Sustainable Lakes Project: A Lake Management Model for the Future

by Paula West and George Orning

Although Minnesota is famous for many things, it is perhaps best known for its abundant lakes, as reflected in our state's nickname. Unfortunately, there is no single government agency in Minnesota responsible for coordinating or overseeing management of the more than 10,000 lakes scattered throughout the state. Instead, these precious natural resources are managed by four different state agencies—the Department of Natural Resources (DNR), the Board of Water and Soil Resources, the Pollution Control Agency, and the Department of Health—which often results in inconsistent regulation and enforcement. Consequently, responsibility for lake management and protection frequently falls to local lake associations, many of which lack the information, tools, or resources necessary to formulate and implement effective lake management plans.

In 1997, the Minnesota Lakes Association,[1] in cooperation with CURA, received $270,000 in funding from the Legislative Commission on Minnesota Resources for the two-year Sustainable Lakes Project. The goal of the project was to assist local lake associations in developing comprehensive lake management plans for five pilot lakes in Minnesota, and to use their experiences to develop a sustainable lake management planning tool that other lake associations and communities could use for their own planning purposes. Funding for the project ended in June 1999 with the completion of the five pilot lake plans, and the *Sustainable Lakes Planning Workbook: A Lake Management Model* was subsequently published by Minnesota Lakes Association, in cooperation with CURA, and with the support of the Minnesota Board of Water and Soil Resources.

This article offers an overview of the Sustainable Lakes Project. First, we explain the goals of, and participant selection process for, the five pilot projects. Next, we discuss the nature of the pilot projects themselves, including the four primary phases of the sustainable lakes approach to developing a comprehensive lake management plan. We conclude by highlighting selected results and outcomes of the five pilot projects, and offering general observations about the Sustainable Lakes Project.

Project Goals and Participant Selection

The Sustainable Lakes Project was intended to strengthen local lake management efforts by providing lake associations with the tools to create a strategic vision for their lake; gather relevant information about their lake and surrounding watershed; assess existing lake management resources and programs; and establish concrete goals, priorities, and policies for a comprehensive lake management plan. The project was developed around the general principles of sustainable development, which envisions a balance among environmental protection, economic growth, and human social needs. In the context of lake management, sustainable development is development that meets the basic needs of all people, without compromising the ability of future generations to use and enjoy a high-quality lake resource.

In order to select participants for the project, applications were solicited from lake associations throughout the state in 1997. Forty completed applications were received by the October 15, 1997, deadline, and the Minnesota Lakes Association board of directors evaluated each application based on the following criteria:

▶ level of support for and participation in the lake association

- size of the lake watershed
- diversity of land uses around the lake
- variety of threats to lake water quality
- size of the lake
- level of recreational use of the lake
- availability of good geographic and water quality data for the watershed
- type and extent of lakeshore development

In addition, an effort was made to select lakes that constituted a geographically representative sample of the major lake regions of Minnesota. To this end, one lake was chosen from each of the following regions:

- Northeast: the relatively undeveloped arrowhead region, which includes the bedrock lakes and Itasca County
- North Central: the low-density development region that encompasses the area around Leech Lake and the upper Mississippi River watershed
- Central: the rapidly urbanizing central lakes region centered around Brainerd
- West: the hilly "transitional" agricultural zone stretching from Willmar through Detroit Lakes
- Metro Fringe: the rapidly expanding suburban ring surrounding the seven-county metropolitan region

Based on these criteria and geographic considerations, the Minnesota Lakes Association board of directors chose five lakes and their corresponding lake associations to participate in the project: Deer Lake, Itasca County (Northeastern Region); Kabekona Lake, Hubbard County (North Central Region); Whitefish Chain of Lakes, Crow Wing County (Central Region); Clitherall Lake, Otter Tail County (West Region); Sugar Lake, Wright County (Metro Fringe Region). The location of each lake is shown in Figure 1.

Each pilot lake association was extensively involved in the discussion and planning process, and made a significant commitment of time and resources to the project. Participating associations agreed to commit to a 12- to 15-month process. They were asked to choose one member to act as the lead contact between CURA and the lake association, and another member to serve on the Sustainable Lakes Project advisory committee. In addi-

tion, the associations identified and involved stakeholders in the planning process, helped to determine the scope of information to be collected, assisted with data collection and data analysis, organized and participated in focus groups and presentations, developed a comprehensive lake management plan, and agreed to implement the plan's objectives.

The Pilot Projects

At the beginning of the five pilot projects, all participating lake associations were asked to develop a broad, strategic vision of what they wanted their lake to look like 20 years from now. In addition, they were asked to determine what needed to be accomplished to achieve that vision, and to establish both short-term and long-term goals consistent with their vision. These strategic visions served as a foundation for the association to develop a sustainable lake management plan specific to their own circumstances, needs, and goals.

Figure 1. Location of the Five Pilot Lakes in the Sustainable Lakes Project

Each lake association approached the task of developing a lake management plan in a slightly different manner. In all cases, however, the lake management planning process was community-based, involving citizens, businesses, and organizations directly or indirectly affected by efforts to manage the lake resource. In addition, the planning process for all participating lake associations centered around three primary objectives:

- to improve development and management practices of lakeshore property owners

- to sustain and enhance resource productivity, and improve the environmental qualities and aesthetics of each lake's watershed
- to enhance the quality of life of each resident of and visitor to the watershed

With the assistance of Sustainable Lakes Project staff, each lake association followed a general planning process that consisted of four identifiable phases: (1) collecting data about the lake and surrounding watershed; (2) analyzing and assessing the collected data; (3) presenting the data to stakeholders and resource managers for review, discussion, and comment; and (4) creating a comprehensive sustainable lake management plan. In most cases, this process lasted approximately 18 months, due in part to the fact that the Sustainable Lakes Project staff assisted with all five pilot projects simultaneously. It is likely that an individual lake association engaged in their own independent lake management planning effort could complete the planning process in nine months to one year.

Phase One: Data Collection. One of the most acute needs of lake associations is the need for accurate data. Because the water quality and general characteristics of a lake are related to the quality and characteristics of the surrounding watershed, access to data on the watershed level is essential to comprehensive planning efforts. Water body or lake basin data (e.g., water depth, fish types, and vegetation) are also critical because they provide specific information about the health of the lake's ecosystem. Information on individual land parcels is important to lake management efforts because individual land management practices directly affect the quality of water in the lake. Finally, lakeshore property owners' observations and concerns about the lake are significant because these individuals are most acutely aware of the problems affecting and activities occurring on the lake.

Watershed Maps. Building on the assumption that water quality and land use practices in a lake's watershed are directly related, physical resource data were collected on soils, zoning, land cover, the amount and type of development, and other resource variables within the pilot lake's watershed. Graduate student assistants involved with the project worked with state and county agencies to locate existing

As a result of the Sustainable Lakes Project, a set of 21 resource maps for all 7,000 minor watersheds in Minnesota is now available for viewing or purchase at the John R. Borchert Map Library located in the Wilson Library on the West Bank Campus of the University of Minnesota.

For a donation of $250 to the Friends of the Map Library, a purchasing group will receive the printed 21-map atlas plus a CD-ROM with the digital images of the maps. Staff of the library will guide your group through the production of the watershed maps. The user-friendly program allows you to determine which boundaries you want mapped, view the data on the computer screen, and print the maps. The maps can also be viewed at anytime without purchasing. The telephone number of the Map Library is 612-624-4549; fax is 612-626-9353.

Each map set includes the following 21 resource maps for each watershed:

Government Political Boundaries
Pre-Settlement Vegetation
Shaded Relief
Slope
Area Roughness
Geomorphology
Public Ownership
Water Features
Land Use
Forest Cover
Soils
Septic Tank Suitability
Groundwater Contamination
    Potential
Erosion (runoff) Susceptibility and
    Water Orientation
Scenically Attractive Areas
Scenically Attractive Private Land
    within 1/4 Mile of a Road
Scenically Attractive Public Land
    within 1/4 Mile of a Road
Scenically Attractive Public Land over
    1/4 Mile from a Road
Possible Agriculture Irrigation Areas
    on Private Land with Less than
    Eight Percent Slope
Aerial Photography
United States Geographical Survey
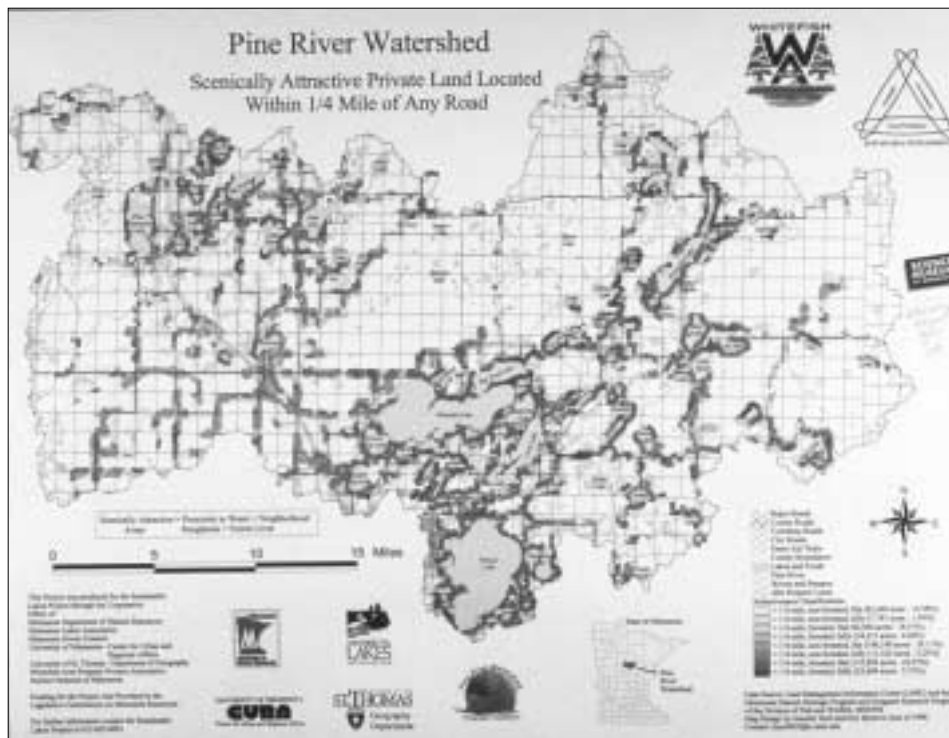
Figure 2. Pine River Watershed Map
This watershed map of the Whitefish Chain of Lakes area depicts scenically attractive private land within 1/4 mile of any roadway. Darker areas on the map correspond to private land in the watershed that is located closer to a road. Because these areas are more accessible, and therefore more likely to experience rapid development, such information can significantly inform water and land management decisions.

Figure 3. Kabekona Lake Watershed Map
This watershed map depicts water features—such as streams, swamps, and marshes—for the Kabekona Lake watershed. Such information helps to demonstrate that each watershed has unique characteristics that differentially affect lake water quality.

watershed-level maps for these variables, and to collect missing data and other information needed to create maps in those instances where they did not already exist.

The data were then converted into a set of 21 resource maps (see sidebar) using geographic information system mapping technology in a joint effort among CURA, the St. Thomas University computer laboratory, and the Minnesota DNR. This effort represents the first integrated and computerized watershed-wide database created through a cooperative venture among state agencies, local governments, and institutions of higher education. Examples of watershed maps are shown in Figure 2 and Figure 3.

The resulting watershed maps served as a key educational tool for the lake associations. The maps helped to define the neighborhood of water impact for each lake, to demonstrate that every piece of land has unique characteristics that differentially affect lake water quality, and to identify specific land use activities that impact the quality of water runoff and in turn affect the water quality of the lake.

Lake Basin Data. Each pilot lake received maps prepared by the Minnesota DNR that identified various characteristics of the lake basin itself, including depth contours, aquatic vegetation growth, and high- and low-water levels. Because the sustainable lakes management model is based on land use impacts to water quality, no specific water quality data were collected. Instead, existing data on water quality gathered by the lake associations were assimilated into the lake basin reports.

Lake basin data are important to any comprehensive lake management plan. For example, aquatic plant inventories, when combined with depth contours and water clarity measurements, help lake associations better manage important aquatic resources (such as fish) by identifying where they are located or threatened. High- and low-water levels can impact everything from real estate development and recreation to weed growth and fish habitat, and can inform both lake and lakeshore resource management.

Parcel Maps. The rationale for gathering parcel data as part of the pilot projects rested on several fundamental assumptions about land use and land management. In essence, each individual lakeshore property owner is a small-scale land use manager who has control over how their land is maintained. It follows that if the quality of each individual property owner's management practices can be improved, then collectively the overall water quality and landscape character of the lake can be enhanced. Thus the importance of parcel-level data. Without such information, it would be hard to implement practices that would reduce land use impacts to the lake because most problems around the lake are solved one parcel at a time. However, if each lake association, working cooperatively with their county government, develops and maintains a database of parcel information on every lakeshore property, they have the ability to monitor each individual parcel manager's impact on the lake, and to isolate and target for change those land use practices that are negatively affecting the lake.

For the Sustainable Lakes Project, information was collected on lakeshore properties surrounding the five pilot lakes, and real estate identification codes were used to build a parcel database of information for each lake. Property information was obtained from various county departments,
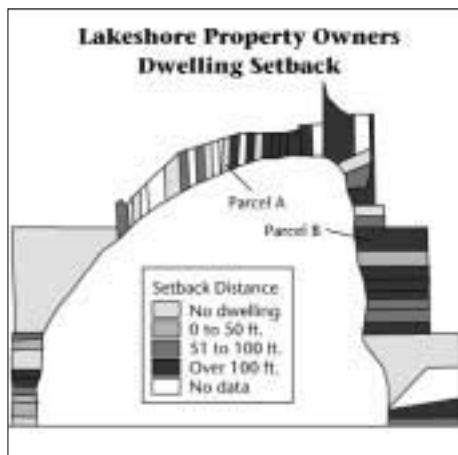
Figure 4. Parcel Map with Accompanying Parcel Photos
Parcel photographs taken from the water are a key part of the data collection process. They provide baseline information about such things as septic system conformance, dock type, dwelling setbacks, lawn management practices, and the state of shorelines for individual land parcels. The photograph above corresponds with Parcel A and the photograph below with Parcel B in the parcel map pictured here (left), which depicts dwelling setbacks from the lake shoreline. Parcel maps are useful tools because they allow education and enforcement efforts to be targeted at individual property owners whose land management practices adversely affect the quality of the lake.

including the Management Information Systems Department, the Assessor's Office, the Planning and Zoning Department, and the Department of Health. In some cases, the participating lake associations already tracked parcel-level information in a database. In other cases, the lake associations collected parcel information by photographing each lakeshore property, and then relating these photographs back to individual parcel records.

Once these data were collected and entered into a database, they were then used to generate a series of parcel maps for each pilot lake. These maps included data on septic systems, private wells, length of property shoreline, market value of the property, type of homestead (residential or nonresidential), and the county's parcel identification number. An example parcel map depicting dwelling setbacks is shown in Figure 4, along with several photographs used to assist in the creation of the map.

Along with lake basin and watershed information, parcel information helped the pilot lake associations assess the management needs of their lake and determine what approaches to take in planning for its sustainable future. For example, using information on septic systems, education and enforcement efforts could be targeted at parcels with unsuitable soils for septic systems or with systems that had not been pumped on a regular schedule. The lake association for Kabekona Lake mapped lawn management, and identified property owners whose lawn management practices—for example, mowing to the edge of the water—could negatively impact the lake. They then targeted these property owners and provided education on better lawn and shoreline management practices. By tracking such things as the location of buildings, property setbacks, wells, and septic drain fields, parcel database maps can also help county planning and zoning offices ensure that the proper permits have been obtained by landowners and that shoreline ordinances are enforced.

Lake User Survey. Another important aspect of phase-one data collection was obtaining information from lakeshore property owners. The surveys included questions about who used the lake, the amount and type of use the lake endured, land management practices on the lake, perceived environmental problems affecting the lake, respondents' demographic characteristics, and their overall impression of the lake. Conduct-

Because shoreland property owners are intimately familiar with the lake and its problems, lake user surveys are an important data collection tool for lake management planning.

ing a property owners' survey is an easy and inexpensive method to obtain such information from the people who are most familiar with the lake. In addition, the survey can inquire about the ways property owners think problems should be addressed, and what management actions they support or oppose.

The Sustainable Lake Project staff created various survey instruments to gather information from property owners.[2] Using the individual lake associations' mailing lists, the surveys were mailed to lake users and landowners on the pilot lakes. Over 5,000 lakeshore property owners were surveyed during the course of the five pilot projects. With the exception of one lake—Lake Clitherall—the survey questions were consistent across all the pilot lakes in the project, and focused on what people did on the lake itself. For the Clitherall Lake survey, another set of questions was included to determine what land activities lake users and landowners engaged in near the lake. The surveys were piloted at Linwood Lake in Anoka County, and survey results were tabulated and analyzed by the Cooperative Park Studies Unit in the University of Minnesota's College of Natural Resources.

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[2] Examples of the surveys used for the Clitherall Lake pilot project can be found in appendix B of the *Sustainable Lakes Planning Workbook.*

Phase Two: Data Assessment. The second phase of the Sustainable Lakes Project involved the analysis and assessment of the collected data in preparation for phase three, the presentation of this information for public review and comment. The goal of the project staff was to package the information in such a way that it could be easily presented to and understood by a lay audience, thereby maximizing the opportunity for public discussion and input in the planning stage.

By combining the information from the watershed maps, lake basin maps, parcel maps, and lake users survey, it was possible for the project staff to determine a set of recommended issues for each lake association to address. For each data map, a bulleted analysis paragraph was created, summarizing the information contained in the map and highlighting important findings or conclusions. The data maps, analysis paragraphs, and list of recommended issues were then presented to each association's Sustainable Lake Project committee, which examined the information in light of the lake association's preestablished vision and goals for lake management. Professional facilitators were used to help committee members generate ideas for how to address the problems and issues identified on the basis of the data, and achieve their visions and goals.

Phase Three: Data Presentation. Once the lake association committee had reviewed the collected data, both the data and a preliminary data assessment were presented to lakeshore residents, lake users, and resource managers for review, discussion, and comment. These presentations were generally made at the lake association's annual meeting, and were organized around the same data maps, analysis paragraphs, and list of recommended issues presented to the lake association's sustainable lake committee. A professional facilitator was used during these public presentations, and attendees were encouraged to ask questions, discuss the data and information collected, comment on issues of particular concern, and devise potential solutions to address these issues.

The type and size of the public presentations varied considerably from lake to lake. For example, the Cross Lake meeting was attended by over 400 people, primarily lakeshore residents. At Sugar Lake, people from throughout the lake watershed were invited to attend the meeting because the lake association decided the issue concerned more than just lakeshore residents. The meeting was also broadcast to a much wider audience on a local public broadcasting system station. In nearly all cases, the public presentation sessions were videotaped, and the results of the discussions were summarized in the lake association's next newsletter.

Phase Four: Lake Management Planning. The planning phase of the Sustainable Lakes Project directly involved members of the pilot lake associations in developing a sustainable lake management plan based on the data collected in earlier phases of the project. As with the data presentation sessions, the nature of the planning sessions varied from lake to lake. For example, those who attended the data presentation session for the Whitefish Chain concluded that a special meeting for association members was necessary to devise a lake management plan, and a day-long facilitated meeting was held for this purpose. In contrast, the association for Clitherall Lake created a special subcommittee charged with establishing a comprehensive plan for the lake.

The sustainable lake management plans created for each lake included short-term and long-term goals that could be quantitatively measured; detailed plans of action, implementation timelines, and lists of responsible

actors; and commitments to review the plans at regular intervals to assess progress and realign goals as needed to meet new challenges. Because each lake is a unique environment, the details of the plans differed from lake to lake. However, all pilot plans included goals and actions directed at shoreland development, lake uses, water management, and water quality.

In addition to creating a framework for managing individual lakes, the comprehensive plans often contributed to integrated planning efforts with local government officials. For example, the lake association for Sugar Lake established a cooperative arrangement with the Wright County Environmental Services Department to regularly update the watershed and lake basin data, and the county subsequently chose to use the Sugar Lake plan as a model for the management of other lakes in the area.

Project Results and Outcomes

The Sustainable Lakes Project resulted in a number of initiatives on the five pilot lakes that were geared toward sustainable lake management. In addition, information gathered from the pilot project data maps and property owner surveys identified broader needs for successful lake management statewide. Finally, project staff gained valuable insights into the Sustainable Lakes Project itself. We discuss each of these project results and outcomes in this section.

Selected Lake Management Initiatives Resulting from the Project. The following are examples of specific lake management initiatives and goals on each of the five pilot lakes that resulted from participation in the Sustainable Lakes Project:

▸ Land cover, slope, and soils maps of the Pine River Watershed are being used to locate areas on the Whitefish Chain of Lakes where development easements can control land use and protect water quality in the watershed. One of the missions of the newly established Pine River Watershed Protection Foundation is to obtain development easements at locations identified by the watershed maps.

▸ Parcel maps of Kabekona Lake identified undeveloped shoreland parcels with potential development problems. The lake association purchased some parcels, and is looking at purchasing others to prevent develop-

ment. As a result of the property owner survey, a fisheries management plan is a high planning priority. The Kabekona parcel database is being used by the association to track septic system maintenance by keeping a record, by parcel, of when the system was last pumped and using the database to identify those systems that need pumping on a three year rotation. This information has allowed the association to negotiate lakewide pumping services, and to explore the purchase or lease of land to use as a "honey wagon" dumping site.

▸ Parcel maps of Sugar Lake helped target specific parcels for better lawn management, and identified the need for more education on proper shoreland lawn management. The aquatic vegetation lake maps were used to develop an aquatic vegetation management plan for the lake. In addition, the association is attempting to form a lake improvement district to address sewer management.

▸ The Whitefish Chain, in cooperation with Crow Wing County and the city of Crosslake, has initiated an assessment of over 2,000 septic systems. The association is also assisting the county in updating its public land management policy.

▸ Irrigation concerns were a major focus of the lake plan for Clitherall Lake. The association attempted to control pivot irrigation near the lake, lobbied for additional regulation of irrigation in the county, and monitored enforcement of shoreland ordinances to ensure a proper setback on all new irrigation machinery and feedlots. Additional goals included developing a recreational trail system and an enhanced fisheries management plan.

Key Findings Concerning Sustainable Lake Management. The Sustainable Lakes Project data maps and property owner surveys identified a number of critical needs for successful lake management throughout the state that might be incorporated into a state funded Minnesota Lakes Initiative. The most significant findings are listed below.

▸ Water quality and land use practices in a lake's watershed are directly related. The most critical data for effective lake management are not

water quality data, but information on land use and settlement patterns within the watershed. In most instances, a relatively small part of the watershed has a major impact on water quality. The crucial areas for water quality include the land within 1/8 mile of a lake, particularly shoreline areas, steep slopes near water, urbanized areas, and cultivated areas.

▶ Information gaps inhibit effective lake management. There is no easily used model that links water quality data to land uses in a lake watershed. Soils maps are too detailed for watershed-wide analysis, but not detailed enough for use with individual parcels and structures. Among state resource management agencies, there is no standardized set of local watershed boundaries across agency or program lines. There are no systematic programs to regularly update the information used in the Sustainable Lakes Project.

▶ Intensive agricultural development in a lake watershed is not always compatible with good water quality. Negative effects include well contamination, aerial spraying of herbicides and pesticides near residential neighborhoods, and uncontrolled runoff of contaminated water. Most local and state zoning ordinances do not contain special provisions for water quality or public health protection from intensive agricultural practices in shoreline areas.

▶ Parcel-based information is the most important building block for effective long-term lake management. Most decisions affecting lake quality are made at the shoreland parcel level by parcel owners. Parcel mapping is an essential component of any state lake initiative, and such mapping should be implemented at the local county level. Better linkage of assessor records to the parcel's physical characteristics can help ensure that revenue streams from lakeshore property continue to exceed the costs of providing government services.

▶ Increased motorized recreation on Minnesota's lakes threatens the peace and solitude valued by many lakeshore property owners. Specific problems generated by increased motorized recreation include noise pollution, unsafe operation of motorized watercraft, and overcrowding caused by excessive use of motorized watercraft on summer weekends and holidays. Currently, no effective state policy or program exists to manage surface water use. Surface water use management should be transferred from a service division of the Minnesota DNR to an operating division, such as Waters or Trails/Waterways. More aggressive enforcement of lake safety rules and regulations is also necessary.

▶ Lakeshore property owners engage in and desire more opportunities for land-based recreation adjacent to lakes. For example, there is a high demand for walking and hiking trails. More land-based recreational opportunities in the vicinity of major recreational lakes would significantly reduce pressure on water resources.

▶ Fish populations are threatened and declining. The average time spent per fish caught is increasing, fish sizes are decreasing, and fewer individuals are catching greater percentages of the total fish harvest. To reverse this decline and improve fishing, management strategies are necessary, including stocking game fish, controlling aggressive fish, limiting fishing hours, restricting the use of certain fishing equipment, reducing bag limits, encouraging catch-and-release practices, and possibly mandating the use of "barbless" hooks as has been done in the Canadian province of Manitoba.

▶ Improper alterations to shorelines and violations of lake zoning ordinances are prevalent. Shoreland education needs to be targeted to those property owners whose land management practices need improvement, as identified by the parcel mapping process. Examples of improper practices include placement of septic systems on poorly suited soil; inadequate septic system operation and maintenance; lawn management practices that result in rapid nutrient runoff into lakes; and removal of shoreline vegetation, which contributes to erosion and runoff.

▶ Lake water pollution is a serious concern on heavily developed lakes. Likely pollution sources include agricultural runoff, lawn runoff, and substandard or faulty septic systems.

Key Findings about the Project. Based on the five pilot projects, Sustainable Lakes Project staff gained valuable insights into the workings of the project itself. First, development of a comprehensive lake management planning following the Sustainable Lakes Project model requires a significant commitment from lake association

The critical areas for water quality include the land within 1/8 mile of a lake, particularly shoreline areas, steep slopes near water, and cultivated areas. Intensive agricultural development in a lake watershed is not always compatible with good water quality, and most zoning ordinances do not contain provisions to protect water quality from the threats posed by intensive agricultural practices.

personnel in order to be successful. Some of the associations involved in the project made the necessary commitment, while others did not. The ultimate success of the pilot projects depended in large part on the degree of commitment achieved.

Second, the most successful planning process was achieved when there was more than one champion of the project on the lake association's sustainable lakes committee. Because lake associations are composed of volunteers, there is often significant turnover among membership. For the Sustainable Lakes Project to succeed, however, continuity of leadership is essential. Multiple champions can help ensure that the necessary energy and commitment are sustained for the duration of the project.

Finally, the Sustainable Lakes Project was an iterative rather than linear process. The model presented in the *Sustainable Lakes Planning Workbook* does not mirror the process followed by any one lake that participated in the project; rather, it attempts to represent what the project staff learned from the process. No single approach will work for every lake or every lake association. Accordingly, the workbook is a living document, and should be viewed as a heuristic device rather than an ideal model that must be followed slavishly. The workbook will best serve its intended purpose if individual lake associations add new ideas and adapt this instrument to their individual needs.

Conclusion

Minnesota's decentralized lake management structure, coupled with increasing development and greater use of lake resources, requires that lake associations take on the critical role of coordinating the management of their lake resources. State and county agencies must work closely with these local lake managers if our most precious natural resources are to be protected for the future enjoyment of all Minnesotans. In addition, local lake associations must make a long-term commitment to effectively manage their lakes and watersheds by developing clear goals for watershed and shoreline development, surface water use management, and fish management. The Sustainable Lakes Project and *Sustainable Lakes Planning Workbook*

provide important tools to help lake associations and state and county agencies achieve these goals.

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George Orning has extensive experience with lake management research beginning 35 years ago as director of the Lakeshore Development Study at CURA, which led to the Minnesota Shoreland Management Program and state classification of all lakes in Minnesota for zoning purposes. He has managed research and policy in the Minnesota DNR Office of Planning, served as research director for the Legislative Commission on Minnesota Resources, and taught land use planning at the University of Minnesota. He has also served on the board of directors of the Minnesota Lakes Association. Orning directed the Sustainable Lakes Management Project with the assistance of University of Minnesota graduate students Chris Matthews, Ciara Schlichting, Daphne Karypis, and Ben Oleson.