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MAXIMIZING THE ECONOMICS OF CLEAN WATER USING A HYDRAULIC DREDGE AND A MECHANICAL DEWATERING PLANT:

CASE STUDY OF LAKE DELAVAN, DELAVAN WISCONSIN

Thomas B. Amaro and Dennis Thomas

WEDA Pacific Chapter
2013 Annual Meeting

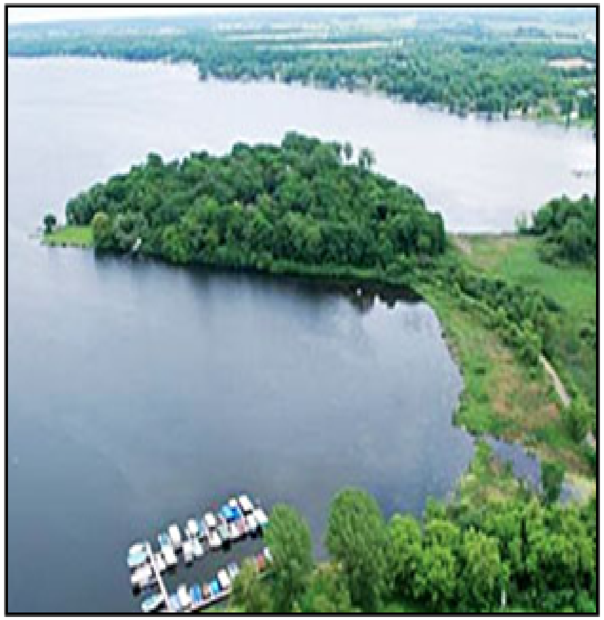
Anybody Wanna go to the Lake?

"Un Happy Leaders"

Economics of Clean Water

In 2005, the Delavan Lake Improvement Association and the University of Wisconsin-Whitewater, released a comprehensive economic study, "What is the Value of a Clean and Healthy Lake to a Local Community?"

"$77 million is generated annually as a result of Delavan Lake and its improved water quality"



- 812 jobs were generated
- The average value of lake shoreline property appreciated $177,000 between 1987 and 2003
- The aggregate land value increased $99 million.

"Delavan Lake is a crucial component to the financial, physical and social fabric of the region and Delavan Lake affects not only the quality of life for local residents, but also has regional economic amplifications".

"Deterioration of lake water (water clarity,milfoil) could be expected to lead to reductions in time spent in Delavan by property owners and visitors, which in turn would have economic implications for the local economy."

Primary Source of Sediment

- 26,000 acre watershed
- 68% of supply water comes thru Inlet
- Inlet & Sedimentation Ponds filter 70% of water
- As of 2007, the Inlet lost 56% of its natural capacity and became less effective at cleansing water flowing into the lake.
- Needed Lake Enhancements will remove 50% of sediment & phosphorus entering from Jackson Creek.

Key Issues for Lake Delavan

Tropic State Index; “Healthy Lake” - TSI of 60 or less

Rating Scale for Phosphorus/Chlorophyll Levels

- Phosphorus – Key contributor to Algal Growth
- Chlorophyll – Key indicator of Algal Growth
- Water Clarity

Lake Delavan Goal – TSI of 55 or less.

Rationale for the $1.6 million Project

*"Following several public meetings, the town board and lake committee undertook the project understanding **<u>that a clean and healthy Delavan Lake is one of the town's single most important assets</u>**", Olsen says. "Maintenance steps taken to help protect that asset will yield multiple and compounding economic and social benefits to the local economy."*

Town of Delavan Administrator John Olsen

Environmental Considerations

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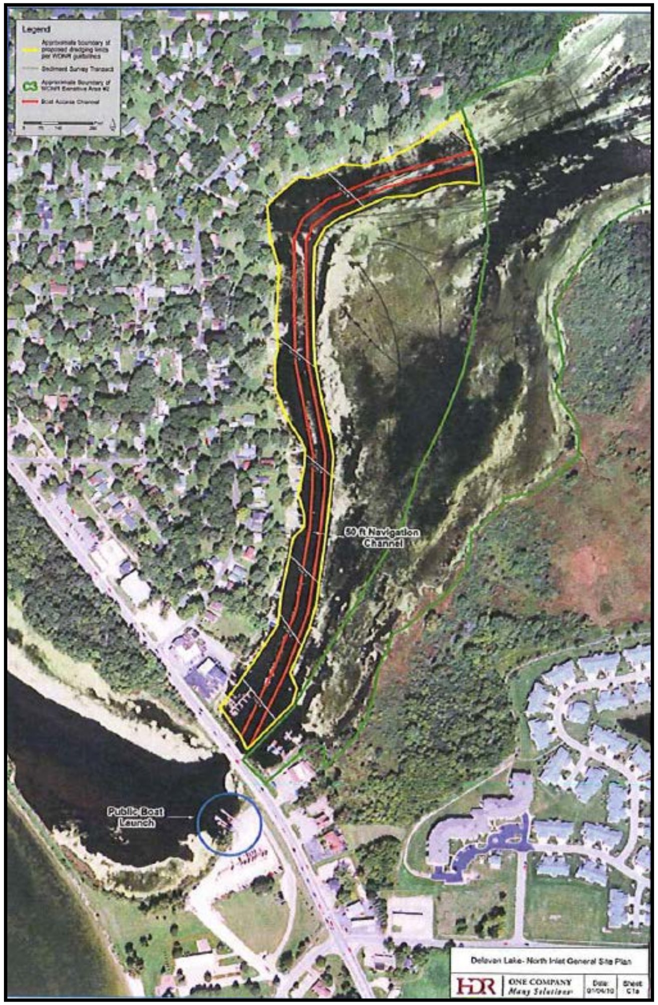


Inlet has long been impacted by nutrient rich sediment contributing to:

- Shallow Water Depths
- Excessive Macrophyte Growth
- Algae Blooms
- Habitat Degradation
- Severe Impacts to Recreational Access

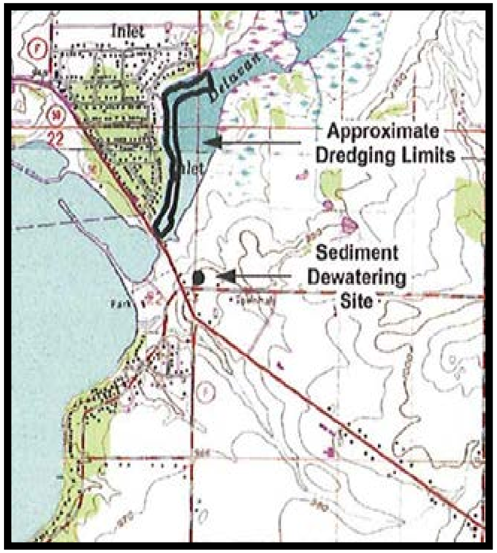
Additional Impacts from High Winds/Boat Activity:

- Disturb & Re-suspend Soft, Shallow Sediment Back Into the Water Column
- Re-mobilization of Phosphorus contributing to Eutrophic Conditions

Dredging Limits were Restricted:

- Presence of High Quality Aquatic Habitat Designated as (WDNR) Wisconsin Dept of Natural Resources Sensitive Area
- “WDNR” Rooted Macrophytes help to stabilize the Underlying Soft Sediment Limiting Sediment & Phosphorus Re-suspension during High Summer Wind Events and,
- Act as a Filtering Mechanism for Incoming Suspended Solids

Delavan Lake North Inlet Project Objectives/Restrictions



- Deepen the Inlet channel to 6 feet in the south end and 5 feet in the north end.
- Remove approximately 45,000 cubic yards of sediment dredged from the Inlet.
- Remove approximately 33,350 pounds of phosphorus, bound in the nutrient rich sediment.
- Mechanical dewater, load and transport reclaimed sediment within less than (1/2) acre of usable space.
- Utilize only lake water in dewatering and return it back to the lake under 30 ml/l T.S.S, per permit requirements.
- Reduce the propensity of soft, flocculent sediment to become re-suspended into the water column as a result of wind and boat induced disturbance.
- Increase water depth within the channel Inlet to improve sediment and nutrient trapping capability for future loading and increased benefit to aquatic habitat.
- Project Budgeted at 1.46 million to be completed within 120 days.

Mobilization

- All dredging, dewatering and support equipment was trucked onsite utilizing non permitted commercial hauling.
- Site preparation took two days, equipment set up was 6 days and testing was completed in four days totaling 12 days from start to finish.
- Onsite personnel consisted of one project manager, two supervisors and six employees.
- Outside contractors were used for electrical hook up into city power.

Unloading of HDPE dredging pipe used for pumping sediment and return water to the lake.

Placement of two additional components for screening and hydro cyclones.

Placement of the portable clarifier tank (in lowered, transport position)

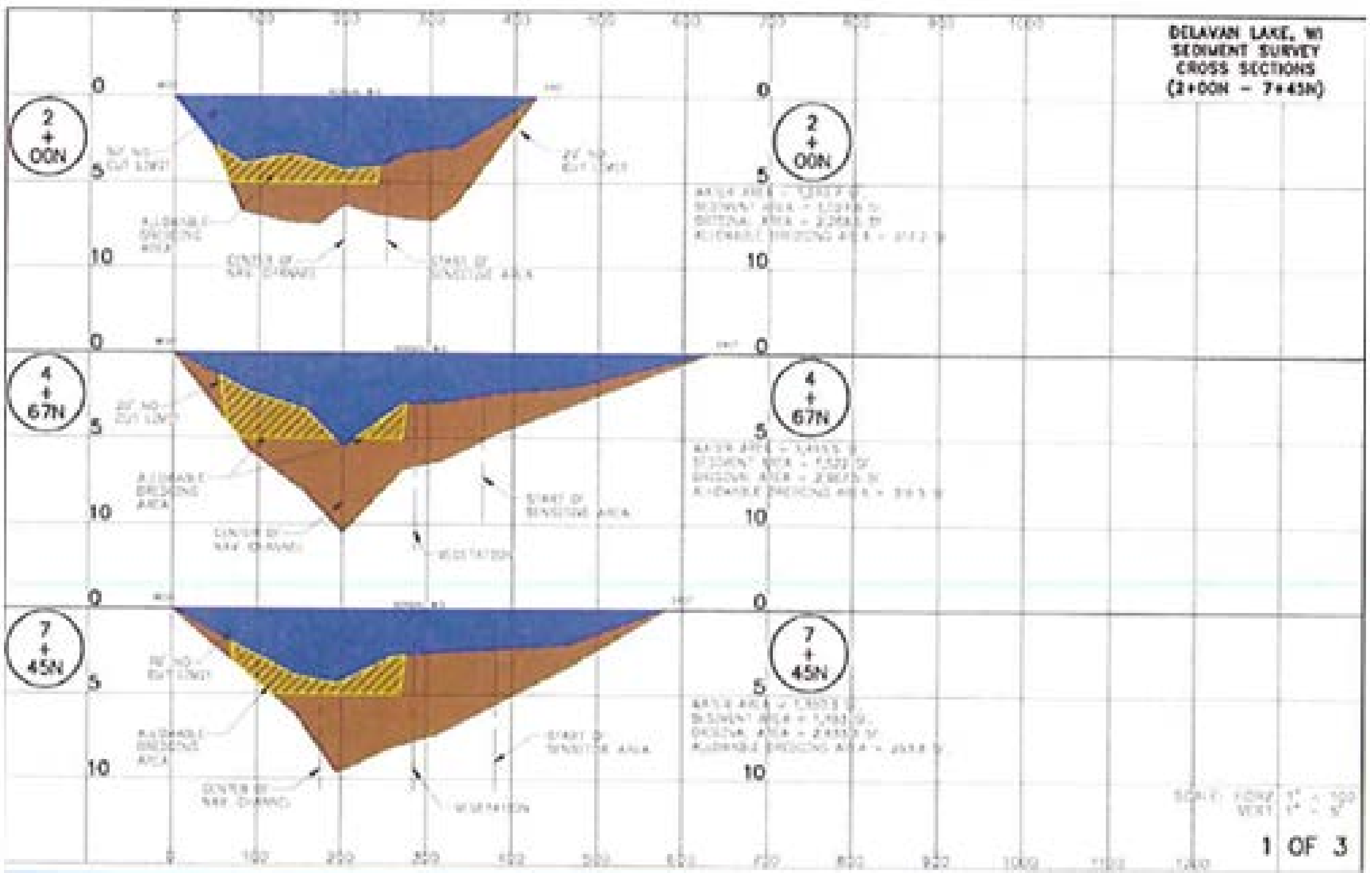
Placement of the portable belt presses.

Dredge

<u>JND Thomas deployed an 8" DSC Moray swinging ladder dredge with GPS positioning capability</u>

- Operate at minimum water depth of 30"
- Ability to work in tight areas by utilizing travel and positioning spuds instead of cables for movement.
- Capable of dredging depths up to 18' with nominal flow rates up to 2,500 gpm @ 185 TDH.
- Cutter head is a sealed planetary drive; 24" inside diameter 5-blade basket cutter with replaceable serrated edges.
- Nominal production capacity for the Moray dredge is 90 in-situ yards per hour in combination with 8" HDPE floating and submerged discharge pipe.

HDR Engineering – Dredging Survey Cross Section



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Dredge & Float Pipe

Dewatering Alternatives
(SDF) Sediment Dewatering Facility

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Table 1. Estimate of Probable Sediment Removal Costs with SDF

Sediment Removal Work Task	Total Dredging Quantity	Estimated Cost
North Inlet Dredging – ($5.00 to $7.00/CY)	41,014 CY	$ 205,070 - $ 287,098
Dredge and Pipeline Mobilization		$ 60,000 - $ 80,000
Construct Sediment Dewatering Pond (10-12 acres)		$ 100,000 - $ 120,000
Subtotal		$ 365,070 - $ 487,098
Contingency (10%)		$ 36,507 - $ 48,710
Subtotal incl. Contingency		$ 401,577 - $ 535,808
Engineering, Permitting & Envir. Assessment (15%)		$ 60,237 - $ 80,371
Total Estimated Cost for Dredging with SDF		**$ 461,814 - $ 616,179**

$ 11.25 - $15.02/cy with Project Completed within 1-2 years

No Provision for Purchasing 10–12 acres for Basin including carrying costs thru Restoration……@ $ Commercial/Recreational Frontage Property/acre plus liability.

Dewatering Alternatives
Mechanical Dewatering/Hauling

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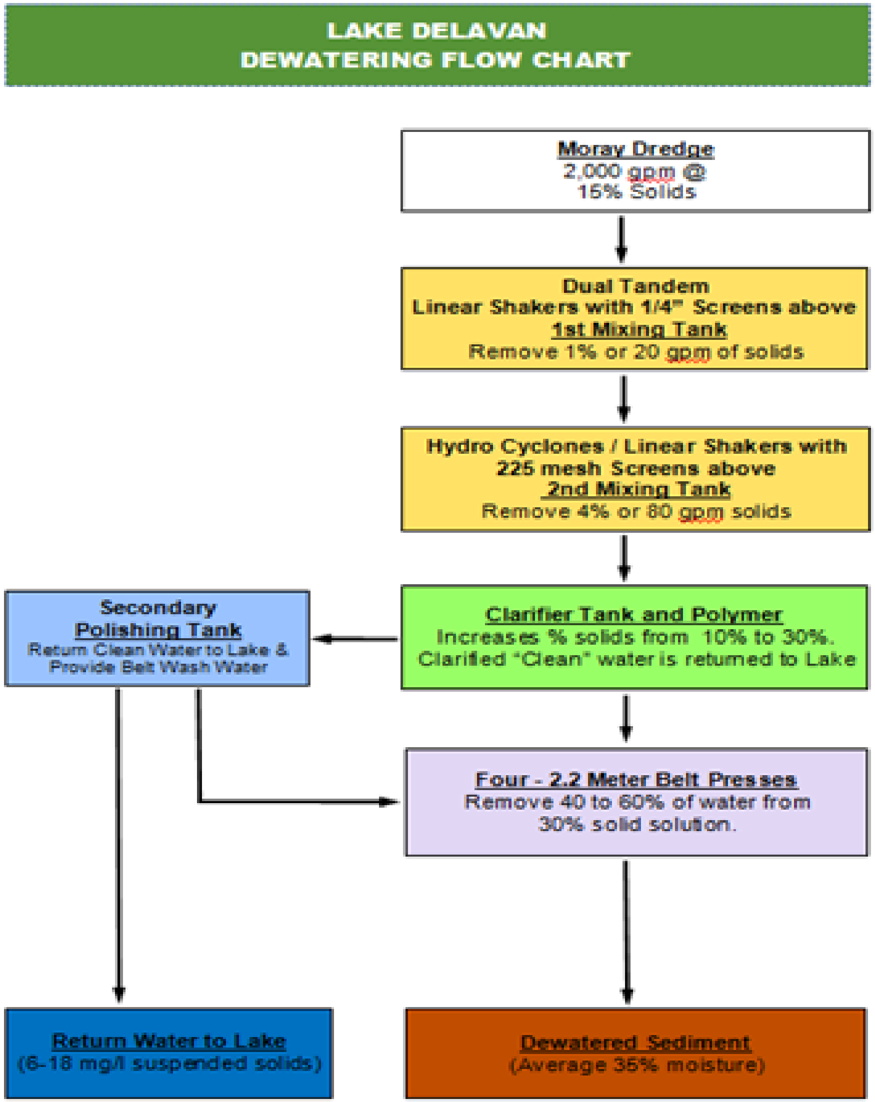
Table 2. Estimate of Probable Sediment Removal Costs with Alternative Dewatering		
Sediment Removal Work Task	**Total Dredging Quantity**	**Estimated Cost**
North Inlet Dredging – ($18.00 to $22.00/CY)	41,014 CY	$ 738,252 - $ 902,308
Includes Dredging, Mobilization and Dewatering		
Contingency (10%)		$ 73,825 - $ 90,231
Subtotal incl. Contingency		$ 812,077 - $ 992,539
Engineering, Permitting & Envir. Assessment (15%)		$ 121,812 - $ 148,880
Total Estimated Cost for Dredging & Dewatering		**$ 933,889 - $ 1,141,419**

$ 22.77 - $27.82/cy with Project Completed in 120 days

No Requirement for Purchasing 10–12 acres for Basin and No liability or carrying costs thru Restoration

Mechanical Dewatering



Dual Tandem Shakers / Primary Mix Tank

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Hydro Cyclone / Linear Motion Shakers

Clarifier Tank

Clean Water from Clarifier

Mechanically Dewatered Lake Sediment

The photos above provide a visual representation of the soil/sediment consistency from Lake Delavan. (center bucket photo)
In-Situ sediment, (top three photos) representing the mixture being introduced into the Clarifier, and remaining photos indicating dewatered sediment.

Dewatering Site

Loading Trucks

Cleaned Water Returned to Lake

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Sediment Re-Use

Sediment re-use in the reclamation of a quarry site.

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Minimal Site Restoration

Before and after pictures of the dewatering site.

Conclusions

- ***Economics of Clean Water are the basis for maintaining a viable and healthy economy for lake based communities.***
- ***With most lakes or inland waterway, their respective watersheds are the key contributor to sedimentation build up.***
- ***There are many steps and processes to minimize the cumulative build up of sedimentation, but eventually, it must be physically removed to maintain water quality.***
- ***A key indicator for a "Healthy Lake" is the Tropic State Index of 60 or less, understanding that the key components of TSI are Phosphorus and Chlorophyll, which ultimately affect water clarity.***
- ***Using an "economic rationale" approach to educating the residents of Lake Delavan resulted in a complete "buy in" by all share holders.***
- ***Environmental Considerations do not preclude the use of Dredging & Mechanical Dewatering as a viable option.***
- ***Clearly defined objectives, restrictions and scheduled completion dates enhanced and solidified the utilization of mechanical dewatering.***
- ***Portable mobilization minimized excessive pre construction costs and time.***
- ***Correct "coupling" of the Dredge selection and Dewatering system capacity insured efficient economies of scale, resulting in the correct balance of thru put.***
- ***Typical Sediment Dewatering Facility (SDF: "Pump & Dump") economics appear less expensive on the front end until costs for land, liability, time (1-2 years), restoration and intangibles are added.***
- ***Mechanical Dewatering alternative economics appear more expensive on the front end until the deductions for land, liability, time (120 days), restoration and intangibles are deducted.***
- ***An advantage of mechanical dewatering with "high flow clarification" is the ability to return lake water used during the process back to its original source, cleaner than before.***
- ***All sediment was re utilized within close proximity of the project which significantly minimized disposal costs.***
- ***Before and after sampling of the Inlet flows through the project site verified the overall reduction of phosphorus.***
- ***Due to all dewatering activities occurring on less than ½ acre with portable above ground components, Site Restoration costs were minimal and completed within the 120 day project timeline.***

Anybody Wanna go to the Lake?

MADISON, WISCONSIN
FROZEN ASSETS
Winter Wonderland Party
CLEAN LAKES ALLIANCE

CLEAN LAKES PROGRAM

"Happy Share Holders"

Anybody Wanna go to the Lake?

"Un Happy Leaders"