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Kirtland Air Force Base
Fuel Spill Cleanup
April 9, 2015

Prepared by
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and
Adria Bodour, Ph.D., AFCEC Environmental Scientist

A Partnership for Success

The following organizations are working together to solve the complex hydrogeologic and engineering challenges posed by the fuel spill site.

Regulatory Basis

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

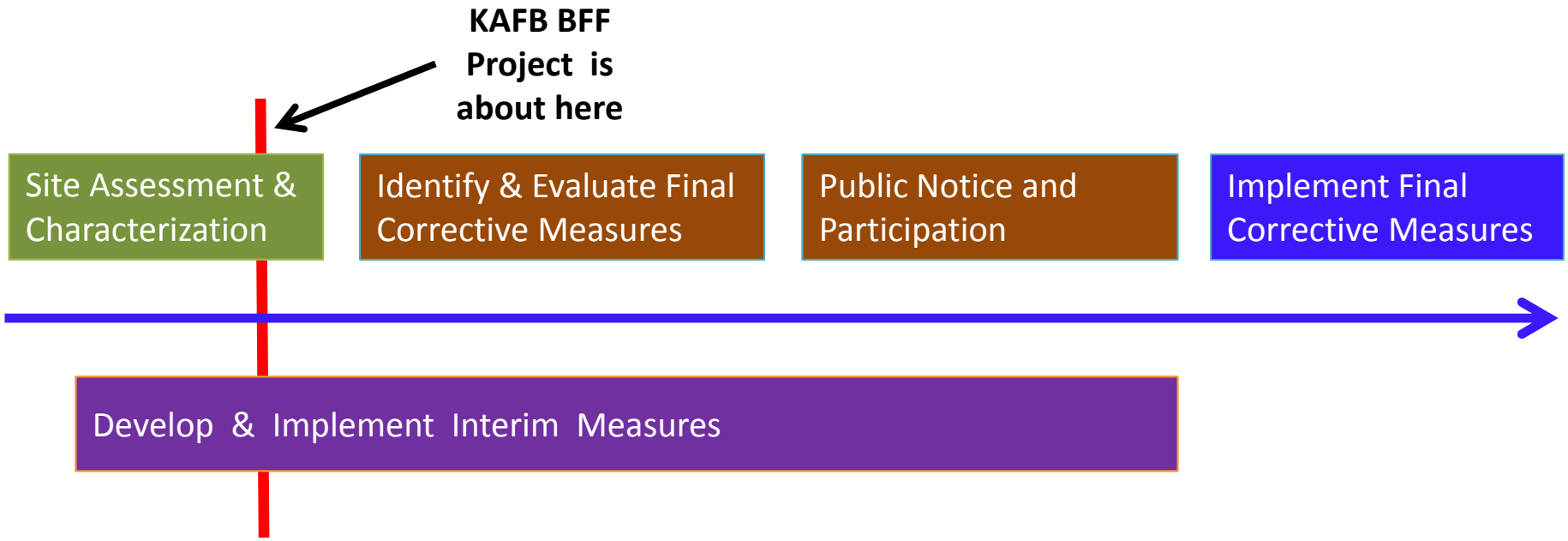
- The Safe Drinking Water Act (SDWA) program; and
- The Resource Conservation and Recovery Act (RCRA) program

Public water systems, such as 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.

RCRA Corrective Action Process

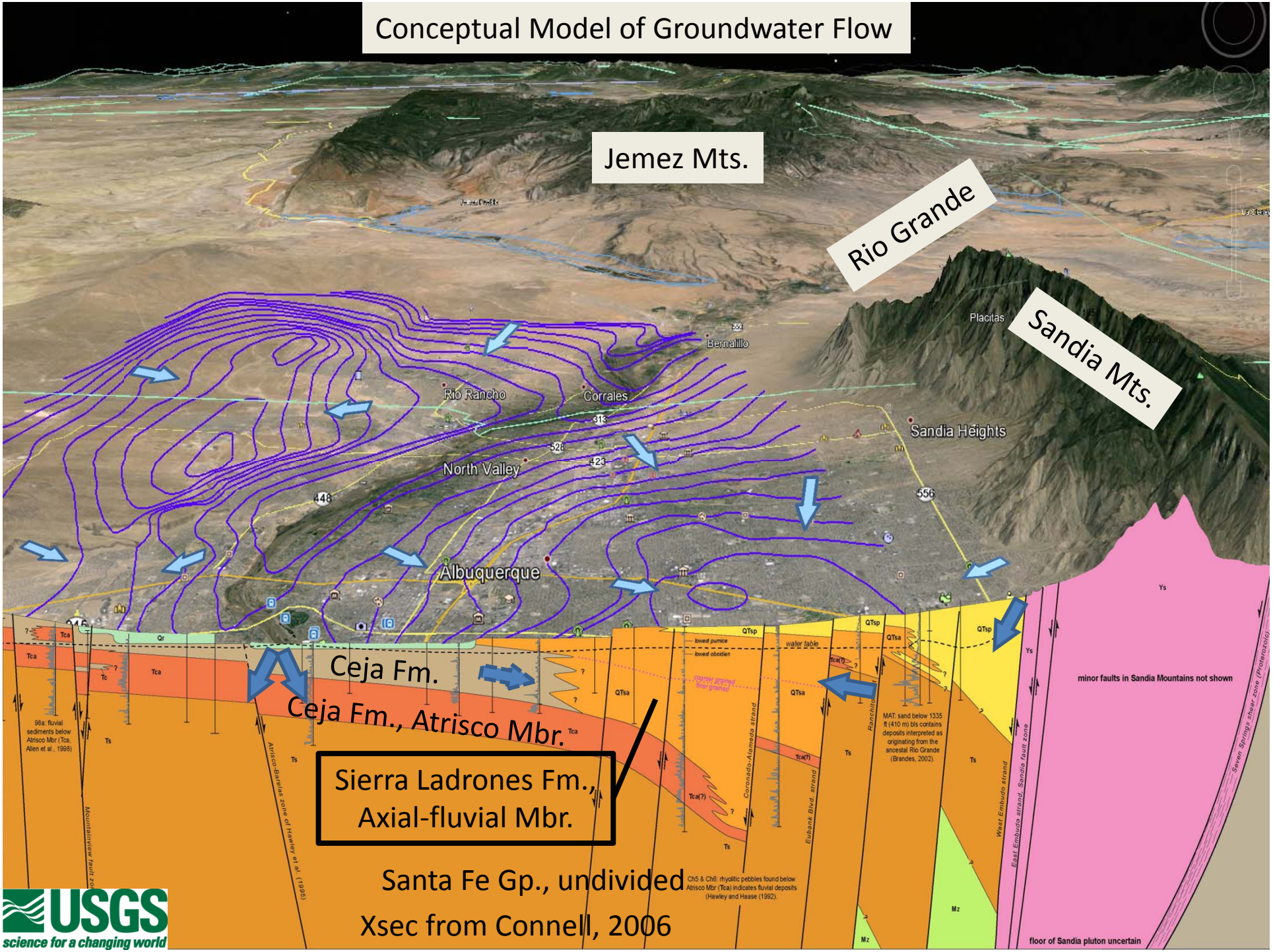
Kirtland Air Force Base must comply with their Resource Conservation and Recovery Act (RCRA) Hazardous Waste Permit, including the Corrective Action Process



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 and ceased use of piping
- **2001** – KAFB notified NMED of groundwater contamination with dissolved fuel constituents
- **2003** – Soil vapor extraction (SVE) technology began to vacuum contaminants from soil
- **2007** – Fuel (light non-aqueous phase liquid, LNAPL) discovered floating on groundwater; attempted to skim LNAPL from water table with limited success
- **2009** – Water level rise begins to submerge LNAPL within aquifer
- **2013-15** – Additional interim measures were initiated

Conceptual Model of Groundwater Flow



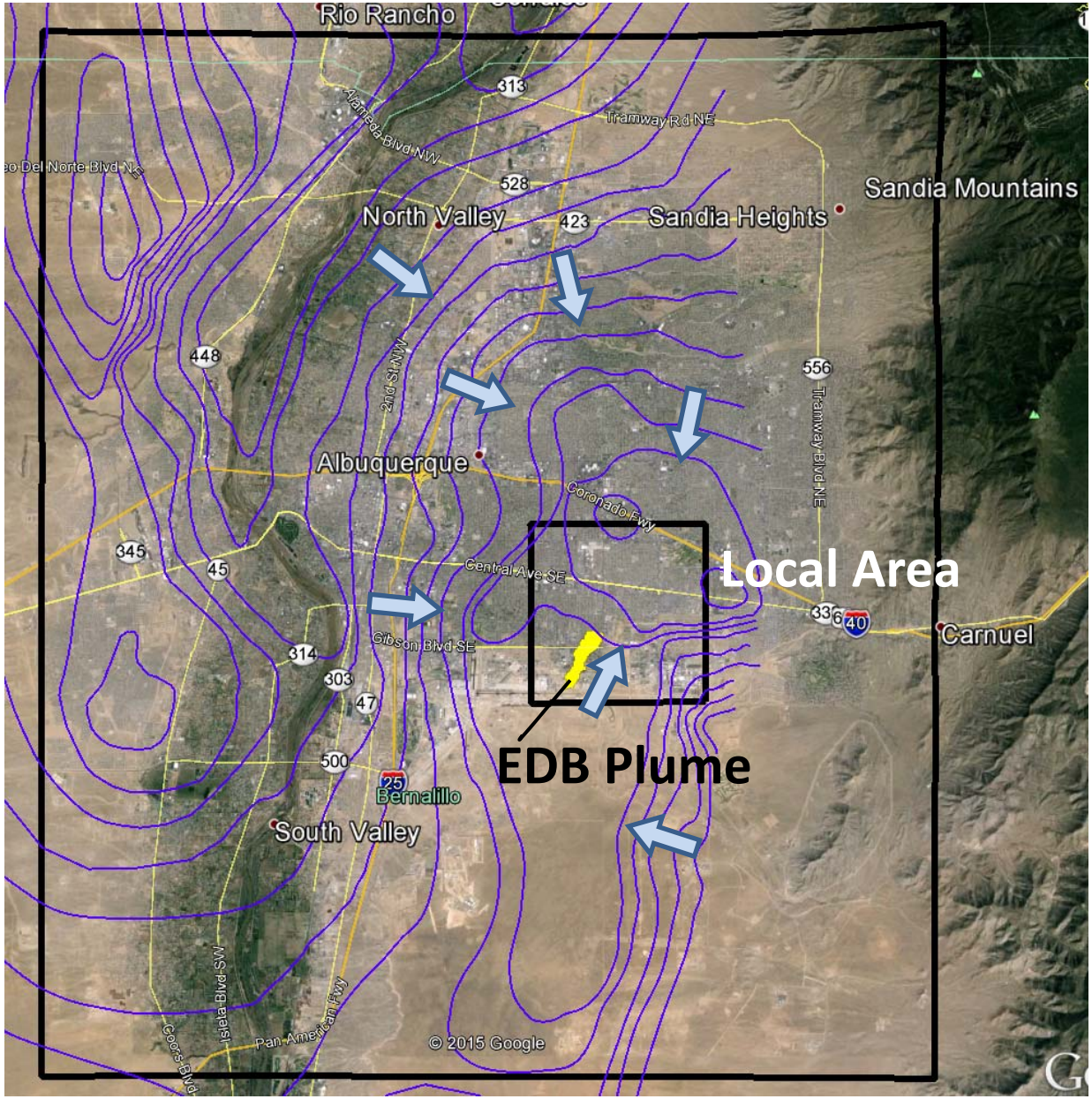
Xsec from Connell, 2006

USGS science for a changing world

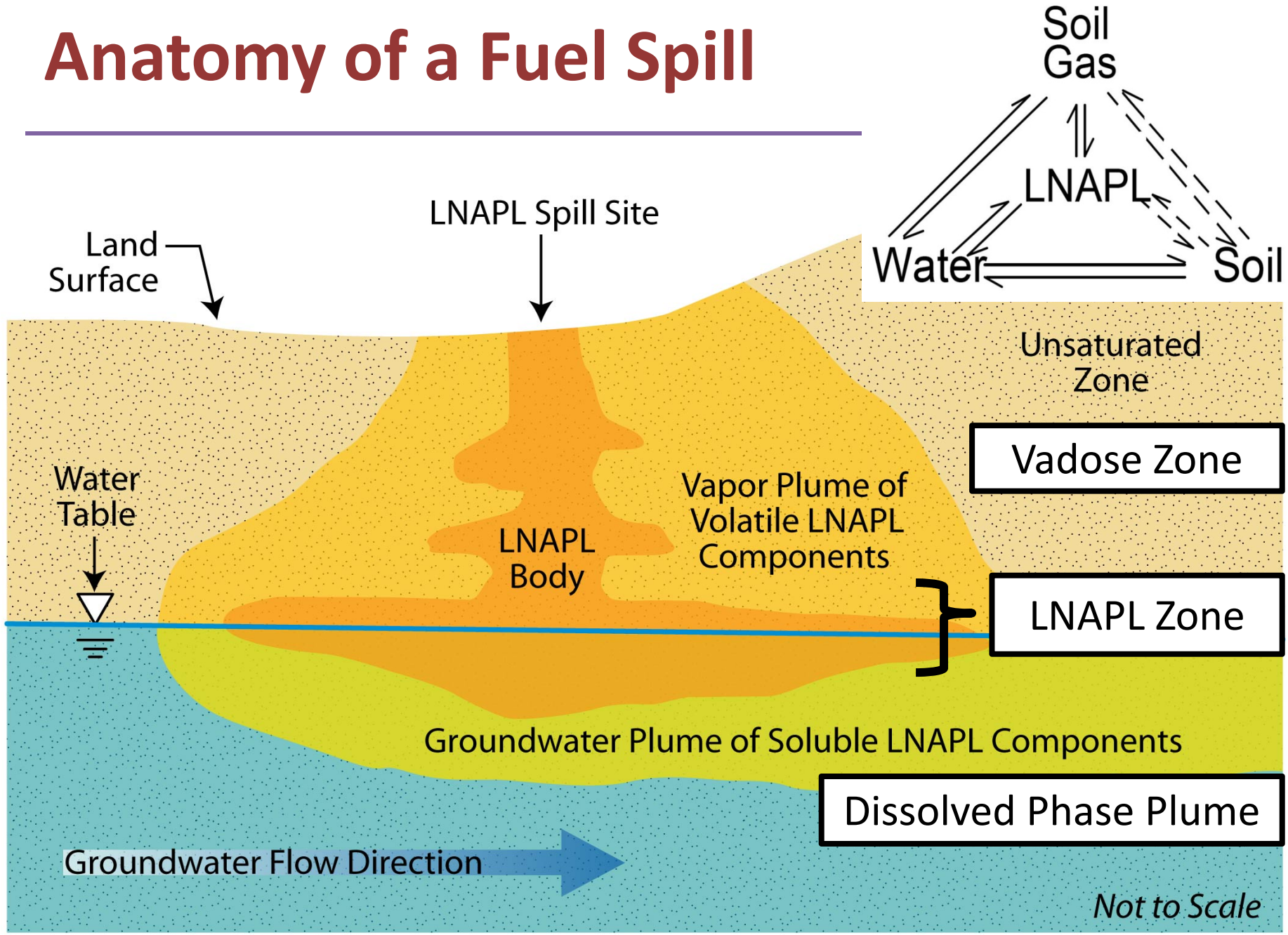
Groundwater Flow in the Sub-Regional Metro Area

2012 production zone water level contours; 5 and 10 feet contour intervals

Groundwater Flow Direction



Anatomy of a Fuel Spill



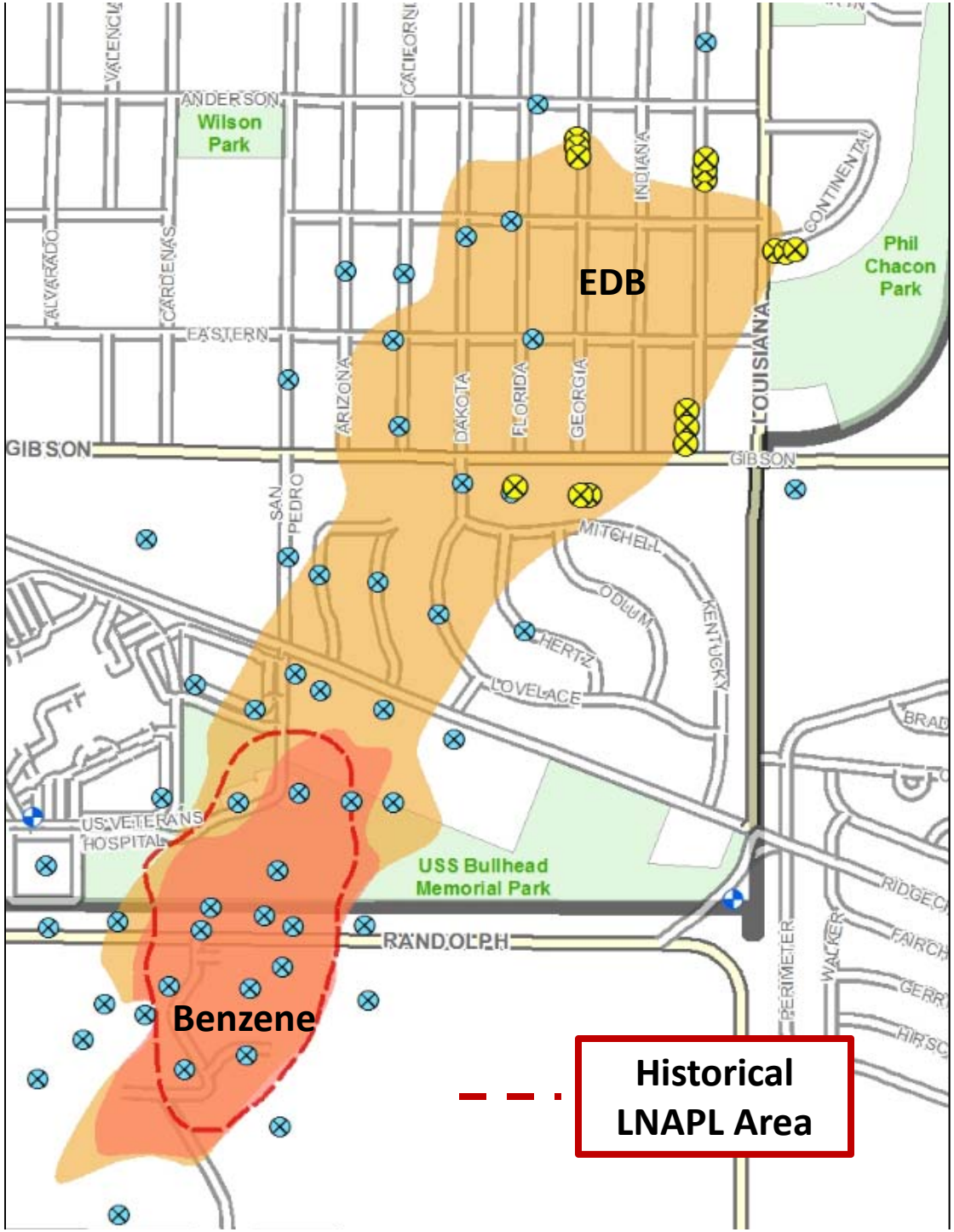
Adapted from Delin et al., 1998, USGS Fact Sheet FS-084-98

EDB Plume

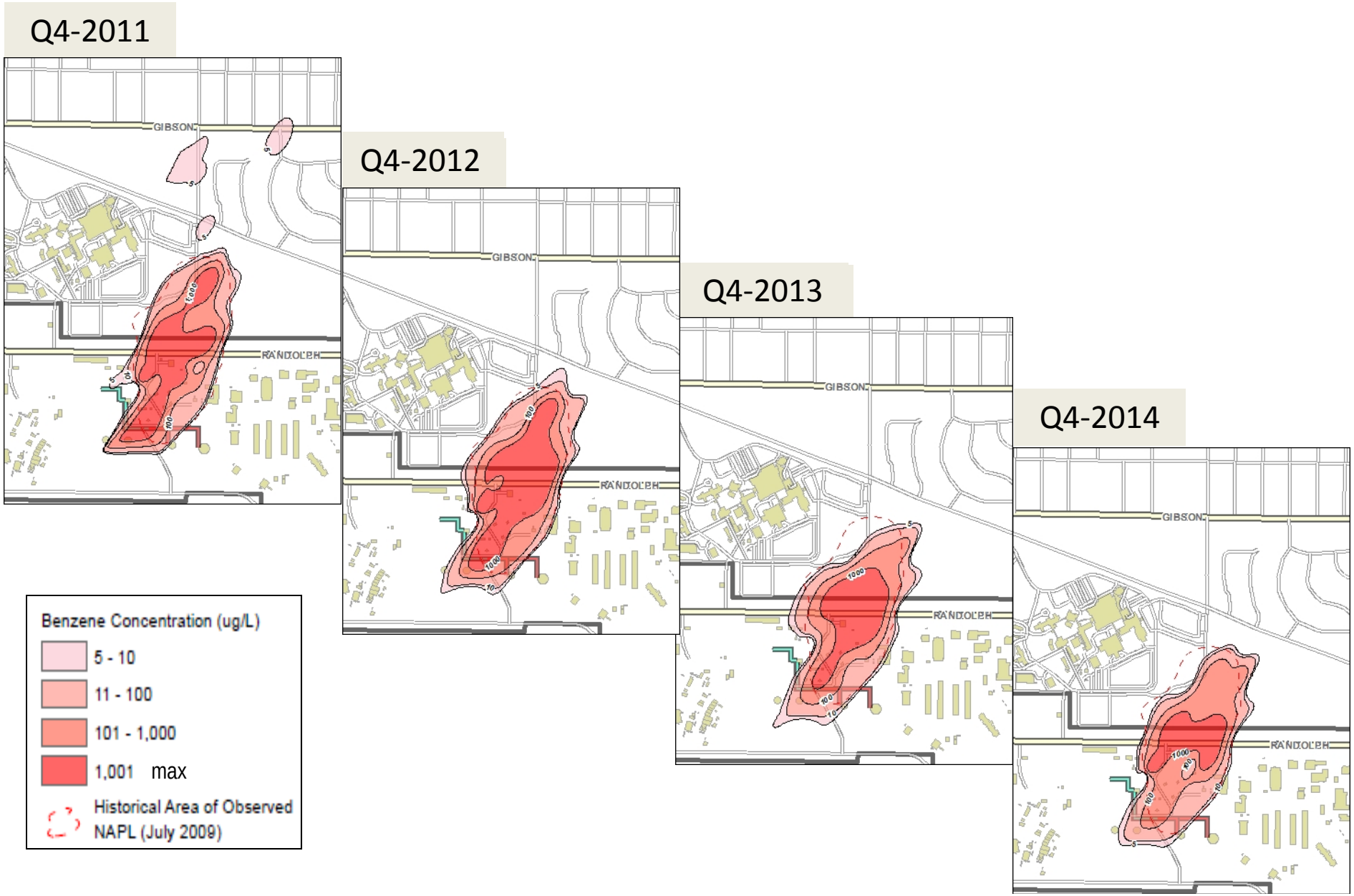
Biodegradation only in the area with dissolved hydrocarbons, EDB plume footprint is much larger than benzene footprint

Benzene Plume

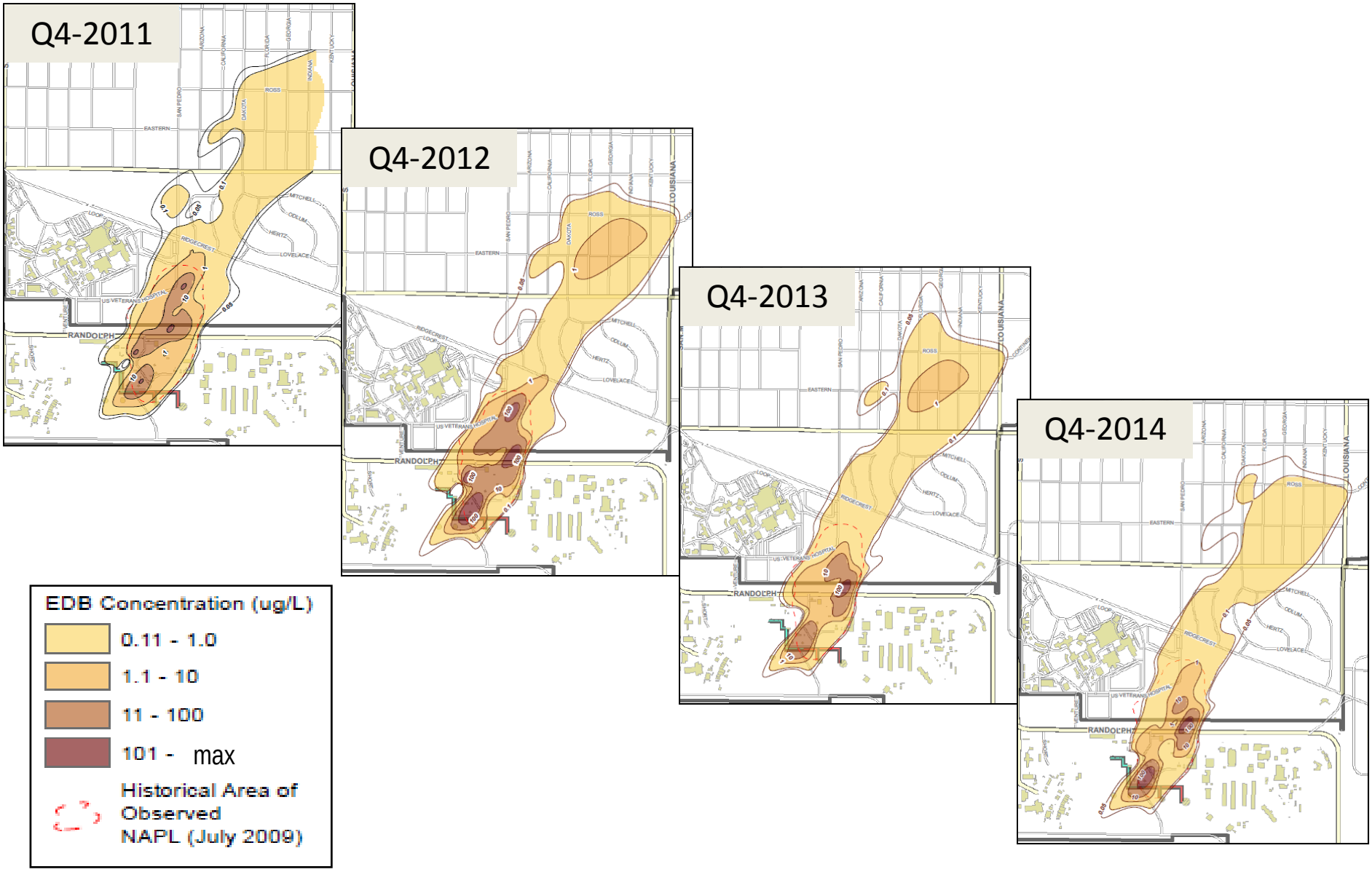
Hydrocarbons are being biodegraded by natural aquifer bacteria



Benzene Plume Stability



Ethylene Dibromide (EDB) Plume Stability



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 ABCWUA Wells**

3) **Remediate LNAPL and associated dissolved phases in the LNAPL area**

4) **Clean up soil in the spill area**

5) **Meet or exceed all requirements for providing public information and involvement**

NMED Strategic Plan Comments

There was general agreement with the goal and strategies.

However:

"Although I agree with the goals of this plan, I have little confidence that the measures proposed here can achieve the goals before the drinking water wells become contaminated by EDB."

"There is great cynicism in the community regarding KAFB's commitment to clean up this spill and our state government's efforts to hold KAFB accountable."

We fully understand these justifiable concerns.

NMED Response to Public Comments

Public trust and confidence must be earned.

Watch what we accomplish in the next 9 months.

Revisit this issue in December 2015.

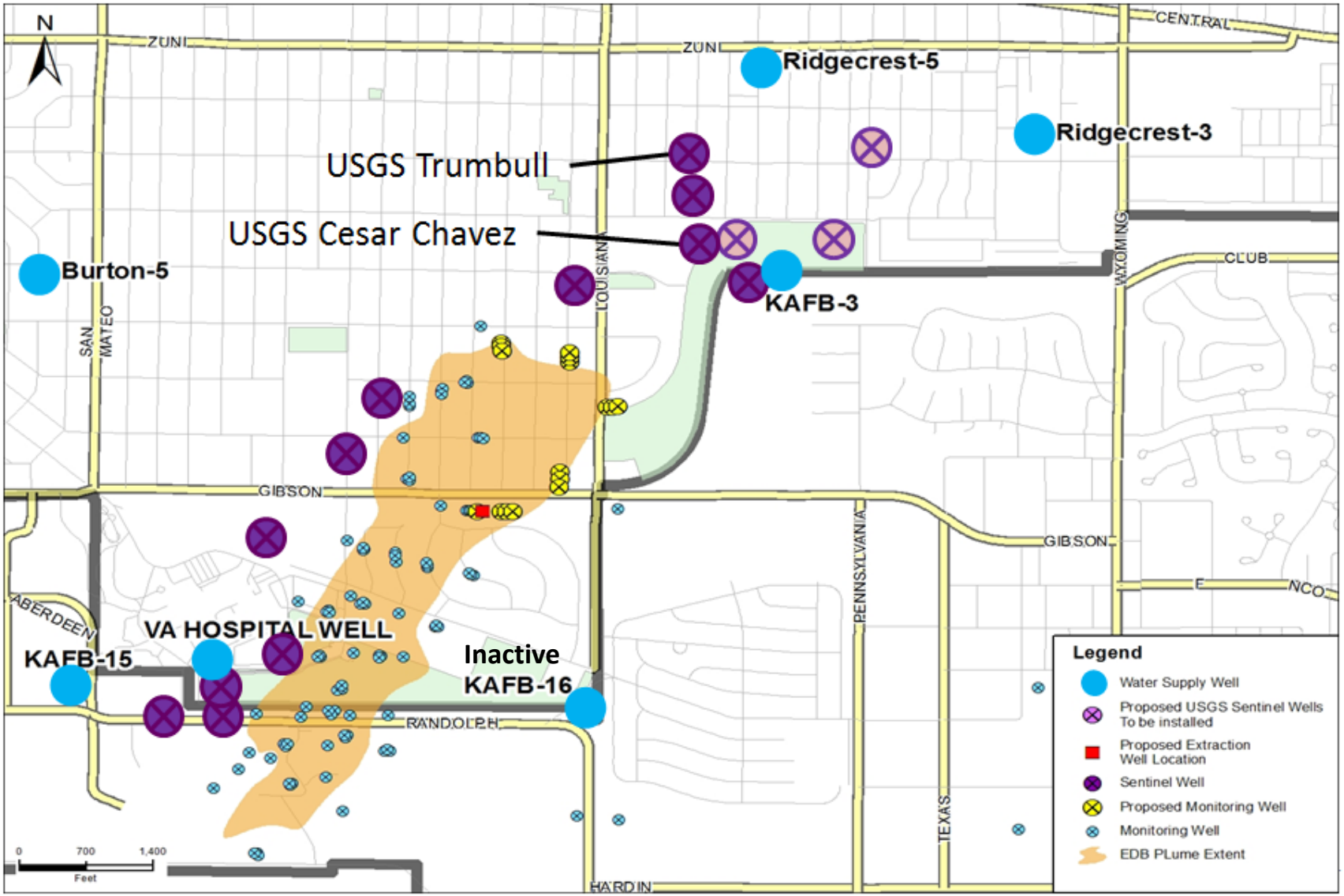
Drinking Water Protection

EDB Drinking Water Standards	
U.S. EPA	**0.05 µg/L**
State of New Mexico	**0.05 µg/L**

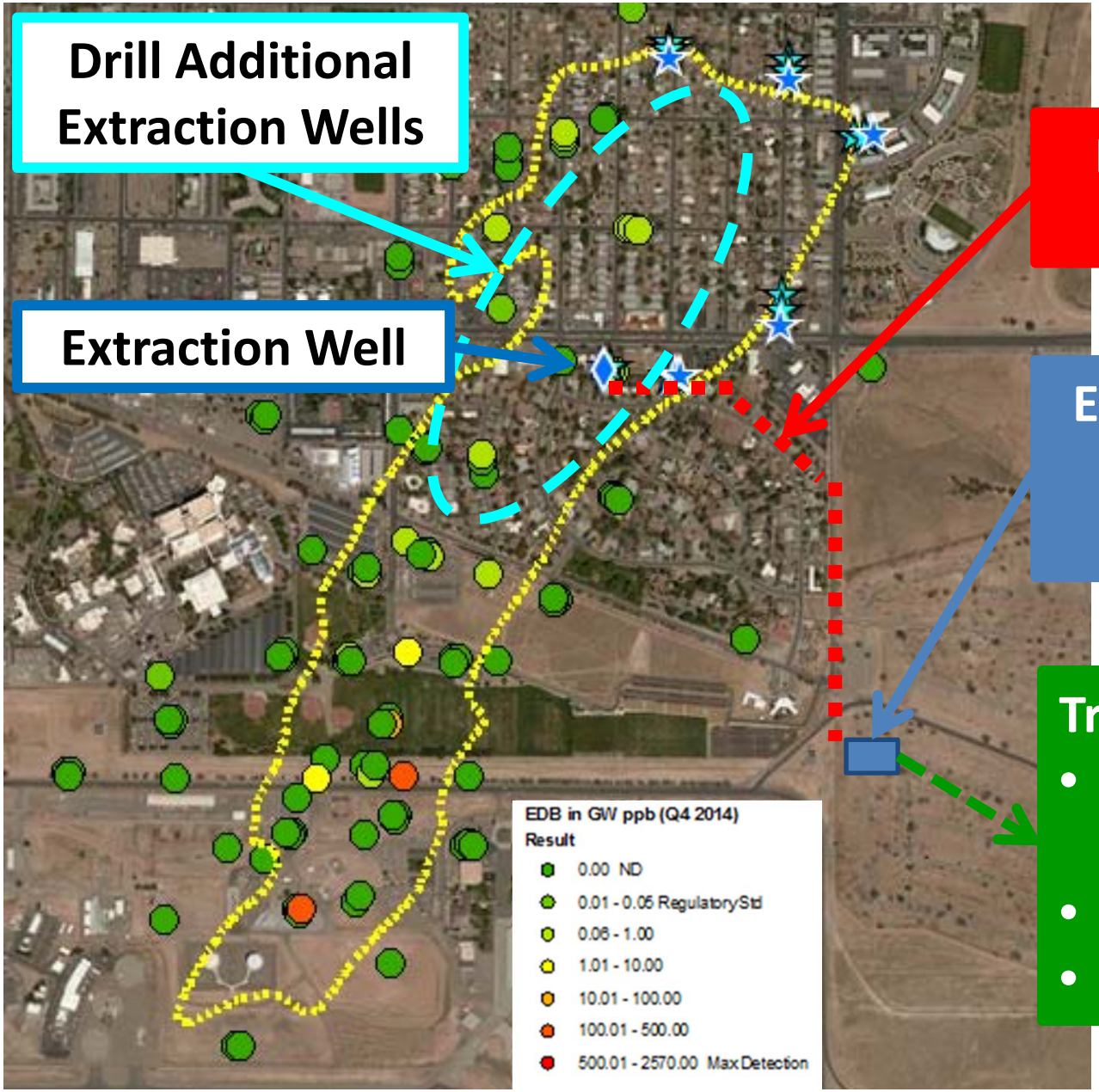
- Public water system must comply with drinking water standards
- SDWA requires testing once every 3 years for EDB and benzene
- Drinking water supply wells in the area are being tested monthly
- No detections of any fuel contaminants in any production well
- EDB regulatory detection limit = 0.01 µg/L 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

Protecting Drinking Water Supply Wells



Collapsing the Dissolved EDB Plume

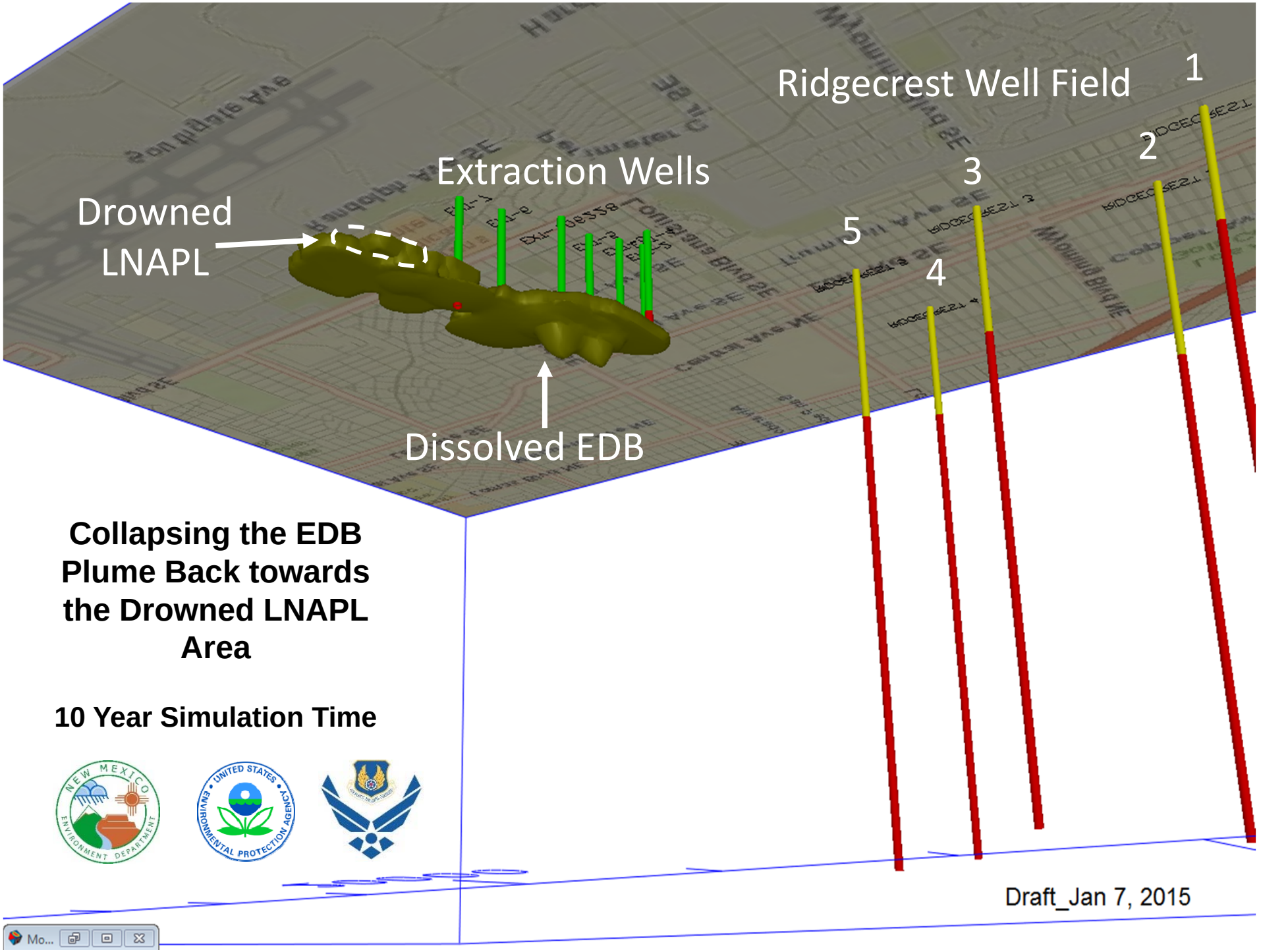


EDB Extracted Water Conveyance Line

EDB Treatment System Using Granular Activated Carbon

Treated Water:

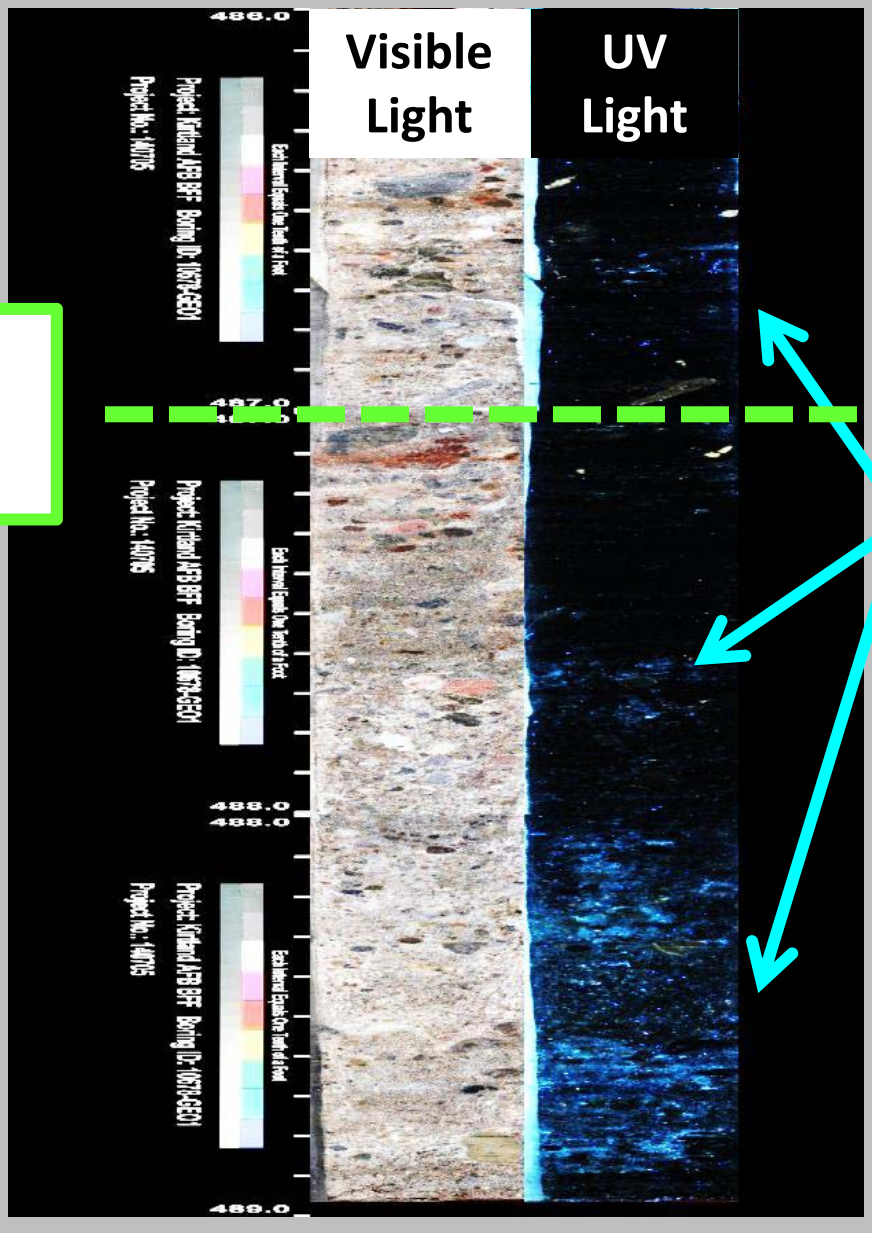
- Infiltration Gallery for Aquifer Recharge
- Landscape Irrigation
- Non-potable Reuse


Ridgecrest Well Field
1
2
3
4
5
Extraction Wells
Drowned LNAPL
Dissolved EDB
Collapsing the EDB Plume Back towards the Drowned LNAPL Area
10 Year Simulation Time
Draft_Jan 7, 2015

Groundwater Plume Takeaway

- **Benzene plume is stable**
- **EDB plume is relatively stable, with slow migration towards the north or northeast with groundwater flow**
- **Public water supply wells are not at imminent risk of contamination**
- **EDB plume will be collapsed before contaminants migrate to a drinking water well**

Drowned LNAPL – Soil Cores



Groundwater Table

LNAPL Under UV Light Fluoresces Blue

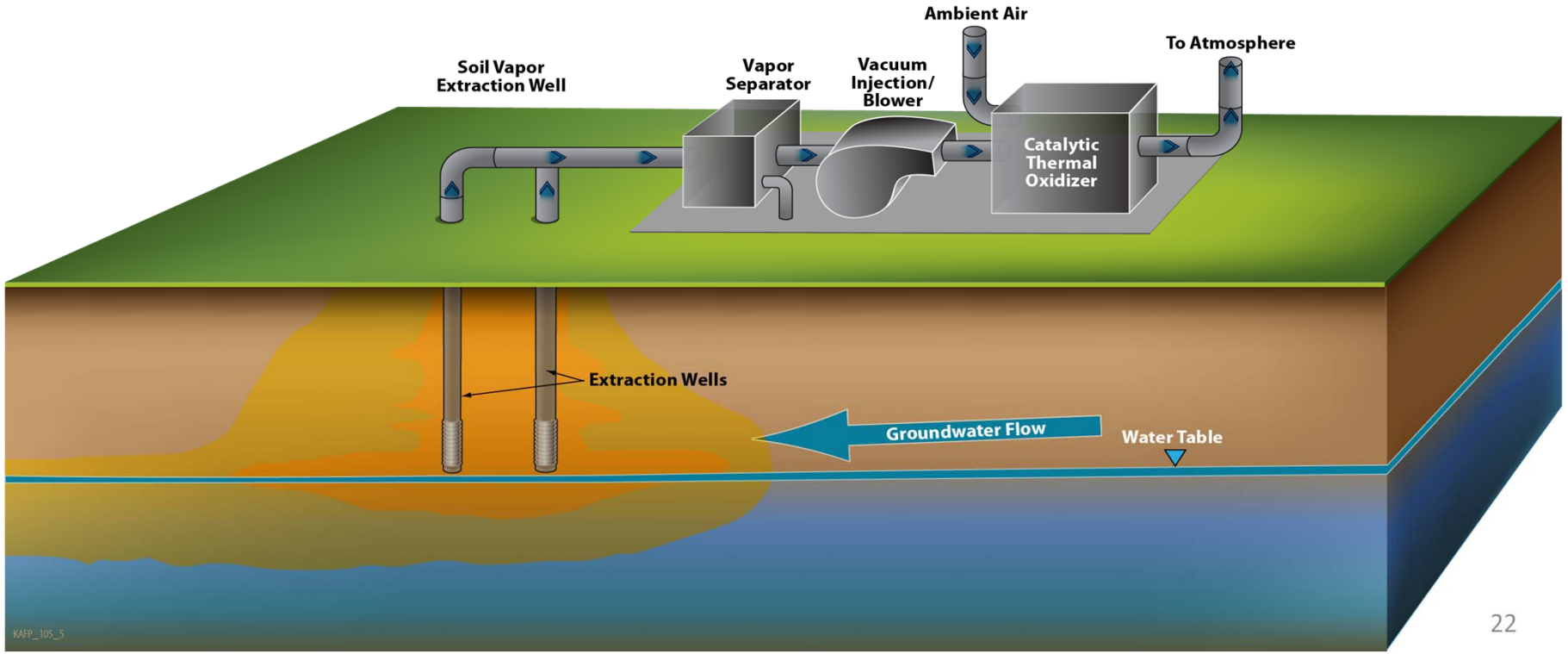
LNAPL Clean Up

- **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**

Comprehensive laboratory testing of bioremediation and an air sparging field pilot test were completed in January 2015

Soil Vapor Extraction

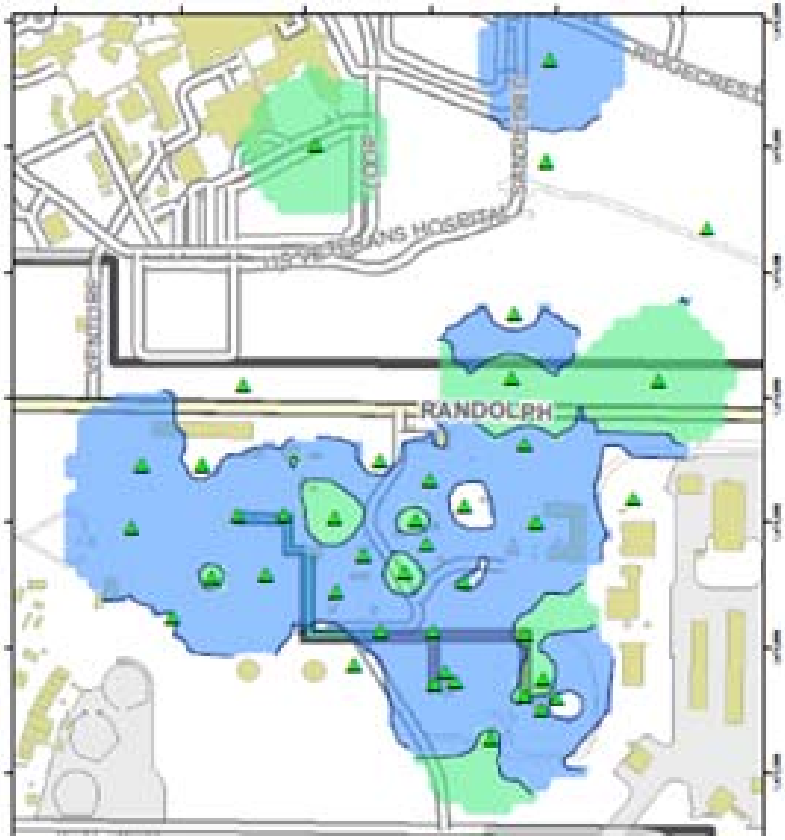
- More than 500,000 gallons (3.5M pounds) of fuel recovered by SVE
- SVE rebound and soil bio-respiration testing is underway
- Vapor is treated in accordance with City of Albuquerque Air Quality Permit requirements



Total VOC Soil Vapor

Q4-2011

Q4-2014

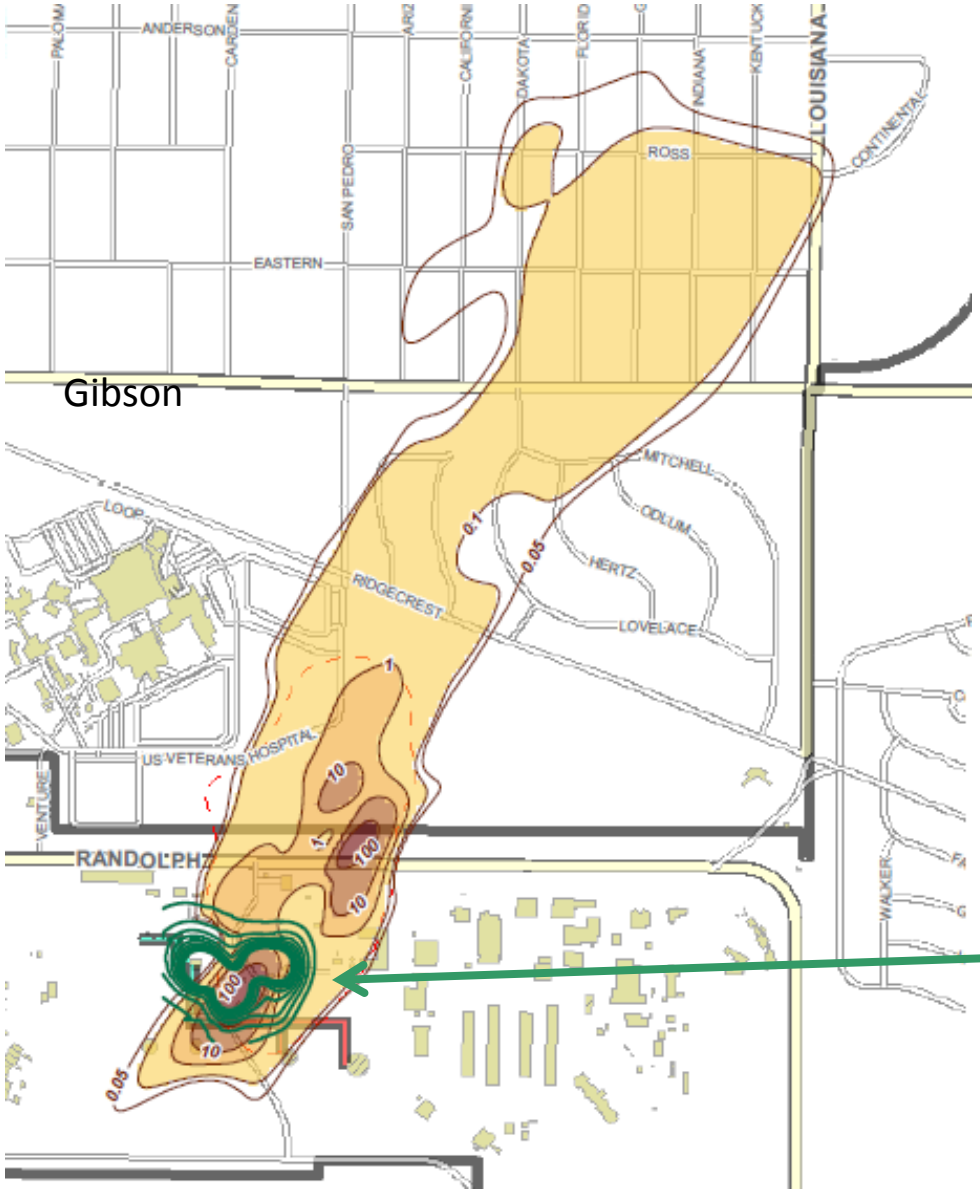


VOC Concentration (ppmv)
- 10 - 100
- 100 - 1000
- 1000 - 10,000
- >10,000

450 feet below ground surface

Benzene and Vacuum at 450 Feet

EDB Plume and Vacuum at 450 Feet



EDB Concentration (ug/L)

- 0.11 - 1.0
- 1.1 - 10
- 11 - 100
- 101 - 190
- Historical Area of Observed NAPL (July 2009)

Observed Vacuum (inches of water)

2015 Site Status

- 4020 tons of contaminated soil excavated since 2000
- 287 soil monitoring wells installed since 2000
- More than 500,000 gallons of fuel recovered by SVE since 2003; soil vapor levels are decreasing
- 127 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 will begin operating in June 2015

Critical Work for 2015

- Complete installation of remaining data gap wells
- Perform SVE rebound testing
  - Identify and attack hotspots
- Conduct in situ respiration testing

- Complete installation of first EDB extraction well and water treatment system, bring online by June 30, 2015
- Install the next three EDB extraction wells, construct full-scale treatment system, bring online by December 30, 2015
- Screen LNAPL remediation technologies, identify best options for lab and field pilot testing

How do I get more information?

Contact NMED:

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Jill Turner,
KAFB project communications lead
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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.