11. CPA PROJECT APPLICATION FORM

[CPC Use Only: Date Received_____By:_____
Assigned CPC #2019 - 08](Requesting funding from CPC 2018 funds.)

If possible, use word processor to fill out form. Please answer all questions, use "N/A" if not applicable.

1. a.) Applicant Name and Organization: Last Anderson First Robert
Organization(s) (if appropriate)_ Co-applicant with Great Pond Advisory Committee

b.) Regional Project: Yes__? or No? NO If Yes, Town/Organization:_____

2. Submission Date: January 18, 2018..revised with permission 1/23/18

3. Applicant Address: St. 270 Whiley Road
City/ State: Groton, MA ZIP: 01450-2237

4. Ph. # 978-273-4051 Email: bobandersongroton@me.com

5. CPA Purpose. Check all that apply:
Community Housing___ (Affordable Housing:___) Historic Preservation:___. Open Space: :X .
Recreation X

6. Town Committee or boards participating: Great Pond Advisory Committee

7. Project Location/Address: Duck Pond Shoreline between 228 and 260 Whiley Road. Also Duck Pond

8. Project Name: Duck Pond Restoration

9. Additional Responsible Parties (If applicable):

Role (specify)	Name	Address	Ph. (cell)	Email
Property/Site Owner	Remigiusz Kaleta Dane Krampitz	228 Whiley Road 260 Whiley Road	860-389-1435 617-697-5654	Remigiusz.kaleta@gmail.com danekrampitz@gmail.com
Project Manager	Robert Anderson	270 Whiley Road	978-273-4051	bobandersongroton@me.com
Lead Architect				
Project Contractor Joe Onorato	Solitude Lake Management	590 Lake Street Shrewsbury, MA 01545	508-250-6238	JOnorato@solitudelake.com
Project Consultants				

10. As appropriate, indicate if proposal requires P&S agreement __ Deed__
Option agreement ___ Other-describe:Easement for access and site location from property owners

11. a.) Assessor info. (map/ block/ lot id.(s)):131/72/0 & 131/71/0 b.) Tax classification type: RA

12. Permits required: Zoning: _____ Historic Preservation: Other : Conservation Commission NOI

13. Historic Commission Approval signoff (when required):_____Date:_____

14. Funding:a.)Requested from CPC: $43,500 b.) Committed other sources:$5,000 + pending

c.) Annual anticipated total income :$ d.) Annual anticipated total expense: $ 4,000.

d.) Anticipated net income (loss): $_____e.) Estimator name/company: Budget attached

15. CCP Objectives - use codes from **Section 5** to indicate all that apply: **5.3, OSRP 1.2. See attached**

16. Project Timelines: Proposed Start Date: May 1, 2018 Projected Complete Date: June 30, 2021 (work will be completed in first year; results data will be collected annually in 2019, 2020, 2021.

17. Estimated Delivery Date of Completion Report to CPC: Intermediate 6/'19, 6/'20; Final 6/'21

18. Project description and explanation (attach additional sheets as needed):

Restoration of Duck Pond, a 26-acre Great Pond that is rapidly eutrophying, by installing a submersed aeration system consisting of a compressor on the shoreline and ten submersed hoses to diffusers at the bottom of the pond at the locations shown on the map. This will restore Dissolved Oxygen at the bottom, resulting in more aerobic bacteria to consume the muck, more oxygen for fish and wildlife, and less Phosphorus released to feed algae and weeds. See attached narrative and flow chart. Project includes six months of aerobic bacteria augmentation for ten acres.

19. Feasibility: Submersed aeration is widely used to improve lake and pond health. See attached Vertex Case Studies for examples.

20. List of attachments:

21. Additional Information: The five abutting residents have committed a total of $4000 in non-CPA funding. The GPAC has committed $1000. We will solicit additional donations from residents of nearby neighborhoods and others interested.
In order to get approvals, prepare site, install system, and start pond restoration this summer, we request CPA funds from the 2018 balance so work can begin upon Town Meeting approval.

22. Management Plan: See attached Management Plan and Budget

23. Applicant Signature: signed: *Robert E. Anderson* Date: 1/18/2018, 1/23 rev.

Co Applicant Signature: Date:

Co Applicant Signature: Date:

Duck Pond is a 26-acre Great Pond that is deteriorating (“eutrophying”). The symptoms are a recent rapid annual increase in nuisance aquatic weeds and an increasingly thick sediment layer of organic material (“muck”). There also has been a decrease in water clarity and fewer fish (fishermen), otters, beavers, and herons. The weeds and bottom muck also are a recreation barrier and safety hazard. The attached photos show the pond in past years and the recent weed growth. They also show some of the wildlife that used to be plentiful.

The increased weed growth indicates an excess of nutrients (the definition of eutrophication), particularly phosphorus, which was confirmed by Nashoba Analytical in August 2017 (.04-.06 mg/L while the EPA water quality criteria specifies under 0.025 mg/L). An ever-thicker layer of bottom muck indicates insufficient dissolved oxygen (DO), which kills the aerobic bacteria needed to consume the organic material like dead weeds and fallen leaves. The replacement anaerobic bacteria can release hydrogen sulfide that is toxic to fish. The lack of DO also creates a “dead zone” along the bottom, which kills or drives out insects, fish, and other wildlife, and it enables more phosphorus to be released from the nutrient-rich sediment layer to feed plants and algae, thus increasing the biomass.

This deteriorating cycle is illustrated in the red portion of the attached flowchart. Insufficient dissolved oxygen causes the results described above. As the organic material is not consumed completely, the bottom muck gets thicker, making the pond more shallow, enabling more sunlight to reach weeds and becoming a barrier to recreation and a safety hazard as described below. Finally, the excess nutrients in the muck, particularly phosphorus, are released to cause further weed growth, which increases the biomass. The long-term reproduction and decomposition of the large biomass causes rapid sediment accumulation that changes the ecosystem from a pond to a wetland marsh.

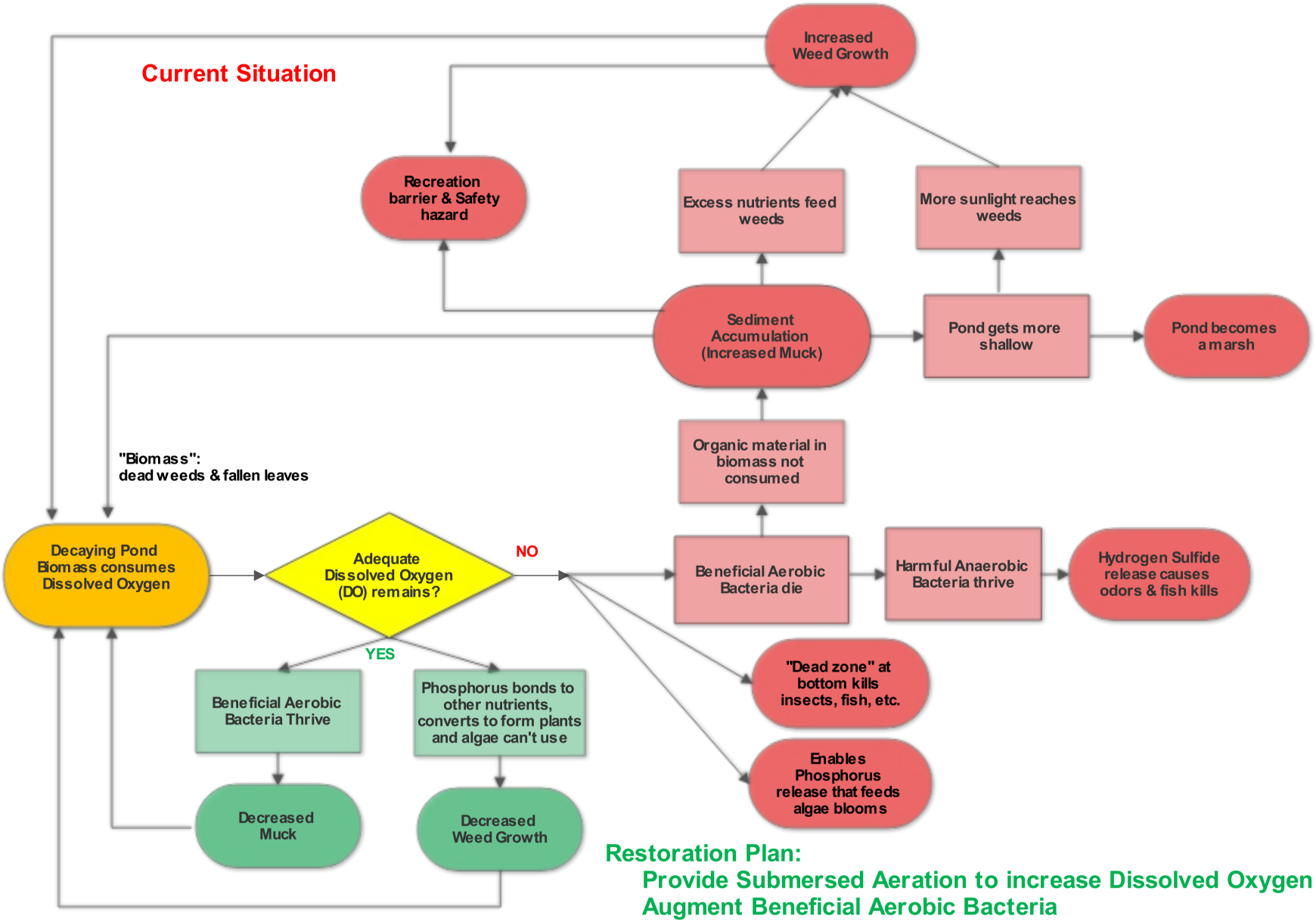
In addition to the environmental impact, the eutrophication of Duck Pond will result in the loss of a beautiful, quiet, natural recreation area and viewscape. There already is a safety hazard caused by the thick weeds and quicksand-like bottom muck for anyone falling out of a kayak or canoe. The thick weed cover and decreasing water clarity cause an even greater safety hazard for someone on a stand-up paddleboard (SUP) because unseen submerged branches can be hit with a fin, causing the rider to fall off. There are recreation barriers for all boaters because a barrier of thick muck prevents access to the pond when the water level drops In the summer, and the thick weeds drag on paddles and fins.

Without pond maintenance to slow the eutrophication process, Duck Pond will become a marsh and will lose the diverse wildlife that have been observed and photographed for years. Without pond maintenance, recreation activities such as canoeing, kayaking, stand-up paddle-boarding, fishing, and ice skating will be lost, as well as the attractive viewscapes enjoyed by those using the Groton Conservation Trust and Groton Conservation Commission trails around the pond.

The proposed Duck Pond Restoration Project includes the installation of an aeration system compressor on the shoreline between Duck Pond and Whiley Road, between 228 and 260 Whiley Road. This location is recommended by GELD as it is near

electrical power that can be trenched from a pole to the system. Ten hoses will pipe air from the system to submersed diffusers at the locations shown on the enclosed Vertex map/diagram. The small air bubbles from the diffusers carry low-oxygen water from the bottom to the surface where is mixes with oxygen-rich surface water and atmospheric oxygen before sinking back to the bottom. After sufficient dissolved oxygen has been restored along the bottom of the pond, aerobic bacteria will return naturally to start consuming the muck and re-establishing a healthy environment for fish and other wildlife. A monthly augmentation of beneficial aerobic bacteria will accelerate this process. The result will be the cycle illustrated on the lower (green) portion of the flowchart. Adequate dissolved oxygen will enable aerobic bacteria to thrive, which will consume more of the muck. It also will help phosphorus to bond to other nutrients and become unavailable to plants and algae, reducing weed growth in the long-term. Less muck and less weed growth will reduce the pond biomass.

The objective is a restored healthy ecosystem and recreational resource in Duck Pond.


Current Situation
Increased Weed Growth
Recreation barrier & Safety hazard
Excess nutrients feed weeds
More sunlight reaches weeds
Sediment Accumulation (Increased Muck)
Pond gets more shallow
Pond becomes a marsh
Organic material in biomass not consumed
"Biomass": dead weeds & fallen leaves
Decaying Pond Biomass consumes Dissolved Oxygen
Adequate Dissolved Oxygen (DO) remains?
NO
YES
Beneficial Aerobic Bacteria die
Harmful Anaerobic Bacteria thrive
Hydrogen Sulfide release causes odors & fish kills
"Dead zone" at bottom kills insects, fish, etc.
Enables Phosphorus release that feeds algae blooms
Beneficial Aerobic Bacteria Thrive
Phosphorus bonds to other nutrients, converts to form plants and algae can't use
Decreased Muck
Decreased Weed Growth
Restoration Plan:
Provide Submersed Aeration to increase Dissolved Oxygen
Augment Beneficial Aerobic Bacteria

Vertex Water Features
Lake Aeration Systems & Floating Fountains
Tel: (800)432-4302 / Fax (954)977-7877

Solitude Lake Management
Duck Pond

LL HE33 10XL5

Legend

Compressor Cabinet
XL5 AirStation
BottomLine Tubing

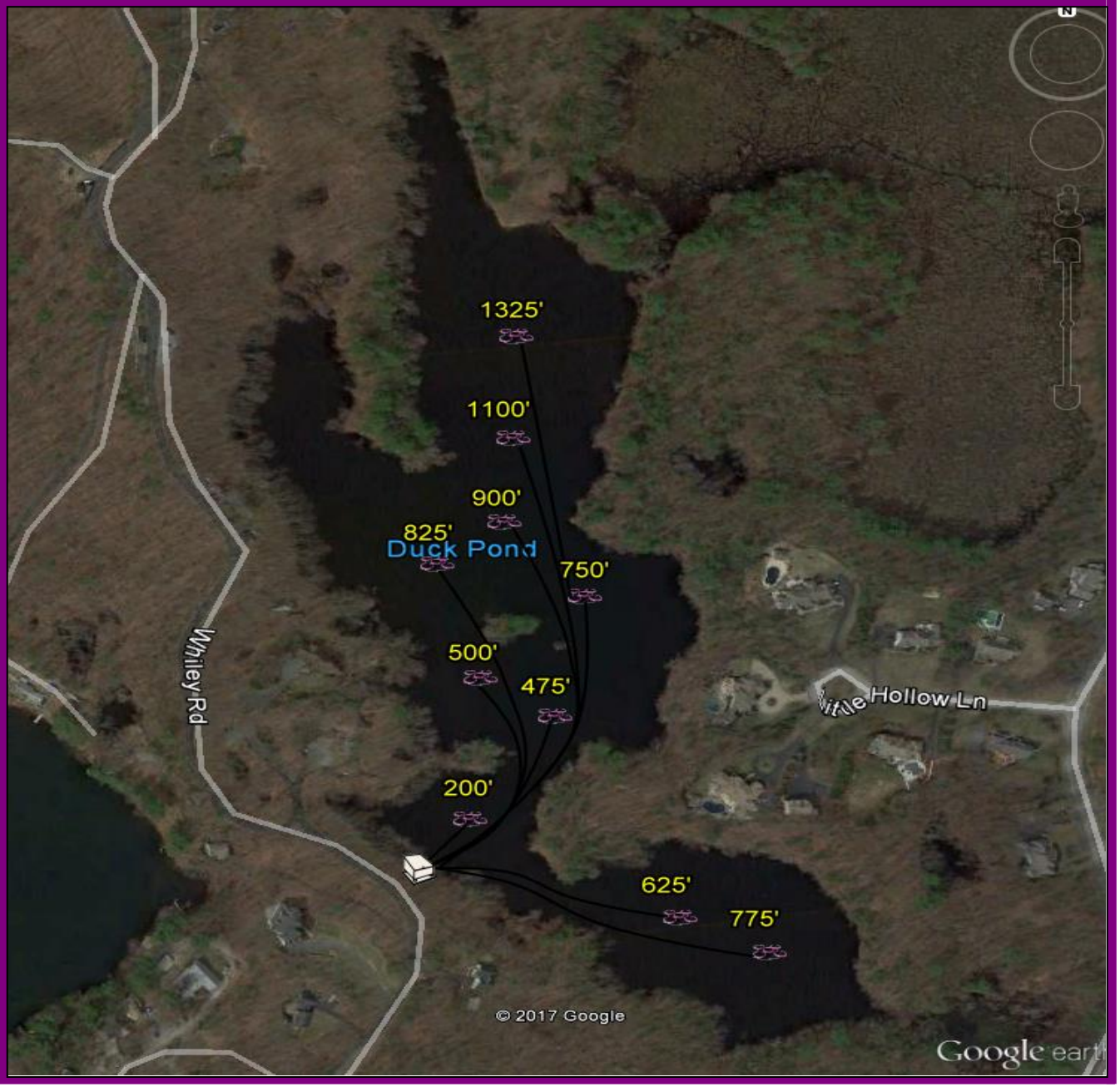
Optional Equipment

Shoreline Valve Box
1" PVC Pipe

Site and System Specifications

Surface Acres:	24.5
Perimeter Feet:	8,125
Lake Volume, Gal.:	28,286,401
Total Acre Feet:	87
# of XL5 AirStations:	10
CFM / AirStation:	2.96
GPM / AirStation:	3,859
Daily Pumpage:	55,565,844
Turnovers/Day:	1.96
System PSI:	11.8

Date: 12/19/17



Your Custom Vertex Aeration System Design Specifications

Lake Solutions Ver. 17 May 2016

Customer Name:	Solitude Lake Management
Contact Name:	Joe Onorato
Site Name/Number:	Duck Pond
Date:	December 19, 2017
Vertex Biologist:	Tamerra Jones

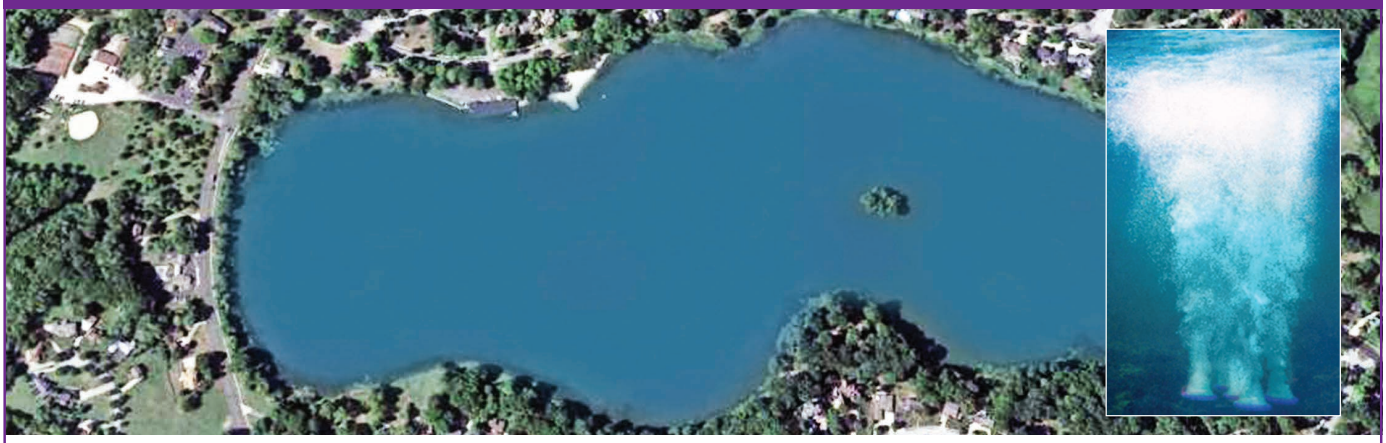
Surface Acres:	24.50
Perimeter Feet:	8,125
Slope Ratio Relative to 1	7.5
Average Center Depth:	4.0
Average Depth	3.5
Circulation Constraint Percentage	0.0
Total Acre Feet	86.8
Lake Volume (Gallons)	28,286,401
Monthly Influent Volume (Gallons)	0
Total Volume Requiring Aeration (Gallons)	28,286,401
GPM / XL5 AirStation	3,859
Gallons Pumped / Day	55,565,844
System Working Pressure (PSI)	11.8
Air Delivery Per AirStation at Depth(CFM)	3.0
Number of XL5 AirStations Specified:	10
Complete Turnovers / Day	1.96

Terminology

Surface Acres:	Total Surface Acres of Entire Water Body
Perimeter Feet:	Distance in Feet Along The Shoreline Around the Water Body
Bottom Slope Ratio :	Distance in Feet From Shoreline For Each Foot Increase in Depth
Average Center Depth:	Average of Depth Readings in Deepest Areas
Average Depth	Average Depth of Entire Lake in Feet
Circulation Contraint %	Reduced Circulation Due to Narrow Lake Areas, Islands, Etc.
Total Acre Feet:	An Acre Foot Equals One Acre One Foot Deep
Lake Volume :	Volume of The Entire Water Body Expressed in U.S. Gallons
Influent Volume:	Water Flowing into Lake that Requires Additional Aeration Capacity
GPM	Gallons of Water Pumped Per Minute
Gallons Pumped / Day:	Total Gallons of Water Pumped by All AirStations Per Day
PSI	Pounds Per Square Inch
CFM	Cubic Feet Per Minute
# of XL5 AirStations:	Recommended Number of XL5 AirStations For Proper Aeration
Turnovers / Day:	Number of Times Per Day the Entire Volume of The Water Body is Pumped From the Lake Bottom to The Lake's Surface

Vertex Water Features
2100 NW 33rd Street, Pompano Beach, Florida 33069
Tel:800-432-4302 / Fax:954-977-7877
www.vertexwaterfeatures.com

Vertex LL 33HE™ Compressor System



Do you want to control unsightly and harmful algae blooms, eliminate foul odors, reduce muck, improve fisheries and add life giving oxygen to your waterway?

The new Vertex LL 33HE™ high efficiency air compressor system is ideal for aerating larger lakes, inland canals, harbors and marinas. The LL 33HE provides you our most advanced technology yet in large single phase compressor systems for restoring impaired waterways.

Features & Benefits

- **Powerful:** Brookwood super-duty 230V single phase HighFlow™ compressors provide 30 PSI of working pressure, for depths up to 50' deep.
- **Higher Efficiency:** Brookwood HighFlow™ systems reduce monthly electric bills about 40% over rotary vane and 10% over other piston compressor systems.
- **Total Airflow:** 33 Cubic Feet/Minute – Industries highest flow rate and a 50% increase over our next largest single phase system.
- **Epoxy Coated Compressor Heads:** New corrosion protective coating protect components against demanding summer temperatures and high humidity.
- **Extended Service Intervals:** When operated 24/7, the compressor service interval is typically every two to three years.
- **Compressor Cabinet:** Heavy gauge, powder coated, reinforced and welded aluminum construction with stainless steel fasteners.
- **Redundant Cooling System:** Three oversized 7" axial fans with excess capacity to protect compressors from over-heating and premature motor failure for world-class reliability.
- **Vertex SafeStart™:** This exclusive technology boosts airflow while allowing safe, automatic restart following power supply interruption.
- **Versatility:** System is totally customizable, operates all models of Vertex AirStations™, BottomLine air supply tubing and VBS remote valve boxes as needed.
- **World's Best Warranty:** 3 years parts coverage on compressor system excluding wearable parts (air filters and compressor maintenance kits), 5 years on all AirStations™ and 15 years on BottomLine™ air supply tubing. See our website for details.

Up Your Game with Vertex quality and performance.

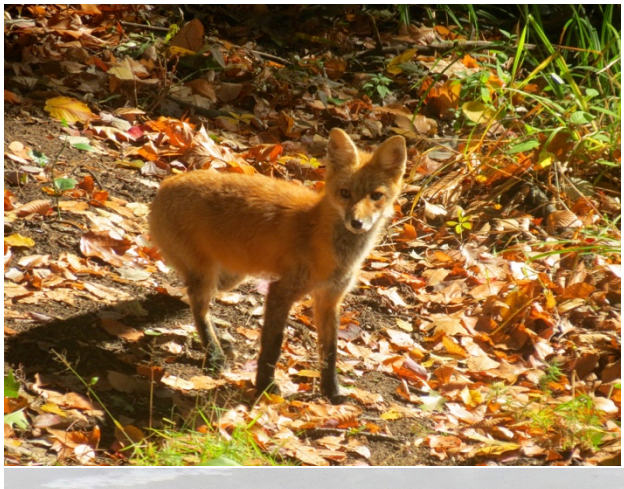
Call Vertex Water Features today for free consulting and design services and the location of a dealer near you.

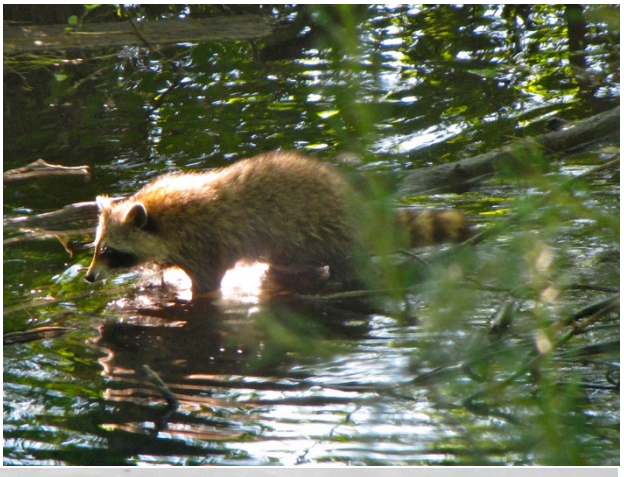
Vertex Water Features
Lake & Reservoir Aeration

(844) 432-4303
www.vertexwaterfeatures.com

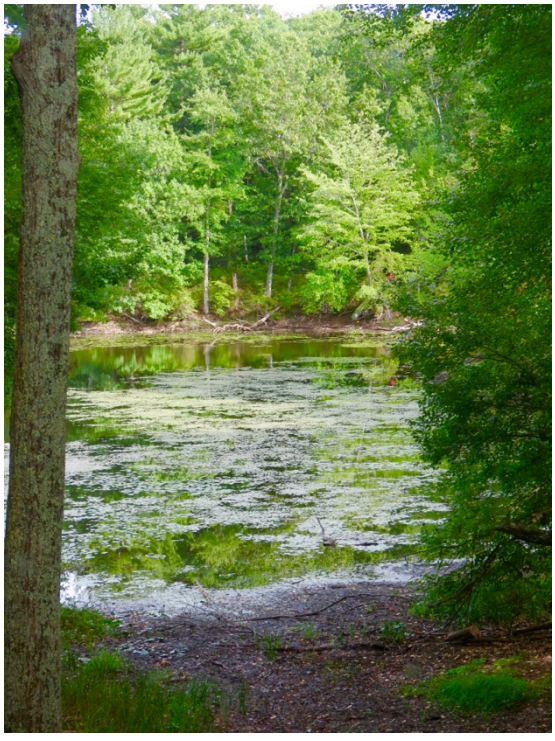
Duck Pond Recreation & Viewscapes (past years without weeds)

Duck Pond wildlife





Duck Pond weeds



Duck Pond “Muck”

A risk to anyone in the pond, and it prevents access when water level drops

Management Plan and Budget (Requesting CPC funds from 2018 balance)

Item	Timing	Responsibility	Budget	Estimate source
1. Conservation Commission NOI:				
NOI filing fees, notice mailings	March	Specialist*, Town	$ 500	Solitude
NOI Preparation & Presentation at CC meeting	March	Specialist*	$ 3,000	Solitude
2. Site Preparation:	May			
Prepare site (4'x5' pad of 3/4" stone, 12" deep), dig/backfill 18" deep trench from pole to site.		Contractor	$3,000	Easthscape, Inc.
Install conduit/wires, meter socket on upper post, 240V & 120V sockets on lower post, wires to pole	May	Electrician	$ 1,700	MacGregor Elec.
Electrical Inspector	May	Town		
Wire secondary power between poles, install meter	May	GELD	$ 400	GELD new svc fee
3. Baseline Measurements (10 locations):				
Muck depth, DO (buy DO meter)	May/June	volunteers	$ 800	online pricing
Analysis: Phosphorus, Nitrogen, etc.	May/June	Nashoba Analytical	$ 1,000	Solitude
4. Submersed Aeration System and Installation:		Specialist*	$ 26,600	Solitude/Vertex
5. Aerobic Bacteria Augmentation (10 acres out of 26)	June-Oct	Specialist*	$ 6,000	Solitude
$1K/mo x 6 months (water temp > 55 degrees)	May '19			
6. CPC reports:	6/ '19, '20 '21	Specialist*	$ 1,500	Solitude
7. Project Electrical Power & Maintenance		GELD, Specialist*	$ 4,000	GELD, Solitude
Total			$ 48,500	
co-funding below:			$ 5,000	
Net CPA request after co-funding below:			$ 43,500	
Potential co-funding sources:		Cons. Comm. FY'19		pending
		GPAC	$ 1,000	
		5 Abutters	$ 4,000	email/texts
		Neighborhood solicitation		tbd
			$ 5,000	

* Specialist: Solitude or equiv. Lake Management company

Management Plan:
Bob Anderson, with oversight by Great Pond Advisory Committee, and frequent communication with CPC, will manage the project, raising non-CPA funding, ordering NOI preparation, scheduling and supervising GELD, Contractor, and Electrician site prep, conducting Specialist vendor proposal and quotation evaluation, approving invoices, scheduling and supervising monthly treatments, and obtaining interim and final report to CPC. Mr. Anderson has extensive experience as an former entrepreneur and former CEO of a public technology company.

The single expensive item in this CPA is the installation of the aeration system, and both the manufacturer and the installer are industry leaders. The Town of Groton has extensive experience with Solitude at other Great Ponds.

CPC Scoring Criteria

12.2.1 Function:
1. Meets goals and objectives laid out in current Master Plan and Open Space and Recreation Plan:

The most relevant connection of this CPA to the Goals and Objectives are these two excerpts. Other relevant quotations are further below.

Ground and surface water pollution, OSRP Page 48:
"Some of the larger water bodies in Groton have or have had water quality problems that decrease the aesthetic and recreational values of these resources. ….[they] have all historically been found to be mesotrophic, the middle stage of a water body's transformation into a swamp or marsh. Many of these ponds are characterized by the presence of noxious aquatic plants. ….. the Town's Great Ponds Advisory Committee continues to explore options for better management of these important natural resources."

Goals & Objectives, Page 79; Seven-Year Action Plan Update, OSRP Pages 81-86:

Goal 1: Promote the preservation of Groton's important water resources.
Objective 1.2: Maintain and improve surface water quality
Action: Encourage development of comprehensive lake management plans for Great Ponds….

Master Plan:
Sustainability Principles, Page 6. Protect Land and Ecosystems:
"Over the course of its land use planning history, the town has shown enormous concern for the protection of environmentally sensitive lands, natural resources,….critical habitats, wetlands, and water resources. These resources need continued protection….. Going forward, Groton could focus more on other aspects of open space such as recreation…."

Statewide Comprehensive Outdoor Recreation Plan (SCORP), Page 52, and OSRP, Page 74/75:

"Recreation activities with….popularity….include swimming, walking, sightseeing, hiking, and fishing;…….. These activities point to needs for ……better access to …..lakes and ponds….."

Open Space and Recreation Plan:
Plan Summary, Page 1:
"Maintaining scenic vistas…is important to the community…"
"Groton has also improved several recreation facilities…"
"The community's dual desires to enhance recreational opportunities and maintain Groton's rural character by protecting…..natural resources form the foundation for this plan"

Resources of regional significance, Other Ponds, Page 6:
In the next iteration of the OSRP, the following sentence should be included prior to the sentence about Flat Pond, because Duck Pond is twice the size of Flat Pond:
"Duck Pond has access via Groton Conservation Trust land on the north end from Lost Lake Drive and a trail along the Conservation Commission shoreline on the east side with additional access from Little Hollow Road and Duck Pond Drive. It is used for light boating, fishing, and skating."

Water Resources, Lakes and Ponds, Page 32:
"Two more of the Great Ponds are located near the lake: Whitney or Cow Pond (37 acres) and Duck Pond (21 acres)" [sic: actually 26 acres]

Page 33:
For recreational purposes, public access is provided via protected open space to all Great Ponds located entirely in Groton except Martins Pond."

Wetlands, Page 36:
Table and text show 4017 acres of total wetlands, of which only 1328 acres are open water (lakes or ponds). Possible interpretation: protect the lakes and ponds from turning into marshes and swamps.

Seven-Year Action Plan Update, Pages 81-86:

Goal 1 is on previous page.

Goal 2. Promote the preservation of important land resources in Groton.
Objective 2.2: Protect lands and water resources of scenic value.
(relevant Goal/Objective, but no specific Action relevant to this CPA)

Goal 3: Provide recreational opportunities for all Groton residents.
Objective: Expand recreational and educational program offerings.
(relevant Goal/Objective, but no specific Action relevant to this CPA)

Goal 4: Promote the efficient management and maintenance of the open space and recreation areas and structures of Groton.
Objective: Implement strategies that will facilitate the care of recreation and conservation areas.
(relevant Goal/Objective, but no specific Action relevant to this CPA)

12.2.1 Function

2. Multiple Funding Sources

The Groton Conservation Commission supports the project but the amount of co-funding, if any, depends upon which accounts can be used and what other commitments exit for the funds in those accounts. This is still undetermined. The five abutting residents have committed $4,000 to show how important they think the restoration is. We will establish a GoFundMe campaign so that residents of nearby neighborhoods can be solicited to make tax-deductible donations to the Town of Groton, earmarked for this project. We think that members of additional committees and boards that are supportive but lack funding priority or availability will donate as individuals through this method. We do not yet have the total percentage of non-CPA funding.

12.2.2 Value

1. Overall application quality: (awaiting CPC feedback during the coming weeks)

2. Degree of urgency: The recent rapid deterioration of Duck Pond indicates that the slope of the eutrophication curve has increased significantly. The more weeds, muck, and phosphorus accumulating in the pond, the longer the restoration will take. This is a low-cost approach (relative to herbicides, weed-harvesting, hydro-raking and Alum) that will slow and eventually reverse the eutrophication. If additional techniques are necessary someday, it will be a smaller and less expensive task than it would be today.

3. Community Support: We have multiple relevant organizations supporting us now. After the Draft CPA is submitted, we will start to build broader community support.

4. Ease of Execution: Easy execution is indicated by the low cost of the project.

5. Level of Risk: No one or organization has identified any risk areas or negative consequences. The ultimate rate of success can't be predicted precisely, but the widespread use of aeration and the case studies from Vertex (enclosed) indicate a high probability of success with minimal on-going power and maintenance costs. The only potential legal issue that has arisen concerns the state's attitude about a Great Pond (by definition in the law) that is not included on the Great Pond list. We understand that we need to include the necessary documentation to satisfy the CPC.

6. Applicant active in process participation: Several of us attend all CPC meetings of this cycle, and Conservation Commission, Great Ponds Advisory Committee, and Groton Lakes Association meetings as well as keeping them informed about our preparation progress.

“Great Pond” Documentation

Placeholder

Landowner Easements Placeholder

Vertex Water Features
Lake Aeration Systems & Floating Fountains

Aerators Case Study: East Twin Lake, MI

Muck Reduced an Average of 2.8' in 10 Years - An Independent Study on the Effectiveness of Vertex Aeration to Eliminate Accumulated Sediment

A report commissioned by an independent party (in Michigan, USA) demonstrates the reduction of organic lake bottom sediments after the installation of a properly designed aeration system.

"In this study, a Vertex CoActive AirStation XL system (see installation diagram below) was designed and installed. Delivering oxygen to the lake bottom using this system is a very effective way to introduce oxygen into eutrophic water. Oxygen is necessary for the bacteria to thrive, and it is the bacteria that do the important work of digesting the nutrient rich sediment.

Detailed data reports are available at the end of this paper.

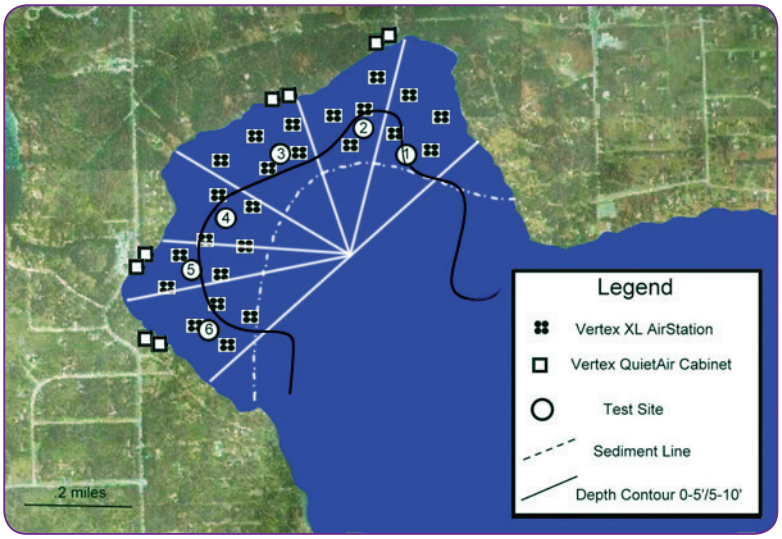
So again, with our assistance positive results are obtained by using aeration in a troubled aquatic environment. How many years of water quality problems, particularly those associated with cyanobacteria will we need before governments take a serious look at phosphorous laden sediment, and then take serious action to remediate the problem?" - *Twin Lakes POA*

Lewiston's East Twin Lake Develops An Aeration System

By Gregory Bator
East Twin Aeration Association, LLC
Twin Lakes Property Owners' Association, Board Member

East Twin Lake is a shallow lake in Montmorency County. The lake, along with its Association sister West Twin Lake, form the heart of Lewiston's determined return to the glory days of its timbering heritage at the turn of the last century. East Twin covers about 900 acres of surface area with 9,300 perimeter feet of shoreline. The lake contains roughly 192 million gallons of water.

Lewiston's timbering times gave this bucolic area its identity, and perhaps more. Almost 100 years since the fires which destroyed the lumbering mill housed on the banks of the East Twin Lake, lake users confronted the timbering past as water levels receded in 2000. Boaters were frequently surprised by a sudden bump as they glided boats across the water. The bump was from the remaining upright pillars that supported a small gauge railroad track that extended far into the lake.



East Twin Lake Aeration Study
Site map of sediment location, depth contours, sampling locations and Vertex aerator placements

A community project removed over 90 dangerous timbers from the lake in 2002. In clearing the lake from these obstructions, discussion turned to the noticeable levels of sediment in East Twin Lake, primarily concentrated at its west side. Was this sediment a sawdust gift from our timbering forefathers that was stored on our sandy-bottomed lake? In 2002, we were determined to come to the aid of our upper mesotropic lake. We were not satisfied seeing our lake filled with unsightly and increasing sediment.

The Problem

East Twin is a relatively shallow lake. Depths range four to eight feet, with some areas no deeper than about 26 feet. The lake bottom is primarily a hard sandy surface. During a period of low water levels, the high sediment level at the western end of our lake became more prominent. The sediment occupied as much as six of the eight feet of depth in many locations. These levels were unacceptable to boaters, water enthusiasts, and fishing aficionados. Our problem area is located at the western end of our lake. This area consists of 160 acres of surface area. An existing island on our lake and a sand bar, which traverses from the island to the northern shoreline, roughly contains it.

How could we rid our lake of this unacceptable sediment? Once we confronted this question, our goal developed. We were determined to improve water quality/clarity, improve property values, and increase lake enjoyment, by decreasing the sediment level.

Studying Our Sediment Problem

Our suspicions that the sediment was submerged sawdust from the timbering operations were unfounded. One of our initial tasks was to determine the composition of our sediment. There were two primary reasons for this work. First, we wanted to ensure that the material was not toxic or harmful if we disturbed the substance. We also recognized that removing a dangerous substance could be very costly, and perhaps beyond a volunteer reach. Second, we wanted to learn the sediment composition in order to design an effective decomposition program.

We engaged the services of a water testing company who analyzed samples of our muck. The sampling study revealed that our sediment consisted of natural organic material including, but not concentrated with sawdust. Armed with this information, we turned to the selection of removal options.

Determining our Options

Undesired sediment could be removed by dredging. We learned that dredging involves two costly steps: the removal process and the disposal process. While removing the sediment could be achieved at considerable expense, securing nearby elevated land to store the material posed a financial burden beyond our means.

Adding biologic agents, tiny bug-like microbes, was another possible solution. The prospect of dumping drums of biologic agents into the lake and charging these agents with the task of eating our muck was cast aside. This also is an expensive process that must be continually repeated. A certain risk that we might be introducing an unknown harmful agent to our waters also dissuaded us from this approach.

We chose to use an aeration method. Adding oxygen to our lake would act similar to a bubbler in our childhood fish tank. Bubbles would circulate water, aerobic activity would thrive, water clarity would improve, and water quality would be enhanced.

Organizing Our Resources: People and Money

The initial study and project determination was made by a small core group of lake supporters spearheaded by Alan Kiriluk, an ardent lake supporter. This group formulated a proposal to identify, fund, and solve our lake's sediment issue. The issue was publicized through our lakes' association newsletter and presented in an hour-long forum at our association's annual meeting in 2003.

The approximate 90 lake supporters received a detailed proposal describing the method of attacking the sediment issue and the level of financial support needed to begin the project. The financial projection assumed that monetary support of all lakefront owners would not be received. The financial targets were built based upon participation of only 30% of lakefront owners and a small group of lake access users. We determined that we would gladly confront the issue of having raised too much money, rather than not enough.

The lake association endorsed the project. Mailings were distributed to all lakefront and lake access property owners requesting their financial support of $5.14 per linear feet of lakefront owned or for back lot owners a flat amount of $257. Most importantly, we indicated that if our target of $50,100 was not raised by a date certain four months later, the project would be stopped and all funds would be returned. Coupling this deadline with a specific proposal and solid information were critical to the project's success. Through personal solicitations, newsletter articles, and direct mailing, approximately $60,000 was raised within a four-month period to meet the project's deadline.

Engaging Professional Services

We determined that an aeration system must be professionally installed and maintained. Several methods of artificial aeration exist. Air can be introduced to a lake by injecting air in the lake, mechanically mixing the water, or agitating the water with paddles or fountains. We chose to inject air into the lake through the use of submerged diffusers that are fed air pumped by shoreline compressors through heavy tubing resting on the lake bottom.

A national company skilled in aeration systems for industrial and large residential projects, Vertex Water Features, was chosen to assist our efforts through their local affiliate Tri-County Aquatics, Inc. Further study and design worked was performed.

Our aeration effort is concentrated in the lake's west end where the sediment problem was most prominent. We contracted for the purchase and installation of eight land-based compressors that would each feed three diffuser units. Each diffuser unit consists of four rubberized membranes containing multiple tiny holes. In total, the four compressors would feed 24 diffuser units consisting of 96 membrane bubblers.

Our total project cost was $44,000.00 in 2004 with an anticipated six to seven thousand dollar professional maintenance and utility expense annually.

Legitimizing the Organizational Effort

The East Lake Aeration Association, LLC was formed with the State of Michigan. Insurance coverage was obtained in the unlikely event unforeseen problems developed. Three property owners and our local township were solicited to house the compressor units on the shoreline of their property. Arrangements were made to bring electrical supply to each compressor unit.

Application was made with Michigan's Department of Environmental Quality (DEQ). Securing the permit to conduct the aeration program was an extensive process. We were required to establish the authority to place the aeration units within the riparian interests of adjoining property owners. We were also required to present the detailed locations of the proposed units and their impact on the lake and its fish population. The DEQ conducted additional study in coordination with the DNR fishery experts, before approving the permit.

The permit was granted. Installation was completed in July 2004 when the aeration units were turned on.

How Does Aeration Work? What Does it Accomplish?

We knew that the sediment levels in our lake created low oxygen levels in the muck. When low oxygen levels are present the water's condition is anaerobic. This is undesirable. When aerobic conditions exist, tiny aerobic organisms can exist to naturally eat up or decompose the sediment at faster rates. This was desired.

Initially, most people believe that the air introduced into the lake supplies the requisite oxygen to create aerobic activity. This belief is not correct. The aeration units pump air into the membranes that create columns of bubbles that circulate the lake's water from bottom to top. When water is exposed to the atmosphere it is oxygenated from a process called diffusion. The chief operative characteristic of our aeration units is actually water circulation.

Our aeration units operate once the lake ice disappears in April and are turned off when the ice reappears in November. The diffuser units and the air hose tubing remain in the water year round; nothing is removed.

When activated, the units operate continuously day and night. The operating units are housed in protected metal cabinets and contain two 1/3 hp compressors. The units are quiet and trouble-free. In total, the units are connected to 12,000 feet of self-weighted bottom line tubing that remains at the lake's bottom. On only one known occasion, a low drafting boat pulled the tubing, with no apparent damage to the boat or tubing. The tubing is connected to 24 diffuser units that each creates four columns of tiny bubbles at the water's surface. The 24 diffuser units are situated in specifically designed locations. The units are not moved. On rare occasions, a unit placed in shallow water surfaces. When this occurs, the unit is weighted and returned to the bottom. On average we have replaced one diffuser unit each season that becomes damaged by ice or contact with a boat if surfaced. When operating, the diffusers present no risk or interference with normal water activities.

The diffuser system circulates over 200 million gallons of water daily. This water circulation allows the biologic oxygen demand (BOD) to reach levels necessary for aerobic activity to occur in the lake. BOD is widely used in environmental engineering practice to determine the amount of oxygen water requires for the sediment breakdown process. Before the aeration program began, the heavy sediment areas were anaerobic.

In other words, the lake was relatively stagnant, holding increasing amounts of suspended muck, with no aquatic organisms existing to eat up the unwanted sediment.

Is Aeration Working? Yes. Is our Sediment Gone? No.

We still have sediment in our lake, but less than before. In our initial project proposal we forewarned everyone that the aeration approach did not seek quick or dramatic results. We entered this program with eyes wide open and spirits prepared for long-term results only. We hoped to reduce our sediment levels by 6 inches per year.

We appear to be exceeding our conservative projections. Testing results are demonstrating continual drops in the undesired sediment levels. After two and a half years of operation, tests are revealing approximately two feet less of sediment in our lake. These tests are conducted 4 times per year in the same locations. Data retrieved from the tests demonstrates reduced sediment levels. These are encouraging results.

Anecdotal reports of lake users have been positive. Increased wildlife has been identified, perhaps attracted by the sediment particles being pushed to the surface. Improved water clarity has also been noted with some west end lake users now being able to see their sandy bottom.

Observations at the 10 Year Mark from TriCounty Aquatics

The average muck depth has gone from approximately 4.3ft to 1.5ft over the past ten years; giving a yearly average reduction of 3.36". It is important to note, however, that most of this reduction occurred within the first 6 years after the installation of aeration. Average muck levels from 2009 to present, have shown little reduction in muck depth and seem to have stabilized. This stabilization could potentially be explained by the fact that some compounds that form during the decay processes (lignocellulose) can become almost chemically inert, where breakdown rates are extremely slow depending on the microbial community.

It is important to understand that previous assessments on the lake's dissolved oxygen levels at the sediment water interface showed that the lake's microbial community was in a predominantly anaerobic state. This is because when oxygen concentrations fall below 2 mg/L (which was observed), the rate of aerobic oxidation is reduced significantly. Anaerobic bacteria can oxidize organic matter without the use of oxygen, but the end products include compounds such as hydrogen sulfide (H_2S), ammonium (NH_4), and methane (CH_4), which are toxic to many organisms. The process of anaerobic

decomposition is also much slower than that of aerobic decomposition and can potentially explain why the lake was accumulating more muck than it was reducing. Having increased oxygen at the sediment water interface most likely caused a shift in the microbial community, increased and expanded the range for desirable benthic macro-invertebrates (i.e., Shredders & Grazers), and improved overall sediment chemistry (i.e., changes in redox state). All of these factors could account for the high reduction rates seen from 2004-2009 and no net gain in muck from 2009 to present.

It can be expected that the lake will regress back into its previous state of accumulating organic muck if the aeration system is turned off. In order to maintain the benefits associated with increased oxygen at the sediment water interface and prolong the lake's "life", it is recommended that the current aeration systems remain running (24hrs/day). Although future operation will come with annual maintenance and operational costs, it is expected that the benefits would outweigh the cost.

It is also recommended that the lake's current sediment monitoring program be continued. This will allow for best management practices into the future that are based off actual data not anecdotal observations.

Contact Resources

www.vertexwaterfeatures.com

www.tri-countyaquatics.com

lewistonlakelivingggmail.com

Eight Vertex Air3 XL4™ Systems installed at East Twin Lake Cove

The Vertex Air3 XL4™ pond aerator is a super-efficient, affordable and safe system. In a typical pond, an Air3 XL4™ can aerate approximately 4-7 acres depending on shape, slope, oxygen demand and other factors. Two 1/2hp (0.75kW) Brookwood™ SafeStart™ compressors, housed in our rustproof aluminum outdoor cabinet, feed three bottom mounted XL AirStations™ utilizing Vertex's MicronBubble™ technology.

The rising force of millions of bubbles circulates the entire water column, entraining bottom water up to the surface allowing vital oxygen to be absorbed and poisonous gasses expelled. With no electricity in the water, Vertex's aeration systems are safe for any type of water recreation.

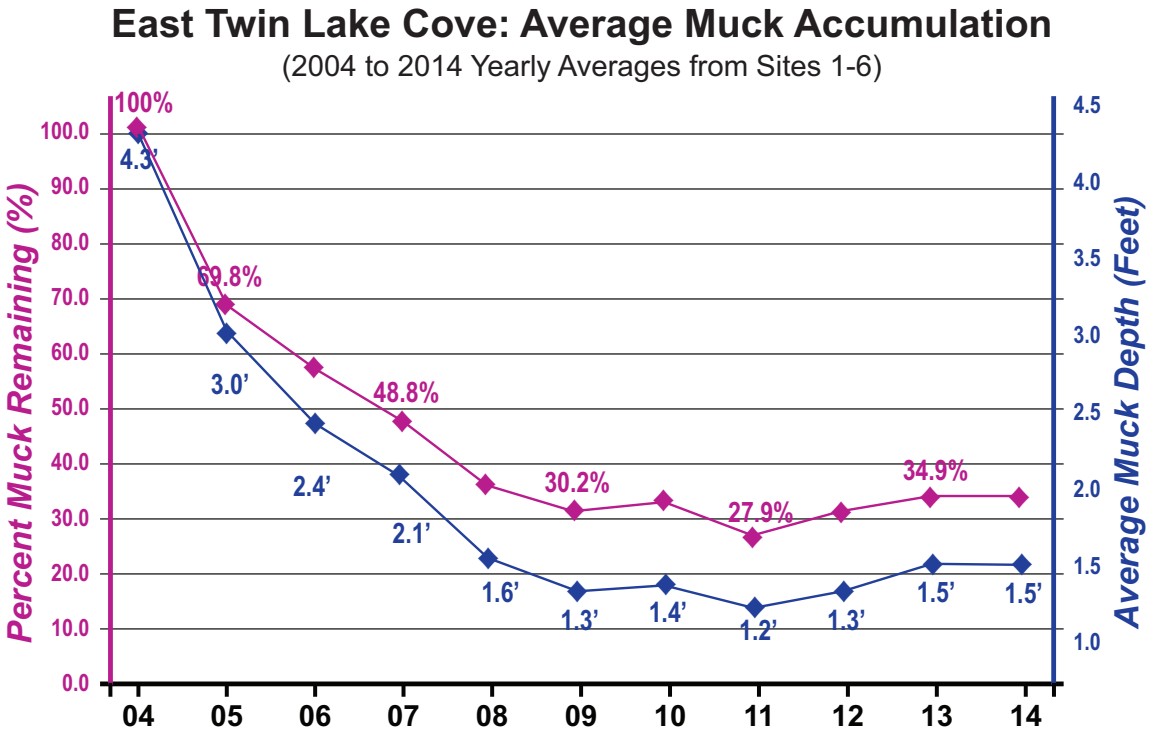
Total System Install

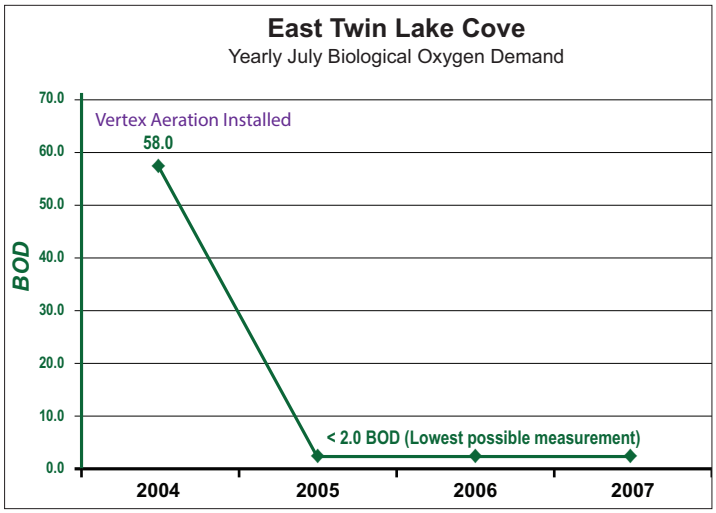
- 24 XL4 AirStations: (96) 9" flexible membrane discs
- 8 QuietAir Cabinets: (16) 1/2hp Brookwood Compressors

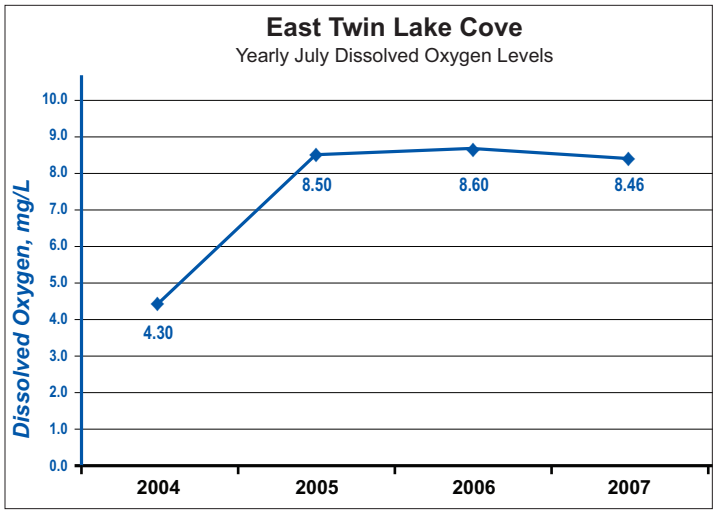
Aeration of East Twin Lake Sediment, BOD and Oxygen Results

In July 2004, eight Vertex Air 3 XL systems were installed by Tri-County Aquatics in a 160 acre cove of an 900 acre lake. At the time of installation, muck measurements with a “sludge judge” were taken at six locations to determine the amount of muck on the bottom. Three of the sites showed levels of 6 and 7 feet of muck and the average for all 6 sites was 4.3 feet of muck. Oxygen readings were taken at the surface and at the bottom to assess the quality of the water. The dissolved oxygen at the surface was 4.0 mg/l while the oxygen level at the bottom was 2.0 mg/L, which is virtually an anoxic environment. A water sample sent to a lab to determine the BOD (Biological Oxygen Demand) returned results of a BOD of 58 mg/L, which was much higher than the available oxygen in the water could oxidize and reduce.

Tri-County Aquatics, Inc, the installer of the aeration system located within East Twin Lake in Lewiston, MI, has been performing multiple sediment readings at six locations within the lake, in order to track aeration’s effect on reducing muck. A summary of the last ten year’s sampling is outlined below.







2100 NW 33rd Street Pompano Beach, FL 33069 • Phone: 800-432-4302 • Fax: 954-977-7963 • www.vertexwaterfeatures.com




Water Quality Solutions

Vertex Water Features
Pond and Lake Aeration

AERATION RESEARCH

15+ Years of Aeration Research and Testing

Vertex introduced the lake aeration industry's first CoActive MicronBubble™ membrane disk technology in 1998. Since then, our rugged aeration systems have performed reliably under the worst natural conditions around the globe.

From our first installations in 1980 to our technology leading AirStations™ of today, Vertex continuously pushes the science of bottom aeration technology forward.

Field testing a prototype for the PondLyfe system.

How do we know our systems work?

We test them. Our scientists perform ongoing field and lab research on ponds and lakes like yours to determine the reliability, efficiency and effectiveness of existing components and prototypes under development. And, if that isn't enough, we ask others to test them too.

Vertex's Dr. Josette La Hée testing water samples from a lake before aeration systems are started.

Why Vertex?

GREAT CUSTOMER SERVICE

- Free aerial mapping, system design and aeration turnover calculations
- A nationwide network of authorized Dealers
- Factory direct assistance from start to finish

CONTINUOUS RESEARCH

- ***Independent aeration performance testing has proven that adding millions of bubbles from the bottom up is the most effective form of aeration***
- Staff PhD biologists conduct ongoing testing of the effects of aeration on a wide range of issues in a variety of waterways
- Ongoing testing of aeration performance and efficiency for oxygen transfer
- Product research, testing and development for quality control and improvement

QUALITY MANUFACTURING

- ETL and CE International electrical safety certification
- Made in USA - Pompano Beach, FL
- LEAN Manufacturing processes - all products are built with strict quality control
- Highest quality components in the industry for rugged construction and dependability
- Member South Florida Manufacturers Association

INDUSTRY BEST WARRANTIES

- Diffuser Assembly: 5 years
- Compressors: 3 years, excluding wearable parts (air filters and compressor maintenance kits)
- Cabinets: Lifetime protection against rust
- Tubing: 15 years

Vertex Water Features
Pond and Lake Aeration

2100 NW 33rd Street • Pompano Beach, FL 33069
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www.vertexwaterfeatures.com

Aeration Helps Restore Lakes Naturally

Ponds and lakes without enough oxygen have a difficult time handling nutrient overloads, especially phosphorus. Dissolved oxygen, critical for water quality, is naturally added by aquatic plants and algae through photosynthesis; and by diffusion at the surface from wind. Animal, plant and bacteria respiration deplete oxygen. Problems occur when oxygen demand is greater than supply.

What You Notice

- Fish kills
- Algal blooms
- Poor water clarity
- Swarming Insects
- Foul odors
- Muck accumulation

Symptoms

- Low oxygen
- Bad water chemistry
- Suspended sediments
- Stagnant stratified water
- Hydrogen sulfide/carbon dioxide gas build up
- Low levels of beneficial bacteria

Aeration at work

Independent research shows that Vertex bottom diffused aeration “turns the lake over”, adding oxygen at all levels, in the most efficient and cost effective way to achieve a healthy balance. Aeration also *improves the effectiveness of biological and chemical treatments* so you use less over time - better for you, better for the water and better for the environment.

Vertex Aeration Chosen for Bahia Del Mar Lake Restoration

Bahia Del Mar is a 14 acre lake located in St. Petersburg, FL. This lake was severely stratified, with large amounts of organic material in bottom waters, high nutrient levels and concentrations of hydrogen sulfide causing a “rotten egg” odor, high biological oxygen demand and very low oxygen levels. The system was unsuitable for fish and other aquatic organisms and posed a health risk to residents. Due to the extreme conditions of the lake a two-pronged approach was undertaken to bring it back to a healthy state.

Treatment

- Aeration: Bathymetric Mapping provided accurate detail about the depths and volume. Two Vertex Systems, an LL 4XL5 Aeration System and a HF 4XL5 Aeration System with sound reduction kits were installed in April, 2012 to provide adequate turnover rates
- Alum application: Our sister company, Aquatic Systems, applied two treatments of Alum to quickly improve water clarity and color, reduce water phosphorus levels and drop out the suspended solids

Results Highlights

- BOD at the bottom of the lake showed a 99% reduction
- The "rotten egg” odor was eliminated
- Oxygen at bottom of the lake increased from 0 to 8 mg/L
- Turbidity went from 113 NTU to 8 NTU – a 92% reduction
- Bottom water Phosphate and Nitrogen Ammonia were reduced by 99%
- Chlorophyll a went down 72%
- Clarity increased 150%

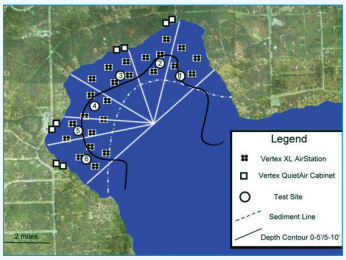
AERATION RESEARCH

Muck Reduced 2.4' in 3 Yrs

Independent report shows the reduction of organic lake bottom sediments.

East Twin Lake is a shallow lake in Montmorency County Michigan. Depths range 4' to 8', with some areas as deep as 26'. During periods of low water levels, the high sediment level at the western end of the lake became more prominent. The sediment occupied as much as 6' of the 8' of depth in many locations.

The problem area was located at the western end of the lake. This area consists of 160 acres of surface area.



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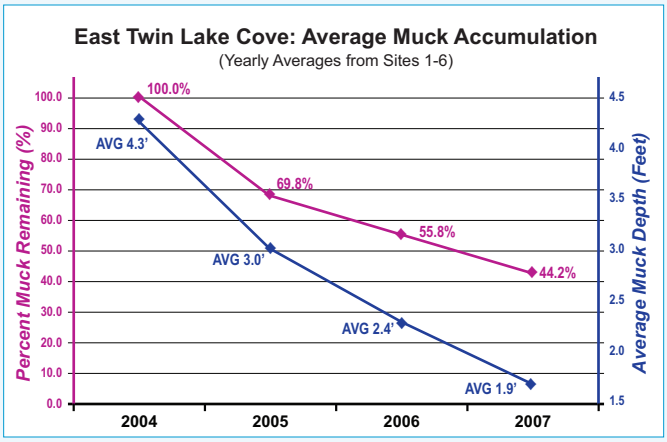
The Results Highlights

After two and a half years of operation, tests showed:

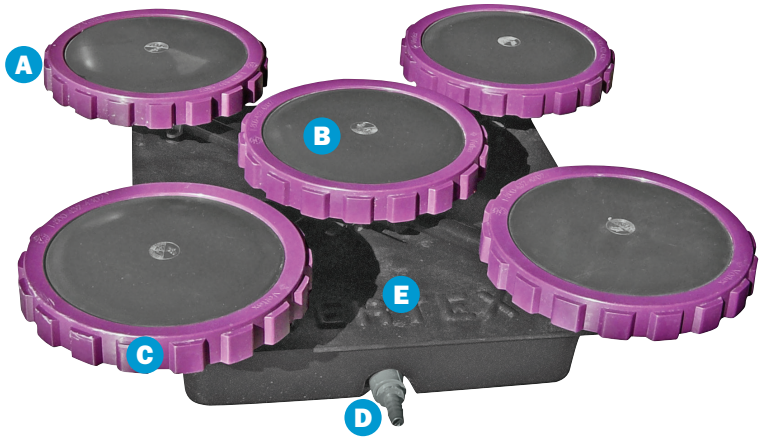
- Approximately 2' less of sediment.
- Increased wildlife and improved water clarity
- Dissolved oxygen at the surface increased
- Biological Oxygen Demand (BOD) decreased to healthy levels



The Vertex Diffuser Advantage

Some aerators add oxygen only at the surface or use large bubbles that escape at the surface, *Vertex diffusers push millions of tiny bubbles from the bottom of the lake to the surface to add oxygen everywhere its needed!*

- 5-year "No Questions Asked" 100% replacement warranty (shipping included)
- Independently tested pumping rates
- StableTrak™ technology increases lift velocity
- FlowControl™ technology equalizes airflow to each disk
- "Delta" shaped surface pattern increases active surface area and aeration efficiency
- Self cleaning disks - no yearly removal or acid cleaning required



AirStation Components

A	Membrane^3 Diffuser disk
B	Clog, wear resistant, flexible polymer membrane
C	Durable diffuser ring
D	Barbed hose fitting for tight connections
E	Lipped chamber to hold ballast

Over 50,000 Membrane^3 diffuser disks sold.
No reported clogged or blown-out membranes.

Vertex Diffuser Model categorized by water depth and lifting rate GPM (Gallons Per Minute)

Air flow = 1.0 CFM (cubic feet per minute) per disk

Depth	XL1 GPM	XL2S GPM	XL2 GPM	XL5 GPM	XL4 GPM
2'	700	1,400			
4'	1,150	2,300			
6'	1,250	2,500			
8'	1,600		3,200	7,700	9,000
10'	1,950		3,900	9,950	9,650
12'	2,150		4,300	10,750	10,050
14'	2,250		4,500	11,850	10,300
16'	2,275		4,550	12,450	10,500
18'	2,350		4,700	13,200	10,650
20'				13,750	10,700
22'				14,150	10,800
24'				14,400	
26'				14,600	
28'				14,700	
30'				14,800	

Lifting rates represent total water flow as recorded in both independent testing and real world data collected by Vertex from installed aeration systems. Lifting rate varies significantly by air flow, water depth and other factors.

Vertex QuietAir™ Cabinets Are Built to Last

Our durable QuietAir™ cabinets with Brookwood™ compressors are designed to fit into the landscape without being obtrusive while providing maximum effectiveness. Choose plug-in connection for waterside electrical service or ***VBS for distant power sources*** (remote valve box, sold separately)

- Highest flow rate of any compressor in its class
- Available in 115V 60 Hz or 220V – 240V, 50/60 Hz
- Oil-free, requires no lubrication
- Superior piston design provides higher pressure
- Quieter operation and longer life than vane compressors - 2 to 4 times the duty cycle
- Thermal overload protection

Cabinet Components

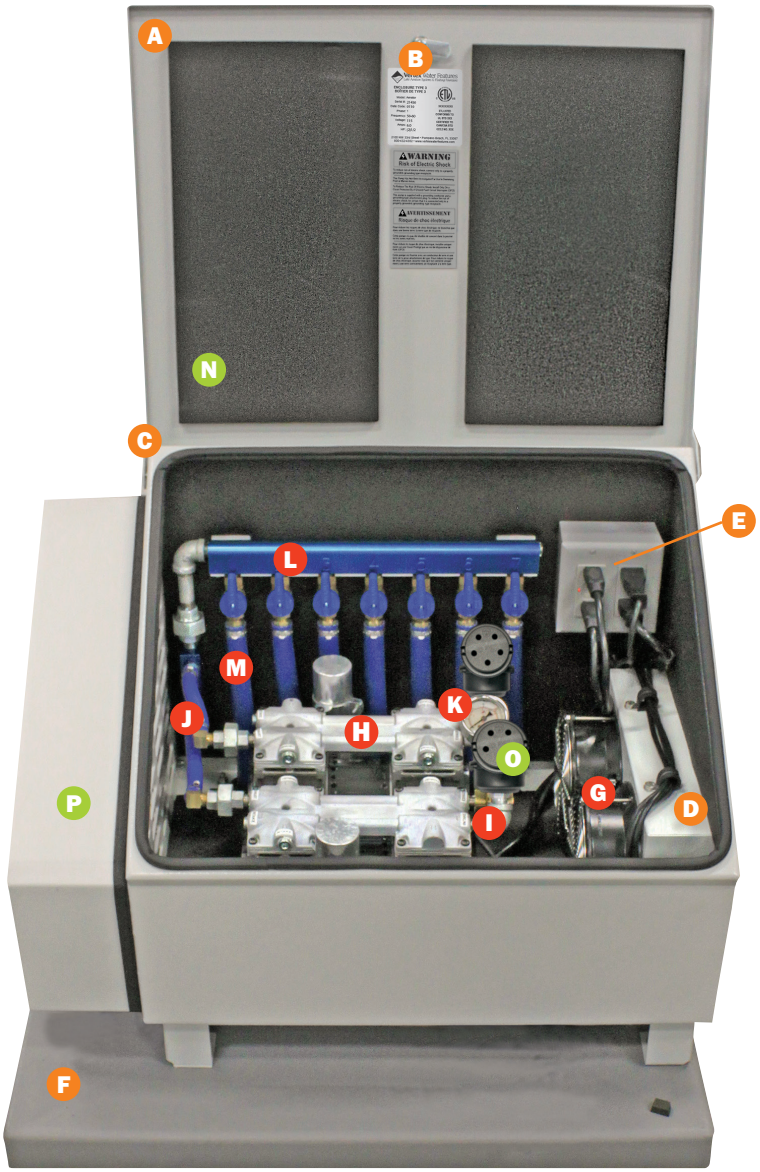
A	Rust free powder-coated aluminum cabinet
B	Weather, child and vandal resistant keyed cabinet lock
C	Stainless steel fasteners
D	Exhaust plenum for longer fan life, noise reduction and weatherproofing
E	Exterior safety on/off switch (on back of cabinet where shown)
F	Mounting pad included

Compressor Components

G	Oversized cooling system
H	Heavy duty Brookwood piston compressors
I	SafeStart™ motor protection technology
J	Pressure relief safety valve
K	Pressure gauge for airflow adjustment
L	High pressure blue anodized manifold
M	High temperature airline hoses

Optional Sound Reduction Kit

N	High density sound adsorbing foam
O	Noise reducing twin muffler
P	Noise reducing side mounted muffler

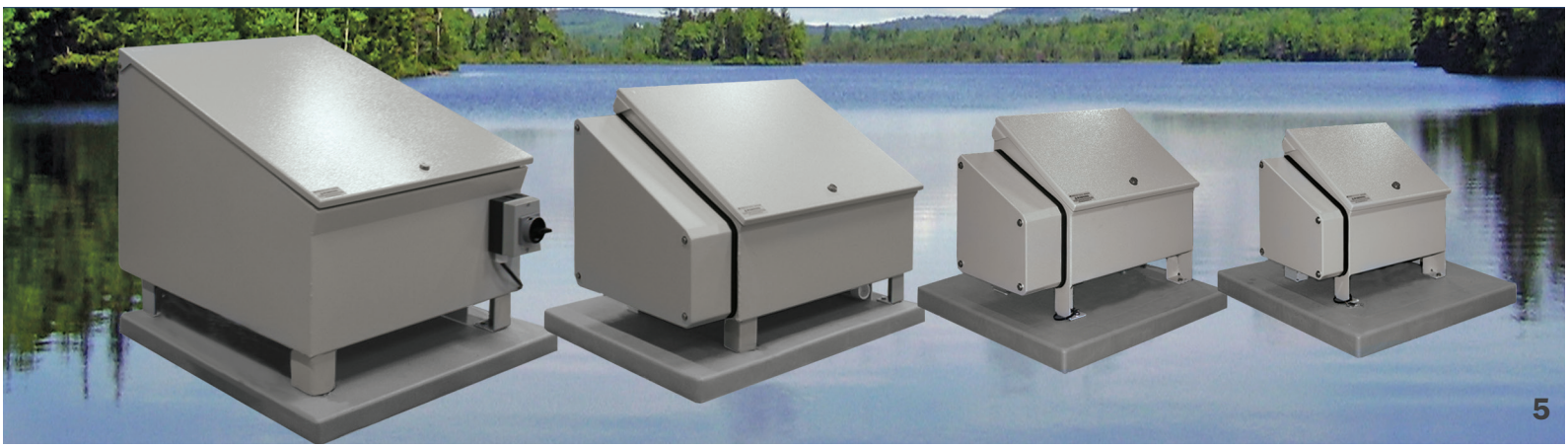


Bottomline™ Tubing

Tubing is sold separately so that you get the amount you need without waste. Our tubing is durable, self-weighted, remains flexible in cold temperatures.

Remote Valve Box

A Remote Valve Box allows installation of the cabinet wherever it is convenient. Place the cabinet where you have power and deliver the air as far as needed.

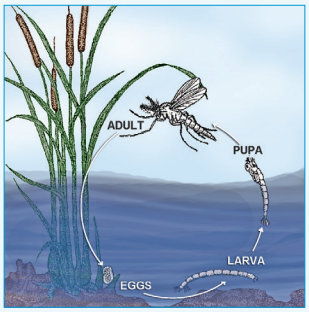


AERATION RESEARCH

Midge Flies Controlled

90% reduction in 16 months without pesticides

Hibbs Grove located in Cooper City, Florida was experiencing an ongoing outbreak of swarming midge flies from their 6.5 acre lake preventing residents from enjoying their lake front property. Sampling indicated an extreme infestation of midge larvae averaging more than six times the recognized nuisance level.

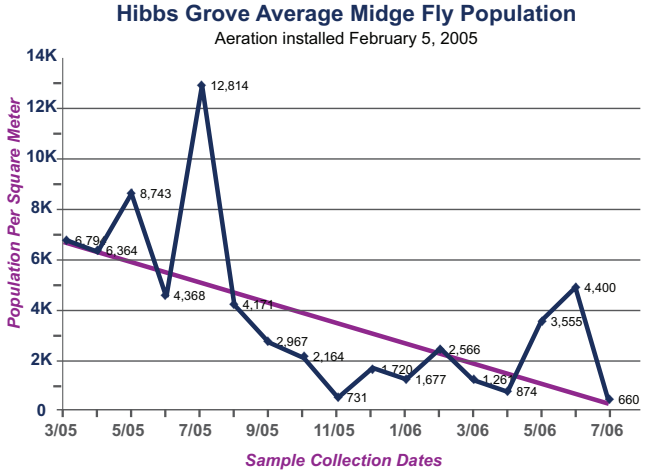


Hibbs Grove turned to the biologists at Vertex Water Features for an environmentally safe solution. Vertex installed a CoActive Air 5 aeration system that provided compressed air to five XL2™ CoActive AirStations placed at the deepest points throughout the lake, effectively circulating the entire water column 0.76 times per day.

The Results Highlights

Oxygen levels increased immediately and accumulated organic muck on the bottom began to decompose, eliminating the habitat and food source that the midge larvae depended on. The improving water quality allowed predators of the midge fly, such as bluegill and aquatic insects to prey on the midges. The resulting increased predation, decreased nutrients and habitat competition contributed to a significant decrease in midge flies.

Within 16 months of the Vertex system installation, the midge fly larvae population had been reduced by 90 percent, from 6,794 larvae/m^2 to just 660 larvae/m^2. Throughout the 16 months, there had been a visible increase in fish, dragonflies and water beetles all of which are natural predators of the midge fly larvae. With continued aeration, the oxygen levels have remained elevated and continue to oxidize bottom muck and suppress the midge fly population.



Comparing Types of Aeration: Points to consider

Professional Design Services

- Free custom aerial mapping, aeration specifications and design
- Free comprehensive performance calculations including CFM, PSI and turnover rate
- Largest selection of compressor systems and diffuser models
- Degreed staff, knowledgeable in aquatic biology, limnology, fisheries sciences and lake management
- National network of qualified, experienced distributors providing local support, service and expertise

Product Quality:

- ***Published independent aeration performance testing has proven that adding millions of bubbles from the bottom up is the most effective form of aeration***
- ETL Equipment listing - products meet UL electrical safety codes
- High efficiency compressors and diffusers provide higher lifting rates with lower power consumption
- 5-year “No Questions Asked” diffuser warranty and 3-year compressor systems warranty, excluding wearable parts (air filters and compressor maintenance kits)
- Self-cleaning diffusers, easy to replace filters, extended compressor service intervals
- Dedicated research and development team working towards continuous product improvement

I installed my Vertex System 5 years ago. It's quiet, and it has been 100% reliable. My pond looks great and my fish are happy and healthy.

Ryan Freeze
Vertex Aeration Owner in Plain City, Ohio

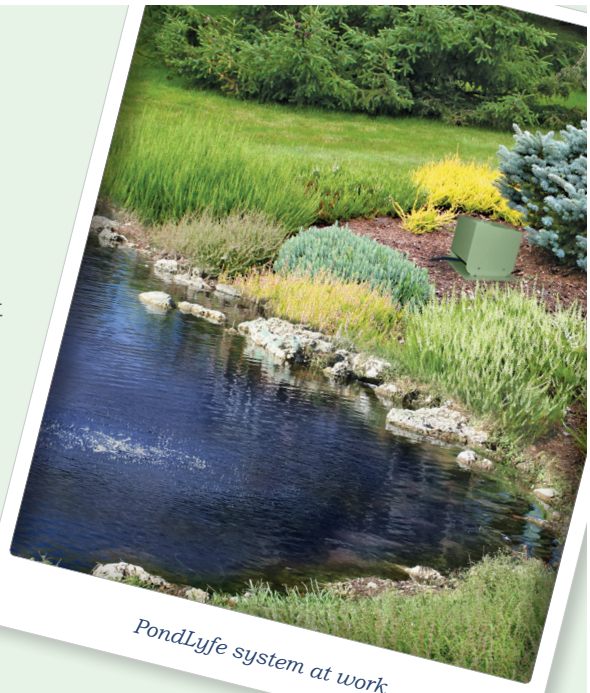
POND·LYFE
NATURAL ~ SAFE ~ EFFECTIVE

PondLyfe aerators from Vertex address the need for a professional quality aeration system at an affordable price for water gardens and smaller ponds up to 1.5 acres in size and up to 30’ deep.

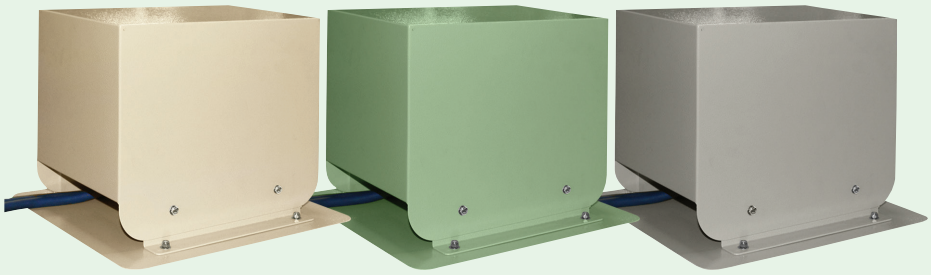
PondLyfe aerators benefit small pond owners who want the best available technology to restore their ponds to a cleaner, clearer and healthier condition naturally by raising oxygen levels, reducing muck, excess nutrients and suspended solids causing murky water.

PondLyfe Specifications

- Horsepower: 1/4
- Max. running amps: 2.0/1.6
- Max. air output (CFM): 2
- Max. aerated acres: 1.5 Acres
- GFCI safety circuit
- Powder coated aluminum cabinet in choice of three colors
- ETL safety certification
- Independently tested AirStations
- Self cleaning membrane diffusers
- Single 5-micron filtration
- Restarts under pressure
- Super quiet operation



PondLyfe system at work



“Our lake maintenance costs have dropped by 60%. The health and appearance of these lakes has improved significantly...”

John Williams
Maintenance & Resident, Lakewood Hills

MICRO·LYFE
NATURAL ~ SAFE ~ EFFECTIVE

Pond Restoration Products for Lake Management Professionals

A healthy lake is clear, odor free and has a balance of wildlife and plants. A lake in distress is often lacking in the necessary bacteria and enzymes to breakdown the organic materials that enter the water and has nutrient levels that are too high. The Micro-Lyfe family of products were developed to restore your lake's biology and bring it back to a healthy balance.

Benefits of using Aeration with Other Products

Bioaugmentation and aeration were made for each other. Aeration and water circulation enhance the natural bacterial digestion of muck and other organic materials in a lake. By supplementing with additional types of bacteria and accelerating enzymes, you speed the nutrient, muck and odor reduction benefits of aeration. Since many of these beneficial bacteria require oxygen to perform at an optimal level, aeration will allow you to use less product to achieve the same effectiveness thereby reducing your treatment cost.

Choosing the right products

Concentrate	Improves and maintains the overall health of your lake ecosystem.
Complete	Diminishes high hydrogen sulfide concentrations that cause a rotten egg smell. Use when installing or restarting a lake aeration system.
Sludge Clear	Reduces muck in the bottom of lakes that are black, flocculent, or full of organic sediments.
Digester	Speeds the breakdown leaves, needles, wood, or other organic plant matter on the bottom.
Blue Power	A blue dye product plus enzymes to improve water quality.
Barley Boss	Helps prevent algae scum on shoreline, especially in newly built ponds.

AERATION RESEARCH

Improved Oxygen, Water Clarity and Nutrient Levels

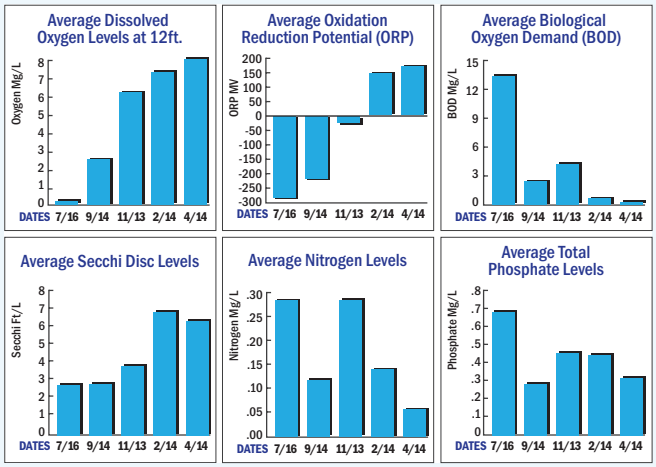
Heron Cay, a high-end gated residential development, was experiencing a number of problems in their 21 acre lake which is central to the community.

With maximum water depths over 20', stratification caused the lake to experience severely low dissolved oxygen levels at the bottom. Having no beneficial bacteria to break down organics, heavy muck accumulation and foul odors from hydrogen sulfide gases were present. The lake was consuming what little available oxygen there was faster than it could be replenished, and excessive nutrient levels from fertilizer runoff only made conditions worse. Additionally, the lake's Biochemical Oxygen Demand (BOD) was extremely high.

The Results Highlights

After the design and installation of a Vertex aeration system consisting of **11 diffuser stations** being fed by compressors totaling only 2-1/4 horsepower, Heron Cay was set up on a monitoring schedule to determine how lake dynamics were being affected. The results over the 4 month monitoring period were dramatic. Within days of initial start-up, the systems six main objectives were beginning to be realized:

- The breakdown of temperature and oxygen stratification
- Increased oxygen levels occurred throughout the entire water column
- Decreased Biochemical Oxygen Demand (BOD) - dropped to below detection levels
- Water clarity increased by 100%, from 3' to 6'
- Excessive nutrient levels decreased; nitrogen down 80%, phosphorus down 59%



Heron Cay's lake has returned to natural, healthy conditions.

Big, small, deep or shallow. Water bodies are not all alike!

While there are a number of issues that affect all different types of waterways, they also have unique ecosystems, uses and physical characteristics that require more than typical cookie-cutter solutions.

- **'Homeowner' ponds**: usually smaller, used for fishing, swimming and watching nature
- **Golf/farm/agricultural use**: irrigation ponds for turf, crops or watering livestock tend to get higher nutrient loads from runoff but need to be low in nutrients for irrigation
- **Community and public lakes**: large, small, natural or man-made. They are not often used for swimming but need to look beautiful
- **Marinas:** can be fresh, marine, brackish or have bacteria and odor problems
- **Canal systems**: man-made for navigation or flood control
- **Reservoirs**: deeper than other types listed. The movement of the water is tightly controlled and stratification is a serious issue

Get the VERTEX Advantage

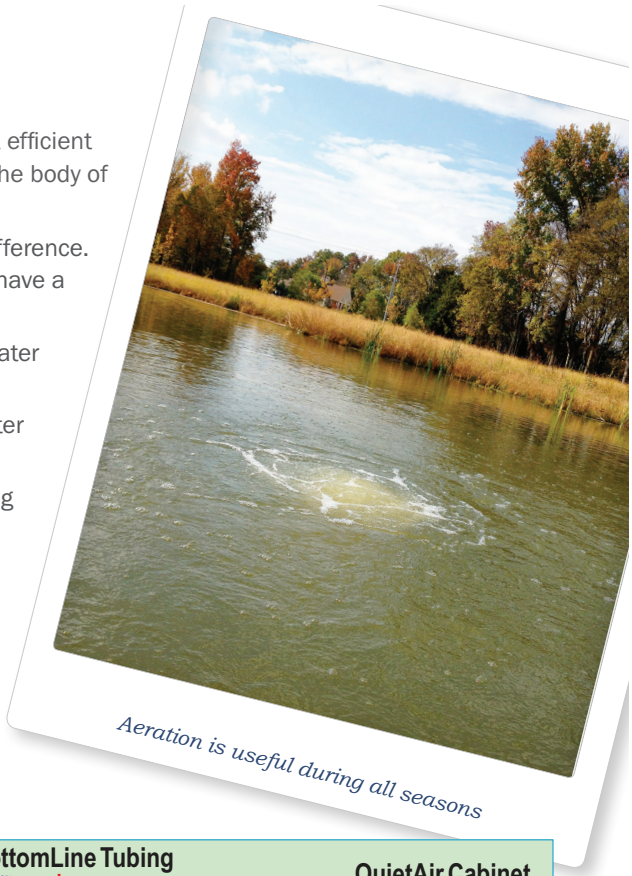
"The Vertex Aeration System was an extremely good investment. I haven't had any more stressed or dying fish!

Bruce Condello
President/Cocreator of Big Bluegill .
Field advisory staff & web moderator of Pond Boss magazine

How *do* we design your perfect system?

Vertex has the widest selection of components in the industry to design the most efficient and cost effective aeration system. To ensure the best turnover rate throughout the body of water with one of our systems we take into account the following:

- **Water Depth**: the range of depths throughout the pond or lake can make a difference. If they vary quite a bit you may need more than one AirStation and each may have a different number of disks
- **Shape**: A fairly round pond is likely to need fewer AirStations than a body of water with multiple 'fingers'
- **Acreage**: correctly sizing a system takes into account the total size of your water body
- **Compressor cabinet location**: Our systems are quiet, but if the cabinet is going to be located by a patio or under a window, we have options to make your system even quieter
- **Power source**: If you have power next to the shoreline a standard system will work. If the power is not by the shore we will design a system with a remote valve box to meet your needs
- **Watershed and inflow**: Excessive nutrient and organic loading from outside sources requires additional aeration capacity



Aeration is useful during all seasons

4 easy steps

1. Measure length, width, several depths and bottom slope
2. Email data to info@ vertexwaterfeatures.com
3. Let our specialists design your custom aeration system
4. Have your new system installed by your nearest Vertex Dealer or do it yourself

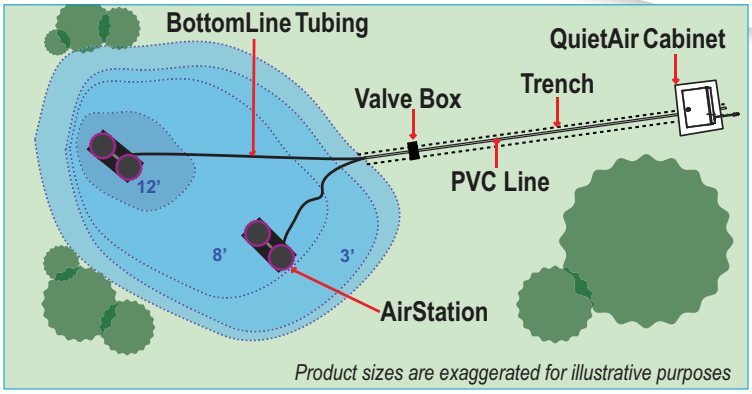


Diagram showing the set-up for a remote valve box aeration system

Same acreage, unique systems!

How different can 2 ponds be?

Many companies tell you that all you need to know is the surface acres and maximum depth. Anyone can see from this example that getting the right system requires a better understanding of your waterway than those two numbers alone can give.

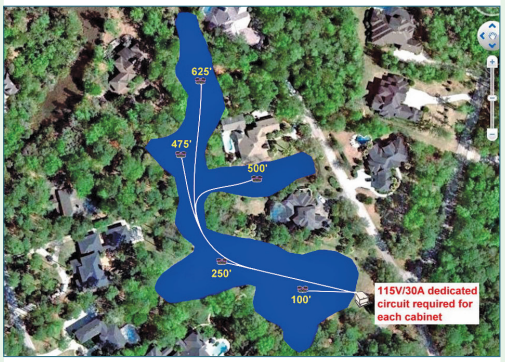
Our aeration specialists work with you to design your custom system

Surface Acres: 2
Volume: 4,818,829 gallons

Air1Plus™ System

- Two XL2 AirStations
- Small QA1 Cabinet
- 1/3 HP
- 2.5 CFM
- Deeper lake

Surface Acres: 2
Volume: 3,493,580 gallons

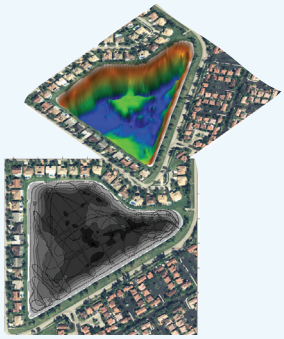


Air5™ System

- Five XL2 Shallow Water AirStations
- Large QA3 Cabinet
- 1 HP
- 8.6 CFM
- Shallower lake

AERATION RESEARCH

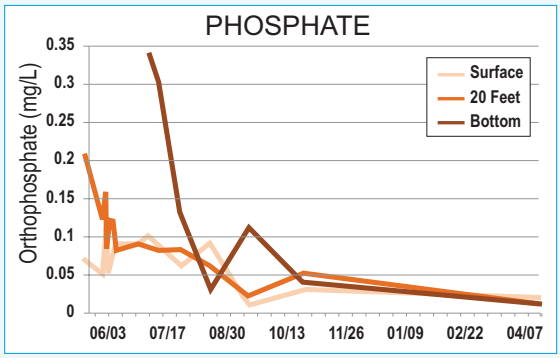
Phosphate and Ammonia Reduction



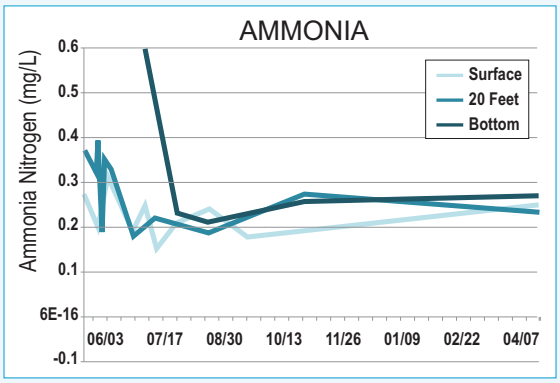
Winston Park is a residential community in Coconut Creek, Florida. Winston Park Lake is 12.7 acres and has a maximum depth of 32' with an average depth of 19.5'. The lake experienced massive fish kills every fall due to a reduction in oxygen during fall turnover, so Vertex installed an aeration system consisting of **six XL5™ AirStations** powered by 3 Brookwood™ compressors totaling 2.25 HP; which produced 14 CFM of air at 19 PSI. This system is sized to turn the water over in the lake at a rate of 0.8 turnovers per day.

The Results Highlights

Nutrients: The highest orthophosphate levels were observed at the sediment-water interface. These levels were reduced from 0.34 mg/L on July 15, 2009 to 0.01 mg/L on April 7, 2010, a 97% decline. Ammonia levels were also highest in the bottom waters and were reduced 55%. Biological oxygen demand (BOD) improved steadily, decreasing to the background detection limit (2 mg/L) by October 23, 2009. This represents a 60% decline in BOD.



Oxygen transfer: On the morning of June 24, the day after the aerators were turned on full-time, oxygen concentrations averaged only 0.7 mg/L (225 kg of oxygen in the entire lake), with surface values topping out at only 1.75 mg/L. Near complete destratification of temperature was achieved by July 8, after 2 weeks of running the aerators full time.



How do we know so much about water? We test it!

Vertex Research Biologist

Our understanding of how much oxygen is needed to restore and maintain ponds is based on continued scientific testing and research of the biodiversity, chemistry and structure of lakes. Issues that are obvious and similar may have very different causes from lake to lake so the solutions will vary as well. Vertex aeration achieves the best results because we know the data.

Water Quality Testing

The knowledge Vertex has gained from testing water chemistry has improved lake restoration plans by:

- Tailoring them to specific pond or lake issues
- Targeting the underlying causes of problems
- Including the most effective techniques (e.g. best time of day or year to treat)
- Documenting what does and does not work for future reference
- ***Vertex biologists are available to review test results done by others as part of a troubleshooting strategy for difficult lakes and ponds.***

Contour map of the lake at Tivoli Reserve in Boynton Beach, FL.

Lake Mapping for Aeration Placement

Vertex performs bathymetric lake mapping in Florida for ongoing research into best practices for aeration system placement:

- Knowing the depths throughout the expanse helps determine the correct type, size and placement of AirStations
- Sedimentation depths show where aeration is most needed
- Vegetation under the surface gives insight on oxygen needs

Effective aeration solutions take into account the topography of the waterway since variations in depths can be enormous.

We don't make products, we make solutions.

Many companies start by building a product. Vertex was started with John Gardner and his aquatic biologists at Aquatic Systems Lake Management company looking for environmentally friendly and sustainable solutions to their customers lake and pond needs. Vertex continues to operate from the idea that aquatic science should be the driving force behind all of our sales and product development, with engineering specialists to ensure the quality and safety of the products themselves.

Dr. Josette La Hée Giving a presentation on fish kills at an industry Conference

Our Team

Research: Our team of biologists and limnologists lead by Dr. Josette La Hée Kitchens and Independent consultant Dr. Amanda Quillen, conduct ongoing studies that include on site and lab testing of water, algae, plant and sediment samples taken before, during and after aeration has been installed.

Sales and Customer Service: Sue Cruz and Conrad Vanderlely are degreed aquatic biologists with years of experience designing aeration systems that produce the best rate of turnover.

Product Design and Manufacturing: Director of Manufacturing Scott Gardner has a natural talent for designing aeration cabinet/compressor systems. His PondLyfe system for smaller ponds is both cost effective and meets our high standards for quality and longevity. All of our systems are assembled at our facility in Pompano Beach and meet the rigorous electrical safety codes for ETL Equipment listing.

The Vertex Dealer Network

Vertex maintains a network of dealers world wide. Our dealers are specialists in lake and pond management with the knowledge, experience and passion to make sure you get the right system for your water's unique needs. Most of them are respected lake management companies in their locations serving customers of all sizes. They don't just want to sell you a product and walk away, they want your pond or lake to be as healthy as it can be.

We only allow lake specialists to specify and sell Vertex systems!

Vertex aeration sales manager Sue Cruz holds a shirt for one of the winners of the Vertex sponsored Pond Boss Expo Fishing Tournament

Why does Vertex build the best aeration systems? We love lakes!




All of our products are manufactured in Pompano Beach, FL USA

Vertex Water Features
Pond and Lake Aeration

844-432-4303
info@vertexwaterfeatures.com
www.vertexwaterfeatures.com

Duck Pond Restoration CPA
Support Letters Index

17a. Groton Conservation Commission (attached)
17b. Groton Conservation Trust (attached)
17c. Groton Board of Water Commissioners (pending: email support, but vote needed at next BOWC meeting)
17d. Groton Lakes Association (pending: email support, but vote needed at next meeting)

TOWN OF GROTON
Groton Conservation Commission
173 Main Street
Groton, MA 01450-1237
(978) 448-1106
Fax: 978-448-1113
ngualco@townofgroton.org

Memorandum

TO: Robin Eibye, CPC Administrator

FROM: Nikolis Gualco, Conservation Administrator

DATE: January 17, 2018

RE: Conservation Commission support of Duck Pond Restoration s Proposal.

At its regular meeting on January 9th, 2018 the Conservation Commission discussed with CPC Applicant Bob Anderson (Duck Pond Restoration Proposal) the details of his proposal and the desired effect it would have on Duck Pond. The majority of the Commission expressed support for this project, which if approved would still require the necessary wetland permitting. Mr. Anderson also sought financial support in match funds for his proposal from the Commission. It is unclear whether or not the Commission is permitted to use Conservation Fund monies to support a project such as this and therefore no financial commitment was made to Mr. Anderson. However, several Commissioners expressed an interest in financially supporting the project if possible.

Delivered
Thank you.

GROTON
CONSERVATION P.O. Box 395 Groton, MA 01450
TRUST

gctrust.org

January 4, 2018

Bruce Easom, Chair

Community Preservation Committee
Town of Groton
173 Main St
Groton, MA 01450

Dear Mr. Easom,

The Groton Conservation Trust (GCT) is a private land trust with a more than 50-year history that owns over 1,400 acres in Groton. The GCT is dedicated to protection, management, and provision of public access to natural lands in town. One of the GCT's parcels, Duck Pond Conservation Area, is located on the eastern side of Duck Pond, and we have trails that run along the pond.

We were made aware of an application from residents of Duck Pond to seek CPA funding for an aeration project to help address the deterioration ("eutrophication") of Duck Pond. We also gained a greater appreciation of the safety hazards from recreational use due to the aquatic weed growth, as well as the issue of declining fish population and the unpleasant smell that are byproducts of the eutrophication. There is evidence that this aeration approach would reduce some of the more damaging effects over a short to mid-term period even as the longer term eutrophication process most likely, would continue. We can also see some benefit in comparing the results from this methodology with other techniques such as harvesting being done at Baddacook Pond.

While the GCT sees the merit of the project, we feel collecting data and analyzing results is a critical element of any funding on our ponds, so we can continue to assess the efficacy of various approaches to minimize the eutrophication that takes place in our local ponds. We are also willing to have two of our Trustees, who teach at the Groton School and Lawrence Academy, respectively to use their students in a project to collect data from the pond.

The GCT appreciates the work that the Community Preservation Committee does and its attention to this matter. If you have questions for us, please do not hesitate to contact me.

Sincerely,

Ted Lapres
President