



CAPE COD
COMMISSION

Alternative Strategies for Improving Water Quality

Section 208 Plan Update, September 26, 2013

Precedent Studies & Alternatives



offshoots
PRODUCTIVE LANDSCAPES

STRATEGIES: Site Scale | Neighborhood | Watershed | Cape-Wide

WASTE WATER 80%

WATER BODYS 8%

IMPERVIOUS 6%

FERTILIZER 5%

NATURAL 1%

- Septic System Title 5
- Innovative Septic Title 5
- Toilets: Urine Diversion
- Toilets: Composting
- Toilets: Packaging
- Low Flow Fixtures
- Grey Water Reuse
- Eco-Machines
- Wetlands: Vertical S
- Phyto-buffer: S
- Permeable React Bar.

DISCHARGE

SECONDARY, TERTIARY & DISCHARGE

- Sewers
- Satelite Treatment
- Cluster Treatment

- Eco-Machines
- Wetlands: Surface Flow
- Wetlands: Vertical LG
- Phyto-irrigation

- Sewers
- Centralized Treatment
- Culvert Widening
- Dredging

- Phyto-buffer: LG
- Permeable React Bar
- Shellfish Aquaculture
- Seaweed Farming
- Eco-Restorer/
Floating Wetland
- Nutrient Harvesting Gabion

- Septic: Regulation
- Toilets: Regulation
- H2O Reuse: Regulation
- Low-Flow Fixtures: Regs
- Growth Management
- Alt. Discharge Options

- Biofiltration Strips
- Green Roofs

- Wetlands: Surface Flow
- Wetlands: Vertical LG

- Landscape Guidelines
- Fertilizer Policies
- Mun. Maintenance Regs

Traditional Approaches

STRATEGIES:

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Neighborhood

Watershed

Cape-Wide

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Innovative Septic Title 5

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Biofiltration Strips

Green Roofs

SECONDARY, TERTIARY & DISCHARGE

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Mun. Maintenance Regs

Site

Neighborhood

Watershed

Cape-Wide

NITROGEN POLLUTION

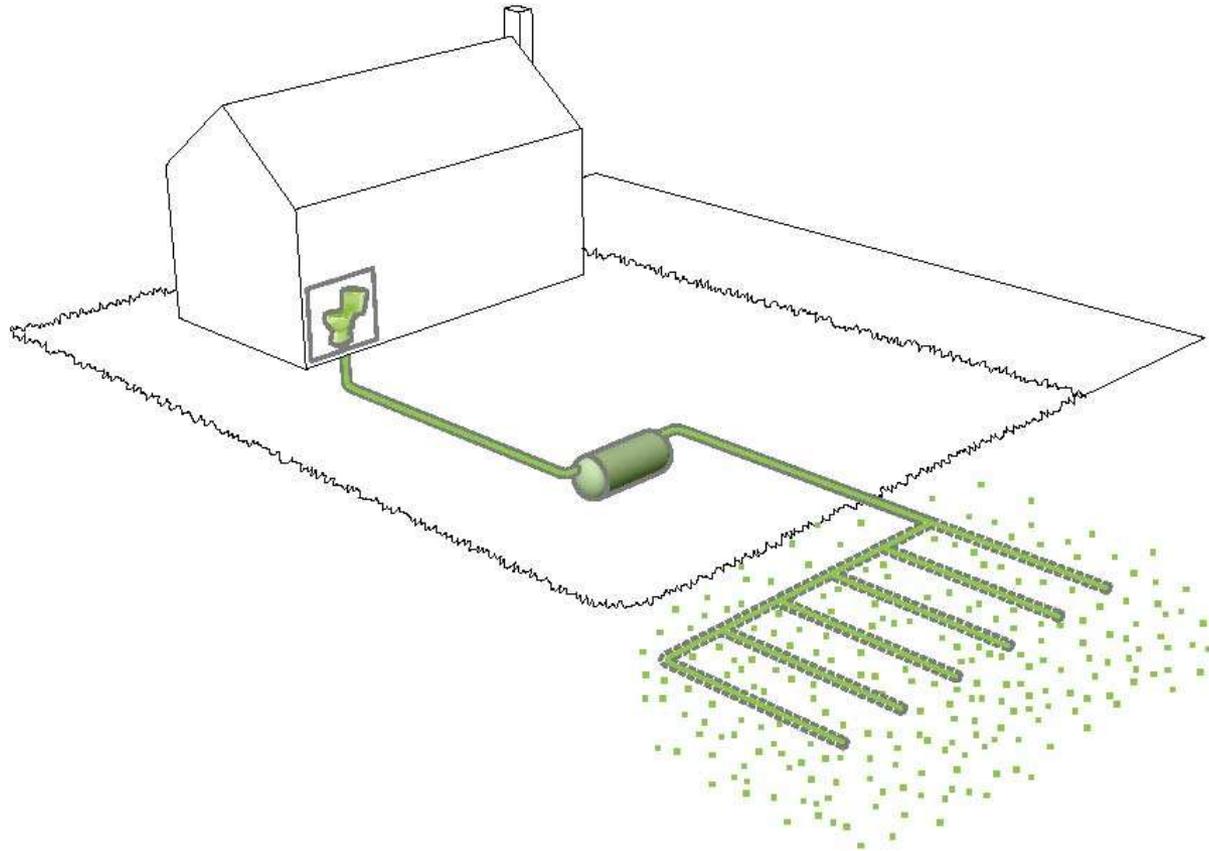
WASTE
WATER

WATER
BODYS

IMPERVIOUS

FERTILIZER

NATURAL



Septic Systems

Site

Neighborhood

Watershed

Cape-Wide

NITROGEN POLLUTION

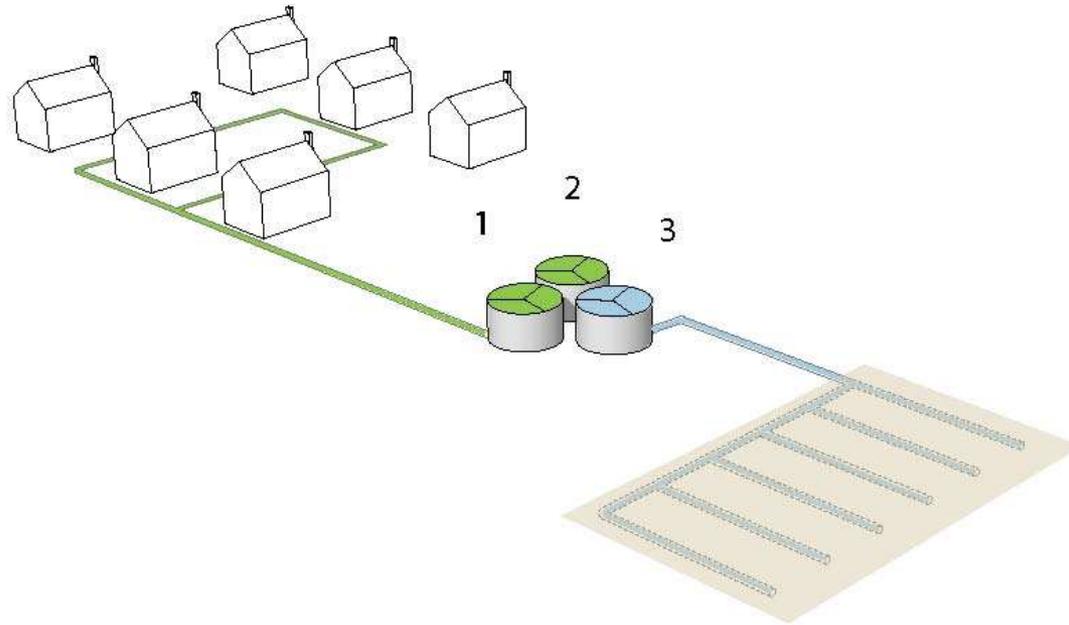
WASTE
WATER

WATER
BODYS

IMPERVI-
OUS

FERTILIZER

NATURAL



Cluster (3-30 Homes) & Satellite (30-1000) with offsite disposal

Site

Neighborhood

Watershed

Cape-Wide

NITROGEN POLLUTION

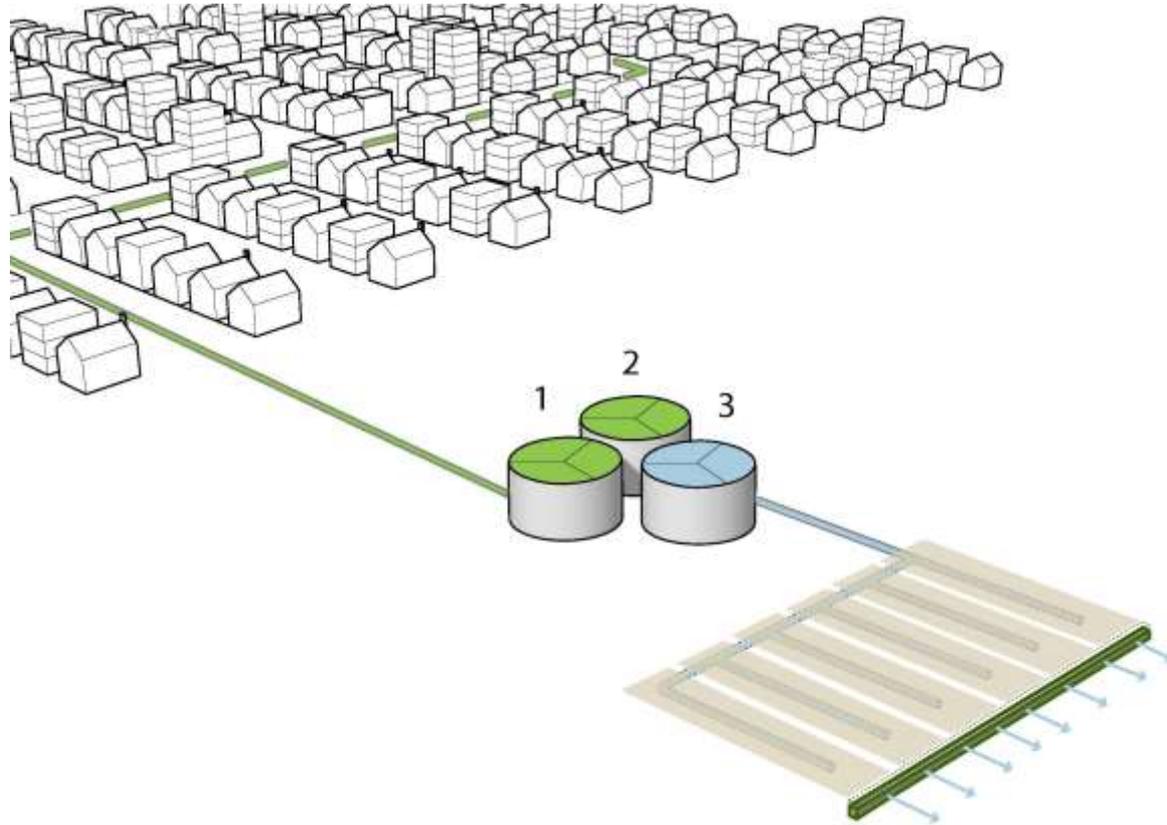
WASTE
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Centralized Treatment

Alternative Approaches

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Biofiltration Strips

Green Roofs

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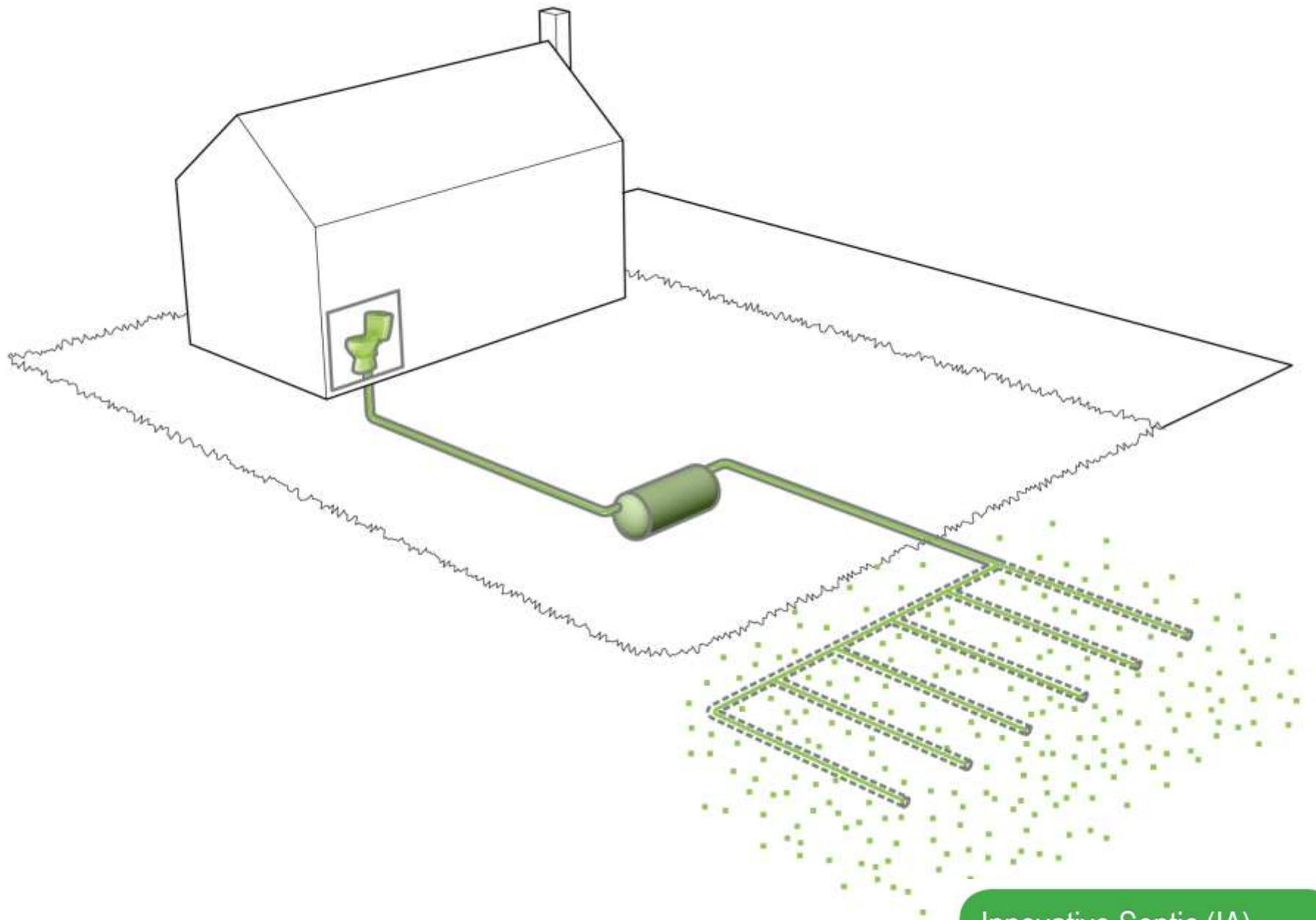
Growth Management

Alt. Discharge Options

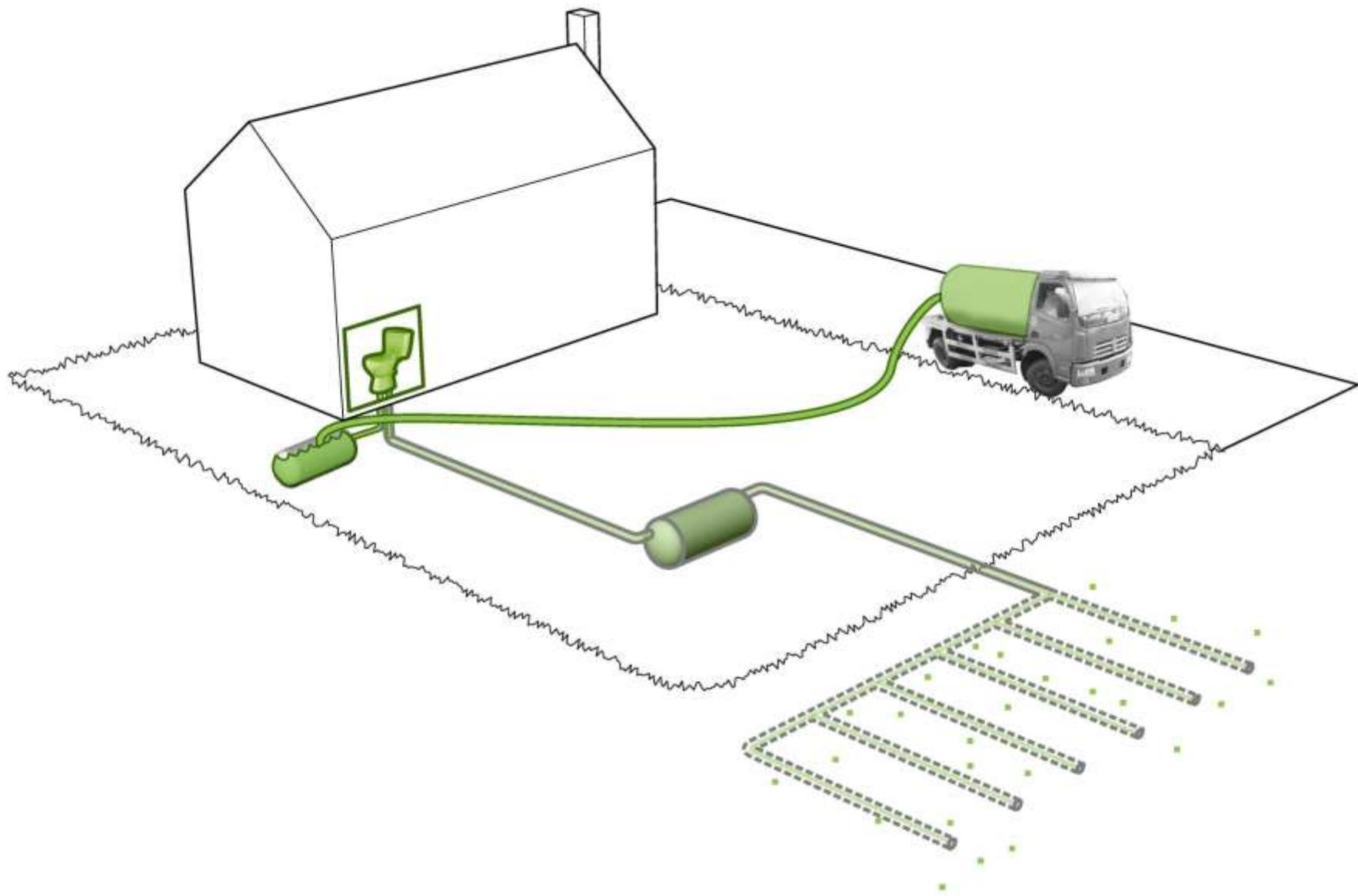
Landscape Guidelines

Fertilizer Policies

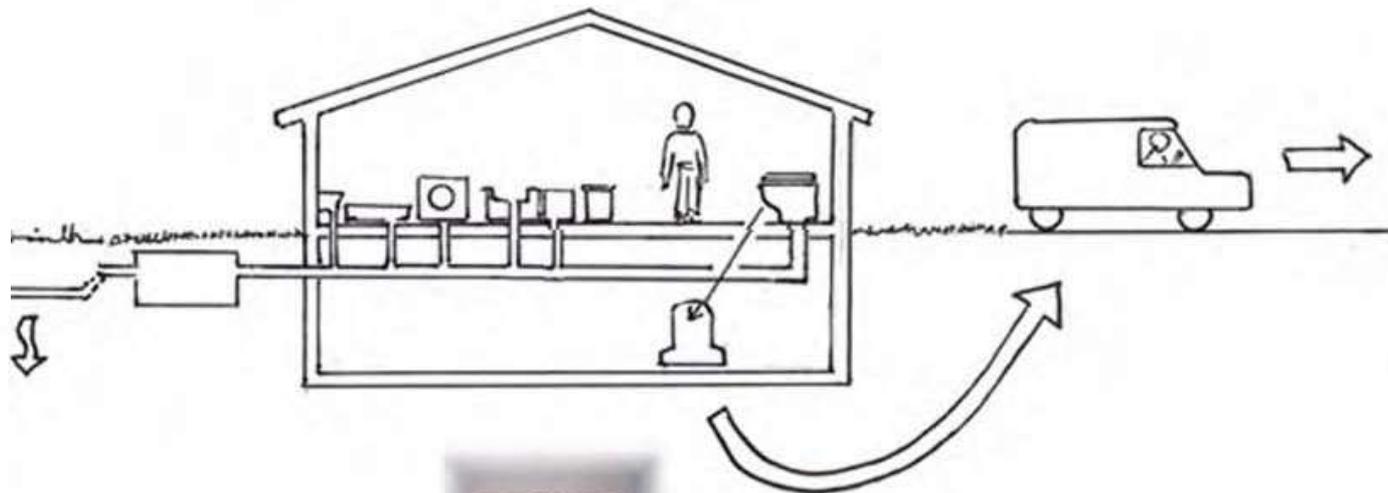
Mun. Maintenance Regs



Innovative Septic (IA)



Toilets: Urine Diversion



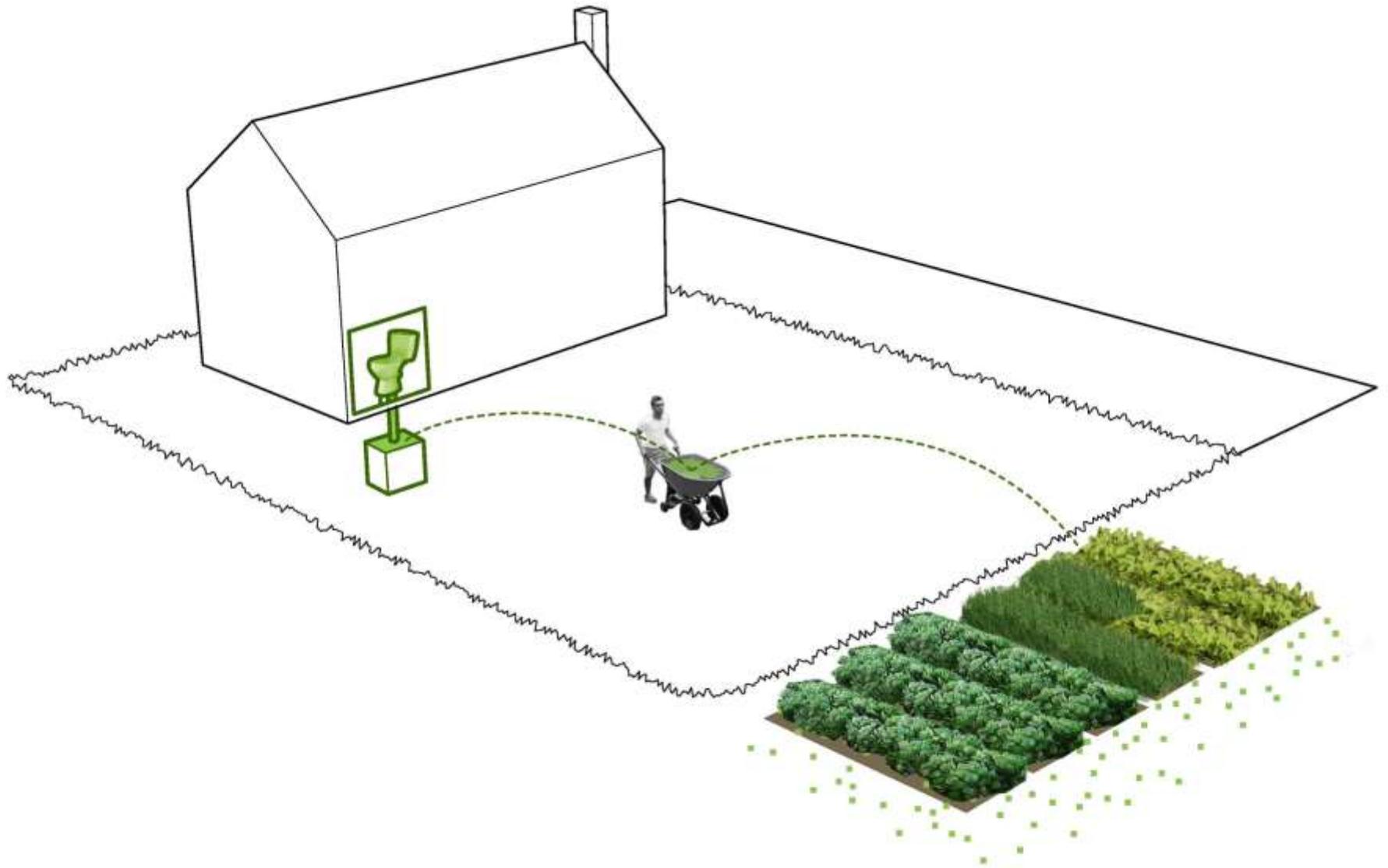
**Waterless
Urinal**

**IBC container
(220 gallons)**

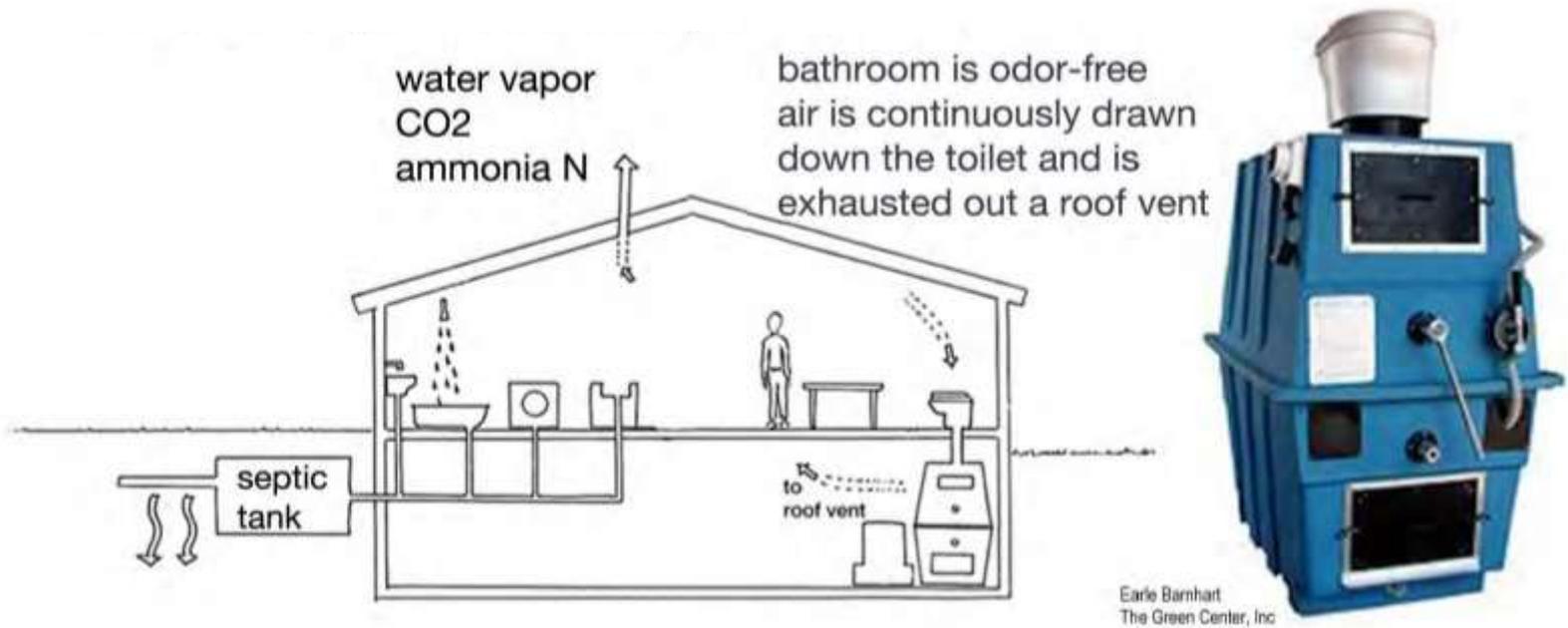


40" x 40" x 48"

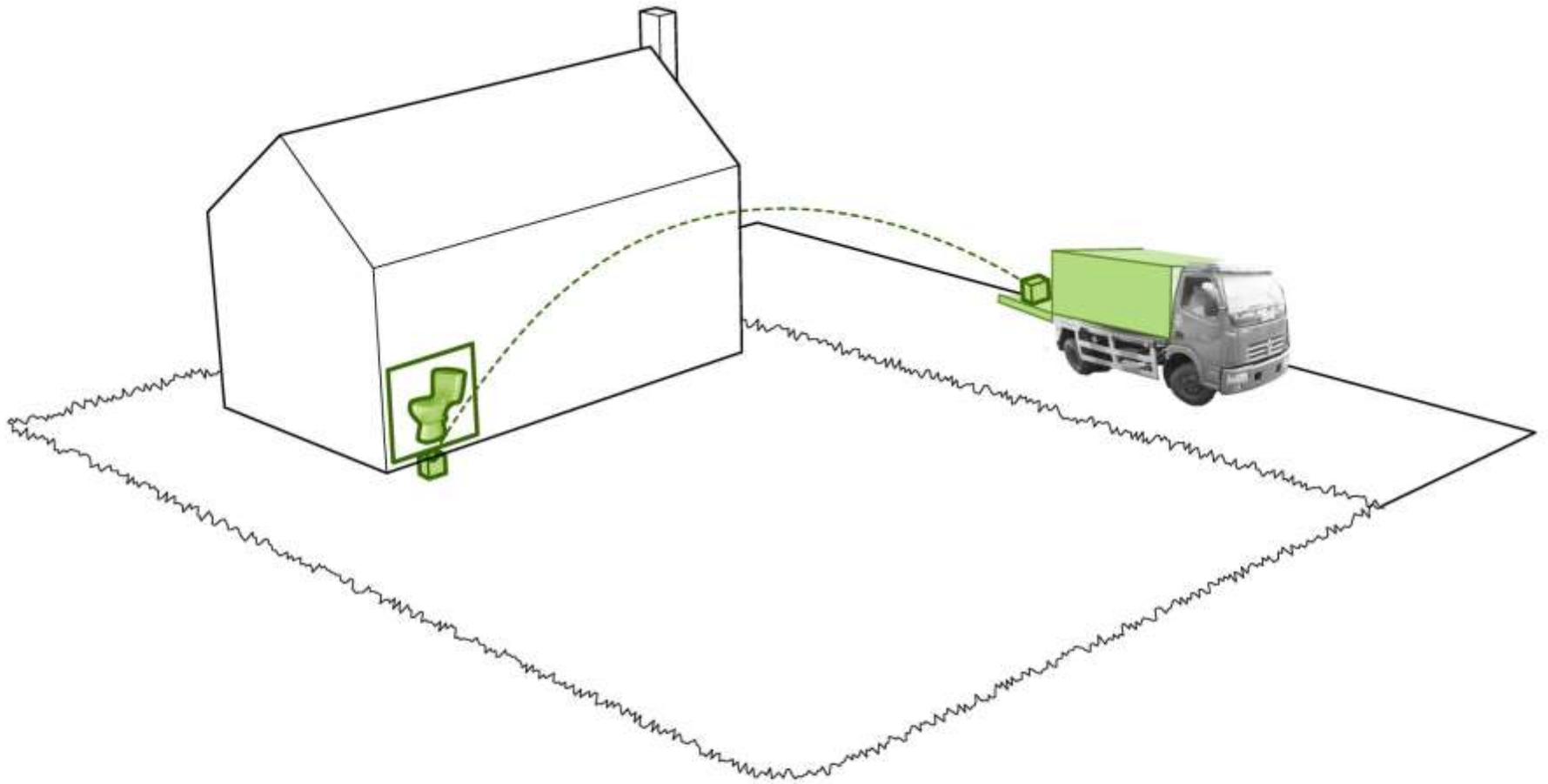
Toilets: Urine Diversion



Toilets: Composting

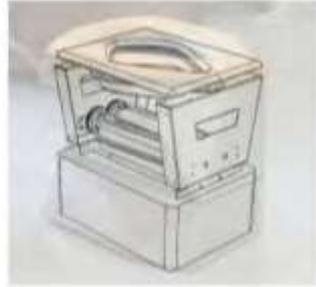


Toilets: Composting



Toilets: Packaging

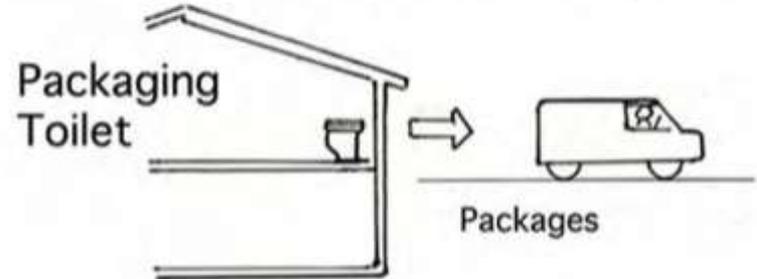
PACTO®



LOOWATT

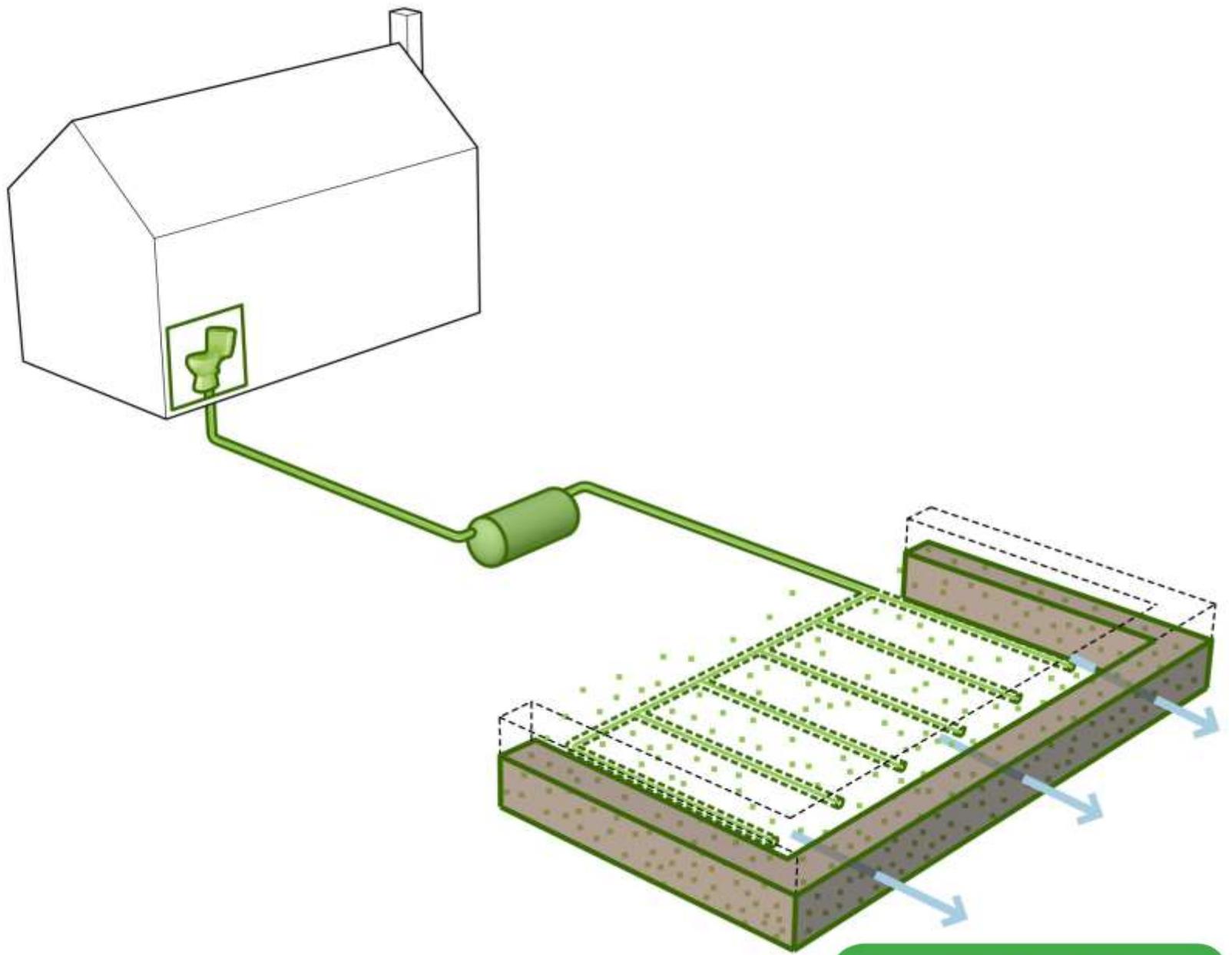
A packaging toilet directs human wastes into a biodegradable package, that is sealed after each use and stored at the base of the toilet.

- No water
- No plumbing
- No electricity
- Movable
- Installs immediately, anywhere
- Water use in house is reduced 30-40%



Earle Barnhart
The Green Center, Inc

Toilets: Packaging



Permeable React Bar.

Alternative Approaches

STRATEGIES:

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Cape-Wide

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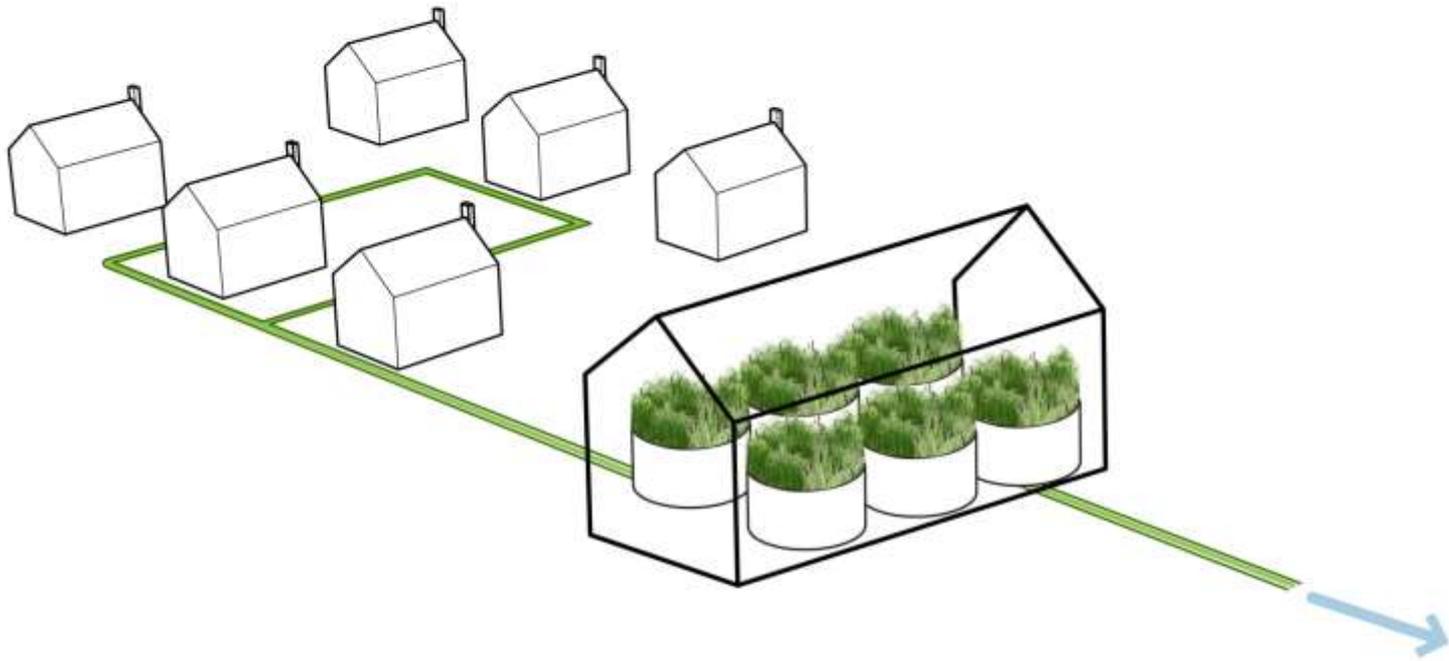
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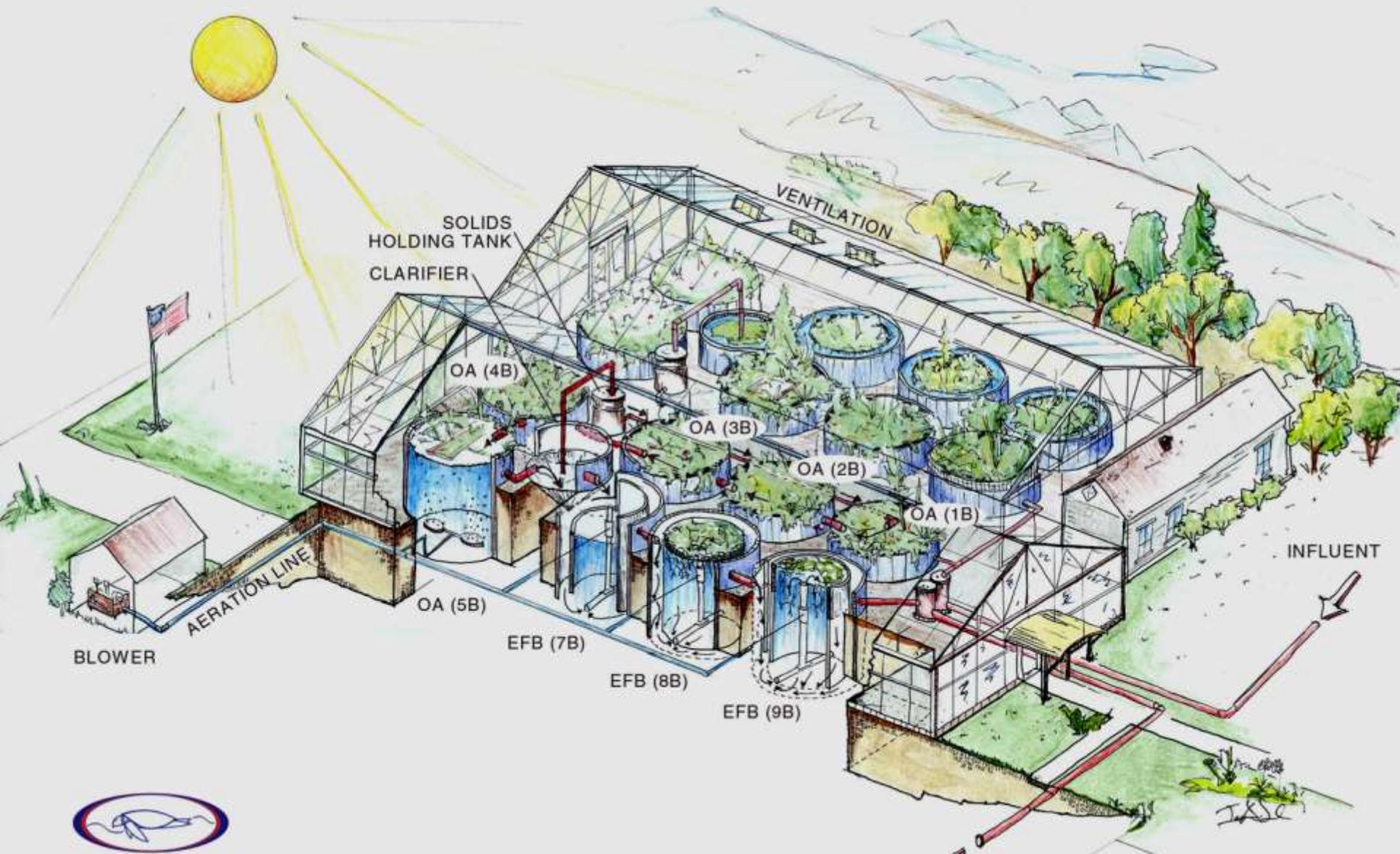
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John Todd Ecological Design, 2000

80,000 gpd wastewater treatment

PRECEDENT: South Burlington, VT WWTF



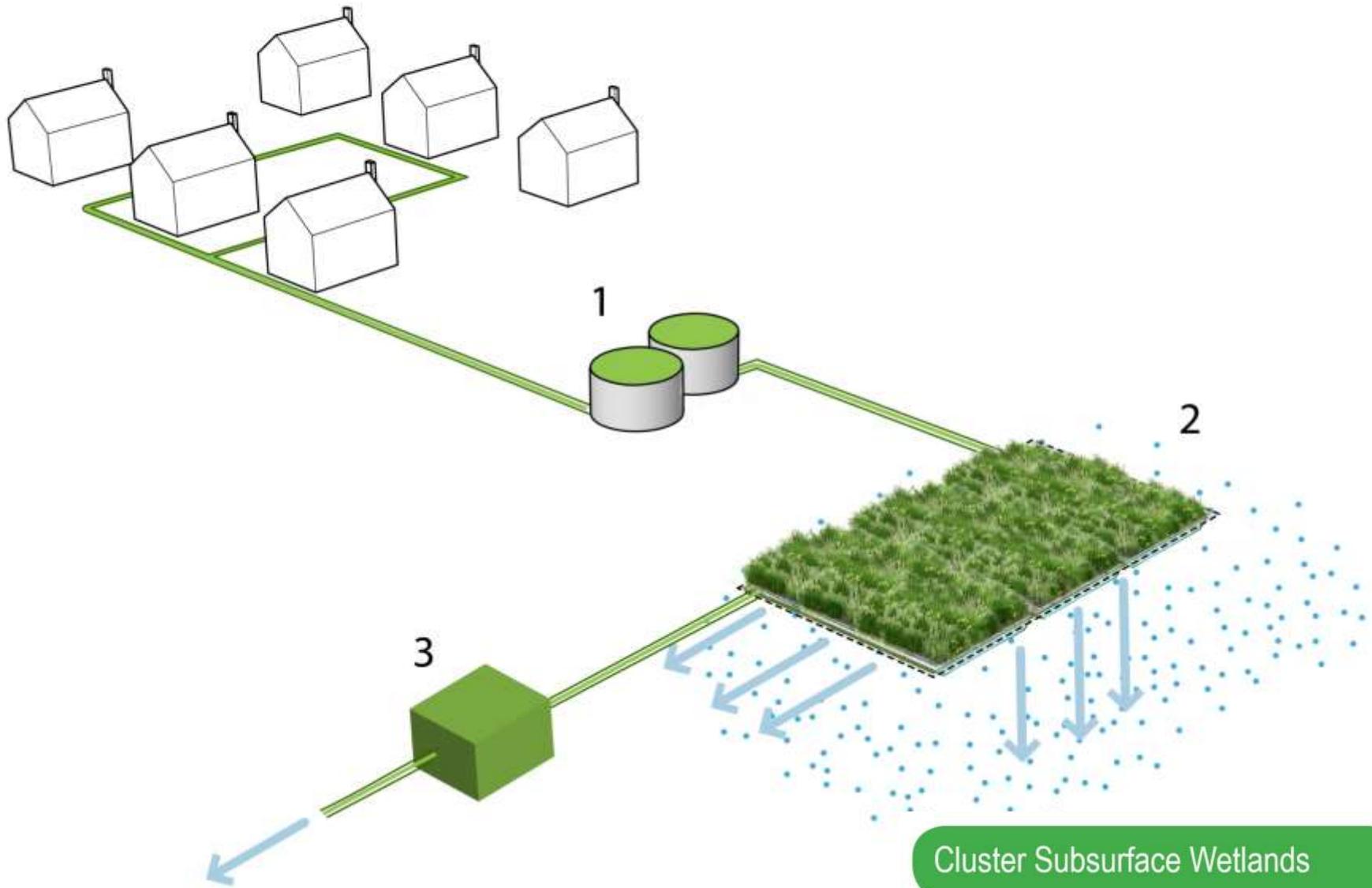
South Burlington:

-System was designed to deal with organic nitrogen loading from municipal sewage.

-Denitrification was later targeted through the uses of pulsed aerobic/non aerobic reactors and the addition of carbon.

-Consistent achievement of an 86.4 % denitrification rate over a continuous 960 day data collection period.





Cluster Subsurface Wetlands

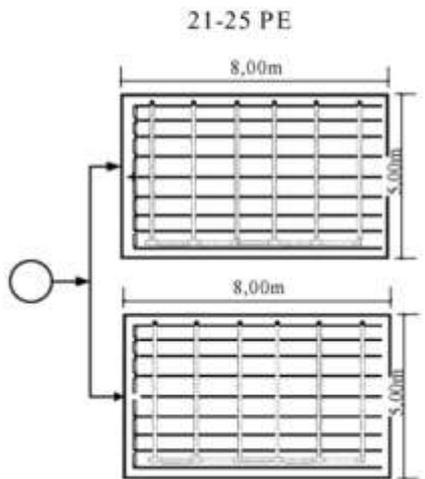
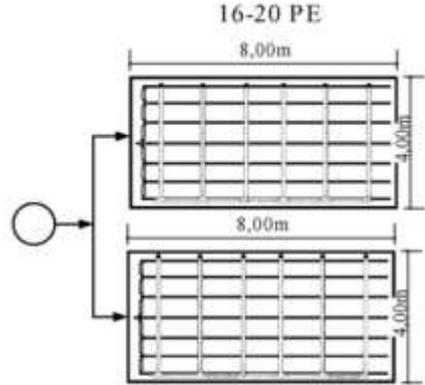
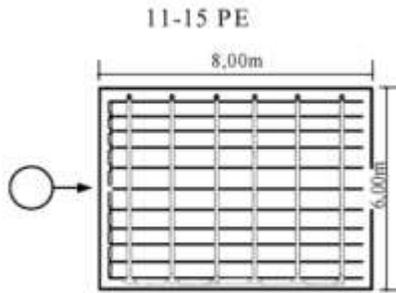
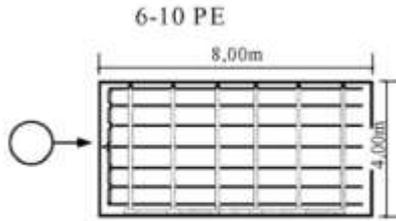
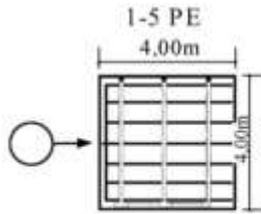
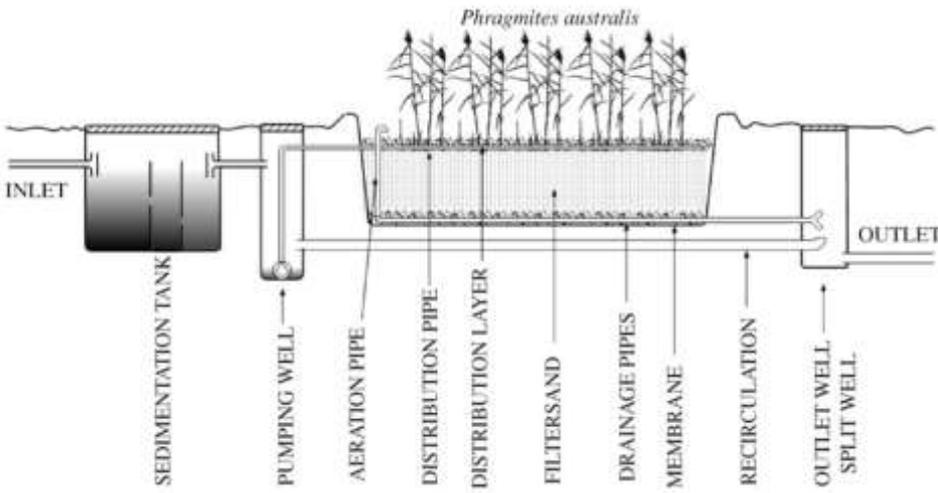
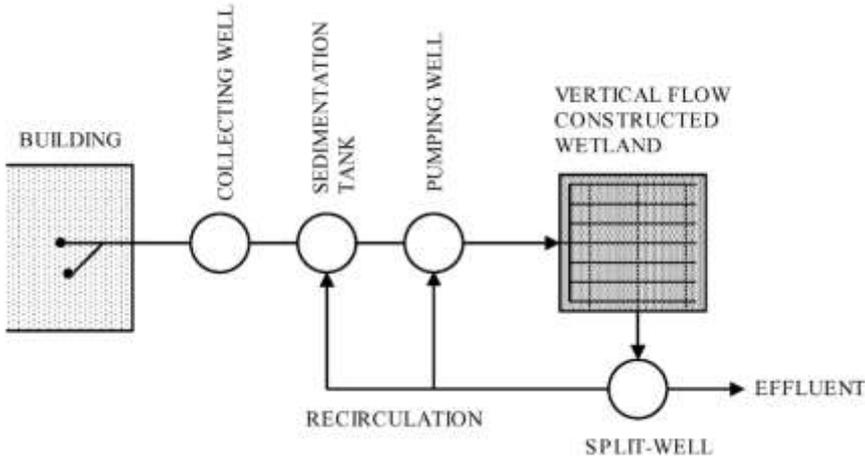


Site Area Needed: 22 Square Feet per person
Provides both secondary and tertiary treatment:
BOD, TSS, Pathogenic Bacteria and Nitrogen, even in winter

Cluster Subsurface Wetlands

Jan Vyzamal

PRECEDENT: Kamen, Czech Republic



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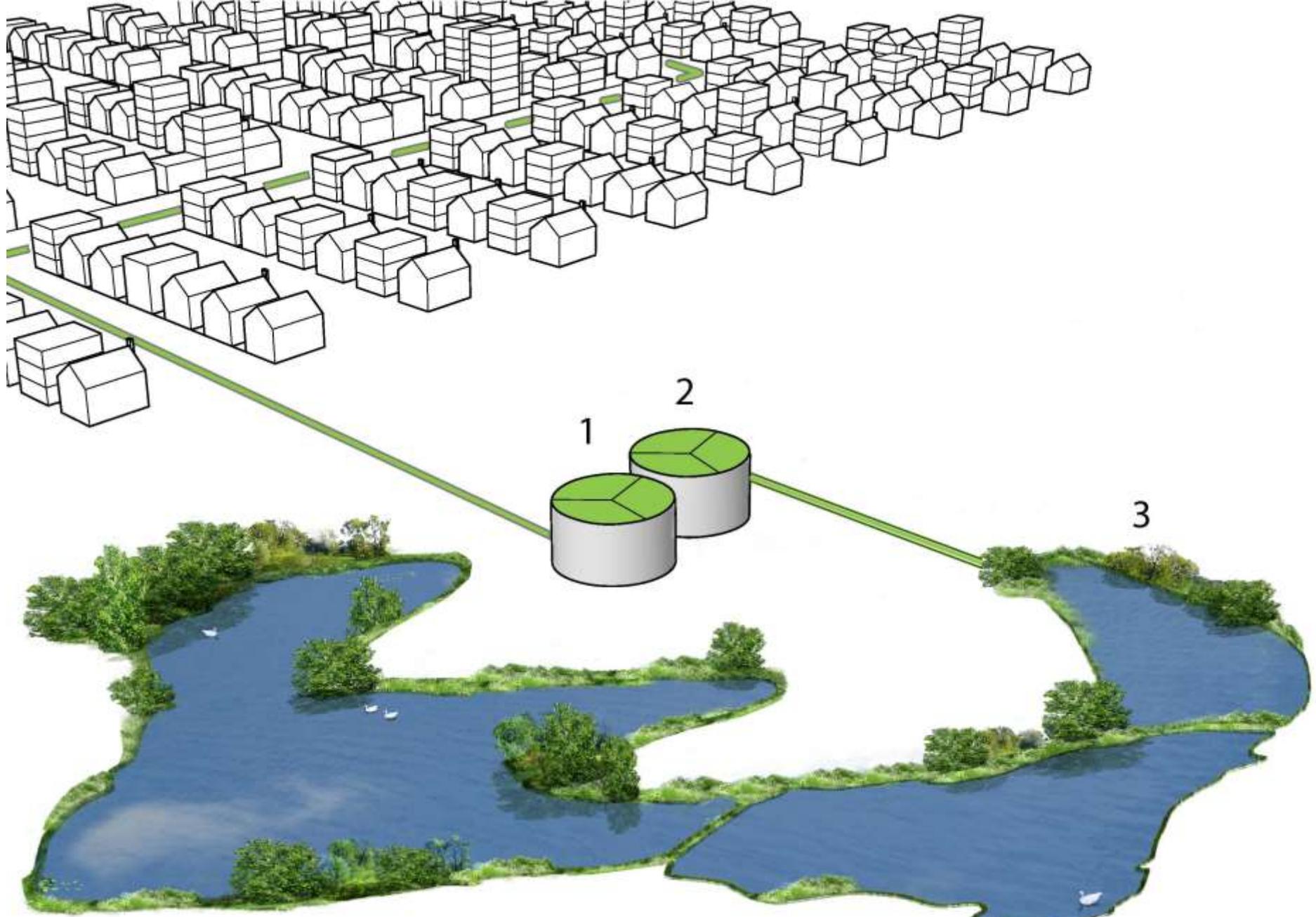
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Wetlands: Surface Flow



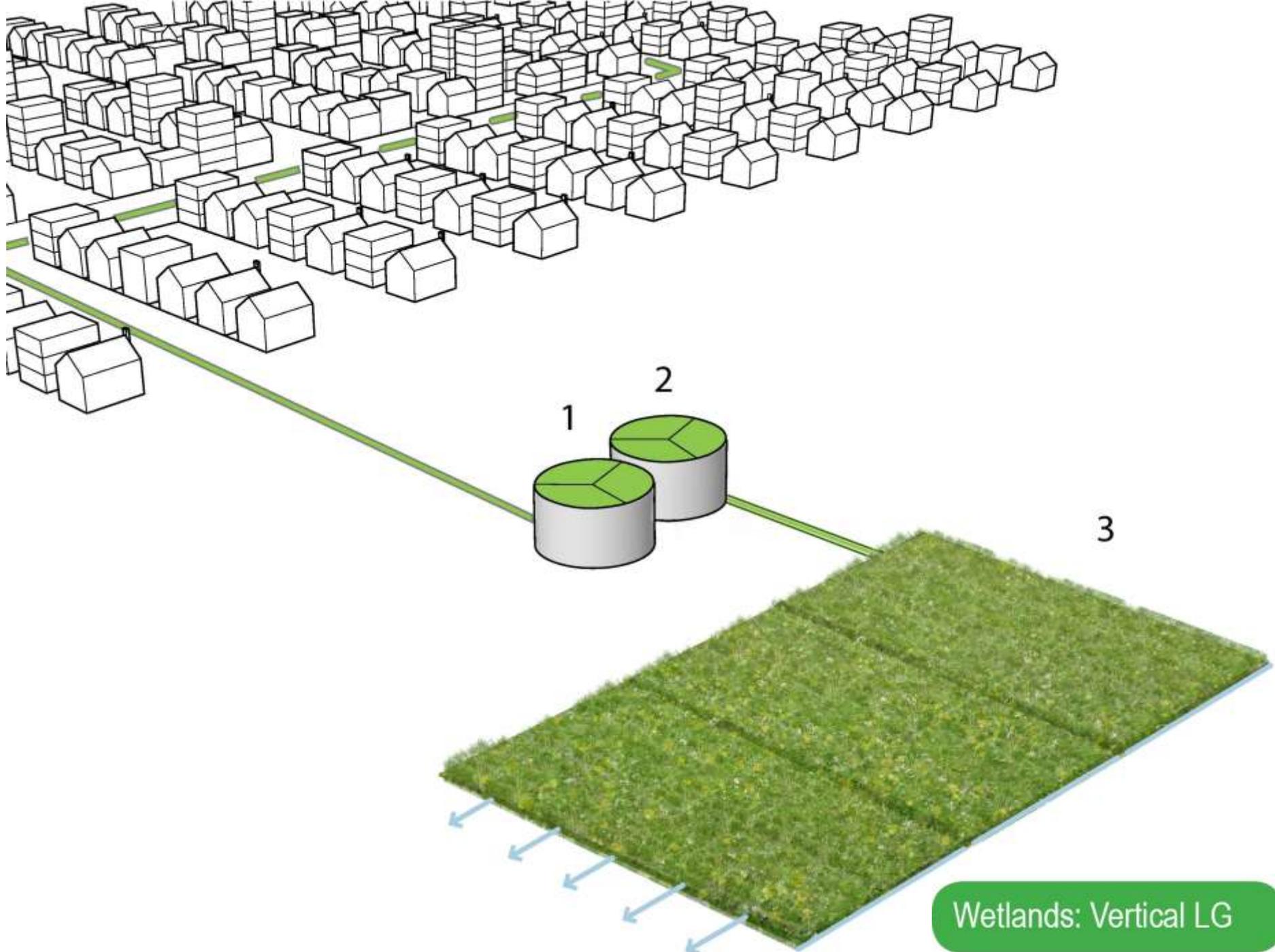
Photograph by Kate Kennen, 2011

Mark Madison, CH2MHill, Portland, OR

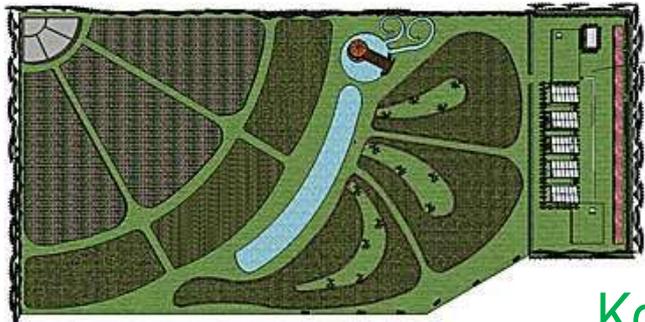
PRECEDENT: Talking Water Gardens, Albany, -Millersburg OR



Photograph by Kate Kennen, 2011



Wetlands: Vertical LG



Hans Brix, 2006 and CWI Website

Koh Phi Phi, Thailand Vertical Wetland Treatment Plant



Site Area: 1000 sq m

Treats: 500 PE

Pre-treatment: sedimentation tank

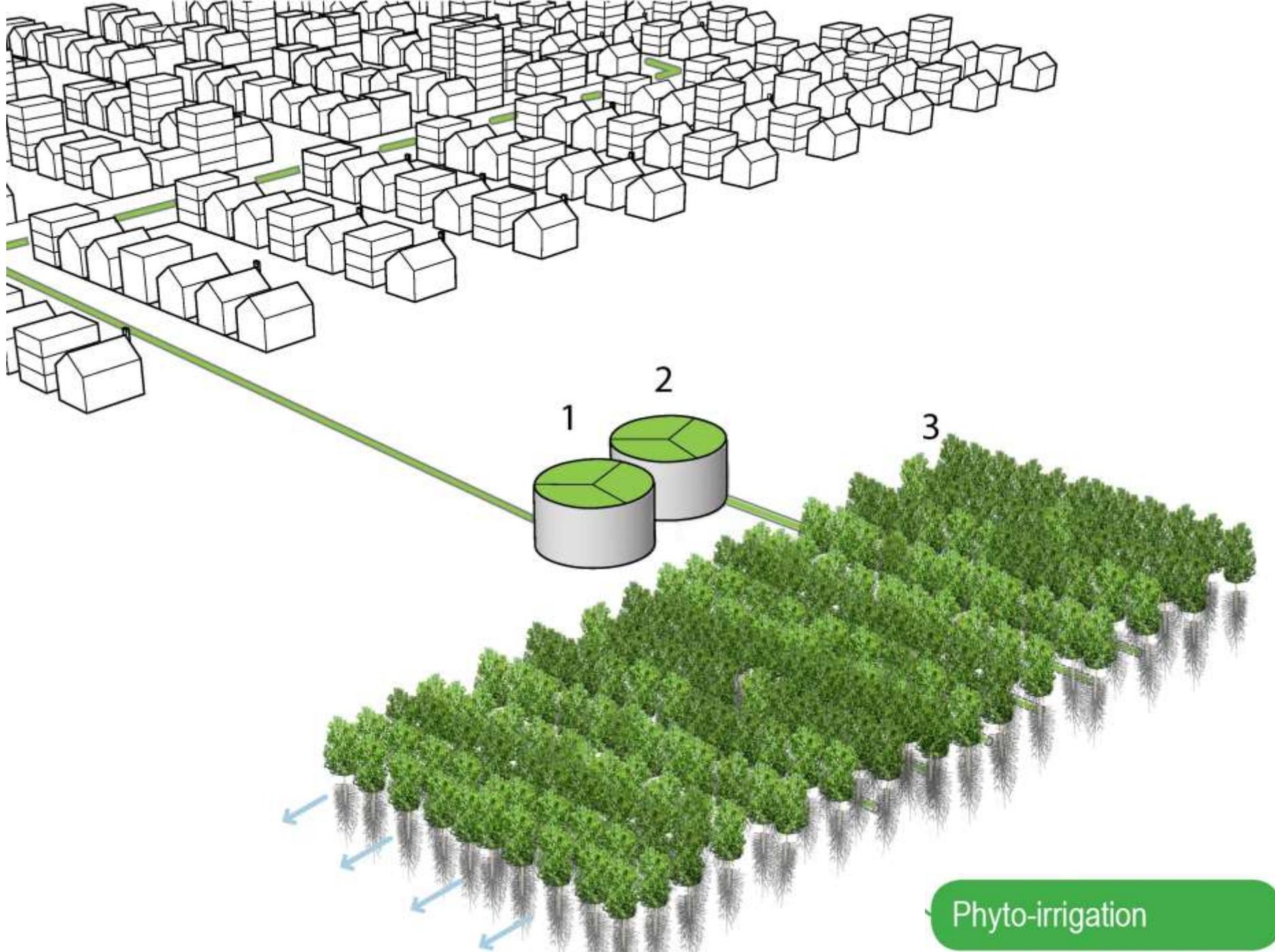
2 vertical subsurface flow wetlands

1 horizontal subsurface flow wetland

1 Free water surface wetland

Blumberg Engineers

Shuangshan Island (Zhangjiagang, Jiangsu Province, China)



Phyto-irrigation



Jason Smeasrod & Mark Madison, CH2MHill, Portland, OR
PRECEDENT: Woodburn, OR Treatment Facility

Excess Nutrient Capacity within the Poplar Tree Plantation Utilized for Biosolids Reuse



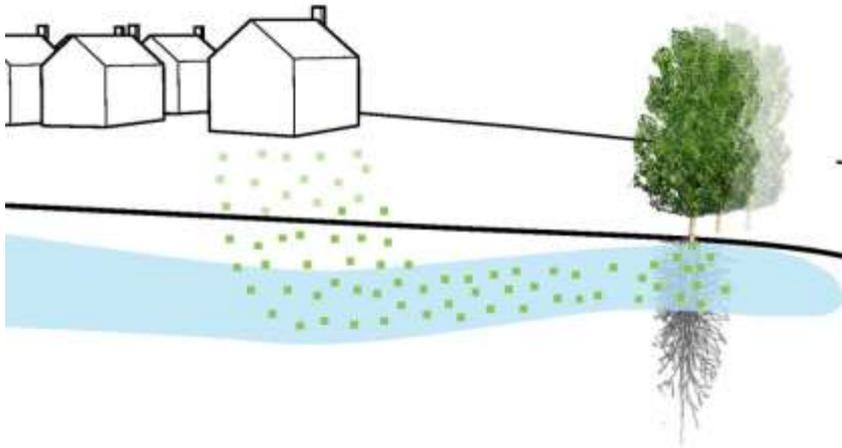
215 lb/ac/yr N Limit
(average across tree age classes)

Annual lbs of Nitrogen per acre



Effluent
28 in/yr
@10 mg/L N

Biosolids
2.9 dT/ac/yr
@52 lbs
PAN/dT



Phyto-buffer: LG

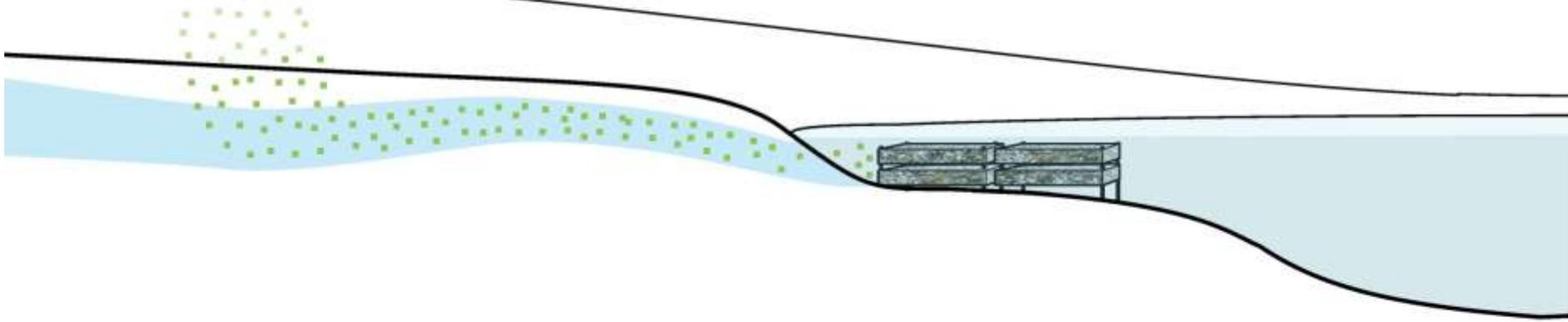
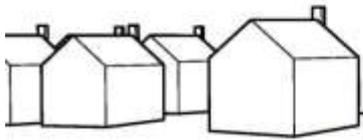


Poplars reach up to 20' Ground Water Depths



Ecolotree and Sand Creek Engineers

PRECEDENT: Fertilizer Factory, North Carolina- Deep Rooting Poplars

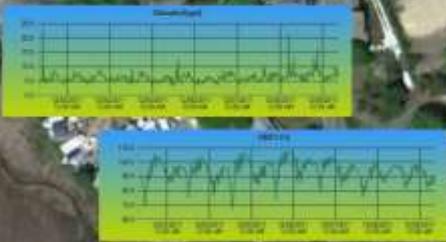


Shellfish Aquaculture

Measuring Oysters' Improvements on Water Quality



Real Time Water Quality



www.capecodextension.org/Marine-Programs/YSI-Water-Quality-Monitoring.html



Overall project area with new catch

- > already 2-3 million additional oysters
- > goal: 8,800 pounds of nitrogen removed per year
- > likely increase in commercial shellfish value of \$1 million/year
- > increased water filtration approximately 100 million gallons/day
- > erosion control
- > sediment reduction
- > increased turtle, eel, juvenile fish habitat



New spat on seaclam catch (small black patches)



YSI Meter

Recycled OysterFest Shells

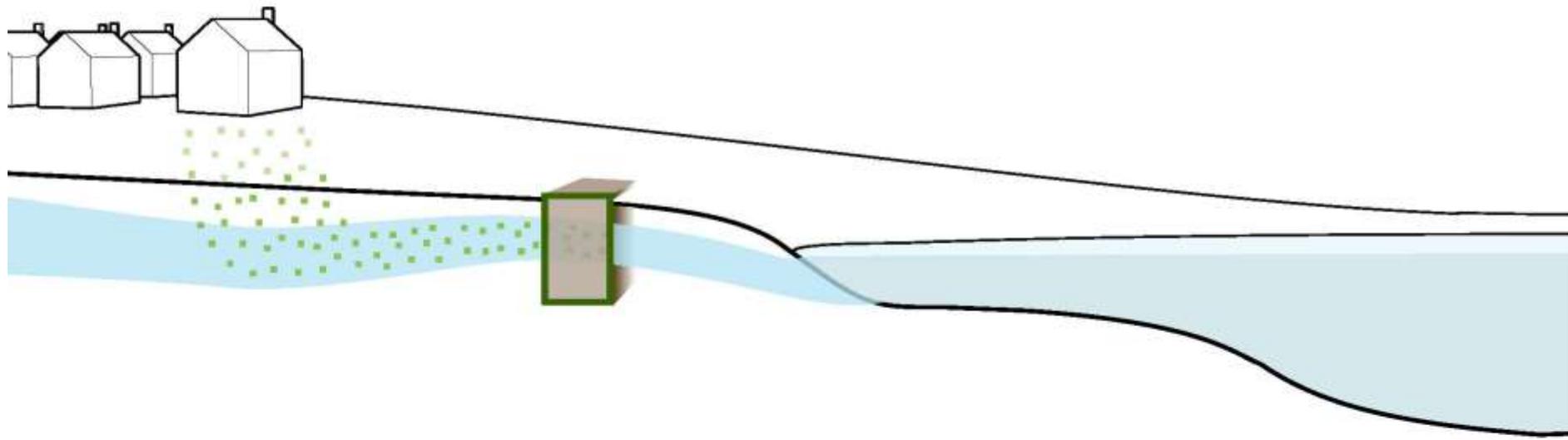
Oyster Spawning Study Area (2.04 acres)

Blueberry Wells

Anamarija Frankic (Umass)

PRECEDENT: Wellfleet Harbor, Cape Cod





Permeable React Bar.



Location of N removal trench – Hard to even see where it is!

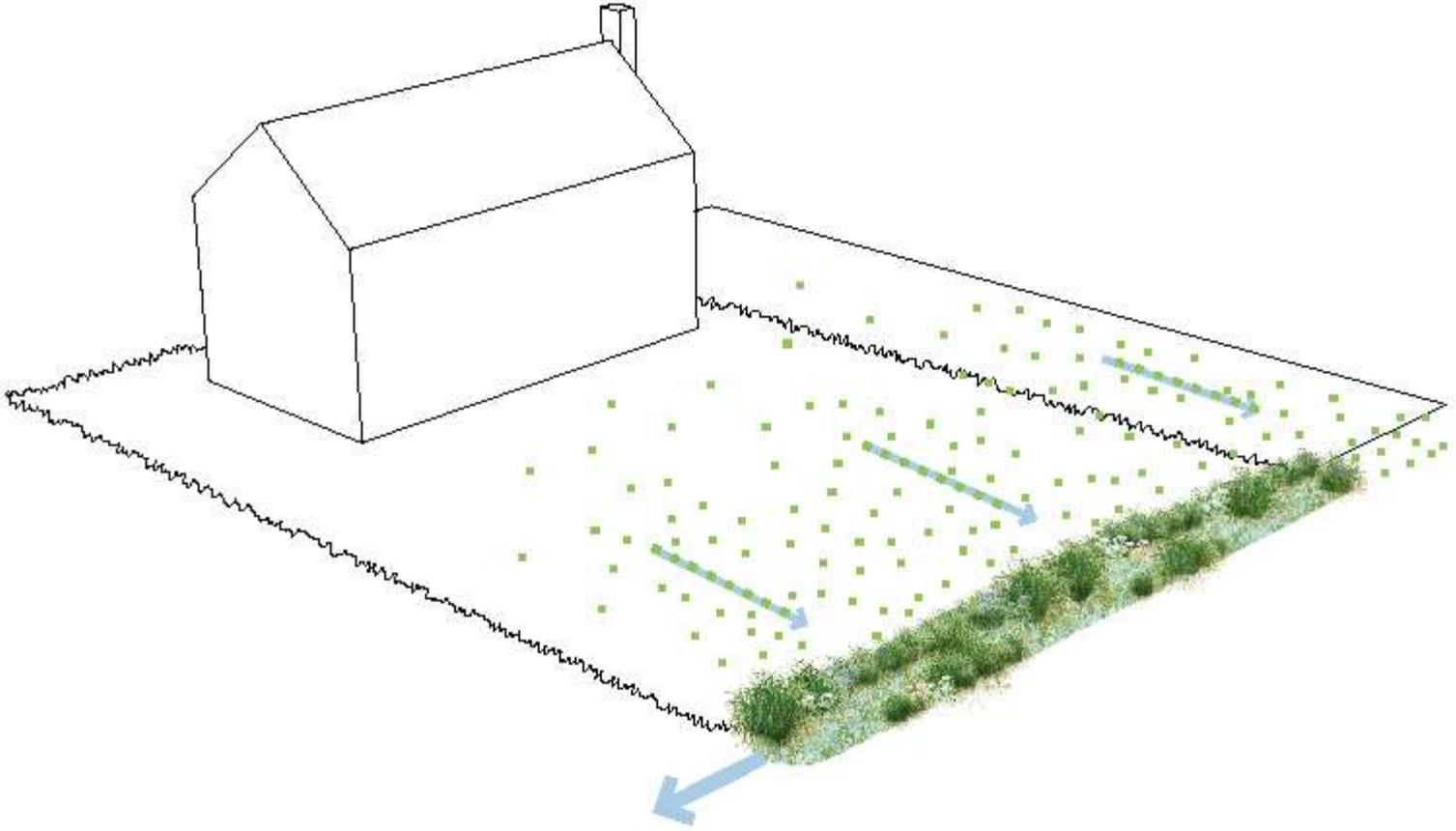


Chips

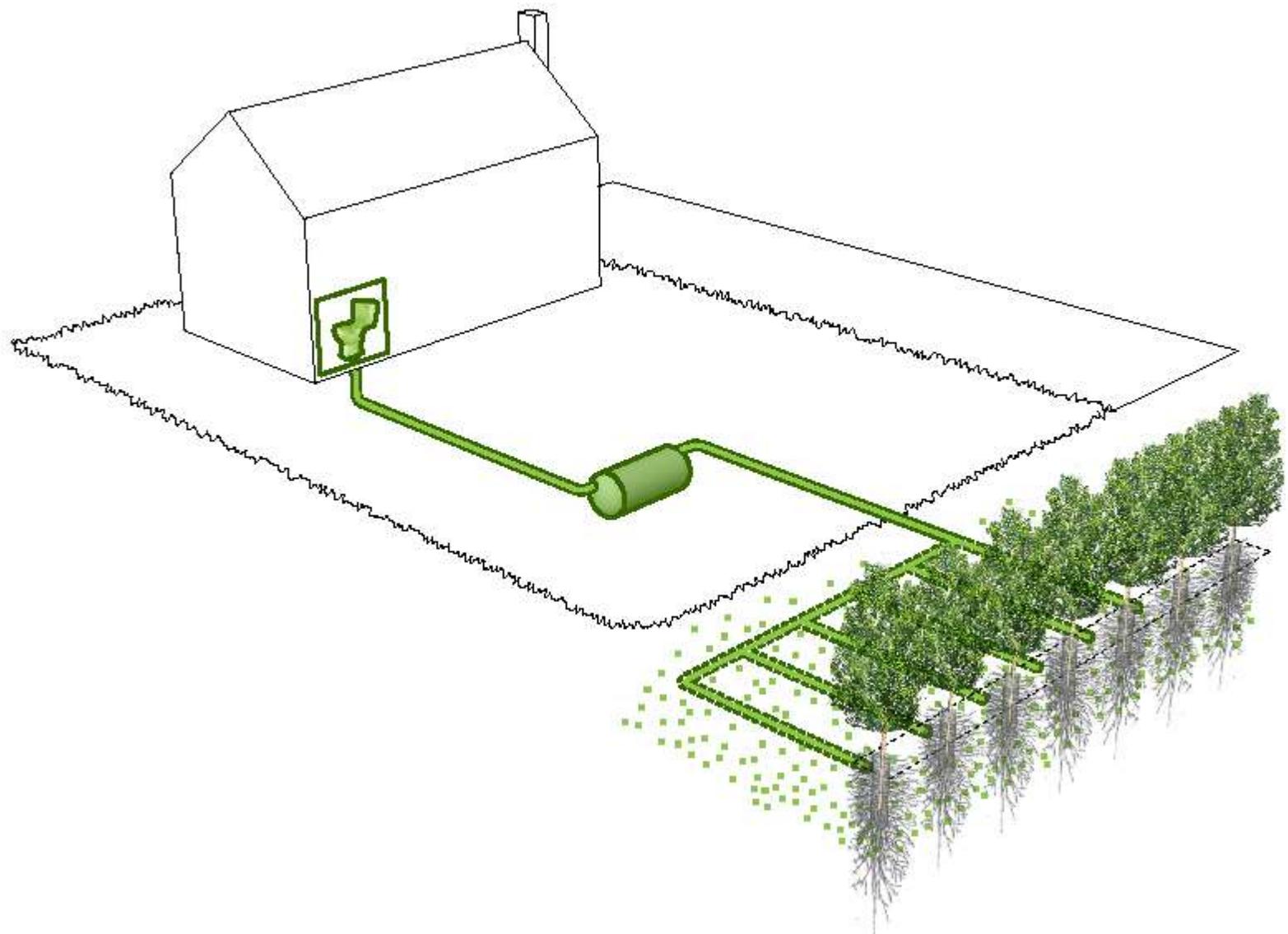


- Nitrate → to nitrogen gas by micro-organisms
- 90-99% removal of nitrate
- Also effective for Phosphorus - fresh water ponds
- 20-30 year media life estimated

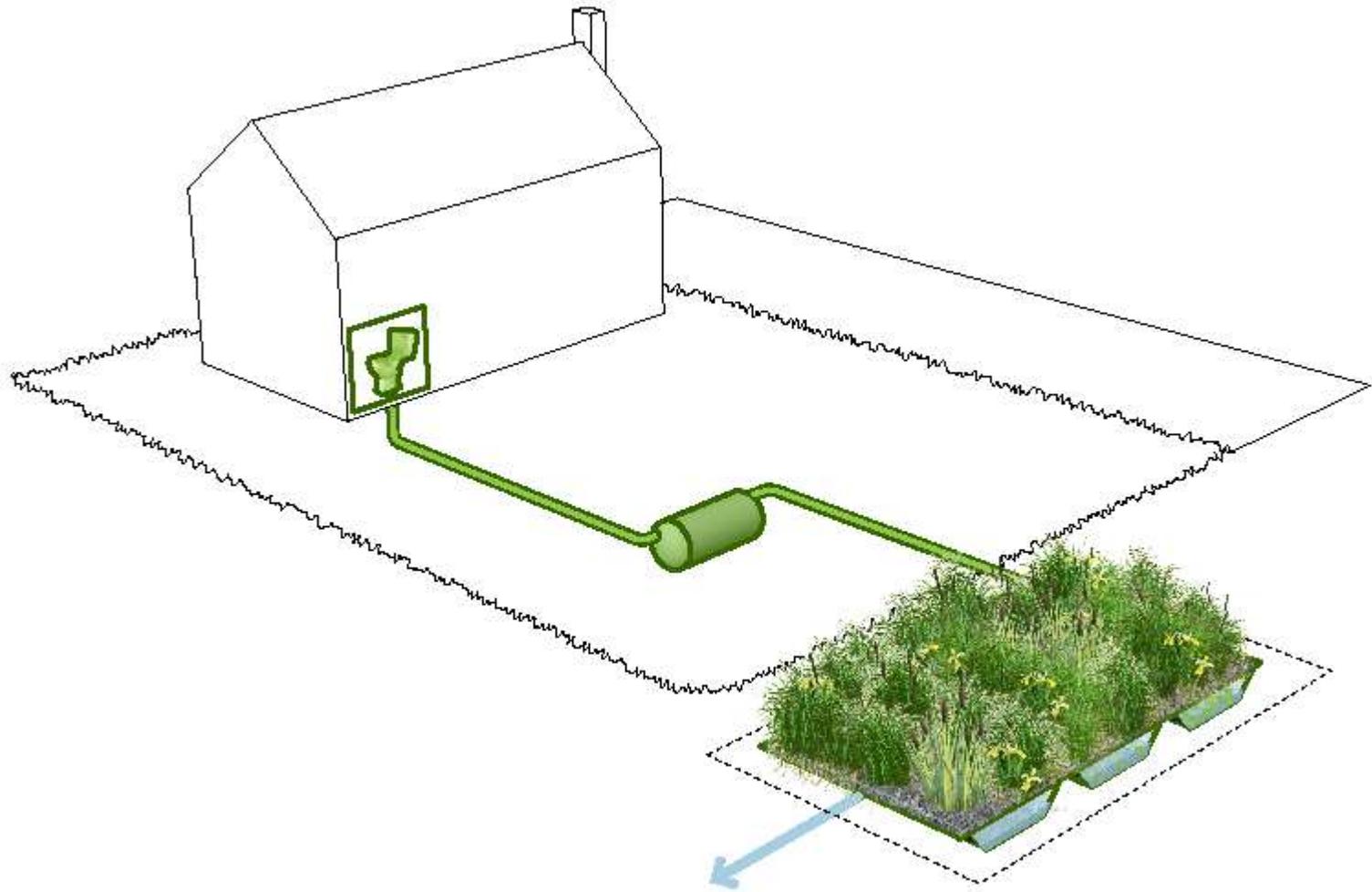
Other Diagrams Drawn



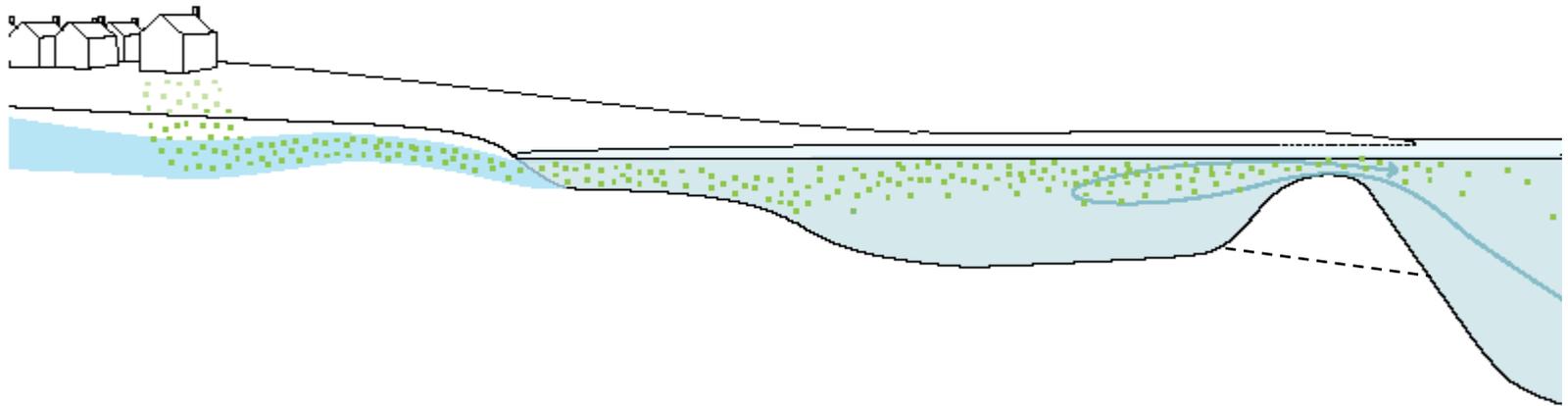
SITE: Bioswales



SITE: Phyto Buffer



SITE: Subsurface Wetland



WATERSHED: Dredging