Phytoremediation and Rhizodegradation Pilot Studies at a 73-Acre Former Waste Water Pond in Northern California

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Background/Objectives. A former 73-acre waste water treatment pond is located adjacent to a coastal estuary with surrounding wetlands. The site contains a surficial layer of historically-discharged material composed of fine-grained material with total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAHs), and metals as chemicals of concern (COCs). Due to the site setting and history, the surface material exhibits high salinity and sodicity. Pilot studies are being performed to evaluate the effectiveness of phytoremediation and rhizodegradation (via indigenous microbes) to achieve remedial goals. The end goal is the restoration of the pond as an estuarine tidal wetland that is similar to the surrounding area. The results of the ongoing pilot studies document rhizodegradation processes/rates through microbial analysis and plant uptake with different plant types, soil amendments, soil aeration methods, and irrigation approaches.

Approach/Activities. The 12-month pilot study involving dewatering a 10-acre portion of the pond to construct irrigated test plots ranging from 1-acre to 10,000 square feet was initiated in October 2016. Some of the plots were used to evaluate the influence of different native plants (*Distichilis spicata* [saltgrass], *Jaumea carnosa* [jaumea], *Atriplex patula* [fat hen], and *Sporobolus airoides* [alkali sacaton]), compost, fertilizer, and gypsum on COC degradation and uptake. Other plots underwent mechanical soil aeration (i.e., rototilling) and amendment addition (mulch, compost, and spent mushroom compost). Plant survival and root zone characteristics were documented. Time series analyses for COCs in the waste material and plants and environmental molecular diagnostics (EMDs) were used to evaluate microbial degradation processes/rates in the rhizosphere, and plant uptake. The EMDs included advanced metagenomics to characterize indigenous microbial communities under the various test conditions, including Next Generation Sequencing (NGS) DNA analysis, QuantArray Petro analysis, and Stable Isotope Probing (SIP). The study also included analyses to estimate degradation rates by employing fingerprint time-series sampling and compound specific isotope analysis (CSIA).

Results/Lessons Learned. The results are expected to demonstrate that native plants can be established in the former waste water pond, with plant diversity, density, and root zone penetration varying with plant type, composting, soil conditioning, irrigation, and meteorological conditions. Indigenous microbial communities were characterized at T=0 in the different plots, including population density in the rhizosphere of the native plant plots, the mechanical aeration plots, and amendment plots. The potential for COC degradation and pathways were also documented. Subsequent data at T=6 and T=end are intended to provide lines of evidence to determine if the pilot studies demonstrate that phytoremediation and rhizodegradation represent a potentially effective remedy for restoring the site. These results will be used in a forthcoming Corrective Measures Study for comparison to more traditional remedial strategies such as excavation, chemical oxidation, and/or capping.