

for fish habitat, and fish spawning habitats such as the floating-leaved and emergent aquatic plant communities located in the West and East Bays.

Native submersed aquatic plants (i.e. Pondweeds, Naiad, and Water Marigold) within Bear Lake are plentiful in select areas (i.e. the West and East Bays) and in depths of between 5-12 feet; however, these communities are currently stressed by the invasion of *M. spicatum* which threatens to displace them. Furthermore, the presence of *M. spicatum* at depths of between 18-21 feet indicates the ability of this plant to colonize a vast majority of Bear Lake. Floating-leaved aquatic plants are rare in the open water areas of Bear Lake due to the high wave energy and inability to successfully root under those environmental conditions. Emergent aquatic plants are also sparse around Bear Lake and are critical habitats for insects and other lake biota. Additionally, they function as erosion guards by stabilizing beach sands that may wash into the lake. A few individual Purple Loosestrife (*Lythrum salicaria*) plants were found during the study and should be removed immediately to avoid further colonization which could out-compete favorable native emergent aquatic plants. The current algal population is well-balanced, yet continuous monitoring of the relative abundance and diversity of the blue-green algal communities is recommended since many of these species can produce microtoxins and are indicative of nutrient loading issues.

6.0 PROJECT RECOMMENDATIONS AND FINANCING

It is highly recommended that the Bear Lake Improvement Board and the residents around Bear Lake adopt the lake water quality and aquatic vegetation guidelines suggested in this management plan. To protect the good biodiversity of native aquatic plants within Bear Lake, chemical herbicides should be minimized and reserved for exotic species only. Additionally, an integrated management approach involving the use of aquatic herbicides and weevils is recommended for the management of *M. spicatum* in Bear Lake.

6.1 Recommendations for the Bear Lake Improvement Board

Every lake management plan derived from a Feasibility Study should offer solutions that are ecologically sound, practical, and economically feasible. Since funds for the suggested management improvements and oversight are limited, it was suggested that the Bear Lake Improvement Board form a Special Assessment District (SAD) around the lake to fund the suggested improvements. After the SAD has been established and the Feasibility Study is complete, a public hearing of practicability must be held to measure public support of the project. In addition, a public hearing of assessment roll is held to inform the public of the proposed costs and estimated special tax assessments. Once the hearings are complete and the project has been approved, a tax roll is prepared to fund the intended lake improvements.

At this time, it is recommended that the Bear Lake Improvement Board consider the implementation of the Integrated Management approach for the control of *M. spicatum* within Bear Lake. This integrated treatment will utilize both the biological control weevil (*E. lecontei*) and the use of chemical herbicides. Since the scope of the *M. spicatum* infestation currently is in excess of 300 acres, it is imperative that a rigorous yet ecologically sound treatment begin immediately. Additionally, the chemical herbicides should consist of systemics which offer long-term control. All aquatic herbicides to be used in Bear Lake must be registered by the United States Environmental Protection Agency (EPA) and must be used according to the safety guidelines listed for that particular herbicide on the MSDS sheet. The aquatic herbicide registration process requires that intense studies on human exposure and health, effects on fisheries and wildlife, biopersistence, and analysis of chemical breakdown products all be assessed to determine if these substances are safe to use in aquatic habitats for the control of nuisance aquatic vegetation. In future years of the Bear Lake improvement program, mechanical harvesting may be useful to remove native aquatic vegetation if it becomes a nuisance and the *M. spicatum* is controlled. In lake areas previously dominated by *M. spicatum*, rigorous growth of native aquatic plants such as Pondweeds may occur since the niche previously occupied by *M. spicatum* becomes available for other aquatic vegetation.

If mechanical harvesting is used in future years of the lake improvement program, it is important to realize that mechanical harvesting machines must have at least 1.5 - 2.0 feet of water depth to operate, and may leave a few stray plants that could wash ashore and would require raking or removal from lakefront beaches. The harvester can; however, make every effort to remove as many stray plants as possible. The harvester must steam wash all equipment prior to entry on Bear Lake to assure that exotic species are not introduced into the lake. In addition, the harvester should never remove aquatic vegetation that is not impeding recreation or navigation, as native aquatic vegetation is an essential component for a healthy inland lake fishery.

Furthermore, a professional limnologist/aquatic botanist should perform two GPS-guided whole-lake grid surveys each year to monitor the growth and distribution of *M. spicatum* and continuously monitor the lake for potential influxes of other exotic aquatic plant genera (i.e. *Hydrilla*) that could also significantly disrupt the ecological stability of Bear Lake. The lake manager should oversee all management activities and would be responsible for the creation of aquatic plant management survey maps, direction of the harvester or herbicide applicator to target-specific areas of aquatic vegetation for removal, administrative duties such as the processing of contractor invoices, and the education of lakefront owners through an educational newsletter and through attending regularly scheduled Bear Lake Improvement Board meetings. The educational newsletter should contain educational tips for residents to recognize and prevent the transfer of invasive species to the lake.

6.1.1 Bear Lake Improvement Board Composition

Improvements for Bear Lake are being implemented in accordance with Part 309, Inland Lake Improvements, of P.A. 451 of 1994, the Natural Resources and Environmental Protection Act. The Bear Lake Improvement Board was formed under this act and includes the following members:

- A Bear Lake riparian owner (usually appointed by the Bear Lake Property Owner's Association)
- A Representative of Pleasanton Township
- A Representative of Bear Lake Township
- A Representative of Bear Lake Village
- A Manistee County Commissioner
- The Manistee County Drain Commissioner

The Bear Lake Improvement Board must also elect a chairperson, secretary, and treasurer to assist with Lake Improvement Board duties.

6.1.2 Cost Estimates for Eurasian Watermilfoil Management

The proposed Integrated Management treatment program for the control of *M. spicatum* in Bear Lake would begin during the summer of 2008. Costs for the Feasibility Study would be covered during 2008. A breakdown of costs associated with Bear Lake improvements is presented in Table 8. It should be noted that proposed costs are estimates and may change in response to changes in environmental conditions (i.e. increases in aquatic plant growth or distribution, or changes in herbicide costs).

<i>Proposed Improvement Item</i>	<i>Estimated 2008 Cost</i>	<i>Estimated 2009 Cost⁴</i>	<i>Estimated 2010- 2012 Cost⁵</i>
Herbicides (systemic) for <i>M. spicatum</i> ¹ for 246 acres @ \$325 per acre	\$79,950	\$59,963	\$40,000
Biological control (weevils); suggested 18,000 units @ \$1.20 per unit & stocking	\$24,000	\$18,000	\$12,000
Engineering Feasibility Study	\$7,000	--	--
Legal Fees	\$10,000	\$3,000	\$1,000
Professional Services (limnologist surveys, oversight, processing, education, newsletter) ²	\$13,000	\$13,000	\$13,000
Contingency ³	\$10,395	\$7,796	\$0
TOTAL ANNUAL ESTIMATED COST	\$144,345	\$101,759	\$66,000

Table 8. Bear Lake proposed budget for management program (2008-2012).

¹ Herbicide treatment scope may change annually due to changes in the distribution and/or abundance of aquatic plants.

² Professional services includes two annual GPS-guided, Point-Intercept aquatic vegetation grid surveys, pre and post-treatment surveys for aquatic plant control methods, oversight and management of the aquatic plant control program, processing of all invoices from contractors and others billing for services related to the improvement program, education of local riparians through the development

and publication of a high-quality, scientific newsletter, and attendance at all regularly scheduled Bear Lake Improvement Board meetings.

- ³ Contingency is 10% of the total project cost, to assure that extra funds are available for unexpected expenses. Note: Contingency may be advised and/or needed for future treatment years.
- ⁴ Cost estimates for 2009 based on 75% of the herbicide and weevil costs for 2008. Note: Herbicide and weevil unit costs given for 2008 may change in 2009 and beyond due to cost of living adjustments for the contractor services and/or products.
- ⁵ Costs of the proposed program for years 2010-2012 are estimates only and may change based on the distribution and/or abundance of *M. spicatum*, costs of products and contractor services, cost of legal fees, and cost of professional limnological consulting services.

6.1.3 Special Assessment District Cost Breakdown

To assist with the costs of the proposed Bear Lake improvements, a Special Assessment District (SAD) is currently being established pursuant to provisions of P.A. 451 of 1994. The SAD is being established through Pleasanton Township, Bear Lake Township, and the Village of Bear Lake pursuant to provisions of P.A. 451 of 1994, the Natural Resources and Environmental Protection Act. The objective of an SAD is to provide an equitable way to disperse costs for a lake-wide improvement project. The SAD is based on established criteria that define “units of benefit” that each individual parcel is proposed to derive from the Bear Lake proposed improvements. Under this plan, riparian lakefront owners are assessed 1.0 unit of benefit. Local and county municipal access sites to the lake will be assessed 0.3 units of benefit. Vacant lakefront parcels that lack a dwelling or operating business and lack adjacent or nearby property that the owner with residence or operating business uses the vacant parcel as access to the lake are assessed 0.5 units of benefit, properties with more than two dwellings, multiple dwellings on

multiple parcels, or a residence and business on one parcel or on multiple adjacent parcels is assessed 2.0 units of benefit. The Village of Bear Lake Campground contains 30 campsites each at 0.2 units per site for a total of 6.0 units of benefit. Under these SAD classification criteria, the approximate costs per group are as follows:

<i>SAD Unit of Benefit Category</i>	<i>2008 Cost Estimate</i>	<i>2009 Cost Estimate</i>	<i>2010-2012 Cost Estimate</i>
0.3	\$113	\$79	\$52
0.5	\$188	\$132	\$86
1.0	\$375	\$264	\$171
2.0	\$750	\$528	\$342
6.0	\$2,250	\$1,584	\$1,026

Table 9. SAD unit of benefit management cost breakdown (2008-2012). Note: Current calculation based on a total of 385 units of benefit. This number may change as SAD is refined, and thus the annual cost estimates per unit of benefit category may also change.

6.2 Recommendations for Other Groups

Although the Bear Lake Improvement Board is essential for the *M. spicatum* treatment control program, other interested groups may also participate in the preservation of the ecological health of Bear Lake.

6.2.1 Water Quality Improvements

The Bear Lake Property Owner's Association (BLPOA) participates in regular water quality sampling of Bear Lake. Such monitoring is continuously recommended to assess the nutrient status of the lake both prior to lake improvements and for years after to reassess water quality

improvements from implemented management techniques. The BLPOA may also create an educational program for riparians to reduce nutrient loads to the lake. The program may include proper septic tank system management, since Bear Lake riparians currently utilize septic tanks for waste. In addition, riparians could be educated on where to purchase P-free fertilizers to reduce the amount of phosphorus to the lake. Riparians and those who recreate on the lake should also be instructed to avoid the dumping of chemicals or other pollutants not intended for aquatic ecosystems into Bear Lake in an effort to protect the good water quality.

6.2.2 Erosion and Sediment Control

The transportation of sand and sediments into Bear Lake may be exacerbated due to increased shoreline erosion. Thus, a lake-wide shoreline protection program may be needed to educate riparians of the importance of lakeside vegetation. Vegetation buffers may be encouraged among lakefront homeowners. Furthermore, the following guidelines available from the Michigan State University Extension Program may assist riparians in adopting an ecologically sound waterfront and help to reduce erosion around Bear Lake.

The guidebook, *Lakescaping for Wildlife and Water Quality* (Henderson et al. 1998) may be ordered online at: <http://web2.msue.msu.edu/bulletins/mainsearch.cfm>. These guidelines include: 1) Maintenance of brush cover on lands with steep slopes, 2) Development of a vegetation buffer zone 25-30 feet from the land-water interface with approximately 60-80% of the shoreline bordered with vegetation, 3) Limiting boat traffic to reduce wave energy and thus erosion potential, 4) Avoiding the use of retaining walls and encouraging the growth of dense shrubs or rip-rap to control erosion, 5) Using only native genotype plants (those native to Bear Lake) around the lake since they are most likely to establish and thrive than those not acclimated to growing in the area soils.

6.2.3 Waterfowl Management and Control

Residents around the lake should discourage the feeding of nuisance waterfowl since they collectively defecate on lakefront lawns and contribute *E. coli* bacteria and nutrients to the lake water. Fecal droppings should be placed in a disposable container and taken to an appropriate landfill. Nuisance waterfowl consist of Canada Geese (*Branta canadensis*), Mute Swans (*Cygnus olor*), and Mallards (*Anas platyrhynchos*). Waterfowl such as the Common Loon (*Gavia immer*) are rare and should be permitted to utilize the shoreline since they are not considered a frequent visitor or nuisance. Although sirens, artificial predators, egg-replacement strategies, and hunting are used to control the nuisance waterfowl populations around lakes, the best prevention strategy is to use a shoreline vegetation buffer to dissuade the waterfowl from approaching the land from the water. Waterfowl are likely to distrust buffer zones since potential predators may be lurking there. Thus, implementation of a shoreline buffer may function to limit waterfowl populations as well as stabilize shorelines and reduce erosion.