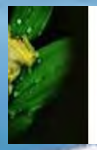
BRINJAC
ENGINEERING
since 1955

LAKE SAVERS™



Floating Island SE
Cleaning Water Natures Way

STEWARDSHIP OF THE SUSQUEHANNA RIVER:

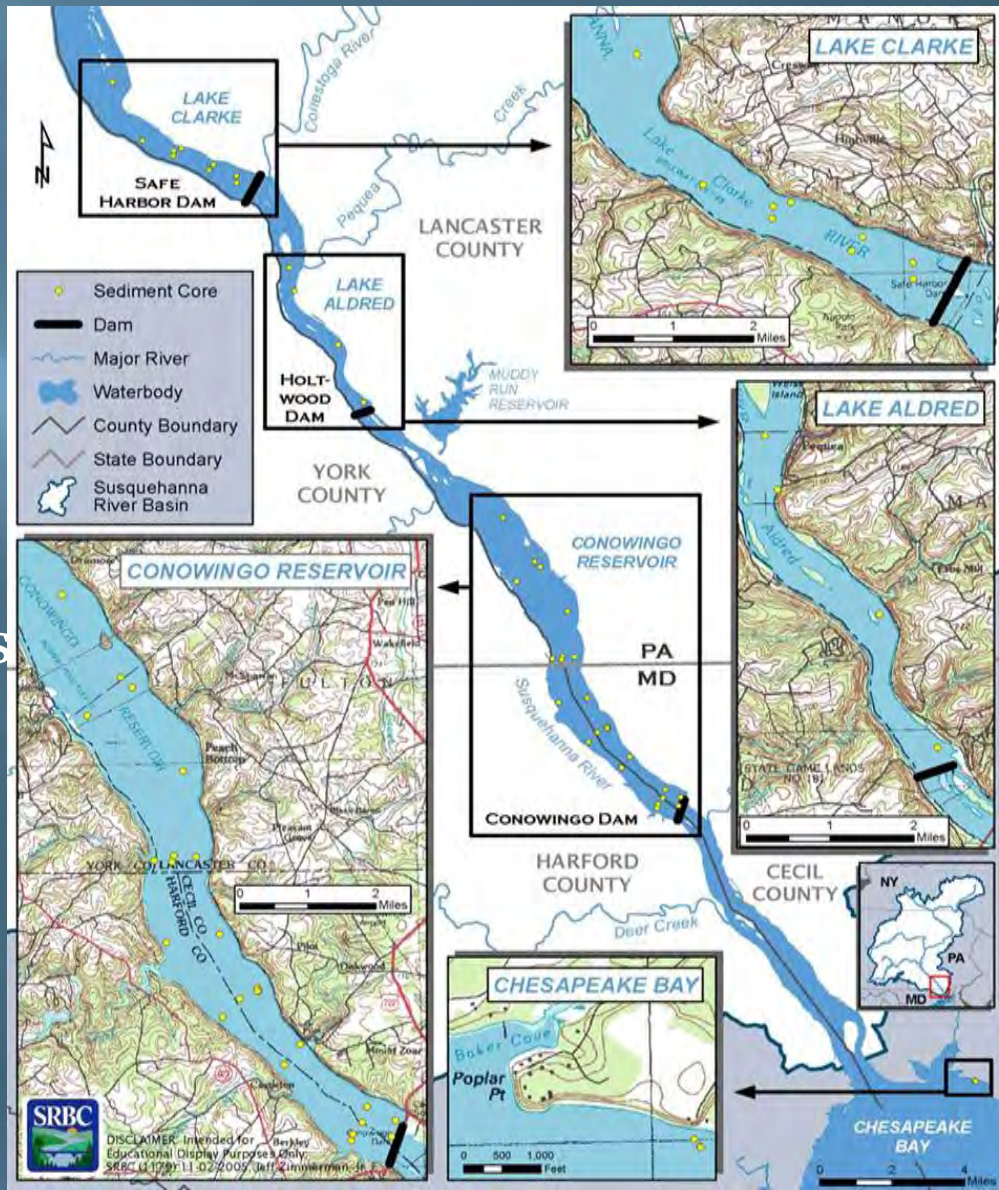
THE KEYSTONE TO RESTORATION

PSALM 24:1 THE EARTH IS THE LORD'S AND THE FULLNESS THEREOF

SEPTEMBER 24, 2012 MDE

Keystone : Dams on the River

- The Chesapeake Bay Agreement called for a 40 percent reduction in controllable nutrients in the Susquehanna River discharge.
- The Lower Susquehanna houses three large hydroelectric dams: Trapping of the nutrients and sediments in a reservoir system formed by the dams was part of this strategy.
- While effective, recent data suggests this strategy is reaching its useful life.

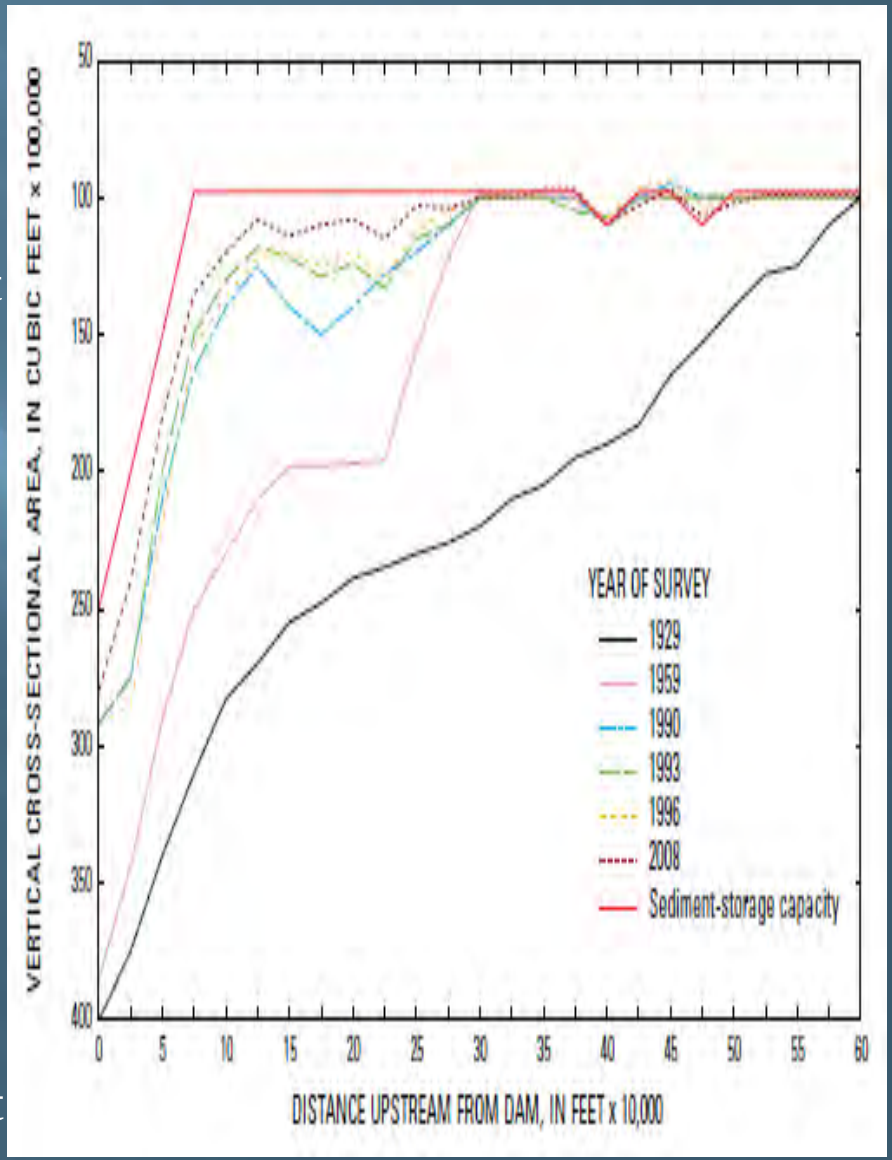


Sediment And Nutrient Changes In the Susquehanna River and Chesapeake Bay

- USGS study: 25% nutrient reduction in upper portion of the Susquehanna River watershed. 50% of total pollutant load in river is in last 80 miles of the lower watershed.
- Bay impact from 1996 to 2011:
  - Phosphorus has increased 55%
  - Sediments have increased 97%
  - Nitrogen has decreased 3%
- In 2011, more Phosphorus and Sediment delivered to Bay than any other year since monitoring began in 1978
- 2011 Tropical Storm Lee delivered a large fraction of the Bay's inputs for the past decade:
  - 2% of total water
  - 5% Nitrogen
  - 22% Phosphorus
  - 39% Sediment

Sediment Behind the Conowingo Dam

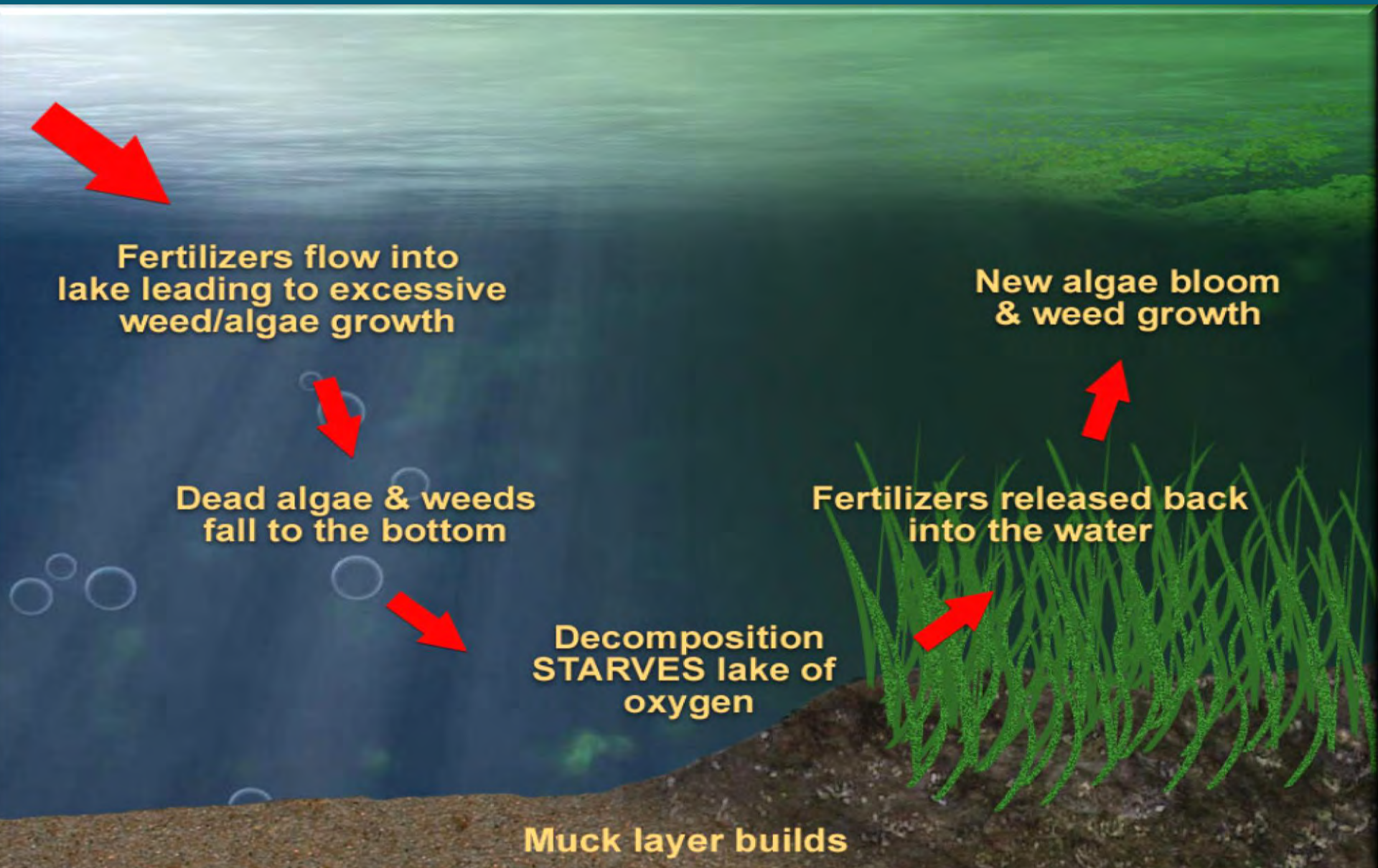
- USGS monitoring data by Bob Hirsch and colleagues indicates that scouring (Of Nutrients/Sediment Behind the Conowingo Dam) may be taking place during lower river flows, perhaps between 200,000 and 300,000 cubic feet per second.
- 2010: Nutrient loads during January, March, October, and December accounted for 62-64 percent of the annual TN load, 69-77 percent of the annual TP load, and 83-91 percent of the annual SS load. (Rain Events)
- That might explain a reversal in phosphorus trends on the river. A steady decline in the phosphorus concentrations monitored at the dam halted in the mid-to-late 1990s, and concentrations have slowly risen the last decade.



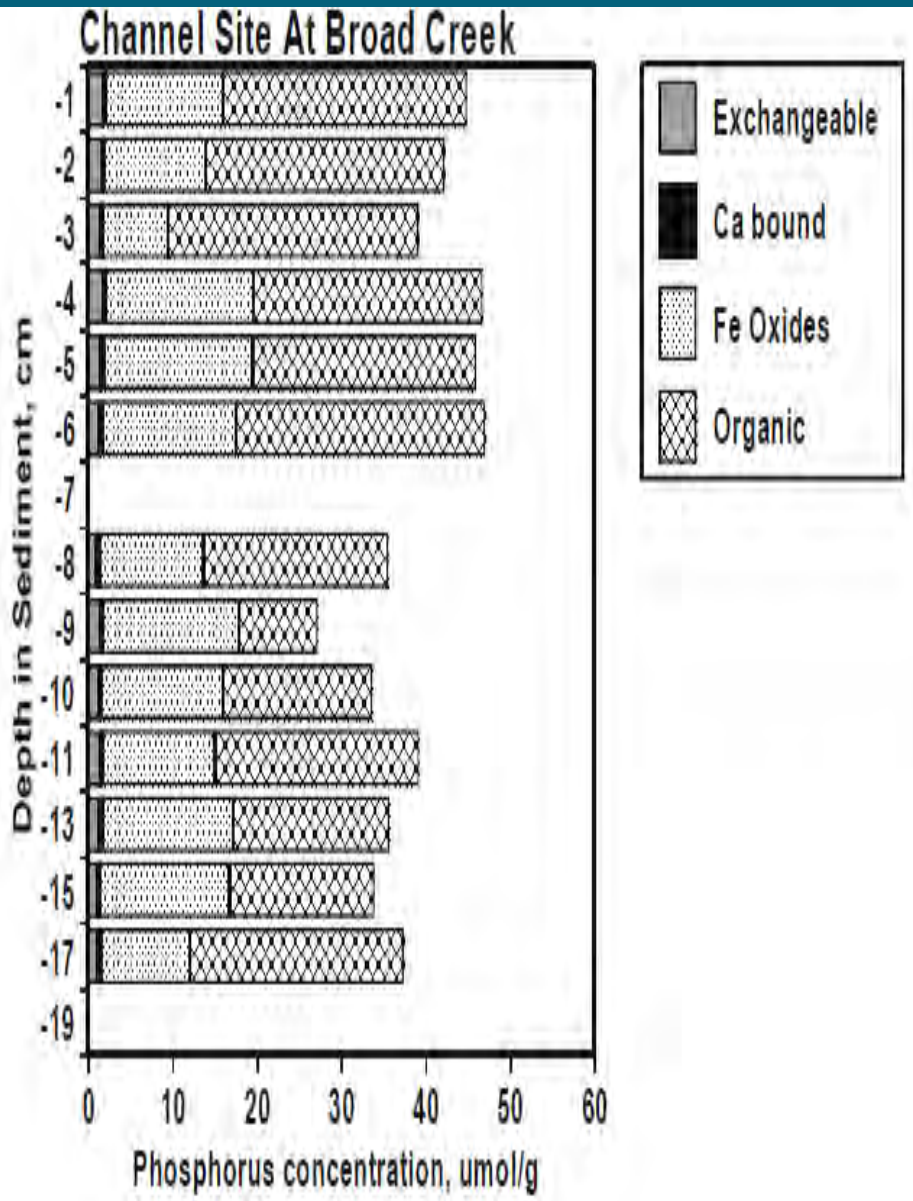
Sediment Behind the Dams: Additional Impacts

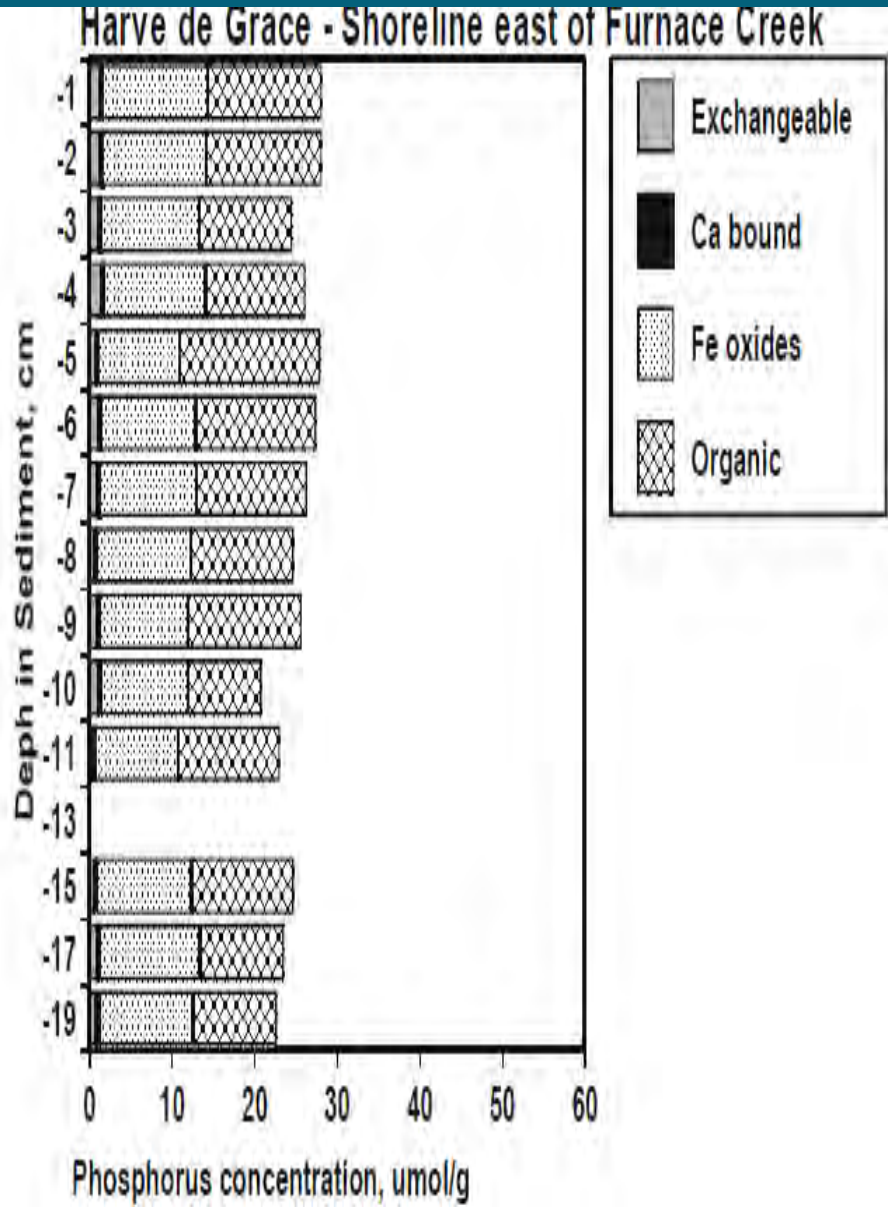
- The Baltimore City's Susquehanna intake is located in the Conowingo Pool, just upstream of the dam.
- Spring and Summer both Temperatures and DO typically range from 23 to 28 degrees Celsius from bottom to surface And DO from 0-8 mg/L (PPM) Causes Aquatic Plant Die-off, Producing Higher Total Organic Carbon (TOC) Levels.
- The resulting drop in DO levels can cause taste and odor problems for drinking water supplies, due to increases in nutrient input to the reservoir and the resulting algal problems.
- Mortality of Small Mouth Bass (YOY) first-year fish. These factors have resulted in a marked decrease in the population, concerning staff biologists and anglers alike. PA F&BC 2011 Report.

Reservoir River Fertilization Process



Study of Phosphorous In Sediment Behind the Conowingo Dam Versus In Bay



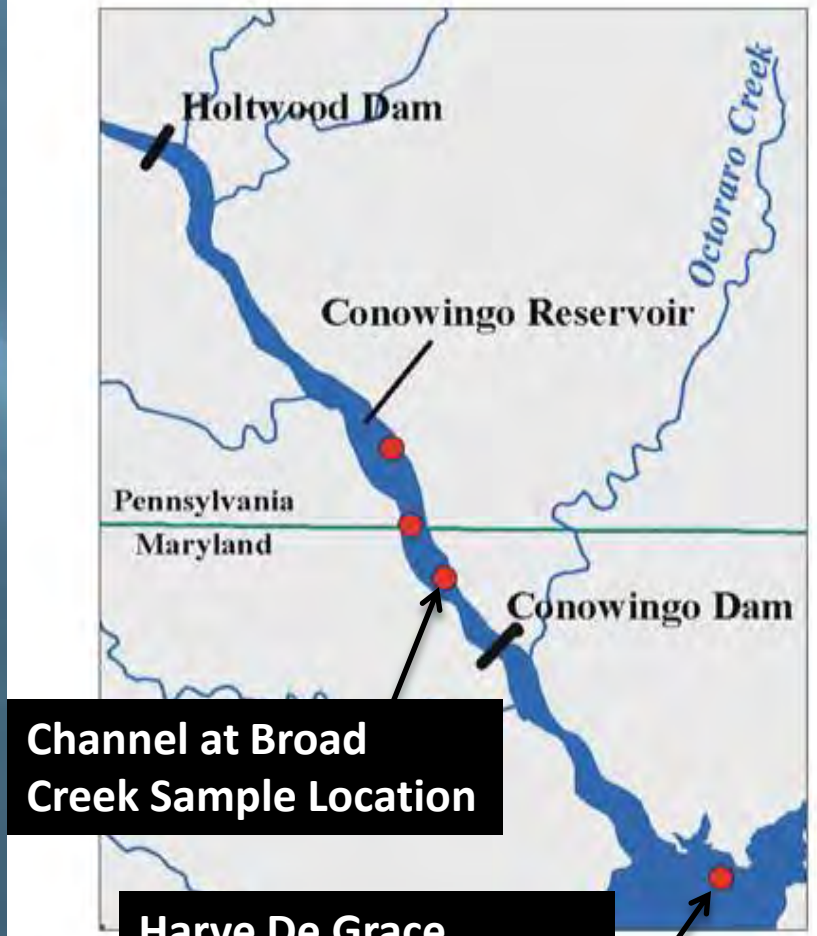


Study of Nutrients and Pollutants In Sediment Behind the Conowingo Dam

- Before dredging can be considered an option, occurrence and distribution of toxic substances within the sediments must be evaluated/treated.

- Some of the largest concentrations of organic phosphorus found in the samples collected for this study were those in bottom sediments from the channel site at Broad Creek in the Conowingo Reservoir.

- The Susquehanna River appears to be the main source of PCBs to the upper Bay while pesticides and PAHs appear to be trapped behind the dams.



Dredging Behind Dams Will Not Work Without Some Preliminary Treatment

- **Dredging does not solve the root problem**
- **Cost prohibitive**
  - **$44M+ annually**
- **Not effective on "muck**
  - **Re-releases surge of nutrients into the Bay**
  - **Leaves a lot behind**
  - **Trauma to food web**
  - **Pollutants in Muck**

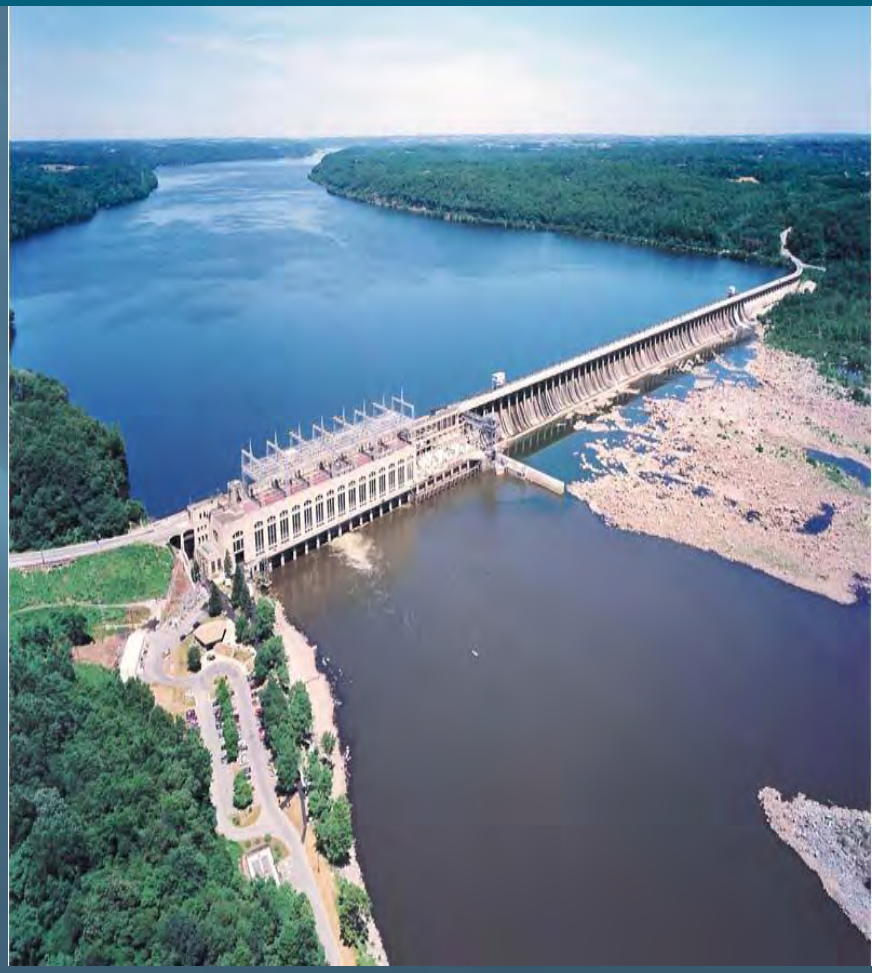
Dams: Keystone To Restoration

Current Reality

- **Safe Harbor, Holtwood and Conowingo Dams are huge liabilities in Nutrient / Sediment /Pollutant Concentration and Loading to Bay.**

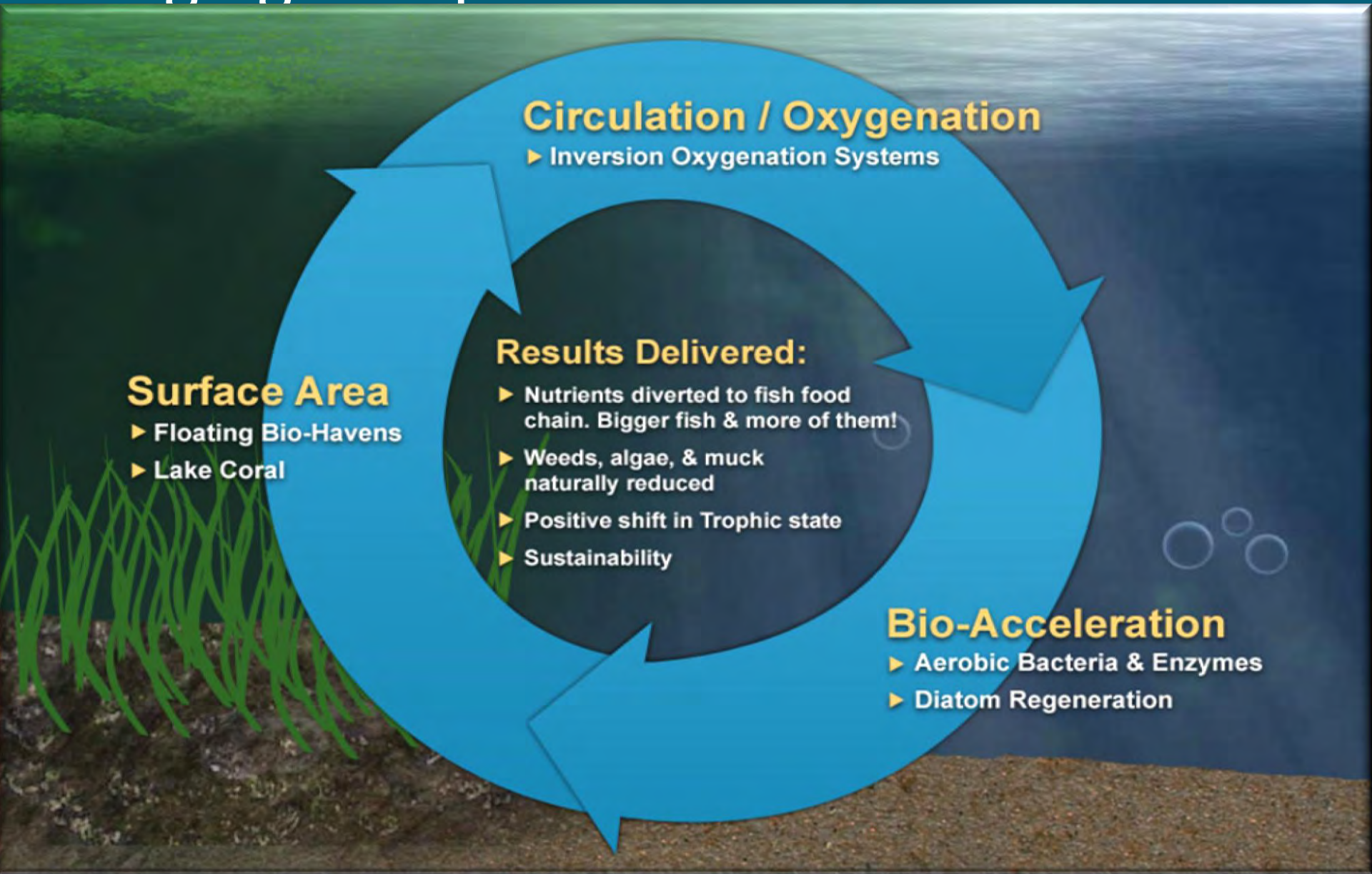
Strategic Vision

- **Safe Harbor, Holtwood and Conowingo Dams are transformed into concentrated "Restoration Zones" for farming nutrients and growing fish while reducing bottom sediment biologically! (System Wide Approach To River and Bay Restoration – ASACE Goals/EPA/PA/MD)**

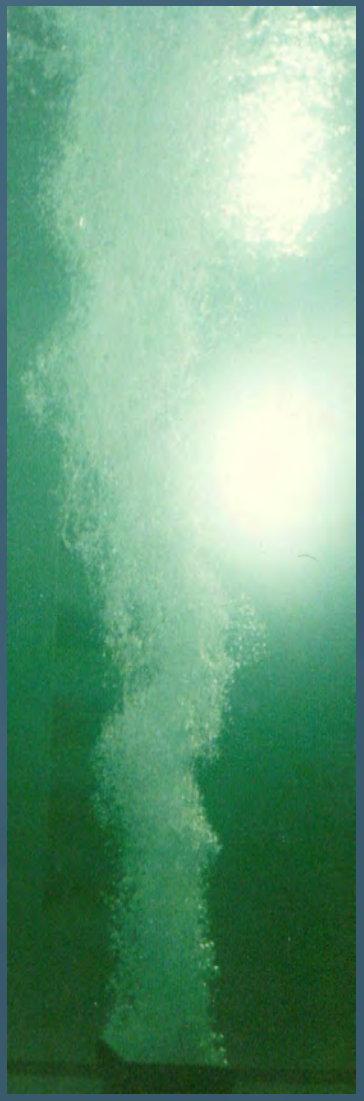



“Biomimicry:
duplicating GOD’s design in a
sustainable, efficient and powerful way
to achieve impeccable environmental
stewardship,
for the benefit of all life.”

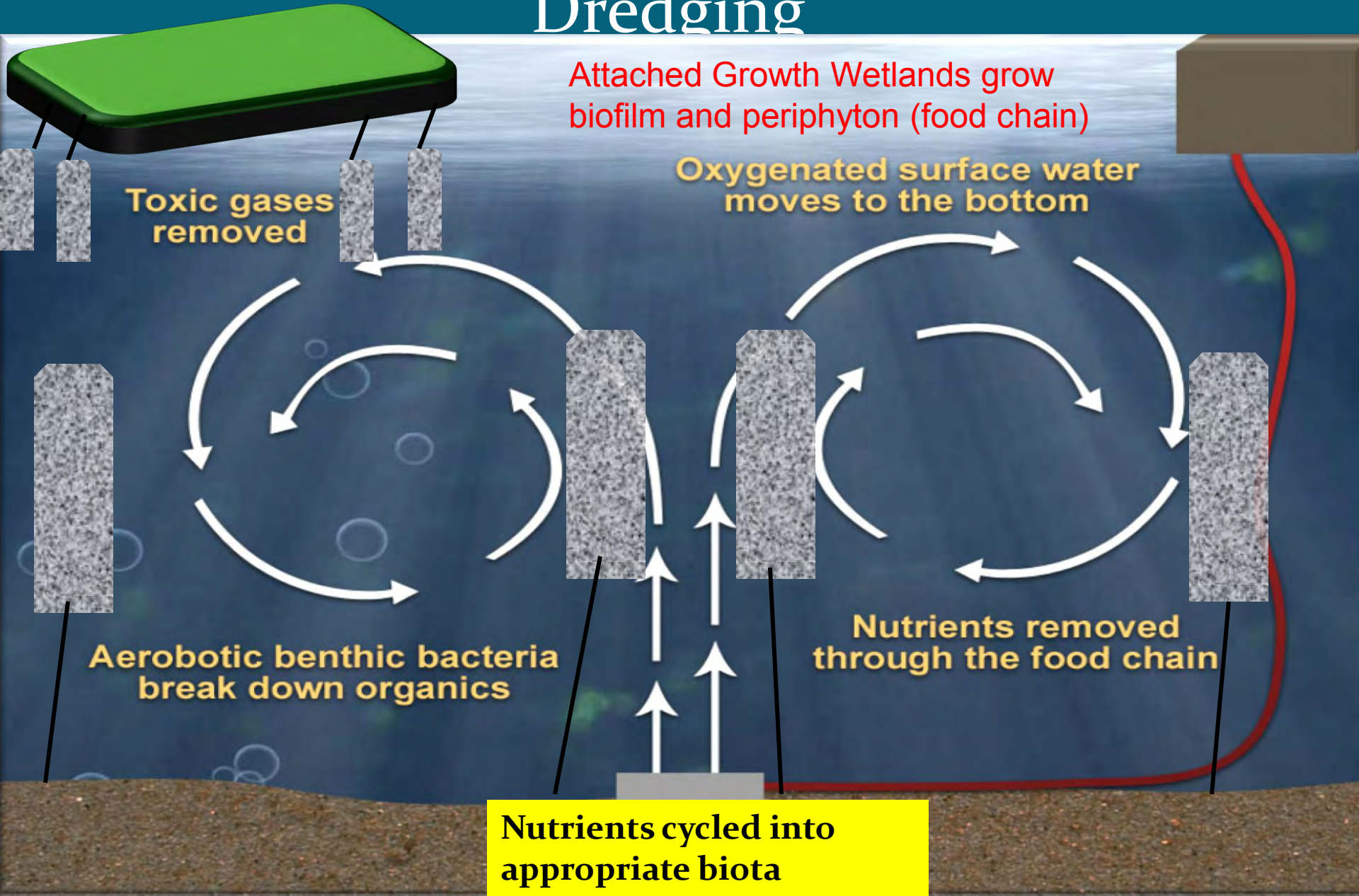
Concentrated Wetland Effect..Biological Dredging Compliments Conventional



Biological Dredging: Circulation/Oxygenation: Laminar Flow Oxygenation



Concentrated Wetland Effect…Biological Dredging



Inversion Oxygenation Equipment

Compressor with enclosure Cover off

Compressors Enclosure Cover

Self-Sinking Airline

Diffuser with Optional Float

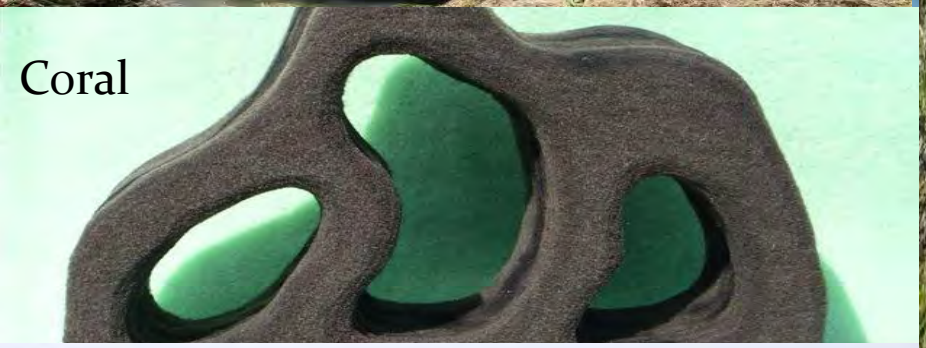
Biological Dredging: Surface Area - Wetlands

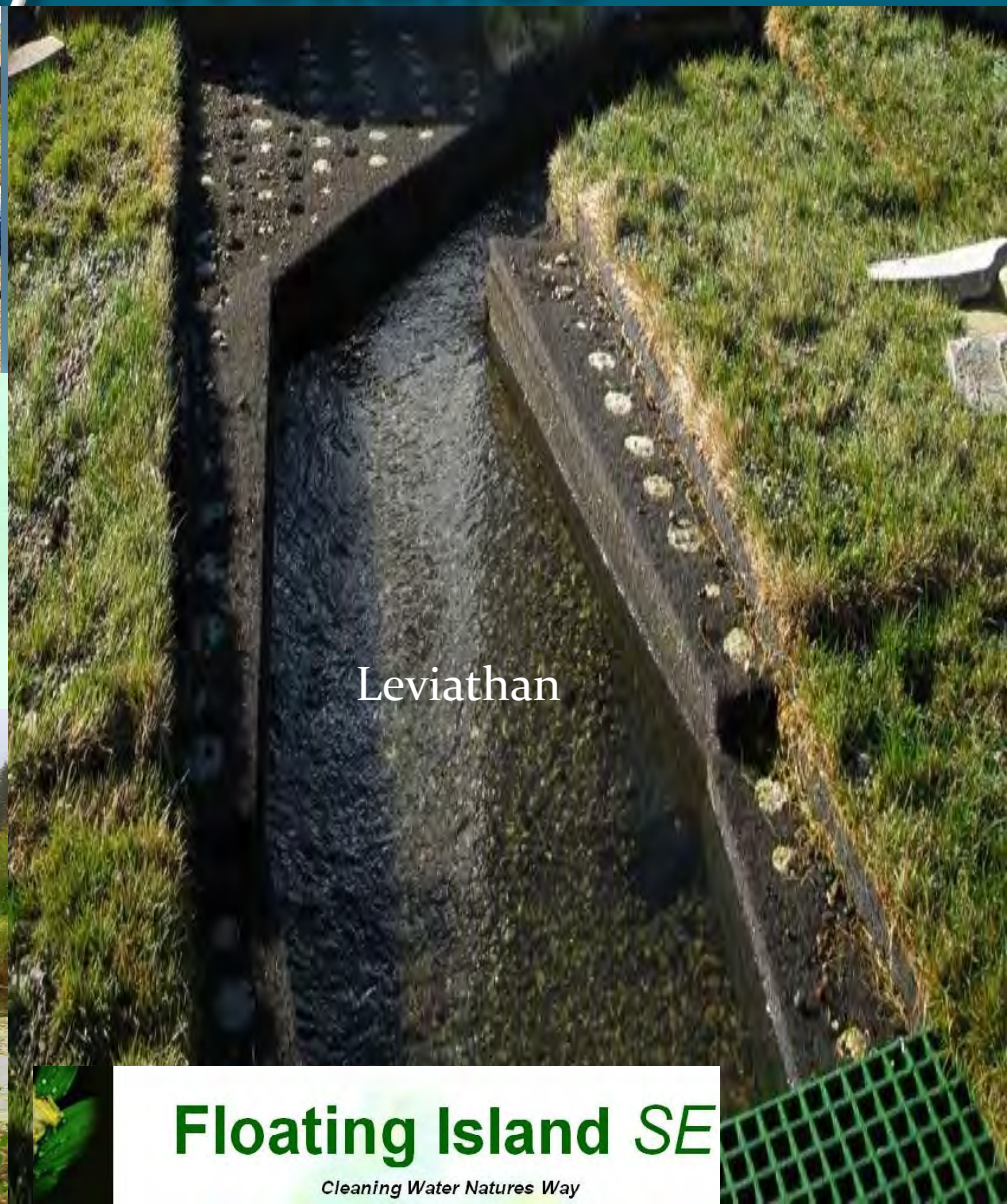
- Every cu ft of matrix yields 375 sq ft of surface area for biofilm growth…….

Nature

FLOATINGISLANDINTERNATIONAL®

Biological Dredging: BioHaven Technology - Wetlands





Biological Dredging: BioHaven Technology - Wetlands

Biological Dredging: BioHaven Technology - Wetlands

Biological Dredging: BioHaven Technology - Leviathan

Biological Dredging: BioHaven Technology: Leviathan

Biological Dredging: Produced Results

- Reductions in organic sediment depth of 8” to 15” are typical in Northern Climates per year in static reservoirs. Rivers may be similar.
- Potential 50% reductions in total Phosphorus in sediment over 24 months as nutrients are cycled into periphyton and biofilm and ultimately to fish.
- Potential 66% reductions in Ortho-Phosphorus over 12 months.
- Reduction in Ammonia nitrogen in the water column and sediment boundary as well as other pollutants/gases.
- Confirmed ability to stimulate Diatom Growth in a variety of aquatic environments. (This is building block for aquatic food web)
- Confirmed increase in zooplankton populations within 7 days of Diatom Regeneration Dosing.
- Lake Savers results documented and verified by independent third party review on numerous projects by CLE Engineering and CH2MHill.
- Floating Islands Technology supported by : Alden Labs Hydrualic Analysis for Design; Dr. Al Cunningham – center for Biofilm Engineering; EPA

Biological Dredging Sample Projects

BioHaven Technology: Floating Islands, Coral , Leviathan Projects:

- **Since 2005 Floating Islands has launched more than 4600 islands**
- **Largest islands – Leviathans in excess of 50,000 ft2 in waterways > Conowingo Reservoir**
- **One (1) Biological Dredging system in 6.5 acre lake in Montana**
- **Floating Islands in Ocean – Atlantic and Pacific**
- **Coral installed on bottom of floating wetlands in Wiconisco WWTP, Wiconisco PA (2003)**

Lake Saver Technology: Diffusers

2010 Installs

- **Lake Benbrook Reservoir Fort Worth Texas – 800+ acre treatment area**
- **Indian Lake Dowagiac, MI – 86 acre treatment area**
- **Lake Bridgeport Reservoir Fort Worth, Texas – 700+ acre treatment area**
- **Massabesic Reservoir, Manchester, NH – 225 acres**

2011 Installs

- **Shickshinny Lake, Shickshinny, PA – 150 acre treatment area**
- **Lake Greeley, Greeley, PA – 150 acres**

2012 Installs

- **Toa Vaca Reservoir Puerto Rico, 800 acres**
- **Indian Lake Expansion Dowagiac, MI – 400 acres**

Biological Dredging Preliminary Design for the Conowingo Reservoir

Inversion Oxygenation Equipment

- 5 Compressors
- 620 12” Mico-Porous Diffusers
- 1.9 Million feet of Self-Sinking Airline

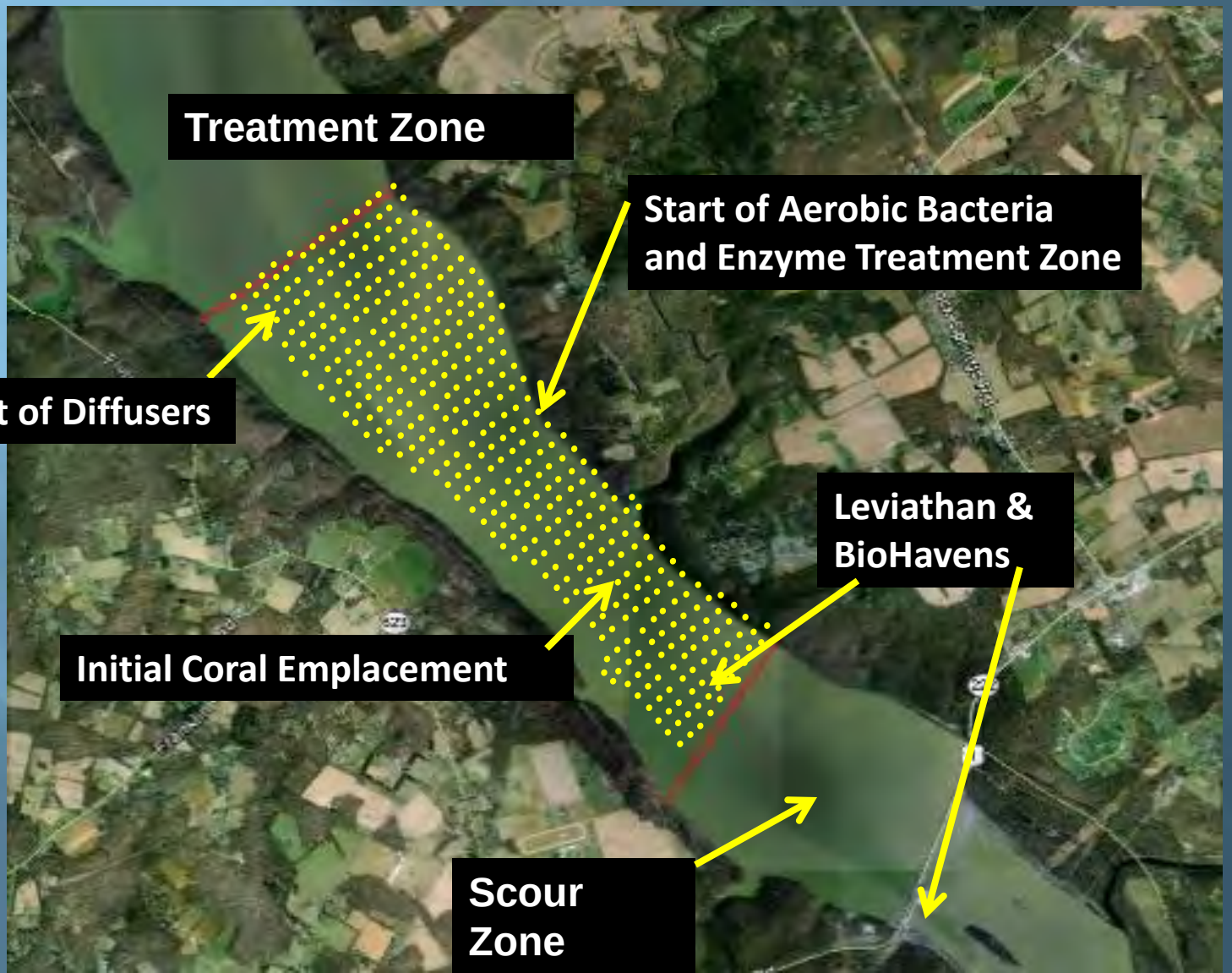
Lake Coral and Leviathan and BioHaven Biofilm Reactor Surface Area

- Coral - 6000 acres or 250 Million Sq Ft Surface Area
- 5 Leviathans/30 BioHavens, 72 Diffusers - 2500 Sq Ft Foot-Print/Leviathan or 1.25M Sq Ft Surface Area
- Aeration system on Leviathans – Double aeration /destratify with uplift tube with aeration on Leviathan platform. Anchor is mobile.

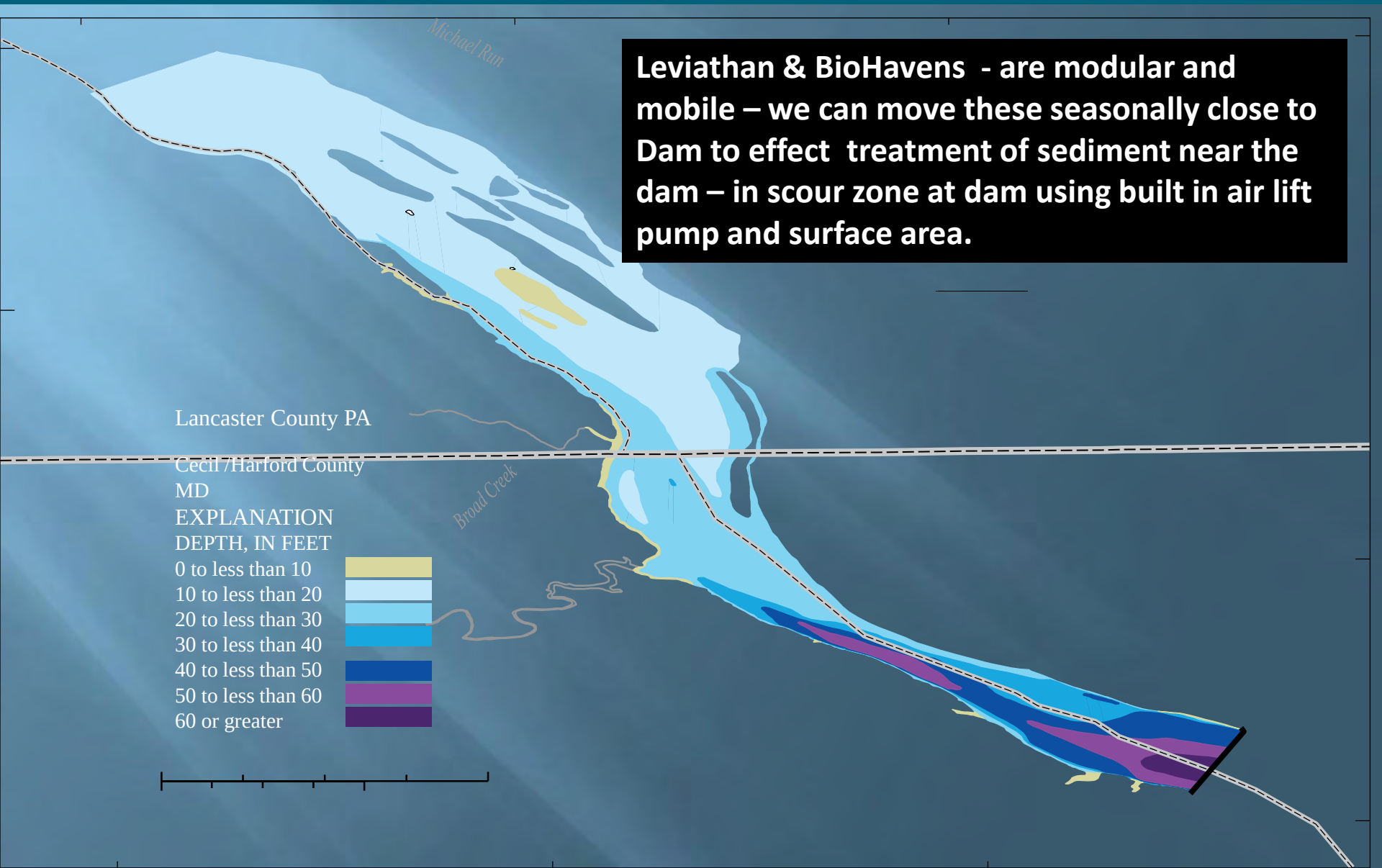
Biological Acceleration Treatment

- 1950 Gallons of Enzyme Treatment
- 1950 lbs of C-Flo Beneficial Bacteria
- 950 Liters of Nualgi Diatom Feed

Biological Dredging Preliminary Design for Conowingo Reservoir

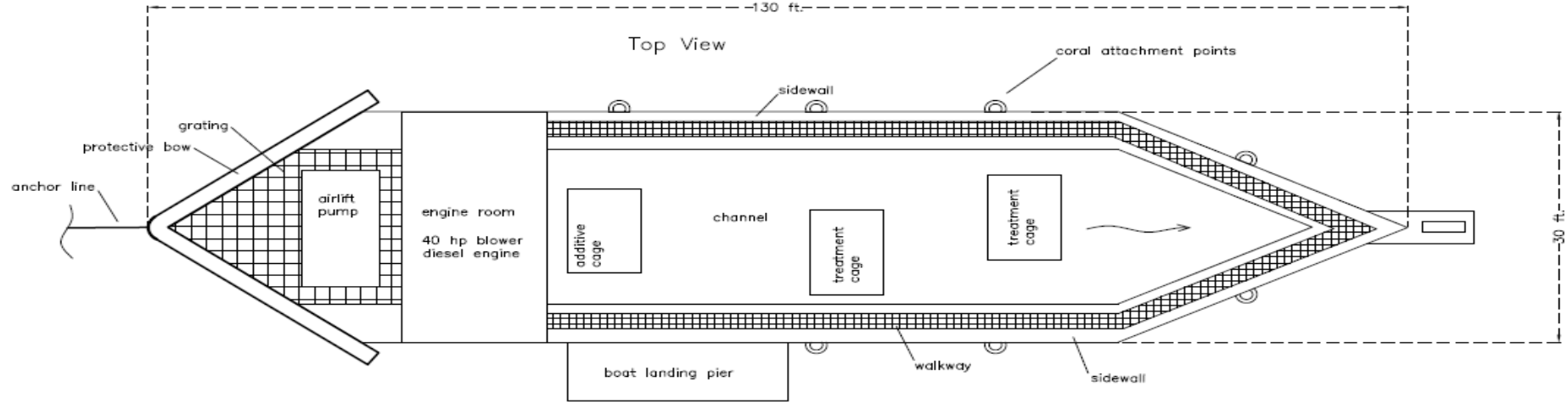


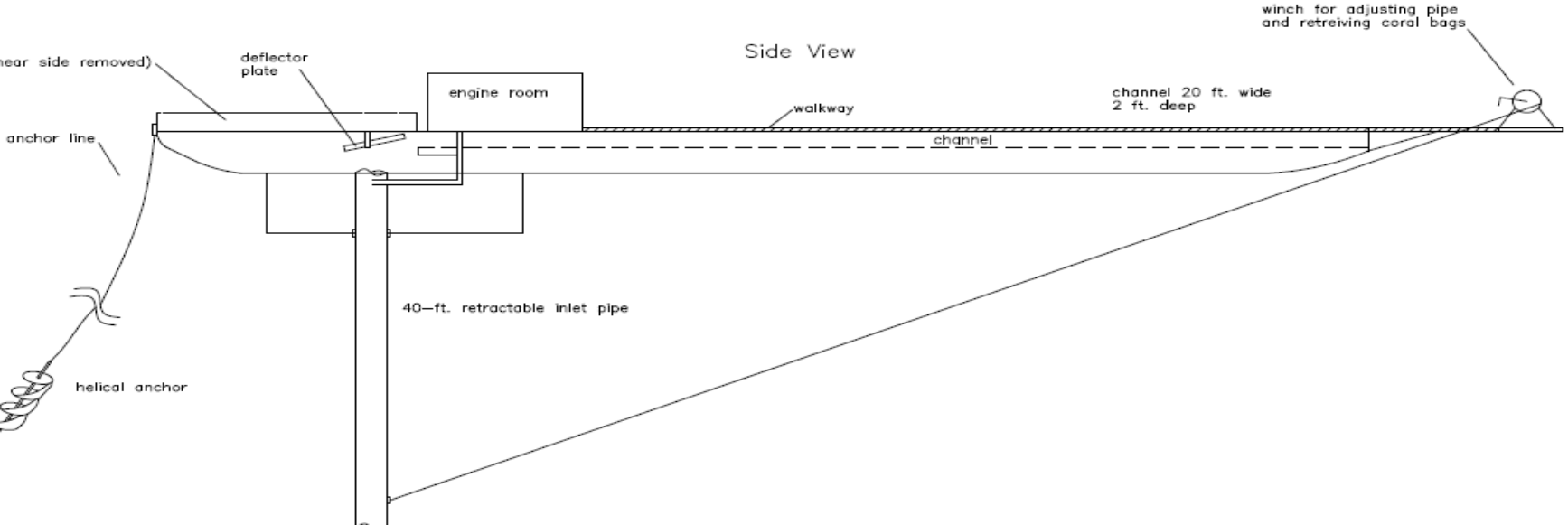
Water Depths Conowingo Reservoir



Leviathan & BioHavens - are modular and mobile – we can move these seasonally close to Dam to effect treatment of sediment near the dam – in scour zone at dam using built in air lift pump and surface area.

Biological Dredging: BioHaven Technology – Leviathan Conowingo





Biological Dredging Preliminary Cost Estimate for Conowingo Reservoir

Conowingo Reservoir (One Time Cost)

Inversion Oxygenation Equipment

- **$4.95 Million**

Lake Coral (Wetlands)

- **$7.8 million**

Leviathan Units (Wetlands)

- **$5 million**

Hydraulic Analysis for Engineering Design (Alden Labs)

- **$250,000**

Annual O&M Estimates

- **$650,000/year (Engineering /Modeling/Sample Analysis/Energy/Maintenance)**
- **$361,100/year – Biological Acceleration Treatment**

Comparison Of Biological vs. Conventional Dredging (Conowingo)

Biological Dredging

- $17.75 Million (one time)
- $250,000 (One-Time) (Engineering/Hydraulics)

Annual O&M Estimates

- $1,011,100/year

- Net Reduction In Sediment (Organic)
- Nutrient /pollutant Removal from Sediment
- Uptake of Nutrients from River
- Increased fisheries
- Decreased O&M cost With Turbines/Water Power Off-Grid
- Simple Technology – Minimal O&M
- Permits – Joint Permit USACE Water Encroachment /NEPA-Env. Assessment/MDE Water Permit

Conventional Dredging

- $44 Million/Year (Maintenance Only)

Sludge Disposal Costs

- $?? Unknown /Year

- NO Net Reduction In Sediment (Only Maintains Inventory at Current Levels)
- Nutrients NOT Taken Up But Distributed Into Water Column From Dredging
- Impact on Aquatic Eco-System – Negative Due to More Soft Silt Being Sent Into Water Column
- High Carbon Footprint, High Impact Environment
- Disposal Costs Could be More than Dredging Costs
- Permits- Joint Permit USACE Water Encroachment Permit /Fisheries-Aquatic EIS/MDE Permit/Disposal site E&S NPDES

Concentrated Wetland Effect/Biological Dredging = In Situ Treatment Of River

- Inert surface area – will have biofilm – in a few days
- High Potential for Verified Sediment Depth Reduction With No Mechanical Dredging
- Reduces Algae and Nuisance Water Plants
- TSS/TDS Reduction in River Flow
- Minimal O&M & No Sediment Disposal Costs
- Improves Fisheries While Oxygenating River (Top to Bottom)
- No Negative Impact to Dam or Water Way Use
- No harmful chemical biomediation
- Lowest cost nutrient reduction
- Makes Conventional Dredging More Effective Since Pollutants in Sediment Layer are Eliminated and Nutrients Reduced
- Potential Income Producer: PA/MD Nutrient Trading Credits

Additional Benefit: Annual Nutrient Removal By Biological Dredging

	Biological Removal Rate (lb/yr/ft3)		Biological Removal (lb/yr)	
Parameter	**Best**	**Average**	**Best**	**Average**
Total P	0.52	0.052	403,000	40,300
Total N	2.4	0.4	1,860,000	310,000
TSS	0.5	0.3	387,500	232,500
BOD	0.7	0.3	542,500	232,500

Questions & Answers

Biological Dredging: Floating Wetlands and Lake Savers

- BioHavens positioned at critical tributary inflow points on the Susquehanna represent particularly cost effective nutrient, TDS and TSS uptake locations. Brinjac Engineering, based on their long term relationship with Floating Island International, is well positioned to design around such systems, and optimization. One way to uptake TSS: biomechanical process by which islands clarify water -As suspended solids come into contact with biofilm, or periphyton, they tend to bond to it.
- BioHavens positioned over deep water locations, ideally situated on the target reservoirs, in combination with Lake-Saver/Clea-Flo aeration systems represent a means by which to cycle nutrients already in place, inventoried, in this waterway. Such nutrients inevitably resurrect, and must be appropriately stewarded. In addition, a separate effort to expose nutrients that flush into zones downstream of reservoirs will be proposed. Testing of optimal bacteria blends will be targeted in association with the channelization system described below.
- Floating Island International is Montana based, and BioHavens are winter hardy. In addition, Lake-Savers has a well established ability to manage both, its aeration systems and all embodiments of BioHaven floating islands, in northern climes. In addition, Lake-Savers is the foremost applicator of Floating Island International's latest embodiment of low cost substratum…trade named Fresh Water Coral. Lake-Savers is in place with a Pennsylvania division fully prepared to operate and maintain the BioHaven with or without aeration systems required to fix the Susquehanna.
- With over 4,600 BioHavens in place, many of which are in public waterways around the world, designing for safe, practical application on the Susquehanna is well within the team's scope.
- We will demonstrate that BioHavens represent a practical way to also tie up massive volumes of carbon in this project. In other words, we will put Pennsylvania on the map relative to being in the forefront around a realistic ability to sequester carbon associated with climate change.
- Demonstration of BioHaven systems, with aeration, can be in place in 2012. We propose a Leviathan reservoir launch by Nov. 30th keyed around winter hardiness questions. We also propose a pilot scale channelization system, by which to measure BioHaven nutrient efficacy relative to the Susquehanna's variable nutrient loading spectrum.

Proposal for Safe Harbor Dam

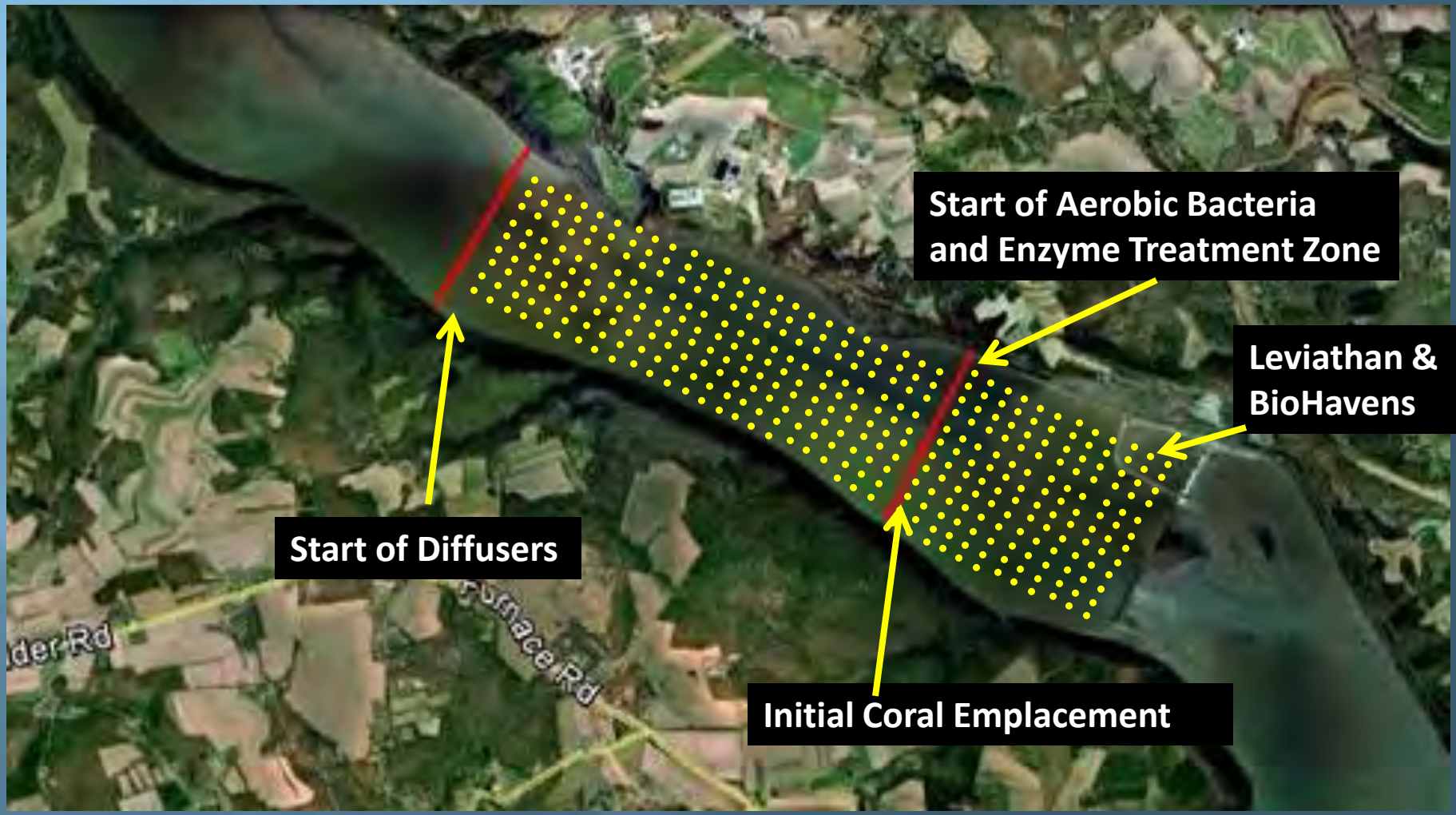
Inversion Oxygenation Equipment

- **4 Compressors**
- **400 12” Mico-Porous Diffusers**
- **550,000’ of Self-Sinking Airline**

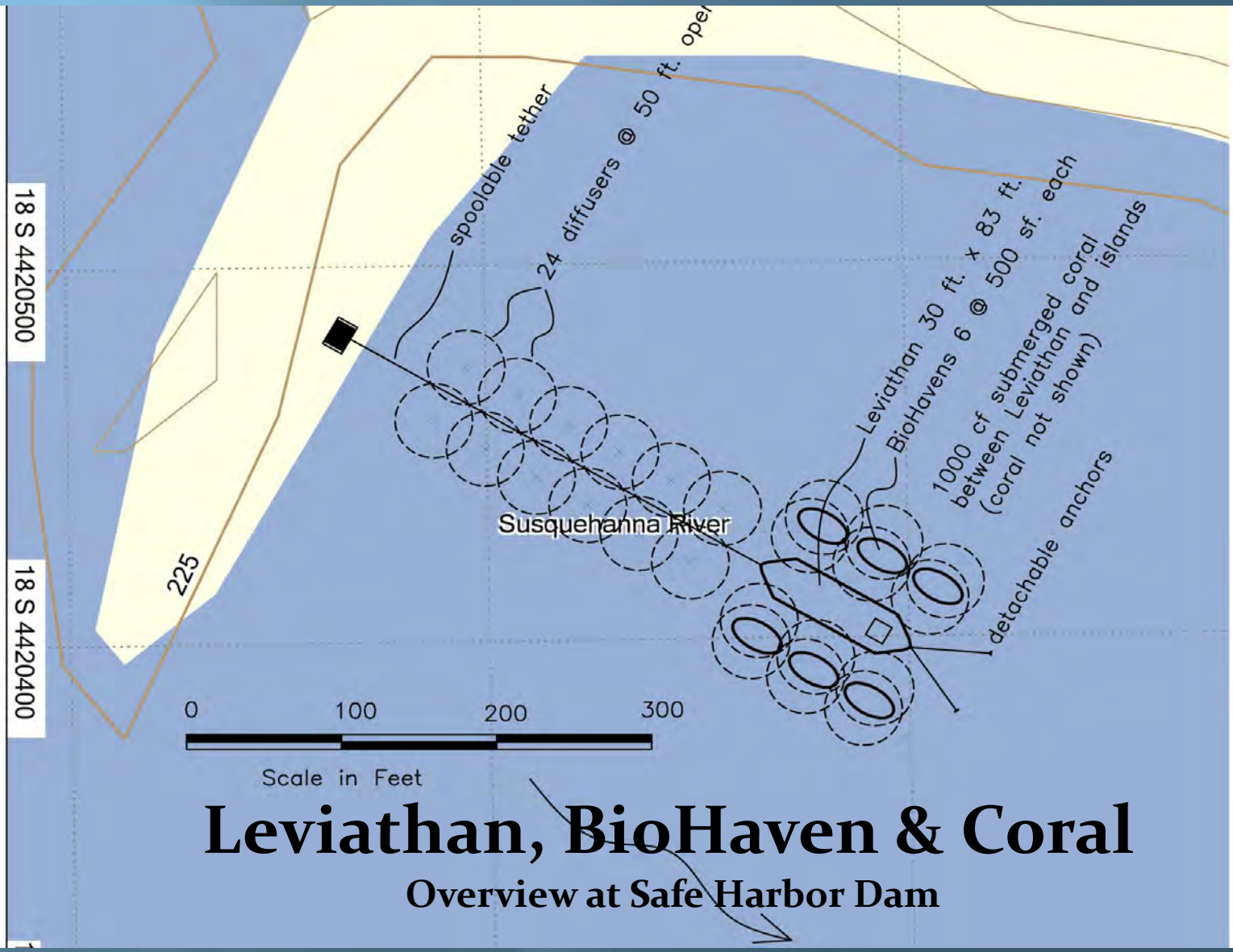
BioHaven Technology

- **Coral - 4000 acres or 170 Million Sq Ft Surface Area**
- **1 Leviathan/6 BioHavens, 24 Diffusers - 2500 Sq Ft Foot Print or 1.25M Sq Ft Surface Area**

Design for Safe Harbor Dam



Design for Safe Harbor Dam



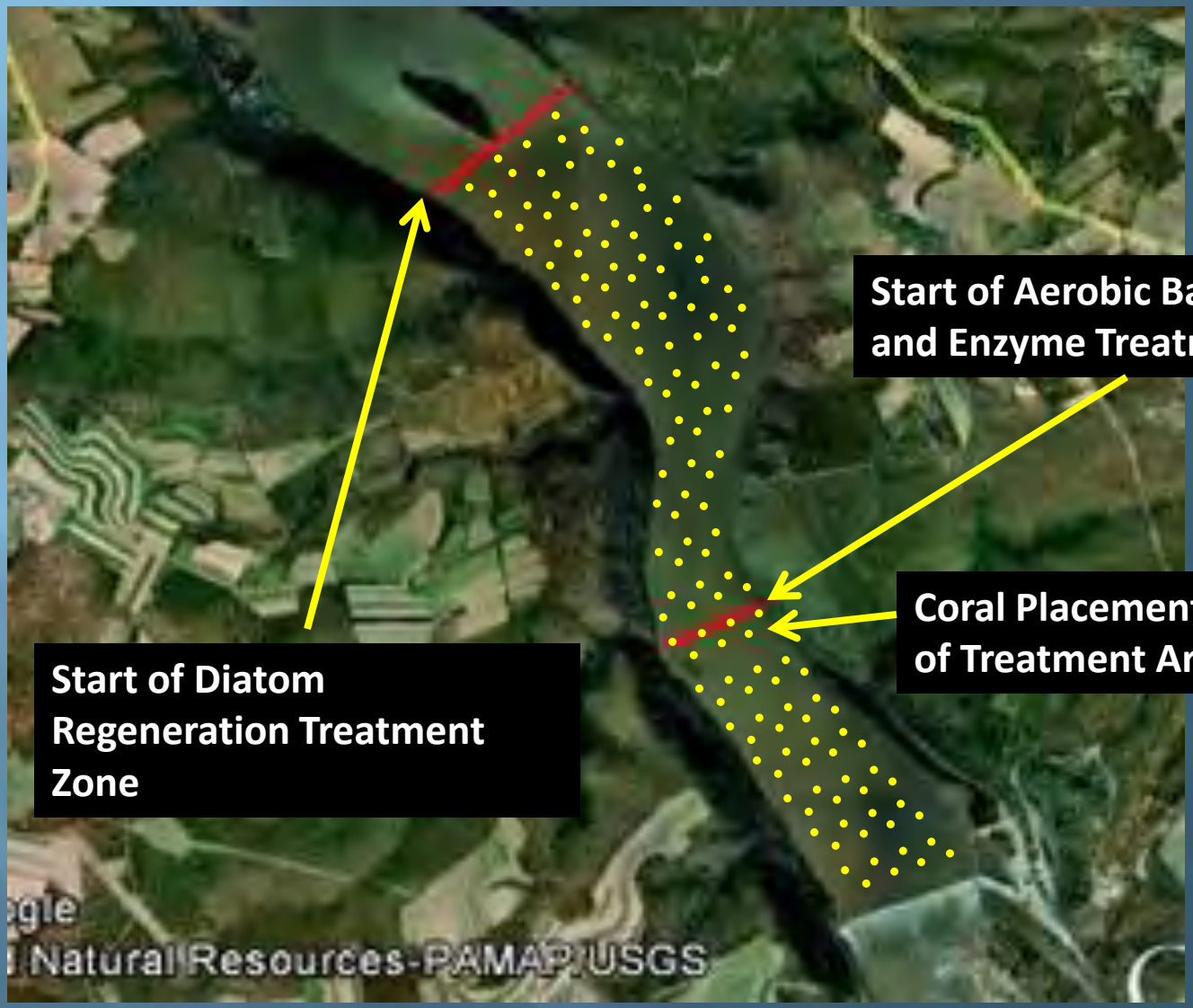
Leviathan, BioHaven & Coral

Overview at Safe Harbor Dam

Cost Estimates for Safe Harbor Dam

Inversion/Oxygenation Equipment	$3.1 M
Leviathan	$1.0 M
BioHavens & Coral	$6.8 M
River Power Generation	TBD
Annual O&M/Reporting Expenses	$400,000

Biological Dredging Preliminary Design for Holtwood



Biological Dredging Preliminary Design for Holtwood

Inversion Oxygenation Equipment

- 3 Compressors
- 238 12” Mico-Porous Diffusers
- 400,000’ of Self-Sinking Airline

BioHaven Technology

- Coral - 4000 acres or 170 Million Sq Ft Surface Area
- 1 Leviathan/6 BioHavens, 24 Diffusers - 2500 Sq Ft Foot Print or 1.25M Sq Ft Surface Area

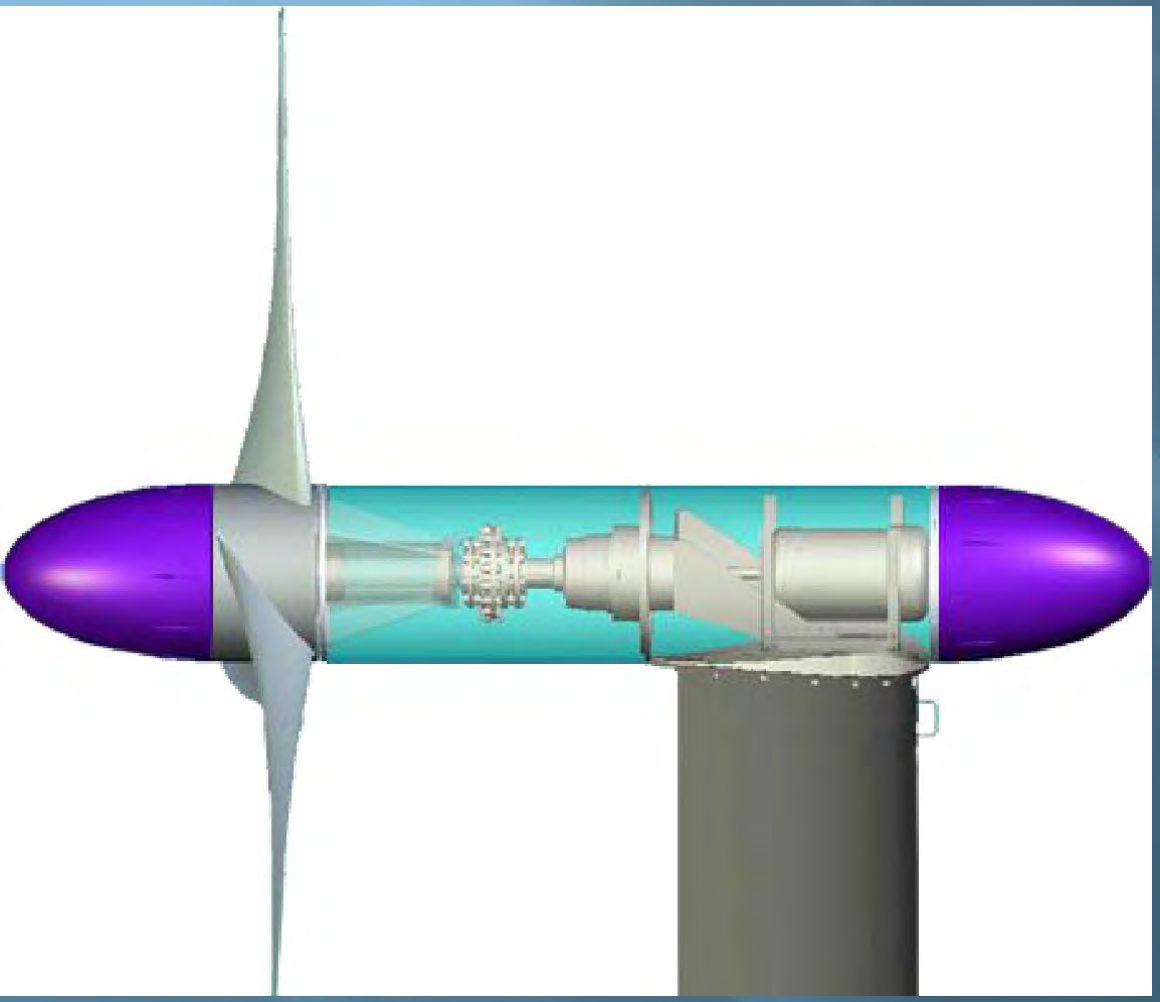
Biological Acceleration

- 325 Gallons of Enzyme Treatment
- 325 lbs of C-Flo Beneficial Bacteria
- 750 Liters of Nualgi Diatom Feed

Preliminary Cost Estimates Holtwood Dam

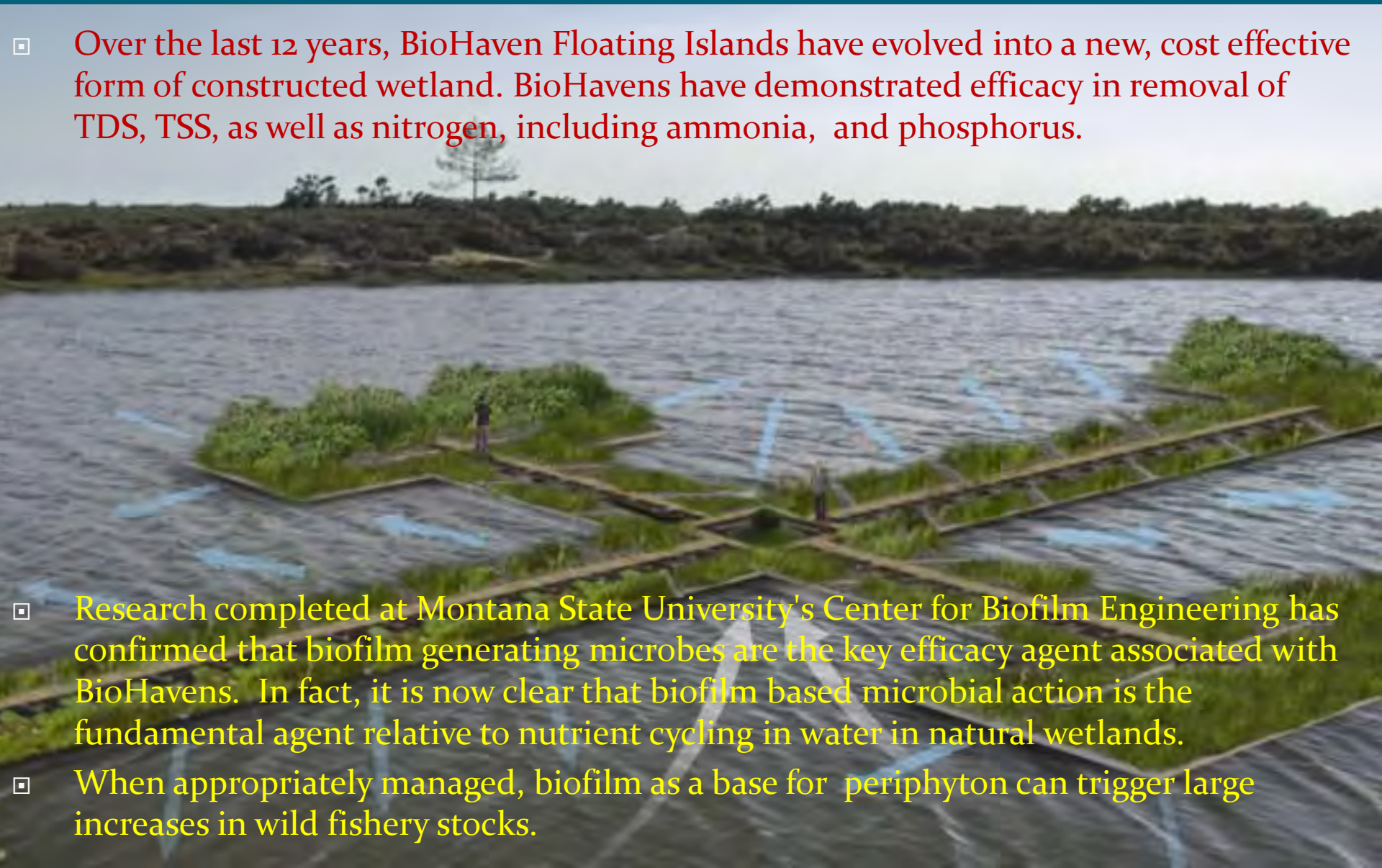
Inversion/Oxygenation Equipment	$2.0 M
Leviathan	$1.0 M
BioHavens & Coral	$6.8 M
River Power Generation	TBD
Annual O&M/Reporting Expenses	$450,000

River Power Generator Off- The Grid



Verdant Power's *Free Flow* Kinetic Hydropower System uses three-bladed, horizontal-axis turbines deployed underwater to generate clean renewable energy from tidal and river currents.

BioHaven® Leviathan®- Restoring A River To Health



- Over the last 12 years, BioHaven Floating Islands have evolved into a new, cost effective form of constructed wetland. BioHavens have demonstrated efficacy in removal of TDS, TSS, as well as nitrogen, including ammonia, and phosphorus.
- Research completed at Montana State University's Center for Biofilm Engineering has confirmed that biofilm generating microbes are the key efficacy agent associated with BioHavens. In fact, it is now clear that biofilm based microbial action is the fundamental agent relative to nutrient cycling in water in natural wetlands.
- When appropriately managed, biofilm as a base for periphyton can trigger large increases in wild fishery stocks.

Case Study : Fish Fry Lake Results – 2011

Parameter	2008	2011
Turbidity (Secchi depth), ft	1.2	19
Total N concentration, mg/L	0.20	0.01
Total P concentration, mg/L	0.041	0.025
DO at 15-ft. depth, mg/L	0.1	6.0
Habitable zone for fish, ft	8	21
Harvestable fish	200 (est.)	4,400

Note: Removing more than 48 lbs/year in phosphorous through fish harvesting and plant harvesting and organic accretion harvesting(bottom sediment) – 2011

Case Study : Fish Fry Lake Results – 2011

	Fish Fry Lake		Jackson Study *		FFL/Jackson Ratio
	Inches	mm	Inches	mm	
Age 1	6.7	170	5.0	126	135%
Age 2	8.7	221	7.3	186	119%
Age 3	10.8	274	9.3	236	116%
Age 4	12.5	318	10.4	264	120%

- 95th percentile data for North American yellow perch from Jackson & Quist (1991)
- Biological Dredging with Leviathan/Lake Savers Oxygenation/Coral produces larger fish and ultimately removal of phosphorous through harvesting.

Case Study: McLean's Pit Landfill, Town of Greymouth, South Island, New Zealand Floating Wetlands

Demonstrating Treatment of Landfill Leachate Using Floating Treatment Wetland Technology

- Location Greymouth, South Island, New Zealand
- Parameters Studied TSS, Total Nitrogen, BOD
- System Type Lagoon
- FTW Size A total of 288 m2 (3,100 ft2); each of three ponds contains
- eight modules with 12 m2 of surface area
- Water Source Landfill leachate
- Installation Date November 2009
- Flow Rate Variable, with highest flows in the winter (rainy season)
- Water Body Depth 0.6 m (2 ft)
- Water Body Area Each pond is 40 m x 12 m (131 ft x 39 ft). There are six ponds,
- with FTW modules in three of them.
- Installed Cost Confidential

Case Study: McLean's Pit Landfill, Town of Greymouth, South Island, New Zealand Floating Wetlands

Results

Parameters	FTW Removal Rate (mg/day/ft²)	Improvement Compared to Pre-FTW
TSS	160	89%
Total Nitrogen	2000	40%
BOD	685	46%

Case Study: McLean's Pit Landfill, Town of Greymouth, South Island, New Zealand Floating Wetlands

Influent (left) vs. effluent (right)

Extensive root system for nutrient uptake

Case Study: Rehberg Ranch Residential Subdivision, Billings, Montana USA – Floating Wetlands

Latest Generation Floating Treatment Wetland Technology:
Achieving Significant Nutrient Removal in Aerated
Wastewater Lagoons

- Subdivision (pop. 560) was built beyond the reach of the city's municipal sewer system.
- Developers constructed an aerated lagoon wastewater treatment system engineered and designed to meet US EPA secondary standards for Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS).
- November 2009, FII, Headwaters Floating Island (HFI), the City of Billings and the Montana Board of Research and Commercialization Technology installed an experimental
- FTW design in one of the subdivision's two aerated lagoons. HFI continues to implement a rigorous monitoring regime to monitor efficacy of the FTW system in comparison to the control lagoon with no FTW. Both lagoons receive the same wastewater.

Case Study: Rehberg Ranch Residential Subdivision, Billings, Montana USA – Floating Wetlands

Results:
As of April 2010, FTW nutrient removal, compared with the control lagoon, has been significant.

Removal of ammonia has improved by 38%, while the phosphorus removal rate has improved by 27%. Removal rates of TSS and BOD are 9% higher in the FTW lagoon than the control lagoon.

Case Study: Rehberg Ranch Residential Subdivision, Billings, Montana USA – Floating Wetlands

Installation Data

Location	Billings, Montana USA
Parameters Studied	Ammonia, nitrate, total nitrogen, total phosphorus, phosphate, TSS, BOD
System Type	Aerated lagoon
FTW Size	2300 ft^2 (214 m^2) FTW (with 1300 ft^2 submerged treatment area and 1000 ft^2 elevated plant growth perimeter). Thickness: 8 inches (20 cm)
Water Source	Municipal wastewater from approximately 140 households
Installation Date	November 2009
Flow Rate	12 gpm (2.7 m^3/hr)
Water Body Depth	Estimated at 12 ft (3.7 m)
Water Body Area	36,000 ft^2 (3,345 m^2)
% Coverage	6.4% of Lagoon Covered by FTW
Installed Cost	$70,000

Case Study: Rehberg Ranch Residential Subdivision, Billings, Montana USA – Floating Wetlands

Operational Data

Average O&M Costs (Labor, Materials)	2 hours/week; no materials
Training Required to Operate	1 day training seminar
Required Additional Inputs	Electricity for pump (1.5 hp/Aquamaster)
Anticipated Lifespan	10 years

Results (Averages since April 2010)

Parameters	FTW Removal Rate (mg/day/ft²)	Improvement Compared to Control Lagoon
Ammonia	480	38%
Total Phosphorus	54	27%
TSS	200	9%
BOD	630	9%

Biological Dredging Projects – Laminar Flow Oxygenation

2010 Installs Lake Bridgeport Reservoir Fort Worth, Texas – 700+ acre treatment area

- **Lake Benbrook Reservoir Fort Worth Texas – 800+ acre treatment area**
- **Indian Lake Dowagiac, MI – 86 acre treatment area**
- **Greenwood Lake Greenwood Lake, NY – 80 acre treatment area**
- **Upper Tarrytown Reservoir, Tarrytown, NY – 30 acres**
- **Little Lakes, Frankfort, Indiana – 30 acres**
- **Massabesic Reservoir, Manchester, NH – 225 acres**

2011 Installs

- **Maple Lake Paw Paw, MI– 40 acre treatment area**
- **Wing Lake Lagoons, Bloomfield Hills, MI – 5 acre treatment area**
- **Shickshinny Lake, Shickshinny, PA – 150 acre treatment area**
- **Lake Greeley, Greeley, PA – 150 acres**
- **Keeler Lake, Decatur, Michigan – 80 acres**
- **Podunk Lake, Hastings MI – 84 acres**

2012 Installs

- **Toa Vaca Reservoir Puerto Rico, 800 acres**
- **Indian Lake Expansion Dowagiac, MI – 400 acres**
- **Austin Lake Portage, MI – 225 acres**
- **Paradise Lake, Carp Lake, MI – 400 acres**
- **Schmidt Lake, Plymouth, MN – 40 acres**

Case Study: Indian Lake Dowagiac, Michigan

About the Lake

- 85 acre Treatment area in a 500 acre lake.
- Treatment area focuses on the Lake's South Basin.
- Main Project Focus: Organic Sediment Reduction
- Secondary Focus: Natural weed control
- Independent Study commissioned by the Lake Association to evaluate project results

Management Program

- Clean-Flo Engineered Aeration installed in April of 2010.
- Clean-Flo bacteria and enzyme treatment applied in June of 2010.

Results

- 1.3 foot reduction in organic sediment in the treatment area.
- Significant reduction in Eurasian Water Milfoil growth in the treatment area.
- Shift in algal species from Blue-Green (cyanobacteria) to green algae species

Indian Lake Impact Study – Engineered Aeration & Beneficial Bacteria Treatment

Impact Study: **Commissioned by the Indian Lake Improvement System to provide independent impact analysis on the Clean-Flo/Lake Savers Restoration Technology**

Company	Lakeshore Environmental Services Grand Haven, Michigan www.lakeshoreenvironmental.com
Project Lead	**Jennifer Jermalowicz-Jones, Director Water Resources** MS Biology & Water Resources Grand Valley State University PhD Candidate Michigan State University Executive Board Michigan Lakes & Streams Association

BACI Study Design *(Before, After, Control, Impact)*		
Control Area *(North Section)*	Microbes Only *(Northwest Section)*	Aeration Plus Microbes *(South Basin)*

Parameters Studied *(See pages 10-28 for details)*		
Water Quality	Sediment Impacts	Aquatic Plant & Algae Growth

- Study to be conducted over 2 years.
- Year 1 results have been reported and are contained in this document.
- This study is one of the most extensive conducted on the impacts of Engineered Aeration and Biological Augmentation on a lake ecosystem

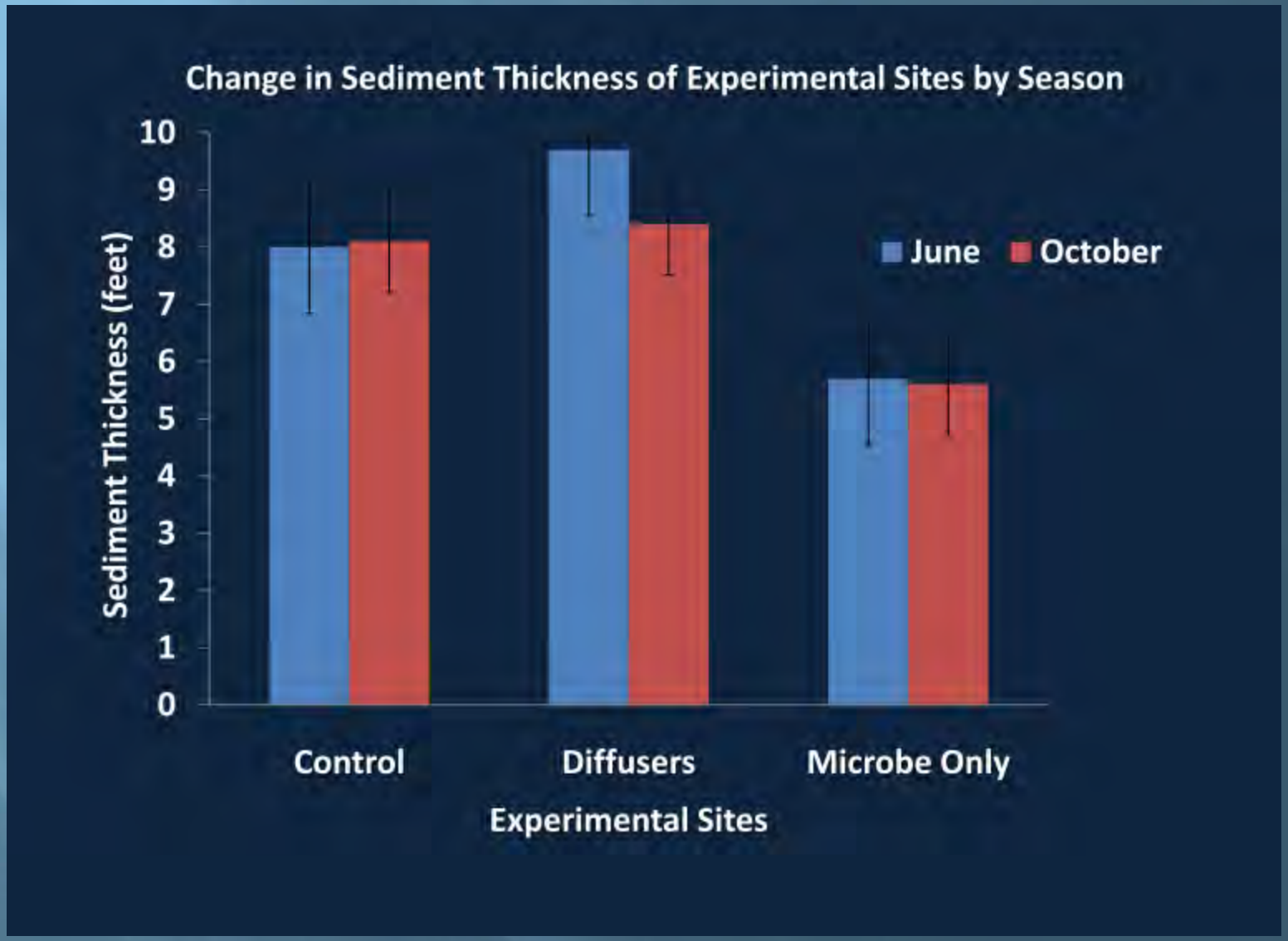
Study Conclusions & Commentary

Lake Shore Environmental Study Conclusion	Lake Savers' Comments		
Sediment depth was significantly reduced in diffuser region from June to Oct as compared to other regions	**Diffuser Site**	**Microbe Only**	**Control**
	1.3 Foot Avg. Reduction	**.1 Foot Avg. Reduction**	**.1 Foot Avg. Increase**
	This is a phenomenal improvement in the treatment area for 5 months of operation.		
Laminar Flow favors Green algae over cyanobacteria *(Blue Green Algae)* and also appears to impact submersed vegetation	**This is consistent with our findings on many projects. Results are even more dramatic in whole lake applications. See details for impact on Milfoil Growth and shift to Green Algal species.**		
A positive correlation exists between sediment TP *(Total Phosphorus)* and OM *(Organic Matter)*	**We would expect TP to continue to drop as OM is reduced. This is consistent with our findings that Phosphorus is removed from the system through the food chain, over time.**		

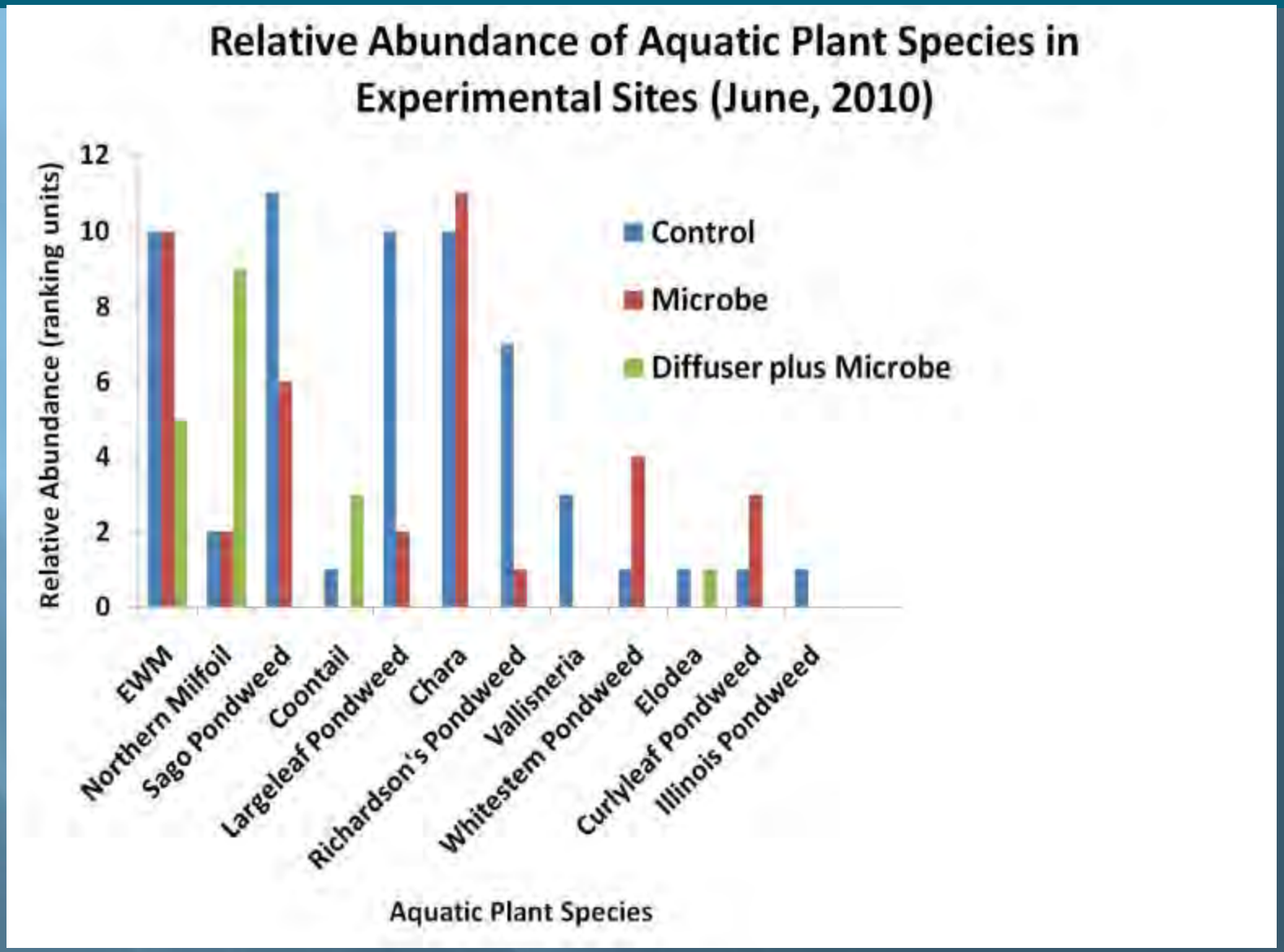
Study Conclusions & Commentary (cont.)

Lake Shore Environmental Study Conclusion	Lake Savers' Comments
Pore water nutrients such as P and N were higher in the diffuser region in both June and Oct.	This is expected as a result of the precipitation of P and N from the water column as a result of iron and manganese oxides binding them to the inorganic sediment in the oxygenated treatment area
No significant differences in water quality parameters such as DO, Ph, Conductance, ORP, Secchi Transparency.	This finding illustrates one of the limits of a partial lake project. Mixing from outside the treatment area often results in a homogenization of the water column. In other projects where the treatment area is more isolated *(such as Greenwood Lake, NY),* we have seen major impacts on these same parameters.
Water Temperature in October was significantly lower for the diffuser region than for the microbe only or control regions.	The system does impact water temp. In October it is possible that air temperatures were cool enough to reduce overall water temperature as the system mixed the water top to bottom.

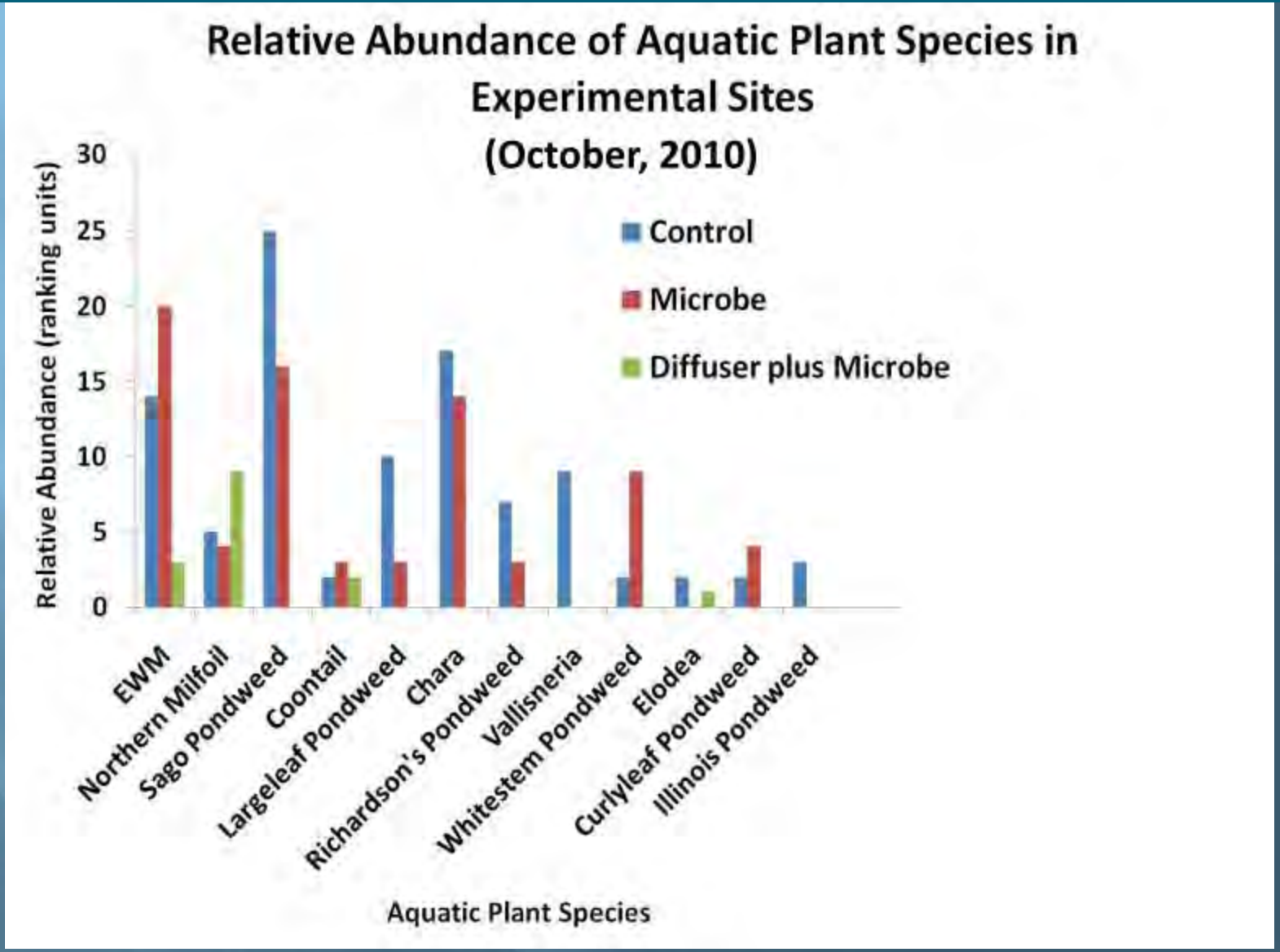
Indian Lake, Dowagiac Michigan



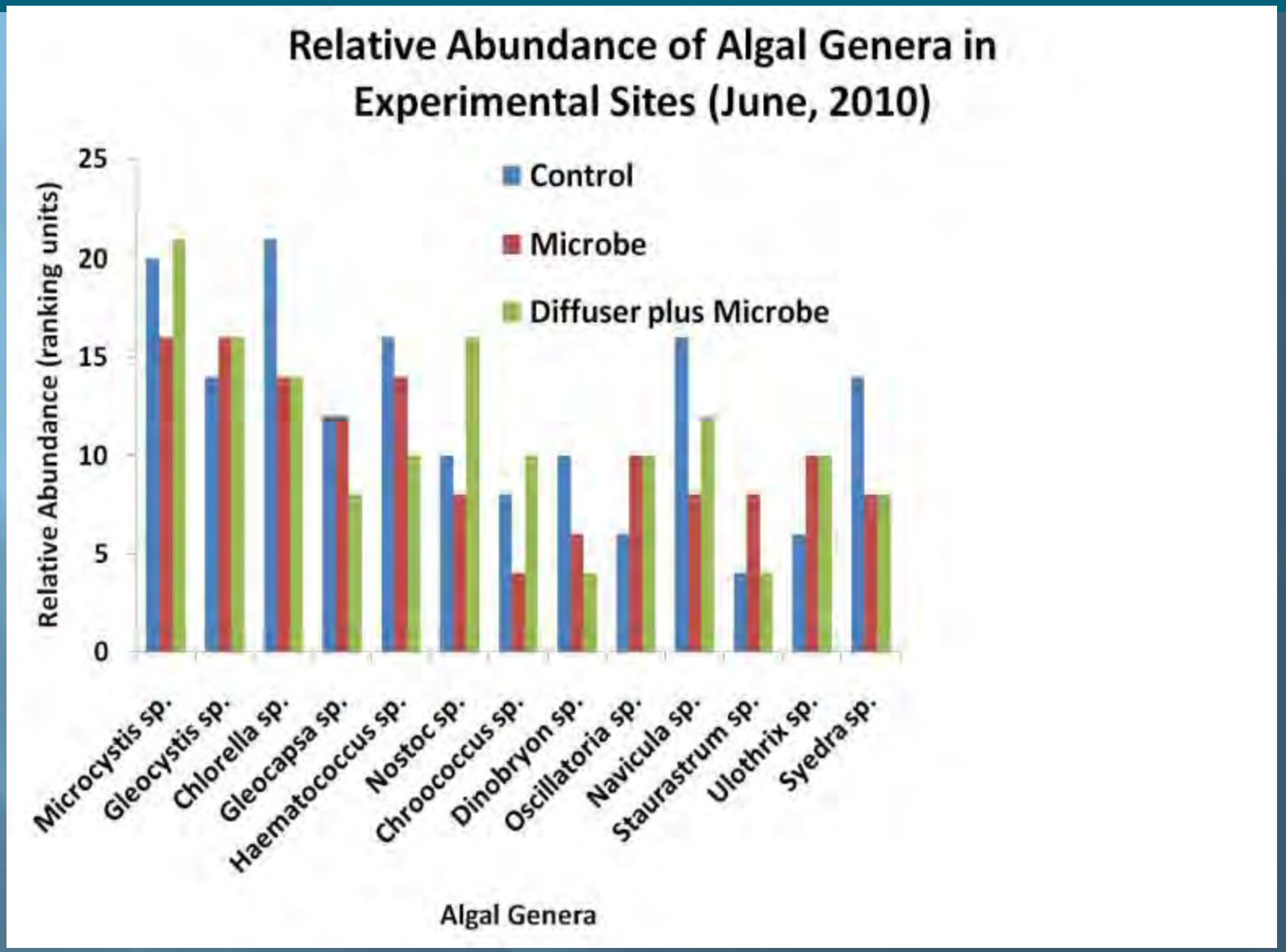
Indian Lake, Dowagiac Michigan



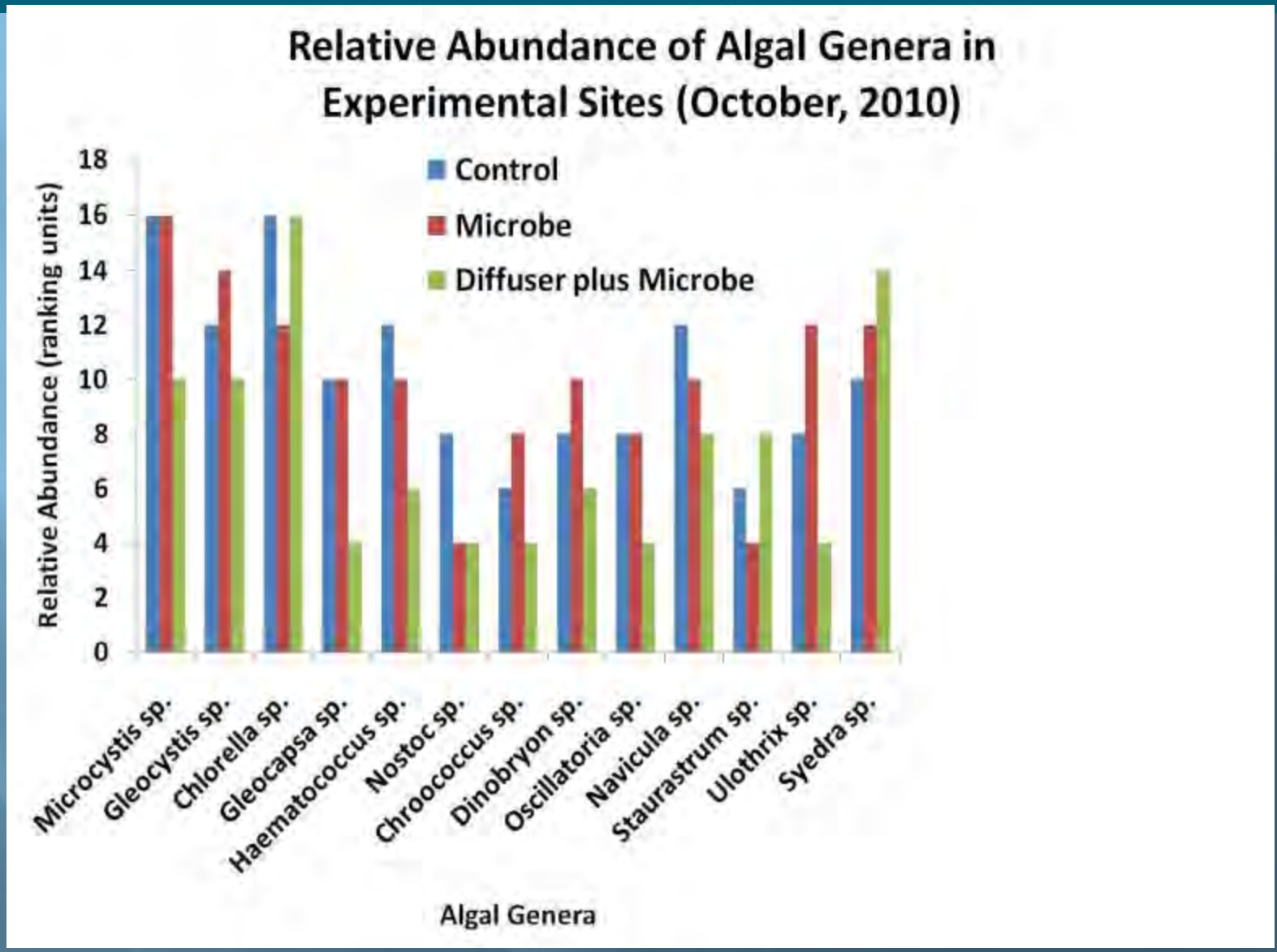
Indian Lake, Dowagiac Michigan



Indian Lake, Dowagiac Michigan



Indian Lake, Dowagiac Michigan



Indian Lake, Dowagiac Michigan Spring 2011 Milfoil Map

Herbicide Treatment Area (Treated 2010)

Clean-Flo Treatment Area

Case Study: Lakes Bridgeport & Benbrook Fort Worth, Texas Area

About the Lakes

- Two large water supply and recreational reservoirs.
- High levels of manganese and hydrogen sulfide resulting in taste and odor issues as well as increased treatment costs.
- Represent two of the largest lake aeration projects in the country. 800 to 1000 acre treatment areas on 13,000 acre Lake Bridgeport and 4,400 acre Lake Benbrook

Management Program

- Clean-Flo System installed in 2010

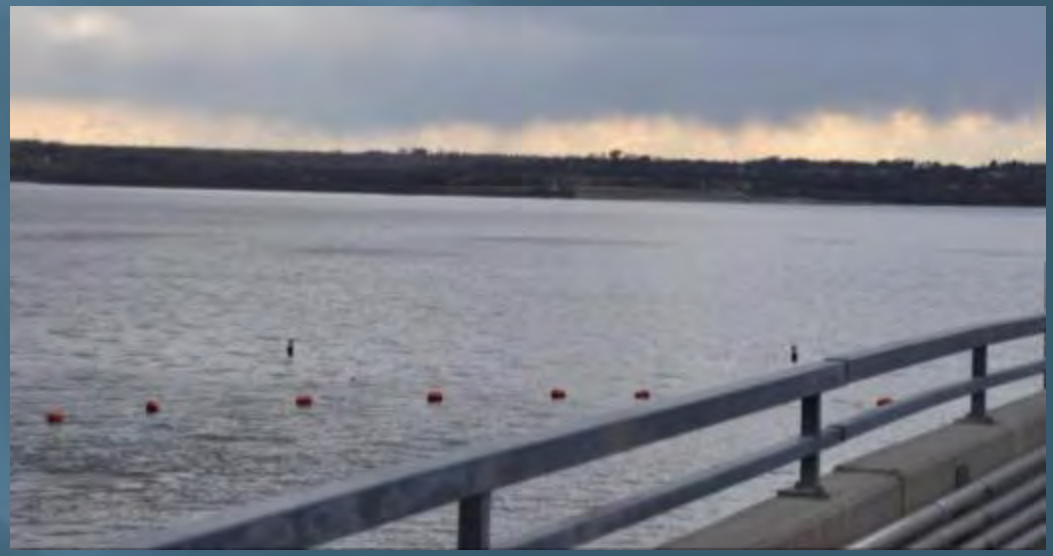
Results

- Data shows the ability to oxygenate to a depth of 16 meters in 1 month of continuous operation. Natural turnover interrupted the process in 2010. We anticipate sustaining a minimum of 4 mg/l DO continuously.

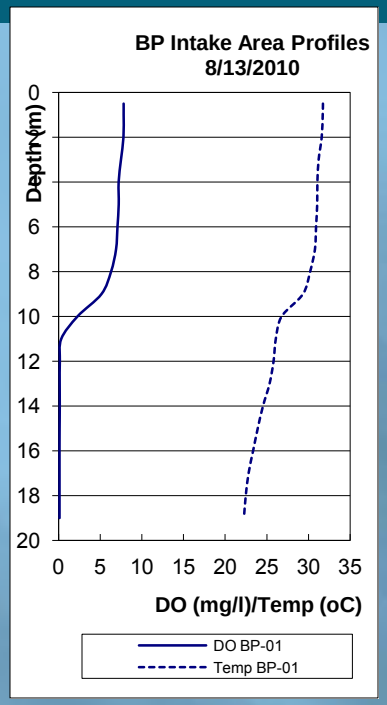
Lakes Bridgeport & Benbrook Systems

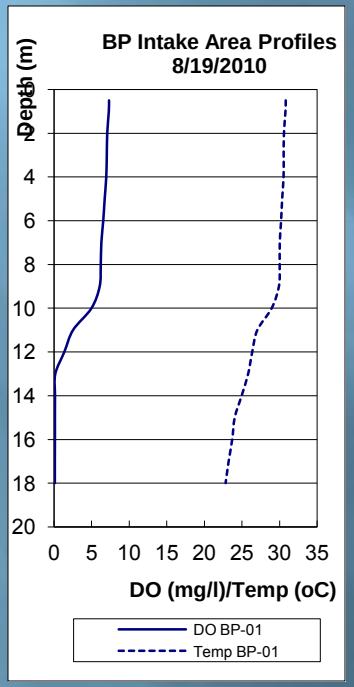
Lake Bridgeport

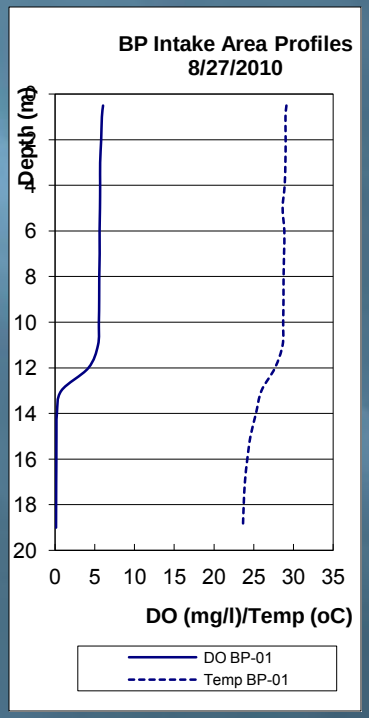
Lakes Bridgeport & Benbrook Systems In Action

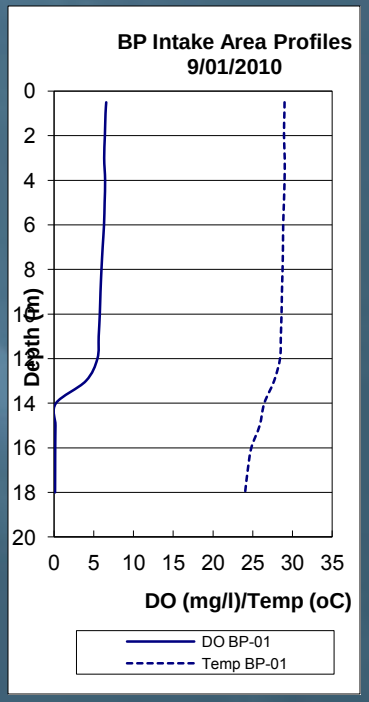


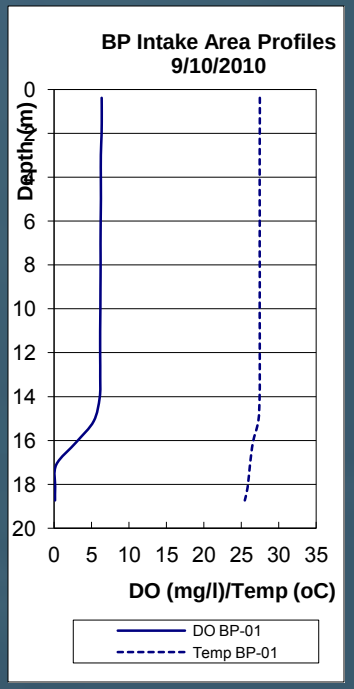
Lake Bridgeport Destratification Progress after 30 Days Continuous Operation











Case Study: Lake Powai, India

About the Lake

- 500+ acre lake in India.
- Hydrilla and Water Hyacinth had taken over the lake.
- Lake heavily polluted from watershed

Management Program

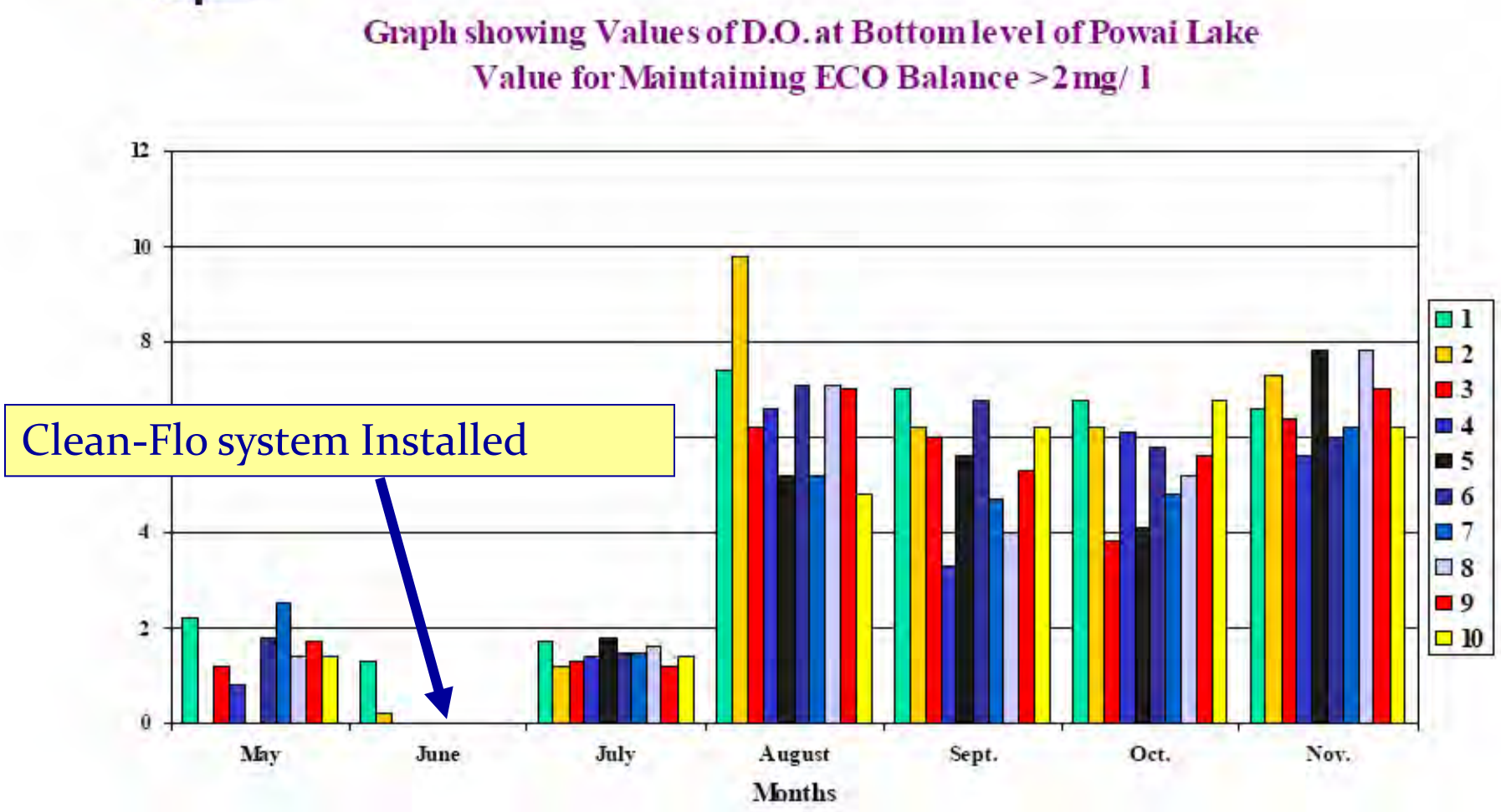
- Clean-Flo Engineered Aeration installed with bacteria and enzyme treatment.
- Harvesting program initiated to reduce Water Hyacinth.

Results

- Nutrient levels in the lake reduced by 90% in the first year.
- Hydrilla and Water Hyacinth reduced to non-nuisance levels.
- Significant improvement in all water quality indicators.

Lake Powai, India – Results

Dissolved Oxygen at Bottom

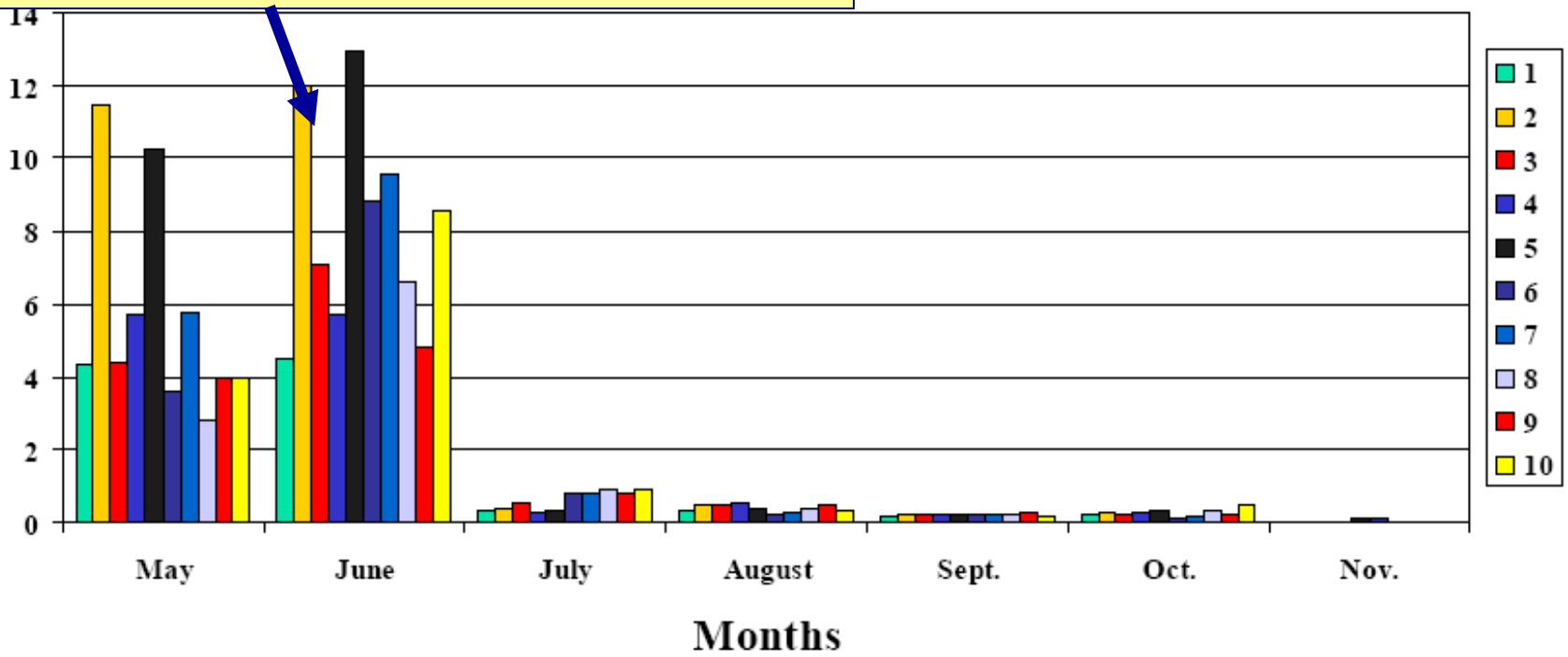


Lake Powai, India – Results

Phosphorus at Bottom

Graph showing Values of Phosphates at Bottom level of Powai Lake
Value for Maintaining ECO Balance 10-35mg/m^3
(values in table are in mg/l)

CLEAN-FLO system Installed



Technical Support/Questions/Web Sites Biological Dredging : Floating Islands and Lake Savers

- Web pages:
- http://www.floatingislandinternational.com/
- http://floatingislandse.com/
- http://lake-savers.com/
- www.brinjac.com;

- Technical assistance: Email addresses

- Bruce Kania, President Floating Islands International:
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- jtucci@lake-savers.com

- Steve Zeller, Project Manager Brinjac Engineering, Inc.
- szeller@brinjac.com;