Appendix B

Arbor Lake Watershed Visioning Plan Summary

Completed, On-Going, and Future Arbor Lake Projects

Phase I - Water Quality Monitoring (2003 – 2006)

Over 130 chemical assessments have been done to date on water from the five inlets and one outlet of the lake (Hazel Creek, Wood Creek, Hobo Drain, Hobo Creek; and The Gully Inlets; and the one Outlet, Sweetwater Creek). We have also analyzed water from a depth of 3 meters in the middle of the lake and compared it with analysis of the surface water. From these data we can make the following observations:

1. Three of the five inlets have elevated Phosphorus concentrations and they are all storm drains.
2. Average Phosphorus levels (mg/L) in the inlets are: Hazel Creek (.16); Wood Creek (.81); Hobo Drain (.92); Hobo Creek (.60); The Gully (.09) while the average Phosphorus concentration in Sweetwater Creek (the single outlet) is .08.
3. The average outflow from the lake, measured at the spillway is 37.1 Liters/sec.
4. -The average inflow from Hazel Creek, (the largest and cleanest inlet) is 16.7 Liters/sec.
5. The lake is stratified from June to September. Phosphorus levels in the surface layer are .1-.2 during that time, while at 3 meters depth they are .6 – 3.0.
6. From water column profiles done by others (DNR and Grinnell College) the thermocline begins at a depth of 2 – 2.5 meters.
7. From published Hypsography 3/4 of the lake volume is above 2.5 meters depth, with 1/4 below that depth. (DNR). The total volume of Arbor Lake is 144,000 cubic meters.
8. During algal blooms, the dominant form of algae is Cyanobacteria (blue-green).

Phase II - Watershed Improvements (2004-2008)

1. Riffle Pools were installed on Hazel Creek and Wood Creek to reduce erosion and improve aquatic habitat. The stream banks were regraded and seeded with native grasses and forbs. (2004)
2. Retention ponds were constructed on The Gully and a small (unnamed) drainage at the north end of the lake. A gravel baffle-dam was installed on Hobo Creek to slow the flow of that inlet to the lake. (2005)
3. Storm interceptors were installed on Hobo Drain and another storm drain (unnamed) at the north end of the lake to catch sediment and debris. (2005)
4. Invasive species of shrubs were removed from forested areas north and west of the lake. Native wetland and forest grasses were planted in their place. Wetland plants were planted on exposed mudflats. (2006)

Preliminary assessment of the earliest of these improvements indicate that the high Nitrogen spike in The Gully, related to Spring planting in its mostly crop land watershed, has been almost completely eliminated by the retention pond. Riffle Pools on Hazel Creek have provided improved aquatic habitat and we now find a healthy population of arenaceous Caddis flies where, before, there were only rare web-spinner forms of Caddis flies. A recent high-water mark, (visible by bent-over grass on the stream banks), two feet above the stream bed, left no evidence of erosion. Before, there were many cutbank areas.

Proposed Additional Watershed Improvements (2007-2008)

1 - Diversion of high Phosphorus water from Hobo Creek and Hobo Drain through a small diameter pipe laid beside the footpath on the south shore of the lake to a location below the dam. The pipe would be sized to divert base-flow of both streams (2.6 + 9.6 Liters/sec), while higher flow during rain events would continue to flow into the lake. A sump pump (or some type of artificial lift) would be required since there is no elevation drop along this route. Nutrient-rich water, thus diverted, could be used to irrigate community gardens or a wetland/rain garden in the valley below the dam. This would reduce water flowing into the lake by 33% while reducing the Phosphorus input by 50%. Average flow over the spillway would be reduced from 37.1 Liters/sec to 24.9 Liters/sec.

2 - Diversion of high Phosphorus water from Wood Creek through the retention pond at the north end of the lake by pumping it from the stream over the berm through a pipe sized for base flow (6.2 Liters/sec). Higher flow during rain events would still flow into the lake. This would not reduce the storage capacity of the pond, but only increase the throughput which at present is practically nil. This would not reduce the water flowing into the lake and would reduce the Phosphorus input by 25%. Average flow over the spillway would remain the same since the retention pond drains into the lake.

Taken together, these two diversions would reduce Phosphorus input by 75%, a dramatic reduction, which would far exceed original watershed improvement goals and pave the way for future clean-up efforts in the lake itself. The 33% reduction in water flowing through the lake may be a bitter pill for those who enjoy the waterfalls below the spillway, but they will still be there in all their glory after each rain.

Phase III - Lake Clean-Up and Management (2009-2010)

Cleaning the lake means removing things we don't want in the lake, like Carp, Algae, Sediment and Phosphorus. One way to do that is to drain the lake. Advantages of draining the lake are that the lake bed can be re-contoured and sediment can be removed which will end Phosphorus recycling from the sediment. It also allows inspection, maintenance and refitting of the lakes plumbing.

The alternative to draining the lake is to initiate a Lake Management Program which uses a multi-discipline approach to restore the lake's natural balance. In effect, each symptom is treated as a separate problem with its own solution. Odem & Flock (1990) list the following lake management practices which have sufficient track records to be rated for "effectiveness".

Alum Treatment to precipitate and inactivate Phosphorus (Excellent)

- Dredging of whole lake (Poor)
- Dredging of lake inlet area (Excellent)
- Dilution (Poor)

- Flushing/Artificial Circulation (Fair)
- Hypolimnetic Aeration (Fair)
- Sediment Oxidation (Good)
- Addition of Algicides (Good)
- Food Chain Manipulation ((Good)
- Hypolimnetic Withdrawal (Good)
- Water Level Drawdown to remove weeds (Fair)
- Weed Harvesting (Good)
- Biological Controls to reduce weeds (Good)
- Addition of Herbicides (Good)

They also rate each practice according to its Longevity; Confidence; Applicability; Potential negative impacts; Capital Cost, and Operating & Maintenance Cost. (http://lakes.chebucto.org/lakerest.html).

Whether or not the lake is drained some elements of a lake management program will be required to maintain it in a healthy state. It might be a good idea to hire a young, degreed, lake ecologist, on a shared basis with surrounding counties, who could manage Arbor Lake together with 5 or 6 other lakes. The Ecology, Restoration and Management of lakes is a mature science with its own professional society called the North American Lake Management Society (NALMS). They are headquartered in Madison, WI, and they publish a peer-reviewed journal.

[This page is intentionally blank.]