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Optimizing Green Remediation in the Design and Implementation of an Anaerobic Bioremediation Remedy

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Background/Objectives. Lifecycle optimization is an important process that has been used in the selection, design, and implementation of remediation systems for several years. Recently green and sustainable remediation (GSR) has been added to this optimization process. A GSR optimization has been conducted in the remediation technology selection, design, and implementation phases at the NASA Former Drum Storage Area (FDSA) at Kennedy Space Center, Florida.

Approach/Activities. This site contains chlorinated volatile organic compounds (CVOCs) in groundwater, which have the potential to discharge to a nearby surface water body. The site is located within a remote area containing marshes and scrub-brush cover. A Corrective Measures Study (CMS) was prepared, which screened nine remedial technologies for the site. The most sustainable remedy, enhanced anaerobic bioremediation, was selected, designed, and implemented at this site. The lifecycle optimization including GSR considerations will be described in this presentation.

Results/Lessons Learned. Sustainable remediation metrics to be considered during screening of remedial alternatives, remedy selection, remedy design, and implementation of the remedy were defined for this project. The metrics, including green house gas emissions (GHG), energy usage, and water consumption, were estimated for each step in the remediation process and compared for each remedial alternative. The evaluations performed show that the largest footprint reductions were achieved during the remedy selection phase. Bioremediation, which had the lowest environmental footprint, was selected as the preferred remedy over technologies such as containment via groundwater extraction or prevention of discharge to the surface water body via air sparging. The sustainability of the remedy was further enhanced during the design process. The design and related sustainability evaluation identified efficiencies in substrate selection and delivery methods and alternative energy sources. The material and equipment usage was decreased by reducing the number of injection locations to focus on higher concentration zones, using a recirculation delivery system, implementing solar power as a renewable energy source, and optimizing the amount of the bioremediation substrate. The system was installed and tested to evaluate bioremediation via recirculation of a mobile substrate. It turned out that the solar-powered recirculation system not only had the smallest net environmental footprint but was also more cost-effective compared to a conventional design using grid-based electricity. Most importantly, not only was the remediation system more sustainable, it was very effective in achieving the overall goal of preventing discharge of contaminated groundwater to the surface water body and reducing CVOC concentrations in site groundwater.