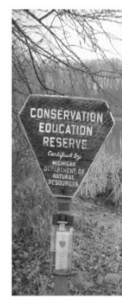
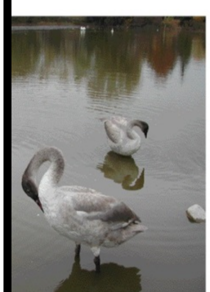
Restoration of the Thurston Pond Ecosystem






July 12, 2013 revision of the February 2005 Thurston Pond Restoration Plan.

1. INTRODUCTION

This report offers a plan and guidance for restoring the health of the Thurston Pond ecosystem, which is the major aquatic feature of the Thurston Nature Center (TNC; Figure 1 and www.thurstonnaturecenter.org). It represents the considerable thoughtful input Thurston Nature Center Committee's (TNCC) Water Steward, Tom Edsall, and other committee members. The TNCC is a volunteer community organization and is a committee of the 501(c)(3) Thurston Parent Teachers Organization; TNCC has been involved with improving the nature center since its founding in 1968.

The report primarily addresses actions for:

* Improving the existing pond outlet structure to permit more effective control of the pond water levels and outflow to Millers Creek.

* Re-grading the pond bottom to deepen portions of the pond to restore a clear water pond, increase its storm water holding capacity, and to permit maintenance draining.

* Using the excess soil created by re-grading the pond bottom to improve the pond and condition and the TNC ecosystem.

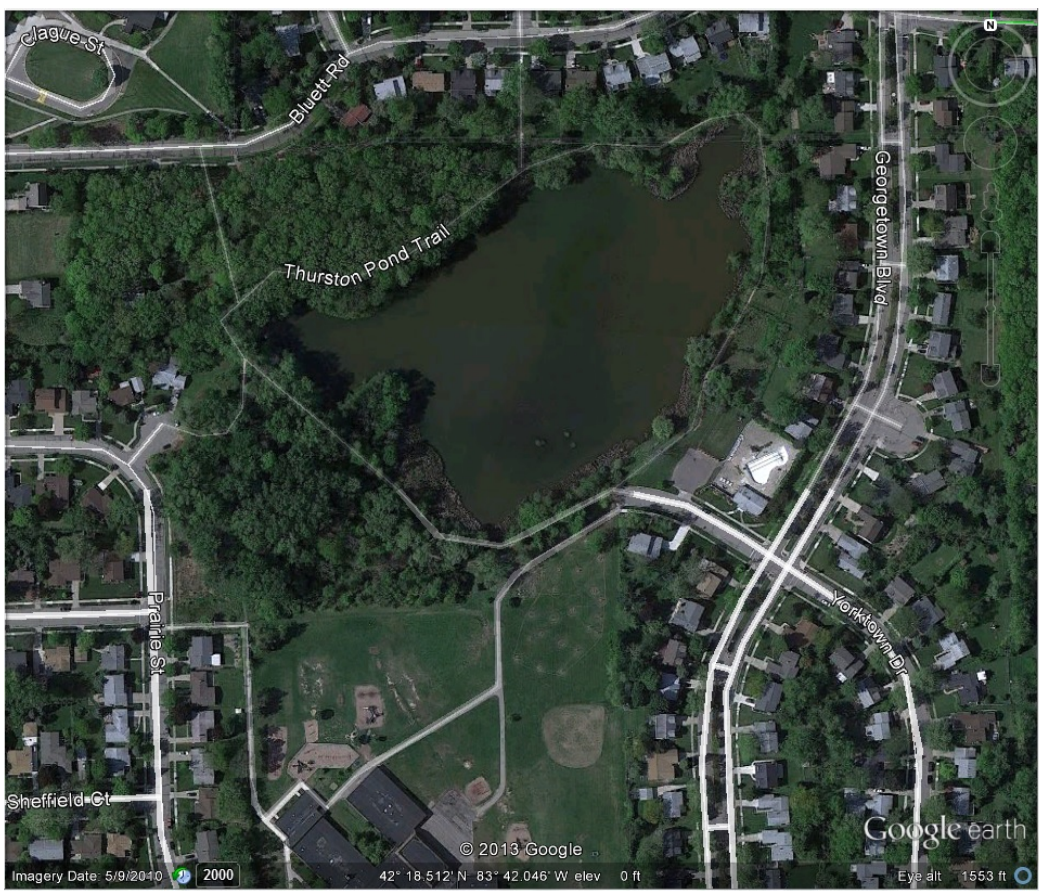


Figure 1: Map of the Thurston Pond area in northeast Ann Arbor, from a May 2010 image in Google Earth.

The report includes:

A **problem statement** discussing the degraded health of the pond ecosystem, its causes, and its impacts on educational and community uses of the pond.

A **goals statement** outlining the changes and desired outcomes needed to improve the health of the pond ecosystem consistent with its intended beneficial use and management.

Descriptions of **specific actions needed** to restore pond health consistent with the goals statement.

A general **schedule** for a three-year period of restoration actions.

2. PROBLEM STATEMENT

Thurston Pond is a small, shallow, water body (Figure 2). Such ponds in the Midwest typically exist in one of two distinctly different water clarity states, clear or turbid. In the small, clear-water ponds, the pond bottom is typically visible when viewed from above the water's surface, whereas in small, turbid-water ponds, the pond bottom is usually not visible where the water is more than a few inches deep. In clear-water ponds, submergent, floating-leaved, and emergent plants dominate the vegetation; invertebrates (insects, zooplankton, and crustaceans) and fishes are present, and biodiversity is high. In turbid-water ponds, microscopic and filamentous algae dominate the open water plant community, submergent and floating-leaved plants are largely absent, and the invertebrate and fish communities are reduced to a few tolerant species. Table 1 reviews changes in Thurston Pond from its historical (late 1960s-1970s) to recent status and how its condition has generally degraded.

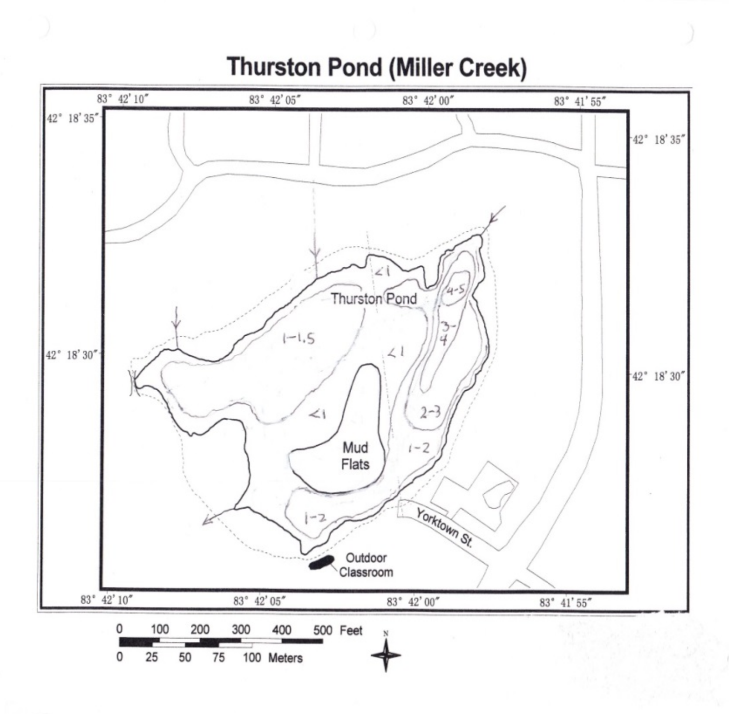


Figure 2: Thurston Pond bathymetric map showing water depth (feet), and the mud flat-island area.

Table 1: Thurston Pond characteristics

Thurston Pond was initially a healthy, clear-water pond, but over its 50-year life it has become a degraded, turbid-water pond. The observed characteristics for these two states are outlined below.

Characteristics of Thurston Pond under clear- and turbid-water states.

Characteristic	State	
	Clear-water (yesterday)	Turbid-water (today)
Maximum water depth	About 6.5 feet over hard clay pond bottom.	About 5 feet.
Sediment infilling	No infilling	In the northeast corner of the pond > 2 feet of soft, loose sediment has accumulated on top of the hard clay pond bottom.
Water supply (storm water and ground water)	Major sources prior to 1972 were ground water and surface runoff from undeveloped lands within the Thurston Nature Center and surrounding area.	Major sources now also include storm water from street drains in the Orchard Hills subdivision and from Clague School property, and ground water from household footing drains
Water level	Initially increased by berm construction at west end of pond.	Decreasing when berm is breached; greater fluctuations due to increase in storm rainfall intensities.
Water clarity	Pond bottom visible in spring throughout the pond; Secchi disk visible on bottom in spring at about 6.5 feet.	Pond bottom visible in spring in water about 1-1.5 feet deep. Secchi disk visible at 3 to 11 inches in 2006.
Water odor	None	Musty
Water color	None; clear.	Brownish or greenish in appearance due to microscopic algae and suspended particles of organic matter.
Dissolved oxygen	Adequate to support all desirable native aquatic life forms throughout the year.	Supersaturated during the day in summer. May be limiting at night during the summer, especially at pond bottom, and in winter under ice. Significant fish kill seen on ice-out in 2003.
Phosphorus	No data; probably low.	Phosphorus levels in water extremely high (up to 0.41mg/L, with 0.018 to 0.18 mg/L also

		sampled); sediment contained 130 – 630 mg/L
Nitrogen	No data; probably low.	Ammonium Nitrogen in sediments 37-430 mg/L
Conductivity	No data.	350-500 microS/cm; problem level is >1000
Total dissolved solids	No data.	Approximately 250 ppm.
Total suspended solids	No data.	Avg. 21 mg/L, range 0.5 to 110 mg/L (2006 data)
pH	No data.	About 7.4-9.8; values > 8.5 can be a problem.
Temperature	Suitable for native plants and warmwater animals.	Suitable for native plants and warmwater animals.
Algae	Low density; no obvious accumulations.	Major cause of low water clarity; may be floating mats of noxious filamentous species.
Rooted aquatic plants	Abundant and diverse.	Low density or absent.
Zooplankton	Unknown.	Low density or absent.
Invasive wetland plants	None recorded	Extensive invasive *Phragmites* invading pond periphery
Aquatic insects	Abundant and diverse	Low density or absent
Fish	Introduced native fishes (bass, sunfishes, and minnows) abundant; bullheads and carp and goldfish absent or present in low abundance; species diversity reflects stocking history.	Low density, absent, or restricted to tolerant native species (bullheads) and exotic species (carp and goldfish).
Amphibians (Thurston Pond, adjacent wet woodland & vernal pond)	Frogs and toads (6 species), and newts and salamanders present (1 species each).	The Ann Arbor frog and toad survey reports low density, 4 species of frogs and toads present, but no newts or salamanders.
Reptiles	Snapping and painted turtles abundant.	Snapping and painted turtles abundant.
Ducks and geese	Mallard ducks and Canada geese abundant; diving ducks as regular spring visitors.	Mallard ducks and Canada geese very abundant; diving ducks less frequently seen.
Wading birds	Three species of herons plus bittern and egret commonly seen.	Great blue herons are commonly seen; egrets are infrequent visitors.
Raptors	Migrating ospreys occasionally seen fishing in the pond in the spring.	Ospreys rarely seen.
Muskrats	Common residents	Absent

The measurements for turbidity, phosphorous, pH, and total dissolved solids made in 2004 and 2006 indicate some serious problems with water quality. The turbidity and phosphorous measurements translate to a Carlson Trophic Index of 90, on a scale from 0 to 100. This reflects a hyper-eutrophic system dominated by algae to the exclusion of a healthy and diverse community of aquatic plants and animals. Using the *Mitchell and Stapp water quality index 1997**, these same four measurements taken together yield a value of 37, on a scale of 0 to 100, thus putting Thurston Pond water quality solidly in the "Bad" category.

Major changes in the pond since 2005 and not reflected in Table 1 are as follows:

The water supply to the pond has been increased by diverting storm water from a 38-acre catchment area north of Bluett Street directly into the pond via a culvert installed beneath the walkway leading from Antietam Drive and Bluett Street to the pond (see Figure 3 map), as well as footing drain discharges from houses. These additional water inputs pass through swirl concentrators put in during 2009, including one that brings water from the Clague Middle School property. These swirl concentrators help remove particles and pollutants in the incoming water to the pond.

The berm bounding the west side of the pond was repaired and elevated in 2009 and the historical overflow water level has been restored, however the berm is threatened by erosion during major rain storm events.

No major changes in the pond biology have been documented since 2005, although invasive *Phragmites* (common reed) has been taking over edge wetlands in recent years.

**Mitchell, Mark K.,and William B. Stapp. 1997. Eleventh Edition. Field Manual for Water Quality Monitoring: An Environmental Education Program for Schools. Dubuque, Iowa: Kendall/Hunt Publishing Company. 276 pages, illustrated.*

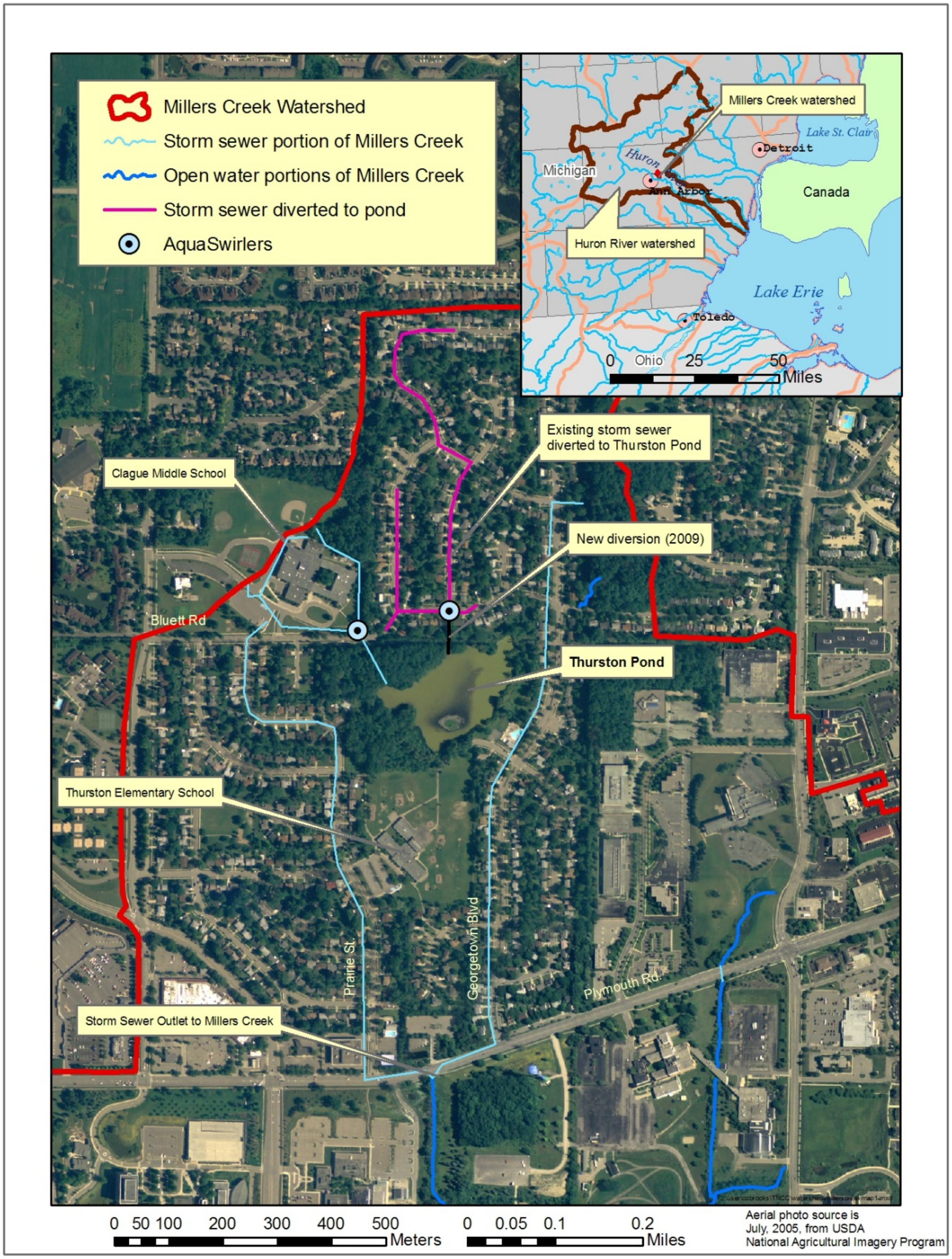


Figure 3: Huron River and Millers Creek watersheds, upper Millers Creek storm water system, Thurston Pond, and Clague School and Antietam Drive storm water inputs to the pond. Not shown is the Thurston Pond outlet to the Prairie Street storm water system.

2.2. Possible Causes for Poor Water Quality.

The factors causing Thurston Pond to degrade from the clear-water state to the turbid-water state cannot be unequivocally demonstrated because historical water quality data are lacking. However, in other similar shallow ponds at this latitude, the change is usually initiated by a human-mediated influx of nutrients from the surrounding watershed. These nutrients stimulate the production of algae blooms in early spring. If there is an insufficient population of zooplankton to "graze down" the enhanced algae population, the algae shades the pond bottom and inhibits or prevents the growth of rooted aquatic plants. If this condition persists for a sufficient number of growing seasons (years), the rooted plant community declines and eventually dies out. The decline of the rooted aquatic plant community makes the nutrients that would have supported their production available to algae, thus further stimulating algae production. The decline and loss of the rooted vegetation also adversely impacts the zooplankton that graze on and help suppress the algae, because these zooplankton typically seek refuge from fish in the stands of rooted plants. The excess production of algae in response to an increase in available nutrients can also contribute to turbidity problems if dead and decaying algal matter remains in suspension or is re-suspended by wind and wave action or by the activities of fish (particularly bullheads, carp, and goldfish) turtles, and waterfowl.

2.3. Impact on Community.

In addition to its role as an educational resource, Thurston Pond is also the focus of intense community use. In a 1998 poll of residents of the Orchard Hills neighborhood, 82% of the 211 respondents stated that they visit Thurston Pond on a regular basis. Unfortunately, only 43% stated that they were at least "satisfied" with the condition of the pond. Although some wildlife remains, and is greatly appreciated by local residents, they report it is greatly decreased in amount and diversity from two or three decades earlier.

2.4. Impact on Educational Opportunities.

As a Nature Center owned mostly by the Ann Arbor Public School District, the mission of providing high-quality educational opportunities is a very important one for Thurston Pond (about 1/5 of the TNC is owned by the Orchard Hills Athletic Club, on the northeast side). Elementary school and other students often visit local ponds as part of the environmental education curriculum. Thurston Pond was a site for this Ann Arbor Public Schools field trip for many years, until several years ago when decreasing density and diversity of aquatic life led to removing Thurston from the list of usable sites. Thurston students are now sometimes bussed to other pond sites, at considerable expense, and Thurston classrooms have greatly reduced opportunities to observe a healthy pond system in their own backyard. In May 2013, Thurston students visiting the pond collected fish, crayfish, snails, frogs, and aquatic insects typically representative of a eutrophic pond environment. Improving the pond habitat would significantly increase its educational uses.

3. MAJOR RESTORATION GOALS

3.1. Maintain an Open-water System While Improving Island and Wetland Habitat.

The current pond area includes about 7 acres of open water, one small, low, island, and about 2 acres of shoreline wetland. A large mud flat appears when summer water levels are lowered by insufficient rainfall, and routine evaporation, and percolation into the ground water table. At low water levels the pond becomes 3 shallow, unconnected, watered basins, and the mud flat becomes temporarily covered with short vegetation. At extremely low water levels, as in 2012, only the northeast portion of the pond is watered (Figure 4). We will preserve as much of the open water area and shoreline wetland as possible, while slightly enlarging the island.

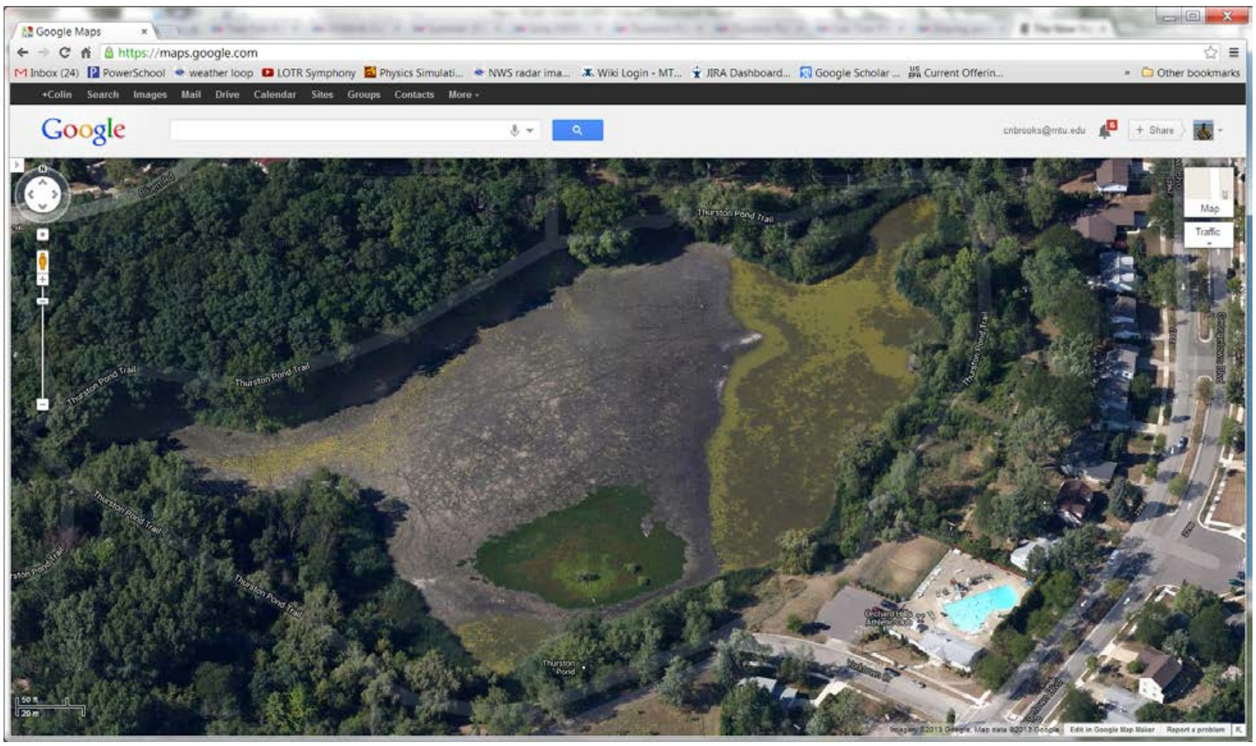


Figure 4: Thurston Pond during drought conditions, as displayed in Google Maps in an August 2012 aerial photograph. Only the northeast pond portion (upper right) still has water, the rest of the pond is dry, and the island-mud flat area (foreground) is becoming vegetated.

3.2. Restore the Clear-water Condition.

Currently the pond water is highly turbid during warm weather. This turbidity is attributable to the high phosphorous content and fertility of the water, which produce excess blooms of algae. We will restore the clear-water condition by reducing phosphorous to non-problem levels, deepening the pond, and reestablishing a plant and animal community that would discourage excess production of algae.

3.3 Improve Biodiversity.

We will improve the health of the pond ecosystem by creating more deep-water habitat and better water level control, removing polluting sediments and improving water quality. This will support a more diverse and productive community of native wading and water birds, warm water fishes, turtles, frogs, toads, aquatic insects, zooplankton, other benthic (bottom-dwelling) invertebrates, and aquatic plants

3.4. Support High Aesthetics.

The restored pond would be enjoyable to look at and experience in any season.

3.5. Support Quiet Recreational Uses.

We encourage continued quiet community uses of the TNC and pond , e.g., for hiking, ice skating, wildlife viewing, or just sitting and relaxing . The pond should be a biologically interesting and restorative place to walk around, sit by, or poke around in. It should be possible to see the pond at key places around the pond. We do not support changes that would contribute to increased human impact and degradation.

3.6. Support Enhanced Educational Uses.

As an urban nature center, and particularly as an area owned in large by the Ann Arbor Public School District, Thurston Pond should offer exciting and rewarding opportunities for environmental education, science experiments, and nature study. Meeting goals 3.4 and 3.5 should significantly enhance the educational resource value of Thurston Pond.

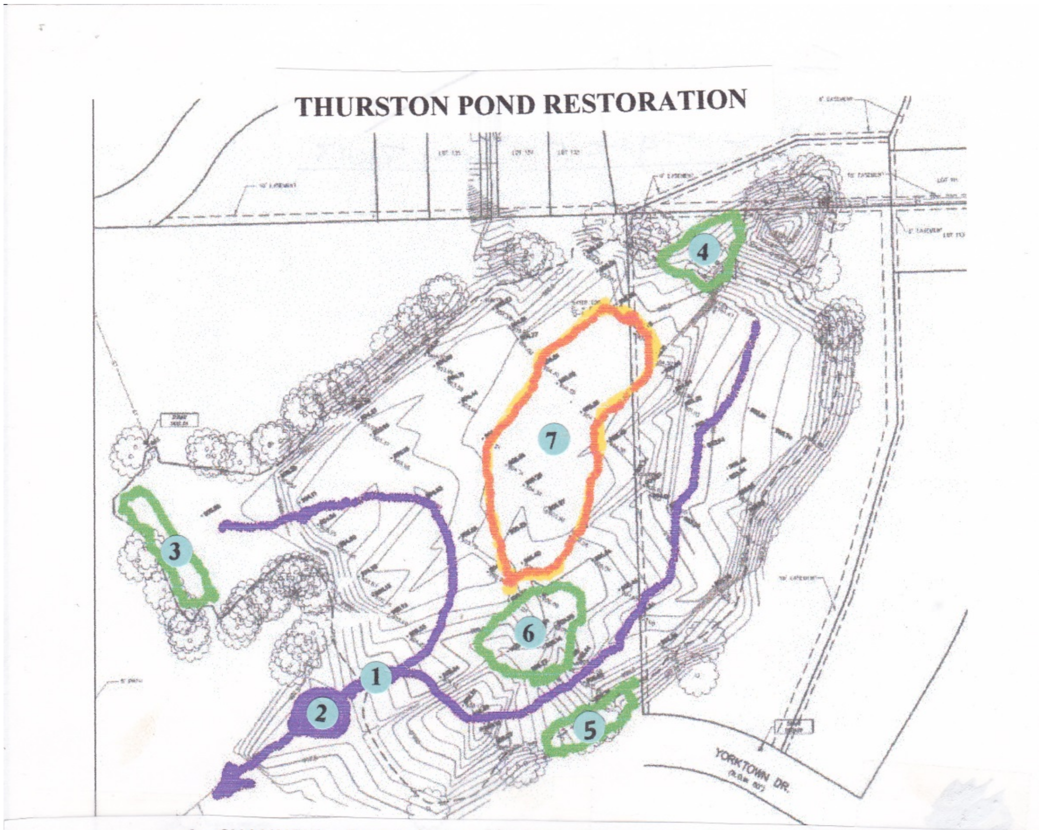
4. RESTORATION ACTIONS

4.1. Re-grade Pond Bottom and Construct New Outlet.

The single most effective set of actions that can be taken to achieve the Thurston Pond ecosystem restoration goals would be to re-grade portions of the pond bottom and to construct a new pond outlet structure. These actions would improve the island habitat, provide more deep-water habitat, and permit the pond to be drained when needed to improve pond water and pond bottom sediment quality and to manage pond plant and animal communities. Removal of the phosphorous-laden sediments will also improve pond water quality.

Re-grading the pond basin would also have the beneficial effect of increasing the capacity of the pond to hold storm water following major storm events. The pond currently functions as storm water retention pond that benefits the city of Ann Arbor, the Millers Creek watershed, and the Huron River. This increased storage capacity would help maintain pond levels during dry years and would have a beneficial effect on Millers Creek, which suffers from flash flows and erosion.

A minimum re-grading effort that would provide more deep-water habitat and allow the pond to be fully drained is shown in Figure 5. The proposed channel extending from the northeast corner of the pond to the pond outlet on the southwest corner of the pond would allow gravity flow of water from the deepest portion of the pond to the pond outlet. A second channel leading from the berm area on the northwest side of the pond to the outlet would help ensure connectivity of that portion of the pond with the outlet during low water years.



1. CHANNELS—Re-grade pond bottom to create a water depth of 4 feet in channels when pond is at overflow elevation at beehive grate.
2. SETTLING BASIN—Re-grade pond bottom to create a water depth of 6-8 feet when pond is at overflow elevation at beehive grate.
3. BERM ADDITION—Deposit excess pond bottom soil on pond side of existing berm to elevate berm by 1 foot.
4. NORTH OVERLOOK—Deposit excess pond bottom soil to an elevation 4-6 feet above pond overflow elevation at beehive grate.
5. SOUITH OVERLOOK— Deposit excess pond bottom soil to an elevation 4-6 feet above pond overflow elevation at beehive grate.
6. ISLAND-- Deposit excess pond bottom soil to an elevation 2 feet above pond overflow elevation at beehive grate; top with sandy soil and plant with native grasses, button bush, and black alder.
7. EMERGENT AQUATIC VEGETATION—Plant throughout with bulrush to stabilize pond bottom and reduce wind-generated turbidity.

Figure 5: Thurston Pond re-grading plan endorsed by the TNCC.

The existing Thurston Pond outlet consists of a beehive grate (Figure 6)through which the pond water overflows into the underground Prairie Street storm water system that discharges into Miller Creek at Plymouth Road. Note that the current emergency outlet (black corrugated plastic pipe visible between two broken blocks of concrete) is about 1 foot in elevation above the beehive grate. TNCC observations in June 2013 revealed that the pond level was within about 3 inches of overflowing the berm when the high water flow shown in Figure 6 was recorded. Thus, the emergency overflow is non-functional.

Figure 6: Existing Thurston Pond outlet at the beehive grate.

Figure 7: Berm overflow and erosion during high rainfall events in 2010 and 2013.

There is continuing danger of berm erosion unless pond re-grading and outlet modifications proposed in this document are undertaken to better handle major storm water event flows that are becoming increasingly common.

Figure 8: A proposed new outlet system for Thurston Pond that would enable improved water level and outflow management.

The TNCC recommends modifying the existing outlet system by replacing the beehive grate structure with a modified stop-log structure similar to the one shown in Figure 8. In the modified stop-log structure, the wall in the foreground would be lowered and connected to a concrete overflow apron several feet wide, with sloping sides, and crossing the berm. Under high-water emergency conditions when the existing storm-water system downstream from the stop-log structure could not carry all of the pond outflow, the overflow apron would allow the excess water to spill over the berm and into the woods on the west side of the pond. The overflow apron would be constructed to allow it to serve as an easily crossed surface feature in the walking trail on the berm. The elevation of the bottom of the channel of the overflow apron would be 1.0 feet lower than the elevation of the lowest crest elsewhere on the pond berm.

Outflow from the pond to the stop-log structure would be carried by an open, 4-foot deep channel cut through the cattail wetland, or by a large diameter concrete culvert buried beneath the wetland. The bottom of the channel or culvert would need to be 4 feet below the elevation of the existing beehive grate to allow the pond is to be drained for pond deepening and removal of phosphorus-laden sediment that is causing eutrophication and preventing restoration of the clear-water condition—the project's major restoration goal. It could also help with control of invasive wetland plants such as *Phragmites*.

If a buried culvert is used as the primary outlet channel from the pond to the stop-log structure, the excess flow under high-water emergency conditions would run on the surface through the cattail wetland to the stop-log structure and then into the woods via the overflow apron.

For the outlet system to function properly a 6 to 8-foot deep settling basin (Area 2 in Figure 5) will need to be created in the pond at the mouth of the outlet channel or culvert. This will trap migrating soft sediment and prevent its discharge into the storm water system and Millers Creek. Sediment accumulating in the basin can be periodically pumped into adjacent wooded areas or elsewhere on site where it can be used constructively.

4.2. Increase Island Elevation.

Use a portion of the excess pond-bottom soil created by re-grading to increase the elevation of the existing island (Figure 9) about 2 feet. Cap the island with loose sandy soil to provide nesting habitat for turtles.

Figure 9: The existing island in Thurston Pond.

5. SCHEDULE FOR RESTORATION ACTIONS

5.1. Modify the existing outlet structure during fall and winter while maintaining normal water levels in the pond.

5.2. Drain the pond in spring and dry the pond bottom soil until it is firm enough to support excavating equipment. Rescue the painted and snapping turtles, maintain some for restocking the pond after it is refilled, and release the rest in suitable habitats on School District property or at other sites approved by the Michigan DNR.

5.3. Re-grade the pond bottom in late spring-early summer. Use the excess soil to elevate the existing island, elevate and widen the berm at the west end of the pond, and create pond overlooks as shown in Figure 5.

5.4. Begin refilling the pond in summer and begin planting desirable native aquatic and wetland vegetation in the pond and on the island. Add terrestrial plants to all shoreline fill areas to minimize erosion.

5.6. Stock the pond in with zooplankton (e.g., *Daphnia* spp.) and return turtles to pond.

5.7. The following spring, stock the pond with a predatory fish species (e.g., largemouth bass fingerlings) to help eliminate any undesirable exotic fishes (e.g., carp and goldfish) that may be illegally introduced into the pond after it is refilled. Also stock adult fathead minnows, golden shiners, or both, to establish breeding populations that provide food for bass and wading birds, including herons and egrets. .

5.8. Throughout the period of restorative action, maintain an accurate chronology of observed events and changes in the pond and its plant and animal communities and continue regular monitoring of water quality. Post this information on the TNC webpage to document successes and aid in developing future management strategies for the pond.

6. RELATED ACTIVITIES

It should be noted that this restoration plan is within the context of efforts of the TNCC and other neighborhood volunteers to restore and maintain the TNC. As Land Steward, Mike Conboy, has lead efforts for the past four decades to plant native Michigan trees, control invasive plants, maintain recreational trails, and offer nature center interpretations to local residents , students, and others. The Thurston Oak Savanna was established in 2009 under the leadership of Neal Foster. Twenty oak trees representing several native oak savanna species planted with the help of local families, students, and Cub Scouts. The project was financed with a $2000 bridge loan from a TNCC member, who was reimbursed after project completion, with a $2000 grant from the Michigan Community Forestry Program. Some of the restoration ideas and pond water sampling data in the present proposal came from a 2010 restoration grant proposal to the EPA's Great Lakes Restoration Initiative, led by Barry Johnson, which yielded cost estimates for pond re-grading and improved storm water retention. The Thurston Oak Savanna and Thurston Nature Prairie on Prairie Street area are being maintained for native wildflowers by TNC volunteers and Thurston School students. As of June, 2013, the TNCC had raised about $8500 for restoration efforts and more fundraising efforts necessary to implement this vision are underway. A related effort to control the invasive, non-native *Phragmites* that is taking over wetland areas is underway with intended implementation in 2013 and 2014. Interested groups are requested to seek out more information at the www.thurstonnaturecenter.org web page that is being regularly updated.

Following are additional representative photos of the TNC and associated activities. The TNCC hopes the Ann Arbor community will continue to support this valuable resource for use by future generations.