In Situ Evaluations of Laminar Flow Aeration Abiotic and Biotic Parameters in Michigan Inland Lakes
Laminar Flow Aeration Research

- In situ studies have been limited!
- Studies require measurement of multiple variables and are time demanding
- Baseline data/ benchmarks are critical
- Important “independent” evaluations
Laminar Flow Aeration Components

End-on view: laminar flow action

Ceramic diffuser head and anchor
Sherman Lake, Kalamazoo County, MI

- Shoreline Length: 3.1 mi
- Surface Area: 168 acres
- Elevation: 861 feet
- Mean Depth: 15.2 feet
- Max Depth: 35 feet
- Retention Time: 3.6 yrs
- Watershed: Lake = 3.4
CLEAN-FLO System Design for Sherman Lake Channel

3-4 Water Depth at time of install
- Diffuser Location
- Compressor Location
- Muck measurement site

Photo from Lake Savers, LLC
Sherman Lake Channel Visual Data (Anecdotal)

Aquatic plant growth near channel (no – Clean-Flo diffuser) Notice: robust Eurasian Watermilfoil growth

Aquatic plant growth in channel (with – Clean-Flo diffusers) Notice: breakdown of organic matter from decaying EWM
* data based on samples from n=4 diffuser sites in channel
Maple Lake, Van Buren County, MI

- Surface Area = 172 acres
- Maximum Depth = 15.0 ft
- Mean Depth = 7.0 ft
- Shoreline Length = 5.7 miles
- Approx. Retention Time = 7 days
- Immediate watershed area = 62,250 acres-NOTE: This is 362 x lake area
- Predominant land use type is agricultural
- Shoreline Development Factor = 2.3
Maple Lake Laminar Flow Aeration Locations

Active site for aquatic vegetation sampling and no herbicide treatments
Maple, Lake, Paw Paw
Pre-Aeration
Summer, 2010
Relative Abundance of Aquatic Plant and Algal Species in Maple Lake Laminar Flow Aeration Pilot Site

Aquatic Plant and Algal Species

- Myriophyllum spicatum
- Potamogeton crispus
- Elodea canadensis
- Potamogeton amplifolius
- Potamogeton zosteriformis
- Utricularia vulgaris
- Scirpus subterminalis
- Nymphaea odorata
- Lythrum salicaria
- Cladophora sp.
- Spirogyra sp.

Relative Abundance (frequency of sampled quadrats)

June, 2010  June, 2011
Indian Lake Experimental Design

Microbial Area

Control Area

Laminar Flow Aeration + Microbe Area
Indian Lake Inlet

- Sediments from watershed enter lake from north
- Attempts to construct vegetation buffers minimally reduce sediments
- Future work on sediment Critical Source detection and mitigation
Milfoil Phenotypic Comparisons by Treatment
What is New for 2012 and Beyond?

- Continuation of LTER laminar flow aeration studies with “Adaptive Watershed Management” (ex. Indian Lake)
- First Lake in the state to implement a “whole-lake” laminar flow system was Keeler Lake (Van Buren County, MI). Measured baseline conditions in 2011; Will measure aeration impacts through 2012 and report to MDEQ
- Measurement of external nutrient system loads in Paw Paw river system and internal aeration system efficacy on Maple Lake with regards to var. water quality parameters
- Continued research on mechanisms of control of laminar flow aeration on EWM degradation
Chippewa Lake, Mecosta County, MI

- High nutrient inputs from surrounding watershed
- Shallow canals and man-made bays require frequent management
Burns Creek Channel
Dissolved Oxygen Data

* data collected in mid-may of successive years
Burns Creek Channel Algal Data

Algal Taxa

* data based on samples from n=4 diffuser sites in channel
Conclusions Thus Far...

- Laminar flow aeration appears to be associated with a decline in cyanophyta colonies and to a lesser extent chlorophyta colonies.
- Laminar flow may have nutritional impacts on rooted, submersed vegetation, thereby impacting EWM and other nuisance growth.
- Laminar flow aeration effectively increased dissolved oxygen at previously anoxic hypolimnia.
- Laminar flow aeration may be a useful tool in combination with watershed management for holistic water quality improvement.
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Questions?