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

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)

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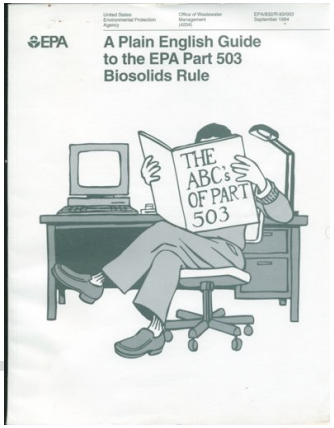
Thanks for slides…

- 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

Happy 20th, Part 503!



"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

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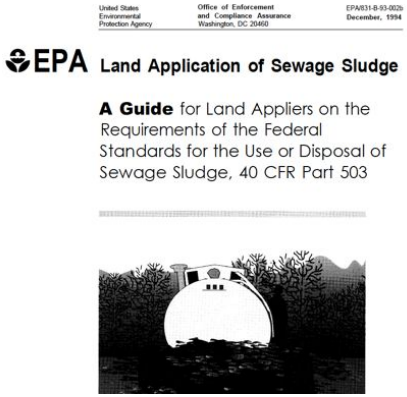
Happy 20th, Part 503!


United States Environmental Protection Agency | Office of Enforcement and Compliance Assurance Washington, DC 20460 | EPA/831-B-93-002b December, 1994

EPA Land Application of Sewage Sludge

A Guide for Land Appliers on the Requirements of the Federal Standards for the Use or Disposal of Sewage Sludge, 40 CFR 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 +….

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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"

– *New Oxford Dictionary of English*, 1998

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.)

lb. Binding Sites reducing Pb, As etc. bioavailability

Energy

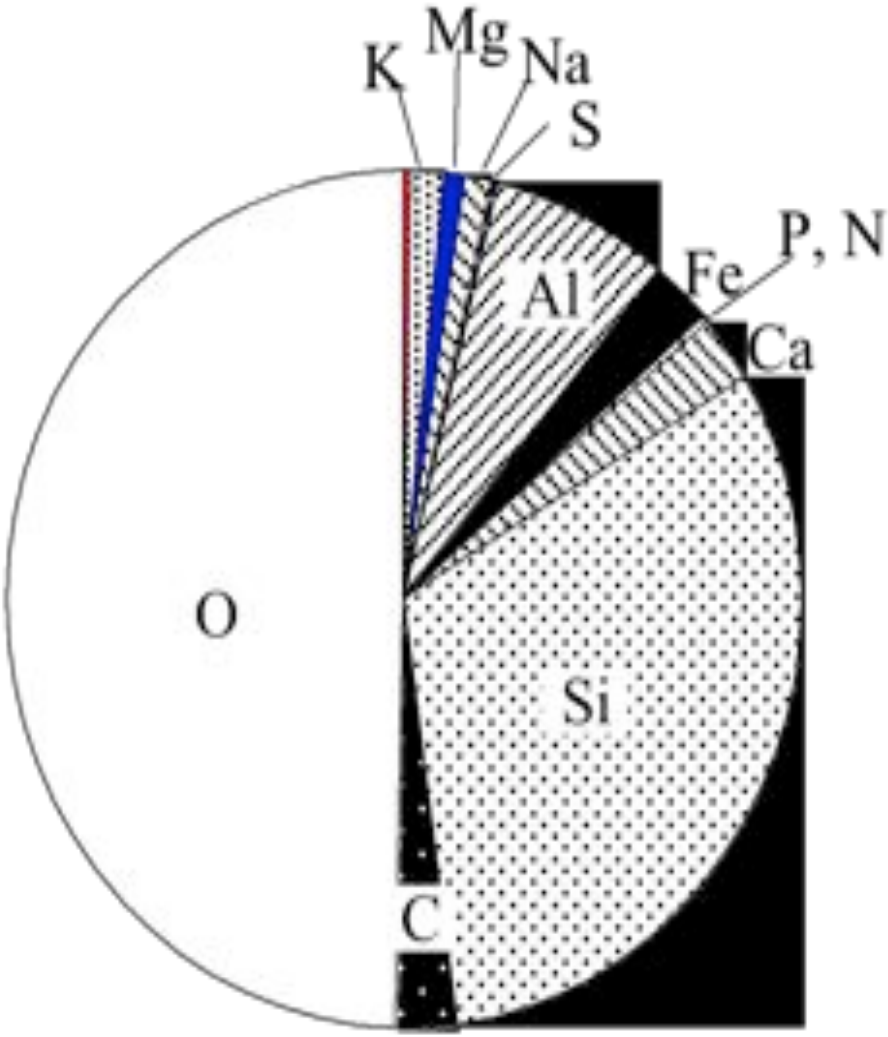
~ 5,000-10,000 Btu/d

(when dry, similar to low grade coal)

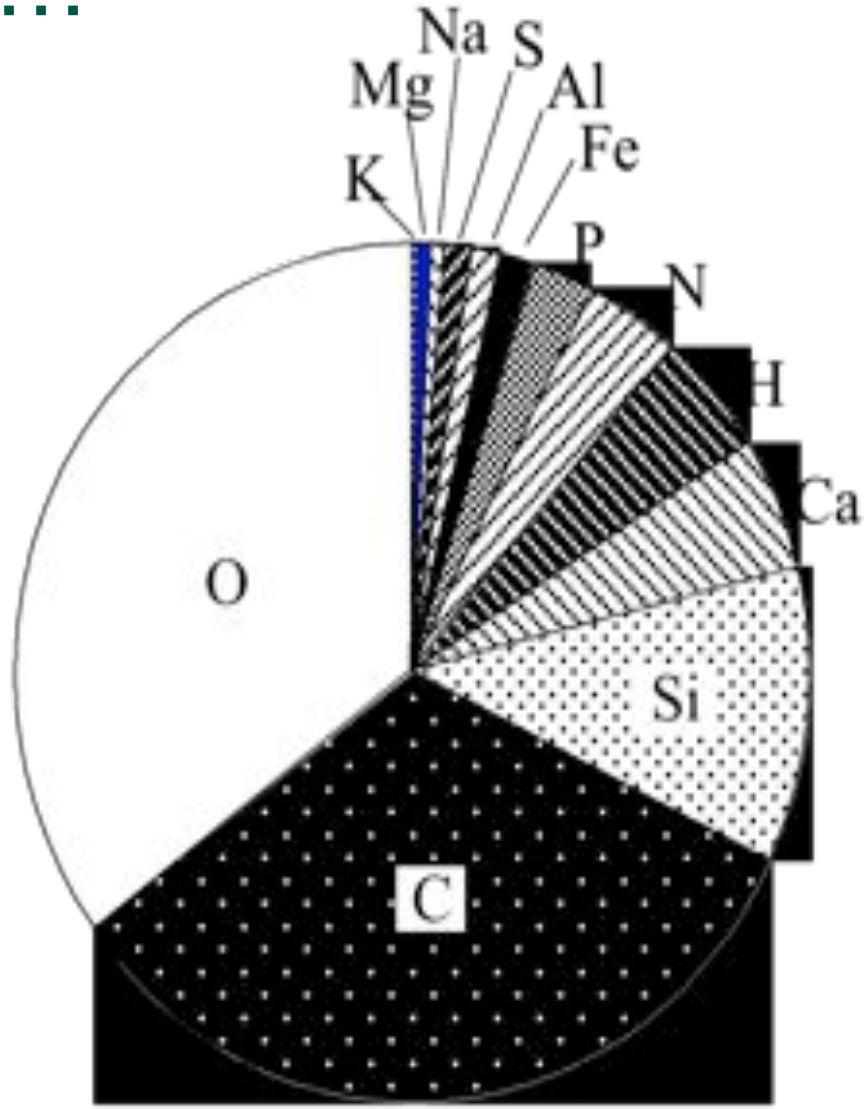
Also:

- 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…



soil



biosolids

What's ideal for sustainability?

WEF has a new policy statement emphasizing resource recovery from biosolids; download it from bottom of www.nebiosolids.org.

MAXIMIZE BENEFICIAL USES OF RESOURCES

Constituent	Benefits	Concerns
Water	valuable in agriculture, arid climate	cost of transport
Organic matter	vital to soils	putrescible, odor
Nutrients	plant & animal food	impacts to water
Energy	renewable, displaces oil/gas	air emissions, no use of nutrients & organic matter

MANAGE TO MINIMIZE POTENTIAL RISKS

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

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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

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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

Middlebury, VT RDP advanced lime stabilized Class A biosolids

25+ years of research

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

* long-term research; many papers

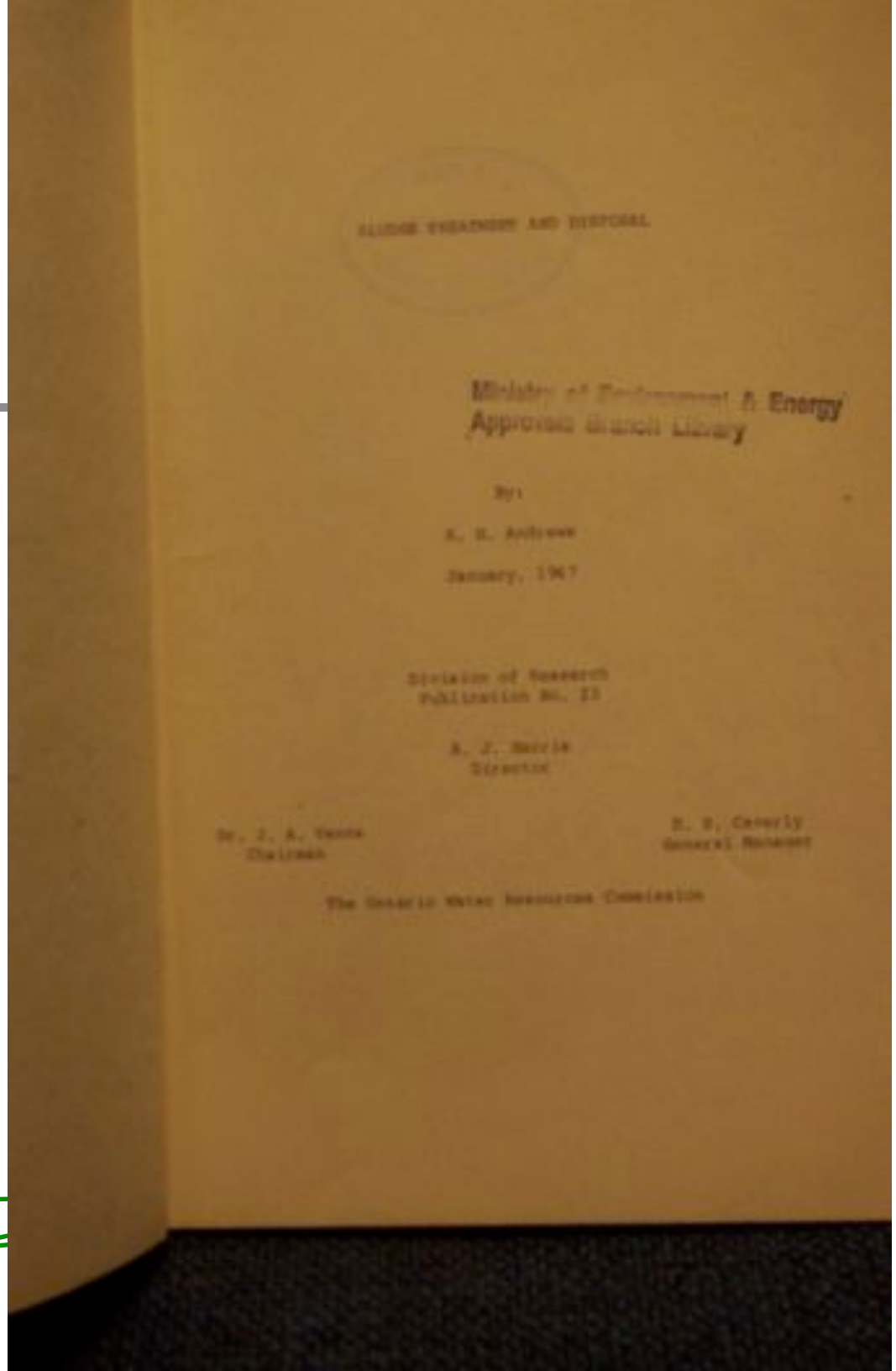
North America:
Significant University Research

- 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…*

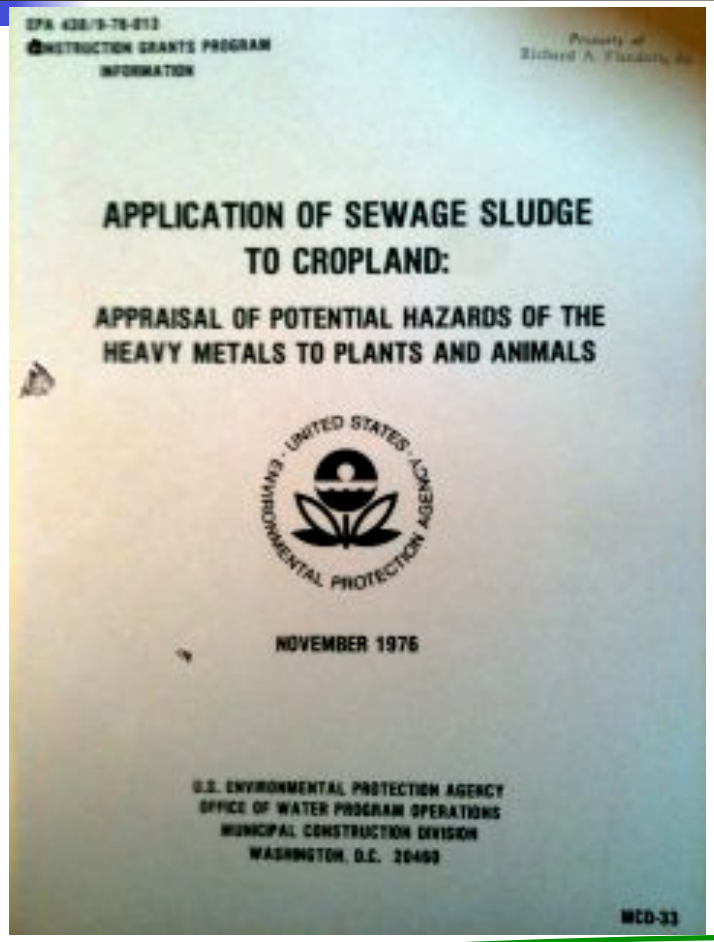
1967:

“Sludge Treatment and Disposal”

Ontario Water Resources Commission



1976:



EPA 430/9-76-013
CONSTRUCTION GRANTS PROGRAM
INFORMATION

Property of
Richard A. Flaherty, Jr.

APPLICATION OF SEWAGE SLUDGE
TO CROPLAND:

APPRAISAL OF POTENTIAL HAZARDS OF THE
HEAVY METALS TO PLANTS AND ANIMALS

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

NOVEMBER 1976

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

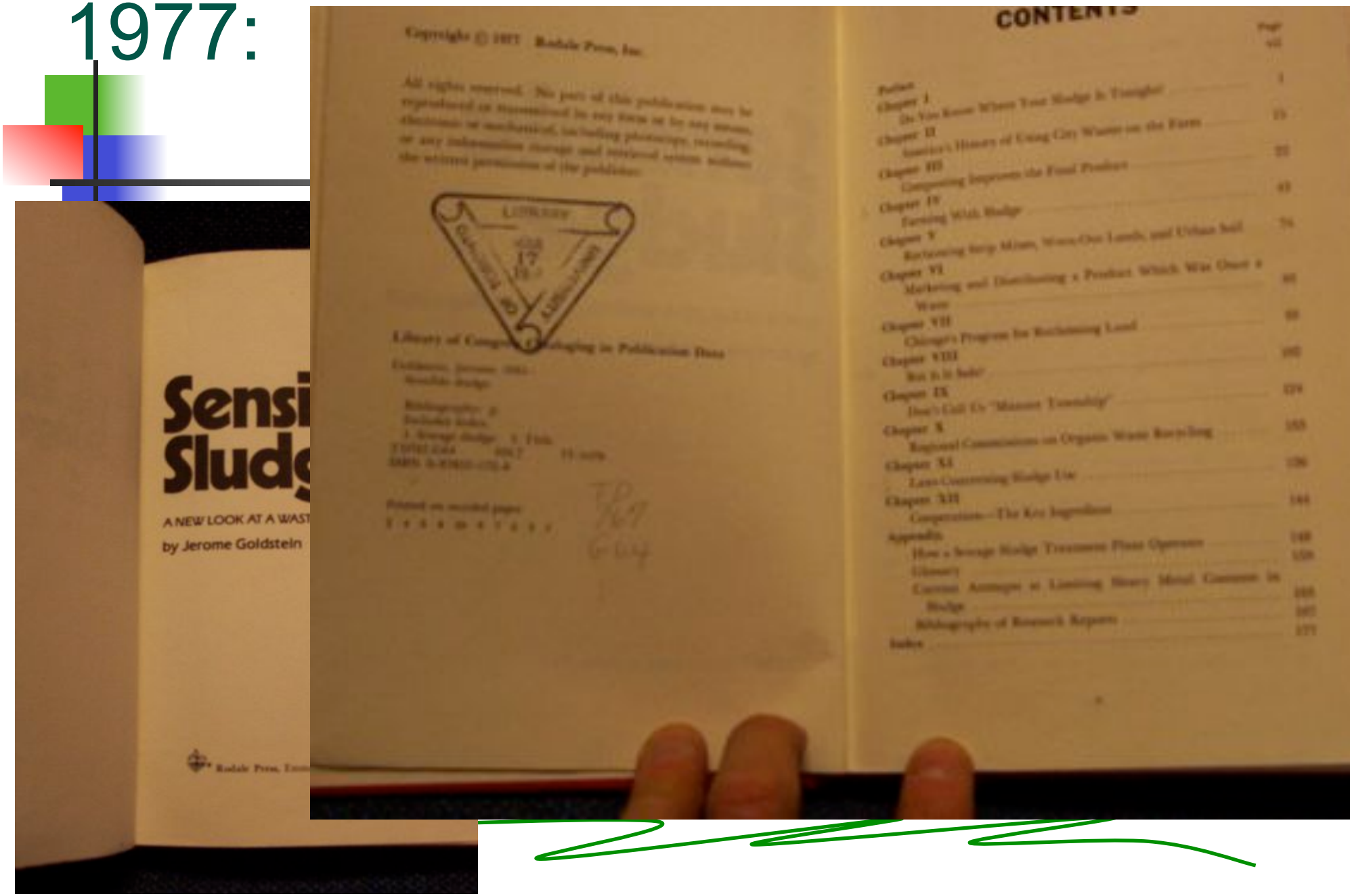
MCD-33

Richard A. Flaherty

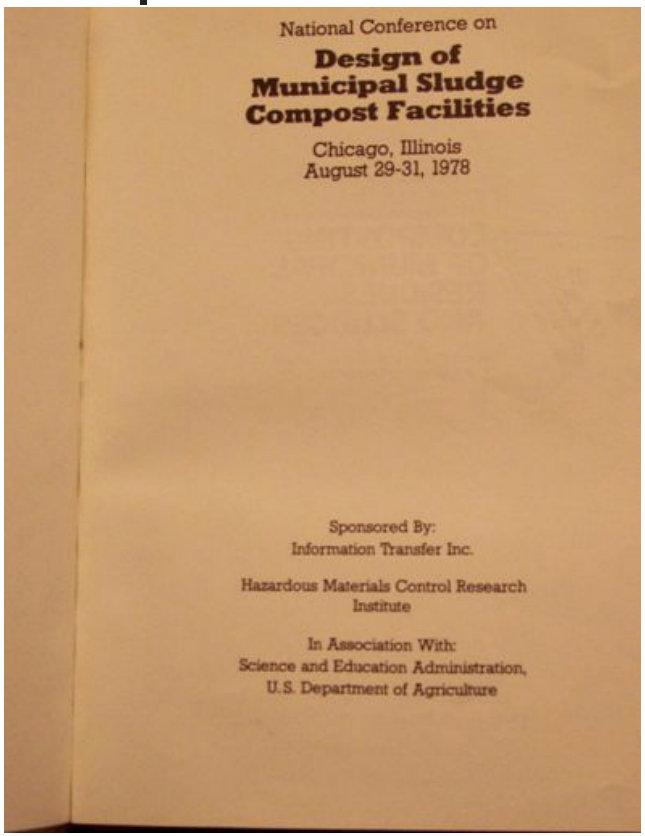
LAND
APPLICATION
OF WASTE
MATERIALS

SOIL CONSERVATION SOCIETY OF AMERICA

1977:


Sensi
Sludg
A NEW LOOK AT A WAST
by Jerome Goldstein
CONTENTS

1978:



National Conference on

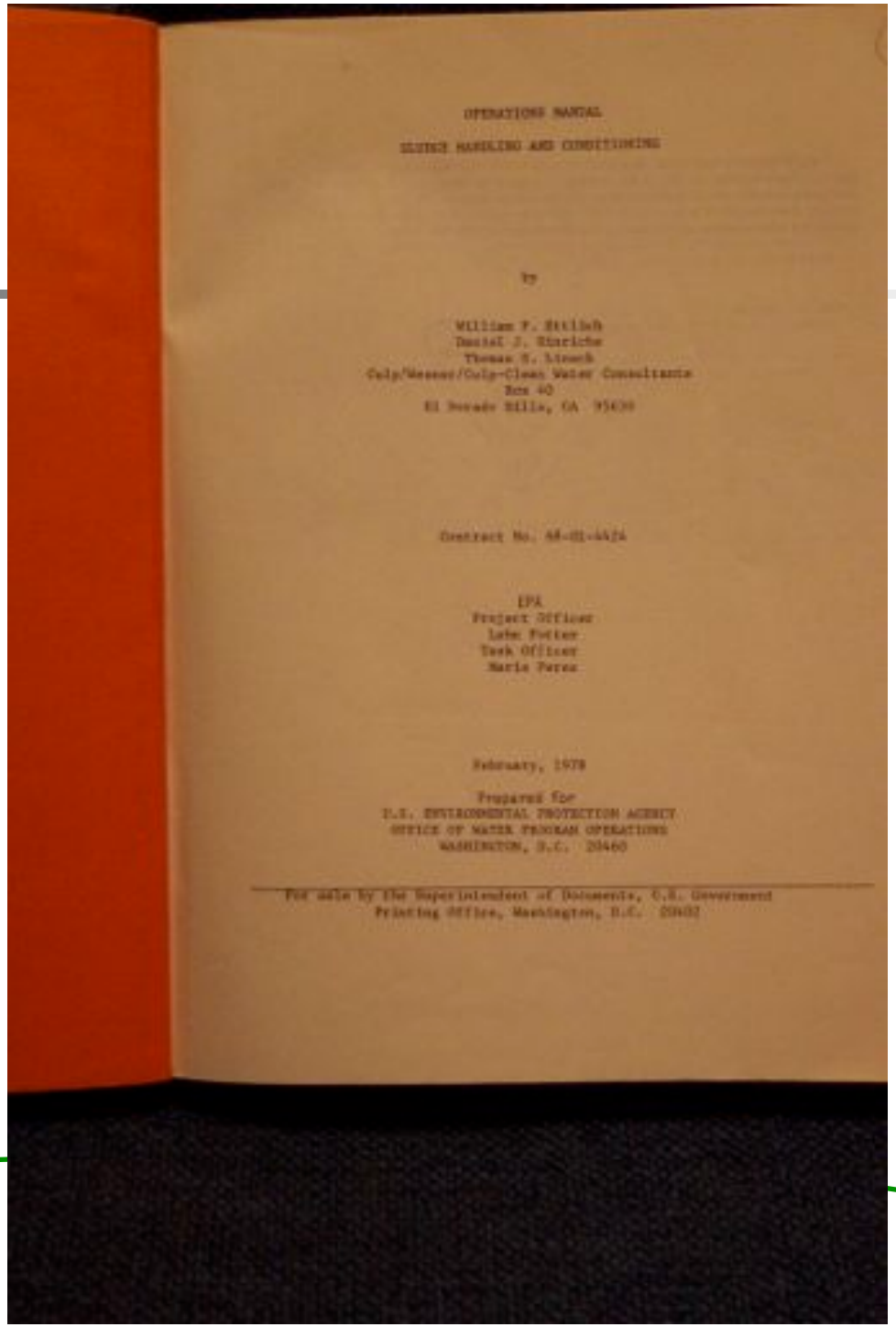
Design of Municipal Sludge Compost Facilities

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 F. Ettlich
Daniel J. Ehrlicho
Thomas S. Lynch
Culp/Wesner/Culp-Clean Water Consultants
Box 40
El Dorado Hills, CA 95630

Contract No. 68-01-4474

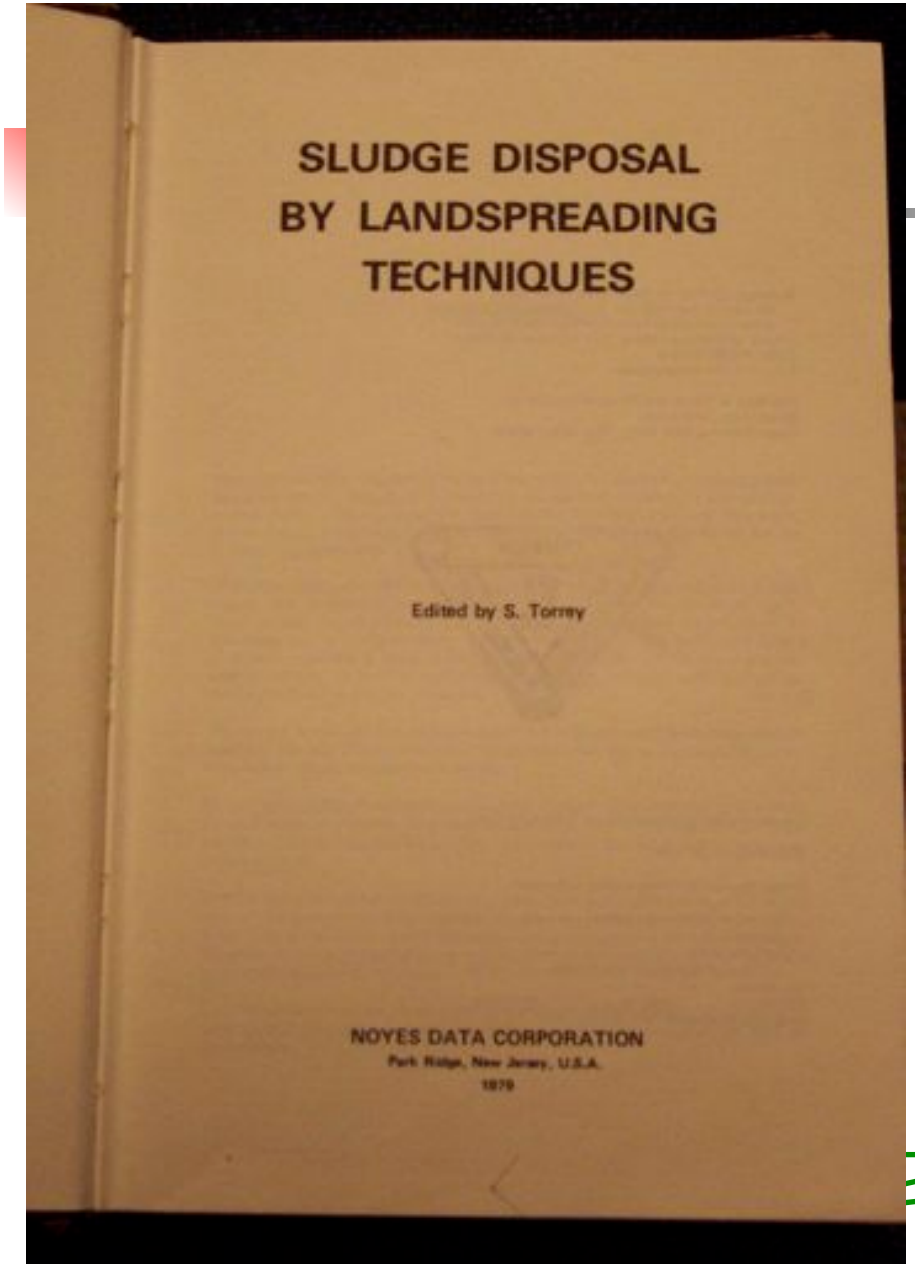
EPA
Project Officer
Lake Porter
Task Officer
Maria Perez

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

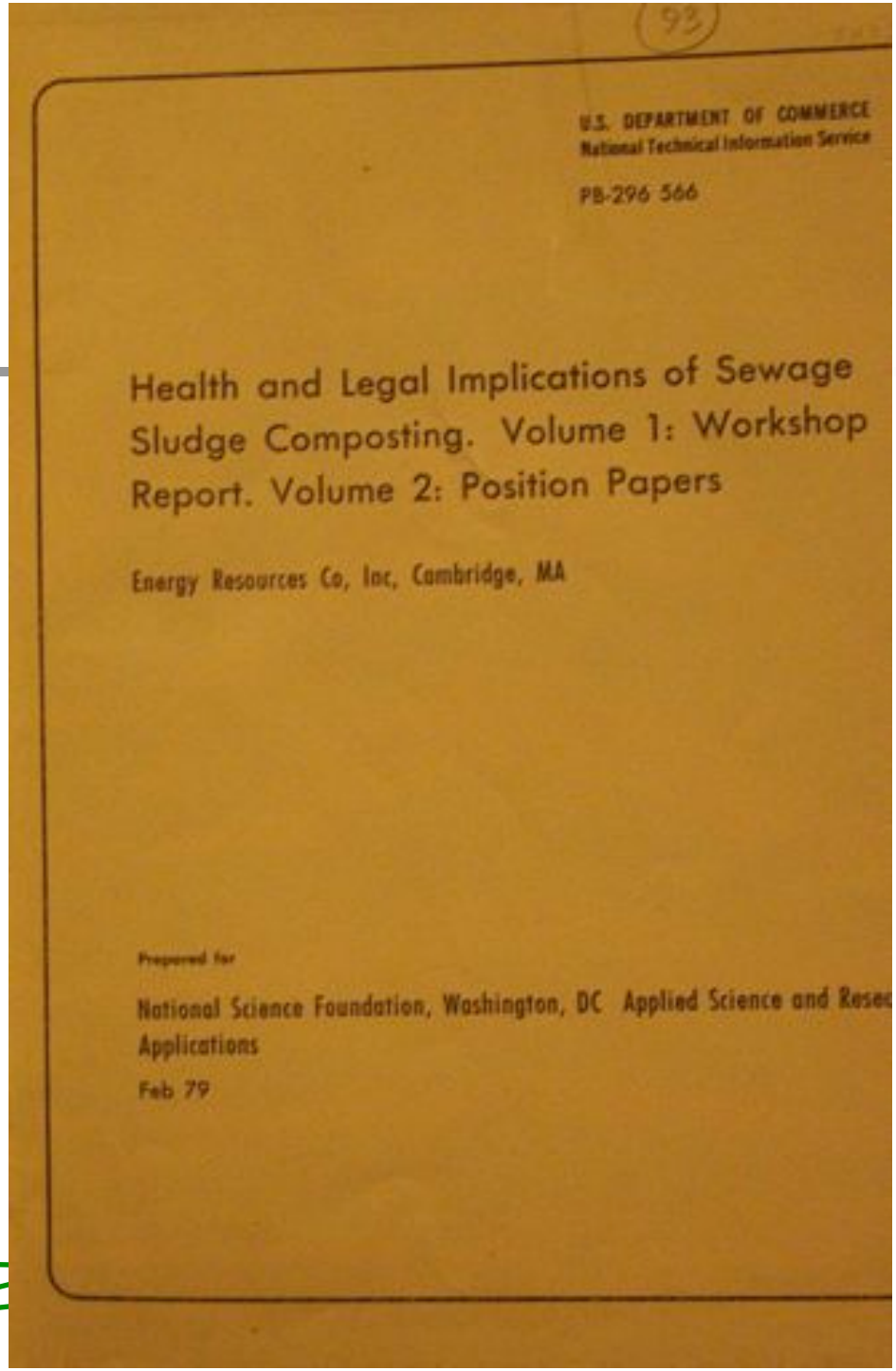
1979:



SLUDGE DISPOSAL
BY LANDSPREADING
TECHNIQUES

Edited by S. Torrey

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



U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-296 566

Health and Legal Implications of Sewage Sludge Composting. Volume 1: Workshop Report. Volume 2: Position Papers

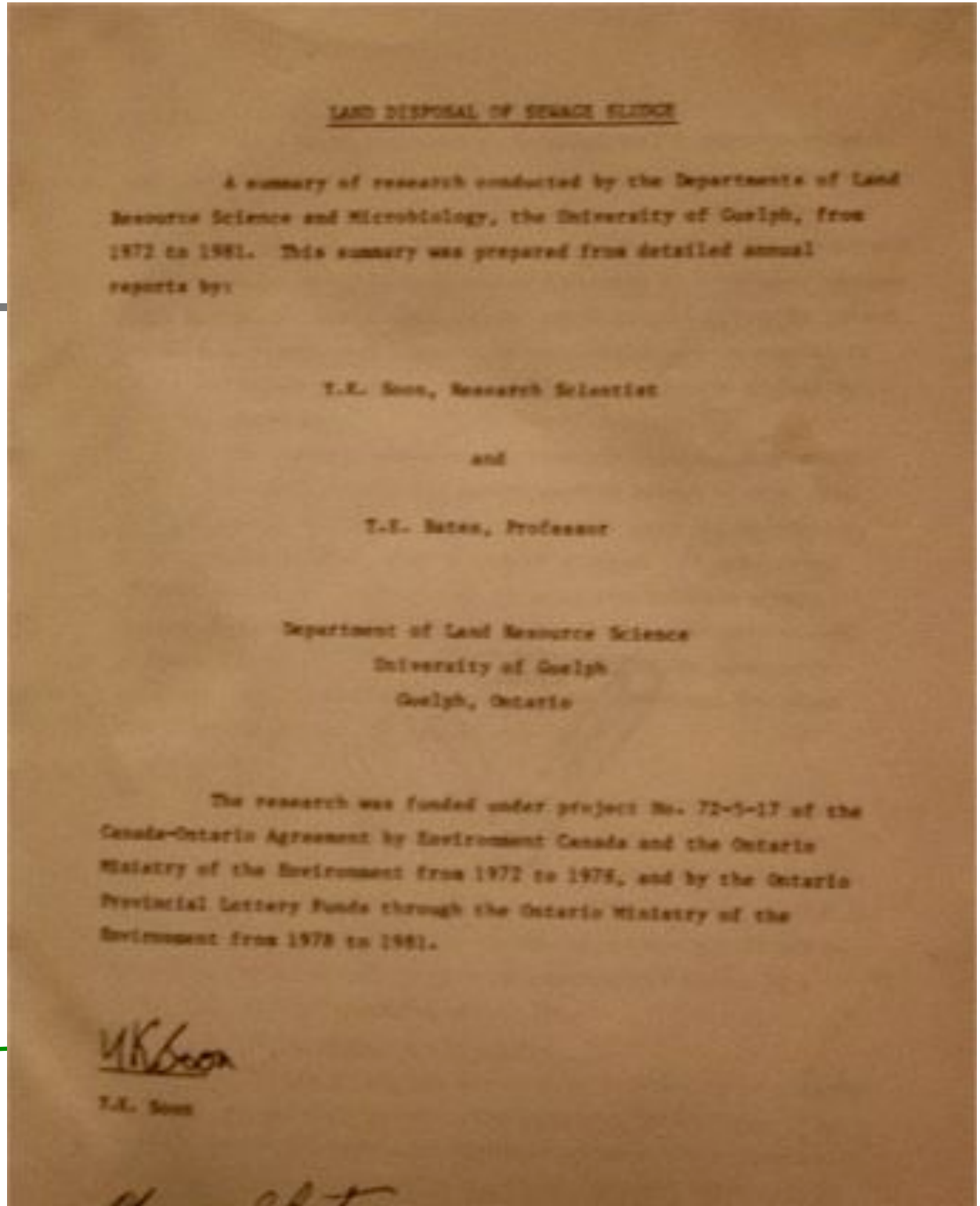
Energy Resources Co, Inc, Cambridge, MA

Prepared for

National Science Foundation, Washington, DC Applied Science and Resea
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.

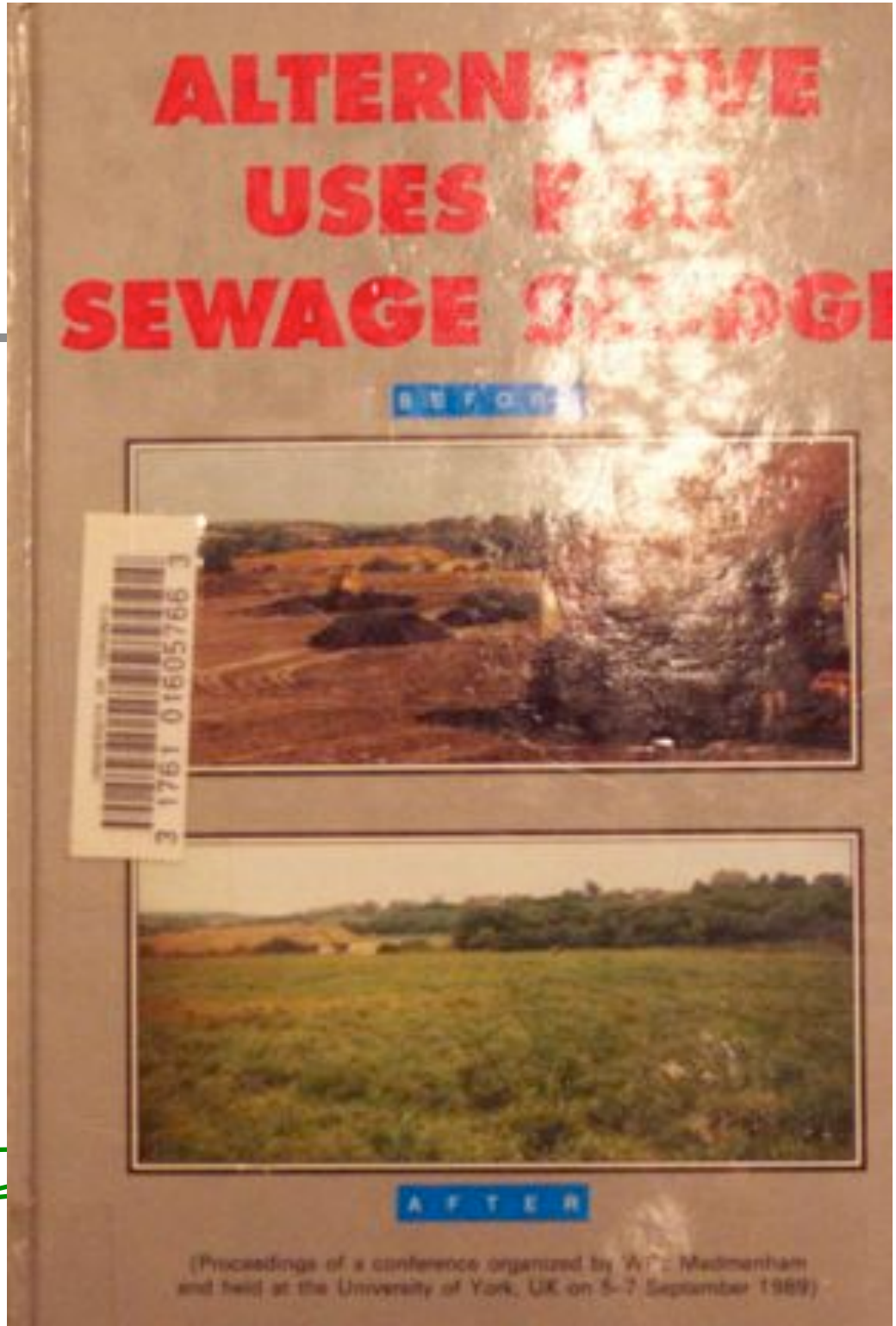
T.K. Soon

1984:


EPA
Environmental
Regulations
and Technology
Use and Disposal of
Municipal Wastewater Sludge
Sept 84

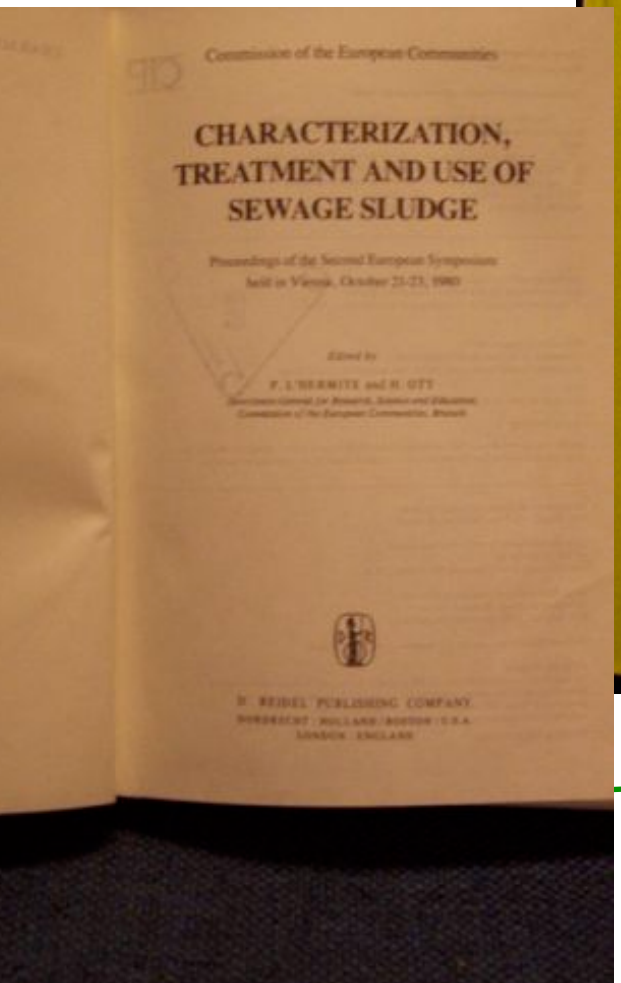
1989:

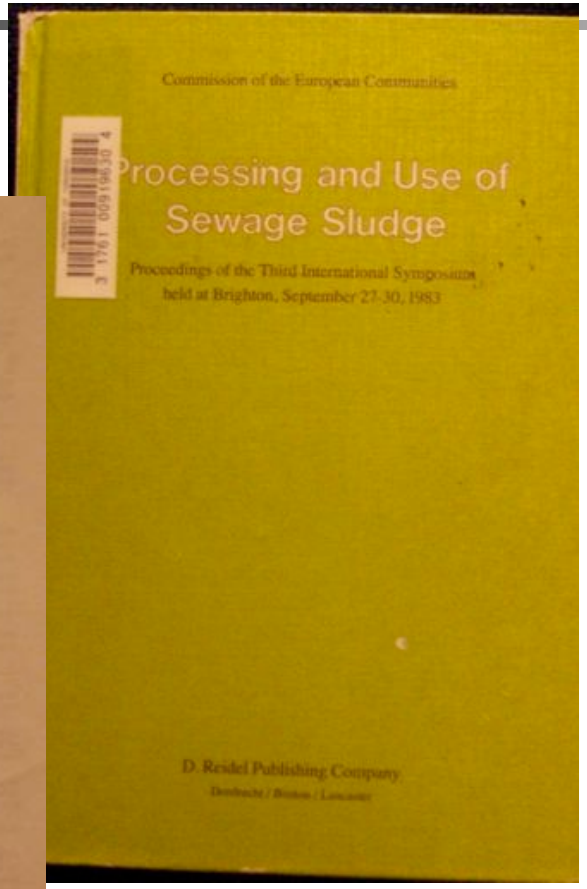
Proceedings of technical conference at University of York, UK



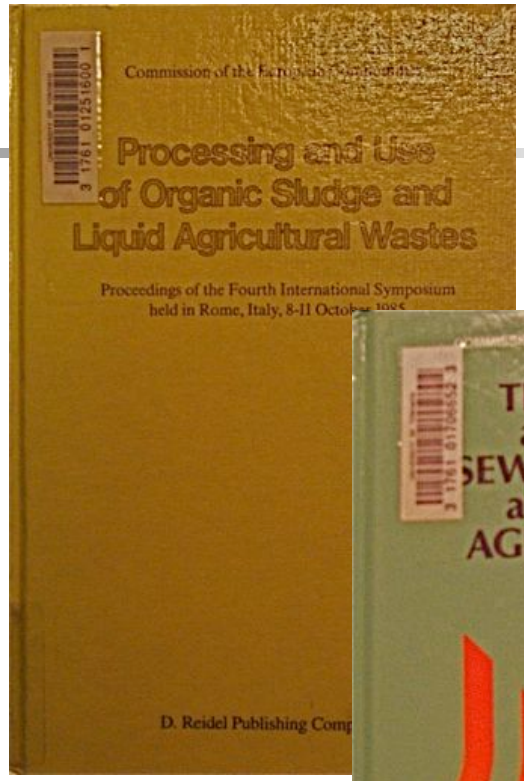
Commission of the European Communities:

1980

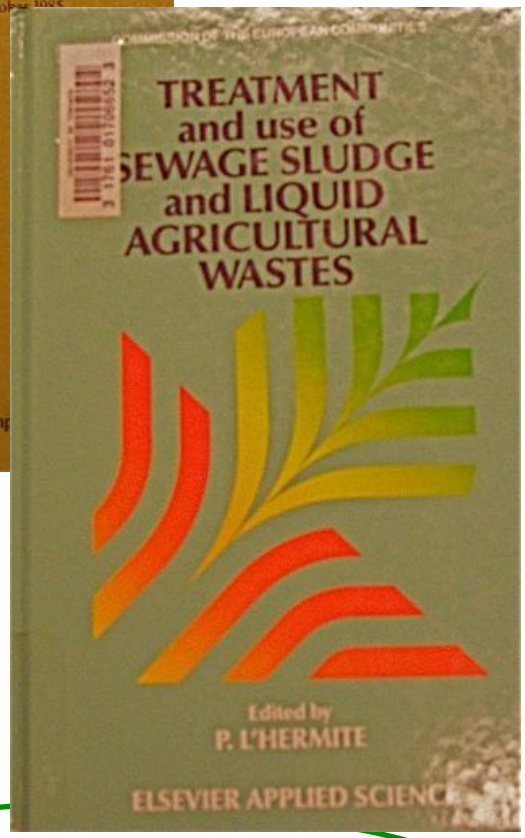




1983

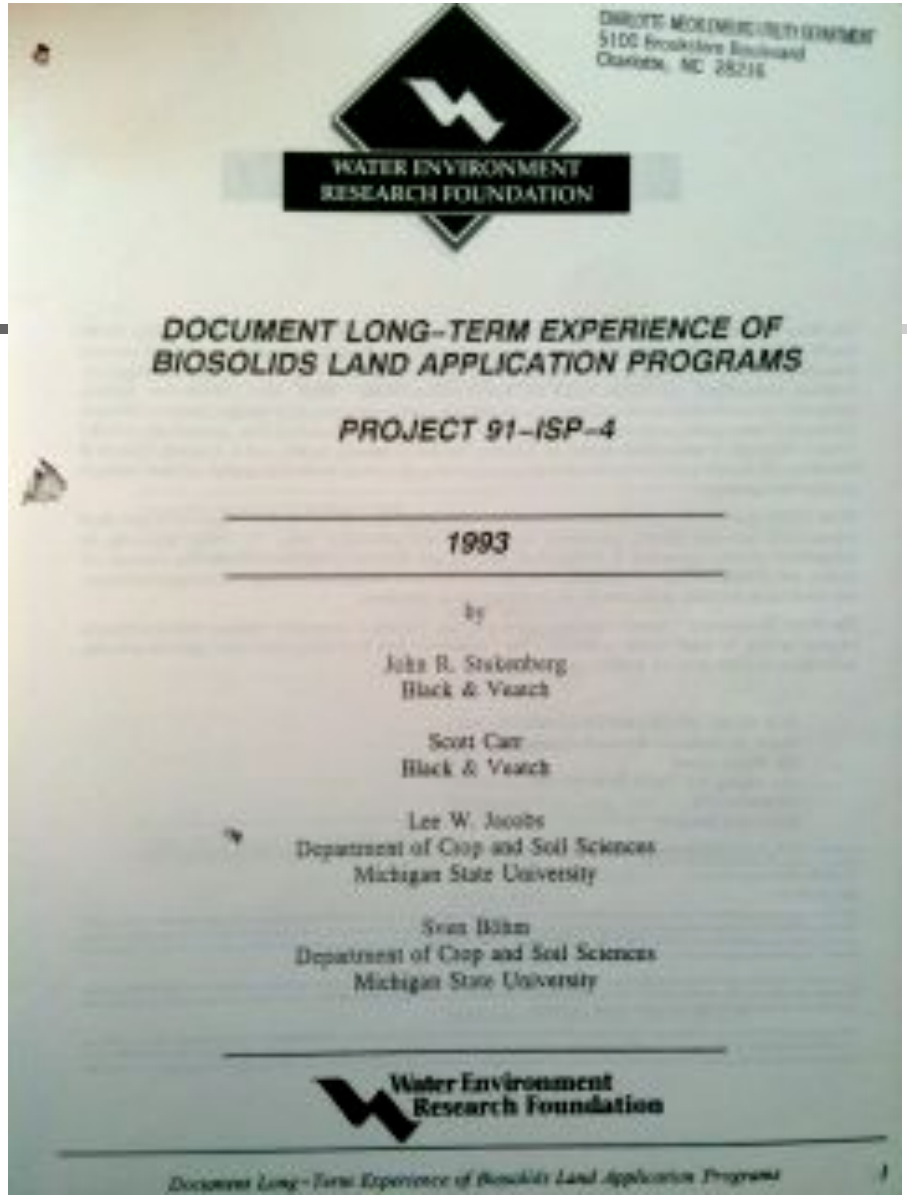


1985



1991

1993:



WATER ENVIRONMENT RESEARCH FOUNDATION

DOCUMENT LONG-TERM EXPERIENCE OF BIOSOLIDS LAND APPLICATION PROGRAMS

PROJECT 91-ISP-4

1993

by

John R. Stukenberg
Black & Veatch

Scott Carr
Black & Veatch

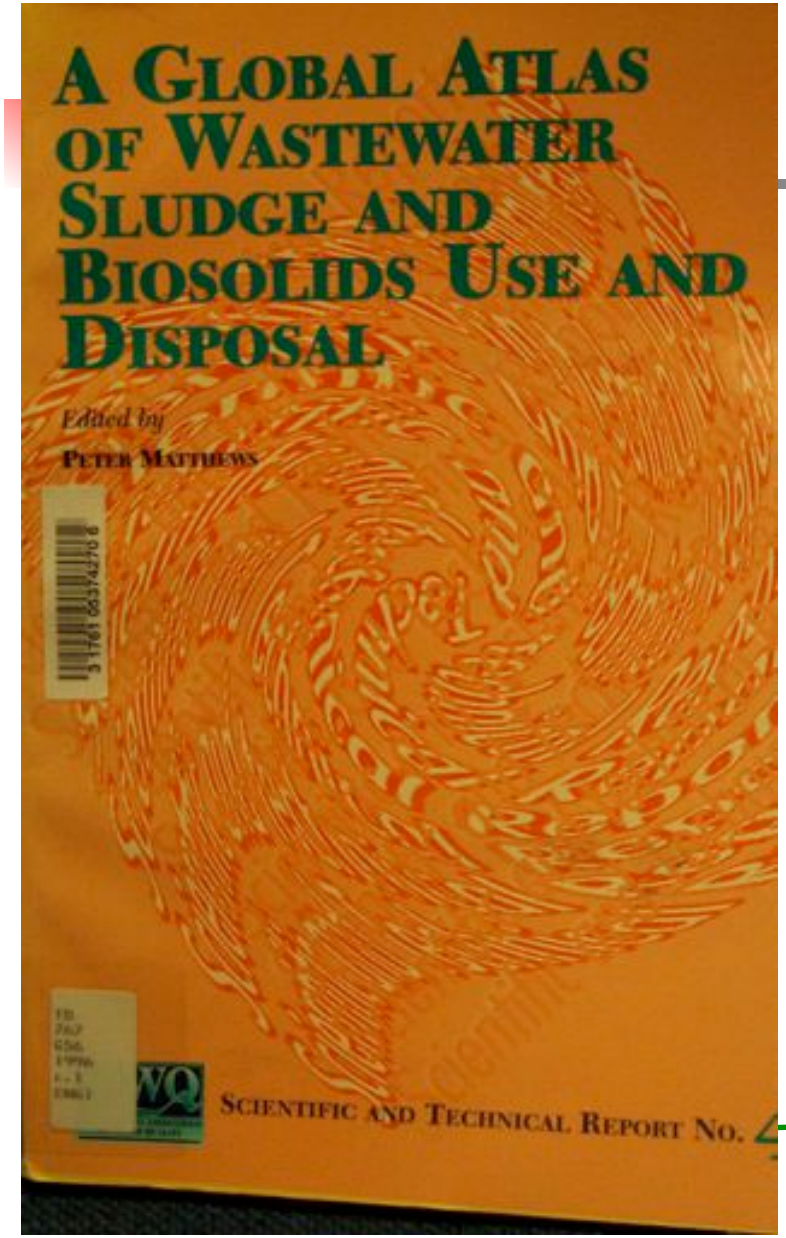
Lee W. Jacobs
Department of Crop and Soil Sciences
Michigan State University

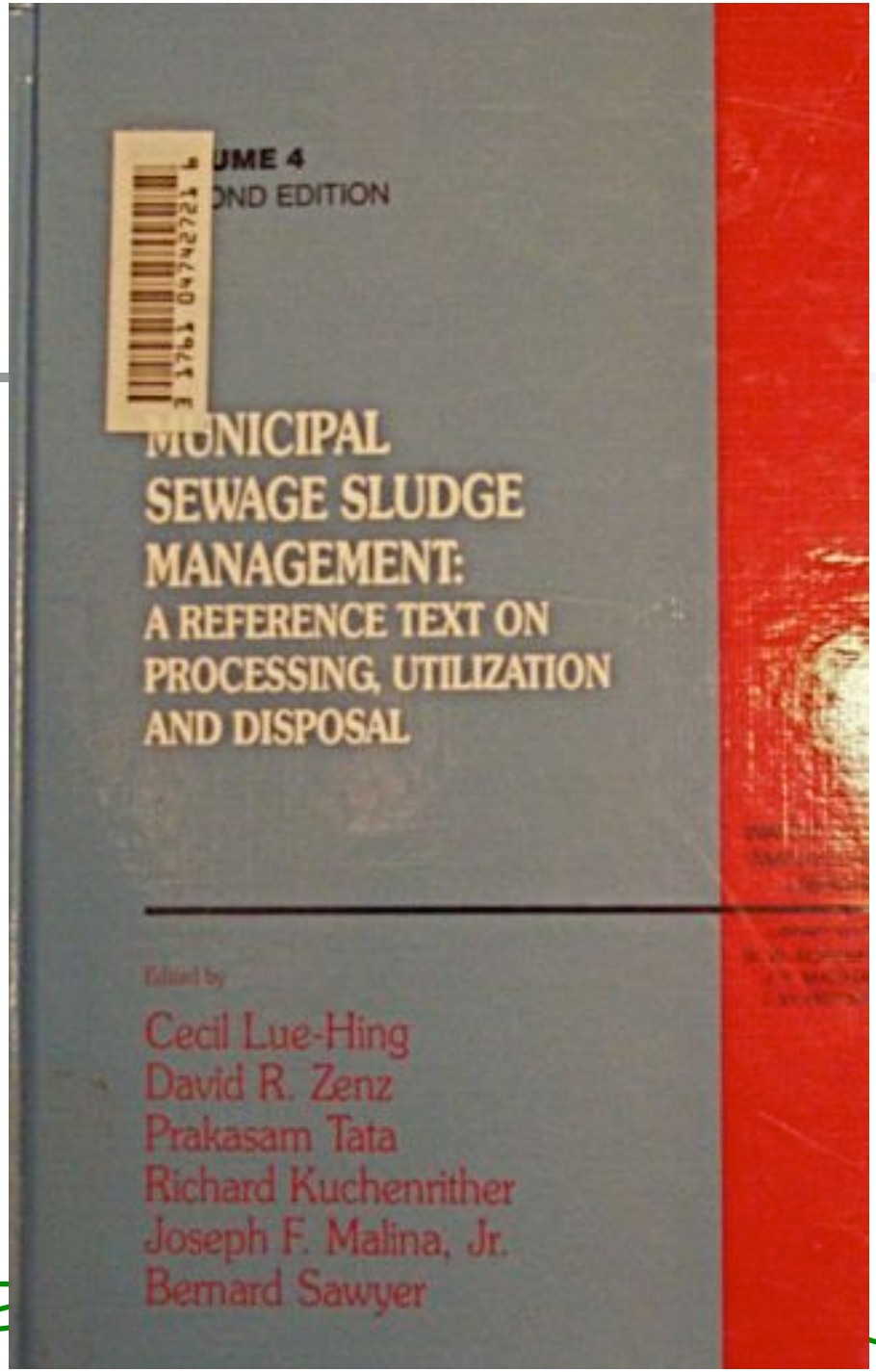
Sven Bihm
Department of Crop and Soil Sciences
Michigan State University

Water Environment Research Foundation

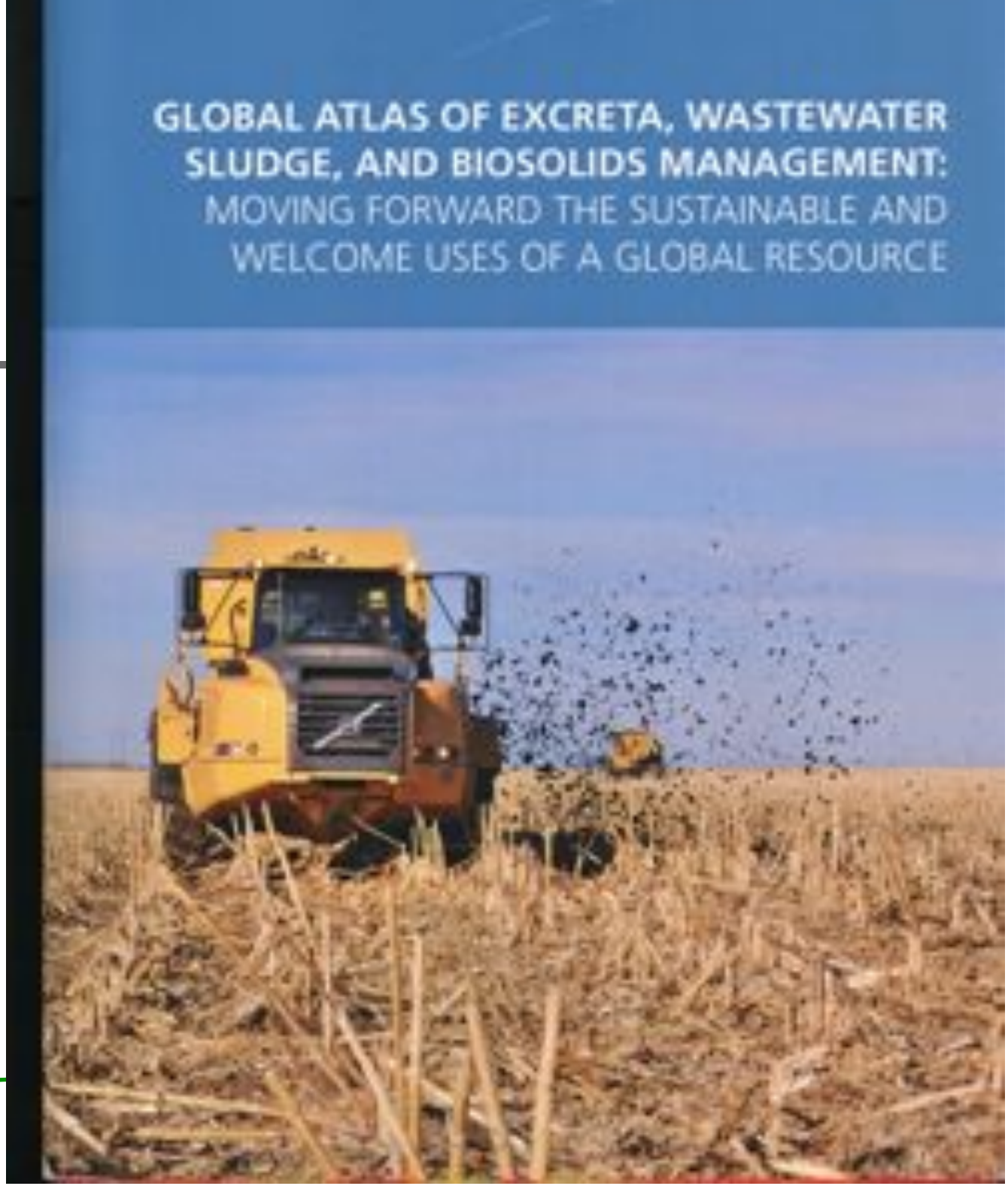
Document Long-Term Experience of Biosolids Land Application Programs 1

1998:


A Global Atlas of Wastewater Sludge and Biosolids Use and Disposal
Edited by
Peter Matthews
Scientific and Technical Report No. 4


UME 4
OND EDITION
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



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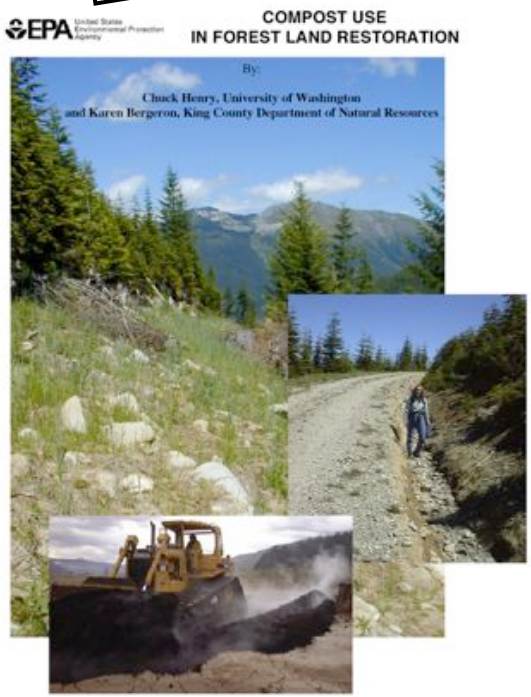
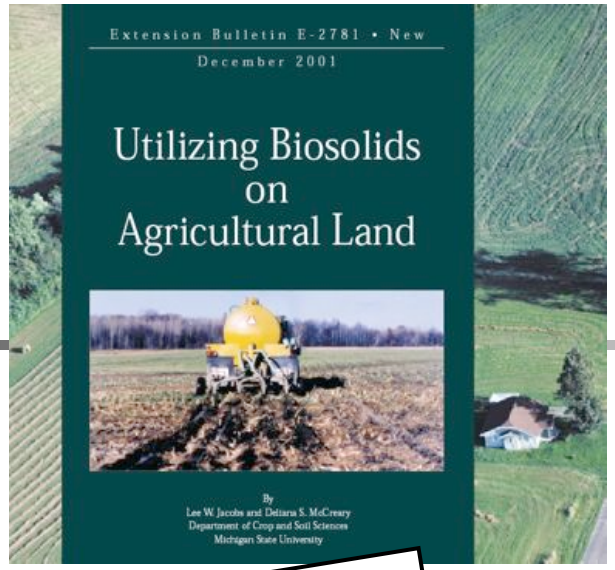
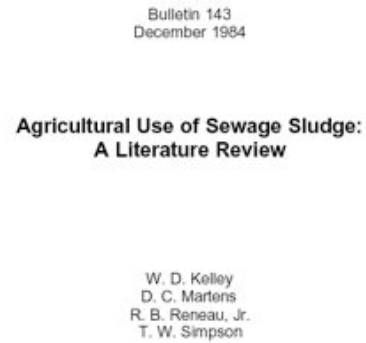
Univ. of WA

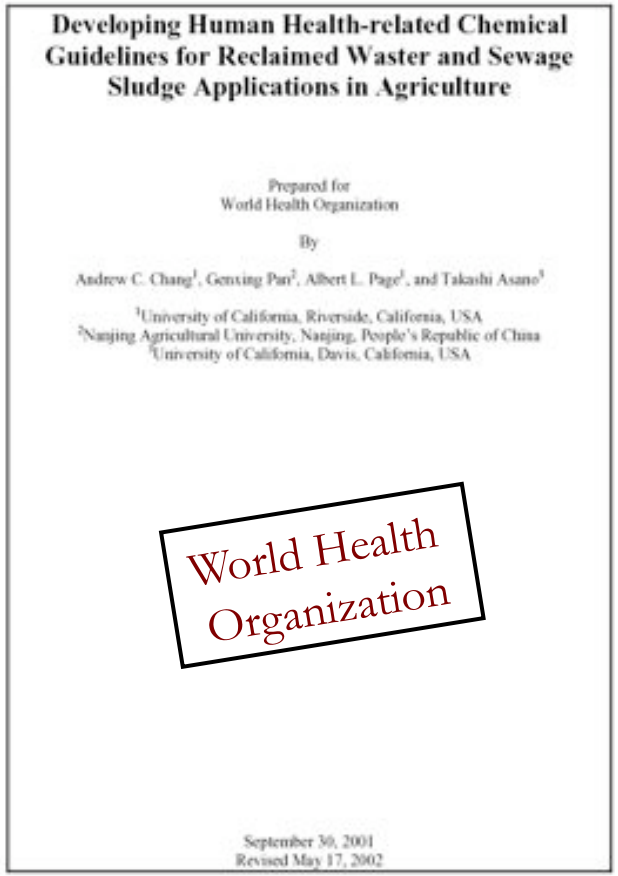




Michigan State



Virginia Tech



World Health Organization

The Use of Biosolids in Maine: A Review.

Univ. of Maine

Oregon State

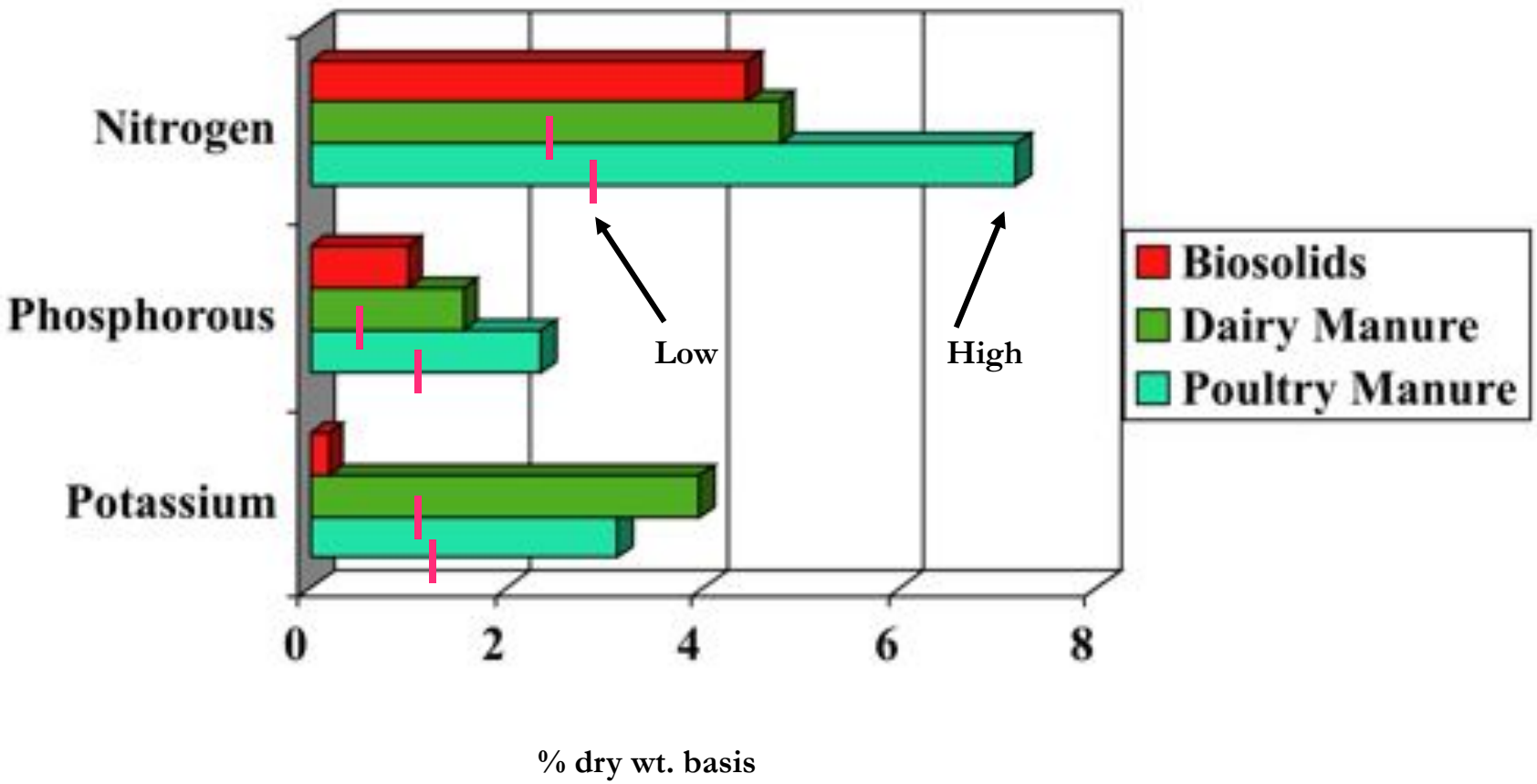
nebra
North East Biosolids & Residuals Association

Research demonstrates benefits….

Metro Vancouver soil manufacturing, using biosolids

Why Farmers Want Biosolids: Nutrient Content

(slide courtesy of Andrew Carpenter, Northern Tilth)

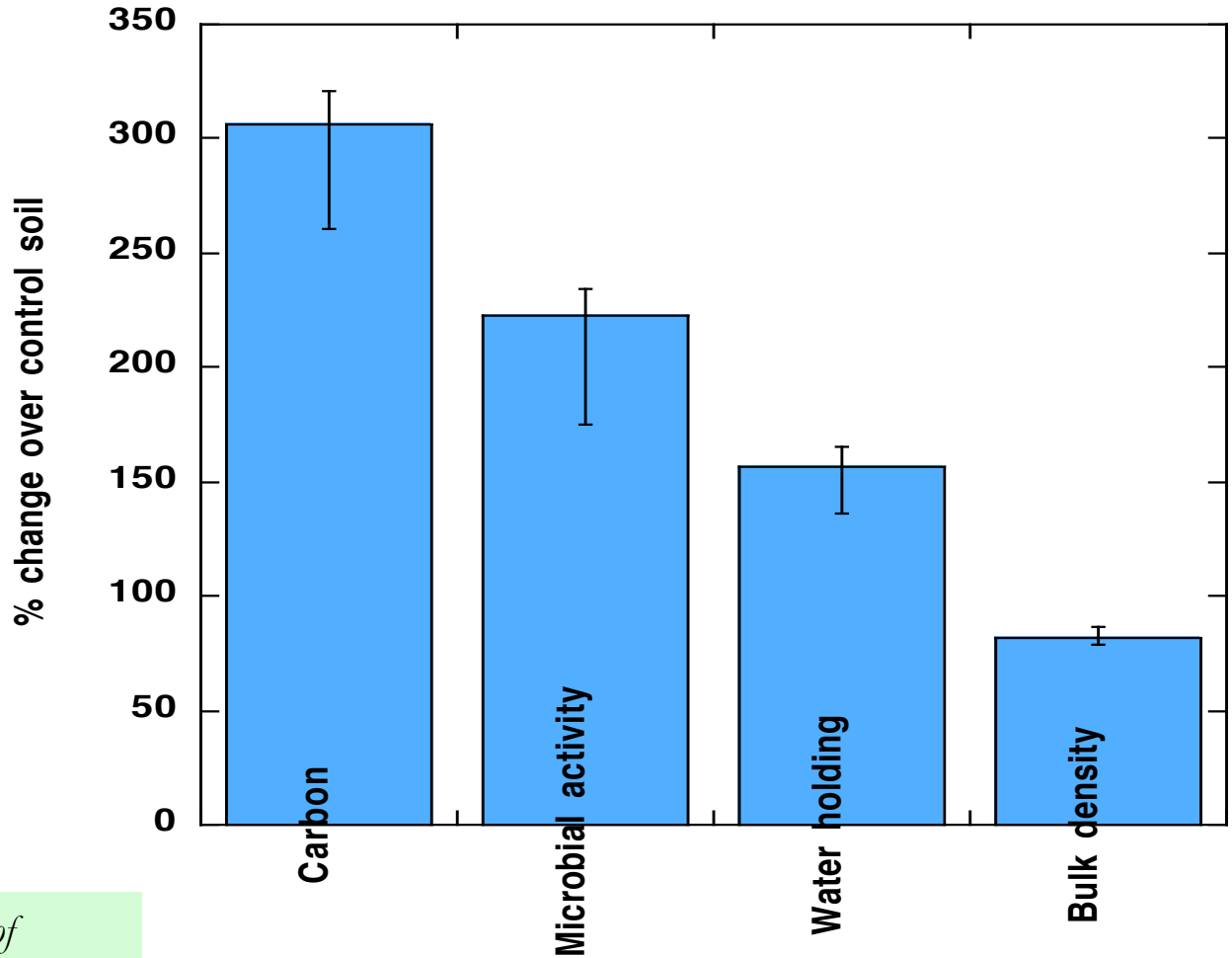


Biosolids values from The Use of Biosolids in Maine: A Review (report by the Mitchell Center)

Manure Values adapted from ASAE Standards 2000

Findings: Organic Residuals are Valuable!

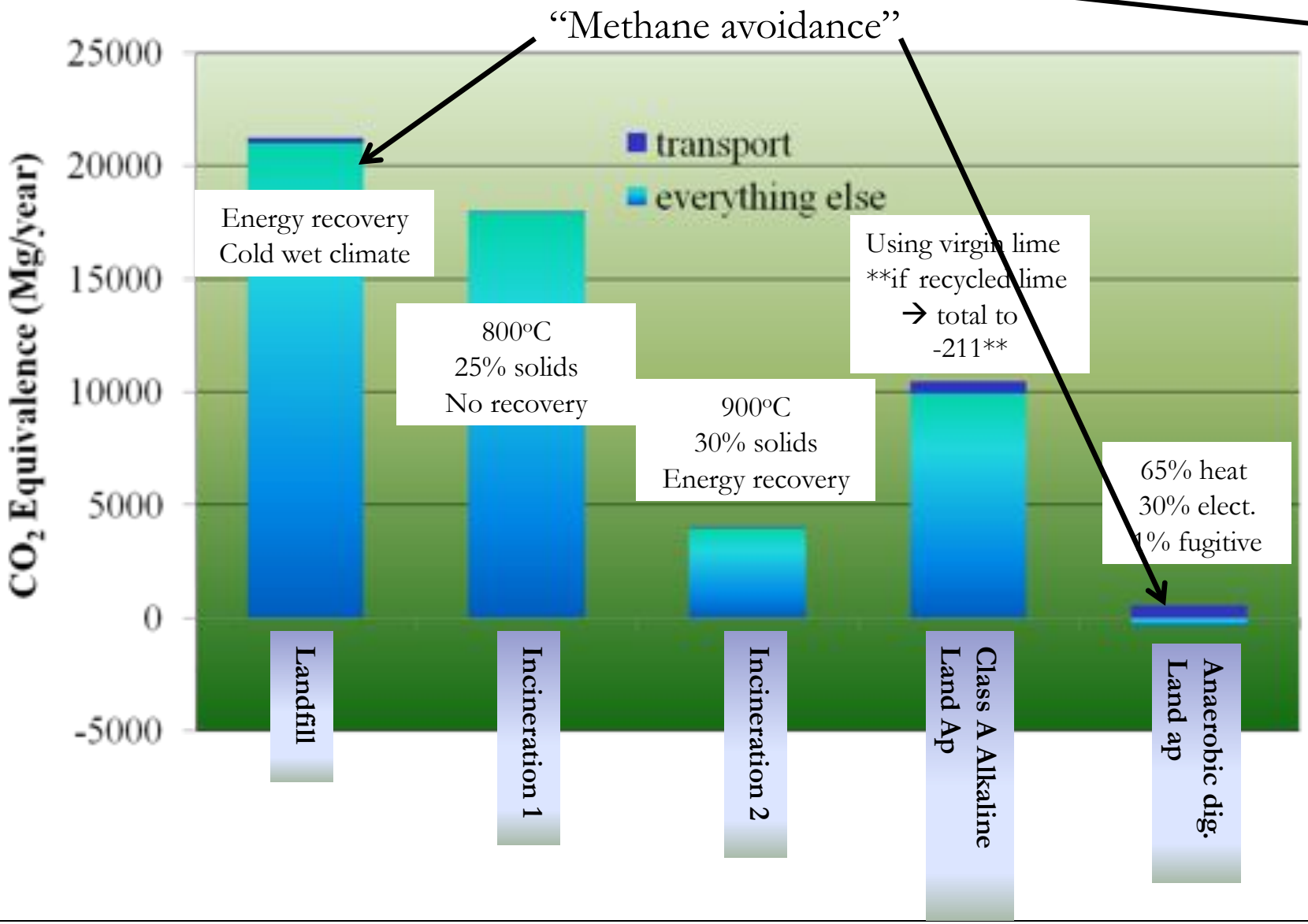
Univ. of WA study – published 2011



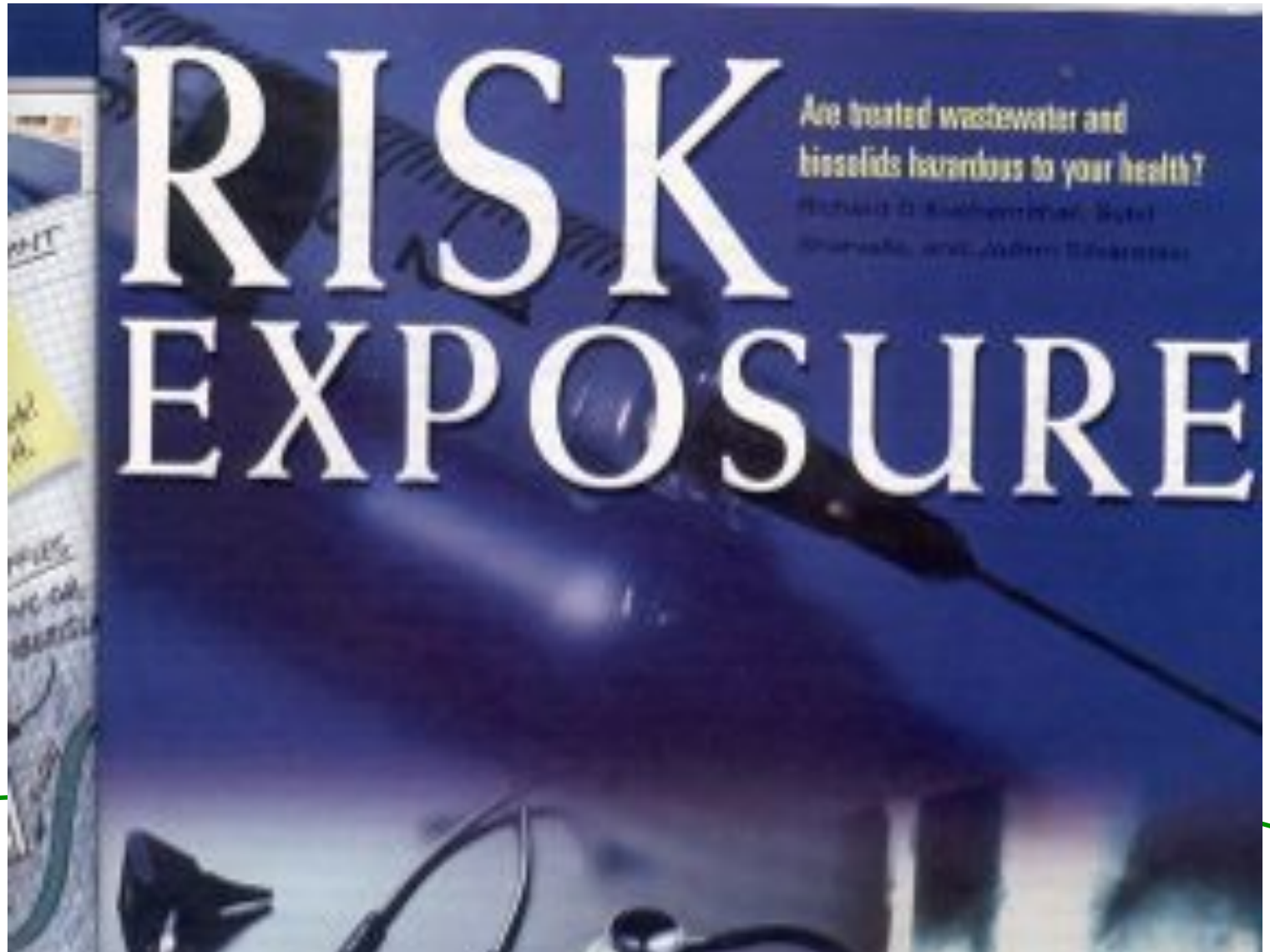
Slide courtesy of Sally Brown, PhD Univ. of WA

Low GHG emissions

SEE http://www.nebiosolids.org/index.php?page=biosolids-management-greenhouse-gas-emissions



Research addresses risks…



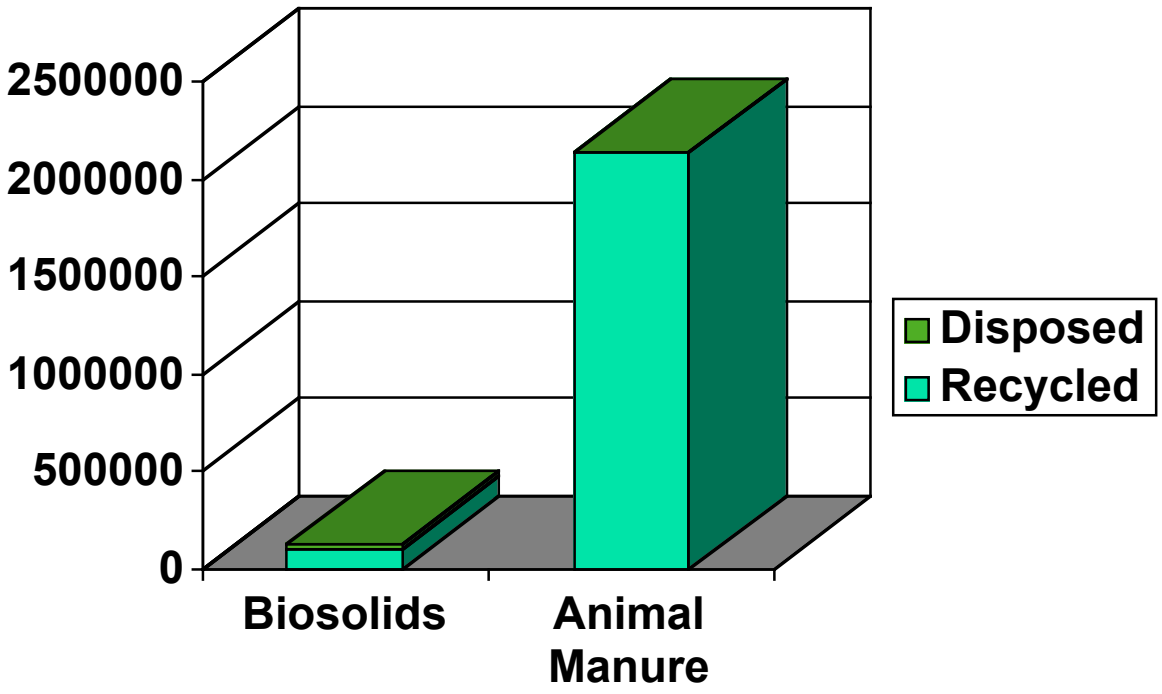
Three major areas of voiced concern:

- "**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



Slide courtesy of Andrew Carpenter, Northern Tilth

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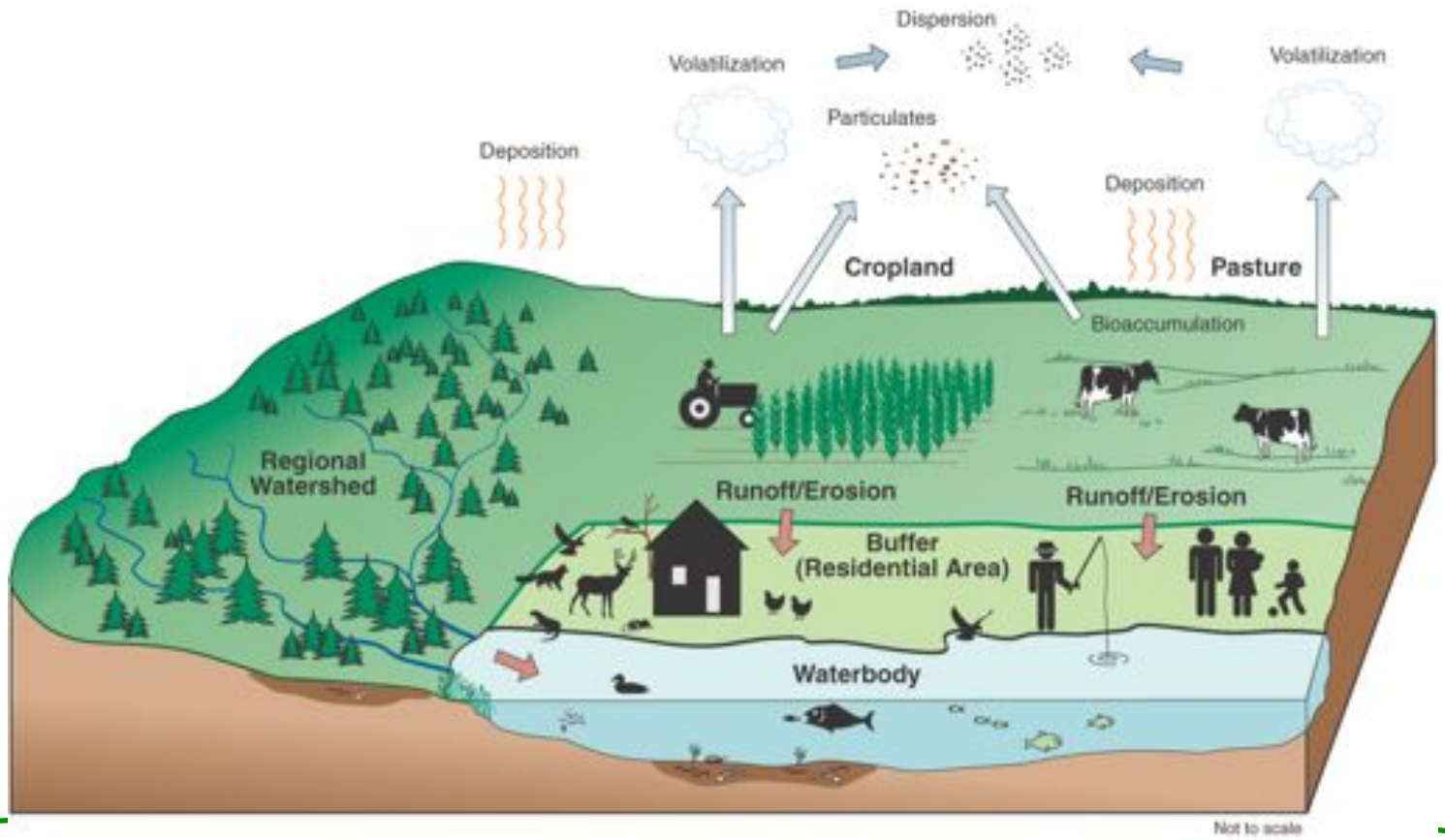
North East Biosolids & Residuals Association

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

Pathway	Highly Exposed Individual
1. Soil→Plant→Human	Farm markets; 2.5% of food
2. Soil→Plant→Human	Home gardens; 60% of garden foods for lifetime
3. Soil→Human	200 mg/day soil/dust ingestion
4. Sol →Plant→Animal→Human	Farms; 45% home-grown meat
5. Soil→Animal→Human	Grazing ruminants; soil is 2.5% of annual diet; 45% home-grown meat.
6. Soil→Plant→Animal	100% of livestock feeds grown on soils
7. Soil→Animal	Grazing ruminants; 2.5% soil in diet.

Pathways for Risk Assessment of Elements in Soils and Highly Exposed Individuals - 2

Pathway	Highly Exposed Individual
8. Soil➔Plant	Sensitive crops; strongly acidic.
9. Soil➔Soil Biota	Earthworms; microbes; metabolic function of soil.
10. Soil Biota➔Soil Biota Predator	Shrews; 1/3 of diet presumed to be earthwroms full of Soil
11. Soil➔Airborne Dust➔Human	Tractor operator.
12. Soil➔Surface water➔Human	Subsistence fishers.
13. Soil➔Air→Human	Farm households
14. Soil➔groundwater→Human	Well water on farms.

Resources: Metals

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

Reducing
Children's Risk from
LEAD in SOIL

Perspective on metals land applied

Table 5
Estimated Total Metals Applied to Land From Various Products
Applied Metals (tons/year)

Metal	Biosolids (1)	Swine Manure (2)	Poultry Manure (3)	Phosphate Fertilizer (4)
Arsenic	14.2	[illegible]	[illegible]	[illegible]
Cadmium	12.59	[illegible]	31	[illegible]
Chromium	168	NA	NA	[illegible]
Copper	1,852	[illegible]	6,103	[illegible]
Lead	215	[illegible]	[illegible]	[illegible]
Mercury	5.07	NA	NA	[illegible]
Molybdenum	34.2	NA	NA	NA
Nickel	94.1	264	NA	121
Selenium	50.89	NA	NA	NA
Zinc	2,081	4,995	8,129	[illegible]

Notes:
(1) Based on metal concentrations presented in Table 2.
(2) Assumed application of 2.85 million dry tons annually (USEPA, [illegible])
(3) Assumed application of 9 million dry tons annually (USEPA, [illegible])
(4) Assumed application of 74.5 million dry tons annually (EPA, [illegible])
(5) Assumed application of 4.4 million tons annually (USDA, [illegible])

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)

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

	Phosphorus Fertilizer (5)	Phosphorus Fertilizers (ranges) (6)	MSW Compost (6)	Wood Ash (7)	Agricultural Soils (4)	Silty/Loam Soils (1)	Miracle-Gro® (fertilizer)	Rite-Aid Central Vite® (vitamins)

Trace Element Chemistry in Residual-Treated Soil: Key Concepts and Metal Bioavailability

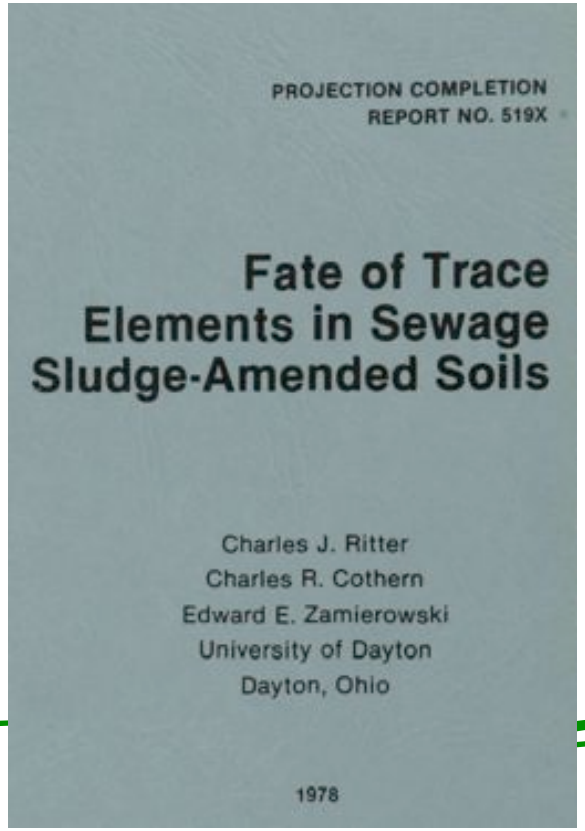
N. T. Basta,* J. A. Ryan, and R. L. Chaney

ABSTRACT

Trace element solubility and availability in land-applied residuals s governed by fundamental chemical reactions between metal constit- ıents, soil, and residual components. Iron, aluminum, and manganese

based paints (The Conservation Fou bazari et al., 1989); land application o manures, biosolids, composts, pestici tion residues; and atmospheric dep

The research on metals in soils goes back decades; this topic is well studied.



Resources: Chemicals

PO Box 422 ■ Tamworth, NH 03886-0422
www.nebiosolids.org

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Cooperatively promoting the environmentally sound recycling of b

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

Introduction
The increased attention being paid to microconstituents (traces of synthetic chemicals
products and daily activities) in the environment has led to questions about the contri

Water Environment Federation®
Preserving & Enhancing the Global Water Environment

Microconstituents in Biosolids

Technical Practice Update

Prepared by **Microconstituents Community of Practice** of th
Committee


BARKING UP WRONG TREE?

EVALUATING EXPOSURE RISK TO TRACE ORGANIC CHEMICALS IN BIOSOLIDS

Due to widespread use of TOrCs in manufacturing of personal care and consumer products, research finds that the greatest human exposure is in the household environment and not via land application of biosolids.

COMMERCIALLY USED CHEMICALS

BIOSOLIDS AND BIOAEROSOLS: THE CURRENT SITUATION

Resources: Pathogens

AMERICAN SOCIETY FOR MICROBIOLOGY

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

Prepared by

Françoise Forcier, Engineer, Agronomist, M. Eng.
SOLINOV Inc., consultants specializing in waste management

Prepared for

Quebec Ministry of Environment

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, Editorss

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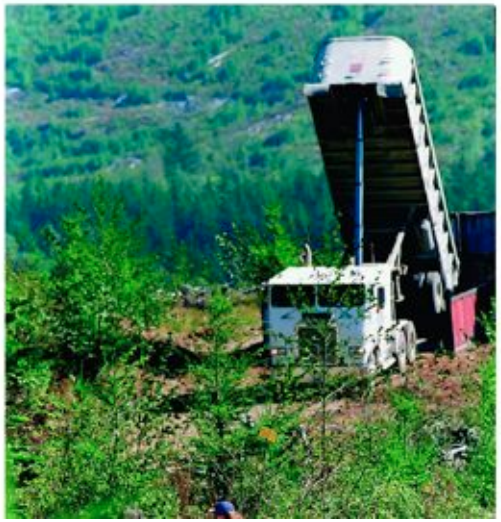
September 2002

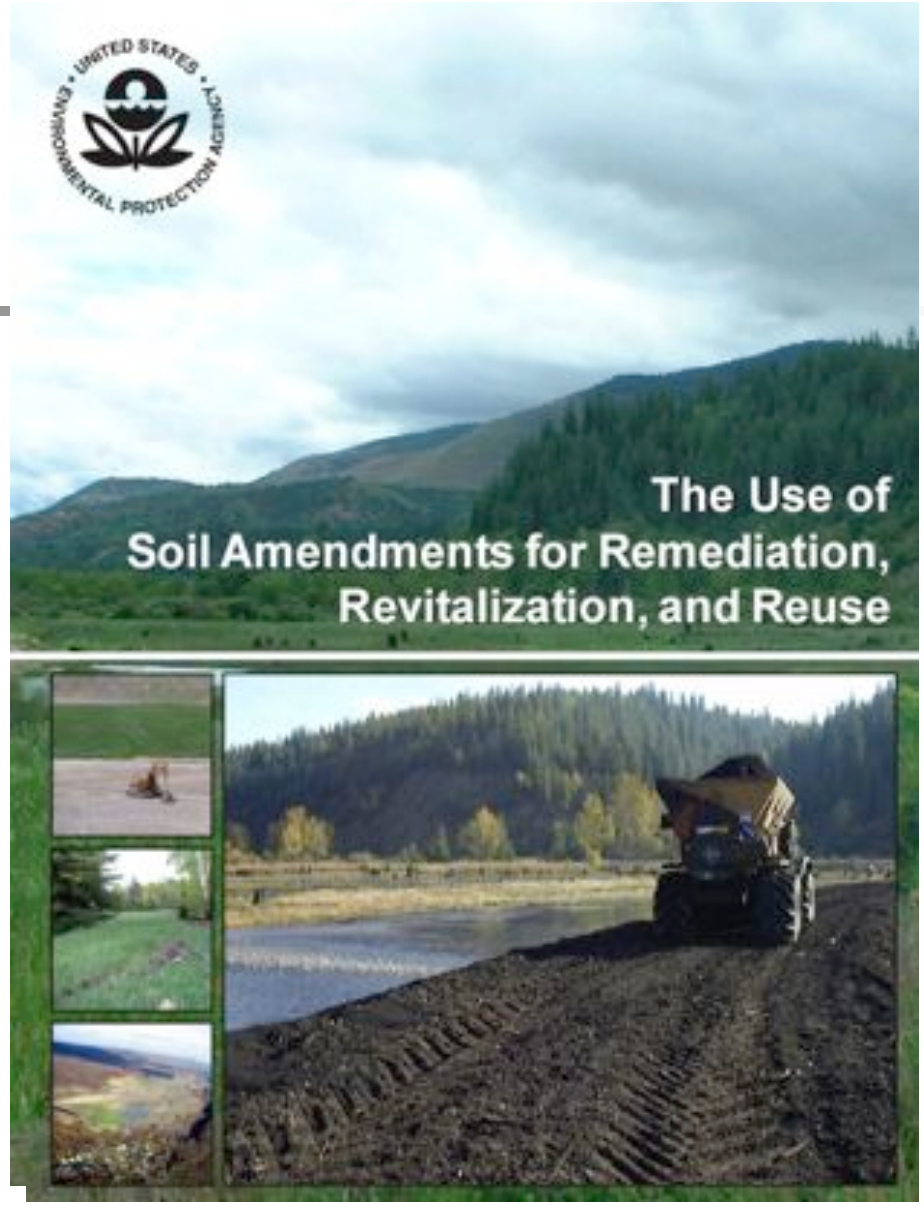
Resources:

United States Environmental Protection Agency | Office of Wastewater Management (4204) | EPA/832-B-00-007 July 2000

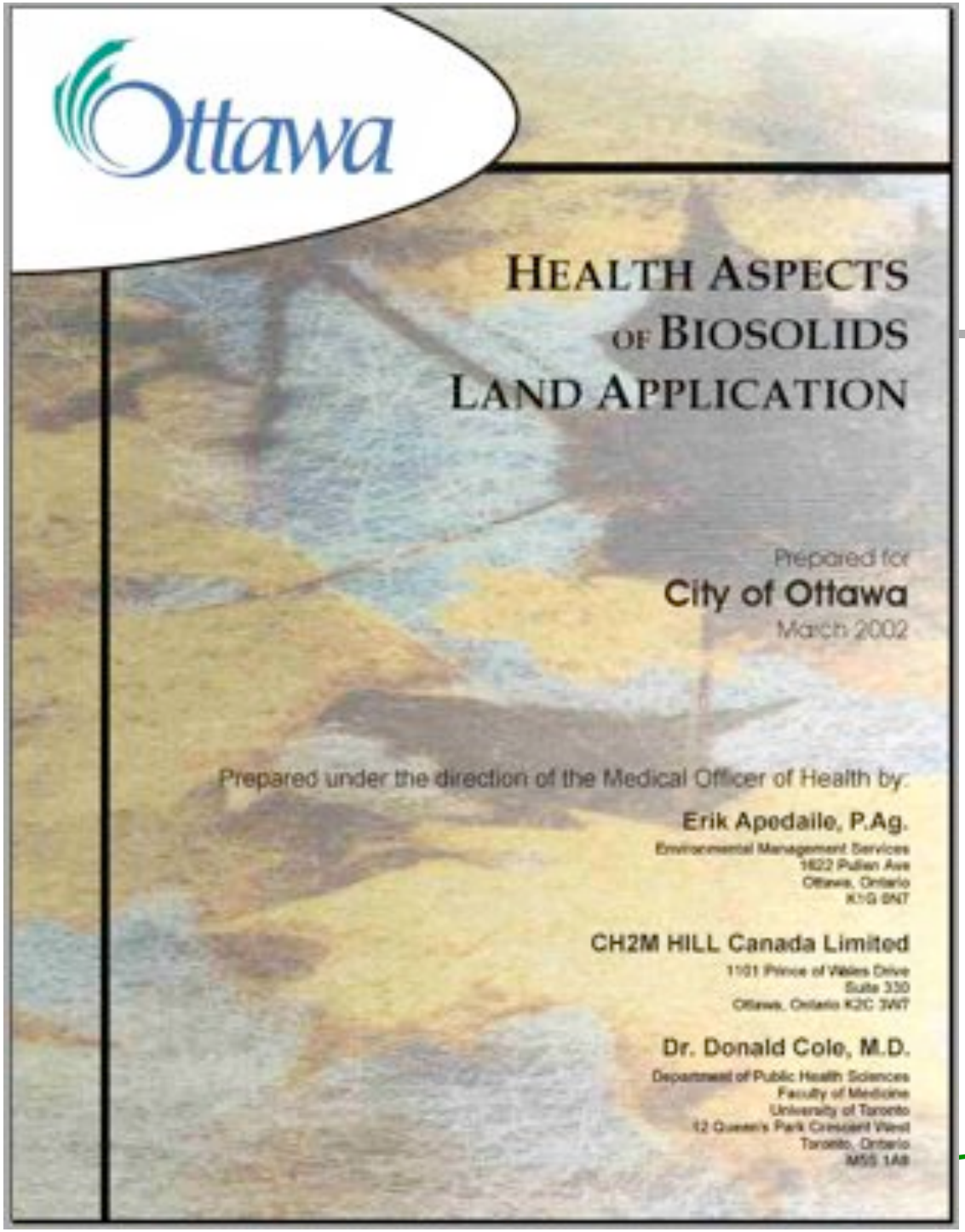
EPA

Guide to Field Storage of Biosolids





EPA documents available online or from NEBRA.



See also: Virginia state health department review, 2007: http://www.virginiabiosolids.com/pdf/Biosolids_Available_Evidence_1107.pdf

Resources:

USGS Monitoring : Denver

- http://pubs.usgs.gov/ds/379/
- http://pubs.usgs.gov/ds/664/

USDA / Univ. of MN: Rosemount

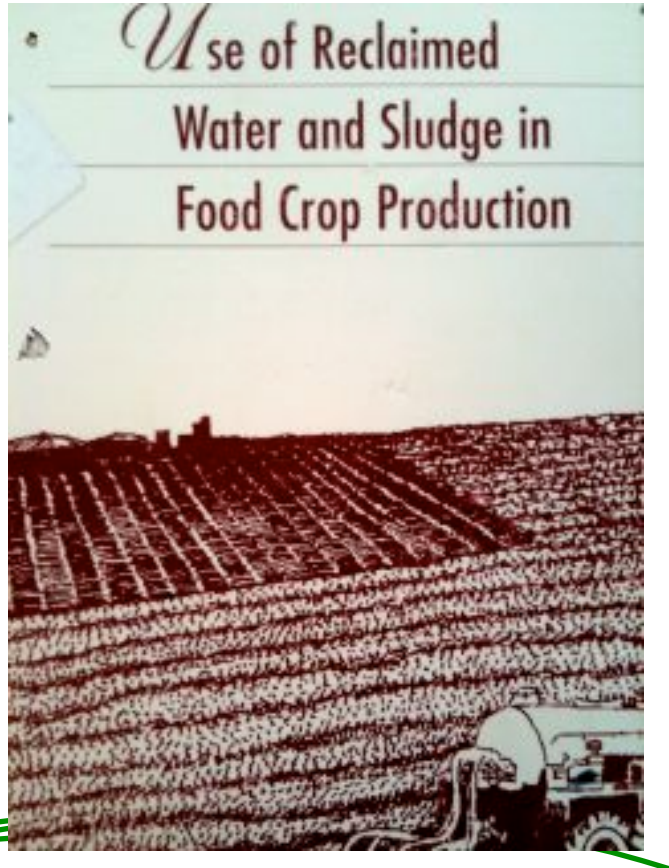
- 20+ years of research, beginning 1973
- http://www.ars.usda.gov/research/publications/publications.htm?seq_no_115=99649

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."



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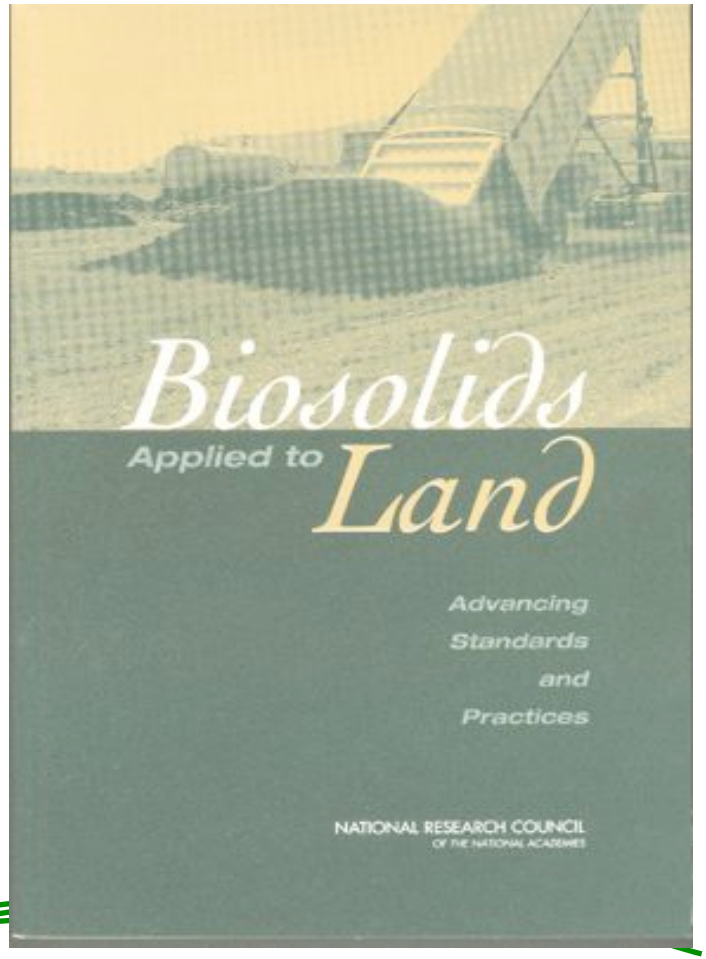
A second review by the NAS in 2002…

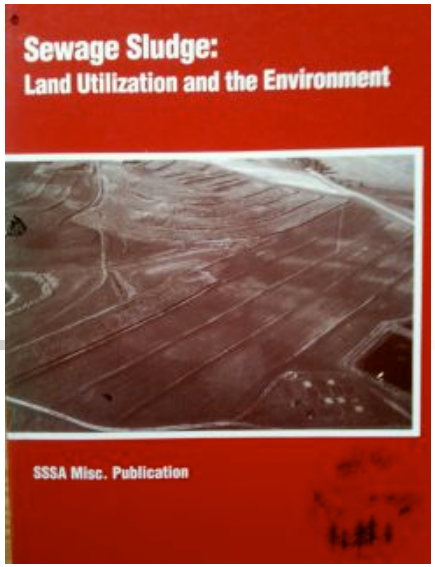
The finding:

”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.”

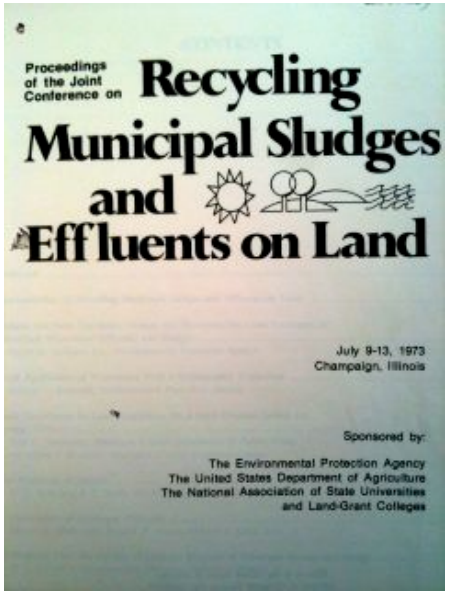


Every 10 years –

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

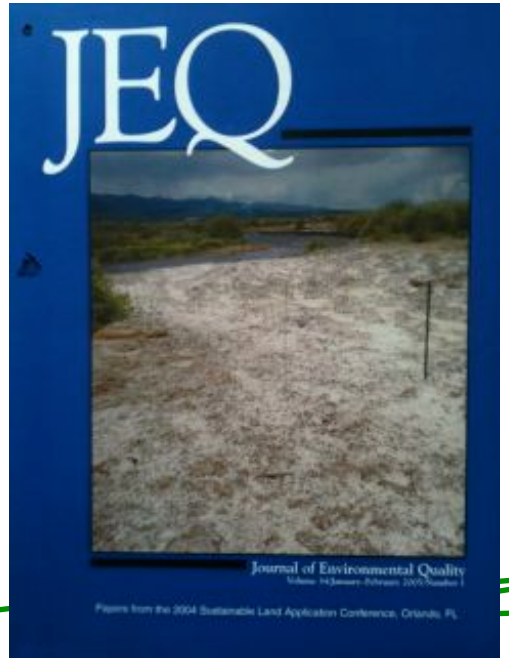


1993 – Univ. of Minnesota – proceedings published by Soil Science Society of America



1973 – Univ. of Illinois

1983 – Colorado



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

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Another way of looking at it…

Bioassays of Biosolids Land Application in Ontario – Lynda McCarthy, Ryerson Univ.

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

Resource: http://www.nebiosolids.org/index.php?page=applying-bioassays-to-biosolids-2

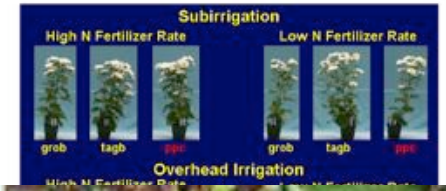
New! Resources:

These recent EPA and other documents are available online…

BIOSOLIDS RECYCLING research notes

NORTHWEST BIOSOLIDS MANAGEMENT ASSOCIATION

Using Biosolids as Growing Media in Greenhouse Production of Chrysanthemums



EPA

Soil Amendments for Site Remediation & Reuse

A COST-EFFECTIVE IN SITU TECHNOLOGY

Contaminated or disturbed soils at Superfund sites and other sites can often be addressed effectively and directly through the application of soil amendments. The use of soil amendments can be a cost-effective in situ process for remediation, revitalization and more.

This fact sheet provides an overview of how soil amendments can be used to address on-site contamination and summarizes some of the resources that are available to assist with this cleanup approach.

DID YOU KNOW?

Technical Assistance for using soil amendments to address contaminated soils is available through EPA's Office of Superfund Remediation and Technology Innovation (OSRTI). For more information, please contact Michele Mahoney by phone at 703-603-9057 or via e-mail at: mahoney.michele@epa.gov

Why use soil amendments at contaminated sites?

What are the advantages of using soil amendments?

CLU-IN

Technologies

CLU-IN | Issues | EcoTools

EcoTools Tools for Land

Soil Amendments

This page discusses soil-related issues, including soil health and the use of soil amendments to revitalize soils in order to make them suitable for sustaining plant life or development.

Why is soil health important?

All components of an ecosystem are dependent on viable and healthy soils for the system to function properly. Increased acidity, the presence of heavy metals and other contaminants, and high concentrations of salts can render a soil infertile by inhibiting plant growth, limiting microbial activity, and altering its physical

REUSING POTENTIALLY CONTAMINATED LANDSCAPES:

Growing Gardens in Urban Soils

This fact sheet provides communities and individuals with general urban gardening information about:

- Common contaminants that can be found in urban soil.
- Ways to identify contaminants and reduce exposure.
- Improving soils and growing plants in mildly contaminated soil.
- Additional resources and technical assistance.

Introduction

Communities throughout the country are turning to urban agriculture and gardening as a reasonable option to increase their access to healthy, nutritious, and low-cost produce. Some of the sites that communities are using for urban gardens were previously home to industrial and commercial operations. A garden on abandoned land can become a new community asset by improving the visual look of a neighborhood and potentially increasing nearby property values. Community gardens provide many benefits, including healthier lifestyles by increasing activity

More information for the urban gardener on soil science, soil amendments, plants, contaminants and their health effects, and additional links is available on EPA's CLU-IN website: www.clu-in.org/ecotools/urbangardens.cfm.

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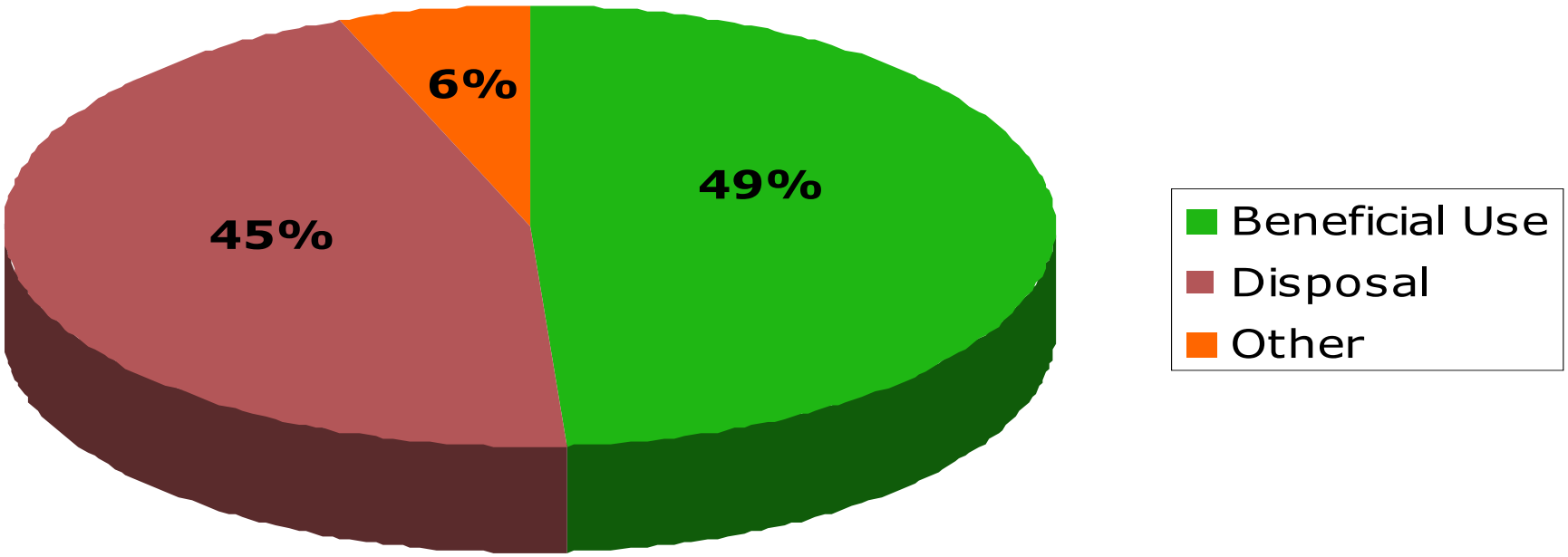
25+ years of practice

- Worldwide
- Agriculture
- Silviculture
- Land reclamation
- Horticulture, golf courses, turf, landscaping, etc.

Biosolids Use and Disposal Practices
2004 U.S. Totals



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Agriculture
still 3/4 of U.S. beneficial use

California, photo courtesy of CASA, 2004

New Hampshire, 2006

University of Nebraska–Lincoln Extension in Lancaster County

Nebraska EXTENSION

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The NEBLINE

May 2012

444 Cherrycreek Road, Suite A, Lincoln, NE 68528 • 402-441-7180 • http://lancaster.unl.edu

Lincoln's Biosolids Land Application Program is 20 Years Old

Barb Ogg
UNL Extension Educator
Dave Smith
UNL Extension Technologist

On May 12, 1992, the first truckload of the City of Lincoln's dewatered biosolids was delivered to farmland 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 buried in the landfill. In the last 20 years, more than 100 area farmers have applied nearly 600,000 tons of biosolids to their cropland, improving their soil and increasing yields.

Biosolids are organic solids separated from wastewater and biologically processed to make them safe to use as an organic fertilizer for crops not in the human food chain.

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 too close to sensitive environmental features 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-safe 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 conservative lot, but a few progressive farmers jumped into using biosolids wholeheartedly right away. Others adopted a wait-and-see attitude; they sat 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 contains significant quantities of all macro and micronutrients needed for crop growth. One application typically increases organic matter in soil about 0.6%, which increases water infiltration and improves soil tilth. For highly eroded or excavated soils, a single biosolids application can immediately make them productive.

Demand for Biosolids

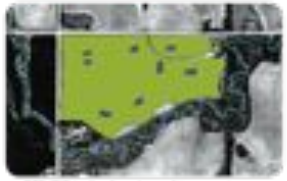
There is more demand than ever for biosolids, but most cooperating farmers are not using biosolids for nitrogen (N). It is the readily available phosphorus (P) that cooperators want. After a single application of biosolids, a P-deficient soil typically increases 30–40 ppm (Bray-P test). With average crop removal rates, it will take 10–12 years for the soil tests 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 to defray application costs. Twenty years later, there is so much demand for biosolids, cooperators are actually paying the city for it. Biosolids are delivered to field storage sites, but cooperating farmers are still responsible for application — either applying it themselves, or

see BIOSOLIDS on page 10

Soil samples are taken to determine the amount of biosolids to apply per field.



GPS/GIS technology is used to map storage (indicated above in purple) and application sites (indicated above in green).

A hauling contractor transports biosolids to approved fields.

Farmers either apply biosolids themselves or hire a custom applicator. Spreaders can be rented for a reasonable cost from the City of Lincoln.

Teaching An Old Guy New Tricks

My favorite biosolids story is about Wally Hansson, who lived in Walton, but had 145 acres on Ashland Road, just inside the Lancaster County line. In 1995, I met Wally at his farm to flag storage sites.

"Wally, we will bring enough biosolids on you won't need to apply any other fertilizer," I said. "In fact, I don't want you to add other fertilizer to this field."

Wally looked at me and said, "I can't believe it. Surely, I need to add something more. Are you sure?"

"Yes, Wally, I am quite sure," I said. "I know it is hard to believe, but trust me, and let's just see what happens."

After his 1994 corn crop was harvested, Wally stopped by the office to sign paperwork.

He said, "I didn't add any other fertilizer, just like you said. But, you were right ... I just harvested the best corn crop I ever got off that field."

As I recall, 1994 was an exceptional year for growing crops in eastern Nebraska. Rains came periodically and at just the right time for growing crops, but Wally credited the biosolids application for his best corn crop ever. Wally passed away in 2010 at age 88. He used to stop by the office sometimes just to pass the time.

—*Barb Ogg*

Biosolids Also Benefit Pastures

Mark Bentes is a grain and livestock farmer north of Lincoln. He has been using biosolids for 10 years on crop fields and about eight years ago tried biosolids to fertilize a pasture for summer grazing of his cow/calf pairs.

"My normal stocking rate for that pasture is about 20 pair," Bentes says. "Biosolids made that field so lush and productive I could have increased my rate. Even after I got my cows off in the fall, there was so much forage left, I was tempted to take a hay cutting."

Since pasture is normally on poorer soils the benefits of using biosolids for both pasture and hay fields can be substantial in increased yields and soil improvement.

—*Dave Smith*

IN THIS ISSUE

CLOVER COLLEGE

Hands-on workshops June 12–13

— see page 9

To go to our home page on your smart phone, scan this code with a QR reader app.

Saguenay, QC – 20 yrs

Ville de Saguenay

SERVICE DES COMMUNICATIONS

Communiqué de presse

POUR DIFFUSION IMMÉDIATE

Valorisation agricole des biosolides à Saguenay

DES ÉTUDES EN ARRIVENT À TROIS CONCLUSIONS POSITIVES

Saguenay, le 11 mars 2011 – « *La valorisation* [illegible] *boues d'épuration que Saguenay produit n'entraîne* [illegible] *sur la teneur en métaux lourds* [illegible] *des sur le lait des fermes réceptr* [illegible] *uel de gestion des boues par la V* [illegible] *ible d'émission de gaz à effet de se* [illegible]

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."

Telles sont les c [illegible] ct récentes sur la valorisation des [illegible] les détails se trouvent dans les [illegible]

Ces études d'imp [illegible] partie 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

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

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Photo: MWRA

Massachusetts Water Resources Authority

Deer Island WWTF

Boston Harbor

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.

Boston, MA Biosolids Pellets

NEBRA Videos: turf example

http://www.nebiosolids.org/index.php?page=biosolids-fertilizer-pellets

Hawk Ridge Compost Facility

Unity, Maine

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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

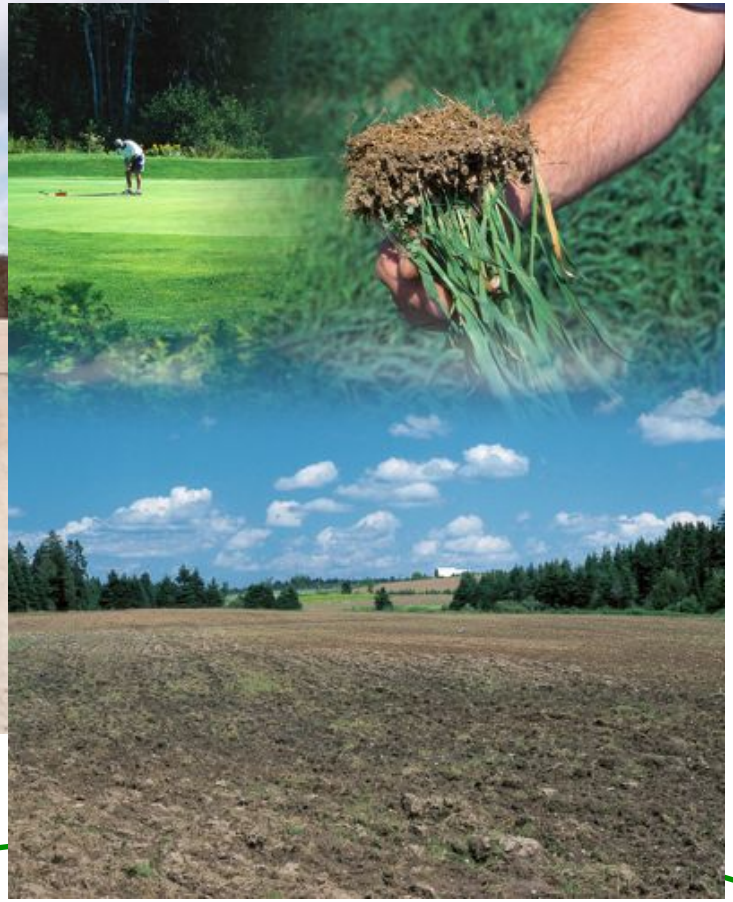
Before reshaping and biosolids compost application

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

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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

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

Land reclamation

3% of U.S. beneficial use… and growing

Washington, photos courtesy of C. Henry

Massachusetts, 2006

Idaho

Massachusetts 2004

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!

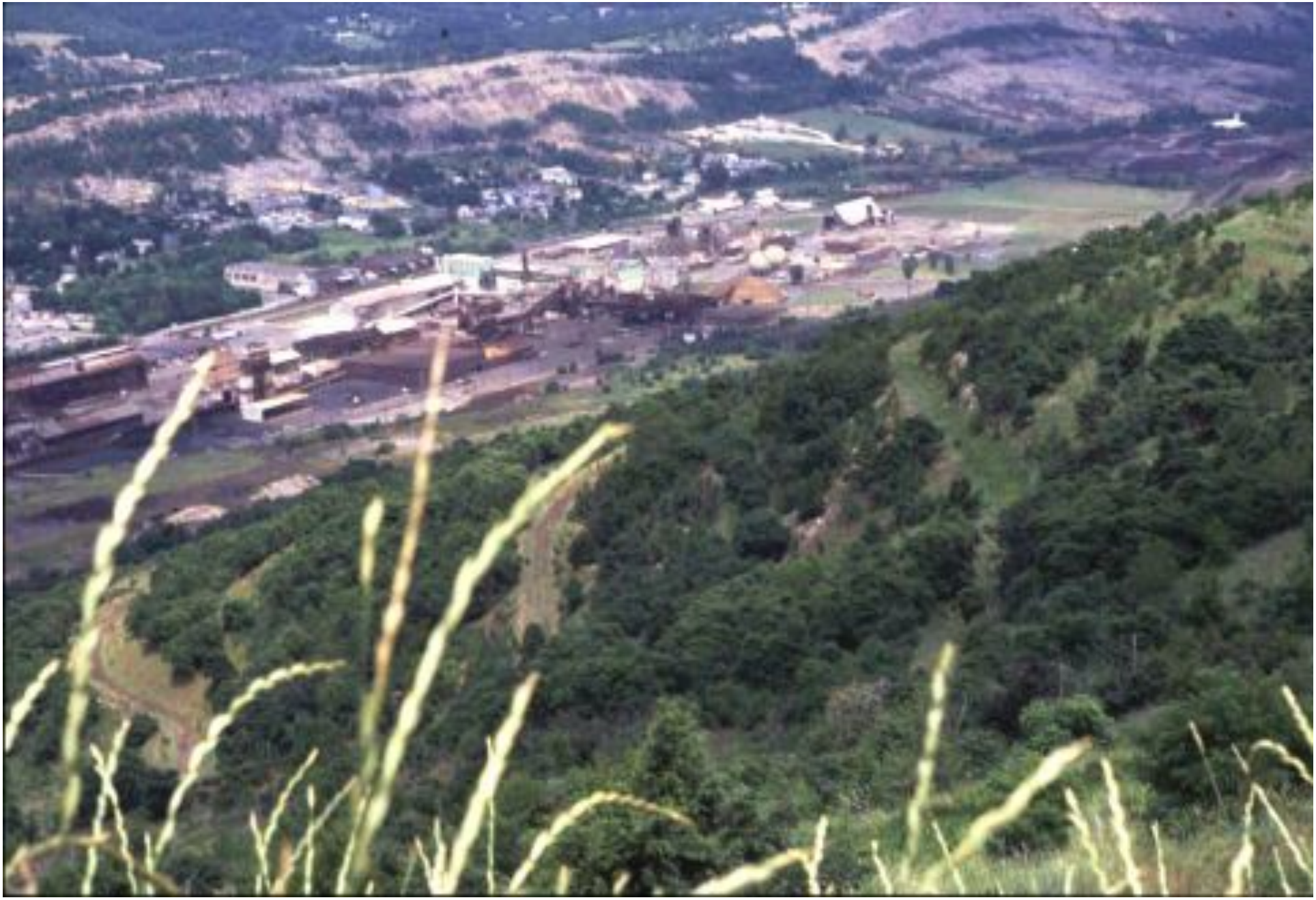
Soil at the Betty Site where biosolids was not used 18 years ago is extremely sterile, with moss and a few legumes.

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.

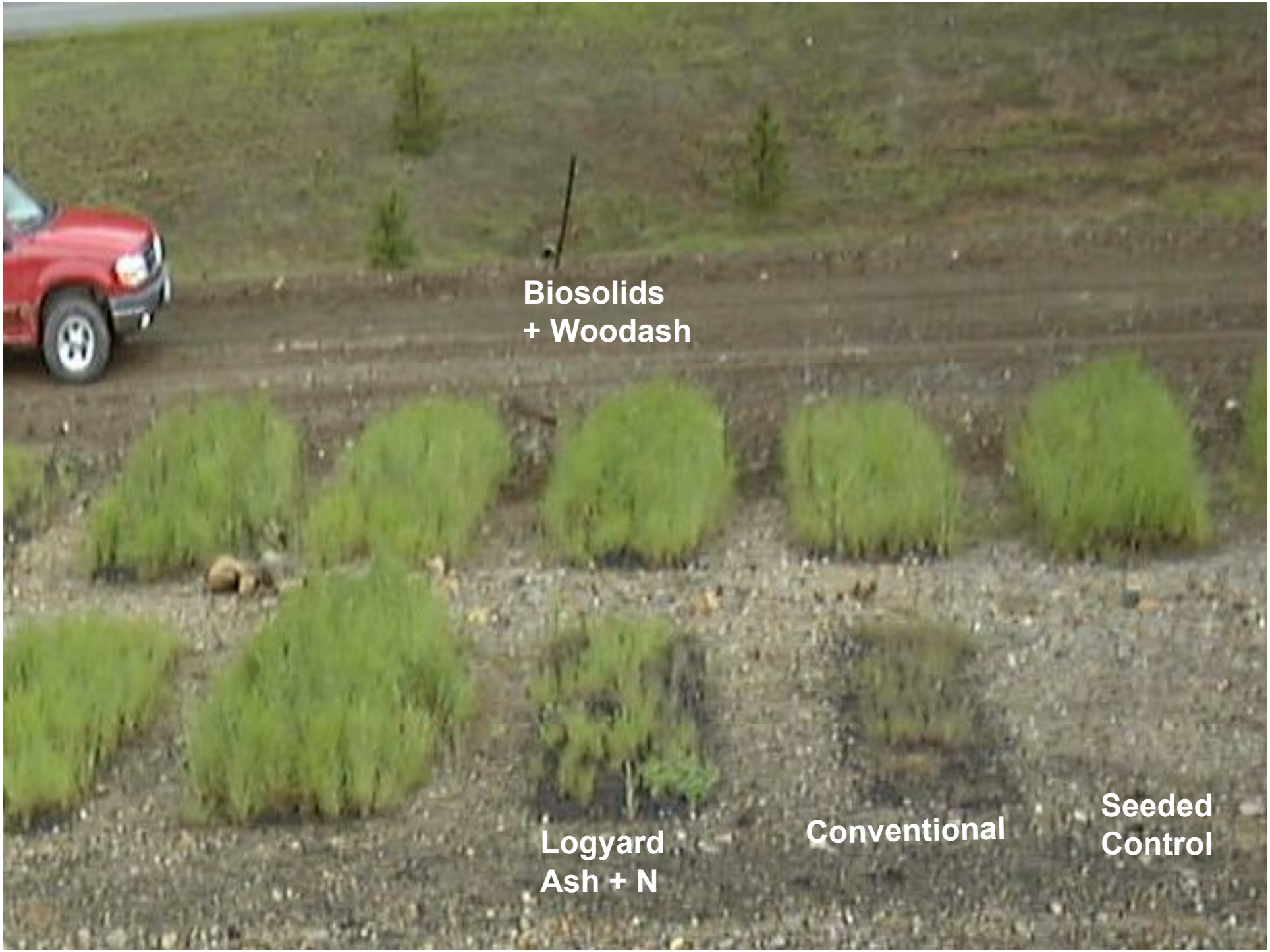

This is the same view as the previous picture, but after reclamation.

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.

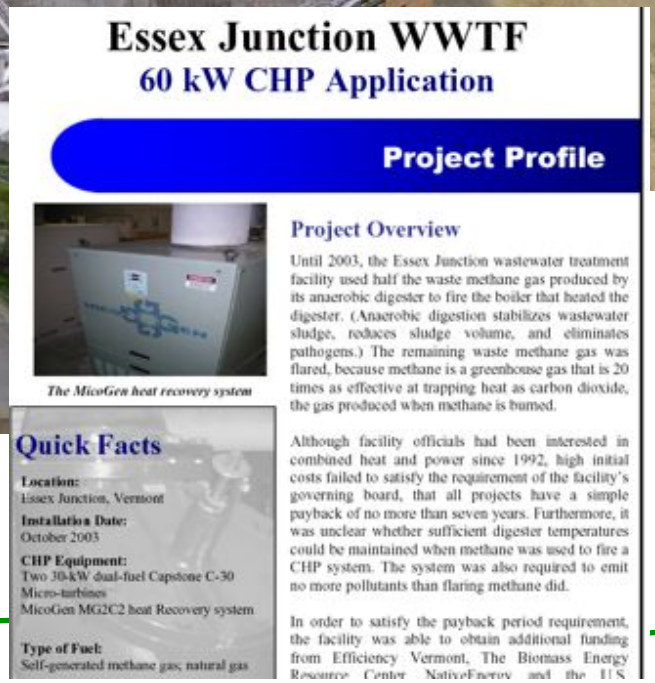

Biosolids
+ Woodash
Logyard
Ash + N
Conventional
Seeded
Control

Biosolids were used for the plantings under the Vancouver Olympic rings;
photo courtesy Metro Vancouver

Energy
biogas

New Hampshire

Massachusetts



Essex Junction WWTF

60 kW CHP Application

Project Profile

The MicoGen heat recovery system

Quick Facts

Location:
Essex Junction, Vermont

Installation Date:
October 2003

CHP Equipment:
Two 30-kW dual-fuel Capstone C-30 Micro-turbines
MicoGen MG2C2 heat Recovery system

Type of Fuel:
Self-generated methane gas; natural gas

Project Overview

Until 2003, the Essex Junction wastewater treatment facility used half the waste methane gas produced by its anaerobic digester to fire the boiler that heated the digester. (Anaerobic digestion stabilizes wastewater sludge, reduces sludge volume, and eliminates pathogens.) The remaining waste methane gas was flared, because methane is a greenhouse gas that is 20 times as effective at trapping heat as carbon dioxide, the gas produced when methane is burned.

Although facility officials had been interested in combined heat and power since 1992, high initial costs failed to satisfy the requirement of the facility's governing board, that all projects have a simple payback of no more than seven years. Furthermore, it was unclear whether sufficient digester temperatures could be maintained when methane was used to fire a CHP system. The system was also required to emit no more pollutants than flaring methane did.

In order to satisfy the payback period requirement, the facility was able to obtain additional funding from Efficiency Vermont, The Biomass Energy Resource Center, NativeEnergy, and the U.S.

Vermont

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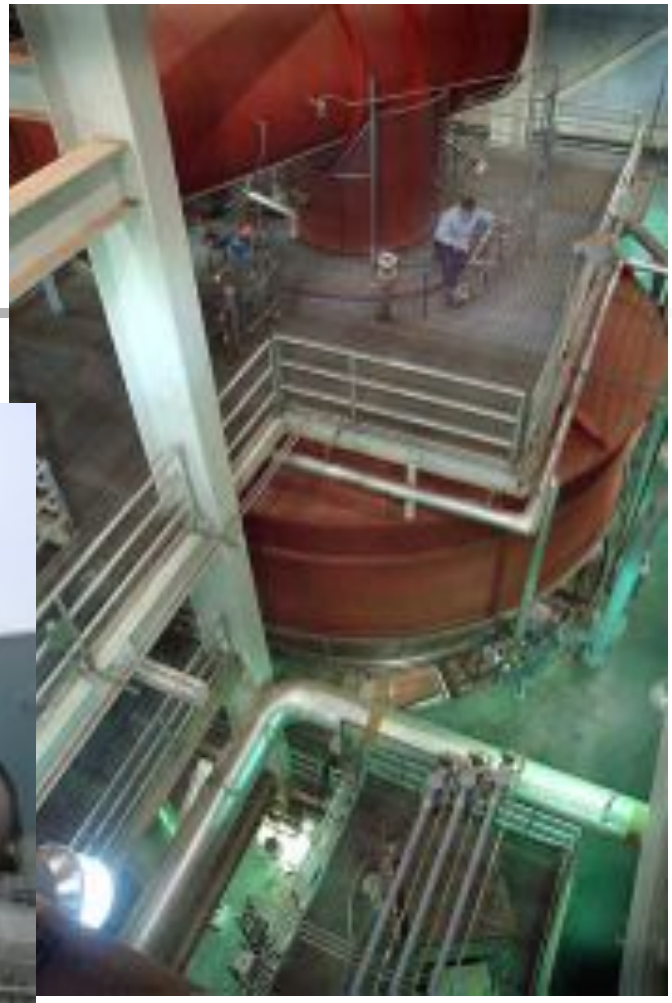
Ste. Hyacinthe, QC

Boston, MA

Energy - incineration with energy recovery

Cement kiln, Wikipedia photo



Minnesota, photo courtesy Metropolitan Council

Energy and Ag!
Biofuels grown with biosolids

Washington

Courtesy of Sally Brown – http://faculty.washington.edu/slb/

Critical: Best Practices

(BMP / Environmental Management System)

National Biosolids Partnership

Certified Management Program

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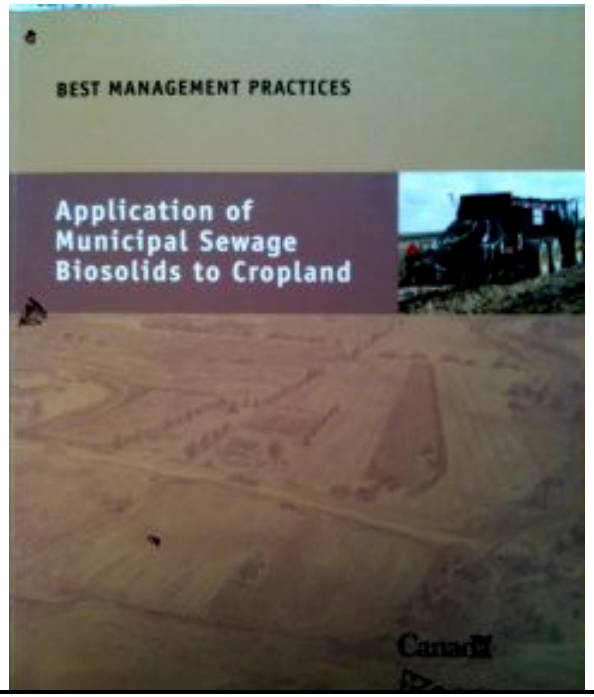
Best practices



NBMA is developing a "Best Practices" document.

by the Province of Ontario, Canadian government, & the Ontario Federation of Agriculture

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And you have to communicate!

WERF Project: Public Perception

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)

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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.

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Nice fact sheet from WEF…

Water Environment Federation
the water quality people

Q&A/Fact Sheet

Land Application and Composting of Biosolids

What are biosolids?

Every day, wastewater treatment facilities across the country treat billions of gallons of wastewater generated by homes and businesses. The treatment process produces liquid effluent that is discharged to water bodies or reused as well as a byproduct of solid residues (sewage sludge) that must be managed in an environmentally responsible manner. Although the terms "biosolids" and "sewage sludge" are often used interchangeably, they are not the same. With further treatment, sewage sludge can yield biosolids, which is defined by the U.S. Environmental Protection Agency (EPA) as *"nutrient-rich organic materials resulting from the treatment of domestic sewage in a treatment facility... that can be recycled and applied as fertilizer to improve*

What are some of the benefits of biosolids land application?

The benefits of biosolids for both soil and veget
ous and well recognized.[6] Biosolids provide prin
(nitrogen and phosphorous) and secondary nutr
calcium, iron, magnesium and zinc. Also, the us
increases crop yields and maintains nutrients in
and unlike chemical fertilizers, biosolids provide
is released slowly over the growing season as th
minera

tion o
recyc
carbo

http://www.nebiosolids.org/uploads/pdf/WEFLandApAndCompostFactSheet-Apr10.pdf

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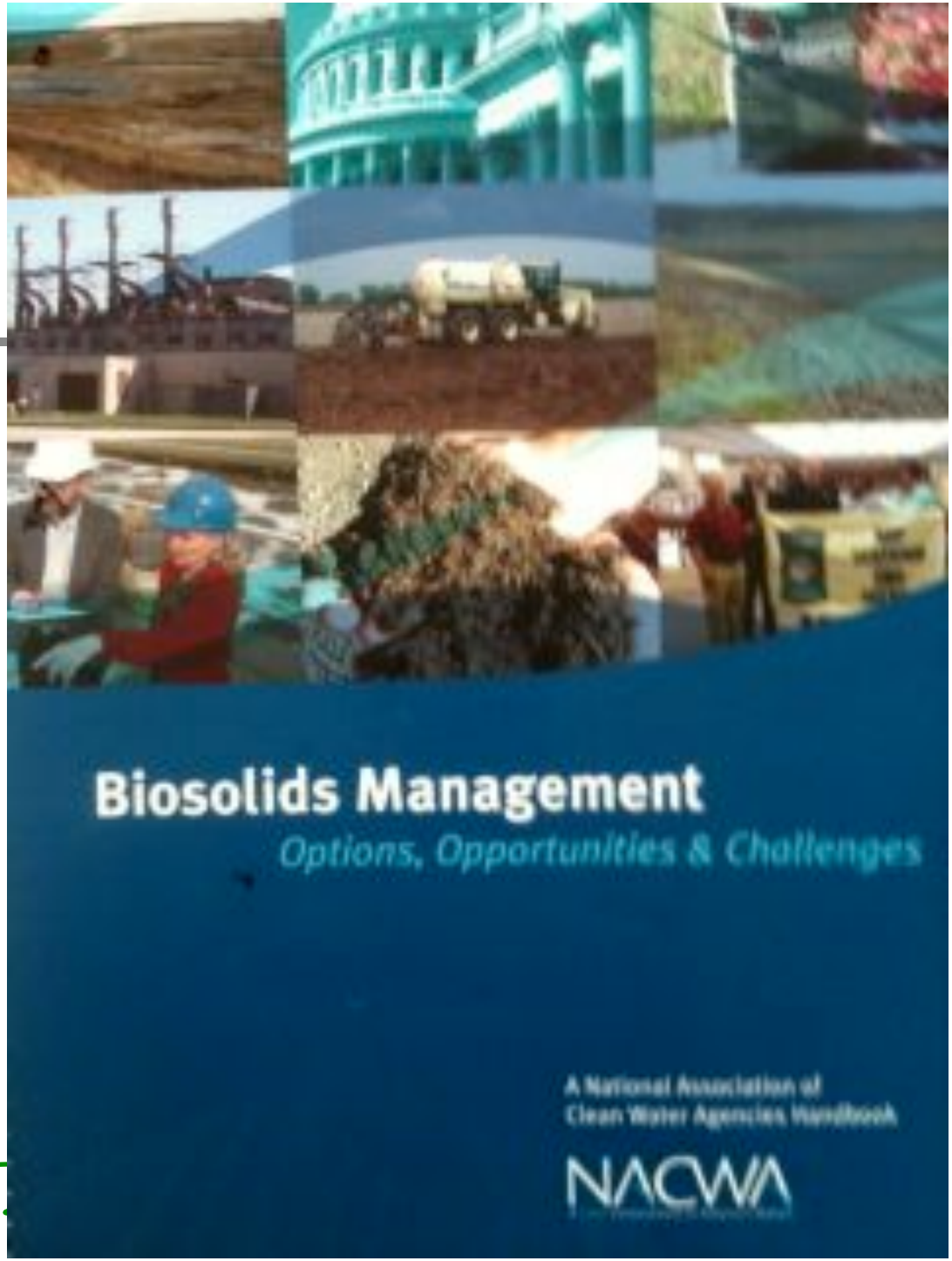
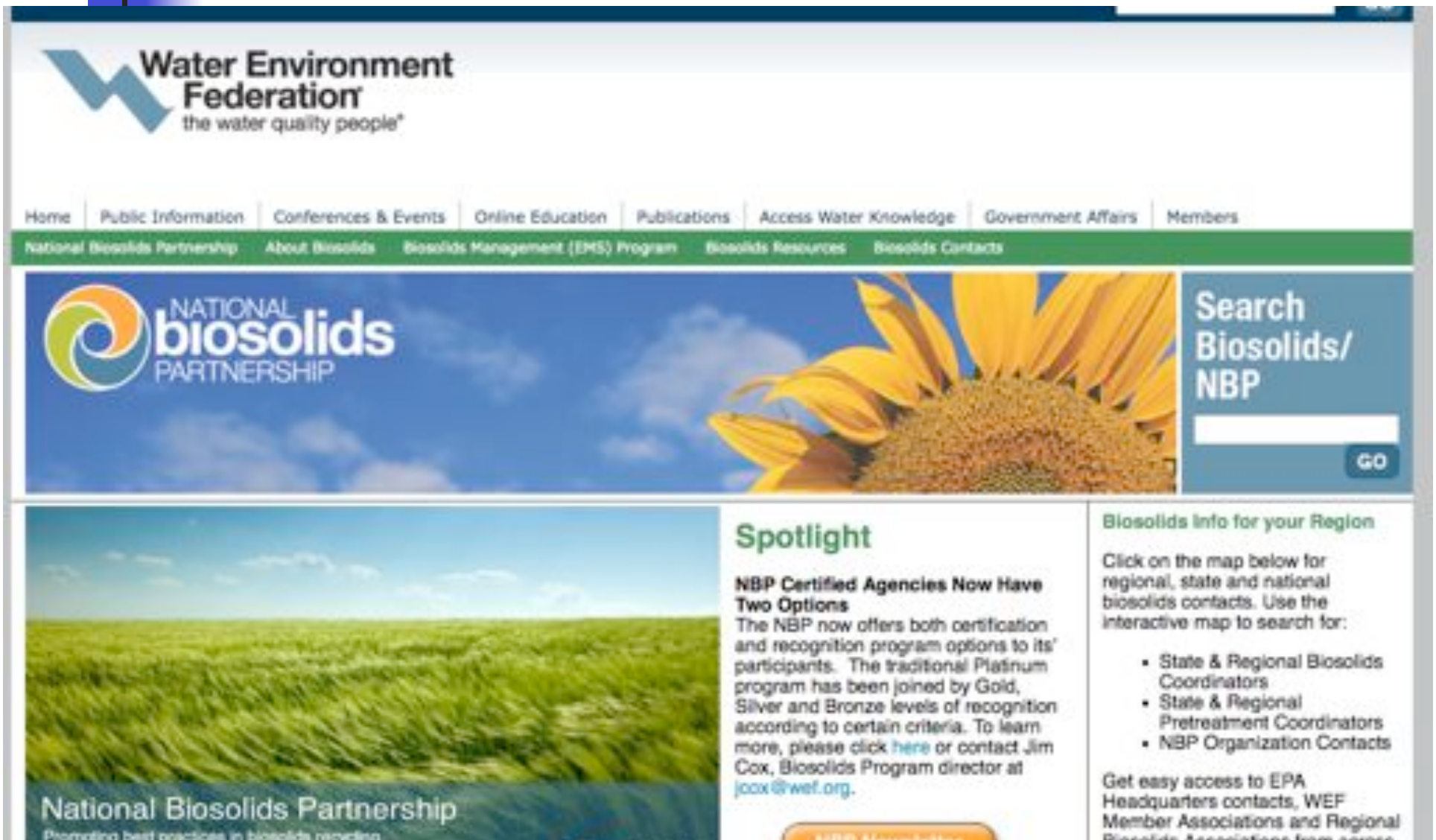
Nice book from NACWA…



Web resource: www.biosolids.org



Web resources…

- www.nebiosolids.org
- www.nwbiosolids.org
- www.virginiabiosolids.com
- http://www.ccme.ca/ourwork/waste.html?category_id=137
- http://www.weao.org/committees/biosolids/biosolids.html
- http://water.epa.gov/polwaste/wastewater/treatment/biosolids/index.cfm
- http://faculty.washington.edu/slb/biosolids_basics.html
- www.loopforyoursoil.com

NEW! Biosolids Video:
Water Environment Assoc. of Ontario

Biosolids: Naturally Sustainable

http://www.endless-films.com/site/?portfolio=biosolids

Sign up for *NEBRAMail* *(free)*

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Distilled biosolids and residuals news for New England and eastern Canada

January 2012

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CONTENTS...

Updated RI Biosolids Regs Effective Jan. 4th

Rhode Island has new "Rules and Regulations for Sewage Sludge Management." They replace regulations adopted in April 1997. "DEM did not receive any formal comments so the regs have been filed with no further changes. They will become effective on January 4, 2012," said Alex Pinto, Senior Engineer at the Rhode Island Department of Environmental Management.

The new regulations were developed ove
years. NEBRA provided comments on a
draft. The most recent final draft was rele
2011, and it incorporates some of NEBRA
commenters' recommendations. That fin
become the adopted set of rules and can be downloaded from the right side of this page.

Click from left side of www.nebiosolids.org.

Thanks for listening.

Questions?

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