

Putting Plants to Work for Stormwater



Listen to their stories ...



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'Putting Plants to Work'

for environmental sustainability and economic development



Mission:

- To develop and promote the strategic use of plants (phytotechnology)
- To provide ecosystem services and solve environmental challenges in managed landscapes
- To serve as Oregon's phytotechnology resource center



So, our story for today,
once upon a time . . .

We developed a problem



Photo courtesy Paul Kay



IMPERVIOUS LAYER
(i.e. Roads, Parking Lots, Rooftops)

NATIVE SOIL

Photo courtesy City of Portland

Conventional Grey Infrastructure

Portland's Tunnel System for Sanitary and Storm Flows




Photo courtesy City of Portland



A single green plant can simultaneously link together 4 major media systems that define our world- water, soil, air, and sun energy



Continuing the story

- What happens if we take a plant's ability to integrate and scale that up into a system?
- I call it the "Stone Soup" approach (read the children's book by that title)
- WQ becomes a process, not a product
- Sustainability also becomes a process- a way of experience or a set of dynamic states, not a thing to build



Rogue Six-Pack Experiment with SW

- Built by Rogue Water and students
- Inspired by John Todd's early Living Machines





Results: Water


	Input	Output	Change
Cu	0.0817 mg/l	0.0055 mg/l	- 93%
Pb	ND	n/a	
Zn	0.134 mg/l	0.012 mg/l	- 91%
pH	7.62	7.78	
TSS	336 mg/l	ND <4 mg/l	- 99%+

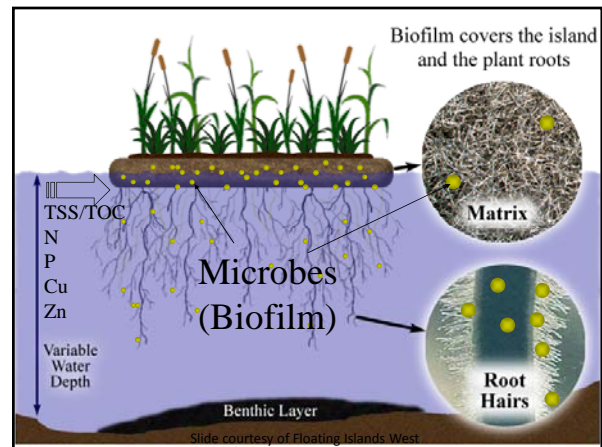
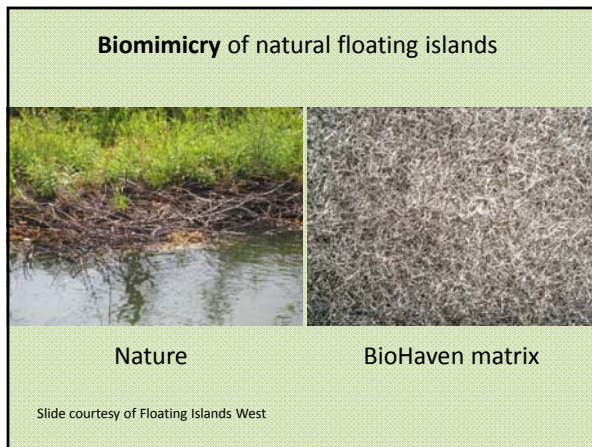
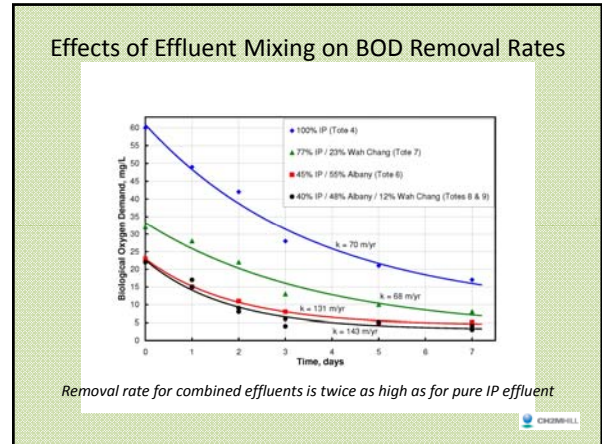
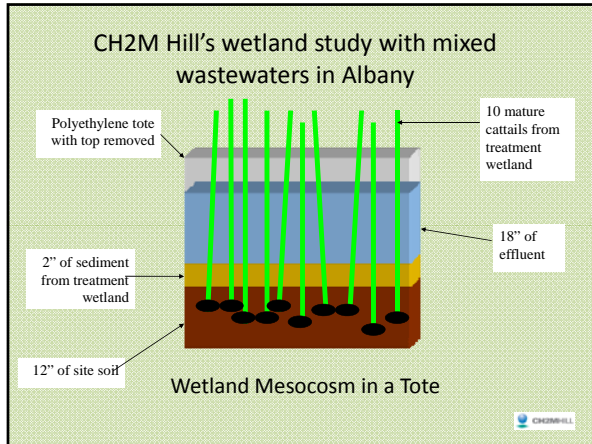
Detention time = 11 days (rationale for timing was convenience)

Eco-Reactor System



To treat agricultural SW run-off while producing crops







Advantages of Floating Wetlands

- Maximizes surface area for microbiology that is in direct contact with the water
- Allows introduction of plant and microbial communities to deeper areas of water than can be tolerated by emergent wetland plants
- Able to be installed in existing ponds with no new construction/excavation, providing additional treatment in existing footprint
- Unique habitat
- More consistent plant performance with varying water depths



Wastewater lagoon

Wiconisco, PA

Wastewater Treatment Facility

Investigating Nutrient Removal Associated with BioHavens

Floating Island International, LLC
5/6/2010

SW/Run-off Applications for Floating Wetlands

- National Institute of Water and Atmospheric Research (NIWA) Report- "Application of Floating Wetlands for Enhanced Stormwater Treatment: A Review"
- Sarah White and Clemson University research

Floating mats in Pond System

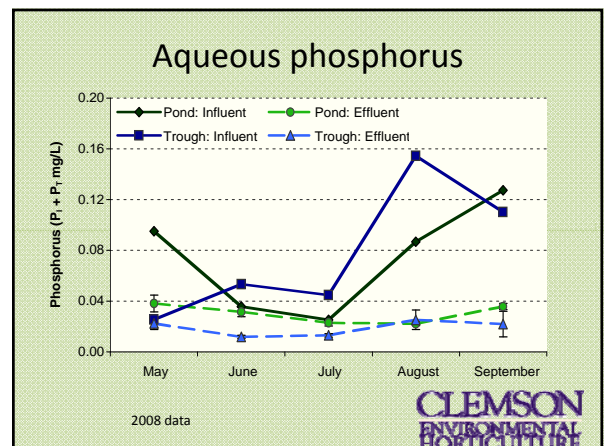
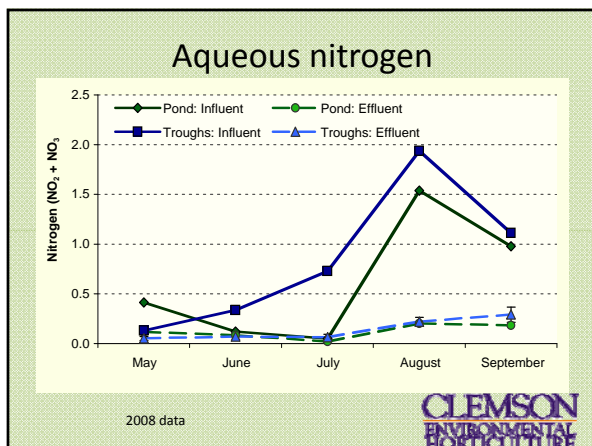
CLEMSON ENVIRONMENTAL HORTICULTURE

Floating Mats in Trough System

- 10 liners per 4 ft² section
- 2 day hydraulic retention time
- Planted Apr. 14, 2008
- Harvested Sept. 18, 2008

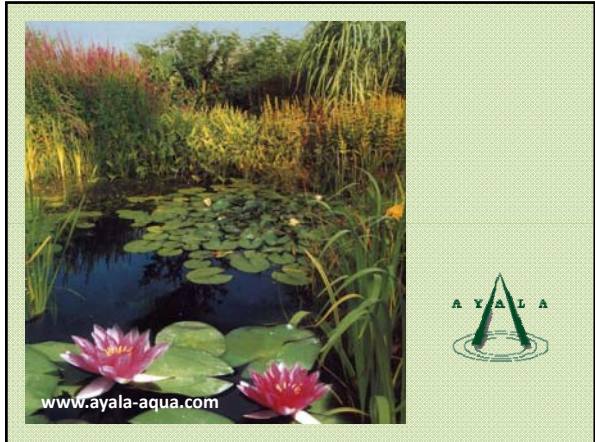
Canna flaccida, Juncus effusus, Agrostis sp., Eleocharis montana

CLEMSON ENVIRONMENTAL HORTICULTURE



Results and Discussion


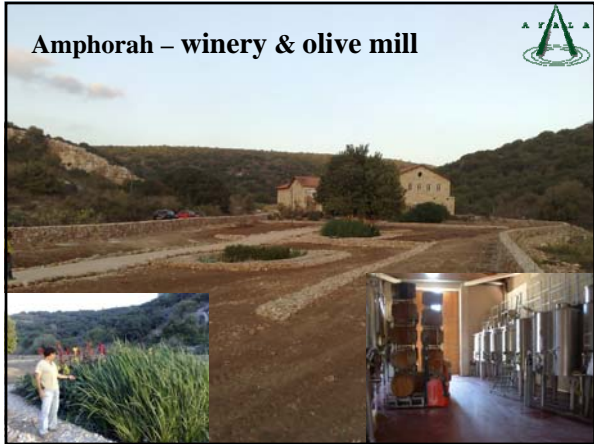
- Suitable treatment for both onsite reuse and offsite release
- N and P are both reduced
 - N removal efficiency 82%- corresponds to constructed wetland treatment
 - P removal often below target limits but not always
- Nutrient removal in ponds was greater than in vegetated channels- especially for P
- N and P uptake by Juncus was higher than for Canna
- P loading was equal to P levels of concern in SW treatment areas of the Everglades

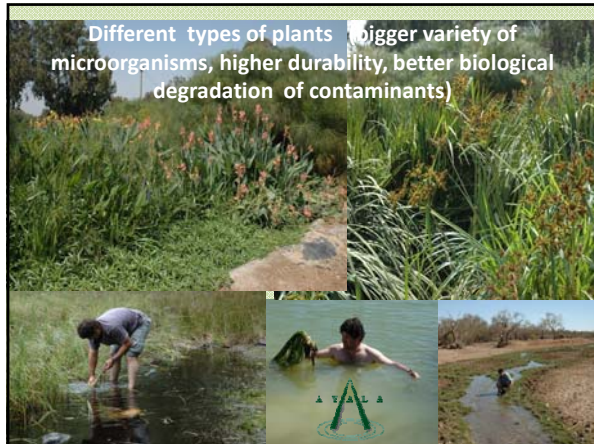


Ayala Water and Ecology

Design criteria for a sustainable system:

- All materials are degradable- minimize use
- **Solar energy** is “yet” available and creates no side effects
- **Gravity** as a moving force
- Healthy environments support healthy **plants** which are powerful supporters of **microorganism** communities
- **Poly-cultural** systems are stronger and more stable
- System **hydraulics**
- Landscape integration- wildlife and reuse



Ecosystem Integration with Greenroofs and Raingardens

<p>Greenroofs</p> <ul style="list-style-type: none"> • Additional treatment to existing footprint • Opportunities for linking in series with living walls, SW planters, etc • Plant options beyond sedum 	<p>Raingardens</p> <ul style="list-style-type: none"> • More natural hydrologic cycle for groundwater recharge • Combines soil and plant treatments, as in a sub-surface wetland
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Tom Liptan's Garage Ecoroof installed 1996

Slide Courtesy Tom Liptan

OSU Extension-

The Oregon Raingarden Guide:
landscaping for clean water and healthy streams

Design guidelines:

- 10% rule with min 0.5 inch/hr infiltration rate and min 6 inch depth
- designed to dry out in 24 hrs
- amended soil
- do not plant like a wetland

Mt Tabor School Rain-garden

Before

reduces city sewer Infrastructure rehab. costs and improves school property and reduces heat island effect...

After

Coming back to the individual plants

and how to choose the *right* ones

Functional Plant Selection Check List

- Right plant, right place
- Extended tolerance
- How will the plant eat and drink?
- What or who will eat the plant?
- Consider the neighborhood.
- Look beyond hardiness to the plant's effect on local temperature.
- Re-evaluate the roles of weeds and mosses.
- What can the plant do and when?
- Site context

Hydrocotyl ranunculoides profile

Hydrocotyl ranunculoides profile

- RPRP- floating aquatic maaaybe wet meadow
- Tolerance- wide range of WQ's
- Heavy biomass growth but won't suck pond dry
- Ducks! People!
- Doesn't necessarily play well with the kids next door
- Great for shade . . . If you live in the water
- H. r. is a native 'weed'
- Effective at lead removal in SW basins
- Isolated SW Tank? WWTP pond with wildlife access?



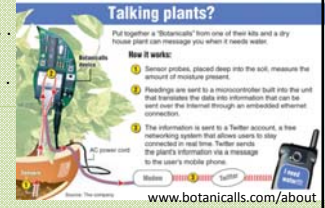
Phytotechnology and Ecology

Moving beyond mechanical systems with static products

Moving beyond plant lists

Embracing complexity

The effectiveness
is in the constant dialogue
between elements of the system.



Thank-you!

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