

# The Use of Future First Planning, the Triad, and Performance-Based Contracting to Accelerate Site Closure at Seymour Johnson AFB



Presented by:  
**Martin Wangenstein, PE, PG**  
**Bay West, Inc.**



## Authors



- Martin Wangensteen, PE, PG  
– *Bay West, Inc.*
- Frank Werner, PE  
– *Seymour Johnson AFB*
- John Cataldo, PE  
– *USACE – Omaha District*
- Megan Kari, PE  
– *NewFields, LLC*



## Acknowledgements



USAF/Air Combat Command

- Margaret Patterson
- Bob Barrett, PE

Seymour Johnson AFB

- Buck Abrams, PE

USACE – Omaha District

Teaming Partners & Subcontractors

- SAIC
- URS
- TN&A

NewFields

- Kandi Brown

NCDENR

- Beth Hartzell



## Contract Overview




SITE NAME	SITE CLOSURE DEADLINE	CURRENT STATUS
F-15 Ramp	MAY 2010	SITE CLOSURE DEC 2008
Radar Tower Site	MAY 2010	SITE CLOSURE APR 2009
Bulk Fuel Storage Area (BFSA)	DEC 2010	REMEDIAL ACTION OPERATIONS
	DEC 2010	SITE CLOSURE MAY 2006
	DEC 2010	SITE CLOSURE MAY 2006
	DEC 2010	REMEDIAL ACTION OPERATIONS
KC-135 Ramp	DEC 2010	REMEDIAL ACTION OPERATIONS
BX Service Station	NOV 2011	SITE CLOSURE FEB 2007
Fire Training Area No. 3	NOV 2011	REMEDIAL ACTION OPERATIONS
Fire Training Area No. 1	NOV 2011	SITE CLOSURE JULY 2007
Fire Training Area No. 2	DEC 2010	SITE CLOSURE OCT 2006
Old Entomology Shop	DEC 2010	SITE CLOSURE DEC 2008
Landfill No. 4	DEC 2010	SITE CLOSURE NOV 2007
Landfill No. 1	DEC 2010	SITE CLOSURE NOV 2007
Landfill No. 2	NOV 2011	SITE CLOSURE NOV 2007
Landfill No. 3	NOV 2011	SITE CLOSURE NOV 2007

4

## Regulatory Framework



 Regulatory oversight performed through three NCDENR regulatory programs:

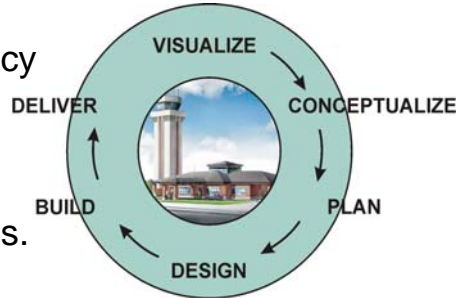
- Underground Storage Tank (UST) Program:  
*SS-04, SS-12, ST-14 and  
BFSA (ST-01, SD-02, SD-03, ST-05)*
- Inactive Hazardous Sites Branch (IHSB) Program:  
*FT-07, FT-19, FT-20, OT-21, OT-29*
- RCRA Program (Landfill) Sites:  
*LF-06, LF-08, LF-15, LF-16*

### Exit/Closure Strategy Based on a Marriage of:

- Future First Planning
- Triad
- Innovative Technologies
- Remedial Process Optimization
- Decision-Based Partnering

### Future First Planning (F2P):

- A process that fuses Base development planning with environmental cleanup to optimize land use.
- Represents a shift in policy where environmental restoration sites are viewed as potential assets instead of liabilities.

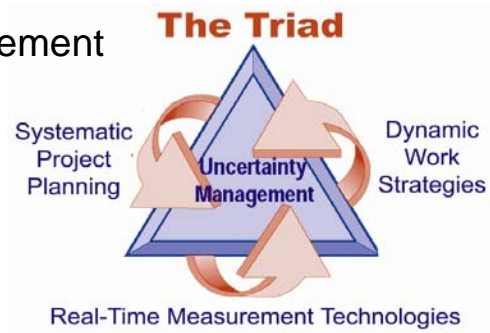


## The Triad



### Uncertainty Management through the Triad:

- Systematic Project Planning
- Dynamic Work Strategies
- Real Time Measurement Technologies





### Systematic Project Planning:

- Developed preliminary Conceptual Site Model (CSM) using data from past investigations
- Evaluated real time analytics and feasibility of use based on anticipated in-field decisions
- Incorporated potential remediation approaches into data collection techniques
- *Cost savings realized through reduced mobilizations*

 Dynamic Work Strategies:

- Decision Trees allowed in field decision-making, preventing equipment down-time and reducing fixed-lab costs
- Flexible work plan allowed changes to occur when the CSM changed
- *Iteratively updating the CSM and continuously adapting the investigative strategy helped to reduce uncertainty and allow for full characterization of the site*

 **Real Time Measurement Technologies:**

- Real time data used to update the CSM throughout the investigation for continuous use to direct additional data collection
- Electronic data (*CPT data, stratigraphic logs, LIF data*) produced/transmitted daily and posted to Bay West's web site for access/review by Client
- *Real Time Measurement allowed the Team and stakeholders to make informed, quantitative site decisions while in the field*

## OT-29

### *Former Radar Tower Site*

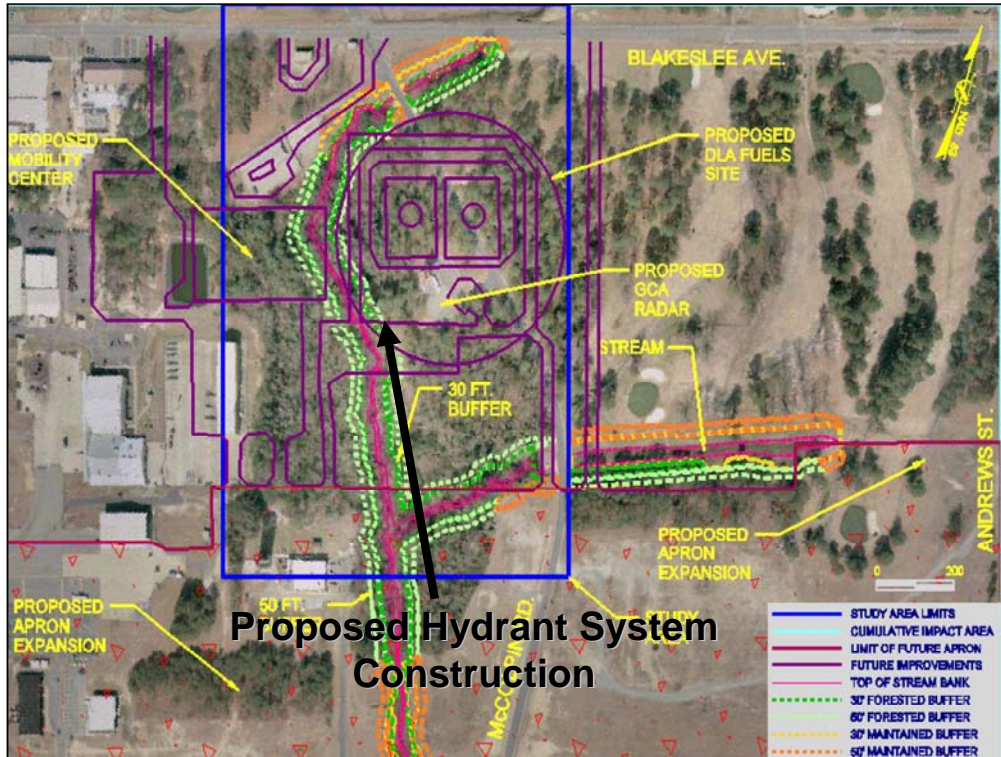


#### Overview

- Pending Mission Critical fuel hydrant system
- Mixed plume of petroleum hydrocarbons and chlorinated hydrocarbons
- Original system installed as Interim Remedial Action
- 1998 construction completed and system started

#### Original System

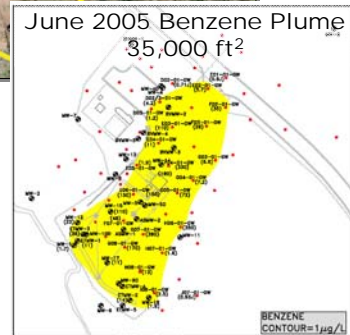
- Biosparge/biovent wells & groundwater extraction trench
- Projected cleanup >20 yrs



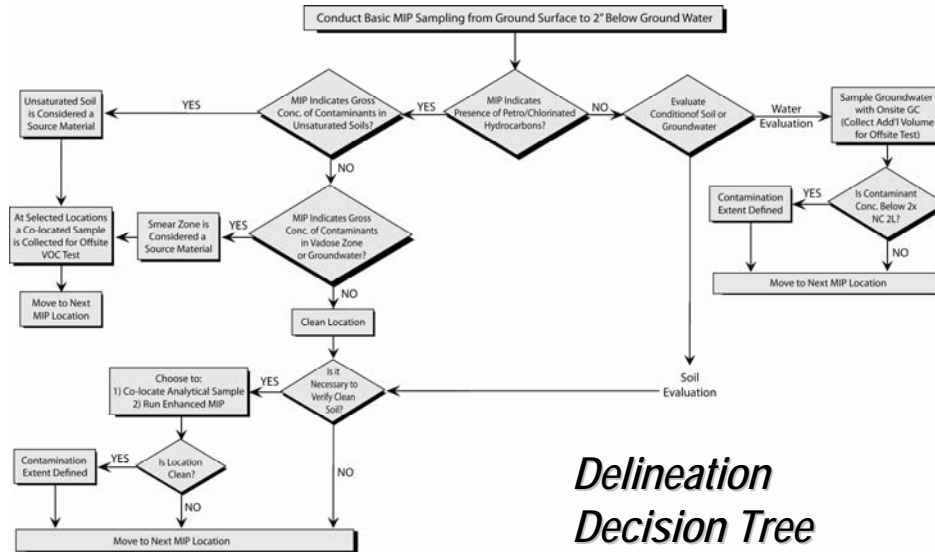
## OT-29 Cleanup Strategy



- ⑥ Site characterization utilizing the Triad
- ⑥ Removal of residual LNAPL using surfactant flush and recovery
- ⑥ Excavation of contaminated soils
- ⑥ Groundwater treatment through chemical oxidation events



# OT-29 Dynamic Work Strategies



## OT-29

### Characterization Actions (TN&A)



- ⑤ Membrane Interface Probe Characterization
  - 55 points analyzed
  - MIP enabled determination of source area and extents



- ⑤ Rapid Analysis
  - Soil and groundwater samples used to correlate data with MIP
  - PID headspace analysis performed on potentially contaminated soil



## OT-29

### *Surfactant Injection*

#### Field Activities:

- Installed temporary injection points within targeted LNAPL area based on Triad results
- Injected 10,000 gal of 1.6% non-ionic surfactant (1,250 gal/well)
- Used MMPE to recover surfactant and >700 gal of petroleum product
- Work completed in 2 weeks



**OT-29**  
*“Hot Spot” Excavation*



- Source removal of 2,000 tons of impacted soil
- Excavation extents based on Triad delineation results – soil removed from 2 areas

***TCE Source Removal  
Adjacent to Radar Tower***



## OT-29 Biopile Construction



### Actions Completed:

- Constructed biopile to treat petroleum/VOC-impacted soil on-site
- Biopile actively vented and moisture content managed
- Highly-impacted soil amended with approx 1,000 gal hydrogen peroxide (12 wt %) & tilled
- Beneficial reuse of cover material for local landfill following treatment



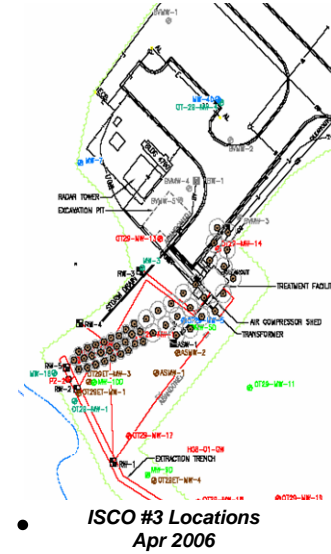
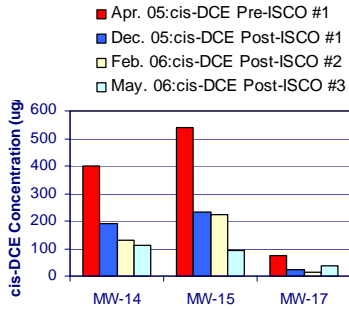
	NCDENR Unrestricted (mg/kg)	Jan. 2005 (mg/kg)	Oct. 2005 (mg/kg)
Benzene	0.006	0.003	ND
Toluene	7.3	0.5	ND
Ethylbenzene	0.24	5.14	0.002
Xylenes	5	31.9	0.03
Aliph. C5-C8	72	659	28
Aliph. C9-C18	3,260	484	910
Aliph. C19-C36	--	271	71
Arom. C9-C22	34	819	355

# OT-29 In Situ Chemical Oxidation



## Actions Completed:

- ISCO Bench Scale Tests (modified Fenton's)
- 3 ISCO events w/287 injection points and approx 75,000 gal oxidizer/catalyst over 50,000 ft<sup>2</sup> area



## OT-29

### *Current Status*



- ⑤ Site remediation activities completed with no impact to the mission-critical fuel hydrant system construction
- ⑤ Received NCDENR concurrence on No Further Active Remediation Status
- ⑤ Cleanup timeframe reduced from 20+ years to 4 years
- ⑤ Projected Savings to Government in excess of \$1.5M

## Bulk Fuel Storage Area (BFSA)

### Setting:

- 400,000-gal jet fuel (JP-4) release (>50,000 gal in subsurface requiring cleanup)
- Estimated 29,000 ft<sup>2</sup> LNAPL plume
- Estimated 395,000 ft<sup>2</sup> dissolved plume
- Legacy treatment system installed in 1998



**BFSA**  
*Cleanup Strategy*



- ② Optimize legacy treatment system to maximize performance prior to design and installation of updated recovery system
- ② Perform Triad-based characterization to expedite plume definition
- ② Design, install, and operate enhanced recovery system

## BSFA

### *Triad LIF/CPT ROST Investigation*



- ⑤ Rapid Optical Screening Tool (ROST) used for simultaneous collection of LIF and CPT data
- ⑤ Data collection provided integrated 3D investigation and mapping of LNAPL and smear-zone vadose soils
- ⑤ 9-day field effort with collection of 98 borings with minimal disturbance to AF mission
- ⑤ Decision Tree utilized to direct field activities



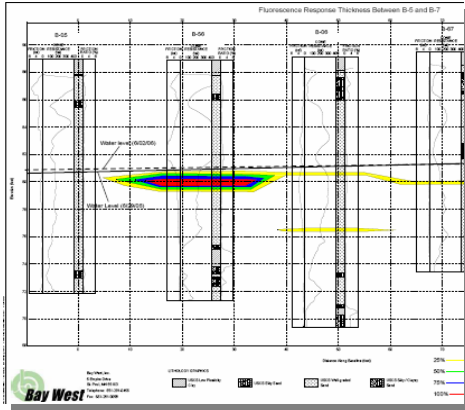
# BSFA

*Real Time Data Collection*

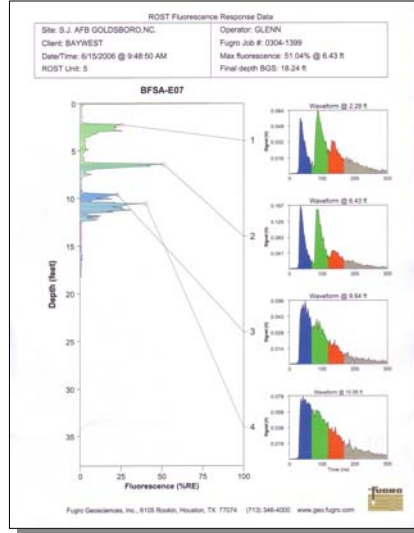


25

# BSFA Data Rendering



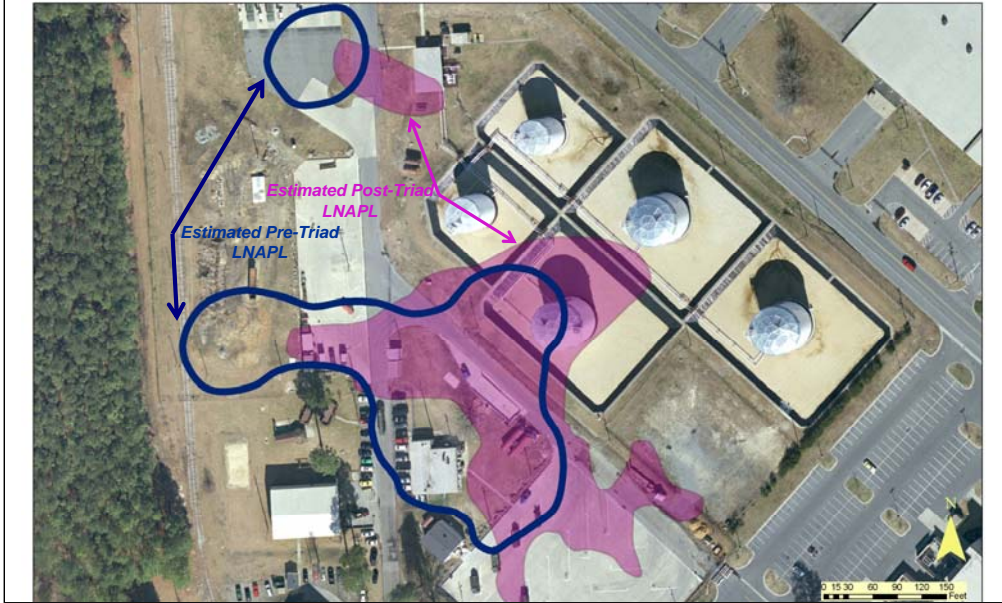
**CPT & LIF Data**



**ROST Data**

# BFSA

## Updating the Conceptual Site Model



**BFSA**  
*Treatment System Expansion*



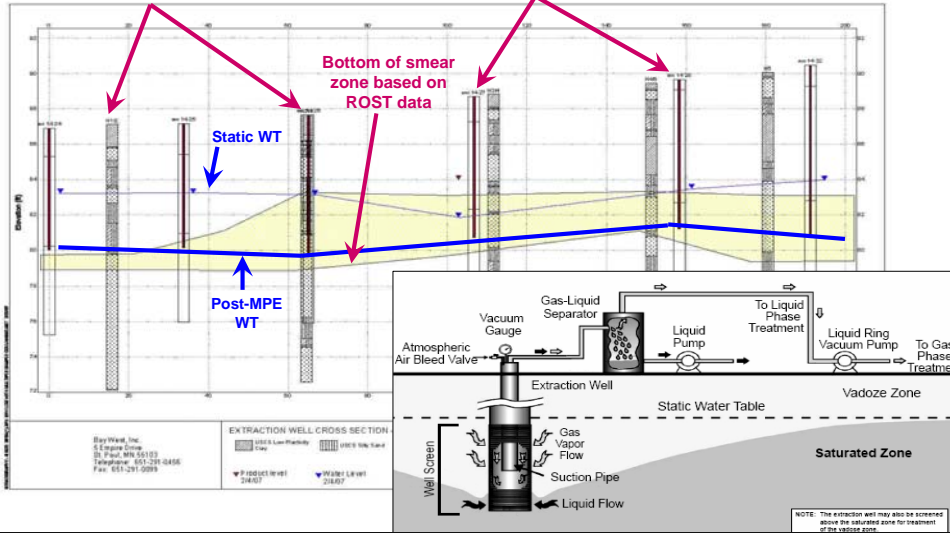
- ⑤ Installation of 65 MPE wells in target areas identified during the Triad investigation
- ⑤ Horizontal drilling and installation of system piping (~3,000 linear ft) to minimize impact to high-traffic, mission critical site area
- ⑤ Installation/Integration of 650-cfm extraction skid to increase recovery volume as estimated from the 3D site models

# BFSA System Enhancement



ROST Point, used to locate contamination and evaluate soil characteristics

Extraction well point installed based on ROST data



# BFSA

## Extraction Well and Manifold Pipe

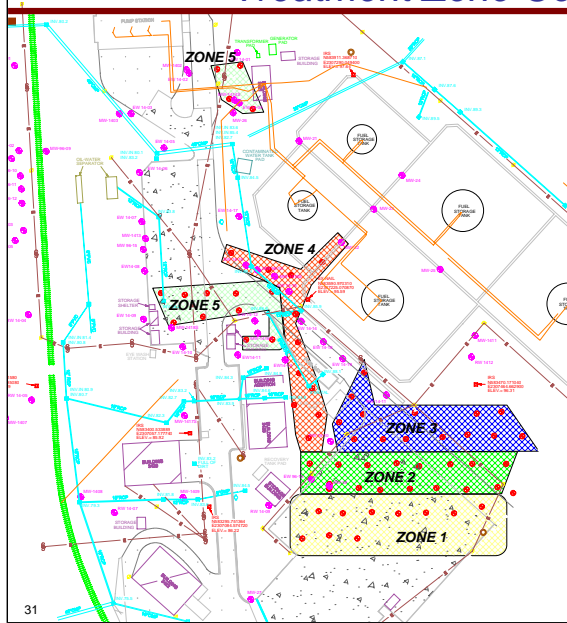


Isolation/  
Bypass Valve

Air Velocity Site Tube

Well Field  
Operation Valve

# BFSA Treatment Zone Configuration



**Trailer Manifold Piping**



# BFSA MPE Trailer System



32



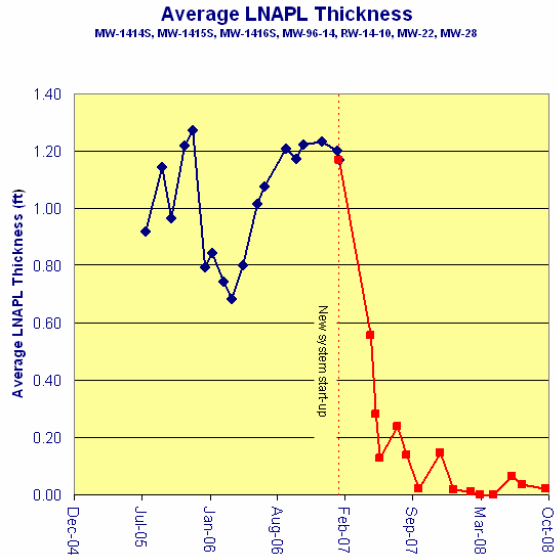
# BFSA

## Current Status



⑤ MPE targeting of Triad-defined LNAPL removed approx 50,000 gal of LNAPL in 12-month period

⑤ Cleanup timeframe estimated to be reduced from 10+ years to 3.5 years



## Summary



### Triad reduced:

- Number of mobilizations & fixed-base lab costs
- Field and reporting efforts
- Time to design and implement remedial action enhancements

### Provided data to revise CSM reflecting:

- More accurate LNAPL distribution (vertical and horizontal)
- Soil impacts below regulatory criteria
- Role of stratigraphy in contaminant transport/recovery

### Resulted in a design targeting source and “hot-spot” areas, reducing cleanup time

## Thank You

---

*Presented by:*

**Martin Wangensteen, PE, PG**  
**Bay West, Inc.**  
**Direct: 651-291-3475**  
**Cell: 651-341-3265**  
**martyw@baywest.com**



# Use of SADA to Expedite a Collaborative Soil Removal Action

Jim Wulff  
Tetra Tech EM Inc.  
Denver, CO

## This Case Study Illustrates:

- How a DST such as SADA can be used to integrate the 3 elements of the Triad
- How SADA can be used to guide a removal action
- How SADA can be used to support collaboration through enhanced visualization

## Barker Chemical Co. Superfund Site

- Removal action for lead and arsenic-contaminated soil
- Approximately 140 acres, two-thirds of which is residential
- Two distinct areas:
  - Garden Mall Court (GMC) a residential development
  - Former Inglis Road (FIR), an abandoned roadbed that can be traced for several miles northeast of GMC.



38

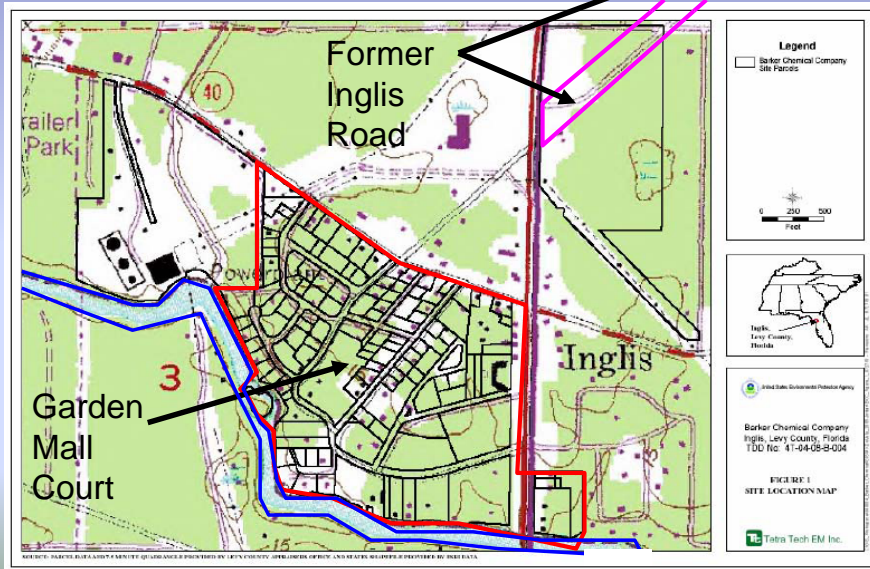
Withlacoochee River borders the site to the south. It flows into the Gulf of Mexico approximately 7 miles to the southwest.

Relatively flat with elevations ranging from sea level to 15 feet above mean sea level (AMSL).

Surface soil and river bank sediment were media of concern

Soil is 2 to 5 feet thick above limestone bedrock; groundwater in bedrock and not appear to be affected by contamination

# BCC Site Map



## Background: BCC Superfund Site

- Former fertilizer manufacturing facility and shipping terminal located near the Gulf Coast of Florida, approximately 80 miles north of Tampa
- Operated from 1904 until 1931, treating low-grade "hard rock" phosphate ore with sulfuric acid to produce superphosphate, a solid fertilizer product
- Produced solid waste consisting of pyrite cinders that likely contained significant quantities of arsenic and lead from the ore roaster
- Waste pyrite cinders reportedly stockpiled in area east of plant, then used as fill material in road beds or used to control vegetation on the plant property

40

Waste material, when present at surface, is stained red



## Red Stained Soil



Former Inglis Road



Garden Mall  
Court



41

Often, the appearance of the surface indicated extents of contamination

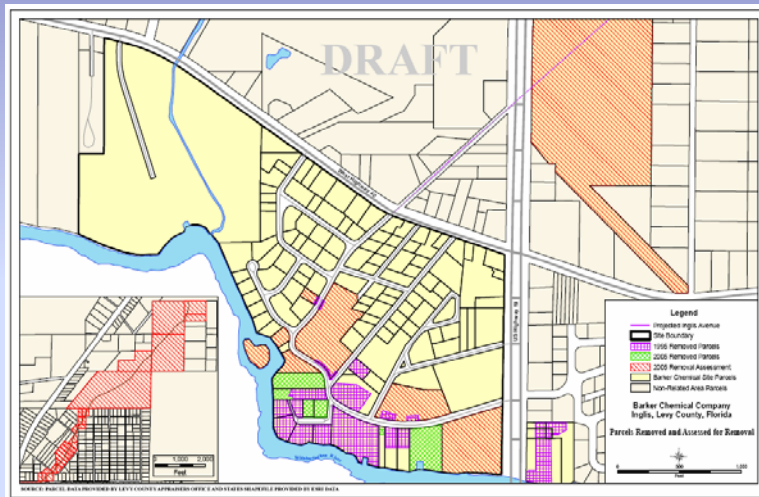
## But Sometimes the Soil is Buried (particularly at GMC)



42

But in other instances, particularly at GMC, the extents of contamination were only visible as soil was being excavated

## Removals: 1995 and 2005

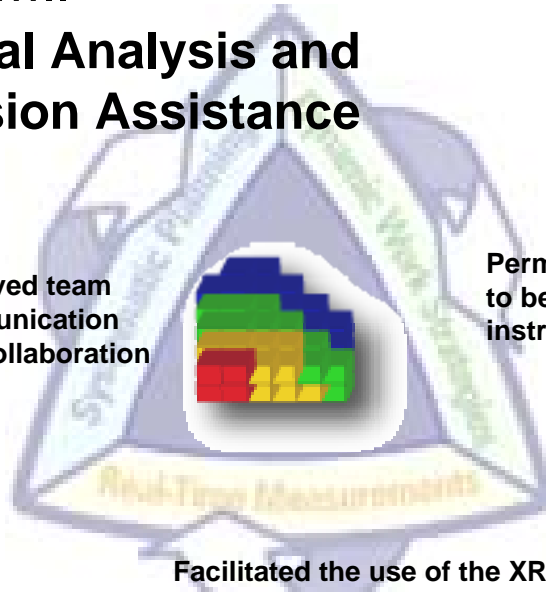


EPA agrees to conduct comprehensive evaluation of site in 2005 and remove contaminated soil above action levels

Enter.....

## **Spatial Analysis and Decision Assistance**

Improved team  
communication  
And collaboration

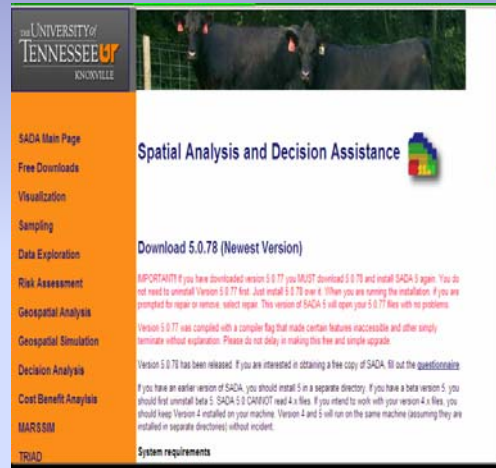


Permitted excavation  
to be guided using field  
instruments (GPS)

Facilitated the use of the XRF  
as a survey / screening tool

## Advantages of SADA

- Cost = free
- Active technical support
  - On-line user group
- Ease of use
  - Data loading module
- Focused on specific technical areas:
  - Sampling design
  - Risk assessment
  - MARSSIM
  - Geostatistics



Potentially applicable to most TRIAD projects



## Two Key Issues:

1. Field XRF analysis of arsenic rarely able to detect arsenic below 30 mg/kg
2. USEPA time-critical action level for arsenic = 40 mg/kg while Florida Department of Environmental Protection (FDEP) action level = 8 mg/kg

# Low Rate of Detection

## Percentage of Detections for XRF and Laboratory Data

analyte	XRF				Laboratory				
	detect	nondetect	total	% detect	detect	j-qual	nondetect	total	% detect
As	26	1178	1213	2.1%	193	35	182	914	55.6%
Pb	768	435	1213	63.3%	316	6	182	504	78.5%

Notes:

As = arsenic

j-qual = estimated value below detection limit

Pb = lead

XRF = X-ray fluorescence

- Solution: Regression equation relating lead concentrations (measured with the XRF) to arsenic concentrations (measured in laboratory) had a correlation coefficient of 0.92.
- Equation was embedded in a spreadsheet to transform lead results to estimated arsenic concentrations wherever the XRF yielded a lead concentration but not an arsenic concentration.



## Four Potential Approaches to Arsenic Detection Issue

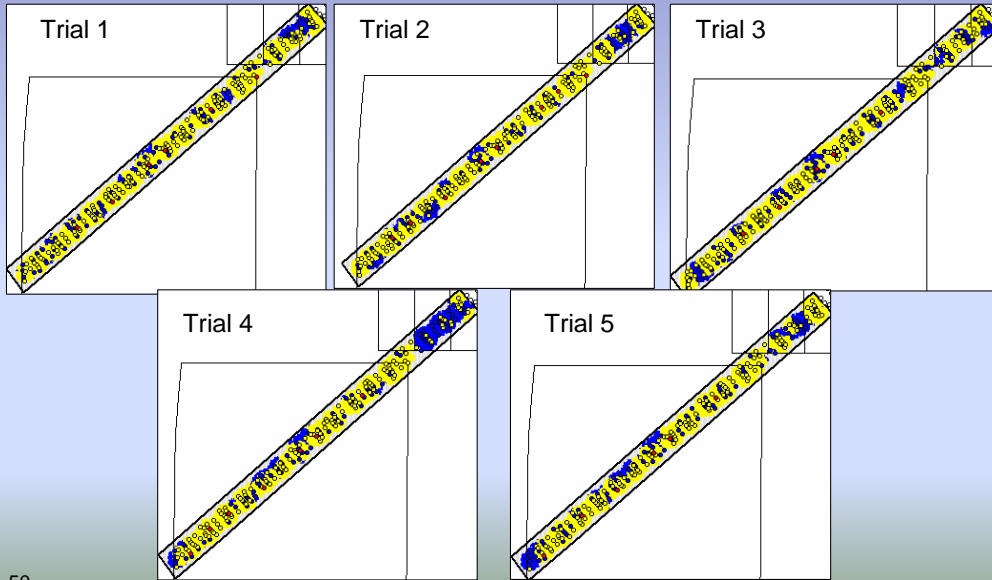
- **The Problem:**

- Detection limits for primary COC (arsenic) are higher than the FDEP action level. Most of the arsenic data is below detection limits (BDL).
- Laboratory data do not have this problem, but are too sparse to effectively contour

- **Potential Solutions:**

- Option 1: Using Random Number Generator to Synthesize Arsenic BDL Data
- Option 2: Using Lead XRF Data to Synthesize Arsenic BDL Data
- Option 3: Merge Options 1 and 2 (use lead>arsenic regression equation when lead is detected; random number generator when lead not detected)
- Option 4: Use Lab Data Only

# Option 1 (Random Number Generator) Variation in Results of 5 "Trials" (contours)



50

## Comparison of Results of Old and Revised Plots

### Option 1

- Volume that exceeds FDEP threshold = **124,650 ft<sup>3</sup>**
- Volume that exceeds EPA threshold = **0 ft<sup>3</sup>**

### Option 2

- Volume that exceeds FDEP threshold = **71,625 ft<sup>3</sup>**
- Volume that exceeds EPA threshold = **0 ft<sup>3</sup>**

### Option 3

- Volume that exceeds FDEP threshold = **89,075 ft<sup>3</sup>**
- Volume that exceeds EPA threshold = **0 ft<sup>3</sup>**

### Option 4

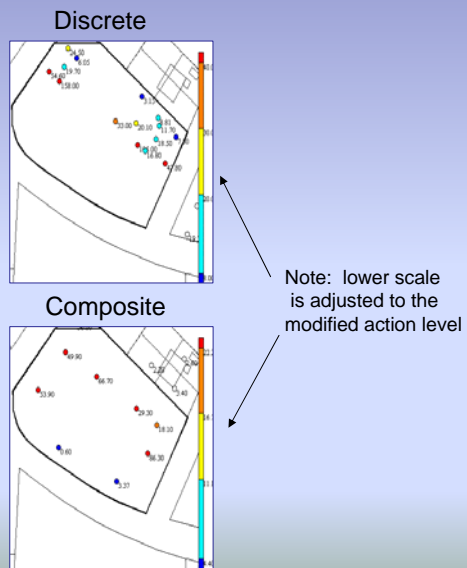
Data too sparse to have meaningful coverage

## The Compromise

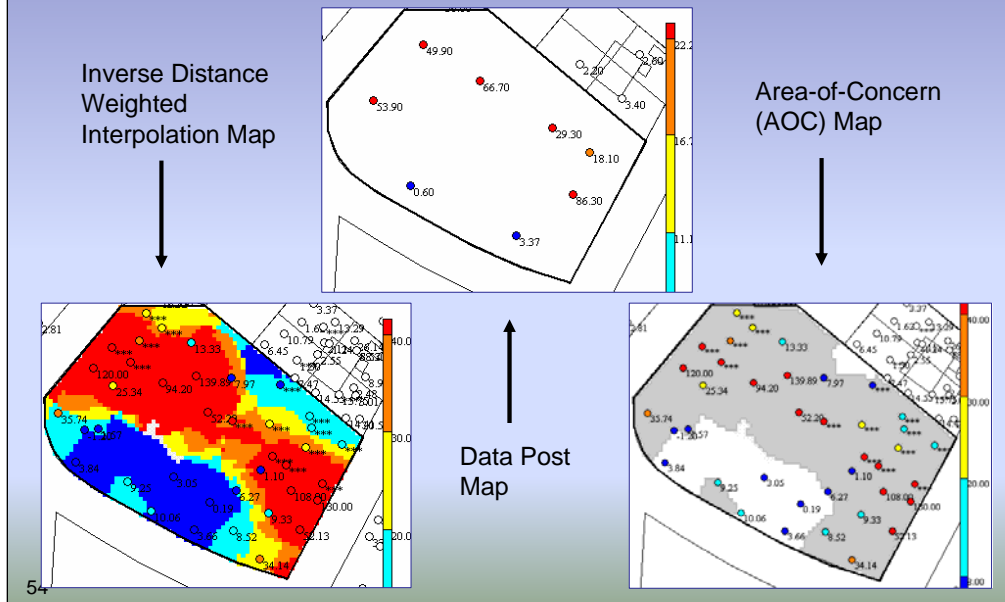
- The compromise agreed to was that EPA would only conduct removals at parcels where composite samples were above EPA action level, however, once an excavation was initiated, it would be extended to include all soil where XRF results indicated soils were above FDEP action level
- EPA also provided maps and analyses to FDEP of parcels that were not removed so that FDEP has the information it will need if they conduct further removal or remediation in the future

# Composite Samples

- The decision to conduct a removal was based on composite vs. discrete sample comparison
- Project team calculated a modified action level of 22 mg/kg through a statistical comparison with discrete samples
- This action level represents the 95 upper confidence level (95UCL) that the composite sample represents the mean of the 5 discrete samples

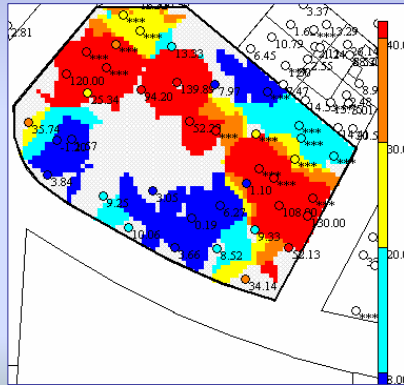


## The SADA Visualization Package (what was created for each parcel)

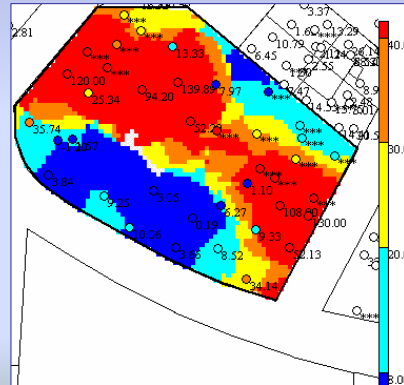


# Analysis: Interpolation (Inverse Distance Weighted algorithm)

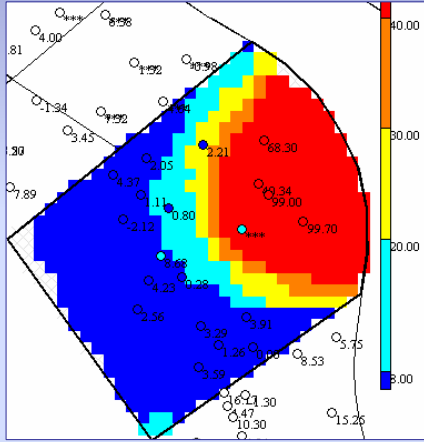
Using a 50' search radius



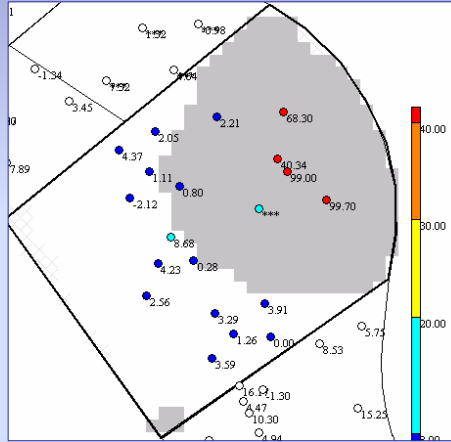
Using a 80' search radius



# Interpolation / AOC Maps



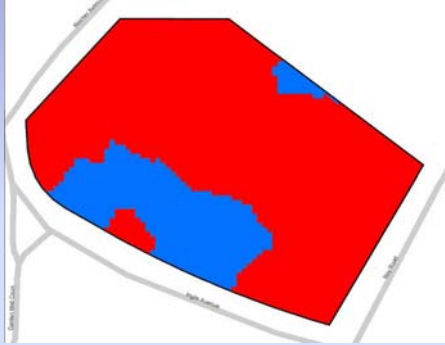
Using a 50' search radius



AOC at 8 mg/kg



## Removal



Excavation Extent Shapefile  
That was exported to Trimble  
(red polygon = area to be excavated)

- Excavation extent maps were developed in SADA to demarcate boundaries on each property parcel scheduled for removal (exported from SADA to ArcGIS as Excel integer arrays)
- Shapefiles (from GIS) were loaded into a Trimble® TSCe back pack GPS unit with sub-meter accuracy.
- SADA 5.0 allows user to create line/point shapefiles, eliminating the need to convert integer data to shapefiles outside of SADA. This change will greatly streamline the process

## Excavation Area: Parcel 103

Enlargement of “removed areas” map from Work Plan



Legacy data / maps could not always be trusted!

## Post-Excavation Confirmation Samples

- Collected at a rate of 1 every 250 square feet following excavation
- 4 of 92 samples exceeded the EPA removal action level of 40 mg/kg for arsenic (4.3%)
- 1 of 92 samples exceeded the EPA removal action level of 400 mg/kg for lead (1.1%)
- Further excavation was constrained by shallow bedrock contact (where there were exceedences)

## Summary of SADA Effort

- SADA was conducted on 42 parcels (between GMC and FIR)
- PowerPoint file was created for each parcel with the following:
  - Data post maps for each group of samples
  - Interpolations (contour maps)
  - "Area-of-Concern" maps
  - An Excel spreadsheet with integer clean/dirty array
- Average time required per parcel: 90 minutes
- Removal actions conducted on 17 of 42 parcels

## Bottom Line

“ The former Barker Chemical Company is currently no apparent public health hazard. Exposure to contamination in the soils is mitigated by the USEPA’s removal of contaminated surface soils. ”

ATSDR Public Health Assessment for Barker  
Chemical Company, Inglis, Levy County, Florida  
May 8, 2008

## Additional Information

- Contact me at 303-312-8834  
jim.wulff@ttemi.com
- SADA website:  
<http://www.tiem.utk.edu/~sada/index.shtml>
- Federal Remediation Technologies Roundtable (FRTR)  
Decision Support Tool (DST) matrix: Barker Case Study  
[http://www.frtr.gov/decisionsupport/PDF/SADA%20Barker%20Final\\_Post.pdf](http://www.frtr.gov/decisionsupport/PDF/SADA%20Barker%20Final_Post.pdf)
- ATSDR public health assessment:  
<http://www.atsdr.cdc.gov/hac/pha/HCPHA.asp?State=FL>



63

# Thank You

After viewing the links to additional resources,  
please complete our online feedback form.

Thank You

[Links to Additional Resources](#)

[Feedback Form](#)