Biosolids to Soils: 25 Years of Research & Practice

Ned Beecher
Executive Director, North East Biosolids & Residuals Association (NEBRA)

November 1, 2012

Webinar by the Ohio Water Environment Association (OWEA)

NOTE: For copies of or referrals to documents mentioned in this presentation, contact the NEBRA office: info@nebiosolids.org.
Thanks for slides…

- Sally Brown, PhD, Univ. of WA
- Andrew Carpenter, MS, Northern Tilth
- Rufus Chaney, PhD, U. S. Dept. of Agriculture
- Nora Goldstein / BioCycle
- Alan Rubin / formerly U. S. EPA
- Bill Toffey, MABA / formerly of Philadelphia Water
- Resource Management, Inc., Holderness, NH
Today’s presentation

- What are biosolids?
- 25+ years of focused world research
  - Research on treatment processes
  - Research on beneficial use options
  - Research on potential impacts to environment, soils, crops, public health
- 25+ years of practice
- Resource recovery - sustainability
"As required by the Clean Water Act Amendments of 1987, the U. S. EPA developed a new regulation to protect public health and the environment from any reasonably anticipated adverse effects of certain pollutants that might be present in sewage sludge biosolids. This regulation, The Standards for the Use or Disposal of Sewage Sludge (Title 40 CFR Part 503) was published in the Federal Register on February 19, 1993."

--A Plain English Guide to the EPA Part 503 Biosolids Rule
Happy 20th, Part 503!

- 1984: Rule development begins
- 1989: Proposed rule
- 1993: Final rule
- 1994: Amendments (no Table 3 Mo limit, CO monitoring for incineration)

“Many of the requirements of the Part 503 rule are based on the results of an extensive multimedia risk assessment. This risk assessment was more comprehensive than for any previous Federal biosolids rulemaking effort, the earliest of which began in the mid-1970s. Research results and operating experience over the past 25 years have greatly expanded EPA’s understanding of the risks and benefits of using or disposing of biosolids.”

--A Plain English Guide to the EPA Part 503 Biosolids Rule

EPA was relying on 25 years of prior research in 1993. Now, 20 years later, we’re up to 40 years +….
What are biosolids?

Sludge: untreated wastewater solids

Biosolids:

**biosolid n. (1990):** "solid organic matter recovered from a sewage treatment process and used especially as fertilizer -- usually used in plural"

– *Merriam-Webster’s Collegiate Dictionary, Tenth Edition*

**biosolids: plural noun:** “organic matter recycled from sewage especially for use in agriculture”

The resources in municipal biosolids

- **Water** ~ 5% (heat dried pellets) to ~ 95% (liquid)
- **Organic matter** ~ 20% to 70% dry weight biological molecules from foods, human waste, runoff, etc., including lipids, proteins, sugars, starches, etc., dissolved and suspended, which contain…

**Nutrients** ~ 12% dry weight

N, P, K, Ca, Fe, & micro-nutrients (Cu, Zn, etc.)

**Energy** ~ 5,000-10,000 Btu/d

(when dry, similar to low grade coal)

**Binding Sites** reducing Pb, As etc.

bioavailability

Also:
- Inert sand, silt, grit, and synthetic particles
- Trace elements (mostly in compounds)
- Pathogenic micro-organisms
- Synthetic and natural organic chemical compounds (including polymer)
Elemental comparison...
What’s ideal for sustainability?

**MAXIMIZE BENEFICIAL USES OF RESOURCES**

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Benefits</th>
<th>Concerns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>valuable in agriculture, arid climate</td>
<td>cost of transport</td>
</tr>
<tr>
<td>Organic matter</td>
<td>vital to soils</td>
<td>putrescible, odor</td>
</tr>
<tr>
<td>Nutrients</td>
<td>plant &amp; animal food</td>
<td>impacts to water</td>
</tr>
<tr>
<td>Energy</td>
<td>renewable, displaces oil/gas</td>
<td>air emissions, no use of nutrients &amp; organic matter</td>
</tr>
</tbody>
</table>

**MANAGE TO MINIMIZE POTENTIAL RISKS**

Reduce/control/mitigate trace elements (e.g. metals), pathogens, synthetic and natural organic chemical compounds.

**WEF has a new policy statement emphasizing resource recovery from biosolids; download it from bottom of www.nebiosolids.org.**
Solids treatment processes
(biosolids are only safe if the treatment process is done right – as required by law!)

- Goal: stabilize solids for final use or disposal (landfilling, soil amendment)
- Make it manageable economically (dewatering, non-putrescible, nice product)
- Reduce risk to public health
  - Pathogen treatment (“Class A” or “Class B”)
  - Vector attraction reduction (VAR)
- Testing & certification of particular treatment systems that achieve pathogen treatment & VAR
Common treatment options…
for application to soil

- Making general use (“Class A”) biosolids includes…
  - Advanced alkaline stabilization (NViro, Lystek, etc.)
  - Autothermal thermophilic aerobic digestion (ATAD)
  - Anaerobic digestion (thermophilic, staged, 2PAD, etc.)
  - Composting
  - Heat-drying
  - Long-term storage / lagoons / testing

- Making limited use (“Class B”) biosolids includes…
  - Alkaline stabilization
  - Anaerobic or aerobic digestion
  - Long-term storage / lagoons / testing
25+ years of research

- Treatment processes
- Beneficial use options
- Potential impacts on environment, soils, crops, & public health
  - Trace elements / heavy metals
  - Synthetic chemicals
  - Pathogens
North America: Significant University Research

- Univ. of Maine
- Univ. of New Hampshire
- Univ. of Massachusetts
- Cornell Univ., New York*
- Penn State Univ.*
- Univ. of Delaware
- Virginia Tech*
- North Carolina State Univ.*
- Univ. of Georgia
- Univ. of Florida*
- The Ohio State Univ.*
- Univ. of MN* / USDA
- Tulane Univ.
- Univ. of Guelph / OMAFRA*
- Ryerson Univ. / OMAFRA
- Univ. of Nebraska*
- Univ. of Manitoba*
- Univ. of Alberta*
- Colorado State Univ.*
- Utah State Univ.*
- Univ. of Arizona*
- Univ. of California – Riverside*
- Washington State Univ.*
- Univ. of Washington*
- Univ. of British Columbia*
- ...and more...

* long-term research; many papers
1967:

“Sludge Treatment and Disposal”
Ontario Water Resources Commission
1976:

APPLICATION OF SEWAGE SLUDGE TO CROPLAND:
APPRaisal OF POTENTIAL HAZARDS OF THE HEAVy METALS TO PLANTS AND ANIMALS

NOVEMBER 1976

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF WATER PROGRAM OPERATIONS
MUNICIPAL CONSTRUCTION DIVISION
WASHINGTON, D.C. 20460

LAND APPLICATION OF WASTE MATERIALS

SOIL CONSERVATION SOCIETY OF AMERICA
1978:

National Conference on
**Design of Municipal Sludge Compost Facilities**
Chicago, Illinois
August 29-31, 1978

Sponsored By:
Information Transfer Inc.
Hazardous Materials Control Research Institute

In Association With:
Science and Education Administration,
U.S. Department of Agriculture

OPERATIONS MANUAL
SLUDGE HANDLING AND CONDITIONING

By
William P. H-y
Daniel J. Marz
Thomas H. Linnich
Culp/Beeson/Culp/Clean Water Consultants
Box 60
El Dorado Hills, CA 95620

Contract No. 68-01-4424

EPA
Project Officer
L. F. Foster
Task Officer
Maria Perez

February, 1978
Prepared for
U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF WATER PROGRAM OPERATIONS
WASHINGTON, D.C. 20460

For sale by the Superintendent of Documents, U.S. Government
Printing Office, Washington, D.C. 20402
1979:

SLUDGE DISPOSAL
BY LANDSPREADING
TECHNIQUES

Edited by S. Tornay

NOYES DATA CORPORATION
Park Ridge, New Jersey, U.S.A.
1979


Energy Resources Co., Inc., Cambridge, MA

Prepared for
National Science Foundation, Washington, DC
Applied Science and Research Applications
Feb 79
UNIV. OF GUELPH RESEARCH, 1972-1981

LAND DISPOSAL OF SEWAGE SLUDGE

A summary of research conducted by the Departments of Land Resource Science and Microbiology, the University of Guelph, from 1972 to 1981. This summary was prepared from detailed annual reports by:

T.K. Soon, Research Scientist

and

T. E. Bates, Professor

Department of Land Resource Science
University of Guelph
Guelph, Ontario

The research was funded under project No. 72-5-17 of the Canada-Ontario Agreement by Environment Canada and the Ontario Ministry of the Environment from 1972 to 1978, and by the Ontario Provincial Lottery Funds through the Ontario Ministry of the Environment from 1978 to 1981.

T.K. Soon
1984:
1989:

Proceedings of technical conference at University of York, UK
Commission of the European Communities:

1980

1983

1985

1991
1993:

DOCUMENT LONG-TERM EXPERIENCE OF BIOSOLIDS LAND APPLICATION PROGRAMS

PROJECT 91-ISP-4

1993

by

John B. Strubenberg
Black & Veatch

Scott Carr
Black & Veatch

Lee W. Jacobs
Department of Crop and Soil Sciences
Michigan State University

Sven Böhm
Department of Crop and Soil Sciences
Michigan State University

Water Environment Research Foundation
1998:

A Global Atlas of Wastewater Sludge and Biosolids Use and Disposal

Edited by Peter Matthews

Municipal Sewage Sludge Management: A Reference Text on Processing, Utilization and Disposal

Edited by
Cecil Lue-Hing
David R. Zenz
Prakasam Tata
Richard Kuchenrither
Joseph F. Malina, Jr.
Bernard Sawyer
2008 Global Atlas
Research demonstrates benefits....

Metro Vancouver soil manufacturing, using biosolids
Why Farmers Want Biosolids: Nutrient Content

(slide courtesy of Andrew Carpenter, Northern Tilth)

Biosolids values from The Use of Biosolids in Maine: A Review (report by the Mitchell Center)

Manure Values adapted from ASAE Standards 2000

% dry wt. basis
Findings: Organic Residuals are Valuable!
Univ. of WA study – published 2011

Slide courtesy of Sally Brown, PhD
Univ. of WA
Low GHG emissions

- **Methane avoidance**

- **Energy recovery**
  - Cold wet climate

- **Incineration 1**
  - 800°C
  - 25% solids
  - No recovery

- **Incineration 2**
  - 900°C
  - 30% solids
  - Energy recovery

- **Class A Alkaline Land Ap**
  - Using virgin lime
  - **if recycled lime → total to -211**

- **Anaerobic dig Land ap**
  - 65% heat
  - 30% elect.
  - 1% fugitive

Research addresses risks…
Three major areas of voiced concern:

- **“heavy” metals**: regulated, non-regulated
- **chemicals**: PCBs, legacy, priority pollutants, microconstituents, PPCPs, radioactivity…
- **pathogens**: traditional, “emerging,” endotoxin, prions, antibiotic resistance, reactivation & regrowth…
First, some perspective...

**Biosolids vs. Manure Volumes (in Maine)**

- Wet tons generated annually

![Bar chart showing biosolids and animal manure volumes, with disposed and recycled categories.](image)

*Slide courtesy of Andrew Carpenter, Northern Tilth*
EPA Risk Assessment for Part 503: Exposure Pathways Assessed Agricultural Land Application Scenario to Assess Human Exposure
Pathways for Risk Assessment of Elements in Soils, and Highly Exposed Individuals - 1

<table>
<thead>
<tr>
<th>Pathway</th>
<th>Highly Exposed Individual</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Soil → Plant → <strong>Human</strong></td>
<td>Farm markets; 2.5% of food</td>
</tr>
<tr>
<td>2. Soil → Plant → <strong>Human</strong></td>
<td>Home gardens; 60% of garden foods for lifetime</td>
</tr>
<tr>
<td>3. Soil → <strong>Human</strong></td>
<td>200 mg/day soil/dust ingestion</td>
</tr>
<tr>
<td>4. Soil → Plant → Animal → <strong>Human</strong></td>
<td>Farms; 45% home-grown meat</td>
</tr>
<tr>
<td>5. Soil → Animal → <strong>Human</strong></td>
<td>Grazing ruminants; soil is 2.5% of annual diet; 45% home-grown meat.</td>
</tr>
<tr>
<td>6. Soil → Plant → <strong>Animal</strong></td>
<td>100% of livestock feeds grown on soils</td>
</tr>
<tr>
<td>7. Soil → <strong>Animal</strong></td>
<td>Grazing ruminants; 2.5% soil in diet.</td>
</tr>
</tbody>
</table>
### Pathways for Risk Assessment of Elements in Soils and Highly Exposed Individuals - 2

<table>
<thead>
<tr>
<th>Pathway</th>
<th>Highly Exposed Individual</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. Soil $\rightarrow$ Plant</td>
<td>Sensitive crops; strongly acidic.</td>
</tr>
<tr>
<td>9. Soil $\rightarrow$ Soil Biota</td>
<td>Earthworms; microbes; metabolic function of soil.</td>
</tr>
<tr>
<td>10. Soil Biota $\rightarrow$ Soil Biota Predator</td>
<td>Shrews; 1/3 of diet presumed to be earthworms full of Soil</td>
</tr>
<tr>
<td>11. Soil $\rightarrow$ Airborne Dust $\rightarrow$ Human</td>
<td>Tractor operator.</td>
</tr>
<tr>
<td>12. Soil $\rightarrow$ Surface water $\rightarrow$ Human</td>
<td>Subsistence fishers.</td>
</tr>
<tr>
<td>13. Soil $\rightarrow$ Air $\rightarrow$ Human</td>
<td>Farm households</td>
</tr>
<tr>
<td>14. Soil $\rightarrow$ groundwater $\rightarrow$ Human</td>
<td>Well water on farms.</td>
</tr>
</tbody>
</table>
A TECHNICAL REVIEW OF:
"THE CASE FOR CAUTION
RECOMMENDATIONS FOR LAND APPLICATION OF
SEWAGE SLUDGES
AND
AN APPRAISAL OF THE USEPA'S PART 503 REGULATIONS"

August 1997 Working Paper
Cornell Waste Management Institute

NOVEMBER 1997
[Includes changes based on EPA review]

New York State Department of Environmental Conservation
Division of Solid & Hazardous Materials
Perspective on metals land applied
Trace metals in other agricultural materials, for comparison

**Chart 3.2: Reported Averages (or Ranges) of Trace Metals Levels in Other Materials (ppm or mg/kg)**

<table>
<thead>
<tr>
<th>Trace Metal</th>
<th>Dairy Manure (4)</th>
<th>Dairy Manure (3)</th>
<th>Feedlot Manure (2)</th>
<th>Pig Waste (2)</th>
<th>Swine Manure (3)</th>
<th>Poultry Litter (2)</th>
<th>Chicken Manure (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic (As)</td>
<td>0.26</td>
<td>0.88</td>
<td>NA</td>
<td>3.7</td>
<td>NA</td>
<td>30</td>
<td>0.66</td>
</tr>
<tr>
<td>Cadmium (Cd)</td>
<td>0.32</td>
<td>0.03</td>
<td>0.2</td>
<td>ND</td>
<td>0.32</td>
<td>ND</td>
<td>0.59</td>
</tr>
<tr>
<td>Chromium (Cr)</td>
<td>5.2</td>
<td>20</td>
<td>NA</td>
<td>61</td>
<td>NA</td>
<td>20</td>
<td>4.9</td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>41</td>
<td>11.6</td>
<td>2.0</td>
<td>501</td>
<td>14.3</td>
<td>1195</td>
<td>13</td>
</tr>
<tr>
<td>Lead (Pb)</td>
<td>6.6</td>
<td>2.1</td>
<td>0.2</td>
<td>ND</td>
<td>1</td>
<td>12</td>
<td>11.5</td>
</tr>
<tr>
<td>Mercury (Hg)</td>
<td>0.09</td>
<td>0.05</td>
<td>NA</td>
<td>ND</td>
<td>NA</td>
<td>NA</td>
<td>0.04</td>
</tr>
<tr>
<td>Molybdenum (Mo)</td>
<td>2.5</td>
<td>22.1</td>
<td>NA</td>
<td>7.9</td>
<td>22.6</td>
<td>NA</td>
<td>95.3</td>
</tr>
<tr>
<td>Nickel (Ni)</td>
<td>7.8</td>
<td>3.3</td>
<td>NA</td>
<td>29.3</td>
<td>NA</td>
<td>NA</td>
<td>3.9</td>
</tr>
<tr>
<td>Selenium (Se)</td>
<td>0.5</td>
<td>NA</td>
<td>5000</td>
<td>ND</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Zinc (Zn)</td>
<td>215</td>
<td>21</td>
<td>8</td>
<td>656</td>
<td>60</td>
<td>631</td>
<td>297</td>
</tr>
</tbody>
</table>

**Notes:**
- From Kabata-Pendias and Pendias, reported in National Biosolids Partnership, 2000.
- From Alpert, 1999
- From Estes, University of New Hampshire, as reported by NH Dept. of Env. Svcs.
- From Milwaukee Metropolitan Sewerage Dist, Milorganite Division, as reported by NH Dept. of Environmental Services.
- From Univ. of MN soil science department, as reported in National Biosolids Partnership, 2000.
- From White Mountain Resource Mgmt, Inc. for ash from electricity generation using only native tree wood chips.

NA = Not available; ND = Not detected.
The research on metals in soils goes back decades; this topic is well studied.
Resources: Chemicals

Information Update:
Microconstituents in Biosolids: Current State of Knowledge
May 12, 2011

Introduction
The increased attention being paid to microconstituents (traces of synthetic chemicals in personal care and consumer products and daily activities) in the environment has led to questions about the contribution of these compounds to the overall environmental impact. Research has shown that the greatest human exposure is in the household environment and not via land application of biosolids.

Water Environment Federation®
Preserving & Enhancing the Global Water Environment

Microconstituents in Biosolids

Technical Practice Update
Prepared by Microconstituents Community of Practice of the Committee
Resources: Pathogens

Land Application of Organic Residuals: Public Health Threat or Environmental Benefit?

Contemporary Perspectives on Infectious Disease Agents in Sewage Sludge and Manure

by J.E. Smith, Jr., P.D. Millner, W. Jakubowski, N. Goldstein and R. Rynk, Editors
Resources:

EPA documents available online or from NEBRA.
Resources:

**USGS Monitoring : Denver**


**USDA / Univ. of MN: Rosemount**

- 20+ years of research, beginning 1973
One more excellent resource:

Evaluating Risks and Benefits of Soil Amendments Used in Agriculture
Bottom line: When trying to set policy on a complex matter, it helps to look at major expert scientific reviews: In 1996, the nation’s premier scientific body, the National Academy of Sciences, concluded:

“In summary, society produces large volumes of treated municipal wastewater and sewage sludge that must be either disposed of or reused. While no disposal or reuse option can guarantee complete safety, the use of these materials in the production of crops for human consumption, when practiced in accordance with existing federal guidelines and regulations, present negligible risk to the consumer, to crop production, and to the environment.”
A second review by the NAS in 2002...

The finding:

“There is no documented scientific evidence that the Part 503 rule has failed to protect public health. However, additional scientific work is needed to reduce persistent uncertainty about the potential for adverse human health effects from exposure to biosolids.”
Every 10 years –

The EPA and major universities hold a conference on the state of the science:

1973 – Univ. of Illinois

1983 – Colorado

1993 – Univ. of Minnesota – proceedings published by Soil Science Society of America

2004 – Univ. of Florida – proceedings in *Journal of Environmental Quality*
Conclusions:

- sub-acute, acute, chronic, and reproductive bioassays indicated no deleterious impact of selected biosolids on selected biota under controlled, laboratory conditions
- use of multi-organism, environmentally-relevant bioassays adds scientific veracity to assessing the sustainability of the land-application process

New! Resources:

These recent EPA and other documents are available online…
25+ years of practice

- Worldwide
- Agriculture
- Silviculture
- Land reclamation
- Horticulture, golf courses, turf, landscaping, etc.
Biosolids Use and Disposal Practices
2004 U.S. Totals

- Beneficial Use: 49%
- Disposal: 45%
- Other: 6%
Agriculture still 3/4 of U.S. beneficial use

California, photo courtesy of CASA, 2004

New Hampshire, 2006
Lincoln’s Biosolids Land Application Program is 20 Years Old

Ralph Ogg
UNE Extension Educator
Dave Smith
UNE Extension Technologist

On May 12, 1992, the first loadcard of the City of Lincoln’s de-watered biosolids was delivered to farmlands in Lancaster County. This event ended a decade of planning by Lincoln’s sanitary engineers to dispose of this municipal organic waste in a more environmentally responsible, beneficial manner — rather than being burned in the landfill. In the last 20 years, more than 100 area farmers have applied nearly 46,000 tons of biosolids on their cropland, improving their soil and increasing yields.

University of Nebraska—Lincoln Extension in Lancaster County has worked with cooperating farmers since the beginning of this program, taking soil tests, making sure biosolids are not applied to close to sensitive waterways and riparian areas that might compromise surface and groundwater, determining application rates, and calibrating equipment. Program goals are to enhance the productivity of area soils through the environmentally sound use of this material and to work with as many farmers as possible. We encourage farmers to apply biosolids as soon as possible and to take steps to reduce odors when they occur. Nebraska farmers tend to be a conservationist, but a few progressive farmers jumped into using biosolids wholeheartedly right away. Others adopted a wait-and-see attitude they set back and watched their neighbor’s corn grow faster and larger and produce higher yields before they were convinced about biosolids.

What’s in Biosolids That Makes It So Good?

Biosolids contain significant quantities of all macro- and micro-nutrients needed for crop growth. One application typically increases organic matter in soil by 0.6%, which increases water infiltration and improves soil tilth. For highly eroded or eroding soils, a single biosolids application can immediately make their productive.

Demand for Biosolids

There is more demand than ever for biosolids, but most cooperating farmers are not using biosolids for nutrients CN. It is the readily-available phosphorus (P) that cooperators want. After a single application of Biosolids, a P deficiency will typically increase 50-60 ppm. With average crop removal rates, it will take 10-12 years for the phosphorus to return to original levels.

Farmers are Paying for Biosolids

At the beginning of the program, it was tough to find farmers who were willing to use biosolids because they had to have a loader, spreader and enough time to apply the material. To encourage more farmers to use biosolids, in 1993, the city began paying cooperators for the dollar value of one ton of Biosolids.

Twenty years later, there is so much demand for Biosolids that cooperators are actually paying the city for Biosolids to deliver to field storage sites, but cooperating farmers are still responsible for application — either applying it themselves or use BRODGES on page 10.

Teaching An Old Guy New Tricks

My favorite biosolids story is about Wally Hansen, who lived in Wisner, but had 140 acres on Ashland Road, just inside the Lancaster County line. In 1995, I met Wally at his farm to flag storage sites.

"Wally, we bring enough biosolids on you won’t need to apply any other fertilizer," I said. "No, I don’t. I want you to add other fertilizer to this field.

"Wally looked at me and said, ‘I can’t believe it. I can’t believe it. I can’t believe it. I can’t believe it. I can’t believe it.’"

I said, "Yes, Wally. I am quite sure," I said. "I know it’s hard to believe, but it’s true and it’s true and it’s true and it’s true.

After he saw how easy it was to harvest, Wally started to the office to sign paperwork. We said, "I didn’t tell you anything, just like you said. But, you were right. I just converted the best manure I ever got all that fell just like you said.

As a result, 1996 was an exceptional year for growing corn in eastern Nebraska. Rain came periodically and at just the right time for growing crops, but Wally eked out the Biosolids application for his corn and we won. He used to stop by the office sometimes just to pass the time.

—Ralph Ogg

Biosolids Also Benefit Pastures

Mark Brown is a retired and former north of Lincoln. He has been using biosolids for 10 years on cow fields and about eight years ago tried biosolids to fertilizer a pasture for improving grass of the cattle pastures.

"My normal mixer ratio for that pasture was 25:3. Ben says, ‘Biosolids in that field so lush and productive I could have increased my rate. Even if you get out a little early in the fall, there is no stock left, I was tempted to take a little cutting.

Since pasture is normally not put on pastures on the livestock grounds for both pastures and for fields can be sustainably improved and soil and improvement.

—Dave Smith

Clover College
Hands-on workshops
June 12-13

Environmental Focus: 3
Urban Agriculture 4
Food & Fitness 6
Homes & Family Living 7
Herbicides 8
Community Focus: 10

In This Issue
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CLOVER COLLEGE
Hands-on workshops
June 12-13
Saguenay, QC – 20 yrs
Valorisation agricole des biosolides à Saguenay
Des études en arrivent à trois conclusions positives


Telles sont les conclusions des études de valorisation des biosolides, qui se situent dans les perspectives de la recherche utilisée sur le pourcentage de lait des vaches et des poules, et récentes sur la teneur en métaux lourds des sols et des rizis. 

Ces études d’impacts sont partiellement d’une série visant à documenter le sujet des biosolides municipaux. Elles ont bénéficié d’un partenariat entre la Ville de Saguenay, le ministère du Développement durable, de l’Environnement et des Ressources naturelles, et les Universités Laval, Sherbrooke et Chicoutimi. 

Univ. of Quebec at Chicoutimi: 20 years of biosolids use at Saguenay with “no negative impacts on the level of heavy metals in the receiving soils; negligible impact on the milk from farms receiving biosolids; and this use of biosolids creates minimal greenhouse gas emissions.”
Forestry

Photos courtesy of King County, WA
http://dnr.metrokc.gov/WTD/biosolids/

Photo courtesy of Philadelphia Water Dept.
Horticulture, landscaping
Class A products are 22% of beneficial use in the U. S. - and are growing…

Québec, 2003

Maine, 2003
Egg-shaped digesters treat the sewage sludge from Boston and 42 other communities before it is heat-dried and pelletized to make a fertilizer product.

Photo: MWRA
Boston, MA Biosolids Pellets
NEBRA Videos: turf example

Hawk Ridge Compost Facility
Unity, Maine
Merrimack, NH biosolids compost

The Great Lawn, Central Park NYC

New England Golf Course

Photos: Merrimack / Agresource
Static pile compost
Southboro, Massachusetts
Spectacle Island, Boston Harbor Islands National Park

Before reshaping and biosolids compost application

After
Co-composting biosolids with MSW (Marlboro, MA)
Static pile composting (Williamstown, Massachusetts)
Gore system static pile compost (Moncton, NB)
Using biosolids compost: Liberty Park, NJ…

before

after

photos courtesy of Eliot Epstein, Ph.D., and Orgro
Using biosolids compost:
White House lawn…

before

after

photos courtesy of Eliot Epstein, Ph.D., and Orgro
Biosolids compost application to sports field
Tufts Univ, Medford, Massachusetts
Using biosolids compost for stream-side stabilization
(My garden, April 2012)
## Operating U. S. Biosolids Composting Facilities

<table>
<thead>
<tr>
<th>U. S. EPA Region</th>
<th>States with Biosolids Composting Facilities</th>
<th>Number of Facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>New England (CT, MA, ME, NH, RI, VT)</td>
<td>35</td>
</tr>
<tr>
<td>2</td>
<td>New York, New Jersey, Puerto Rico</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>Delaware, Maryland, Penn, Virginia, W. Virginia</td>
<td>26</td>
</tr>
<tr>
<td>4</td>
<td>Florida, Georgia, Kentucky, N &amp; S Carolina, Tenn</td>
<td>32</td>
</tr>
<tr>
<td>5</td>
<td>Indiana, Michigan, Ohio, Wisconsin</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td>Arkansas, New Mexico, Oklahoma, Texas</td>
<td>31</td>
</tr>
<tr>
<td>7</td>
<td>Iowa, Kansas, Missouri, Nebraska</td>
<td>14</td>
</tr>
<tr>
<td>8</td>
<td>Colorado, Montana, S. Dakota, Utah, Wyoming</td>
<td>38</td>
</tr>
<tr>
<td>9</td>
<td>Arizona, California, Hawaii, Nevada</td>
<td>20</td>
</tr>
<tr>
<td>10</td>
<td>Alaska, Idaho, Oregon, Washington</td>
<td>30</td>
</tr>
<tr>
<td>None:</td>
<td>Alabama, Illinois, Louisiana, Minnesota, Mississippi, N. Dakota</td>
<td>TOTAL 266</td>
</tr>
</tbody>
</table>

TOTAL 266
Land reclamation
3% of U.S. beneficial use... and growing

Washington, photos courtesy of C. Henry
Land Reclamation

a two-year-old NH reclaimed gravel pit

a one-year-old NH reclaimed gravel pit

the “manufactured topsoil” develops a sustainable soil ecosystem
Gravel pit reclamation, MA, 2006
Philadelphia, PA Biosolids
What Philadelphia Accomplished

- Restored the productivity of 4,000 acres of stripped mine lands
- Utilized 1,000,000 tons of biosolids
- Additionally benefited waters and habitats
- Supported the mining economy with $40 million in reclamation services
The starting point for reclamation can be formidable.
And, the final result can be lovely!
Soil at the Betty Site where biosolids was not used 18 years ago is extremely sterile, with moss and a few legumes.
This is the soil at the Betty Site where biosolids was used 18 years ago. It is dark and rich for about 6 inches. The grass cover remains dense, and root growth is vigorous.
The Hegarty mine reclamation site is located in Clearfield County, Pennsylvania. Approximately 15,000 wet tons of ALCOSOIL were used to reclaim 85 acres.
This is the same view as the previous picture, but after reclamation.
Palmerton, PA, 1980; Dead Ecosystem on Blue Mountain.
Palmerton, PA, 1999: Looking down revegetated Blue Mountain.
Highly Zn-phytotoxic smelter and mine waste contaminated soils at Bunker Hill, ID;

**Background** = Biosolids+Wood-Ash Remediated

**Foreground** = Seeded control hazardous soil.
Biosolids were used for the plantings under the Vancouver Olympic rings; photo courtesy Metro Vancouver
Energy biogas

Massachusetts

New Hampshire

Vermont
Ste. Hyacinthe, QC

Boston, MA
Energy - incineration with energy recovery

Cement kiln, Wikipedia photo

Minnesota, photo courtesy Metropolitan Council
Energy and Ag!
Biofuels grown with biosolids

Courtesy of Sally Brown
- http://faculty.washington.edu/slb/
Critical: Best Practices
(BMP / Environmental Management System)
Best practices

NBMA is developing a “Best Practices” document.

by the Province of Ontario, Canadian government, & the Ontario Federation of Agriculture
And you have to communicate!
Through this project, we changed our perspective from a focus on

PUBLIC ACCEPTANCE
(“Accept our way of seeing things!”)

to

DEVELOPING PUBLIC PARTICIPATION &
PUBLIC RELATIONSHIPS
(significant public input; earning public trust)
Ways to Enhance Trust

- Partner with credible third-party sources.
- Demonstrate trustworthy characteristics (empathy, honesty, competence, dedication).
- Practice organizational consistency and accessibility (solid track record).
- Start small and build, checking back with people to see how they think it is going.
- Involve the community in the development of acceptable health, environmental, & research studies procedures.
- Enhance monitoring by helping set up local oversight by trusted local people.
Nice fact sheet from WEF…

Nice book from NACWA...
Web resource: www.biosolids.org
Web resources…

- www.nebiosolids.org
- www.nwbiosolids.org
- www.virginiabiosolids.com
- http://www.weao.org/committees/biosolids/biosolids.html
- http://water.epa.gov/polwaste/wastewater/treatment/biosolids/index.cfm
- www.loopforyoursoil.com
NEW! Biosolids Video:
Water Environment Assoc. of Ontario

http://www.endless-films.com/site/?portfolio=biosolids
Sign up for NEBRAMail (free)

Click from left side of www.nebiosolids.org.
Thanks for listening.

Questions?

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