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High-Resolution Site Characterization to Refine Conceptual Site Models

2017 Geo^{3}T^2 Conference

April 11, 2017

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Geosyntec Consultants of NC, PC

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Presentation Outline

- Historical context and background of Site
- Objectives and goals of investigation
- Short primer on HRSC
- Field assessment activities
- Data reduction and conclusions
- Path forward
- Conclusions

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Background

- Abandoned wood treating facility
- Site operated from 1953 to 1983
- Initial actions taken in 1984 following strong creosote odors in a supply well
- NPL Site in 1986
- Creosote & CCA used
- 40 acre site
- Water wells and surface water at risk

1998

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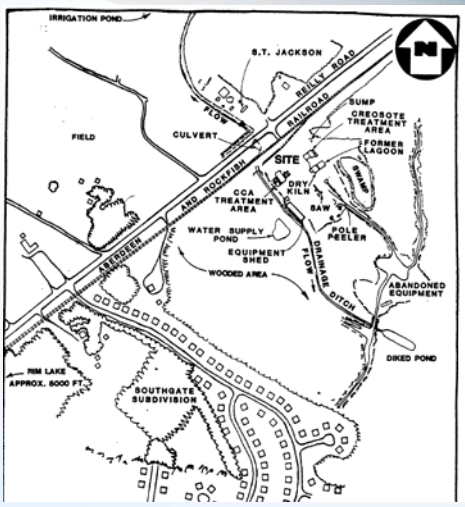
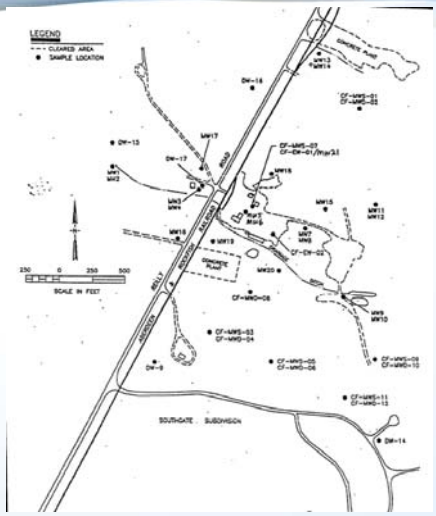
Remedial Investigation





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Initial Soil Remedy

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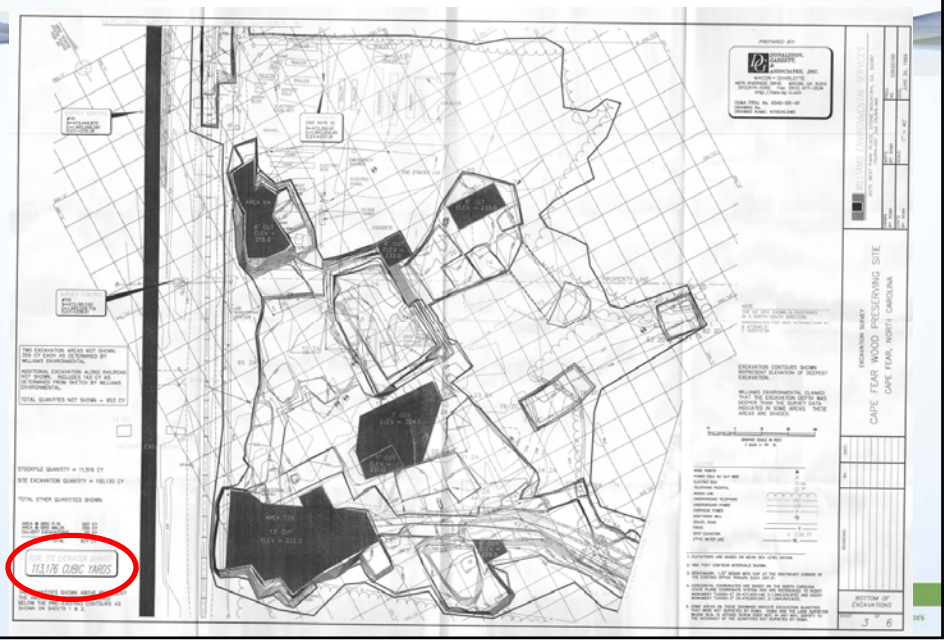
Final Excavation



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Initial Soil Remedy

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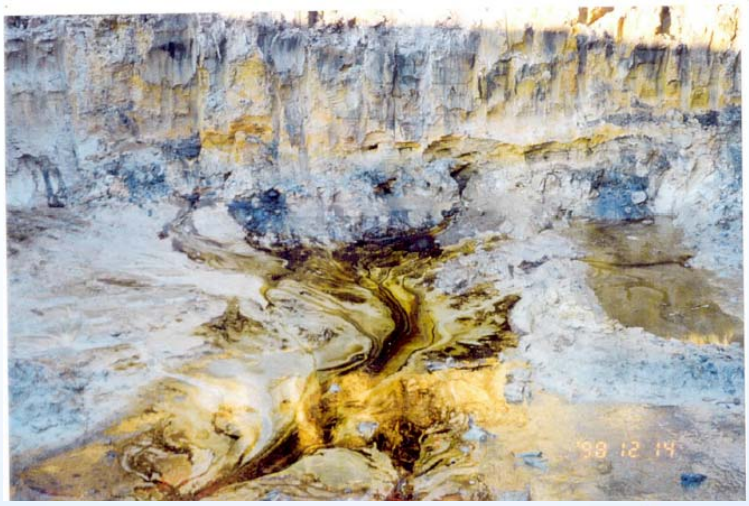
DNAPL



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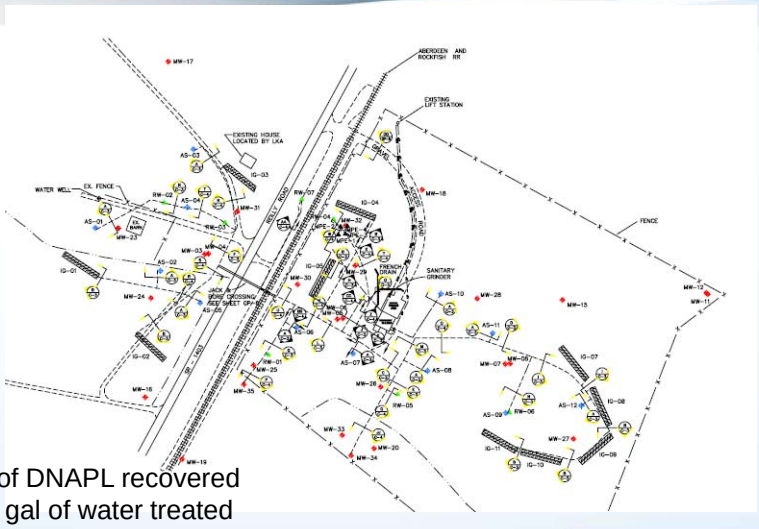
Groundwater Remedy

2001



20,000 gal of DNAPL recovered
43,000,000 gal of water treated

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Focused FS Objectives

- Delineate DNAPL
- Refine areas of DNAPL gross contamination and residual
- Establish Contaminant Media Zones (CMZs) based on degree of impact (mobile DNAPL, residual DNAPL, extended plume)
- Estimate leachability potential
- Evaluate remedial options

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HRSC

EPA's Definition of HRSC

High-resolution site characterization (HRSC) strategies and techniques use scale-appropriate measurement and sample density to define contaminant distributions, and the physical context in which they reside, with greater certainty, supporting faster and more effective site cleanup.

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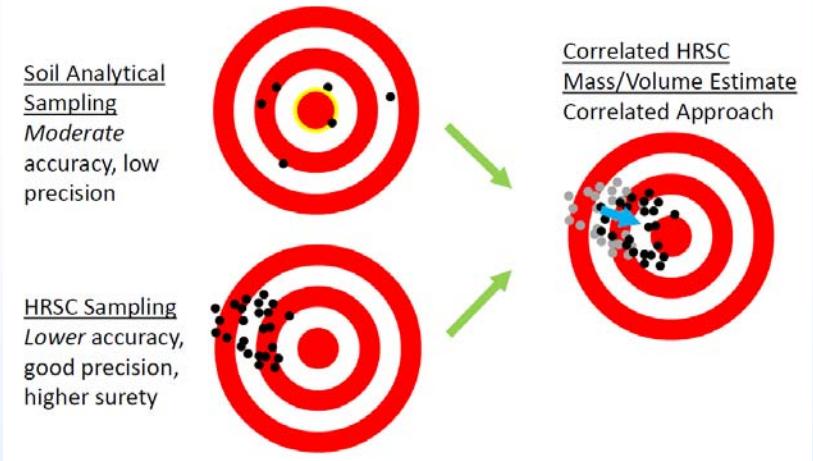
Delineation/Mass Estimation Approach



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Correlated HRSC Approach

- Identify suspect areas based on research
- Use HRSC to "screen" locations and depths
  - ~200' to 300' per day tool advancement
  - Applies to LIF, MIP, HPT, CPT
- Collocate borings adjacent to a portion (30%) of HRSC points
  - Visual logging
  - Collect analytical samples at depths based on HRSC
- Correlate screening data with visual and analytical results

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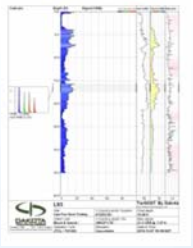
TarGOST®

- HRSC tool developed by Dakota Technologies, Inc.
- Laser-induced fluorescence tool
- Tar-specific Green Optical Screening Tool (TarGOST®)
- Tuned to coal tars and creosote
- Vertical accuracy of <1 inch
- Real-time data
- 200-300 ft/day



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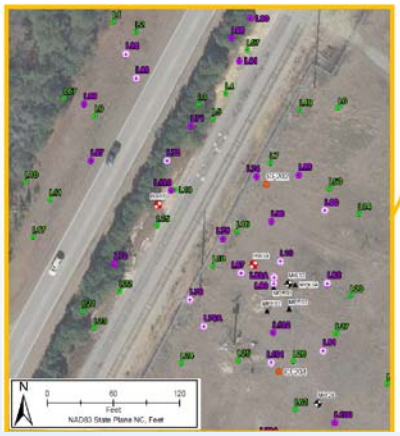
Cape Fear Wood Preserving Site TarGOST® Layout



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Tests and Analyses

- TarGOST® (103 points)
  - 70 points in 2009
  - 33 points in 2015
- Sonic Borings (20 locations) collocated with TarGOST®
  - Lithology
  - Total PAHs
  - SPLP PAHs
  - % NAPL Saturation (ASTM D425, Dean-Stark method)
  - Geotechnical parameters
  - Visual NAPL on confirmation logs

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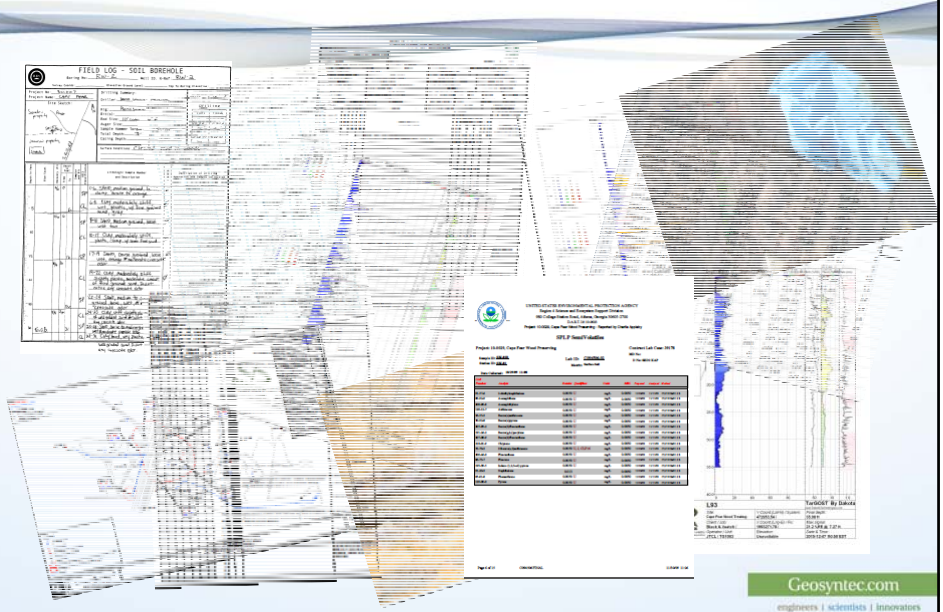
Data Analysis



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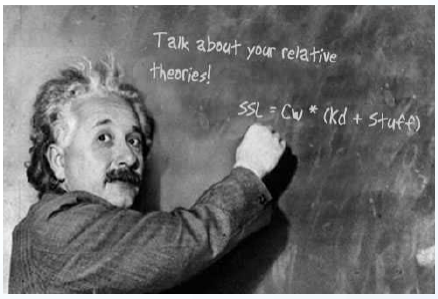
Data Quantity

- Over 100K TarGOST® Points
  - Logs plus x, y, z, %RE
- 45 lithologic logs for evaluation
  - Heterogeneous
- 100's analytical data points
  - SVOCs, SPLP, etc.
- Geotechnical parameters
  - Grain size analysis, porosity
- Survey data
- NAPL properties
  - Viscosity, free product mobility
  - Residual sat, specific gravity



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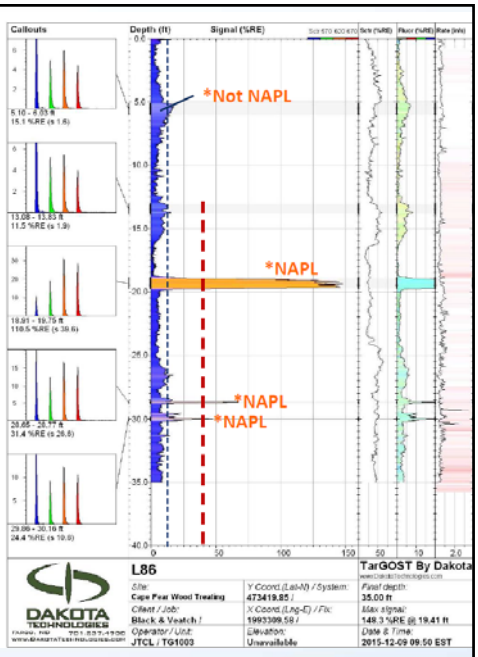
TarGOST® Result – L86

Site-Specific:

- > 40 %RE = NAPL
- 11% < %RE < 40 = Determine from callout/log
- Assign designations:
  - "definite"
  - "probable"
  - "unlikely"
  - "not NAPL"

*NAPL = Definite NAPL



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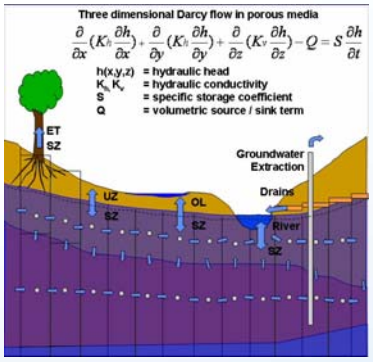
Weighing Results

- Quantitative vs semi-quantitative data
- Multiple lines of evidence
- Multi-variable analysis
  - Normal & transformed data
- Effects of hydrogeological setting



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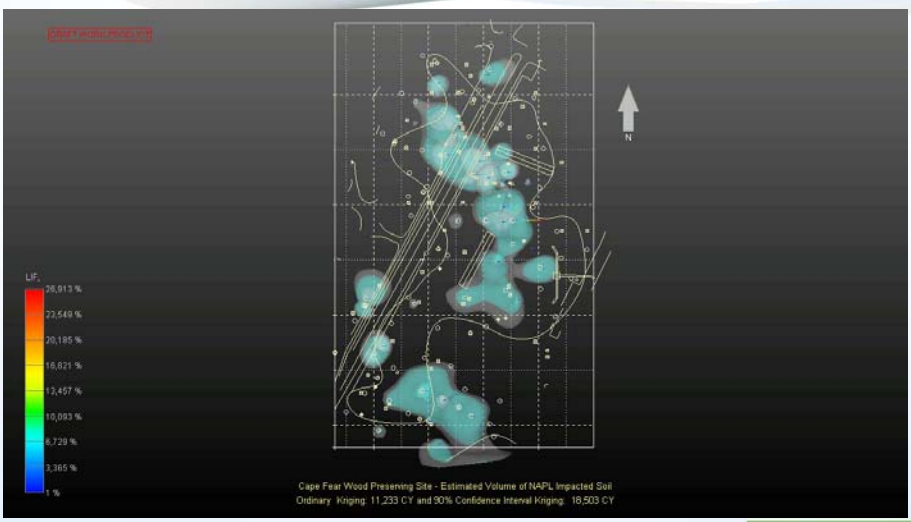
3-D Visualization



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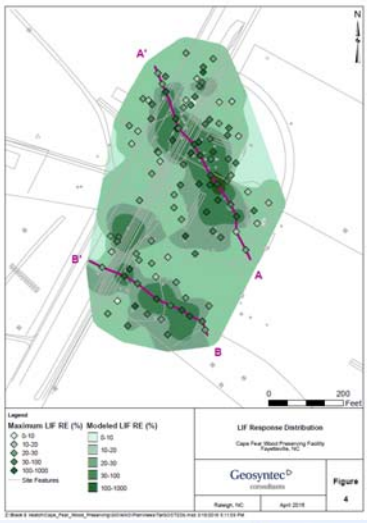
EVS Tools

- Cross-sectional analysis
- Volume estimation
- Ground truthing



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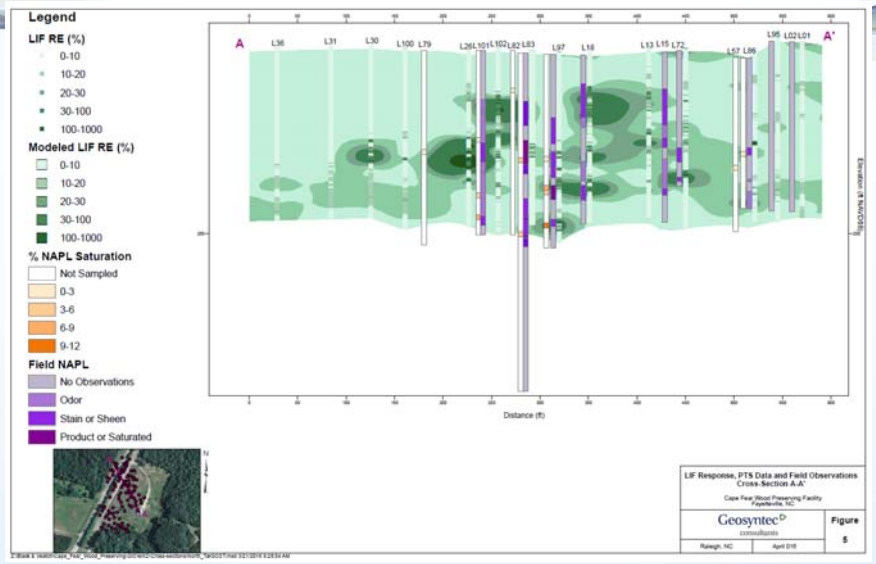
Building off of 3-D



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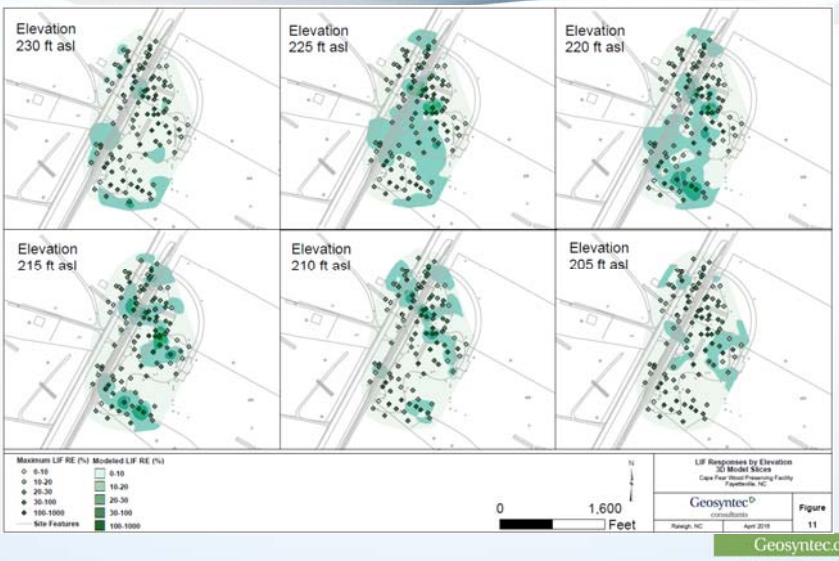
Elevation Slices



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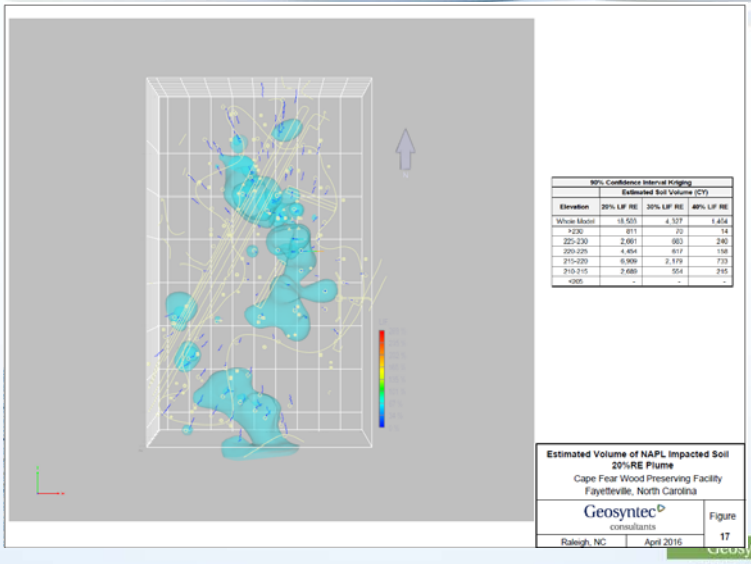
Volume Estimates



90% Confidence Interval Kriging			
	Estimated Soil Volume (CY)		
Elevation	20% LIF RE	30% LIF RE	40% LIF RE
Whole Model	18,555	4,327	1,454
>230	811	72	14
225-230	2,661	983	240
220-225	4,454	617	158
215-220	6,909	2,179	733
210-215	2,680	554	215
<205	-	-	-

Estimated Volume of NAPL Impacted Soil
20%RE Plume
Cape Fear Wood Preserving Facility
Fayetteville, North Carolina

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Raleigh, NC | April 2016

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Path Forward

- Two remedial approaches retained for Focused Feasibility Study
  - Thermal remediation – 2006 Pilot Study
  - In situ stabilization (ISS)
- Design requirements
  - Reduce NAPL mobility
  - Mitigate NAPL leaching
  - Improve soil physical properties

Reference: Stabilization and Solidification of Contaminated Soil and Waste: A Manual of Practice, Ed Bates and Colin Hills

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In Situ Stabilization

- Samples collected from each CMZ
- Different mix designs
- Test mix samples for hydraulic conductivity, leachability and strength

Design Mix [1]	Mix Composition			Estimated Reagent Cost ($/ton of untreated soil) [2]
	Soil	Portland Cement Type I/II	GBFS	
CMZ1-Mix-1	100	3	6	$ 16.2
CMZ1-Mix-2	100	3	9	$ 22.1
CMZ1-Mix-3	100	4	8	$ 21.6
CMZ1-Mix-4	100	4	12	$ 29.4
CMZ1-Mix-5	100	5	10	$ 27.1
CMZ1-Mix-6	100	5	15	$ 36.8
CMZ1-Mix-7	100	6	12	$ 32.5
CMZ1-Mix-8	100	6	18	$ 44.2
CMZ1-Mix-9	100	7	14	$ 37.9
CMZ1-Mix-10	100	8	16	$ 43.3

Design Mix [1]	Mix Composition			Unconfined Compressive Strength (psi) [2,3]	Hydraulic Conductivity (cm/sec) [2,3,4]
	Soil	Portland Cement Type I/II	GBFS		
Stage II CMZ1-Mix-1	100	3	6	197	4.4×10^{-8}
Stage III CMZ1-Mix-1 Triplicate No. 1	100	3	6	241	8.2×10^{-8}
Stage III CMZ1-Mix-1 Triplicate No. 2	100	3	6	223	4.9×10^{-8}
Stage III CMZ1-Mix-1 Triplicate No. 3	100	3	6	224	1.2×10^{-7}
Stage III CMZ1-Mix-1 Triplicate Average				229	8.4×10^{-8}

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Conclusion

- Use correlated data to visualize contaminant mass
- Identify and prioritize areas of remediation based on risk
- Implement an efficient and effective remedy
- Save client time and money!

If dealing with recalcitrant contaminants that will require remediation, then a correlated HRSC/traditional approach may be warranted

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Questions?

Acknowledgements

Hillary Thornton, EPA Region 4
Ed Hicks, Black & Veatch
Ernest Mott-Smith, Black & Veatch
Darci Scherbak, Black & Veatch
Raphael Siebenmann, Geosyntec

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