

Biosolids Extreme Makeover!



With your hosts:
Harry Compton and Sally Brown

West Page Swamp-
Bunker Hill, ID
Before



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West Page Swamp-
Bunker Hill, ID
During- 1998



West Page Swamp-
Bunker Hill, ID
After- 2005- **See it shine!**



Jasper County, MO
Before



Jasper County, MO
During- 2000



Jasper County, MO
After- 2003 Pretty Nice!



Leadville, CO
Before- 1997



Leadville, CO
During



Leadville, CO
After- 2005- A Stunner!



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Green Remediation

Restoration Alternatives



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EPA's OSWER Priorities

- **Revitalization**
- **Recycling**
- **One Clean-up Program**

Mine Sites

- Lack of vegetation is a result of:
 - Low fertility
 - Poor soil physical properties
 - Acidity
 - Metal toxicities
 - Salts

Goals of Remediation

- Reduce bioavailability of contaminant in place
 - In-situ treatment in EPA lingo
- Rebuild soil or build new soil
- Restore soil function
 - Sustain plant growth
 - Sustain soil fertility
- Establish native plant ecosystem

Residuals as Soil Amendments

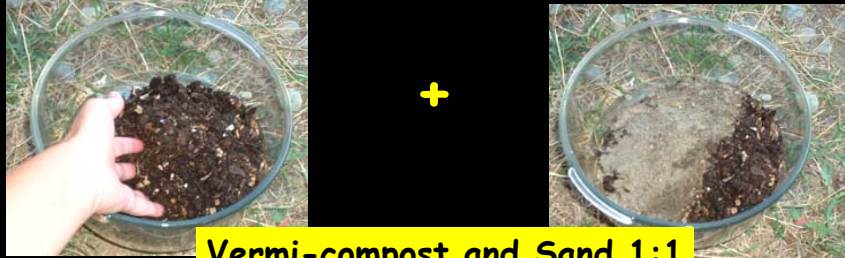
Why use wastes?

- **Alternative to conventional remedial technologies**
 - **lower costs**
 - **recycling wastes for a better use**
 - **Can be economical large scale solutions**
 - **Use application expertise from generators**

And Now

- For a live studio demonstration
- Touch and smell the residuals!
- See how they make water move!
 - Changes in soil properties when you add organics

Remote/Almost Live



Vermi-compost and Sand 1:1



Adding Water



Compost changes two things

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Bulk density, Water holding capacity



- Compost makes the soil lighter- easier for plant roots
- Compost increases ability of soil to hold onto water
Increases drought resistance

Steps in design

Site history

Soil sampling and analysis

- Identify site problems
 - Contaminants
 - Soil physical conditions
 - Climate
- Inventory of available materials
- Identify appropriate mixtures

And Now- a behind the scenes, step by step look and how to guide

- Bunker Hill, Idaho
 - Contaminated wetland
- Leadville, Colorado
 - River-deposited tailings

So that you'll be able to do this at home!!!!

West Page Swamp- ID

Goal: Wildlife Protection from
Acute Pb Poisoning



A person wearing a white jacket, light blue pants, and a purple cap is crouching in a dry, cracked swamp, collecting a sample. The ground is parched and cracked, with some shallow pools of water in the background. The person is holding a small green container.

•Lead	30,000 ppm
•Zinc	15,000 ppm
•Cadmium	100 ppm

Our
Answer:
Compost
Wood ash
Cap



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Scientific basis of treatments

Like a skin graft

- Barrier to contaminated sediments
 - Preferred rooting
 - Limit - access to tailings
- Create a functional wetland
 - Reducing conditions
 - Reduction of sulfur
 - Formation of galena
- Galena
 - Reduces Pb availability
 - Further reduces ecosystem threat

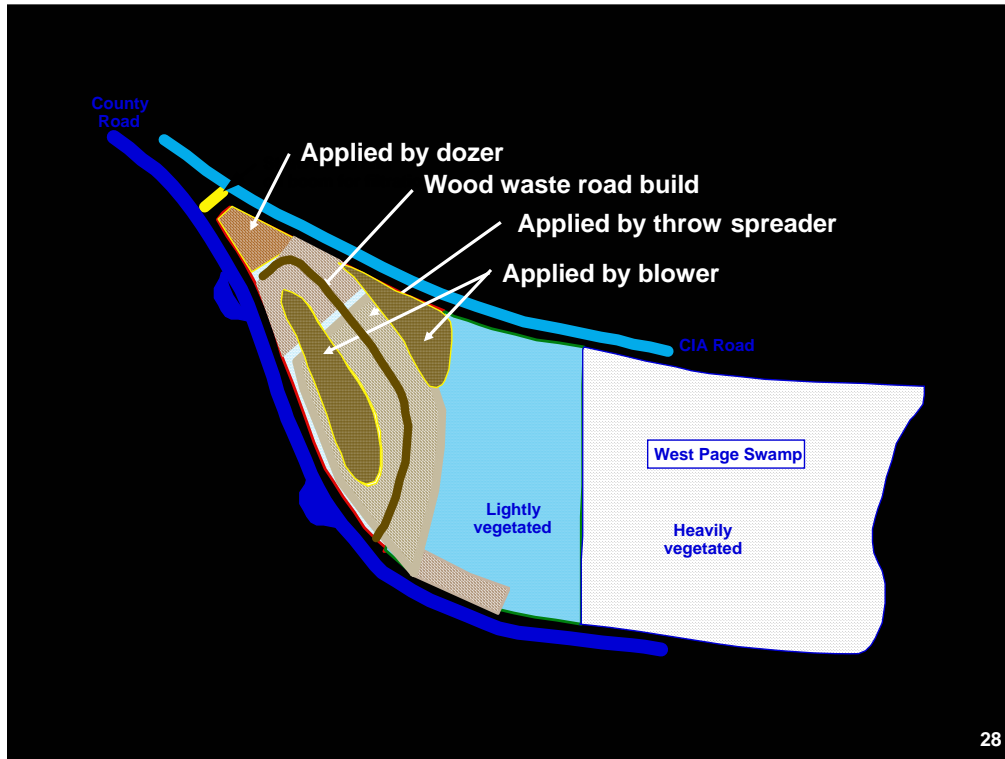
Our Special Recipe

- Biosolids - compost add:
 - nutrients
 - organic matter = wetland muck
 - Microbial food source
- Wood ash/waste lime add:
 - pH adjustment
 - Mineral soil
- Wood waste/other C-rich residuals:
 - limits N availability
 - Road building

Biosolids
compost

**15 cm deep
treatment of a
mixture of:**













1998



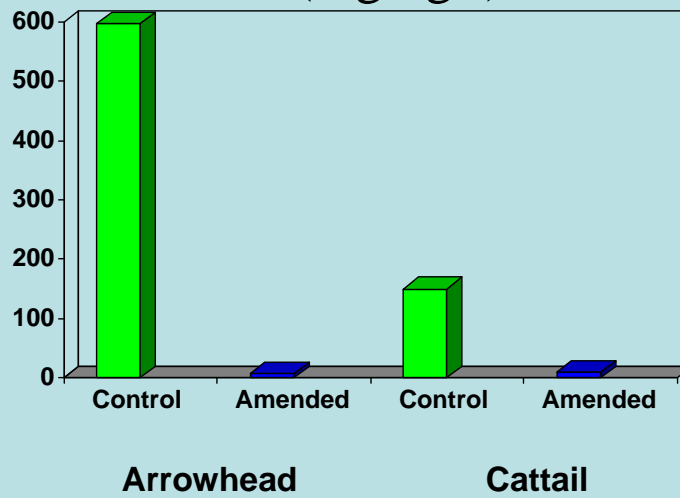
1999



2000

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Ecosystem Implications- Wetland - Plant lead (mg kg⁻¹)



**2005-
Collecting cores for metal
speciation/bioavailability
analysis**



More Galena!
XAS- Kirk Scheckel NRMRL

At Interface	At Depth
60% Galena	53% Galena





Historic mine tailings washed down and accumulated in deposits up to and exceeding 2'

Deposits are toxic to riparian vegetation



Contaminated soils, barren of vegetation, are highly susceptible to continued erosion by the river



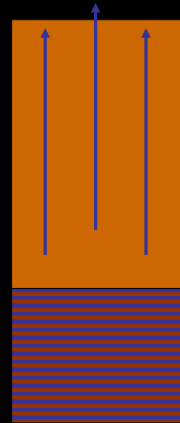
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Risks

- Re entrainment of tailings
 - Risk to river ecosystem
- Stabilized tailings
 - Potential risk to upland ecosystem

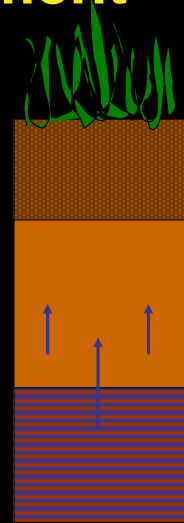
Soil System

- Pyritic tailings
 - Highly acidic
- Fluctuating water table
- Often insufficient rainfall
 - Reduced metals oxidize
 - Are wicked to soil surface
 - Salt crust



Biosolids/Lime amendment

Increase subsoil and surface pH
Increased organic matter at surface reduce wicking effect
Precipitate metals currently in solution on oxides in biosolids
Increased microbial activity increase potential for reduction and sulfide precipitation
Two mechanisms to reduce metal availability









Leadville, CO 1997 - 2000

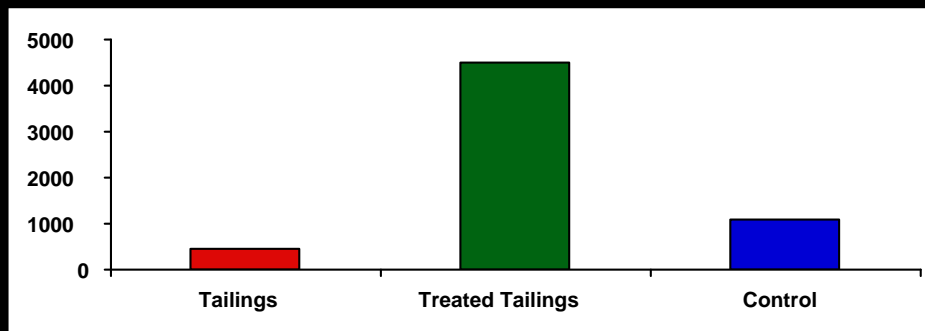


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Beauty is more than skin deep
Ecological Assessment
Mark Sprenger, US EPA ERT

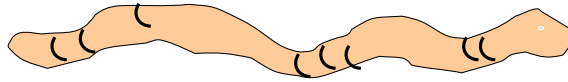
- Leadville, CO
- Similar results from Jasper County
- Similar results from Palmerton, PA

Microbial Function CO₂ Evolution



Earthworm Survival

	Tailings	Biosolids amended tailings	Upstream control
Survival	0%	89± 3	96
Biomass	-----	12 mg	6.8



Leadville in August



Plant Diversity



Plant Diversity Small Plots

- Plant Zinc
 - Range from 80-500 ppm
- Species Per plot
 - Shepard's purse
 - Poa paulustris
 - Yarrow
 - Pineapple weed
 - Potentilla
 - Sedge
 - Timothy
 - Alkali grass
 - Tufted hairgrass

Small Mammals

- Trapping
 - Analysis of body burden
 - Concentrations in specific organs
- Modeling to assess potential for food chain transfer
 - Primary risk - direct soil ingestion assuming 100% bioavailability of soil metals

BODY BURDEN

Herbivore Pathway-safe



Soil



Carnivore Pathway-safe

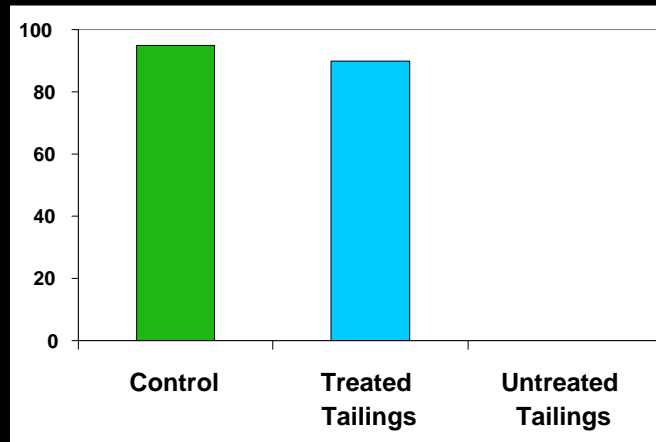
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Re entrainment

- Safe on land, if amended soils are re suspended in Arkansas River



Re-entrainment Study Fathead Minnow % Survival



Restored sites may be attractive

- But data shows that they are not an attractive nuisance

Sure Sign of Success



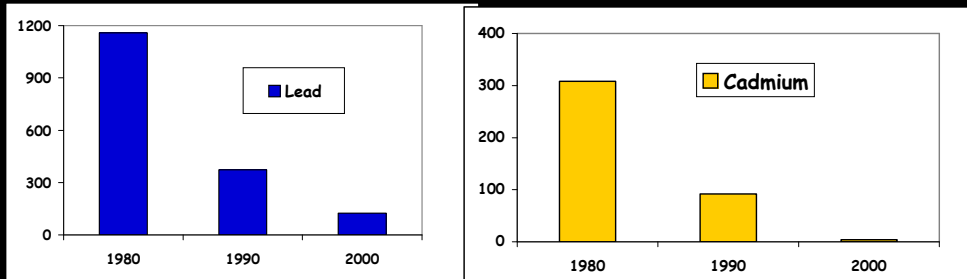
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When you try this makeover Concerns using residuals

- Not a commodity
 - No fixed price or infrastructure
 - Generators not used to process
- Perception that they contain toxic levels of contaminants

Better than Botox

Aren't many metals left to worry about



Data from Chicago Water Reclamation District
(generates 200,000 dry tons of biosolids per year)

Biosolids:

Pathogens are treated before biosolids can be land applied



- You won't be making headlines from your spinach salad

- Other residuals (like manures) waiting period before garden vegetables should be grown

<http://www.cheeseboard.co.uk/>

Residuals

Because they work at highly contaminated sites

- Will be effective at a wide range of sites
- Where ecosystem restoration is a goal

Residuals offer an inexpensive and rapid way to lay a foundation for restoration

Thank You

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