

Monitoring and Evaluation

The true test of the efficacy of this watershed management plan will be the implementation of the plan goals and objectives. Implementation of watershed plan goals and objectives for site-specific activities will require continuous monitoring. Evaluation of monitoring activities will also be necessary to determine the progress and effectiveness of the proposed activities.

MONITORING PLAN

Exhibit 63 summarizes the key elements of the proposed monitoring plan that correspond to specific actions items listed under Goals and Objectives (Exhibit 57). For elements that involve sampling, a map of monitoring locations can be found in Exhibit 64. Monitoring of conditions within the Portage Lake watershed is a key component of this watershed plan since the focus is on sustaining current conditions that support designated and other beneficial uses. The proposed monitoring plan will also help fill information gaps on both habitat conditions and conformance with water quality standards. The intent of the monitoring plan is to detect changes in environmental conditions early enough to develop corrective actions before significant impairments occur. The monitoring plan focuses the three priorities of the watershed plan—public health, aquatic ecosystem health, and groundwater protection.

EXHIBIT 63
Portage Lake Watershed Monitoring Plan

Type of sampling	Frequency	Start date/ End date	Locations	Total number samples/year	Estimated cost/year*	Responsibility/ potential partners
Public Health						
<i>E. coli</i> (bacteria) Portage Lake swimming areas	<ul style="list-style-type: none"> Once per week through time of operation (assume May 31–Oct 1) for Village Beach (public beach—per District 10 Uniform Sanitary Code pending adoption) Once per month at other sites May 31–Oct 1 	Summer 2008/2011	Up to five swimming areas in Portage Lake including: <ul style="list-style-type: none"> Portage Point Inn Little Eden Camp Village of Onekama Beach Covenant Bible Camp Wik-A-Te-Wak 	Village: 18 weeks x 3 replicates = 54 samples; Other sites: 4 months x 4 sites x 3 replicates = 48 samples.	Village: 54 samples x \$20 = \$1,080; Other sites: 48 samples x \$20 per sample = \$960. Total = \$2,040	<ul style="list-style-type: none"> Onekama Township Village of Onekama Covenant Bible Camp Little Eden Camp Portage Point Inn Portage Lake Environmental Association Portage Lake Association District 10 Health Department Onekama Consolidated Schools Portage Lake Watershed Forever Michigan Department of Environmental Quality (MDEQ)
<i>E. coli</i> Lake Michigan beach/Onekama Township	Once per week through time of operation (July–mid-September in past)	2008/2011	Lake Michigan beach north of Portage Lake Channel Onekama Township Park	11 weeks x 3 replicates = 33 samples	33 samples x \$20 = \$660	<ul style="list-style-type: none"> District Health Department #10 Onekama Township MDEQ

Type of sampling	Frequency	Start date/ End date	Locations	Total number samples/year	Estimated cost/year*	Responsibility/ potential partners
<i>E. coli</i> Other sites	Three times per year for at least four sites of suspected sources	2008/TBD	High-density residential areas along Portage Lake, near mouths of selected tributaries, and at areas of heavy use (boat launches and marinas)	4 sites x 3 events x 3 replicates = 36 samples each year	36 samples x \$20 = \$720	<ul style="list-style-type: none"> • Onekama Township • Portage Lake Environmental Association • Portage Lake Association • District 10 Health Department • Portage Lake Watershed Forever • Onekama Consolidated Schools • MDEQ
Aquatic Ecosystem Health						
Long-Term Trend Water Quality Data Dissolved oxygen (DO), phosphorus, Chlorophyll a, clarity (Secchi), temperature, and pH	Twice per year each year (spring and fall turnover)	2008/TBD	At two deepest basins in Portage Lake and at least one other area (established sites)	DO: 2 events x 3 sites = 6 samples; Total Phosphorus: 2 events x 3 sites = 6 samples; Chlorophyll a: 2 events x 3 sites = 6 samples; Clarity: 6 Secchi disk readings; Temperature profile pH = 6 reading using pH meter	DO: 6 samples by titration process = \$0; Total Phosphorus: 6 samples x \$21 = \$126; Chlorophyll a: 6 samples x \$55 = \$330; Clarity: \$0; Temperature: \$0; pH: \$0. Total = \$456	<ul style="list-style-type: none"> • Onekama Consolidated Schools • Portage Lake Watershed Forever • Onekama Township • Village of Onekama • MDEQ

Type of sampling	Frequency	Start date/ End date	Locations	Total number samples/year	Estimated cost/year*	Responsibility/ potential partners
Dissolved Oxygen Profile	At least three times per year every three years during summer stratification to detect duration of DO depletion	2008	At two deepest basins in Portage Lake	Hydrolab/YSI: Assume donated use and labor	S/V/D	<ul style="list-style-type: none"> • Portage Lake Watershed Forever • Little River Band of Ottawa Indians • Michigan Department of Natural Resources (MDNR) • MDEQ • Onekama Consolidated Schools
Dissolved Oxygen Profile	At least twice per year every three years at two locations during summer stratification over a 24-hour period	2008	At two deepest basins in Portage Lake	Hydrolab/YSI: Assume donated use and labor	S/V/D	<ul style="list-style-type: none"> • Portage Lake Watershed Forever • Little River Band of Ottawa Indians • MDNR • MDEQ • Onekama Consolidated Schools
Tributary Survey Inventory benthos, bank erosion sites, road/stream crossing, fish migration barriers, habitat, wetlands, bank cover, water temperature, etc.	Once every five years	2010–13	Walking in up to seven tributary streams at sites TBD including: <ul style="list-style-type: none"> • Schimke • Onekama • Glen • Dunham 	TBD	\$1,000+S/V/D/N	<ul style="list-style-type: none"> • Portage Lake Watershed Forever • Little River Band of Ottawa Indians • MDNR • MDEQ • U.S. Fish and Wildlife Service • Onekama Consolidated Schools • Townships and Village

Type of sampling	Frequency	Start date/ End date	Locations	Total number samples/year	Estimated cost/year*	Responsibility/ potential partners
Shoreline Survey Wetlands, erosion, shoreline development, <i>Cladophora</i> and invasive plant species	Every five years late May–early July	2008–10	Boat/kayak/canoe survey of Portage Lake	None	\$1,000+S/V/D/N	<ul style="list-style-type: none"> • Portage Lake Watershed Forever • Little River Band of Ottawa Indians • MDEQ • MDNR • Onekama Consolidated Schools • Onekama Township
Fisheries Surveys Creel, walleye, general lake survey, tributary	Every five years	TBD	Creel: public access sites and boat survey; Walleye: electroshocking; Lake: netting and electroshocking; Tributary: electroshocking	TBD	\$1,000+S/V/D/N	<ul style="list-style-type: none"> • MDNR • Little River Band of Ottawa Indians • U.S. Fish and Wildlife Service
Aquatic Plant Survey	Once every 5–10 years during late July/early August	2008–10	Use grid system to map lake	TBD	\$1,000+S/V/N	<ul style="list-style-type: none"> • MDNR • MDEQ • Portage Lake Watershed Forever • Onekama Consolidated Schools
Storm Water Inventory and Monitoring	Inventory once, monitor every year during base flow and storm flow conditions	TBD	TBD after inventory	TBD	\$1,000+S/V/N	<ul style="list-style-type: none"> • Village of Onekama • Onekama Consolidated Schools • MDEQ • Portage Lake Watershed Forever

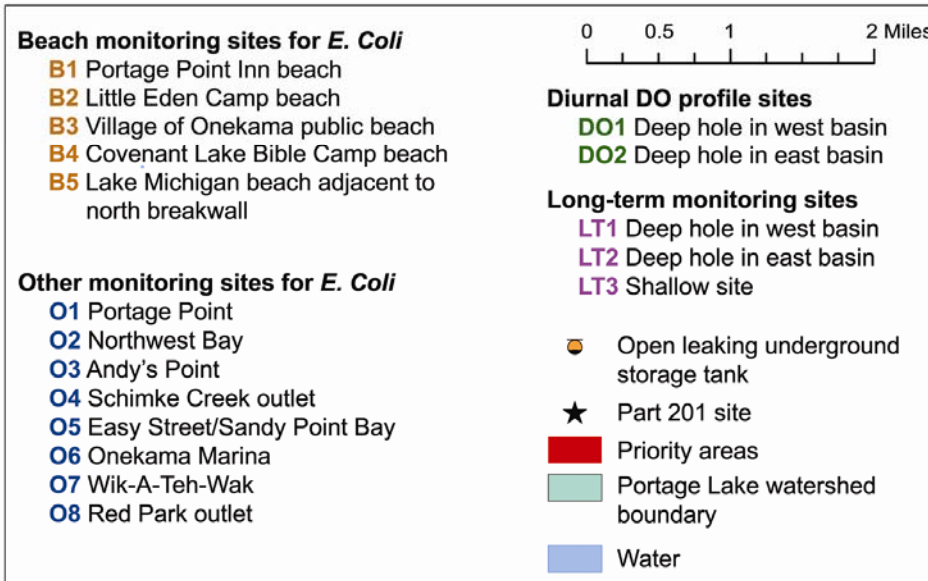
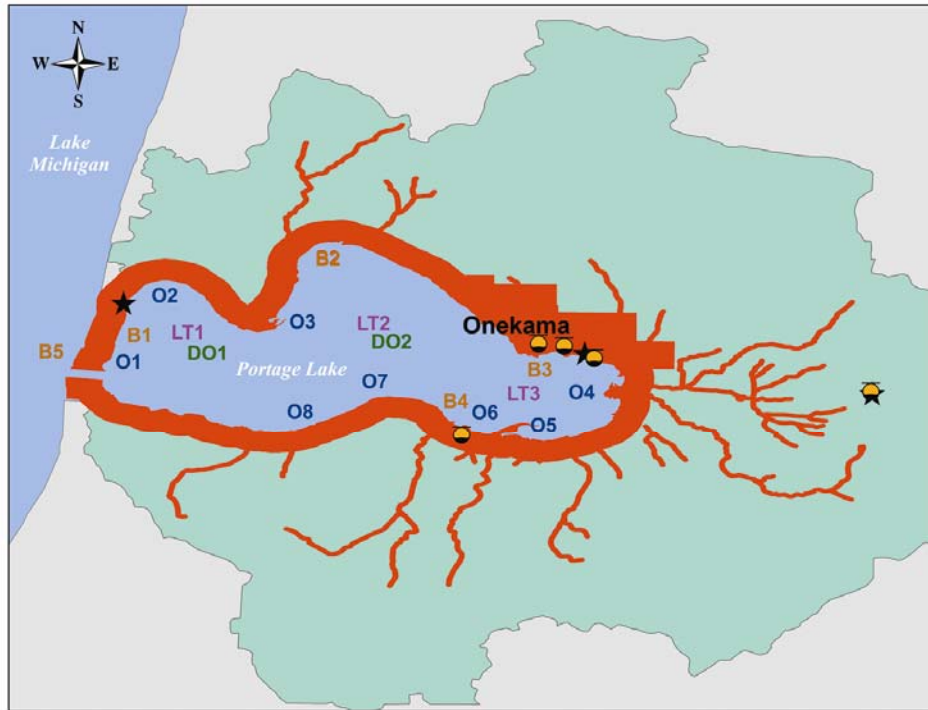
Type of sampling	Frequency	Start date/ End date	Locations	Total number samples/year	Estimated cost/year*	Responsibility/ potential partners
Groundwater Protection						
Artesian Wells and Abandoned Wells	Inventory once, plug abandoned wells	Year TBD	TBD after inventory	TBD	\$1,000+S/V/N	<ul style="list-style-type: none"> • District 10 Health Department • MDEQ • Village of Onekama • Townships • Portage Lake Watershed Forever • Onekama Consolidated Schools
Map Locations of Scenic Vistas and Historical Significance	2008	2010–13/TBD	Watershed	NA	S/V	<ul style="list-style-type: none"> • Portage Lake Watershed Forever • Little River Band of Ottawa Indians • Manistee County Historical Society

SOURCE: Public Sector Consultants Inc., 2007.

*The estimated cost figures do not include anticipated volunteer time, existing educational material that will be adapted, donated equipment, PLWF newsletter that will deliver educational information, or staff support for coordination of all tasks within the watershed plan. Project coordination is estimated at \$45,000–\$65,000 per year (1/FTE) depending on experience and responsibilities. PLWF newsletter is estimated to cost \$2,265/newsletter for 1,000 copies to produce and mail. Elements that require volunteer time (V), staff time (S), PLWF newsletter (N), donated equipment (D), and/or existing educational material (M) are noted.

EXHIBIT 64

Map of Monitoring Locations in the Portage Lake Watershed



SOURCE: Public Sector Consultants Inc., 2007, using data from MDEQ, 2007b, MDIT/CGI (Manistee Final Wetland Inventory), and MDIT/CGI (LP Watersheds).

As a not-for-profit group, the Portage Lake Watershed Forever organization will seek public-agency and private-entity partners, train volunteer watershed stakeholders and, when necessary, raise funds in order to implement the proposed monitoring plan. In some

cases technical laboratory services will be contracted to perform needed chemical or bacteriological analyses. In most cases the cost, types and frequency of sampling, locations, and partners have been identified along with the projected start and end dates. For some sampling activities, such as stream monitoring, specific locations, the cost and time needed to train volunteers, and other elements will need to be determined.

The monitoring plan reflects the priorities of the watershed stakeholders based upon available information and the potential threats to protected and desired uses. The end point and measures of success are based primarily upon meeting and maintaining state water quality standards. In the absence of specific water quality standards, other measures have been established. The monitoring plan focuses the three priorities of the watershed plan—public health, aquatic ecosystem health, and groundwater protection. If the water quality standards and critical aquatic habitats for these three priorities are met, all existing designated uses can be protected. The monitoring plan also provides for collecting information on non-water-related desired natural resource uses that the Portage Lake Watershed Forever organization is also including in its watershed plan.

Public Health

Monitoring of *E. coli* bacteria to determine compliance with both total-body and partial-body contact water quality standards will require more frequent sampling and added sites in the future. Testing in public swimming areas will be conducted in compliance with the District 10 Health Department's pending Uniform Sanitary Code and will include the popular swimming areas in Portage Lake as well as the swimming area in Lake Michigan immediately north of the Portage Lake Channel. Once every three years other areas of Portage Lake will be sampled for *E. coli* to determine year-round compliance with total- and partial-body contact standards where human uses near the shoreline pose a threat of bacterial contamination.

Aquatic Ecosystem Health

The primary concerns and/or threats to ecosystem health in the Portage Lake Watershed are over-enrichment or eutrophication, loss of critical physical habitat, and changes in the quantity and quality of groundwater. Fortunately, historical monitoring of productivity of Portage Lake has created a baseline that can be used to determine changes in the productivity or trophic status of the lake. As part of the science education curriculum at Onekama High School, students have participated in annual monitoring of critical parameters needed to establish whether the trophic status of Portage Lake has changed. Students have monitored and reported on total phosphorus, transparency, and chlorophyll *a* that together can be used to establish a trophic status index (TSI), which has been used widely throughout Michigan, Wisconsin, and other states to monitor productivity. With the support of Portage Lake Watershed Forever, this routine annual monitoring can continue, supplemented by other monitoring efforts.

Dissolved oxygen concentrations in Portage Lake will be measured to establish conformance with state water quality standards as well as to supplement information related to the potential threat of over-enrichment. While current information indicates that state standards are being met, more information is needed on DO levels during a 24-hour period to assure that minimum levels are being met both in the summer stratification

period and throughout the year. The monitoring plan includes testing during periods where there has not been sampling in Portage Lake recently, and complements the annual DO analyses conducted as part of the spring and fall sampling by Onekama Lake High School students. In addition, DO measurements will be made to determine whether the period of DO depletion in deeper portions of the lake is increasing in terms of intensity or length of time during the period of spring through fall temperature stratification.

A *Cladophora* algae survey will also be conducted under the monitoring plan to establish whether there are significant nearshore sources of phosphorus (e.g., septic tank/tile field, sheet runoff coming from lawns, storm water runoff from impervious surfaces) that are contributing to enrichment of the lake. This information will be used in combination with *E. coli* monitoring to evaluate the effectiveness of current septic tank/tile fields serving a significant portion of the residences surrounding Portage Lake. The planned *Cladophora* survey can be compared to the previous algae surveys that provide a baseline for measuring changes over time.

A baseline survey of rooted aquatic plants (macrophytes) is needed to determine the status of various exotic, invasive plant species identified in this plan. The monitoring plan calls for mapping of macrophyte growth with particular attention to identifying areas that have purple loosestrife, *Phragmites* within adjacent wetland areas, and Eurasian watermilfoil in the lake proper. These three species are very aggressive and monitoring can assist in determining whether their abundance represents a threat to designated protected uses (e.g., swimming, boating, habitat for fish and wildlife) that needs to be addressed. Because of existing very low water levels of Portage Lake, the previous inventory completed in 1991 does not provide an adequate baseline for levels of invasive species.

The remaining undisturbed shoreline habitat in Portage Lake and the habitat quality in tributary streams have been identified as critical to the survival, reproduction, and growth of resident fish and wildlife populations. The monitoring plan outlines efforts to identify and map critical shoreline wetlands and other undisturbed shoreline littoral zones in the lake and conditions on tributary streams through use of trained volunteers. At the same time, trained volunteers will be recording visual observations of potential problems (erosion areas, fish movement impediments in streams, bank vegetation, storm-water discharge pipes, etc.) and collecting samples (benthos and simple water chemistry and temperature). Although the details of the sampling, mapping, and recording of information by the volunteers are yet to be determined, successful use of volunteers in other watersheds (e.g., Clinton River, Rouge River, and Huron River) will be used as models for developing this program.

In partnership with the MDNR, the USFWS, the MDEQ, and the Little River Band of Ottawa Indians, sampling of fish populations in Portage Lake and its tributaries, periodic biological monitoring of tributary streams for sea lamprey control, and hoped-for benthos monitoring by the MDEQ, will complement other information on ecosystem health and habitat changes.

Groundwater Protection

While the MDEQ is addressing known sources of groundwater contamination in the watershed caused by surface discharges of hazardous materials or leaking underground storage tanks of hydrocarbon products, an inventory of uncapped industrial hydrocarbon/mineral wells and abandoned domestic water wells is needed. In partnership with appropriate local and state authorities, the monitoring plan includes efforts to identify, map, and appropriately plug unused wells because they provide direct access of potentially contaminated surface water to groundwater aquifers. Groundwater aquifers provide drinking water to watershed residents and are also a major source of cool, unpolluted recharge water to Portage Lake and tributary streams. One portion of the monitoring effort will be to identify and close flowing artesian wells that no longer serve their intended purpose and may be contributing to depletion of essential groundwater aquifers.

EVALUATION

In cooperation with its partners, the Portage Lake Watershed Forever organization will routinely evaluate the monitoring results. Where baseline information is currently available, new monitoring information will be compared to baseline information and if significant adverse changes are noted, specific actions will be recommended to expand monitoring efforts to further define the source of the problem or, if the source is known, direct action will be taken to correct the problem. Where specific numeric or narrative water quality standards apply, exceedances will be reported and actions needed to implement best management practices and/or to institute regulatory actions will be recommended. The monitoring plan identifies specific times to evaluate results and to determine the need to modify, expand, or eliminate monitoring activities, or take corrective actions. Unless otherwise specifically noted, the monitoring results and the watershed plan will be reevaluated every five years beginning in 2010. If the review of monitoring results identifies significant problems prior to the established evaluation date, further direct actions will be taken to address the documented problem and, if appropriate, immediate actions and public notification will occur to minimize potential imminent threats to public health or the environment.

A measure of success will be confirmation that all water quality standards continue to be met and designated uses are protected. Where state standards are not available, the measure of success will be no evidence of significant deterioration of current environmental conditions. If information is uncovered through monitoring that state water quality standards are not being met or that other changes have occurred that will likely impair protected or desired uses, further actions will be recommended to address the most likely sources of the impairments.

Successful establishment of the institutional structure to assure implementation of the recommendations of this plan is critical. While volunteers can contribute substantially to the monitoring effort, the Portage Lake Watershed Forever organization needs to formalize its structure and operations as recommended to assure that it has staff that can organize and manage the elements in the monitoring plan and evaluate the results.