BIOLOGICAL TREATMENT of RUNOFF

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27 July 2017

CLEMSON
PLANT AND
ENVIRONMENTAL SCIENCES

SCRI - CLEAN WATER^3
REDUCE, REMEDIATE, RECYCLE

Water challenges & concerns


Irrigation timing?
Cultural practices?
Plant diseases?
How much have I lost?
$ and *opportunity cost*

Biological treatment technologies

- Sediment basins
- Filter strips
  - Vegetative buffers
  - Vegetative waterways
- Constructed water (wetland) treatment basins (CWs)
  - Surface-flow
  - Subsurface-flow
- Floating wetlands

Sediment/erosion control

- Develop an erosion / sediment control plant
- Prevent sediment from leaving the nursery
  - stabilize critical areas – grass (time of year) or mulch
  - erosion control blankets/netting

Sediment basins

Bioretention basin

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Filter strips

Bands of vegetation used between production areas & retention ponds

- Slow runoff
- Trap:
  - Sediment
  - Fertilizer
  - pesticides
  - (potentially) pathogens

Before they enter surface water

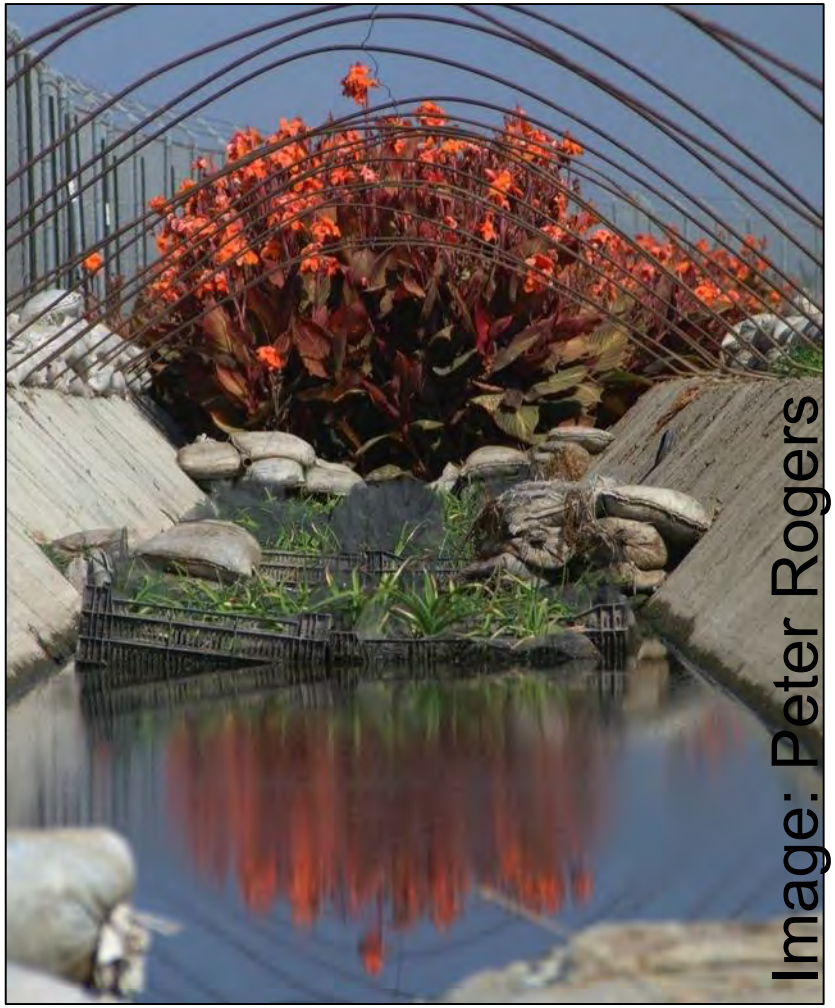

Image: Peter Rogers

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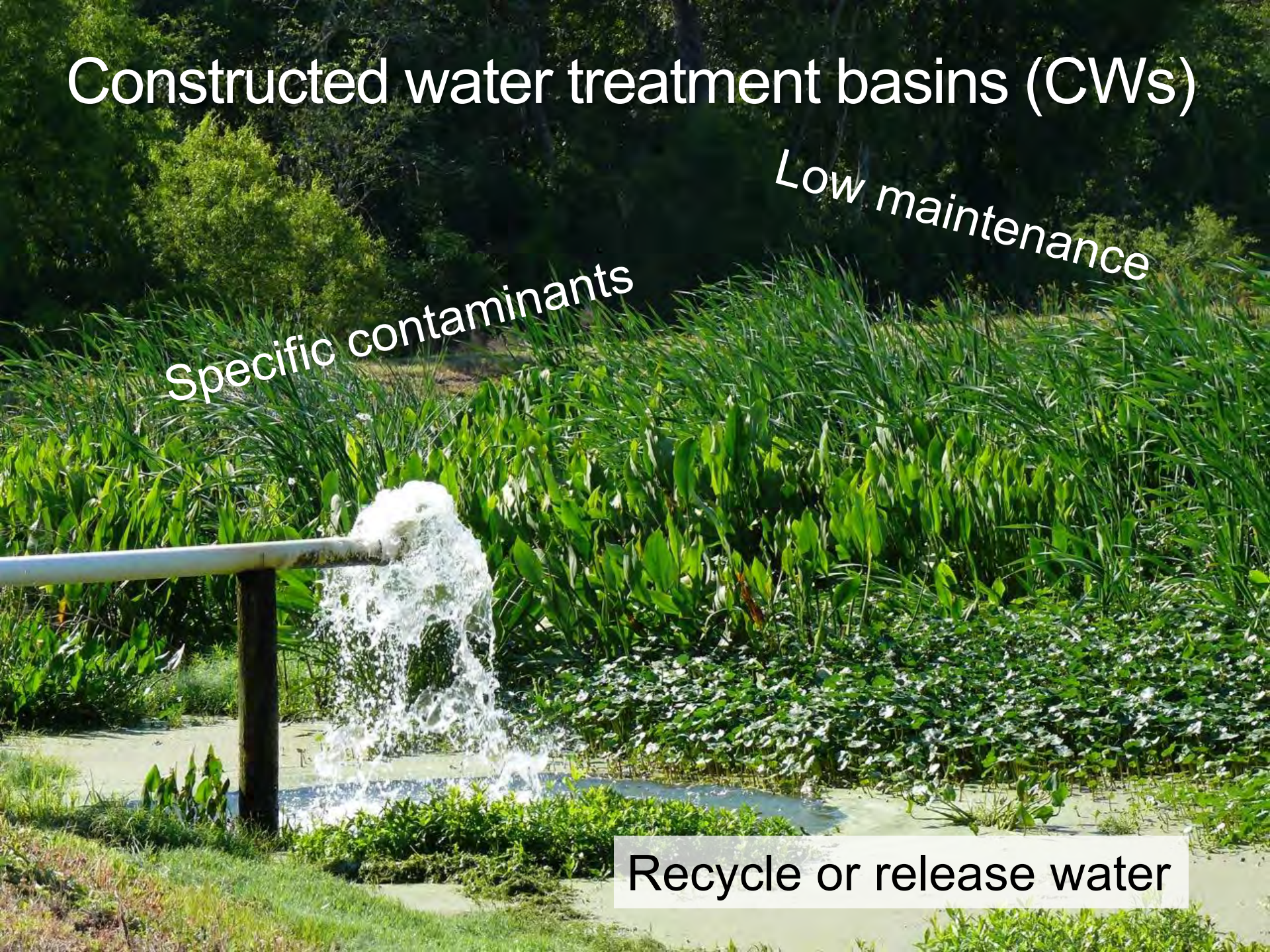
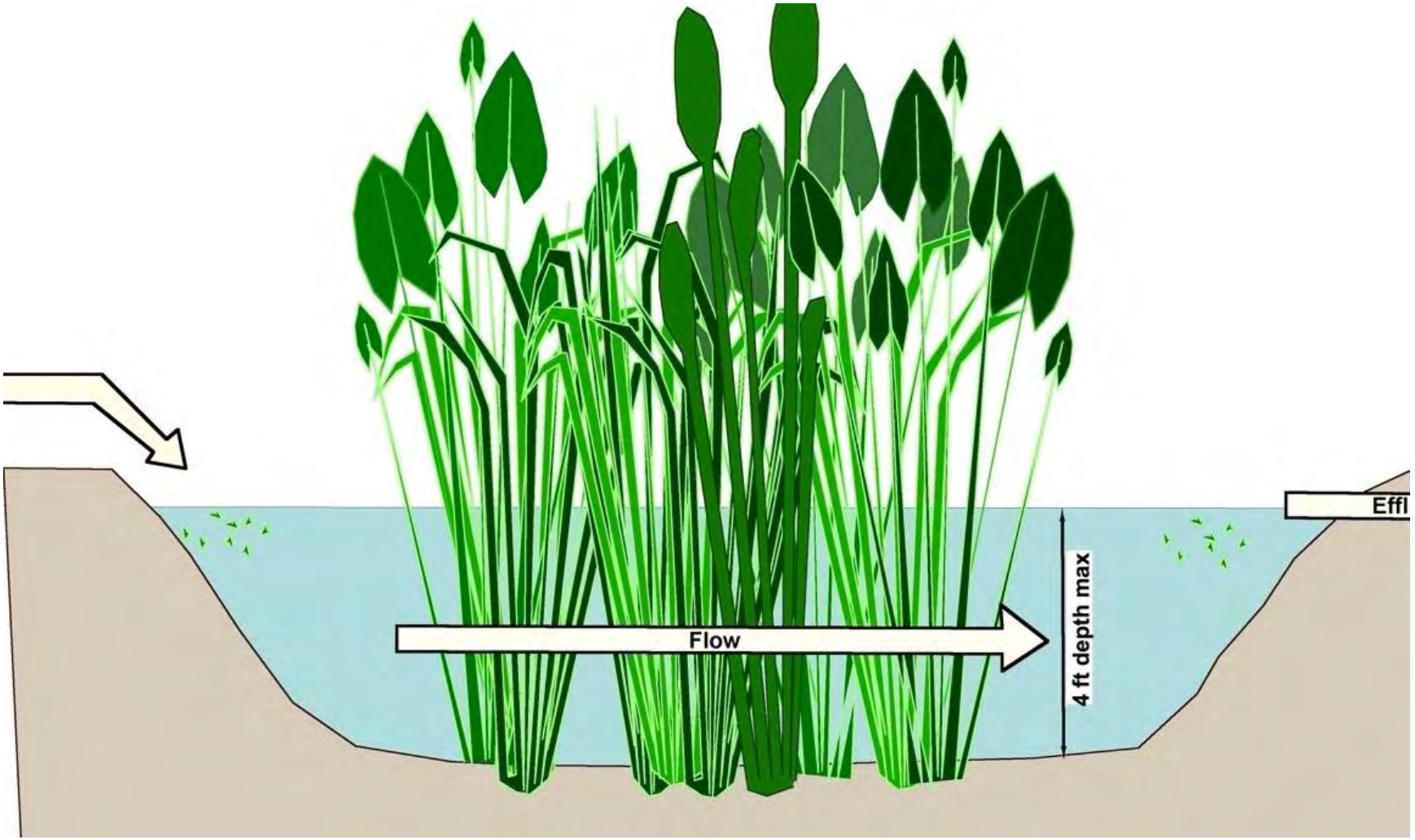

Constructed water treatment basins (CWs)
Low maintenance
Specific contaminants
Recycle or release water

Wetland (water basin) functions

- Soils provide habitat for microbes
- Microbes process
  - nutrients
  - organic contaminants
- Vegetation slows water
- Plant uptake/absorption
  - nutrients
  - trace metals
  - other compounds

Surface-flow CWS



Case Study: Monrovia® Cairo, GA

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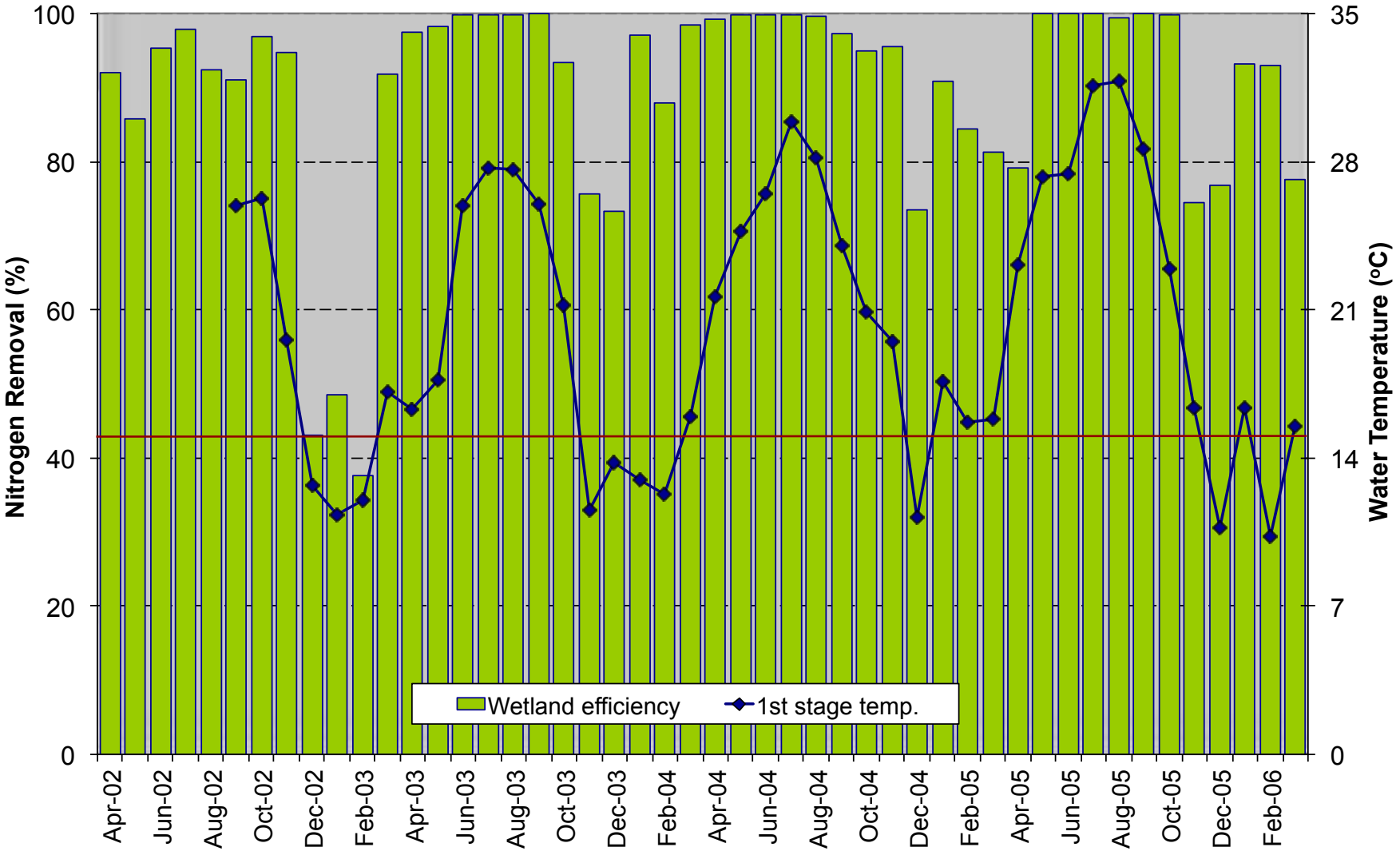
REDUCE, REMEDIATE, RECYCLE

Case Study: CW1 – 14 years

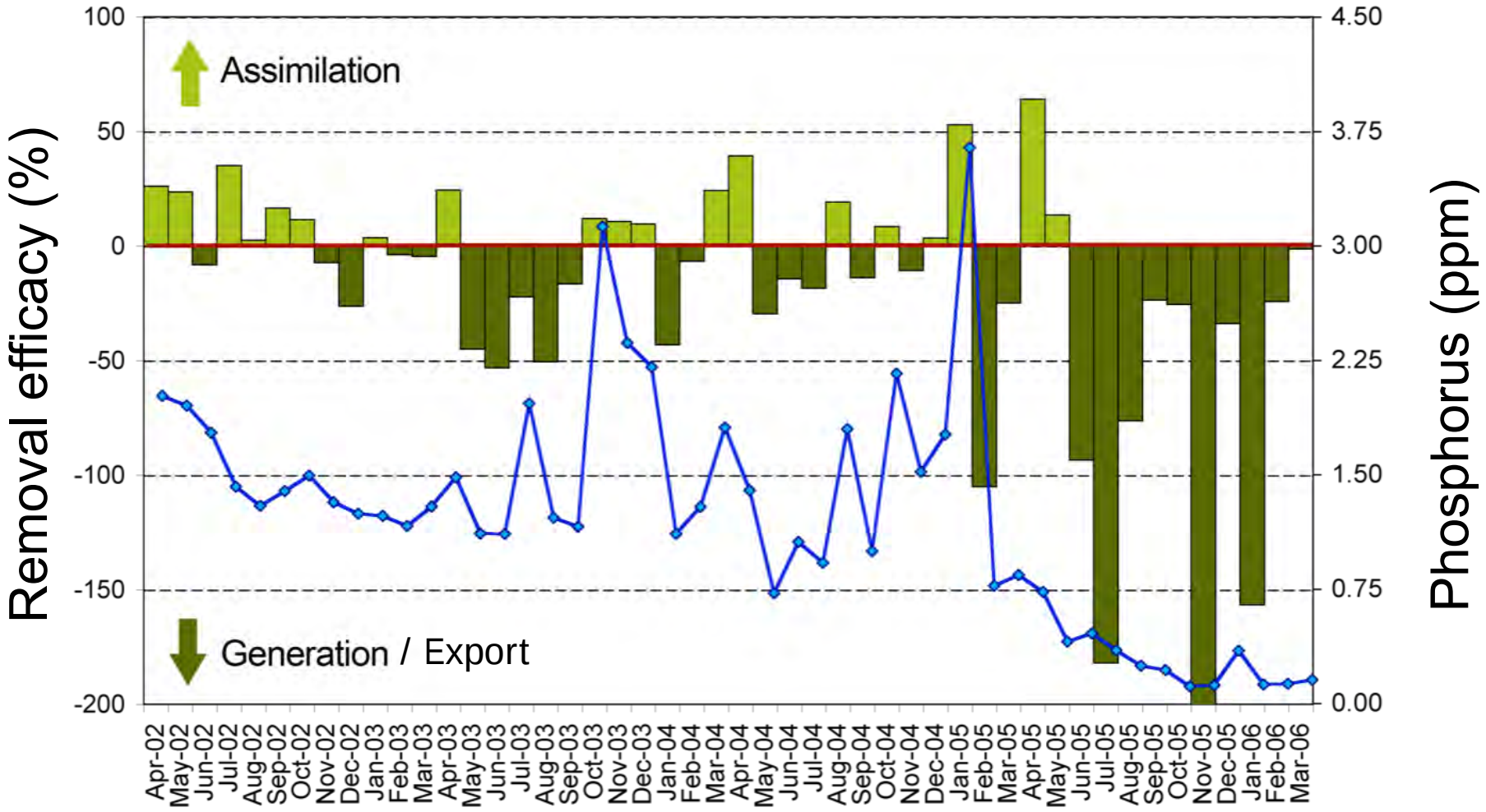
- 120 acres of production drain to wetland
- 9.3 acre wetland
- Two-stage
  - deep cell
  - shallow cell

How well do surface-flow CWs clean nursery runoff?

Nitrogen results



Phosphorus results

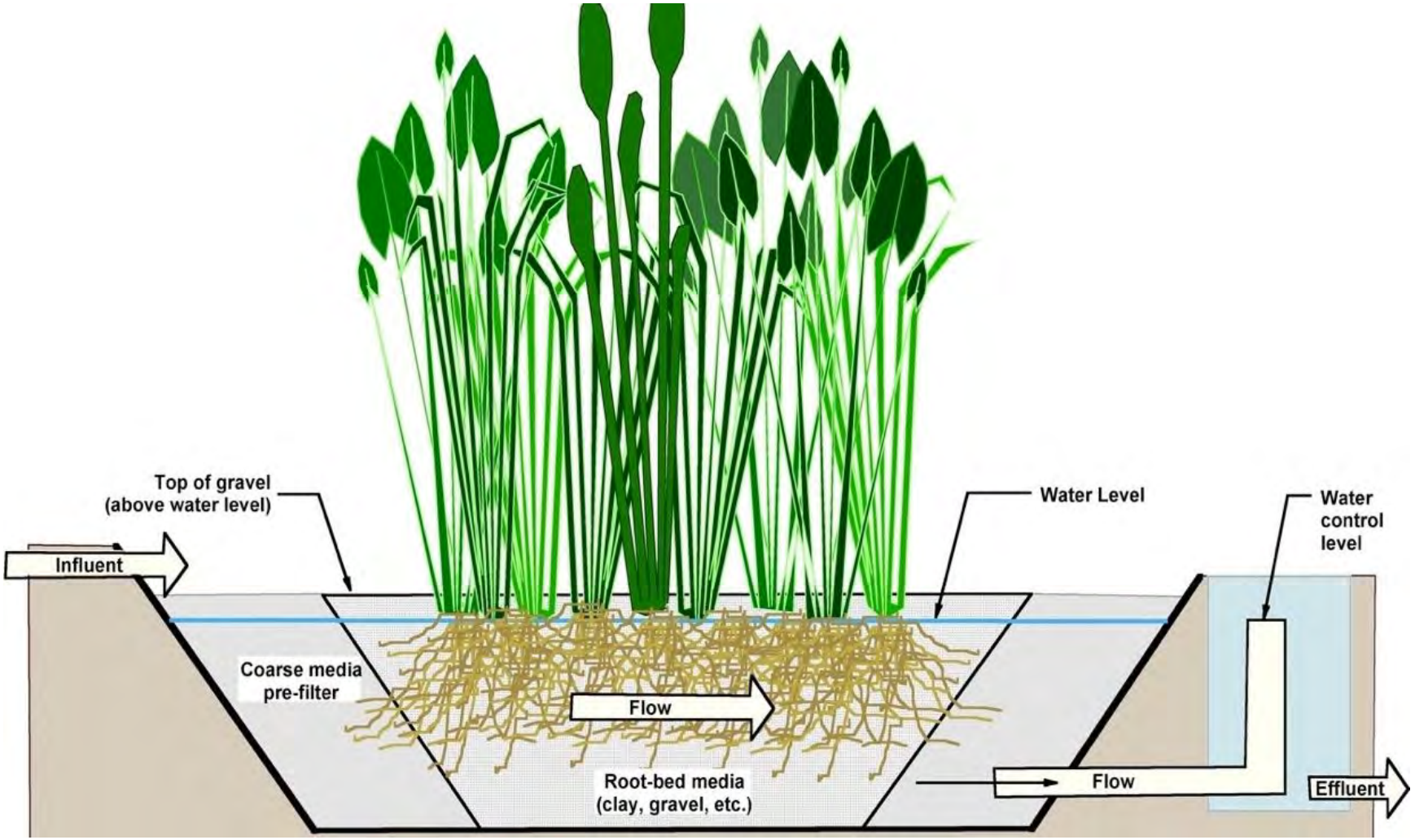


Surface-flow CWS

- Most efficient with high to moderate runoff volumes
- Efficient nitrogen removal
- Phosphorus not consistently treated
- Pesticide removal 50-98%
  - organochlorine
  - organophosphate
  - pyrethroid

Subsurface flow CWS

Subsurface flow CWS



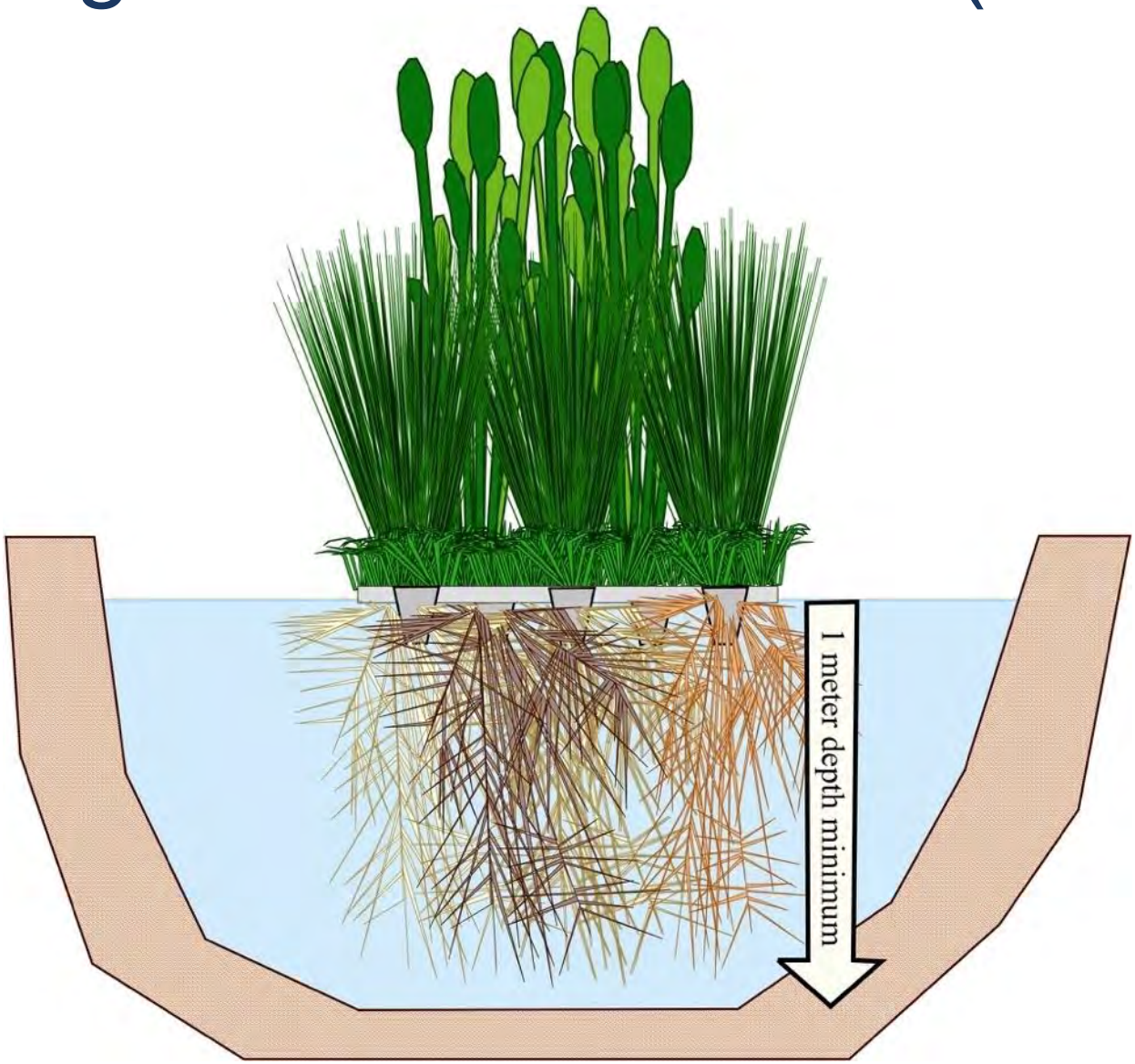
Subsurface flow CWS

- Reduce ammoniacal N emissions
- Efficient nitrogen & phosphorus removal
  - sediment will become P saturated
- Pesticide removal depends upon pesticide class

Floating treatment wetlands (FTW)

Image source: Floating islands international

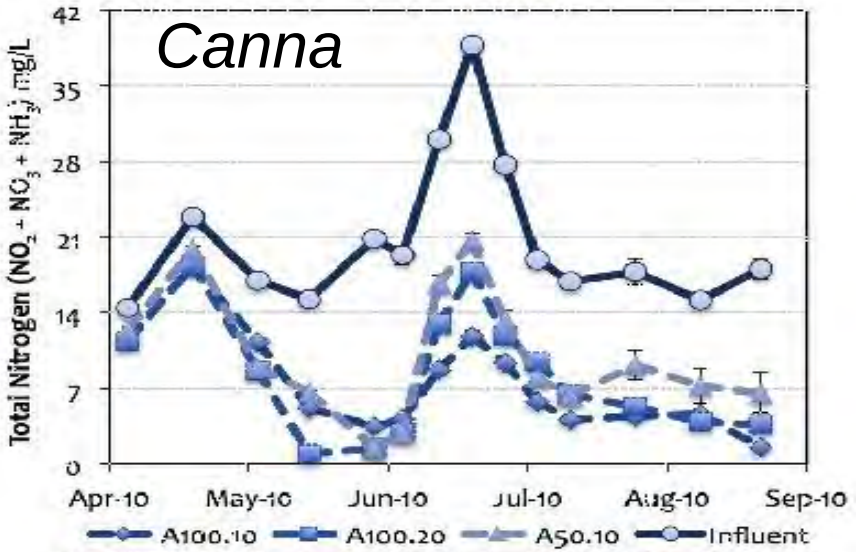
Floating treatment wetlands (FTWs)

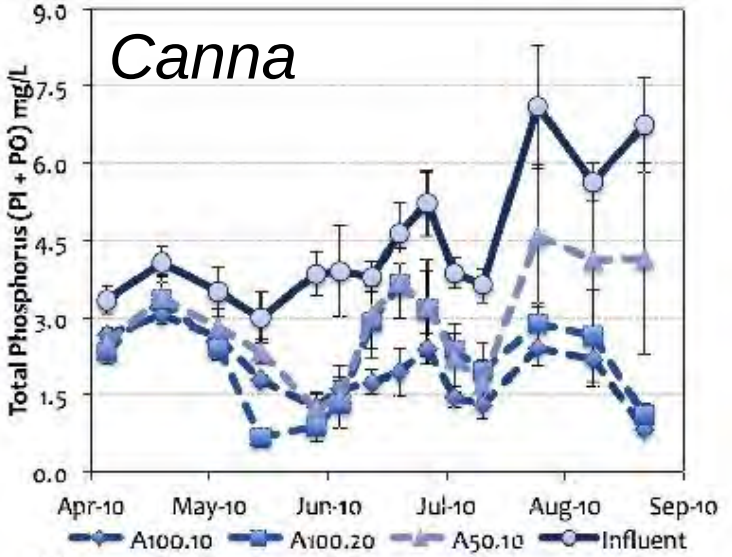


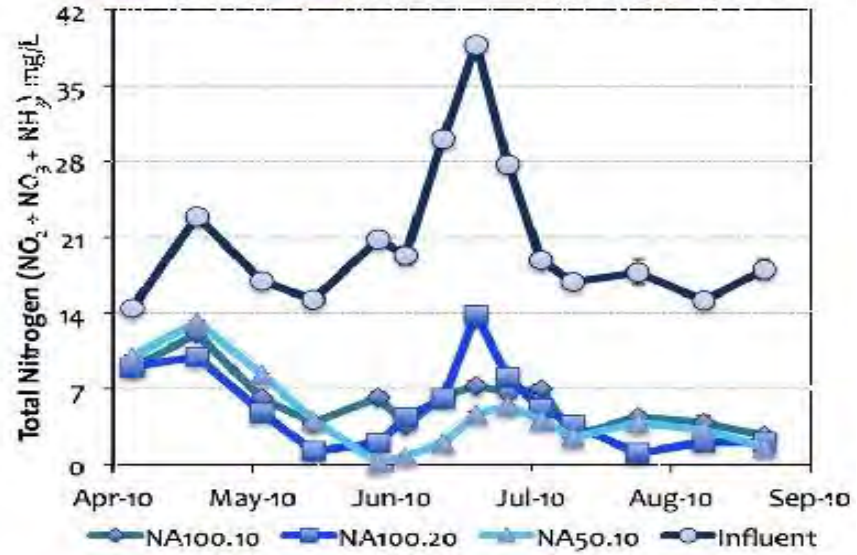
Floating wetland: functions

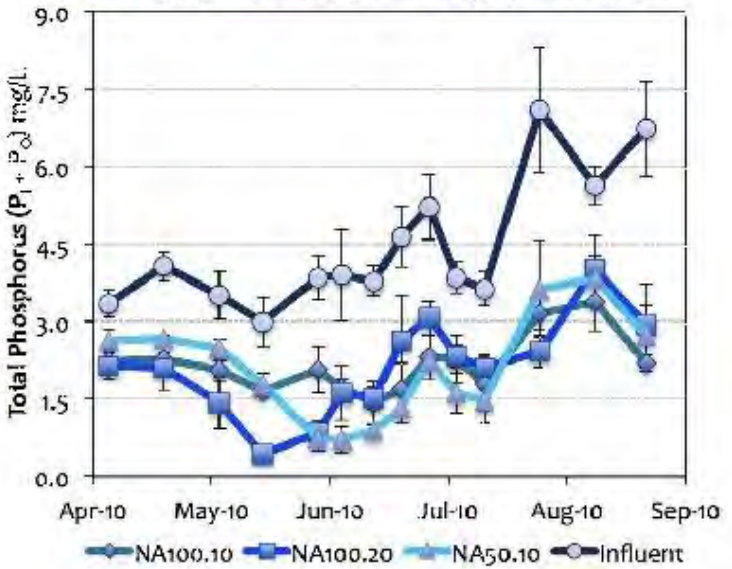
- Large root surface area for microbe habitat
- Particulate filtration
- Nutrient removal
- Provide “edge” shelter & general wildlife habitat

N & P remediation









Remediation efficiencies

	Water Treatment Basin Design (% Removal)			
Contaminant	Filter strip	FTW	Surface flow	Subsurface flow
TSS	41 -100	-	71 ± 35	83
TP	27 - 96	44 ± 75	9 - 54	33 - 90
TN	48 - 85	58 - 84	50 - 90	19 - 90
Herbicides*	30 - 91	?	24 - 100	24 – 97

TSS = total suspended solids | TP = total phosphorus | TN = total nitrogen

* Removal efficacy vary by compound, some not removed

Conclusions

- Each technology discussed has specific benefits and limitations
- Technology applied for remediation depends upon site-specific considerations
  - operation size
  - treatment volume
  - contaminants of concern

Contact Information

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Resources:
Constructed Wetlands: A How to Guide for Nurseries
Available for free: https://goo.gl/KQyGDU

Cleanwater3.org – treatment technology information