Status of Ex-Situ and In-Situ Treatment Methods

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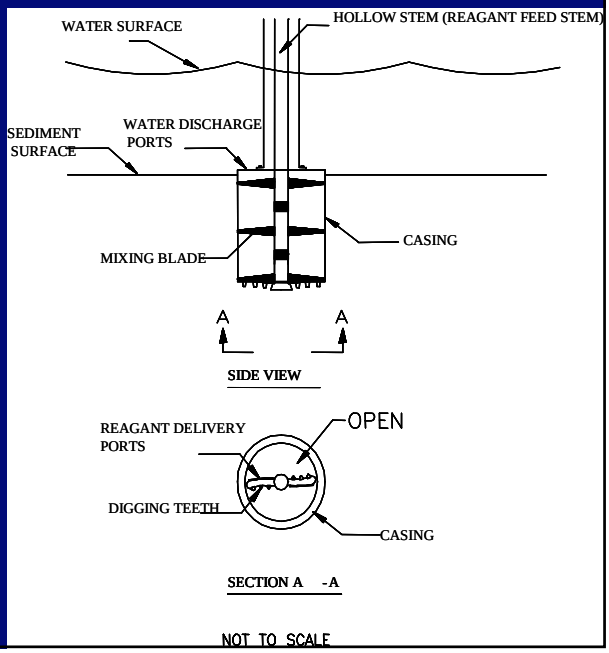
In-Situ Treatment

- Abiotic dechlorination of PCBs
- Sequestration using carbon, apatite
- In-situ reagent delivery

In situ mixing/excavation/capping device

Seaway Environmental Technologies



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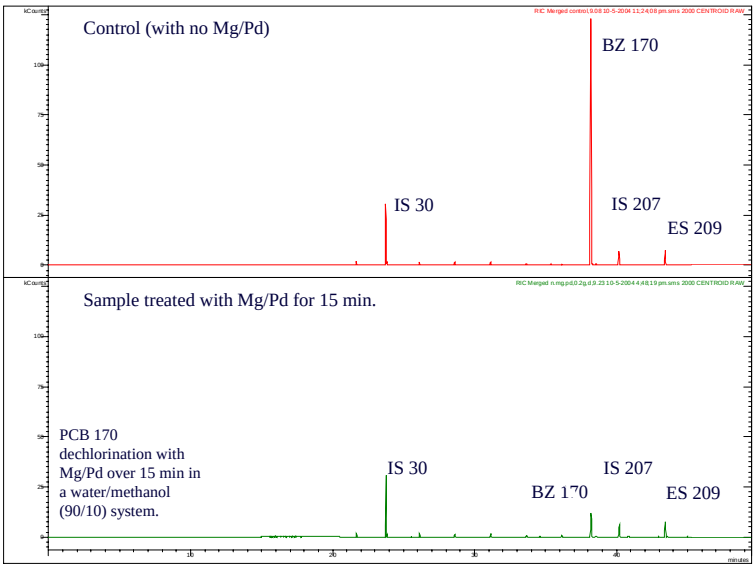
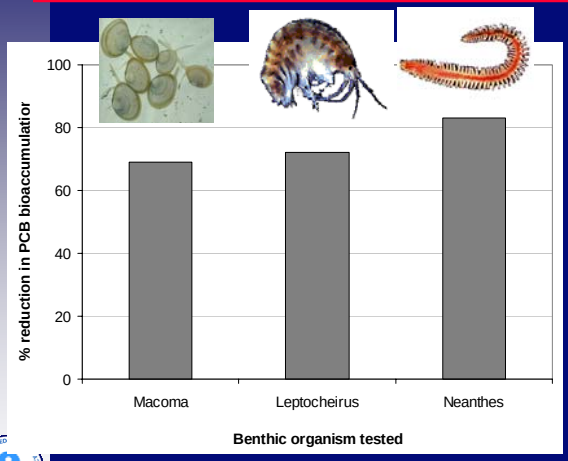
Bimetallic reduction of PCBs



Stanford/ UMBC PCB Bioaccumulation Reduction by Activated Carbon Amendment



1 mo. GAC contact:
- *Macoma:* 69%
- *Leptocheirus:* 70%
- *Neanthes:* 82%

6 mo. GAC contact:
- *Leptocheirus:* 75%
- *Neanthes:* 87 %

Effect manifested quickly under optimum mixing and benefit not lost with time

Stanford/ UMBC Preliminary Field Testing at Hunters Point (Fall 2004)

Aquamog: an underwater rototiller
Aquatic Environment, Concord, CA

Retrieving clam cages

Water sampling above treatment plots at high tide

Field measures of success:
- Homogeneity of carbon mixing
- Reduced PCB uptake by Macoma nasuta
- Reduced PCB uptake by SPMD
- Minimal sediment resuspension and PCB release

Participants:
- Stanford University
- University of Maryland Baltimore County
- Waterways Experiment Station
- Navy
- Battelle
- Aquatic Environment

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Apatite sequestration of metals

For:
Pb, Cd, Cu, Zn, Ni, As, U, F, Br, Cl, Etc.

Metal Adsorption (at low ppb)

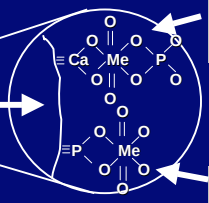
Flow

Metal Diffusion

Rock Apatite Particle

$Ca_5(PO_4,CO_3)_3(OH,F)$

Rock Apatite Surface



Adsorbed metal ions to Ca surface site (Fuller et al., 2002)

Adsorbed metal ions to P surface site (Fuller et al., 2002)

Metal Surface Precipitation (at high ppb)

Flow

Metal Diffusion

Rock Apatite Particle

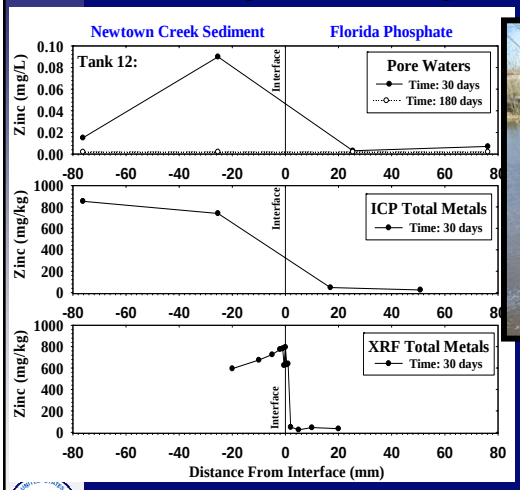
$Ca_5(PO_4,CO_3)_3(OH,F)$

Rock Apatite Surface

$(Ca,Pb)_5(PO_4)_3OH$
$Pb_5(PO_4)_3Br$
$Zn_5(PO_4)_3F$
$Cu_5(PO_4)_3OH$
$Cd_5(PO_4)_3OH$
$Ca_5(AsO_4)_3OH$
$(UO_2)_3(PO_4)_2 \cdot 8H_2O$

Metal Phosphate Surface Precipitate

Apatite sequestration of metals



4" of intact cap deployed. No obvious size sorting.

1.5" of mixing between Phosfil and underlying sediments

New York/New Jersey Sediment Decontamination Technologies Demonstration Program

- Program initiated in 1992 under the Water Resources Development Act
- Partners: US EPA Region 2, Brookhaven National Laboratory, and New Jersey (NJ) Department of Transportation Office of Maritime Resources
- Develop and demonstrate technologies from bench-, pilot-, to full-commercial scale
  - Meet desired treatment efficiencies
  - Cost-effective compared to other placement options
  - (~$35-70/$yd^3$)
  - Process or store 1500 yd^3/d and achieve commercial-scale capacity of 500,000 yd^3/yr
  - Saleable beneficial use product from post-treated material
- In 1998, NJ provided further funding to the program
- $42 million in Federal and State resources, combined with private investment

Technologies Approaching Full-Commercial scale Status under NY/NJ Program

- Baycycle
  - Rotary kiln heating pelletized, mixed with shale, dewatered dredge material at 2,500ºF temperatures
  - Treat moderate to high levels of contamination
  - Pellets can be used as lightweight aggregate
  - Large demonstration scale level project on commercial kiln expected startup in early 2005.
- Harbor Resource Environmental Group - chemical oxidation/stabilization process
  - $KMnO_4$ and fly ash or Portland cement added to material
  - Target low levels of sediment contamination
  - Produces non-structural fill for beneficial use
  - Conducting a demonstration for 4,350 yd^3 in NJ

Cement and similar products

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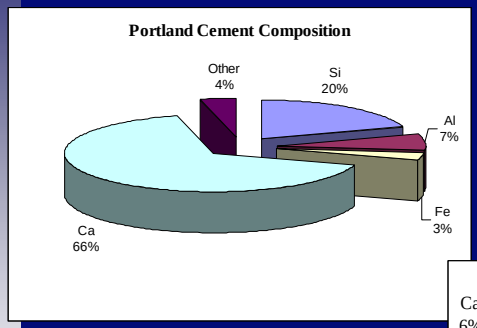
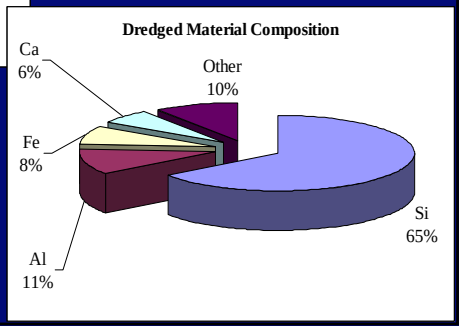
Capitalize on inherent characteristics of dredged materials – cement production in existing facilities





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Pilot Scale Manufacture

Batch rotary kiln used to mimic full scale

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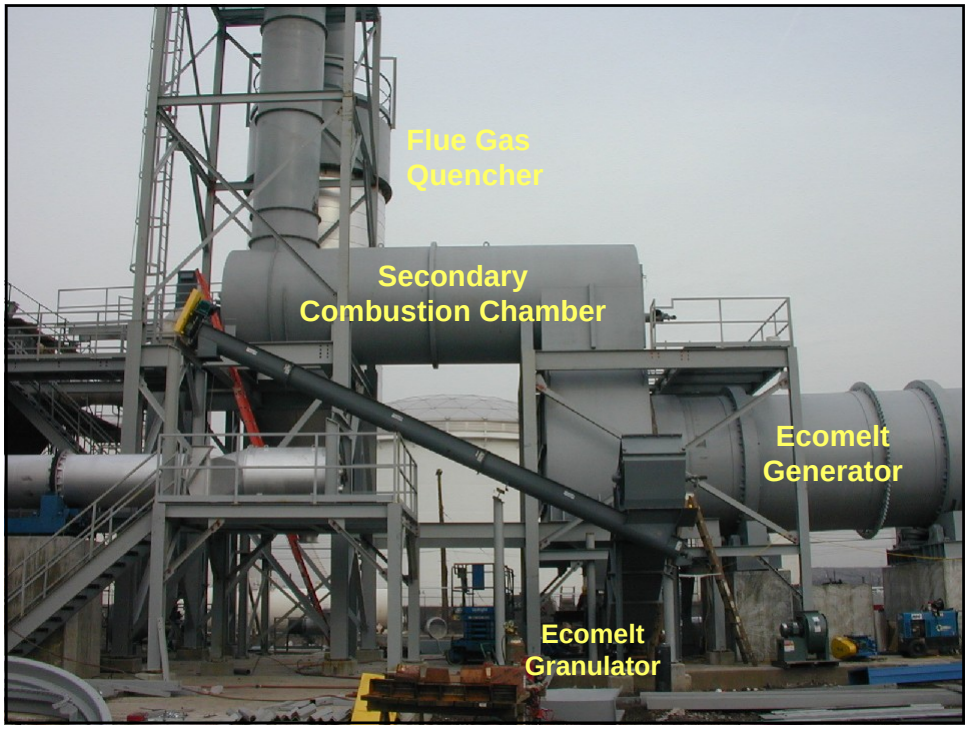
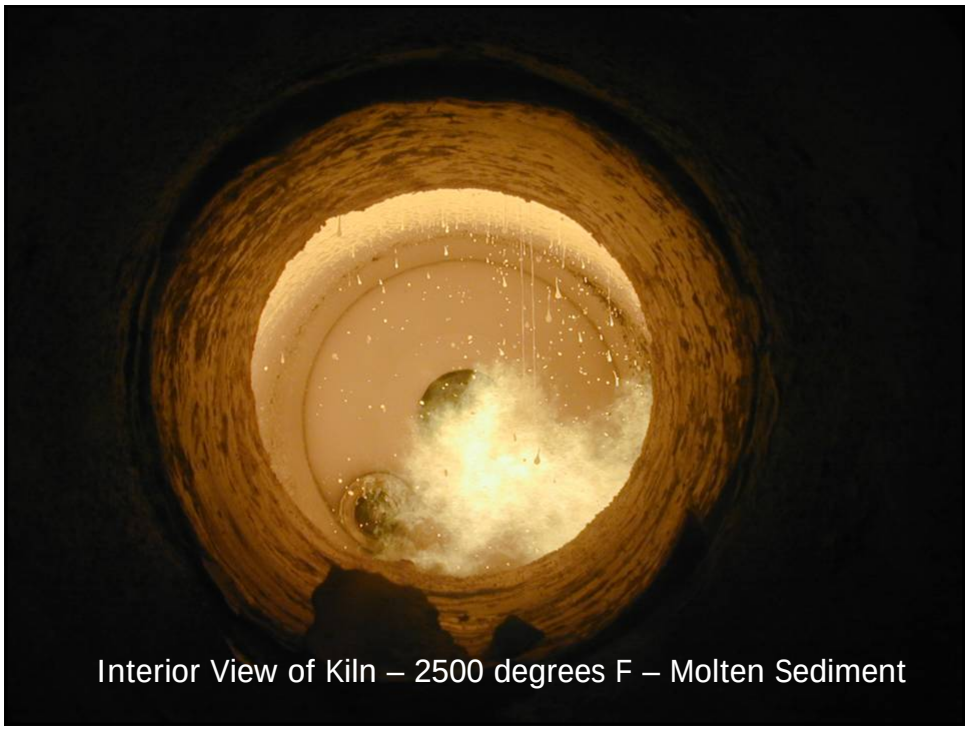
PANYNJ Cost Estimating Working Meeting Summary: 4/25/02

	Low End ($/yd^3)	High Estimate ($/yd^3)
Transport to Lafarge	5.00	5.50
River barge rental	0.50	1.00
Dock modifications	0.12	1.25
Debris rem. & dispos.	3.75	4.45
Mechanical transport	3.00	5.00
Slurry transport	2.15	3
Kiln modification	0.50	0.50
Dewatering & disp.	2.50	5.50
Screening	0	2.00
Kiln cleaning	1.00	2.00
Permitting	0.02	0.05
Mechanical Total	**18.84**	**24.00**
Slurry Total	**15.29**	**25.00**

Cement-Lock

- Gas Technology Institute - Cement-Lock Technology
  - Thermo-chemical process that blends dredged material with amendments and "melts" mixture at 2,450^{o}F
  - Treat moderate to high levels of contamination
  - Glassy granular product (EcoMelt) grounded to produce construction- grade cement similar to Portland cement
  - Full-scale demonstration plant (30,000 yd^3/yr) is on-line in Bayonne, NJ conducting an initial 450 yd^3 test to collect environmental data (including air) for commercial start-up
  - SITE project




Interior View of Kiln – 2500 degrees F – Molten Sediment


EcoMelt
0 INCHES
0 CM

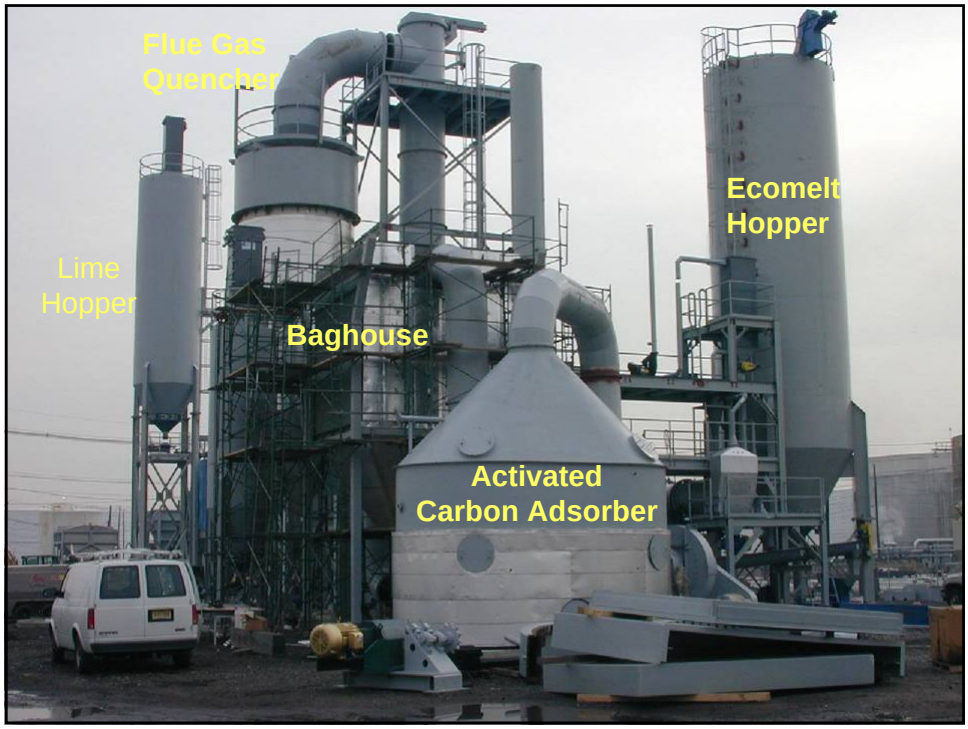

Pulverized EcoMelt

Beneficial Use

Construction Grade Cement / Concrete

Cement Lock Back End

Pollution Control Equipment



Flowable fill

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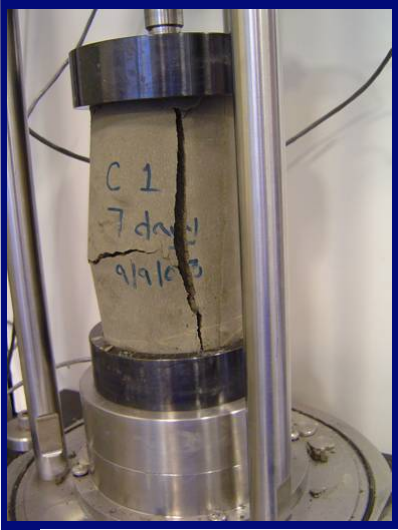
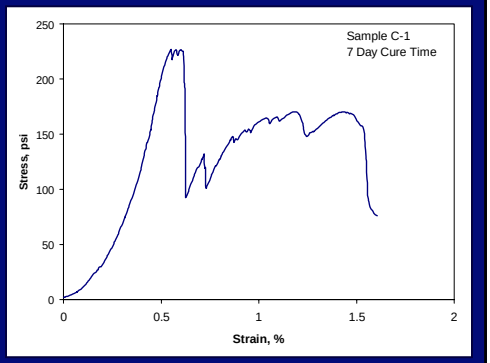
Production of flowable fill from contaminated sediments





Statistically model strength, flow and unit weight to develop optimized mixes

$$\text{Flow} = 9.68\,S + 37.23\,W - 22.73\,CFA - 26.64\,C + 185.17\,W\,CFA$$

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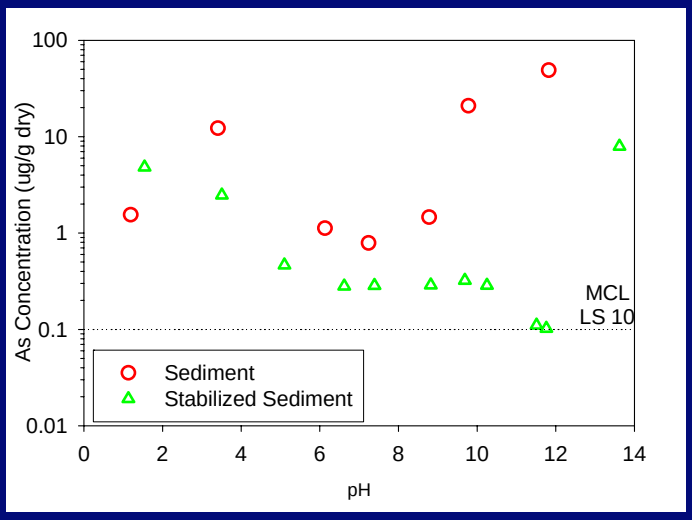
Characterization of metals release - flowable fill



pH-dependent leaching

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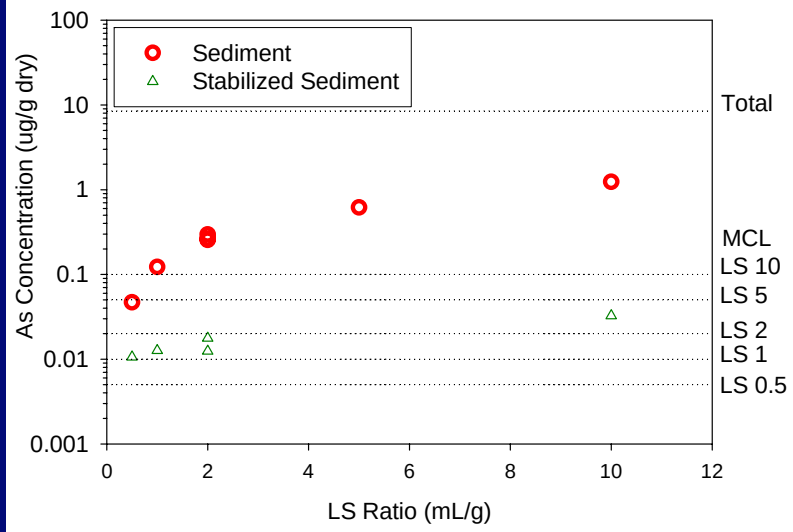
Characterization of metals release - flowable fill



LEACHING AS A FUNCTION OF LS

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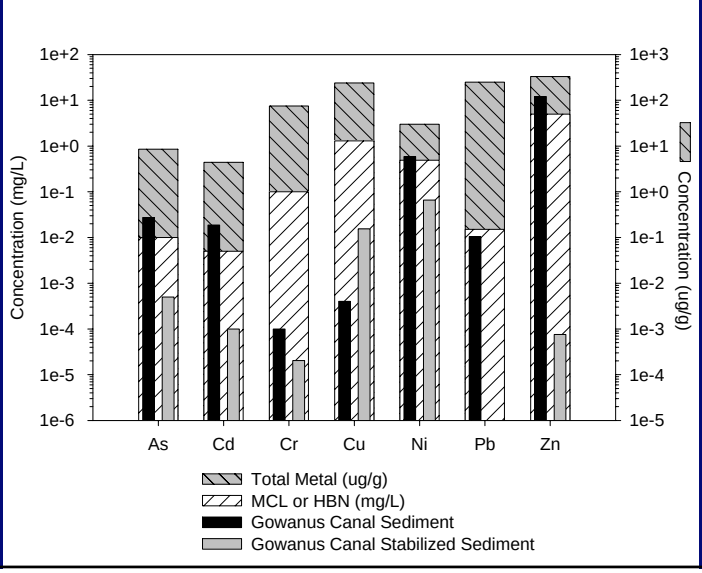
Characterization of metals release – Industrial Waste Management Evaluation Model (IWEM) results



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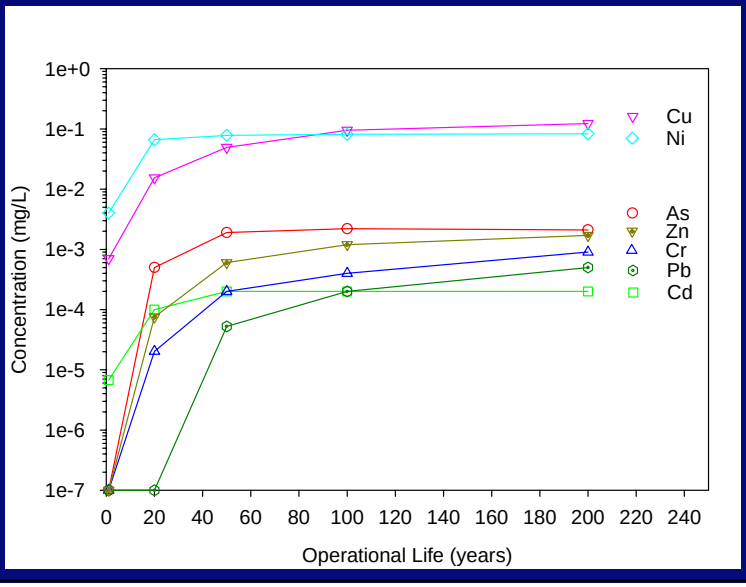
Characterization of metals release – IWEM results



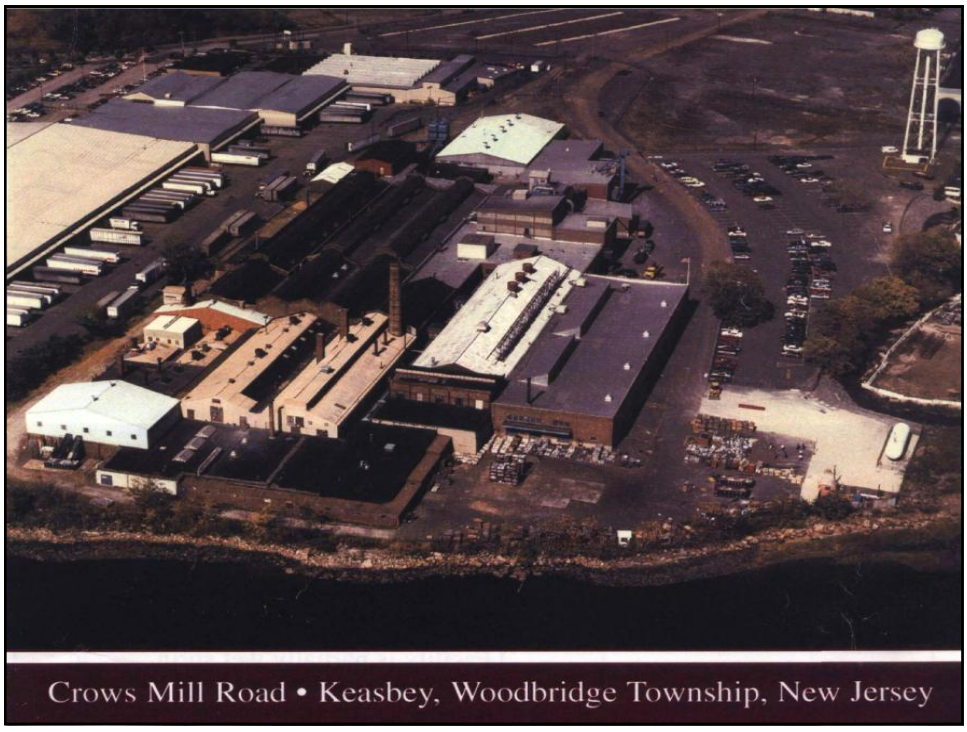
BioGenesis

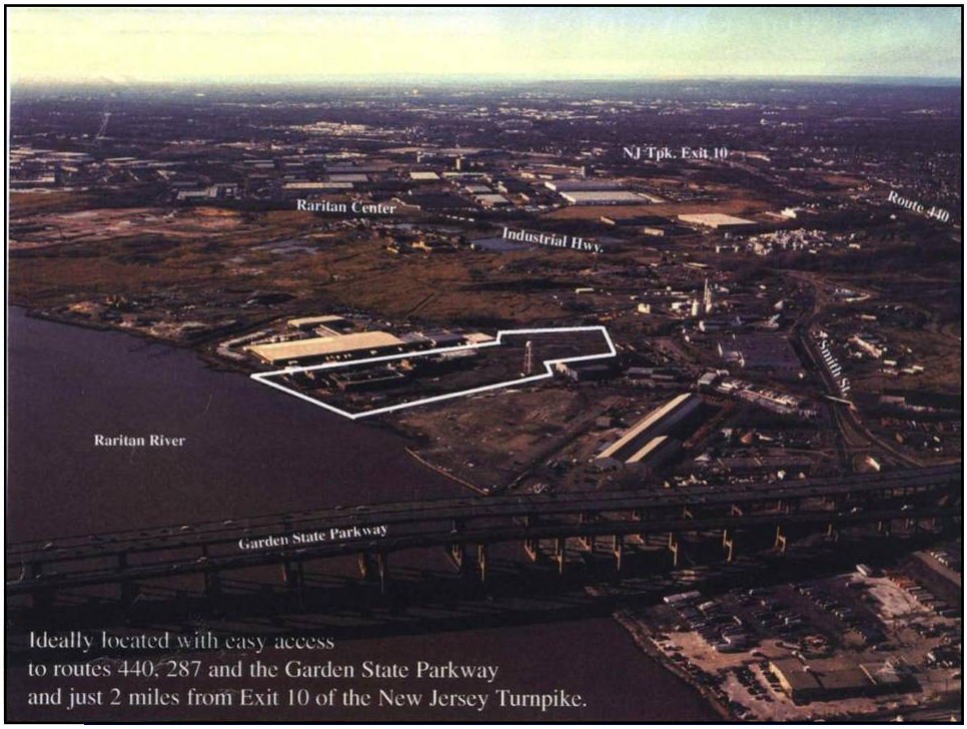
Pilot-scale Demonstration – Kearny, NJ 1999-2000

- BioGenesis Sediment Washing Technology
  - Separation of "clean" fractions, surfactants/oxidizing agents for organics, and metals treated separately
  - Target low to moderate contaminated sediments
  - Topsoil and bricks as beneficial use products
  - Facility to process 250,000 yd3/yr expected to be operational by first ¼ 2005.
  - Superfund Innovative Technology Evaluation (SITE) project

BioGenesis Pilot-Scale Demo
Venice, Italy Port Authority

Manufactured soil





Next Steps for NY/NJ Program

- Moving forward with permitting to a regional "treatment processing facility" with beneficial use on the Raritan River in Keasbey, NJ
  - Host BioGenesis Sediment Washing, Baycycle rotary kiln light weight aggregate process and dewatering capabilities for GTI Cement-Lock Technology for a full-scale demonstration in Bayonne, NJ
  - Includes a Great Lakes ore barge for common front-end storage up to 37,000 yd^3
  - Expected to be operational by December 2004.
- Port of Venice in Italy - Biogenesis Sediment Washing Technology demonstration completed in January 2004
- In 2005, planning to demonstrate integration of decontamination technologies with sediments from the Passaic River Superfund site in NJ
- Points of Contact
  - **Eric Stern, EPA Region 2 (212-637-3806 or stern.eric@epa.gov)**

http://www.bnl.gov/wrdadcon