

This project has been financed with Federal Funds from the Environmental Protection Agency (EPA) to the Massachusetts Department of Environmental Protection (the Department) under an s. 319 competitive grant. The contents do not necessarily reflect the views and policies of EPA or of the Department, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.

4TH ANNUAL CAPE COASTAL CONFERENCE

From Disposal to Treatment: Can Small Changes in Leachfields Reduce Nitrogen to Our Marine Embayments?

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The art and science of septic systems

Where we were.....





A brief primer on the design and construction of septic system on **Cape Cod**





Typically there are three main soil layers that we are concerned with in placement of septic system soil absorption systems on Cape Cod and the Islands.

A Horizon B Horizon	Topsoil with organics and mineral material Typically a loamy sand or sandy loam	S	he layers very typically tripped away and not used for oil treatment
C1 Horizon C2 Horizon	Typically a sand or loamy sand Typically a sand	Tł re	nis layer often stripped away and placed with "Title 5" sand
		T b v c p	This layer, typically devoid of biological activity compared with shallower soil layers, is often used for leachfield blacement.

Commonly, an excavation is made such that the soil absorption system is placed in the C Soil Horizon







This strategy limits the natural systems from helping with wastewater treatment

Nitrogen – a case in point....



When a soil absorption system is placed in the C Horizon and that horizon is predominantly sand, there is **limited** denitrification due to a carbon limitation and lack of anoxic conditions



Provide a source of carbon

Provide a source of carbon Facilitate anoxic conditions

Provide a source of carbon Facilitate anoxic conditions AFTER the nitrification step

Provide a source of carbon Facilitate anoxic conditions

We could reduce the nitrate to nitrogen gas (a process also called denitrification)

Nitrogen gas

Ν

CARBON!

A source right under our nose

Wood in various forms represents a slow release form of carbon for use by the bacteria involved in *denitrification*



This is not new !



Permeable Reactive Barriers (PRB)



Denitrification Activity, Wood Loss, and N2O Emissions over 9 Years from a Wood Chip Bioreactor

Long-Term Performance of In Situ Reactive **Barriers for Nitrate Remediation**

by W.D. Robertson^{a,} D.W. Blowes^{a,}, C.J. Ptacek^{a,}, and J.A. Cherry^a

Comparing Carbon Substrates for Denitrification of Subsurface Drainage Water

Article in Journal of Environmental Quality · May 2006

Woodchip barriers widely used in agricultural settings

Journal of Environmental Quality

SPECIAL SECTION

MOVING DENITRIFYING BIOREACTORS BEYOND PROOF OF CONCEPT

Temperature and Substrate Control Woodchip Bioreactor Performance in Reducing Tile Nitrate Loads in East-Central Illinois

Mark B. David,* Lowell E. Gentry, Richard A. Cooke, and Stephanie M. Herbstritt

A Brief Data Summary of Experiments Performed at Massachusetts Alternative Septic System Test Center



Small-scale unsaturated flow "layer cake"





Small scale unsaturated flow system hydraulically loaded at code-prescribed rate





Layer Cake Total Nitrogen (TN) Data



LC TN



Large scale "permeable reactive barrier" system (Silt-sawdust layer)







Large scale "permeable reactive barrier" system (Silt-sawdust layer)





Hill Denite Total Nitrogen



Three simple things Think shallow Spread out • Amend



Horizons

O (Organic) A (Surface)

B (Subsoil)

C (Substratum)

R (Bedrock

Think Shallow

Improves contaminants of emerging concern removal Improves nitrogen, phosphorus and pathogen removal.







Shallow soils-based systems integrate wastewater disposal and treatment by using natural processes in the most biologically active and diverse soil ecosystem.

Spread it out

The greater and more uniform the dispersal of septic tank effluent to the soil particles, the better the treatment.

Amend





Research suggests that amending portions of the leachfield may facilitate reduction of nitrogen

(amendments for other contaminants may be possible)

So, why don't we do these things ?

- Systems would have to take up more areal area in order to accommodate lower hydraulic loading rates;
- Systems would require regular annual maintenance;
- Designs would be more difficult (and hence expensive);
- Inertia;
- Science in some areas would have to be refined;
- Etc...etc.

