Biosolids
Extreme Makeover!

With your hosts:
Harry Compton and Sally Brown

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West Page Swamp-
Bunker Hill, ID
Before

2

West Page Swamp-
Bunker Hill, ID
During- 1998

3

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

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Jasper County, MO
Before

5

Jasper County, MO
During- 2000

6

Jasper County, MO
After- 2003 Pretty Nice!

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Leadville, CO
Before- 1997

8

Leadville, CO
During

Leadville, CO
After- 2005- A Stunner!

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Green Remediation

Restoration Alternatives

Harry R. Compton
Environmental Engineer
U.S. EPA - ERT
Sally Brown
University of Washington U

UNIVERSITY OF WASHINGTON

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EPA's OSWER Priorities

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

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Mine Sites

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

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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**

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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**

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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

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Remote/Almost Live

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Vermi-compost and Sand 1:1

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Adding Water

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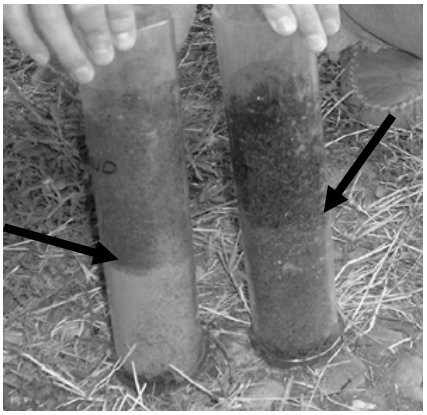

Compost changes two things

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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

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Steps in design

- Site history
- Soil sampling and analysis
- Identify site problems
  - Contaminants
  - Soil physical conditions
  - Climate
- Inventory of available materials
- Identify appropriate mixtures

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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!!!!

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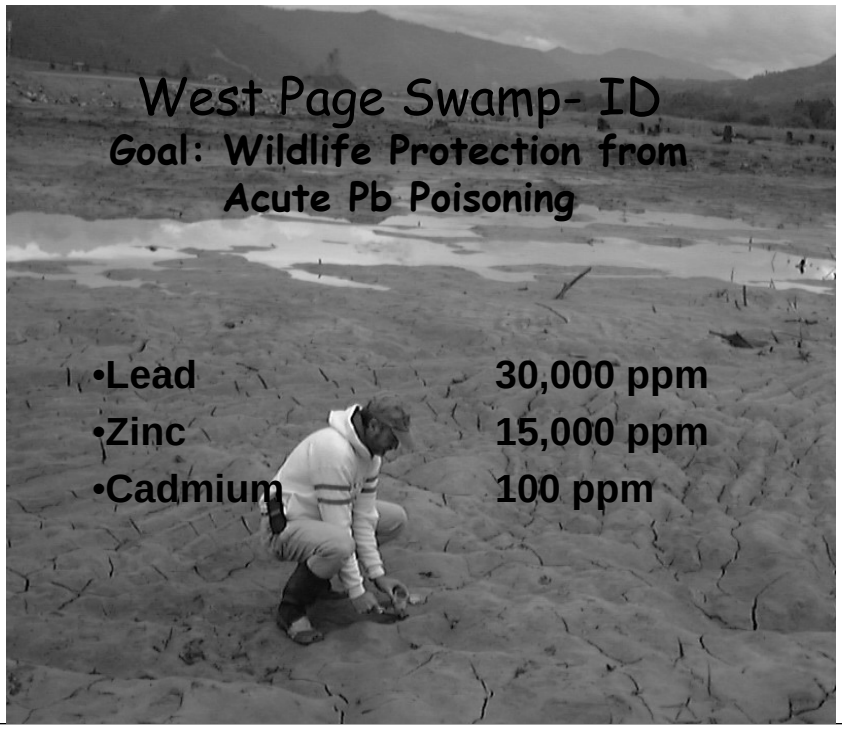
West Page Swamp- ID
Goal: Wildlife Protection from Acute Pb Poisoning
•Lead 30,000 ppm
•Zinc 15,000 ppm
•Cadmium 100 ppm
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Our Answer: Compost Wood ash Cap

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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

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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**

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15 cm deep treatment of a mixture of:

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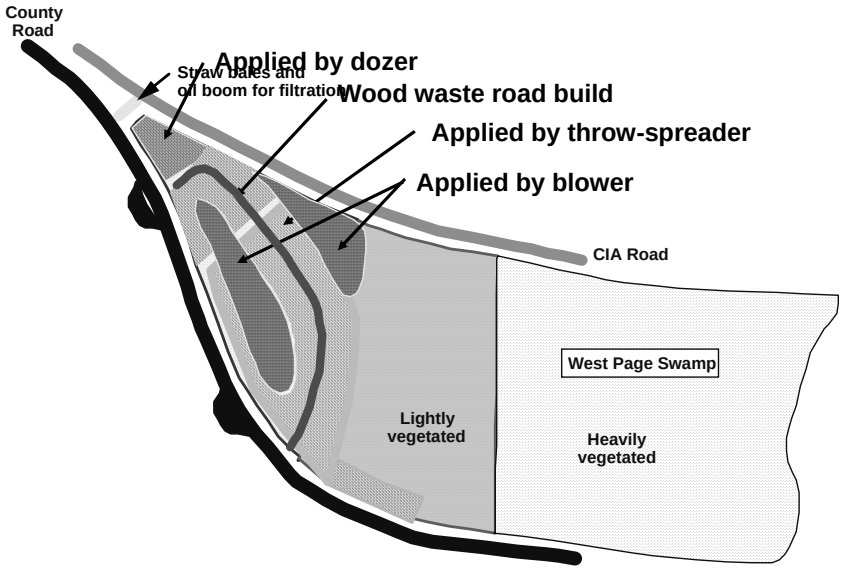
County Road
Straw bales and oil boom for filtration
Applied by dozer
Wood waste road build
Applied by throw-spreader
Applied by blower
CIA Road
West Page Swamp
Lightly vegetated
Heavily vegetated

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1998

1999

2000

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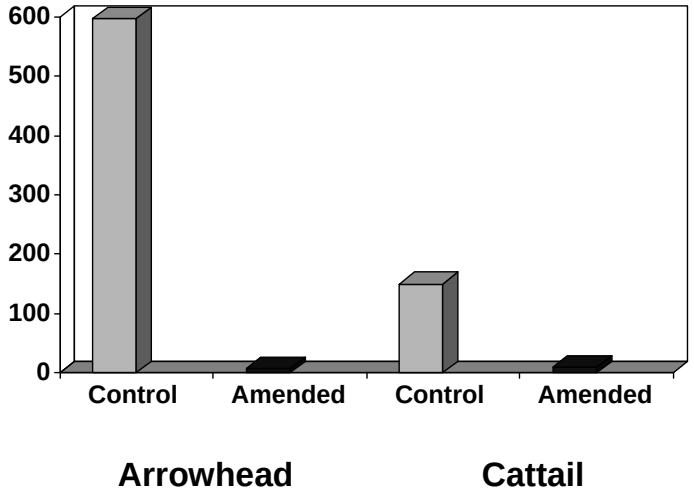
Ecosystem Implications- Wetland - Plant lead ($mg\ kg^{-1}$)



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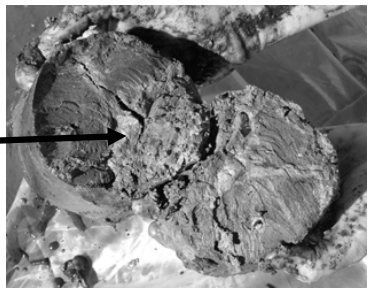
2005-
Collecting cores for metal speciation/bioavailability analysis



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More Galena!
XAS- Kirk Scheckel NRMRL

At Interface	At Depth
60% Galena	53% Galena

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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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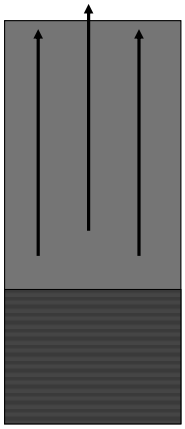
Risks

- **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**



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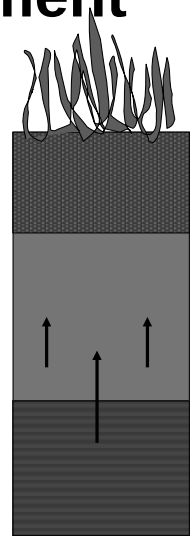
Biosolids/Lime amendment

- **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**



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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

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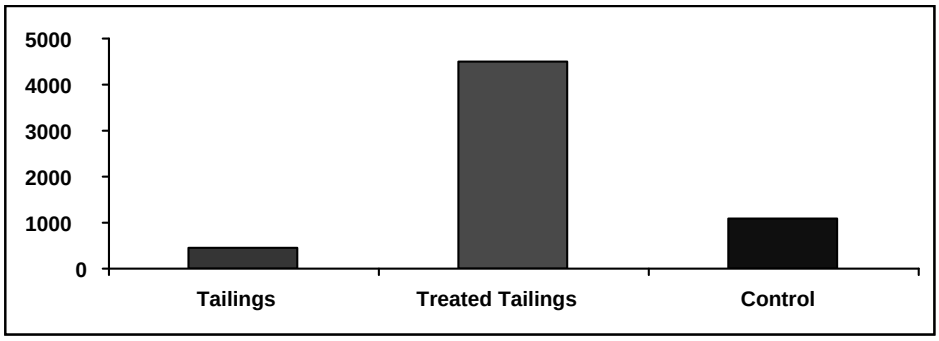
Microbial Function
CO_2 Evolution



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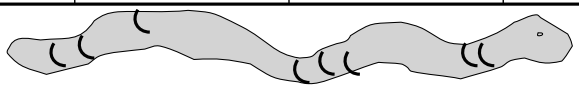
Earthworm Survival

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



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Leadville in August

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Plant Diversity

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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

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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**

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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**

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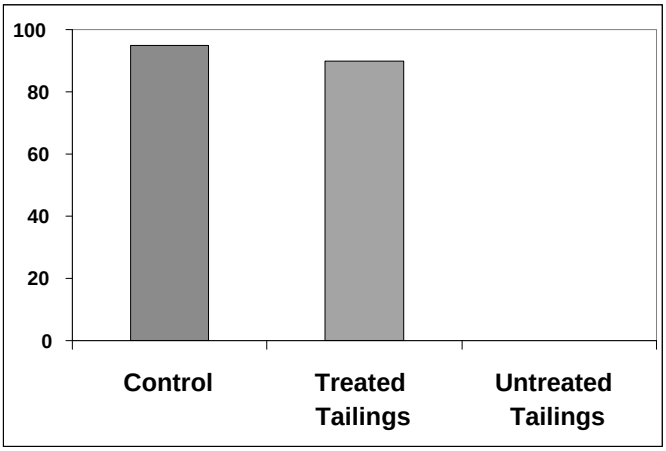
Re-entrainment Study
Fathead Minnow % Survival



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Restored sites may be attractive

- But data shows that they are not an attractive nuisance

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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

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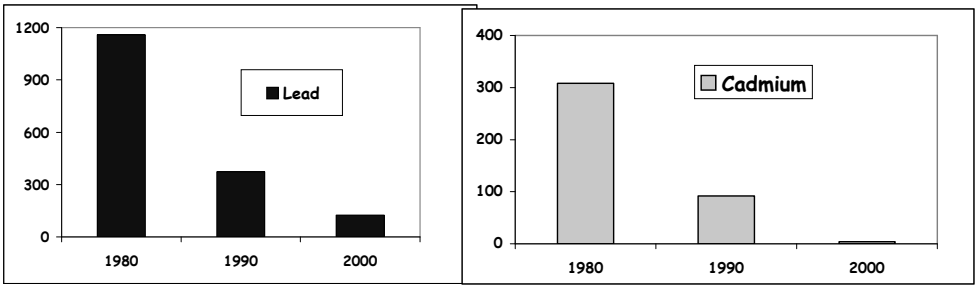
Better than Botox

Aren't many metals left to worry about



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

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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/

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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

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Thank You

After viewing the links to additional resources, please complete our online feedback form.

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