Segregation of Metals Contamination for Remediation by Cluster Analysis

RemTech 2012 – Confidential Site

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Confidential Site

- Some of our best environmental work is completed on legal files, and we cannot publish results.
- Special permission to present on a confidential basis
- Goals
  - Setting
  - Problem
  - Approach
  - Results

Setting

- Landowner with an area to fill
- Construction company fill to move
- Tested fill and everything ok
- Moved the fill
- When all fill moved someone sampled the fill
- It was contaminated with metals

Consequence

- Construction Company
  - Here are test results of what hauled
  - I have no issue
- Land Owner
  - Here are results of what is here
  - I have an issue
- Independent Consultant
  - Thoroughly investigated site
  - There was contamination of metals
  - Does not match prior results
  - More soil hauled than agreed
  - Source of extra soil unknown
  - All soil contaminated.
  - All removed to treatment. >$1,000,000

Premise

- Everyone Sued
- Premise Asserted
  - Metals above standard, want all soil with those metals removed
  - NSTS present throughout
- Counter
  - NSTS naturally occurring.
  - Must be way to segregate soil

Preliminary Results and Stats

- NSTS was a red herring.
  - 5x detection limit not valid
  - Took standard from USEPA and research.
  - Was naturally occurring background issue
- Metals Contamination
  - Look at all the metals, not just ones regulated.
  - Can we differentiate the data using statistics
  - Segregate soils based geochemical signature

Blind Analysis

- Provided all data to independent statistician blindly
  - Just provided the metals, pH and PAH data
  - Eliminated contamination parameters
  - No information on where it came from on the site
  - Completed an analysis to break it up into the respective populations.

Detailed Stats

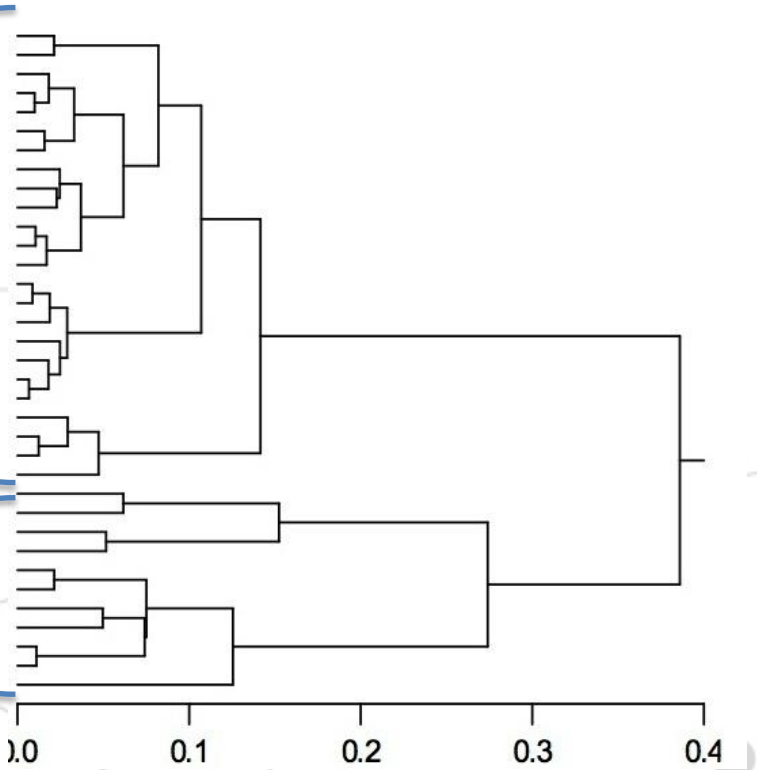
- Spearman Correlation of all possible sample pairs.
  - Non-parametric r^2 value.
  - Indicator of overall chemical similarity
  - Spearman matrix constructed using the Euclidean distance from Spearman correlation coefficients.
  - Non-metric multidimensional scaling.
  - Creates clusters – distance in two dimensions, then vectors, and finally clusters of like chemical parameters.

Statistical Results – Cluster Tree

- Following cluster tree was created.

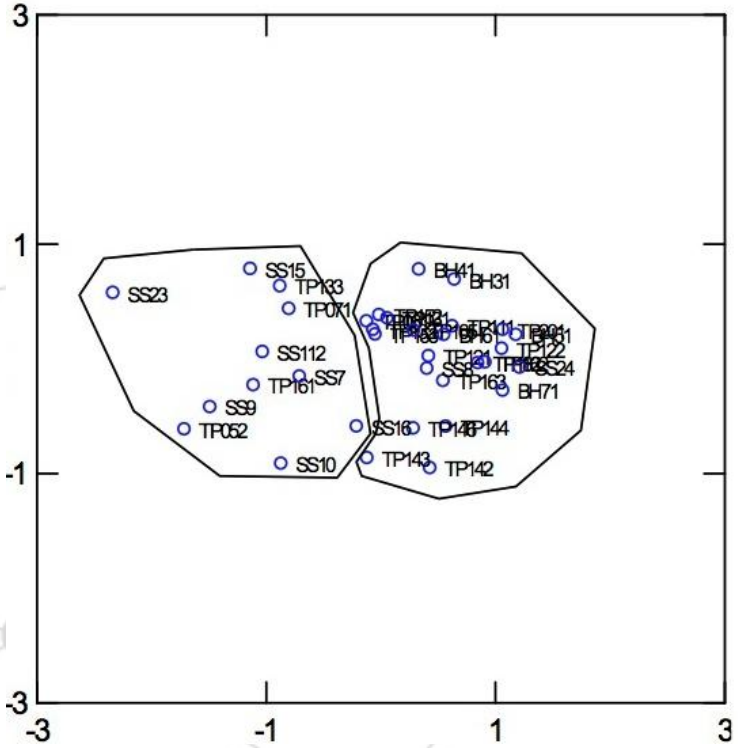
Natural Fill Source
Three separate naturally occurring materials

Additional Fill Source
Two related but different materials



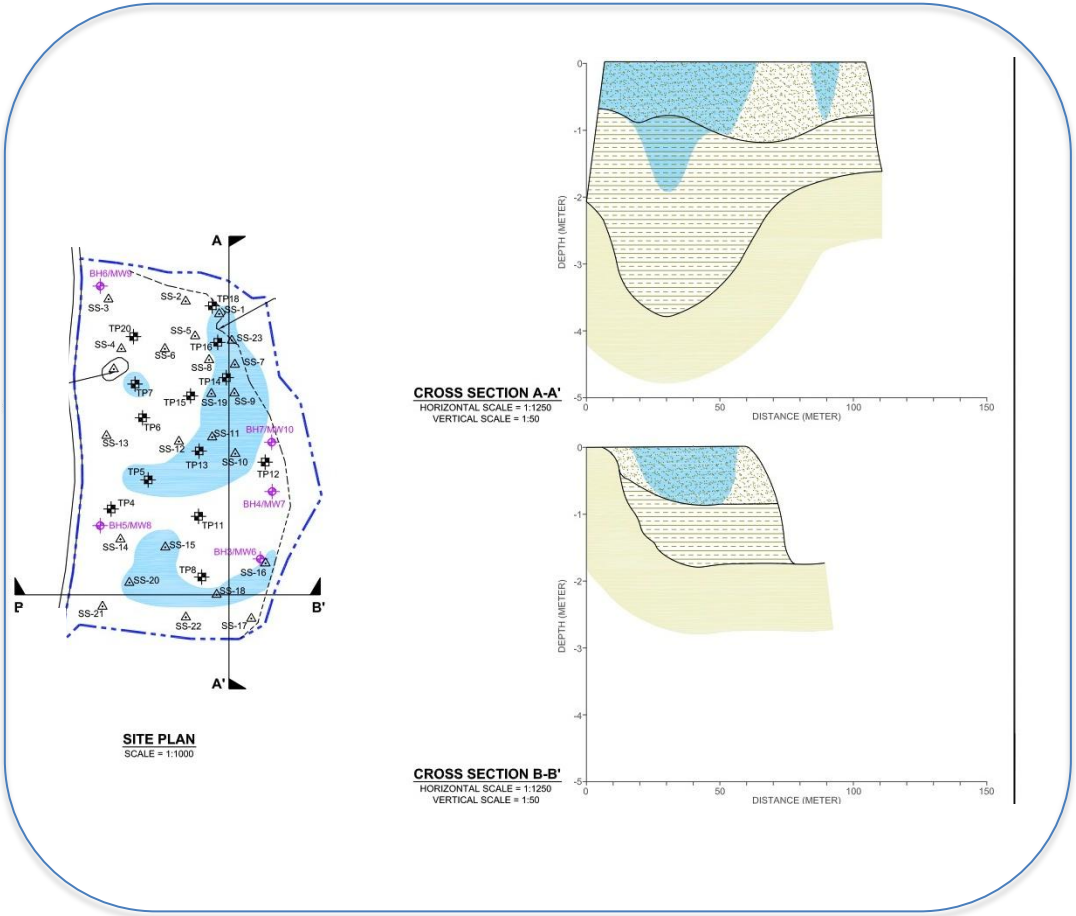
Statistical Results - NMDS

- Following clusters were formed.



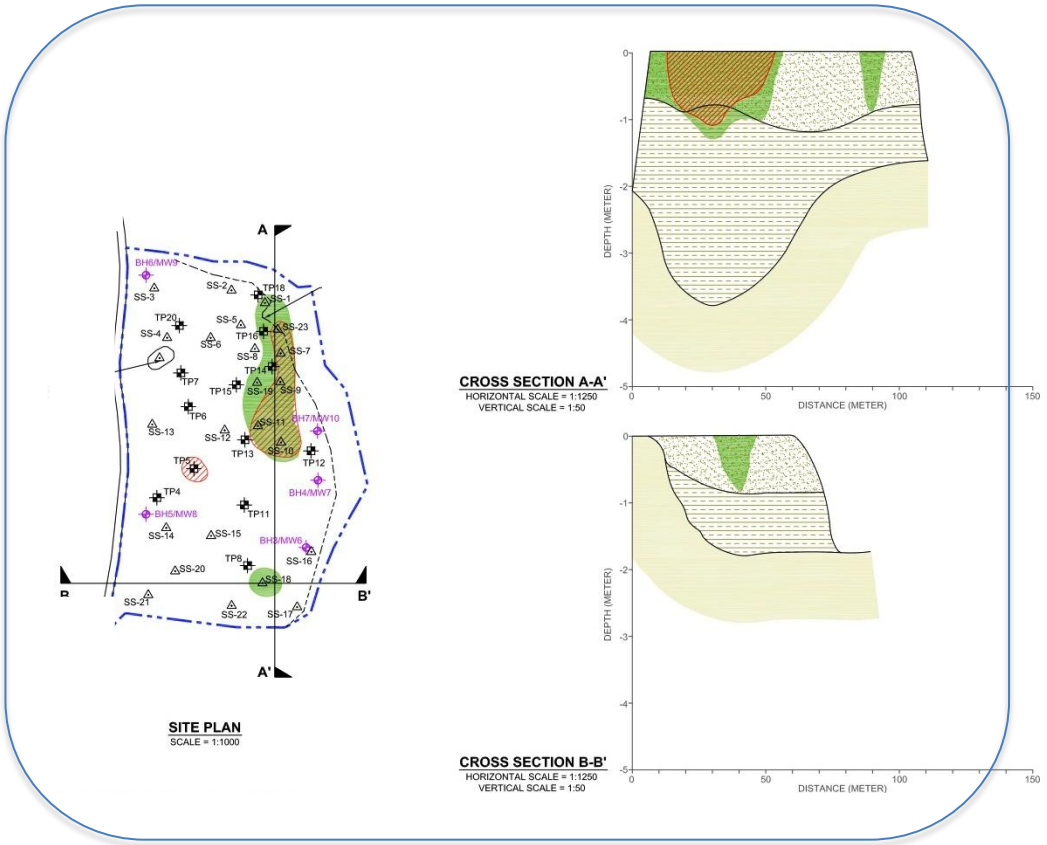
Groupings Plotted on Site Diagram

- Data points from the distinct cluster plotted.



Groupings Plotted on Logs

- Data points from the areas with contamination plotted.
- All fell within the distinct area.



What Does it All Mean?

- All soil scheduled to come to site was brought to the site.
- At the end of the job soil was brought to the site from another site. Statistically different
- Can segregate that soil easily based on location, soil type, and colour
- Cost of remediation was >$1,000,000, but now <$100,000.
- Landowner okayed just population removal
- Contractor agreed to remove to close file
- Somebody somewhere had their site remediated for free

Conclusions?

- Don’t just concentrate on the contamination. The rest of the analysis tells a story.
- Engage a statistician. You may be able to see the pattern but they can prove it.
- If you are using a fill site, secure it. There are people who are looking to dump their problem on you.

Questions? Thank You!

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