

## Section K: Monitoring and Evaluation

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The true test of the efficacy of the watershed management plan will be the implementation and attainment of the plan goals and objectives. Implementation for site-specific activities will require an evaluation to determine the progress and effectiveness of the proposed activities.

### MONITORING PLAN

The monitoring plans outlined in Exhibits 93 and 94 were developed to: (1) address the information gaps identified in the development of this plan; (2) ensure continuation of those monitoring efforts that in some cases have been occurring over a 30-year period; and (3) provide new information to help assure that any water quality or habitat problems or concerns can be detected early and appropriate actions taken before significant adverse changes occur that affect protected or desired uses of Bear Lake or Bear Creek and its tributaries.

Current and historic conditions of environmental quality are extensively documented in the Watershed Conditions section of this report which serve as a baseline against which monitoring efforts should be based. Since the majority of available data and information suggests that watershed conditions meet or exceed state water quality standards a minimal goal and criteria for measuring the efficacy of plan actions is no decline from current conditions.

Implementation costs are estimated and, to a certain extent, are variable based on use of contractors, donated equipment, volunteer, or in-kind staff time. These costs are represented in the watershed goals and objectives section of this report.

#### ***Bear Lake Monitoring Plan***

Since existing information is inadequate to determine whether or not the water quality standards (WQS) established to protect public health are being met, additional sampling is needed. The monitoring plan in Exhibit 93 includes *E. coli* bacteria sampling at five sites in Bear Lake with high wading and swimming activity every two weeks from June through September on an annual basis. This will assure residents and visitors using the lake that Full-Body Contact and Partial Body Contact WQS are being met.

Similarly, existing information on the concentration of dissolved oxygen in Bear Lake is inadequate to determine whether or not the WQS for a warmwater lake of 5.0 milligrams/liter (mg/l) minimum during a 24-hour period are being met. Dissolved oxygen concentration levels are expected to be at the lowest in early morning hours and highest during late afternoon following peak photosynthetic activity in the open water season. Thus, at least three dissolved oxygen samples are proposed at two locations in Bear Lake for at least one day in June, July, and August. Unless samples reveal levels below WQS, the dissolved oxygen sampling would be for one year only.

Monitoring for phosphorus, chlorophyll *a*, and transparency (Secchi disk readings) has been occurring on Bear Lake for more than 30 years by property owner volunteers in cooperation with the Michigan Lake and Stream Associations and the Michigan Department of Environment Quality (MDEQ). This annual sampling is now part of the Michigan Clean Lakes Program. Over the years the sampling has been adjusted and expanded to include more sampling dates and increased sampling for total phosphorus. The sampling plan for these three parameters in Bear Lake, outlined in Exhibit 93, reflect the changes planned for 2013 and beyond. Any significant changes in phosphorus, chlorophyll *a*, and transparency readings in Bear Lake could signal changes in lake productivity.

Since the chemical treatment for Eurasian milfoil began, surveys to locate and estimate abundance of this invasive species have occurred on an annual basis. This survey work should continue. In addition, once

every five years a survey to estimate the total biomass of rooted aquatic plants (macrophytes) should be completed to provide a measure of plant productivity over time.

Fisheries surveys in Bear Lake are periodically conducted by the Fisheries Division, Michigan Department of Natural Resources (MDNR). Fixed sampling stations and methods have been established to monitor the status of fish populations in Bear Lake with an emphasis on evaluating the walleye stocking program. The Little River Band of Ottawa Indians (LRBOI) also conduct periodic surveys of walleye in Bear Lake and several other nearby lakes of specific interest to the tribe.

### ***Bear Creek Monitoring Plan***

The current information on *E. coli* bacteria levels in Bear Creek and tributaries is not adequate to determine whether or not WQS to protect public health are being met. The monitoring plan in Exhibit 94 proposes a one-year sampling effort for *E. coli* at four locations twice during the period from June through August. The four sampling sites would be at Little Bear Creek below the Bear Lake outlet, and three sites in Bear Creek at the 13 Mile Road bridge, at Coates Highway bridge, and at the first bridge above the confluence with the Manistee River. Pending results of these tests, the need for future sampling and the frequency can be evaluated.

Dissolved oxygen samples collected over the last decade in Bear Creek and its tributaries suggest that the WQS of a minimum of not less than 6.0 mg/l in any 24-hour period during summer low flow conditions and not less than 7.0 the rest of the year may not be being met in some locations. The proposed one-year sampling for dissolved oxygen includes paired sampling (1/4 mile upstream and downstream) at a road crossing site downstream of the Bear Lake outlet in Little Bear Creek, one above and below the 13 Mile Road bridge on Bear Creek, and one upstream and downstream of the Coates Road Highway bridge in the Lower Bear Creek. The monitoring would include three sampling times for each day an hour after sunrise, mid-day, and an hour before sundown. The two sampling dates proposed are in mid-July and mid-August at each location. If no problems are detected, a single-year sampling may be sufficient.

The LRBOI has conducted background water quality, habitat, and fisheries surveys in the lower portions of Bear Creek. This periodic sampling by the tribe has contributed to a better understanding of water quality, habitat, and fisheries in the watershed. The MDEQ conducts periodic sampling in Bear Creek for a variety of water quality and habitat parameters in response to specific pollution investigations or as part of routine statewide monitoring. The frequency of the routine monitoring by the MDEQ is dependent upon available funding and statewide priorities.

The U.S. Fish and Wildlife Service, Department of the Interior (USFWS) conducts stream surveys prior to application of chemicals to control sea lamprey in Bear Creek. The information on bottom substrate, stream temperatures, dissolved oxygen, and flows is collected once every three to four years by the USFWS at established sampling locations. In addition, the U.S. Forest Service, Department of Agriculture (USFS) has conducted biological and physical habitat surveys in the downstream areas of Bear Creek for baseline information related to the designation of this portion of the river as a National Scenic River (NSR). Future field work by the USFS to determine any significant changes in the segment of the Bear Creek designated as a NSR has not been established.

The MDNR Fisheries Division has established a Fixed Site Index Station located at Leffew Road (Old Iron Bridge) in the Upper Watershed of Bear Creek as part of its statewide fish population monitoring program. The Leffew Road Index Station will be sampled for three consecutive years beginning in 2011 under the Fixed Site Index Station fish sampling protocol. In addition to electroshocking to determine status of trout and salmon populations, habitat data and 24-hour temperatures will be collected during the three-year sampling period. The next round of three-year index sampling would begin in 2017 unless specific issues require more frequent stream surveys. An electroshocking fisheries survey of Bear Creek

tributaries is being considered and may be implemented when resources are available. MDNR Fisheries Division surveys of other portions of Bear Creek may occur based upon issues or concerns that have been identified in the past or those that may arise in the future.

Monitoring, evaluation, and restoration related to the control of stream bank and road crossing erosion sites have been and will continue to be ongoing activities carried out by the Conservation Resource Alliance, the Bear Creek Watershed Council, and its partnering organizations and agencies. Severe and moderate erosion sites along Bear Creek and major tributaries have been mapped and activities now focus on monitoring restored sites, developing plans, and funding remedial actions on the remaining problem areas.

### EXHIBIT 93. Bear Lake Monitoring Plan

Purpose and type of sampling	Frequency	Start date/ end date	Locations	Total number of samples/year	Responsibility/ potential partners
<i>E. coli</i> (bacteria) swimming/ wading areas	Once every two weeks June through September	2013 and each year thereafter until results indicate lower or higher frequency appropriate	Township park, MDNR public access site, three other locations (TBD)	Variable with approximately 32 samples days/year	District Health in cooperation with BLWA and BLPOA
Fish population surveys	TBD	TBD	Established sampling locations	Sufficient to detect significant changes in abundance/ growth/ reproduction of major species	MDNR Fisheries (potential expanded monitoring by LRBOI)
Aquatic plant survey (Eurasian milfoil, etc.)	Once each year	2013 and thereafter as needed	Established locations	NA	Bear Lake Improvement Board
Rooted aquatic plants biomass estimate	Once every five years	Beginning in 2013	Entire lake	TBD	BLPOA, BLWC
Monitor phragmites	Annually	Ongoing	Entire lake	NA	BLPOA, BLWC
Conduct hardened shoreline inventory	Commence 2013	Updated as appropriate	Entire shoreline	NA	BLPOA, BLWA, MDNR, MDEQ, MCPD
Transparency (Secchi disk readings)	Once every two weeks from April through Oct.	2012 and annually thereafter	Established sampling location	14 samples	Bear Lake property owners, MDEQ, Township/Village, and Public Health District
Total phosphorus	Mid April and early September	2012 and annually thereafter	Established sampling locations/ depth	4 samples	
Chlorophyll <i>a</i>	Mid-May through early September	2012 and annually thereafter	Established sampling locations/ depth	12 samples	
Dissolved oxygen	Once in June, July and Aug. three times/day	2013 one year sampling	Two sites (TBD) at 5ft. depth	18 samples	

SOURCE: Public Sector Consultants, 2012.

NOTE: BLWA=Bear Lake Watershed Alliance; BLPOA= Bear Lake Property Owners Association.

**EXHIBIT 94. Bear Creek Monitoring Plan**

<b>Purpose and type of sampling</b>	<b>Frequency</b>	<b>Start date/ end date</b>	<b>Locations</b>	<b>Total number of samples/year</b>	<b>Responsibility/ potential partners</b>
<i>E. coli</i> (bacteria) near road crossings	Twice during summer period	One year only unless problems detected	Four locations identified in text	Use of standard WQS protocols	District Health Department, Bear Creek Watershed Council and others
Fish population surveys plus 24-hour temperatures	At least one index site <i>for three consecutive years</i>	2012 and 2013, then again in 2017, 2018, and 2019	Leffew Rd. Index Station	NA	MDNR fisheries (LRBOI that may include other locations)
Soil erosion and sedimentation control	Yearly	Ongoing activity	Numerous sites on Bear Creek and tributaries	NA	Conservation Resource Alliance, Bear Creek Property Owners and organization and agency partners
Prepare agricultural property assessment	Update as necessary	2013/2014	Bear Creek and tributaries	NA	BCWC MDARD, MDEQ, MSCD
Dissolved oxygen	Three times/ day at each of six locations in July and Aug.	One year unless problems observed	Upstream and downstream at three locations identified in text	36 with potential use of electronic measuring device	TBD by Implementation Team

SOURCE: Public Sector Consultants, 2012.

**EVALUATION**

The Greater Bear Watershed Committee and Implementation Team will be responsible for evaluating monitoring results and relative attainment of plan goals and objectives. The watershed plan should be re-evaluated every five years beginning in 2018, unless noted otherwise. Results should be compared to existing baseline information and data. If significant adverse changes occur, recommendations will include additional monitoring to further define the concern or corrective actions if water quality or other standards are being exceeded. Currently, the Greater Bear Watershed does not have any total maximum daily load (TMDL) restrictions in place. If TMDLs are implemented in the future, goals of the watershed plan should be amended to coincide with TMDL watershed goals.

Successful implementation of plan recommendations and attainment of goals and objectives will be enhanced by establishing an institutional structure to strengthen coordination of stakeholder groups and assure implementation.

**COST OF PLAN IMPLEMENTATION**

The estimated cost of implementing all recommended actions to achieve watershed plan goals and objectives (Exhibit 89 and 90) as well as the information and education actions to achieve watershed plan goals (Exhibits 91 and 92) ranges from \$7,654,000 to \$9,236,000 over the 10-year horizon of the plan (see Exhibit 95).

**EXHIBIT 95. Cost of Plan Implementation**

<b>Goal</b>	<b>Estimated Cost (Low)</b>	<b>Estimated Cost (High)</b>
General Information & Education Tasks	\$119,500	\$119,500
Pathogens Affecting Humans	\$155,000	\$185,000
Ecosystem Health	\$4,545,000	\$4,785,000
Hazardous Materials	\$56,000	\$106,000
Invasive Species	\$1,050,000	\$1,850,000
Groundwater	\$120,000	\$120,000
Joint Planning and Development	\$1,285,000	\$1,685,000
Sustainable Implementation of Greater Bear Watershed Plan	\$191,500	\$200,500
Evaluation and Revision of Management Plan Progress	\$131,000	\$185,000
<b>Total</b>	<b>\$7,653,000</b>	<b>\$9,236,000</b>

SOURCE: Public Sector Consultants, 2013.