

5TH ANNUAL CAPE COASTAL CONFERENCE

Pond Restoration and Elimination of Cyanobacteria Blooms



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December 6, 2017

PROBLEMS

- Eutrophication: Excess nutrients
(phosphorous)-> Algae blooms
- Cyanobacteria (Blue-Green Algae) can be toxic
Public Health Advisory
- Dissolved oxygen depletion -> Fish kills
- Species diversity reduced

ASSESSMENT

- Water Quality Monitoring
 - Field data
 - Water Samples – Lab analysis
 - Deployed Sondes
- Nutrients - Phosphorous
 - Sources: AECOM 2010

Santuit Pond Water Quality Data

Ponds and Lakes Stewards (PALS) 2001 -

Cape Cod Commission

Mashpee Environmental Coalition

UMass Dartmouth SMAST

Mashpee Water Quality Monitoring Program 2008 -

Mashpee Wampanoag Tribe

Town of Mashpee

UMass Dartmouth SMAST

Friends of Santuit Pond

Massachusetts Dept. of Environmental Protection 2009

Massachusetts Dept. of Public Health 2009 - 2013

MDPH

CDC

Santuit Pond Diagnostic Study 2009 - AECOM

YSI 6600 and EXO Sondes

PARAMETERS MEASURED:

- Chlorophyll
- Cyanobacteria Pigment -
Phycocyanin
- Dissolved Oxygen
- pH
- Salinity – Conductivity
- Temperature
- Turbidity

SAMPLING FREQUENCY:

- 15 Minute Intervals





**Santuit Pond Pre-treatment (2008)
Blue-green algae bloom**

Photo: Richard York



Santuit Pond Pre-treatment (2008)
Blue-green algae surface film

Photo: Richard York

Species of Cyanobacteria (Blue Green Algae) In Santuit

Dolichospermum smithii (= *Anabaena*)

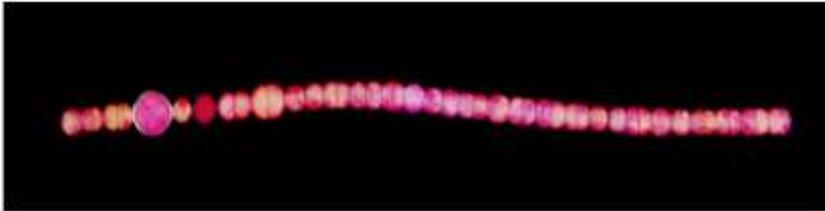


Photo: Barry Rosen USGS

Microcystis aeruginosa



Photo: Barry Rosen USGS

Aphanizomenon sp

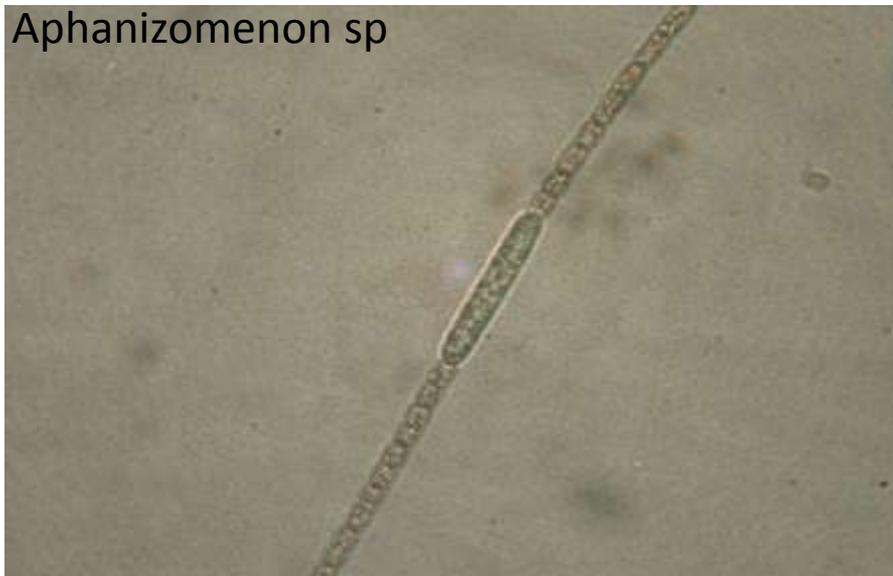


Photo: Richard York

Woronichia naegelina (= *Coelosphaerium*)

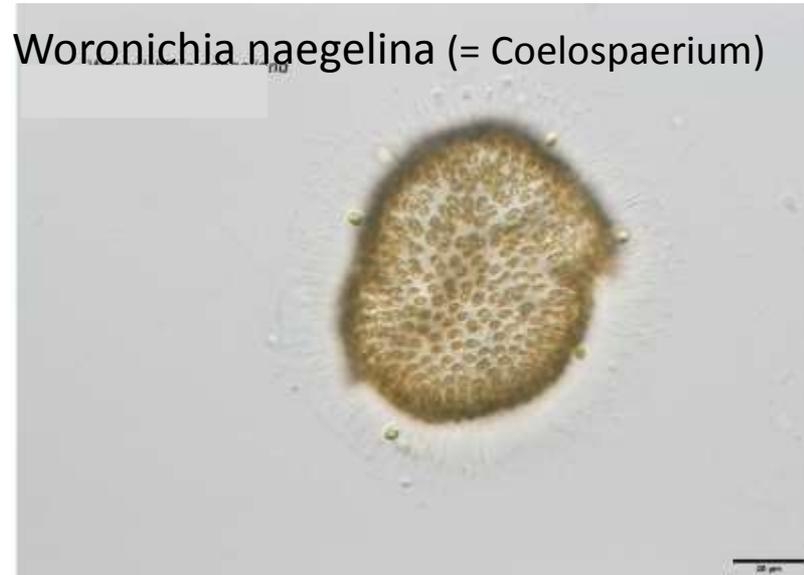


Photo: Barry Rosen USGS

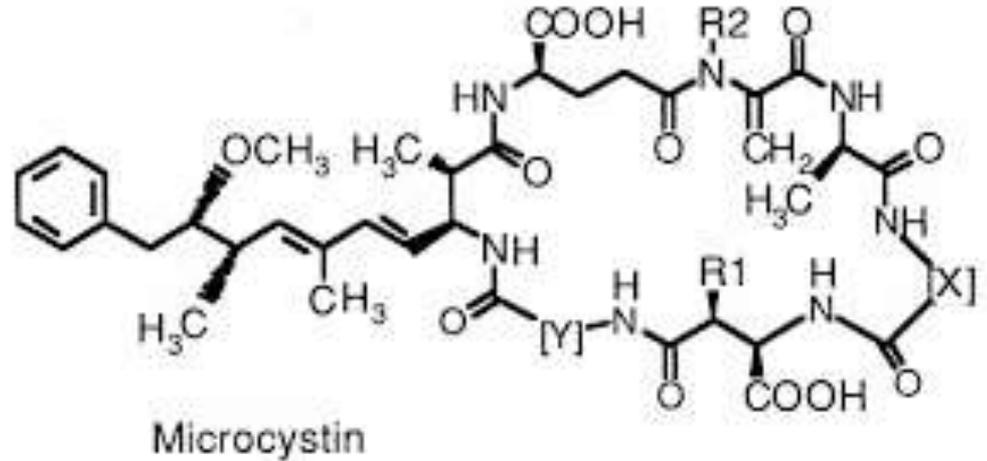
Microcystin Toxin

1990s Cliff Pond, Brewster:

Dog Mortality

2009-2013 Santuit Pond, Mashpee:

Mass. DPH Study – No toxin detected



HEALTH ADVISORY
≥ 70,000 cells/milliliter

Mashpee Health Department

Signs provided by Mass. DPH



CAUTION

PUBLIC HEALTH ADVISORY

CYANOBACTERIA BLOOM PRESENT



Waterbody Unsafe for People and Pets



Do not swim.



Do not swallow water.



Keep animals away.



Rinse off after contact with water.

Call your local health department with questions:



Additional info on algae can be found at:
www.mass.gov/dph/algae

REMEDIATION ACTIONS

- In Pond
 - Water Circulation – SolarBee Installation
- Source Reduction
 - Stormwater Catchment Installation



Santult Pond

■ Storm Water Catchment Installations
Mashpee DPW



Santuit Pond Diagnostic Study Mashpee, Massachusetts



Santuit Pond Phosphorous Loading

Summary (AECOM 2010, Table 6-5)

<u>TP Inputs</u>	<u>Modeled TP Loading (kg/yr)</u>	<u>% Total TP Load</u>
Direct precipitation	17	5
Internal [sediment]	297	78
Waterfowl	3	1
Septic Systems	19	5
Cranberry Bogs	13	3
Watershed		
Surface runoff	18	5
Groundwater	<u>12</u>	<u>3</u>
	TOTAL	
	380	100

Santuit Pond Circulator Prediction

AECOM 2010

<u>Parameter</u>	<u>Pre-treatment</u>	<u>Post-treatment</u>
P Load (kg/yr)	380	180*
TP (ug/L)	80	38

*Phosphorous load from sediments (78 % of total load) predicted to be reduced by 67 % after circulation of oxygenated water to the bottom of the pond (52% reduction of total load). Oxygenated sediments release less phosphorous than anoxic sediments.

SANTIUT POND

SolarBee Locations

SolarBee units not to scale.

Santuit Pond –

170 acres

9 foot maximum depth

5 foot average depth

Groundwater fed

Flushing rate 3 times/year

Watershed 1,250 acres



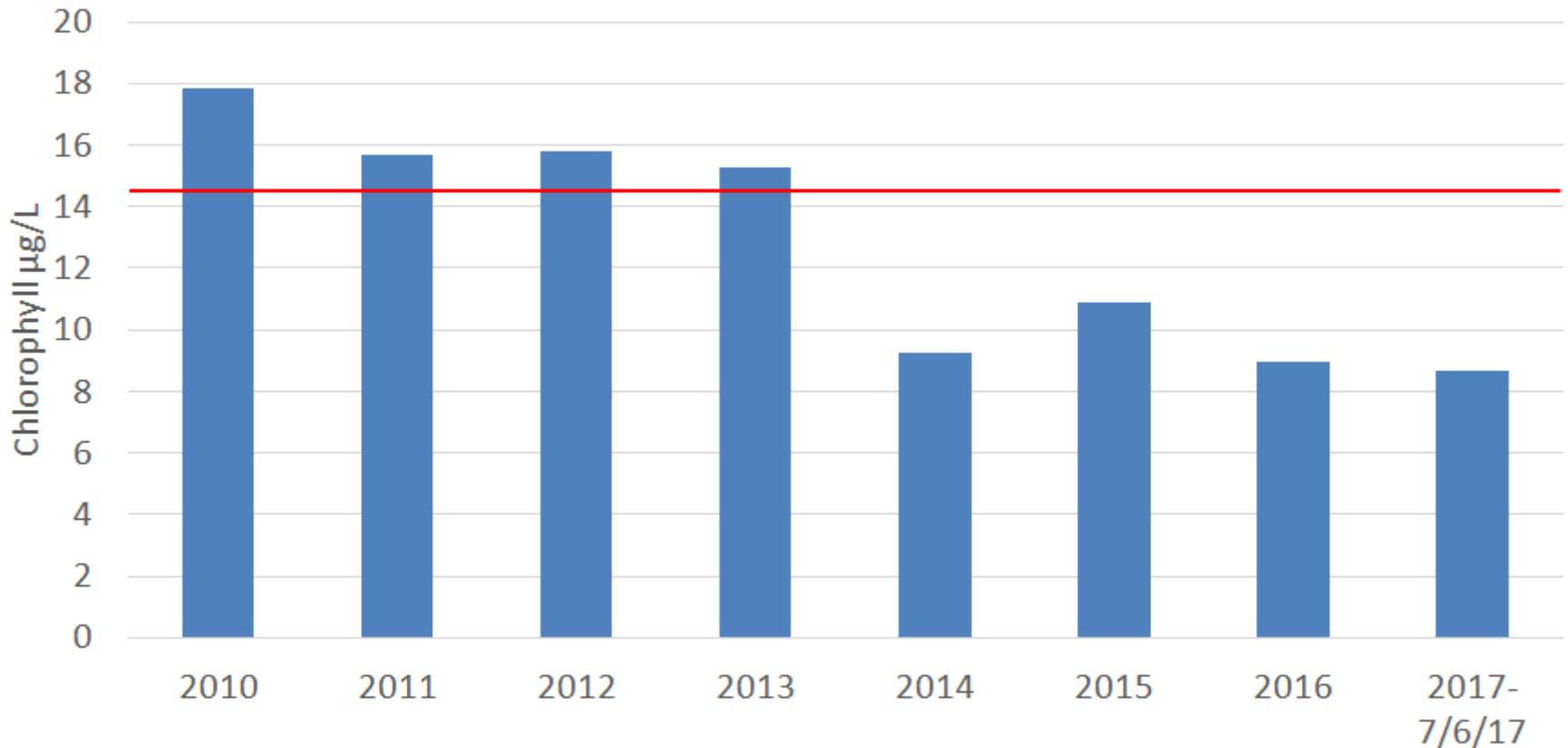
SolarBee in Santuit Pond



Effect of SolarBees on Santuit Pond

- | <u>Parameter</u> | <u>Pre-deployment</u> | <u>Post-deployment</u>
2017 -> July 7, 2017 |
|---|----------------------------|--|
| Secchi Visibility (m)
(Summer average) | 0.52 | > 2.8 See bottom |
| Algal Surface Film | Present | Absent |
| Chlorophyll (ug/l)
(average) | > 14 | < 10 |
| Total Phosphorous | 80 | 20 |
| Fish health | Reduced
(No fish kills) | Healthy |

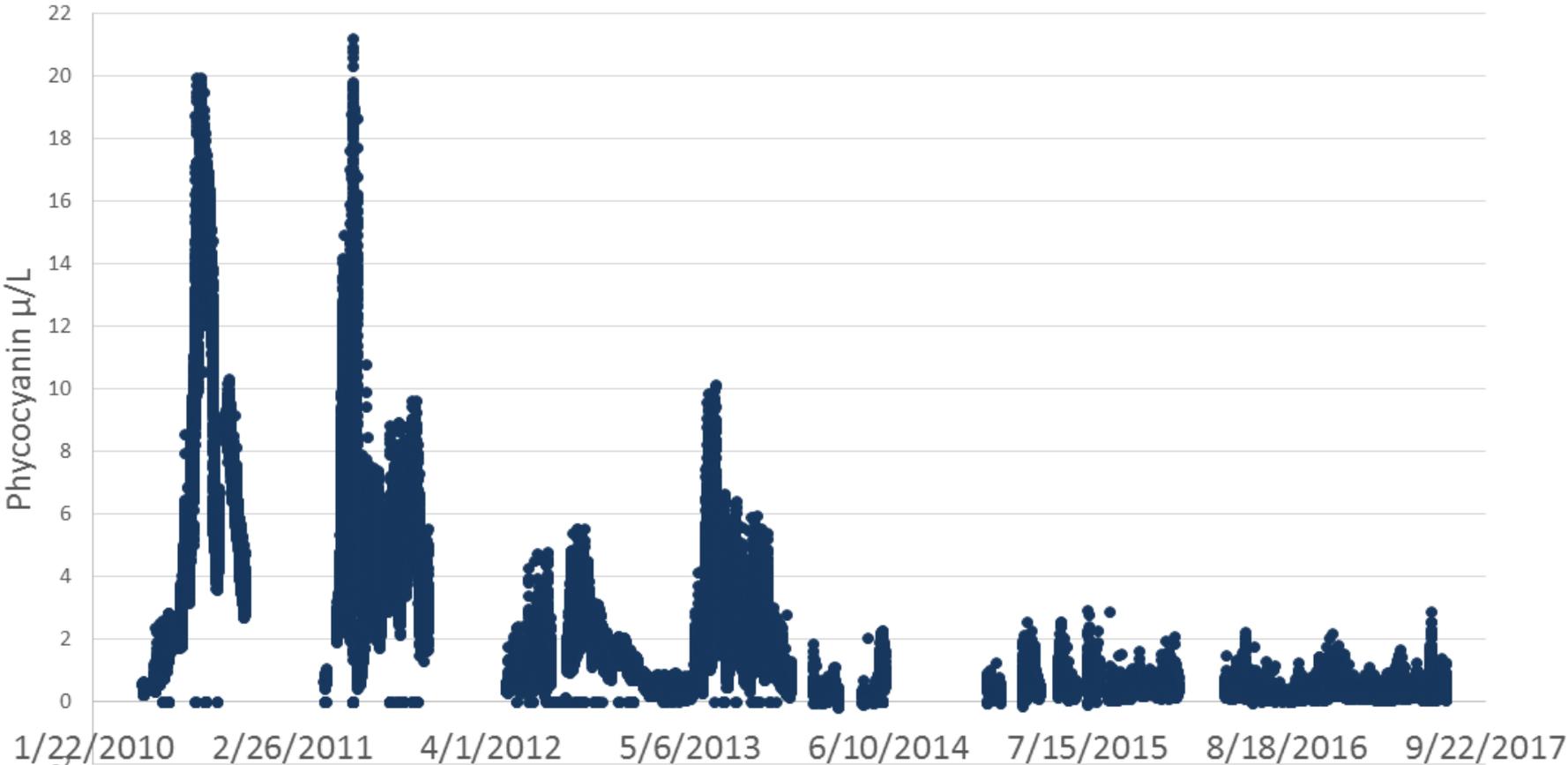
Santuit Pond Average Chlorophyll Concentrations 2010-2017



International Eutrophication Level: $\geq 14.3 \mu\text{g/L}$ average Chlorophyll a

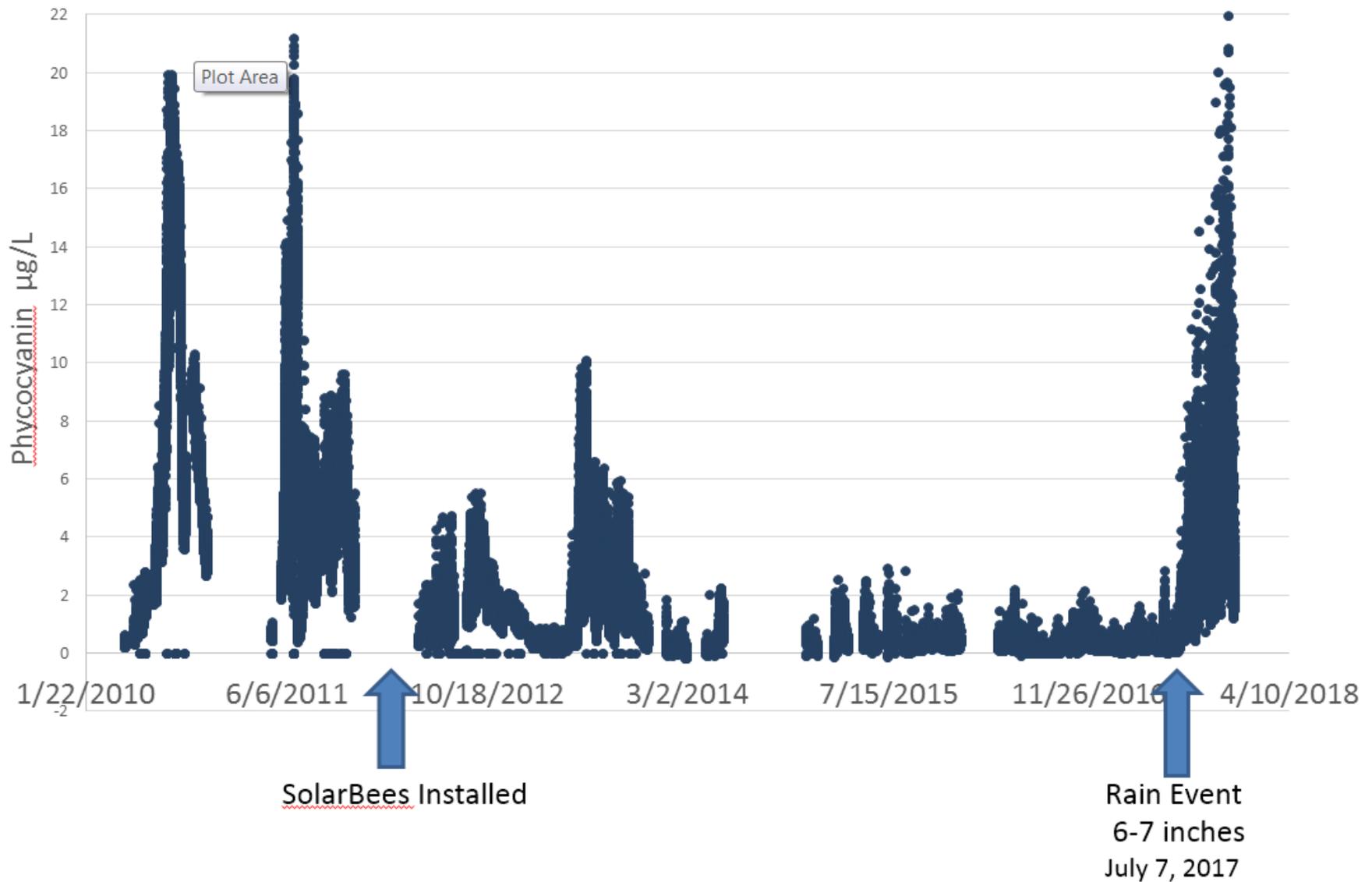
Lakes and reservoirs. Vol. 3: Water quality: the impact of eutrophication. (2000). Shiga, Japan: UNEP-International Environment Technology Centre (IETC) ; International Lake Environment Committee Foundation (ILEC)

Cyanobacteria (Phycocyanin Concentration)



SoalrBees Deployed

Cyanobacteria (Phycocyanin Concentration)



Santuit Pond After Rain Event July 2017



PROGNOSIS

- Cyanobacteria bloom will die off winter 2017
– 2018

Cells will settle to the bottom and decompose

- No algae blooms – Summer 2018

SolarBee water circulation will limit phosphorous flux to water from sediment (decomposed algae).

No blooms until another extreme rain event
(Previous extreme rain event (6") 1998)

Collaborators:

- Friends of Santuit Pond
- Mashpee Environmental Coalition
- Mashpee Wampanoag Tribe Natural Resources Dept.
- Massachusetts Department of Public Health
- Town of Mashpee
- University of Massachusetts Dartmouth SMAST