

Kirtland Air Force Base Fuel Spill Cleanup

October 14, 2015



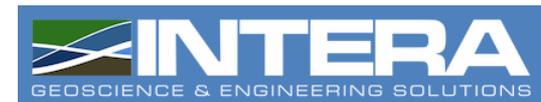
Prepared by
Dennis McQuillan, Geologist
and
Diane Agnew, Hydrogeologist

A Partnership for Success

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



US Army Corps of Engineers

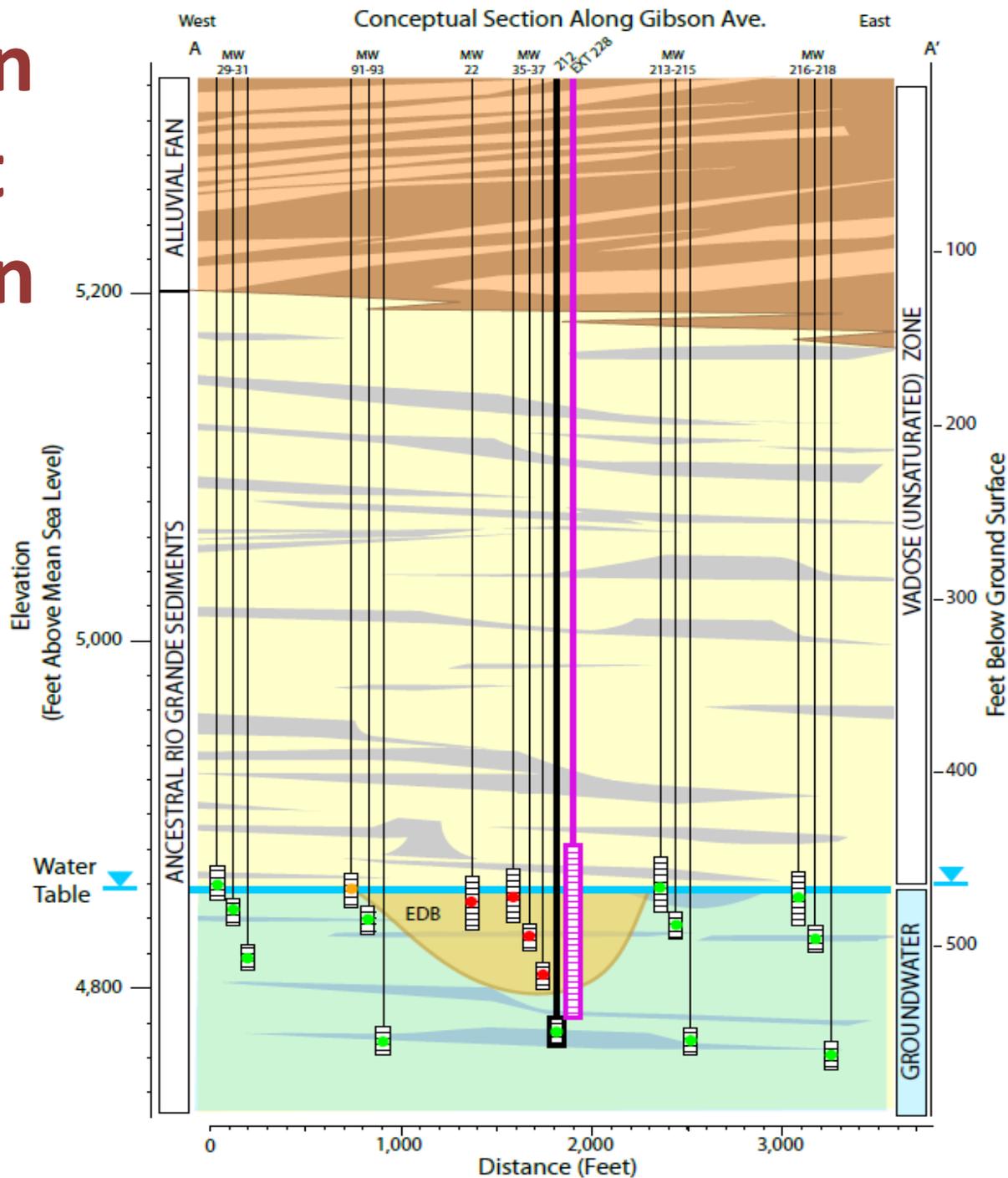
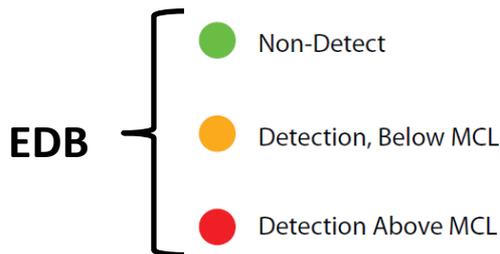
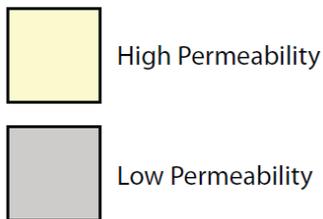


Cross Section ~ West-East Along Gibson

Alluvial Fan Sediments



Ancestral Rio Grande Sediments

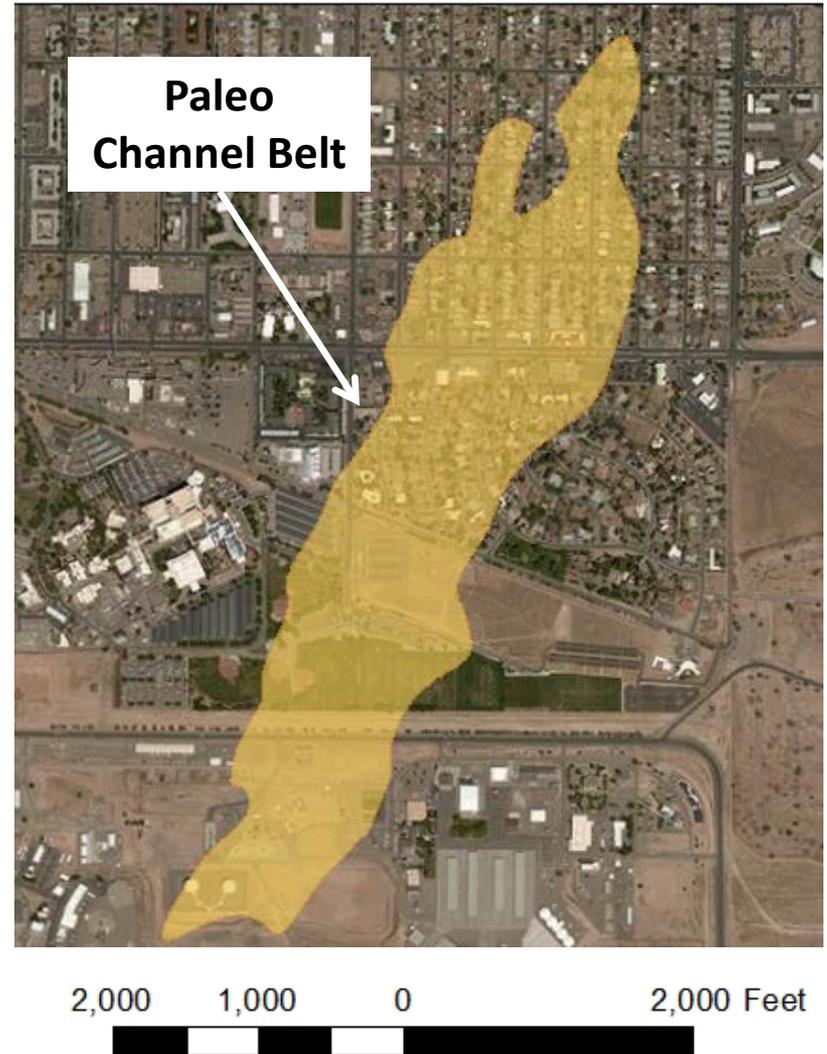


Rio Grande Braided Stream Channel Belt

Rio Grande Braided Stream
In Albuquerque South Valley



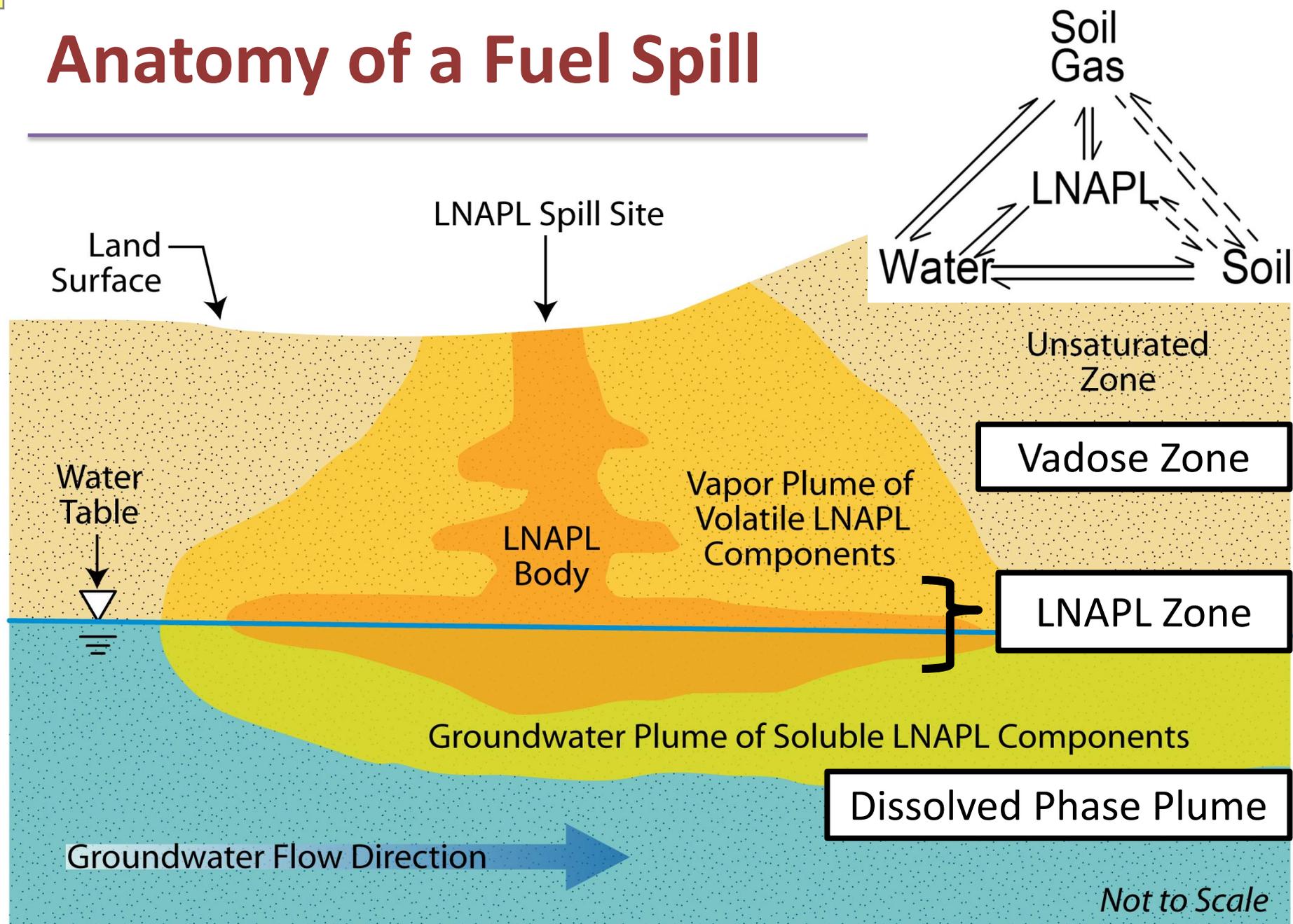
Shallow EDB Plume



KAFB Fuel Spill History

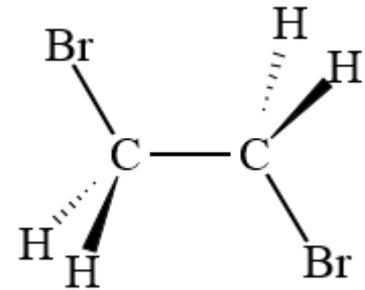
- **1951-53** – Kirtland Air Force Base (KAFB) Bulk Fuels Facility (BFF) constructed
- **1975** – Handling of aviation gasoline containing the additive ethylene dibromide (EDB) discontinued
- **1999** – KAFB notified NMED of soil contamination from underground piping leak, and ceased use of piping
- **2001** – KAFB notified NMED of groundwater contamination with dissolved fuel constituents
- **2003** – Soil vapor extraction (SVE) begins to vacuum contaminants from soil
- **2007** – Fuel (light non-aqueous phase liquid, LNAPL) discovered floating on groundwater
- **2009** – Water level rise begins to submerge LNAPL within aquifer
- **2014-15** – Inter-agency partnership, additional interim measures
- **2015** – Groundwater cleanup begins

Anatomy of a Fuel Spill



What is EDB?

- Ethylene dibromide (EDB) is a colorless liquid that is found naturally in oceans and is also manufactured for industrial purposes.
- Use of EDB as a pesticide was banned in 1984.
- Until 1983, EDB was used as an anti-knock agent in leaded gasoline and aviation fuel



For more information visit the sites below:

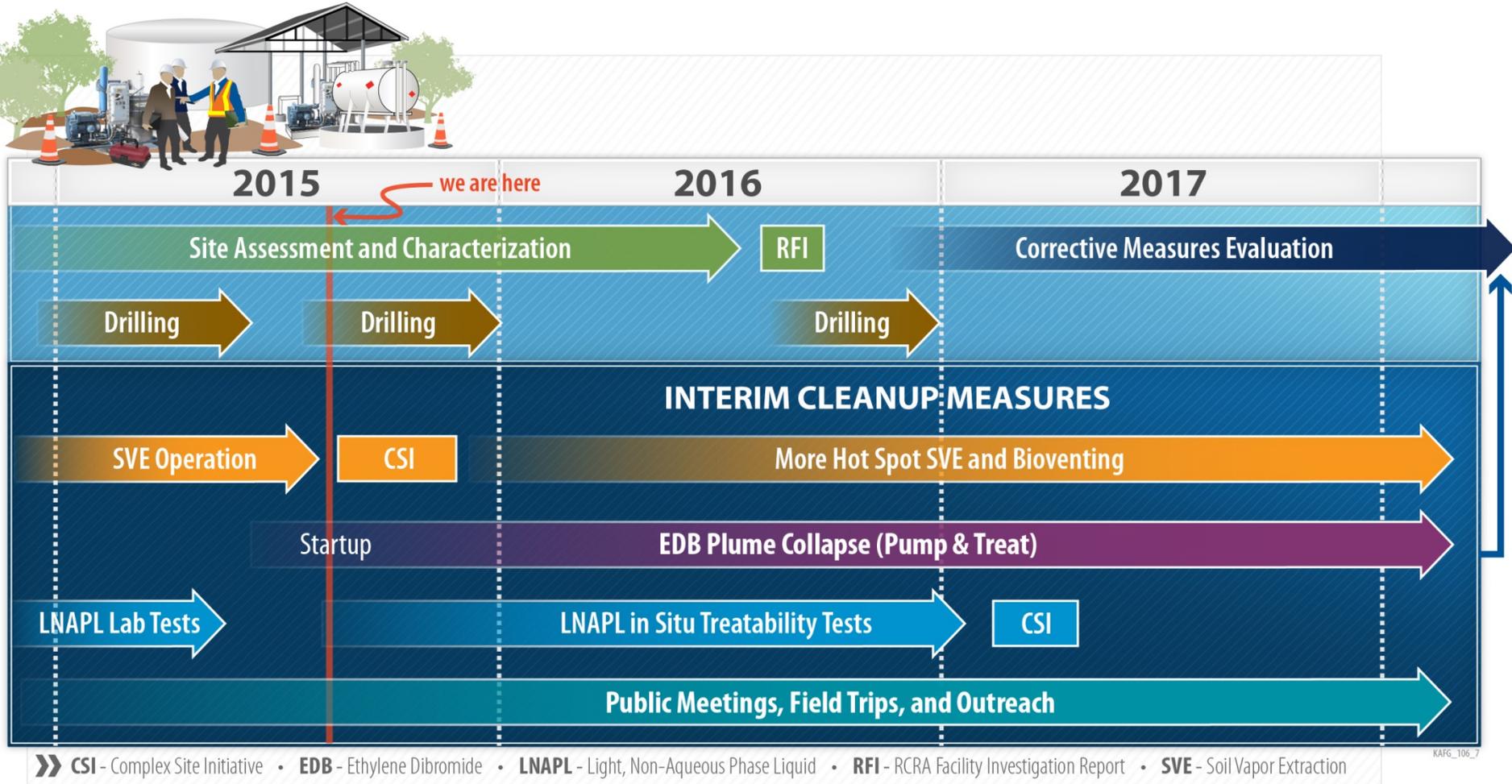
United States Environmental Protection Agency

<http://water.epa.gov/drink/contaminants/basicinformation/ethylene-dibromide.cfm>

Agency for Toxic Substances & Disease Registry

<http://www.atsdr.cdc.gov/MMG/MMG.asp?id=1143&tid=251>

RCRA Corrective Action Timeline 2015-17



Regulatory Basis

The New Mexico Environment Department (NMED) has been granted primacy by the U.S. Environmental Protection Agency to administer:

- The Safe Drinking Water Act (SDWA) program; and
- The Resource Conservation and Recovery Act (RCRA) program

Public water systems, the ABC Water Utility Authority, Kirtland AFB and the VA Hospital, must deliver water to consumers that meets SDWA standards.

Kirtland AFB must comply with their RCRA Hazardous Waste Permit, including the Corrective Action Process.

Drinking Water Protection

EDB Drinking Water Standards

U.S. EPA	0.05 µg/L
State of New Mexico	0.05 µg/L

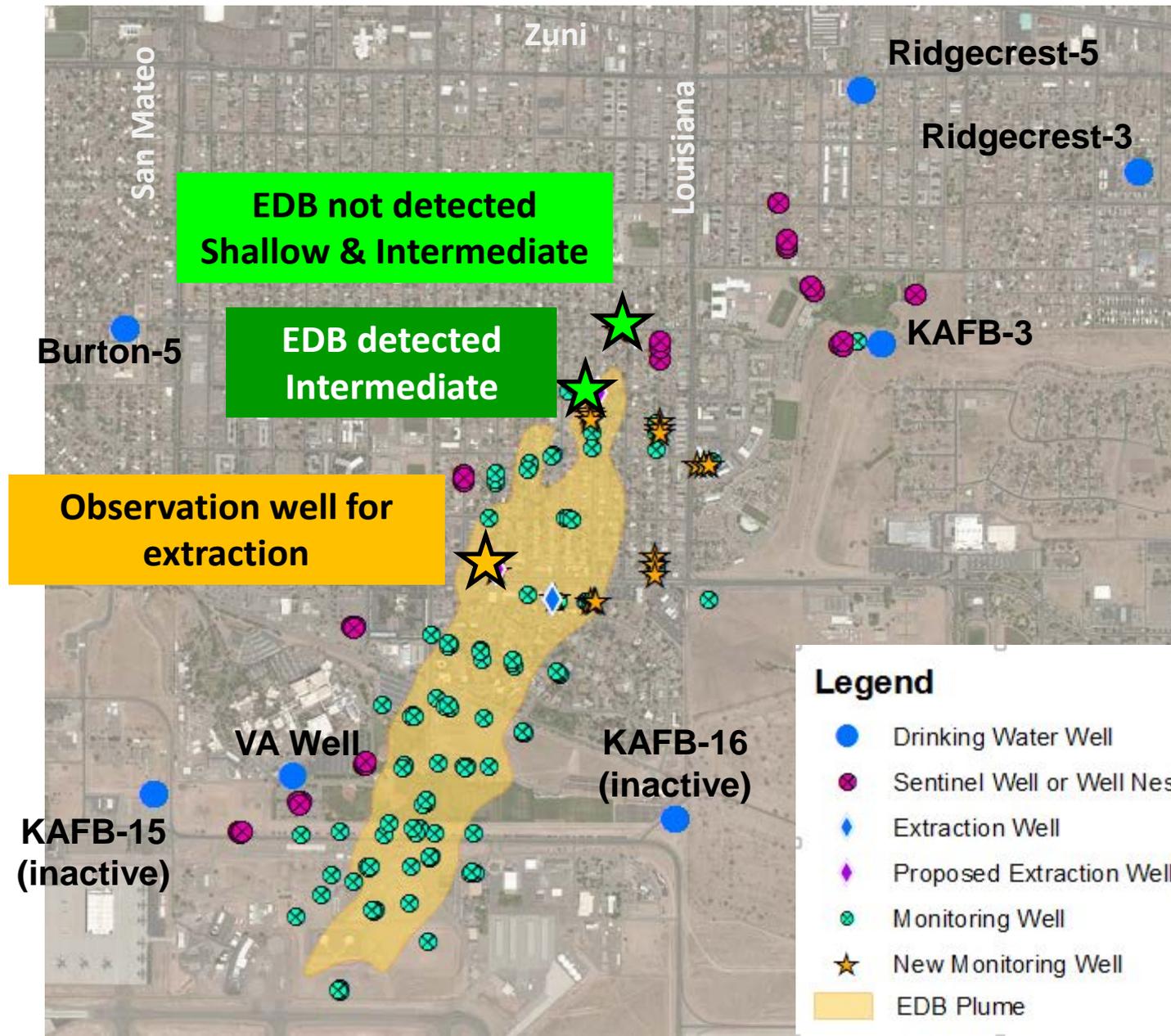
- EPA and NMED both recommend that EDB be kept to zero concentration in drinking water. However, the enforceable standard is set at 0.05 µg/L.
- Federal law requires testing once every 3 years for EDB and benzene; sampling increases to quarterly if contaminants are detected.
- Drinking water supply wells in the area are being tested monthly.
- No detections of any fuel contaminants in any production well.
- EDB regulatory detection limit = 0.01 µg/L for public water systems.
- Sentinel wells have been installed to provide early detection of any plume migration in the direction of the water supply wells.

Dissolved EDB will not be allowed to impact any drinking water supply system at detectable concentrations.

Monthly Wellhead Testing Shows No Drinking Water Contamination



Protecting Drinking Water Wells



Collapsing the EDB Plume

2nd and 3rd
Extraction
Wells (2015)

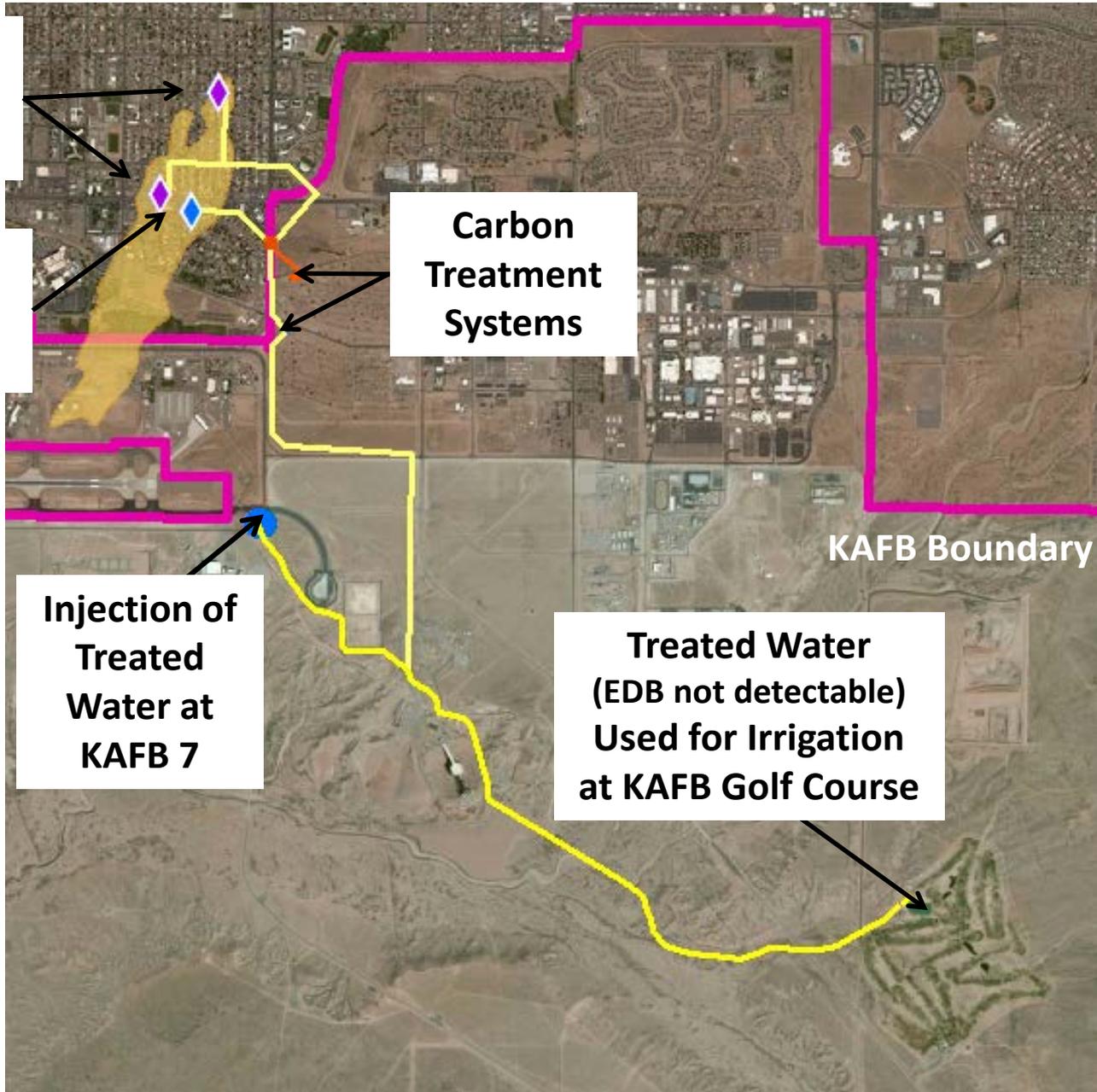
First
Extraction
Well

Carbon
Treatment
Systems

KAFB Boundary

Injection of
Treated
Water at
KAFB 7

Treated Water
(EDB not detectable)
Used for Irrigation
at KAFB Golf Course



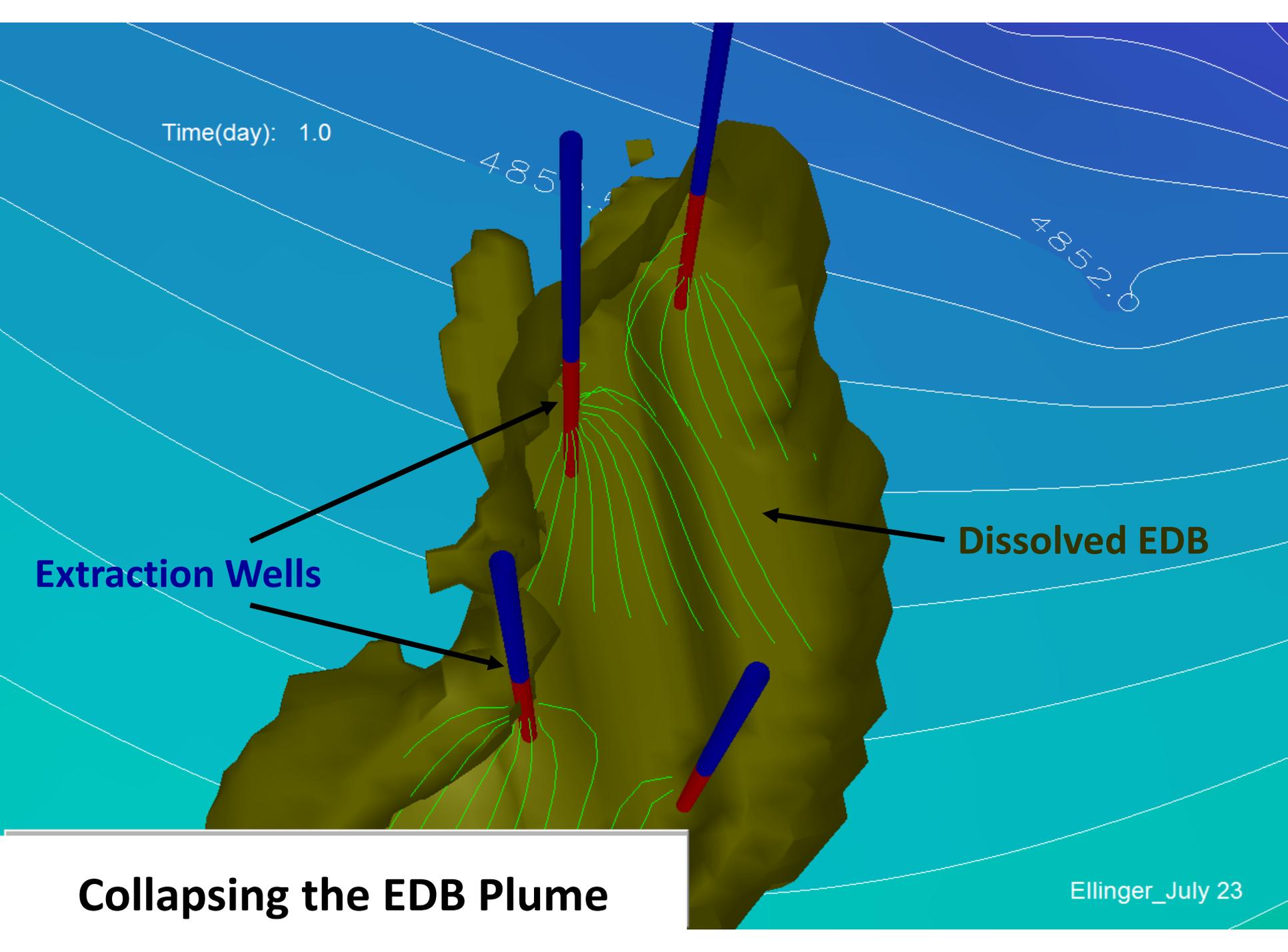
Time(day): 1.0

Extraction Wells

Dissolved EDB

Collapsing the EDB Plume

Ellinger_July 23



Groundwater Pump-and-Treat Full-Scale System



Excavation and leveling of building pad



Pouring of floor of building



GAC tanks and building walls

Pump on skid for full-scale treatment system

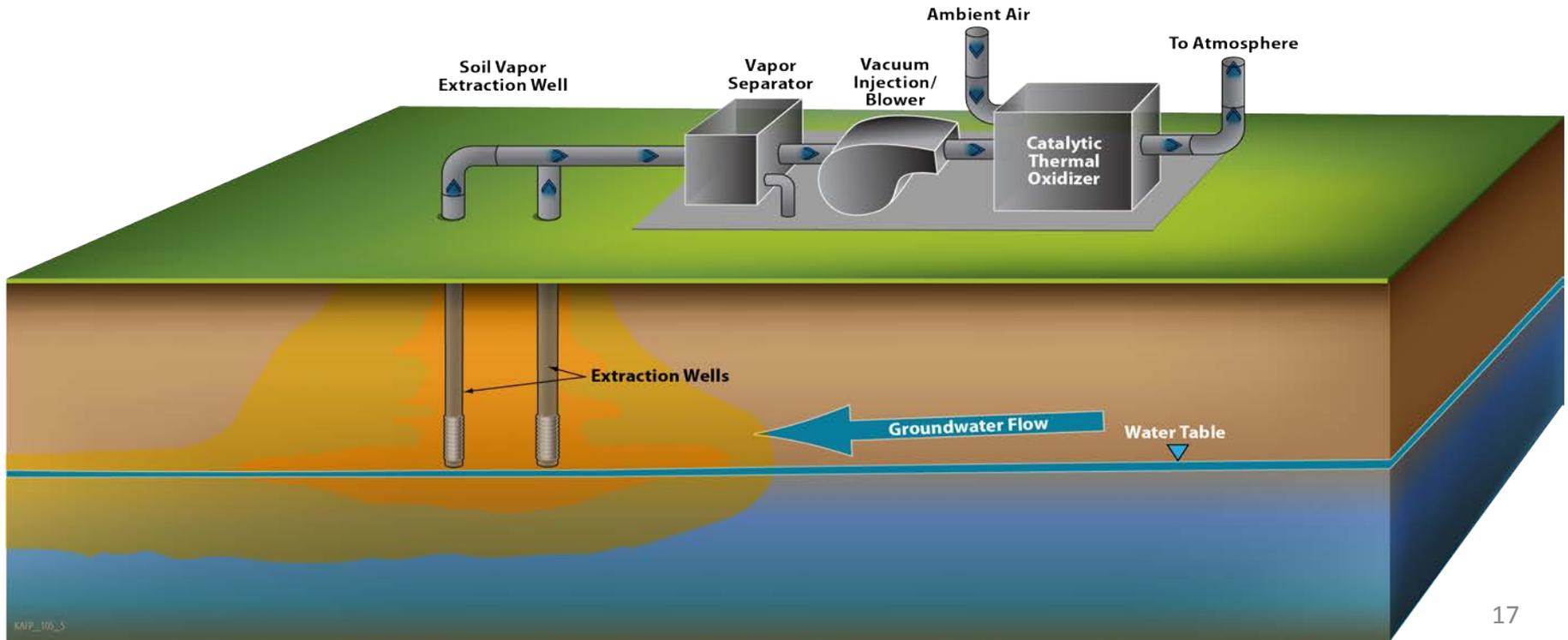


Discharge point at Tijeras Golf Course pond on Kirtland AFB



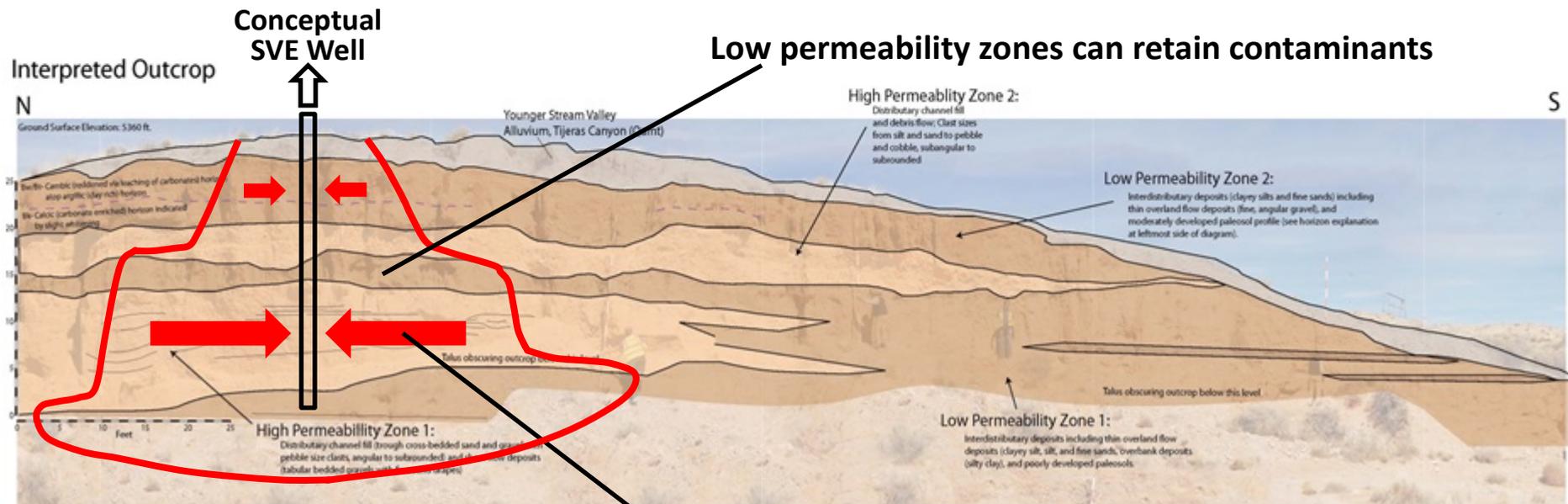
Soil Vapor Extraction

- More than 600,000 gallons of fuel recovered by SVE
- After 12 years of SVE, soil vapor concentrations are decreasing
- Vapor is treated in accordance with City of Albuquerque Air Quality Permit requirements
- SVE rebound and bio-respiration testing completed in July 2015



Alluvial Fan

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



SVE vapor flow greater in high permeability zones



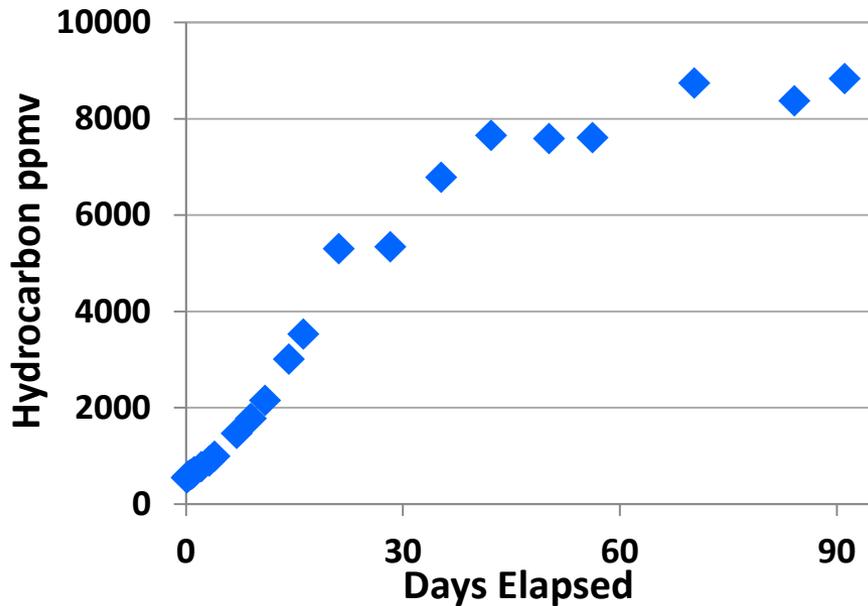
In Situ Respiration Testing

- **Soil bacteria consume hydrocarbons with oxygen and emit carbon dioxide**
- **Measured oxygen, carbon dioxide, and hydrocarbon vapor will help identify:**
 - **Areas for continued SVE**
 - **Areas where treatment should switch from SVE to bioventing**
 - **Areas that need no further treatment**

Find the sweet spot for biodegradation and enhance it.

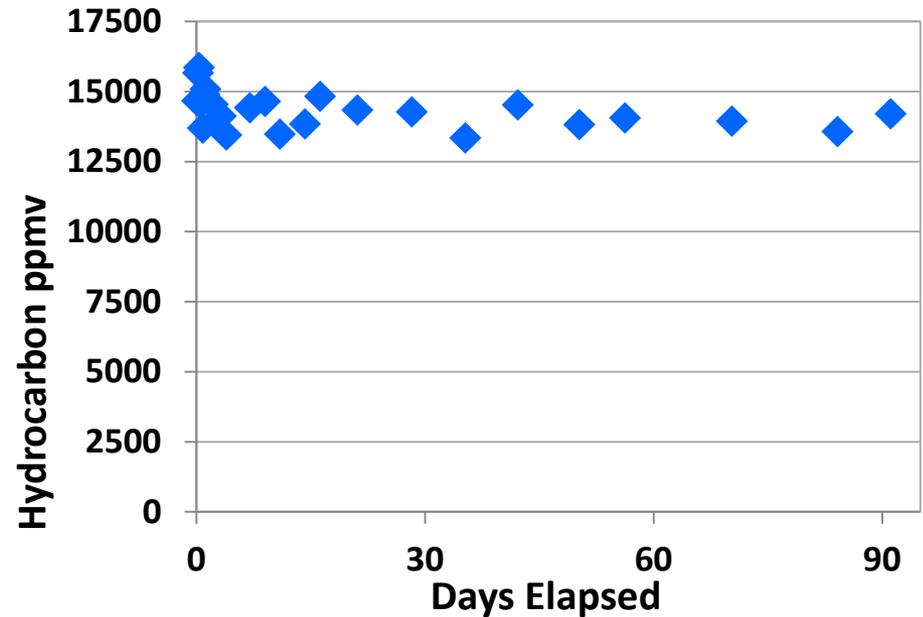
SVE Shutdown Rebounding Testing

**SVMW-03 at
250 ft below ground surface**



**Hydrocarbon concentrations
increased (rebounded)**

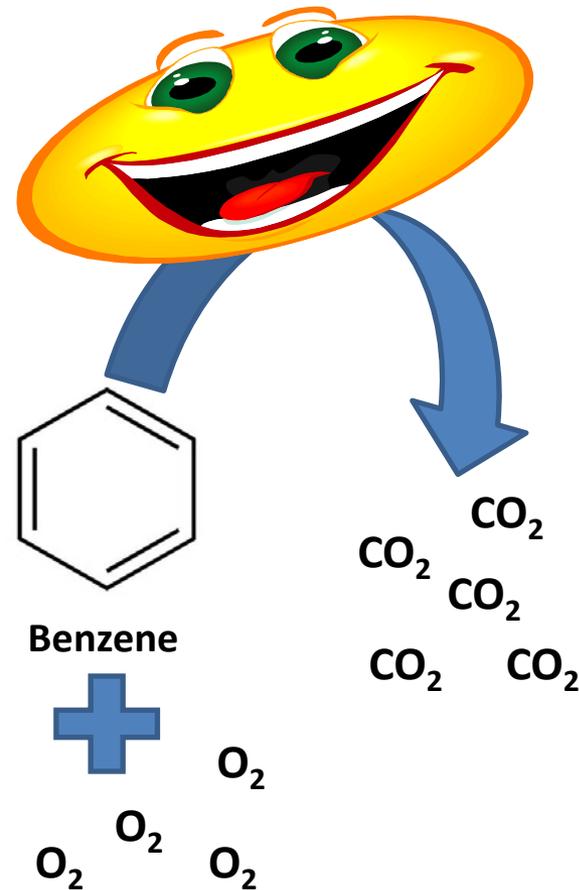
**SVMW-03 at
300 ft below ground surface**



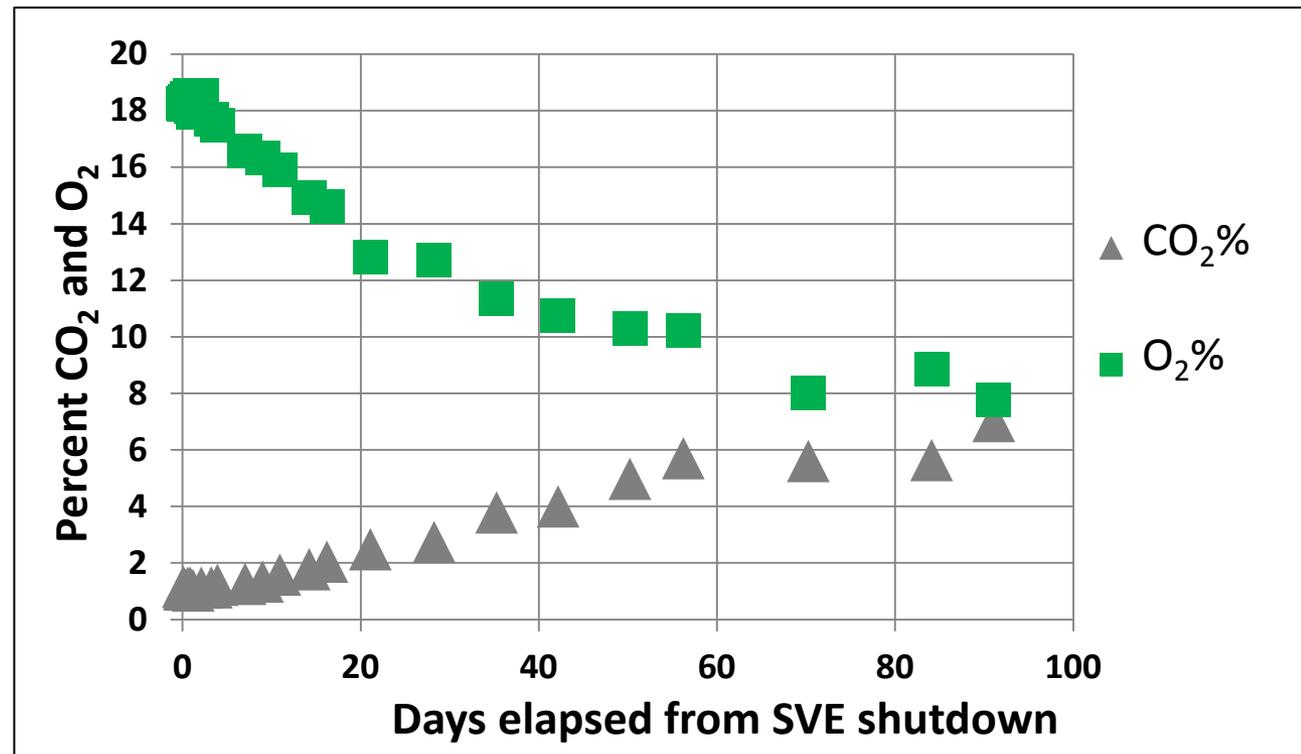
**Hydrocarbon concentrations
remained stable**

Soil Bio-Respiration Testing

Naturally occurring soil bacteria are present throughout subsurface
Bacteria consume O_2 , produce CO_2 as they biodegrade or “eat” fuel

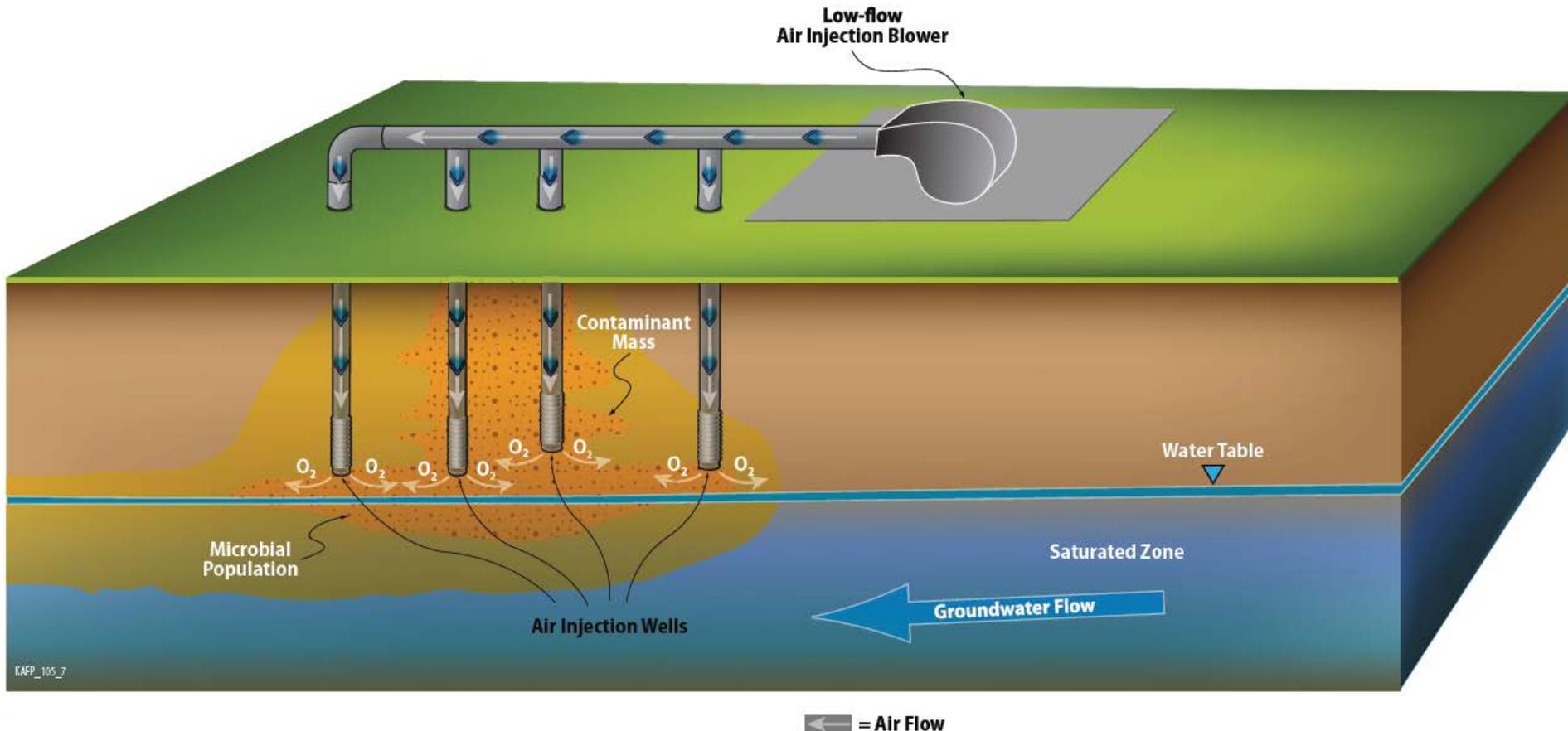


SVMW-03 at 250 ft below ground surface

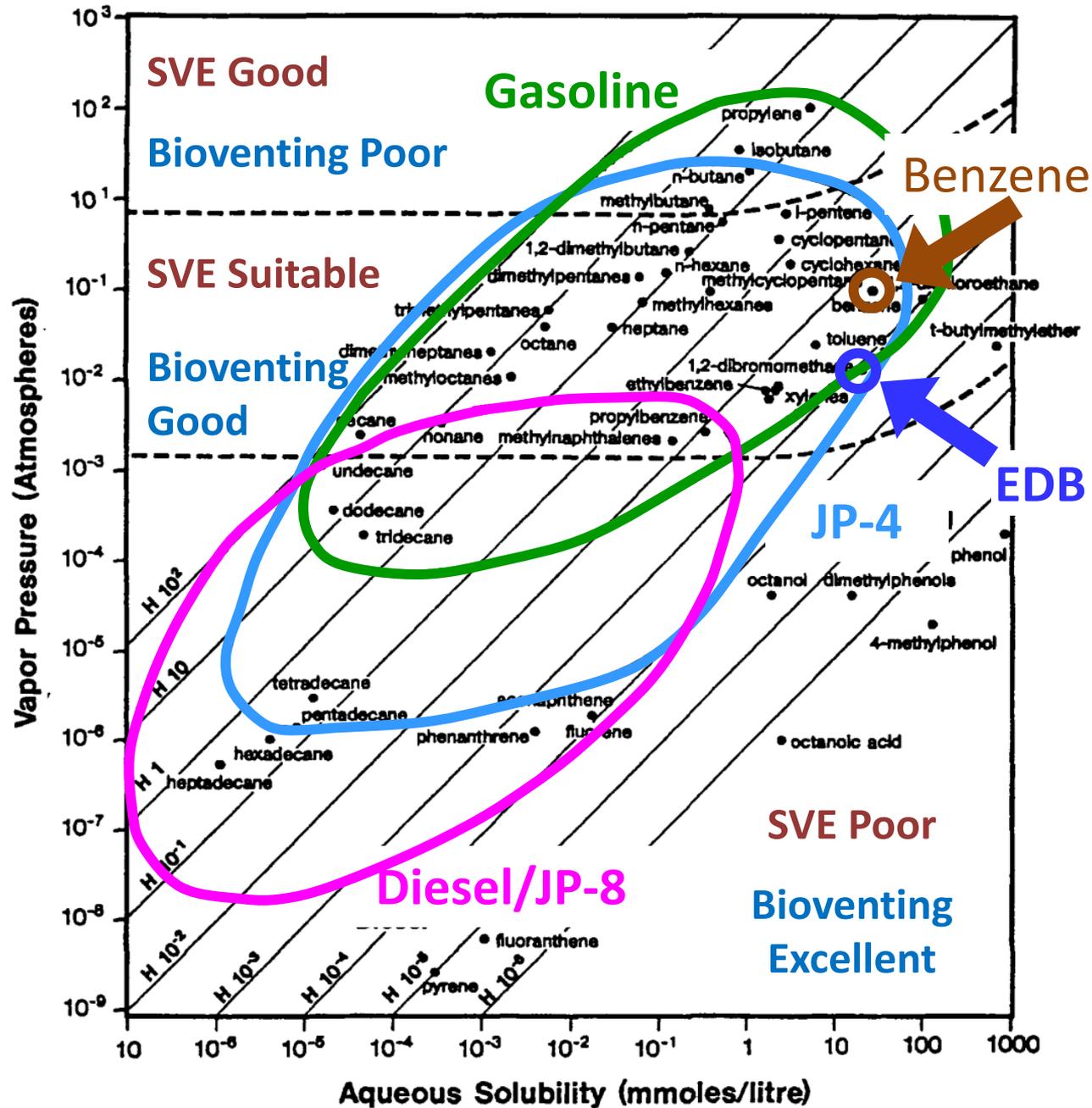


Bio-Venting

- Air is injected into the vadose zone to deliver oxygen to soil bacteria to help them biodegrade contaminants

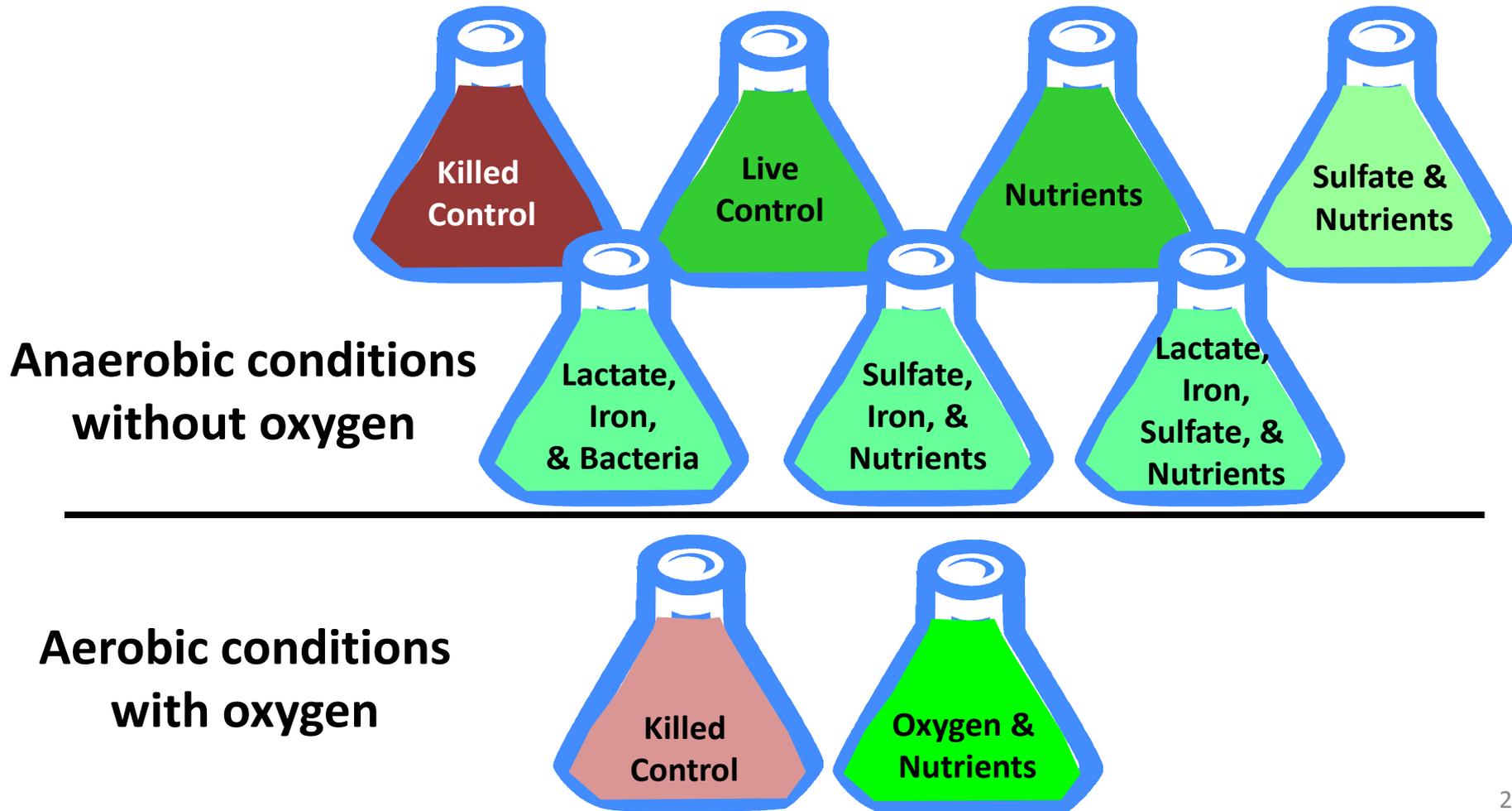


Suitability Ranges for SVE and Bioventing



Laboratory Microcosm Testing

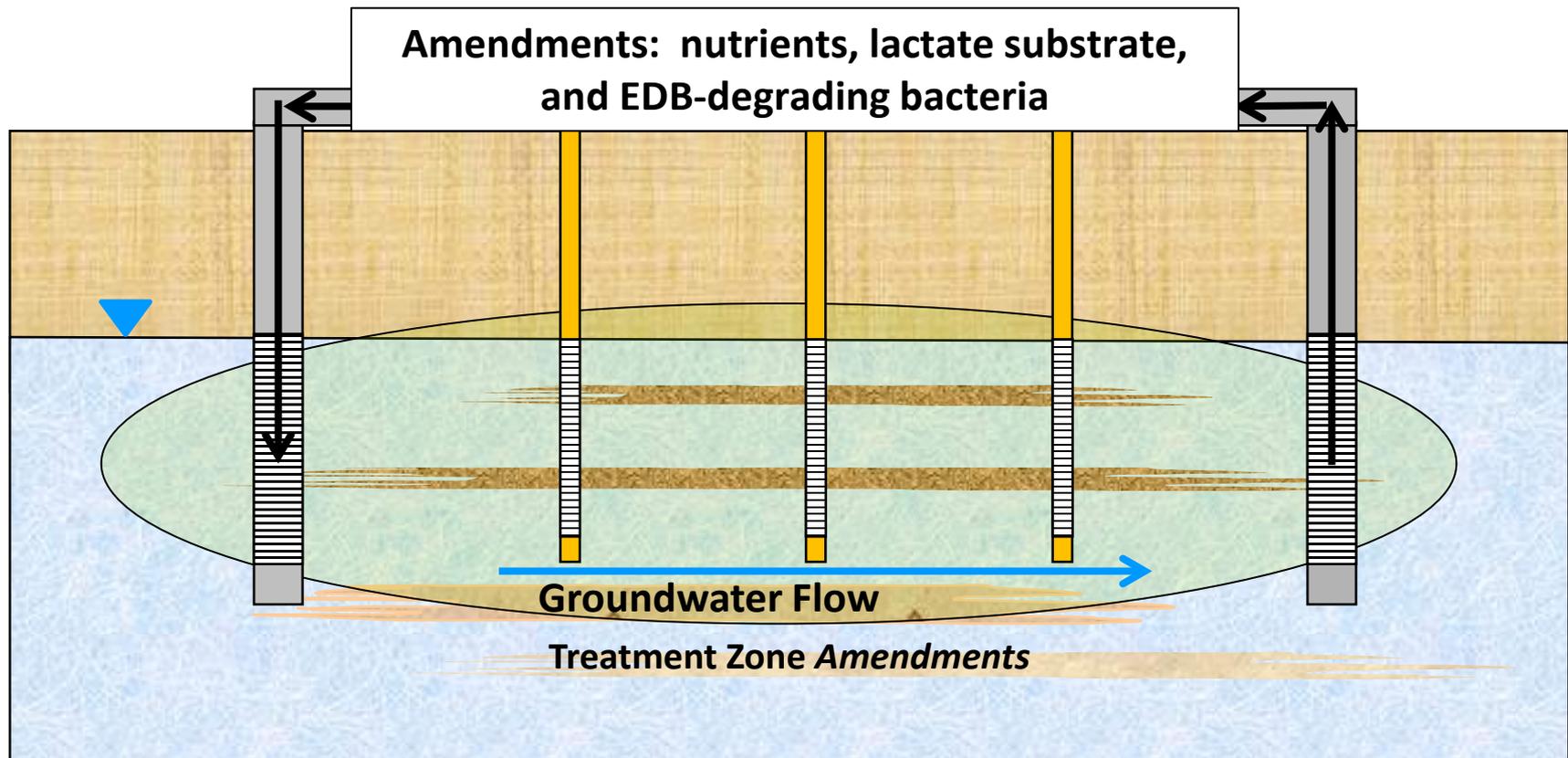
Identify potential technologies to biodegrade EDB



Anaerobic Biodegradation Pilot Test

Groundwater Recirculation

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





LNAPL Clean Up

- **Technically challenging due to groundwater depth and submerged LNAPL from rising water table**
- **Screening potential technologies for interim measures**
- **Conduct laboratory and field scale pilot tests for potentially suitable technologies**
- **Collect continuous core samples from the source area to determine evaluate presence and nature of LNAPL at the site**

2015 Site Status

- **4020 tons of contaminated soil excavated since 2000**
- **287 soil monitoring wells installed since 2000**
- **More than 600,000 gallons of fuel recovered by SVE since 2003; soil vapor levels are decreasing**
- **135 groundwater monitoring wells installed since 2000**
- **Water table continues to rise**
- **Groundwater plumes are relatively stable**
- **Monthly testing of drinking water wells continues to show no evidence of contamination**
- **No contaminant detects in any sentinel wells**
- **First of up to 8 extraction wells to collapse EDB plume began operation in June 2015 with an additional two online by end of the year**

NMED Strategic Plan Summary

Goal: *Protect Albuquerque's aquifer and the drinking water supply wells in the area of the fuel spill*

Strategies to Achieve the Goal:

- 1) Continue robust groundwater and wellhead monitoring**
- 2) Collapse the dissolved EDB Plume away from the Albuquerque Bernalillo County Water Utility Aquifer Wells**
- 3) Clean up soil in the spill area**
- 4) Remediate Light Non-Aqueous Phase Liquid (LNAPL) and associated dissolved phases in the LNAPL area**
- 5) Meet or exceed all requirements for providing public information and involvement**

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

Upcoming Events

- **Public Field Trip – October 24, 2015 (registration closed)**
- **Public Meeting – November 17, 2015**



How do I get more information?

Contact NMED:

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KAFB project technical lead
dennis.mcquillan@state.nm.us
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.