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Name of Action Team:
Technologies Promoting the Sustainable Use of Contaminated Sediments and the Beneficial use of Waste-Related Materials

Team Leader:
Eric A. Stern – USEPA Region 2 – Division of Environmental Planning and Protection

Champion: Kathy Callahan * – USEPA Region 2 / Deputy Regional Administrator
[Callahan has since retired from Region 2 – May 08]

Current Team Members:
Charles Harewood – Region 2 – RCRA Programs Branch
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Marc Tuchman – Great Lakes National Program Office
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Kelly Madalinski - OSWER - Office of Superfund Remediation and Technology Innovation
Dennis Timberlake - ORD, NRMRL - LRPC

Environmental Problem:
Contaminated sediments on the order of many millions of cubic yards pose a national problem both in navigational, Superfund and solid waste programs. Remedial options are often controversial, as disposal and standard treatment options can be costly, require long-term monitoring programs, result in human and ecological exposures, and may not be widely accepted by local communities. Since 1994, Region 2 has been working with their federal and state partners (DOE, USACE. NJDOT) on innovative sediment decontamination technologies with beneficial use applications. What makes these technologies innovative is the production of beneficial use end-products such as construction-grade cement, manufactured soils, bricks, geotechnical fill, and light-weight aggregates. Innovative sediment decontamination technologies with beneficial use applications provide an opportunity to actually use contaminated sediments as a *resource* rather than simply disposing of them in upland or aquatic facilities or monitoring them in situ for long-periods. The ETC action team was formed led by Region 2 to take this concept one step further in creating a sustainable recycling program which would incorporate an efficient method of materials handling for other media such as municipal solid waste, construction debris, sewage sludge, and even medical and electronic waste. These additional treatment uses would allow EPA Programs, such as Superfund, RCRA, GLNPO, Dredged Materials, and Brownfields to utilize treated sediments resulting in an integrated approach to materials management.

Name of Priority Project:
New York/New Jersey Harbor Sediment Decontamination Program

Technology Challenges:

Utilizing *existing cross-program applications,* promote more efficient environmental and economic revitalization of contaminated sites by building a sustainable multi-media recycling program based on innovative decontamination technologies that manufacture high-value, beneficial use products. EPA, in conjunction with their partners, has realized that these technologies form the basis of a holistic, cross-program management and recycling approach for contaminated sediment sites in that they address and consider dredged material management, environmental restoration and revitalization, and environmental sustainability. In addition, when coupled with economic drivers, these sediment decontamination technologies could contribute to the revitalization and redevelopment of communities by using the beneficial use products, derived from previously contaminated site sediment, directly at the sites.

Essential features of a regional sediment decontamination *treatment train* program for processing dredged material to produce environmentally acceptable beneficial-use materials is critical to regional integrated sediment management. This train consists of components that include use of environmentally sound dredging methods, a storage facility that acts as a buffer to match disparate dredging and processing rates, decontamination technologies for removal of contaminants, and beneficial use of the post-treated material. This treatment train is being demonstrated during 2005-2007 using Passaic River, NJ Superfund sediment and navigational dredged material from the Port of New York/New Jersey. The near commercial level operations employ both a non-thermal sediment washing and a thermo-chemical rotary kiln technology to manufacture soil and construction-grade cement. On a commercial-scale level, ex-situ technologies need to be cost-competitive with other disposal/placement components of a dredged material management plan such as stabilization/solidification, Confined Disposal Facilities (CDFs), Confined Aquatic Disposal Facilities (CADs), and containment islands. Important factors in the economic performance include the development of regional markets for the beneficial use products, and a long-term flow of dredged material to optimize the processing economics by keeping a system operating 24/7, 330 days/year. These are essential factors for securing the capital needed to develop a self-sustaining enterprise in sediment decontamination processing or *environmental manufacturing*. However, navigational dredged material alone does not support an attractive business model for sediment processing with innovative technologies because of uncertainties in dredging cycles and volumes, construction schedules, fish and spawning migratory windows, dredging contract litigation etc. The economic model can be improved by adding co-processing of contaminated sediments from Superfund sites, aquatic brownfields and upland contaminated soils, fly-ash, and kiln dust from RCRA programs, electronic-waste, and tires from solid-waste programs. This is needed to obtain higher income streams and the needed long-term multi-feed material to operate a regional facility with common-front end material handling capabilities for several technologies. Other beneficial use applications utilizing dredged material/contaminated sediments co-mingled with waste products for beneficial use include steam, and electrical generation from thermal systems. This is one application of environmental sustainability using different feedstocks to sustain a long-term economical operation in *environmental*

manufacturing that is economically viable, but that requires *cross-program coordination* within state and federal regulatory agencies

Stakeholder and Partner Involvement:

W.Scott Douglas - New Jersey Department of Transportation / Office of Maritime Resources (New Jersey Sediment Decontamination Program)

Keith W. Jones - Brookhaven National Laboratory / U.S. Department of Energy – Department of Environmental Sciences

Kevin Gardner - University of New Hampshire / Department of Civil Engineering - Center for Contaminated Sediments Research

Arthur Ostaszewski - Michigan Department of Environmental Quality - Hazardous Waste Technical Support Unit

Michael Keegan – US Army Corps of Engineers / New England District – Environmental Planning Division

George Wisker – CT Department of Environmental Protection – Office of Long Island Sound Programs

Douglas Reid-Green - BASF Corporation / Department of Ecology and Security

FY07-FY08 Accomplishments:

Utilizing existing programs to accomplish the objectives/goals of this action team, two innovative sediment decontamination technologies conducted cross-program processing of (1) navigational dredged material and (2) Superfund Passaic River contaminated sediments in FY06-07. In January 2007, three separate talks on the decontamination program efforts were presented at the Battelle 4th International Conference on the Remediation of Contaminated Sediments – Savannah, GA. Sediment washing of navigational and Passaic River sediments were completed in June 06 and demobilization of the facility was completed in December 06. Approximately 14,000 cubic yards of sediment was treated under this sediment washing demonstration. Post-treated sediment that has passed NJ State Residential Soil Criteria was stockpiled and is awaiting a manufactured blended soil demonstration/application at Montclair State University for use on their physical grounds. Post-treated sediment was also used as geotechnical fill at a NJ brownfields industrial business park. Approximately 100 cubic yards of post-treated (non-blended) sediment was transported to the Port Authority of Bridgeport, CT (PAB). A beneficial use project is in development (FY-08) with the USACE New England Division, CT DEP, and the PAB to work with landscape companies to produce a high grade beneficial use top soil using sediment from the Passaic River, NJ Restoration Project for application in CT . Partnering with the USACE – New England, and CTDEP regarding treatment technologies and beneficial use applications is crucial to finding

solutions for dredged material management for Long Island Sound and impacted harbors and Bays in CT.

Processing of Passaic River Superfund sediments using a full-scale demonstration thermo-chemical rotary kiln process commenced in December 2006. This thermal process operating at 2600^{o} F produces an inert pozzolonic glass material from melted sediments that is combined with Portland cement to produce a blended construction-grade cement. The EPA Superfund Innovative Technology Evaluation Program (SITE) conducted 3 days of air-stack testing. In May 2007, another 5 day demonstration test which again included 3 days of air stack testing focused on (1) flame management (2) modifier mixing, and (3) beneficial use of construction-grade cement. Co-mingling tires and electronic waste with high Btu values for waste to energy generation is still being considered by the private sector for commercialization opportunities.

- These 2 innovative technologies have been evaluated technically and economically to be considered as part of a remedial option under the EPA/USACE/NJDOT Focused Feasibility Study for the Passaic River Superfund Restoration Study

FY08 Objectives and Accomplishments

- Complete data evaluation, and finalize two deliverables on sediment washing, and thermal–chemical rotary kiln technologies with beneficial use applications
    - The sediment washing deliverable is in a draft final review stage. It is expected to go final in September 2008. The thermo-chemical rotary kiln technology is expected to go final in August 2008.

- Conduct 2 demonstrations of (1) manufactured soil and (2) construction-grade cement on the campus of Montclair State University, NJ for use in landscaping and sidewalks, Initiate a research/monitoring program to look at soil stability and sidewalk wear/strength.
    - Post-treated manufactured soil from the Passaic River, NJ will arrive at the MSU campus on July 9, 2008. This material will be blended with compost to produce a manufactured soil for campus landscaping purposes. Furthermore an analog research project at MSU will be combining food residual waste that has undergone aerobic digestion using an on-campus incubator with decontaminated sediment.
    - Five barrels of pulverized Ecomelt from the thermo-chemcial rotary kiln process has been delivered to the campus of MSU. This material will be added to Portland Cement (40 Ecomelt / 60 Portland) to manufacture a construction grade cement to pour 165 feet of sidewalk on campus.
    - Both of these demonstrations will commence in the summer of 2008.

- Conduct a manufactured soil demonstration in cooperation with the USACE-New England Division, CT DEP, and the Port of Bridgeport, CT using post-treated

sediment from NJ. Work with CTDEP in developing markets and beneficial use criteria for this product.

- This work is presently underway. In June 2008, three blends of manufactured soil were created using decontaminated (sediment washed) sediment from the Passaic River. The first blend used a 5:1 ratio of mulch to sediment, the 2nd blend used a 3:1 ratio and the 3rd blend used a 1:1 ration of aggregate material to sediment. All three blends were mechanically mixed and segregated for analytical testing. Regional landscape and aggregate companies are engaged in this demonstration in order to determine the efficacy of developing a business model using sediments for manufactured soil production.

- Collaborate with the USACE Waterways Experiment Station on a peer review of the *State of the Art of Sediment Treatment Technologies*
  - On-going

- Conceptualize and develop a working model for a regional multi-use processing facility utilizing different innovative technologies and beneficial end uses.
  - On-going. Focus is internationally – China. One example is using a high temperature thermal process in highly eutrophic systems with contaminated sediments. Utilize the algae as biofuel.

- Identify potential partners with industrial cross-media residuals which could be combined in the sediment feedstock
  - On-going. Food residuals / compost combined with sediments are an example.

- Pursue partnership opportunities with the Great Lakes Dredging Team, National, and Regional Dredging Teams, EPA Region 5 Center of Excellence for Sustainable Residual Management, the Great Lakes Commission, LNPO, Portland Harbor, and international ports and harbors.

Continuing Supporting Objectives:

- Identify marketable beneficial end uses.

- Support and collaborate on beneficial use basic and applied research.

- Identify and provide links between industrial residual producers, sources of dredged materials/contaminated sediments, treatment technologies, markets for end users, and venture capitalists for developing a long-term self-sustaining environmental manufacturing industry.

- Develop and sponsor a national workshop: *Creating A Comprehensive Environmental Management Program for Waste Reuse and Site Revitalization.* This would include EPA cross-program representation, private sector - economic

development, stakeholders and end-users, and government organizations such as the United Nations Environmental Program (UNEP), and the UNEP International Environmental Technology Center which could be a catalyst for promoting environmental sustainable development. Publish proceedings of the workshop.

- Identify policy and recommend policy changes needed to implement this action team program. Coordinate and work with the appropriate EPA and state offices to implement them.

- Identify regulatory challenges to implement and permit these technologies with beneficial use applications. Work with appropriate offices to develop regulatory / permitting strategies to overcome these challenges.

- Implement one or more field-scale demonstrations of multi-media processing using existing technologies. Encourage submitting proposals to the EPA OSWER Innovations Workgroup for implementing demonstrations such as *The Application of Coal Ash and Dredged Materials as Cement Feedstock for Beneficial Use and Sustainable Development.*

- Develop and implement a public outreach program.

- Publish findings of this action team in a peer reviewed journal.

Current Funding and Additional Resources Required:

Funding to support the EPA and NJDOT Sediment Decontamination programs is over. Upon receipt of the final reports expected by the end of FY08 – all invoices will be expended. Currently there is $1million obligated to the DoE Brookhaven National Laboratory from the USACE New England Division to support sediment decontamination and beneficial use efforts for Bridgeport Harbor, CT. EPA Region 2 is involved in this project using in-kind resources. Funding to support multi-media demonstrations using existing full-scale existing and innovative technologies that have undergone bench-pilot-scale testing would be helpful.

Talk Presented at SedNet – Oslo – May 28th 2008

Sustainable Urban and Environmental Management Restoration Applications Using Sediment Treatment Systems with Beneficial Use

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Strategies for sustainable management of contaminated sediment systems have been in development over the last several years. One example is the European Union Sediment Research Network (SedNet) that links contaminated sediment assessment and impacts to economic, and social policy challenges in watersheds and river basins within the EU. Similar challenges exist in the United States within sediment impacted urban waterways and ports. The US Environmental Protection Agency (USEPA) /US Army Corps of Engineers (USACE) Urban Rivers Restoration Initiative (URRI), and the USACE Regional Sediment Management National Demonstration Program (RSM), have components addressing sustainable sediment management within riverine, coastal and urban aquatic environments focusing on both (non) and contaminated sediments. The nature of urban watersheds and ports impacted by contaminated sediments, has evolved RSM further from a national environmental management focus to regional estuarine and coastal targeted watershed initiatives in the urban New York/New Jersey (Port) harbor region. Environmental management in these multi-complex urban settings requires a coordinated cross-programmatic – interdisciplinary approach. This pertains to sediment management that may require remediation and restoration on a regional and community scale level taking into account a watershed approach. Management of contaminated sediment remediation and restoration projects is a long-term challenge in assessing, designing, building and monitoring over the long term to determine sustainability especially where sites suitable for placement of sediments are limited. One component of an integrated sediment management program is the application of innovative in and ex-situ sediment treatment technologies coupled with beneficial use and restoration opportunities. Treated sediment may be used beneficially as manufactured soil, construction-grade cement, lightweight aggregate, and geotechnical structural fill. The economic benefits derived from their manufacture may serve as an economic driver in the redevelopment of adjacent environmentally / socially impacted communities. Furthermore, sustainable utilization of beneficial use products from treatment processes spares consumption of non-renewable resources. USEPA, NJ Department of Transporation, and Brookhaven National Laboratory working in partnership with the private sector has integrated a *treatment train* concept based on the results of projects and demonstrations (bench through full-scale) that have taken place regionally and internationally over the past decade (1994-2007). A full-scale *treatment train* was demonstrated during 2005-2007 using navigational dredged material from the Port and the Passaic River, NJ Superfund site. Sediment washing and thermo-chemical technologies with beneficial use endpoints were employed. Integration that includes both navigational and Superfund sediments from urban environmental restoration projects are critical to accomplish enough flow-through capacity for these technologies to succeed economically on a large scale. Other programs that may benefit from sediment treatment technologies include brownfield cleanups (soils, sediments, and demolition and construction debris), which coupled with in-situ capping technologies can promote habitat and wetland terracing restoration opportunities allowing enhanced public access in an urban environment such as in Gowanus Canal, NY. Integration of technologies as part of a multi-media regional processing facility could provide long-term sustainable infrastructure in conjunction with confined disposal facilities (CDFs) and confined aquatic disposal (CADs) to provide active storage capacity to make these facilities renewable. Estimates of natural topsoil left worldwide range from 50-100 years. Manufacturing landscape topsoil from a sediment washing process and manufacturing construction-grade cement with electric power co-generation from thermal technologies coupled with beneficial use / environmental manufacturing materials perhaps, makes these innovative technology applications an

environmental sustainability program – advancing from mere *remediation* to complete environmental restoration. A summary of the results and conclusions for demonstrated individual projects (Passaic River and Gowanus Canal) will be presented and the implications for a possible regional treatment facility discussed. This is a promising pathway for creating a commercially viable, sustainable *environmental manufacturing* industry.

Performance Measures:

Goal 2: Safe and Clean Water - Ensure drinking water is safe. Restore and maintain oceans, watersheds, and their aquatic ecosystems to protect human health, support economic and recreational activities, and provide healthy habitat for fish, plants, and wildlife.	
Objectives, Sub-Objectives, Annual Performance Goals, Performance Measures	**How Innovative Sediment Decontamination Technologies with Beneficial Use Products Help to Meet Goals**
Objective 2.1: Protect human health by reducing exposure to contaminants in drinking water (including protecting source waters), in fish and shellfish, and in recreational waters. **Sub-Objective 2.1.2:** Fish and shellfish safe to eat. The quality of water and sediments will be improved to allow increased consumption of safe fish and shellfish as measured by strategic targets. **Sub-Objective 2.1.3:** Water safe for swimming. Percentage of the stream miles and lake acres identified by States in 2000 as having water quality unsafe for swimming where water quality that is restores to allow swimming.	Removing contaminated sediment from a waterbody eliminates or reduces exposure to human and ecological receptors. Removal with aquatic or upland disposal potentially creates new exposures, may be expensive, and often does not have community support. Disposal locations will also become limited eventually. Innovative treatment of the sediment, with the production of a beneficial use end product, is appealing to communities and can actually be used on the site after treatment in a reuse scenario. The cost of treatment can also be reduced if other media (such as soils, sewage sludge, municipal solid waste (MSW), etc.) are also being treated. Public acceptance and reduced costs can, therefore, potentially lead to quicker cleanup, safer water and food, and the revitalization of contaminated sediment sites.
Objective 3.1: Science and Research: Provide and apply a sound science foundation to EPA's goal of clean and safe water by conducting leading-edge research and developing a better understanding and characterization of environmental outcomes under Goal 2.	Support of innovative treatment technologies enhances and accelerates current contaminated sediment research efforts and provides data necessary to make and support crucial decisions on high impact and high visibility sites. These technologies are currently being evaluated under ORD's SITE
Goal 3: Land Preservation and Restoration: Preserve and restore land by using innovative waste management practices and cleaning up contaminated	

properties to reduce risks posed by releases of harmful substances.	
Objectives, Sub-Objectives, Annual Performance Goals, Performance Measures	**How Innovative Sediment Decontamination Technologies with Beneficial Use Products Help to Meet Goals**
Objective 3.1 Preserve Land: Reduce adverse effects to land by reducing waste generation, increasing recycling, and ensuring proper management of waste and petroleum products at facilities in ways that prevent releases **Sub-Objective 3.1.1:** Reduce Waste Generation and Increase Recycling **Annual Performance Goal 001:** Divert 33.4% (80 million tons) of municipal solid waste from land filling and combustion, and maintain the national average municipal solid waste generation rate at no more than 4.5 pounds per person per day.	Many innovative treatment technologies resulting in beneficial use products are suitable for other media besides sediment such as municipal solid waste. The production of a beneficial product diverts MSW from land fills.
Objective 3.2 Restore Land: Control the risks to human health and the environment by mitigating the impact of accidental or intentional release and by cleaning up and restoring contaminated sites or properties to appropriate levels. **Sub-Objective 3.2.2:** Clean up and re-use contaminated land **Annual Performance Goal 005:** Control the risks to human health and the environment at contaminated properties or sites through cleanup, stabilization, or other action, and make land available for reuse. **Related Performance Measures:** - Number of Superfund construction completions - Number of Superfund hazardous waste sites with human exposures controlled	Removing contaminated sediment from a waterbody eliminates or reduces exposure to human and ecological receptors. Removal with aquatic or upland disposal potentially creates new exposures, may be expensive, and often does not have community support. Disposal locations will also become limited eventually. Innovative treatment of the sediment, with the production of a beneficial use end product, is appealing to communities and can actually be used on the site after treatment in a reuse scenario. The cost of treatment can also be reduced if other media (such as soils, sewage sludge, coal ash, municipal solid waste (MSW), etc.) are also being treated. Public acceptance and reduced costs can, therefore, potentially lead to quicker cleanup, safer water and food, and the revitalization of contaminated sediment sites.

- Number of final remedies selected at Superfund sites - Number of final remedies selected at RCRA sites	
Objective 3.3 Enhance Science and Research: Provide and apply sound science for protecting and restoring land by conducting leading-edge research and developing a better understanding and characterization of environmental outcomes under Goal 3.	Support of innovative treatment technologies enhances and accelerates current contaminated sediment research efforts and provides data necessary to make and support crucial decisions on high impact and high visibility sites. These technologies are currently being evaluated under ORD's SITE program.

Lessons Learned: [Please identify at least a couple lessons learned. This can be a start for what you will report on at the ETC face-to-face meeting in May 2008.]