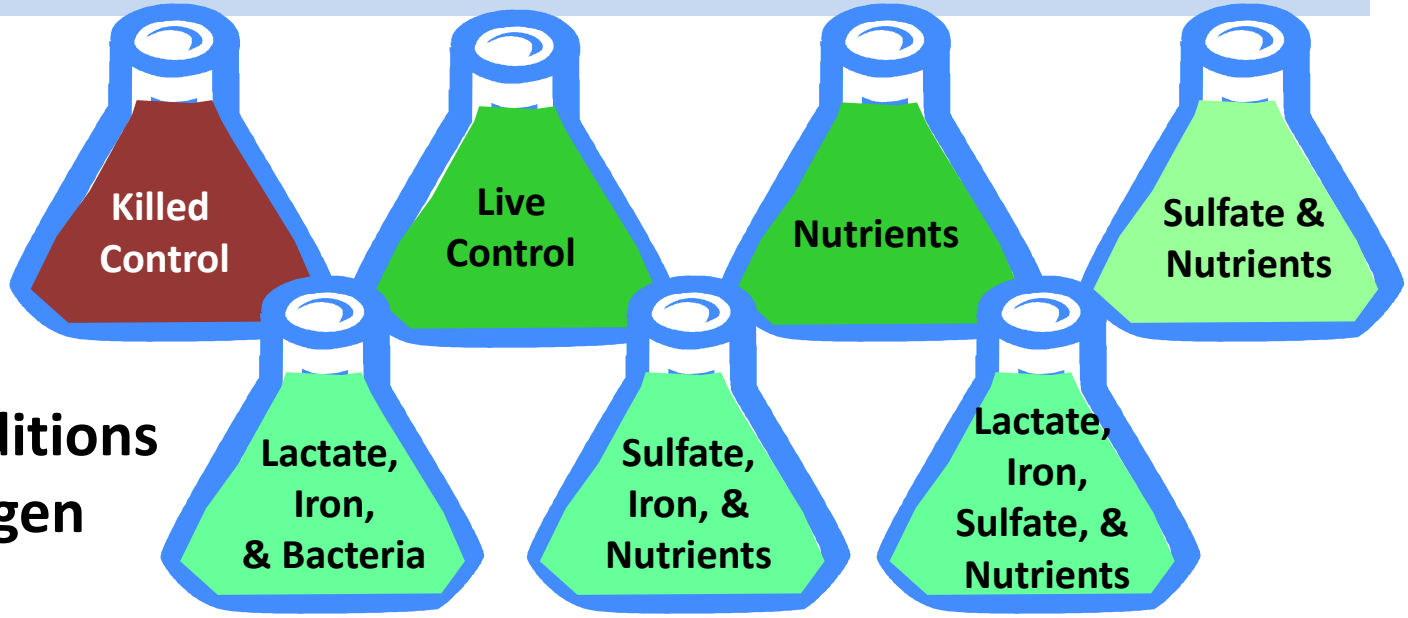
3. **Areas with no rebound, and high O_2 do not need further treatment.**

Light Non-Aqueous Phase Liquid (LNAPL)

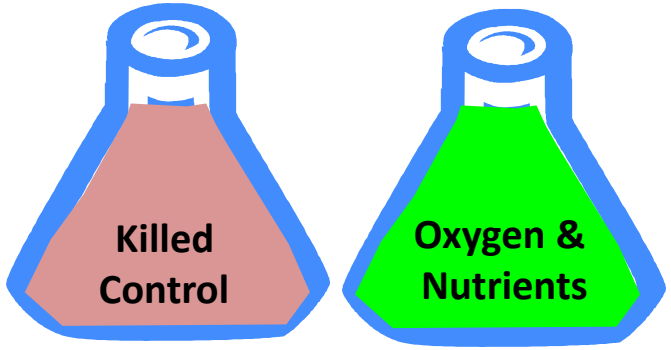
Identified potential technologies for interim measures

Laboratory microcosm tests were conducted:

Anaerobic conditions without oxygen



Aerobic conditions with oxygen



Laboratory Microcosm Test Results

Anaerobic:

- **Complete EDB degradation when bacteria were added**
- **Minimal EDB degradation without bacteria added.**
- **Molecular methods indicated the presence of EDB degrading bacteria in site groundwater**

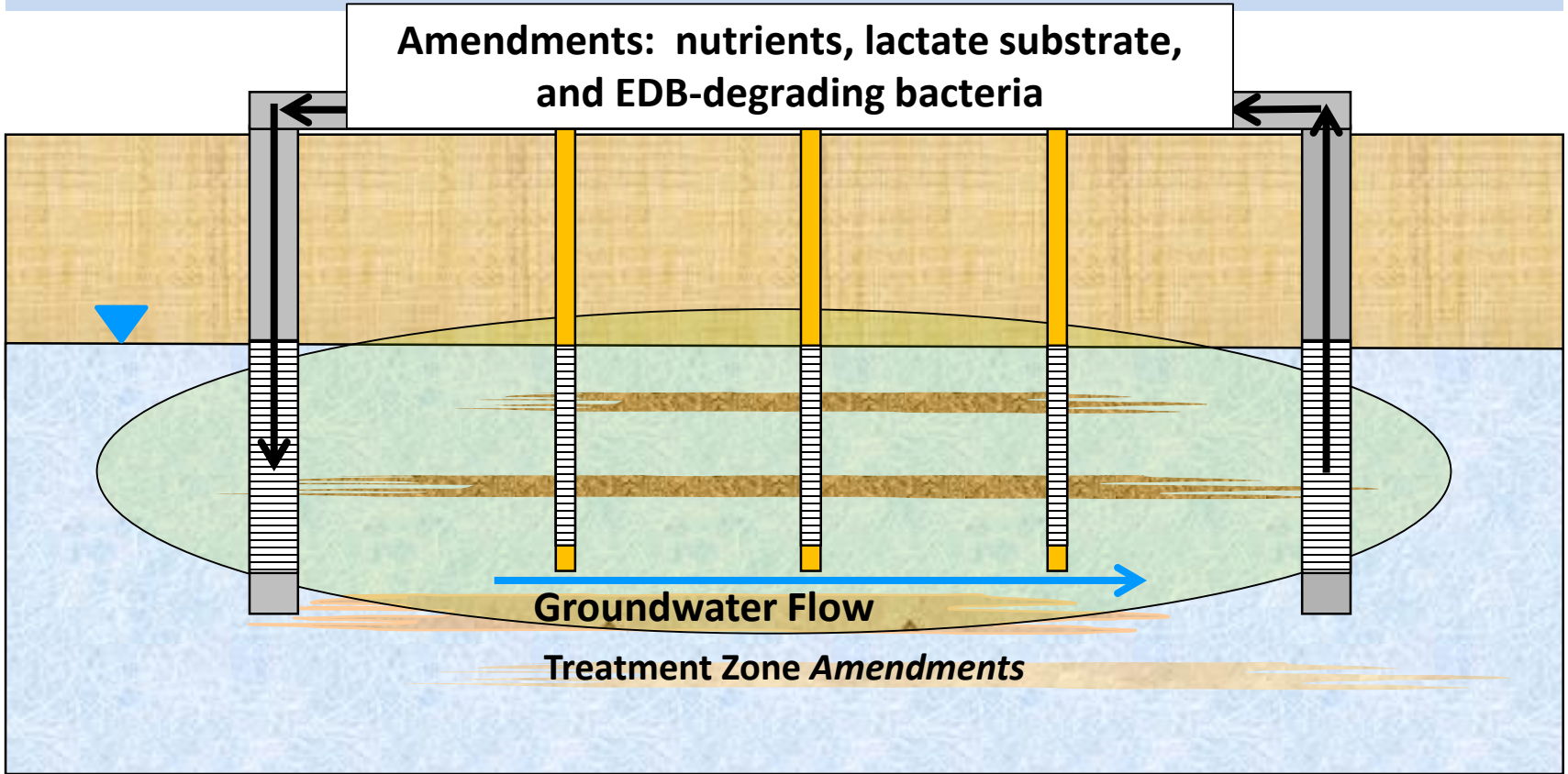
Aerobic:

- **Complete fuel compounds & partial EDB degradation (50%)**
  - **May have run out of food**
- **Molecular methods indicated the presence of EDB degrading co-metabolic enzymes in site groundwater**

Anaerobic Biodegradation Pilot Test

Groundwater Recirculation

- **Pump groundwater - Add amendments in phased approach**
- **Inject amended water up-gradient to create recirculation cell to support anaerobic biodegradation EDB**

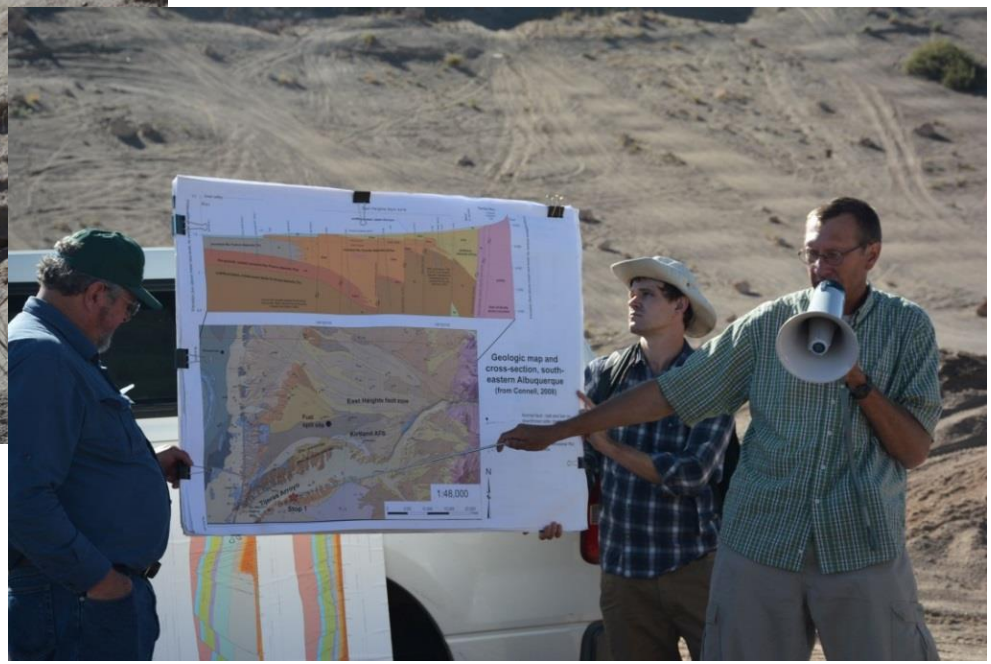


Recap

- Drinking water supply wells show no contamination
- EDB groundwater plume not migrating towards KAFB-3 and Ridgecrest-3
- Extraction of EDB plume began June 2015
- Finalizing data collection for shutdown testing; evaluate data to identify suitable treatments
- Designing an in-situ anaerobic pilot test to clean up LNAPL

Upcoming Events

- **Public Field Trip – October 2015**
- **Public Meeting – November 17, 2015**



Questions & Answers

- **One question/comment per turn at the microphone**
- **Each question/comment will be allotted 3 minutes – please respect this time limit so others will have an opportunity to be heard**
- **In addition, comment cards have been made available**
  - **Return completed comment cards to Air Force staff**
  - **Questions will be incorporated into the FAQ portion of the Kirtland AFB BFF Spill project website:**

    www.kirtlandjetfuelremediation.com

How do I get more information?

Contact NMED:

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KAFB project technical lead
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505-827-2140

Jill Turner,
KAFB project communications lead
jill.turner@state.nm.us
505-222-9548

NMED Website and Listserv: http://www.nmenv.state.nm.us/

Contact the Air Force:

Air Force Civil Engineer Center
Office of Public Affairs
2261 Hughes Ave, Ste 155
Joint Base San Antonio-Lackland TX 78236-9853
(210) 925-0956 or (866) 725-7617
Email: afcec.pa@us.af.mil

Air Force BFF-specific spill website: www.kirtlandjetfuelremediation.com

Kirtland AFB website at http://www.kirtland.af.mil in the Environmental Issues section for Public Records.