Illinois River Sediment as Topsoil: Current Assessment

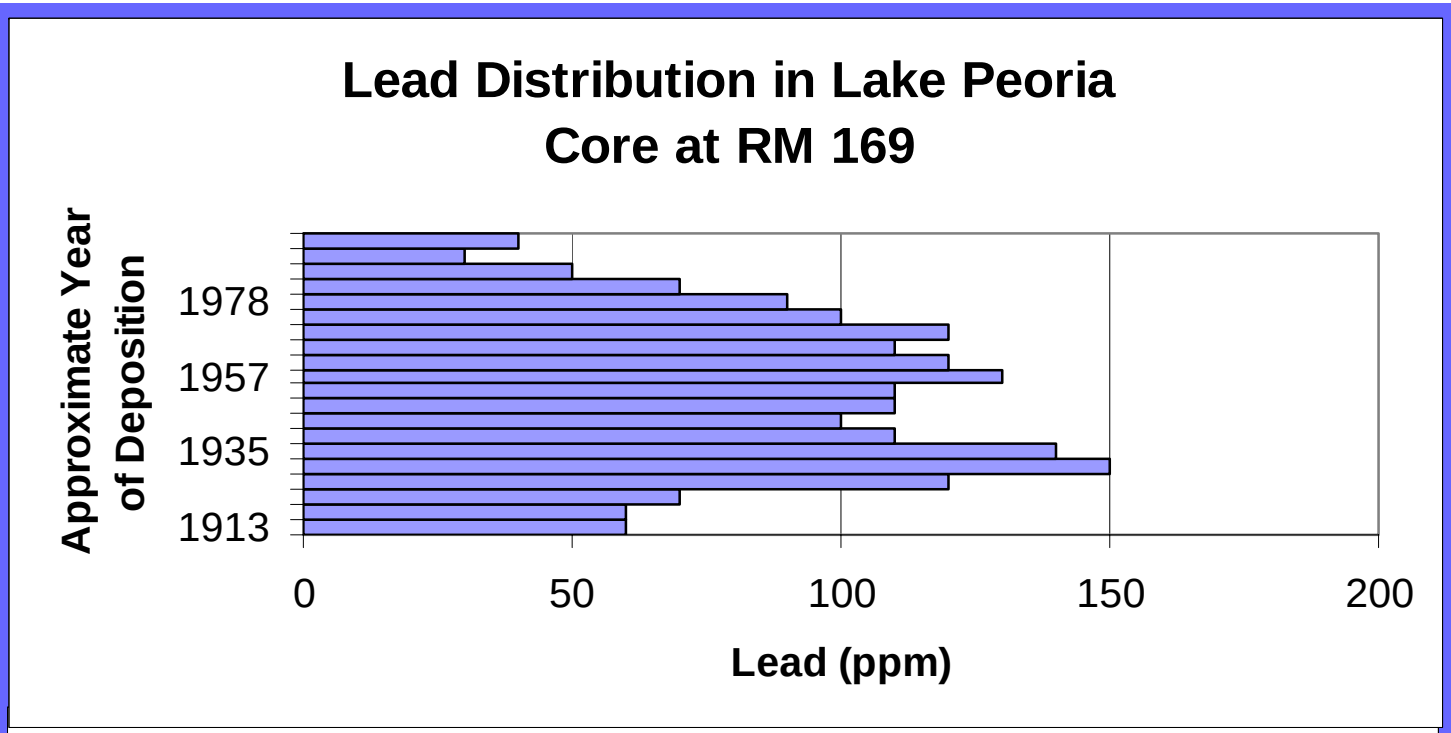
Dr. Robert Darmody
University of Illinois, Department of Natural Resources and Environmental Sciences

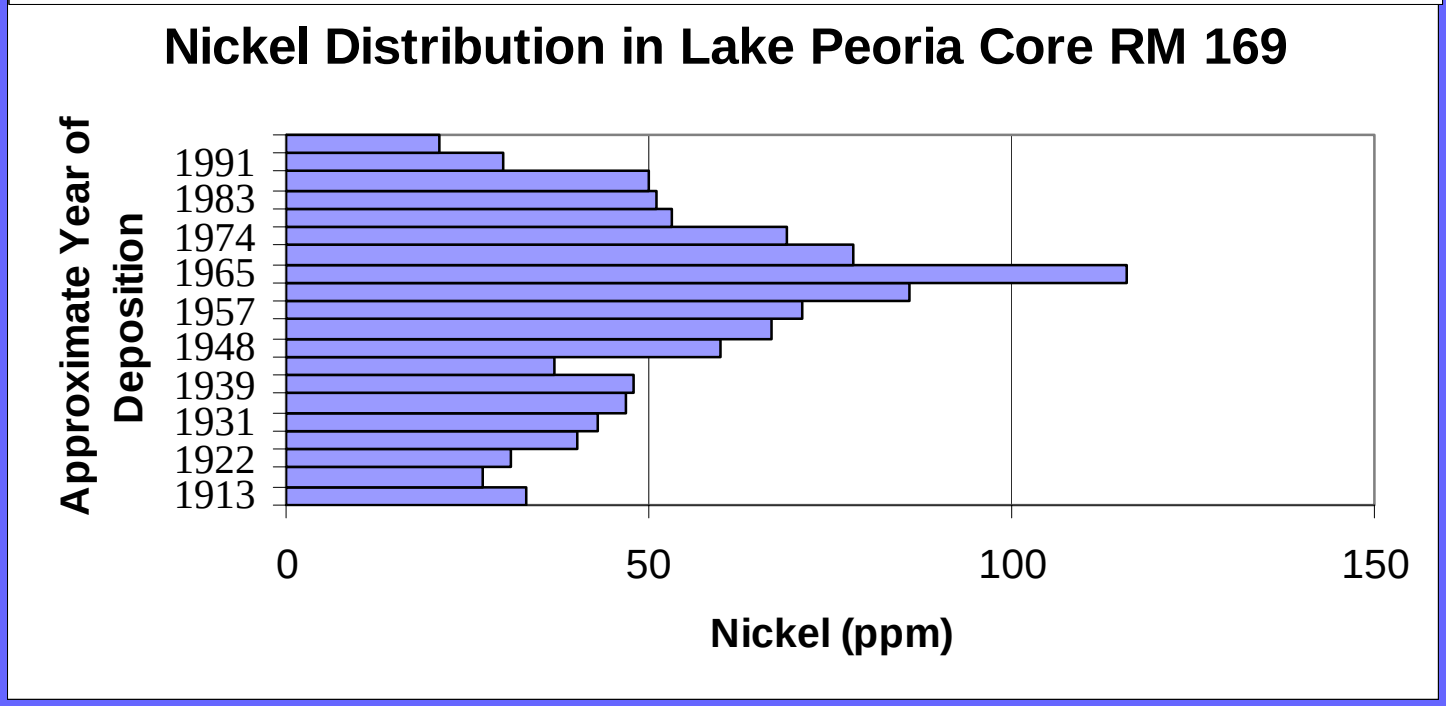
Dr. John Marlin
Illinois Waste Management and Research Center

Characteristics of 20 Sediment Cores from 20 mile Reach of Peoria Lake

Parameter	mean	range
Sand %	6	1 – 44
Silt %	40	26 – 56
Clay %	54	19 – 72
Total P mg/kg	1003	574 -1660
TKN mg/kg	1138	117 – 3020
Inorganic C %	1.3	0.3 - 4.0
Organic C %	2.9	1.3 - 5.9

ISGS Data


Lead Distribution in Lake Peoria
Core at RM 169
Approximate Year of Deposition
1978
1957
1935
1913
0
50
100
150
200
Lead (ppm)


Nickel Distribution in Lake Peoria Core RM 169
Approximate Year of Deposition
1991
1983
1974
1965
1957
1948
1939
1931
1922
1913
0
50
100
150
Nickel (ppm)

ISGS Data

Sediment Utilization Research Projects

1. Greenhouse I study of plant growth and metal uptake in sediments
2. Greenhouse II study of plant growth and metal uptake in sediment - biosolid mixtures
3. Field corn and soybean plots of sediments on sandy soils

Collection of Sediment for Greenhouse I Experiment

Greenhouse Experiment I
Crop Yields

Within pairs, sediment on left, topsoil on right

Metal Contents (mg kg^{-1}) of Soil and Sediments Used in the Greenhouse Experiment I

Material	Cd	Cr	Cu	Ni	Pb	Zn
Drummer-Flanagan	< 1	29	20	22	18	60
Fresh Sediment	3	48	43	38	40	241
Weathered Sediment	4	61	43	36	54	293

Note: Metal contents are somewhat higher in sediments than in topsoil.


Tomatoes from Greenhouse I

Metal Contents (mg kg^{-1}) of Tomatoes Grown in Soils and Sediments in Greenhouse I

Material	Cd	Cr	Cu	Ni	Pb	Zn
Drummer-Flanagan	0.1	2	13	2	0.5	26
Fresh Sediment	0.4	< 2	12	1	0.4	25
Weathered Sediment	0.5	< 2	8	1	0.3	21
Peoria	0.4	< 2	10	1	0.2	20
Champaign	0.2	3	21	13	0.9	21

Note: Metal content of tomatoes grown in sediment was not significantly different from those grown in topsoil or in back yard gardens.

Greenhouse Experiment II

Experimental Design

Treatment	Sediment %	Biosolids %
1	100	0
6	70	30
7	50	50
10	0	100
16	Control = Standard Greenhouse Mix	

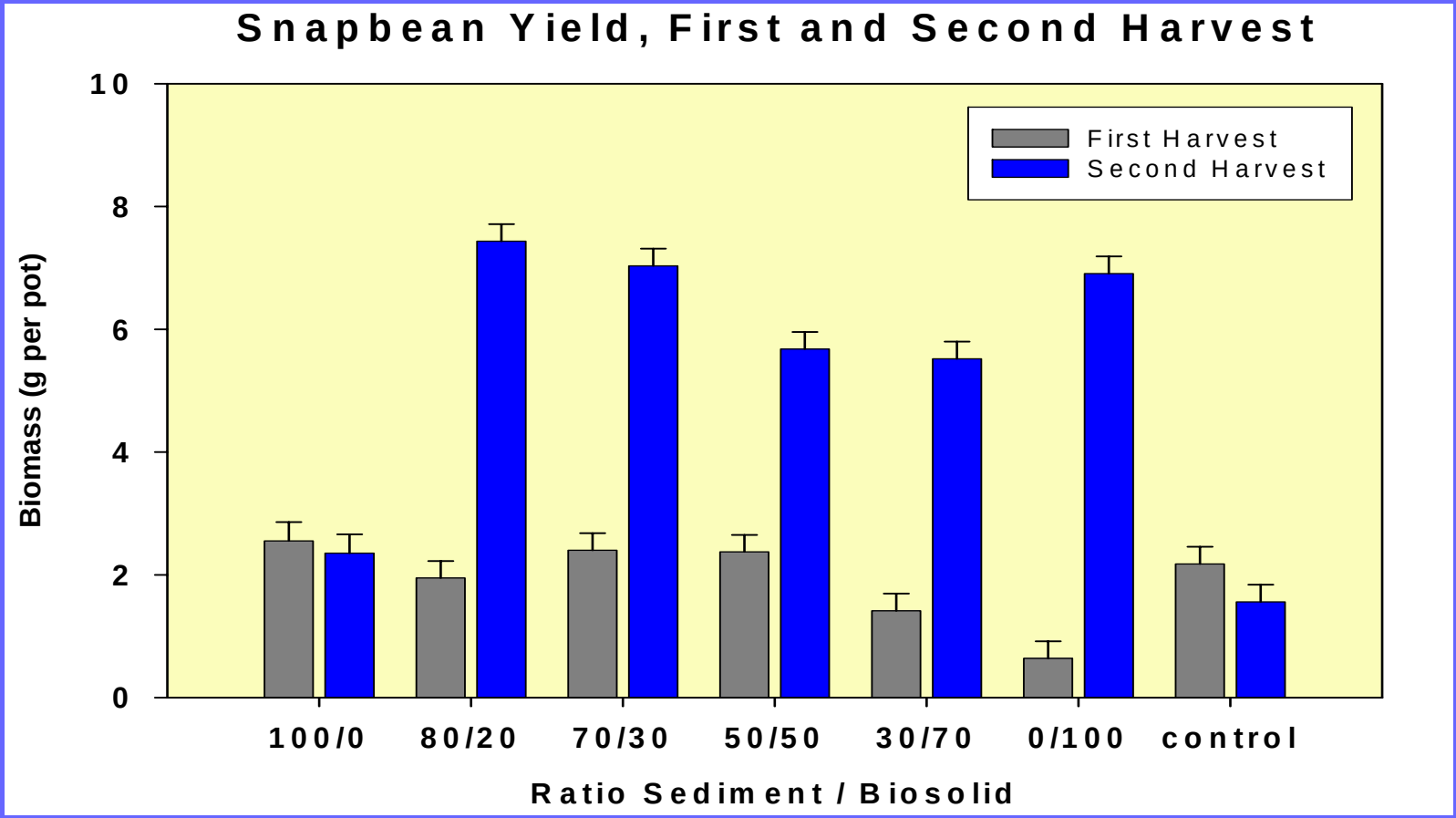
Greenhouse Experiment II

Sediments + Biosolids

Start of experiment

End of experiment

Yields in Greenhouse II



Note: Biosolids had a impact on yields primarily because no fertilizer was added. Salts in biosolids depressed initial yield, leaching salts increased yield.

Snapbean Metal Concentration, Greenhouse II

Treatment S-B	As	Mo	Cu	Zn
	---------- mg kg^{-1} ----------			
100-0 †	0.2	15	5	31
70-30	0.2	5	6	52
50-50	0.2	5	6	58
0-100	0.7	9	9	101
control	0.2	7	3	22

† Sediment % - Biosolid %

Note: Snapbeans grown in 100% biosolid had higher As, Cu and Zn, 100% sediment plants had higher Mo. Mixing the two decreased metal uptake.

Sand Farm Sediment Research Plots

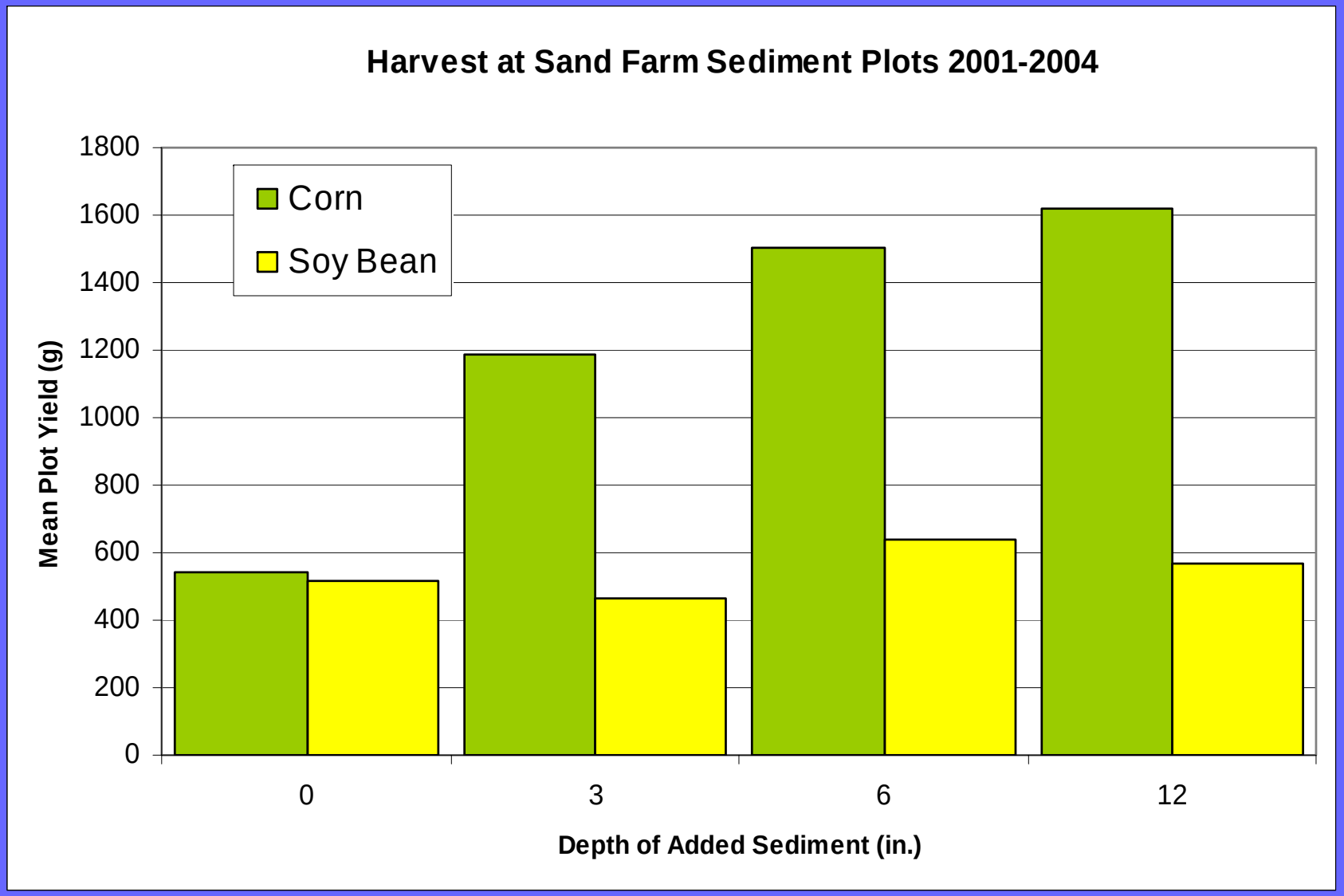
0, 3, 6, and 12 Inches of Sediment Added to Sand Soil in 3 research plots

Sand Farm Crop Harvest

Corn plant height at harvest time

Sand Farm Corn Ears
Sediment vs. Native Soil

Sand Farm Crop Harvest



Note: Sediment Increased yield due to increased soil moisture holding and fertility.

Summary of Research Project Results

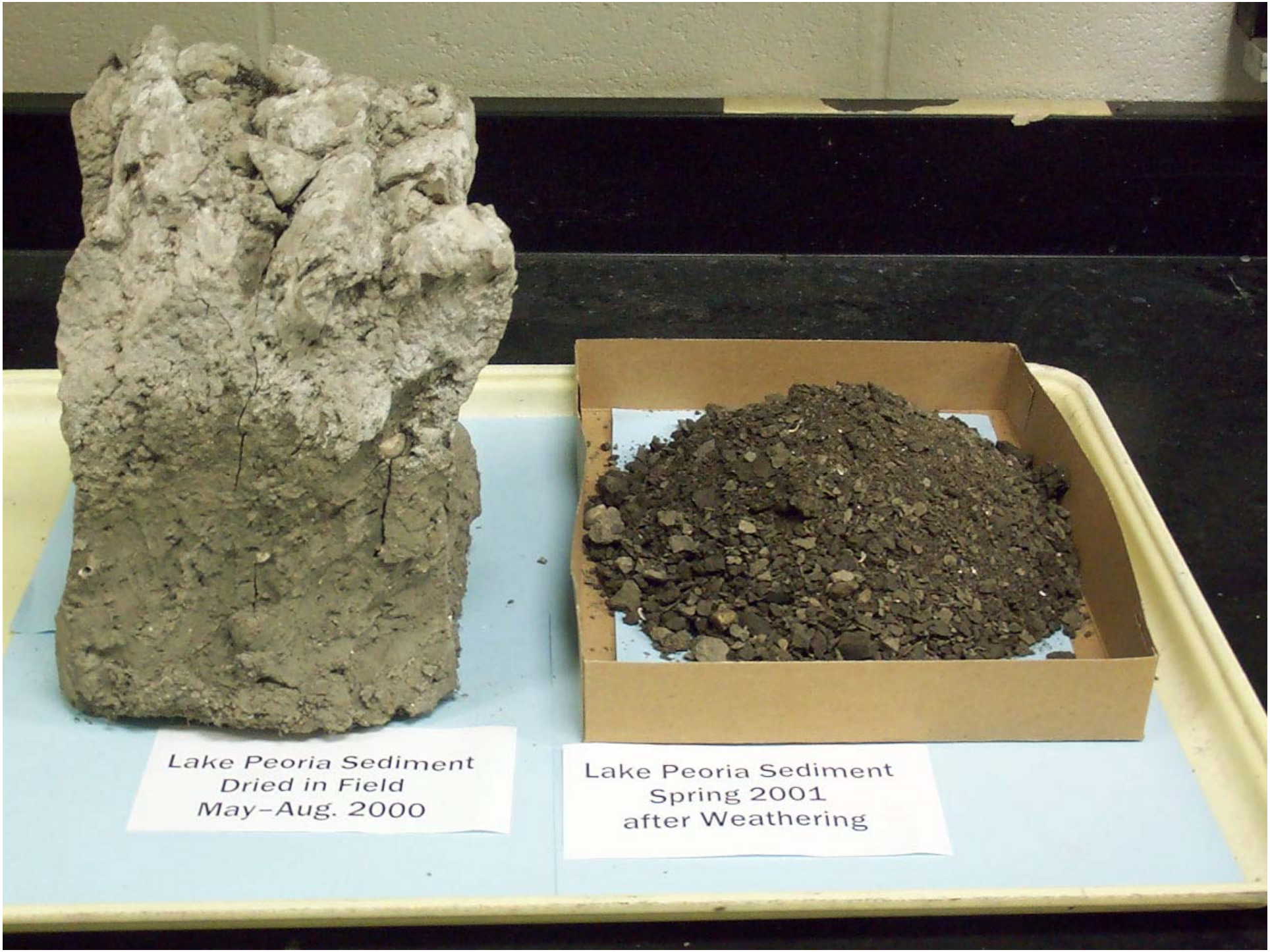
- Sediment metal content may be elevated compared to background for soil and varies with depth and location in the river.
- Metal uptake is noted in plants grown on sediments, but levels are generally not at hazardous amounts.
- Sediments make fertile topsoil, plants grow well on prepared sediments.

Sediment Utilization Demonstration Projects

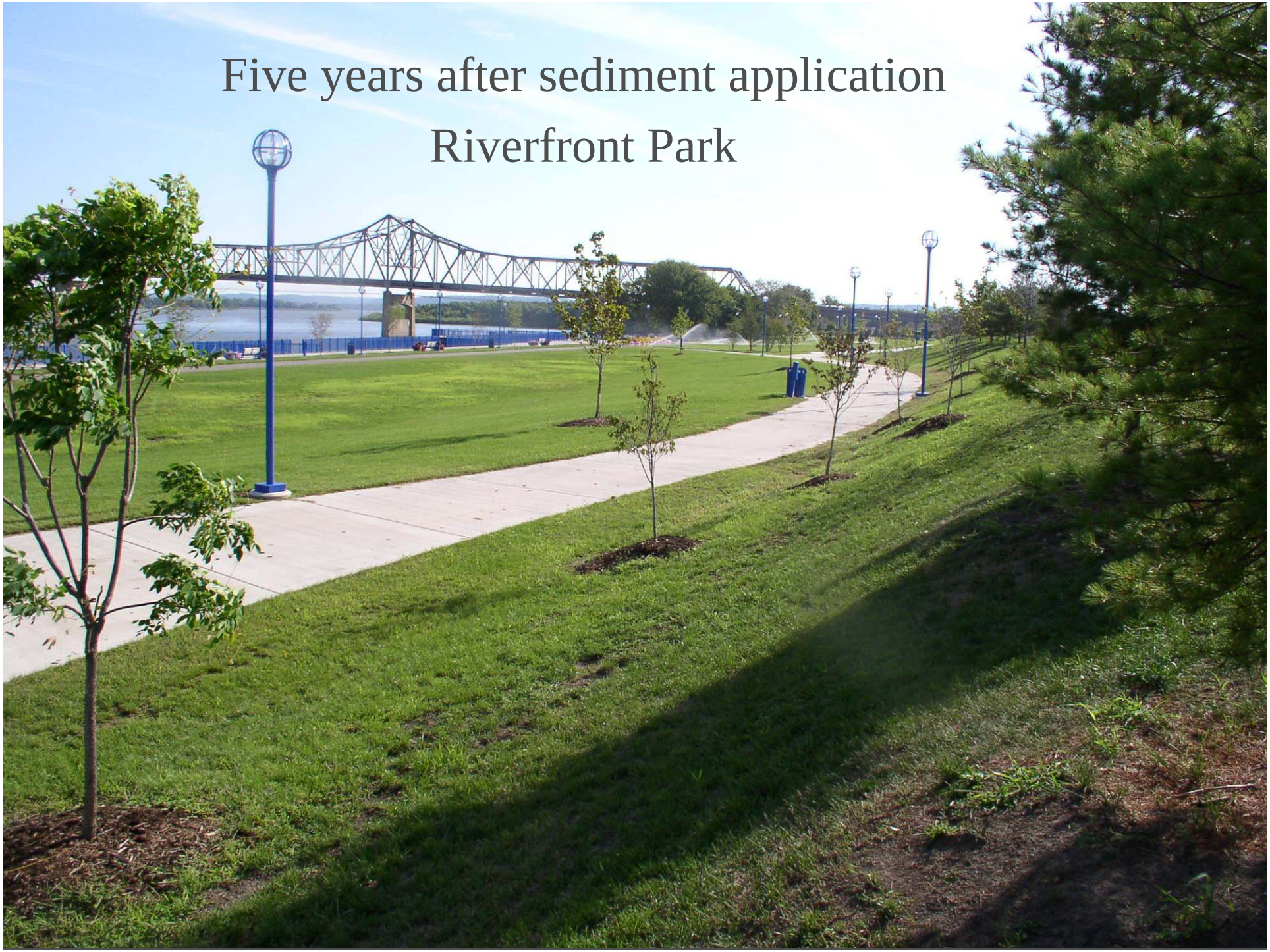
1. East Peoria Park, topsoil on brownfield
2. Paxton Landfill, plant growth on landfill cover
3. Banner Marsh, drying and weathering
4. USX, brownfield reclamation


East Peoria Sediment Demonstration Site

East Peoria Sediment Demonstration Site, 1 month after application


Lake Peoria Sediment
Dried in Field
May–Aug. 2000
Lake Peoria Sediment
Spring 2001
after Weathering

East Peoria Sediment Demonstration Site, four months later


Five years after sediment application
Riverfront Park


Paxton Landfill 10/7/02
10. 7. 2002


Paxton 1,
Oct. 7, 2002
10. 7. 2002

Paxton 1 Sediment Plot


Plant Roots on Sediment
at Paxton, 9/2003

Banner Marsh Sediment Drying Demonstration


Banner Marsh Sediment Drying Demonstration

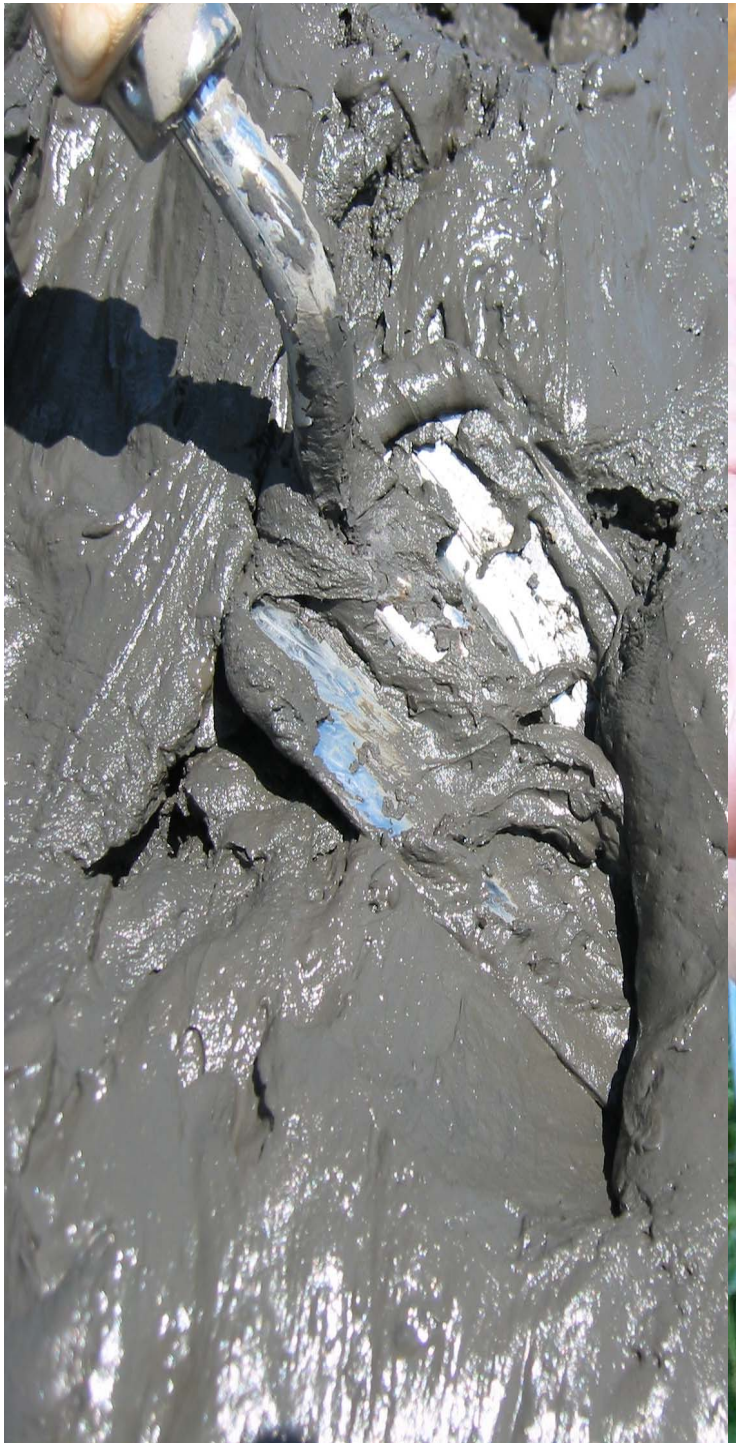

John Marlin, out standing in his field
i.e. the USX sediment south site

Summary of Demonstration Projects

- Sediment is a fluid paste initially, then dries to a hard state, then weathers to form soil aggregates.
- Plants will grow in prepared / weathered sediments.
- With time, sediment makes good topsoil.

Take Home Message

- Sediment we used has no inherent properties that would preclude use as topsoil substitute.
- Mixing of sediment and biosolid increase plant growth and decrease metals uptake.
- Poor initial physical structure improves with weathering.
- Sediment may take a long time to dry, best to let it dry in thin layers



Good Topsoil From Dredged Illinois River Sediment