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Real World Integration of Real Time Data Sets

REAL-TIME DATA COLLECTION & INTERPRETATION FOR BETTER DECISION-MAKING

November 19, 2008
The Publick House
Sturbridge, MA

November 20, 2008
NHDES Offices
Concord, NH

Matthew Ruf
Director of Direct-Push/Direct-Sensing Services
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Introduction

- S2C2 – Who we are.
  - Company focuses on Streamlined Site Characterization
  - S2C2 has been performing these services for over 10 years
  - Over 20-Year History of Site Characterization using real-time data

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Real Time Data

- Direct-Sensing Tools
  - Electrical Conductivity Probe
  - Membrane Interface Probe (MIP)
  - Fuel Fluorescent Detector (FFD)
- Mobile Laboratory
  - GC/MS Methods:
    -Volatiles
    -Semi-Volatiles
    -PCBs, Pesticides, TPH
  - Metals by XRF
- Other Real Time Technologies
  - Geophysical surveys
  - PID
  - Global Positioning System
- Data Visualization

Collaborative Data

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Choosing the right tool for real-time data

Overburden

- Membrane Interface Probe (MIP)
  - BTEX : Dissolved phase
  - CVOCs: Source Area & Dissolved
- Fuel Fluorescent Detector (FFD)
  - Hydrocarbons: Residual and Free Product
  - Not Dissolved phase
- Electrical Conductivity (EC)
  - Soil Lithology
  - Historic Fill
  - Preferential Pathways/Targeting sample Intervals
- Mobile Laboratory
  - SVOC – PAHs, Pesticides, PCBs
  - VOCs Below MIP detection limits and Speciation
  - Metals - XRF

Bedrock

- Mobile Laboratory
  - Rock Coring w/ packer testing
- Flute Liners
- Downhole Geophysical

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Characterization of Historic Fill Using Electrical Conductivity (EC) and a Hand Held XRF

Background:

- Multiple acre former industrial site
- Historic Fill extended to a depth of 15’ bgs. with high levels of metals
- Water table 5’ bgs.
- Remedy “Hotspot “ removal

Problem:

- Characterization of Fill material difficult using traditional techniques

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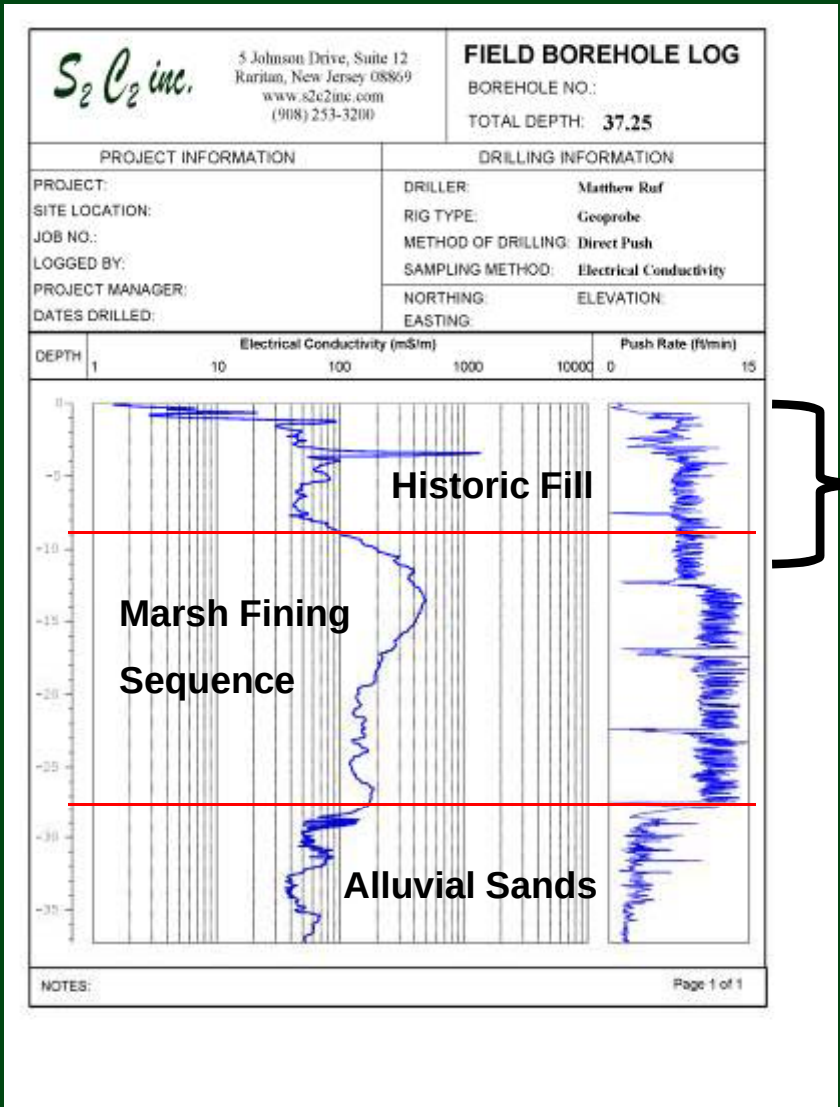
Solution



XRF Sample (2-2.5 ft)
Cr - 185 mg/kg
Cu - 371 mg/kg
Zn - 799 mg/kg
Pb - 612 mg/kg
As - ND

XRF Sample (4-4.5 ft)
Cr - 83,643 mg/kg
Cu - 52 mg/kg
Zn - 5,095 mg/kg
Pb - 562 mg/kg
As - ND

XRF Sample (9.5-10 ft)
Cr - 150 mg/kg
Cu - ND
Zn - 187 mg/kg
Pb - 143 mg/kg
As - ND

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Why was real time data important for this site?

- Accurately determining the extent of Historic Fill
- Target sampling interval
- Generate a detailed model of Metals impacts in relationship with lithology
- Decrease size of impacted “hotspots” -which decreased remediation costs

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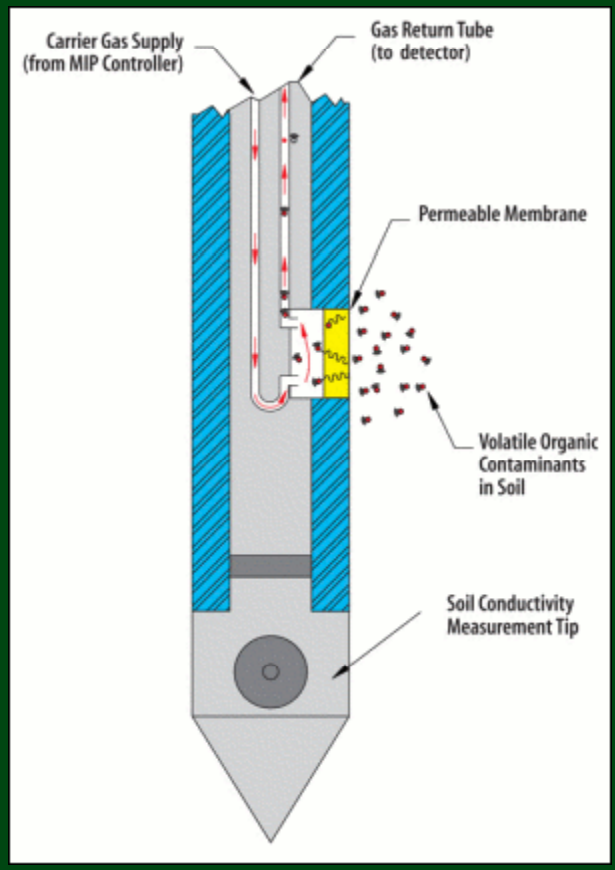
Membrane Interface Probe

- Screening tool with semi-quantitative capabilities.
- Simultaneous chemical and lithologic data.
- Diffusion occurs by concentration gradient from formation to carrier gas.
- Detectors are configured for expected contaminants .
  - PID (BTEX compounds)
  - ECD/ELCD/XSD (Chlorinated Specific)
  - FID (Straight chain hydrocarbons)
- Must follow ASTM D7352-07 Standard Practice for MIP!!
- Geoprobe MIP Service Specialist



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Characterization of a PCE source area using a MIP

Background:

- Active “green” dry cleaning facility in a small strip mall.
- Water table approximately 7’bgs.
- Well set from 4 to 14’ bgs.
- Phase I revealed a broken underground pipe that was thought to be the source.
- Prior to MIP Investigation 2-3 days of traditional sampling and analysis was performed, 4 well were installed and sample
- Estimated cost to date for the investigation 25-30k

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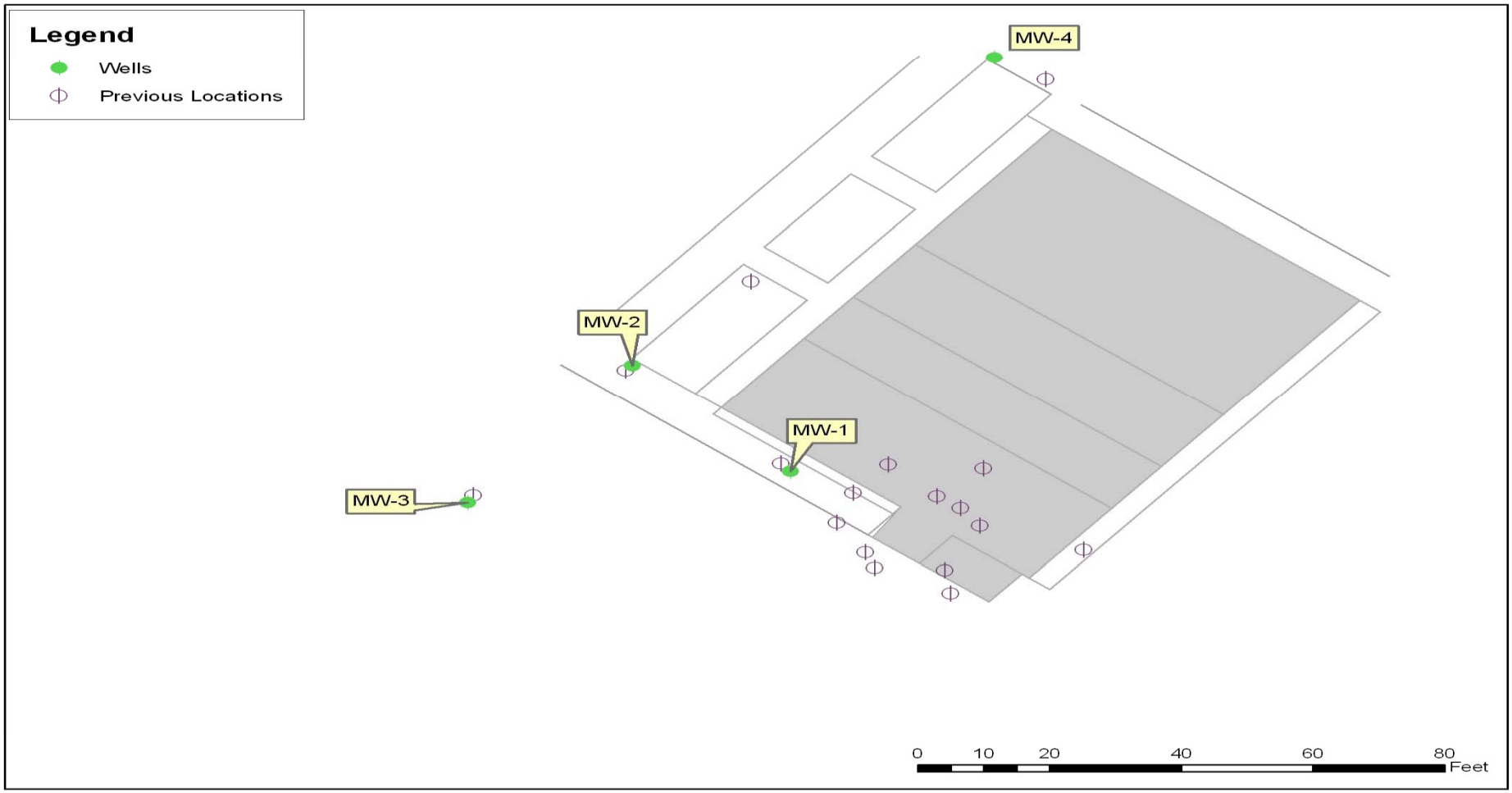
Case Study
Map of previous work done at the site



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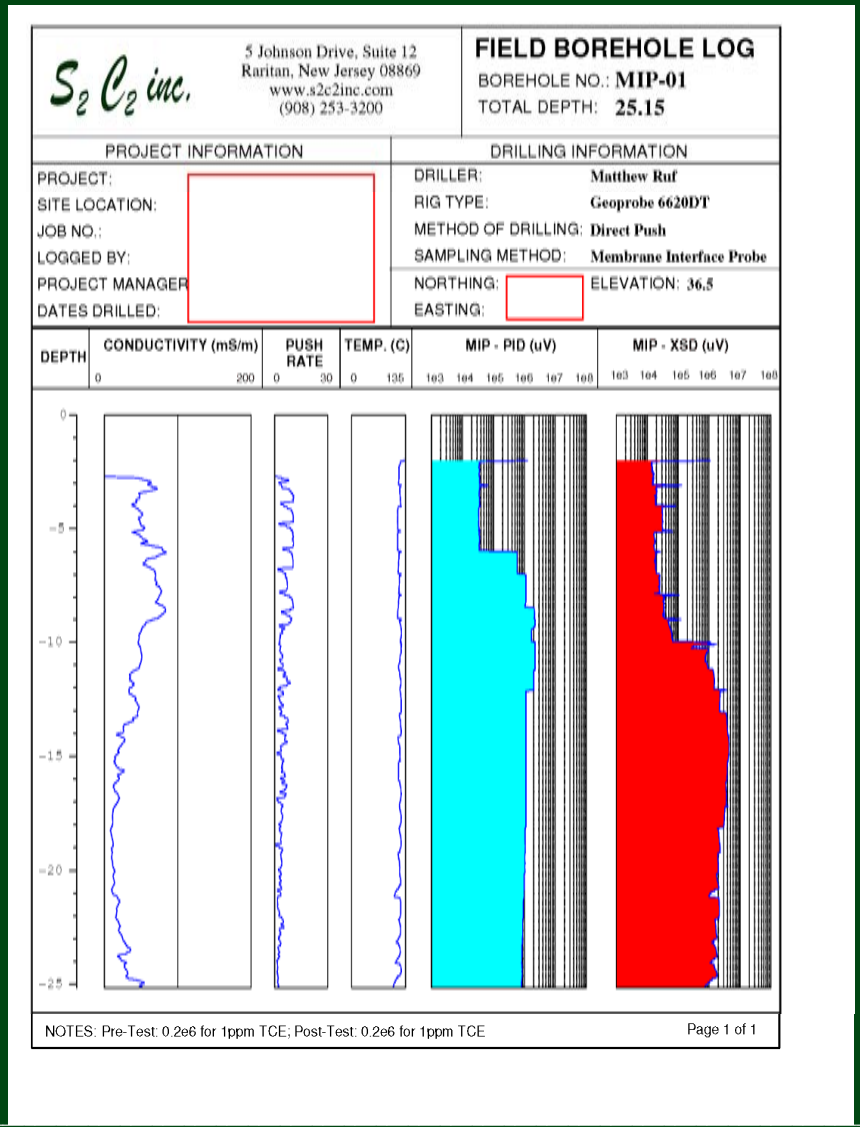
Initial MIP Location at Suspected Source Area



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FIELD BOREHOLE LOG
BOREHOLE NO.: **MIP-01**
TOTAL DEPTH: **25.15**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:		DRILLER:	Matthew Ruf
SITE LOCATION:		RIG TYPE:	Geoprobe 6620DT
JOB NO.:		METHOD OF DRILLING:	Direct Push
LOGGED BY:		SAMPLING METHOD:	Membrane Interface Probe
PROJECT MANAGER		NORTHING:	ELEVATION: 36.5
DATES DRILLED:		EASTING:	

DEPTH | CONDUCTIVITY (mS/m) 0 200 | PUSH RATE 0 30 | TEMP. (C) 0 35 | MIP - PID (uV) 1e3 1e4 1e5 1e6 1e7 1e8 | MIP - XSD (uV) 1e3 1e4 1e5 1e6 1e7 1e8

0 -5 -10 -15 -20 -25

NOTES: Pre-Test: 0.2e6 for 1ppm TCE; Post-Test: 0.2e6 for 1ppm TCE

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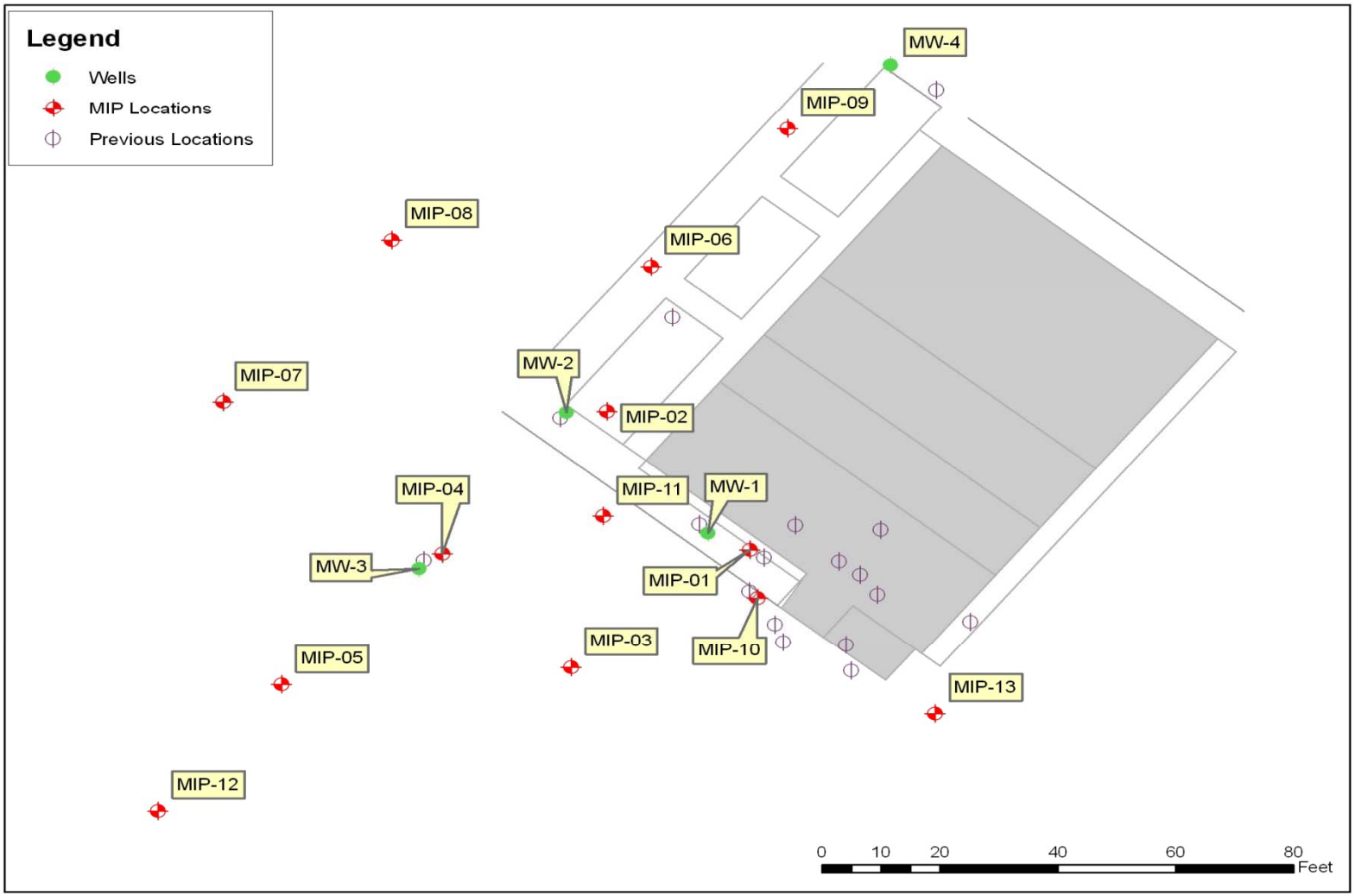
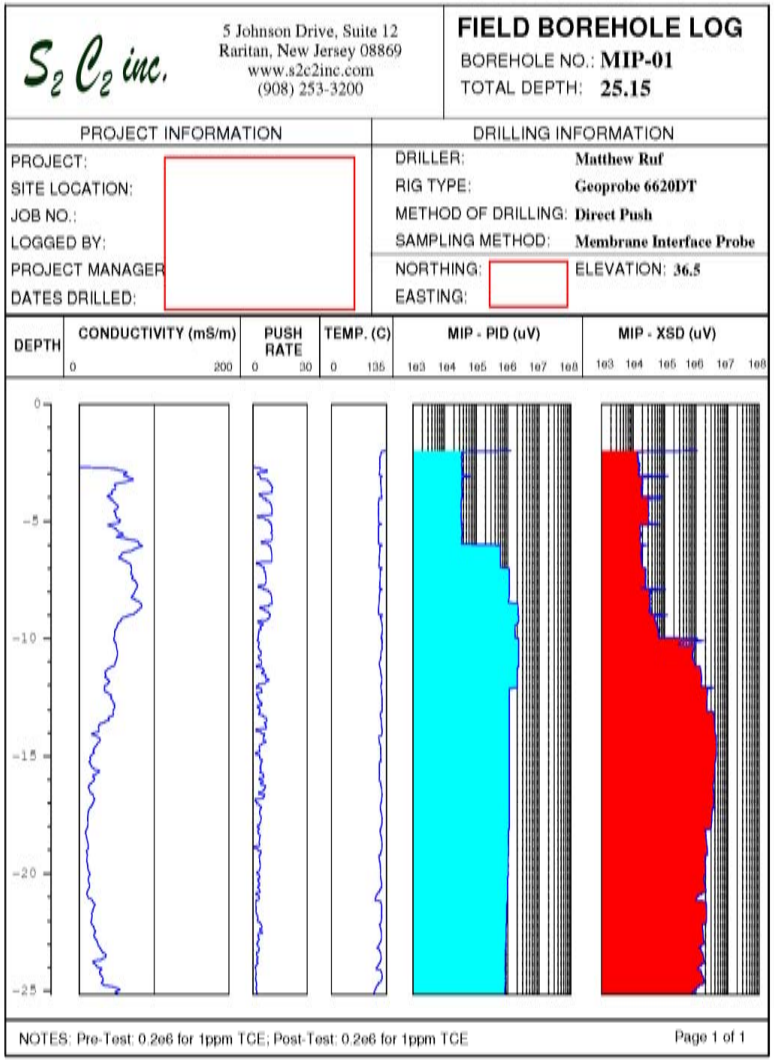
Case Study 2

Map of completed MIP locations at the site



Initial CSM & Final CSM Source Areas



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PROJECT:		DRILLER:	Matthew Ruf
SITE LOCATION:		RIG TYPE:	Geoprobe 6620DT
JOB NO.:		METHOD OF DRILLING:	Direct Push
LOGGED BY:		SAMPLING METHOD:	Membrane Interface Probe
PROJECT MANAGER:		NORTHING:	ELEVATION: 36.5
DATES DRILLED:		EASTING:	

DEPTH | CONDUCTIVITY (mS/m) 0–200 | PUSH RATE 0–30 | TEMP. (C) 0–135 | MIP - PID (uV) 1e3–1e8 | MIP - XSD (uV) 1e3–1e8

NOTES: Pre-Test: 0.2e6 for 1ppm TCE; Post-Test: 0.2e6 for 1ppm TCE

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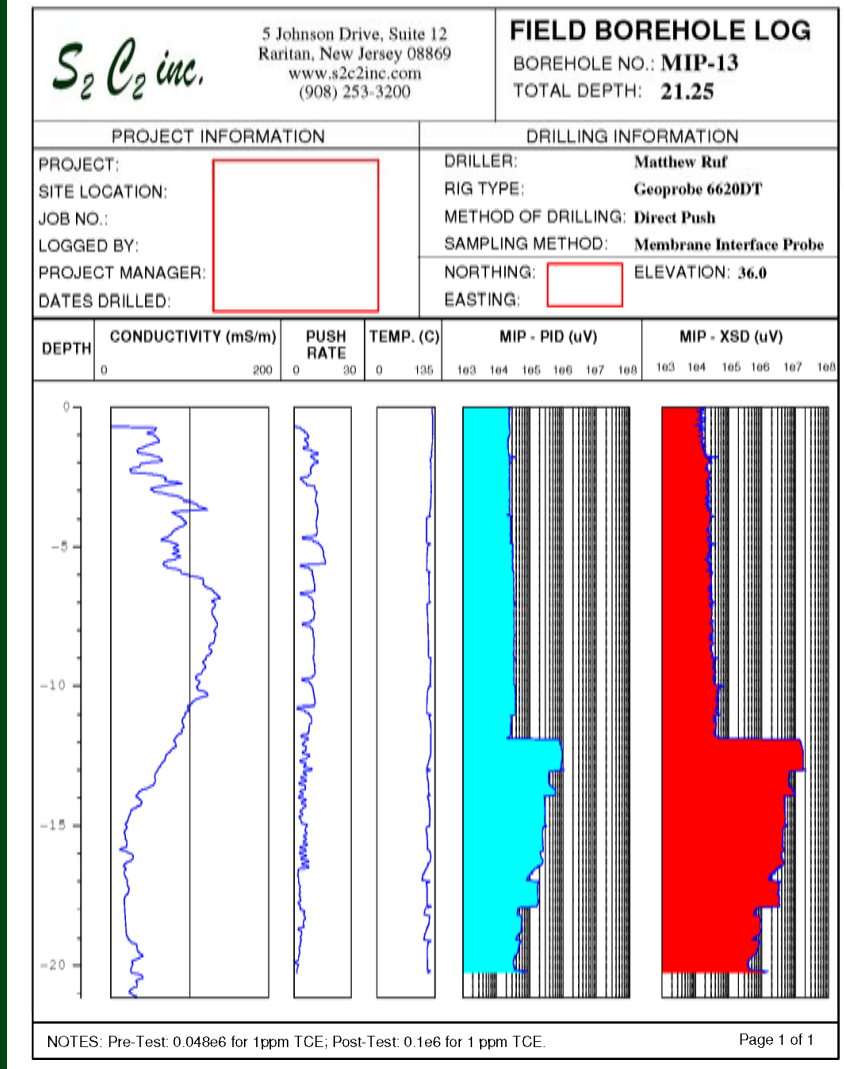

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FIELD BOREHOLE LOG
BOREHOLE NO.: **MIP-13**
TOTAL DEPTH: **21.25**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:		DRILLER:	Matthew Ruf
SITE LOCATION:		RIG TYPE:	Geoprobe 6620DT
JOB NO.:		METHOD OF DRILLING:	Direct Push
LOGGED BY:		SAMPLING METHOD:	Membrane Interface Probe
PROJECT MANAGER:		NORTHING:	ELEVATION: 36.0
DATES DRILLED:		EASTING:	

DEPTH | CONDUCTIVITY (mS/m) 0–200 | PUSH RATE 0–30 | TEMP. (C) 0–135 | MIP - PID (uV) 1e3–1e8 | MIP - XSD (uV) 1e3–1e8

NOTES: Pre-Test: 0.048e6 for 1ppm TCE; Post-Test: 0.1e6 for 1 ppm TCE.

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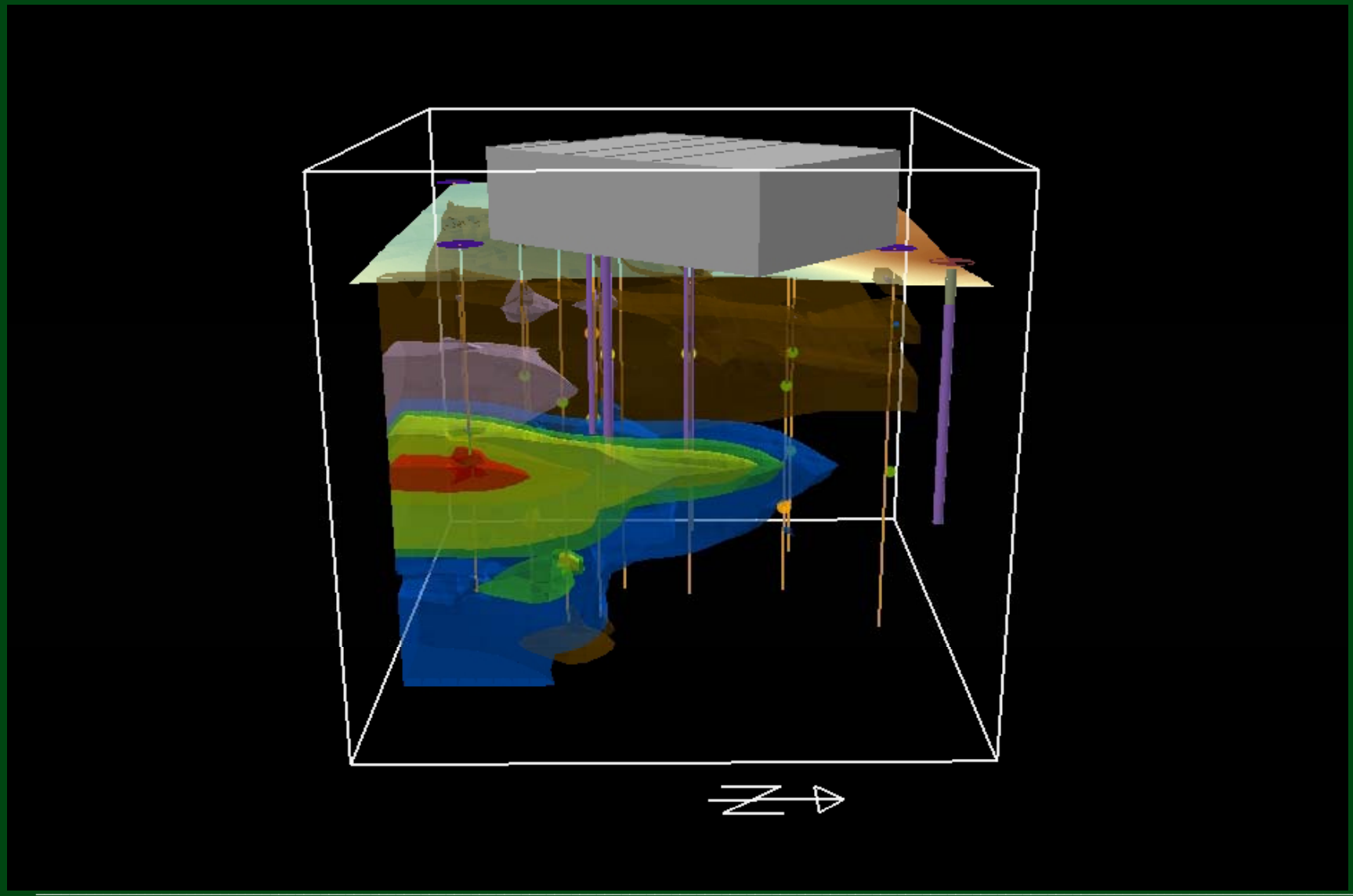
Current PCE Model



Project Results

- Initially focused on delineation of dissolved phase
- More delineation is now required
- Well depth and location are now wrong
- Total cost before MIP investigation > $25,000
- Cost of MIP investigation with analysis < $ 15,000

When to use the MIP

- Define Lithology & Total VOCs Simultaneously
  - Initial investigation tool at new sites
  - Delineation down to 150 ppb total VOCs
  - Source Area delineation (10 vs. 100 ppm)
  - Prior to remediation to target impacted zones
  - Prior to placement of wells (location & depth)

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Fuel Fluorescent Detector (FFD)

- Dual Downhole Fuel Fluorescent Detector (FFD) detects the fluorescence produced by aromatic hydrocarbons when excited by an ultraviolet (UV) light source.
- The FFD probe is coupled with Cone Penetrometer Technology (CPT) which gives a simultaneous read-out of lithology.
- Continuous, real-time data generated during the push allows for rapid delineation of Light Non-Aqueous Phase Liquids (LNAPLs) in the subsurface.

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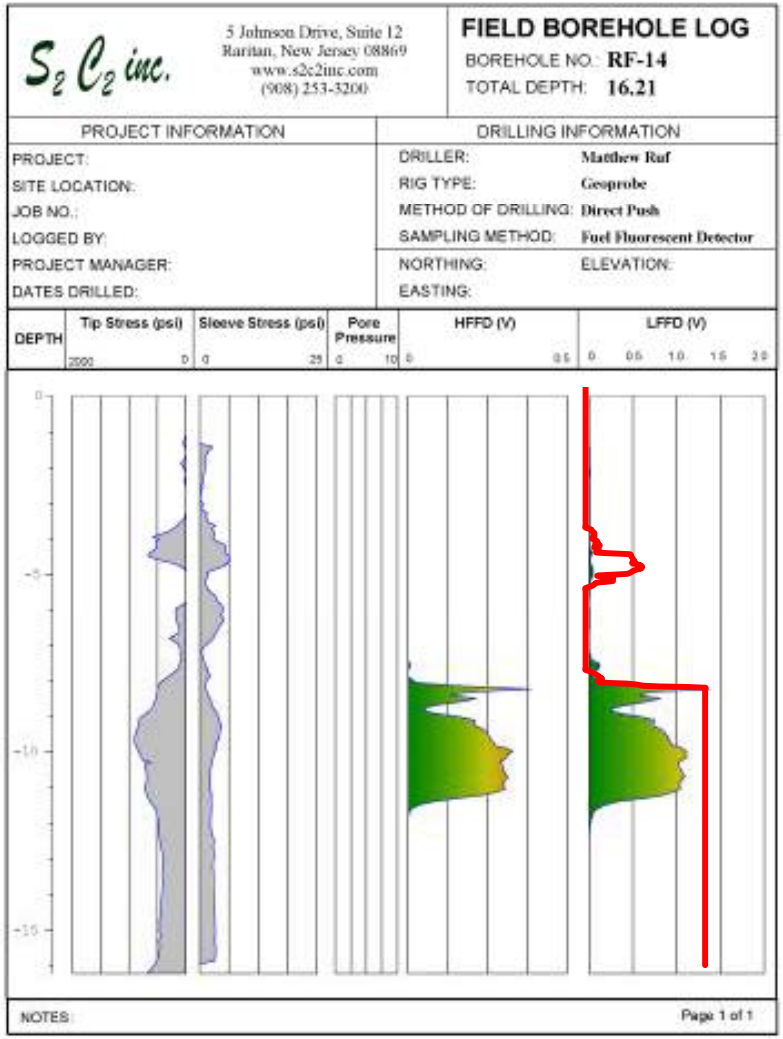
FFD Output



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FIELD BOREHOLE LOG
BOREHOLE NO.: **RF-14**
TOTAL DEPTH: **16.21**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:		DRILLER:	Matthew Ruf
SITE LOCATION:		RIG TYPE:	Geoprobe
JOB NO.:		METHOD OF DRILLING:	Direct Push
LOGGED BY:		SAMPLING METHOD:	Fuel Fluorescent Detector
PROJECT MANAGER:		NORTHING:	ELEVATION:
DATES DRILLED:		EASTING:	

DEPTH | Tip Stress (psi) 2000 0 | Sleeve Stress (psi) 0 25 | Pore Pressure 0 10 | HFFD (V) 0 0.5 | LFFD (V) 0 0.5 1.0 1.5 2.0

0 -5 -10 -15

NOTES:

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When to Use FFD

- **Define Lithology & Delineate Free or Residual Product**
  - Targeted investigation tool for hydrocarbon impacts
  - Free product delineation
  - Prior to remediation to target impacted zones
  - Placement of wells

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Project Summary – Brownfields Site

- Initial Characterization
  - Minor CVOC impacts and free-phase diesel in a number of wells
  - Wells on the site were installed to bisect water table, not set in context to geologic units.
  - Public Entity purchased property - $500,000 put in escrow
- Problem:
  - Project manager wasn't convinced that the initial characterization was correct

Solution

- Dynamic Work Strategy
  - 12 electrical conductivity pushes
  - 36 Fuel Fluorescent Detector (FFD) pushes
  - 46 Membrane Interface Probe (MIP) pushes
  - 10 - Soil and groundwater Category I laboratory samples
- Data incorporated into a project database and modeled in GIS.
- Final 3D-model was used to evaluate volumes of LNAPL and CVOC impacted soil at the site for Remediation Cost Estimates.

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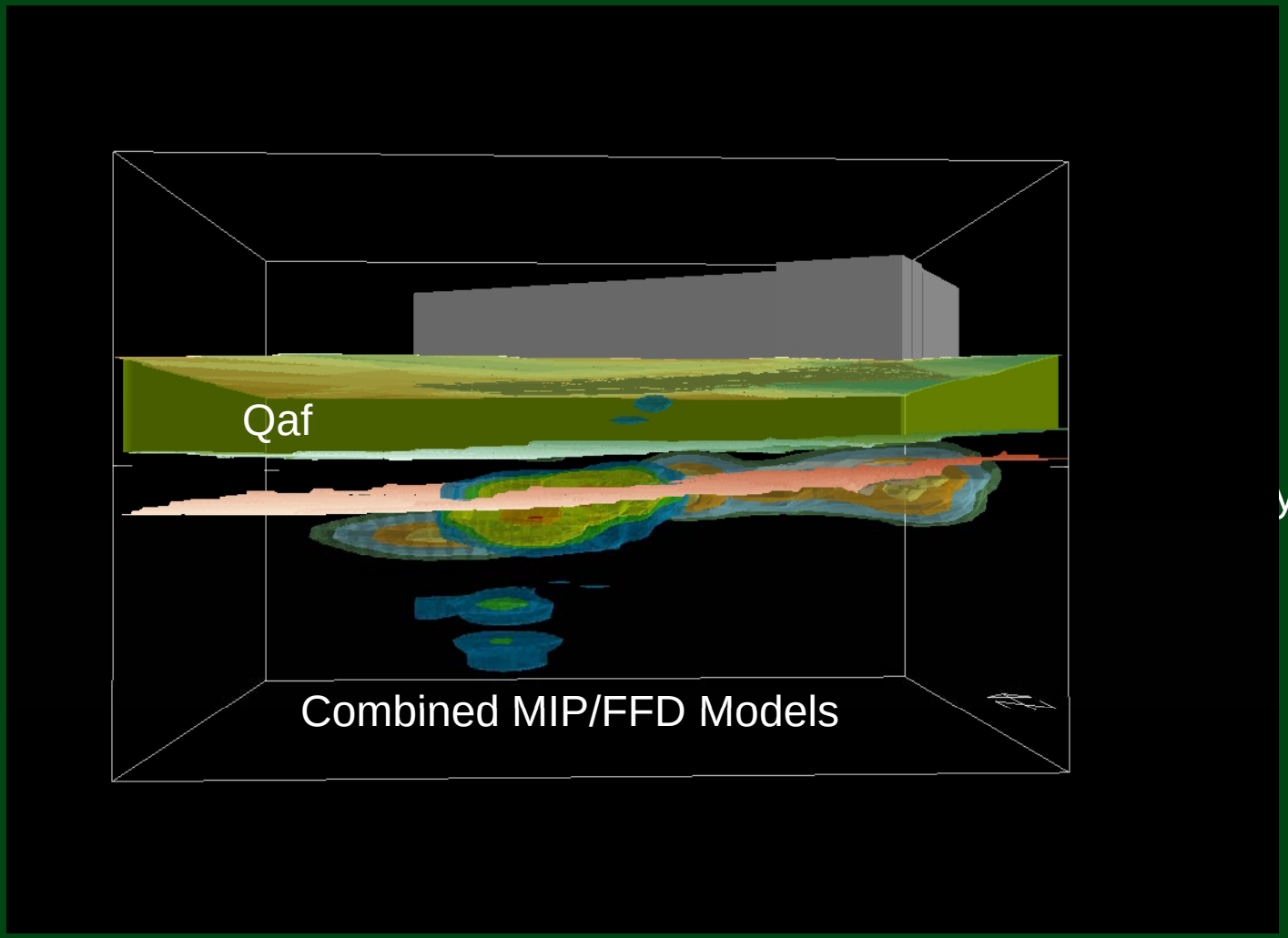
Project Summary – Brownfields Site



y Profiles

Results

- Lithology Rapidly Characterized using EC
  - Determined 3 distinct geologic units
  - Well installed without regard to these units
- MIP determined that Chlorinated impacts were minor and were associated with unknown subsurface structure.
- FFD revealed diesel impacts underestimated
- Amount set aside in escrow insufficient for remediating the site

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Tips for successful collection of real-time date

- Education
  - Training Seminars
  - Geoprobe's Website
  - Triad Website
  - Vendor's Website
- Include your subcontractors into the project from the beginning
  - Direct-Sensing operators are not drillers
- Strong Systematic Planning
  - Setup good lines of communication and establish project-specific goals upfront
- Pick the proper tool for the job

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Questions?

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