

# Environmental Emerging Technologies

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# Why Bother with Emerging Technologies?



# Risks of Trying Something New

- Everyone will laugh at you
- Uncertainty of the results
- Difficult to justify costs with confidence
- Challenging to deviate from status quo



*"Your kids are gonna love it"*

# Risks of Not Trying Something New

- Your competitors will beat you to the punch
- Your team's expertise will stagnate
- You may not be maximizing financial performance

**FOMO** [*FOE-MOE*]

**NOUN**

**ANXIETY THAT AN EXCITING OR INTERESTING EVENT  
MAY CURRENTLY BE HAPPENING ELSEWHERE.**

# Innovation and Business

- Justifying the use of emerging technologies
- Balancing value to clients with profit for your firm
- Attracting and maintaining talent
- Health and safety
- Balancing costs of training with potential for growth



# Overview of Environmental Project

- Due diligence
- Site characterization
- Active remediation or institutional controls
- Post remediation or attenuation monitoring
- Closure / No Further Action Status





# Focus Areas for Emerging Technologies

- Due diligence
  - Drones
  - Handheld devices and interactive maps
  - Automated deliverable generation
- Site assessment
  - Remote monitoring equipment
  - In-situ direct push soil and groundwater assessment
  - Resistivity with Induced Polarization (RES-IP) geophysical survey
  - 3-Dimensional site modeling applications

# Focus Areas for Emerging Technologies

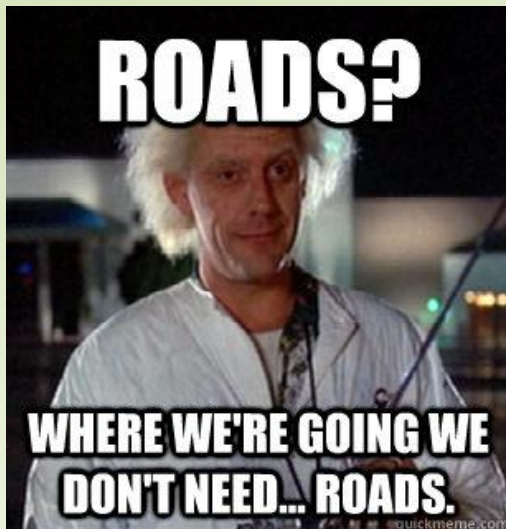
- Remediation and Institutional Controls
  - In-situ LNAPL treatment and surfactants
  - Natural source zone depletion (NSZD) measurement techniques
  - Electrical resistivity heating (ERH)





# Drones – Due Diligence

- Access to remote and/or unsafe environment
- Aerial imagery
- Customizable camera and GPS configurations



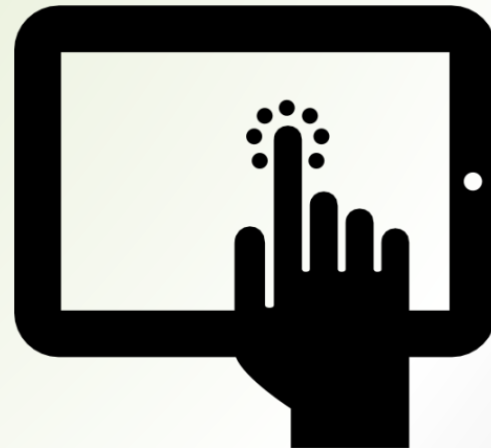
# Business Advantages

- Expands range and capabilities in remote areas
- Limits personnel exposure to harsh environments
- Saves time to respond and gather information



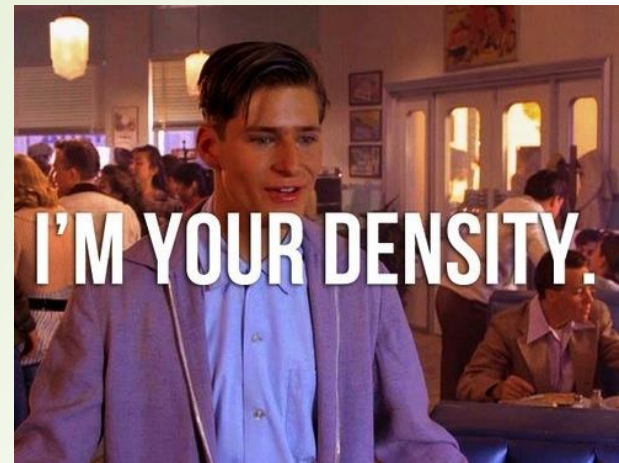
# Handheld Devices

- Tablets configured with field forms for data collection
- Streamlines data management
- Secure cloud-based data storage
- Cellular connectivity allows for data transmission in real time



# Automated Report Generation

- Customizable report templates for streamlining reports
  - Efficiency
  - Consistency
  - Quality
  - Cost effective
- Can be integrated with handheld devices
  - Data tabulation
  - Photo logs
  - GIS, eQis, and other data repositories



# Site Assessment

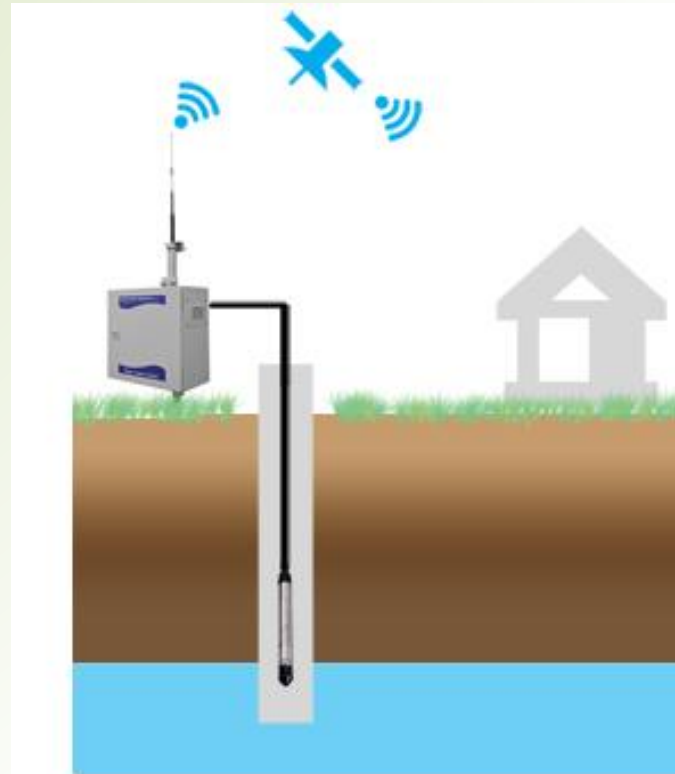
- Remote Monitoring
- Direct Push In-situ Soil and Groundwater Assessment
- RES-IP Geophysical Surveys
- 3-D visualization for conceptual site models





# Remote Groundwater Monitoring Equipment

- Dedicated transducers
- Dedicated conductivity meters
- Technical and business advantages
  - Safety
  - Scalable
  - High resolution data
  - Efficient
  - Data consistency
  - Data reliability





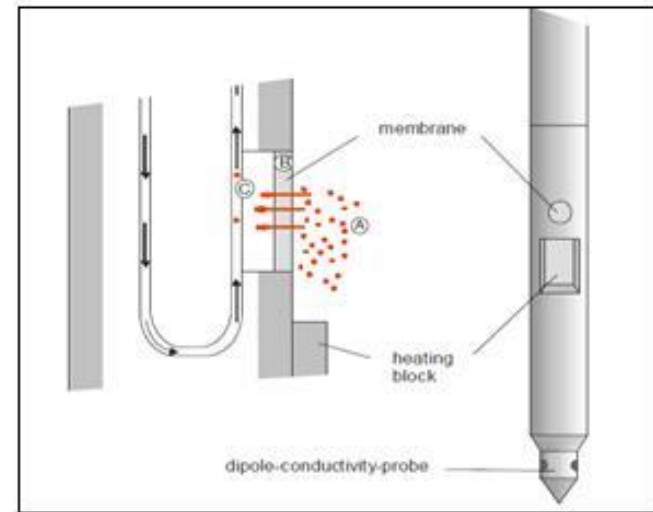
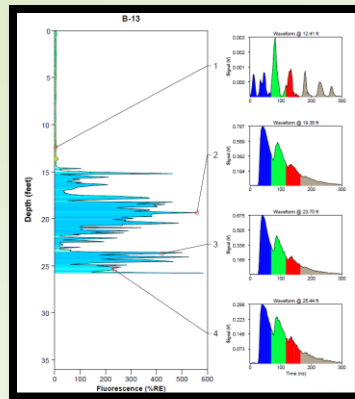
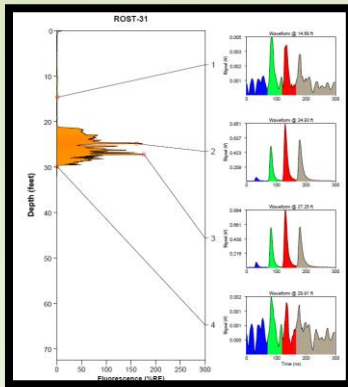
# Direct Push In-situ Soil and Groundwater Assessment

- Laser-induced fluorescence (LIF)
- Membrane Interface Probe (MIP)
- Soil electrical conductivity (EC)



# LIF, MIP, and EC Equipment

- Cone-penetrometer direct push rig
- 25-ton truck with 20-ton+ downward hydraulic ram advancing tooling
- Equipment measures hydrocarbons (LIF), volatiles (MIP), and electrical conductivity (EC)



# LIF Technical Pros and Cons

- Pros
  - Results can be correlated with soil samples
  - Rapid drilling compared to other methods
  - Detects low volatility hydrocarbons
  - Identify comingled hydrocarbons (i.e. crude oil vs. condensate)
- Cons
  - Soil type can limit drilling depths
  - Doesn't detect everything
  - Results are somewhat qualitative without lab data

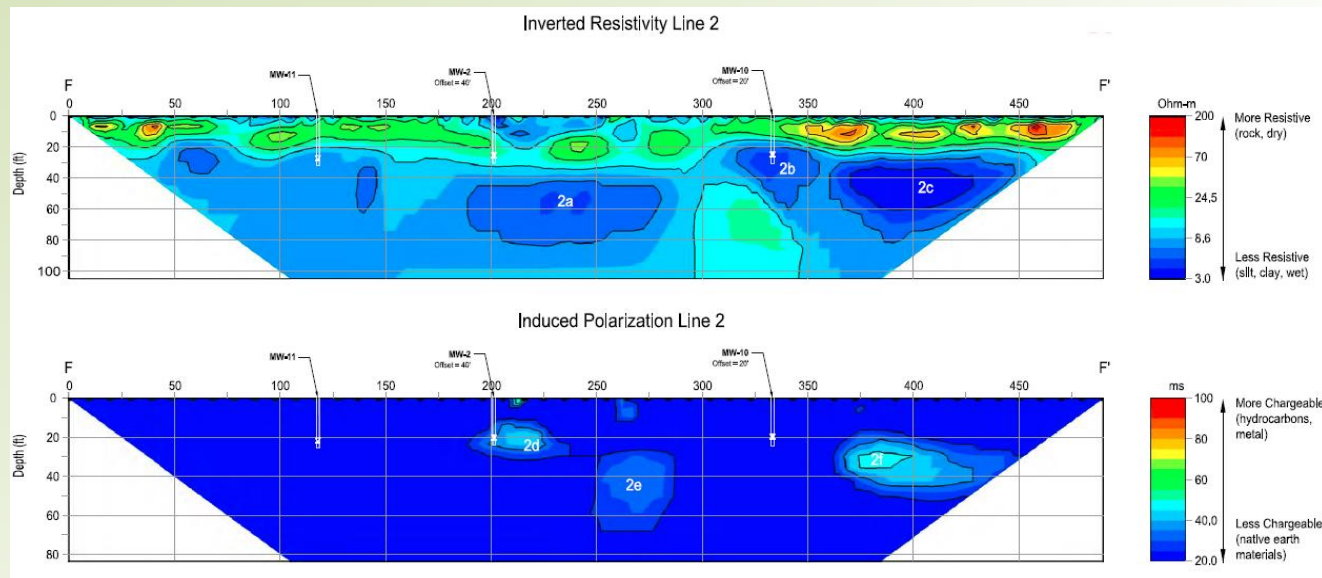
# Value

- Velocity of data collection
  - Real time data analysis
  - High resolution data
  - Optimize in real time to reduce drilling footage
- Less waste generated
  - No soil cuttings
  - Reduced decon time and waste
- Reduced lab analysis and sample handling
- Reduction in regulatory exceedance data points
- Reduced exposure to contaminated media

# RES-IP Geophysics

## Resistivity with induced polarization (RES-IP)

- Measures soil resistivity from the surface
- Equipment measures the time for electrical charge to dissipate
- Areas with hydrocarbon dissipate electrical charge more slowly





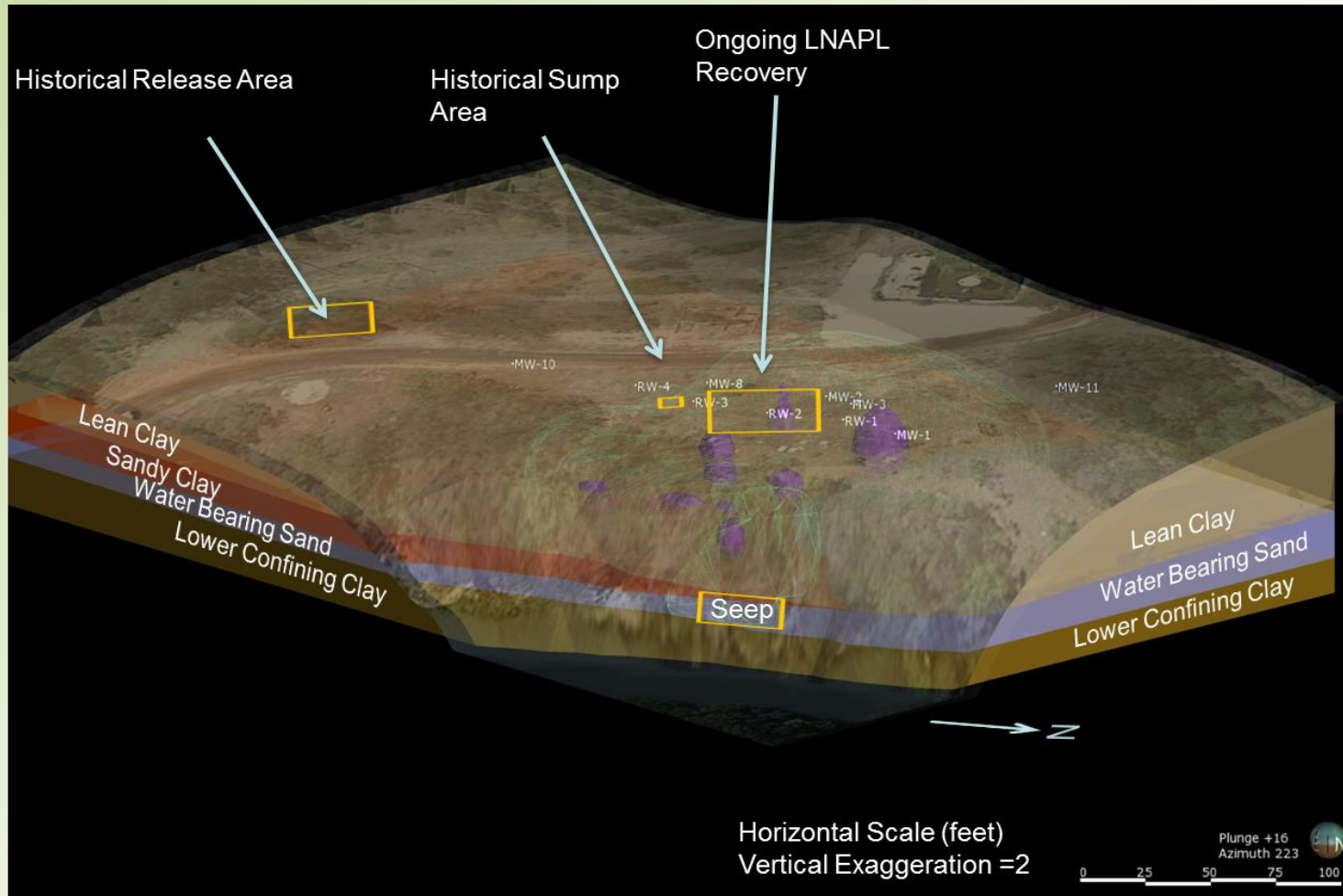
# RES-IP Applications

- Open spaces – no pavement or buildings
- Metal features can interfere with results
- Effective to several hundred feet deep
- Assess large areas and greater depths
- Target future assessments more efficiently
- Cost effective compared to drilling
- Identify preferential flow paths





# 3-D Site Visualization



# Remediation

- Emerging technologies in remediation
  - In-situ chemical applications
  - Soil gas flux analysis for Natural Source Zone Depletion (NSZD) arguments
  - Electrical Resistance Heating (ERH)

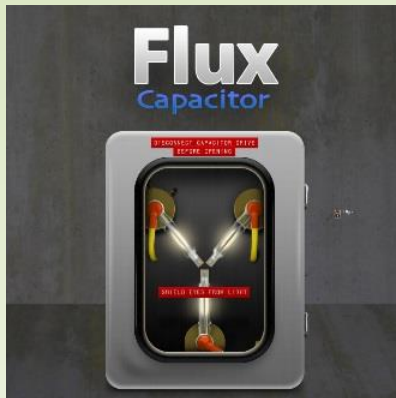


# In-situ Chemical Applications

- Chemical destruction of contaminants in place
  - Less waste generation and labor
  - Scalable to large or small sites
  - Reduce the project lifecycle for lower concentrations
- Chemical surfactants for enhancing recovery of contaminants
  - Desorption of contaminant from soil
  - Shorten project lifecycle with more efficient recovery

# Soil Gas Flux Analysis

- Optimize drilling and remediation areas
- Natural Source Zone Depletion (NSZD) strategies
  - CO<sub>2</sub> traps
  - Li-COR soil gas flux equipment
- Minimally intrusive
- Cover large areas efficiently and safely



# Electrical Resistance Heating

- Probes to heat subsurface for evaporation or destruction of contaminants
- Used with vapor recovery and treatment equipment
- Increases effectiveness of vapor recovery
- Reduces project lifecycle
- Technology has gotten more cost effective





# In Summary

- Emerging technologies range from simple and practical to highly complex
- Innovative approaches can be cost effective
- Opportunities for efficiency, velocity, and safety
- Emerging technologies can be applied to every phase of a project





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