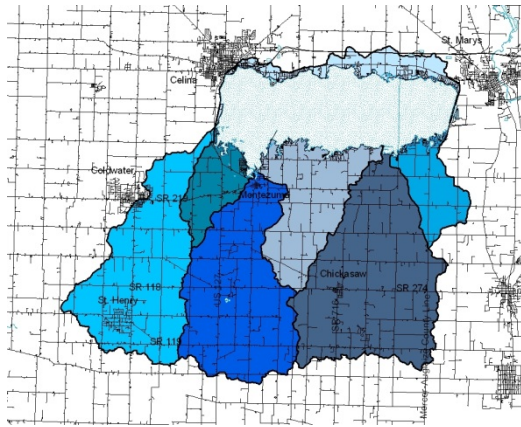




ENGINEERS | PLANNERS | SCIENTISTS | CONSTRUCTION MANAGERS

Ecosystem Restoration with Guerilla Tactics

Grand Lake St. Marys



*March 7, 2018
FWWA – Green Bay, WI
Presented by,
Joseph Pfeiffer, PWS*



Guerilla Tactics – *The application of unconventional approaches by small groups of individuals against a larger more formidable opponent that seeks to utilize the strengths of the opponent against itself.*

We are at War.....

We understand the enemy.....

We have the commitment.....

We have the weapons.....

But.....we are an insurgency

Grand Lake St. Marys – Mercer County, OH

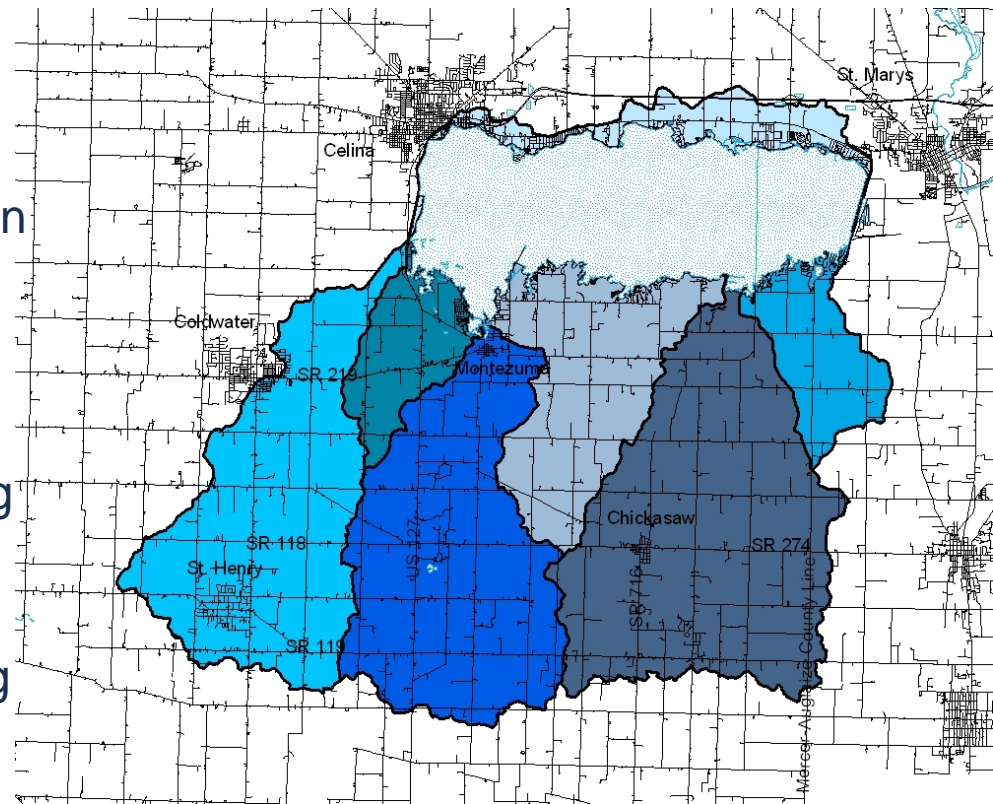


► Grand Lake St. Marys

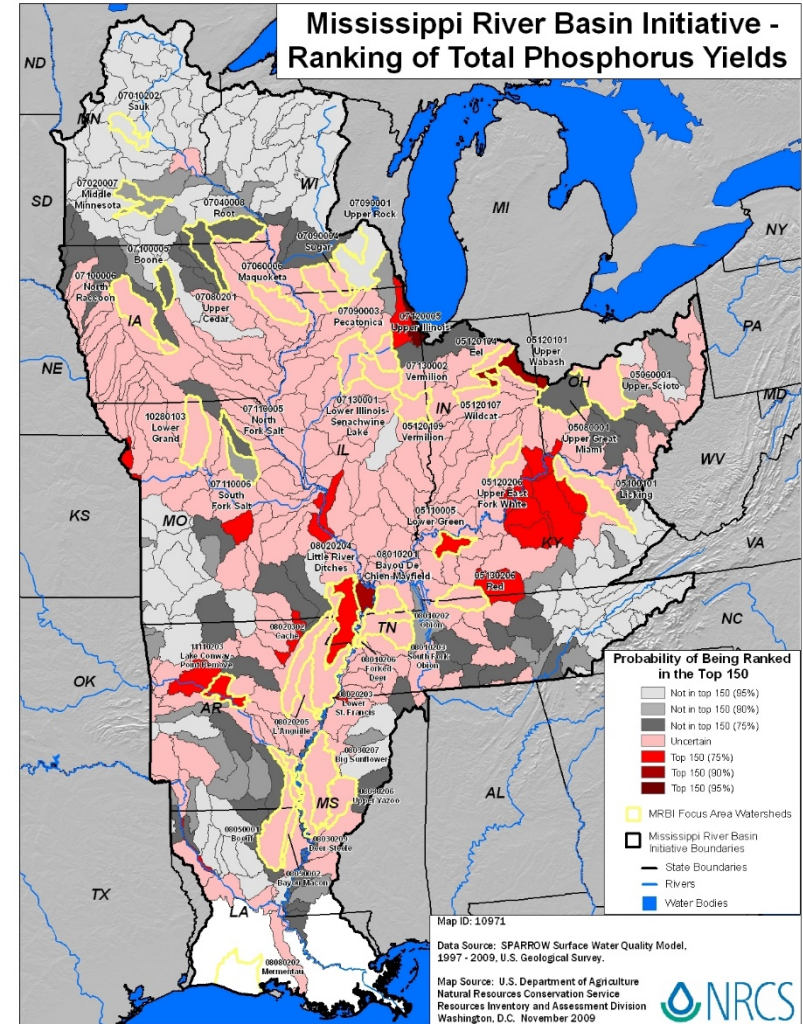
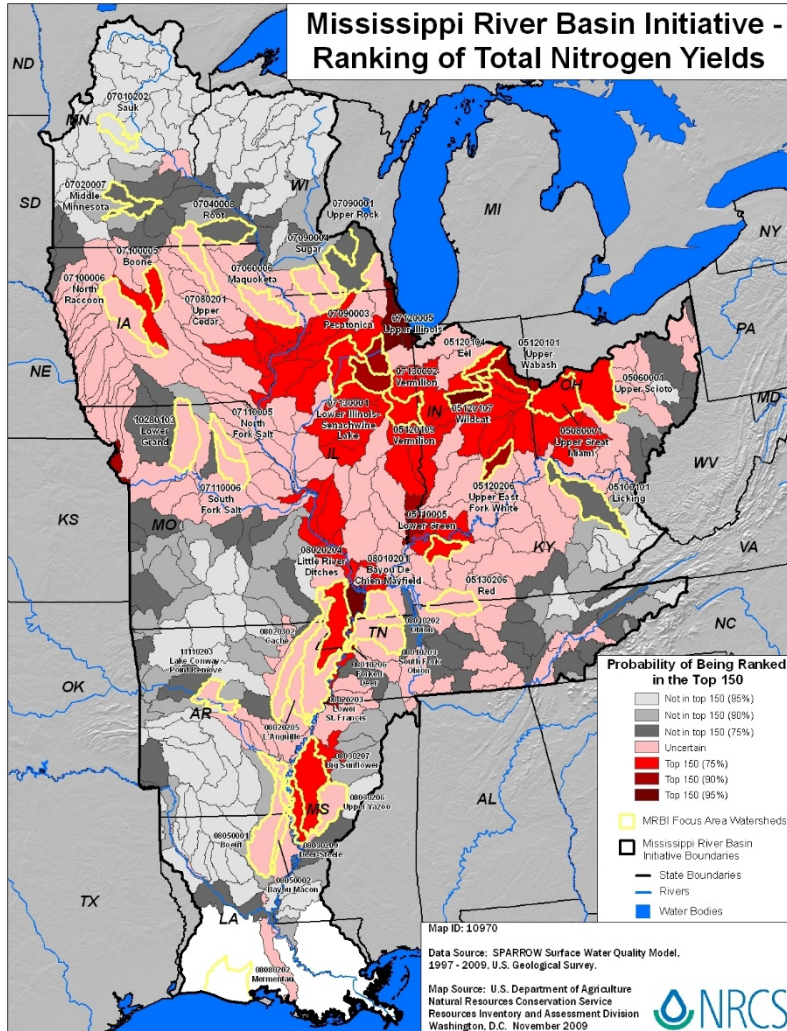
- 21 square mile man made lake in West Ohio
- 52 square mile watershed
- 425 million in agricultural production
- 125 million in tourism

► Key issues

- Excessive nutrient loading resulting in Hypo-trophic condition in lake and watershed
- Blue Green algal blooms producing microcystin toxins



Grand Lake St. Marys – Mercer County, OH



Grand Lake St. Marys – Mercer County, OH



► Impacts

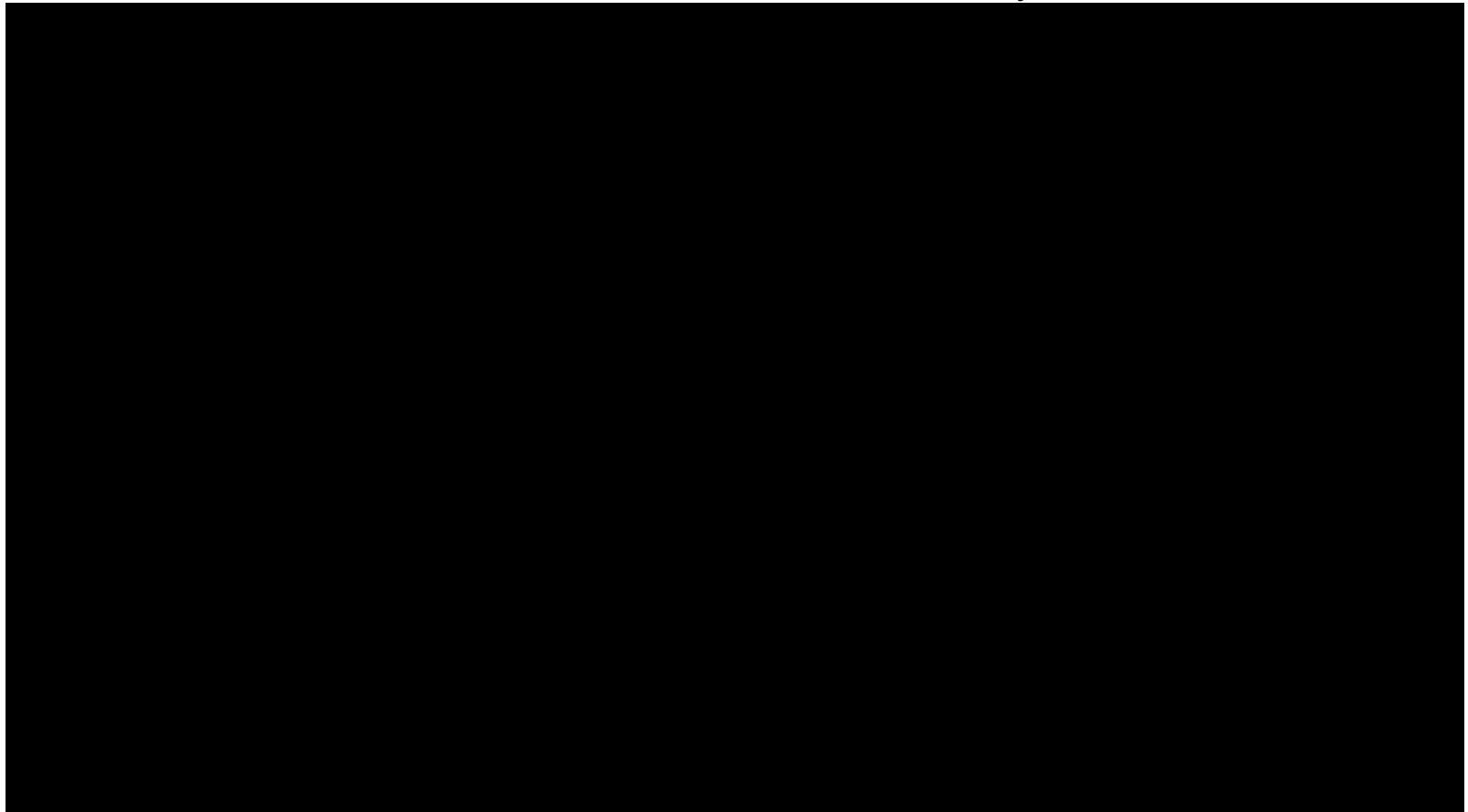
- Algal blooms shut down all use of the lake in 2009/10
- Estimated loss of \$77 million to local economy
- Loss in housing value of 25 million
- No Freddie Mac/Fannie Mae funding for homes in proximity to lake
- Identified public health threat



Grand Lake St. Marys – Mercer County, OH



- Ohio Governor Strickland News Conference – July 30, 2010



The Daily Standard Celina, Ohio

Grand Lake St. Marys – Mercer County, OH



► Primary Responses

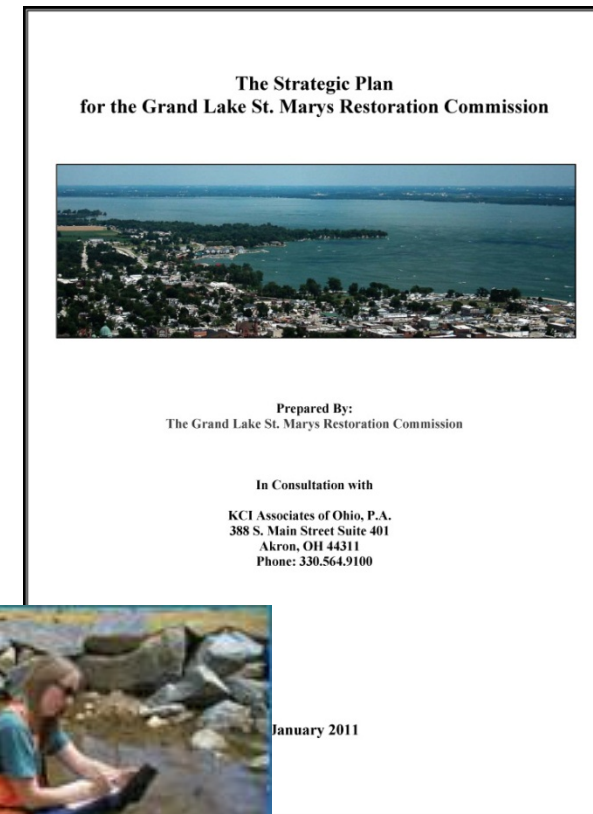
- State of Ohio TMDL
- Emergency watershed regulations put into place
- NRCS funding of conservation practices
- Local formation of the Grand Lake St. Marys Restoration Commission



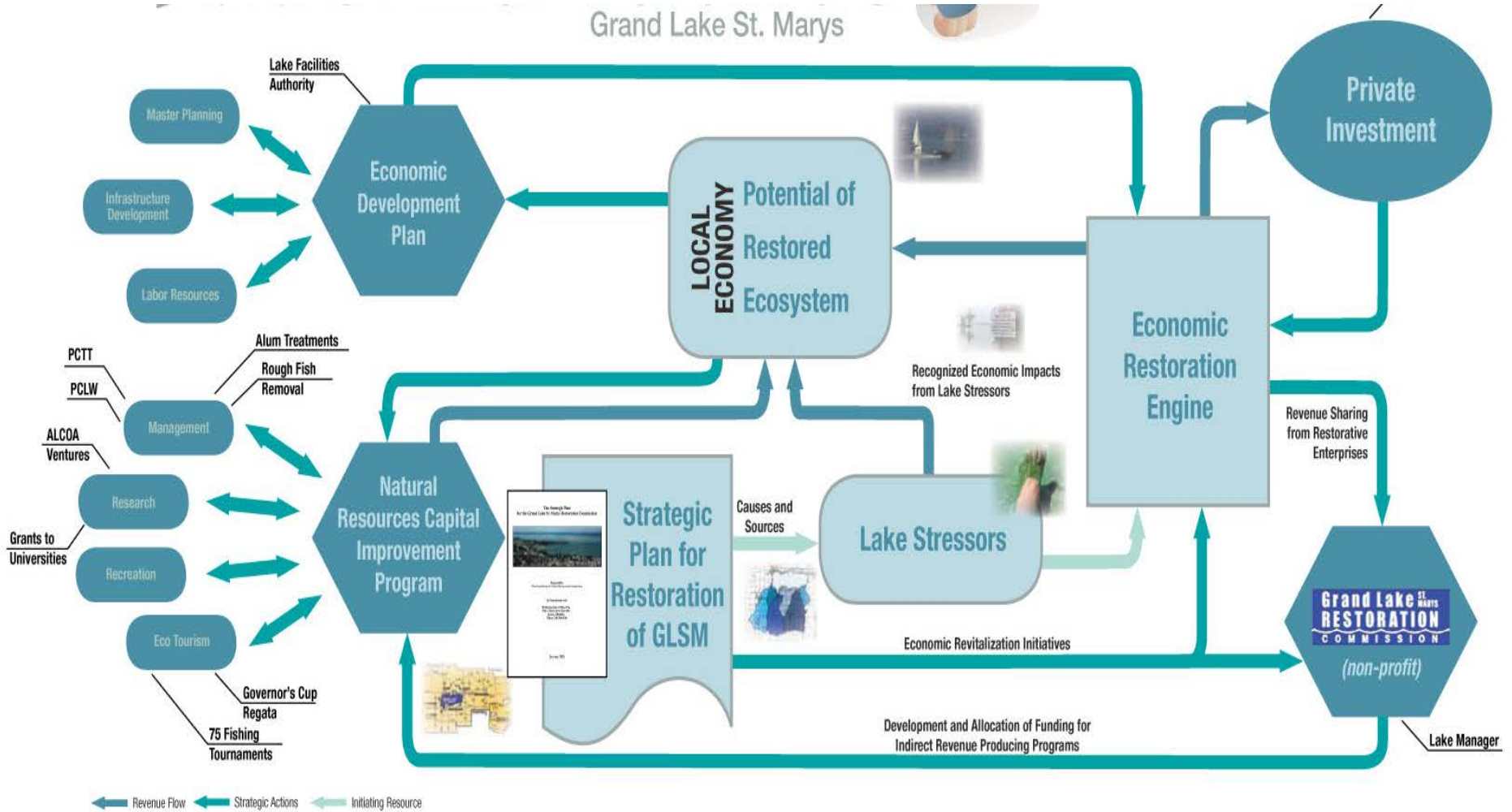
Grand Lake St. Marys Strategic Plan



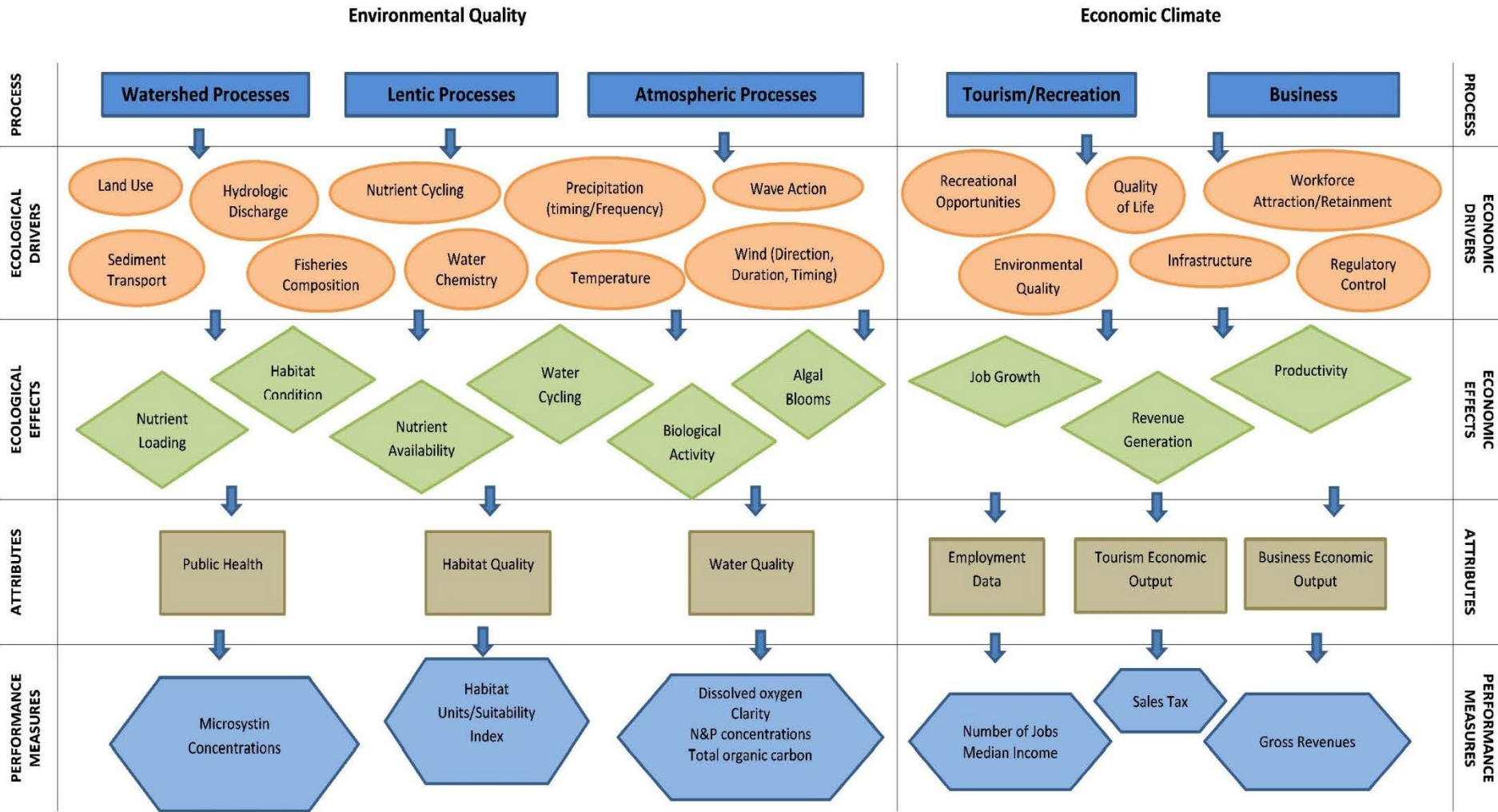
- **Commissioned by LRC**
- **Focused on Comprehensive Approach**
- **Strong Emphasis on Economic Viability**
- **Included both Economic and Ecological Drivers**
- **Cornerstone Elements**
 - **Simultaneous and coordinated attack**
 - Historic residual problems
 - Existing processes
 - Future Direction



GLSM Strategic Plan - Tactical Diagram



Conceptual Ecosystem Revitalization Model - CERM



Strategic Plan - Weighting Matrix



- ▶ **Economic Benefit Potential (weight -15%)** Eco-Tourism, Recreational Use/Capacity, Research, Business Establishment
 - ❖ High – 20 pts Moderate – 10 pts Low – 5 pts N/A – 0 pts

- ▶ **Scale of Effect (weight - 10%)**
 - ❖ Regional – 100 pts Watershed – 50 pts Local – 20 pts

- ▶ **Lag time to Functional Effect (weight - 10%)**
 - ❖ Immediate – 100 pts <12 months – 60 pts 12 months – 2 years – 40 pts >2 years –pts

- ▶ **Term of Effect (weight – 15%)**
 - ❖ 1 to 5 years - 20 pts 5 to 10 years – 40 10 to 20 years – 60 pts Permanent – 100 pts

- ▶ **Economic Value Estimate (weight – 45%)**
 - ❖ >\$10 million – 100 pts 5 to 10 million – 60 pts 2 to 5 million – 40 pts >2 million – 20 pts

- ▶ **Implementation Strategy – (weight - 5%)**
 - ❖ TIF – 50 pts Grant – 30 pts Stimulus – 40 pts Public – 20 pts

Strategic Plan – Matrix Prioritization



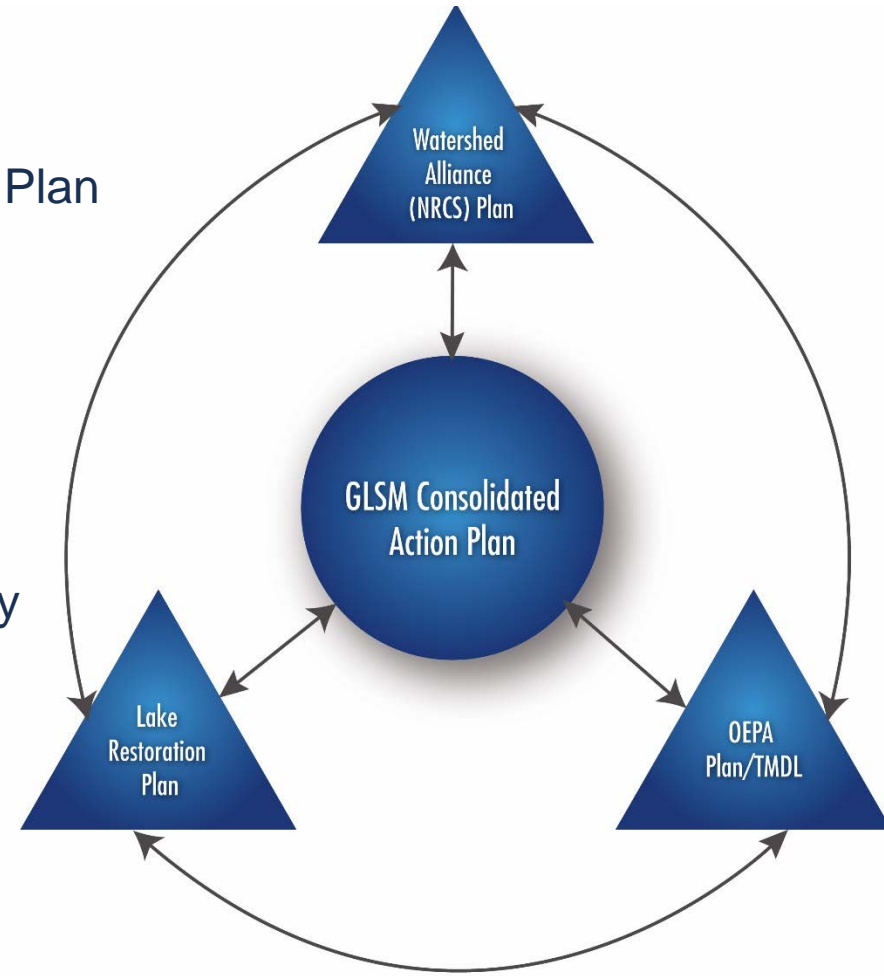
LRC	Economic Benefit	Scale of Effect	Lag Time to Functional Effect	Term of Effect	Economic Value	Implementation Strategy	Total Score
Littoral Wetland Restoration	8.25	5	6	15	45	2.5	81.75
Sequestration of Soluble Reactive Phosphorus	6.75	10	10	3	45	2.5	77.25
Dredge Sediment Depositions	7.5	5	2	15	45	2.5	77
Beneficial Use of Organic Waste	7.5	5	6	9	45	4	76.5
Treatment Train Establishment	7.5	5	6	9	18	2.5	48
Rough Fish Removal	5.25	5	10	3	9	2	34.25
Algal Flipping	8.25	5	6	3	9	1	32.25
Aeration and Circulation	8.25	5	6	3	9	1	32.25
Water Level Management	8.25	5	6	3	9	1	32.25

GLSM Consolidated Action Plan



► Grand Lake St. Marys Strategic Restoration Plan

- Re-vitalization focus
- Integration of existing efforts
 - NRCS
 - OEPA
 - Lake Improvement Association
- Self-perpetuating approach (economically sustainable)



Consolidated Action Plan – Matrix Prioritization



NRCS	Water Quality	Scale of	Lag Time to	Term of	Nutrient Load	Implementation	Total
Project	Benefit	Effect	Functional Effect	Effect	Removal	Strategy	Score
Cover Crops	12	8	10	3	45	5	83
Conservation Tillage	9	8	10	3	45	5	80
Manure Management Technology	12	6	6	6	45	1.5	76.5
Filter Strips or Riparian Buffers	12	8	6	9	27	2	64
Filter Areas	12	6	6	6	27	4	61
Wetlands	12	3	4	15	18	2	54
Tile Control Structures	6	5	6	6	18	4	45
Milkhouse Wastewater	6	2	6	6	18	4	42
Lawn Fertilizer Reduction	12	1	10	3	9	5	40
Septic Systems	12	1	10	3	9	5	40
Streambank Protection	9	6	6	3	9	5	38
Nutrient Management Plans	9	4	6	3	9	1	32

OEPA	Health/Welfare	Scale of	Lag Time to	Term of	Nutrient Load	Implementation	Total
Project	Benefit	Effect	Functional Effect	Effect	Removal	Strategy	Score
Lake Alum Treatment	3	10	10	6	45	5	79
Hydrogen Peroxide/ Alum Treatment	3	10	10	6	45	5	79
Dredging	3	10	2	9	45	1.5	70.5
Constructed Wetlands	3	2	10	9	27	1.5	52.5
Controlled Drainage	1.5	2	10	9	27	1.5	51
Treatment Systems on Tributaries	3	2	4	9	27	5	50
Restoration of Buffers and Streams	3	2	6	9	27	1.5	48.5
Filter Strips/Areas (*FOTG 393-Designed)	1.5	2	6	9	27	1.5	47
Grassed Waterways	0.75	2	6	9	27	1.5	46.25
Conservation Tillage	0.75	2	6	3	27	1.5	40.25
Manure Handling and Storage	1.5	2	6	9	18	1.5	38
Shoreline Maintenance	0.75	2	6	6	18	2.5	35.25
Tributary Alum Treatment	1.5	2	6	3	18	4	34.5
Conservation Planning	1.5	2	4	6	18	1.5	33
Aeration or Water Column Circulation	0.75	10	4	3	9	4	30.75
Cover Crops	1.5	2	4	3	18	1.5	30
Drawdown	0.75	10	4	3	9	1.5	28.25
Nutrient Management Plans	0.75	2	2	3	18	1.5	27.25

Consolidated Action Plan – Project Priority Ranking



- ▶ Provides Comprehensive Project list
- ▶ Does Not Negate Individual Plans
- ▶ Basis for Political Action Plan

Project	OEPA	LRC	NRCS	Total Score
Dredge Sediment Depositions	88.5	77	83	248.5
Sequestration of Soluble Reactive Phosphorus	82	77.25	87	246.25
Beneficial Use of Organic Waste	81.5	76.5	82	240
Dredging	70.5	82.5	83	236
Hydrogen Peroxide/ Alum Treatment	79	76.5	75	230.5
Lake Alum Treatment	79	75.75	75	229.75
Manure Handling and Storage	52.5	75.5	83.5	211.5
Conservation Tillage	49.5	50.5	80	180
Manure Management Technology	49.5	50.5	76.5	176.5
Tile Control Structures	56.5	74.5	45	176
Constructed Wetlands	51	45	79.5	175.5
Treatment Systems on Tributaries	50	42	81.5	173.5
Filter Areas	56.5	47.25	61	164.75
Tributary Alum Treatment	35.25	44.25	83.5	163
Cover Crops	39	29	83	151
Treatment Train Establishment	50	48	51.5	149.5
Wetlands	29.5	64.5	54	148
Filter Strips or Riparian Buffers	43.5	40.25	64	147.75
Rough Fish Removal	56.5	34.25	54.5	145.25
Conservation Tillage	40.25	42.25	56.5	139
Filter Strips/Areas (*FOTG 393-Designed)	47	39.75	50	136.75
Restoration of Buffers and Streams	48.5	37.25	50	135.75
Milkhouse Wastewater	48	41	42	131
Controlled Drainage	46.25	30	50.5	126.75
Lawn Fertilizer Reduction	49	35.5	40	124.5
Cover Crops	34.5	44	42	120.5
Grassed Waterways	38	28.75	51	117.75
Nutrient Management Plans	43	41.25	32	116.25
Algal Flipping	49	32.25	32	113.25
Streambank Protection	38.5	33.5	38	110
Septic Systems	35.5	33.5	40	109
Aeration and Circulation	36.5	32.25	32	100.75
Water Level Management	36.5	32.25	32	100.75
Conservation Planning	33	35.5	27.5	96
Nutrient Management Plans	27.25	31.5	29.5	88.25
Aeration or Water Column Circulation	30	28.75	27	85.75
Shoreline Maintenance	30.75	28.25	22	81
Drawdown	28.25	31	21	80.25
LRC				
OEPA				
NRCS				

Consolidated Action Plan - CRA



- Developed 8 Critical Response Actions to address
 - Chemical Treatments
 - Dredge Accumulated Sediments
 - Beneficial Use of Organic Waste
 - Watershed Best Management Practices
 - Rough Fish Removal
 - Lake Manager
 - Natural Resources Capital Improvement Program
 - Water Pollution Control Loan Fund
 - Economic Infrastructure



Specific Response Action Implemented

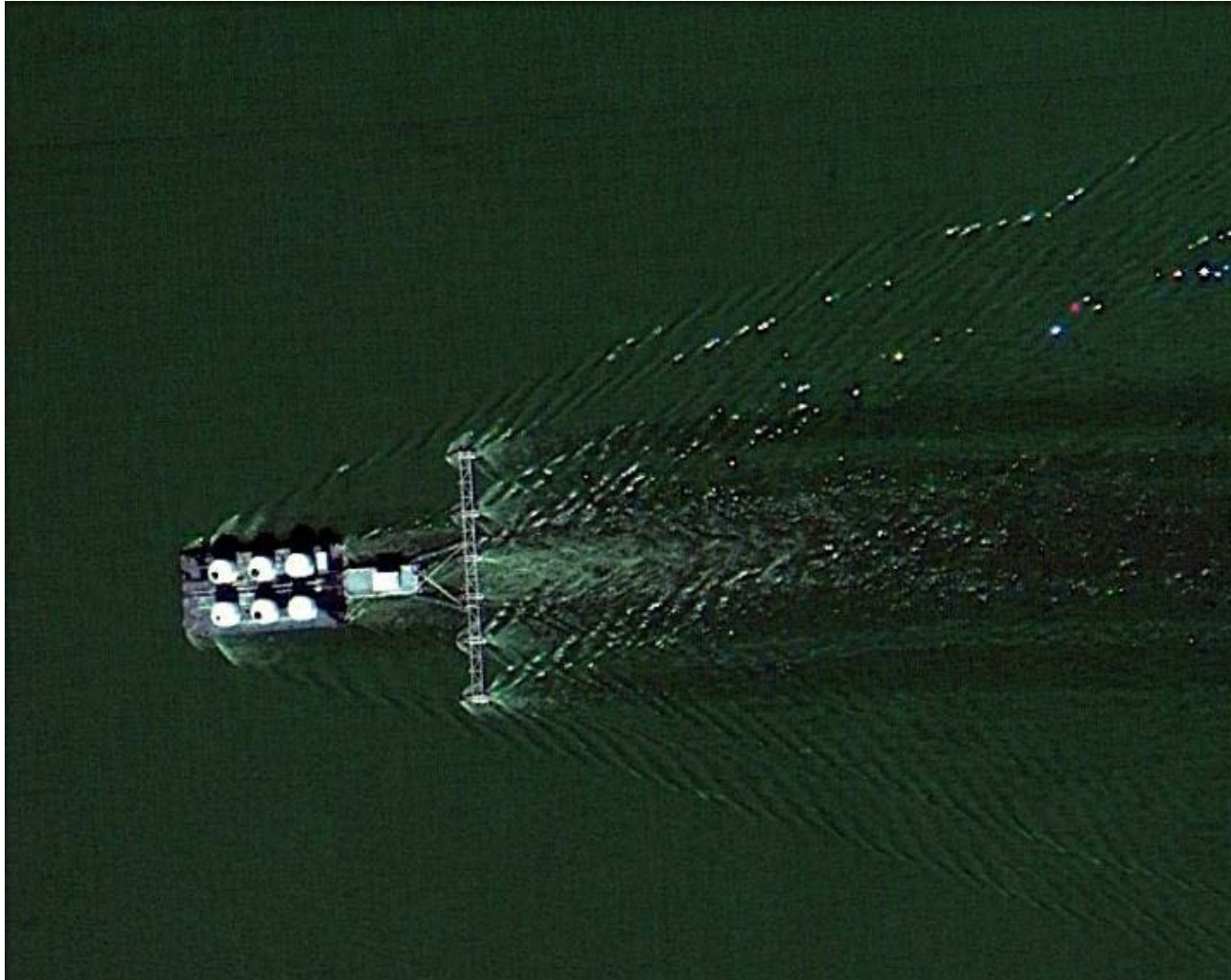


- ▶ **Alum Treatment**
- ▶ **Solar Bees**
- ▶ **Prairie Creek Treatment Train**
- ▶ **Prairie Creek Littoral Wetland**
- ▶ **Cold Water Creek Treatment Train**

Alum Treatment



Alum Treatment



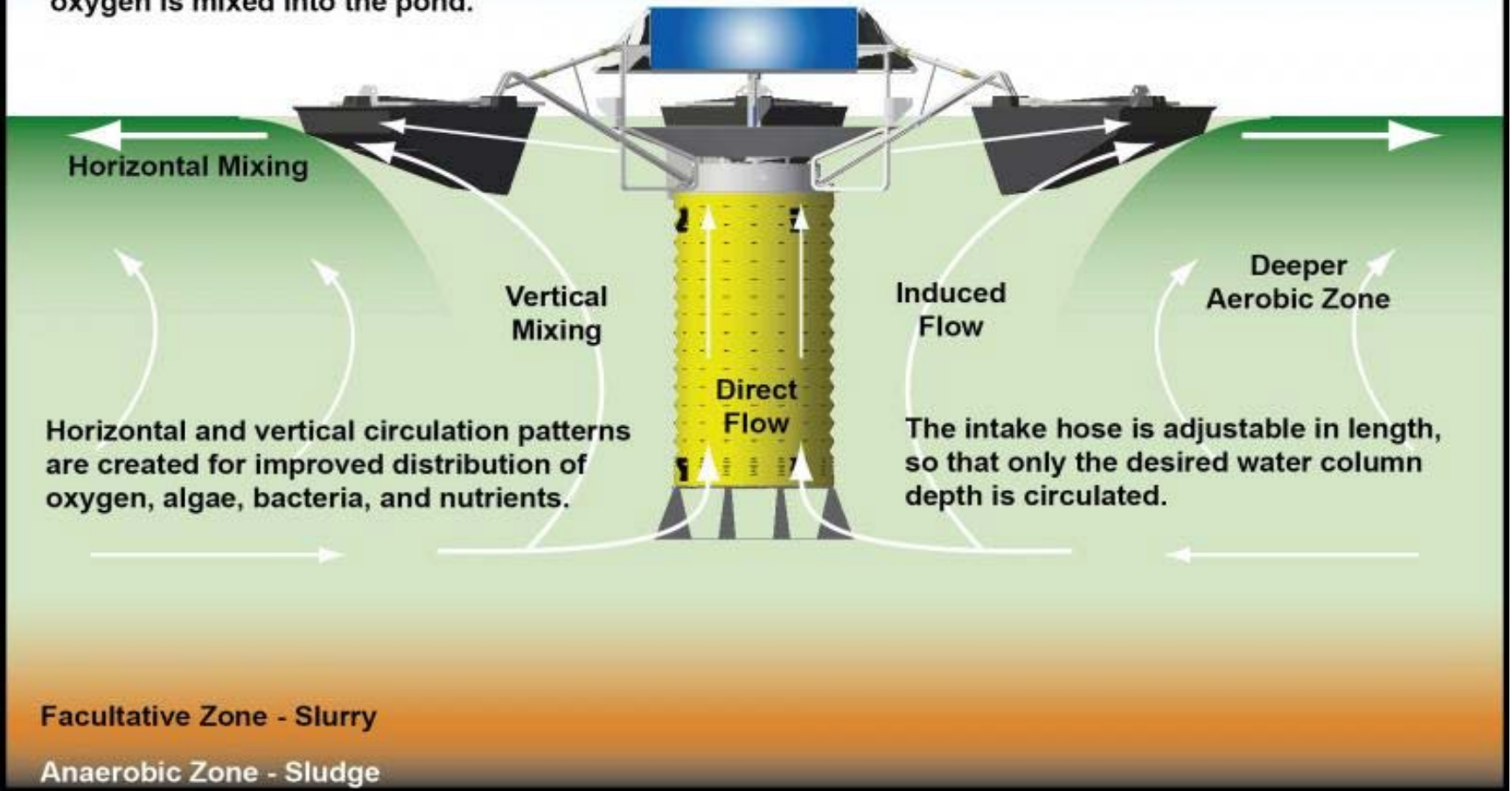
Alum Treatment



Solar Bees



During the day, supersaturated oxygen in the top two feet are captured and mixed deeper into the pond. At night, when the surface is below saturation oxygen, surface re-aeration occurs and atmospheric oxygen is mixed into the pond.



Solar Bees

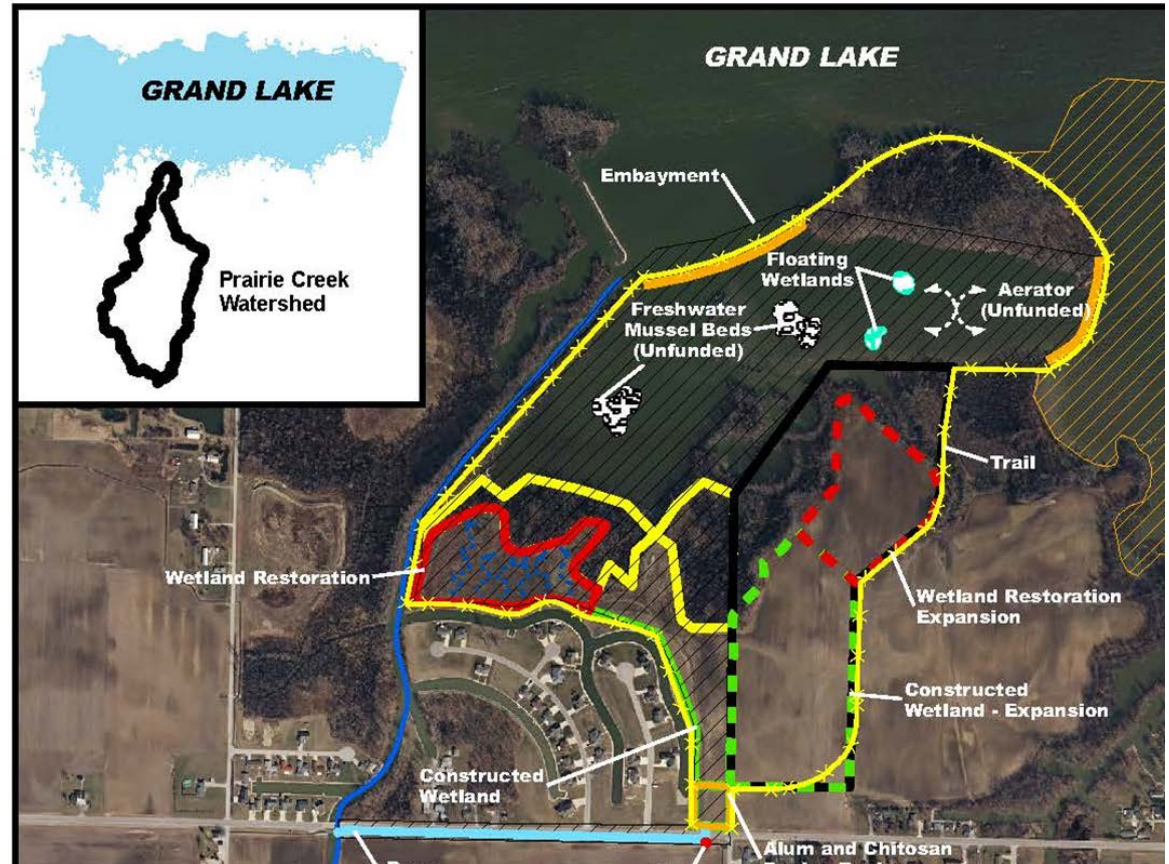


Prairie Creek Treatment Train - PCTT



Prairie Creek Treatment Train

- Engineered
 - Mechanical Pumping
 - 4 MGD
- Bio-Technical
 - Constructed Wetlands
 - 10 acres
- Natural
 - Restored Wetlands
 - 30 acres



Prairie Creek Treatment Train - PCTT

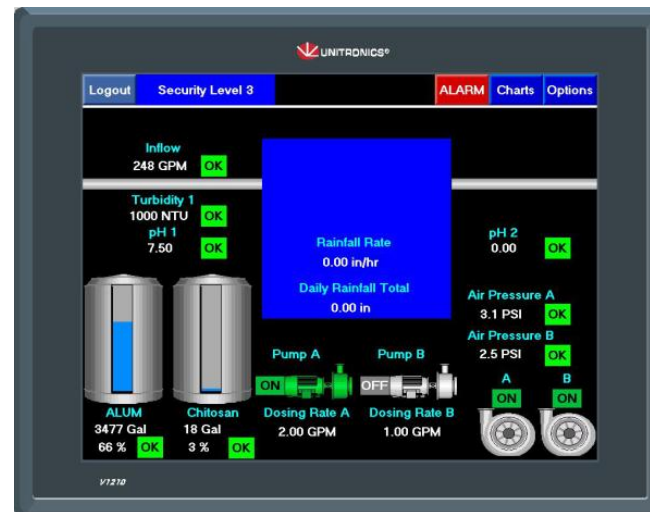


Prairie Creek Treatment Train - PCTT



MAID System

- Controls pumping into system
- Doses chemical as required
- Tracks water quality
 - Ph
 - Turbidity
 - Flow rates
- Allows remote monitoring and control



Prairie Creek Treatment Train - PCTT



Constructed Wetland Cells

- Five cells, alternating deep and shallow water

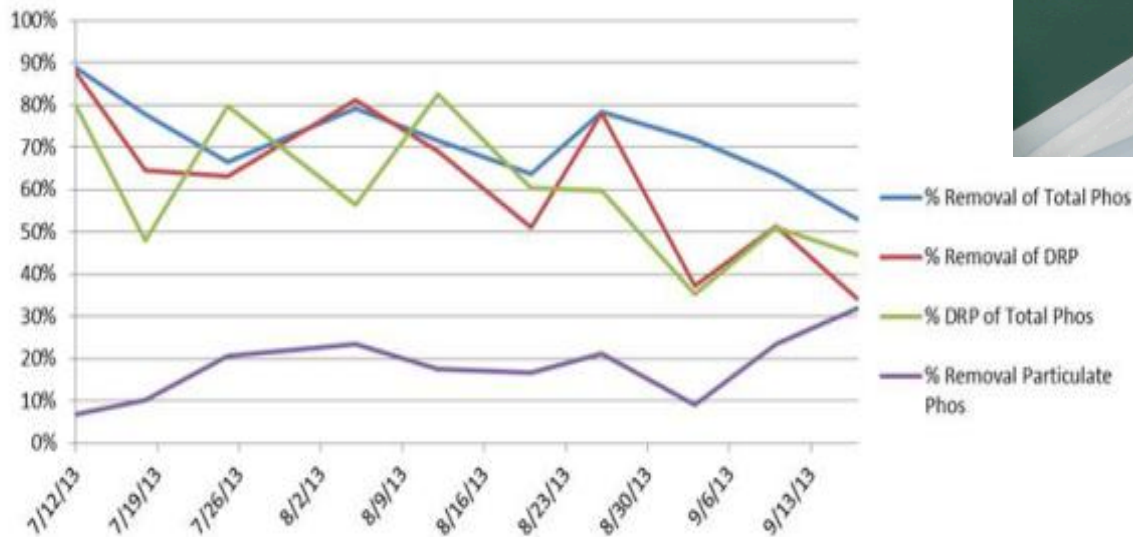


Prairie Creek Treatment Train - PCTT



Results

- 65% reduction in Total Phos
- 30% reduction in Total N
- Trophic shift in embayment



Prairie Creek Treatment Train - PCTT



Prairie Creek Littoral Wetland - PCLW



Basic Design

- Deep and shallow marsh system
- Designed to improve Fish and Wildlife habitat
- Will receive flow from PCTT
- Encapsulation of nutrient laden sediment



Prairie Creek Littoral Wetland - PCLW



Prairie Creek Littoral Wetland - PCLW

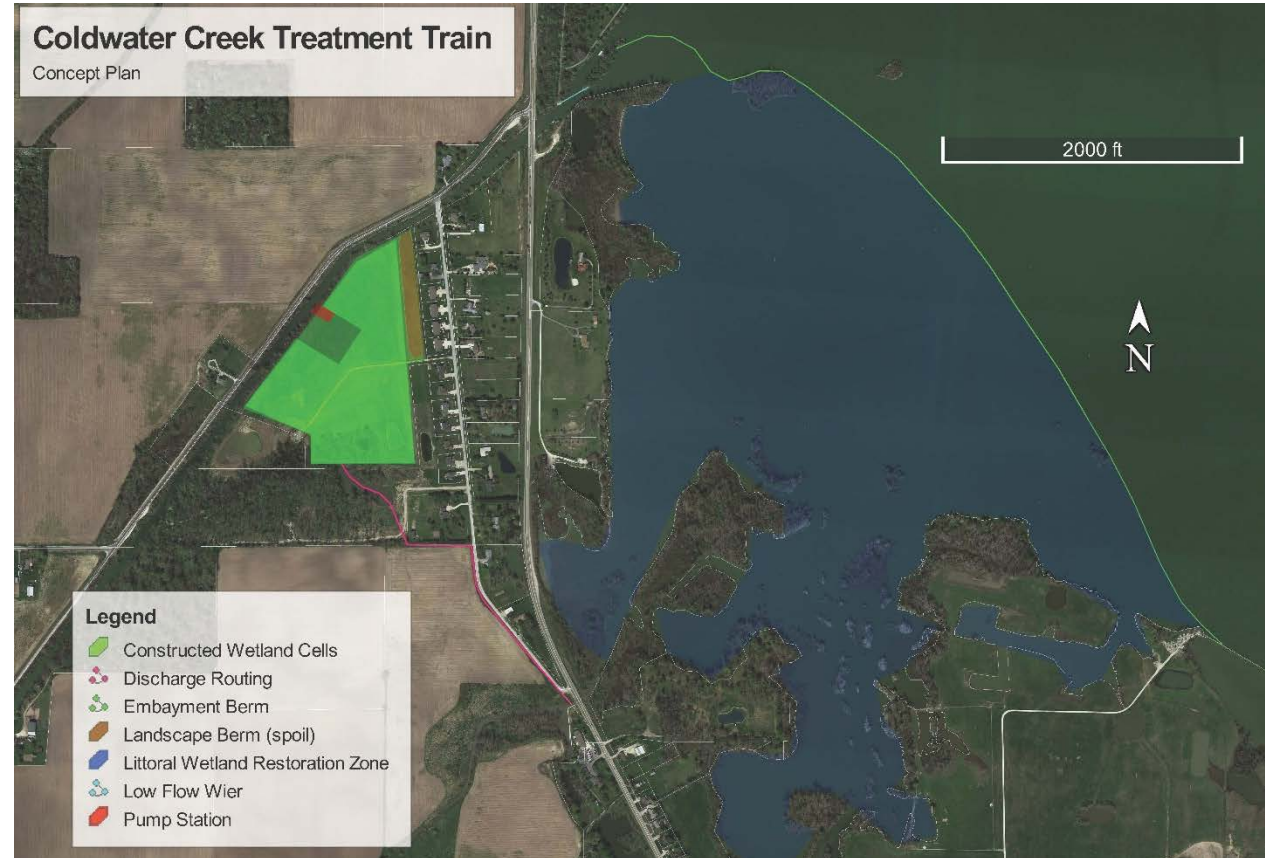


Coldwater Creek Treatment Train - CCTT



Cold Water Creek Treatment Train

- Engineered
 - Mechanical Pumping
 - 6 MGD
- Bio-Technical
 - Constructed Wetlands
 - 15 acres
 - Flow Diversion
- Natural
 - Restored Wetlands
 - 250 acres



Coldwater Creek Treatment Train - CCTT



Coldwater Creek Treatment Train - CCTT



Results



Restoration Investment

- Investment of over 7 million in response efforts by project partners
 - In lake Alum treatment
 - Development of systems to treat nutrient loading
 - No major blooms since 2010

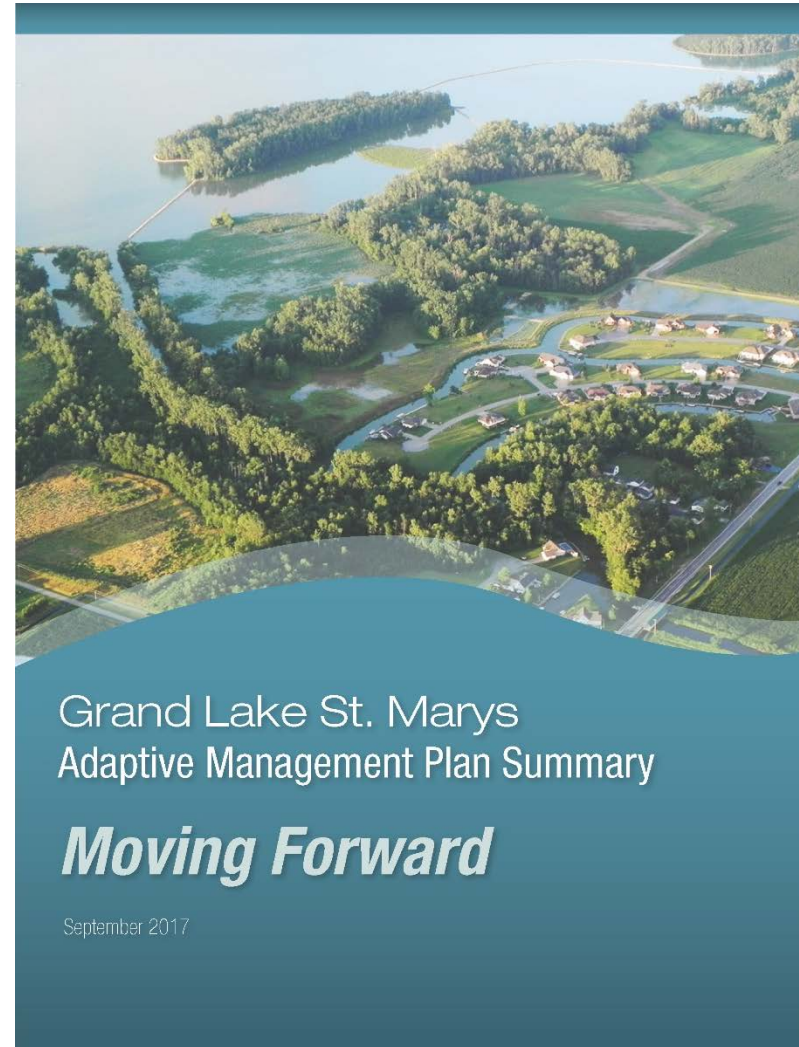
Economic Response

- Estimated Return on Investment of nearly 65 million to local economy
 - Initiation of multiple corporations using stressors as material
 - Lowest un-employment rate in Ohio (4.9%)
 - 20% increase in tax collections
 - 32% increase in real estate conveyances
 - Resurgence of recreational economy hotels, restaurants, facilities, events

Adaptive Management Plan



- ▶ No Plan Survives First Contact
- ▶ Re-Evaluation of Plan Premises
- ▶ Re-Affirmation of Partners
- ▶ Re-Engagement of Stakeholders



Conclusions



- **Ecosystem restoration is a societal endeavor not just a rural initiative**
- **Solutions to mitigate the existing problem and resolve the future ones must integrate the concepts of sustainability and economics**
- **Collaboration between key stakeholder groups is imperative to generating and sustaining momentum to win the war**



QUESTIONS