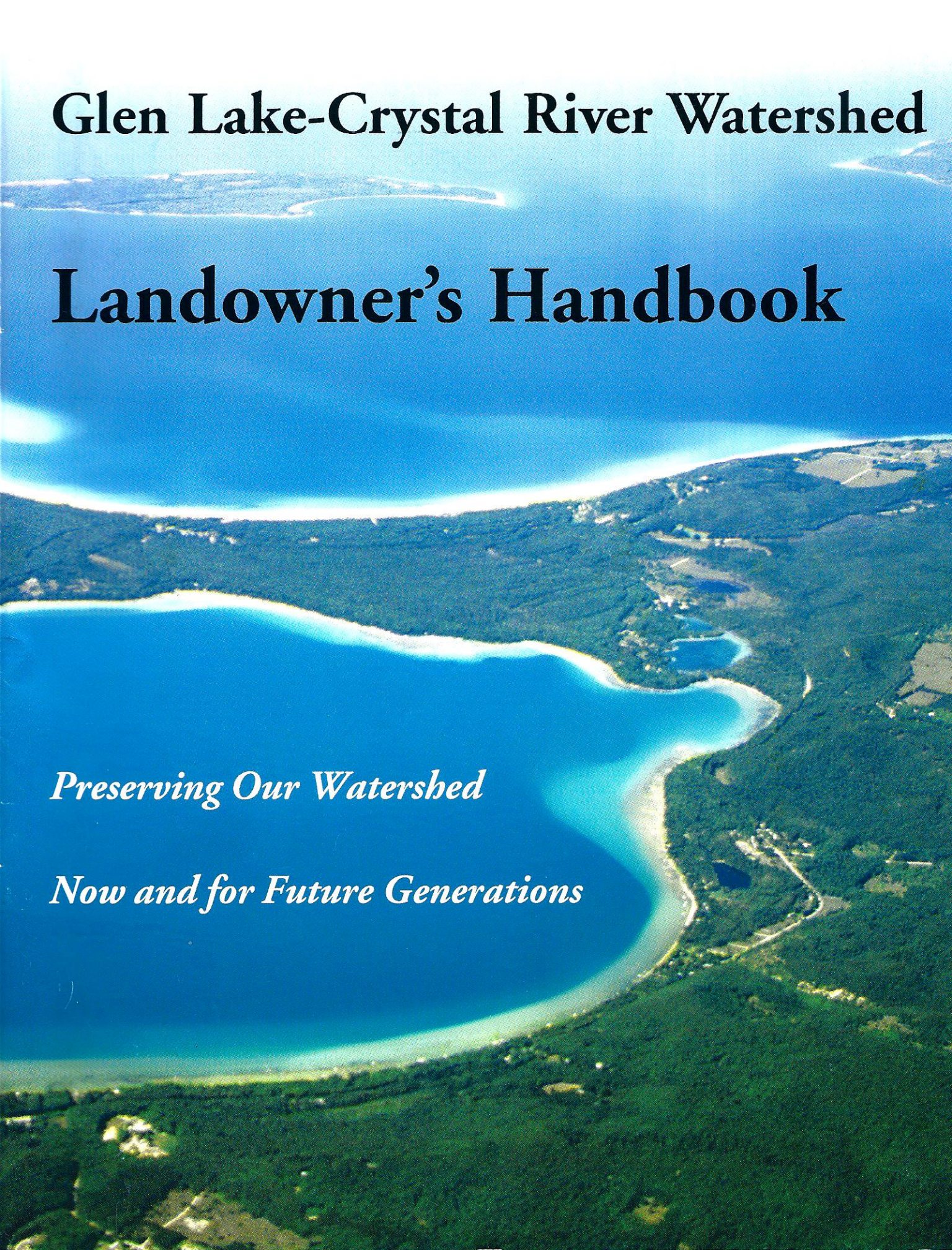
Glen Lake-Crystal River Watershed

Landowner's Handbook



Preserving Our Watershed

Now and for Future Generations

The Glen Lake-Crystal River Watershed
Landowner's Handbook

by Mark Stone

In collaboration with Sarah Litch
and members of
the Glen Lake Association

www.GlenLakeAssociation.com

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Living Where Nature Comes First

The waters of Glen Lake have nourished generations of human inhabitants—from the days when natives wintered on its shores, through the arrival of European settlers and the resettlement by today's residents. Even now, after the clearing of the primeval forest, the mining of the soil and the surge of urban development, Glen Lake remains an excellent example of a pristine northern Michigan lake. It has endured. Whether despite human activity or because of human activity, Glen Lake remains a symbol of the quality of life that northern Michiganians have come to treasure.

But how long will the waters of Glen Lake remain clear and healthy?

The fate of Glen Lake-Crystal River watershed stands at an historic crossroads. The urban growth of the Traverse City region is spreading into the lake basin, and with it, many of the practices that have converted so many pristine lakes into weed choked ponds. But today, we have the tools and techniques at our disposal to change the habits of the past—we can enjoy Glen Lake and its environs and at the same time protect its water quality.

This publication explains how you, as a member of the Glen Lake community, can contribute to the well-being of Glen Lake, participate in the protection of this valuable resource and, in the process, enhance the value of your property. In the following pages, you will read about the physical characteristics, history, and prognosis for the future of Glen Lake. We will introduce you to the problems, the causes, and the tools at your disposal to protect the lake's water quality.

The quality of our water will be the gauge by which we measure our success. As the water quality goes, so goes the fate of the natural systems. Like the proverbial canary in the mine, the waters of the Glen Lake-Crystal River (GL-CR) Watershed can tell us about ourselves, the state of our general health, and the grave risk of carrying on with the status quo.

Watershed Dynamics....4

The Problem—Threats to the Watershed....14

The Solution—Best Management Practices....22

Critical Areas and Land Protection....46

Community Action 52

The Watershed Today

What we call the Glen Lake-Crystal River Watershed includes all the land areas that drain into Glen Lake.

What we call the Glen Lake-Crystal River (GL-CR) Watershed includes all the land areas that drain into Glen Lake. It encompasses a 19.4 square mile portion of Leelanau County (12,415 acres) including portions of Glen Arbor, Empire, Kasson and Cleveland Townships. From Glen Lake, the GL-CR Watershed drains through Fisher Lake and the Crystal River into Sleeping Bear Bay and Lake Michigan. (See the map on pages 28 and 29.)

Big Glen Lake has a surface area of 4,870 acres and includes 10.5 miles of shoreline. The lake has a maximum depth of 130 feet and a mean depth of 70 feet. It has been classified as an oligotrophic lake and is considered to have excellent water quality.

The much shallower Little Glen Lake has a surface area of 1,400 acres and includes about 6.5 miles of shoreline. The lake has a maximum depth of 13 feet and a mean depth of 6.2 feet. It is classified as a mesotrophic lake and is considered to have good water quality.

Big and Little Glen Lakes are joined by a shallow channel under the causeway of M-22, known locally as The Narrows. (Except where appropriate to distinguish the two bodies of water, this book will refer to both lakes as simply Glen Lake.)

The Glen Lake-Crystal River Watershed is a subwatershed of Lake Michigan, which accounts for a portion of the Great Lakes Watershed. The Great Lakes Watershed finishes its trip to the Atlantic Ocean through the St. Lawrence River—one of the many great rivers that drain the other watersheds of eastern North America.

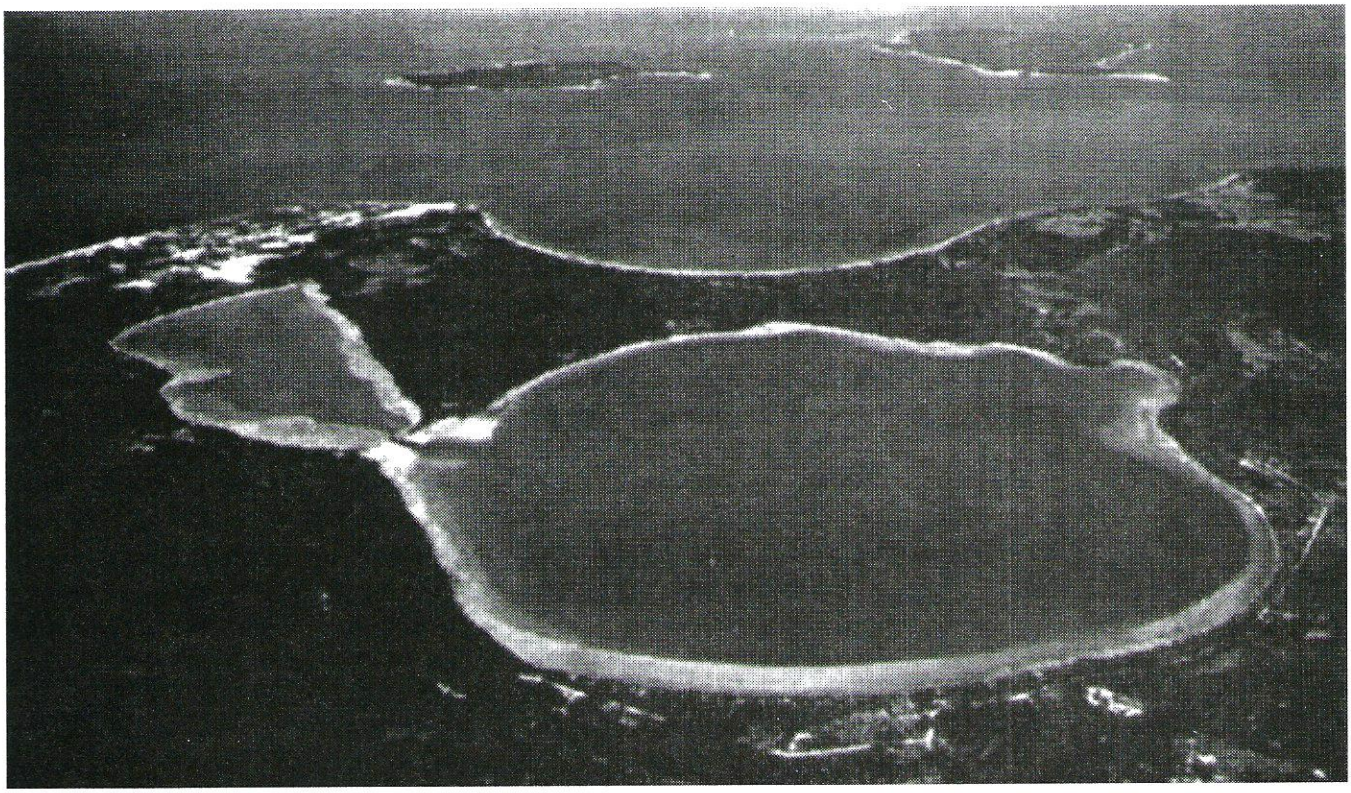
The story of a watershed begins with a simple drop of rain, or a flake of snow. To better explain the dynamics of a watershed, we'll now trace the life cycle of a raindrop, a ground's eye view, if you will, of how a watershed works.

The Life Cycle of a Raindrop

Unfortunately, with the increase in human activity the voyage of a raindrop is likely to encounter a paved driveway, a road crossing, a run through a construction site, or a dash across a recently fertilized lawn. In each of these cases, the rainwater will collect tiny particles of sand, soil, nutrients, and toxic chemicals that accumulate into larger and larger quantities called non-point source pollution.

Michigan is blessed with an abundance of fresh water that most people in the world can only dream about. Northwest Michigan's position on the eastern shore of Lake Michigan exposes it to a constant supply of lake effect rain and snow riding the prevailing westerly winds and dropping on the forests and fields of the countryside. From the moment those raindrops strike the earth they seek out the path of least resistance and move downhill under the invisible force of gravity. But each raindrop could end up taking any number of routes to a variety of destinations.

The rain that strikes the ground in a light spring shower may fall among the foliage and seep into the ground. There it will probably be absorbed by the root system of some thirsty plant. Or, it



may trickle along the surface of the ground a short while until it reaches a depression where other raindrops gather with it, and together they form a wetland. In the wetland, if it once again avoids the absorbing roots of plant life, it will work its way below the root zone into the sandy subsoil where it will continue a very slow downward migration into the groundwater system. Eventually, the raindrop and its fellow travelers will strike a denser soil level comprised of clay which the groundwater cannot easily permeate. The water flow will then accumulate until the pressure pushes the flow horizontally through the porous gravel and sand formations above the clay. These formations, called "water bearing sand" are the target of well drillers on the surface, and indeed, at this point the raindrop could very well be sucked into the intake end of a household water well.

More likely, the raindrop will remain in the groundwater for years, possibly hundreds or thousands of years, slowly moving further and further down into the bottom of the groundwater basin. The final destination will usually be an underground seepage into the bottom of a spring-fed lake, stream or river. Either there, or farther downstream, the raindrop will eventually evaporate back into the atmosphere and start the trip all over again.

The rain that strikes the ground during a heavy rainstorm may take a very different path. Since the ground can only absorb so much rain at a time, instead of soaking into the ground, the raindrop will probably flow further over the surface of the ground, join with others of its kind and form rivulets of run-off. The rainwater run-off will hurry downhill and join with other rivulets to form small tributaries, which in turn begin to join together, and before long the flow becomes a stream and then a full-fledged river. In a

The Two Glen Lakes

This aerial view shows Big Glen Lake and Little Glen Lake (the smaller body of water to the left) from the southeast with Lake Michigan in the background (South and North Manitou are visible on the horizon at top). At one time a bay of Lake Michigan, geologists believe that lower water levels eventually cut Glen Lake off from the bigger lake a few thousand years ago. Preserving the heavy forest cover in the watershed is a key factor in maintaining the lake's water quality.

(Photo provided by the courtesy of Aerial Graphics of Grand Rapids, MI. Reprints available, (800) 780-3686)

A watershed comprises the complete system of surface water and groundwater, taking in the entire drainage basin for a main watercourse... The actions of every riparian, lakeside or streamside, impacts the quality of every other riparian's water.

As goes the quality of the Glen Lake-Crystal River watershed—so goes Glen Lake and the Crystal River. And it befalls every individual to use the precious watershed responsibly and protect the lifeblood of our community.

pristine Michigan woodland environment, the raindrop would likely dodge and weave through vegetation on its entire route to the river, and would reach the watercourse filtered and clean.

Unfortunately, with the increase in human activity the raindrop's route across the surface of the ground is more likely to include a paved driveway, a road crossing, a run through a construction site, or a dash across a recently fertilized lawn. In each of those cases, the rainwater—now called stormwater—will collect tiny particles of sand, soil, nutrients and chemicals that roll along with the flow and, like the raindrops, gradually accumulate into larger and larger quantities. When they reach the deeper, slower current of a stream, the heavier particles settle to the bottom and coat the gravel, disrupting and—if the particles accumulate in enough quantity—possibly destroying the normal life cycles of the creatures that live among the gravel. Likewise, aquatic plants and bacteria that play limited roles in the lake's natural ecosystem gorge themselves on the new nutrients and multiply into unnatural size and numbers. In other words, the watershed can be profoundly altered by human activity that we view as "normal."

A watershed comprises the complete system of surface water and groundwater, taking in the entire drainage basin for a main watercourse. Watersheds are shaped by gravity, terrain and the movement of water. Since water is so critical to life, watersheds provide the sustenance of human communities and define cultures.

Watersheds also *define* communities. As Glen Lake connects us to places as far flung as the ocean, so it connects us in a special way with our neighbors. Caring for the watershed is a community responsibility—the actions of every riparian, lakeside or streamside, impacts the quality of every other riparian's water. As goes the quality of Glen Lake's watershed—so goes Glen Lake. And it befalls every individual to use the precious watershed responsibly and protect the lifeblood of our community.

Geology of the GL-CR Watershed

If you had stood at The Narrows at the time of, say, 15,000 B.C., you would have found it a most inhospitable place. Actually, the closest you could have stood to The Narrows would have been 3000 feet straight up, because the ice covering the area at that time was over a half mile thick. Some tens of thousands of years ago the earth went into a cycle of cold weather. Average temperatures dropped. In the northern reaches of the globe, snow remained throughout the summer months. Each winter season, the snow steadily accumulated and the weight of additional snow compacted the lower levels into ice. Thus were born the glaciers.

But the ice was not content to lie still. To escape the increasing pressure from all that weight, the edge of the ice cap began to creep forward. Like most things that flow, the ice sought the paths of least resistance, like river valleys, and dug those depressions even deeper. The ice flows scraped the bedrock and bulldozed huge piles of rocks and sediments into hills called moraines. The

glaciers acted like great primordial plows, hence geologists use the term "till" to describe the heaped-up debris the ice formations left as ridges. One ancient glacier stalled temporarily, and left what geologists have coined the Manistee Moraine, a formation that now includes the rolling uplands of the GL-CR Watershed.

By 10,000 B.C., temperatures were on the rise, and the glaciers had begun to decline. People often refer to the "retreat" of the glaciers, but actually glaciers don't retreat, they only advance—and then they just melt away. In the process of melting they created huge lakes in depressions of the earth along with torrents of runoff. As the land was relieved of the great pressure of the glaciers, the ground began to rise. Melt waters saturated the porous layers of glacial till, gravel, and sand, gravitating downward until they met the resistant layers of impermeable clay or bedrock and there the melt water became groundwater.

The levels and shape of the Great Lakes changed frequently by geological standards, as did their direction of flow. In the not so distant past, Glen Lake itself was, more or less, a bay of Lake Michigan; as Lake Michigan was once a tributary to the Mississippi River. The Great Lakes' surface levels eventually dropped and began to stabilize—and the great body of water that would come to be known as Lake Michigan receded to its present shoreline. The common sand deposits of our region are the remnants of old Great Lakes' shorelines, sand shoals, and well-sorted sands and mucks deposited in the shallows of the ancient lake.

For thousands of years nature was left undisturbed to complete its work. The initial roaring rivers of glacial melt slowed and narrowed to quiet streams and rivers. Finer sediments accumulated and provided plants an opportunity to take root. As plants and ani-

Early Logging

Winter was the work season of choice for the early loggers since frozen ground and snow allowed easier passage for the horse drawn lumber sleds into the hills and swamps around Glen Lake. Customary practice was to clear cut stands of trees and drag the logs to the nearest watercourse or railway line for transport to the sawmill. Sawlogs were stockpiled, usually as large rafts floating in the lake, during the winter months in order to have enough raw material to feed the sawmills during the year. The team pictured above is believed to be working for D.H. Day because it shows oxen skidding logs from the woods—Day's teams were some of the few in the area to use oxen.

Clear cutting left little cover on the scarred land after the trees were removed and allowed large amounts of soil to erode into nearby streams. It took decades for the ecosystem to recover.

(Photo provided by the courtesy of Empire Area Heritage Group.)

The watershed remained in this totally natural cycle for thousands of years. Until an epochal event: the arrival of western civilization.

mals died they added nutrients to the ground and their bodies became the building blocks of topsoil. Beech and maple trees claimed the most fertile uplands of the watershed, while hardy oak and pine stands populated the poorer drought-prone soils. In the wetlands, white cedar, red maple, black spruce, and black ash thrived in the plentiful moisture. And the water changed. The sediments that had been swept off the glacial till by runoff and clouded the glacial rivers, became increasingly trapped by vegetation to aid in the building of soils. Eventually the plant life became a giant living filter, constantly purifying the waters and providing a haven for trout and grayling. The watershed remained in this totally natural cycle for thousands of years. Until an epochal event: the arrival of western civilization.

The Settlement Era

Imagine how the Glen Lake basin appeared to the first European settlers.

Imagine how the Glen Lake basin appeared to the first European settlers. The pristine waters of the lake teemed with an abundance of fish, the forests and meadows with ample game. The basin and surrounding hillsides were thick with stands of giant hardwoods. It was a land of opportunity—a land to thrive on. They travelled through so much equally pristine land on the way here, that they probably believed the forests to go on infinitely. America needed food, and here were the fish and game. America needed lumber to build, and here were the trees.

Before the arrival of European immigrants, for thousands of years Native Americans lived in a fairly stable balance with the natural systems as hunters, gatherers, and opportunistic farmers—for short periods they impacted areas and then moved on, allowing the ecology to regenerate. The region around Glen Lake was exceptional even in that era of general abundance. The plenitude of fish and the ease with which the villagers captured them in the shallow water offered a ready food supply. Present day Glen Arbor was even the site of a Native American council ground.

In 1848, John LaRue, reputed to be the area's first European American settler built a cabin at the mouth of the Crystal River and established a trading post. At the time, South and North Manitou were already waypoints of the Great Lakes shipping traffic and well on the way toward settlement. The first settlers to join LaRue engaged mostly in coopersmithing (making barrels), to supply shipping containers for the salted fish that LaRue produced from his fish and fur trade with the native Americans. Soon, however, the hunting and gathering economy was pushed aside by industry, as the first ferry dock on the mainland was constructed at Sleeping Bear Bay in 1857 to supply cordwood fuel for steamships. (Steamships had already been servicing Glen Arbor since 1855.) Two years later in 1859, John Fisher dammed the Crystal River for the use of Glen Arbor's first sawmill and the production of lumber began.

The captains of American industry rolled up their sleeves and set to work. Fueled by the Homestead Act of 1862, lumbermen systematically stripped the forests, milled the wood and set it upon ships

for destinations like Chicago and Detroit. After Fisher, lumbermen built three more sawmills in the watershed: W. D. Burdick on the east side of the lake (now Burdickville), J. O. Nessen on the west side, and D. H. Day to the northwest. Nessen's operation included the construction of a short rail line to ship the lumber to the Glen Arbor docks. Typical of the time period, Nessen's investment was short termed. Within a few years he'd depleted his forest stands, run short of raw material, dismantled the sawmill, and moved on.

D. H. Day's commitment to the area was more permanent and diversified. Besides his lumber mill, Day established an orchard and produce operation, the Glen Haven Canning Company and a steamboat service. As a lumberman, he appreciated the importance of sustainability and managed cut over areas to improve regeneration. Today, Day's legacy is preserved in his cannery buildings, now part of the Sleeping Bear National Lakeshore, and his farm nearby.

By 1910, Glen Arbor's lumber boom was drawing to a close, but a new economy was beginning to take shape: resort tourism. Glen Arbor's proximity to Lake Michigan and the ferry traffic offered easy access to the increasingly affluent urban population of Chicago and Glen Arbor was quickly discovered as a resort destination. Former rooming houses for the lumberjacks, such as the Grady Inn (now the Sylvan Inn), were converted to tourist hotels. Other proprietors followed suit. Places such as Walkers Inn, Langrick's Inn, Kum-an-Dyne and the Homestead were popularized in the downstate press. The student dormitories of the Leelanau School (established in 1921), served as guest rooms during the summer tourist season.

D. H. Day could see the trend and adjusted accordingly, in fact, his vision was ahead of its time—maybe too far so. In the 1920s, D.

Weekend Excursion ~ 1910

Taken around 1910, this photo of the S.S. Missouri docked at Glen Arbor testifies to the importance of ferry service to the early community. Northern Michigan Transportation Company billed the Missouri's schedule as the perfect getaway for busy Chicago businessmen. During the summer months, the ship left Chicago at 6:00 p.m. on Friday, arrived at Glen Arbor on Saturday morning, left Glen Arbor Sunday evening and returned to Chicago by 8:30 a.m. on Monday morning.

(Photo provided by the courtesy of Sleeping Bear Press, from the volume "Vintage Views of Leelanau County" by M. Christine Byron and Thomas R. Wilson.)

State Park No. 1

Located between Glen Haven and Glen Arbor, Michigan State Park No. 1, also called D. H. Day Estate Park was actually one of the first State Parks as its name suggests. In an act of enlightened self-interest, D. H. Day donated the property to the State. His businesses in Glen Haven then catered to the campers that stayed in the facility and the campers in turn carried word of the area's attractions back home. In 1929 the Park hosted 44,891 visitors. By contrast, the Traverse City State Park hosted 27,403 visitors the same year. The facility was integrated into the Sleeping Bear National Lakeshore in the 1970s—which now typically hosts over a million visitors per year.

(Photo provided by the courtesy of Sleeping Bear Press, from the volume "Vintage Views of Leelanau County" by M. Christine Byron and Thomas R. Wilson.)

H. Day laid out the plan for a resort development, he coined as "Day Forest Estates." The resort included a meandering golf course surrounded by home sites on forested lots. He succeeded in finishing the golf course, but the Great Depression forced him to abandon the development. Hikers and boaters with a keen eye can still make out the location of overgrown fairways on the slopes of Alligator Hill. In design, Day's vision was the same formula which led to the success of several northern Michigan resorts.

The resort industry drew a transient population to the Glen Lake area in the summer, but industry based on natural resources pretty much collapsed by the 1930s and with it the year-round population. Only pockets of standing timber remained. Excessive harvesting of fish and game destroyed commercial fishing, trapping and hunting. Farming activity was little more than subsistence because the weak and sandy soils of northern Michigan, further depleted by erosion, were no match in productivity to the fertile lands being settled elsewhere. Communities all over northern Michigan followed the same trend as the natural bounty of the area was exhausted—and so was the region's economy. Eventually, ferry service to the area ceased adding greatly to the new isolation.

In the wake of the lumbering activity, surface runoff on the denuded land carried huge amounts of sediment into the lakes and their tributaries. The outhouses and garbage dumps introduced new types of nutrients into the watershed that began to change the chemical balance in the water. Certain types of microorganisms became abundant and altered the food chain. Early on, surface water became unsafe to drink. As shallow hand-pump wells became tainted, and outbreaks of disease became more frequent, the fragile dynamics of our water supply began to dawn on people. Deeper wells were drilled, septic tanks were introduced, and health codes

established to protect people from themselves.

Looking at the forested hillsides around Glen Lake and its pristine water, it's sometimes difficult for today's residents to understand how poor the environmental quality of the GL-CR Watershed was early in the 20th century. So, how did we get from there to here? The answer is relatively simple: the human population crash and the decades of low impact that followed it. The absence of human activity allowed the natural systems to rebound unhindered, the forests to regenerate, the waters to filter, and the fauna to repopulate.

Looking at the forested hillsides around Glen Lake and its pristine water, it's sometimes difficult for today's residents to understand how poor the environmental quality of the GL-CR Watershed was early in the 20th century. So how did we get from there to here?

By 1961, the beauty of the region had recovered to such an extent, that a small group of visionaries led by U. S. Senator Philip Hart initiated legislation to establish the Sleeping Bear Dunes National Lakeshore and preserve parts of the area on a permanent basis. A debate ensued with some local resistance, however the new Park eventually opened for business in 1976. Today Sleeping Bear Lakeshore owns over 40% of the land in the GL-CR Watershed—a significant factor toward the goal of keeping the watershed in a natural condition.

Now, we are in the midst of a new population surge that appears to be a lot more permanent. It seems like everybody wants to live around Glen Lake. Is this the beginning of just another boom and bust cycle, or will we break the pattern and create a sustainable community?

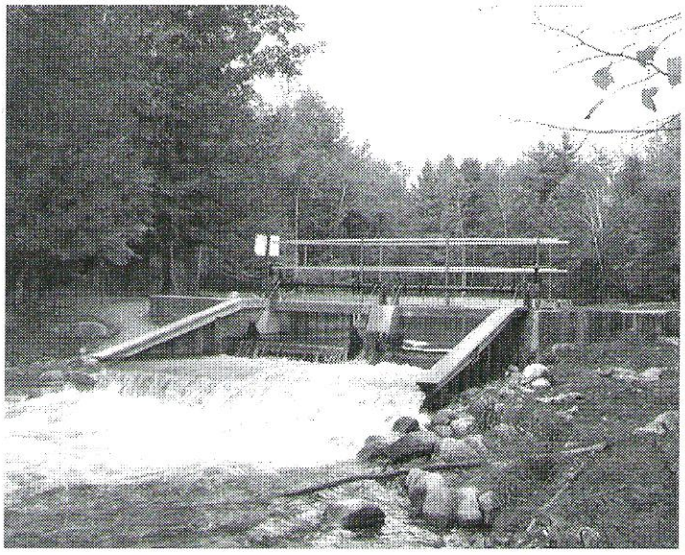
The Modern Era and The Glen Lake Association

In its early years, the Glen Lake Association organized around the issue of water levels. In the 1920s and 30s, the dam on the Crystal River was no longer functioning and the level of Glen Lake and the Crystal River fluctuated widely with the weather. In 1938, the Fisher Mill site at the headwaters of the Crystal River was deeded to the Glen Lake Improvement Association—the precursor to the Glen Lake Association. However, even after the dam was rebuilt, balancing the water levels in Glen Lake and the Crystal River was a continuing challenge. Finally, after a survey of riparians in 1944 the county court set the level at 596.75 feet above sea level and established the measurement point at the south pier of the Narrows Bridge.

According to the last census, Leelanau County grew at one of the fastest rates in the Grand Traverse Region, the State of Michigan and the entire midwestern region.

The Glen Lake Association (GLA) was founded in 1954 by Ove Jensen, Arthur Huey and Dr. Charters. The stated object of the association was "for the purpose of advancing the general interests of Glen Lake and its surrounding townships and to better the living conditions, aid in the development and improvement of the above and provide a better life in the Glen Lake area." The incorporators and Board of Directors were William Peppler, Harford Field, Leonard Brown, and Ove Jensen. Two others with a strong commitment to the association in the early years were William Downey and Sarah Johnson. (Sarah volunteered with the association for 25 years!) That same year, the Glen Lake Improvement Association deeded the dam and its two-acre site and other assets to the newly formed Glen Lake Association. The circuit court directed the Glen Lake Association to assume control of the lake level and the dam.

In 1955, the Glen Lake Association purchased the lookout site on Burdickville Hill from the estate of T.H. Goodspeed and assigned it to



The Crystal River

Recreational canoeists have been enjoying the unspoiled beauty of the Crystal River for generations and continue to be drawn to the watercourse. In 1940, a writer for the Leelanau Enterprise described the route this way: "When you are drifting down this stream you feel as though civilization with its myriad worries and cares is far removed—that this is the real world and that the other is just some fretful dream."

For over 50 years, GLA volunteers have operated the Crystal River dam and monitored the levels of both Glen Lake and the Crystal River. GLA also maintains the dam and recently rebuilt the structure with GLA funds. Though water levels have spawned some controversy in recent years, GLA is dedicated to maintaining appropriate levels for both the river and the lake. The GLA Water Level Committee now consists of both Glen Lake riparians and Crystal River riparians. They interface with the Glen Lake-Crystal River Technical Committee comprised of representatives of the GLA Water Level Committee, the Crystal River riparians, the National Park Service, the Michigan Department of Environmental Quality, and the Leelanau County Drain Commissioner.

(Crystal River Dam photo provided by the courtesy of Glen Lake Association. Canoeist photo provided by the courtesy of Sleeping Bear Press, from the volume "Vintage Views of Leelanau County" by M. Christine Byron and Thomas R. Wilson.)

the Leelanau County Road Commission. This site is now known as Inspiration Point. It is often the place where people first fall in love with this "jewel of a lake." GLA's president wrote in 1957, "The purpose of the Glen Lake Association is to preserve the natural beauty of this vicinity and to promote the safety and pleasure of all the community." A "bold action" was taken to reduce the dues from $5 to $2 so that more people could contribute to the work of the association!

In the 1980s, GLA created a Citizen's Council to tackle issues such as swimmer's itch, lake levels and zoning, which later evolved into the 15 committees of the present day GLA. The GLA conducted a cladophora study of the lake and a follow-up questionnaire to riparians—a program which continues to this day by the GLA biologist using a Stewardship Checklist. About the same period, the GLA began taking daily lake water level readings at the Narrows under contract with the United States Geological Survey.

In the 1990s the principal areas of concern for GLA broadened out into swimmer's itch control, maintenance of the dam and water levels, water safety, water quality in the lake and watershed, and the coordination of actions of the GLA with township boards, the National Park Service, Department of Natural Resources and Department of Environmental Quality. In 1991, The Glen Lake Association in concert with the MDNR, and the United States Environmental Protection Agency conducted a major water quality study of Glen Lake. Also, Glen Lake was one of the first sites in the nation for a research study to control swimmer's itch in an inland lake. (For more information on the GLA's activities, see page 52.)

Visions of the Future and Current Trends

According to the last census, Leelanau County grew at one of the fastest rates in the Grand Traverse Region. From 1990 to 2000 the county's population rose 28% and future projections indicate a steady growth rate for years to come. This means that over 10,000 more people will be moving into the county by the year 2020. They will be attracted to Big Glen Lake, Little Glen Lake and the surrounding area partly because of the pristine water quality and the recreational attractions. But, as more and more people discover these beautiful lakes, the more difficult it will be to maintain their current outstanding water quality.

Additionally important, is the fact that Glen Lake lies at the foot of surrounding hills that are mostly forested. What happens uphill and upstream will find its way downstream and eventually impact Glen Lake.

With this in mind, a number of organizations working in the watershed came together in 2002–03 to write a Watershed Management Plan. The organizations include: the Leelanau Conservancy, the Glen Lake Association, the Friends of the Crystal River, Conservation Resource Alliance, Leelanau School, Glen Lake/Maple City School District, the four local townships, Leelanau County government offices, the MDEQ and MDNR, the EPA, and the National Park Service. These organizations are now working together with a management plan that includes goals and objectives that will help maintain high quality resources in the GL-CR Watershed.

Much of the future development may occur along steep slopes high above the lakes or along the remaining undeveloped shoreline and wetland areas. Small cabins on forested lots are being replaced by large homes with lawns and paved driveways. Once trees are removed and replaced by lawns and impervious surfaces, sediments and pollutants flow into the lakes at a much greater rate and have a commensurately greater impact on fish habitat, water clarity, and weed growth. Fertilizers and weed killers used on these lawns eventually wind up in the lakes, as do nutrients from septic systems. In addition, more and more seasonal residents are moving to the region on a permanent basis and having more dramatic impacts on the lakes for simple reasons, such as a septic system that operates twelve months per year instead of six.

In recent years, there has also been a growing concern about the effect of pollutants from hundreds or even thousands of miles away impacting lakes with large surface areas like Glen Lake. In this scenario, pollutants from industrial activities find their way into the jet stream and are, eventually, deposited in the lakes. Research into what is called "atmospheric deposition" is now under way to determine where these chemicals originate. For instance, significant levels of mercury have led to health advisories and cautions about the consumption of larger fish caught in Glen Lake, yet the lake has never been the site of a tannery or other industrial operation that used mercury. Scientists suspect that this toxic chemical among others originate from distant sources.

Ironically, the very features that attract new residents—clean air and water, safe streets, uncrowded recreational lands, and available well-paying jobs—are the very features that are most threatened by a surge in population growth. Public officials see the imminent growth and have developed comprehensive plans for the four townships surrounding Glen Lake. These townships in the watershed are zoned communities, but zoning regulations alone will not guarantee the quality of life around Glen Lake. The future of our environment boils down to the activities of each and every member of the watershed—in our homes, work places, playgrounds and all points in between.

Clearly, if we are to preserve the GL-CR Watershed in a condition approaching what it is today, watershed residents will have to break the conventional pattern and search out new ways to live in harmony with natural dynamics. The ideas in this handbook provide an excellent beginning.

The Friends of the Crystal River

The Friends of the Crystal River came together in 1986 in response to a proposal by the Homestead to build a golf course and housing development on the banks of the Crystal River. Besides breaking the tranquility of the Crystal River, the development would have disrupted a rare and fragile wetland known as the Crystal River Dune/Swale Complex. So, the Friends advocated for the addition of the property to the neighboring Sleeping Bear National Lakeshore instead.

From a group of about twelve people, the Friends quickly grew to over 700 members and many people in the area have membership in both the Glen Lake Association and The Friends of the Crystal River. Friends—as well as thousands of others—use the river for recreational activities such as boating, fishing, swimming and for educational, artistic and scientific activities.

The mission of the group is "to explore ways and means of preserving the natural, ecological, historic, recreational, aesthetic and educational values of the Crystal River and its adjacent lands; protect the sensitive wetlands, floodplain, flora and fauna in this unique watershed; maintain and improve the water quality of the river; educate the public regarding the use and enjoyment of this classic wetland's natural resource; and raise money and take other action necessary for the protection of the Crystal River."

Checks and Balances

Ecosystems are systems of checks and balances. Human activity removes some of the checks and throws the system out of balance.

Ecosystems are, by definition, systems of checks and balances. Each element, from the inorganic rocks in the stream bed, to the deer grazing in the streamside meadow, plays an important role in the system. In the natural order, when one member of the system becomes too numerous, nature has its own checks and balances to restore order. A principal objective of long-term water quality management is to keep the natural systems intact and make use of nature's tremendous capacity to clean itself.

As we have seen time and again, humans usually don't encounter the natural checks and balances to their activities until long after the damage has been done. In effect, humans must be self-regulating in order to protect the very land and water from which they derive their sustenance. Hence, the origin of the Health Department, FDA, EPA, and the myriad of other regulatory agencies charged with the protection of our health and welfare.

Waterfront Living and Stewardship

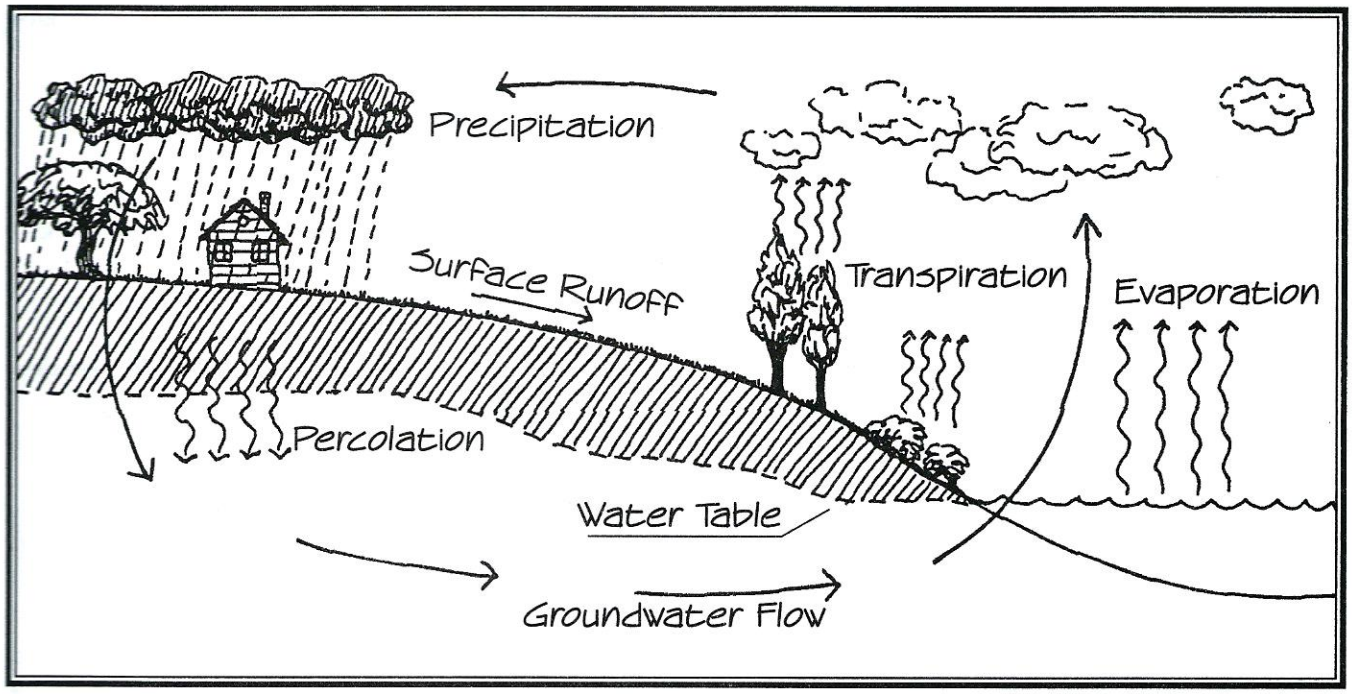
Green keeps the water clean.

Ironically, the home on the water that represents a high quality of life to the owner (something one has worked many years to attain) and fosters a deeper appreciation of nature's beauty—is itself a disruption to the natural world that the inhabitants live there to appreciate. From the first shovel of dirt when breaking ground, to the last flush of the toilet into the septic tank, your house negatively impacts the ecosystem around it and to a much greater extent than most people realize.

As you read in the last chapter, the lakes of northern Michigan contain clear water for a reason—they are relatively free of nutrients that cause heavy biological activity in the lake. Nutrients occur naturally, but a series of natural coincidences have combined to leave these lakes nutrient poor, and therefore exceptionally clear. Firstly, the geological forces that created the lakes also left mostly sandy and well drained soils that haven't accumulated particularly high levels of nutrients to begin with. Secondly, the lakes are young by geological standards and haven't had much time to "age" by accumulating nutrients and organic matter. Thirdly, for millennia the shores and tributaries of Glen Lake were buffered by heavy vegetation that absorbed much of the nutrients before they reached the lake. In short, green keeps the water clean.

Non-point source pollution is the accumulative effect of many different sources of contamination—any one of which, by itself, appears to be a minor threat to the water quality.

Water quality degrades remarkably fast when human activity strips away the natural vegetation from the lakeshore and replaces it with the conventional suburban landscape. Collectively, hundreds of homeowners apply thousands of pounds of fertilizers to their new lawns. Each year, hundreds of thousands of gallons of



waste water soak into the ground around Glen Lake from septic systems. A substantial portion of the nutrient content in the fertilizers and waste water migrates into the lake—paved surfaces, roof decks and the loss of shoreline vegetation all expedite the movement of nutrients into the lake. If you've ever seen the suburban lakes of metropolitan Detroit, you know that aquatic weed growth and murky water quickly follow in this devolutionary process.

But Glen Lake doesn't have to become another murky weed-choked lake. If we shift our thinking—embrace a new paradigm—Glen Lake could become an even more pleasant place to live. This chapter and the stewardship checklists will help set you in that new direction, and, you will find in the following suggestions the potential to deepen your appreciation for the lake even further. But before we talk about the solutions, let's first take a look at the problems.

Non-Point Source Pollution

The principal threat to Glen Lake's water quality begins with three primary sources: phosphorus, nitrogen, and ordinary sediments. Phosphorus and nitrogen are naturally occurring elements that act as essential chemical building blocks for living organisms. Sediments are water borne particles of sand, clay, and plant and animal debris—the basic "stuff" of soil. In the appropriate quantities and place, phosphorous, nitrogen and sediment are critical to all forms of life and, hence, critical to the Glen Lake-Crystal River ecosystem as well. However, humans use phosphorous and nitrogen in everything from food and household products, to lawn and garden fertilizer, and it seems we are always breaking the soil somewhere. Because these elements are such common by-products of human activity and waste wherever humans live, these com-

The Water Cycle—Basis of Life in the Watershed

A hydrology cycle represents the constant movement of water from the earth's surface to the atmosphere, and back again. In the process, water becomes a force of change, as it erodes and carries various materials along with it. Non-point source pollution can join the water flow at any stage of the cycle: as air pollution, stormwater runoff, soil erosion, groundwater contamination, and many more ways. The key to protecting water quality is the basic understanding of the water cycle and the problem of how contaminants get into the water cycle. The solutions can be surprisingly simple.

pounds find their way into the watershed system in larger than natural amounts and wreak havoc.

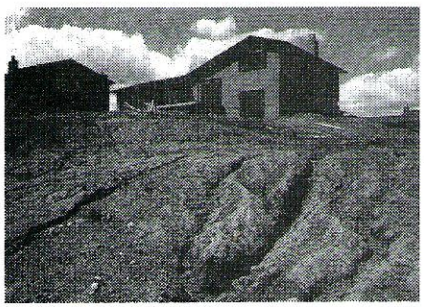
We call these types of pollutants "non-point source pollutants." Scientists coined the term "non-point source" to distinguish these substances from "point source" pollutants. Point source pollutants are the classic smoking gun: i.e., an industrial waste pipe emptying chemicals into a river. Non-point source pollutants become a problem because of the cumulative effect of many different sources—any one of which, by itself, appears to be a minor threat to the watershed.

Phosphorous Levels in Glen Lake and Other Selected Lakes

Lake	County	K in ppb.
Glen Lake	Leelanau	4
So. Lake Leelanau	Leelanau	5
Higgins Lake	Roscommon	6
No. Lake Leelanau	Leelanau	7
Crystal Lake	Benzie	7
Indian Lake	Kalamazoo	11
Ore Lake	Livingston	18
Robinson Lake	Newaygo	32

(Phosphorous in parts per billion. All tests performed in 1995. Michigan DNR Data)

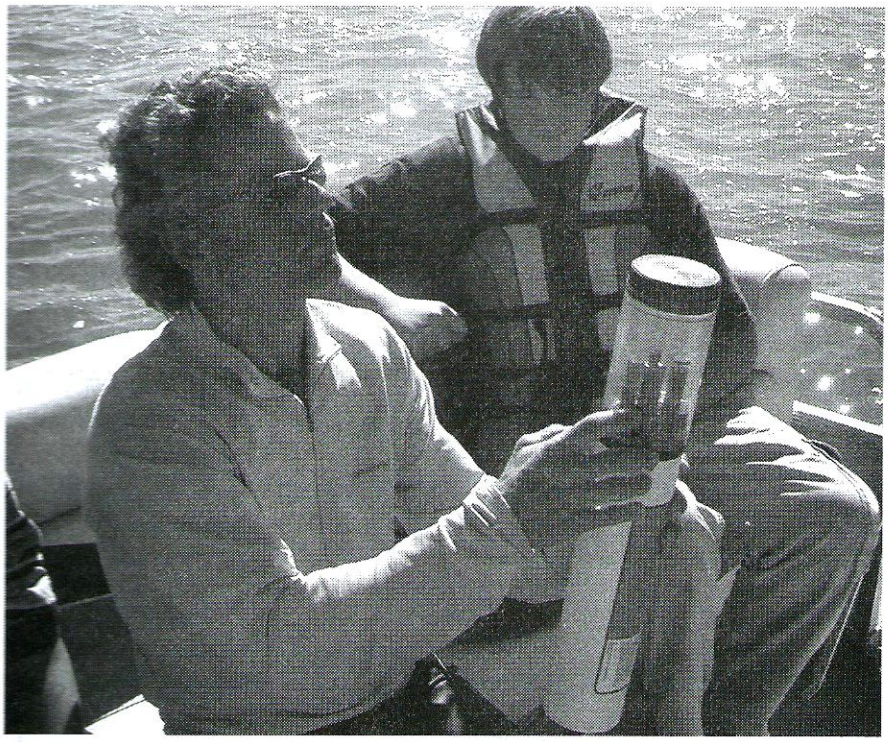
Phosphorus—The Growth Regulator



Construction sites can erode at 2000 times the rate of stable vegetated lands. In the process, tons of loose sediments are released into nearby drainage ditches and creeks carrying nutrients and other chemicals. With construction and development spreading into once rural areas, sediments from construction have become a leading cause of non-point source pollution.

A little bit of phosphorus goes a long way—which is a good thing for life on earth. The element is not especially plentiful and yet, plant and animal growth rates are directly related to the amount of available phosphorus. Too low phosphorus levels in soil will result in stunted plant growth. Each time a crop is harvested from a field, or grass mown and collected from a lawn, a certain amount of the phosphorus is removed with it. To replenish the supply of available phosphorus, farmers and home gardeners spread fertilizers and manures. In addition to fertilizer, an array of household, office and factory chemicals—from matchheads to detergent—contain phosphorous compounds as an ingredient. Eventually, through overuse or improper disposal, much of this phosphorus will attach itself to sediments and hitch a ride in rainwater run-off, septic leachate, or wind, and eventually work its way into surface waters.

As phosphorus makes its way into the watershed it will continue to do what it does best—encourage growth of algae and weeds. Only now, in the biology of a stream or lake, too much phosphorus will *over-stimulate* the growth of aquatic weeds and algae. The effects of too much phosphorous gradually become apparent: sandbars turn into weedbeds, clean rocky shoals become covered with slime and waving mosses, and clear water is clouded by an



over-abundance of microscopic plant life. By then it may be too late. More plant life produces more dead plant material and the accelerated decay of plant matter robs the water of its oxygen supply. Meanwhile, the phosphorous accumulates in the decayed material and continues to stimulate growth at higher and higher rates. In the worst cases, phosphorus contamination can literally choke fish and aquatic animal populations to death.

Sediments—The Telltale of Erosion

We've all seen the chalky or muddy colored run-off streaming down the edge of a roadway after a rainstorm. Trace the path of the run-off all the way upstream and you will be certain to find some type of disturbed ground at its origin: a construction site, a newly plowed field, or maybe an exposed bank. Muddy water is the telltale sign of erosion, muddy water is an enemy of life in a stream, and muddy streams create murky lakes.

The "mud" in muddy water is sediments, a mixed bag of soil components: particles of sand, clay, and bits of organic material, that have been dislodged from the ground and carried away by running water. When the sediments enter the creek, the sand and clay settle to the bottom when the current slows down and, over time, can accumulate in thick layers on a creek or lake bottom. The sand and clay seals off the natural gravel streambed that is the critical habitat for the aquatic plants, insects and other creatures that make up the basis for a northern watershed's food chain. Of course, there are some species that can survive in such an environment, but they aren't the species associated with clear pristine northern lakes, such as trout. Eventually, with the heavy accumulation of sediments in a body of water, the native population of fish

A Scientific Approach

Water monitoring and testing is a critical factor in assessing and tracking the health of the watershed and Glen Lake ecosystem. Rob Karner (at left), Glen Lake Association's staff biologist, checks the sensor unit of the GLA's Hydrolab before lowering it overboard to take readings. The Hydrolab is a state-of-the-art device for instantly measuring water characteristics at various depths such as temperature, dissolved oxygen, ph level and conductivity that indicate water quality. Other test equipment used in the GLA testing program include a Ponar dredge, plankton net and depth sounder. Routine water samples are collected and submitted to a Michigan State University laboratory to determine the levels of chemical compounds such as phosphorous and chlorophyll-a.

In 2004, GLA acquired new high tech equipment and GLA's biologist and volunteers collect data on a regular schedule at fixed sites. Test results provide the community with a baseline and ongoing data that is critical to examine trends and provide decision makers with credible evidence to guide policy.

In addition to the water quality testing program, GLA sponsors a cladophora shoreline study and outreach program for the affected shore owners. Cladophora is an algae which only grows in water where a heavy concentration of nutrients is available—thus indicating a possible source of pollution such as a defective septic system. GLA is also in the third year of an aquatic plant survey of Glen Lake in which the group inventories the location, type and density of aquatic plant species in the lake. Thankfully, no invader species such as Eurasian milfoil or hydrilla have thus far been found by the survey.

and the other creatures on which they depend for food will diminish and the stream will become a virtual aquatic desert.

In heavy concentrations, sediments can obstruct critical sunlight for aquatic plants, ruin fish spawning areas, clog the gills of fish, and reduce the amount of dissolved oxygen in the water. Perhaps the single most damaging effect of sediment particles is that they pick up chemical hitchhikers, like phosphorus, nitrogen and toxic chemicals, which will then be deposited in the stream with the sediment.

Increased traffic and construction in the Glen Lake-Crystal River Watershed has intensified the effects of sedimentation. Road-stream crossings, storm drains, parking lots, and other impervious surfaces (such as roofs) all accelerate the speed and volume of run-off and exacerbate erosion problems. It's important to note here that all these problems—phosphorous, nitrogen, hazardous chemicals, sediment and impervious surfaces—are closely related, but so are the solutions.

Impervious Surfaces—The Road to Less Pavement

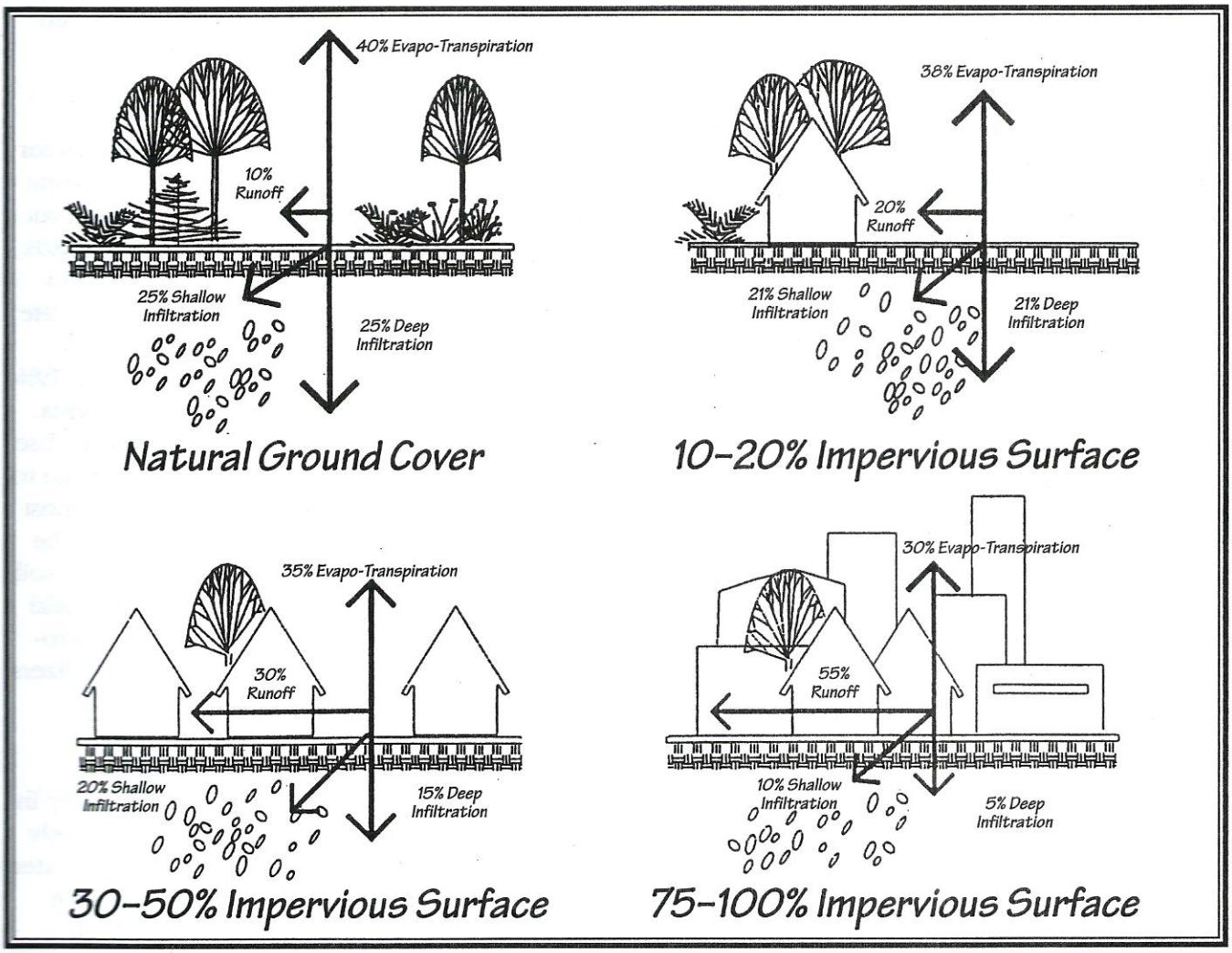
Impervious surfaces increase the accumulation, speed and volume of stormwater and, therefore, pollutants to the nearby creeks and rivers.

An impervious surface is defined as any surface in an urban landscape that blocks rainfall from absorbing or soaking into the ground (including roads, streets, driveways, parking lots, sidewalks, and rooftops). Impervious surfaces increase the accumulation, speed and volume of stormwater and, therefore, pollutants to the nearby creeks and rivers.

As the percentage of impervious surface increases in a given drainage area, stormwater from rain and melting snow also increases. The stormwater that collects on impervious surfaces becomes runoff that joins the natural drainways and streams and can dramatically increase the peak flow rate beyond normal levels. Higher peak flows cause the stream channel to erode and gradually enlarge by widening or down cutting. The channel enlarges by the force of the water scouring the sediment from the channel sides or bottom. The sediment is carried downstream and deposited, which in turn disrupts healthy aquatic habitat. Besides changing the shape of streams and destroying aquatic habitat, the heavier stormwater causes higher stream water temperatures, speeds up the entry of air-deposited pollutants into local streams and lakes, and affects the balance of ecosystems sensitive to water levels, such as wetlands. If all the additional stormwater that collected on the impervious surfaces would have soaked into the ground, as it does in a natural landscape, most pollutants would have been filtered out before entering the water system.

Of all non-point source pollutants, nitrogen poses the most serious and immediate threat to people.

A simple way to consider the issue is to observe how much of the surface area is covered by greenery. If it's not green, chances are it's impervious. Research studies show clearly that watersheds with as little as 10% impervious cover will begin to show the first stages of stream and lake degradation. Once that figure reaches 20-30%, fish habitat, aquatic life and water quality will dramatically diminish. In many urban areas, where impervious cover is nearly



50%, streams no longer contain natural vegetation and must be lined with concrete banks and bottoms for flood control.

This problem worsens when homeowners design their buildings and landscaping to direct runoff from their driveways, roof gutters, etc., directly into Glen Lake. They may be happy to eliminate the stormwater from their lot, but most don't realize the impact it has on the lake. A much better solution (explained on page 32) is to approach the problem by using natural dynamics such as ground and plant absorption to handle stormwater.

Nitrogen—Too Much of a Good Thing

Of all the non-point source pollutants, nitrogen clearly poses the most serious and immediate threat to people. Many forms of nitrogen, such as nitrates, are water soluble and can easily move through surface and ground waters. Once in the groundwater, the nitrates will eventually be pumped back to the surface through wells and used in the home. When consumed by infants and young children, nitrates can build up to toxic levels in their small bodies and interfere with the blood's ability to absorb oxygen. Hence, the term "blue baby syndrome" for nitrate toxicity, a very

Paving the Road to Disaster

The illustration above shows the dramatic increase in the accumulation, speed and volume of stormwater runoff as the proportion of land surface covered by impervious material increases. A 10–20% increase in impervious surfaces can double the amount of runoff into streams and lakes carrying nutrients, sediment, toxic chemicals and other contaminants with it. On the other hand, when stormwater soaks into the ground or trickles over a natural forest floor, the soil and vegetation filter out the contaminants before the water reaches the surface water supply—green keeps the water clean.

Hazardous Household Materials

Look for signal words on the labels of household products. The following signal words carry specific meanings:

Poison	*Highly Toxic*
Danger	*Flammable, Corrosive or Toxic*
Warning	*Moderate Hazard*
Caution	*Mild to Moderate Hazard*

The following materials should never be disposed of by pouring down a drain or toilet (especially a septic system) or thrown out with ordinary garbage.

In the Workshop:
- *All Paints*
- *Varnish*
- *Solvents*
- *Paint Remover*
- *Glues & Adhesive*
- *Flashlight Batteries*

In the Garage:
- *Antifreeze*
- *Batteries*
- *Brake Fluid*
- *Motor Oil*
- *Other Lubricants*
- *Car Wax*
- *Gasoline*
- *Other Fuels*

In the Kitchen & Bathroom:
- *Ammonia-based Cleaners*
- *Bleach*
- *Bug Spray*
- *Floor Cleaners & Strippers*
- *Furniture Polish*
- *Metal Polish*
- *Moth Balls*
- *Nail Polish*
- *Nail Polish Remover*
- *Pharmaceuticals*
- *Spot Remover*
- *Shoe Polish*

On the Lawn & Garden:
- *Fertilizer* • *Weed Killer*
- *Pesticide* • *Rat Poison*

dangerous condition that can lead to permanent damage or even death. In adults, nitrates can cause stomach and intestinal problems, diarrhea, and diuretic effects.

Health department officials have known of the dangers of nitrogen poisoning for years and have enforced strict standards for drinking water purity. All new water wells to be used for drinking should be tested for nitrate content and pass approval before use. Drinking water wells are generally located away from septic fields to avoid seepage of wastewater along the well shaft. Septic field placement and construction standards are aimed at keeping nitrate leaching into the well to a minimum.

Although one of the most common elements (it comprises 79% of our air), nitrogen remains one of the most elusive of elements. Plant life needs large amounts to build cell tissue, but can only use certain forms of the element. Gardeners and farmers never seem to have enough nitrogen in their soil, because one of the forms most available to plants, nitrate, is also very soluble in water. Thus, the available nitrate can be easily leached from the upper levels of soil or swept away in run-off. Routine removal of crops from the field or grass clippings from the lawn also depletes the available nitrogen. As a result, farmers and homeowners apply nitrogen fertilizers to increase yields and maintain lush green lawns.

Household and industrial waste water also contain large amounts of nitrogen compounds. Septic fields can be a major source of nitrates making their way into groundwater, especially in the residential areas of Glen Lake. The sandy soils that commonly underlay northwest Michigan accelerate the leaching of wastewater into the groundwater and make proper septic field maintenance especially important in the Glen Lake-Crystal River watershed.

Hazardous Chemicals—A Little Goes A Long Way

Although the most common and destructive pollutants in the Glen Lake-Crystal River watershed are not the notorious compounds that go by names like DDT, PCB, or strings of syllables that end in "ene," these chemicals have become so common in everyday use that they deserve mention. These toxic substances, many of which are carcinogenic (cancer causing) in tiny amounts, have begun to permeate our surface and groundwater in significant quantities.

One gallon of waste motor oil (which contains an array of toxic chemicals) poured into the soil and making its way into the groundwater supply can contaminate thousands of gallons of groundwater, ruin water wells, and take hundreds of years to work its way out of the system. Most of these chemicals pose highly technical and expensive problems for removal, and, thankfully, our lakes remain comparatively free of toxic substances.

Oil, gasoline, antifreeze, and old paint are just a few examples of products that contain hazardous chemicals found in almost any home or garage in the Glen Lake-Crystal River watershed. When these chemicals are disposed of with other household garbage,

they are carted off to the landfill and buried, where eventually they, too, can enter the groundwater. Even worse, many of these chemicals enter the water system unobstructed, as homeowners pour oil on gravel driveways to keep the dust down, or simply pour these chemicals down the drain and into the septic system.

So where do you dispose of this stuff? Leelanau County sponsors a hazardous chemical collection program, and many chemicals, like waste motor oil, can be recycled into useful products. Contact the Household Hazardous Waste Collection, 256-9812.

The Powerful Medicine of Common Sense

Non-point source pollutants can be reduced by the simplest of means: a change in personal habit, or maybe some landscaping. Yet, in practical terms, they can pose the most difficult problems to solve. Taken as an isolated incident, it may be hard to believe that the little bit of waste motor oil we spread on the driveway to keep down the dust could be harmful. Multiply that activity by a hundred homeowners, or a thousand, and soon the cumulative effect will be disastrous. And each one of those homeowners will need to be reached, informed, and, most importantly, convinced, on an individual basis, to change their habits.

Non-point source pollutants can be reduced by the simplest of means: a change in personal habit, or maybe some landscaping. Yet, in practical terms, they can pose the most difficult problems to solve.

Luckily, the available remedies to these non-point source pollutants are fairly simple to understand and appeal to common sense. And with your cooperation, the impact of non-point source problems can be dramatically reduced.

An important point to keep in mind—by definition, non-point source pollutants are carried by water. Water runoff and erosion carry them into the groundwater or surface water system, where they then become pollutants. Therefore, any place where there is a movement of water is a potential problem area. The key is either not to allow the pollutants to enter the water system at all, or to slow down the run-off of water and allow natural filtration systems to remove the pollutants before they enter the surface or groundwater.

As you read on and learn about basic best management practices (BMPs), think carefully about your property—you may be able to apply a few simple principles and develop your own BMP. Then, share your solutions with your neighbors.

In the Glen Lake-Crystal River Watershed Landowner's Stewardship Checklist book you will find a set of action checklists which will allow you to "check" things you already do as a good steward of the watershed. Unchecked items are goals to work toward in your stewardship of the Glen Lake-Crystal River Watershed.

In the Glen Lake-Crystal River Watershed Landowner's Stewardship Checklist book you will find a set of action checklists which will allow you to "check" things you already do as a good steward of the watershed.

It will take community effort to effectively reduce non-point source pollution in the Glen Lake-Crystal River watershed.

The Household Water System

Continued from Page 23

liquid wastes in the septic tank flow into a drainfield (2). The drainfield is a grid of perforated drain pipes buried in gravel and covered with several feet of soil. The liquid waste from the septic tank flows through an outflow pipe and into the drainfield. There, the waste waters soak into the gravel, migrate into the soil (3), and eventually join the groundwater flow (4). In the drainfield, another form of bacteria (aerobic, or oxygen-using) continues to break down compounds in the waste water.

Unfortunately, even a properly designed and operating septic system will still allow waste water to carry toxic chemicals and nutrients (such as phosphorous and nitrogen) into the groundwater.

The Illustration dramatizes the need to maintain the septic system properly. Note that the same groundwater supply that the effluent from the septic tank joins is also where the household water well draws its supply (5). Typically, household wells utilize an electric pump to extract groundwater and deliver it to the house through the plumbing system (6). The suction of the well pump usually causes a localized shift in the groundwater flow (7) that can accelerate the movement of local contamination toward the well.

Toxic chemicals, especially hydrocarbons like gas or oil, or PCBs, etc., can migrate long distances through the groundwater supply, and small quantities of toxics can contaminate huge quantities of water. Once the toxic chemical reaches the groundwater, it will follow the groundwater flow (often for many miles) and become virtually impossible to remove.

ABSOLUTELY NEVER use a toilet or drain to dispose of toxic chemicals (see page 20 for a list). Whether you use municipal sewers or septic fields, your toxic wastes today will be tomorrow's environmental calamity.

Best Management Practices

The first rule of stewardship is to leave the land and water in better condition than you find it. If you have a younger generation in your family, then that statement needs no further explanation. As we have the privilege to live on the water, so we bear the responsibility to protect the quality of the water.

The remainder of this chapter contains a series of positive actions you can take as a resident to protect the quality of the Glen Lake-Crystal River watershed. Best Management Practices, or BMPs, are simple actions that any landowner can take to reduce the destructive impact of human activity on the environment. Like most good management techniques, BMPs will benefit you in more ways than one. Besides protecting the environment, you will reduce waste, improve the looks and value of your property, and save yourself money.

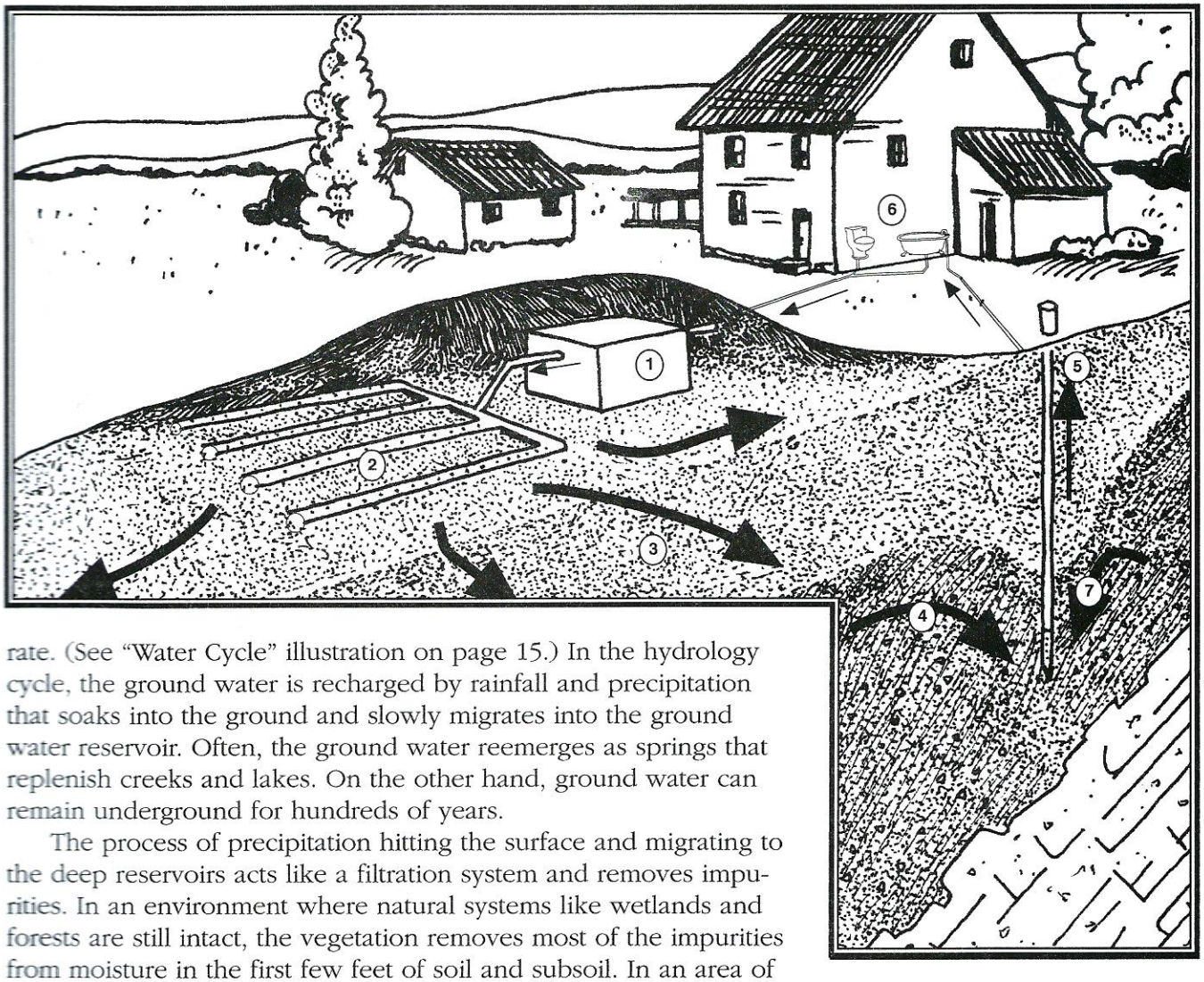
A best management practice, like stewardship, is like planting a maple tree. It's a long-term investment that you probably won't see come to full maturity. The reward that you draw is watching the tree grow and the hope that someday, a great grandchild will sit in the shade on a hot summer day and thank whoever planted that beautiful tree. Only in this case, they'll be dipping their toes into the crystal clear water of Glen Lake and paddling down the Crystal River—circa 2050.

These are the best of the Best Management Practices, customized to the needs of the Glen Lake-Crystal River Watershed. Some will apply to your household more than others, but take the time to review all the BMPs, so as to inform yourself of how to live a low impact life on nature. Common sense is the most powerful medicine for curing non-point source pollutants.

Well Water Safety

If at any time your drinking water suddenly develops a strange color, smell or taste—stop drinking it immediately and get it tested! Your household water supply is nothing to fool around with—it's your most serious and immediate vulnerability to water pollution. The majority of residents in the GL-CR watershed rely on wells that tap the ground water to supply their homes, businesses and farms. Therefore, you act as your own water utility and bear the primary responsibility for protecting yourself and your family.

In general, the ground water of the GL-CR watershed is of exceptional quality. Layers of porous material, such as sand and gravel, lie beneath the surface of the land and hold large amounts of freshwater. These water-bearing formations act like giant sponges that hold the water in a subterranean reservoir. Like surface water, ground water also flows, although at a much slower



rate. (See "Water Cycle" illustration on page 15.) In the hydrology cycle, the ground water is recharged by rainfall and precipitation that soaks into the ground and slowly migrates into the ground water reservoir. Often, the ground water reemerges as springs that replenish creeks and lakes. On the other hand, ground water can remain underground for hundreds of years.

The process of precipitation hitting the surface and migrating to the deep reservoirs acts like a filtration system and removes impurities. In an environment where natural systems like wetlands and forests are still intact, the vegetation removes most of the impurities from moisture in the first few feet of soil and subsoil. In an area of dense human development, the moisture that enters the ground water often bypasses natural filtration systems. For instance, the effluent from a properly operating septic system is broken down by biological activity in your septic tank and field. Nevertheless, the biological activity produces nutrients that begin the downward migration into the ground water supply without passing through a "green" living filter such as a wetland. If too many septic fields load the ground water in a concentrated area, the result can be unhealthy levels of compounds such as nitrogen and phosphorus. (See "The Household Water System" illustration on this page for a graphical explanation of the interaction between drinking water wells and septic systems.)

Test your drinking water.

Arrange to have your well water tested periodically (your health department provides this service). It may have been decades since it was last tested—and don't rely on the test results of a neighbor! Two water wells side by side could be tapping two different water-bearing formations, with two very different water quality results.

The Household Water System

The further your home from town, the more likely you use a well for drinking water (5) and some form of a septic system or holding tank to dispose of household waste water (1–2). (See illustration above.) The drain pipes of the household plumbing system carry the waste water to a large concrete tank buried near the house (1). Solids in the waste water settle to the bottom of the tank. Greases and oils float to the surface. Anaerobic bacteria in the tank (bacteria that thrive without oxygen) decompose the wastes into by-products such as carbon dioxide, methane and water. If the system is a holding tank, the tank is regularly pumped out and the waste is usually spread in agricultural fields.

In most septic systems, the decomposed

Continued on Page 22

Water Conservation

As the illustration on page 23 portrays, the household water system is similar to any commercial or industrial user of water. We "consume" water in the household by pumping in the clean stuff, adding our wastes or other by-products of our usage, and then flush the tainted water down our drain or toilet. Every household is, in effect, an unregulated polluter.

It's a proven fact that as the volume of water consumption in a given household rises, so does the amount of non-point pollutants released into the water system. So, by simply cutting household consumption you'll reduce contamination. You'll also save money, either by reducing your water bill, or reducing your electricity use to operate the pump in your well.

Test for leaks.

Test for leaking toilets by adding food coloring to the tank. Without flushing, note whether any color appears in the bowl after a half hour. Small leaks in faucets can result in sizable accumulations. Put a measuring cup under a dripping faucet for half an hour. The quantity in the cup multiplied by 48 is how much that faucet leaks in a day. If you are on city water, turn off all your fixtures and then check the meter. If the dial still moves, you have a leak.

Watch your habits.

If you have a dishwasher, run it only when you have a full load—the same goes for the clothes washer. Set water control levels on appliances to their lowest effective setting appropriate to the load. Take more showers, baths use 30 to 50 gallons each. Avoid running the water continuously while while washing the dishes, shaving, brushing teeth, washing hands, or washing your car. Water the lawn only when necessary.

Continued on page 25

Work only with reputable well drillers.

Always work with reputable, licensed well drillers that secure the proper permits. Ask for references and check with the Health Department if you have any doubts.

Familiarize yourself with your well.

Identify the location of your water well and septic field. The well shaft should be sealed around the perimeter to stop surface water from working its way down the side of the well shaft and directly into the ground water (not just in dry conditions, but also during rainstorms). THIS IS A COMMON WAY THAT WELLS BECOME TAINTED! Make certain that the well is far enough away from the septic field that effluent from the septic system has no opportunity to work its way into the ground water alongside the well shaft. In general, make certain that your septic field is in proper working order.

Protect your well.

Never dispose of toxic chemicals, such as gasoline, motor oil, antifreeze, solvents, etc., in your drain (and thereby into your septic system) or by spreading on the ground or driveway. These chemicals can migrate deep into the earth and a small amount can taint huge quantities of ground water. See the sidebar on page 20 for a list of hazardous materials which require careful disposal.

Waste Water and Septic Systems

Virtually every home in the GL-CR watershed uses some form of a septic system or holding tank to dispose of waste water. (See illustration on page 23 for a graphical description of the septic system.) The drain pipes of the household plumbing system lead to a large concrete tank buried near the house. Solids settle to the bottom of the tank. Greases and oils float to the surface. Anaerobic bacteria (bacteria that thrive without oxygen) in the tank decompose the wastes into by-products such as carbon dioxide, methane and water. If the system is a holding tank, the tank is regularly pumped out and the waste is usually spread in agricultural fields.

Most septic systems use a drainfield. The drainfield is a grid of perforated drain pipes buried in gravel and covered with several feet of soil. The septic tank is designed so that as wastes in the septic tank break down into liquids, the waste water moves through an outflow pipe and flows into the drainfield. There, the waste waters soak into the gravel and migrate into the soil. In the drainfield, another form of bacteria (aerobic, or oxygen-using) continues to break down compounds in the waste water.

Since drainfields release large amounts of tainted waste water into the ground, they must be located far enough from the lakeshore to minimize the amount of contaminants that reach the open water. Contaminants in the wastewater are trapped in the subsoil as the water migrates from the drainfield, so the distance the drainfield seepage must travel is proportional to the amount of

contaminants the soil can remove. Hence the need for pumpback systems. The pumpback system collects the household wastewater in a holding tank near the house and pumps the waste to a drainfield located where the seepage won't harm the lake water quality. Some homes on Glen Lake use pumpback systems.

Septic systems do an excellent job of eliminating dangerous organisms such as coliform bacteria. Unfortunately, even a properly designed and operating septic system will still allow waste water to carry nutrients like phosphorous and nitrogen into the lake. Nevertheless, it will do a lot better job than an outdated or faulty system. Thus, the need to maintain the system properly—for your family's health and the lake's health. Follow these simple recommendations to minimize the risk of septic system problems.

Work only with reputable and conscientious contractors.

Be wary of contractors who offer to save you money by cutting corners. A properly located and installed septic system provides a safe and effective method of wastewater treatment. An improperly installed septic system can spell disaster for the entire neighborhood, by polluting the surface and/or groundwater with nitrates, fecal bacteria and viruses. Properly operating septic systems require sludge removal every 3 to 5 years, when the sludge level exceeds 1/3 of the tank volume. Talk to your neighbors about coordinating maintenance and reduced cost through a group pumping program.

Familiarize yourself with the location, operation and design of your septic system.

Make sure you know where your septic tank and drain field are located in the yard. That way you will be able to keep track of potential problems. See page 23 for a simple explanation of the operation of your septic system. (Some forms of clear waste water, such as the outflow of a sump pump or a foundation drain, do not need to drain into your septic system and can be routed elsewhere—but not directly into a lake or stream.)

Keep drainfields clear.

Drainfields are one of the few places you don't want to plant trees. Root systems will clog and interfere with the flow through the pipes. Keep cars and heavy equipment off the drainfield to protect it from compaction. Direct rainwater from gutters and runoff from paved areas away from the drainfield. Too much water on the drainfield will accelerate the leaching of nutrients. Never build or pave over a drainfield or septic tank.

Watch for signs of septic system damage or failure.

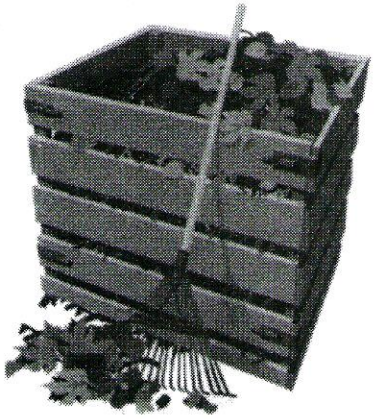
Foul odors around the septic tank or drainfield, sewage odor in the basement, depressions in the surface of the ground in and around the drainfield, lush green grass over the drainfield, spongy or soggy areas in the drainfield, cladophora growth near your shoreline, and a backed-up or sluggish toilet are all indicators of

Water Conservation

Continued from page 24

Replace equipment and fixtures with conservation models.

Install a water conservation shower head, they can reduce the volume of flow by 25% with little noticeable effect on performance. Two half-gallon plastic bottles filled with water and placed in your toilet tank can cut the number of gallons per flush from 5 to 4. Look into a "suds saver" washing machine next time it's slated for replacement. A seeping hose will put irrigation water exactly where you want it without loss from evaporation. Compost your garbage rather than using a garbage disposal. Garbage disposals use a great deal of water and add solids to an already overloaded septic or sewer system.



The Compost Pile

Compost is a dark, crumbly mixture of decomposed organic matter, such as garden wastes, grass clippings, leaves, twigs and food scraps. Anything that was once alive will naturally decompose, but avoid the following additives to your compost pile: diseased plants, pet feces, dead animals, meat or fish scraps, grease and cooking oil.

Compost piles trap heat generated by the activity of microorganisms. A 3 foot by 3 foot by 3 foot pile is considered a minimum size for hot, fast composting. Piles wider or taller than 5 feet don't allow enough air to reach microorganisms at the center. The biological action functions best when the materials are as damp as a wrung-out sponge and have many air passages. The active bacteria in compost thrive in temperatures between 110° and 160°F. Use a pitchfork to turn or mix the pile occasionally to add air that will sustain high temperatures and control odor (some gardeners construct their compost bins with two or three cells to allow for an empty cell in which to rotate the pile). Preparing the compost additives by chopping or shredding will accelerate the decomposition.

Compost absorbs and holds nutrients and moisture in the soil until plants can use them and loosens and aerates soil. Mix 2 to 5 inches of compost into vegetable and flower gardens each year before planting. As a mulch, spread an inch or two of compost around bedding and vegetable plants.

possible problems in the septic systems. Immediately secure the help of a professional if you suspect any problems.

Be careful of what goes down the drain or toilet.

Anything disposed of in the drain or toilet ends up in the septic tank. Household chemicals and cleaners, such as bleach or drain cleaner, should be avoided because they kill off the bacteria that break down the solid waste in the septic tank. Without the bacteria to break them down, solids will build up and can cause back-ups. Garbage disposals can overload the septic system and make frequent maintenance necessary. The following items should never be put down the drain as they will not break down in the system: grease, hair, cigarette butts, facial tissues, paper towels, feminine hygiene supplies, bandages, paint, solvents, motor oil, pharmaceuticals, or any other household hazardous waste. Don't use toilets as trash cans!

Conserve water use.

The more water that flows through the septic system, the faster and more intense will be the release of nutrients into the ground. As a rule, by conserving water you will reduce nitrogen releases. Water conservation will also cut electricity bills, since the water well uses AC power to pump the water into the household. Distribute laundry loads throughout the week to avoid overloading the system and **always use detergents without phosphates.**

Beware of the "quick fix."

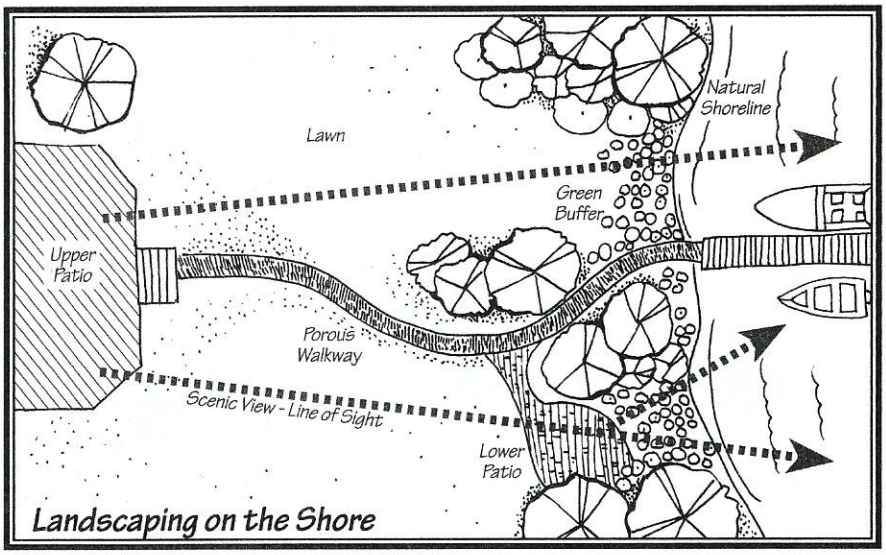
Commercial chemical products that claim to clean septic tanks are no substitute for proper maintenance. These products convert the organic material in the septic tank into a liquid that will move quickly through the drainfield. Accelerating the normal decay process from solid waste to liquids will send much larger amounts of nutrients into the water systems and could contaminate nearby surface and groundwater.

Landscaping & Lawncare

Landscape and lawncare are critical factors in protecting the water quality of Glen Lake and the Crystal River. The most important zone of your property is the 30–50 feet that immediately borders the lake, river and tributary creeks, but the actions you take anywhere in your yard can determine whether algae and aquatic plant growth will overtake the lake or river. Follow these recommendations and let nature do the work—**green keeps the water clean**.

Preserve green buffers around wetlands, rivers, creeks and lakeshores.

Wetlands and green buffers in the form of shrubs and trees can remove huge amounts of nutrients such as phosphorus and nitrogen before they enter watercourses. Buffers also provide essential shade to keep the water cool enough to sustain trout and other cool water aquatic populations. The vegetation slows the speed of run-off, allowing sediments to settle out and the nutrients to be absorbed by



the roots. Damage usually begins when natural green buffers are removed from the banks of the water, surface run-off drains unimpeded into the water and carries with it destructive sediments and nutrients. Buffers also deliver benefits to homeowners. They stabilize erodable shorelines, provide privacy, can cut your winter heating bills by breaking wind velocity, and reduce noise from a lake or roadway.

Recommendations for the minimum width of a greenbelt vary from 15 to 35 feet, but the wider the greenbelt, the more effective it will be. Choose a mixture of plant materials (grasses, groundcover, shrubs and trees) that will vary in root depth and plant height. Native species will require less care and grow more vigorously, but only if the chosen species match the growing conditions of your site.

What's the *easiest* method to establish a green buffer? Just stop mowing near the shore. Eventually, native species will recolonize the shoreline and create a natural greenbelt.

Preserve natural cover and forest stands.

Trees help slow run-off from the moment the rain falls. Leaves slow the speed of falling rain, the trees then absorb and utilize large amounts of water, and the root systems slow run-off and provide paths for the moisture to enter the ground. On the average, tree root systems are about the size and extent of their branches. Root systems hold the loose northern Michigan soils intact and resist erosion. Before starting a construction project, contact your conservation district to learn how to protect standing trees from soil compaction by heavy equipment.

Choose the right grass and plants for your site.

Plants suited to northern Michigan will require less fertilizers, pesticides, and additional watering, because their requirements are adapted to the natural soils, pests, and climate. Native plants will tend to provide more satisfying results in your lawn and garden. As a rule, the more exotic the plant, the more potential need for chemical use. For instance, Kentucky bluegrass requires 4–7 lbs. of nitrogen annually per 1000 sq. ft. Creeping red fescue only requires about 2 lbs. per 1000 sq. ft. Local nurseries can help in the selection of appropriate species for your site.

Landscaping on the Shore

Glen Lake Association offers a "Naturalize Your Shore" program to property owners who wish to reestablish a green buffer on their shoreline. The program brings the owner together with a lake biologist and landscape designer to assess the site and create a preliminary design and computer rendering of how the planting would look when completed. Next, the team draws a scale map and layout with detailed planting instructions that can be used by the homeowner or a contractor to calculate estimates for labor and materials. After planting, the team reconvenes to evaluate the results.

A shoreline landscaped to protect water quality preserves the natural character of the lakeshore and still affords the access and scenic views that a riparian homeowner expects. In the diagram above, a wide buffer of native vegetation comprised of large and small trees, shrubs, and groundcover maintains the healthy filtration dynamics of shoreline vegetation. The mix of size and textures of plant types allows strategic placement of lines of sight for scenic views. A walkway and lower patio nestled in the green buffer's trees enable people to relax close to the water and still feel private. If properly designed and maintained, a landscape such as illustrated here would require minimal maintenance and no pesticides or fertilizers.


GLEN LAKE-CRYSTAL RIVER WATERSHED
86°00'00"
44°52'30"
Map Key
Watershed Boundary
State/Provincial Highway
County Primary
Principal Local Road
Other Roads/Trails
Settlement/Village
Township Boundary
Latitude/Longitude Line
Local Park
National/State Park
Public Campground
Nature Preserve
Picnic Area/Rest Stop
Scenic Overlook
Trailhead-Hike
Trailhead-X-Country Ski
Swimming Area
Boat Ramp
Marina/Harbor
Lighthouse
Tourist Info
Museum/Library
Golf Course
Point of Interest
Barrier-Free
Land Relief (in meters)
Over 270 m.
Over 340 m.
320–340 m.
300–320 m.
280–300 m.
260–280 m.
240–260 m.
220–240 m.
200–220 m.
180–200 m.
171–180 m.
0–5 ft.
5–15 (10) ft.
15–25 ft.
25–50 ft.
50–75 ft.
75–100 ft.
100–125 ft.
Over 125 ft.
Glen Lake Depths (in feet)
0
Mile
2
Lake Michigan
GLEN HAVEN
GLEN ARBOR
Little Glen Lake
Big Glen Lake
EMPIRE
MAPLE CITY
BORDICKVILLE
Sleeping Bear National Lakeshore
Map Copyright © 2005 Michigan Maps, Inc. • MichiganMapsOnline.com

Native Plants for Greenbelts in Northern Michigan

Wet Conditions

Groundcover:

- sensitive fern
- hog peanut
- clearweed
- Canada wildginger
- moonseed
- Virginia bluebells

Shrubs:

- red osier dogwood
- highbush cranberry
- speckled alder
- ninebark

Trees:

- white cedar
- eastern tamarack
- eastern hemlock
- white spruce
- red maple
- basswood

Upland Conditions

Groundcover:

- bearberry
- creeping juniper
- bracken fern

Shrubs:

- common juniper
- American filbert
- mapleleaf vibernum
- gray dogwood
- black chokecherry

Trees:

- eastern white pine
- sugar maple
- white oak
- white birch
- red pine
- red oak
- ironwood

Consider groundcover plants in lieu of lawn.

Use of groundcover, shrubbery, and the natural flora of northern Michigan can enhance the character of your landscape, create variety, and will require less maintenance and chemical use than lawns.

Gauge watering to plant requirements.

A small rainfall gauge set up in the garden or lawn will help you determine how much water a sprinkler delivers over a period of time. Over watering will leach nutrients from the soil and cause run-off, and with the excess water goes the nutrients—away from the plants and into the watershed. In the process, the homeowner will be forced to apply more supplemental fertilizer, and the cycle will begin again. Frequent shallow watering will encourage shallow rooting, crabgrass invasion, and disease. Moisten the soil to a depth of four to six inches (usually about one inch of water). Lakeside owners should use water drawn from the lake.

Don't burn yard wastes—establish a compost pile for organic wastes.

It may seem safer to burn leaves and brush at the lakeshore, but the ashes and smoke particles concentrate nutrients into soluble forms that will dissolve quickly into the water. A compost pile located away from the water will provide you with a constant source of organic material for your garden and lawn and reduce your need for fertilizers. Also, discarding the organic kitchen wastes in the compost pile (except meat scraps) will reduce your volume of rubbish or lighten the load on your septic system.

Avoid the use of fertilizers.

Most soils in Michigan don't require artificial fertilizers to support healthy grass. Choosing hardy grass varieties with low nitrogen needs (such as red fescue), cutting the lawn no shorter than three inches, mulching the clippings back into the lawn, and watering with lake or river water will eliminate the need for fertilizer altogether. Again, lake water supplies far more nutrients to the turf than well water. At the very least, apply fertilizers no closer than 30 feet from the water.

If you must fertilize, test your soil annually.

Test results will allow you to calibrate fertilizer application to exactly the amount necessary. If you must fertilize, then test first. In fact, your lawn and garden may not need fertilizer at all (or only a single component), but the addition of some other lacking element. Depending on the requirements of your soil, you may be able to use zero phosphorous and low nitrogen fertilizers, or consider alternative organic fertilizers that contain less soluble forms of these elements. Test kits are available at garden shops and nurseries, or you may want a more sophisticated test performed on the soil sample by a laboratory.

Use the right fertilizer at the right time.

Once you're sure of which fertilizer your soil requires, read the instructions for application carefully. Seasonal changes, temperature,

and moisture requirements can vary greatly from product to product. Misapplication will cost you money in wasted fertilizer and accelerate the entry of nitrogen and phosphorous components of the fertilizer into the watershed. Avoid fertilizing in the fall. Late in the year, turf does not require supplemental nutrients because it is moving into a dormant stage.

Consider alternatives to chemical use to control specific insects and weeds.

Instead of blanket sprayings of pesticides and herbicides to control insects and weeds, integrate chemical use with techniques that minimize favorable conditions for pests and maximize natural obstacles to pests. Careful observation is to pest control what soil testing is to fertilizing. Make use of the following tactics to reduce or eliminate the need for pesticides: encourage natural predators, change habitats favorable to pests, time planting and harvesting to avoid peaks of pest presence, choose pest-resistant plant varieties, maintain growing conditions to maximize plant resistance to disease, diversify plantings to avoid susceptibility to one type of pest, apply natural parasites and insect hormones to attack and confuse the normal life cycle of pests.

If you must use them, read and follow pesticide directions carefully.

Pesticides and herbicides are, by definition, poisons and should be handled with appropriate caution. Apply only the amount directed by the label—overuse or misuse can hurt your plants—and pets—as well as the environment. Unless the label specifically calls for it—keep pesticides well away from wells, streams, wetlands or any other body of water. Apply pesticides only when there is no forecast for rain and never apply pesticides to bare ground.

Buy only as much pesticide as needed.

Over time, pesticides will deteriorate and lose their effectiveness sitting on a shelf and the leftovers will simply be more hazardous chemicals to dispose of later. Pesticides and herbicides should be stored in their original containers, well away from living quarters, in a well-ventilated area, and OUT OF CHILDREN'S REACH!

Choose the least toxic chemical for the job.

Chemicals with labels that use the word "caution" are considered less toxic, whereas the term "warning" indicates more toxicity. Insecticidal soap, Bacillus thuringiensis (BT), milky spore and oil sprays are effective and relatively safe alternative pesticides for many situations.

Choose lawn care providers wisely.

Select a lawn care company that will truly customize its service to your lawn's needs. Require that the company perform a soil test before applying any fertilizer or pesticides.

Why is my beach always changing?

"You can never step on the same beach twice."

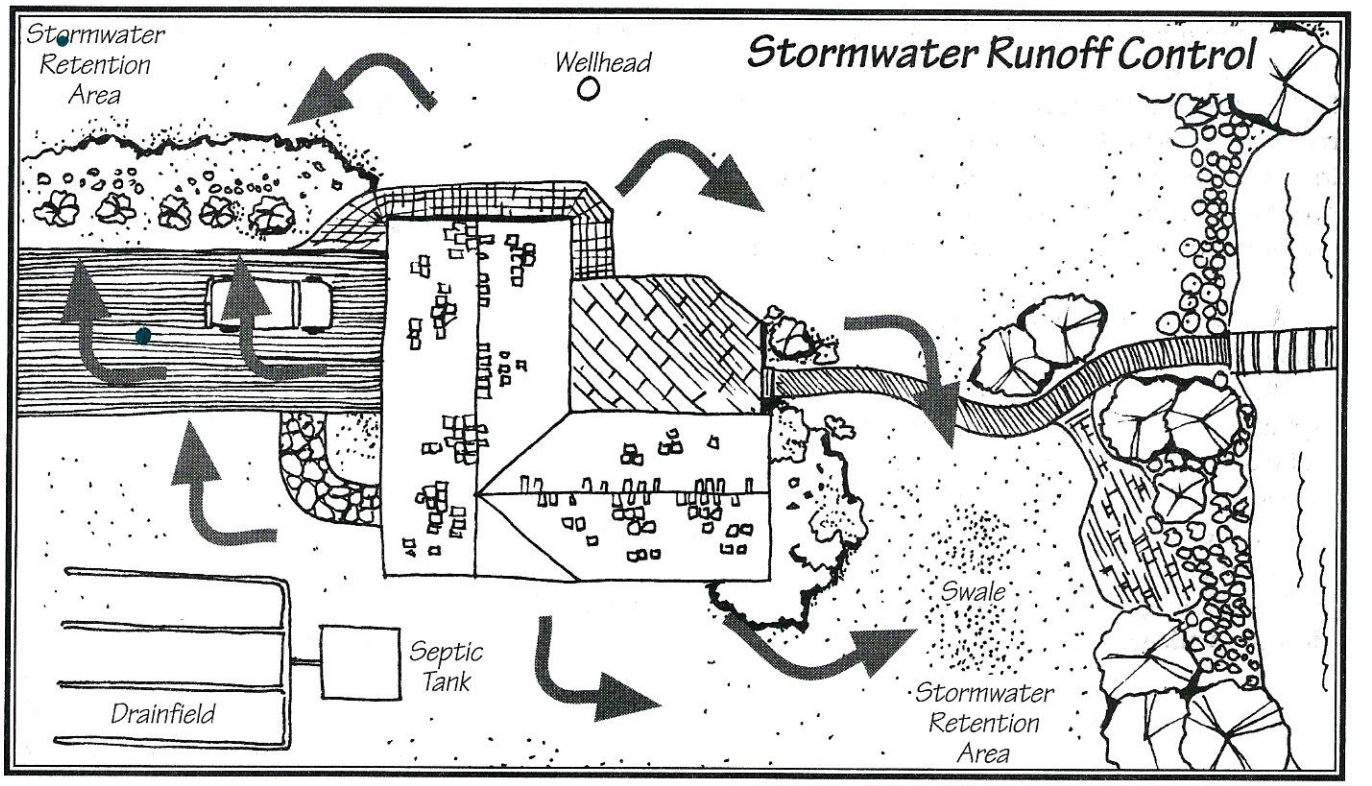
Our beaches were brought to us by the glaciers, the last of which receded 10,000 years ago leaving us with sand that is made up primarily of quartz, a little feldspar and even less magnetite with a sprinkling of garnet, calcite, ilmenite, hornblende and epidote. Our sand consists of rocks, crystals and lakeshells that have been eroded over a long period of time by wind, water, and ice.

Your beach is a dynamic land form, constantly in motion, ever changing, altered by wind and waves in a continual process of beach building and erosion. Seasonal cycles of sand deposition and loss dramatically affect the appearance of your beach from summer to winter and even from day to day. Most of the sand removed from winter beaches is deposited in small offshore sandbars and returned from the lake shallows to the shoreline by the gentler waves of summer. Thus the summer beach sand can rest a few hundred feet from the shore during the winter months. In the spring smaller and less powerful waves begin to rebuild your beach by lifting the grains of sand onto the shore while being too weak to haul them back out to the lake again.

Besides being transported perpendicularly to the shore, sand is suspended in the water, transported along the coast by longshore currents resulting from the waves hitting the beach at an angle, bouncing back at an angle and picking up sand grains as they rebound. This zigzag action of waves hitting your shore can move sand parallel to the beach. These longshore currents are small but persistent in our lake but can alter the beach over a period of several years. The wind can also transport the sand and deposit it either up or downshore.

The prevailing winds, current, and slope of the shore determine the wave's energy. A shorter, steeper slope results in more erosion than a long slope, which dissipates the energy before it reaches the land. If the slope is shallow the waves will break before reaching the beach, decreasing

Continued on page 33



Stormwater Runoff

A building generates stormwater runoff because precipitation collects on impervious surfaces such as roofs and driveways into concentrated flows. A properly designed landscape will contour the property to direct runoff into areas where it can collect temporarily and soak into the ground or where vegetation has an opportunity to absorb the runoff. The arrows in the diagram above indicate the general direction of surface runoff in a properly designed landscape. Note that the runoff is steered away from the septic system and the wellhead. (Excessive runoff can interfere with drainfield operation or seep down the well shaft and introduce contaminants into drinking water.) This plan establishes two stormwater retention areas designed to temporarily "store" runoff: a swale, or depression, in the lawn behind the shoreline green buffer; and a border garden beside the driveway planted with hardy native perennials that tolerate occasional flooding. The patios and walkways are constructed of porous materials to further inhibit the collection of runoff.

Impervious Surfaces & Stormwater Run-off

As the run-off flows, so flow the contaminants. During rainstorms, when run-off crosses impervious surfaces such as driveways, roofs and porches—even turf lawns—the moving water accumulates and carries along loose particles, most of them microscopic. When the run-off slows, the particles drop out of the current. The key to stormwater run-off control is to slow down the runoff before it enters the lake or the lake's tributaries, so the particles drop out—or filter out—of the run-off before they can enter the body of water and cause problems. Whenever possible, use a porous surface instead of asphalt or concrete.

Divert runoff from driveways, roof gutters, roads and other impervious surfaces away from the lake, not into it.

When heavy concentrations of runoff accumulate on a roof or driveway, our first compulsion is to channel the flow into the lake as quickly as possible. **Nothing could be worse for the lake.** Runoff carries sediment and nutrients. So a better method is to direct the runoff into areas where it will filter through vegetation or soak into the ground.

Design a stormwater runoff "handling" system for your property.

First, slow the runoff down by replacing concrete or asphalt channels with grass lined ditches. Then, set up the drainage pattern to direct the flow into an area where the runoff can harmlessly col-

lect and temporarily flood. This is called a retention pond. The retention pond should lie on a porous substrate, such as sand, and be lined with thick vegetation (turf will do). The water in the retention pond will soak slowly into the ground and work its way into the lake, but only after most of the nutrients have been filtered out. An overflow pipe can protect adjacent areas or buildings from flooding during times of extraordinary run-off.

Replace impervious surfaces with porous surfaces to minimize rainwater run-off.

Wood decking, concrete lattice pavers, brick, and porous asphalt can all provide an attractive hard surface for patio areas, while still allowing rainwater to permeate the ground and reduce run-off problems. Concrete and sealed asphalt gather, concentrate, and accelerate rainwater run-off and exacerbate erosion problems. Paved areas should divert run-off into grass or vegetation-covered land to allow gradual absorption into the ground. **Be a zero discharge landowner.**

Erosion Control & Shoreline Stabilization

After paying the market rate for Glen Lake or Crystal River waterfront property, who can blame a lakeside or streamside dweller for their panic as they watch wind-driven waves slowly eat away at their shoreline. Typically, the first reaction is to build a physical barrier and stop the erosion immediately and permanently. The fact is, shoreline erosion is bad for the health of the lake as well as the landowner. The challenge is coming up with a solution that satisfies the needs of the landowner and preserves the integrity of the water quality at the same time.

In general, seawalls generate as many problems as they solve. Seawalls are often installed after natural shrubs and trees have been removed, and thereby indirectly increase the nutrient load in the lake. The more seawalls around a lake, the more quickly the lake's water quality deteriorates. Also, the wave action against a seawall generates a turbulence that loosens sediment, clouds the water and frees up nutrients. When seawalls replace overhanging vegetation and shore plants in the shallows, the immature fry of gamefish species and baitfish have nowhere to hide and feed and eventually, the native reproduction of fish will diminish.

Another popular feature for the waterfront is a sandy beach for swimming. If the sandy beach doesn't occur naturally, many people will simply truck in a few loads of sand and make one. Unfortunately, it's probably the worst thing a homeowner can do from the standpoint of water quality. The sandy slope will attract runoff from a wide area during rainstorms and channel the runoff straight into the lake. **Sand beaches do not filter nutrients.** Remember, water will always follow the path of least resistance.

The biggest generator of erosion is construction. When the typical forest cover of the GL-CR watershed is cleared for a building, the disturbed soil will erode 2000 times faster than when it was

Why is my beach always changing?

Continued from page 31

the erosive power of the waves. The direction of the prevailing winds determines which shoreline around the lake is most affected by erosion or sand deposition. Shorelines with natural vegetation having deep-rooted plants help to protect the shoreline from the energy of the waves and the ice slabs that may bombard it after the spring breakup of the ice.

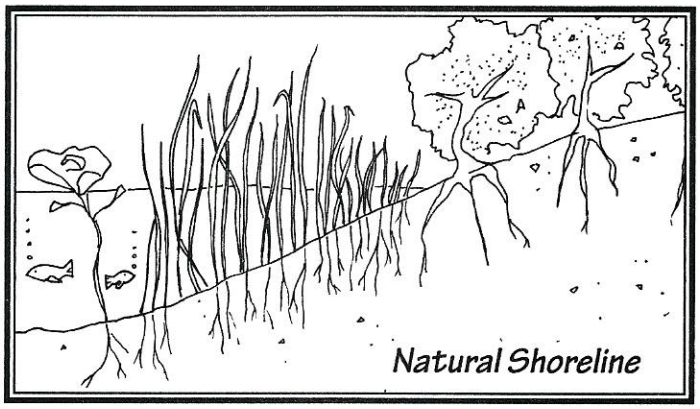
Sand replenishes the shore from eroding uplands, streams, underwater springs and longshore drift.

Strong waves tend to carry away sand and anything attached to sand. So sometimes jetties are built to form a barrier to the natural river of sand created by longshore current. Sand piles up at the jetty and beaches downstream of the jetty are robbed of their sand.

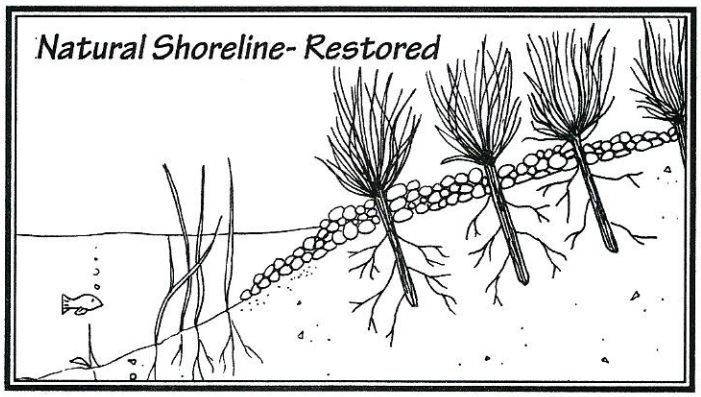
Seawalls, which are rigid, tend to deflect all of the energy of the waves, which increases erosion and accelerates the speed of the longshore current. Once waves reach the shoreline it bounces off the seawall with more energy than a wave washing back from a normal beach. More sand is carried offshore, promoting beach loss. Sand depletes in front of the seawalls and as the shore in front of the seawalls gets deeper, the waves get larger.

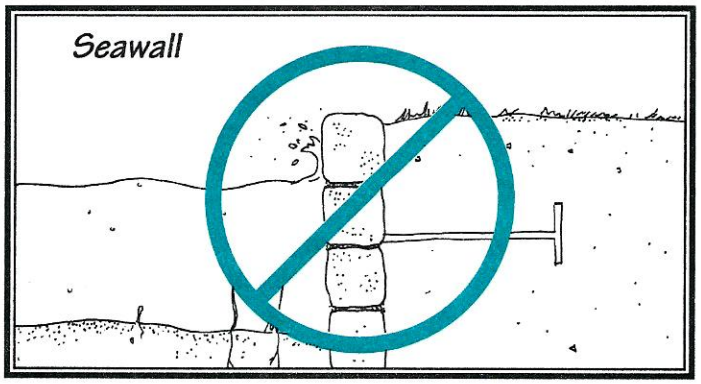
The width of your beach is also affected by the water level of our lake. The amount of snow and rain we have during the year and the amount of evaporation resulting from variations in temperature throughout the year determine our lake level. Another factor is the regulation of the dam. Water levels of Glen Lake are lowered in the fall and winter months to prevent beach and shore erosion by waves and ice slabs after winter ice breakup. Homeowners can be deceived about lake level when observing their shorelines. The factors mentioned above all contribute to how much beach we see at our properties. The lake levels at the USGS gage at the Narrows can be above the nominal reading and because of shifted sands at a given location in the lake can appear low.

Enjoy the ever changing and unique character of your beach!



The illustration above shows the ideal conditions for a stable and pollution-preventing shoreline—natural vegetation. The root structure of the vegetation holds together the bank and resists erosion. Shoreline aquatic plants absorb and deflect wave action before it can cause damage. The second panel shows a revetment structure designed to restore a natural shoreline by stabilizing with rock and planting willow stakes. When the willows reach full size their root structures will stabilize the bank. Note that the seawall depicted below may provide structural stability, but it creates a biological desert in the shallows before it and provides no filtration of nutrients in runoff. Installing seawalls around a lake is one of the fastest ways to destroy its ecological integrity.





intact! As a result, local counties strictly enforce the Soil Erosion and Sedimentation Control Law which requires a permit for any earth change near a lake or stream, or that disturbs more than an acre. To receive a permit, the applicant must submit an approved plan and take precautions to minimize erosion. (See page 56 for contact information for local permits.) Don't forget, construction projects may require zoning permits, building permits, and even wetland permits as well. Check with your local authorities before you break ground.

Unfortunately, we can't have it both ways. The more we develop our waterfronts like swimming pools, the more the lake will become like a swimming pool—and we'll need the pool chemicals to keep it useable. A more constructive approach is to establish (or reestablish) a green buffer at the shoreline between the water and the soil. A combination of small rocks, temporary barriers, and plantings can quickly become an effective deterrent to shoreline erosion and more aesthetically pleasant in the bargain.

Leave natural vegetation on shorelines.

As a rule of thumb, the size of a plant's root system is relatively the size of its trunk and branches. It follows that the extensive root system of a mature tree or shrub can consolidate and strengthen a substantial portion of shoreline. Leave natural vegetation in place and prune very selectively to establish a view. Leaving shoreline vegetation is substantially easier than re-establishing it, and in the process you will probably avoid shoreline erosion problems before they begin. If you already have a breakwall at your shoreline, consider having it removed by a shoreline restoration specialist. Another alternative would be to establish a 20' wide green buffer behind it.

When a wave sweeps into a shoreline wetland, a myriad of stems, branches and leaves absorb the energy of the wave before it can reach the soil level. In the winter, shallow wetlands freeze solid and resist the tons of pressure that result from wind-driven ice pushing up against the shore. Similarly, shallow sloping shores also deflect and frustrate the force of water. When these natural barriers are removed, we are left with a naked power struggle between man-made contrivances and the forces of nature. In the struggle between the natural forces of wind, water, and ice, on the one hand, and man made structures, like seawalls, rocks, or the unreinforced lip of a yard on the other, the forces of nature will always win. Man-made obstacles need regular maintenance. Natural obstructions maintain themselves, and work better, too.

Use plant material to stabilize problematic shorelines.

A wide variety of techniques have been developed over recent years that combine plants with physical structures to stabilize shorelines. Usually, the structure is temporary in order to allow the live plant material to root and eventually replace the structure as the principal means of stabilization. One technique uses live stakes (cuttings of species that will sprout from branches) driven into a rip-rap reinforced embankment (see figure on page 34). The buried ends of the stakes root, the exposed ends of the stakes leaf, and eventually the bank becomes an unbroken thicket of willow trees.

Even if you already have a seawall, you may want to consider replacing it with a plant supported embankment. Seawalls do little to filter nutrients from runoff and migrating groundwater. The shallow water in front of seawalls affords no cover for baitfish or the fry of fish species, and the turbulence stirs up sediment and discourages the rooting of plant life. Biotechnical erosion control measures (the technical name for the above mentioned stabilization technique) make a perfect shoreline buffer when installing a shoreline greenbelt.

Avoid installing beach sand.

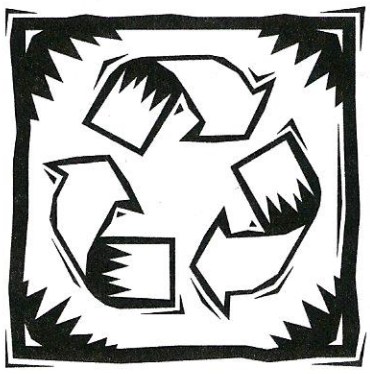
If your slice of the shoreline was suitable for a sandy beach, chances are that nature would have already established one there. Artificial beaches are very poor filters of nutrients and attract the snails and waterfowl that cause swimmer's itch. Since an artificial beach usually abuts a fertilized lawn, it acts as a racetrack for nutrients washing into the lake. Dumping sand at a shoreline will probably require a Soil Erosion Permit, so contact the proper authorities if your heart is set on it. Better yet, anchor a swimming raft in the deeper water and take the kids to the Lake Michigan shore when they want to play on the beach.

Waste Disposal—Refuse, Reuse and Recycle

If there is one thing that you can do to go easier on the earth, it's to refuse, reuse and recycle. Not only do you avoid burying garbage, but you reduce the need for refining new raw materials, save huge amounts of energy, and can save money in the process. When you hear the debate about acid rain, the greenhouse effect, strip mining, and the cutting of the rainforests, the real crux of the issue is material consumption. Recycling is the way to lessen demand.

Virtually all the solid waste collected in the watershed is buried in landfill sites within 10 miles of Glen Lake and the Crystal River. The landfill is designed to encase the garbage, mixed with soil, in huge cells of heavy watertight fabric. The facility covers dozens of acres and rises high above the natural grade of the countryside. It uses state-of-the-art techniques to protect groundwater from contamination by chemicals in the refuse, but the landfill will be there forever, and forever can include a lot of variables.

The residents of the GL-CR Watershed have a convenient loca-



Where to Recycle in the Glen Lake Area:

Plastic, Metal, Paper, Glass and Cardboard:

• Waste Management–Empire

Takes paper, cardboard, clear glass, plastics #1 and #2, and metal.

From M-22 in Empire, turn on Fisher Street, then right on LaCore Street. Bins are at the end of the street. Always open.

• Waste Management–Traverse City

Takes all of the above in addition to green and brown glass.

2294 Cass Street, Traverse City

Open Mon.–Fri., 8:00–5:00

Flashlight Batteries:

• Fire Station-Fire Fighters Local 646

510 W. Front St., Traverse City

(231) 946-0230

Computers, Electronics:

• Grand Traverse Co. Resource Recovery

Make reservation at: (231) 941-5555. Provide a list of the items you plan to recycle. You will receive an invoice and confirmation letter prior to the collection as well as directions to the collection site. The charge is $5 per item.

GLA Water Quality Efforts

Yesterday —The Work Begins

Since the inception of the Glen Lake Improvement Association, now know as the Glen Lake Association, water quality has been an important focus of the organization. As a humble beginning in 1973, the Michigan Department of Natural Resources collected data on Big Glen Lake to document water clarity using secchi disk readings. The Glen Lake Association and the Michigan Department of Natural Resources collected secchi disk and chlorophyll-a data from the Glen Lakes from 1979 to 1989. For over twenty years the association has done a Cladophora Shoreline Survey to determine areas around the lake that have an overabundance of this filimous, green algae nourished by a phosphorus overload.

In 1972, Karl Curry, a graduate student at Central Michigan University, compiled the first baseline study of Glen Lake. The Michigan Department of Natural resources tested for dissolved oxygen between 1973 and 1984. In 1990, Dr. Don Matschke secured funds for a new study. Dr. Tim Keilty and Dr. Matschke, along with the combined efforts of the Glen Lake Association, the Michigan Department of Natural Resources, and the Region V Environmental Protection Agency carried out an extensive study of the Glen Lakes to address the question of whether or not the riparians and the community were doing all they could to minimize deterioration of the lakes. Some of Karl Curry's early test sites were used. The study was designed to be able to compare Karl Curry's data with the Keilty data, but also to study new and more far reaching aspects of the lake's health. Focuses of the study were the lake's hydrology, nutrients, deepwater sediments, water chemistry, plankton, aquatic plants, soils around the lake, and mercury contamination in the lake trout and smallmouth bass.

Recommendations from this study included: working towards the reduction of airborne

Continued on page 37

tion that can handle their household recycling needs. (See the sidebar on page 35 for more information on location and hours.) If you have never recycled before, visit the center and see for yourself how easy it is to recycle.

Since the spring of 1995, landfills are no longer allowed to accept lawn and garden wastes. Open burning may be a convenient way to dispose of these wastes, but the ashes of brushfires contain concentrations of the nutrients that pollute the water. Establish a compost pile in your yard, not just for lawn clippings and brush, but for organic kitchen wastes as well, and your garden will be the more beautiful for it.

Water Quality, Clarity and Aquatic Weeds

Twenty people will probably have twenty different opinions on what exactly constitutes good water quality. Most would agree that colorless clear water, free of suspended solids would be the first qualification. For those folks who have spent most of their lives in the south, or even downstate Michigan, the clarity of northern lakes such as Glen Lake is breathtaking. On the other hand, informed residents know that the lakes' water quality depends on a fragile ecological balance. Things could change quickly in Glen Lake.

Seasonal changes and weather conditions can also have an impact on clarity. A sustained wind can churn up loose sediment in shallows and cloud the water, as can the biannual temperature inversion that causes a flip-flop between bottom and surface water. The cold winter freeze can set back the advance of weed beds and biological activity temporarily, but where the conditions are right, weeds and aquatic plants will grow quickly in northern lakes.

Scientists measure clarity with a Secchi disk. The secchi disk is a small black and white plate that is lowered into the water on a line. The technician determines the depth at which the disk can no longer be seen and establishes a numerical rating. Other important indicators are the phosphorous and chlorophyll-a levels. Both compounds are directly related to biological activity which produces particulates and clouds water. Just a few parts per billion of phosphorous and chlorophyll-a can determine the difference between a coffee-colored backwater and a clear trout lake.

Old timers around Glen Lake will identify weed beds that have expanded over recent years or appeared where there were none before. Like the microbiological activity, the weeds too, benefit from the exploding amounts of available nutrients in the water. "Treating," (which is actually poisoning) weed beds only treats the symptoms, not the cause, and can lead to wider problems in the ecosystem.

Over long periods of time, lakes slowly fill with sediment and accumulate nutrients from the thousands of generations of plants and animal life. This process is known as eutrophication and is the natural aging process, or succession of lakes. Given enough time, all lakes will eventually become more and more like a swamp. When human populations move into a lake watershed, the aging process accelerates dramatically. It normally may take thousands of years for

a lake to deteriorate in a natural system; with human residents it can occur in a matter of decades, or less.

Why do humans age a lake so quickly? The answer is simple: our activities upset the balance and accelerate the movement of nutrients into the water system at a fast pace. Nevertheless, a few simple alterations to behavior can greatly slow the aging process of the lake.

The root cause of murky water is the microscopic aquatic plant growth that is accelerated by the nutrient phosphorous. Therefore, most of the solutions to water clarity focus on reducing or eliminating phosphorous from the water system.

Fertilize at least 30 feet from the water.

Avoid the use of fertilizers within 30 feet of the shorelines of the lake or tributaries. If possible, switch to landscape techniques that need no artificial chemical stimulation. If you must use fertilizer, use one that contains no phosphorous. A soil test will usually confirm that the compound is unnecessary around the lake—especially if you are watering with lake water. A 20–20–20 fertilizer is high in phosphorous. A 20–0–20 fertilizer contains no phosphorous. See page 26 for Landscaping and Lawn Care.

Avoid nutrient-rich household products.

Avoid the use of household products, such as detergents, that contain phosphorous. When phosphates (a phosphorous compound common in detergent) enter the septic system, they easily migrate into the drain field and can seep into the lake water. A properly designed and installed septic field will protect you from harmful bacteria, but it will not stop the entry of nutrients into the water system—only you can, by not using phosphorous in the first place.

Control stormwater runoff.

Divert runoff from impervious surfaces like roofs and driveways into vegetated areas where the sediment can settle and plants can absorb the nutrients. Nutrients will attach themselves to common sediments and follow runoff.

Keep shorelines natural.

Avoid installing seawalls at the lake shore. The action of waves at a seawall create turbulence and stir up sediments in the shallows that cloud the water and release nutrients. Sea walls are also poor filters for nutrients in surface runoff. Maintain the natural vegetation and you will be rewarded by cleaner lake water. See page 33 for Shoreline Stabilization.

Aquatic weeds are a <u>community</u> problem, not a personal problem.

Never attempt to treat aquatic weed beds on your own. Weed treatment is a technically complicated process that impacts everyone that uses the lake and it's illegal without a permit. It's a process that should be used only as a last resort and only after a community consensus.

GLA Water Quality Efforts

Continued from page 36

emissions of mercury from such sources as coal burning facilities and municipal incinerators, identifying cladophora "hot spots" around the lake and encouraging riparians to remedy septic problems and discontinue inappropriate fertilizer use, encouraging naturalization strips at the lakeshore, controlling road runoff, management of stormwater, and continuation of the monitoring of the physical and chemical water quality parameters of Glen Lake.

Today—The Work Goes On.

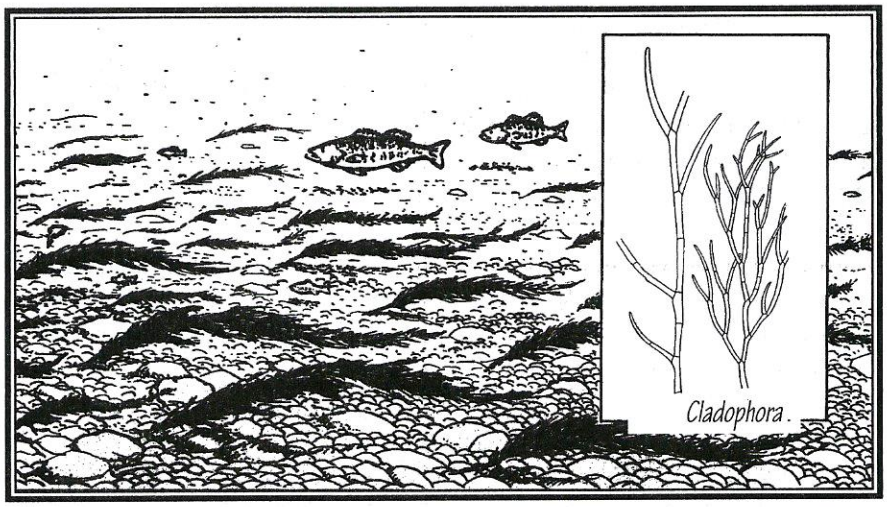
As the stresses on our pristine waters and shores of Glen Lake increase with new development, more year round residents, and larger homes replacing the cottages of times past, the need to protect the waters of our lakes, rivers and streams is more important than ever. The Keilty study, the Glen Lake/Crystal River Watershed Management Plan, the Cooperative Lakes Monitoring program of the Michigan Lake and Stream Associations, and the Sleeping Bear National Lakeshore and Leelanau Conservancy testing program are the guardians of the Glen Lake/Crystal River Watershed.

The Glen Lake Association has hired a part time biologist to aid in the work of monitoring the lake. Volunteers test the lake following the Cooperative Lakes Monitoring procedures. A yearly Cladophora study pinpoints shoreline problems. Our biologist works with Riparians to modify their shoreline and property problems to protect the lake. An aquatic plant study done by the association has pressed and catalogued the plants of the lakes and continues yearly searches for invasive aquatic plant species. The association has seven scientists serving on a science review panel to review our work and make recommendations.

Cladophora Survey

Be on the lookout for cladophora, a peculiar mossy looking aquatic weed. The plant is usually green and characteristically waves and undulates freely in the current. The branches are tufts that can grow to about eight to ten inches in length and can thickly carpet entire areas or occur in isolated clusters. Clusters can also break loose and form balls which float around the lake. Upon closer inspection, the tufts are comprised of a main axis and finer filaments that branch off.

In 2004, Rob Karner, GLA's staff biologist, conducted a shoreline survey of Big and Little Glen Lakes looking for cladophora growth. As a follow up of this study, Rob visits with the property owners with the highest cladophora survey index scores. He makes recommendations to reduce nutrient loading at their shorelines, such as irrigating lawns with lake water and the use of Clean Green® fertilizer, which is available by contacting Rob or the Northwoods Hardware store.



Cladophora

Be on the lookout for this peculiar mossy looking aquatic weed. Specifically, cladophora is a genus of relatively large forms of algae with about a dozen species that inhabit the Glen Lake environs. It grows on rocks or other hard-surfaced bottom material on which it can anchor, and to grow it needs at least a moderate amount of wave action. Most importantly, it needs a rich source of nutrients—a lot of nutrients, and its presence around the shore of Glen Lake and Crystal River can identify a localized phosphorous source. The plant will thrive especially in a spot that has a continuous rich stream of phosphorous input from a faulty septic system, animal wastes, fertilizer, etc.

The plant is usually green and characteristically waves and undulates freely in the current. The branches are tufts that grow to eight to ten inches in length that can thickly carpet entire areas or occur in isolated clusters. Upon closer inspection, the tufts are comprised of a main axis and finer filaments that branch off.

Don't panic at the sight of cladophora in the shallows, but take it as a sign. Cladophora growth can help to pinpoint problem areas. It could indicate a septic problem, chronic fertilizer over-application or even a soil erosion problem—and point the way to remedial action. If you do find it on your shore or downstream, GLA offers a free program to confirm and evaluate cladophora growth. (See sidebar on page 38.)

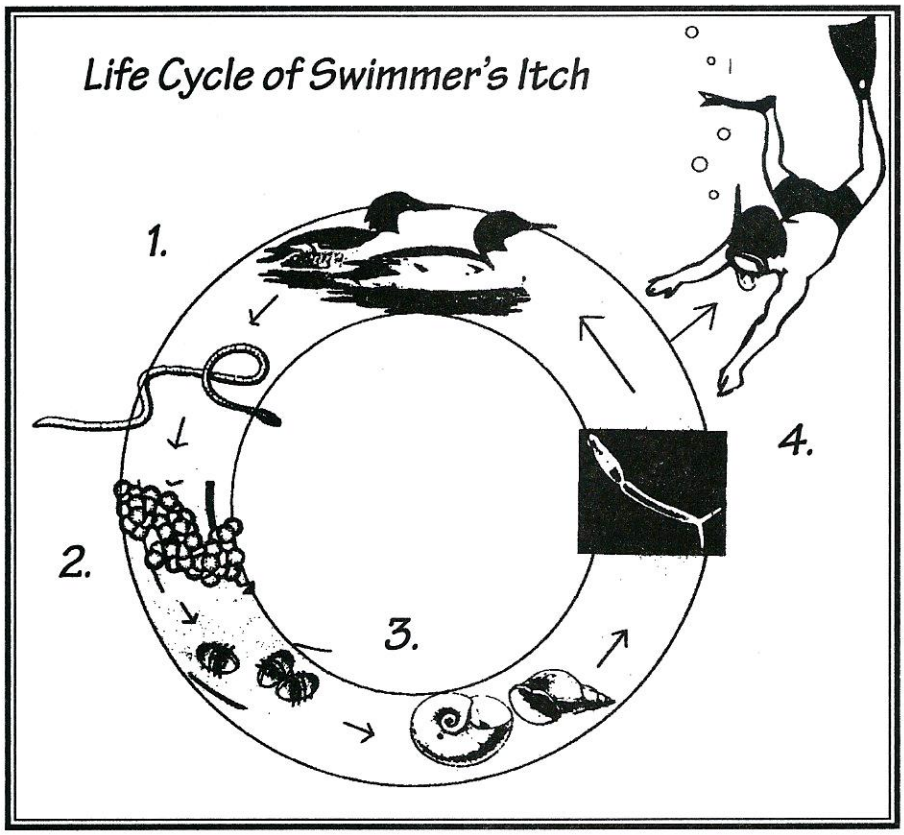
Swimmer's Itch

Swimmer's itch is a little like poison ivy—not everybody that is exposed develops a reaction to it, and you can take measures to avoid it. Eradicating it altogether in Glen Lake may be possible, but is probably not feasible.

The problem starts when swimmers encounter the larvae of a tiny flatworm. The larva, called cercaria, is about 1/32 of an inch long and is a parasite looking for a host body in which to burrow and grow. When cercaria encounter a human and burrow into the

skin, the larvae soon die since humans aren't a suitable host. The swimmer may develop an allergic reaction to the dead parasite in the form of reddened skin and intense itching. The discomfort is usually gone in a couple of days and poses little serious threat to the victim's well-being. It may come as little comfort to the afflicted, but less than half of the people that encounter cercaria are prone to the allergic reaction.

At the stage where the cercaria latches on to a human, the larva is actually searching for a waterfowl host, such as duck or goose. If it finds the proper host, the larva burrows into the animal's tissue and grows into a mature schistosome flatworm. Eventually, the mature flatworm lays eggs which reenter the lake by way of the bird's droppings and hatch into another form of larva called a miricidia. The miricidia needs to find a snail host in which to burrow and generate cercariae, and when the cercariae leave the snail host in search of a waterfowl host, the cycle becomes complete.



Swimmer's Itch Life Cycle

The diagram above shows the cycle that leads a parasite to enter the skin of lake swimmers and causes a painful itch.

1) Flatworms become adult worms in veins that surround the intestines of certain birds and rodents (especially mergansers).

2) Female worms lay eggs that enter intestines and hatch when released into water through feces.

3) Eggs hatch into swimming larvae that enter snails. They elongate into germinating sacs that produce thousands of new parasites called cercariae.

4) Cercariae mistake swimmers for their normal host birds and rodents, penetrate their skin and consequently die, which causes the condition called swimmer's itch. Cercariae that burrow into their normal hosts complete the cycle and become flatworms, as in stage 1.

At least nine different species of flatworms that produce the swimmer's itch reaction inhabit northwest Michigan, and each one requires a different waterfowl and snail host combination to complete its life cycle. In Glen Lake, the merganser duck is the most common host for the parasite and GLA administers a program to remove the waterfowl from the lake. (See sidebar on page 40). Several strategies of swimmer's itch control are currently in the experimental stage. These focus on treating waterfowl with a drug that will kill the flatworms and leave the bird unharmed. Formerly, copper sulfate was used to chemically control the problem by poisoning the snail hosts. Unfortunately, copper sulfate is an indiscriminate poison that kills a wide array of aquatic plants and animals which are critical to the general health of the lake. Also, the chemical is relatively ineffective in deeper water, and in a short period of time the flatworms and the host snails recolonize the treated areas. Note that strict laws control the use of copper sulfate—application of the chemical into the lake requires a permit issued by the Department of Environmental Quality.

Take precautions to avoid swimmer's itch infection.

• Towel off vigorously after swimming and change into clean dry clothes. It can take 10–30 minutes for the cercariae to burrow

into the skin after contact. The larvae cannot tolerate dry conditions and will die immediately.

- Avoid swimming at midday when the cercaria are most active and in areas exposed to prolonged onshore winds (the larvae drift near the surface and accumulate in a wind).
- Avoid warm shallow water and swim in deeper water where the snails are unlikely to occur.
- Apply an oily substance such as sunscreen or insect repellant (such as DEET for adults) before entering the water.
- DO NOT FEED waterfowl and attract them into your swimming area. Their droppings will only exacerbate the problem.
- In case of exposure, some feel that the application of a topical antihistamine, such as Benadryl, will relieve the itch. Other suggested products are Calamine, Caladryl or Sarna lotions. The Prescription Shop in Glen Arbor is accustomed to handling this discomfort and stocks the above products.

Swimmer's Itch Control Program

If one of your family or party shows signs of swimmer's itch, feel free to contact the Swimmer's Itch Hotline at Glen Arbor Prescription Shop for advice on treatment. The Prescription Shop is also tallying reports of infection to help GLA track infection rates and areas where contact commonly occurs.

Glen Lake Association continues to aggressively work toward a permanent solution to the nagging problem of swimmer's itch. A GLA sponsored research program identified merganser ducks as having the highest degree of infection of the common local waterfowl. In 2004, nine families of mergansers consisting of 13 hens and 84 chicks were captured, inoculated, and relocated by contractors working on behalf of GLA. Of the snails collected to determine the level of infection, 500 contained cercariae and were removed. Residents are urged to contact Rob Karner, GLAs staff biologist, if mergansers are observed on the lake (231) 334–5831.

Sport Fishing and the Glen Lake Fishery

We know from the records of bygone days that a more diverse and plentiful population of fish once inhabited the waters of Glen Lake. The fish could move freely from Lake Michigan to Glen Lake and above. No doubt, the shoals of Glen Lake and its tributaries were an important spawning grounds for Lake Michigan lake trout and coasters (a lake-running speckled trout) among other species. With the construction of the dam on the Crystal River, fish access back and forth to Lake Michigan was impeded. Today some fish species can move back and forth between Lake Michigan and Glen Lake, but changing habitat and modern pressures around the shorelines have permanently altered the aquatic ecosystem in Glen Lake.

At 4800 acres, Glen Lake is big enough to have attracted the interest of the Michigan Department of Natural Resources to develop the recreational fishery and over the years the DNR has attempted to establish or improve the populations of a variety of gamefish. From 1956 through 1973, the DNR attempted to establish a rainbow trout fishery. Then, from the early 70s through 1997 they focused on brown trout and splake. The rainbows appeared to have migrated out the Crystal River, and though they maintained a decent splake fishery, the brown trout never took. After 1997, the agency only stocked lake trout, which thrive in the lake. In 2004 a new program was begun to establish steelhead and rainbow trout.

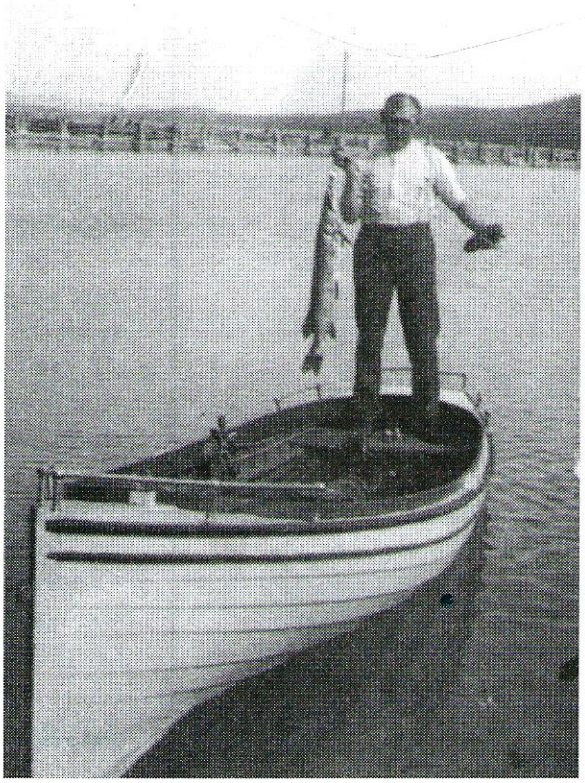
Little Glen is shallow and has customarily been regarded as a premier inland perch fishery. The lake also holds steady populations of northern pike, cisco, bluegill, sunfish, largemouth bass and smallmouth bass. In the early 1990s, the DNR unsuccessfully attempted to establish walleye in Little Glen Lake. Of course, all gamefish are able to move freely between Big and Little Glen Lakes, but each species favors one lake or the other.

Although no attempt to establish salmon or trout by planting in the Crystal River is on record, a small number of rainbows run up

the river in the spring and some coho and chinook annually stray into the river each fall. The river also supports a limited population of smallmouth bass and panfish.

The aquatic systems that support gamefish are finite—there are only so many adult individual fish of any given species in Glen Lake. It may be difficult to believe, but humans are the principal predator of the gamefish population in the lake. Humans are the only predator that customarily keeps the finest and largest individuals of their prey, whether it be a northern pike, lake trout or perch. The impact of over-fishing patterns has far reaching consequences that can result in situations like a stunted panfish population.

Fishing regulations are a dynamic and evolving code to protect the integrity of the fisheries, while still allowing as much access as possible to anglers. Since fisheries biologists can't customize regulations for each lake, they settle on reasonable albeit generalized rules that apply to entire regions. Thus, anglers should look beyond the letter of the law to the spirit of the law. For instance, just because bass season is open, catching late spawning bass off their beds will destroy not just one individual, but a whole new generation—what's legal may not be proper. Some anglers find the temptation to ignore daily creel limits to be irresistible when they no longer have to disembark at a public boat launch and risk the inspection of a DNR officer. Nevertheless, private access to the lake should carry more responsibility and interest in following intelligent procedures, not less.



Glen Lake Fishing

This photo was taken around 1920 with the Narrows in the background. Human beings remain the dominant predator of large sportfish species in Glen Lake—the only predator that customarily harvests the largest, strongest and best breeding stock of its prey. The increase of angler numbers, improvements in technology, and a diminished habitat make it imperative that anglers observe both the letter and the spirit of catch limits.

(Photo provided by the courtesy of Sleeping Bear Press, from the volume "Vintage Views of Leelanau County" by M. Christine Byron and Thomas R. Wilson.)

Obey fish and game laws.

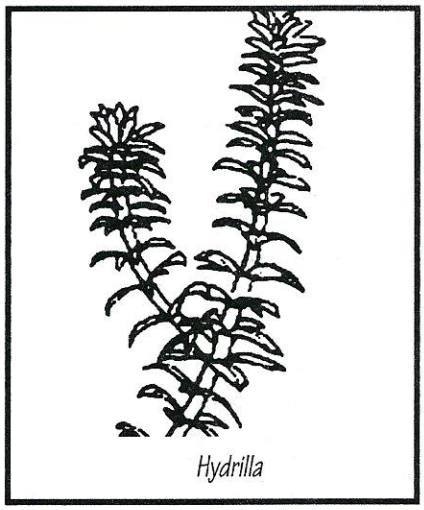
Take no more fish than you need and observe creel limits. The collective impact of human fishermen can devastate a fish population. Humans are the only predator that methodically takes the strongest and largest individuals from the population.

Preserve the aquatic habitat.

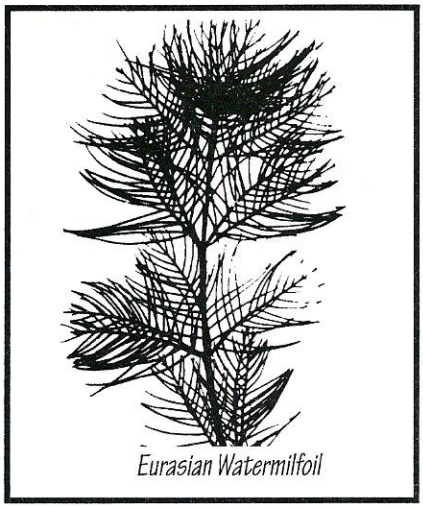
Maintain a natural lake shore thick with vegetation and minimize disturbances to overhanging branches. Protect the natural shoreline nursery grounds. Take precautions to stop nutrients from entering the watershed. Don't leave refuse in the lake.

Take precautions on the consumption of your catch.

Since large trout from Glen Lake warrant an official warning on the consumption, common sense would dictate caution. Toxic chemicals are found in the adults of virtually all foraging fish species in large Michigan inland lakes. Fish like lake trout live relatively long lives at the top end of the food chain. Over the years, the small quantities of toxic chemicals in their food sources, such as baitfish, accumulate in the predator's body tissue. As a rule of thumb, the older and larger the fish, the more undesirable chemicals it will contain. The fatty tissues accumulate the highest con-



Hydrilla



Eurasian Watermilfoil

Don't Pick Up Hitchhikers!

Keep an eye out for the invasive species pictured here that are the three most likely (out of many) to infect Glen Lake.

An invasive species' principal means of movement from lake to lake is as a hitchhiker on a watercraft. Therefore, the GLA employees man the Day Forest Road boat ramp on Little Glen Lake from early June on weekends and every day from June 15 through Labor Day to help boaters clean and inspect their watercraft for invasive species before launch into Glen Lake. But they can't reach every boater.

Follow these simple precautions when launching into Glen Lake:

Thoroughly wash and examine your watercraft before launching into Glen Lake.

Continued on page 43

centrations of contaminants, so anglers are encouraged to filet and trim as much fat off the fish as possible. Small children and fetuses are most susceptible to damage from toxic chemicals and pregnant or nursing mothers will pass these chemicals on to their babies.

Take precautions to eliminate hitchhiker species when moving your boat from one lake to another.

Get in the habit of scrubbing the propeller, trailer, hull and live box when you haul your boat out of the water and flush the water from the engine's cooling system—away from the lake, of course. All it takes is one contaminated boat and Glen Lake could be further contaminated by zebra mussels and quagga mussels. Zebra mussel larvae will die fairly quickly when the boat dries out, but the same larvae can live extended periods in the engine's coolant system if it holds water.

The risk of invader species is not confined to zebra mussels. Other non-native plant species and even diseases (in fish slime on the walls of the livebox) could be inadvertently unleashed on the Glen Lake-Crystal River ecosystem.

Invasive Species and Watercraft

Thankfully, Glen Lake remains largely free of invasive and alien species (non-native species that artificially enter and disrupt ecosystems). A host of species threaten the lake unless we keep a constant vigil and seal off the likely entry points. That's why the GLA operates a power wash and inspection program at the Day Forest Road boat launch site to educate the boating public on the importance of keeping these critters out of our lake.

Zebra and quagga mussels, probably the best known of the invasive species, are shellfish that attach to most hard submerged surfaces, including boat hulls, rocky shoals, intake pipes, buoys, docks, and even native species of freshwater clams (which they usually overwhelm once the zebra mussels become established). The mussels will affix to each other's shells and form large colonies that feed on native plankton in enormous quantities, thus disrupting the food chain. Zebra mussels have no native predators. A small population of zebra mussels was discovered in Little Glen Lake in 2004 and volunteers removed hundreds of aliens.

The round goby, the ruffe and the snakehead are examples of invasive fish species. The ruffe is a cold water fish from northern Europe similar to the perch. A fierce competitor with native gamefish for food and habitat, as the ruffe numbers increase the native species typically decline. Not all invasive animal species are obvious. Foreign zooplankton, such as the spiny water flea and the fish hook water flea, are miniature animals that can drastically alter the food chain on a microscopic basis with macroscopic result.

The two most dangerous invasive aquatic plant species are Eurasian watermilfoil and hydrilla. Watermilfoil plants have long flexible stems with feather-like leaves attached in 12 or more whorls of four. Hydrilla's growth pattern is similar to watermilfoil

with smaller sets of leaves on a central stem. Once established, either plant grows and spreads quickly into thick mats that choke out native plants and fish habitat. The effects on the lake's ecosystem and esthetic appeal can be disastrous.

One thing all these invasive species have in common: their most likely entry point to Glen Lake is as a hitchhiker on a watercraft. The boat or PWC hull, the cooling system in the motor, the baitbox—anywhere that water from an infested area can be carried into Glen Lake could host the aliens. The eggs or larvae of zebra mussels, the seeds or fragments of watermilfoil or hydrilla is all it would take to start a new infestation in Glen Lake.

Thoroughly wash and examine your watercraft away from the lake before launching into Glen Lake.

Larvae, eggs and plant fragments can survive anywhere water accumulates on the watercraft. Before backing down to the ramp, briefly start your engine to blow all the water out of the cooling system—away from the lake. Rinse and dry your boat to make sure all possible hitchhikers have been eliminated. If no rinse equipment is available, vigorously rub down your hull and exposed motor surfaces with a rough towel. Drain your boat's live wells and dry them out. Never transfer drawn water from Lake Michigan or any other inland lake into Glen Lake—that includes bait buckets containing water from bait shops, water skis and even scuba equipment.

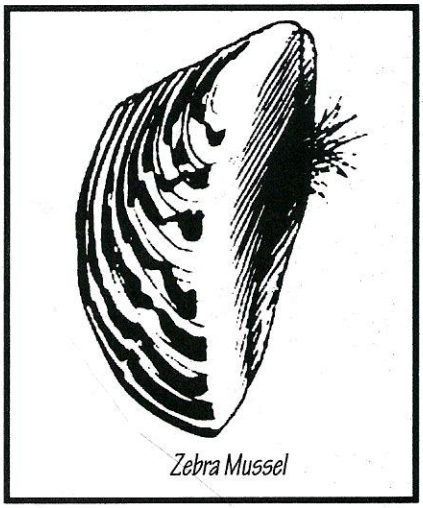
Always launch your boat or PWC at the Day Forest Road boat ramp, which is the only public boat launch site on Glen Lake. The ramp is manned by GLA employees operating a free powerwash and inspection from early June on the weekends, and every day from June 15 through Labor Day.

Waterborne plants can also be transported from lake to lake by trailers. The trailer may catch on aquatic plants while backed into an infested lake and transported to a new location. Check the boat trailer as well.

Watercraft Operation

GLA advocates a balanced approach to watercraft operation and management that allows us to have fun on the water, but still respect our neighbor's rights and safety in the process. The operation of motor boats has always been accompanied by some environmental dangers, such as exhausts, the potential for fuel spillage and boaters' sewage. But the advent of the jetski and PWC (personal water craft) has brought about a new era of controversy and challenge. As a rule of thumb operators should try to be sympathetic to the sensibilities of others. For instance, although the rules allow PWCs to operate between 8 am and 1 hour before sunset, operation between the hours of 11 a.m. to 6 p.m. will be less disruptive to the peace and quiet of the lake.

The statistics demonstrate the risks associated with PWCs. Of all the reported watercraft accidents in 1995, 45% involved PWCs.

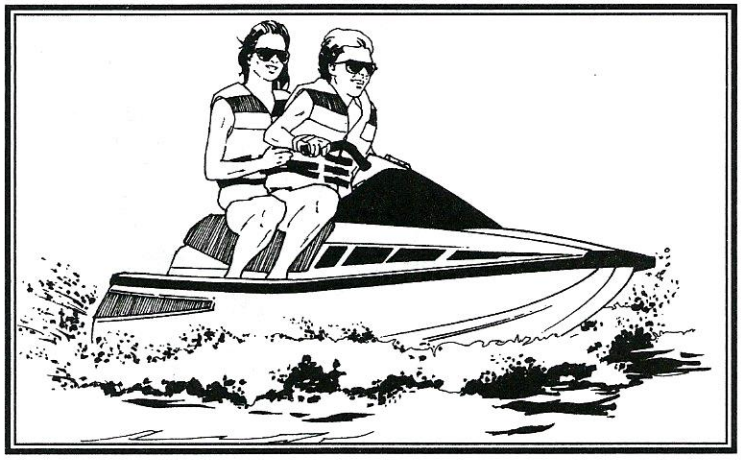


Zebra Mussel

Don't Pick Up Hitchhikers!

Continued from page 42

Before backing down to the ramp, briefly start your engine to blow all the water out of the cooling system. Rinse and dry to make sure all possible hitchhikers have been eliminated. If no rinse equipment is available, vigorously rub down your hull and exposed motor surfaces with a rough towel. Drain your boat's live wells and dry them out. Never transfer drawn water from Lake Michigan or any other inland lake into Glen Lake—that includes bait buckets containing water from bait shops, water skis, and even scuba equipment.



Two Main Problems with Personal Watercraft (PWC): Noise and Safety

- *Ride quietly away from shore.*
- *Enjoy your ride, tricks, spinouts, etc., in the middle of the lake.*
- *Change your mid-lake locations often.*
- *Return to shore quietly.*
- *Stay well away from other boats, PWCs, docks, shores, swimmers, and moored boats.*

One third of those, involved a PWC with no other boat, and another third involved a collision of two PWCs. Seventy-five percent of the PWC accidents involved operators with no instruction. Over half of the PWC accidents involved operators other than the owner.

Respect speed limits, no wake zones, and other water safety regulations.

On Glen Lake, all watercraft must maintain a slow, no wake speed within a 100 foot distance from the shoreline, docks, swimmers, swimming areas, fishing boats, sailboats, or moored vessels (200 feet from divers' buoys). Michigan enforces noise limits for watercraft. All Michigan inland lakes have a general speed limit of 55 m.p.h. and common sense always applies. No wake areas protect sensitive shorelines from erosion and the nesting and spawning areas of our wildlife. Unless you fully understand how to operate your boat according to marine laws, leave it at the dock—ignorance of the law is no excuse. Don't hesitate to report violations to the Leelanau County Sheriff Department (where you can also get a copy of the Michigan Water Safety Act). Violators of the marine safety code need to be challenged—for their own good and the safety of all.

Did you know?

- A person must be 14 years old to operate a jetski (PWC—personal water craft) or motorboat in Michigan. Persons 12 to 14 years of age may operate a PWC if accompanied by a parent or guardian and both carry a boating safety certificate, the PWC is equipped with a lanyard shut-off attached to the parent and the PWC is designed to carry two or more persons.
- The owner or person in charge of a water craft is personally liable for illegal use.
- PWCs may not be operated between one hour before sunset and 8 am.
- PWC operators and passengers must wear a Coast Guard approved life jacket.
- PWCs may not cross within 150 feet behind another vessel, other than a PWC, unless the PWC is operated at no-wake speed.
- Unless at a no-wake speed, PWCs may not be operated in less than 2 feet of water—faster speeds in deep blue water only.
- Sailboats and other non-motorized watercraft always have the right of way over motorboats.
- The owner of any vessel is personally liable for any damage to life or property resulting from the wake created by negligent operation of his vessel.
- Circular boat operation, such as waterskiing, must be in a counter-clockwise fashion insofar as it is reasonably possible.
- Boats and PWCs towing waterskiers must carry a second per-

son or "spotter" in addition to the driver, and be equipped with a rear view mirror.

Keep fuels, solvents, detergents and sewage away from the lake.

Contrary to popular practice, dockside is not the ideal place to wash your boat. Rinse your boat with lake water, but never wash your boat in the lake or use detergent on your boat or rinse it directly into the water. The same rule goes for paint jobs, varnishing and stripping—all of which require chemicals that must be kept out of the water. Fuels should always be stored and handled in an area where there will be no risk of spills into the lake water.

Relieving oneself in the lake is not only poor hygiene, but is also illegal.

If you intend to be on the lake for an extended period, then you should make contingency plans for toilet needs. State law prohibits the operation of watercraft with toilet facilities unless wastewater is contained in a holding tank. Dispose of wastes only in a proper facility. On a similar note, bathing and washing hair in the lake with a bar of soap causes the same type of degradation in water quality as washing your boat with detergent.

Piloting a boat under the influence of alcohol can be more dangerous than in wheeled vehicles—and is just as illegal.

Research has shown that several hours of exposure to boat engine noise, wind, sun, and motion on the water produces an effect called "boater's hypnosis." The condition is a type of fatigue that slows reaction time and judgement in a similar way to alcohol. The addition of alcohol consumption to boater's hypnosis can accelerate the effect of alcohol at much lower blood levels. Over 50% of all boating fatalities involve alcohol.

In the event of an emergency, alcohol intoxication can greatly complicate survival. With alcohol in the bloodstream, the body loses heat at a higher rate and will accelerate the effect of hypothermia from a fall into cold water or being stranded in a chilly rain. Alcohol also intensifies the effect of caloric labyrinthitis, the disorientation caused by water entering the ear. An intoxicated person can easily become disoriented to the surface and swim downward to their death.

Respect wildlife.

Consider all the challenges of survival for species trying to live in the natural world. The last thing they need is to have someone bear down on them in a motorboat just to watch them take off flying. Unnecessarily disturbing wildlife causes them to burn energy for no purpose, can disrupt nesting and feeding patterns, and in the worst case harm the animals directly. Wildlife is already under tremendous pressure—give them wide berth and let them be.

Conservation Tools for Critical Areas

Some areas of the GL-CR Watershed require special tools to protect the unique role they play in preserving the quality of water. Known as "critical areas," these properties include wetlands, shoreline and streamside greenbelts, and upland groundwater recharge areas. Because of the vulnerability of critical areas in the water cycle, human activity in these locations must be either very restricted or non-existent.

While township, county, and state governments regulate and, in some cases, prohibit certain land use activities in critical areas, in practical terms, the future of the land lies in the hands of the individual landowner. In fact, few landowners realize they have the right to extend protection of their property beyond their current ownership and, for all practical purposes, forever. On the one hand, landowners may donate a gift of land to a conservation organization, like the Leelanau Conservancy. Or, the Conservancy can help the landowner place a conservation easement upon their property that permanently restricts development on the property—yet leaves the property in private ownership.

Private landowner initiatives are extremely flexible, and can be adapted for use by residential and agricultural landowners alike, as well as developers, industrialists, and other commercial stewards of land. The only requirement for participation is that the property contain significant natural, agricultural, or scenic features.

Before we look at land protection tools in detail, let's first take a look at the areas of the watershed that are defined as "critical" to the long-term health of Glen Lake and the Crystal River. Areas of the watershed that could have a disproportional impact on surface and groundwater quality include wetlands associated with the Crystal River and Glen Lake waterside greenbelts, and upland groundwater recharge areas.

Wetlands

Wetlands come in a variety of types, shapes and sizes. All forms of wetland share one thing in common—a diversity of flora and fauna unmatched in any other land type in the region. The wetlands in the Glen Lake-Crystal River Watershed serve as a filter for non-point source pollutants, purifying the water on its way to the lake. The roots of wetland vegetation pull nutrients from the water while the plants trap sediments and other pollutants, making wetlands our most efficient and inexpensive water treatment systems. Wetlands also provide important flood areas to act as settling basins for sediments and help maintain healthy water temperatures by providing dense shading over surface waters. Most of the wildlife in the watershed is dependent on the breeding habi-

The wetlands in the Glen Lake-Crystal River Watershed serve as a filter for non-point source pollutants, purifying the water on its way to the lake.

tat, the cover, or the abundant food provided by the wetlands—from the black fly to the whitetail. Two wetland areas in the GL-CR Watershed are of special concern: Hatlem Creek and the Crystal River Dune-Swale Community.

The largest surface water tributary to Glen Lake, Hatlem Creek is classified as a second order cold water stream and designated as a trout stream by the DNR. The creek enters Big Glen Lake on its south shore and enters the lake after meandering through an ecologically rich wetland that provides a diverse habitat for many threatened and endangered species. The undisturbed wetland is the key to the biological diversity and its preservation makes it a high priority in the GL-CR Watershed.

During the statewide Natural Features Inventory in 1989, two biologists cited the Crystal River dune and swale community as one of the best of only 40 such sites in the entire State. By definition, the dune and swale community contains both wetland (swale) and upland (dune) ecosystems intertwined into a single ecological community. The community hosts over 12 identified threatened and endangered species and acts as the scenic backdrop to the winding course of the Crystal River.

Greenbelts & Greenways

Shoreline greenbelts include the banks of Glen Lake and its tributaries and are especially critical in areas where there are no wetlands bordering the water. The width of these greenbelts may vary from 10 feet between a lawn's edge and the water, to several thousand feet along the course of a creek. The width of a greenbelt across a piece of land is, in most cases, proportional to the landowner's commitment to protecting the water quality.

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Greenbelts protect a body of water from non-point source pollutants and from thermal impacts. Naturally vegetated greenbelts slow surface runoff before it enters the water, allowing sediments and other pollutants to settle out. Uncontrolled sedimentation will alter the habitat of invertebrates and fish and increase phosphorous loads in the lake. Fish spawning is especially susceptible to sediments covering spawning areas in creeks. Vegetative buffers block direct sunlight which would warm the water and damage the cold water habitat of the creek. Lake trout, brown trout, and the invertebrates on which they feed are dependent on the cold temperatures of Glen Lake's tributaries.

Waterside greenbelts also provide corridors for the movement of other forms of wildlife and can be important links between the watershed's wild areas. In this case, they become greenways and an important feature of a region's ecosystem. Greenways can become a corridor for human traffic as well, and are often coordinated with the planning of hiking and skiing trails. As lands become more fractured by development patterns, greenways become increasingly important as highways for foraging wildlife.

Upland Groundwater Recharge Areas

Balancing the inevitable development of the recharge areas with the protection of forest cover and erodable slopes is critical to the health of the Glen Lake-Crystal River Watershed.

The upland groundwater recharge areas are chiefly located in upper elevations of the GL-CR Watershed. The highly permeable soils and the topography of these areas strongly favor the fast infiltration of rainwater into the groundwater. A large portion of Glen Lake's baseline water supply originates in these upland recharge areas. It is also likely that many drinking-water wells are directly affected by these areas. Groundwater contamination from faulty septic systems and excessive fertilization and pesticide use are a main concern for this portion of the watershed.

Many of these areas are also forested and/or have steep slopes that are highly susceptible to erosion. Because of their high elevations and scenic views, the upland recharge areas are among the most highly desirable building sites in the watershed (after shorelines). Balancing the inevitable development of the recharge areas with the protection of forest cover and erodable slopes is critical to the health of the Glen Lake-Crystal River Watershed. Since there are relatively few regulations protecting these critical upland areas, responsibility for the conservation-minded development and protection of these areas will fall more squarely on the shoulders of the landowner.

Conservation Easements

In the Glen Lake-Crystal River Watershed, the Leelanau Conservancy administers the land conservation tools—the legal mechanisms through which watershed landowners can permanently protect the conservation values of their land that are important to sustaining the quality of the watershed.

The effort to protect the beauty and natural integrity of the Glen Lake-Crystal River Watershed is hardly confined to the above mentioned critical areas. Perhaps somewhat less critical, but no less important in the long term, are the open lands, forests and Sleeping Bear Dunes National Lakeshore lands that contribute to the overall welfare of the natural systems.

You've already read in previous chapters of the many ongoing programs to mitigate the impact of human activity on the natural systems. Now we will familiarize you with the proactive programs in place to head off trouble before it starts. These are the tools of stewardship—long term plans that recognize the integral role of natural systems in the community and the ways in which we make these plans permanent.

In the Glen Lake-Crystal River Watershed, the Leelanau Conservancy administers the land conservation tools—the legal mechanisms through which watershed landowners can permanently protect the conservation values of their land that are important to sustaining the quality of the watershed. Conservation easements and gifts of land are the primary tools used in the Glen Lake-Crystal River Watershed. Regardless of whether or not their property includes a critical area, by learning more about these tools, landowners will become aware of their property rights and the voluntary land protection options available to them. Land protection tools offer flexible means by which individual landowners can protect the critical watershed areas on their property and achieve their long-term goals for their land.

Conservation Easements—Answers to Common Questions:

What is a conservation easement?

A conservation easement is a legal agreement a landowner makes to limit the type and amount of development that may take place on his or her land. Each easement's restrictions are tailored to the particular parcel of land and to the interests of the individual owner.

To understand the easement concept, think of owning land as holding a bundle of rights. Generally, a landowner may give away the whole bundle, or, in the case of a conservation easement, extinguish one or two of those rights. These may include, for example, the right to construct buildings, to subdivide the land, to restrict access, or to harvest timber. To give away or extinguish certain rights while retaining others, a landowner grants an easement to an appropriate third party.

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The specific rights a property owner forgoes when granting a conservation easement are spelled out in each easement document. The owner and the prospective easement holder identify the rights and restrictions on use that are necessary to protect the property—what can and cannot be done to it. The owner then conveys the right to enforce those restrictions to a qualified conservation organization, such as a public agency or the Leelanau Conservancy.

How long does an easement last?

An easement can be written so that it lasts forever. This is known as a perpetual easement. An easement runs with the land—that is, the original owner and all subsequent owners are bound by the restrictions of the easement. By granting an easement in perpetuity, the owner may be assured that the resource values of his or her property will be protected indefinitely, no matter who the future owners are. The easement is recorded with the county so that all future owners and lenders will learn about the restrictions when they obtain title information.

Why grant a conservation easement?

Landowners grant conservation easements to forever protect the quality and character of their land from inappropriate development. Conservation easements ensure long-term conservation of land which they value and which contains important natural features. Gifts of perpetual easements can also qualify a donor for income tax, property tax and estate tax benefits. Most conservation easements involve tracts of 40 acres or more. However, parcels as small as 10 acres can be protected if the land possesses high ecological values, such as over 200 feet of continuous frontage on a lake, stream or river, significant habitat for wildlife and or rare and endangered species or other critical resource values.

Landowners grant conservation easements to forever protect the quality and character of their land from inappropriate development.

What are the financial advantages of granting an easement?

The U.S. Congress has recognized that the granting of a conservation easement provides a tangible benefit to the public and, in most cases, involves the donation of property value. Therefore, the gift of a qualified conservation easement in perpetuity can be a charitable contribution for federal income tax purposes. The value of the gift is measured by the decrease in the estimated fair market value of the land based on two appraisals before and after the easement donation. The difference between the two is the value of the charitable contribution which may be deducted from federal income taxes. For example:

Fair market value of the property before the easement donation:	$80,000
Fair market value of the property after the easement donation:	$45,000
Value of the easement donation:	$35,000

Valuations must be done by a competent land appraiser taking all relevant factors into consideration. Donors may deduct the fair market value of the easement donation, up to 30% of their annual adjusted gross income. If the entire deduction cannot be taken in the year of the gift, there is a five year carry over period to complete the deduction. Landowners should consult their legal and tax advisers before completing a land gift or a conservation easement.

Are other tax benefits involved?

Conservation easements may result in a reduction in federal estate taxes, Michigan inheritance taxes, and property taxes. When the land passes to heirs, it should be appraised at the lower fair market value and therefore reduce the estate and inheritance taxes. Heirs may be able to retain property they otherwise would be forced to sell to pay the taxes.

Landowners may also benefit from potential reductions in real property taxes. A property's tax assessment usually is based on the property's market value, which reflects the property's development potential. If a conservation easement reduces the development potential of the property, it may reduce the level of assessment and the amount of the owner's property taxes. The actual amount of reduction, if any, depends on many factors. Since properties and the restrictions in conservation easements vary, they must be evaluated on a case-by-case basis.

Does an easement allow public access?

No. The property remains protected from trespass just as any other private land, unless the owner specifically requests that access be allowed.

How restrictive is an easement?

An easement restricts development to the degree that is necessary to protect the significant values of that particular property. If the goal is to preserve a pristine natural area, for example, an easement may prohibit all construction, as well as activities that would

alter the land's present natural condition. If the goal is to protect farmland, an easement may restrict subdivision and development while allowing for structures and activities necessary for and compatible with the agricultural operation.

A landowner in the Glen Lake-Crystal River Watershed may choose to only place restrictions on lakeshore or streamside greenbelts, steep slopes, wetlands or other critical watershed areas on his or her land, and leave the remainder of the land unrestricted. Whatever the case may be, even the most restrictive easements typically permit landowners to continue the traditional uses of the land. By definition, conservation easements are very flexible documents that can be tailored to meet the needs of the landowner while protecting the natural values of the land.

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What are the Leelanau Conservancy's responsibilities when accepting the donation of a conservation easement?

The Leelanau Conservancy, under Michigan law, is a qualified charitable organization devoted to conservation that can accept and hold conservation easements. If a conservation easement meets the Conservancy's criteria and is accepted, the Conservancy assumes the responsibility for monitoring compliance with the terms of the donated easement. This is done through yearly inspection visits to the easement site upon arrangements with the landowner. The Conservancy documents the original condition of the property and maintains written records of the annual monitoring visits. If the terms of the easement are breached, the Conservancy has the legal right to require that the property be restored to its prior condition.

Gifts of Land

Property important to water quality, wildlife, or the scenic beauty of the Glen Lake-Crystal River Watershed can be donated directly to the Leelanau Conservancy. Provided the property meets the Conservancy's criteria and IRS regulations for acceptance of a land gift, the donation of land to the Conservancy affords the highest level of protection for the property. Like donors of conservation easements, donors of gifts of land may deduct the fair market value of the donation, up to 30% of the landowner's annual adjusted gross income. If the entire deduction cannot be taken in the year of the gift, there is a five-year carry-over period to complete the deduction. Landowners should consult their legal and tax advisors before completing a land gift or a conservation easement.

Property important to water quality, wildlife, or the scenic beauty of the Glen Lake-Crystal River Watershed can be donated directly to the Leelanau Conservancy.

Properties donated to the Conservancy become permanent nature preserves with management plans developed to provide for responsible, perpetual stewardship. Donors of land frequently choose to dedicate their gift in honor or memory of a loved one.

Occasionally, properties of particular natural value and sensitivity will qualify for acquisition. In such cases, the Conservancy works with groups of neighbors and concerned citizens to raise funds locally for purchase of the property.

Glen Lake Association and the Community

Projects of the GLA:

- *Monitoring the lake and river levels at the narrows bridge and in the Crystal River for the United States Geological Survey*
- *Crystal River Dam maintenance*
- *Control of the Crystal River Dam in partnership with Crystal River riparians.*
- *Preservation Fund and Endowment Fund*
- *Newsletter sent to members three times a year*
- *Cladophora Shoreline Surveys each summer*
- *Shoreline Management consultation and naturalization design*
- *Water Testing Program with Michigan Lake and Stream Associations*
- *Water Testing Program with Sleeping Bear National Lakeshore*
- *Water Testing Program with contracted biologist*
- *Science Resource Panel to assist planning and evaluating of water quality projects*
- *Glen Lake/Crystal River Watershed Management Plan written and approved*
- *Glen Lake/Crystal River Landowner's Handbook written and distributed*
- *Merganser capture, inoculation and transfer each Spring*
- *Safety buoy placement*
- *Arranging dredging at the Narrows*
- *Invasive species prevention and boat spray operation and educational signage*
- *Glen Lake Association web site*

Could there be a better example of the inter-reliance of people and their activities than a community that shares a lake? Every riparian knows how sound travels long distances over the surface of the water and lights can be seen from miles. A faulty septic field at one home may be responsible for cladophora growths in front of several homes. The anglers share the fish population, the birders share the avian population. And the water distributes and shares its pollutants with every one in equal measure, regardless of the pollutants' source.

Glen Lake requires special protection and the area is home to a number of organizations devoted to various aspects of conservation and environmental protection. For example, the Glen Lake Association represents the interests of riparian landowners, but also engages in a broad range of activities that benefit anglers, swimmers, and environmentalists.The Sleeping Bear National Lakeshore manages its portion of the watershed and lakeshores and collaborates closely with the GLA on many issues. The Leelanau Conservancy works to protect natural lands in the watershed. The Michigan Lake and Stream Associations and Tip of the Mitt Watershed Council perform critical technical support for the GLA in a wide range of needs, from water quality testing to policy-making. State and local agencies administer water, wetland, and wildlife management and enforcement. The county sheriff enforces boating regulations. Indirectly, the actions of local townships, villages and road commissions can have serious ramifications on the lake community, especially in regard to land use planning and zoning. And the list goes on.

The Glen Lake Association, created in 1954, is a non-profit organization dedicated to the protection, preservation, and continued improvement of the beautiful Glen Lake-Crystal River Watershed. The association works through its members, riparian and non-riparian, in conjunction with the Michigan Lake and Stream Associations, the Leelanau Conservancy, the Sleeping Bear Dunes National Seashore and other environmental groups to maintain the pristine quality of the Glen Lake-Crystal River Watershed. About half of the total land owners around the lake are association members as well as many other lake supporters. The annual meeting of the association is held each year in mid-August at the Glen Arbor Town Hall to elect new officers, display work done in the past year and present information to the membership at large. Members receive a newsletter, *Alligator and Inspiration*, three times a year and a web site is actively maintained by the association to provide details on the work of the association. This work is carried out by volunteers: a board of ten which meets each month as well as fourteen standing committees involving forty-two people who meet throughout the year. These committees work hard to provide many services to the lake riparians and to maintain the quality of the lake and surrounding area.

The Glen Lake Association provides practical care of the lake for

the recreational enjoyment of both riparians and visitors. Buoy placement at the narrows, boat launch, rocky areas and river entrance enhance safe navigation as does arranging for periodic dredging at the narrows, the channel to the Fisher Lake, and at the DNR boat launch.

The association has maintained, rebuilt (in 2002) and controlled the level of the dam at the Crystal River since 1954 to facilitate safe access to the lake in the summer and minimize ice damage on shore in the winter. The dam is now controlled by the Glen Lake Association Water Level Committee comprised of Glen Lake and Crystal River riparians. This committee follows control procedures stipulated by the Technical Committee composed of representatives from the Water Level Committee, the MDEQ, the National Park Service, the Leelanau County Drain Commissioner, and the Crystal River Preservation Association. Water level readings are taken on a regular basis by the association at the narrows bridge. The USGS has installed level measurement devices in the Crystal River.

The problem of swimmer's itch in pristine northern lakes is a problem we continually monitor and control in our own lake. The association tracks where and when anyone contracts swimmer itch by maintaining a swimmer's itch hotline. The GLA has had various programs over the years to control this problem with an emphasis on ridding the lake of its Merganser duck population, the primary carrier of the parasite causing swimmer's itch. The association is actively involved in monitoring, researching and controlling swimmers itch in the lake. Beginning in the spring of 2004 the association contracted with a firm which traps the Merganser broods of 10-16 ducklings on the lake, inoculates them, and relocates them to an environment where the snail part of the parasite cycle does not exist. The program is scheduled to last a minimum of three years.

The preservation and stewardship of the Glen Lake-Crystal River Watershed requires planning and commitment of those who truly love the land and water of the watershed. An understanding of the long range issues related to the health and beauty of our watershed resulting in providing education, planning, testing, data collection and astute stewardship is a goal of the association. This is a role that works in concert with the preservation committee and with water quality and environmental issues. The GLA Preservation Fund ensures that funds are used appropriately as part of our stewardship.

The GLA water quality committee, the Friends of the Crystal River, and the Leelanau Conservancy developed the Glen Lake Water/Crystal River Watershed Management Plan in 2003 and was approved by the Michigan DEQ. This incorporates all of the designated and desired uses of a watershed, seeks to determine which are most threatened, identifies the most critical pollutants and environmental stressors to the watershed and resolves to remedy them. This plan is available on our web site.

Water quality monitoring of Glen Lake is a cooperative project. The Leelanau Conservancy Watershed Council periodically tests Glen Lake as does the Sleeping Bear National Lakeshore. The Preservation Committee provides the funding for testing equipment for the GLA water quality committee and the field biologist that we hire to provide direction and expertise in this endeavor. The association con-

Items lost and found on the lake can be posted on the GLA web site at: GlenLakeAssociation.com to assist in recovery of these items.

Riparian Rights and Responsibilities:

The word "riparian" and "littoral" are often used interchangeably to refer to lakefront and river front property. The riparian rights are generally referred to as "rights to use the water for (1) recreational purposes, such as swimming, bathing, wading, boating, etc.; (2) domestic use and fishing; (3) rights of wharfage or dockage; and (4) the right of access to navigable water."

Any such use must be reasonable, and in some instances, reasonableness is determined by the application of certain Michigan laws such as the Inland Lakes and Stream Act.

In terms of ownership, the commonly held view is that riparian owners own the bottom land to the center of the lake, river or stream. As such, the bottom lands are not available for possessory uses by non-riparian owner, but may only be used for purposes incidental to recreational use of the waterway. For example, it may be that a non-riparian boat owner may anchor his vessel for fishing purposes, but would not be able to anchor the same boat for storage purposes or for camping purposes without permission.

The public's right to navigate upon a lake or stream entitles it to use the water for recreational purposes, and a riparian owner must

Continued on Page 54

Riparian Rights and Responsibilities:

Continued from page 53

take reasonable steps not to cause injury to the persons using the easements or the navigable waters. What is reasonable use by a riparian owner is ultimately a question that would be decided by a judge or jury and would depend on all the facts and circumstances of the particular case.

While we may claim "ownership," we should consider it a privilege to be here. We must treat our waterways and shorelines with great care and respect. Maintain a greenbelt. Water and fertilize according to GLA recommendations. Maintain boats, etc., so that there is no leakage of oil or gas into the water. Do not litter. Operate noisy watercraft away from shorelines to maintain the serenity of the area. Be a responsible riparian.

ducts regular tests from May through September as part of the Cooperative Lakes Monitoring Program administered through the Michigan Lake and Stream Associations. and Stream Association. Testing done ranging from once a week to once a year are water clarity, spring and late summer total phosphorous, chlorophyll a, dissolved oxygen, temperature, pH, conductivity, aquatic plant survey, plankton sampling, bottom sampling, cladophora shoreline survey, and a stewardship survey with riparians with high cladophora readings. The GLA water quality committee and our biologist assess these factors that affect water quality and recommends best practices to riparians to assure high quality lake water conditions are maintained. The association also provides direct consultation to riparians who wish to alter their shoreline and property to reduce or eliminate contaminate intrusion into the lake by making suggestions on alterations in landscaping, shoreline management, and septic maintenance.

The association manages a voluntary spray down of boats and flushing of outboards and out drives at the boat launch on Little Glen to help prevent the entry of exotic species into our lake. Students are hired during the high traffic season and hours and paid by the GLA. Zebra Mussels were discovered in the summer of 2003 in the lake but there are many other exotics that could greatly impact our lake such as Eurasian Water Milfoil and Hydrilla.

Types of Regulation

Americans strongly dislike being told what they can and cannot do with their land. On the other hand, we also believe that we have the right to protect our land, water, and related interests from the folly of our neighbors. Throughout our history, we have fought battles on the field and in the courtroom to determine the limits and extent of the rights of landowners and their use of the land and water.

Land use regulations attempt to balance these rights and protections. Although, at first glance, they may appear as obstacles to progress—in reality, they are formulas for the best way to progress without compromising the quality of life.

Land use regulations attempt to balance these rights and protections. Although, at first glance, they may appear as obstacles to progress—in reality, they are formulas for the best way to progress without compromising the quality of life.

The array of regulations and overlapping jurisdictions can be quite confusing (building a home may require several permits and involve half a dozen agencies), and the process of securing permits for a project can be frustrating. The agency personnel who process your permits are there to advise you on the safest way to proceed. You may have to consider some alternative ideas—keep an open mind!

If you hire a contractor to do your project, chances are he or she will secure the proper permits for you. Make sure you review all permits to see to it that they are in order and ask questions. If you have doubts, contact the permitting agencies. As the landowner, you are ultimately responsible for any activity on your property.

Consider how you would classify your project. Is it land alteration or land use? Land alteration would include excavation, changes in contour, or any activity which disturbs the surface of the ground. Land use would include residential, industrial, and commercial construction. Whatever you intend to do, there are a host of sources for advice and information. (See page 56 for a summary of permit requirements and

contact information.)

Land Alteration

~Activities that Require Permits

If your activity falls into the category of land alteration, you should contact the county soil erosion officer. The soil erosion officer is the enforcement authority of the Soil Erosion and Sedimentation Control Act.

Activities that would fall under this ordinance include excavation, land clearing, land filling, and shoreline stabilization. Any activities that fall under the auspices of these regulations require the proper permit. Soil Erosion and Sedimentation Control Permits are required for any earth change, land surface changes and disturbances within 500' of a lake or stream, or of more than one (1) acre in size. District technicians are available to help landowners determine whether their site is environmentally sensitive and requires a permit.

Always determine the classification of your property before initiating any type of land alteration. Remember that wetlands, lakes, and streams fall under special restrictions. Again, county officials will be able to inform you if your activities may require special permits from the Department of Environmental Quality, but you, as landowner, are ultimately responsible for determining whether your site is environmentally sensitive.

You and your community's health and safety rely on the professionalism of the contractor you engage to do the job—never cut corners on these critical systems.

Land Use & Building

~Activities that Require Permits

If your activity falls into the category of land use, start by talking to the local zoning administrator. All the jurisdictions in the GL-CR are zoned communities and each has restrictions on size, placement, etc., of virtually any type of construction.

Michigan has a tradition of strong township government. State law provides for the primary responsibility of regulating land use to the local level. Hence the formation of township and municipal planning commissions, zoning ordinances and zoning boards of appeal. Generally speaking, zoning ordinances regulate the use of land and water, particularly as it relates to construction of buildings, parking areas, fences, etc.

Landowners in the watershed who are planning to excavate for the construction, the moving, the alteration, or the repairing of any building or other structure should contact their village or township zoning administrator to secure a land use permit before proceeding with the project. In most cases, any work on a structure exceeding 100 square feet, with the exception of ordinary repairs, will require a permit from the appropriate township.

New water wells and septic fields, or major alterations to either, will require special permits from the Environmental Health Department. Specific steps must be taken to properly locate and install wells and septic systems. You and your community's health and safety rely on the professionalism of the contractor you engage to do the job—never cut corners on these critical systems.

Required Permits and Where to Get Them

Activity	Permit Needed	Permitting Agency
Build a house, garage, pole barn, or other outbuilding.	Zoning permit, land use permit, and/or a building permit.	Local Zoning Administrator and County Building Code Enforcement.
Install a drinking well.	Drinking well permit.	Leelanau Health Dept. 256-0200
Septic System	Septic system permit Inspection, Approval, Site Evaluation, Soil Erosion Control Permit.	Leelanau Health Dept. 256-0200 Leelanau Cons. District 256-9783
Install a septic system.	Septic system permit Inspection, Approval, Site Evaluation, Soil Erosion Control Permit.	Leelanau Health Dept. 256-0200 Benzie Health Dept. 256-0201 Leelanau Cons. District 256-9783
Disturb earth within 500 feet of any water body, or any earth disturbance of one acre or more regardless of location. Disturb earth within 100 feet of regulated wetland. Disturb earth for a proposed driveway with slope of 10% or greater regardless of location.	Soil Erosion & Sedimentation Control Permit, Part 91 of Act 451.	Leelanau Cons. District 256-9783
Fill, drain, dredge or build on a wetland.	Permit required under Part 303 of Act 451 Soil Erosion Control Permit	MDEQ 231-775-3960 Leelanau Cons. District 256-9783
Dredge, fill, add beach sand, or build a permanent dock, seawall, or riprap shoreline protection in a natural or artificial lake, pond, river, or stream.	Permit required under Part 301 of Act 451 Section 10 (Federal Rivers and Harbors Act for mouth of Crystal River only) Soil Erosion Control Permit	MDEQ 231-775-3960 U.S. Corps of Engineers 616-842-5510 Leelanau Cons. District 256-9783
Install a temporary dock (summer season).	No permit required.	Local Zoning Administrator.
Build in a high risk erosion area.	Permit required under Part 323 of Act 451, Soil Erosion Control Permit.	MDEQ 231-775-3960 Leelanau Cons. District 256-9783
Build in a critical dune area.	Permit required under Part 353 of Act 451, Soil Erosion Control Permit.	MDEQ 231-775-3960 Leelanau Cons. District 256-9783
Build in a designated flood plain.	Permit required under Part 31 of Act 451, Soil Erosion Control Permit.	MDEQ 231-775-3960 Leelanau Cons. District 256-9783
Construct a new dam, reconstruct a failed dam, repair, enlarge, alter, abandon, or remove an existing dam.	Permits required under Part 31, Part 301 & Part 315 of Act 451, Soil Erosion Control Permit.	MDEQ 231-775-3960 Leelanau Conservation District 256-9783
Alter or occupy the river channel, streambed, or floodplain (all structures, including bridges and culverts).	Permits required under Part 31 & Part 301 of Act 451, Soil Erosion Control Permit.	MDEQ 231-775-3960 Leelanau Conservation District 256-9783
Major Developments	Environmental impact statement. Local governments may request an environmental impact statement on any proposed major action within their jurisdiction that may have a significant impact on the environment or human life. Soil Erosion Control Permit.	MDEQ 231-775-3960 Leelanau Conservation District 256-9783
Discharge wastes from a small business or treatment plant.	Permits required under Part 31 (Surface Water) & Part 22 (Ground Water) of Act 451	MDEQ 231-775-3960

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