

Green/Sustainable Petroleum Management: Building a Dataset around an Intuitive Connection

Andy Pennington (andy.pennington@arcadis.com) (Arcadis, Chicago, IL)

Jessica Gattenby (Arcadis, Tampa, FL)

Rick Ahlers (Arcadis, San Diego, CA)

Cullen Flanders (Arcadis, Syracuse, NY)

Davinder Randhawa (Arcadis, Columbus, OH)

Marc Chalfant (Arcadis, Seattle, WA)

Shannon Dunn (Arcadis, Minneapolis, MN)

Background/Objectives. Stakeholders are increasingly recognizing that in many cases the remedial actions implemented to comply with removal of petroleum NAPLs to the extent practicable often lead to costly and time-consuming remedial actions with little reduction of risk or overall life cycle. The emergence of a risk-based NAPL management approach has developed concurrent with the development of GSR concepts and sustainable best management practices in remedy selection. To date, beyond general statements about effectively using resources and avoiding unnecessary efforts within the NAPL community, little recognition of the overlap between the practice areas of GSR and risk-based NAPL management has occurred. New technologies and assessment approaches offer value both in terms of GSR-focused metrics and science-based, attainable endpoints that avoid inefficient or unnecessary uses of resources. These approaches can demonstrate that short-term risk is absent and that NAPL is being naturally depleted at substantial rates, or manage risks with tailored, low-maintenance measures for a more green and sustainable remedial strategy.

Approach/Activities. A range of projects were reviewed to examine the sustainability benefits of several risk-based or innovative NAPL management tools, including:

- Use of the Oleophilic Bio-barrier (OBB), a permeable, self-regenerating barrier, to prevent surface water sheens (in contrast to conventional containment measures)
- Use of Thermal In-situ Sustainable Remediation (TISR), at type of low-temperature thermal enhancement, to promote biodegradation and reductions in NAPL saturation
- Use of NAPL stability and transmissivity data to transition from NAPL recovery to monitoring or closure-in-place, based on a lack of risk or achievement of a practical limit (in contrast to ongoing recovery to reach volume or thickness targets)
- Use of measured natural source zone depletion rates to support ending NAPL recovery, based on the magnitude of benefit provided by NSZD relative to that provided by hydraulic recovery efforts.

The benefits of each of these approaches relative to conventional or status-quo measures were reviewed following the USEPA *Principles for Greener Cleanups* methodology. The results offer a concrete expression of the value that these tools can offer, paralleling the benefits offered by other BMPs referenced in existing GSR documentation. Highlighting the use of sustainable best management practices (SBMPs) in reviewing the data and approaches to these NAPL projects will promote awareness of GSR among NAPL project managers and awareness of newer NAPL management options among remediation project managers and sustainability practitioners, outside of the specialized NAPL technical community that has developed the approaches.

Additionally, building on these project examples, a meta-study scale review will be presented that assesses the potential green and sustainable benefits of applying these concepts at a portfolio-wide level. This review identifies an estimated number of sites where low-efficiency NAPL recovery has been conducted despite few, if any, indications of risk. With the understanding that

NSZD provides significant and on-going mass depletion, the potential sustainability benefits of a risk-based closure-in-place endpoint will be discussed.

Results/Lessons Learned. The case studies demonstrate correlation between GSR principles and the application of risk-based NAPL management tools, and illustrate the significant green and sustainable benefits that can be achieved by identifying science-based, attainable remediation objectives and choosing appropriate remedial technologies.