Contaminated Site Management: *A strategic approach that reduces time and cost to closure*

The remediation industry has witnessed an explosion of new technical options in the domain of in-situ and on-site remediation treatment protocols. A sound process respects the core competencies, such as engineering, geology and hydrogeology, among other scientific specialties, while integrating what is new and relevant in the world of innovative remediation technologies. The "Reduce Time And Cost to Closure" (RTAC) Program seeks to take into consideration a strategic approach and looks to offer value to reduce time and cost at each step by asking the following:

- What must be done that is actually necessary?
- If intervention is required, what are best practices?
- How can we employ underutilized technologies intelligently and effectively?
- Is there anything technologically "disruptive" that can make a significant difference?

First Things First – Is this Trip Necessary?

In some cases, negotiation can be more powerful and less costly than active treatment. The tools for this initiative are things like risk assessment and petitioning for monitored natural attenuation (MNA) as a remedy. With MNA, spending is effectively restricted to a monitoring program within guidelines as negotiations with the regulatory authorities dictate.

The history of regulatory decision-making is a highly variable process and by using a variety of arguments, not the least of which employ some of the newer environmental diagnostics, one may achieve successful, less costly outcomes.

"Doing the Ordinary Better"

If intervention is required by practical or regulatory drivers, there are some definite "do's and don'ts." In this initiative, seek out ways to "do the ordinary better." Essentially, one should ask "What really needs to be done?" and "What is the best way to do it?" Nested in this required best practices structure is a variety of operations:

- Making sure the site is properly characterized – poor site characterization is the most common cause of poor results
- Choosing the right technology – this is an art as well as a science involving a proper understanding of the benefits and constraints
- Giving proper oversight to vendor recommendations, which can be biased in a sales-driven process
- Understanding where advanced tools and processes may factor in to making process improvements in a cost-effective manner

Underutilized Technologies and Processes

There is a variety of technologies that can be characterized as being underutilized. Some have been around for a while and are just being applied to environmental science. Pay special attention to these advances and incorporate them, but always properly integrated into "core competency" – problems are solved at the first level with engineers, geologists, hydrogeologists and scientists. Some underutilized technologies and processes include:

Environmental Molecular Diagnostics (EMDs)

There are two major analytical components that dominate the EMD options and are recognized by regulators, including in guidance documents from U.S. EPA and the Interstate Technology Research Council (ITRC). The first technique, Molecular Biological Technologies (MBTs), is ostensibly, but not restricted to, an analysis of the microbial ecology by looking at nucleic acids – primarily DNA. This information is very refined in identifying individual contaminant degraders and the enzymes they employ. The other technique is called Compound Specific Isotope Analysis (CSIA), which looks at shifts in isotopes in the contaminant molecules to establish that degradation is occurring (works for both biotic and abiotic mechanisms) and has applications in allocation for mixed plumes. An example of a molecular diagnostic Microarray process is illustrated in Figure 1a. An example of Forensic Applications of CSIA is illustrated in Figure 1b.

Figure 1a

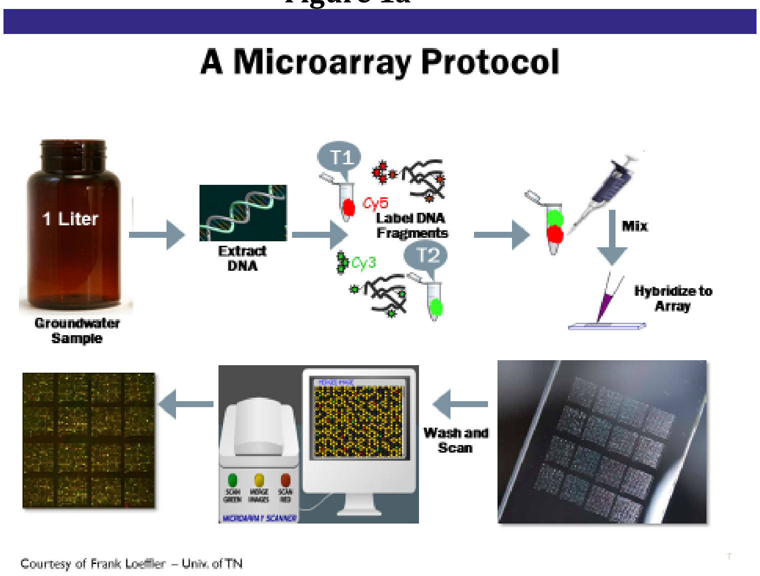
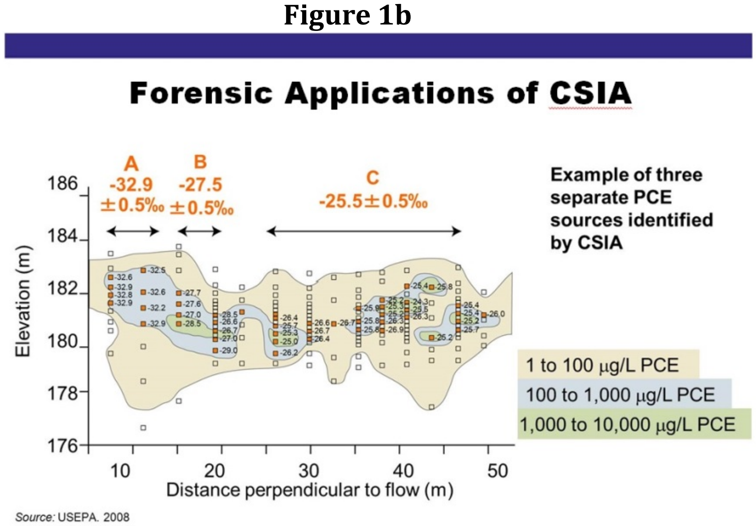


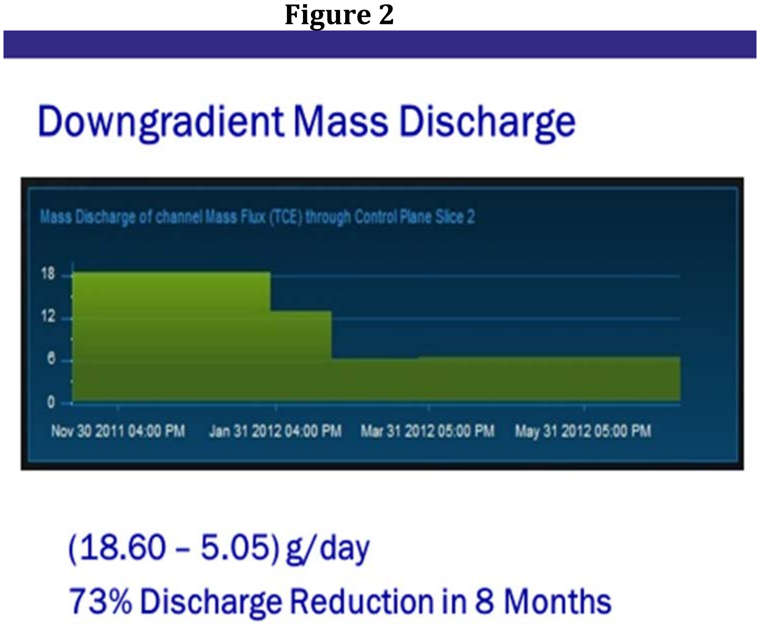
Figure 1b



Flux Discharge Analysis (FDA)

The use of FDA has the potential to be a revolutionary step in proper site characterization and in tracking the impact of remediation efforts. In FDA, a series of wells that transect the plume perpendicularly is installed to better capture the true nature of an environmental impact. Once characterized this way, it becomes easier to evaluate the benefits of a treatment in ways that are far more illuminating than dealing with the disparate patterns offered by individual monitoring well data. For clients with portfolios of sites, FDA is very useful in “racking and stacking” the problems at hand to get a better up-front assessment of what is really going on; it is akin to hospital triage in that it allows for prioritization of sites in need attention first. Figure 2 is an example of flux/discharge output.

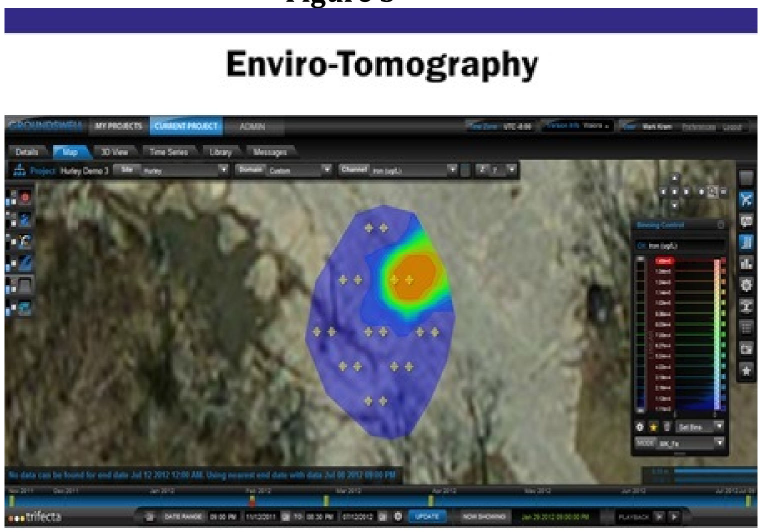
Figure 2



High-Resolution Site Characterization

This also has two analytical techniques: invasive and non-invasive. Invasive techniques use direct-push technologies to sample the subsurface with a variety of tools, in some cases as simple as heating the matrix and driving vapors sequentially to the surface where a vertical contamination profile can be created. Other times, the geological matrix can be mapped with a variety of borehole diagnostic tools to track the likely flow paths of contamination and engineer ways to contact the relevant areas with treatment reagents. In the case of non-invasive techniques, images are generated by a variety of techniques ranging from seismic inputs, to radio waves, to electrical resistance measurements – similar to non-invasive medical diagnostics. The term for this “scanning aspect” is “enviro-tomography.” Figure 3 is an example.

Figure 3



Disruptive Technologies

The apex of the RTAC Program is the ability to use some technologies that some refer to as “disruptive,” meaning their introduction can make a very significant difference in site management. There are four such options in Industry Leading Technologies (ILTs):

- Bioaugmentation with Archaeal Organisms – using a unique group of microorganisms that form their own taxonomic Kingdom on par with plants and animals. This is largely applicable to hydrocarbon or other organic sludges, such as pulp and paper waste.
- Accelerated Remediation Catalysis (ARC) – managing effluents with an emphasis on compounds that are recalcitrant to standard treatment systems (such as 1,4-D and perflurocarbons), but also applicable to all reducible or oxidizable contaminants. A key value proposition is that there are significant economic and footprint advantages over Advanced Oxidation Processes (AOPs) and resin-based technologies. ARC is initially applicable to groundwater from pump-and-treat systems with promising applications on industrial effluents and landfill leachates.
- Thermozyme – a unique approach to manage PCBs, dioxins and 1,4-dioxane in soils, sediments and demolition wastes.
- MiProbe Technology – a sensor-based system that measures relative aerobic metabolic activity and mass loss of NAPLs on a site and can transmit data in real time to the cloud for computer visualizations.

As remediation science has evolved over several decades, the industry is in a much different space than it was in before. Clearly there are a number of relevant and exciting new things to consider in managing contaminated sites.

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