Geocells: An Innovative Approach to Capping Sediments in High-Energy Sandy Sediment Environments

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Background/Objectives. At the Tittabawassee River in central Michigan, sediment deposition during the early 1900s coincided with the direct discharge of wastewater from a chlorine manufacturing process into the river; the wastewater discharges included graphitic carbon particles containing sorbed chlorinated dibenzofurans. Furans belong to the dioxin family of chemicals, due to their similar chemical structures. Mixing of the graphitic particles with the sediments that deposited in the channel bottom led to the presence of furans in some areas of the sediment bed. One objective at this site was to identify, screen, select, and implement effective strategies for remediating the river bottom. One technology that stood out among the others is the use of a natural deposition Cellular Containment Systems (CCS) to cap sediment deposits in the river.

Approach/Activities. Cores were collected along the river bottom to understand the distribution of furans and dioxins in the river, and to identify the areas with the highest furan and dioxin concentrations. River bottom stability analyses were conducted to characterize the erosion potential of the river during normal and high flow events. Stability surveys included a geomorphological survey and assessment of the river, multiple bathymetric surveys to evaluate the potential for erosion, and modeling. Areas of the river with deposits that have the potential of contributing furan and dioxin mass to the river were identified for remediation. Potential remediation strategies included removal, capping / stabilization, or monitored natural recovery.

CCS is a capping approach that promotes natural sedimentation through the placement of geocells. The CCS caps are designed to isolate contaminated sediments from physical erosion, eliminating the potential for sediments to serve as a secondary source of furans and dioxins to the river and its adjoining floodplain. Multiple individual geocell units are attached together to obtain the desired sized geocell system for each remedial area. During higher flow periods, uncontaminated sediment loads are carried into the river from upstream. Over a short time, the geocells fill with sediment through natural bedload movement of particles, filling from upstream to downstream forming a natural cap. Once filled, each individual cell can lose or gain a small amount of material, but the entire grid is self-stabilizing insofar as it continues to be filled with new bedload entering from upstream.

Results/Lessons Learned. As of the end of 2017, approximately 90,000 square feet (2 acres) over five separate areas have been remediated using the natural deposition CCS. The CCS has proven extremely resilient to high-flow events and erosion, and appears to be self-stabilizing as stated above. The CCS caps are cost effective and can be installed in remote and difficult to access locations. The CCS materials can be delivered to the remedial site using small off-road vehicles or small shallow draft vessels and can be installed by hand with minimum equipment, although water depth is a consideration for implementation. This presentation will discuss the work that supported this unique use of CCS, their design, installation, and long-term performance.