# Optimizing the Site Investigation Process

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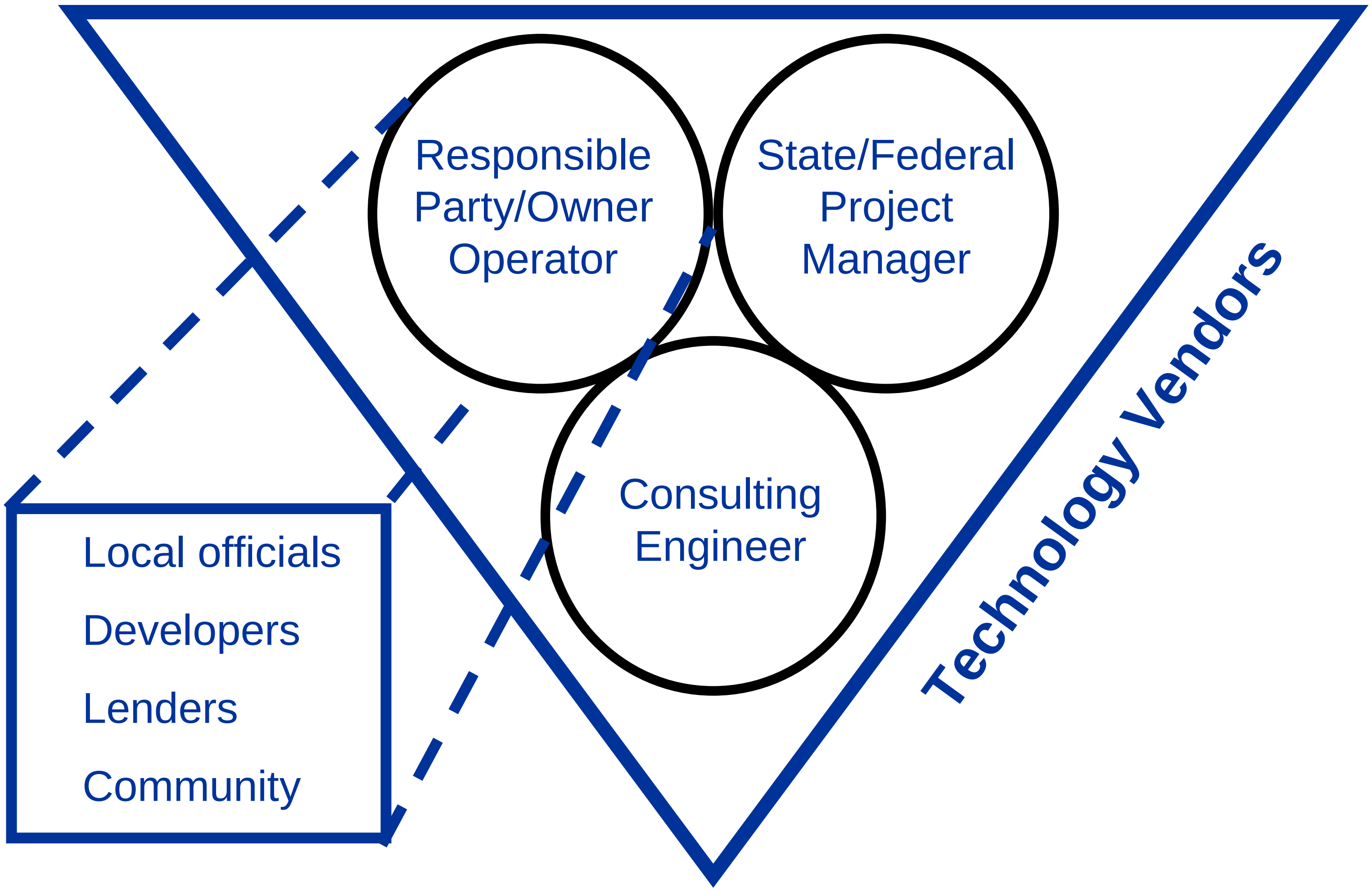
# Course Goal and Learning Objectives

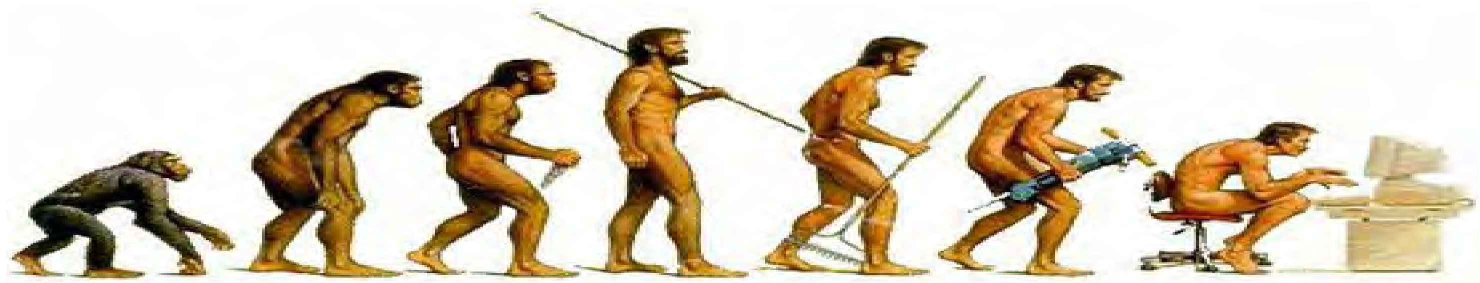
- Goal
  - Maximize investigation project effectiveness
- Learning Objectives
  - Best technical and business practices to streamline environmental cleanup
  - Improve confidence in decision-making, manage risk more effectively
  - Achieve cleanup goals faster and at less cost
  - Design and effectively implement dynamic work strategies (DWS) for all phases of project life cycle
  - Utilize real-time measurement tools, collaborative data sets, and adaptive strategies in characterization and remediation

# Target Audience



# Evolution of Optimization Concepts

- Optimization originally focused on long-term monitoring networks and Superfund site pump & treat systems
- Success spawned consideration of optimization concepts for other technologies and project phases
  - *Ex-situ* and *in-situ* technologies, IC/EC, combined remedies
  - IDR during design, investigation and remediation BMPs (i.e., Triad)
- Findings - significant cost/benefit improvements in remedy performance from better site characterization, conceptual site models and uncertainty management



# Office of Solid Waste and Emergency Response (OSWER)


- Develops standards and regulations for hazardous and non-hazardous waste (RCRA)
- Promotes resource conservation and recovery (RCRA)
- Cleans up contaminated property and prepares it for reuse (Brownfields, RCRA, Superfund, UST)
- Helps to prevent, plan for, and respond to emergencies (Oil spills, chemical releases, decontamination)
- Promotes innovative technologies to assess and clean up contaminated soil, sediment, and water at waste sites (Technology Innovation)

# Office of Superfund Remediation and Technology Innovation (OSRTI)

## Technology Innovation Field Services Division (TIFSD)

- OSRTI - implements and manages Superfund program
- TIFSD Core Mission:
  - Advancing best practices in site cleanup
  - Technology support to EPA Regional project managers, states, local governments, tribes
  - Informational support to cleanup community at large
- Primary activity areas to advance mission:
  - Evaluate and document innovative technologies
  - Transfer knowledge through publications, training, internet, etc.
  - Provide direct technical support at sites in Superfund, Brownfields, RCRA and UST
  - Manage analytical services for the Superfund program

# Presentation Overview

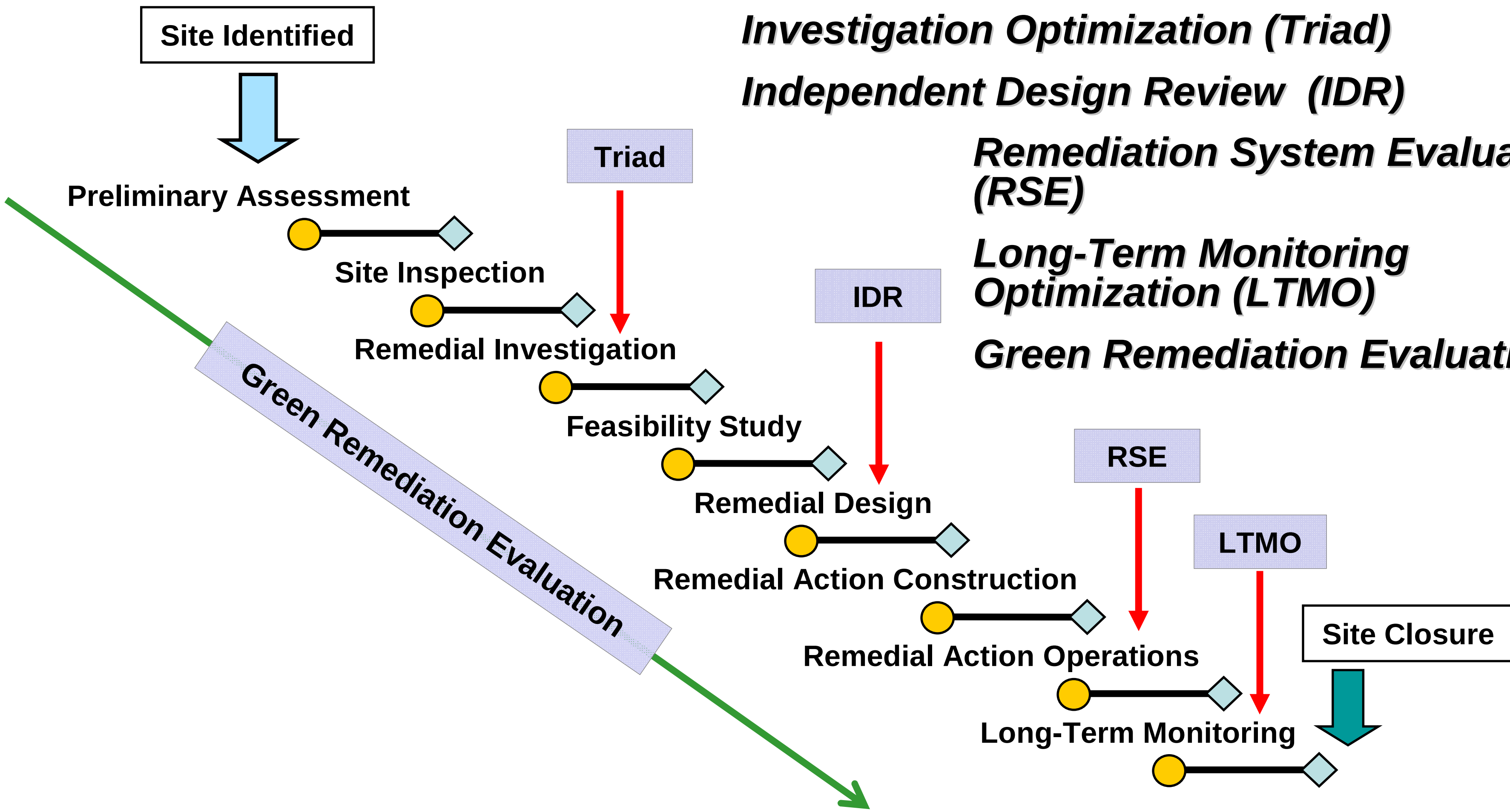
- Optimizing the Site Investigation Process
  - Definition and Business Case
- Primer and BMPs
- Treatment of Data in an Adaptive Environment
- Implications for Remedy Design and Implementation
- High Resolution Site Characterization
- Case Study
- Information Resources
- Questions
- Extra Information: Potential Application to EU Directives

# Definition and Business Case

# What is Investigation Optimization?

Comprehensive and systematic review of a site's past, current, and planned investigation activities; by a team of independent technical experts; to identify time savings, cost savings and ways to manage and reduce site uncertainty.

# Optimization Conducted in Every Phase of Cleanup Process




*Investigation Optimization (Triad)*

*Independent Design Review (IDR)*

*Remediation System Evaluation (RSE)*

*Long-Term Monitoring Optimization (LTMO)*

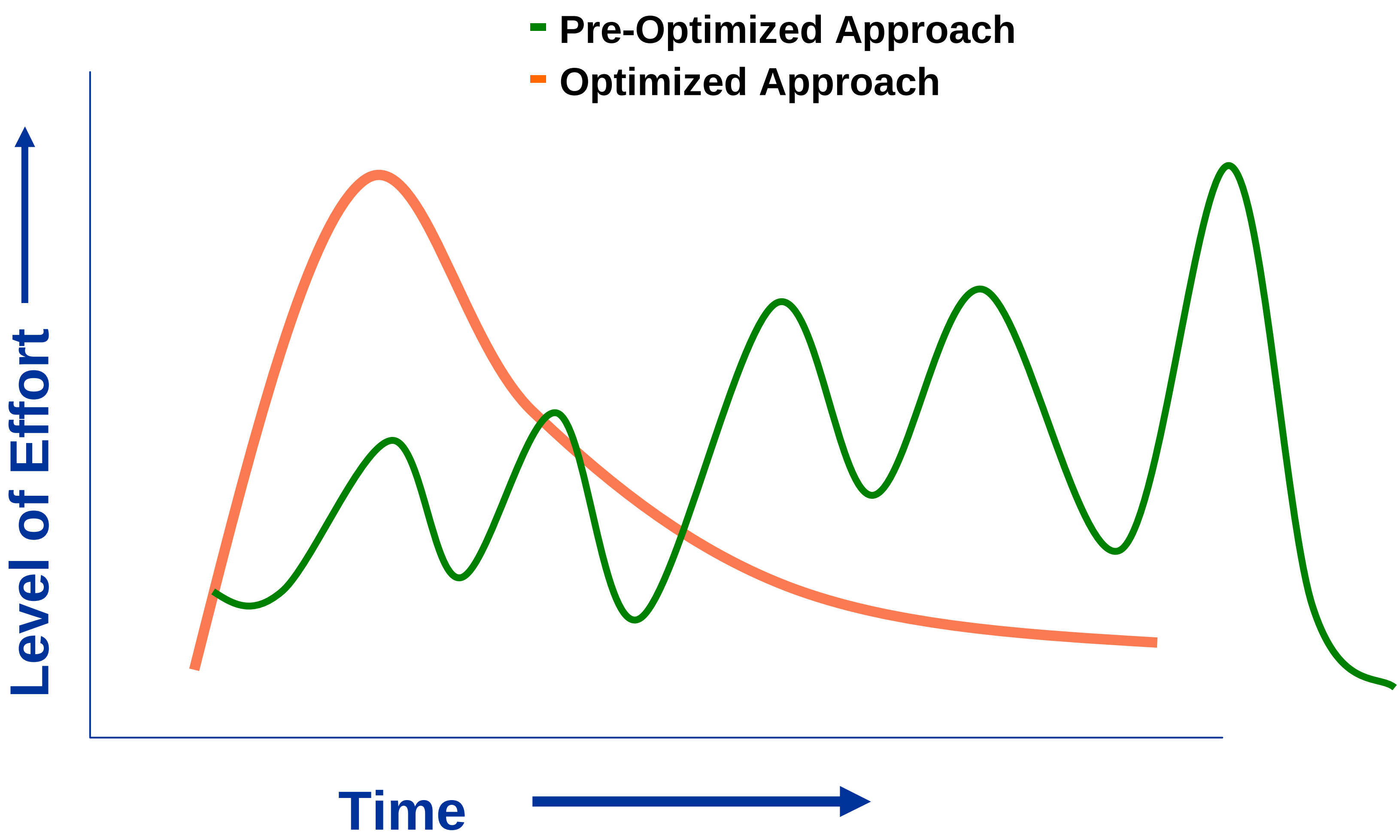
*Green Remediation Evaluation*

# Increasing Site Decision Confidence

| Analytical Uncertainty | Sampling Uncertainty | Site Decision Uncertainty | Resource Uncertainty |
|---|---|---|---|
| Methods? | Media? | Risk? | Funding? |
| Quantity? | Methods? | Action Levels? | Schedule? |
| Quality? | Location | Remedy? | Personnel? |
| Validation? | Distribution? | Stakeholder | Logistics? |
| Appropriate | Depth? | Acceptability? | Weather? |
| Use? | Purpose? | | |

Identify and prioritize uncertainty that needs to be actively managed

# Reducing Level of Effort / Time



# Examples of Actual Project Savings

| Project Name | Time Saved | Costs Saved |
|---|---|---|
| Cos Cob Brownfields Site | ~1 year | 35% |
| Private Radioactive Site | Not Determined | 50% on analytical |
| Fort Lewis Army Base | 1-2 years | 40-50% on analytical |
| Shaw Air Force Base | 1-2 years | $1.5 M |
| Vint Hill Army Base | 2 years | 50% |
| Camp Pendleton Marine Base | 3 years | $2.5M |

Sources: US Environmental Protection Agency and US Army Corps of Engineers.

# Triad BMPs Support Early Optimization Efforts

- Triad applicable to entire project life cycle but provides high value at site characterization stage
- Common finding of IDR, RSE and LTMO optimization efforts
  - Better site characterizations yield better remedial results
- Investigation optimization represents a merging of Triad and other optimization effort findings
  - Significant project benefit derived when applied earlier in the project life cycle

# Elements and Process

# Elements

- Investigation Optimization Practice
- BMPs for Adaptive Site Management
  - Systematic Planning
  - Life Cycle Conceptual Site Models (CSMs)
  - Dynamic Work Strategies
  - Real-time Measurement Technologies
  - Adaptive Work Plan Development
- Technical Assistance Services

# Investigation Optimization Practice

- Initiation
  - Identified as need during Superfund Five Year Review
  - As requested by project stakeholders
  - As otherwise programmatically triggered
- Assemble Optimization Team
- Discovery
- Review
- Recommendations

# Assemble Optimization Team

- Team Leader
- Common areas of primary team expertise
  - Geosciences
  - Chemistry
  - Engineering
- Potential areas of support team expertise
  - Risk assessment
  - Biology
  - Data management
  - Quality Assurance
  - Specialty technology vendors

# Discovery

- Historical site investigation workplans and reports
- Conceptual site model (CSM)
- Geologic, hydrogeologic, hydrologic and analytical data sets
- Data evaluation, management and communications plan and systems
- Regulatory information
  – e.g. agency contacts, relevant guidance, ARARs, PRP information
- Contractual / scope of work documentation
- Historical project cost information
- Other project documentation of site-specific significance
  – e.g., Regulatory review comments, responses, etc.

# Review – Documents and Data

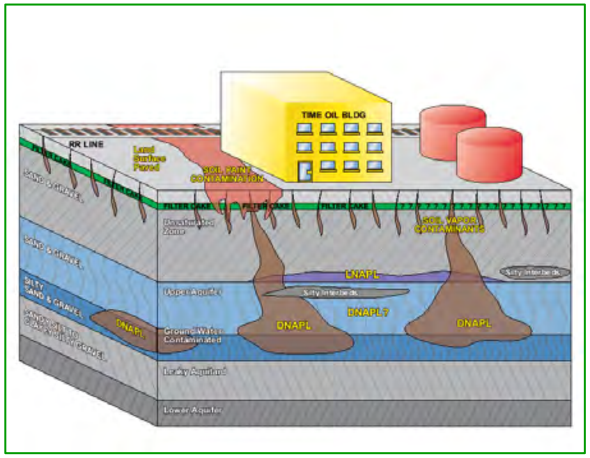
- Does a CSM exist?  Is it comprehensive?
- Are data of acceptable type and quality?
- Are data scale-appropriate relative to heterogeneity and unique physiochemical attributes?
- Have all media been considered?
- Have all contaminants of concern been identified?
- Are all receptors identified?
- Have all exposure pathways been identified?
- Are risks characterized and quantified?
- What other data gaps exist in any of the above?
- Can existing project documentation effectively support decision-making?

# Review - Team Interview

- What are your program / site objectives?
- Who are key project stakeholders? What are their goals?
- What is the nature and status of stakeholder relations?
- Is there consensus on exit strategy and site conditions?
- What are your current critical path obstacles to getting key site decisions made?
- What are your primary site uncertainties?
- How confident are you that the site is fully characterized and the CSM is complete?
- What are your resource and schedule constraints?

# Recommendations

- Create / improve CSM using existing data
- Design investigations based on data gaps and uncertainty management
- Use high resolution site characterization methods to fully characterize site
- Use dynamic work strategies for field efforts
- Leverage real-time measurement technologies
- Collect collaborative data to support risk assessment, remedy selection, and design
- Communicate and maintain consensus using 3-D visualization technologies
- Promote meaningful community engagement
- Reduce environmental footprint of activities



# Challenges

- Resistance to change / perceived intervention
- Inertia of process indifferent to results
- Lack of technical expertise and resources
- Lack of stakeholder consensus
- Costs of recommendations must be less than cleanup

# BMP: Engaging Stakeholders

# Gaining Stakeholder Acceptance

- Ensure Stakeholders have basic best practice knowledge
- Understand current regulatory guidance
- Identify specific obstacles to acceptance
  - Perceived vs. actual
- Develop relationships with advocates
- Meet to present proposal to use best practices
  - Provide primer on best practices
  - Demonstrate technical method applicability
  - Show sensitivity/present solutions to constraints
- Secure and document commitments to participate

# Sustaining Stakeholder Participation

- Follow through with strong systematic planning effort/partnering ethic
- Agree to project communications plan
  - On-site versus remote project decision making team
  - Frequency and type of communication keyed to data/decisions
  - Meetings or conference calls supported with Web-conferencing
  - Project websites for key data/document sharing
- Establish trust through delivering on commitments
- Deal with issues objectively, clearly, and with respect
- Use the CSM as the basis for establishing and documenting agreement on decisions

# BMP: Systematic Planning

A process for building a consensus vision for conducting environmental investigation and remediation

# Unique Aspects of Systematic Planning

- Preliminary CSM developed prior to / updated during planning
- Updated “Baseline” CSM is used to develop:
  - Project and data quality objectives; based on data gaps
  - Detailed outline of a dynamic work strategy (DWS)
- Stakeholder concerns and specific decision criteria are identified and integrated into work plans
- Critical decisions and decision-making processes pre-defined

(continued)

# Unique Aspects of Systematic Planning

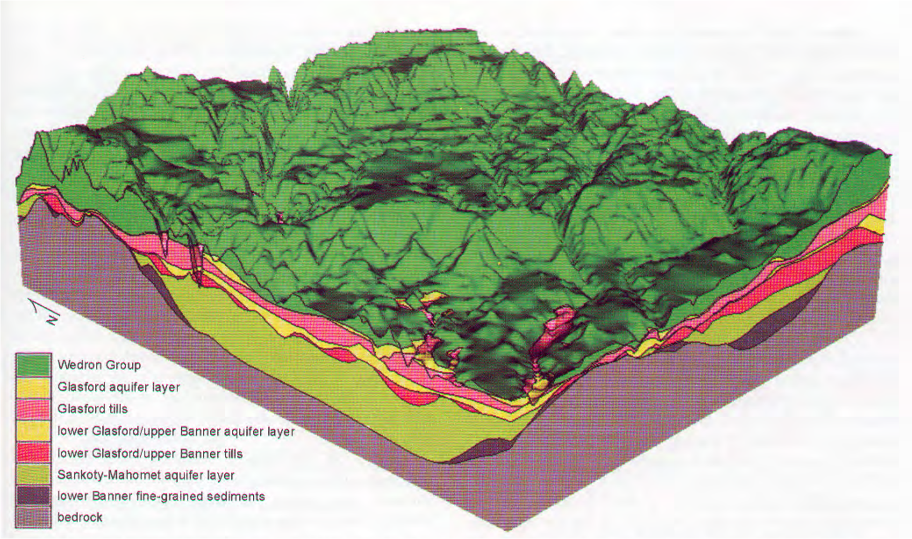
- Critical decisions and decision-making processes pre-defined
- Acceptable levels of uncertainty identified and quantified
- Real-time technologies are identified and agreed to
  - Demonstrations of method applicability (DMA) needs identified
- QA/QC requirements are identified, clearly stated and agreed to
- Planning efforts consider reuse, performance metrics, exit strategies, and non-technical uncertainties

# Systematic Planning Meeting Activities

- Introduction and consensus on primary project goals, authority, and lines of communication
- Identify key site decisions and decision-making processes, decision logics, rules, etc.
- Create a Baseline CSM based on refinement of a Preliminary CSM
- Identify key data gaps and areas of uncertainty
- Identify real-time technologies to collect data
- Develop detailed outline for DWS
- Evaluate exit strategies, contingencies, and performance metrics

# BMP: CSM

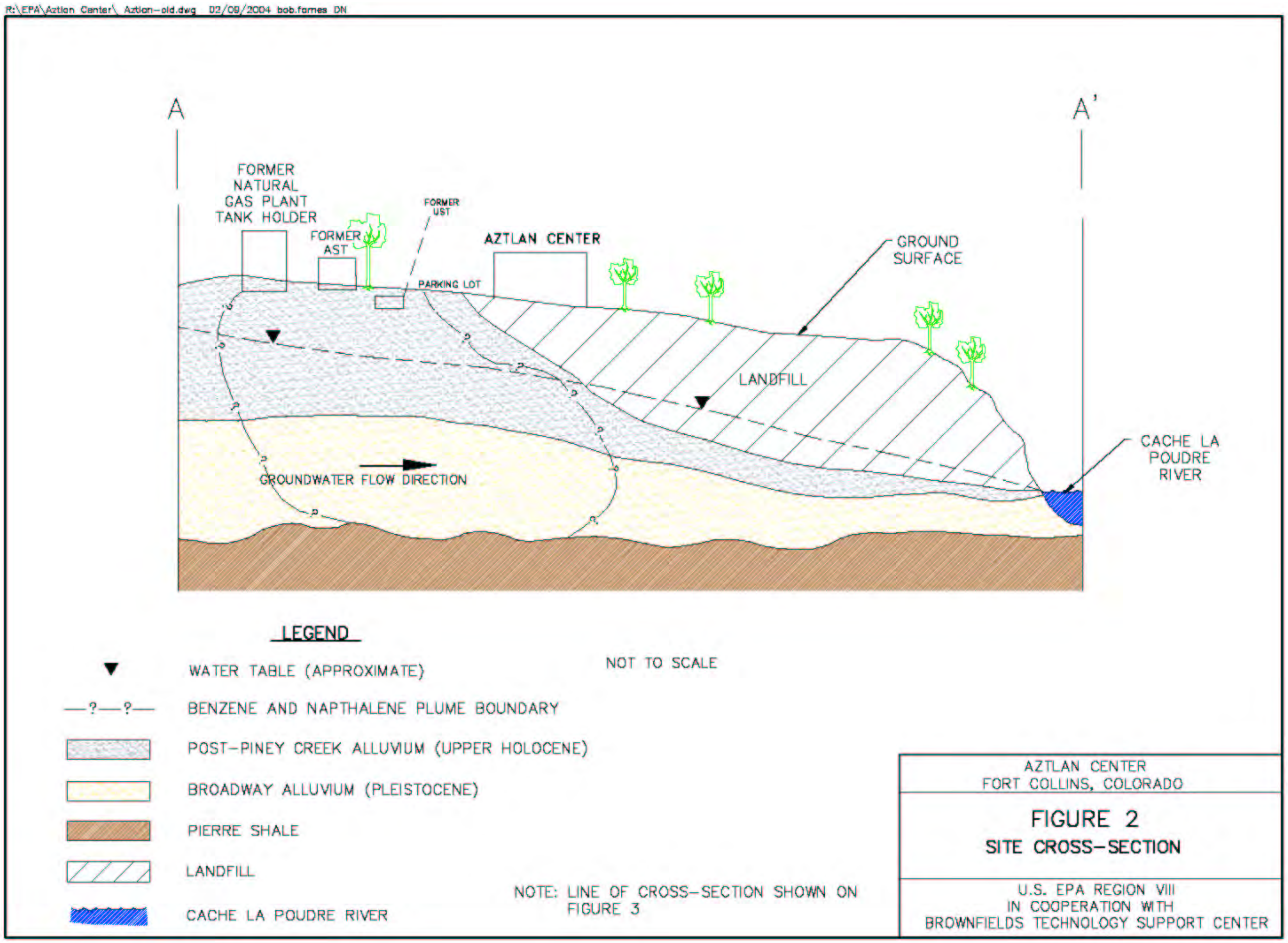
- Written and graphical expression of site knowledge
- Primary basis for project design and execution
- Updated throughout project life cycle
- Not **unique** but . . . ***essential*** to successful projects.



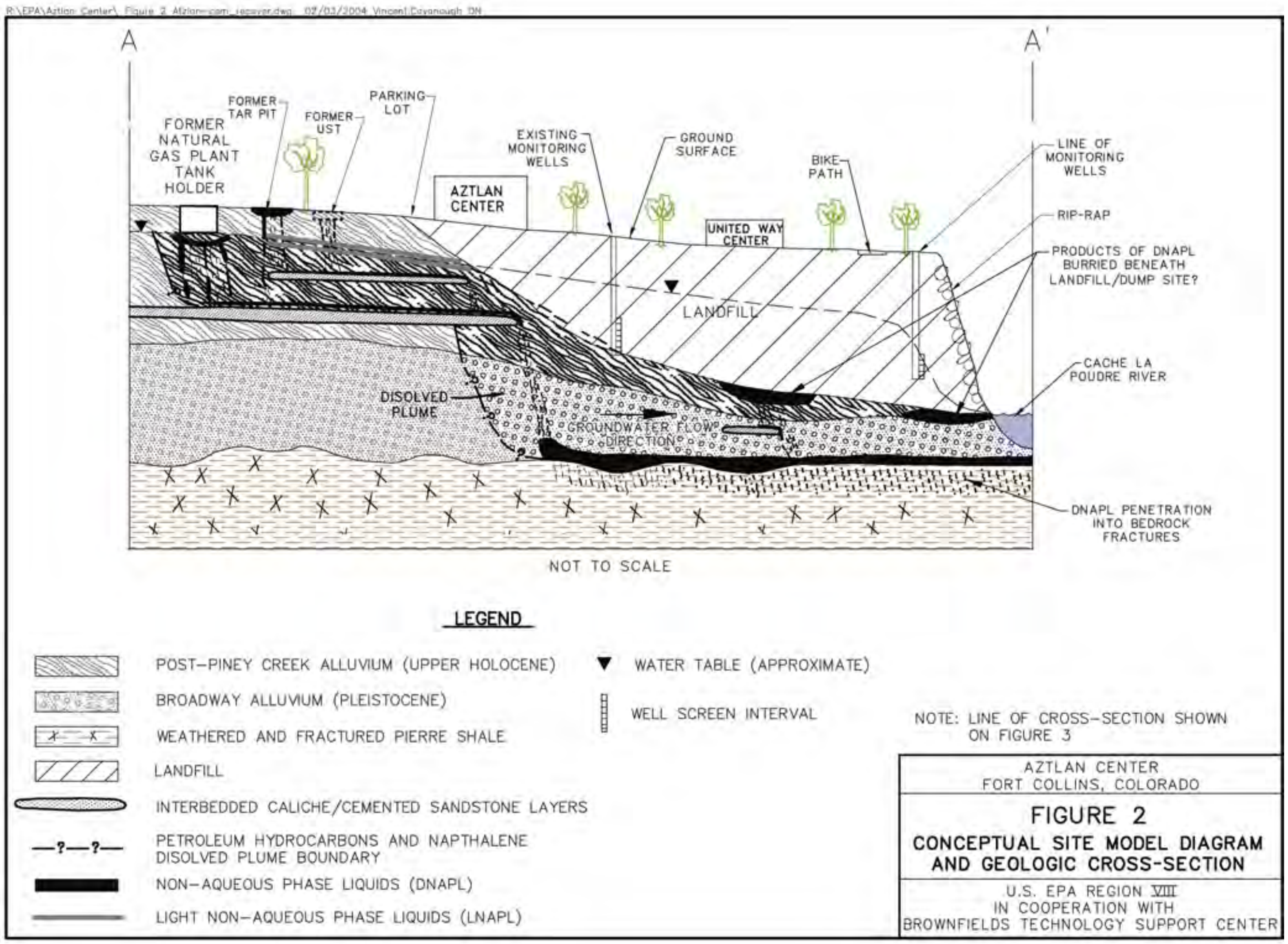
# Life Cycle CSM Supports Project Phases

- Preliminary CSM
  - Developed prior to systematic planning
- Baseline CSM
  - Product of systematic planning; documents stakeholder consensus
- Characterization CSM Stage
  - Used to guide investigation efforts and support decision-making
- Design CSM Stage
  - Used to support basis for remedy design
- Remediation/Mitigation CSM Stage
  - Used to guide efforts, meet objectives and support optimization
- Post Remedy(s) CSM Stage
  - Documents attainment of remediation objectives and goals

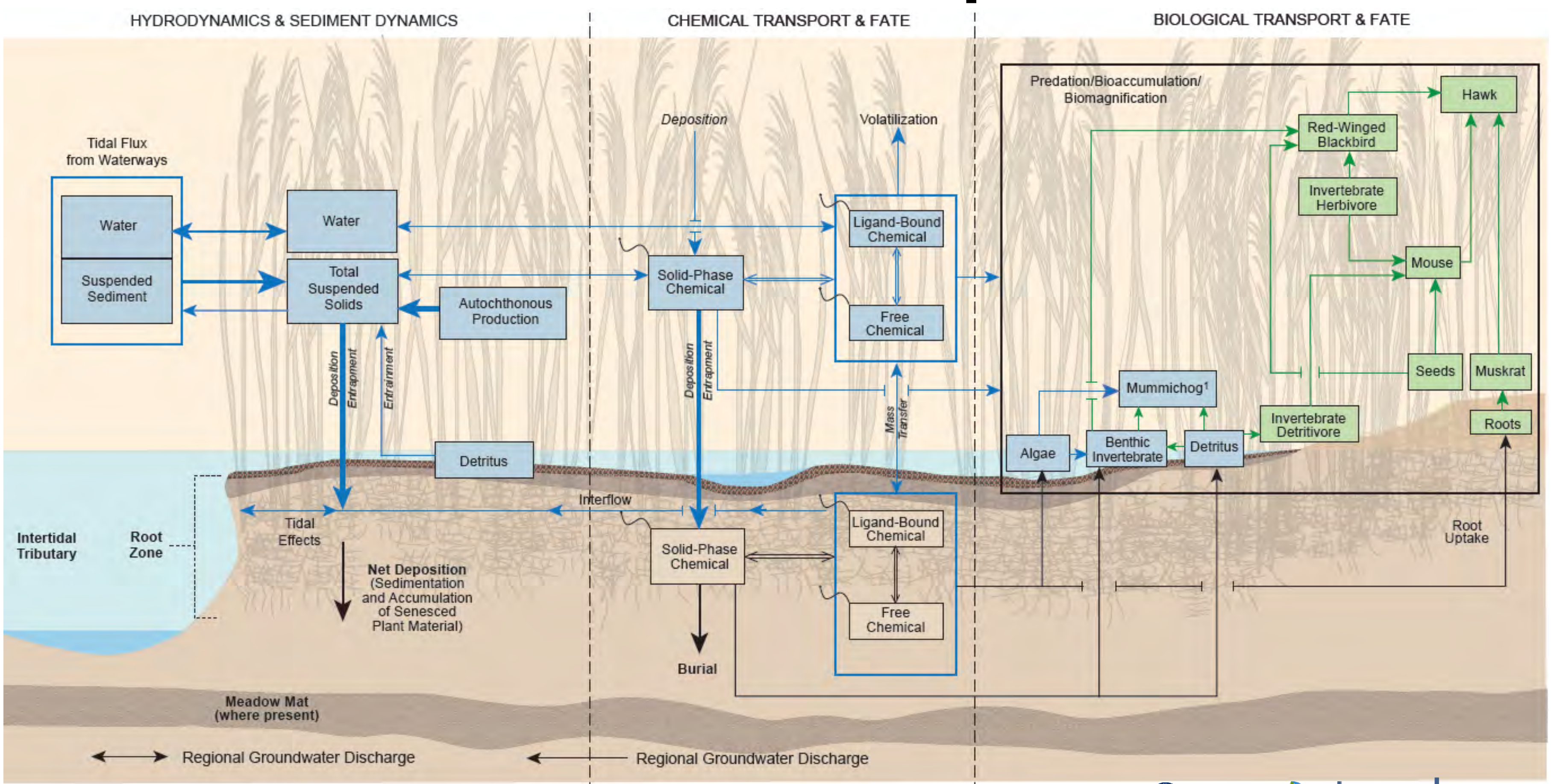
# Example Baseline CSM



# Example Characterization Stage CSM – Nature and Extent

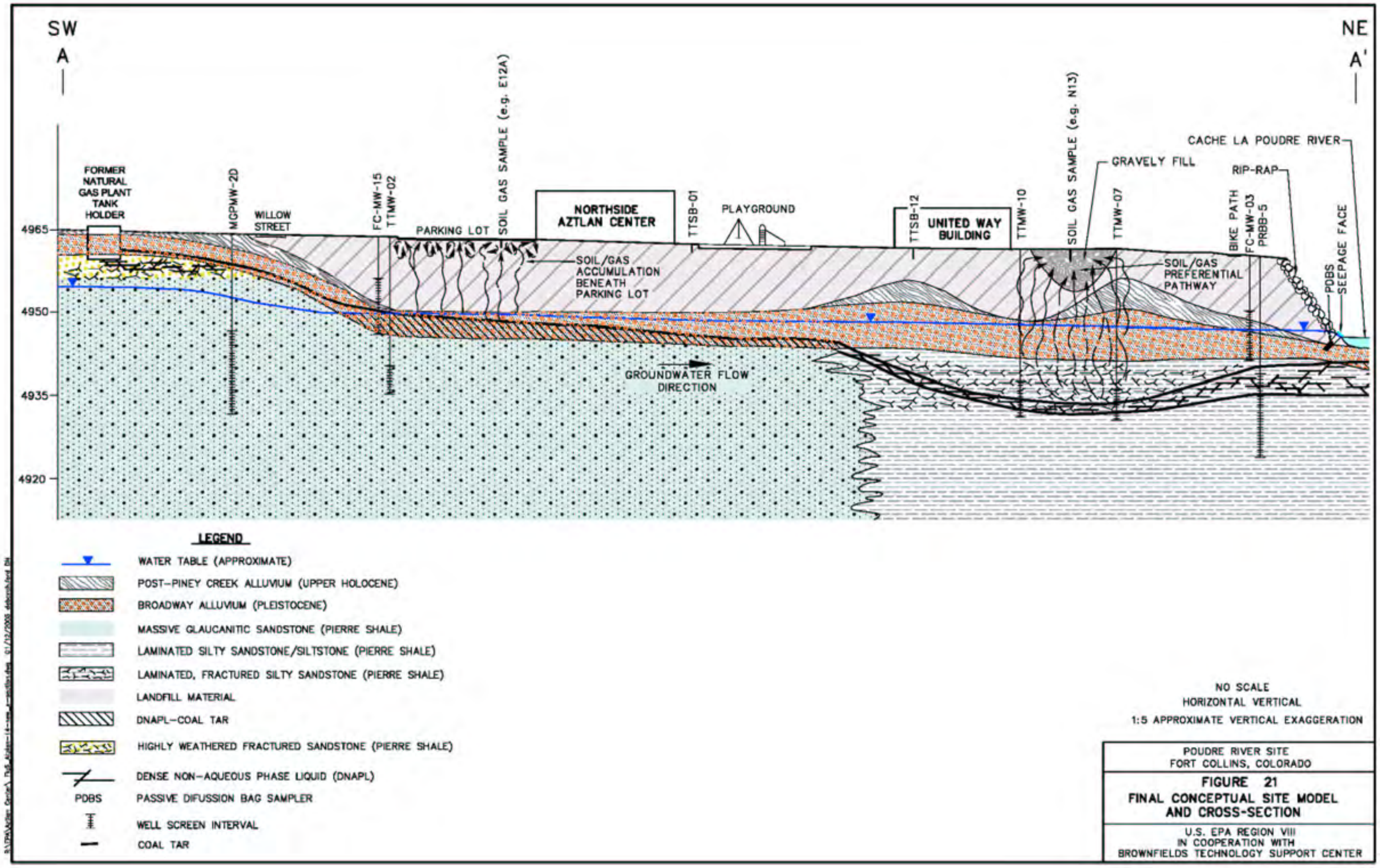


# Example Characterization Stage CSM – Fate and Transport

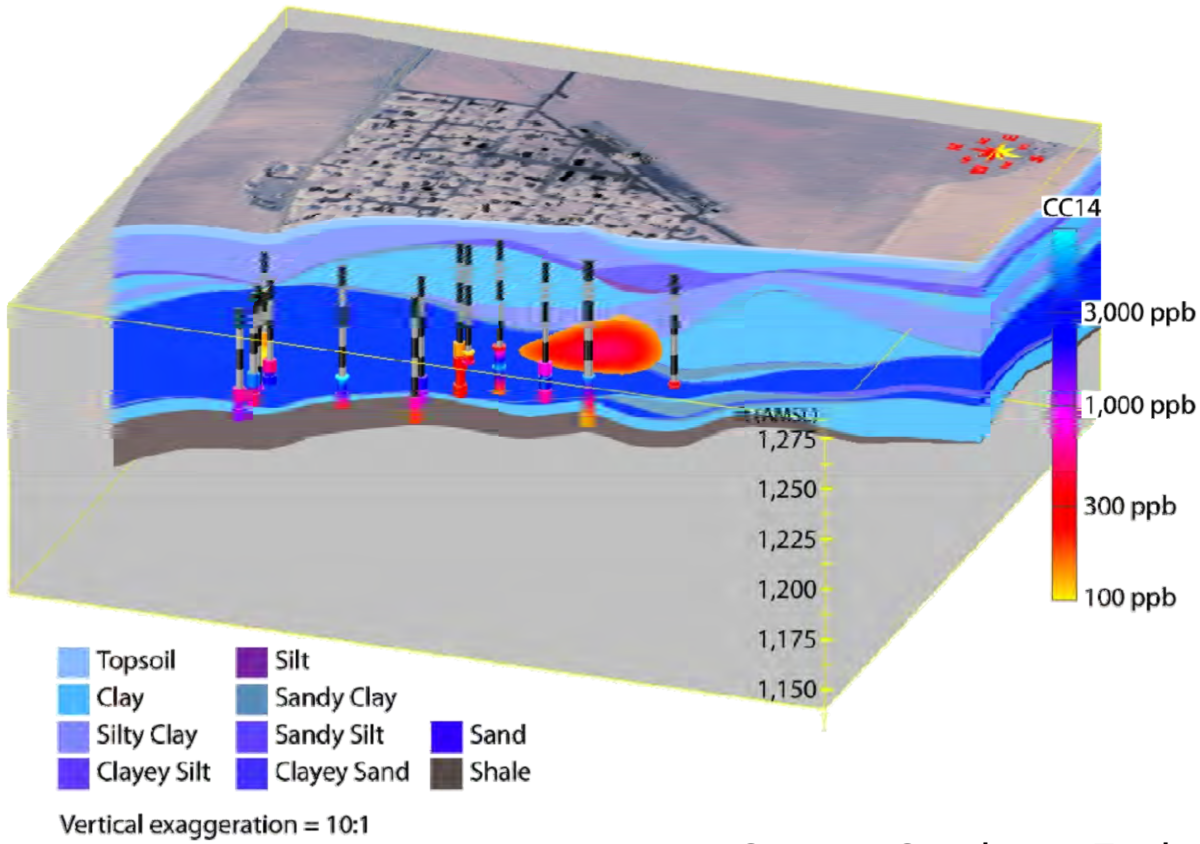



Source: Geosyntec consultants, integral consulting inc.

# Example Design Stage CSM



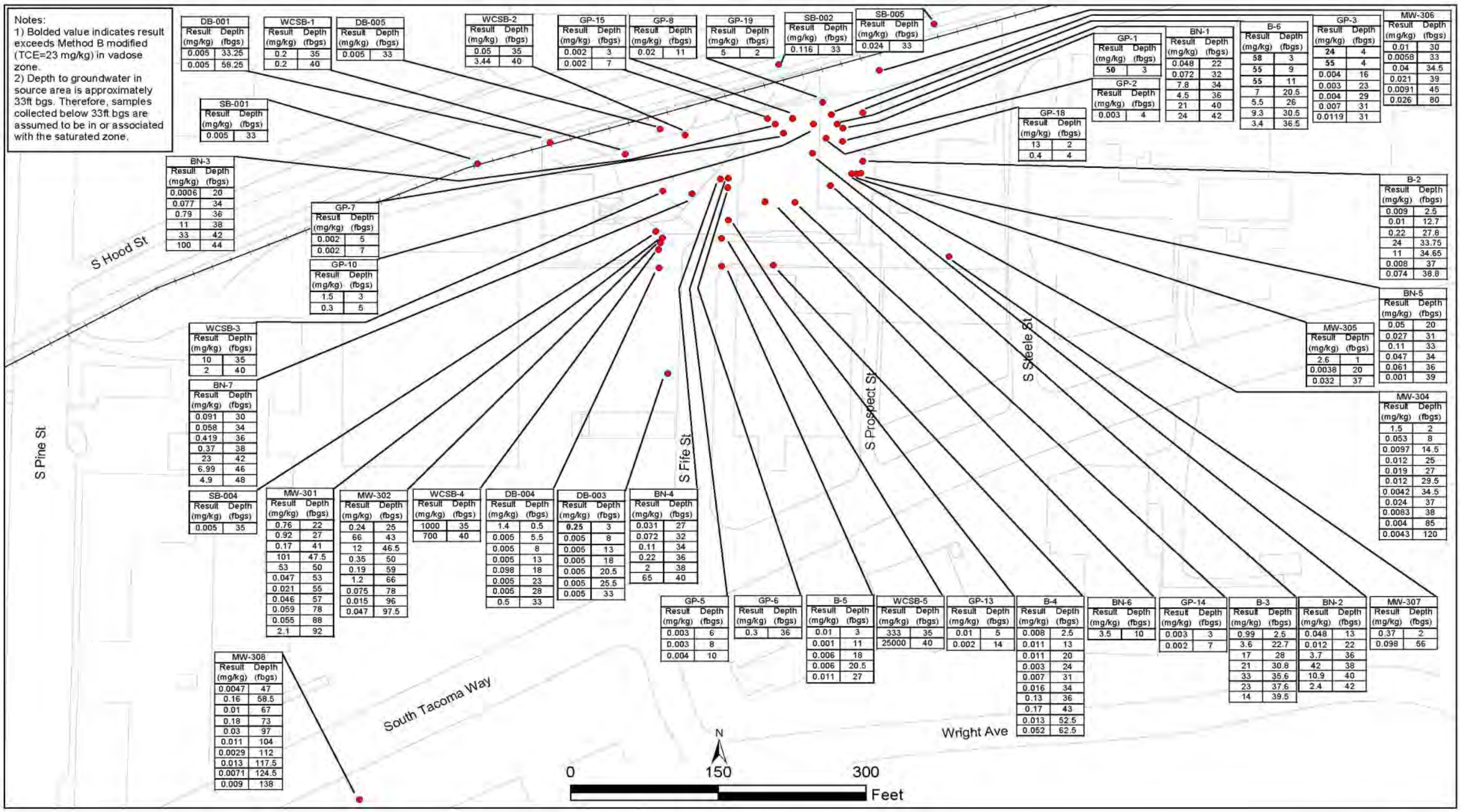
# Emerging CSMs: 3-D Visualization and 4-D Visualization Over Time




Source: Sundance Environmental & Energy

# Key CSM Paradigm

*Are You Effectively Using Data or Confusing With Data?*




Well 12A Superfund Site
Tacoma, Washington

Figure 2-6
Trichloroethylene in Soil

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# Treatment of Data in an Adaptive Environment

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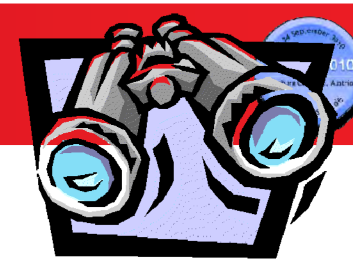
# Demonstration of Method Applicability

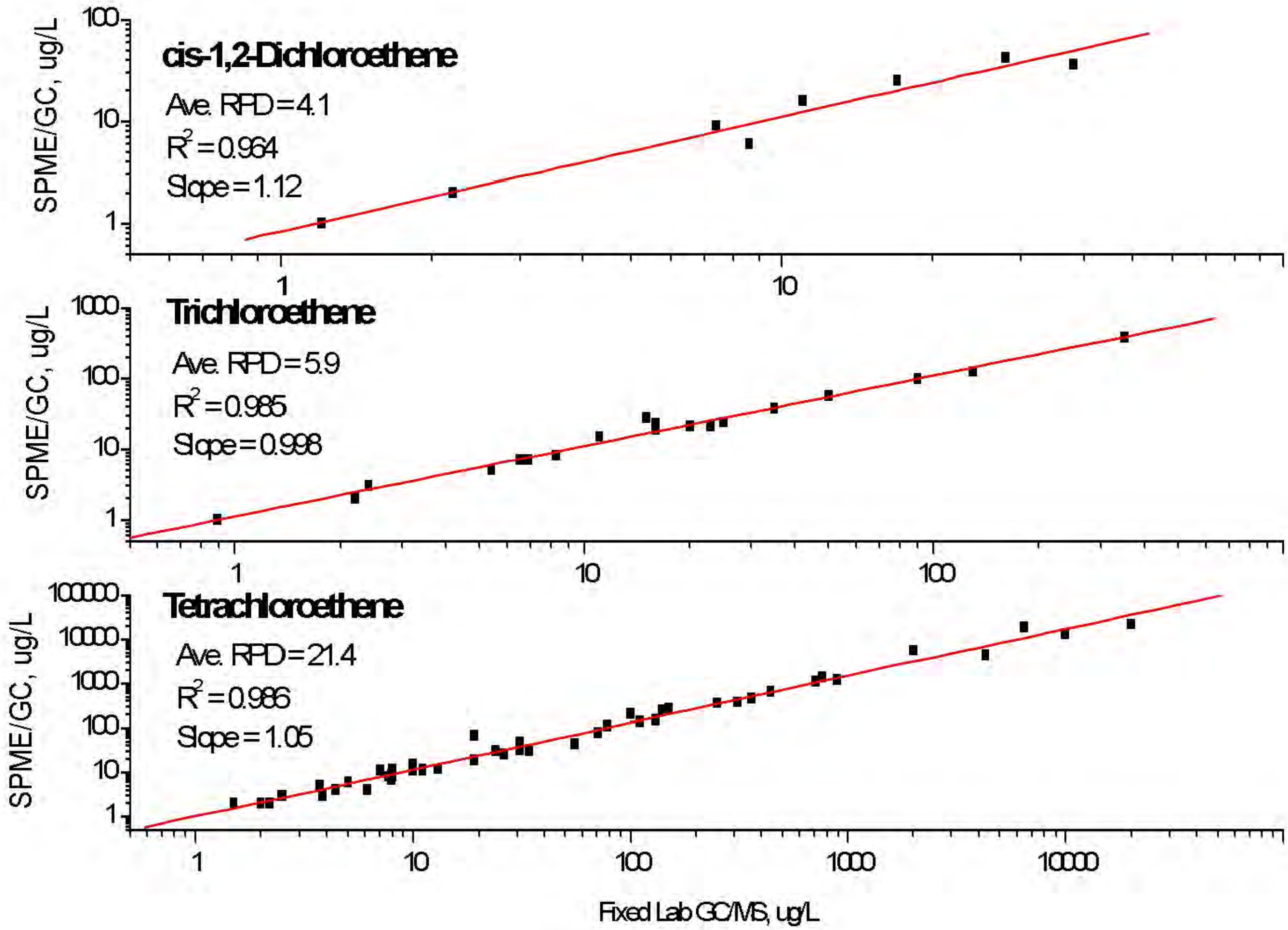
- Initial site-specific technology performance evaluation
  - Direct sensing methods and field-generated data systems
  - Sample design, collection techniques, preparation strategies
- Goal → establish that proposed technologies and strategies can provide information appropriate to meet project decision criteria
- Reasons to conduct DMA
  - Greatest sources of uncertainty usually sample heterogeneity and spatial variability
  - Relationships with established laboratory methods often required to make defensible decisions
  - Highlights laboratory and field method advantages/challenges



# What to Look For in a DMA

- Effectiveness – Does it work as advertised?
- QA/QC issues
  - Are Detection and Reporting Limits for site matrices sufficient?
  - What is the expected variability? Precision?
  - Bias, false positives/false negatives?
  - How does sample support effect results?
  - Develop initial relationships of collaborative data sets that provide framework of preliminary QC program
- Matrix issues?
- Do collaborative data sets lead to the same decision?
- Assessing alternative strategies as contingencies

# Case Example: DMA for use of Onsite versus Fixed-Based Laboratory



# Collaborative Data Sets Address Analytical and Sampling Uncertainties

| Cheaper/rapid | Costlier/rigorous |
|---|---|
| Field-based analytical and screening methods | Laboratory analytical methods |
| ↓ | ↓ |
| Targeted high density sampling | Low DL + analyte specificity |
| ↓ | ↓ |
| Manages CSM and sampling uncertainty | Manages analytical uncertainty |

**Collaborative Data Sets**

# Confirming Collaborative Data Sets

- Collaborative data sets are powerful!!
- Multiple lines of evidence = "weight of evidence"
- Collaborative data sets go beyond simple lines of evidence
  - One method provides information for when another is required or beneficial
- Control multiple error sources
  - Sampling design, matrix, prep, analytical, etc.
- Result:  increased confidence in the CSM; better decisions, better remedy implementation

# BMP: Dynamic Work Strategy

A work strategy that incorporates the flexibility to adapt to information generated by real-time measurement technologies

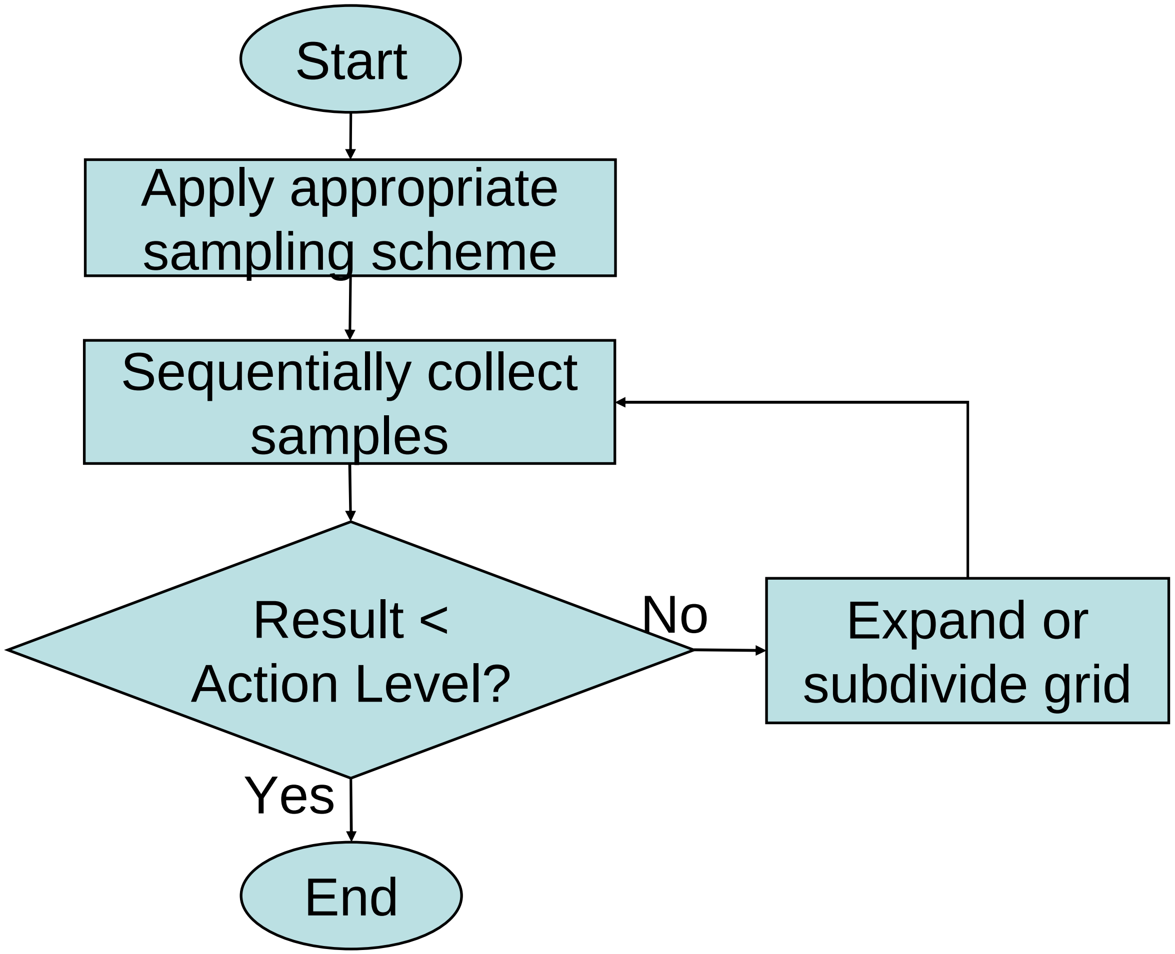
# Elements of a Dynamic Work Strategy

- Baseline CSM and identified data gaps
- Project goals, data quality objectives (DQOs), action levels and decision criteria
- Demonstrations of Method Applicability (DMA)
- Real-time measurement technologies / collaborative data design
- Adaptive sampling and analytical approach
- Decision logic diagrams / decision support tools (DSTs)
- Project schedule and activity sequencing
- Data management, assessment, visualization, and communication plan
- Stakeholder meetings, roles, and responsibilities
- Health and safety/site logistics

# How can Adaptive Work Plans Be Streamlined?

- Easy to understand and use in the field
- Efficiently targets uncertainties
- Focuses QA/QC where most needed
- Expedites review, revision and approval process
- Reduces development cost and time
- Reduced document production supports “green” initiatives

# Decision Logic Diagram for Delineation



# Sequencing Resources Example

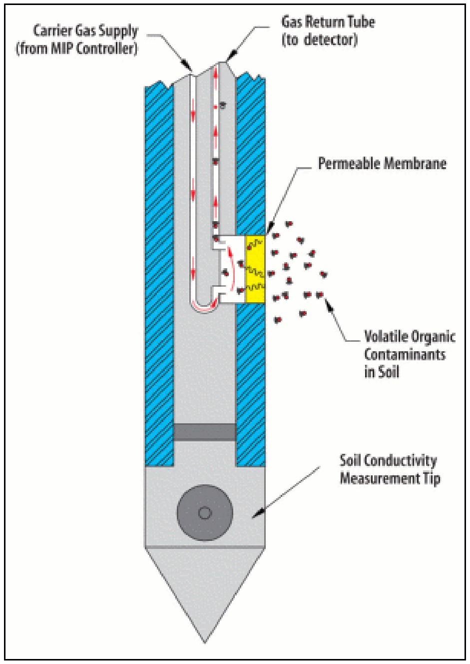
- Mobile laboratory throughput estimated at 30-50 water or 15-20 soil samples/day
- Field crews can collect average of 20 subsurface samples/day (5 locations, 4 samples per hole)
  - Resources allow 50 locations and 7 days mobile laboratory
- <u>Days 1 to 3</u> – field team stakes initial 15 locations based on CSM and collects 60 subsurface samples
- <u>Days 1 to 2</u> – mobile laboratory crew and equipment on-site, co2nduct QC activities and setup
- <u>Day __</u> – laboratory is ready to run with first day backlog (20 samples)
- <u>Days 3 to 8</u> – location results in real-time, summarized daily, DWS de9rives next 25-35 locations.
- <u>Day __</u> – All crews demobilization, laboratory provides final summary data package

# BMP - Real-Time Measurement Technologies

Real-time = within
a time frame that allows
the project team to react
to the information while
in the field

# Real-Time Measurement Technologies

- Direct sensing technologies
- Field-generated data systems




# Direct Sensing Technologies

Tools that provide instantaneous data.

| Technology | Matrices | Data Provided |
|---|---|---|
| UV methods (UVF, UV lamp) | Water, soil | TPH, PAH, and DNAPL |
| Geophysical tools – surface | Soil, fill, bedrock | Sources, pathways, macro-stratigraphy, and buried objects |
| XRF (screening mode) | Soils, material surfaces | Metals |
| MIP (EC, PID, FID, ECD, XSD) | Soil, water | VOCs, hydrocarbons, and DNAPL |
| Neutron Gamma Monitors | Soil, water, material surfaces | Radiation |
| Hydraulic conductivity profilers | Soil, water | Hydraulic conductivity, lithology |
| Geophysics – downhole (natural gamma ray, self potential, resistivity, induction, porosity/density, and caliper) | Soil, fill, bedrock | Lithology, groundwater flow, structure, permeability, porosity, and water quality |
| CPT, high-resolution piezocone | Soil, water | Lithology, groundwater flow |

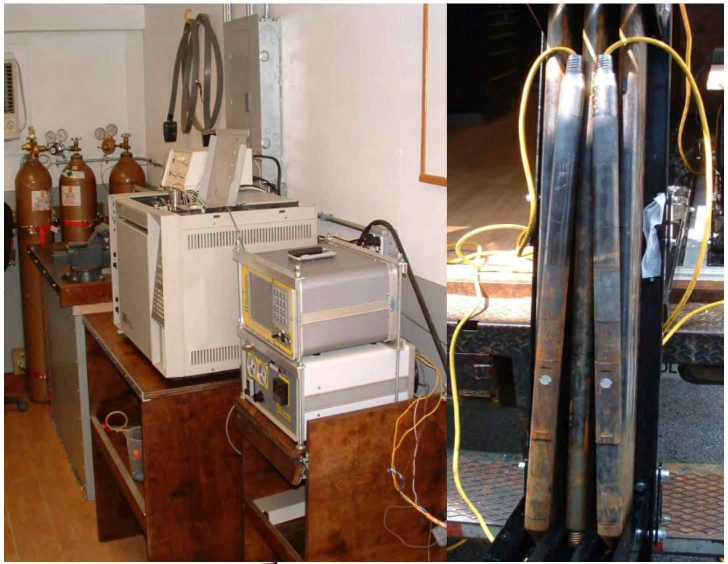
# Field-Generated Data Systems

Technologies that require various lengths of time to produce end data.

| Technology | Matrices | Data Provided |
|---|---|---|
| Direct push samplers | Water, soil, active soil gas | Sample, physio-visual data |
| Field-XRF analyzer (bench-top) | Soil, sediments, material surfaces | Metals |
| Immunoassay test kits | Water, soil, material surfaces | SVOCs, PCBs, pesticides, and Dioxins/Furans |
| Miscellaneous colorimetric kits | Water, air | Water quality, hazardous vapor |
| Mobile laboratory – definitive | Water, soil | VOCs, SVOCs, pesticides, PCBs, explosives, metals, and wet chemistry |
| Field GC and GC/MS – screening | Water, soil | VOCs, SVOCs, pesticides, PCBs, and explosives |
| Passive diffusion samplers | Water, soil gas | VOCs, SVOCs, and contaminant flux |
| Permeameter | Soil | Hydraulic conductivity |
| Conventional drilling | Water, soil, bedrock | Physio-visual data, multiple constituents |

# Case Example – Real-Time Membrane Interface Probe (MIP)

- MIP Use
  - Relative VOC concentrations
  - Vadose and saturated zones
  - Locate source areas/plume cores
- Strengths
  - Vertically continuous measurement
  - Real-time soil EC log
  - Real-time VOC distributions log
  - ~ 150 to 200 linear feet/day
- Limitations
  - Sensitive instrumentation/limited depth of penetration
  - Units of concentration do not directly correlate to soil or groundwater concentrations
  - System does not identify/distinguish between analytes
  - VOCs can be speciated with onsite GC



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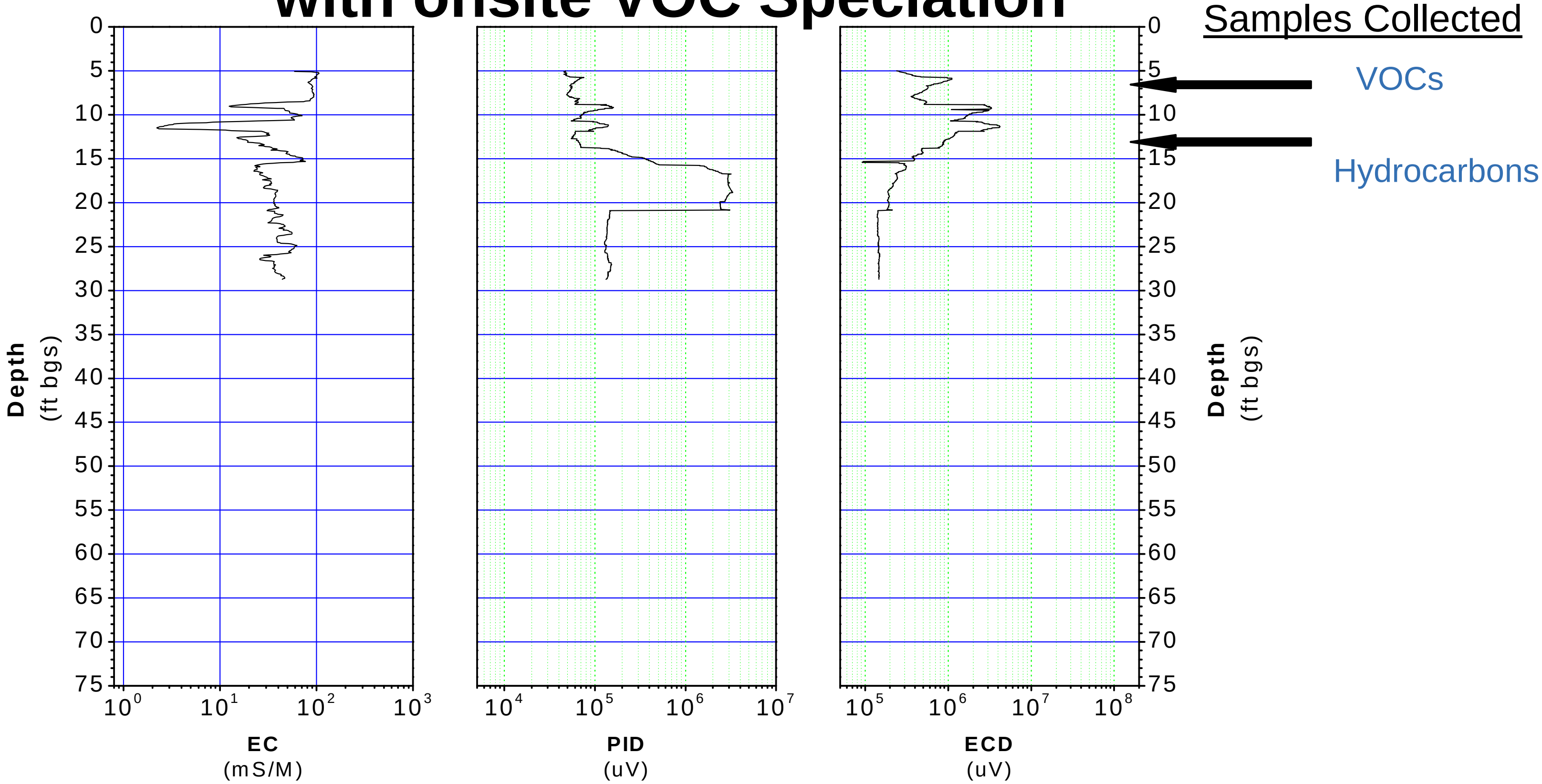
# Case Example – Real-Time MIP

## with onsite VOC Speciation




| LOC | DEPTH | Trans 1,2-DCE | 1,1-DCA | Cis 1,2-DCE | TCA | TCE | PCE | TCE:THOC | Presence of Hydrocarbons |
|---|---|---|---|---|---|---|---|---|---|
| MIP-13 | 11 | 0 | 0 | 120 | 624 | 5,035 | 0 | 0.87 | NO |
| MIP-13 | 18 | 0 | 0 | 1,645 | 0 | 365 | 672* | 0.18 | YES |

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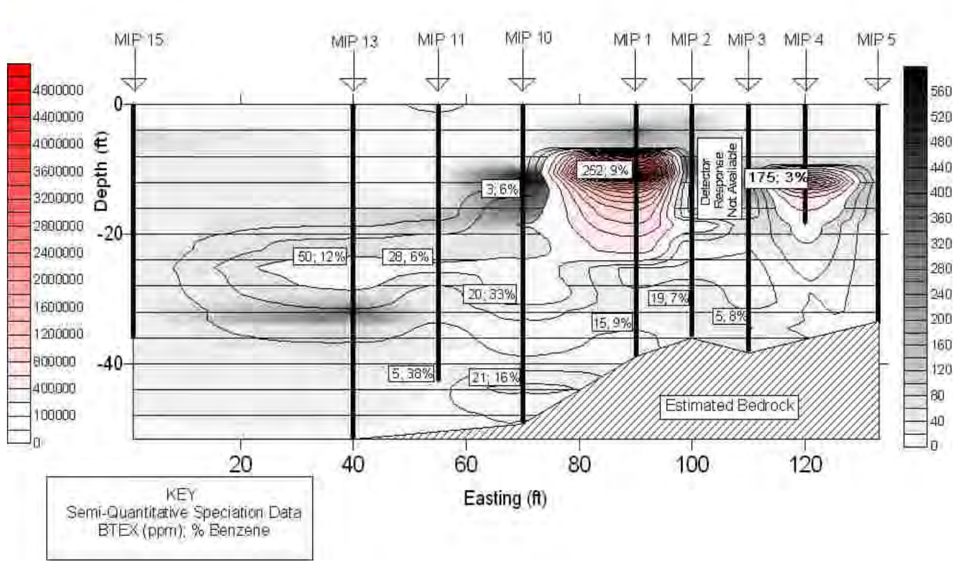
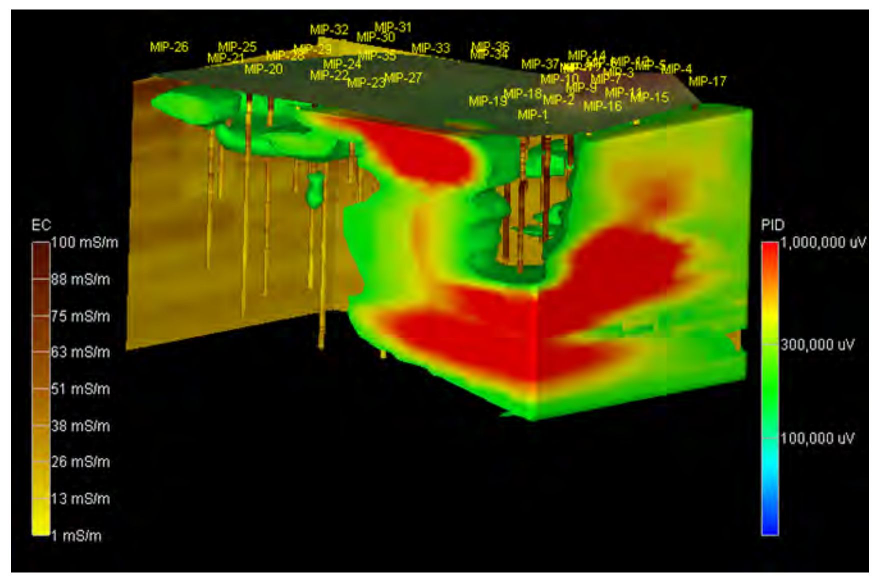
# Case Example – Real-Time MIP

## 2-D/3-D Visualizations of MIP Data

### 2-D Stratigraphic Cross-Section




### 3-D Contamination Visualization

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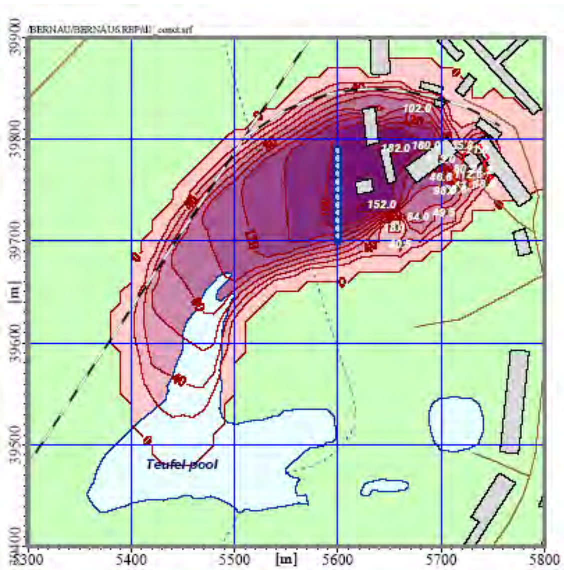
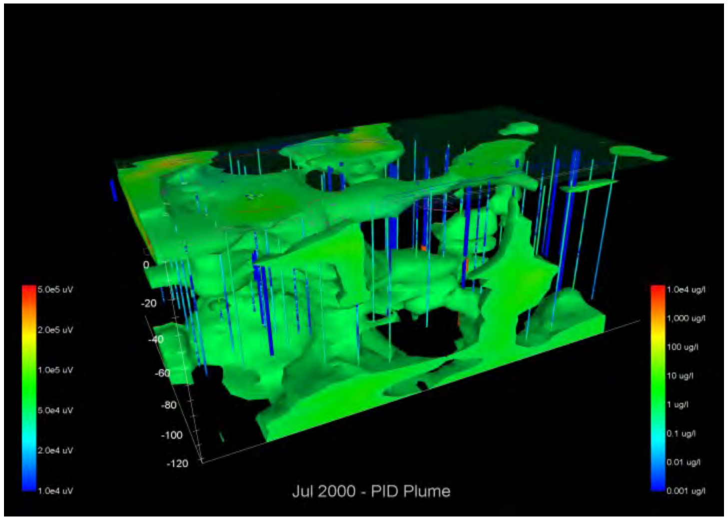
# Data Visualization Tools

- Tools are available for visualizing and evaluating subsurface data in 2-D and 3-D

Typical 2-D map of plume based on 7 wells




3-D plume visualization based on over 50 sampling locations

- Estimate distributions, volume, mass, and behavior over time in high resolution (4-D)

# Technical Assistance Services


- Project Strategy Consultation
- Facilitation of Systematic Project Planning
- Development of:
  - Conceptual Site Models (CSMs)
  - Dynamic Work Strategies
- Assistance with selection of innovative and real-time investigation technologies
- Evaluation of remedial technologies
- Review of remedial designs
- Training – Live / Webcast / Archived

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# Implications for Remedy Design and Implementation

# Implications for Remedy Design and Implementation

- Adaptive characterization methods provide basis to understand spatial and temporal nature of contaminants
- High resolution characterizations provide strong basis for remedy selection
- 3-D visualization provides ability to better target remedy
- Scale-appropriate measurement provides basis more accurate and efficient design
- Combination of these ensures higher confidence in remedy appropriateness and performance

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# High Resolution Site Characterization

# Use of *In Situ* Treatment is Rising

- More effective treatment technologies exist
- Technology selection trade-offs favor *in situ* treatment
  - Less materials handling
  - Reduction in cost and H&S concerns
  - Capable of reaching lower depths
  - Can be delivered where needed

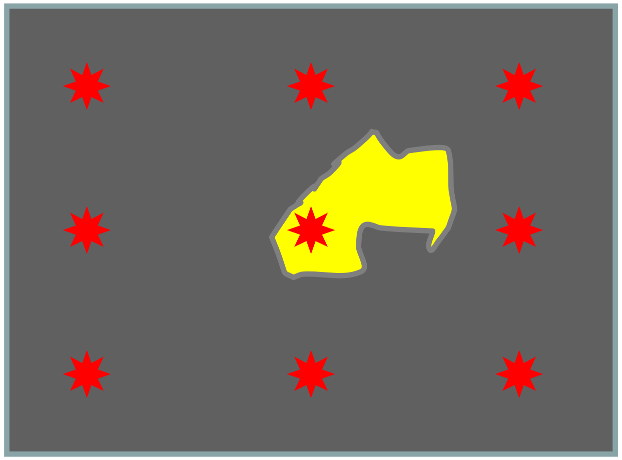
High resolution site characterization strategies and technologies provide greater site understanding

# High Resolution Site Characterization Supports *In Situ* Treatment

- More effective treatment
  - Higher confidence that site is fully characterized
  - Tighter source(s) identification and delineation
  - More accurate mass and volume estimations
  - Targeted vs. shotgun remedy design and implementation
  - Improved monitoring of remedy performance
- Reduced treatment costs
  - Treatment focused on the problem area
  - Reduced residual contamination
  - Savings in treatment compounds and waste handling
  - Reduced need for long-term O&M

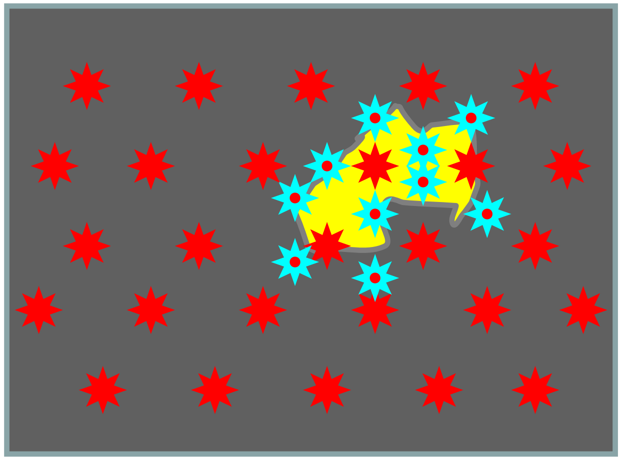
# Strategies
# High Resolution Source Characterization of Soils

Low Resolution Sampling Strategy



**Results**
- Low data density
- Poorly-defined contamination
- Uncertainty about clean area

High Resolution Sampling Strategy



**Results**
- High data density
- Well-defined contamination
- Certainty about clean area

# Strategies
# Media-Sequenced Site Characterization

- Environmental media processes are inter-related, yet sometimes addressed as separate investigation units
  - Use media to form basis of sequenced investigation strategy
  - Develop plan for each media of concern
  - Simultaneously characterize site and identify issues unique to each media
- Characterize sites more effectively and completely using high resolution approaches
  - Utilize transects to locate sources and delineate plumes faster and with more accuracy
  - Identify and address high-risk concerns quickly
- No 'one-size-fits' all solutions – approaches must be site-specific

# Example of Media-Sequenced Site Characterization

- Site background information
  - DNAPL VOCs in soil and overburden groundwater known, but not characterized
  - Site has potential source area, occupied buildings and downgradient stream
- Step 1 – Gaining/losing stream assessment
  - Determine whether groundwater discharges to stream
  - Delineate length of gaining area of stream

(continued)

# Example of Media-Sequenced Site Characterization

- Step 2 – Passive diffusion bag sampling and analysis of porewater
  - Confirm whether VOCs are discharging to stream
  - Focused on gaining area of stream at groundwater-sediment interface
- Step 3 – Vertical groundwater profiling
  - Transects normal to groundwater flow
  - Located between stream and suspected sources
  - Identify plume(s) and plume core(s)
  - Update the CSM and project from stream locations though plume(s) and plume cores to location of sources

(continued)

# Example of Media-Sequenced Site Characterization

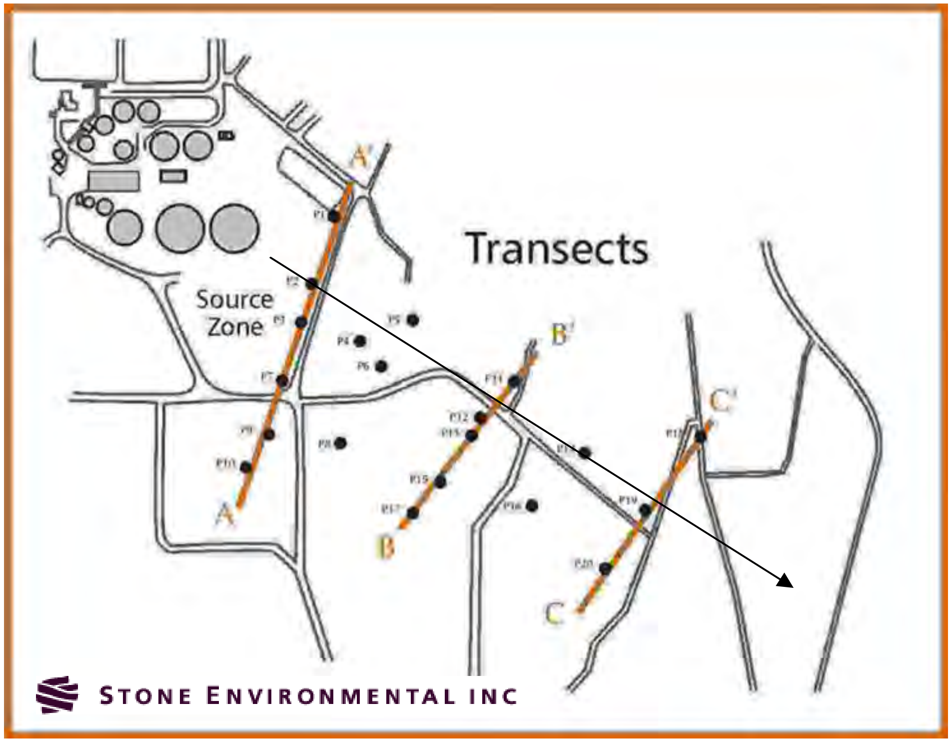
- Step 4 – Additional vertical groundwater profiling
  - Confirm source area(s) and delineate plume(s)
  - Confirm whether plume(s) flows under and past stream
  - Continue profiling until downgradient extent bounded
- Step 5 – Vapor intrusion evaluation
  - Sample soil gas adjacent to buildings near source(s) and plume(s)
  - Take appropriate actions to sample indoor air as applicable
- Site characterization completed in one mobilization
  - CSM can be updated for subsequent phases

# Strategies
# Transect-Based Plume Characterization

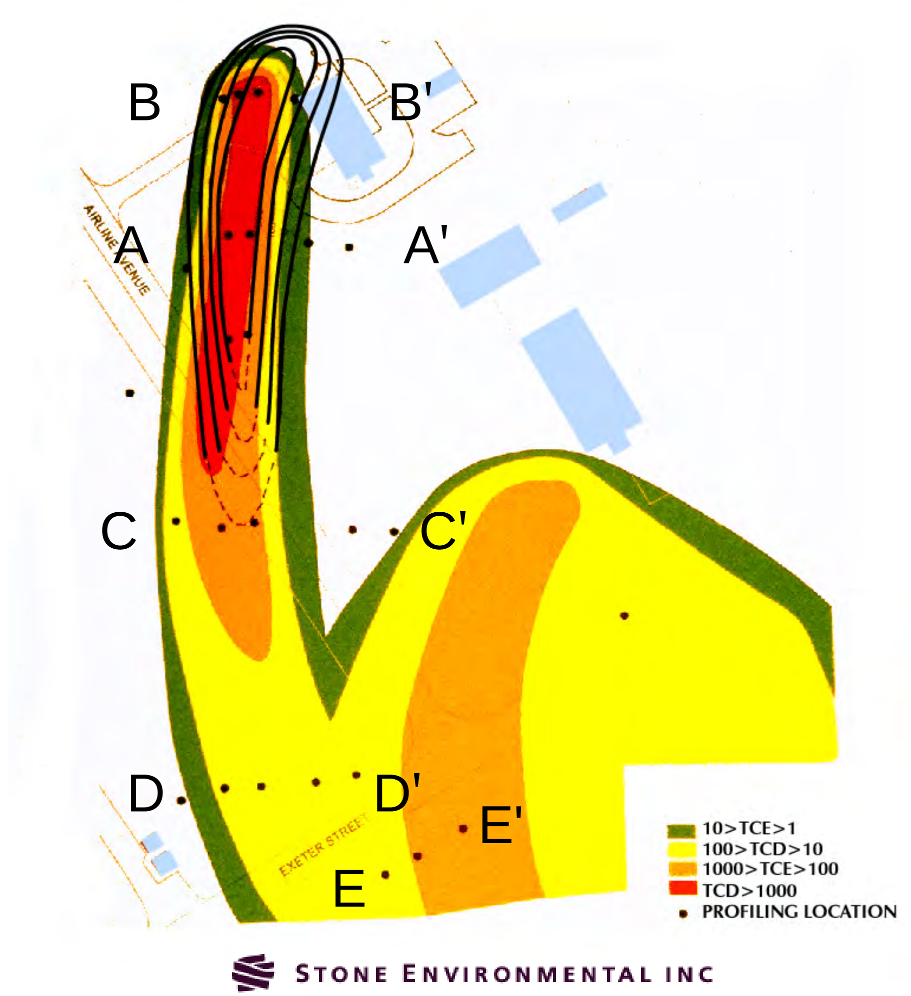
•**<u>Transect</u>**: Line of vertical profiles oriented normal to the direction of the hydraulic gradient (GW flow)

•**<u>Sample Interval</u>**: Vertical dimension of the sampled portion of the aquifer

•**<u>Sample Spacing</u>**: Vertical distance between samples

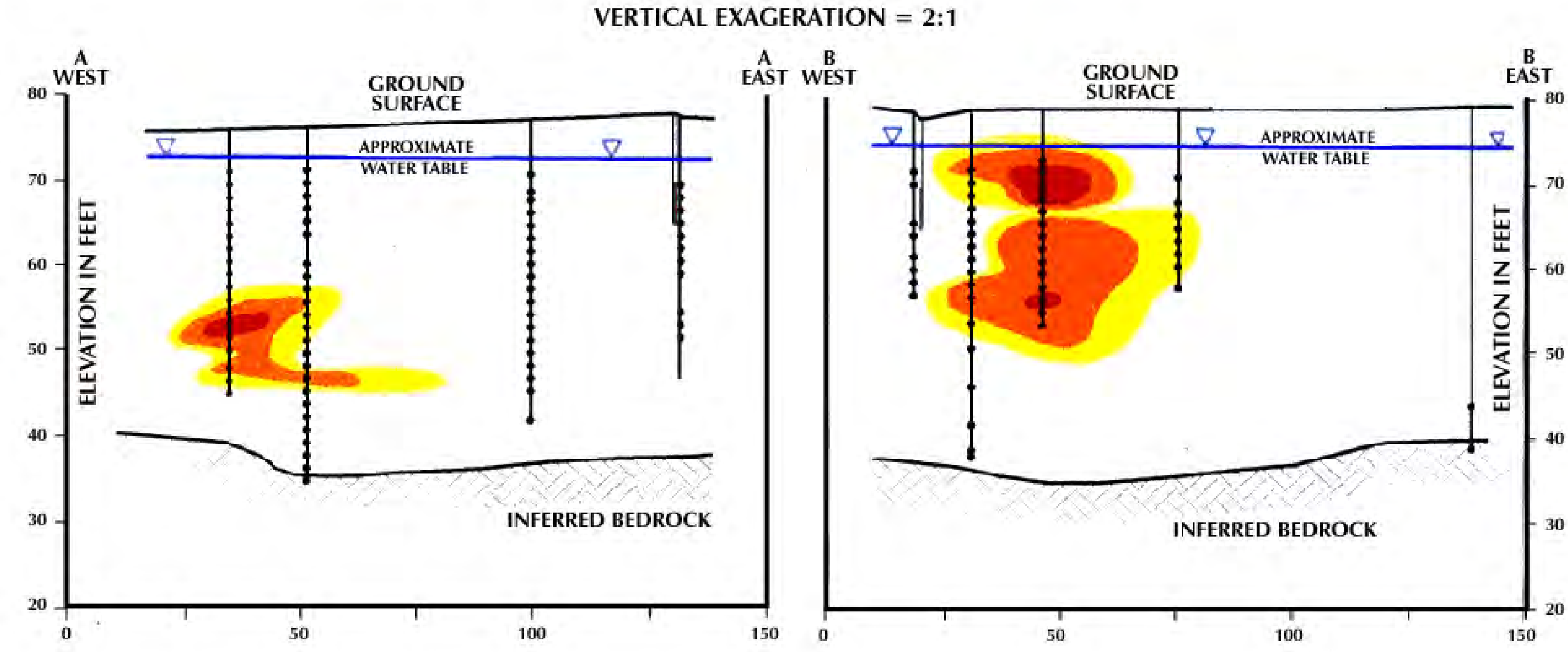


# Case Study: Secondary Groundwater Plume Characterization, Pease AFB, NH

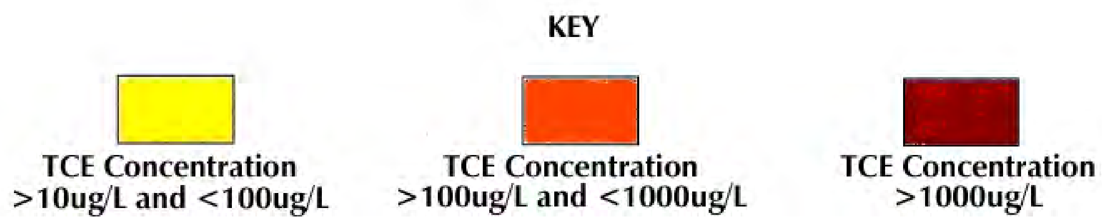



- VOC and POL release site
- VOCs potentially impacting two bedrock supply wells
  - Concern over DNAPL in bedrock
- Prior monitoring well investigation did not accurately characterize the plume
  - Defined as "short plume"
- 5 Modified Waterloo Profiler transects performed normal to plume axis
  - A - A' = Downgradient of Source
  - B - B' = Through Source Area
  - C - C' / D - D' / E - E = Downgradient plume delineation

# High Resolution Transect Sampling Showed TCE Plume Sinking with Distance from Source (vs “short plume”)




**DOWNGRADIENT** **SOURCE AREA**

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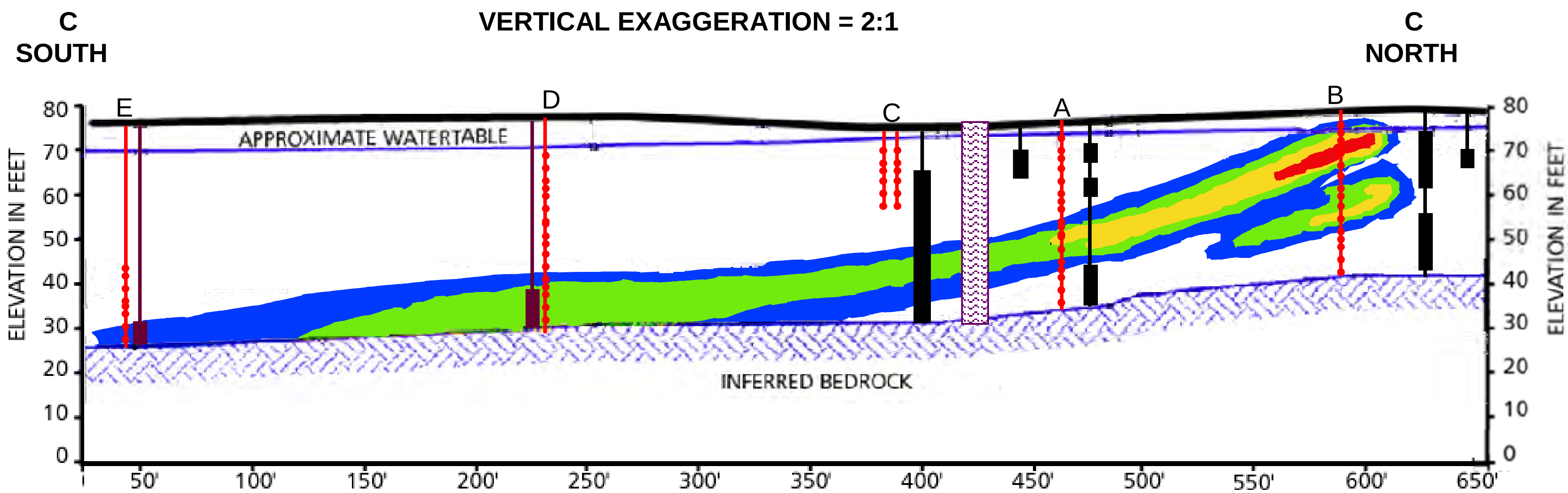
# Plume Anatomy Characterization & Remediation:
## Vertical Profiling vs. Monitoring Well Effectiveness




KEY

| TCE/TOX >10% and <20% | TCE/TOX >20% and <30% | TCE/TOX >30% and <40% | TCE/TOX >40% and <50% | TCE/TOX >50% |
|---|---|---|---|---|

Prior Investigation Monitoring Well · GW Profile · New Monitoring Well

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Salzburg Congress, Austria
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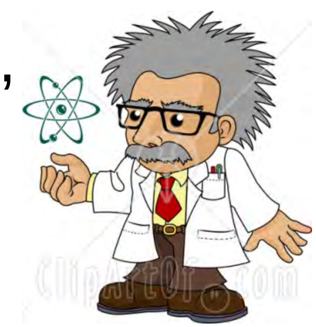
# Investigation Optimization
# Case Study

# BCF Oil State Superfund Site Brooklyn New York

- Optimization review, recommendations, and technical support provided by EPA
- Initiated in late 2006
  - Requested by project stakeholders (NYC, NYDEC)
  - Redevelopment interest, elements of Triad BMPs to expedite process and optimize investigation
- Optimization team assembled late 2006
  - Expertise in chemistry, geology/hydrogeology, engineering, direct sensing tools, data management/visualization



# BCF Oil – Discovery

- Substantial amount of historical site information
  - Basis for document *“Suggestions Concerning Streamlining the Characterization Effort in Support of Reuse at the BCF Oil Site, Brooklyn, New York”*- Draft Dec 2006, finalized early 2007
- 1.85-acre former petroleum distribution and waste oil recycling facility
  - Located on the English Kills/Newtown Creek in Brooklyn
  - Historical operations dating back to1933
  - USTs and ASTs on site
  - PCB contaminated waste oil found to impact most of the storage and processing tanks at the facility -1994
  - EPA removal actions performed 2000-2002
  - Subsequent RI required under State Superfund program


BCF Oil - Aerial Photo 2006

# BCF Oil – Historical Timeline Prior to Optimization

1900 - 1933
Newtown Creek
Embayment Filled
Property Created

1933 - 1980
Petroleum Distribution Facility On Site

1980 - 1994
Waste Oil
Recycling
Operations

1940 - 1994
Historical USTs and ASTs On Site
Associated with Petroleum Distribution
and Oil Recycling Operations

1994
PCB Contaminated Waste Oil
Impacts Storage and Processing
Tanks/Pipes- Facility Closed

1998
Preliminary
Subsurface Investigation

2000 - 2002
EPA
Removal Actions

2005
Site Inspection
GW Sampling

# BCF Oil – EPA Removal Actions 2000-2002

- Provided 24-hour site security during operations;
- Sampled 91 drums, 16 USTs, 4 ASTs, 1 tank truck, and 2 roll-off storage bins;
- Collected 4 soil samples from test pits in unidentified locations, 1 sediment sample from an unidentified location, and 7 groundwater samples from existing monitoring wells;
- Processed and removed 804,537 gallons of oil, sludge, and aqueous waste from the USTs, ASTs,and other containers;
- Removed 65,640 pounds of scrap metal;
- Removed one cubic yard of asbestos;
- Triple-rinsed ASTs with solvent, and then covered, closed, and bolted all ASTs and pipes to prevent access; and,
- Decontaminated and collected wipe confirmation samples for PCB analysis from the USTs, and then backfilled them in place

# BCF Oil – Post Removal Conditions

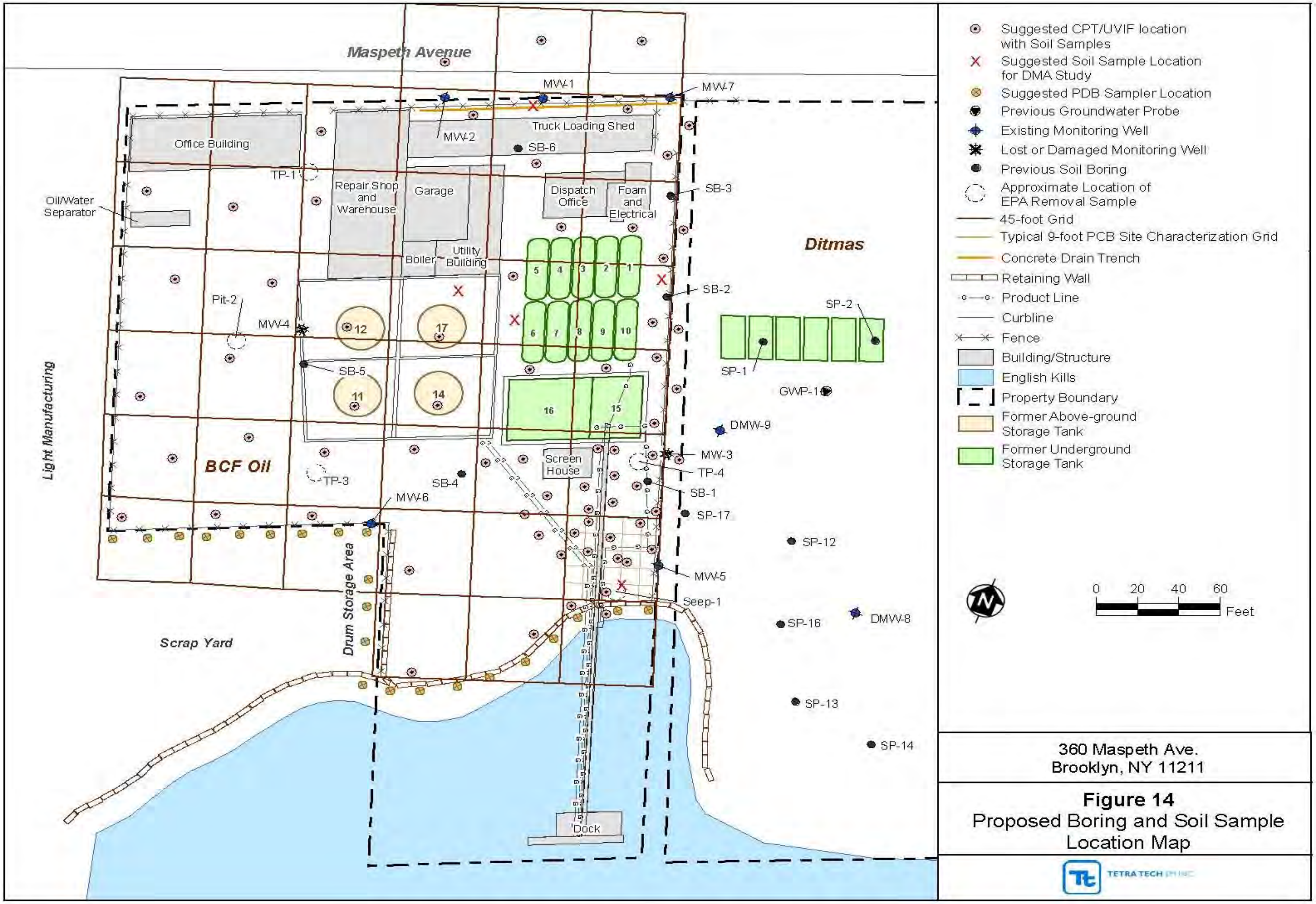
- Residual environmental concerns
  - Redevelopment interest - currently NYC impound lot
  - NYDEC State SF site
  - NYDEC requirements needed to be met for closure and redevelopment
    - Evaluate potential for PCBs >1 ppm
    - Free, mobile, or recoverable product
    - Impacts to English Kills
    - Neighboring properties
    - NYDEC requirements to characterize historic fill
  - NYDEC open to BMPs and suggested technologies
    - Contractor was less enthusiastic

# BCF Oil – Optimization Review Products

- Preliminary CSM development
  - Site maps, regional and site cross-sections
  - Historical detection maps and contaminant contours
  - Geologic/Hydrogeologic setting, GW contouring
  - Pathway/receptor networks
  - Examples of decision logic diagrams to drive dynamic site activities
- Potentially applicable innovative technologies
- Considerations for sequencing RI activities

# BCF Oil – Recommendations

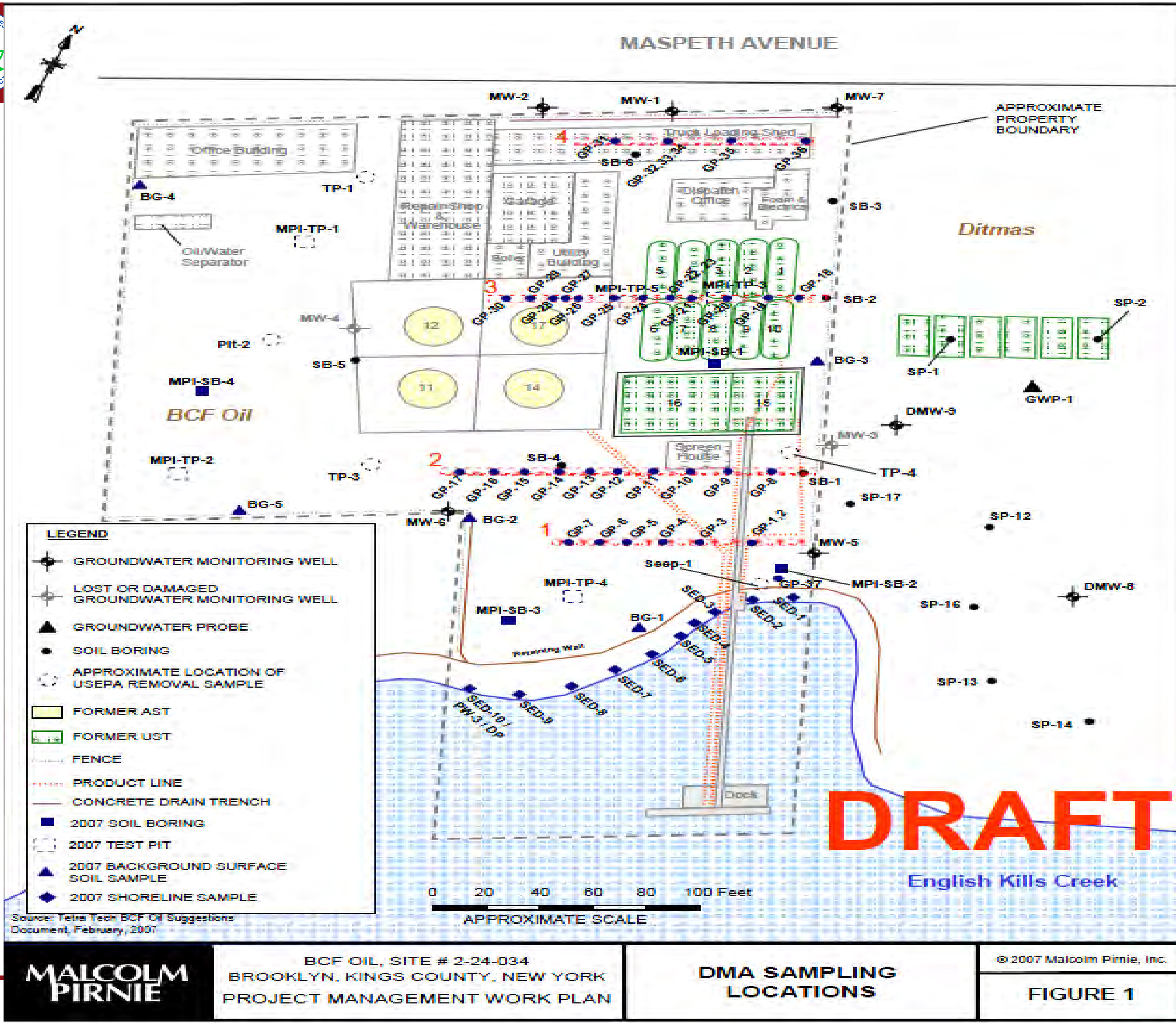
- Systematic planning – Held in Feb 2007
  - Convened stakeholders from EPA HQ, EPA R2, NYC, NYDEC, consultants, property owner
- Products
  - Uncertainty tables highlighting CSM data gaps and information needs to achieve closure
  - Suggested applicable technologies and DMA design
  - Proposed initial sampling locations and accompanying dynamic decision logic
- Challenges
  - Consultant wanted traditional test pits and laboratory analysis
  - Highlight value of DMA, necessary to evaluate direct push platforms, suggested technologies, and contractor-suggested techniques



Maspeth Avenue
MW-1
MW-7
MW-2
Truck Loading Shed
SB-6
Office Building
TP-1
Repair Shop and Warehouse
Garage
Dispatch Office
Foam and Electrical
SB-3
Oil/Water Separator
Ditmas
Boiler
Utility Building
SB-2
SP-2
Pit-2
MW-4
SB-5
SP-1
GWP-1
DMW-9
Light Manufacturing
BCF Oil
Screen House
MW-3
TP-4
TP-3
SB-4
SB-1
MW-6
SP-17
SP-12
Drum Storage Area
MW-5
Seep-1
SP-16
DMW-8
Scrap Yard
SP-13
SP-14
Dock
Suggested CPT/UVIF location with Soil Samples
Suggested Soil Sample Location for DMA Study
Suggested PDB Sampler Location
Previous Groundwater Probe
Existing Monitoring Well
Lost or Damaged Monitoring Well
Previous Soil Boring
Approximate Location of EPA Removal Sample
45-foot Grid
Typical 9-foot PCB Site Characterization Grid
Concrete Drain Trench
Retaining Wall
Product Line
Curbline
Fence
Building/Structure
English Kills
Property Boundary
Former Above-ground Storage Tank
Former Underground Storage Tank
0 20 40 60
Feet
360 Maspeth Ave.
Brooklyn, NY 11211
Figure 14
Proposed Boring and Soil Sample Location Map
TETRA TECH

# BCF Oil – DMA for Technologies

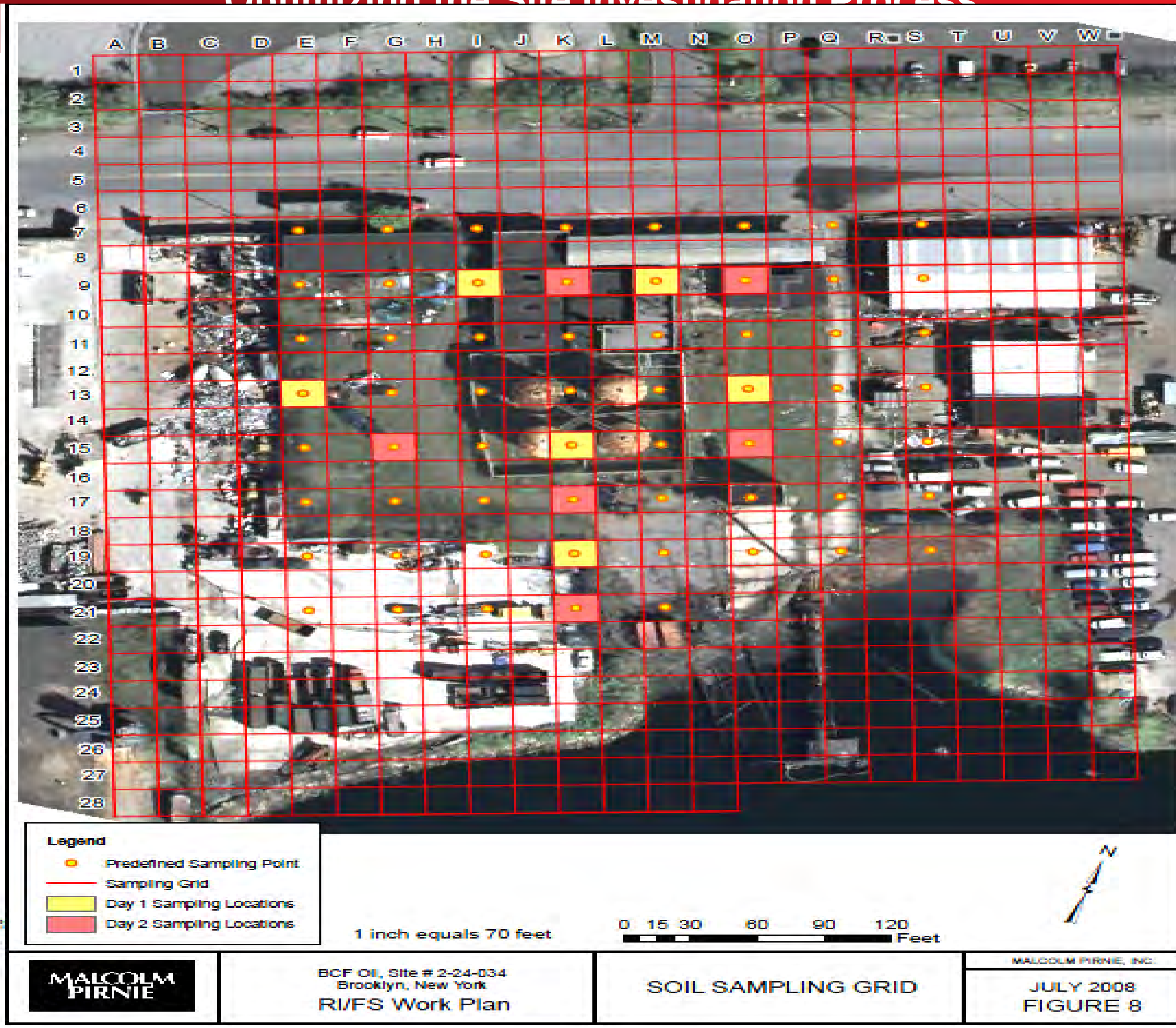
- On-site DMA work completed in 3 days (September 2007)
  - Suggested tools included direct push tools- EC, CPT, FFD/LIF, TPH/PCB test kits, geophysical tools, push point samplers (sediments)
- DMA Results
  - Direct push >30', back hoe <10', some refusal near shoreline due to rip rap and concrete features
  - PCB test kits, decent correlation with laboratory results
  - Push points clogged; recommended slotted PVC
  - LIF promising (product sent to vendor, good fluorescence)
  - EM survey provided useful subsurface information to optimize drilling and sample collection

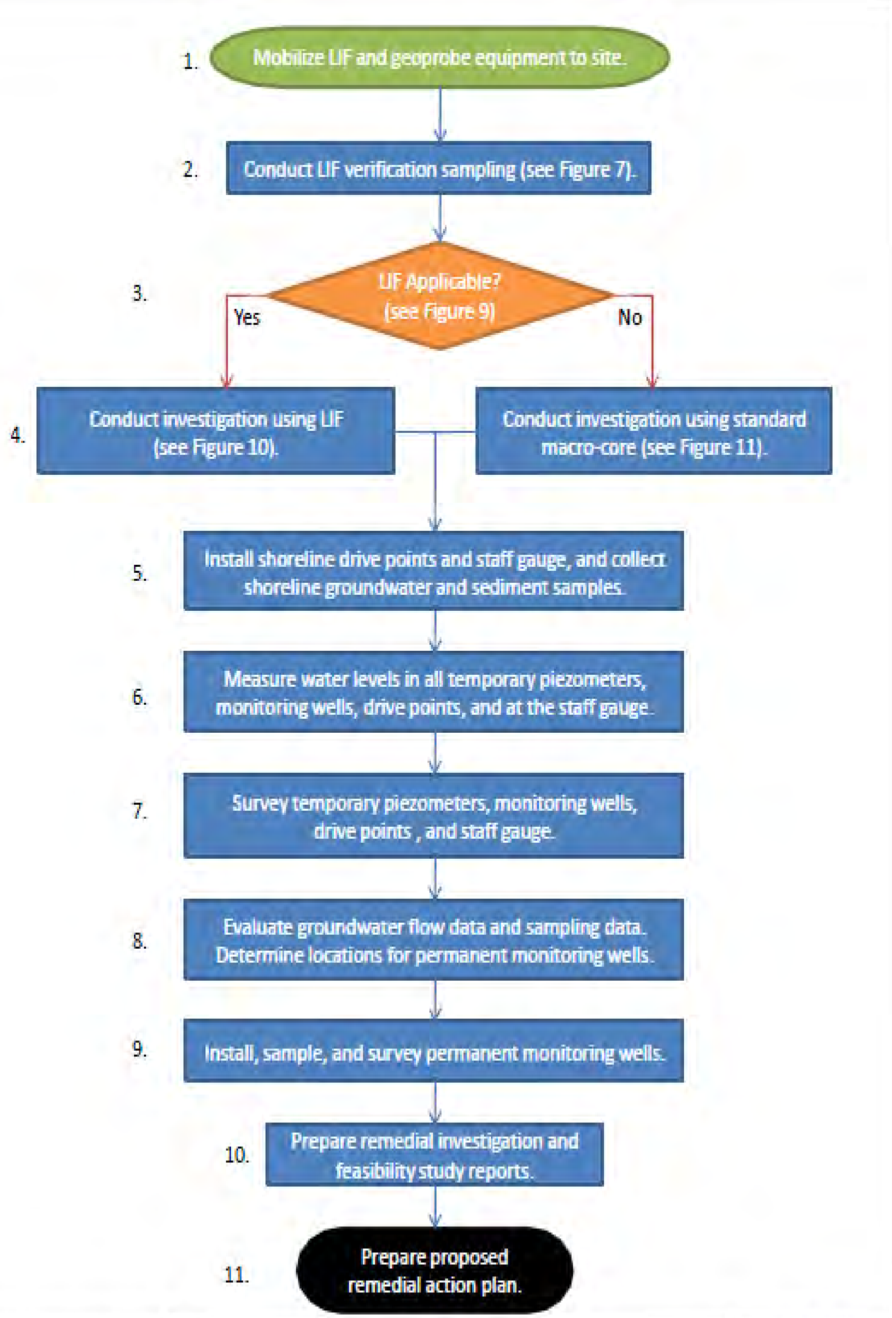

MASPETH AVENUE
N
APPROXIMATE PROPERTY BOUNDARY
MW-2
MW-1
MW-7
Truck Loading Shed
Office Building
SB-6
SB-3
Dispatch Office
Foam & Electrica
Repair Shop & Warehouse
Garage
Boiler
Utility Building
Ditmas
BG-4
TP-1
MPI-TP-1
Oil/Water Separator
MPI-TP-5
MPI-TP-3
SB-2
SP-2
MW-4
Pit-2
SB-5
MPI-SB-1
BG-3
SP-1
GWP-1
MPI-SB-4
BCF Oil
DMW-9
MW-3
Screen House
TP-4
MPI-TP-2
TP-3
SB-4
SB-1
SP-17
BG-5
MW-6
BG-2
SP-12
MW-5
Seep-1
MPI-TP-4
GP-37
MPI-SB-2
DMW-8
MPI-SB-3
BG-1
SP-16
Retaining Wall
SP-13
SP-14
Dock
DRAFT
English Kills Creek
LEGEND
GROUNDWATER MONITORING WELL
LOST OR DAMAGED GROUNDWATER MONITORING WELL
GROUNDWATER PROBE
SOIL BORING
APPROXIMATE LOCATION OF USEPA REMOVAL SAMPLE
FORMER AST
FORMER UST
FENCE
PRODUCT LINE
CONCRETE DRAIN TRENCH
2007 SOIL BORING
2007 TEST PIT
2007 BACKGROUND SURFACE SOIL SAMPLE
2007 SHORELINE SAMPLE
0 20 40 60 80 100 Feet
APPROXIMATE SCALE
Source: Tetra Tech BCF Oil Suggestions Document, February, 2007
MALCOLM PIRNIE
BCF OIL, SITE # 2-24-034
BROOKLYN, KINGS COUNTY, NEW YORK
PROJECT MANAGEMENT WORK PLAN
DMA SAMPLING LOCATIONS
© 2007 Malcolm Pirnie, Inc.
FIGURE 1

# BCF Oil – Technical Assistance

- 1 year delay due to contract negotiations and NYDEC budget issues
- RI finally conducted in 2009
  - Short mobilization, only 2 weeks
  - LIF work, sediment sampling, groundwater and soil grab samples with direct push rig,
  - Optimization team provided data evaluation, suggestions for direct push locations, real-time CSM updates
  - LIF very successful: limited product on site, no major PCB issues, fill material characterized
  - Suggestions for final well placement provided in a formal document

# Optimizing the Site Investigation Process





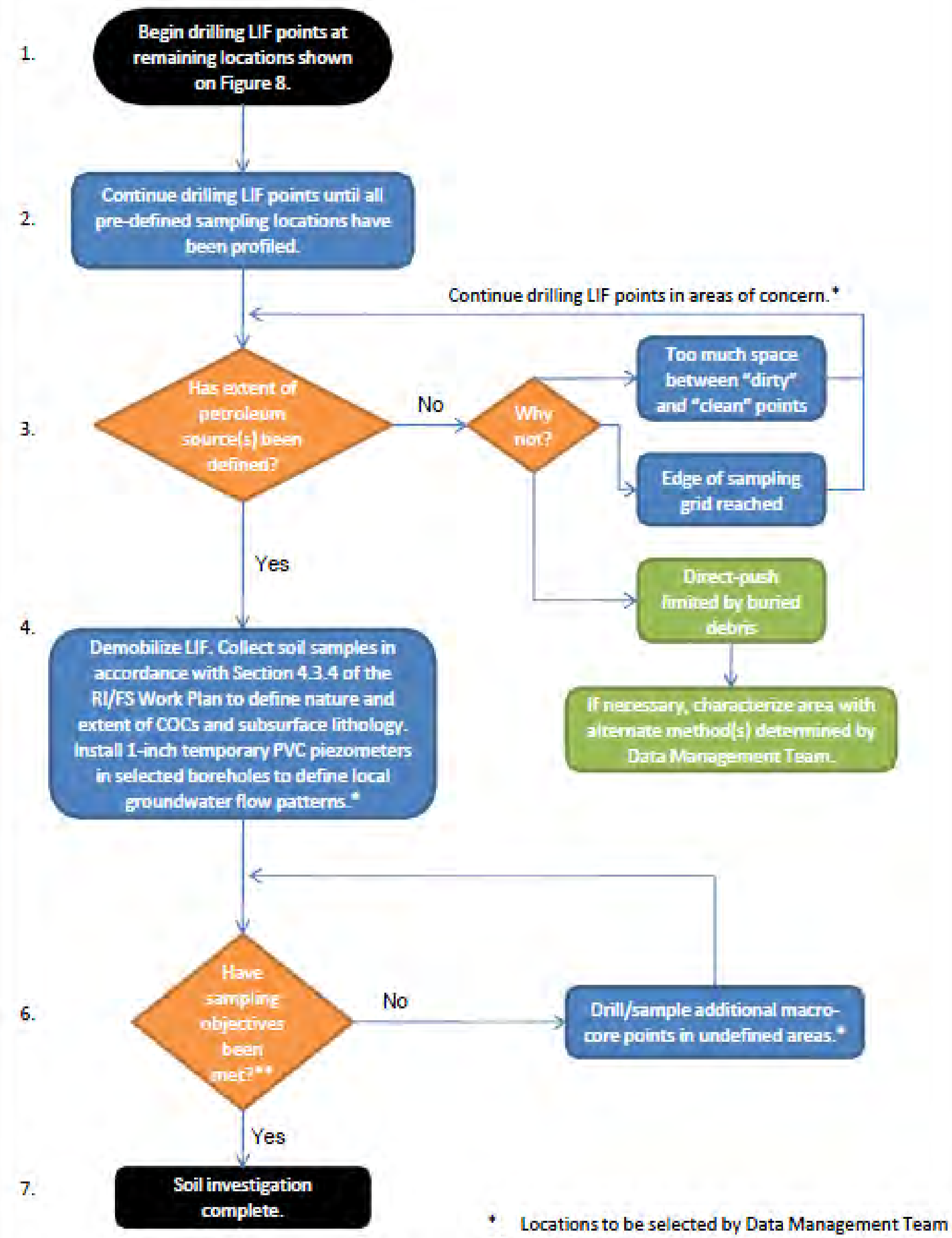

MALCOLM PIRNIE

BCF OIL, SITE # 2-24-034
BROOKLYN, KINGS COUNTY, NEW YORK

OVERALL PROJECT FLOW STRATEGY



FIGURE 6




* Locations to be selected by Data Management Team

** Objectives are to define nature and extent of COCs, subsurface lithology, and groundwater flow patterns

MALCOLM PIRNIE

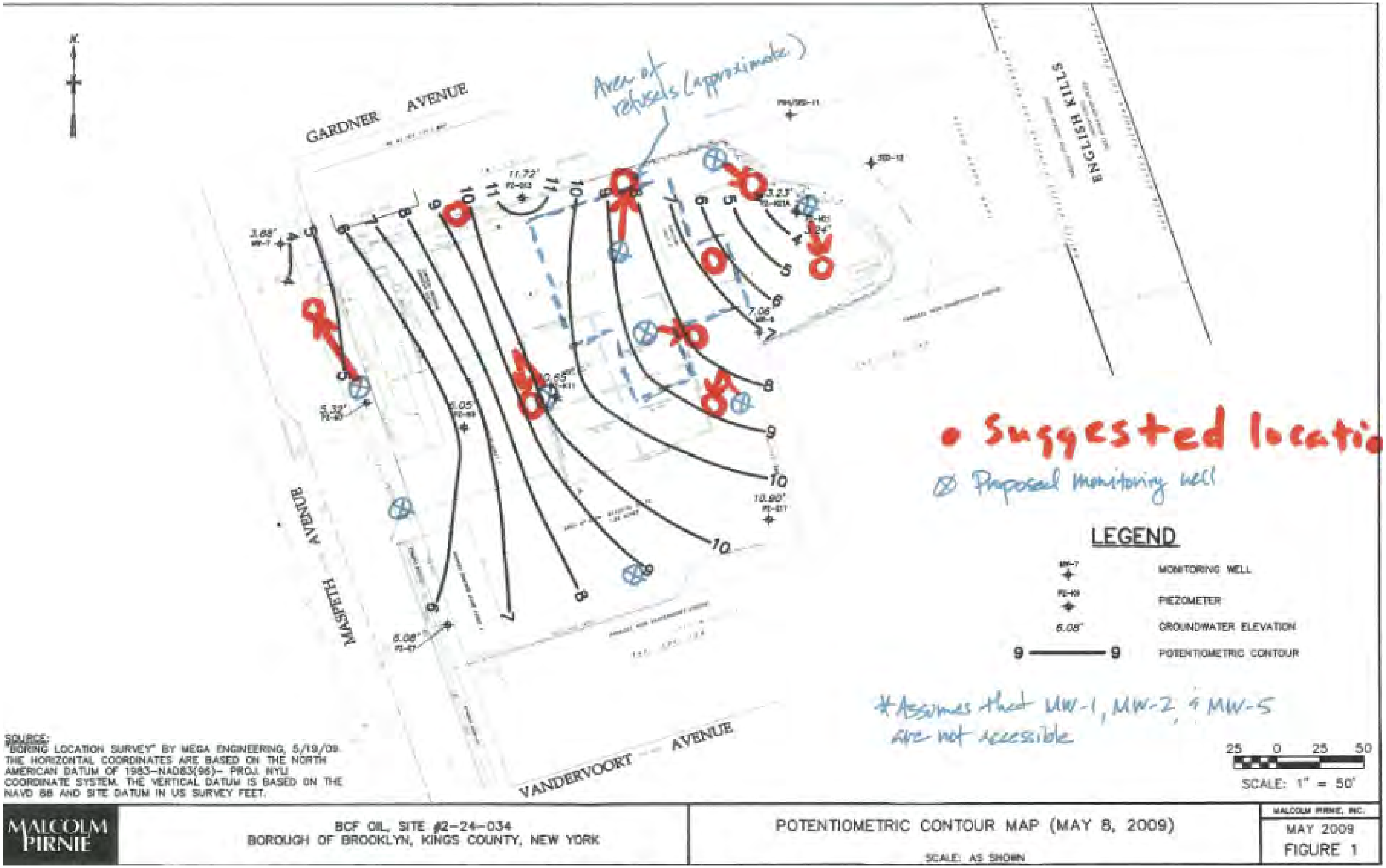
BCF OIL, SITE # 2-24-034
BROOKLYN, KINGS COUNTY, NEW YORK

SOIL INVESTIGATION FLOW CHART (LIF)



FIGURE 10

# BCF Oil – Post RI Well Placement



# BCF Oil – Status in 2010

- RI completed in 2009
  - Awaiting comments on final report
- Optimization team provided suggestions for final well placements
  - Wells installed, sampling conducted
- Discuss additional steps (if any) with NYDEC
- Site closure pending NYDEC findings but availability for redevelopment is expected

# Information Resources

# "Self-Help" Information Assistance

- Guidance Documents
- Special Issues Primers
- Technical Bulletins
- Fact Sheets
- Case Studies
- Technology Descriptions
- Web-resources

**www.clu-in.org**

Provides information about innovative treatment and site characterization technologies

Acts as a forum for all waste remediation stakeholders

**Community of Practice (CoP)**

US and EU Triad practitioners share knowledge and project experience

Free membership comprised of federal and state agencies, private contractors, and academia

Contact EPA for information on how to join today!

**Triad Resource Center**

**www.triadcentral.org**

Multiple resources dedicated to effective Triad implementation

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# Questions?

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

# Thank You!

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# Additional Information:
# Potential Application to EU Directives

# Baselines, Stakeholders and Site Liability

- Multiple Baseline Scenarios
  - Site Sales and Acquisitions
  - Pollution and Remediation Insurance
  - Liability Transfers and Contractual Negotiations
  - Land Valuation
  - Redevelopment
- Diverse Baseline Stakeholders
  - Owners / Operators / Banks / Insurers / Service Providers
  - Member Nations / Competent Authorities / NGOs / Individuals
- "What is the baseline condition that needs to be reached and does the liability for reaching it belong to me?"
  - Use BMPs to characterize baseline condition
  - Use CSM to illustrate baseline for liability management

# Address Various Site Management Needs

- Illustrate baseline prior to and after new site development
- Stakeholder agreement on baseline at time of site sale / purchase
- Quickly determine whether “imminent threat” exists
- Complete site characterizations within required timeframes
  - < 5 years; prior to Competent Authority “cost recovery”
- Demonstrate monitored natural attenuation (MNA) remedial options
- Expedite and lower cost of “self-directed remediation”
- Cost-effectively characterize “alternate site” for remediation
  - When primary site is determined unable to be restored

# Use CSMs to Manage Site and Liabilities

- Support operational permit requirements (e.g., extractive industries)
  - Initial permit and 5 year “waste management plans” updates
  - Establish basis for financial guarantee
  - Support site inspections and “up-to-date” recordkeeping
  - Demonstrate site closure and post-closure
- Negotiate costs / coverages with environmental insurers
- Defense in judicial review proceedings with individuals and NGOs
- Illustrate Site-related Biodiversity
  - Habitats Directive – relevant flora, fauna; NATURA 2000 sites
  - Birds Directive – relevant birds and migratory features
- Support claim of “no fault” for environmental damage
- Negotiate “degree of fault” in cases of “multiple party causation”

# Use CSMs to Manage Remediation

- Reach stakeholder consensus on remedial requirements
- Negotiate remedial option(s) with Competent Authorities
- Benchmark Primary / Complementary / Compensatory remediation
  - Determine what data are required to achieve each CSM version
- Refine understanding of source area dimensions
  - Smaller source area = lower cost to remediate
- Demonstrate soils (land) no longer pose risk to human health
  - Evolve CSM as remediation proceeds until no risk is determined
- Use updated CSM to document “revised baseline” for future use