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Project Title: Promotion of a New UNH Sediment Remediation Technology

Project Description: My outreach project is part of a larger effort at the UNH Contaminated Sediments Center (CSC) to develop, demonstrate and promote new technologies for sediment remediation. Traditionally, university researchers have done well at developing and demonstrating new technologies, but have not done so well at promoting the technology for use in the real world. For environmental technologies, one difficulty is that the technologies are so new that the end-users don't know very much about them or how they work. For example, if you are trying to sell a better computer, it is a safe bet that your audience already knows what a computer is and how it works, so you can focus on what your computer does better than other computers. Environmental technologies require a significant outreach effort to potential end-users just to educate them about what it is and how it works. Once this is done, the technology can be compared to other technologies. However, the most appropriate means to conduct this outreach effort are not very well established. In 2004, I received a grant from the Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET) to conduct a technology transfer project to promote the use of our most mature technology, a phosphate-based reactive capping technology. This outreach project is a follow-on effort to the technology transfer project, and seeks to assess the effectiveness of the original outreach effort as well as refine how future outreach should be conducted.

Background Information/Problem Statement: Contaminated sediments have adversely impacted marine life, disrupted the ecological food chain, and have resulted in fish advisories, which can have a significant adverse impact on local economies. To understand the scope of this problem, consider that when preparing its Contaminated Sediment Management Strategy, the US Environmental Protection Agency (EPA) reported that about 10% of the Nation's surficial sediments were contaminated, corresponding to a volume of 1.2 billion cubic yards of material that must be treated. Similarly, a 1993 survey of Naval facilities found that 94% of the respondents had at least 1 contaminant of concern. The most common contaminants were metals (76%), PCBs (72%), other hydrocarbons (72%) and fuels (45%). It is clear that remediation of all this sediment will cost billions of dollars. And it is also clear that new and innovative technologies are required to meet the technical challenges associated with the remediation of these sediments.

New technologies are needed because environmental dredging, the remediation solution of choice for many sites, can be very expensive and potentially disrupts the local ecosystem. In addition, even specialized environmental buckets can leave residual contaminated sediments that require additional treatment. Even if the dredging is successful, growth along the Nation's waterways is making it more difficult to find suitable sites for upland disposal facilities, which further increases the cost of remediation. A potential alternative to dredging is in situ reactive capping.

A reactive cap is essentially an engineered structure that is placed on top of the contaminated sediment. Typically there is a layer of reactive material directly above the sediment, with a layer of clean sand or sediment on top of the reactive material. The contaminants are transported out of the sediment by diffusion or advection and pass into the reactive layer where the metals are chemically bound to the amendment. The sand/silt layer serves as a habitat for benthic organisms, prevents bioturbation from reaching the amendment layer, and protects the amendment from scour. In the end, a reactive cap significantly reduces the bioavailability of the metal contaminants, thus reducing bioaccumulation of metals, and also provides a new, clean habitat.

The CSC has shown that reactive caps constructed with phosphate-based apatite minerals are very effective in sequestering heavy metals by a process of adsorption and precipitation. The inventor, Dr. Taylor Eighmy of UNH was awarded United States patent 6,209,637 in recognition of this work. Apatite reactive capping was then chosen as one of three technologies for the first phase of a federally funded demonstration of promising reactive capping techniques on the Anacostia River in Washington, D.C. (http://www.hsrc.org/hsrc/html/ssw/anacostia/). The demonstration site is off of the Washington Navy Yard, an area high in zinc, lead, chromium and other heavy metals. A 80 ft by 100 ft cap composed of an unbound 6 inch layer of apatite overlain by 6 inches of clean sediment was placed in spring of 2004. Ease of deployment, chemical isolation, and physical stability of the cap have been monitored as part of the project.

As part of the CICEET Technology Transfer Project, I took the data from the Anacostia River demonstration and used it to promote our technology. I gave our technology a name "Barrierite", created a website (http://unh.edu/phosphatebarrier/) and began to promote it to potential end-users. I did this by meeting with end-users at conferences and having them visit UNH. As part of my Outreach Scholar project, I am reviewing what was done and I am following up with contacts to see how effective the outreach effort has been.

Project Details

Goals and Objectives: This project seeks to develop a methodology to successfully promote the real world use of contaminated sediment remediation technologies being developed at the UNH Contaminated Sediment Center. This will be done by reviewing the outreach efforts conducted for our most mature technology, assessing the effectiveness of these efforts, and then refining our approach.

To assist me in this project, I have engaged two MBA students from WSBE to conduct interviews with a population of potential end-users to determine if they know of our technology and to gauge their interest in it.

The outcomes of this project will be a database of potential end-users. From this database, I intend to form a core group of supporters who will work with the CSC to develop and promote our technologies. A second outcome will be system of promoting our technologies, complete with assessment methods.

Target Population/Audience: The initial target population includes consultants, non-governmental organizations, federal agencies and state agencies that deal with contaminated

sediment remediation. This initial population will be interviewed by the two MBA students, and then a revised population pool will be developed. The core group of technology supporters will be developed from this group.

Methods: I have developed a large database of contacts from my technology transfer efforts. A group of roughly 50 contacts were chosen and provided to the MBA students. The students called these contacts and asked them a set of questions that was developed with Michelle Gregoire of UNH ORPC (Appendix A). Students are currently putting the results of their conversations into a database. When the database is complete, I will follow up with the interested groups. In my conversations, I will be working to determine what we need to do better in terms of technology outreach. I'll also be trying to identify potential external partners.

Evidence of External Collaboration and Partnership: At this time, I have identified three consultants, two from Arcadis BBL and one from Environ who are interested in our technology and have requested more information regarding our work at UNH. One consultant has indicated that he would be willing to serve as a technical advisor with regard to the development and marketing of current and future remediation technologies.

In addition, an ocean engineering firm from New Bedford, MA heard about my efforts and contacted me to partner on an SBIR grant proposal with them.

Expected Impact: After meeting with the UNH ORPC, I decided that the best way to proceed with our technology development is to organize a consortium of internal and external partners that will help develop, test and promote the CSC's remediation technologies. Our ultimate goal is to have an external partner license our technologies, providing funds for continuing research. We have begun working with internal partners in WSBE and other colleges. This outreach project will allow me to identify external partners and to develop relationships with them.

Scholarly Connection: I will incorporate this project into my CICEET Technology Transfer project. In addition, the data generated by this outreach effort will give me the information I need to convince external partners to engage in SBIR and STTR type Federal grants to continue our work. I will also incorporate some the end-user feedback into a paper I am writing on our technology.

Evaluation Plan: The survey being conducted by the MBA students will provide a baseline understanding of what potential end-users know of our technology. The survey will also help quantify the effectiveness of my technology transfer project. I will assess the outreach component of this current project by tracking website hits, information requests and the growth the consortium from baseline levels. I will further assess the outreach effort by surveying the population again in the future, to see how they perceive our technology, and how that changes from baseline levels.

Appendix A

Barrierite™ Phone Interview Script - Consultants
May 30, 2007

Hello. My name is _____. I'm calling on behalf of professors at the University of New Hampshire, specifically Kevin Gardner, Jeff Melton and Taylor Eighmy of the Civil Engineering Department. They have developed a new technology for contaminated sediment rediation I am an MBA student and I am helping them gather information that will help their research. Can you give me 5 minutes of your time to answer some questions?

Yes.	No.
Are you familiar with reactive capping for sediment remediation?	Have you ever dealt with metal contaminants during your sediment remediation projects?

Yes.	No.
Have you considered or used reactive capping for any remediation projects?	Have you ever dealt with metal contaminants during your remediation projects?

Yes.	No.
Please describe the situation… For what type of contaminants did you use reactive capping (metal, organic)? What type of RC technology did you use?	What is the major reason you have not considered reactive capping for your project? What more would you like to learn about reactive capping? What are your biggest concerns about reactive capping?

Yes.	No.
Please describe the situation… For what type of contaminants did you use reactive capping (metal, organic)? What technology did you use? What would you like to learn about reactive capping?	Thank you for your time. Would you like more information about this technology, if so, may Dr. Melton contact you? **END**

Thank you for your time. Are you interested in obtaining more information on pilot-scale work for reactive capping technology? If so, may Dr. Melton contact you? **END**

Barrierite™ Phone Interview Script - Regulators
May 30, 2007

Hello. My name is _____. I'm calling on behalf of professors at the University of New Hampshire, specifically Kevin Gardner,
Jeff Melton and Taylor Eighmy of the Civil Engineering Department. They have developed a new technology for contaminated sediment remediation. I am an MBA student and I am helping them gather information that will help their research. Can you give me 5 minutes of your time to answer some questions?

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To confirm, are you the person in your agency who deals with contaminated sediment remediation?

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Yes.	No.
Are you familiar with reactive capping for sediment remediation?	Would you please tell me who I should contact in your agency? END

Yes.	No.
Has reactive capping been considered or used on a project that you were involved with?	Have you ever dealt with metal contaminants during your remediation projects?

Yes.	No.
Please describe the situation… For what type of contaminants did you use reactive capping (metal, organic)? What type of RC technology was used?	Does your agency have specific concerns or questions about reactive capping?

Yes.	No.
Please describe the situation… For what type of contaminants did you use reactive capping (metal, organic)? What technology did you use?	Thank you for your time. Do you have any questions about this project? Should I have Dr. Melton contact you? **END**

Thank you for your time. Do you have any questions about this project? Should I have Dr. Melton contact you? **END**