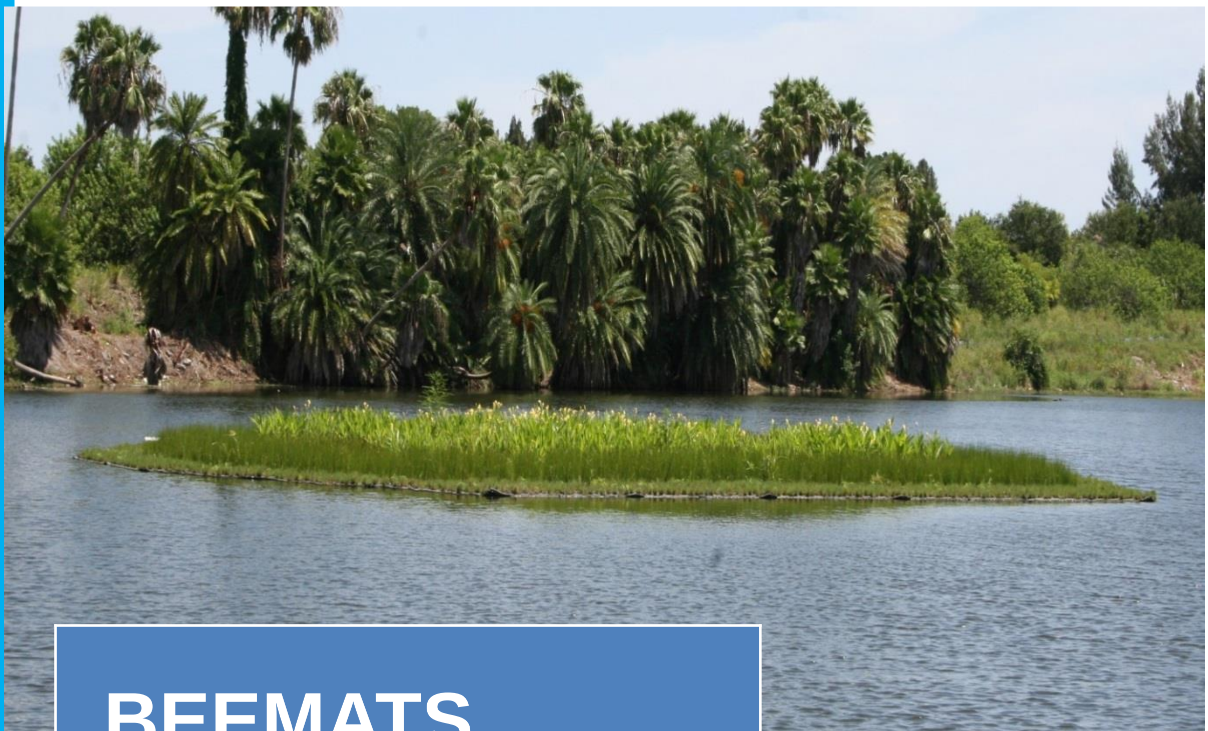


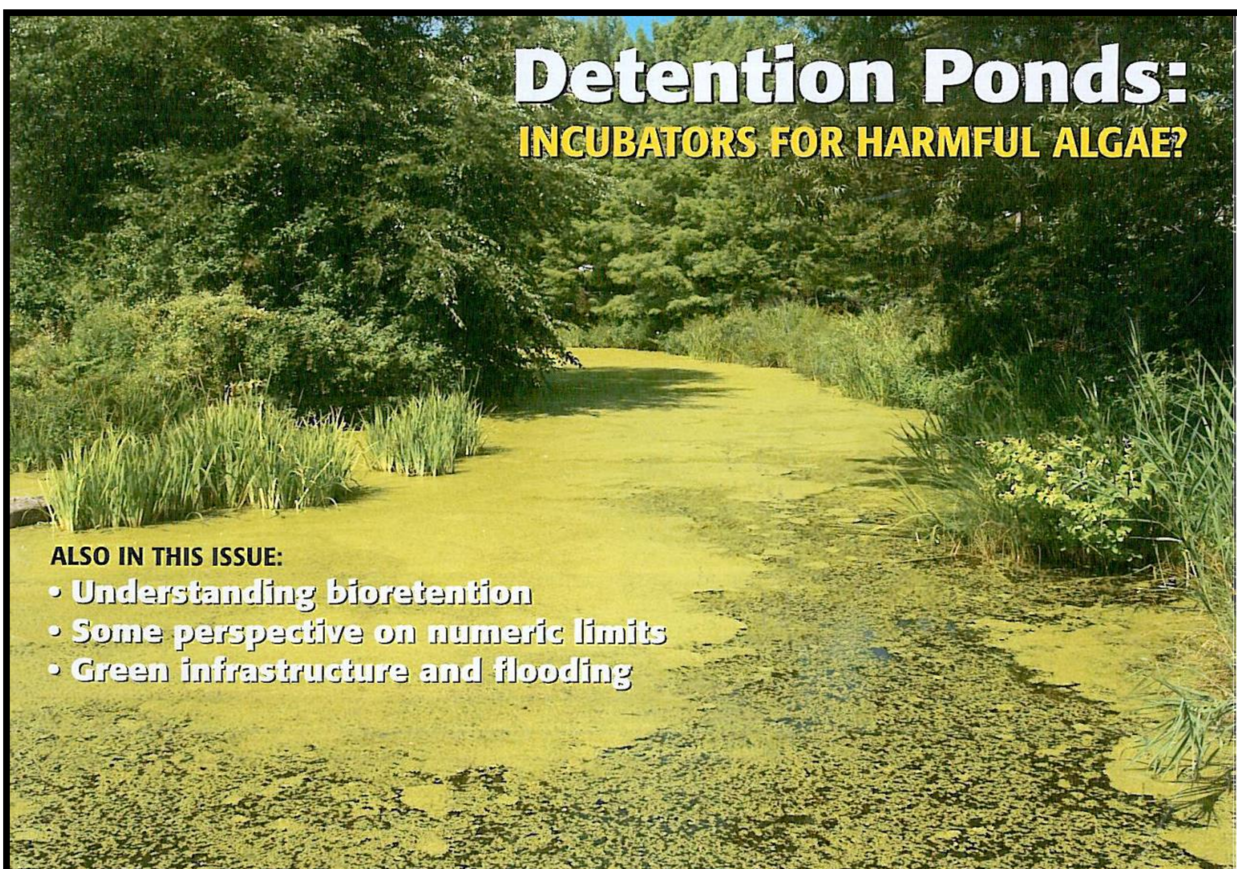
BEEMATS

Managed Aquatic Plant Systems

PLANTS NEED PHOSPHORUS

PHOSPHORUS FEEDS PLANTS

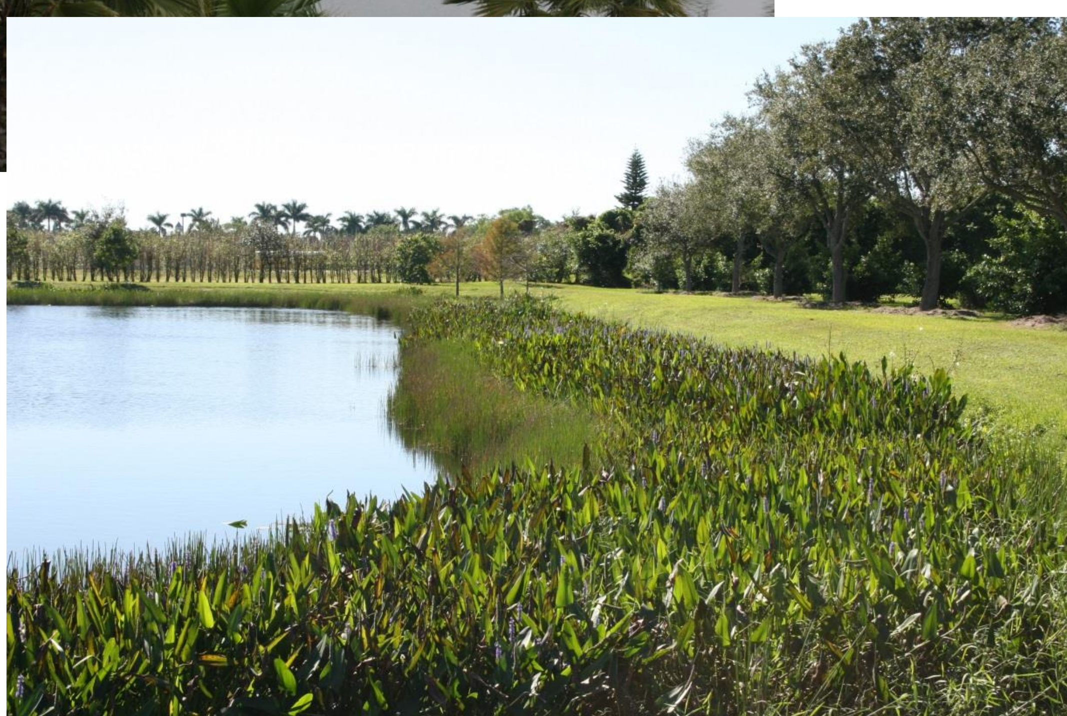
ALL KINDS OF PLANTS



Unfortunately, herbicide application is the standard method for dealing with unsightly nuisance vegetation in water. Dying plants may cause oxygen depletion and over time, the dead biomass accumulates on the pond bottom, replacing sandy sediments with organic muck.

In a study of the Indian River Lagoon, Trefrey (8) reports that about 20% of the bioavailable forms of nitrogen and phosphorus enter the water column as upland run off,
22% comes via base flow seepage through the substrate and
40% of the NH_4 and PO_4 in the water comes from “muck flux”, released by decomposing organic matter stored in the sediments, resulting from erosion and herbicide treated biomass.

The most common method for addressing nutrient pollution in storm water is through the detention of runoff in created ponds or passive wetlands (STAs). Stewart notes that the inherent flaw in these systems is that, while they may retain nutrients through precipitation, adsorption and sedimentation, most of the stored nutrients are still present.(7). Drescher reports that storm water ponds in South Carolina frequently accumulated contaminants, sediments and nutrients at a higher rate than direct runoff, prior to discharging to waters of the State.(1).



Beemats are active biological treatment systems that utilize macrophyte plants to remove phosphorus from water, the same way terrestrial plants deplete phosphorus from soil. The roots and attached biofilm are suspended in the water below the mats, where they accumulate and store soluble nutrients. The plants and biofilm are periodically harvested and the nutrients that have been sequestered in the biomass are removed and recovered. The removal rates can be directly measured as a percentage of the collected biomass.

Clemson University

2008 – 2010 Study by Dr. Sarah White (9)

4.5 g P/m^2/yr. (70.99 lbs. P/ac/yr.)

51.5 g N/m^2/yr. (459.48 lbs. N/ac/yr.)

		Nitrogen		Phosphorus	
		2008	2009	2008	2009
	Daily Load	(g/m²/day)		(g/m²/day)	
Pond	Inflow	11.7 (4.02)	362.09 (139.69)	3.01 (0.47)	12.30 (4.39)
	Effluent	4.15 (1.33)	39.62 (12.88)	1.09 (0.33)	4.54 (0.42)
Vegetated Channels	Inflow	44.0 (10.0)	674.46 (137.73)	11.7 (2.50)	42.60 (5.25)
	Effluent	18.5 (5.93)	230.39 (66.20)	2.36 (0.81)	17.27 (2.08)
	Concentration	(mg/L)		(mg/L)	
Pond	Inflow	0.55 (0.20)	8.96 (3.46)	0.08 (0.01)	0.30 (0.11)
	Effluent	0.12 (0.02)	1.12 (0.37)	0.03 (0.01)	0.13 (0.01)
Vegetated Channels	Inflow	0.70 (0.23)	3.95 (0.81)	0.07 (0.01)	0.25 (0.03)
	Effluent	0.03 (0.01)	1.69 (0.53)	0.02 (0.01)	0.13 (0.02)

Deep Creek

Fresh Water

2009 Study for SJRWMD (5)
19. 31 g P /m^2/yr (172.3 lbs. P/ac/yr.)
260 g N/m^2/yr. (2,319.71 lbs. N/ac/yr.)

Patrick Air Force Base

Fresh Water

2010 – 2011 Study by Dr. Harvey Harper (4)

25.0 g P/m^2/yr (223.0 lbs. P/ac/yr.)

45.4 g N/m^2/yr. (405.6 lbs. N/ac/yr.)

TABLE 37

CALCULATED AREAL NUTRIENT UPTAKE RATES FOR THE FLOATING BEEMAT ISLANDS

NUTRIENT	MEAN AREAL UPTAKE (g/m^2-year)
Nitrogen	45.4
Phosphorus	25.0

TABLE 38

COMPARISON OF PLANT NUTRIENT UPTAKE WITH NUTRIENT LOADINGS TO THE POND

PARAMETER	TOTAL NITROGEN (kg)	TOTAL PHOSPHORUS (kg)
Final Plant Uptake	4.22	2.32
Total Mass Load to Pond	69.0	16.0
Percentage of Incoming Loading Removed	6.1%	14.5%

Indian Hills Recreation Area

Fresh Water

Project for the City of Ft. Pierce – planted in 2014

20.76 g P/m^2/yr (185.25 lbs. P/ac/yr.)

188.5 g N/m^2/yr. (1,681.8 lbs. N/ac/yr.)

INDIAN HILLS RECREATION AREA
Replanting Schedule & Biomass Analyses

Name	Original Planting Date	Replant Date	# Months	Lab Sample #	Date	Biomass net Wt. (lbs)	Nitrogen (lbs)	Phosphorus (lbs)	Nitrogen Per Year (lbs)	Phosphorus Per Year (lbs)
Island 1	6/2014	1/2016	19	AZ00384	1/19/2016	9,940.00	268.38	39.74	169.5	25.1
Island 2	8/2014	2/2016	18	AZ01188	2/19/2016	11,170.00	312.76	31.28	208.51	20.85
Island 3	8/2014	3/2016	19	AZ02087	3/23/2016	11,400.00	228.00	30.78	144.00	19.44
Island 4	9/2014	4/2016	19	AZ02666	4/15/2016	11,040.00	309.12	29.81	195.11	18.83
Island 5	10/2014	7/2016	21	AZ05250	7/27/2016	13,800.00	276.00	27.6	157.71	15.77
Island 6	10/2014	6/2016	20	AZ04318	6/22/2016	14,020.00	224.32	19.63	134.59	11.78
Island 7	10/2014	6/2016	20	AZ04001	6/8/2016	13,980.00	264.64	20.97	152.78	12.58
Island 8	10/2014	11/2016	25	AZ07741	11/3/2016	11,900.00	238.00	28.56	114.24	13.71
Island 9	10/2014	11/2016	25	AZ07854	11/9/2016	12,120.00	218.16	23.03	104.72	11.05
Island 10	10/2014	11/2016	25	AZ08037	11/16/2016	14,319.00	214.79	28.64	103.1	13.75
Island 11	10/2014	9/2016	23	AZ06448	9/14/2016	12,240.00	159.12	19.58	82.96	10.22
Island 12	10/2014	9/2016	23	AZ06449	9/14/2016	13,720.00	219.52	23.32	114.53	12.17
TOTAL						149,649.00	2,922.81	322.94	1,681.80	185.25

Titusville Senior Center Park

Fresh Water

Project for the City of Titusville – planted in 2015
Two harvests / year
48.51 g $P/m^2/yr$ (432.79 lbs. P/ac/yr.)
401.14 g $N/m^2/yr.$ (3,578.97 lbs. N/ac/yr.)

Brevard County – Merritt Ridge

Saline

With Solar Bee - 13.72 g P/m^2 /yr. (122.42 lbs. P /ac / yr.)
114.33 g N/ m^2/yr. (1,020.04 lbs. N/ac / yr.)

Control - 4.51 g P/m^2/yr. (40.21 lbs. P/ac/yr.)
49.58 g N/m^2/yr. (442.35 lbs. N/ac/yr.)

Brevard County – Flounder Creek Rd.

Fresh Water

22.36 g P/m^2/yr. (199.49 lbs. P/ac/yr.)
146.15 g N/m^2/yr. (1,303.94 lbs. N/ac/yr.)

Brevard County – Huntington Blvd.

Saline

10.15 g P/m^2/yr. (90.52 lbs. P/ac/yr.)
101.48 g N/m^2/yr. (905.42 lbs. N/ac/yr.)

Brevard County – Lake George

Saline

13.06 g P/m^2/yr. (116.52 lbs. P/ac/yr.)
156.73 g N/m^2/yr. (1,400.0 lbs. N/ac/yr.)

Brevard County – Wickham Park

Fresh Water

32.83 g P/m^2/yr. (292.68 lbs. P/ac/yr.)
371.12 g N/m^2/yr. (3,308.76 lbs. N/ac/yr.)

Martin County – Old Palm City

Saline

Two Harvests per year

56.26 g P/m^2/yr. (501.98 lbs. P/ac/yr.)
156.44 g N/m^2/yr. (1,395.76 lbs. N/ac/yr.)

Beemats Floating Treatment Wetlands have several advantages over passive storm water treatment systems. The storage of phosphorus in the sediments of storm water detention ponds does not mean removal from the system (7). Likewise, accumulation of phosphorus within STAs or in the biomass of rooted shoreline vegetation and non-harvestable floating wetlands does not equal removed phosphorus (6), (7). Phosphorus storage in those systems averages 7 to 10 lb/ac/yr (2), while phosphorus removal rates in harvestable floating treatment wetlands are 70 to200 lb/ac/yr.(3) (4) (5) (9) .

Beemats are portable and adaptable. It is easy to deploy them in any water body, from small ponds to canals or ditches within STAs, to natural lakes, estuaries or rivers. They are designed for easy harvesting and replanting. All of the plants and materials are re-useable or recyclable. The patented aerator pots are made of biodegradable plastic so the mature plants can be trimmed and installed along shorelines after they have performed their water cleaning duties. Some plants are also broken down to small pieces and re-grown for future floating wetlands, while the rest of the biomass is trimmed and composted. We recycle much of the compost by screening and mix it with peat to make potting soil at our native plant nursery.

Our floating wetlands only require 3 - 8% of the surface area needed by a storm water pond or STA to remove the same amounts of nitrogen and phosphorus. There are cost savings for infrastructure, real estate, earth moving construction and time.

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