Research of Danny Reible relevant to in-situ management of contaminated wetland and subaqueous sediments

Research into the management of contaminated wetland and subaqueous sediments is focused on in-situ containment, alone or in combination with treatment layers, and on assessment of processes that might compromise in-situ management approaches. Many of the contaminated sediment sites that we currently face exhibit conditions that are problematic for conventional capping. Dr. Reible's group works with many such sites allowing the identification of several common issues that require further research in order to develop appropriate responses. Specific problems under investigation include,

Gas and NAPL mobility in sediments – many current sites exhibit significant entrapped gas or nonaqueous phase liquids (NAPLs) whose mobilization may compromise the success of in situ-capping or treatment efforts. Research is underway to develop an improved experimental procedure to assess the response (mobilization) of this gas or NAPL to the disturbance and loading associated with sediment capping and resulting consolidation processes. This research is focused on developing a variant of traditional triaxial cell consolidation testing using undisturbed cores and realistic loadings combined with simultaneous measurement of consolidation and phase and contaminant mobilization. This research is coupled with complementary research into active capping technologies that can mitigate gas or NAPL mobilization including evaluation of the filtering effects of conventional sand caps and the effectiveness and appropriate design of organoclay amended caps

Biogeochemical response to capping – capping contaminanted sediments inherently results in significant modifications of the biogeochemical environment of the sediment contaminants. These modifications may be positive, e.g. development of strong anaerobic conditions which limits mobility of some metals and may eliminate mercury methylation, or negative, e.g. the reduction in biodegradation of many hydrophobic organic compounds under strongly anaerobic conditions. The evaluation of the dynamics of these biogeochemical changes and their influence on contaminant mobility and fate is the subject of this area of Dr. Reible's research. This research considers both changes in the sediment underlying a cap and the changes in the cap itself. An important product of this research is expected to be a better understanding of the biogeochemical environment within the cap and the effectiveness of a cap in the promotion biodegradation processes. This research is focused on evaluating these processes under both generic conditions and at specific sites where the fate processes within a sediment cap are an important design constraint.

Bioavailability of sediment contaminants- it is increasingly recognized that bulk sediment concentrations provide a limited indication of the potential toxic effects of the sediment. Bioavailability research conducted in Dr. Reible's research laboratory is focused on the development of better tools for the in-situ assessment of bioavailability and the practical implications of common management approaches, e.g. capping, on bioavailability. Solid phase microextraction fibers are a useful analytical tool in the laboratory for assessment of porewater concentrations, often a good indicator of bioavailability. The development of practical approaches to using this tool in the field is underway and includes the demonstration of the relationship to organism uptake and

effects measured simultaneously. Part of this research is directed toward assessing the effectiveness of commonly used "backfill" approaches to the management of dredging residuals at contaminated sediment sites. Although effective at reducing bulk sediment concentration, reductions in bioavailability associated with this approach are unproven.

Active Capping of Contaminated Sediments- Dr. Reible's research is also directed toward continuing the development of new approaches to combining capping and treatment of sediments. Some of these approaches are directed toward control of specific contaminants, such as organoclays to manage NAPLs as described above, but other aspects of this research are directed toward general improvement in the options available for simultaneous containment and treatment of sediment contaminants. Part of this research is directed toward continuing monitoring of the efficacy of the caps placed during the Anacostia River Active Capping Demonstration led by Dr. Reible. Other components of this research are directed toward the laboratory evaluation of new potential capping materials and procedures, including the use of combination caps for simultaneous metal and organic contaminant sequestration with erosion control. Specific materials under consideration, either alone or in combination, include phosphate minerals, activated carbon, organoclays, zero-valent iron and a variety of biopolymers.