Best Practices Used in the Triad Approach to Characterize TCE in Ground Water at Hurlburt Field, FL

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Some Key Triad Best Practices

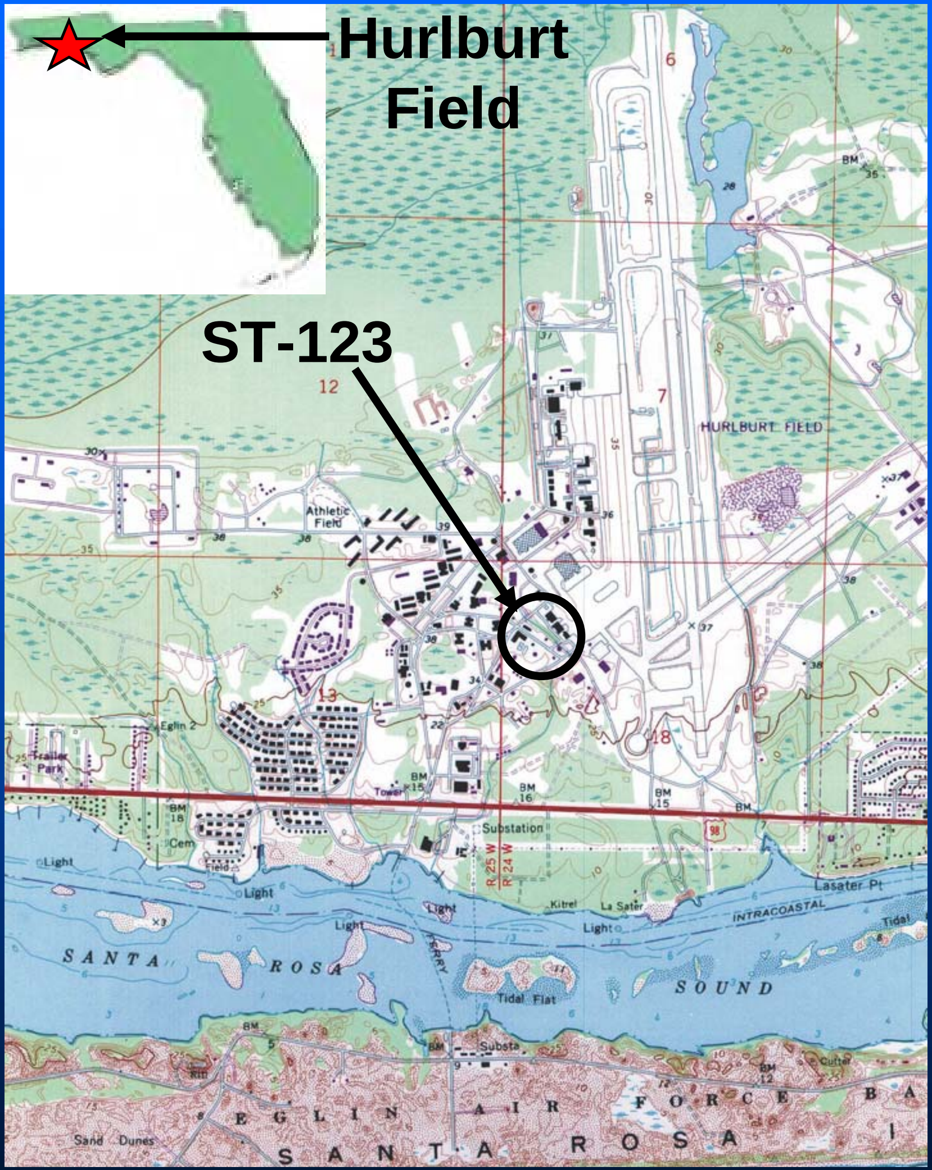
- Robust Conceptual Site Model
- Focus on Decision Uncertainty
- Development of an Exit Strategy
- Development of Decision Logic
- Use of Dynamic Work Strategies
- Emphasis on Data Representativeness
- Use of Collaborative Data Sets

This presentation will use the project chronology to show how these practices were incorporated at ST-123

USAF Florida Triad Initiative

Hurlburt Field

Site ST-123



Brief Background on Site ST-123

- POL fuel yard constructed in the 1940s to store jet fuel, waste fuel, and waste oil.
- All ASTs were removed prior to May 1994.
- Regional Hydrogeology: Three Significant Units
  - Surficial Sand-and-Gravel Aquifer
  - Pensacola Clay Confining Unit
  - Floridan Aquifer
- Groundwater Contamination Contained within the Surficial Sand-and-Gravel Aquifer

Brief Background on Site ST-123 (cont.)

- Groundwater has been impacted by petroleum constituents and chlorinated volatile organic compounds (CVOCs).
- HRC® was injected into the surficial aquifer between a depth of 15 and 65 feet bls in January 1999 (6,000 pounds), October 2000 (540 pounds), and August 2001 (4,118 pounds).
- 1,348 tons of petroleum-contaminated soil were excavated from the shallow zone in April 2001.
- 1,203 pounds of ORC® were injected into the groundwater beneath the excavated area in August 2001 to enhance degradation of BTEX.

Brief Background on Site ST-123 (cont.)

- While some degradation was noted, the distribution of TCE and its degradation products apparently became more widespread.
- It was felt the path to developing a Statement of Basis and closure was still unclear.

USAF Florida Triad Initiative

- An initial use of Triad principles had shown the promise of expediting characterization and closure
- In May 2004, a meeting was held in Tallahassee to plan the implementation of the Triad Approach at three USAF Florida sites.

MacDill Avon Park Hurlburt

Systematic Planning

- The initial systematic planning session was held for ST-123 at Hurlburt over three days 22-24 June 2004.
- A second planning session was held on 26 July
- FYI
  - – Mobilization to field – early October
  - – Characterization complete – January 2006

Systematic Planning (cont.)

The key “best practice” elements and flow of an initial systematic planning session are:

- Day 1
  - Present a robust CSM (for instance)
    - Exposure pathways
    - Regulatory environment
    - Contaminant properties
    - Known and potential source areas
    - Stratigraphic conditions
  - Define existing uncertainties
    - Use worksheets
  - State the Exit Strategy
    - Focus on what closure means and how to prove it.
  - Develop a high level decision logic

Systematic Planning (cont.)

- Day 2
  - Using past experience, postulate likely remedies
  - Continue to add and resolve decision uncertainty and contingencies
  - Further refine the decision logic building in contingencies
  - Develop data quality objectives

Systematic Planning (cont.)

Day 3

- Discuss available investigative technologies
- Determine whether Demonstrations of Method Applicability will be required
- Incorporate the use technologies into the decision logic
- Develop the basics of the data management and communication plan
- Discuss schedule, budget, and contracting issues.

Systematic Planning (cont.)

The “right” stakeholders must be present.
If they have “veto” power, they must be included.

- Project manager
- Regulators
- Technology Specialists
- Geologists
- Data managers
- Mapping specialists
- Members of Public
- Attorneys
- Risk Assessors
- Field Lead
- Contracting officer
- Developers

Systematic Planning (cont.)

Key tools and techniques

- Uncertainty Worksheets
  - Sampling uncertainty (resolved in field)
  - Non-sampling uncertainty (resolved by authority, research, consensus)
- Graded Approach
  - Assists in prioritization of activities
  - Allows the focus of information gathering to be on areas of most important uncertainty
- Focus on Data Representativeness
- Use of Collaborative Data

Systematic Planning
Basic Hurlburt Exit Strategy

- Getting a clear statement of and consensus on the Exit Strategy is important
- Do it early in the process because it forms the objective for the high level decision logic
- For Hurlburt: Meet FDEP groundwater standards in sand and gravel aquifer (i.e., similar to MCLs). Consensus was achieved on this issue.

Systematic Planning
Basic Hurlburt Exit Strategy

It was recognized that it was possible that the FDEP groundwater criteria, known as Option A, would not be able to be met.

So, the strategy discussion centered on Option B:

- Establishing and quantifying threshold conditions that would trigger alternative actions
- Description of potential alternative actions
- Specification of the types of data that would serve to distinguish between the likelihood of implementing a particular alternative action.

Systematic Planning
Key Hurlburt Data Gaps

As the CSM discussion proceeded, sources of uncertainty were identified and attempts were made to quantify and prioritize the items of uncertainty.

- Source of contamination?
- DNAPL concentrations, where and how much?
- CVOC delineation in all zones, what is the extent?
- Contaminant transfer between the upper and lower intermediate zones, what is causing the downward gradient?
- Exposure pathways, are CVOCs volatizing into the indoor air of the Avionics Building from the shallow groundwater?

Systematic Planning
- Hurlburt Example
Semi-quantitatively assessing uncertainty

	Vadose Zone	0-30 ft bls	30-60 ft bls	60-150 ft bls	
				60-100	100-150
Source (what we know in MW-12 area)	10%	30%	80% confident about distribution around MW-12	5%	0%
Boundary (monitoring)	NA	90%	90%	7%	0%
Flow (direction)	NA	100%	10%	80%	10%
Yield/Para-meters	NA	80%	30%	30%	0%

Systematic Planning
Worksheets Used to Track Key Uncertainties

The key is to state each element of uncertainty in such a way that a clear answer can be provided.

For sampling related uncertainties, this means that measurements can be made that will clearly address the uncertainty

These statements and resolutions translate directly into data quality objectives.

Systematic Planning – Elements of a Sampling Uncertainty Worksheet

- Define the uncertainty
- Proposed Resolution
- Type of Information Required for Resolution
- Quality specifications (i.e., sample support, detection limit, type of analysis, etc.)
- Quantity
- Priority (H,M,L), Timing
- Responsibility for action

Systematic Planning – Elements of a Non-Sampling Uncertainty Worksheet

- Define the uncertainty
- Proposed Resolution
- Requirements for information to achieve resolution
- Priority (H,M,L), Timing
- Responsibility for action

Systematic Planning
Sampling Uncertainty Example Statements

How does the stratigraphic heterogeneity vary with depth?

How does the TCE distribution vary with the variation in stratigraphic heterogeneity?

For deployment of chemical oxidation as a potential remedy, how does the concentration of TCE vary with depth.

Hurlburt Triad Investigation (October 2004 - January 2005)

- As a result of the sessions, Project Objectives were:
  - Delineate vertical and horizontal extent of groundwater plume (NFA) criteria at key locations (source area, ST123-MW-16, downgradient)
  - Delineate source area, identify target treatment areas, and determine if NFA is a feasible option at Site ST-123
  - Obtain conceptual design data for potential remediation
  - Determine if MNA is applicable to site
  - Evaluate protectiveness of human health and the environment
  - Develop closure strategy

ST-123 General Project Decision Logic

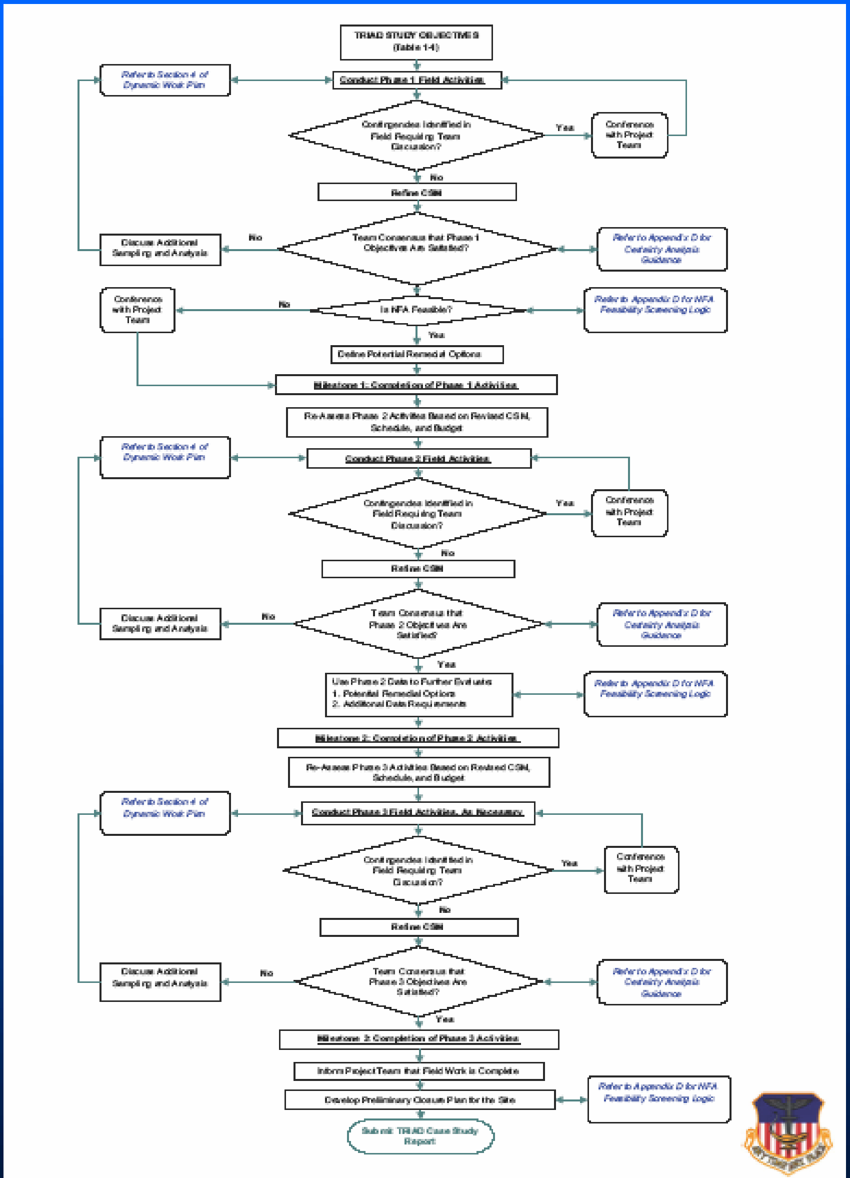
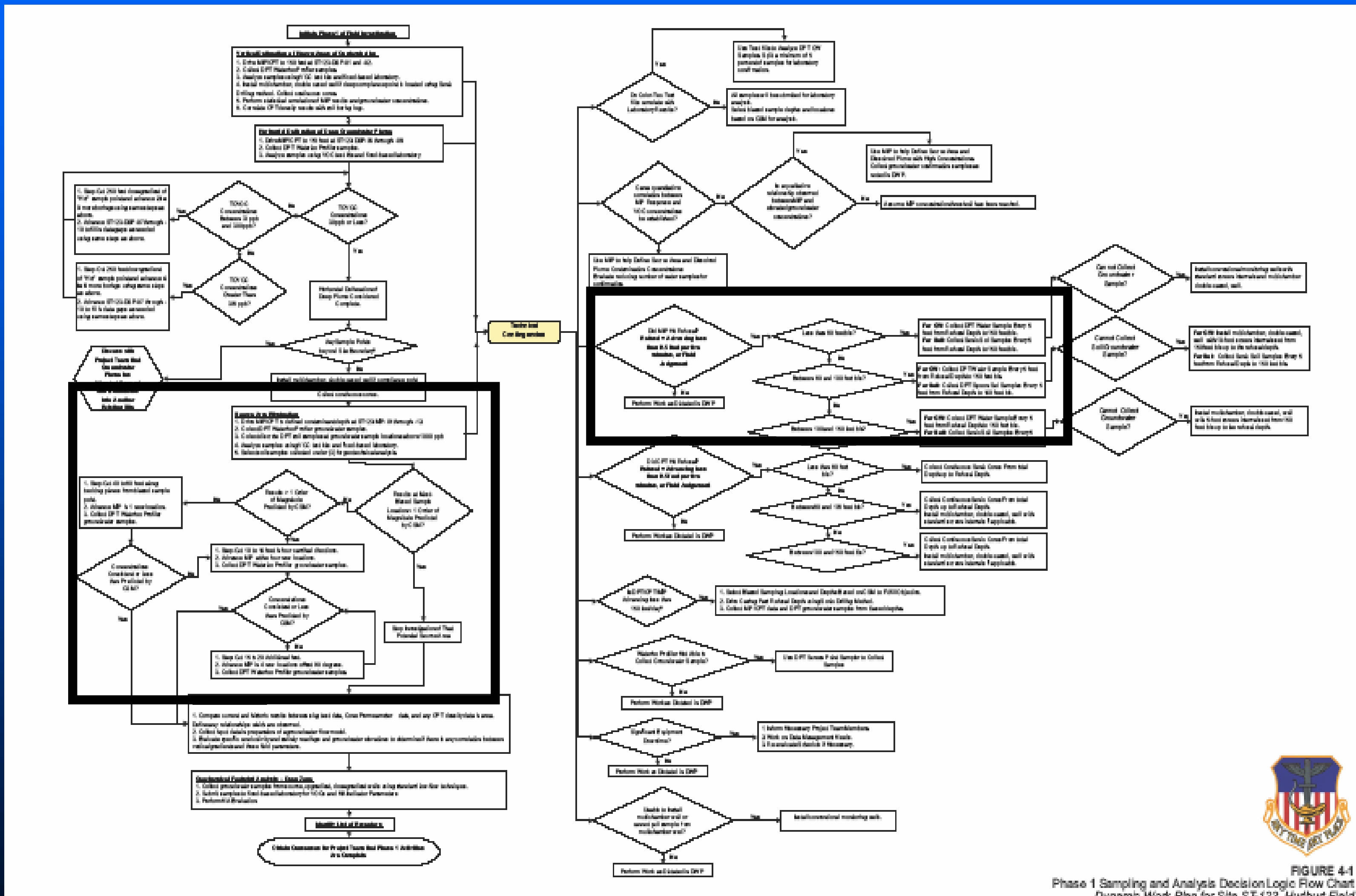


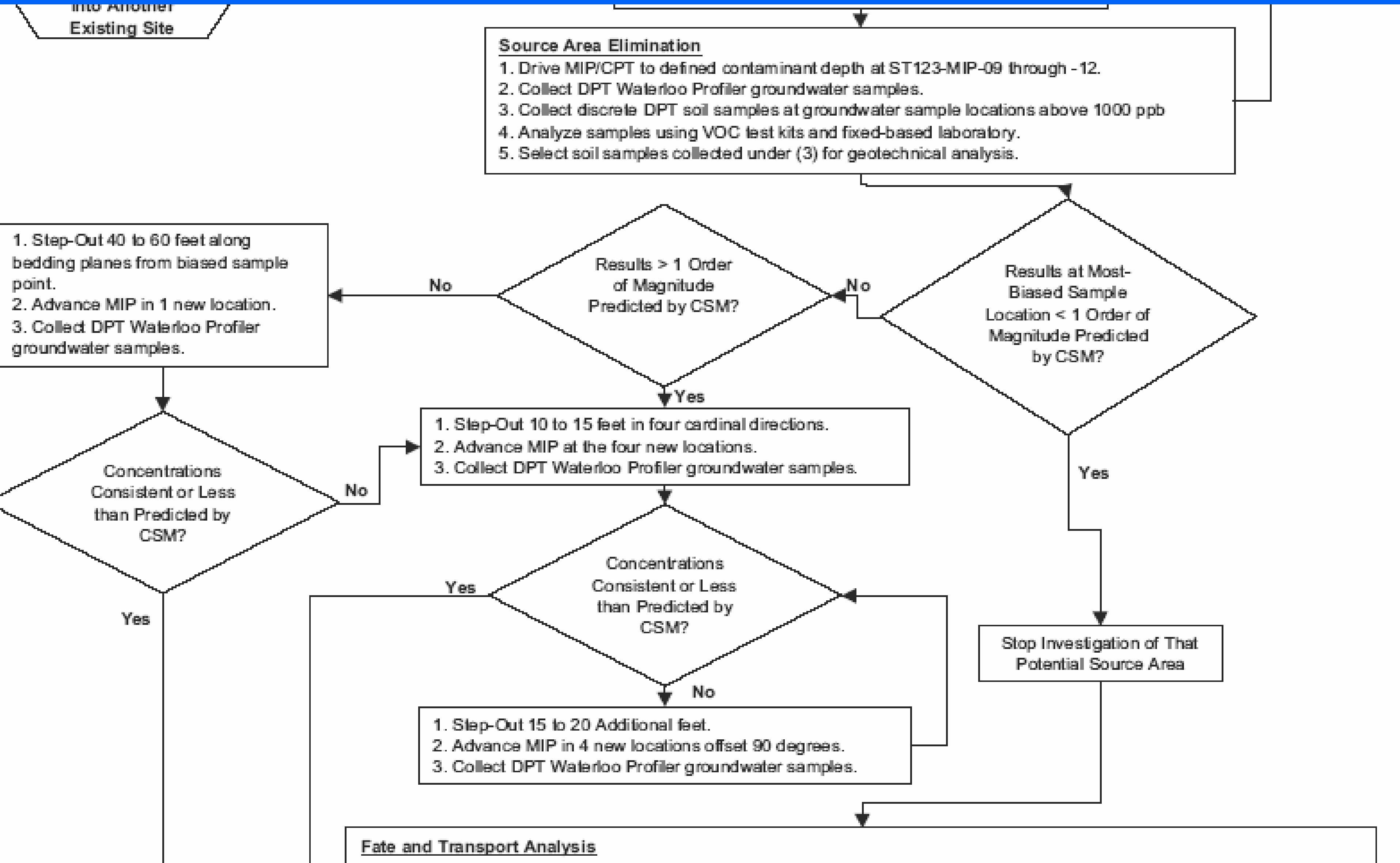
FIGURE 1-2
General Project Decision Logic Flow Chart
Dynamic Work Plan for Site ST-123, Hurlburt Field

Systematic Planning

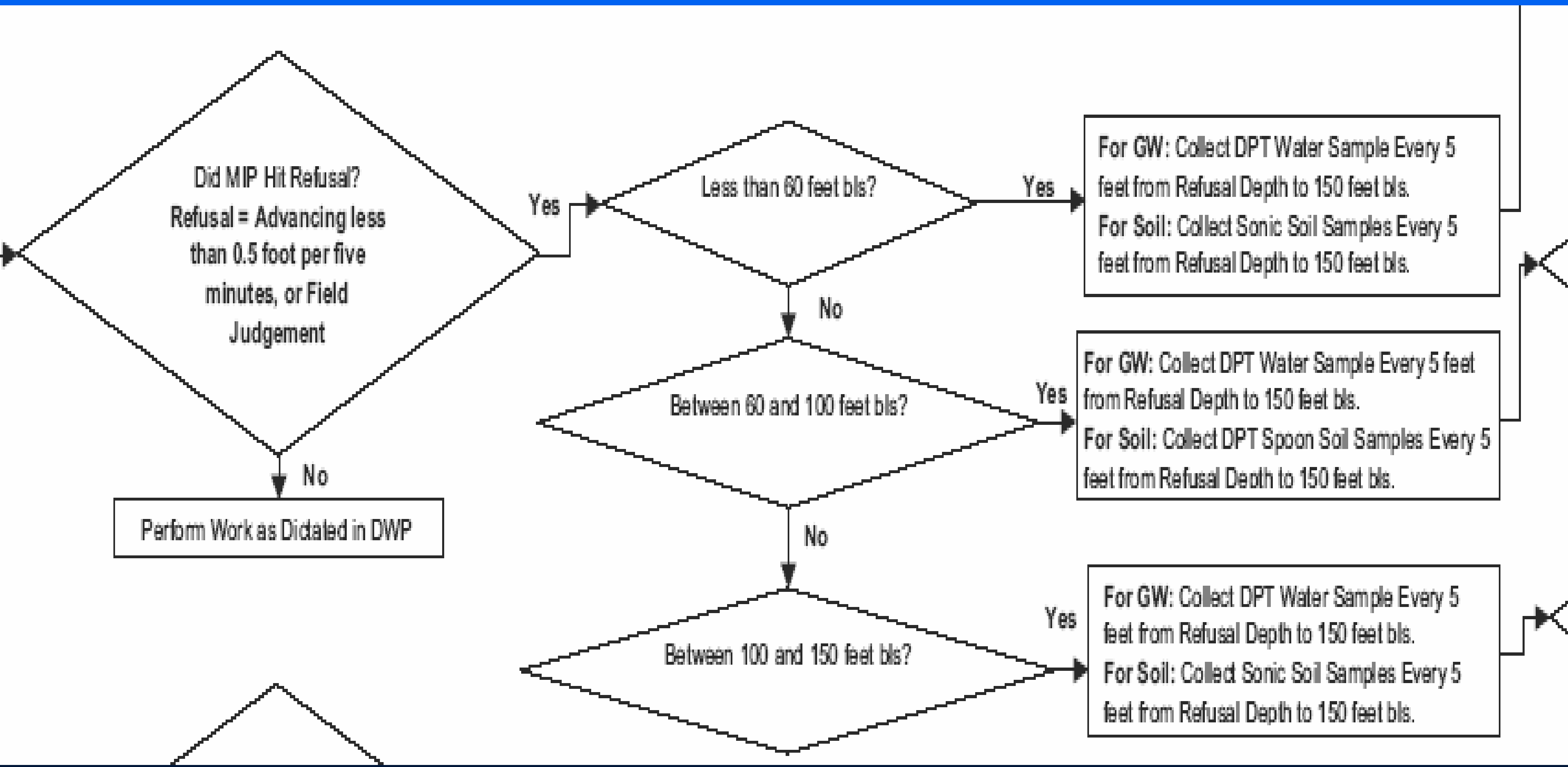
Sampling and Analysis Decision Logic



Sampling and Analysis Decision Logic
Source area Definition



Sampling and Analysis Decision Logic
Technology Contingency Logic



ST-123 Data Management and Communication

- Conference calls and meetings
- Field communications
- Daily e-mail status reports
  - Description of day's activities
  - Updated sample location maps
  - Various logs
  - Activities proposed for next day
  - Periodically provided updated graphical analyses
- File transfer protocol (FTP) site
  - All attachments uploaded to FTP site daily

Decision-making authority

- Because systematic planning was used prior to development and implementation of the workplan, stakeholders were comfortable with the process for collecting data and the decisions to be made.
- A high degree of decision making authority was vested in field team lead.
- Work plans were quickly reviewed and when there was a need to consult stakeholders on field decisions, the process went smoothly because everyone was prepared.

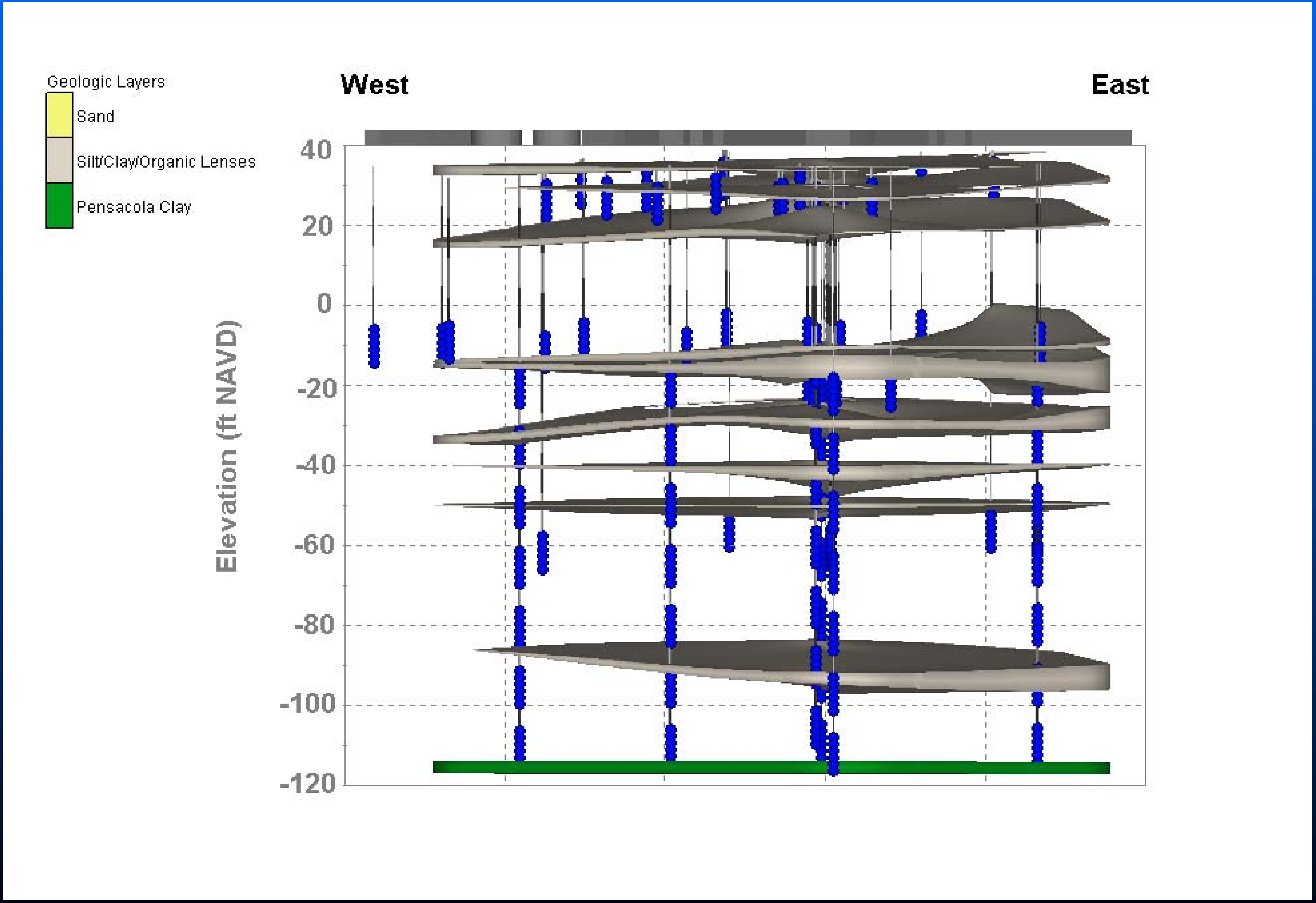
Data Representativeness and Collaborative Data - Example

- Distinguishing the geometry of the source area relative to potential treatment techniques.
- Key elements:
  - Stratigraphic heterogeneity
  - Distribution of VOCs within strata
- Tools: MIP, CPT, boring logs

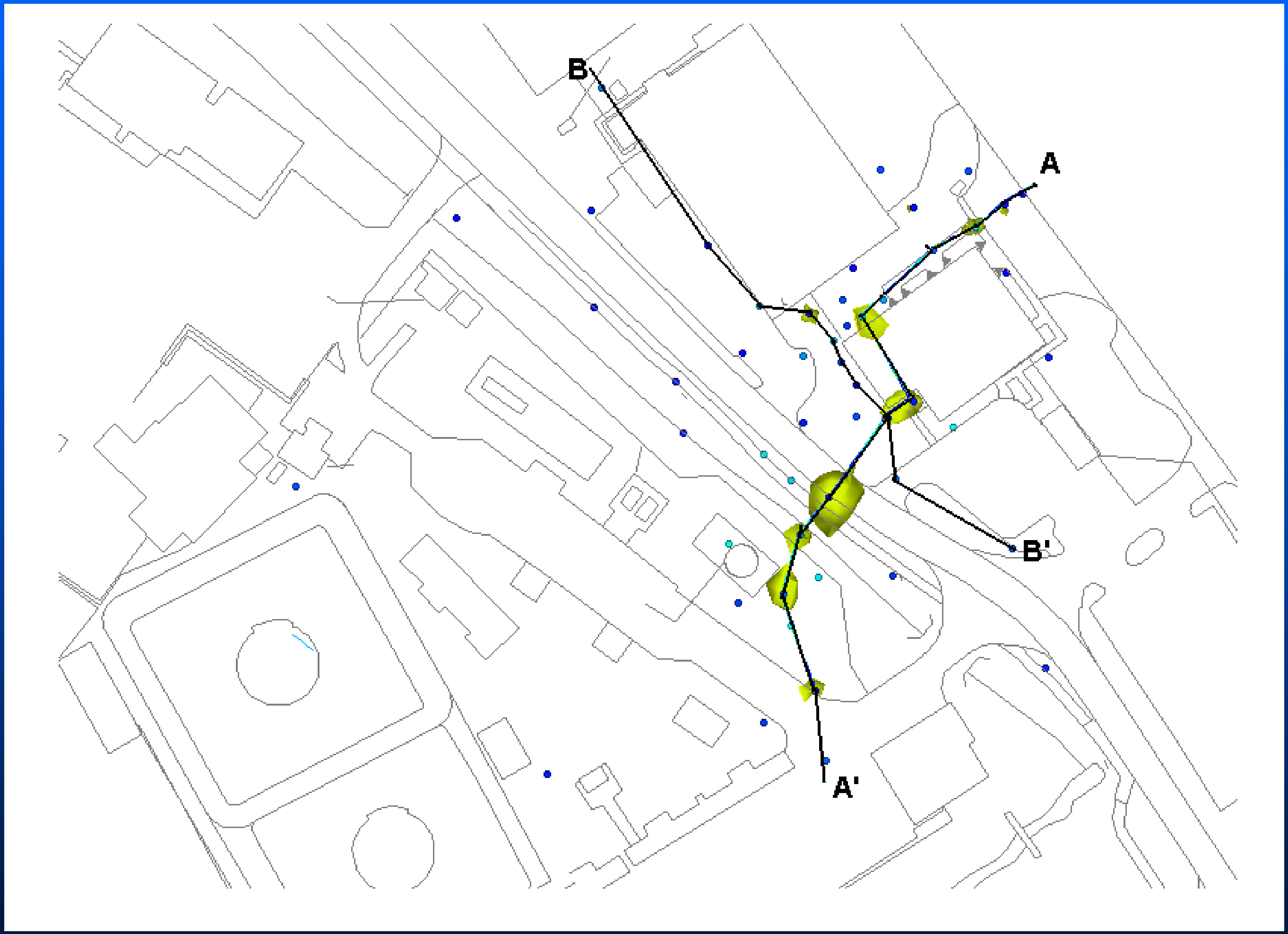
Data Representativeness Collaborative Data - Example

- Distinguishing the distribution of concentrations of VOCs in the source area relative to potential treatment techniques.
- Key elements:
  - Spatial variation of VOC concentration
- Tools: ColorTec colorimetric kits, off-site laboratory methods, Demonstration of Method Applicability for test kits

Post-Investigation Lithology

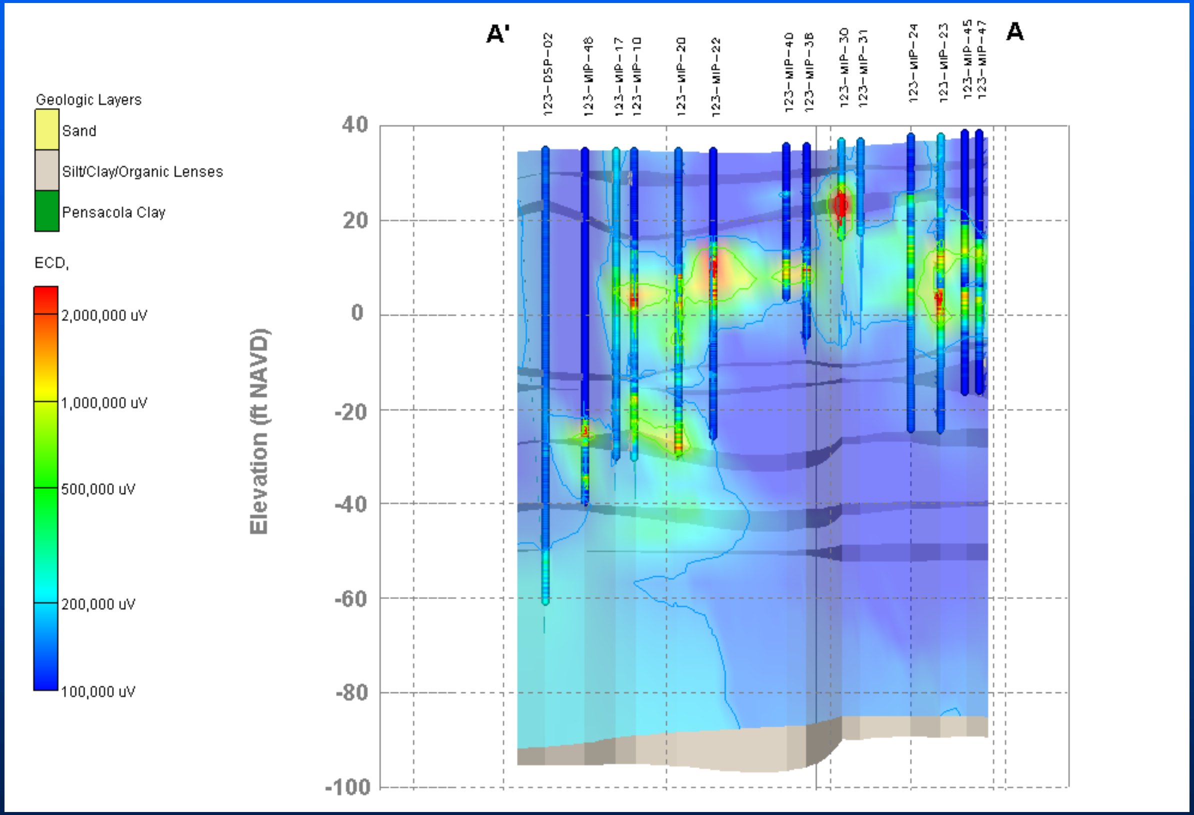


ECD Response Fence Diagrams



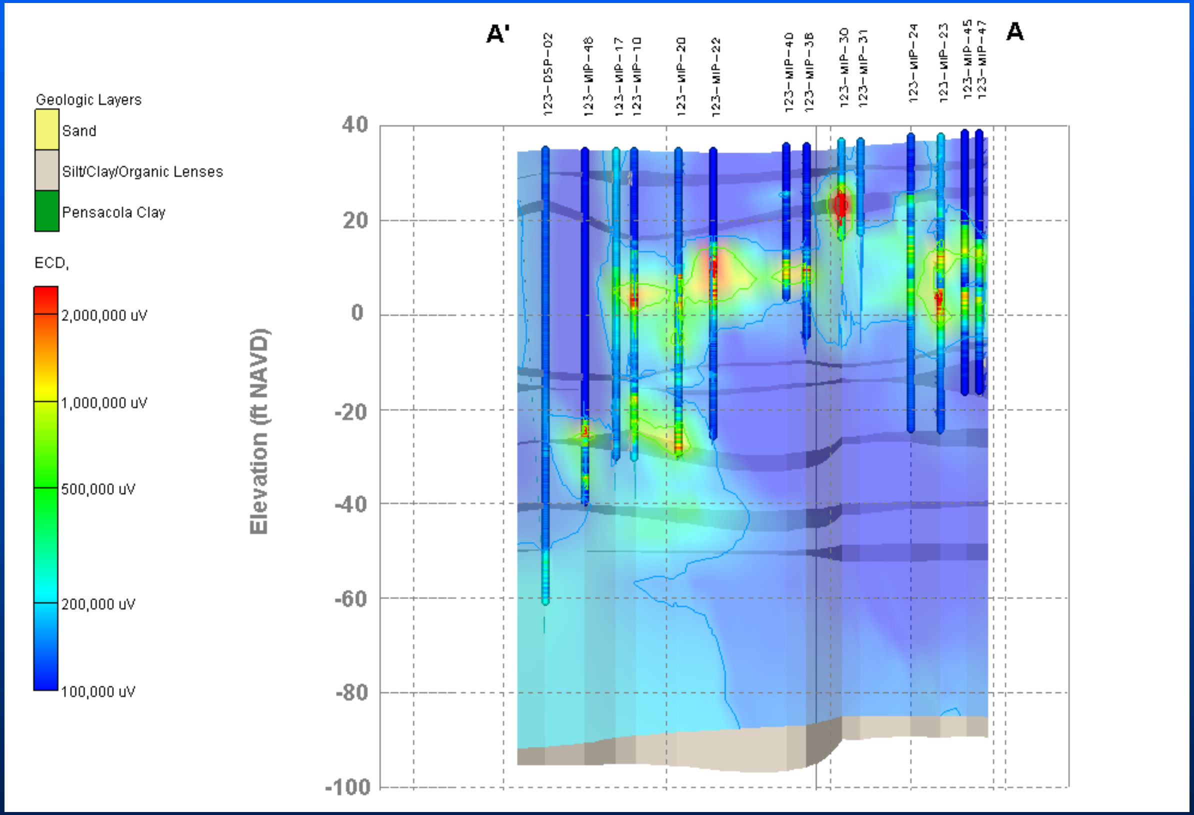
ECD Response Fence Diagrams

Cross-section A-A



ECD Response Fence Diagrams

Cross-section A-A



ST-123 Results

Pre and Post comparisons follow;

Pre-Triad Lithology

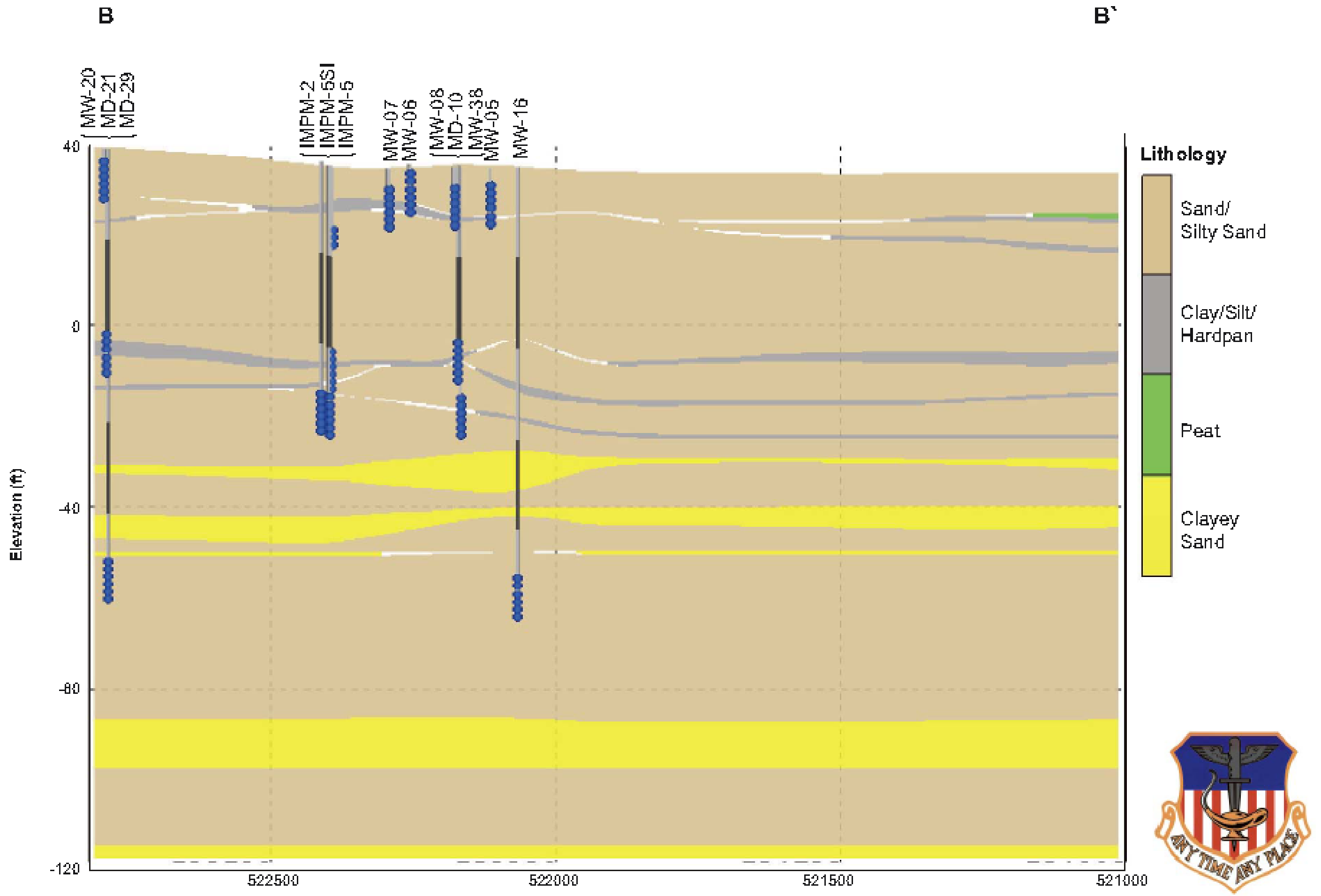


Figure x
Geologic Cross Section B-B`
Site ST-123, Hurlburt Field

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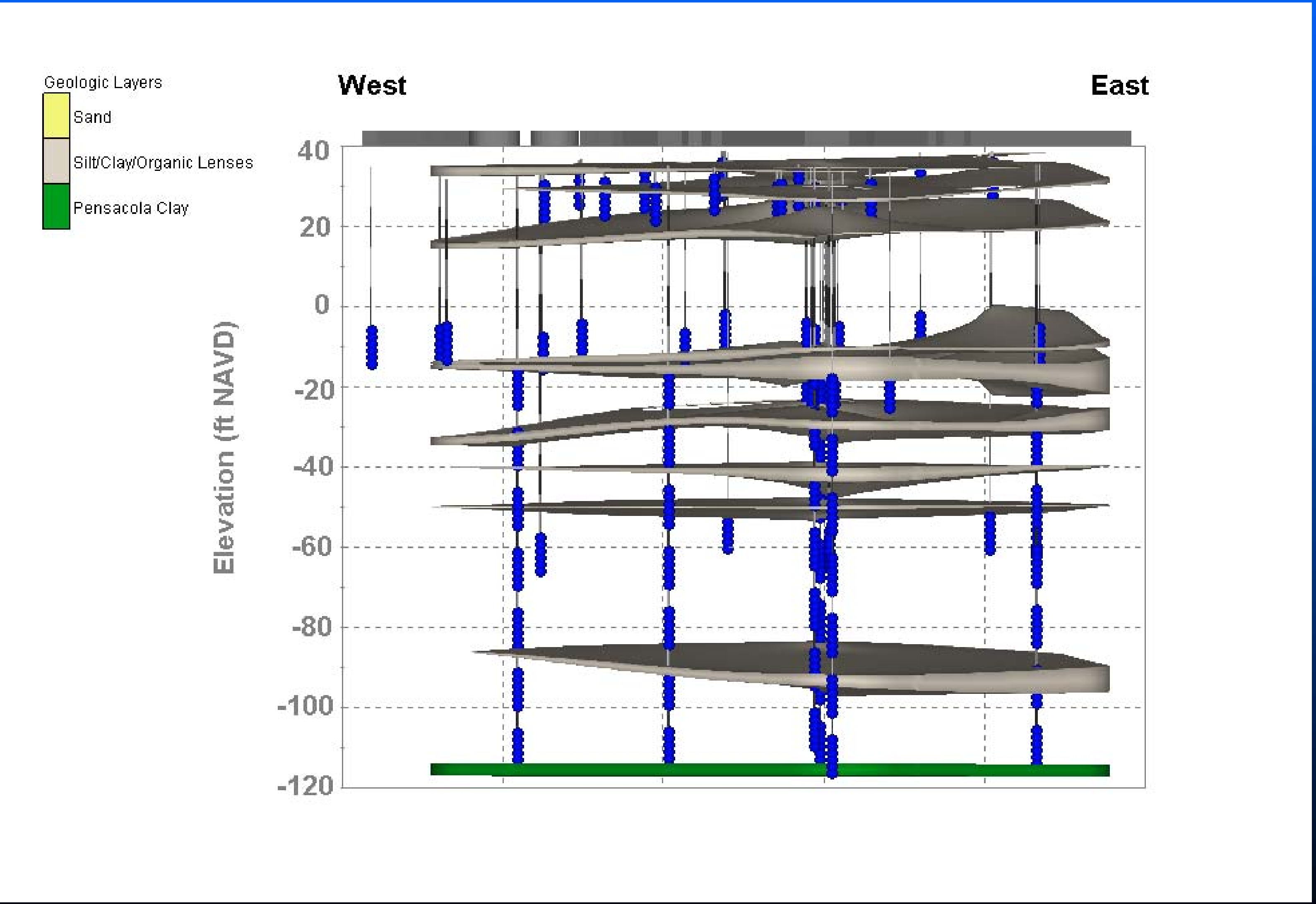
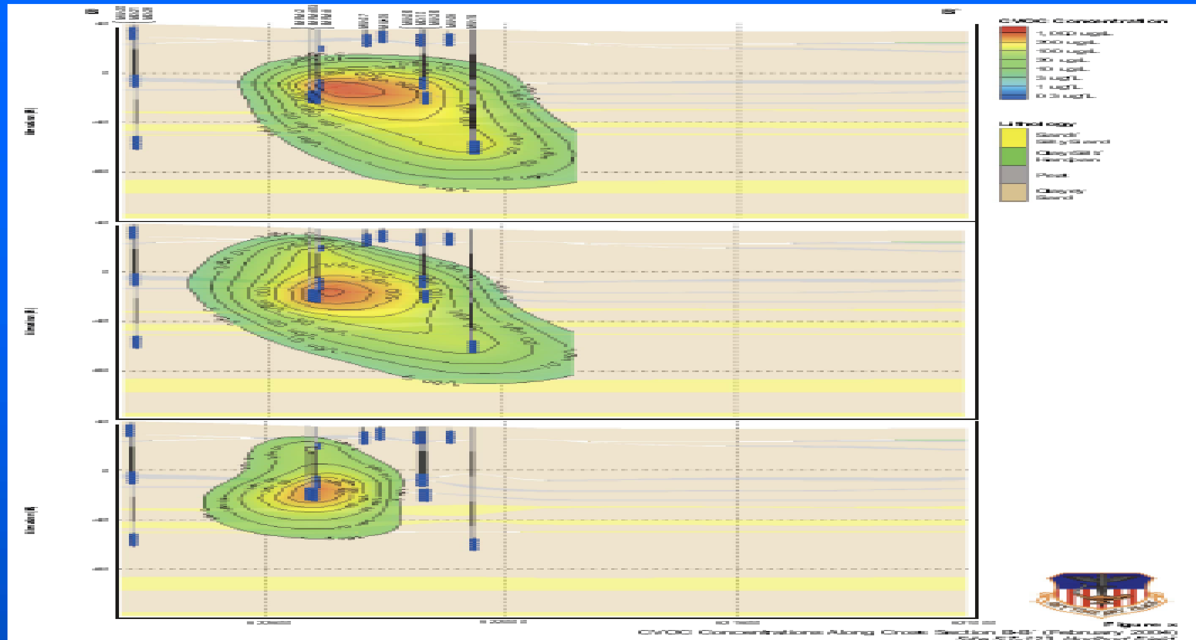
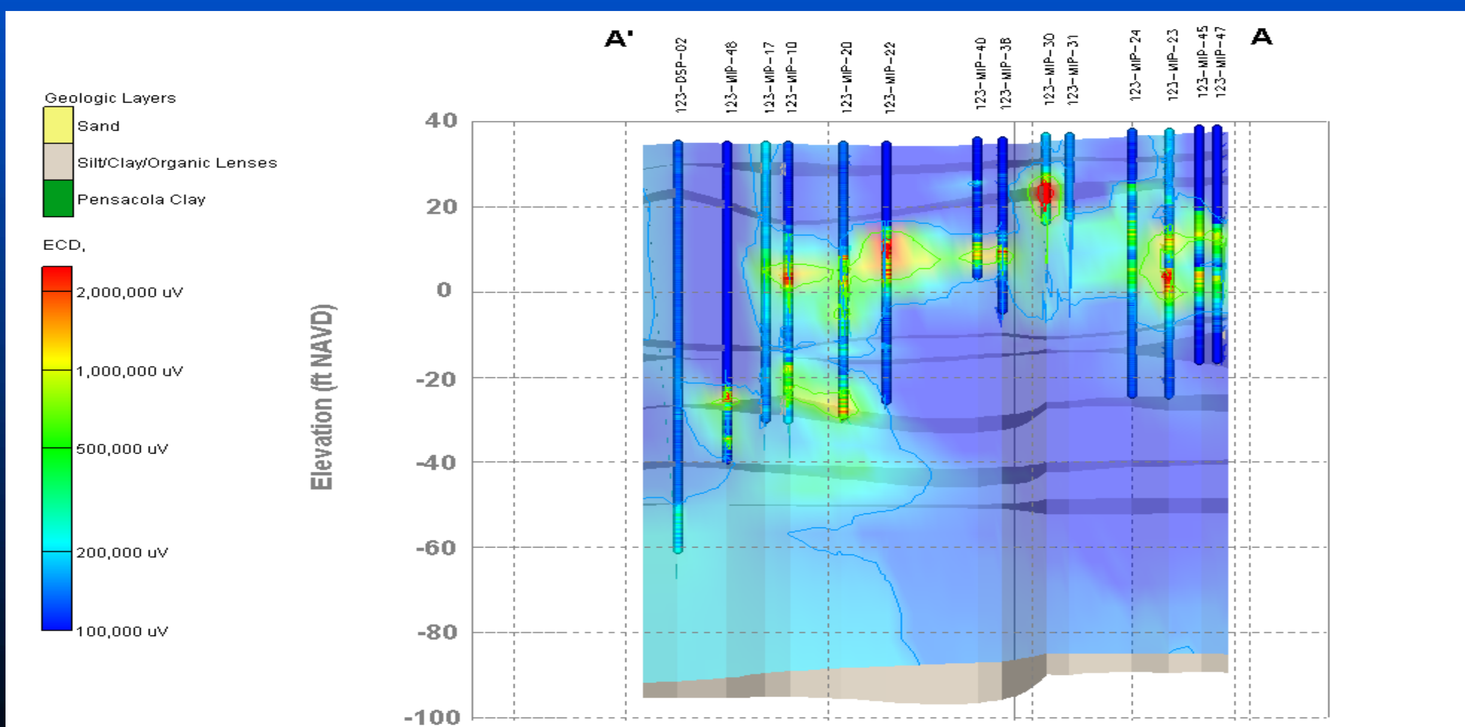
Post-Investigation Lithology



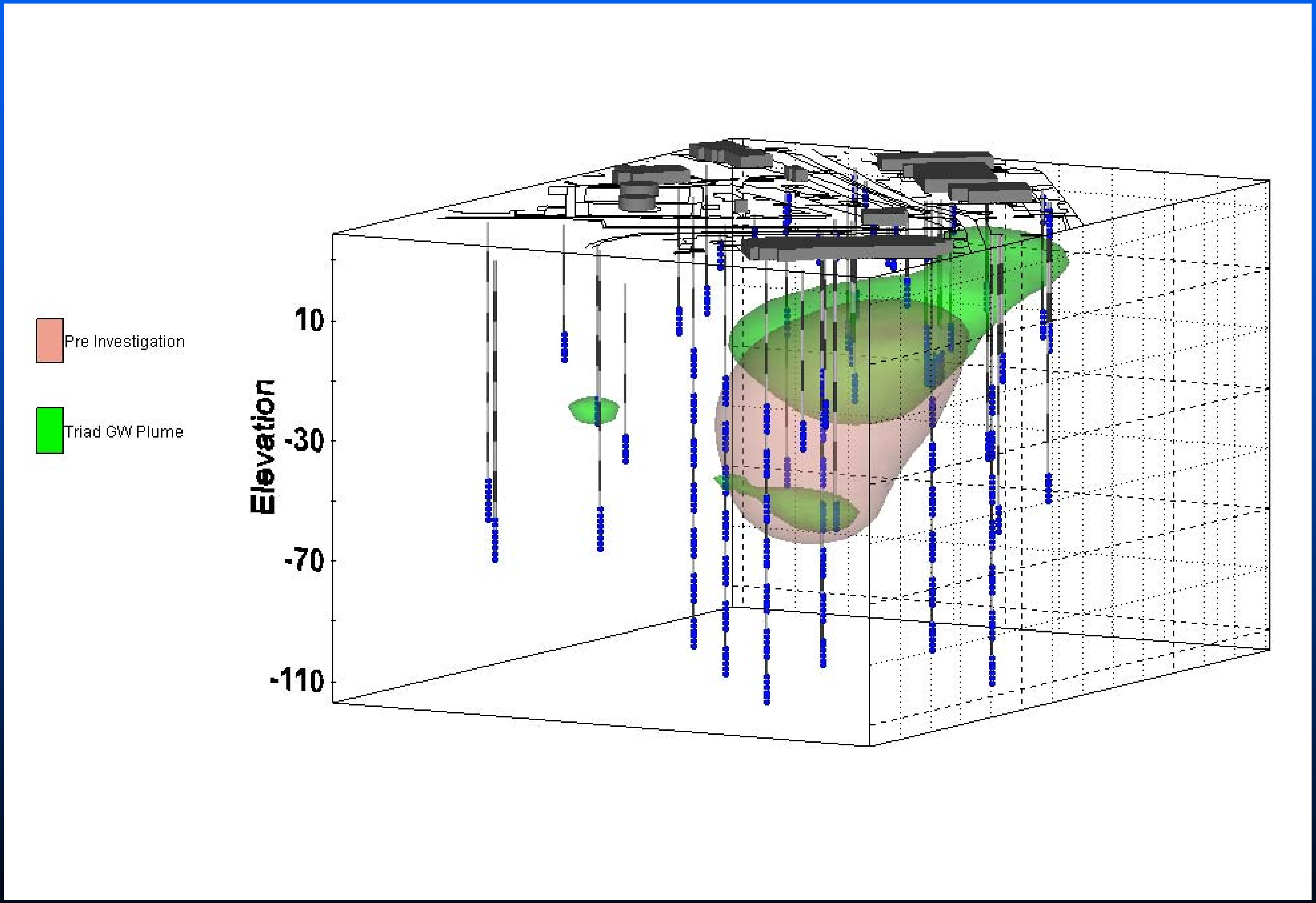




A'
A
123-DSP-02
123-MIP-48
123-MIP-17
123-MIP-10
123-MIP-20
123-MIP-22
123-MIP-40
123-MIP-38
123-MIP-30
123-MIP-31
123-MIP-24
123-MIP-23
123-MIP-45
123-MIP-47
Geologic Layers
Sand
Silt/Clay/Organic Lenses
Pensacola Clay
ECD,
2,000,000 uV
1,000,000 uV
500,000 uV
200,000 uV
100,000 uV
Elevation (ft NAVD)
40
20
0
-20
-40
-60
-80
-100

Comparison of Source Compounds in Groundwater (Pre- and Post-Triad Investigation)

Perspective View



ST-123 Results

- Identification of near-surface source area previously undiscovered
- Greater resolution of contaminant distribution within lithology sufficient for determining practicability of treatment technologies
- Sufficient information to proceed with Statement of Basis