Policy, Regulation, & Management of Organic Residuals

Ned Beecher • North East Biosolids & Residuals Assoc.

November 2, 2016 • Marlborough, MA

Presented to:

Managing Phosphorus in Organic Residuals Applied to Soils,
a UMass Extension Symposium

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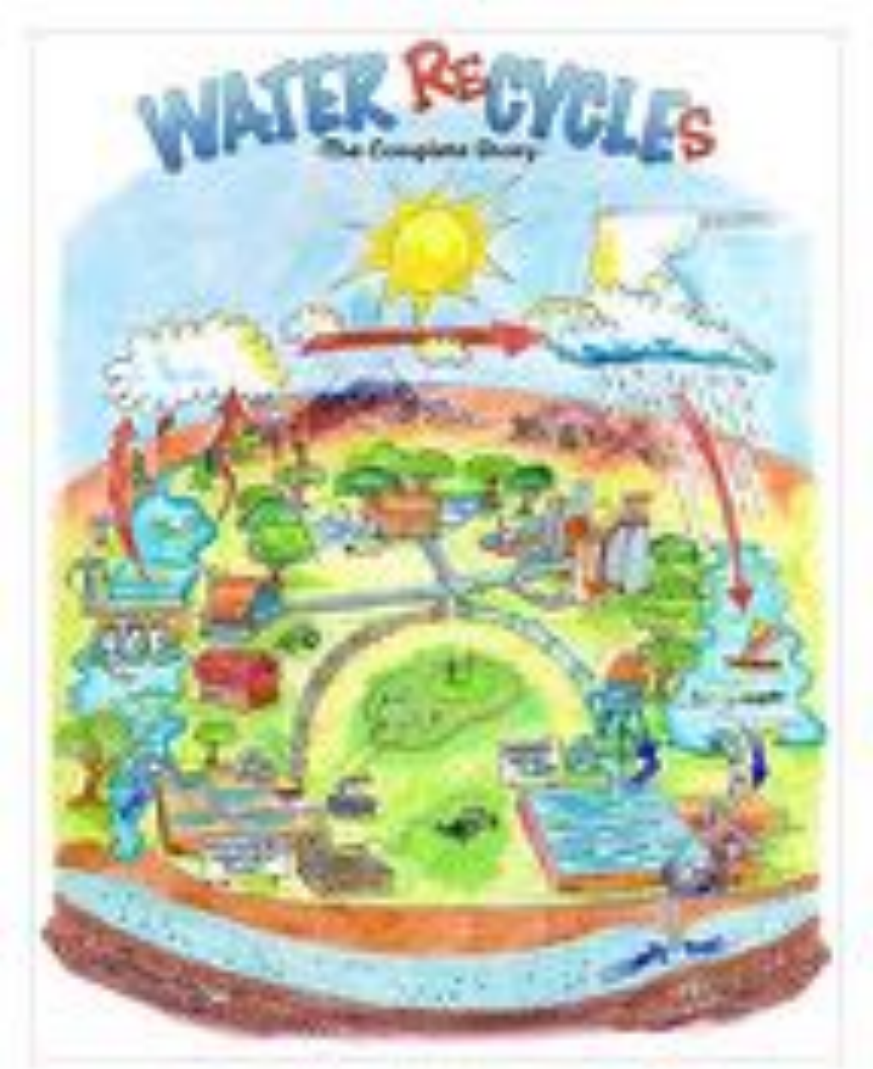

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Acknowledgements

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  - Andrew Carpenter, MS, Northern Tilth
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  - Sally Brown, PhD, University of Washington
  - Geoff Kuter, Agresource
  - Casella Organics
  - Resource Management, Inc.

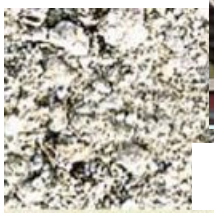
Our focus is P, a critical nutrient for life

- Primary function energy transport – ATP
- Essential for seed production, root growth, stalk strength and early maturity
- One of three primary macro-nutrients
  - The "P" in N-P-K
- Taken up by crops at a rate of 20-50#/acre per year

Slide courtesy of Northern Tilth.

and our focus is organic residuals

- Contain carbon (C) - derived from biological organisms
- A significant fraction of "waste" streams
- Varying degrees of putrescibility
- Highly putrescible residuals can cause malodors
- Contain resources: energy, major & minor nutrients, organic matter – excellent for soil building & plants



Pulp & paper mill sludge

Wood ash

Fats, oils, grease (FOG)

Source-separated organics

Food processing & other commercial residuals

Wastewater solids/sludge (biosolids when treated)

Manures
Wood chips

a key question:

- How do we develop a balanced system for use of organic residuals, with all their benefits, without adding to negative environmental impacts caused by phosphorus (P) leaching and runoff?
- Hopefully, we can come out of the day with some insights & direction….

Peak Phosphorus ?

- 90 year supply of economically recoverable phosphorus at current rate of use
- Population pressures will likely increase demand
- Geopolitical concentration of phosphate rock deposits
- Possibility of increased environmental risks with untapped deposits

P is a limited resource….

- We should be recycling it wherever we can before tapping limited mineral sources.
- It is easily kept out of chemical fertilizers.
- There should be incentive structures to encourage local recycling of local P found in biosolids and other organic residuals (e.g. food scrap composts & digestates).

Slide courtesy of Northern Tilth.

Jarvie et al, 2015

The Pivotal Role of Phosphorus in a Resilient Water–Energy–Food Security Nexus

Helen P. Jarvie,* Andrew N. Sharpley, Don Flaten, Peter J. A. Kleinman, Alan Jenkins, and Tarra Simmons

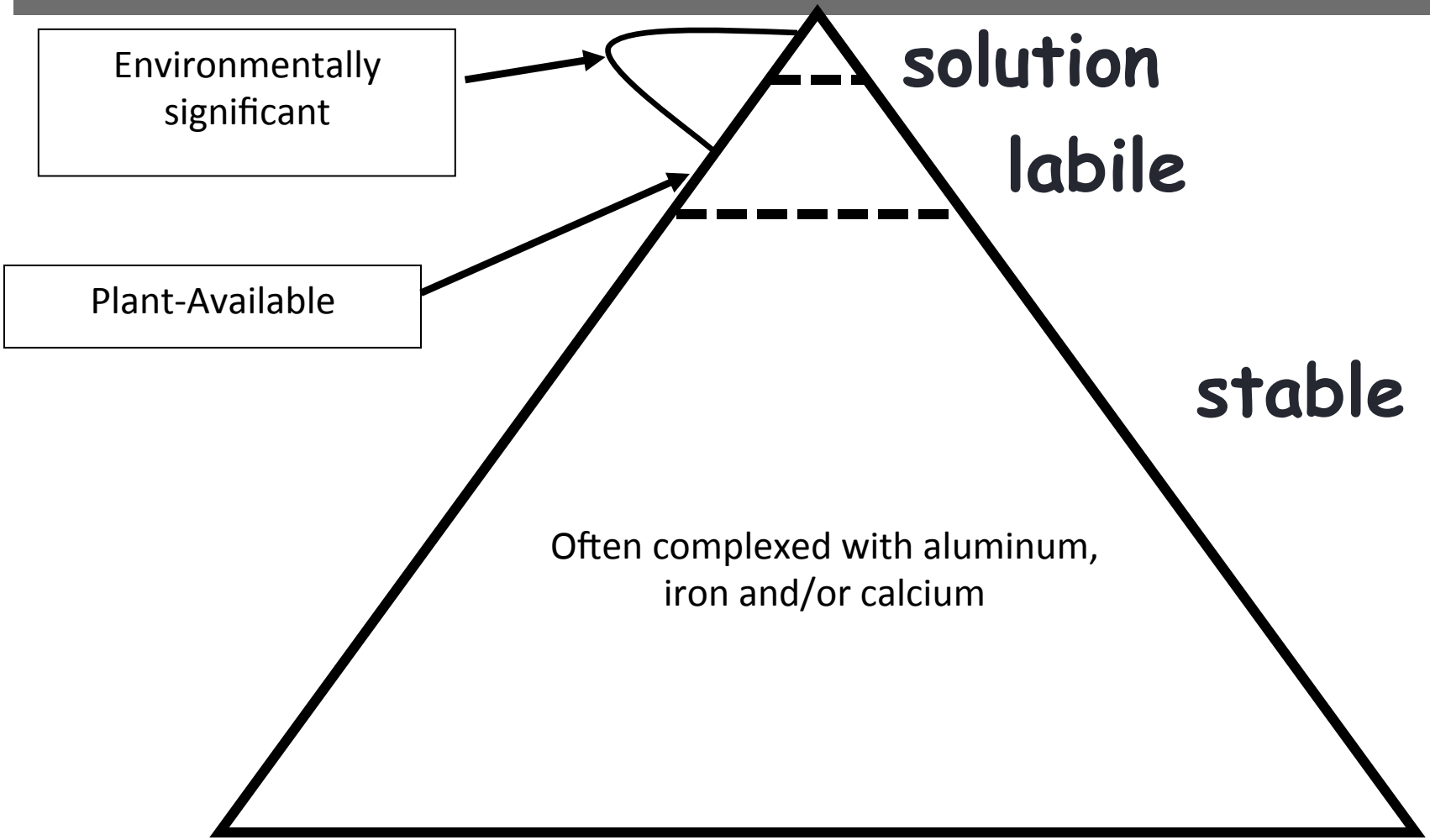
Abstract

We make the case that phosphorus (P) is inextricably linked to an increasingly fragile, interconnected, and interdependent nexus of water, energy, and food security and should be managed accordingly. Although there are many other drivers that influence water, energy, and food security, P plays a unique and under-recognized role within the nexus. The P paradox derives from fundamental challenges in meeting water, energy, and food security for a growing global population. We face simultaneous dilemmas of overcoming scarcity of P to sustain terrestrial food and biofuel production and addressing overabundance of P entering aquatic systems, which impairs water quality and aquatic ecosystems and threatens water security. Historical success in redistributing rock phosphate as fertilizer to enable modern feed and food production systems is a grand societal achievement in

The Phosphorus Paradox at the Heart of a Converging Water, Energy, and Food Securities Challenge

The water–energy–food security nexus—the complex interrelationships and interdependencies between three critical resources that underpin human life and civilization—has been identified as one of the greatest challenges for the global economy and sustainable development (World Economic Forum, 2011; Engel and Schaefer, 2013; Olsson, 2015; Perrone and Hornberger, 2014). To date, the role of phosphorus (P) within this nexus has been overlooked. In this "Environmental Issues" contribution, we make the case that P is inextricably

Soil Phosphorus



From Craig Cogger, WSU, then brazenly adulterated by Northern Tilth

Critical soil phosphorus levels

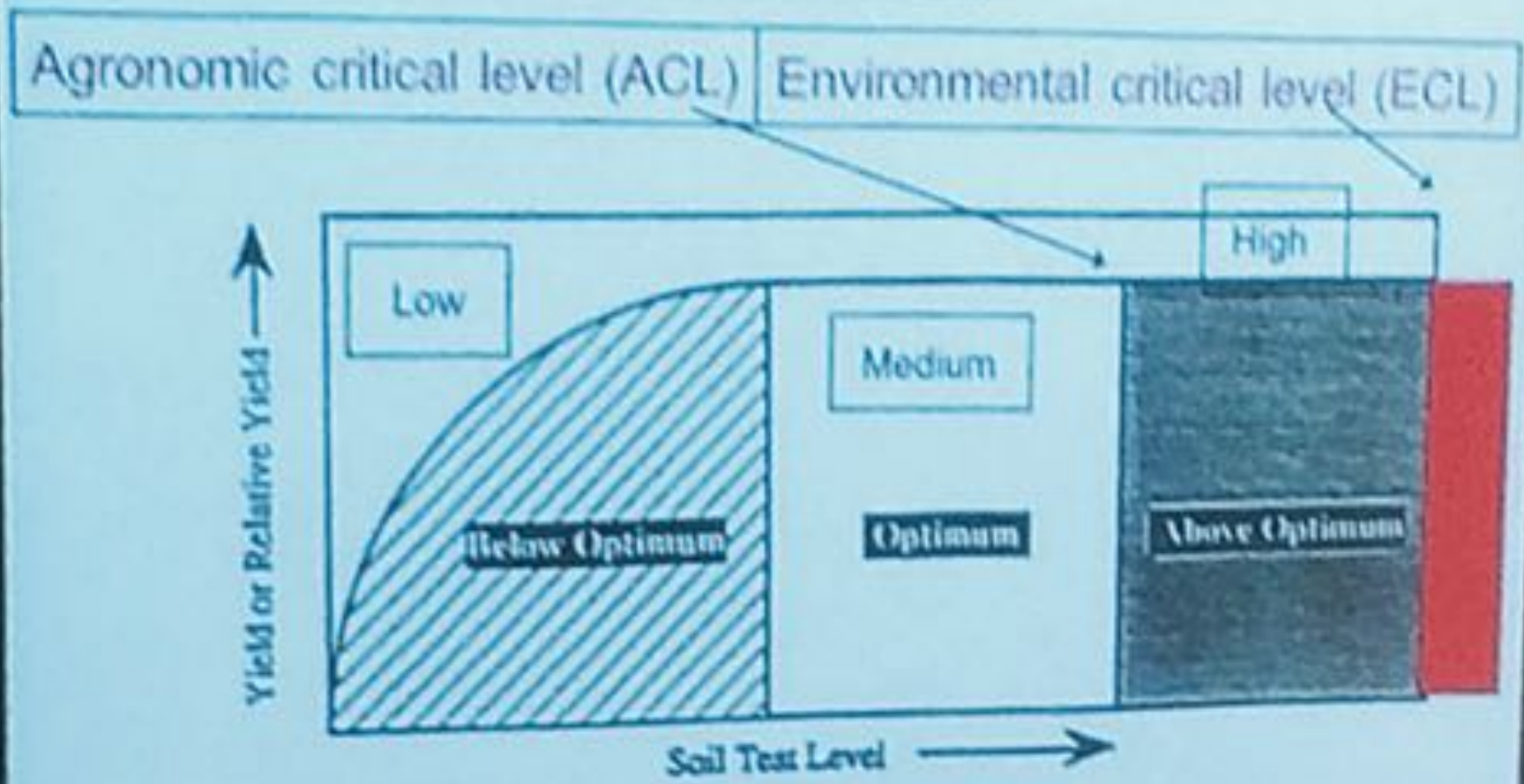


Figure 12-3. Response curve used to divide soil test levels into below optimum, optimum, and above optimum categories.

Soil Health

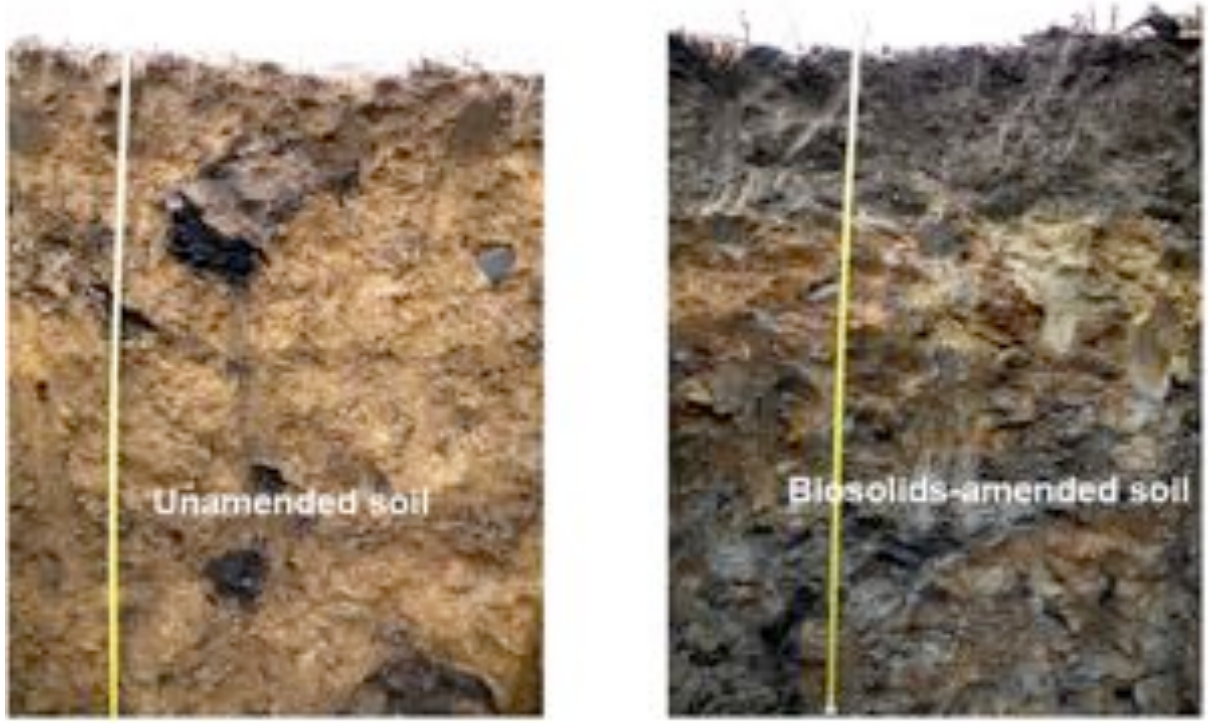
- Maintain high level of soil organic matter
- Optimize water stable aggregate level
- Have good level of nitrogen mineralization
- Maintain a biologically active soil
- Minimize physical or chemical soil disturbance
- Use appropriate inputs based on soil nutrient and soil health analyses.

– from George Bird, MI State Univ.

from the International Year of Soil (2015)

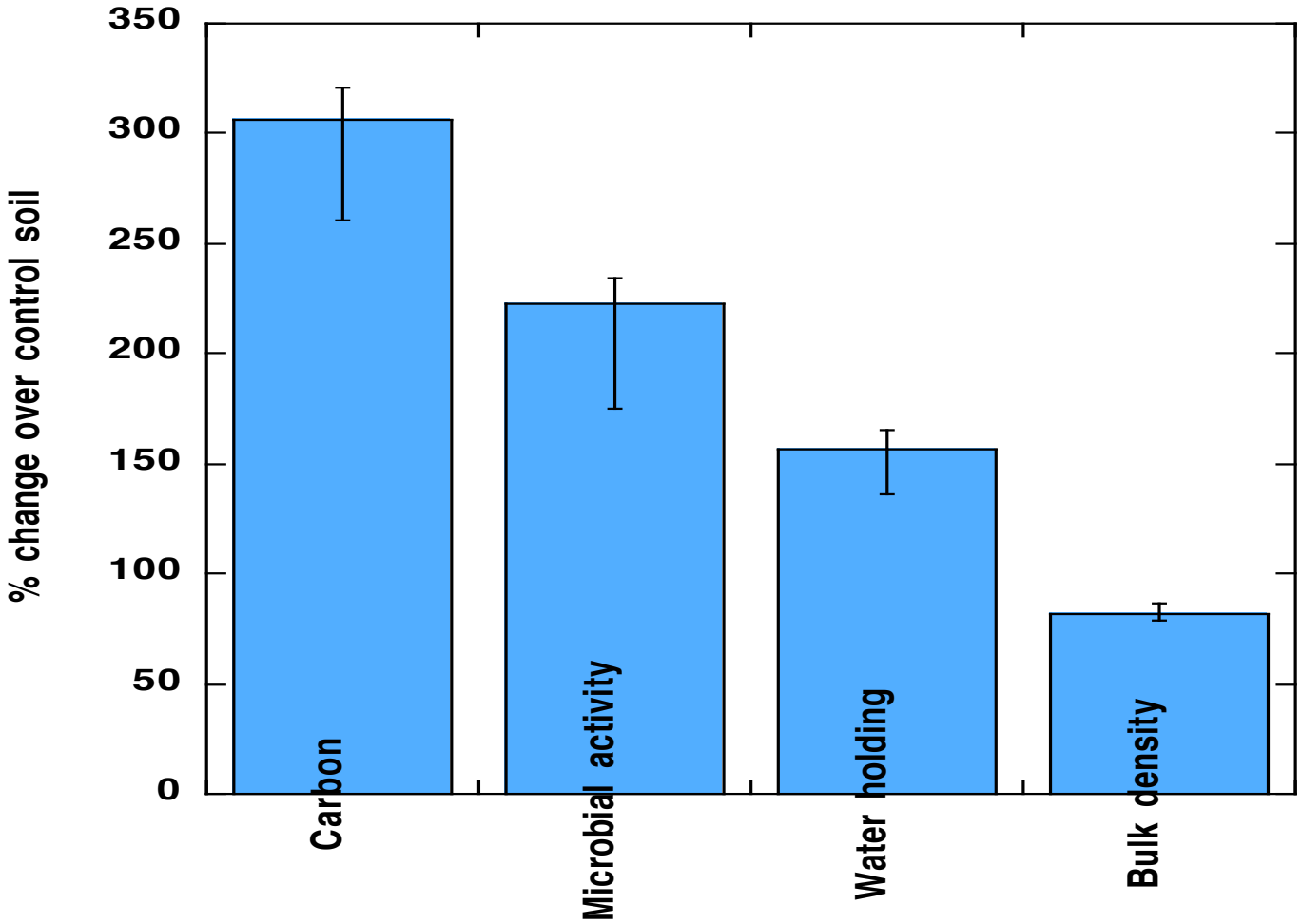
40+ Years of Research

…has shown the benefits & manageable risks



Biosolids improve soils.

Organic matter improves soil quality.



Numerous studies demonstrate the benefits derived from adding organic matter, such as biosolids, to soils: higher carbon content (carbon sequestration), increased microbial activity, increased water-holding capacity, and lower bulk density (which means easer tillage & handling).

– Dr. Sally Brown, Univ. of WA, 2011 research

Managing organic residuals:

What's ideal for sustainability?

MAXIMIZE BENEFICIAL USES OF RESOURCES

Constituent	Benefits	Concerns
Water	valuable in agriculture in dry times	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 if incinerated

MANAGE TO MINIMIZE POTENTIAL RISKS

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

Soil & crop benefits from organic residuals

from RecyclingWorks

What happens to food once it is composted?

Finished compost is tested and graded, which determines its final use. The resulting product can be used on site at the processing facility such as a farm, or it can be sold as a product that enriches soil by improving its structure and increasing its moisture and nutrient retention. When compost is used in farming, gardening and landscaping applications, it provides organic nutrients to plants without the use of chemical fertilizers and retains moisture in the soil, reducing the need for watering.

http://recyclingworksma.com/how-to/materials-guidance/food-waste-2/

But here is the challenge: P in organics

Compost nutrients (lb/cubic yard) applied preplant, Sept 2008

Compost Analysis	Biosolids compost	Yard debris compost
Ammonium-N	0.9 (high)	0.04 (low)
C:N	23	19
Phosphorus (P)	4 (high)	2 (low)
Potassium (K)	1 (low)	5 (high)

Organic Matter & P Availability

- "There was no evidence that P solubility was enhanced in soils with higher levels of organic matter; in fact, soils with higher levels of organic matter tended to have less P in solution at all levels of soil test P than soils with lower levels of organic matter. Higher SOM levels were associated with higher levels of oxalate-extractable Fe and Al and, therefore, higher P sorption capacities…."

  - Ohno et al., Univ. of Maine, 2006

nebra Recycled organics: Tools for sustainability.

Policy, regulations, & guidelines on use of organic residuals in Massachusetts

Decades of efforts to control P (and N)

- Agricultural nutrient management planning
  - Focus on N (leaching/groundwater) & P (runoff, surface water)
  - NRCS Code 590 – January 2012
- Turf & lawn fertilizer regulations are more recent
  - Focused mostly on P
  - Key provision: soil test must show need before P is applied
  - ~15 in Mid-west & Northeast, also WA
  - Some exempt residuals
  - NEIWPCC → model state regulation

NEIWPCC

MassDEP regulations for organics

- Typical regulations for managing digestates, composts, etc.
- MassDEP regulations for organics
  - Commercial Food Waste Disposal Ban – 310 CMR 19.00
  - Site Assignment Regulations - 310 CMR 16.00
    - General Permit (smaller facilities)
    - Recycling, Composting, or Conversion Permit
    - Site Assignment
  - Beneficial Use Determination (BUD)
  - Biosolids ("sludge") Regulations - 310 CMR 32.00
  - NEW: Massachusetts Dept. of Agricultural Resources Plant Nutrient Management Regulation

MDAR Plant Nutrient Management

- Chapter 262, laws of 2012: https://malegislature.gov/Laws/SessionLaws/Acts/2012
- 330 CMR 31.00 http://www.mass.gov/eea/agencies/agr/pesticides/plant-nutrient-management.html
- 2 Fact Sheets
  - Turf & Lawns
  - Agriculture
- UMass Amherst Extension Guidelines

330 CMR 31.00 – Purpose is Laudable

- "limitations on the application of plant nutrients to lawns and non-agricultural turf to prevent these non-point source pollutants from entering the surface and groundwater resources of the Commonwealth of Massachusetts."
- "These state-wide limitations on plant nutrient applications will enhance the ability of municipalities to maximize the credits provided in the National Pollution Discharge Elimination System permits issued by the United States Environmental Protection Agency.
- "330 CMR 31.00 further ensure that plant nutrients are applied to agricultural land in an effective manner to provide sufficient nutrients for plant growth while minimizing the impacts of the nutrients on water resources in order to protect human health and the environment."

USDA Code 590 – Nutrient Management

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

NUTRIENT MANAGEMENT

(Ac.)

CODE 590

DEFINITION

Managing the amount (rate), source, placement (method of application), and timing of plant nutrients and soil amendments.

PURPOSE

- To budget, supply, and conserve nutrients for plant production.
- To minimize agricultural nonpoint source pollution of surface and groundwater resources.
- To properly utilize manure or organic by-products as a plant nutrient source.
- To protect air quality by reducing odors, nitrogen emissions (ammonia, oxides of nitrogen), and the formation of atmospheric particulates.
- To maintain or improve the physical, chemical, and biological condition of soil.

Plant Food Control Officials (AAPFCO) and be accepted for use by the State fertilizer control official, or similar authority, with responsibility for verification of product guarantees, ingredients (by AAPFCO definition) and label claims.

For nutrient risk assessment policy and procedures see Title 190, General Manual (GM), Part 402, Nutrient Management, and Title 190, National Instruction (NI), Part 302, Nutrient Management Policy Implementation.

To avoid salt damage, the rate and placement of applied nitrogen and potassium in starter fertilizer must be consistent with land-grant university guidelines, or industry practice recognized by the land-grant university.

The NRCS-approved nutrient risk assessment for nitrogen must be completed on all sites unless the State NRCS, with the concurrence of State water quality control authorities, has determined specific conditions where nitrogen leaching is not a risk to water quality, including drinking water

MA Existing Guidance

Energy and Environmental Affairs

Search... in Energy & E SEARCH

Main Menu Go

EEA Home > Agencies > MassDEP > Water Resources > Wetlands & Watersheds > Manure Management for Healthy Horses

Horsekeeping & Water Quality: Manure Manag Horses

Proper manure management is an important consideration for everyone who owns h
Containing, treating, and disposing of horse manure routinely has many benefits, fro
maintaining friendly relations with our neighbors, protecting water quality, and helpin
keep our horses healthy and happy. Manure-related nuisances, such as flies, and
debilitating conditions such as thrush, scratches, parasite infestation, and abscesses
be prevented by employing some simple best management practices (BMPs) aroun
property. Integrating BMPs into your horse operation is a proactive way to protect th
environment and your horse's health.

What are the health risks from manure?

MASSACHUSETTS DEPARTMENT OF FOOD AND AGRICULTURE FACT SHEET - FARM PRODUCTS AND PLANT INDUSTRIES

Manure Management: Protecting Water Resources from Nutrient Pollution

Animal waste from barnyards, manure pits and field application can pollute ground and surface water when not contained or applied properly. By making Best Management Practices (BMPs) part of a conservation plan, a farmer can greatly reduce the chances of contamination. A manure system should prevent contamination of water in lakes, streams, springs and wells.

BMPs are managerial, such as manure management, rotational grazing, and conservation tillage, or structural, such as manure pits or lagoons, terraces and fencing.

You can prevent contamination of groundwater by observing the following practices:

MANAGERIAL

Apply manure appropriately - Determine the rate of application that will fulfill the crop's nutrient needs without causing environmental problems. This includes:

- **Timing** - Spread manure only when conditions are favorable. Avoid spreading manure in the winter

Current UMass Extension Guidelines

Soil Test Phosphorus Category					
Compost/organic amendment P_2O_5 content	Very Low/Low Optimum		Optimum		Above Optimum
% P_2O_5 (dry wt.)	P_2O_5 (lbs/acre)	Compost (tons/acre)	P_2O_5 (lbs/acre)	Compost (tons/acre)	
Low (0.1 to 0.5%) 0.25%[2]	330	120	82	30	No application
Medium (0.5 to 1.5%) 1%	330	30	55	5	No application
High (1.5% to 3.0%) 2%	330	15	No application		No application

From UMass Extension, 2016: Compost Analysis & Interpretation: https://ag.umass.edu/sites/ag.umass.edu/files/fact-sheets/pdf/compost_analysis_and_interpretation_with_test.pdf

nebra Recycled organics: Tools for sustainability.

Treatment & management of organic residuals in Massachusetts

Fertilizers

- P indicated as P_2O_5 = 2.29 * Total P
- 00-44-00 to 00-52-00 Triple superphosphate
- 18-46-00 to 21-54-00 Diammonium phosphate
- 00-3-00 to 00-8-00 Raw Phosphate Rock
- 04-12-00 Bone meal

Options for certified Organic

- 05-05-06 Fish blood and bone
- 11-08-02 to 16-12-03 bird guano
- 03-02-02 poultry manure

Animal manures

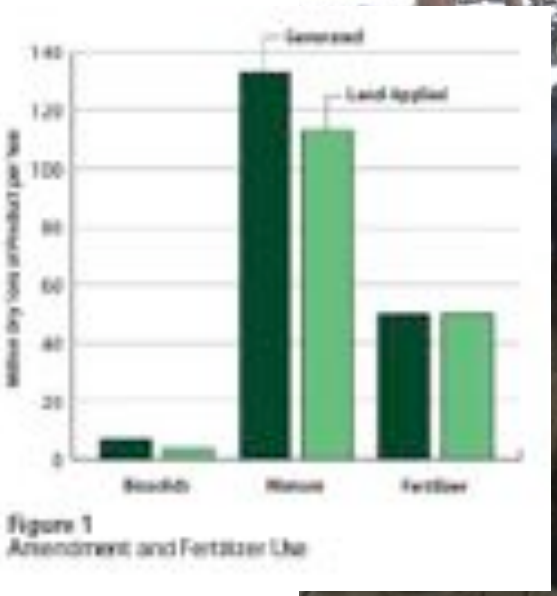


Figure 1
Amendment and Fertilizer Use

Biosolids

- Bay State Fertilizer
  - Farm sites, farmland restoration, and land reclamation – new turf establishment
  - 4 – 3 – 0 fertilizer analysis
- Biosolids Compost – .1.7 P_2O_5 (Hawk Ridge, Unity, ME)
- Lime-stabilized: 4.5% P_2O_5

Biosolids pellet fertilizer

- Bay State Fertilizer (from MWRA, Deer Island)
- Greater Lawrence Sanitary District

Making & using biosolids compost

The Great Lawn, Central Park NYC

Streambank stabilization, PA

Spectacle Island, Boston, MA

Residuals Composting

Central Valley, California

Fabric-covered composting, Moncton, NB

Static pile composting, Southboro, MA

Co-composting w/ MSW, Marlboro, MA

composting biosolids & yard debris

Active Composting Sites

05/2012

From MassDEP website

Report Summary

Total Tons Reported 2010: 369,541

Active Compost Sites by MassDEP Region and Site Type

Site Type	*MassDEP Region* Central	Northeast	Southeast	Western	*Totals*
Municipal	36	42	57	33	168
Private	0	0	0	0	0
Commercial	8	10	15	3	36
State	0	0	1	1	2
Federal	0	2	0	1	3
Agricultural	1	5	2	4	12
Totals	45	59	75	42	221

Many of these composts are likely > 0.67% P_2O_5 and are subject to the MDAR rules.

Please direct questions or comments about this data to John Fischer, (617) 292-5632, MassDEP, Bureau of Waste Prevention, Division of Planning and Evaluation.

Reclamation of Disturbed Sites

Spectacle Island in Boston Harbor was reclaimed with biosolids compost and other recycled organics, 2004.

- Bulk material market
- Used to restore healthy soil ecosystem and either native vegetation or cropland
- Prices: vary, often $0
  - Uses a lot of biosolids
- Trend: increasing use, because of huge benefits – biosolids use is best practice for this kind of reclamation

Land application for reclamation…

Use of Class A biosolids pellets & paper mill residuals to establish a new hay field on an old gravel pit site.

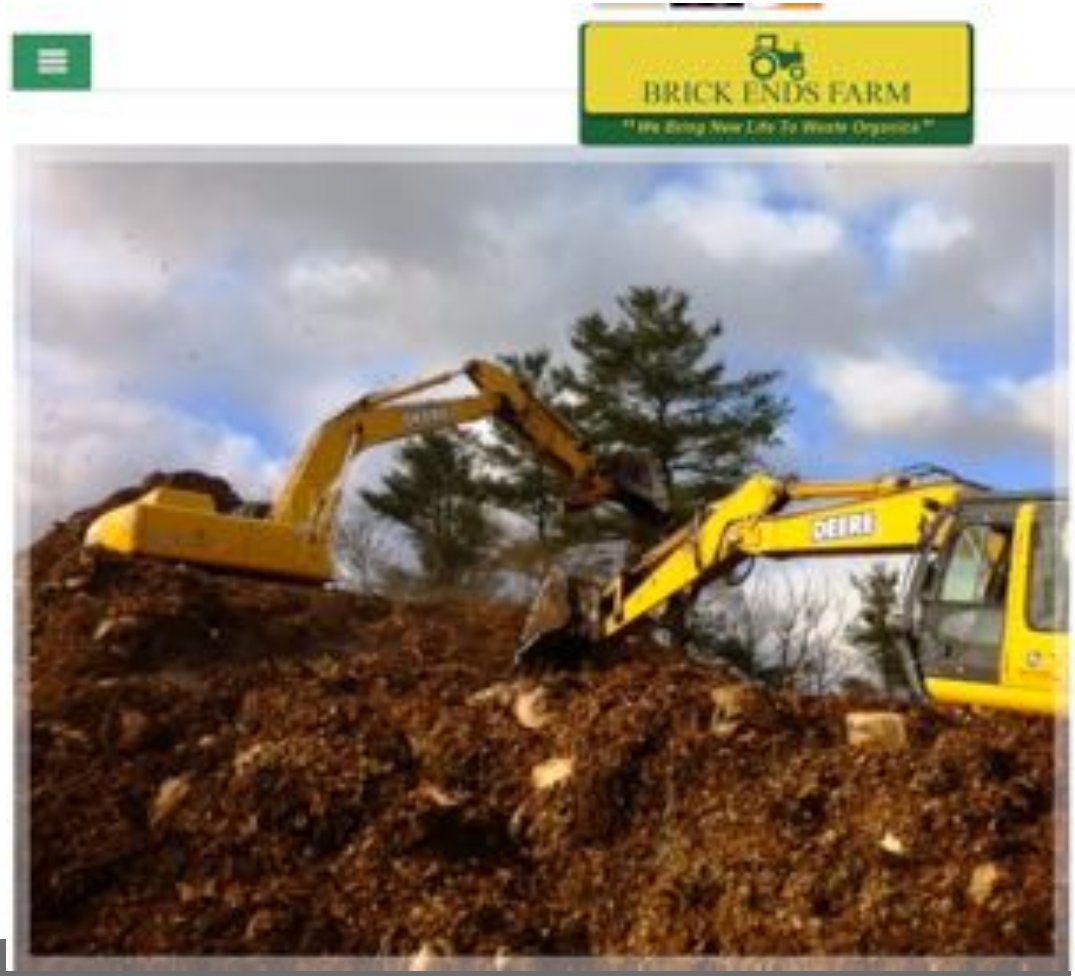
Reclaiming land with organic residuals

Creating a new field with organic residuals

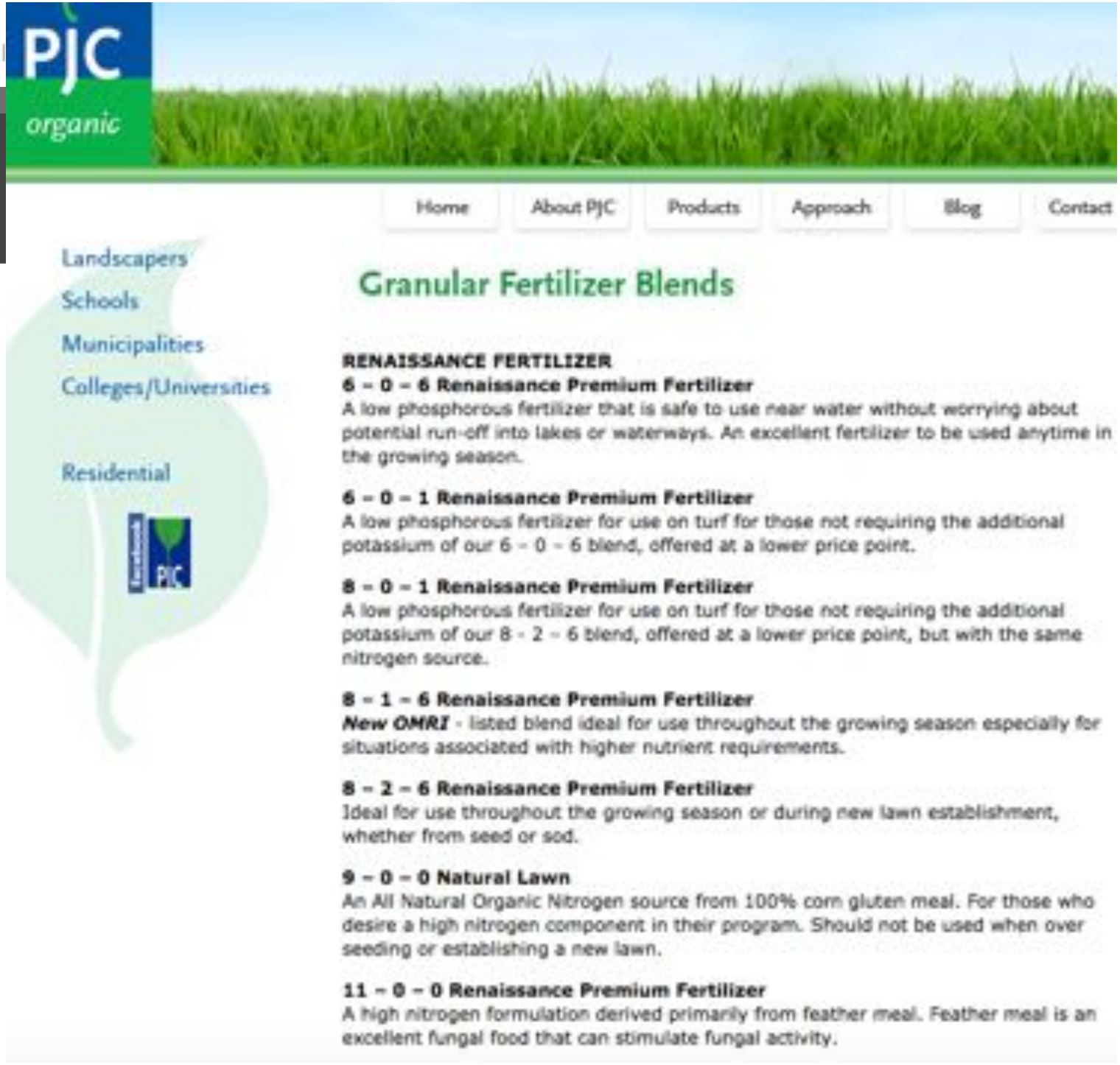
Class A alkaline stabilized biosolids

Other composts

- Leaf & yard waste
  - 0.4% P_2O_5



nebra Recycl



Some of these have P and are subject to the MDAR rules.

Fertilizers & Amendments

Home / All products / Fertilizers & Amendments

Showing all 6 results

Default sorting

Stonington Plant Food 5-2-4

Lobster Meal 6-2-0

Kelp Meal 1.4-0.8-1.0

Fish Bone Meal 5-13-0

Alfalfa Meal 2.2-0.4-2.3

Wiscasset Blend Earthworm Castings

Some of these have P and are subject to the MDAR rules.

- Anaerobic digestion (AD) at distribution center
- Serves 212 stores
- 95 tons / day inedible food (not donate-able)
- 1.25 MW electricity = 40% of distribution center needs

What goes in & what comes out…

IN: SSO, etc.

OUT: Biogas (rich in methane)

OUT: Digestate

Digestate can be treated further by composting…

Anaerobic digester

nebio

Farm digesters

- Longview Farm
- Jordan Farm

Jordan Farm, Rutland, MA
manure, food scraps
Digestate is land applied on farm – *and is subject to MDAR rules.*

Digesters

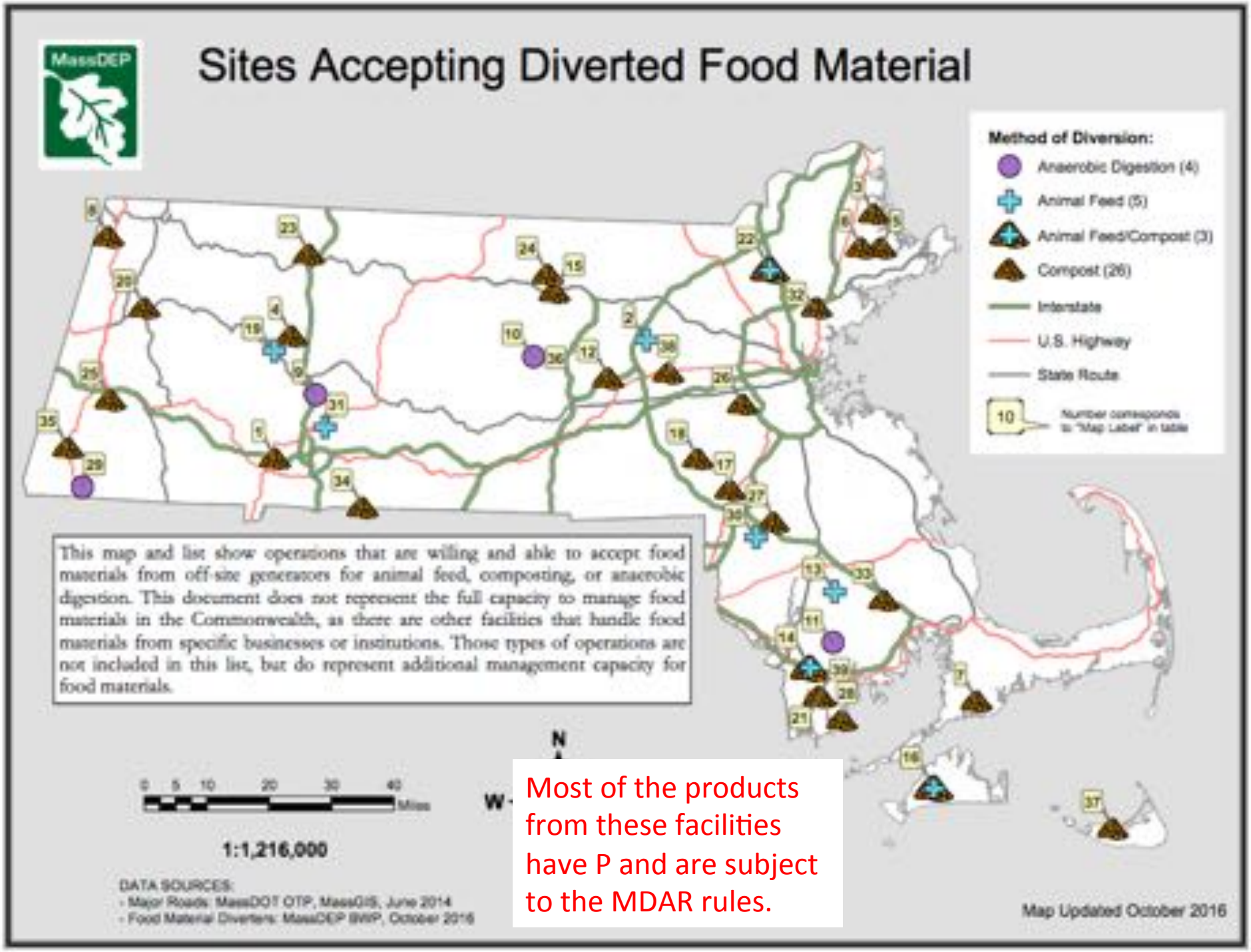
CRMC, New Bedford, MA:
food scraps, FOG, etc.

These digestates have P and are subject to the MDAR rules.

Longview Farm, Hadley, MA:
manure, food scraps

Other residuals…

- Wood ash - 1.6 P_2O_5 (a Maine ash)
- Biosolids SSI ash (used as P fertilizer)
- Short paper fiber (< 0.67% P threshold)
  - Erving .07% P_2O_5
  - SCA (Glens Falls, NY) .07% P_2O_5
- Food processing residuals directly land applied, such as dairy whey (likely > 0.67% P threshold of MDAR rules)
- Film gelatin land applied


MassDEP
Sites Accepting Diverted Food Material
Method of Diversion:
Anaerobic Digestion (4)
Animal Feed (5)
Animal Feed/Compost (3)
Compost (26)
Interstate
U.S. Highway
State Route
10
Number corresponds to "Map Label" in table
This map and list show operations that are willing and able to accept food materials from off-site generators for animal feed, composting, or anaerobic digestion. This document does not represent the full capacity to manage food materials in the Commonwealth, as there are other facilities that handle food materials from specific businesses or institutions. Those types of operations are not included in this list, but do represent additional management capacity for food materials.
N
W
0 5 10 20 30 40
Miles
1:1,216,000
DATA SOURCES:
- Major Roads: MassDOT OTP, MassGIS, June 2014
- Food Material Diverters: MassDEP BWP, October 2016
Most of the products from these facilities have P and are subject to the MDAR rules.
Map Updated October 2016

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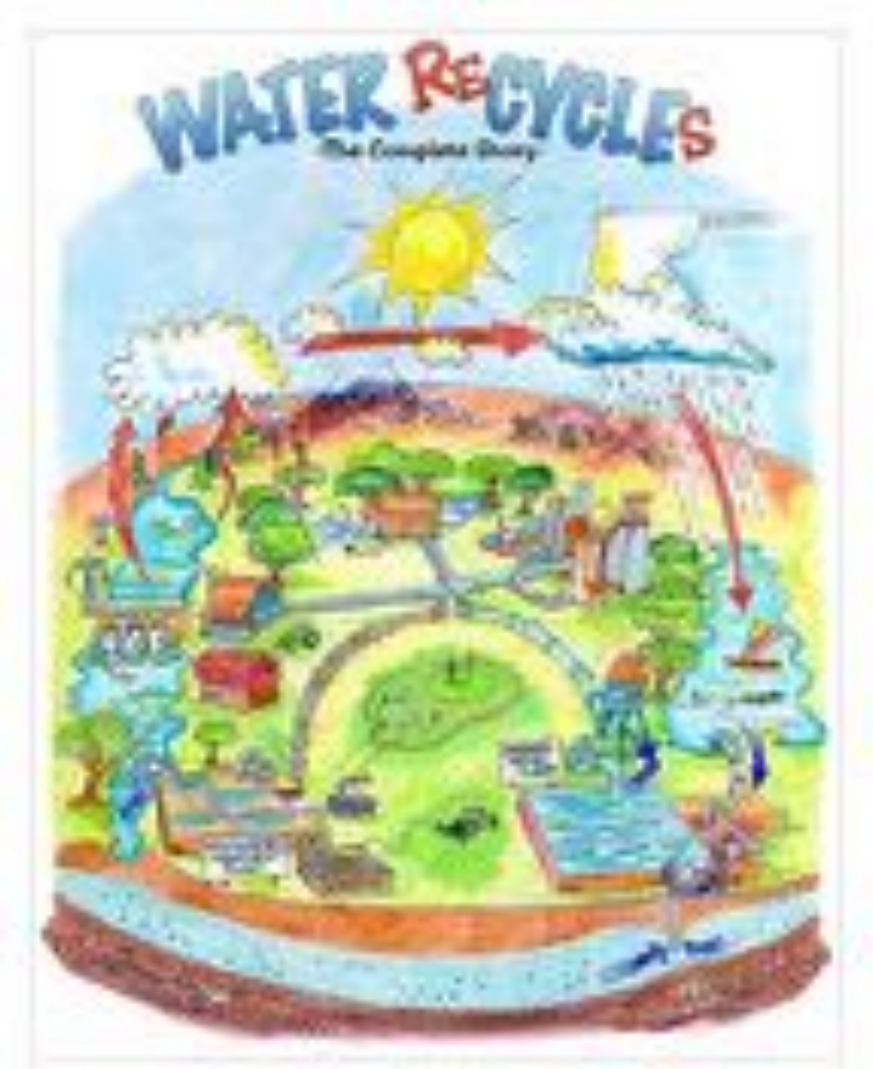

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