CHAPTER 5: IMPLEMENTATION AND EVALUATION

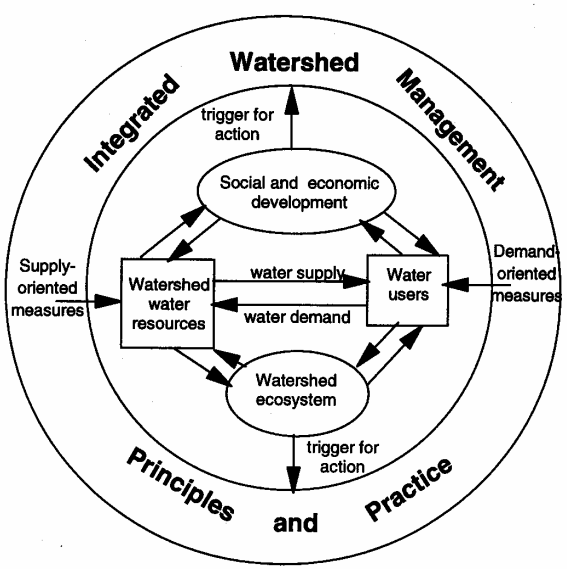
Taking a closer look at Chilson Creek Photo: HRWC

This chapter outlines considerations in the implementation and evaluation of the Huron Chain of Lakes Watershed Management Plan, as well as the interplay between evaluation and implementation, which shapes the revision process. A successful watershed plan is ultimately defined not by what is written on the pages of the plan, but by how the recommended plans and programs are put into action. A successful plan for implementation also recognizes that the state of the watershed changes over time. As such, evaluating the effectiveness and appropriateness of the actions taken to implement the plan, as well as the ability to adapt these actions to the changing conditions of the watershed, is critical.

5.1 INTEGRATED WATERSHED MANAGEMENT AND ADAPTIVE MANAGEMENT

A watershed is a complex integrated system with the whole being greater than the sum of its parts. This complexity stems for the ever-changing interaction of social, economic, and biophysical forces. The interplay of these forces, as shown in Figure 5.1, is the basis for the concept of integrated watershed management.

Figure 5.1. Forces Affecting Integrated Watershed Management[178]



Integrated watershed management is, by definition, dynamic in nature. Implementing the Huron Chain of Lakes Watershed Management Plan in a way that follows the principles of integrated watershed management therefore requires continuous evaluation of the effectiveness of the management alternatives in meeting the Plan's goals and objectives. The concept of "adaptive management" is central to successful implementation of the Plan. Adaptive management incorporates research into conservation action. Specifically, it is the integration of design, management, and monitoring to systematically test assumptions in order to adapt and learn.

The goals and recommendations of this Plan are based on the understanding of the conditions of the natural watershed ecosystem at the time this Plan was developed. However, both the conditions of the watershed and the goals and actions will change over time as new information is collected, available resources for implementation are assessed, and the values and needs of the watershed's residents evolve.

As stated by Veissman (1990) in Heathcote's Integrated Watershed Management: Principles and Practices:[179]

> *Watershed management institutions evolve from needs identified at some milestone in time. The problem is that times change, and so do needs. Unfortunately, institutions seem to march on with entrenched constituencies, and many in existence today are addressing yesterday's goals or addressing today's problems with yesterday's practices.*

Changes in social and economic forces can trigger changes in watershed management practices. Similarly, changes in a watershed's ecosystem can indicate a need for altered watershed management practices. Adaptive management recognizes the dynamic interplay of these forces, which implies a need to continually evaluate progress toward the meeting the Plan's goals and objectives.

5.2 Watershed Plan Implementation

Each Phase II community and agency must submit a SWPPI by May 1, 2006 that details the actions they will implement to meet the goals and objectives of the Huron Chain of Lakes Watershed Plan. The MDEQ will review these SWPPIs to ensure that actions meet Phase II requirements. The MDEQ will also review the annual reports that the communities will submit to report on progress toward meeting the goals and objectives of the Plan, as well as the activities related to their IDEP and PEP. These reports also help to ensure that compliance is being met for the objectives of the Phase II programs, while also keeping the Huron Chain of Lakes Steering Committee on track toward achieving the broad goals of water quality and natural resource protection and improvement.

To ensure successful implementation, nine key elements should be addressed, as summarized in Table 5.1 on the following page.

Table 5.1. Nine Key Elements of Successful Watershed Plan Implementation[180]

1. Appoint a single lead agency to act as an advocate and facilitator for the plan with the community and with political representatives.
2. Strong linkages to existing programs, including local and regional land use planning processes, water quality and flow monitoring programs, and similar programs, to optimize use of available information and minimize duplication of effort.
3. Clear designation of responsibilities, timetables, and anticipated costs for project actions.
4. Effective laws, regulations, and policies to provide a framework for the tasks identified in Element 3.
5. Ongoing tracking of the degree of implementation of management actions and of the success of those actions once implemented.
6. Ongoing monitoring and reporting of progress, both to assess the effectiveness of individual actions and to sustain public and political interest in and enthusiasm for the plan.
7. Ongoing public education and communication programs to consolidate and enhance the social consensus achieved in the planning process.
8. Periodic review and revision of the plan.
9. Adequate funding for these activities.

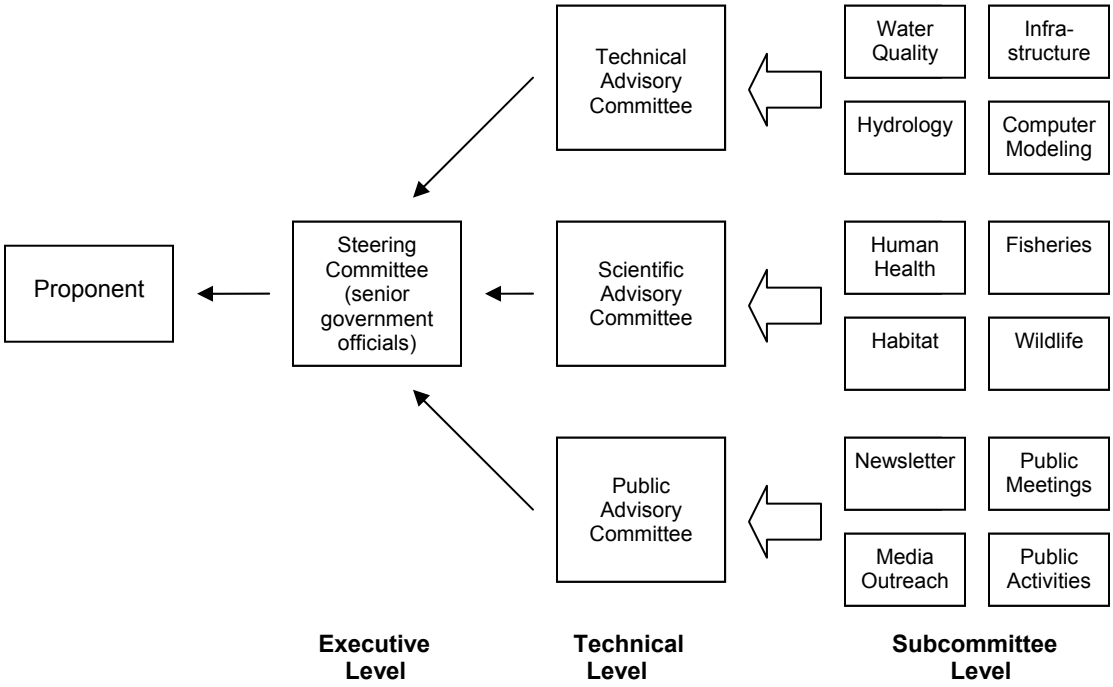
5.2.1 Advisory Committee Structure

To facilitate implementation of the Huron Chain of Lakes Watershed Management Plan over time, a framework for a series of working groups will help to provide a useful feedback loop for determining how, and the extent to which, the goals and objectives of the Plan are being successfully implemented. These working groups would ideally be comprised of the following groups of stakeholders:

- Managers, planners, coordinators, and their staff members
- Boards and steering committees
- Volunteers (citizens and watershed stewards)
- Environmental Interest Groups
- Funding Groups

These groups of stakeholders should ultimately allow for input and implementation assistance from a broad cross-section of all stakeholder and interest groups in the watershed, as outlined in the Huron Chain of Lakes Watershed Public Participation Plan (see Appendix H). Figure 5.2 provides a theoretical example of a two-tier advisory committee structure that could be employed to oversee the implementation and evaluation of the Huron Chain of Lakes Watershed Management Plan. A multi-tiered advisory structure is better suited for large watershed planning projects, as is the case in the Huron Chain of Lakes Watershed, as opposed to a single-tiered structure which is better suited for smaller, short-term projects.[181]

Figure 5.2. A Typical Two-tier Advisory Committee Structure



A committee structure based on the organization shown in Figure 5.2 could be used to implement, evaluate, and revise the watershed plan over time. The "proponent" (lead agency) in this schematic would be the Livingston County Drain Commissioner's Office, which would ultimately provide support for, and oversight of, the activities of the Steering Committee and smaller committee/ subcommittee levels. The "Steering Committee" might be comprised of stormwater program managers and staff who recommend final decisions to be coordinated with support from the Livingston County Drain Commissioner. The "advisory committees" might be staffed by land use planners, commissions, boards, interested citizens, environmental group advocates, scientists, etc. that will pull together various aspects of the data and results during the implementation phases of the Plan (i.e. water quality data, public education initiatives, illicit discharge investigations, etc.).

The importance of public representation and broad stakeholder involvement throughout any advisory committee structure must be stressed, as these individuals are in a position to explain and influence community opinion and help to build support for needed changes. One of the first tasks of the Livingston County Drain Commissioner's office and current members of the Huron Chain of Lakes Steering Committee should be to begin developing an advisory committee structure that allows for involvement by a broad range of stakeholders as discussed above.

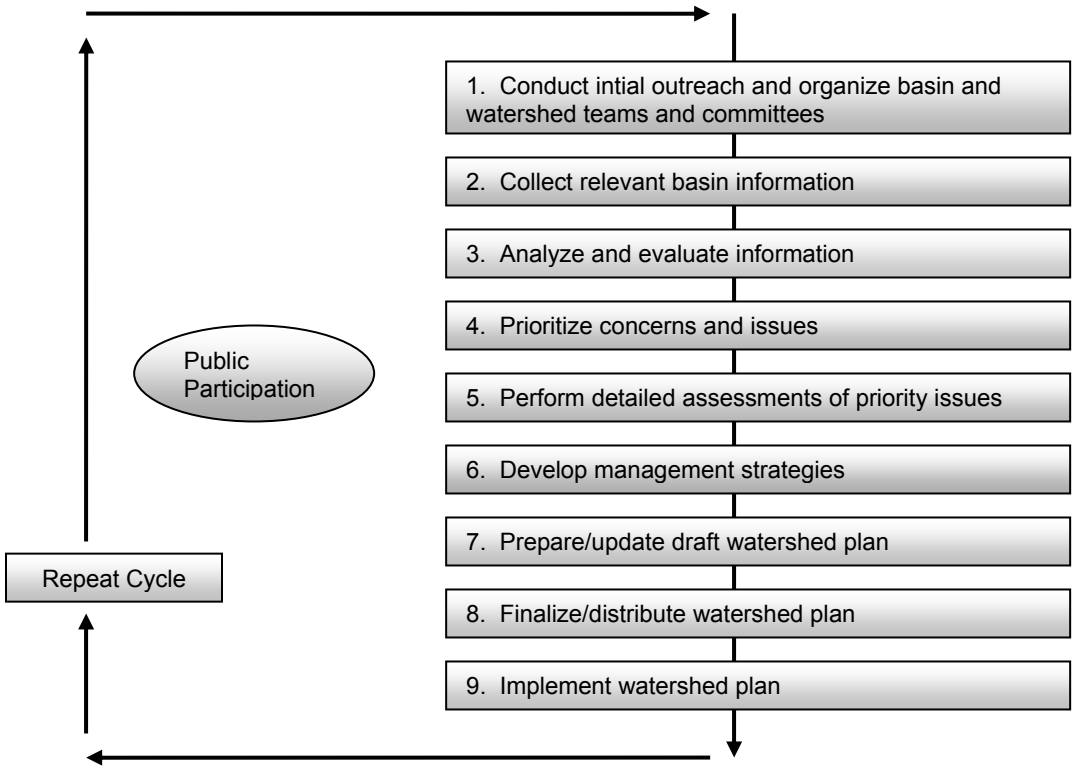
5.2.2 Watershed Plan Revisions

As noted in the Certificates of Coverage for each primary community/entity in the Huron Chain of Lakes Watershed, the MDEQ requires a revised version of the Huron Chain of Lakes Watershed Management Plan by be submitted by November 1, 2007, or a written determination not to revise the Plan. The Huron Chain of Lakes Steering Committee will continue to meet on a regular basis (at least quarterly), with oversight and support by the Livingston County Drain Commission's office to ensure that the Plan is being implemented on a watershed-wide basis. The LCDC's water

resources coordinator will oversee the coordination effort. In addition, updates regarding watershed plan implementation and activities related to the Phase II stormwater efforts will be updated on the LCDC's stormwater website.

Applying the concept of adaptive management to the revision process is essential for successful implementation of the Plan. Evaluation of a specific management alternative (using the methods discussed in the next section) may suggest a change is needed to affect the desired result, or a shift in focus from one management alternative to another may be needed. The iterative nature of watershed planning, implementation, and revision is shown below in Figure 5.3.

Figure 5.3. Typical Steps in a Watershed Management Cycle[182]



5.3 Evaluation Methods for Measuring Success

How can we measure whether the management alternatives listed in the Action Plan have been successful at reducing pollutants? That is to say, have changes in behavior occurred among target audiences, how many management practices have been implemented, or have documented improvements in water quality occurred? There are a number of different ways to measure progress toward meeting the goals for the Huron Chain of Lakes Watershed. Objective markers or milestones will be used to track the progress and effectiveness of the management practices in reducing pollutants to the maximum extent possible (see Table 5.2). Evaluating the management practices that are implemented helps establish a baseline against which future progress at reducing pollutants can be measured. The U.S. EPA identifies the following general categories for measuring progress:

1. **Tracking implementation over time.** Where a BMP is continually implemented over the permit term, a measurable goal can be developed to track how often, or where, this BMP is implemented.
2. **Measuring progress in implementing the BMP.** Some BMPs are developed over time, and a measurable goal can be used to track this progress until BMP implementation is completed.
3. **Tracking total numbers of BMPs implemented.** Measurable goals also can be used to track BMP implementation numerically, e.g., the number of wet detention basins in place or the number of people changing their behavior due to the receipt of educational materials.
4. **Tracking program/BMP effectiveness.** Measurable goals can be developed to evaluate BMP effectiveness, for example, by evaluating a structural BMP's effectiveness at reducing pollutant loadings, or evaluating a public education campaign's effectiveness at reaching and informing the target audience to determine whether it reduces pollutants to the MEP. A measurable goal can also be a BMP design objective or a performance standard.
5. **Tracking environmental improvement.** The ultimate goal of the NPDES storm water program is environmental improvement, which can be a measurable goal. Achievement of environmental improvement can be assessed and documented by ascertaining whether state water quality standards are being met for the receiving waterbody or by tracking trends or improvements in water quality (chemical, physical, and biological) and other indicators, such as the hydrologic or habitat condition of the waterbody or watershed.

Although achievement of water quality standards is the goal of plan implementation, the Steering Committee members need to use other means to ascertain what effects individual and collective BMPs have on water quality and associated indicators. Instream monitoring, such as physical, chemical, and biological monitoring, is ideal because it allows direct measurement of environmental improvements resulting from management efforts. Targeted monitoring to evaluate BMP-specific effectiveness is another option, whereas ambient monitoring can be used to determine overall program effectiveness. Alternatives to monitoring include using programmatic, social, physical, and hydrological indicators. Finally, environmental indicators can be used to quantify the effectiveness of BMPs.

Environmental indicators are relatively easy-to-measure surrogates that can be used to demonstrate the actual health of the environment based on the implementation of various programs or individual program elements. Some indicators are more useful than others in providing assessments of individual program areas or insight into overall program success. Useful indicators are often indirect or surrogate measurements where the presence of the indicator points to likelihood that the activity was successful. Indicators can be a cost-effective method of assessing the effectiveness of a program because direct measurements sometimes can be too costly or time-consuming to be practical. A well-known example is the use of fecal coliform bacteria as an indicator of the presence of human pathogens in drinking water. This indicator has been successfully used for more than a century and is still in widespread use for the protection of public health from waterborne, disease-causing organisms.

Table 5.2 presents environmental indicators that have been developed specifically for assessing stormwater programs.[183] Water quality indicators 1 through 16—physical, hydrological, and biological indicators—can be integrated into an overall assessment of the program and used as a

basis for the long term evaluation of program success. Indicators 17 through 26 correspond more closely to the administrative and programmatic indicators and practice-specific indicators.

Table 5.2. Environmental Indicators for Assessing Stormwater Programs

Category	#	Indicator Name
Water Quality Indicators This group of indicators measures specific water quality or chemistry parameters.	1	Water quality pollutant constituent monitoring
	2	Toxicity testing
	3	Loadings
	4	Exceedence frequencies of water quality standards
	5	Sediment contamination
	6	Human health criteria
Physical and Hydrological Indicators This group of indicators measures changes to or impacts on the physical environment.	7	Stream widening/downcutting
	8	Physical habitat monitoring
	9	Impacted dry weather flows
	10	Increased flooding frequency
	11	Stream temperature monitoring
Biological Indicators This group of indicators uses biological communities to measure changes to or impacts on biological parameters.	12	Fish assemblage
	13	Macroinvertebrate assemblage
	14	Single species indicator
	15	Composite indicator
	16	Other biological indicators
Social Indicators This group of indicators uses responses to surveys, questionnaires, and the like to assess various parameters.	17	Public attitude surveys
	18	Industrial/commercial pollution prevention
	19	Public involvement and monitoring
	20	User perception
Programmatic Indicators This group of indicators quantifies various non-aquatic parameters for measuring program activities.	21	Number of illicit connections identified/corrected
	22	Number of BMPs installed, inspected and maintained
	23	Permitting and compliance
	24	Growth and development
Site Indicators This group of indicators assesses specific conditions at the site level.	25	BMP performance monitoring
	26	Industrial site compliance monitoring

Measurement and evaluation are important parts of planning because they can indicate whether or not efforts are successful and provide a feedback loop for improving project implementation as new information is gathered. If the Steering Committee is able to show results, then the plan likely will gain more support from the partnering communities and agencies, as well as local decision makers, and increase the likelihood of project sustainability and success. Monitoring and measuring progress in the watershed necessarily will be conducted at the local level by individual agencies and communities, as well as at the watershed level, in order to assess the ecological affects of the collective entity actions on the health of the Huron River and its tributaries in the Huron Chain of Lakes Watershed.

Monitoring and measuring progress in the watershed will be two-tiered. First, individual agencies and communities will monitor certain projects and programs on the agency and community levels to establish effectiveness. For example, a community-based lawn fertilizer education workshop will be assessed and evaluated by that community. Also, with the implementation of a community project such as the retrofitting of detention ponds, the individual community responsible for the implementation of that task may monitor water quality/quantity parameters before and after the retrofit in order to measure the improvements. Secondly, there will be a need to monitor progress and effectiveness on a regional – subwatershed or watershed – level in order to assess the ecological affects of the collective community and agency actions on the health of the river and its tributaries.

The Steering Committee recognizes the importance of a long-term water quality, quantity and biological monitoring programs to determine where to focus resources as they progress toward meeting collective goals. These physical parameters will reflect improvements on a regional scale. The monitoring program should be established on a watershed scale since this approach is the most cost effective and consistent if sampling is done by one entity for an entire region.

5.3.1 Qualitative Evaluation Techniques

As seen in the Huron Chain of Lakes Action Plan, as well as the Storm Water Pollution Prevention Initiatives (SWPPIs) of each individual entity, there are and will be a range programs and projects implemented to improve water quality, water quantity and habitat in Huron Chain of Lakes Watershed– from constructing wet detention ponds to public education programs. Finding creative ways to measure the effectiveness of each of these individual programs will be recorded for each task under the individual SWPPIs.

A set of qualitative evaluation criteria can be used to determine whether pollutant loading reductions are being achieved over time and whether substantial progress is being made toward attaining water quality standards in the Watershed. Conversely, the criteria can be used for determining whether the Plan needs to be revised at a future time in order to meet standards. A summary (Table 5.3) of the methods provides an indication of how these programs might be measured and monitored to evaluate success in both the short and the long term. Some of these evaluations may be implemented on a watershed basis, such as a public awareness survey to evaluate public education efforts, but most of these activities will be measured at the local level. By evaluating the effectiveness of these programs, communities and agencies will be better informed about public response and success of the programs, how to improve the programs and which programs to continue. Although these methods of measuring progress are not tied directly to measurements in the river, it is fair to assume that the success of these actions and programs, collectively and over time, will impact positively on the instream conditions and measurements of the river system that are investigated concurrently as described below.

Table 5.3. Summary of qualitative evaluation techniques for the Huron Chain of Lakes Watershed

Evaluation Method	Program/Project	What is Measured	Pros and Cons	Implementation
Public Surveys	Public education or involvement program/project	Awareness; Knowledge; Behaviors; Attitudes; Concerns	Moderate cost. Low response rate.	Pre- and post- surveys recommended. By mail, telephone or group setting. Repetition on regular basis can show trends. Appropriate for local or watershed basis.
Written Evaluations	Public meeting or group education or involvement project	Awareness; Knowledge	Good response rate. Low cost.	Post-event participants complete brief evaluations that ask what was learned, what was missing, what could be done better. Evaluations completed on-site.
Stream Surveys	Identify riparian and aquatic improvements.	Habitat; Flow; Erosion; Recreation potential; Impacts	Current and first-hand information. Time-consuming. Some cost involved.	Identify parameters to evaluate. Use form, such as Stream Crossing Inventory, to record observations. Summarize findings to identify sites needing observation.
Visual Documentation	Structural and vegetative BMP installations, retrofits	Aesthetics. Pre- and post- conditions.	Easy to implement. Low cost. Good, but limited, form of communication.	Provides visual evidence. Photographs can be used in public communication materials.
Phone call/ Complaint records	Education efforts, advertising of contact number for complaints/ concerns	Number and types of concerns of public. Location of problem areas.	Subjective information from limited number of people.	Answer phone, letter, emails and track nature of calls and concerns.
Participation Tracking	Public involvement and education projects	Number of people participating. Geographic distribution of participants. Amount of waste collected, e.g. hazardous waste collection	Low cost. Easy to track and understand.	Track participation by counting people, materials collected and having sign-in/evaluation sheets.
Focus Groups	Information and education programs	Awareness; Knowledge; Perceptions; Behaviors	Medium to high cost to do well. Instant identification of motivators and barriers to behavior change.	Select random sample of population as participants. 6-8 people per group. Plan questions, facilitate. Record and transcribe discussion.

Adapted from: Lower One SWAG, 2001

5.3.2 Quantitative Evaluation Techniques

In addition to measuring the effectiveness of certain specific programs and projects within communities or agencies, it is beneficial to monitor the long-term progress and effectiveness of the cumulative watershed efforts in terms of water quality, water quantity and biological monitoring. Watershed-wide long-term monitoring will address many objectives established for the Huron Chain of Lakes Watershed, and Goal 8 to increase monitoring of water quality, water quantity, and biological indicators. A monitoring program at the watershed level will require a regional perspective and county or state support. Communities and agencies in the watershed agree that there has not been adequate data collection (number of sites or frequency) to most effectively manage the watershed. Wet and dry weather water quality, stream flow, biological and other monitoring will afford communities and agencies better decision making abilities based on more data as implementation of this plan continues. Suggestions for the monitoring program are presented below. Details for the monitoring program will be decided and approved by the Steering Committee.

Parameters and Establishing Targets for River Monitoring
Upon reviewing the data collected for the Watershed Management Plan, the Steering Committee members recognize the need to augment the type of parameters monitored, the number of locations in the watershed, and the frequency of wet weather monitoring. A holistic monitoring program will help communities and agencies to identify more accurately water quality and water quantity impairments and their sources, as well as how these impairments are impacting the biological communities that serve as indicators of improvements.

Parameters
Establish a long-term monitoring program so that progress can be measured over time that includes the following components:

- Increase stream flow monitoring to determine baseflows and track preservation and restoration activities upstream. Include as physical and hydrological indicators: stream widening/downcutting; physical habitat monitoring; increased flooding frequency; and stream temperature monitoring.

- Collect wet and dry weather water quality data in the watershed to better identify specific pollution source areas within the watershed, and measure impacts of preservation and restoration activities upstream. Include as water quality indicators: water quality pollutant monitoring; loadings; exceedence frequencies of water quality standards; sediment contamination; and human health criteria.

- Increase biological data monitoring (fish, macroinvertebrates, and mussels) and use these as indicators of the potential quality and health of the stream ecosystem. Include as biological indicators: fish assemblage; macroinvertebrate assemblage; single species indicator; composite indicator; and other biological indicators.

- Identify major riparian corridors and other natural areas in order to plan for recreational opportunities, restoration and linkages.

- Review and revise currently established benchmarks and dates based on new data.

- Increase the use of volunteers where possible, for monitoring program (habitat, macroinvertebrates) to encourage involvement and stewardship.

Based on the goals of the watershed, the monitoring plan should measure Dissolved Oxygen (DO), Bacteria (*E. coli*), Phosphorus (P), total suspended solids (TSS), sediments, stream flow, conductivity, fisheries and aquatic macroinvertebrates, temperature, physical habitat, and wetlands.

Establishing Targets
Measuring parameters to evaluate progress toward a goal requires the establishment of targets against which observed measurements are compared. These targets are not necessarily goals themselves, because some of them may not be obtainable realistically. However, the targets do define either Water Quality Standards, as set forth by the State of Michigan, or scientifically-supported numbers that suggest measurements for achieving water quality, water quantity and biological parameters to support state designated uses such as partial or total body contact, and fisheries and wildlife. Using these scientifically-based numbers as targets for success will assist the Steering Committee in deciding how to improve programs to reach both restoration and preservation goals and know when these goals have been achieved. These targets are described below.

Dissolved Oxygen: The Michigan Department of Environmental Quality (MDEQ) has established state standards for Dissolved Oxygen (DO). The requirement is no less than 5.0 mg/l as a daily average for all warm water fisheries. The Administrative Rules state:

> . . . for waters of the state designated for use for warmwater fish and other aquatic life, except for inland lakes as prescribed in R 323.1065, the dissolved oxygen shall not be lowered below a minimum of 4 milligrams per liter, or below 5 milligrams per liter as a daily average, at the design flow during the warm weather season in accordance with R 323.1090(3) and (4). At the design flows during other seasonal periods as provided in R 323.1090(4), a minimum of 5 milligrams per liter shall be maintained. At flows greater than the design flows, dissolved oxygen shall be higher than the respective minimum values specified in this subdivision.
>
> (Michigan State Legislature. 1999)

Bacteria: State standards are established for Bacteria (*E. coli*) by the MDEQ. For the designated use of total body contact (swimming), the state requires measurements of no more than 130 *E. coli* per 100 milliliters as a 30-day geometric mean during 5 or more sampling events representatively spread over a 30-day period. For partial body contact (wading, fishing, and canoeing) the state requires measurements of no more than 1000 *E. coli* per 100 milliliters based on the geometric mean of 3 or more samples, taken during the same sampling event. These uses and standards will be appropriate for and applied to the creek and those tributaries with a base flow of, or greater than, 2 cubic feet per second.

Phosphorus: The state phosphorus (P) concentration limit is a monthly average of 0.5 mg/L for surface waters in order to prevent nuisance plant growth in receiving lakes and impoundments. The State also requires that “nutrients shall be limited to the extent necessary to prevent stimulation of growths of aquatic rooted, attached, suspended, and floating plants, fungi or bacteria which are or may become injurious to the designated uses of the waters of the state.” Monitoring frequency and number of sites for phosphorus and nitrogen needs to be increased to capture seasonal variation and dry and wet weather conditions.

Total Suspended Solids/Sediment: No numerical standard has been set by the state for Total Suspended Solids (TSS) for surface waters. However, the state requires that "the addition of any dissolved solids shall not exceed concentrations which are or may become injurious to any designated use." To protect the designated uses of fisheries and wildlife habitat, as well as the desired recreational and aesthetic uses of the surface waters in the watershed, there are recommended targets established on a scientific basis. From an aesthetics standpoint, it is recommended that TSS less than 25 mg/l is "good", TSS 25-80 mg/l is "fair" and TSS greater than 80 mg/l is "poor." The TSS target, therefore, will be to maintain TSS below 80 mg/l in dry weather conditions. Another measurement that can be used to determine sediment load is to determine the extent of embeddedness of the substrate (how much of the stream bottom is covered with fine silts) and the bottom deposition (what percentage of the bottom is covered with soft muck, indicating deposition of fine silts). These are measurements taken by the SWQAS protocol habitat assessment conducted by MDEQ every five years, and by the Adopt-A-Stream program more frequently. Rating categories are from "poor" to "excellent." The target should be to maintain SWQAS designations of "excellent" at sites where they are attained currently, "good" at sites where they are attained currently, improve "fair" sites to "good," and improve "poor" to "good" through the implementation of this plan.

Stream Discharge: Stream flow, or discharge, for surface waters do not have a numerical standard set by the state. Using the health of the fish and macroinvertebrate communities as the ultimate indicators of stream and river health is most useful in assessing appropriate flow. Recommended flow targets for the river and its tributaries will be established once the necessary research has been conducted that will determine the natural, pre-development hydrology and current hydrology. Peak flow data is needed to compare more accurately observed flow to the target flow. A USGS stream gage is located on the Huron River downstream of the bridge at Hamburg Road in Hamburg Township that provides continuous measurement of discharge. Data generated at the station can assist in establishing an appropriate flow target and assessing any progress made toward that goal.

Conductivity: Conductivity measures the amount of dissolved ions in the water column and is considered an indicator for the relative amount of suspended material in the stream. The scientifically-established standard for conductivity in a healthy Michigan stream is 800 microSiemens (μS), which should be the goal for the Huron River and its tributaries. Levels higher than the standard indicate the presence of stormwater runoff-generated suspended materials.

Fisheries: Numerical or fish community standards have not been set by the state. However, the Michigan Department of Environmental Quality has developed a system to estimate the health of the predicted fish communities through the GLEAS 51 (Great Lakes Environmental Assessment Section) sampling protocol. This method collects fish at various sites and is based on whether or not certain expected fish species are present, as well as other habitat parameters; fish communities are assessed as poor, fair, good, or excellent. The state conducts this protocol every five years in the Huron River Watershed. The target should be to maintain GLEAS 51 scores of "excellent" at sites where they are attained currently, "good" at sites where they are attained currently, improve "fair" sites to "good," and improve "poor" to "good" through the implementation of this plan. The GLEAS 51 protocol also identifies whether or not there are sensitive species present in the Huron River and its tributaries, which would indicate a healthy ecosystem. Certain species are especially useful for demonstrating improving conditions. These species tend to be sensitive to turbidity, prefer cleaner, cooler water, and their distribution in the Huron Watershed is currently limited. The target is to continue to find species currently found,

assuming that stable or increasing numbers mean that habitat and water quality is maintained or improved.

Benthic Macroinvertebrates: Similar to the assessment of fish communities, the state employs the GLEAS 51 protocol for assessing macroinvertebrate communities on a five-year cycle for the Huron River Watershed. The Adopt-A-Stream program of the Huron River Watershed Council currently monitors macroinvertebrate health and physical habitat on 19 sites in the Huron Chain of Lakes Watershed using an adaptation of the GLEAS 51 procedure. The sites are monitored for macroinvertebrates two or three times each year and periodically for physical habitat health. The monitoring target for macroinvertebrate communities will be to increase MDEQ and Adopt-A-Stream monitoring sites to improve the existing database and attain GLEAS 51 scores of at least "fair" at sites that currently are "poor," and improve "fair" sites to "good," and maintain the "good" and "excellent" conditions at the remaining sites.

Temperature: The state standard lists temperature standards only for point source discharges and mixing zones – not ambient water temperatures in surface water. However, recommendations for water temperature can be generated by assessing fish species' tolerance to temperature change and these guidelines are found within the statute. Although some temperature data have been collected in the Huron Chain of Lakes system by the Adopt-A-Stream program of the Huron River Watershed Council, additional studies are needed to establish average monthly temperatures and whether increased temperatures are a problem for stream health.

Wetlands: An annual review should be done of MDEQ wetland permit information and local records in order to track wetland fills, mitigations, restoration and protection to establish net loss or gain in wetlands in the watershed. The target for this parameter is to track the net acres of wetland in the watershed to determine action for further protection or restoration activities.

Details regarding responsible parties, monitoring standards, sampling sites, and frequency of monitoring for qualitative and quantitative evaluation techniques will need to be defined and approved by the Steering Committee and integrated into individual SWPPIs as funding is secured.

Table 5.4 presents evaluation methods that will be used to track the progress and effectiveness of the management alternatives–presented in the Action Plan–in reducing pollutants and impairments to the maximum extent possible.

Table 5.4. Methods of Evaluating Progress for the Watershed Management Alternatives in the Huron Chain of Lakes Action Plan

Management Alternative		Method of Evaluating Progress
Managerial: Ordinances and Policies		
1	Adopt phosphorus reduction ordinance	Track # of fertilizer reduction ordinances/policies adopted
2	Adopt native landscaping ordinance	Track # of native landscaping ordinances/policies adopted
3	Adopt no dumping ordinance	Track # of no dumping ordinances/policies adopted

Management Alternative		Method of Evaluating Progress
4	Adopt pet waste ordinance	Track # of pet waste ordinances/policies adopted
5	Adopt private roads ordinance	Track # of private roads ordinances/policies adopted
6	Adopt Purchase of Development Rights ordinance	Track # of PDR ordinances adopted
7	Adopt stormwater management ordinance (e.g., Livingston Co.)	Track # of stormwater management ordinances adopted
8	Adopt wetlands ordinance w/ natural features setback	Track # of wetlands ordinances adopted
9	Support County-wide septic system time-of-sale ordinance	Track # of ordinances adopted
10	Adopt overlay zoning for riparian corridor	Track # of ordinances adopted
11	Enhance site plan review requirements	Survey communities to compare pre- and post-site plan review enhancements
12	Incorporate Low Impact Design principles	Develop manual of coordinated standards for watershed
13	Improve enforcement of litter laws and nuisance properties	Track # of complaints and amount of litter collected
14	Improve enforcement of SESC policies	Track # of soil erosion and sedimentation violations and corrections
15	Review and revise SESC policies and practices	Track # of soil erosion and sedimentation violations and corrections
16	Improve enforcement of construction site inspections	Track installation and maintenance of construction site BMPs and # of violations and corrections
17	Minimize total impervious cover in zoning ordinance	Track # of zoning ordinances with measures to minimize impervious cover; Reduce build-out scenario impervious levels
18	Promote open space preservation in zoning ordinance and master plan	Track # of zoning ordinances and master plans that promote open space preservation
19	Review and revise grading and land clearing policies	Track # of BMPs employed and maintained
20	Revise parking standards for new development/redevelopment	Track # of zoning ordinances with measures to minimize impervious cover
21	Revise Stormwater Management Standards - pond landscaping	Track # of entities with enhanced pond landscaping requirements
Managerial: Practices		
22	Incorporate results of conservation planning analyses into local ordinances and policies	Track # of local ordinances and policies incorporating conservation planning
23	Disconnect directly-connected impervious surfaces (e.g. downspouts)	Track # of homes with disconnected downspouts
24	Practice high-powered street and parking lot sweeping	Track # of lineal feet swept and amount of debris removed
25	Provide pet waste bags in parks and public areas	Conduct public surveys; Track public participation

Management Alternative		Method of Evaluating Progress
26	Increase amount of refuse containers and review their distribution	Conduct public surveys to measure pre- and post-measure public participation
27	Practice alternative drain practices that improve protection of stream and riparian habitats	Track BMPs established throughout riparian corridor
28	Storm drain/catch basin marking	Track # of storm drains marked; Track public participation
29	Reduce use of conventional road de-icers	Track reduction in amounts of road salt used
Managerial: Studies and Inventories		
30	Develop and implement a coordinated monitoring strategy to measure water quality, water quantity and biota	Track development of monitoring strategy
31	Initiate hydrologic and hydraulic studies	Track data generated from studies; Rating curves developed
32	Inventory and stabilize eroding streambanks	To be established in upcoming permit cycle
33	Inventory areas lacking stormwater management for retrofit opportunities	To be established in upcoming permit cycle
34	Investigate opportunities for recreation areas	To be established in upcoming permit cycle
35	Municipal mapping of wetlands	
36	Conduct natural features inventories	Track # of inventories
Managerial: Public Information and Education		
37	Homeowner education about septic system maintenance	Conduct public surveys; Track public participation; Stream surveys
38	Provide watershed education to residents	Conduct public surveys
39	Provide trash management information and education to public	Conduct public surveys; Track items and households from clean-up events; Stream surveys
40	Provide information and education program to homeowners on yard and lawn care, native landscapes	Conduct public surveys; Track public participation; stream surveys
41	Promote county soil testing program	Track # of soil tests submitted; Conduct public surveys
42	Provide information and education program to homeowners on proper pet waste management	Conduct public surveys; Track public participation; Stream surveys
43	Provide information and education to farmers	Conduct public surveys; Track participation; Stream surveys
44	Provide recreational vehicle (RV) Waste Disposal Education	Conduct public surveys; Track participation; Stream surveys
45	Regular storm water-related information on cable TV	Track # of televised spots; Track participation in events and practices; Conduct public surveys
46	Watershed-related articles in community newsletters	Conduct public surveys; Track public participation

Management Alternative		Method of Evaluating Progress
47	Watershed-related news and I & E materials on entity website	Conduct public surveys; Track public participation
48	Develop and distribute education materials on Low Impact Design tools for land use decision makers	Conduct focus groups; Comparative analysis of developments pre- and post-implementation of LID campaign
49	Promote reporting system for illicit discharges	Track # of illicit connections identified and corrected; Track # of complaints
50	Household Hazardous Waste Collection Site/Day	Conduct public surveys; Track public participation
51	Yard Waste Collection and/or Recycling	Conduct public surveys; Track public participation
52	Watershed and River crossing signage	Conduct public surveys; Track # of signs erected
Managerial: Illicit Discharge Elimination		
53	Conduct outfall screening program	Track # of illicit connections identified and corrected
54	Perform smoke/dye testing	Track # of illicit connections identified and corrected
55	Develop a reporting system/follow-up plan for illicit connections	Track # of illicit connections identified and corrected
56	Trace illicit connections	Track # of illicit connections identified and corrected
57	Enforcement for non-correction of illicit discharges	Track # of illicit connections identified and corrected; Track amount of fines collected
58	Train staff to identify illicit discharges	Track # of staff trained; Track # of illicit connections identified and corrected
59	Minimize seepage from sanitary sewers	Stream surveys
60	Minimize seepeage from on-site sewage disposal systems	Stream surveys
61	Update outfall and/or drainage map	Track # of maps updated
62	Develop and implement method to identify and record outfalls from new construction	Track # of entities employing method in new construction; Track # of illicit connections identified and corrected
Managerial: Coordination and Funding		
63	Establish long-term committee of community/entity representatives to promote implementation of the Watershed Management Plan	Track implementation of WMP; Track # of committee meetings; Track consistent participation of representatives
64	Conduct work sessions to prioritize specific projects for funding, establish estimated costs, and identify funding mechanisms	Track prioritization for project funding, project cost estimates, and funding mechanisms; Track implementation of WMP; Track # of work sessions
65	Ensure consistency of ordinances among the Huron Chain of Lakes communities	Track prioritization for project funding, project cost estimates, and funding mechanisms; Track implementation of WMP; Track # of work sessions
66	Improve drain maintenance coordination with County and/or MDOT	Track prioritization for project funding, project cost estimates, and funding mechanisms; Track implementation of WMP; Track # of work sessions

Management Alternative		Method of Evaluating Progress
67	Create partnerships with institutions, schools, and private sector to promote a collaborative effort in watershed management	Number of partnerships established and maintained; Number of people reached through partnerships; Track BMPs established across partnerships
87	Seek alternative funding sources	Track number of proposals submitted; Track dollars and match raised
69	Secure funding and develop partnerships to conduct monitoring	Implementation of monitoring program
70	Create a funding source for land acquisition and protection	Track dollars raised for land acquisition and protection
71	Create law to allow illicit discharge enforcement as a source of revenue	Track progress of bill creation
Vegetative		
72	Construct stormwater wetlands	Stream surveys; Track acres of practice throughout watershed; Pollutant removal efficienty
73	Create and maintain grassed waterways	Stream surveys; Track area of practice throughout watershed
74	Create and maintain vegetated filter strips	Stream surveys; Track area of practice throughout watershed
75	Plant and maintain riparian buffer	Stream surveys; Track area of practice throughout watershed
76	Install bioretention areas in developed/redeveloping areas	Stream surveys; Track area of practice throughout watershed; Pollutant removal efficiency
77	Install grassed swales, where feasible	Stream surveys; Track area of practice throughout watershed; Pollutant removal efficiency
78	Install pond buffer native plantings	Stream surveys; Track area of practice throughout watershed
79	Practice agricultural conservation cover	Stream surveys; Track acres of practice throughout watershed; Pollutant removal efficiency
80	Practice conservation crop rotation with cover crop and mulch/no-till	Stream surveys; Track acres of practice throughout watershed; Pollutant removal efficiency
81	Restore wetlands	Stream surveys; Track acres of practice throughout watershed; Pollutant removal efficiency
82	Install rain gardens	Stream surveys; Track area of practice throughout watershed; Pollutant removal efficiency
83	Reduce turf/ replace with shrubs and trees	Track area of practice throughout watershed
84	Evaluate areas for in-stream habitat restoration techniques	Records of all inventoried surface waters; Track area of practice throughout watershed; Stream surveys
85	Stabilize soils at crossing embankments	Baseline and ongoing embeddedness/stream habitat studies; Track completed road stream crossings; Track stabilized road stream crossings; Pollutant removal efficiency
Structural		
86	Construct stormwater retention/detention basins or other structures that promote infiltration and detention of runoff	Stream surveys; Track area of practice throughout watershed; Pollutant removal efficiency

Management Alternative		Method of Evaluating Progress
87	Install infiltration trenches/basins	Stream surveys; Track area of practice throughout watershed; Pollutant removal efficiency
88	Install vegetated roofs	Stream surveys; Track area of practice throughout watershed; Pollutant removal efficiency
89	Install best available technology to reduce nutrients at permitted point sources	Stream surveys; Track # of eligible and participating point sources; Pollutant removal efficiency
90	Install catch basin inserts	Stream surveys; Track # of practice throughout watershed; Pollutant removal efficiency
91	Install grade stabilization structures	Stream surveys; Track # of practice throughout watershed; Pollutant removal efficiency
92	Install porous pavement	Stream surveys; Track area of practice throughout watershed; Pollutant removal efficiency
93	Install sand and organic filters	Stream surveys; Track area of practice throughout watershed; Pollutant removal efficiency
94	Construct sediment trapping devices at construction sites	Stream surveys; Track area of practice throughout watershed; Pollutant removal efficiency
95	Repair misaligned/obstructed culverts	Baseline and ongoing embeddedness/stream habitat studies; Track completed culverts; Pollutant removal efficiency
96	Stabilize road/bridge surfaces	Baseline and ongoing embeddedness/stream habitat studies; Track stabilized road/brige surfaces; Pollutant removal efficiency

5.4 Parting Words

The Huron Chain of Lakes Watershed Management Plan was created to provide a strong foundation and framework for improving water quality in the Huron Chain of Lakes Watershed and protecting its valuable natural resources for future generations. The authors hope that choosing a consensus-based approach to developing the Plan will pay off in the form of a strong sense of ownership and unanimous support for the Plan in the years to come.

The task ahead of implementing this watershed management plan demands patience, persistence, determination, and cooperation of many partners and stakeholders at all levels. No matter how much effort and dedication was put into the Plan, it is of little value gathering dust on the shelves of the communities it is intended to serve. The concept of watershed management is new to many communities in the Huron Chain of Lakes Watershed and is only in the infant stages of being realized as a fundamental consideration in maintaining a high quality of life for its residents and protecting its natural resources for future generations. However, as these communities continue to face the challenges of balancing growth with natural resource protection, the costs of maintaining the status quo and the benefits of long-term planning on a watershed scale will become increasingly apparent.

Each community in the Watershed now has a choice. It can regard the Plan as merely another completed requirement of its Phase II stormwater permit and move on to the next requirement, or it can use the Plan as it is intended: to guide each community not only in fulfilling its own permit requirements, but also in partnering with other stakeholders throughout the watershed to protect the land and water that connects us all.

REFERENCES

[1] Southeaset Michigan Council of Governments. Community Profiles. http://www.semcog.org/data/communityprofiles. Accessed 2005.
[2] *Ibid.*
[3] Michigan Natural Features Inventory, http://www.mnfi.org, accessed 2005
[4] Olsson, K. 2002. Conservation Planning in the Huron River Watershed Final Report submitted to the U. S. Environmental Protection Agency Great Lakes National Program Office. Ann Arbor, MI: HRWC.
[5] Hay-Chmielewski, E. M., P. Seelbach, G. Whelen, and D. Jester. 1995. Huron River Watershed Assessment. Lansing, MI: MDNR, Fisheries Division.
[6] U.S. Geological Survey. http://waterdata.usgs.gov/mi/nwis/rt. Accessed 2005.
[7] Hay-Chmielewski et al.
[8] Michigan Department of Natural Resources. 2000. National Inventory of Dams database. Lansing, MI: MDNR.
[9] Southeast Michigan Council of Governments. Southeast Michigan Land Use Profiles, 2000. http://www.semcog.org/data/LandUse. Accessed 2005.
[10] Southeast Michigan Council of Governments. Monthly Population Estimates at http://www.semcog.org/data/populationestimates. Accessed 2005.
[11] Southeast Michigan Council of Governments. Community Profiles. http://www.semcog.org/data/communityprofiles. Accessed 2005.
[12] *Ibid*.
[13] Southeast Michigan Council of Governments. Building Permits. http://www.semcog.org/data/buildingpermits. Accessed 2005.
[14] Southeast Michigan Council of Governments. Southeast Michigan Land Use Profiles, 2000. http://www.semcog.org/data/LandUse. Accessed 2005.
[15] *Ibid.*
[16] Michigan Department of Environmental Quality. List of Active NPDES Permits. http://www.michigan.gov/deq/0,1607,7-135-3313_3682_3713-10780--,00.html. Accessed 2005.
[17] Riggs, E. 2003. Mill Creek Subwatershed Management Plan. Ann Arbor, MI: HRWC.
[18] Livingston County Department of Public Health Environmental Health Division. 2002. Environmental Awareness Handbook. Livingston County, MI.
[19] Michigan State Legislature. Part 4. Water Quality Standards. Promulgated pursuant to Part 31 of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.
[20] Michigan Lakes and Streams Associations. http://www.mlswa.org/secchi.htm. Accessed 2005.
[21] Dakin, T. and Martin, J. 2003a. Monitoring Gazette, Winter-Spring 2003. Ann Arbor, MI: Huron River Watershed Council.
[22] Michigan State Legislature.
[23] Michigan Department of Environmental Quality, Water Bureau website http://www.michigan.gov/deq. 2005. Lansing, MI: MDEQ.
[24] Michigan Department of Environmental Quality, Beach Monitoring website http://www.deq.state.mi.us/beach. 2005. Lansing, MI: MDEQ.
[25] Dakin and Martin. 2003a.
[26] Wehrly, et. al. 2003. in Huron River Watershed Council, Winter-Spring Monitoring Gazette, 2003.
[27] Michigan State Legislature.
[28] Martin, J. and Dakin T. 2003b. The Quality of a Hidden Treasure: the Davis Creek Report. February 2003. Ann Arbor, MI: HRWC.
[29] Dakin and Martin. 2003a.
[30] Hay-Chmielewski et al.
[31] Brown and Funk in Hay-Chmielewski et al.
[32] Yant and Humphries in Hay-Chmielewski et al.
[33] Hay-Chmielewski et al.
[34] Michigan Department of Natural Resources. 2000. Michigan stream classification: 1967 system. Chapter 20 *in* Schneider, James C. (ed.) 2000. Manual of fisheries survey methods II: with periodic updates. MDNR Fisheries Special Report 25. Ann Arbor, MI: MDNR.

[35] U.S. Environmental Protection Agency. 1980. Modeling Phosphorus Loading and Lake Response under Uncertainty: A Manual and Compilation of Export Coefficients. EPA report No. 440/5-80-011.
[36] U.S. Environmental Protection Agency, Office of Water. 2000. Nutrient Criteria Technical Guidance Manual: Lakes and Reservoirs, 1st Edition. Report No. EPA-822-B00-001.
[37] Hay-Chmielewski et al.
[38] Martin and Dakin. 2003b.
[39] Great Lakes Environmental Center and Limno-Tech, Inc. April 2004. Davis Creek Watershed/Limekiln Lake Nutrient Monitoring Study. Lansing, MI: MDEQ Water Division.
[40] Reznick, R. 1985. Yerkes Drain at South Lyon Site Assessment, August 29, 1985. Lansing, MI: MDEQ
[41] Michigan Department of Environmental Quality. 1992. Chronic Toxicity Assessment of Yerkes Drain in the Vicinity of South Lyon, Michigan. Lansing, MI: MDEQ Surface Water Quality Division.
[42] Michigan Department of Environmental Quality. 1998. Dissolved Oxygen and Time of Passage Study for Yerkes Drain at South Lyon and Green Township, Michigan, July-August 1998. Lansing, MI: MDEQ Surface Water Quality Division.
[43] Alexander, M. 2000. Water Quality and Phosphorus Loading Analysis of Strawberry and Limekiln Lakes, and Water Quality Analysis of Sandy Bottom Lake, Livingston County, April 1998- September 1999. Lansing, MI: Surface Water Quality Division, MDEQ.
[44] *Ibid.*
[45] Kraft, J.K. Staff Report, Fish Kill Complaint, Nichwaugh and Lime Kiln Lakes, Green Oak Township, Livingston County. 1978. Lansing, MI: Great Lakes and Environmental Assessment Section, Surface Water Quality Division, Michigan Department of Environmental Quality.
[46] Kosek, S. April 1996. A Nutrient Chemistry Survey of Kent, Brighton, Ore, Limekiln, and Sandy Bottom Lakes, Livingston and Oakland Counties, April 13, 1994 and April 24, 1996. Lansing, MI: GLEAS, SWQD, MDEQ.
[47] Goodwin, K. 2004. Nutrient Status of Limekiln Lake in Livingston County. Lansing, MI: SWQD, MDEQ.
[48] *Ibid.*
[49] *Ibid.*
[50] Alexander. 2000.
[51] Great Lakes Environmental Center and Limno-Tech, Inc.
[52] *Ibid.*
[53] Goodwin.
[54] Great Lakes Environmental Center and Limno-Tech, Inc.
[55] *Ibid.*
[56] Personal communication with Mark St. Charles, Green Oak Township Supervisor. January 2005.
[57] Martin and Dakin. 2003b.
[58] *Ibid.*
[59] Ibid.
[60] Adopt-A-Stream macroinvertebrate and stream habitat monitoring data. 1994-2003. Ann Arbor, MI: Huron River Watershed Council.
[61] Kosek, S. 1993. A Biological Survey of the Huron River and Selected Tributaries, Oakland, Livingston, Washtenaw, and Wayne Counties, June-October 1992. Lansing, MI: MDEQ, GLEAS.
[62] Hay-Chmielewski et al.
[63] Michigan Department of Environmental Quality as reported to the Storage and Retrieval Water Quality Database (STORET): http://www.epa.gov/ow. Accessed 2005.
[64] Adopt-A-Stream macroinvertebrate and stream habitat monitoring data.
[65] *Ibid.*
[66] *Ibid.*
[67] Fusilier, W. and Fusilier, B. 2005a. Lake of the Pines Water Quality Studies 1994-2004. Dexter, MI: Water Quality Investigators, Inc.
[68] Fusilier, W. and Fusilier, B. 2005b. School Lake Water Quality Studies 1995-2004. Dexter, MI: Water Quality Investigators, Inc.
[69] Fusilier, W. and Fusilier, B. 2005c. Pickerel Lake Water Quality Studies 1994-2004. Dexter, MI: Water Quality Investigators, Inc

[70] Adopt-A-Stream macroinvertebrate and stream habitat monitoring data. 1992-2003. Ann Arbor, MI: Huron River Watershed Council.
[71] Martin, Joan. Huron River Watershed Council. Personal communication. 2005.
[72] Hay-Chmielewski et al.
[73] Huron River Watershed Council. 2002. Brighton Lake Subwatershed Management Plan. Ann Arbor, MI: HRWC.
[74] *Ibid.*
[75] Michigan Department of Environmental Quality as reported to the Storage and Retrieval Water Quality Database (STORET): http://www.epa.gov/ow. Accessed 2002.
[76] Michigan Department of Natural Resources. 1978. Water Quality and Phosphorus Loading Analysis of Brighton and Ore Lakes, 1977-1978. Lansing, MI: MDNR
[77] Pacifica Northwest Environmental Research Council. 1975. National Eutrophication Survey, Report on Brighton Lake, Livingston County. Working Paper #187. Washington, D.C.: U. S. Environmental Protection Agency.
[78] Alexander, M. 1999a. Total Maximum Daily Load (TMDL) for Phosphorus in Brighton Lake. Lansing, MI: MDEQ SWQD.
[79] Michigan Department of Natural Resources. 1978.
[80] Michigan State University. 1971. Twelve lakes Water Quality Study. USEPA. 2000. Nutrient Critical Technical Guidance Manual: Lakes and Reservoirs, 1st edition. Report no. EPA-822-B00-001. Washington, D.C.: USEPA Office of Water.
[81] *Ibid.*
[82] Pacifica Northwest Environmental Research Council.
[83] *Ibid.*
[84] Michigan Department of Natural Resources. 1978.
[85] Schaedel, A. 1978. Water Quality in Southeast Michigan: Inland Lakes. Southeast Michigan Council of Governments.
[86] Alexander, M. 1999b. Water Quality and Phosphorus Loading Analysis of Brighton, Kent, and Ore Lakes, Livingston and Oakland Counties, April 1998-April 1999. Lansing, MI: MDEQ/SWQD
[87] Fusilier, W and Fusilier, B. 2004a. Long Lake Water Quality Studies, 1994-2003. Dexter, MI: Water Quality Investigators, Inc.
[88] Michigan State University.
[89] Fusilier and Fusilier. 2004a.
[90] Fusilier, W and Fusilier, B. 2005d. Woodland Lake Water Quality Studies, 1994-2004. Dexter, MI: Water Quality Investigators, Inc.
[91] Michigan Water Resources Commission. 1996. Limnological Data from Ten Lakes, Genesse and Livingston Counties, Michigan, Sept. 1965.
[92] Michigan State University.
[93] Uncited source in HRWC Brighton Lake Subwatershed Management Plan.
[94] Fusilier, W and Fusilier, B. 2005a.
[95] U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics. http://www.epa.gov/opptintr.html. Accessed 2005.
[96] Michigan Department of Environmental Quality. 2001. Fish Containment Monitoring Program 2001 Annual Report. Lansing, MI: MDEQ-SWQ.
[97] Michigan Department of Environmental Quality Fish Containment Monitoring Program Online Database. http://www.deq.state.mi.us/fcmp Accessed 2005.
[98] Michigan Department of Community Health, Environmental and Occupational Epidemiology Division. 2004. 2004 Michigan Family Fish Consumption Guide. Lansing, MI: MDCH.
[99] Adopt-A-Stream macroinvertebrate and stream habitat monitoring data. 1992-2003. Ann Arbor, MI: Huron River Watershed Council.
[100] Kosek. 1993.
[101] Michigan Department of Environmental Quality as reported to the Storage and Retrieval Water Quality Database (STORET): http://www.epa.gov/ow. Accessed 2005.
[102] Cooperative Lakes Monitoring Program. 2002. Annual Summary Report. Lansing, MI: MDEQ Water Division.
[103] *Ibid.*

[104] *Ibid.*
[105] Michigan Department of Environmental Quality. 2003. Michigan's Public Access Lakes 2003 Lake Water Quality Assessment. http://www.deq.state.mi.us/documents/deq-wd-swqas-intrepapp3.pdf. Accessed 2004.
[106] Dodge, K. 1984. Interoffice communication #47 re: Burroughs Farm Development, Chilson Creek, Livingston County. Jackson, MI: Department of Natural Resources
[107] Adopt-A-Stream macroinvertebrate and stream habitat monitoring data. 1992-2003. Ann Arbor, MI: Huron River Watershed Council.
[108] USEPA, Office of Water website: http://epa.gov/ow. accessed March 2005.
[109] Michigan Department of Environmental Quality. 2004. Michigan's 2004 Methodology for Determining Water Bodies Requiring TMDLs, Appendix VI. Lansing, MI: MDEQ Water Division, Surface Water Quality Assessment Section.
[110] Adopt-A-Stream macroinvertebrate and stream habitat monitoring data. 1992-2003. Ann Arbor, MI: Huron River Watershed Council.
[111] Cooperative Lakes Monitoring Program data. 1999-2003.
[112] *Ibid.*
[113] Adopt-A-Stream macroinvertebrate and stream habitat monitoring data. 1992-2003. Ann Arbor, MI: Huron River Watershed Council.
[114] Scott, A.M. 1992. A biological Survey of Honey Creek, Livingston County, August 12, 1991. Lansing, MI: MDNR Surface Water Quality Division.
[115] Hay-Chmielewski et al.
[116] *Ibid.*
[117] Scott.
[118] Jackson, G. 1972. An Investigation of the Portage River and Little Portage Lake, Washtenaw County, October 11, 1972. Lansing, MI: Michigan Department of Natural Resources, Bureau of Water Management, Water Resources Commission.
[119] Fusilier, W and Fusilier, B. 2004b. Little Portage Lake Water Quality Studies, 1997-2003. Dexter, MI: Water Quality Investigators, Inc.
[120] Scott.
[121] *Ibid.*
[122] Adopt-A-Stream macroinvertebrate and stream habitat monitoring data. 1992-2003. Ann Arbor, MI: Huron River Watershed Council.
[123] Scavia, E. 1986. Horseshoe Creek Bacteriological Sampling, November 7, 1986. Ann Arbor, MI: Huron River Watershed Council.
[124] Adopt-A-Stream macroinvertebrate and stream habitat monitoring data. 1992-2003. Ann Arbor, MI: Huron River Watershed Council.
[125] Michigan Department of Environmental Quality Fish Containment Monitoring Program Online Database. http://www.deq.state.mi.us/fcmp Accessed 2005.
[126] Michigan Department of Community Health, Environmental and Occupational Epidemiology Division. 2004. 2004 Michigan Family Fish Consumption Guide. Lansing, MI: MDCH.
[127] Waggoner, C. 1991. Biological Survey of Horseshoe Lake Drain, Washtenaw County, Michigan, August 11, 1988. Lansing, MI: MDNR Surface Water Quality Division.
[128] Wuycheck, J. MDEQ. Personal communication May 2004.
[129] Adopt-A-Stream macroinvertebrate and stream habitat monitoring data. 1992-2003. Ann Arbor, MI: Huron River Watershed Council.
[130] Hay-Chmielewski et al.
[131] Alexander, M. 2000. Water Quality and Phosphorus Loading Analysis of Strawberry and Limekiln Lakes, and Water Quality Analysis of Sandy Bottom Lake, Livingston County, April 1998-September 1999. Lansing, MI: MDEQ, Great Lakes and Environmental Assessment Section, Surface Water Quality Division.
[132] Alexander, M. 1999. Water Quality and Phosphorus Loading Analysis of Brighton, Kent, and Ore Lakes, Livingston and Oakland counties, April 1998-April 1999. Lansing, MI: MDEQ, Great Lakes and Environmental Assessment Section, Surface Water Quality Division.
[133] Grant, 1978 in Alexander, M. 1999. Total Maximum Daily Load (TMDL) for Phosphorus in Ore Lake. Lansing, MI: MDEQ Surface Water Quality Division.

[134] *Ibid.*
[135] Alexander, M. 1999. Water Quality and Phosphorus Loading Analysis of Brighton, Kent, and Ore Lakes, Livingston and Oakland counties, April 1998-April 1999. Lansing, MI: MDEQ, Great Lakes and Environmental Assessment Section, Surface Water Quality Division.
[136] Cooperative Lakes Monitoring Program. 2003. Annual Summary Report. Lansing, MI: MDEQ Water Division.
[137] Grant, 1978 in Alexander, M. 1999. Total Maximum Daily Load (TMDL) for Phosphorus in Ore Lake. Lansing, MI: MDEQ Surface Water Quality Division.
[138] *Ibid.*
[139] Alexander, M. Total Maximum Daily Load (TMDL) for Phosphorus in Strawberry Lake.
[140] *Ibid.*
[141] *Ibid.*
[142] Blumer, S. U.S. Geological Survey. Personal communication July 2005.
[143] Costello, Danny. National Weather Service Detroit/Pontiac. Flood Statistics for the Huron River at Hamburg as presented in meeting packet for the Hamburg Township Environmental Review Board and Flood Hazard Prevention Committee, July 28, 2005. Hamburg, MI
[144] Grant, J. 1978. Biological Survey of the Huron River, Kent Lake to Barton Dam, 1977-1978. Lansing, MI: MDNR Water Quality Division.
[145] *Ibid.*
[146] Aiello, K. 2002. Michigan Water Chemistry Monitoring 2002 Report. Lansing, MI: MDEQ Water Division.
[147] *Ibid.*
[148] Adopt-A-Stream macroinvertebrate and stream habitat monitoring data. 1992-2003. Ann Arbor, MI: Huron River Watershed Council.
[149] Scavia, E. 1984. Water Quality Testing on Portage and Baseline Lakes. Ann Arbor, MI: Huron River Watershed Council.
[150] *Ibid.*
[151] Kosek, S. 1998. A Nutrient Chemistry Survey of Brighton, Kent, Ore, Portage, Sandy Bottom, and Strawberry Lakes, Livingston, Oakland, and Washtenaw Counties, April, June, and August 1997. Lansing, MI: MDEQ Surface Water Quality.
[152] Grant, J. 1978. Biological Survey of the Huron River, Kent Lake to Barton Dam, 1977-1978. Lansing, MI: MDNR Water Quality Division.
[153] Kosek, S. 1993.
[154] Adopt-A-Stream macroinvertebrate and stream habitat monitoring data. 1992-2003. Ann Arbor, MI: Huron River Watershed Council.
[155] Southeast Michigan Council of Governments. 2005. Huron River Chain of Lakes Major Survey Findings. Detroit, MI: Southeast Michigan Council of Governments.
[156] Lower One Subwatershed Advisory Group. 2001. Lower One Rouge River Subwatershed Management Plan. Rouge River Wet Weather Demonstration Project.
[157] Scheuler, T. 1994. The Importance of Imperviousness. Subwatershed Protection Techniques 1 (fall 1994). Ellicott City, MD: Center for Watershed Protection.
[158] Cave, K., T. Quasebarth, and E. Harold. 1994. Selection of Stormwater Pollutant Loading Factors. Rouge River National Wet Weather Demonstration Project.
[159] Wiley, M. and J. Martin. 1999. Current Conditions, Recent Changes, and Major Threats to the Huron River: a Report on Eight Years of an Ongoing Study. Ann Arbor, MI: Huron River Watershed Council.
[160] Center for Watershed Protection. 1995. Assessing the Potential for Urban Watershed Restoration. Watershed Protection Techniques. 1(4): 166-172. Ellicott City, MD: Center for Watershed Protection.
[161] Brown, E., A. Peterson, R. Kline-Roback, K. Smith, and L. Wolfson. February, 2000. Developing a Watershed Management Plan for Water Quality; and Introductory Guide, Institute for Water Research, Michigan State University Extension, Michigan Department of Environmental Quality, P.10.45 R323.1100 of Part 4, Part 31 of PA 451, 1994, revised 4/2/99.
[162] Livingston County Health Department. 2005. Septage Receiving Station Fact Sheet.
[163] The Rouge River Project. 2004. Overview Description of OSDS Management Program. http://www.rougeriver.com/techtop/osds/overview.html. Accessed 2005.

[164] Aichele, Steven S.. 2005. Effects of Urban Land-Use Change on Streamflow and Water Quality in Oakland County, Michigan, 1970-2003, as Inferred from Urban Gradient and Temporal Analysis. U.S. Geological Survey Scientific Investigations Report 2005-5016.
[165] American Farmland Trust. 2001. Protecting farmland makes fiscal sense for two townships in Calhoun County. AFT, East Lansing, MI.
[166] American Farmland Trust. 2002. Farming on the edge. Washington, D.C.: American Farmland Trust.
[167] Ibid.
[168] Michigan Land Use Institute. 1999. Evidence of deep ideological attack on the state wetlands law. MLUI. Winter 1999 Great Lakes Bulletin.
[169] Olsson, K., and E. Worzalla. 1999. Advance Identification of Wetlands: Enhancing Community Wetlands Protection and Restoration in the North Fork, Mill Creek. Final Report Submitted to the U. S. Environmental Protection Agency. Ann Arbor, MI: Huron River Watershed Council.
[170] Center for Watershed Protection. 1998. Better Site Design: A Handbook for Changing Development Rules in Your Community. Ellicott City, MD: Center for Watershed Protection.
[171] *Ibid.*
[172] Galli, J. August 1992. Analysis of Urban BMP Performance and Longevity in Prince George's County, Maryland. Department of Environmental Programs. Metropolitan Washington Council of Governments.
[173] U. S. Environmental Protection Agency, Office of Water, NPDES Program, Menu of Stormwater Best Management Practices, June 2005.
[174] Claytor, R., and T. R. Schueler. 1996. Design of Stormwater Filtering Systems. Ellicott City, MD: Center for Watershed Protection.
[175] U. S. Environmental Protection Agency, Office of Water, NPDES Program, Menu of Stormwater Best Management Practices, June 2005.
[176] Lowrance, R., L.S. Altier, J.D. Newbold, R.R. Schnabel, P. M. Groffman, J. M. Denver, D. L. Correll, J. W. Gilliam, J. L. Robinson, R. B. Brinsfield, K. W. Staver, W. Lucas and A. H. Todd. 1997. Water Quality Functions of Riparian Forest Buffers in Chesapeake Bay Watersheds. Environmental Management Vol. 21, No. 5, pp. 687-712.
[177] Lower One Subwatershed Advisory Group. 2001. Lower One Rouge River Subwatershed Management Plan. Rouge River Wet Weather Demonstration Project.
[178] *Ibid.*
[179] Heathcote, I.W. 1999. Integrated Watersehed Management: Principles and Practices. New York: John Wiley and Sons, Inc.
[180] *Ibid.*
[181] *Ibid.*
[182] Adapted from: MSU Institute of Water Research, et al. 2000. Developing a Watershed Management Plan for Water Quality. Lansing, MI: Michigan State University.
[183] Claytor, R. in Schueler, T. R. and H. K. Holland. 2000. The Practice of Watershed Protection. Ellicott City, MD: The Center for Watershed Protection.

Action Plan

[a] Combined Downriver Watershed Inter-Municipality Committee. 2005. Combined Downriver Watershed Management Plan - draft.
[b] Riggs, E. H.W. 2003. Mill Creek Subwatershed Management Plan. Ann Arbor, MI: Huron River Watershed Council for the Michigan Department of Environmental Quality.
[c] Middle One Subwatershed Advisory Group. 2001. Middle One Rouge River Subwatershed Management Plan. Rouge River Wet Weather Demonstration Project.
[d] Fishbeck, Thompson, Carr & Huber, Inc. for Grand Valley Metropolitan Council. 2004. Lower Grand River Watershed Management Plan.
[e] Ferguson, T., R. Gignac, M. Stoffan, A. Ibrahim, and J. Aldrich. 1997. Cost Estimating Guidelines – Best Management Practices and Engineered Controls. Rouge River National Wet Weather Demonstration Project.