Building Superior Coastal Communities

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Contents

Introduction

Submerged under saltwater…layered with lava…scoured by mile-high glaciers…the history of the landscape of the Lake Superior region is as varied and colorful as the progression of seasons across its current cloak of temperate forest. Lake Superior, born of ancient Glacial Lake Duluth whose old shoreline can be found high on the ridges of the North Shore, has changed over time, also: species have waxed and waned; peoples have come and gone; water levels have risen and fallen. Whether by natural or human forces, a common theme for the Lake Superior watershed is **change**.

There are many things we still do not fully comprehend, but humans are at a point in this dynamic history where we have an unprecedented understanding of the natural environment, and an ability to predict the consequences of the alterations we make to it. Knowledge coupled with foresight gives us the means to create and evaluate options for protecting our resources as our communities grow and the environment changes.

Changes to this region and its human population are inevitable. It is our hope that this book will give you a better understanding of how these changes may affect your community and Lake Superior, and provide you with ideas and tools to help your community plan for these changes.

A Superior Place

What makes the Western Lake Superior region such a desirable place to visit, live and raise a family? Many opinion surveys[1] have supported what most of us, if asked, would put on a list:

- Spectacular natural beauty
- Superb outdoor recreational opportunities
- Healthy woods, lakes, and streams where we can hunt, fish, and explore
- Strong sense of community
- Abundant natural resources supporting an economy partially built on mining, forestry, recreation, and tourism.

As more people discover the Northland, our challenge is to plan for a future that accommodates growth and a healthy economy while protecting the high quality environment that makes this a superior place.

When we think of Lake Superior, we often think in superlatives – coldest, deepest, biggest – with good reason. Lake Superior, the largest lake in the world by area, holds a staggering 10% of the world's increasingly precious fresh water.[2] The enormity of the lake and small numbers of people living in its western basin make it tempting to think that our activities have little or no impact. Not so! This giant of a lake is surprisingly sensitive to disturbance. Equally sensitive to disturbance, the land surrounding Lake Superior involves steep stream slopes, thin and infertile soils, easily eroded sandstone bluffs and stream channels, and fragile coastal wetlands.

To understand why the Lake Superior *Watershed* (right) is so susceptible, we need to look back in time. The region has a fiery past, and it has a frozen one – lava flowing over a billion years ago cooled into thick layers of basalt, which glaciers sculpted into cliffs and ground into sand. Thousands of years later, roughly 28% of Lake Superior's U.S. shoreline continues to exist as cliffs and exposed bedrock. Sandy glacial deposits have become the Apostle Islands and Bayfield Peninsula in Wisconsin. Large lakes left by retreating glaciers deposited the red and grey clays that cover the South Shore of the lake. These clay soils line the ecologically important wetlands that cover 14% of Lake Superior's U.S. coastline, mostly on the South Shore.[3]

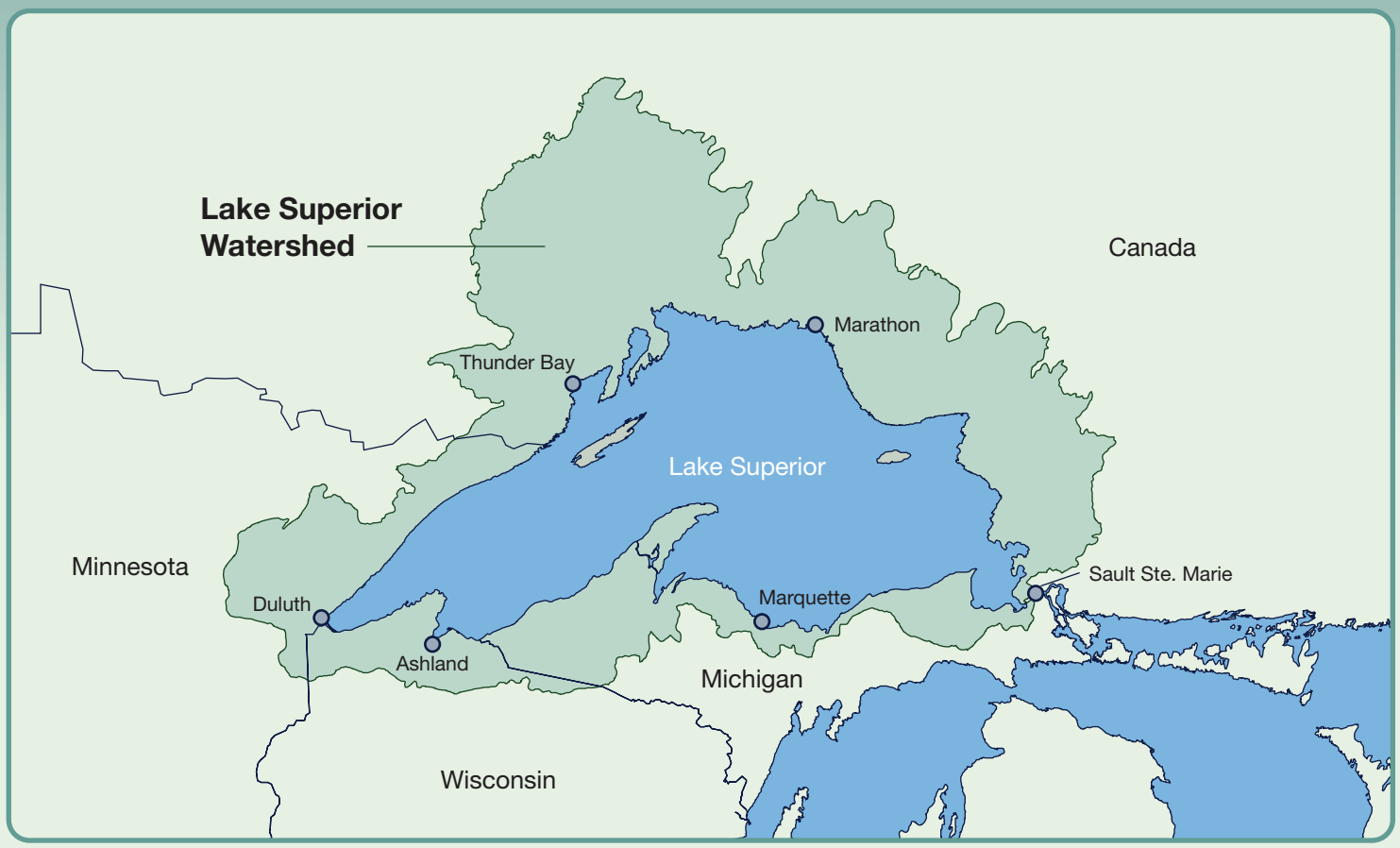
Consider the following:

- It takes 191 years for the tremendous volume of water in Lake Superior to be refreshed from rainfall and inflows. This means that pollutants can remain in the lake for a very long time.
- Lake Superior, cold and low in nutrients, cannot support as much or as many different kinds of plant and animal life as can the other Great Lakes.
- Most of Lake Superior is very deep, making the water rimming the "nearshore" even more valuable. These warmer shallows support the food web, especially on the wetland-rich South Shore, where they provide high quality nursery habitat and spawning grounds for fish.

Lake Size → 31,700 miles^2
Watershed Size → 49,300 miles^2
Volume → 3,000,000,000,000,000 gallons
Deepest Point → 1,332 feet
Average Water Temperature → 40°F

Watershed — an area of land that drains to a particular lake or stream; watersheds can be defined at various scales (for example, the Lake Superior Watershed contains thousands of smaller watersheds, each draining to a particular lake or stream).

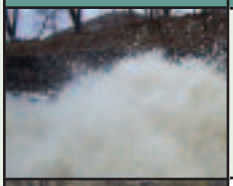
Covered primarily by temperate forests, the Lake Superior Watershed rests on shallow bedrock. Heavy clay soils, and steep gradients make it susceptible to human impacts.



Impacts

Human activities within the Lake Superior Watershed have frequently harmed water quality, both currently and historically. In some ways, we are still living with the legacy of past land use activities.

As Europeans settled the region in the mid 1800's, the Lake Superior Watershed—lands, streams, and wetlands—dramatically changed. Logging and farming removed much of the forest cover, which resulted in an increase in the volume and velocity of water entering streams. Stream channels changed – erosion increased in upper reaches while sedimentation increased downstream. One Wisconsin study suggests sediment loads increased five-fold due to deforestation during this time.[4] Gravel beds, required for fish spawning and home to aquatic insects, were filled in with these fine sediments. Streams in our area remain sensitive to erosion, partly because of the damage that occurred in the 1800's.[4]

	Impact	What Does it Do?
	**Increased Runoff** Land alterations increase the rate and amount of runoff from the watershed	Causes flooding, carries pollutants, erodes stream channel and banks, and destroys stream habitat
	**Excessive Sediment** Dirt and sand washing from paved surfaces or eroding from banks and disturbed ground accompanies storm-water runoff and increased stream flows	Smothers aquatic habitat, depletes oxygen, reduces water clarity, and carries nutrients and toxic contaminants
	**Increased Nutrients** Excess fertilizers on lawns or fields, failing septic systems, and animal waste add nitrogen and phosphorous	Stimulates excessive algae and aquatic plant growth, lowers dissolved oxygen levels, degrades aesthetics and native aquatic life
	**Increased Water Temperature** Warmer water running off of impervious surfaces, removal of streamside vegetation, and reduction in groundwater flows causes streams to become warmer	Harmful to trout and other cold water species, promotes spread of invasive species and excessive algae and aquatic plant growth, reduces dissolved oxygen levels in water
	**Bacteria** Undesirable microorganisms can enter waters through failing septic systems, sewer overflows, and animal (including pet) waste	Some are harmful to humans, untreated waste can cause numerous diseases
	**Toxic Contaminants/Heavy Metals** Mercury, pesticides and herbicides, industrial by-products (i.e. dioxin), cleaning compounds, and leaking vehicle fluids poison waters	Harmful to humans and aquatic life at fairly low levels; many resist breakdown and some accumulate in animal tissues, and can lead to mutations or diseases

Red clay sediment from the Nemadji River empties into Lake Superior. The Nemadji and other streams were heavily impacted by land clearing activities around the turn of the century, which destabilized the stream channels, rendering them even more susceptible to erosion from increased runoff.

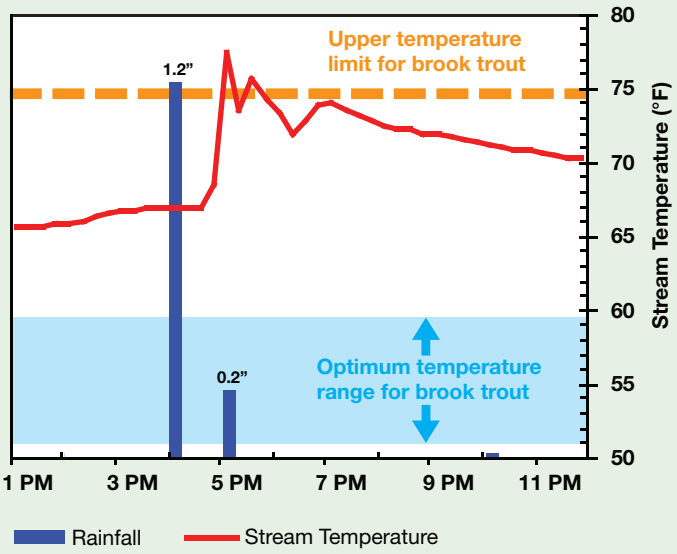
The forests that grew back along much of Lake Superior's shore helped stabilize the soil, but land clearing, roads, and new construction continue to quickly usher water into streams, often carrying pollutants and causing erosion. Stormwater also warms as it flows across hot pavement, sometimes enough to increase stream temperatures to degrees that can reduce or eliminate habitat for cold water fish species, such as trout. We also see rapid shoreline erosion along parts of the Lake Superior coast, with some measurements suggesting shoreline losses exceeding 3 feet per year in certain locations.[5] Shoreline erosion depends on soils, slope, wave action, and at least two things we can control:

- Vegetative cover, and
- Shoreline stability

As homes and roads are built near the coast, the stability of the shoreline can be reduced because of increased runoff and the loss of vegetation.

Another human impact is an increase in nutrients reaching Lake Superior, its streams, and wetlands, resulting in excess algae or aquatic plants. Nutrient-poor environments like Lake Superior are especially sensitive to added nutrients from the watershed, as is evident to anyone who has slipped on algae-covered rocks along a Lake Superior shore. Most of our activities on land contribute plenty of hitchhiking nutrients, whether from failing septic systems, fertilizer, pet wastes, or other sources.

Tischer Creek Temperatures – August 3, 2005



Summer runoff from impervious surfaces, such as roads, parking lots, or rooftops, can be much warmer than stream water and affect stream temperatures. We can see this impact in monitoring data for Tischer Creek in Duluth. After 1.4 inches of rain fell on the Tischer Creek watershed on Aug 3, 2005 (air temp: 73° F), the stream temperature jumped 10° F in less than 30 minutes at the stream monitoring site, which lies below significant impervious surfaces that drain into Tischer Creek through the storm sewer system. (Data from www.lakesuperiorstreams.org)

Algae growing in Amity Creek in Duluth, MN. Excessive algal growth like this indicates increased nutrients in the stream.

Following Trends

As we look toward the future, Lake Superior's citizens and policy makers have a difficult assignment – to make land use decisions that:

- Consider the natural sensitivity of the Lake Superior Basin's environment
- Minimize the negative impact on natural resources from increasing development and population growth
- Maintain or improve the cultural and environmental qualities that people find attractive

At a community level, making thoughtful decisions necessitates an understanding of recent trends and projections for our region's demographics, economies, and environmental quality.

We live in one of the less populated areas of Minnesota and Wisconsin…but for how long? Minnesota and Wisconsin state demographers tell us we can expect to see growth in our coastal counties over the next 25-30 years,[6] with popular locations like Cook County expected to add over 2,600 new residents by 2030. With large areas of Lake Superior's coastal counties in public ownership (particularly away from the lake), development pressure will likely remain greatest along the coast.

However, inland areas are not exempt from development pressure. For example, the high ridgeline on the North Shore and lands adjacent to the South Shore wetlands are coveted real estate. Adding roads and buildings increases the quantity and velocity of water flowing over the land, and this can increase erosion rates and destabilize the bluffs. Development along bluffs or ridgelines also changes our visual image of Lake Superior's coast, and is of concern to many residents[1] as views of unfragmented forestlands become interrupted with homes, driveways, or towers.

Large land sales from timber, mining, and power company holdings are another trend linked to increasing development pressure and escalating land values. Natural resource managers estimate that nearly one million acres of large, undeveloped parcels of Minnesota forests previously open to the public are at risk of being sold to investment companies, which often divide and re-sell the land. Subdivision along with the smaller tracts of private land that are being built upon could reduce the area available for recreation, fragment wildlife habitat, and increase the pressure on water resources.[7]

Who owns the watershed?

Private lands tend to be more concentrated along the shore than other areas of the watershed. In some western Lake Superior counties, up to 96% of the shoreline (areas within 1 km of the lake) is privately owned (St. Louis, Douglas).

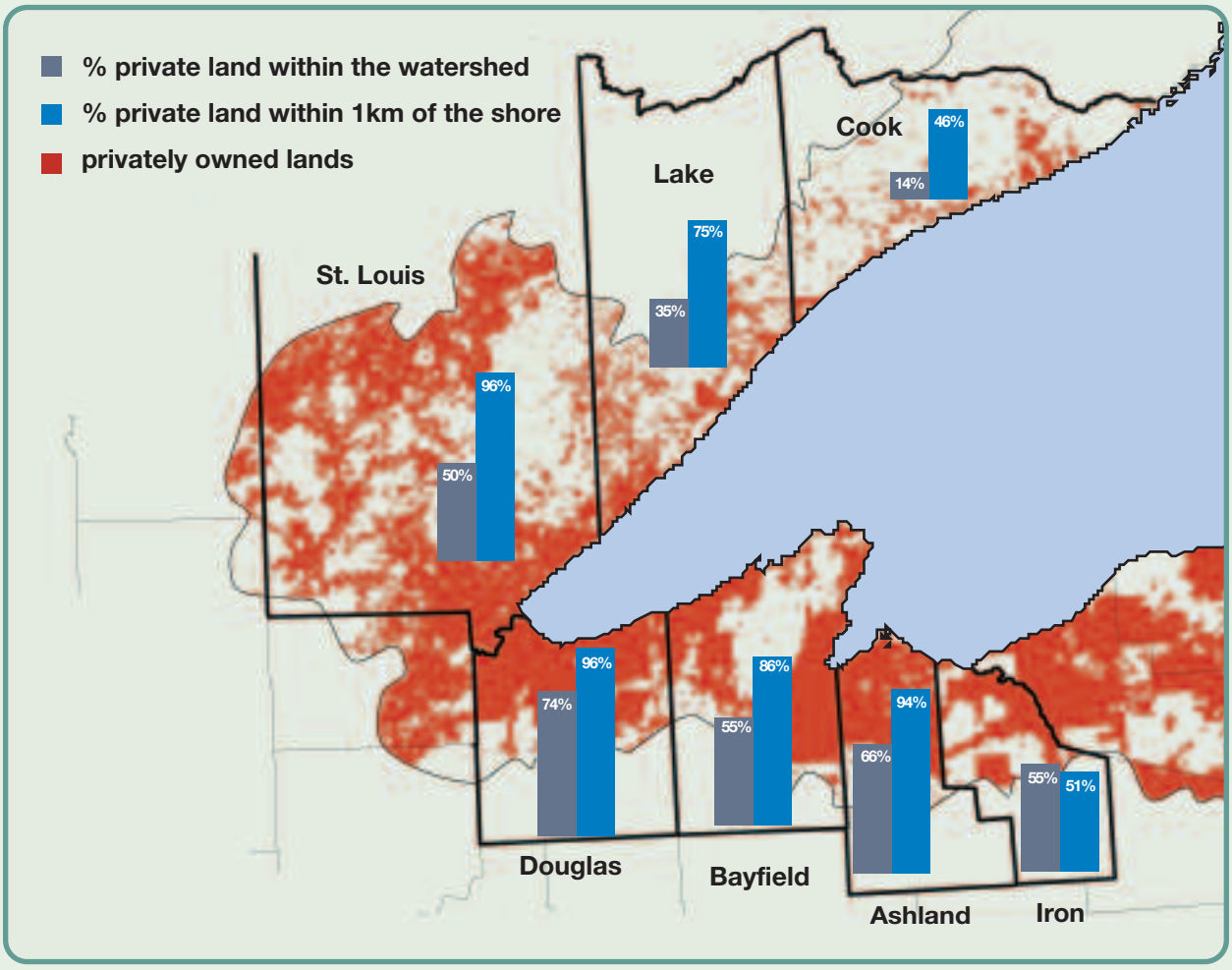
Source: 1990 Great Lakes Ownership Database, *Lake Superior Decision Support Project*, Natural Resources Research Institute.

Ownership was summarized for both the entire area of the county that lies within the Lake Superior Watershed and for all areas of land within 1 km (0.62 miles) of the Lake Superior shoreline. (right)

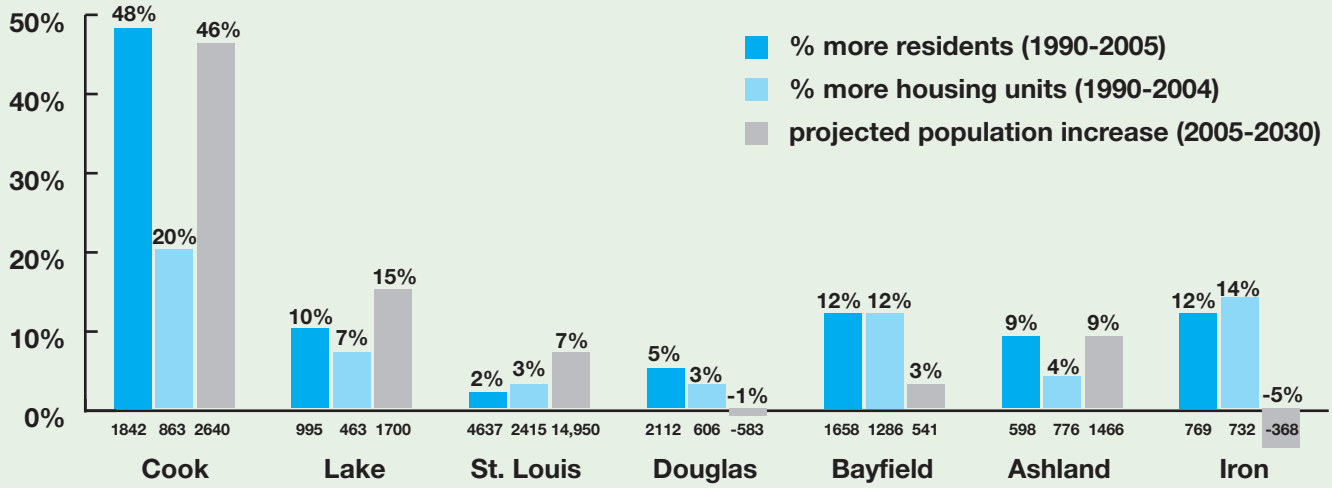
Changes in Population and Housing[6] (right)

Minnesota and Wisconsin demographers have tallied past population and housing changes, and have predicted future population changes for this region. Past trends show significant growth over the last 15 years, with expectations for continued growth in most of the region. The projections do not estimate increases in seasonal or recreational use, such as summer homes or condominiums. Values listed beneath the bars are the total number of people and total number of housing units by county. Between 1990 and 2030, Cook County's population is expected to have more than doubled. 2004 housing data were estimated by the U.S. Census Bureau.

A Comparison of % Private Land Ownership Along the Coast of Lake Superior vs. Watershed-wide for Each County



Population Changes 1990-2005, Housing Unit Changes 1990-2004 and Population Projections 2005-2030



Watch the Indicators

Scientists have discovered that you can get a good idea of how land use activities are impacting water quality and quantity in our lakes, streams, and wetlands by looking at what's happening in the watershed. Three *environmental indicators* used to predict land use impacts on water quality at the scale of a watershed are:

- forest cover,
- water storage, and
- impervious surfaces.

With the help of computers and maps, each of these indicators can be measured or otherwise assessed at different points in time (both past and present), and can be predicted for the future. Development trend data, local zoning ordinances, forestry practices, and other sources of information are used for these analyses. This kind of modeling can be useful to see what might lie ahead for our own communities and the Western Lake Superior Watershed.

Environmental indicator — a quality measured to assess the condition of some aspect of an ecosystem. A good indicator is relatively easy and inexpensive to measure and gives a clear signal of condition. Environmental indicators can provide early warning signals of environmental problems, allowing these problems to be solved before they become severe and more expensive or impossible to fix. (from glei.nrri.umn.edu)

Forest Cover:

What is this? The coniferous and deciduous forests that have dominated the Lake Superior Basin since the retreat of the glaciers play a key role in determining how much water runs off the land.

What does it do? As rain falls, the first thing it hits is often the leaf of a tree. Anyone who has stood under a tree during a rainstorm knows that leaves can hold water: up to a half inch of rainfall or more, actually.[8] As rain starts trickling through to the ground, the forest floor, with all the old leaves and detritus, retains up to about 4/10ths of an inch.[8] Between the leaves and floor, the forest can hold almost an inch of rain, but we're not done! The roots of a tree, as they move through the soil, create tiny pathways for water to infiltrate into the ground (especially important in clay soils). These roots also help hold soil in place and prevent erosion.

What are the effects? Research on the historical conditions along Fish Creek near Ashland suggests that the removal of forest cover led to five times more sediment in the stream and floods that were three times larger than average. The effects are still evident in destabilized banks.[4] Other projects in Minnesota and Wisconsin have found that when "older" trees (trees at least 10-20 years) are removed from more than half of the watershed, water quality suffers from increased sediment, nutrients, and warmer temperatures,[9,10] degrading habitat for fish and other aquatic organisms.

Water Storage/Wetlands:

What is this? Storage in a watershed refers to anything that holds (or stores) water, such as lakes, ponds, streams, and, of critical importance, wetlands. Some watersheds naturally have little storage, and some have more.

What do they do? Rainfall that reaches the ground and starts running off is "stored" on the landscape and kept from running immediately downstream. As the water is detained, sediments drop out, nutrients and some other pollutants can be taken up or transformed by plants or bacteria, some of the water evaporates back to the atmosphere, and some can infiltrate into the ground to become groundwater. Wetlands are also critical habitat for many birds, frogs, and other organisms.

What are the effects? When wetlands and other storage structures drop below 5-10% of the watershed area, Minnesota and Wisconsin researchers have found significantly larger flood events, more erosion, and more sediment and nutrients flowing downstream. Wetlands have also been shown to reduce bacteria and metals, such as lead, in downstream waters.[11]

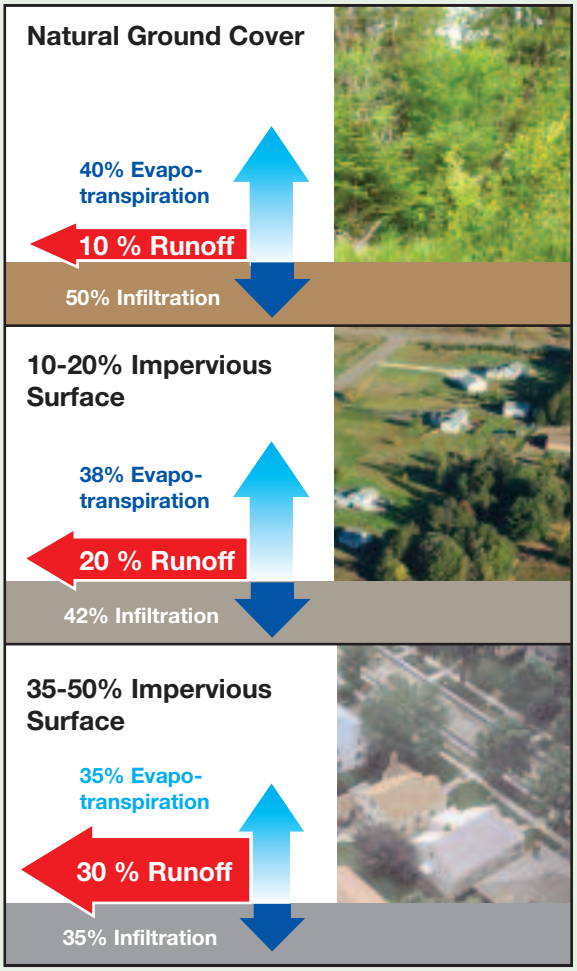
A Note About Wetlands — Not all wetlands are always wet! Some might be dry for most or all of the year, and many have trees or shrubs such as white cedar, black ash, alder, dogwood, or willow. While knowing your trees can help, defining a wetland often requires the skills of a professional wetland delineator. Wetlands are officially defined as having wetlands soils, wetland vegetation, and standing water or saturated soils for at least part of the year.

Impervious Surfaces:

What is this? Impervious surfaces, such as rooftops, parking lots, gravel or paved roads, and sidewalks do not allow water to infiltrate through them.

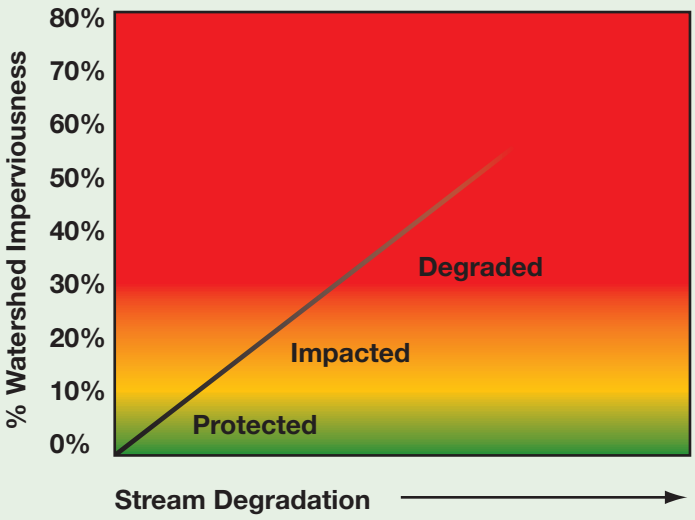
What do they do? Impervious surfaces provide a surface for the accumulation of pollutants (such as dirt, oil, or grass clippings), prevent the recharge of groundwater and the natural processing of pollutants that can happen when in contact with soil and plants, may significantly warm the water that flows across them, and may provide an express route for runoff directly into nearby waterways. Impervious surfaces do not absorb water, and almost all of the rainfall runs off very quickly.

What are the effects? As surfaces become less permeable, they increase runoff, carry accumulated pollutants, cause higher water velocities, produce larger flood peaks, and create more erosion downstream. Less water returning to the ground may reduce the groundwater that feeds streams with cool water during hot or dry periods, which is critical for maintaining trout populations. Impacts to water quality become more apparent as the percent of impervious surfaces in a watershed increases to 5-10% of the area; once 25% of the watershed is covered by impervious surfaces, severe degradation should be expected unless significant stormwater controls are implemented.[12]



As imperviousness in a watershed increases, more and more water that had infiltrated into the ground or evaporated becomes direct surface runoff into nearby waterways.

Relationship Between % Imperviousness and Water Quality



Take Charge of the Future

As more people discover the beauty and quality of life in this unique part of the world, what can Western Lake Superior communities do to retain the region's environmental, aesthetic, and cultural qualities?

Getting Started

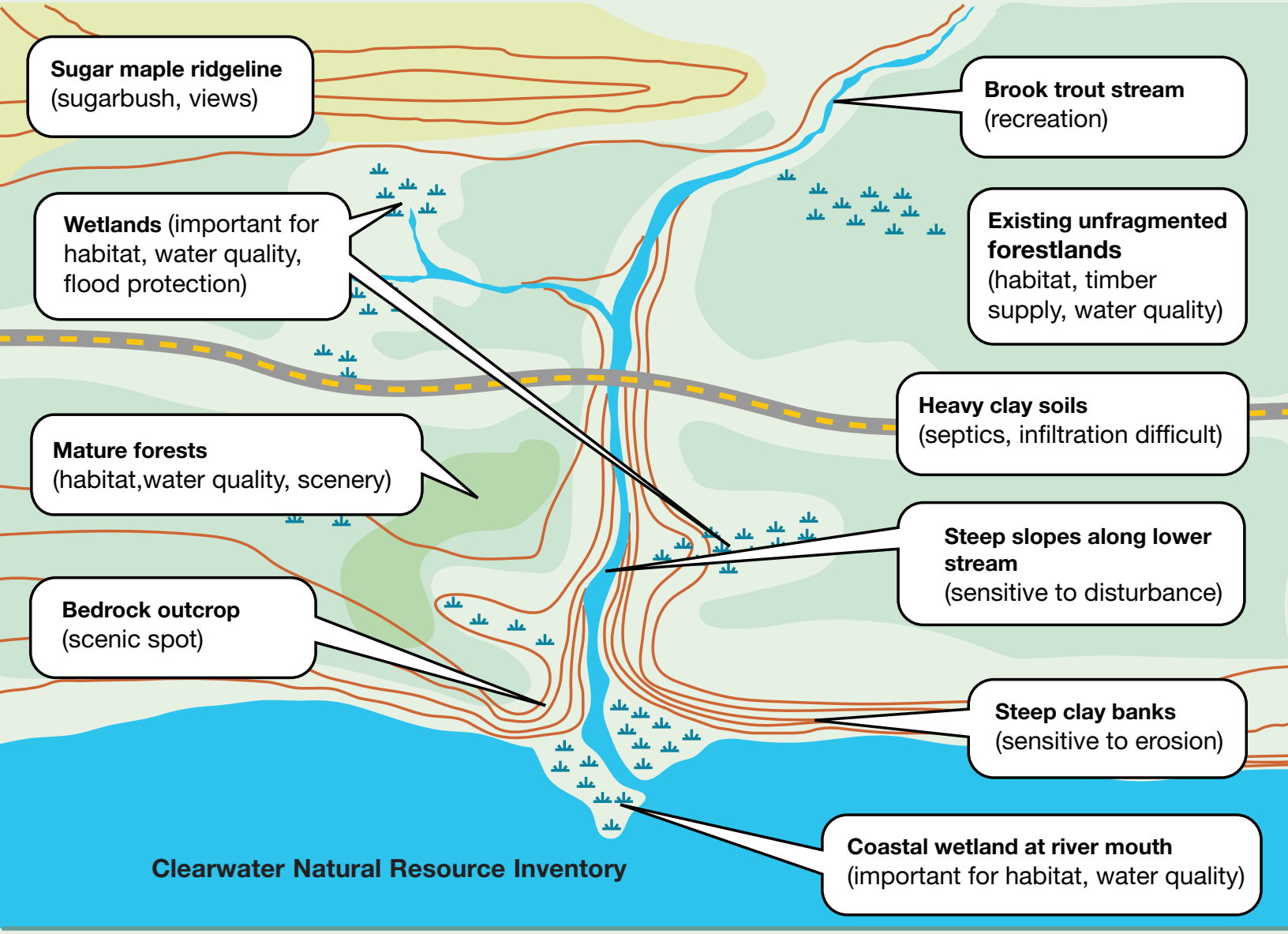
Most proactive communities develop a *comprehensive land use plan*, containing a vision and goals to guide development within the community, along with recommended strategies to help the community reach its goals. These strategies typically include laws, such as zoning and subdivision ordinances, but may also include education and incentives, which are often forgotten.

A Missing Link

Conducting a *natural resource inventory* (NRI) before decisions are made about where development should be concentrated is an often-neglected aspect of community planning. Looking carefully at the natural resources in your community with assistance from natural resource experts helps determine what the resources encompass and how sensitive they are. This information helps the community determine areas that are:

- not suitable for development (e.g., wetlands, highly erodible lands, critical areas for wildlife habitat or water quality protection)
- desirable for scenery or recreation (e.g., parks, open spaces, or “viewsheds”)
- most appropriate for residential or commercial development (e.g., adequate soils for septics, proximity to utilities, main roads, or community centers)
- most suitable for natural resource-based uses (e.g., wild rice or maple syrup production, forestry, agriculture)

Natural Resource Inventory — a natural resource inventory and assessment identifies and prioritizes the natural resources that a community needs to manage through its comprehensive plan and operational strategies.[13] See the Minnesota Department of Natural Resources’ Guide to Using Natural Resources Information at www.dnr.state.mn.us/nrig.

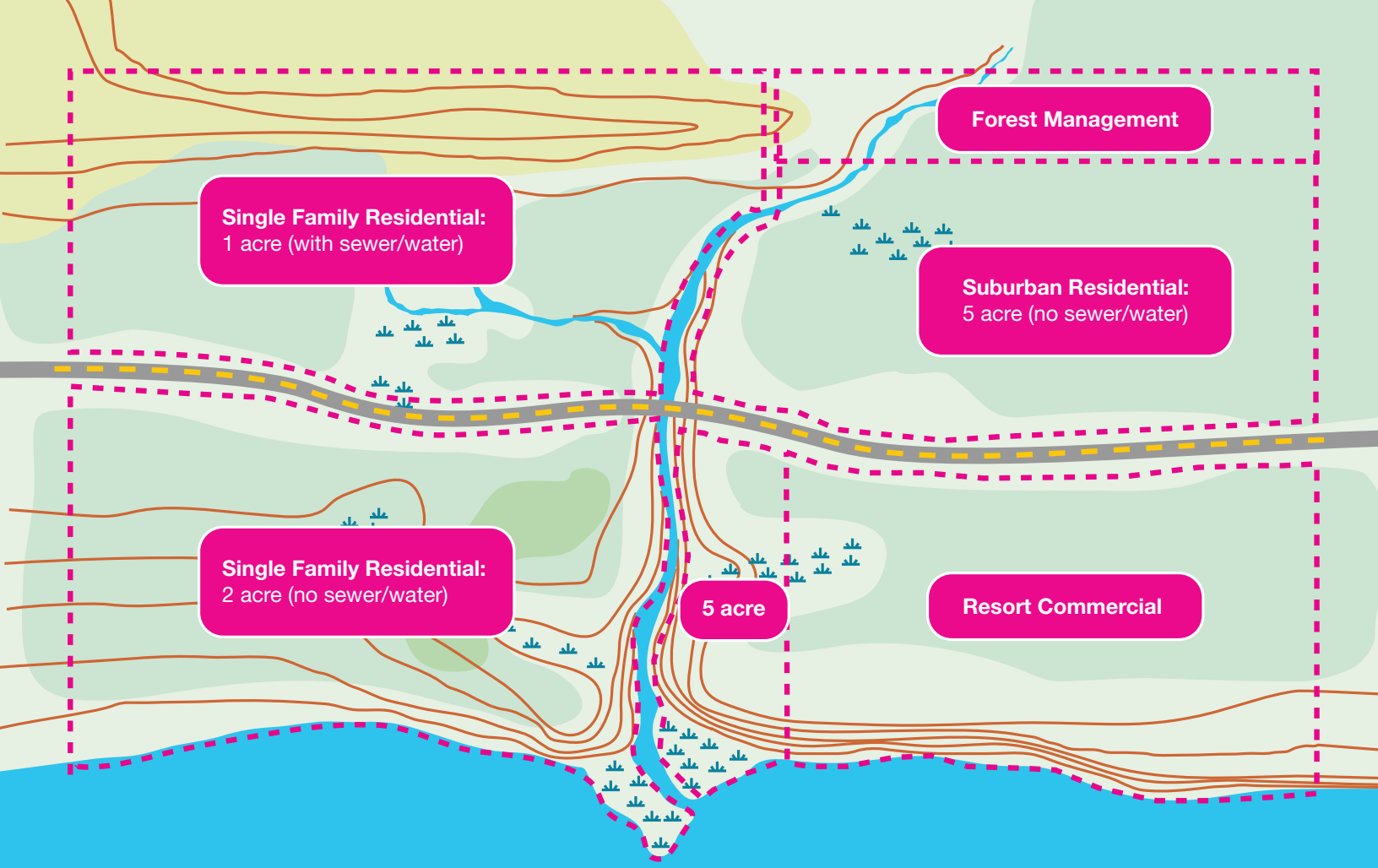


A Visit to "Clearwater"

The simulated Lake Superior community of "Clearwater" is anticipating the development of an 80-acre parcel to accommodate growth pressures from second homebuyers and telecommuters looking to move to the woods. Even though the community is hoping to grow, community members are also concerned about the potential changes, and Clearwater's leaders are reexamining their comprehensive plan; this time, they are starting with a natural resource inventory (above).

A close look at the natural resources on this largely undeveloped parcel reveals a combination of sensitive areas (wetlands, steep slopes, a trout stream), heavy clay soils where on-site wastewater systems are problematic, scenic natural features, and areas valuable for natural resource management or wildlife habitat (sugar maples, mature and unfragmented forests).

Comprehensive Land Use Plan — often referred to as a comprehensive plan, or 'comp plan' for short, this document is the basic foundation for local planning. It lays out a community's vision and priorities and describes where, how, and in some cases when development will occur. Comprehensive plans stipulate the ultimate goals and the rules of the game: efficient transportation, adequate employment, affordable and adequate housing, community and individual pride, and access to clean air, water and open space. For more information, see www.mnplan.state.mn.us/pdf/2002/UnderConstruction.pdf.



Current zoning map, listing minimum lot sizes for residential areas.

Planning Revisited

Clearwater leaders asked themselves whether their current community plans and associated ordinances would promote land use decisions on this 80-acre parcel that fit their community's vision and goals.

Clearwater's first comprehensive plan contained the following vision:

Clearwater desires to be a community that is well managed, oriented towards the well-being of its citizens, and in balance with its many natural amenities.

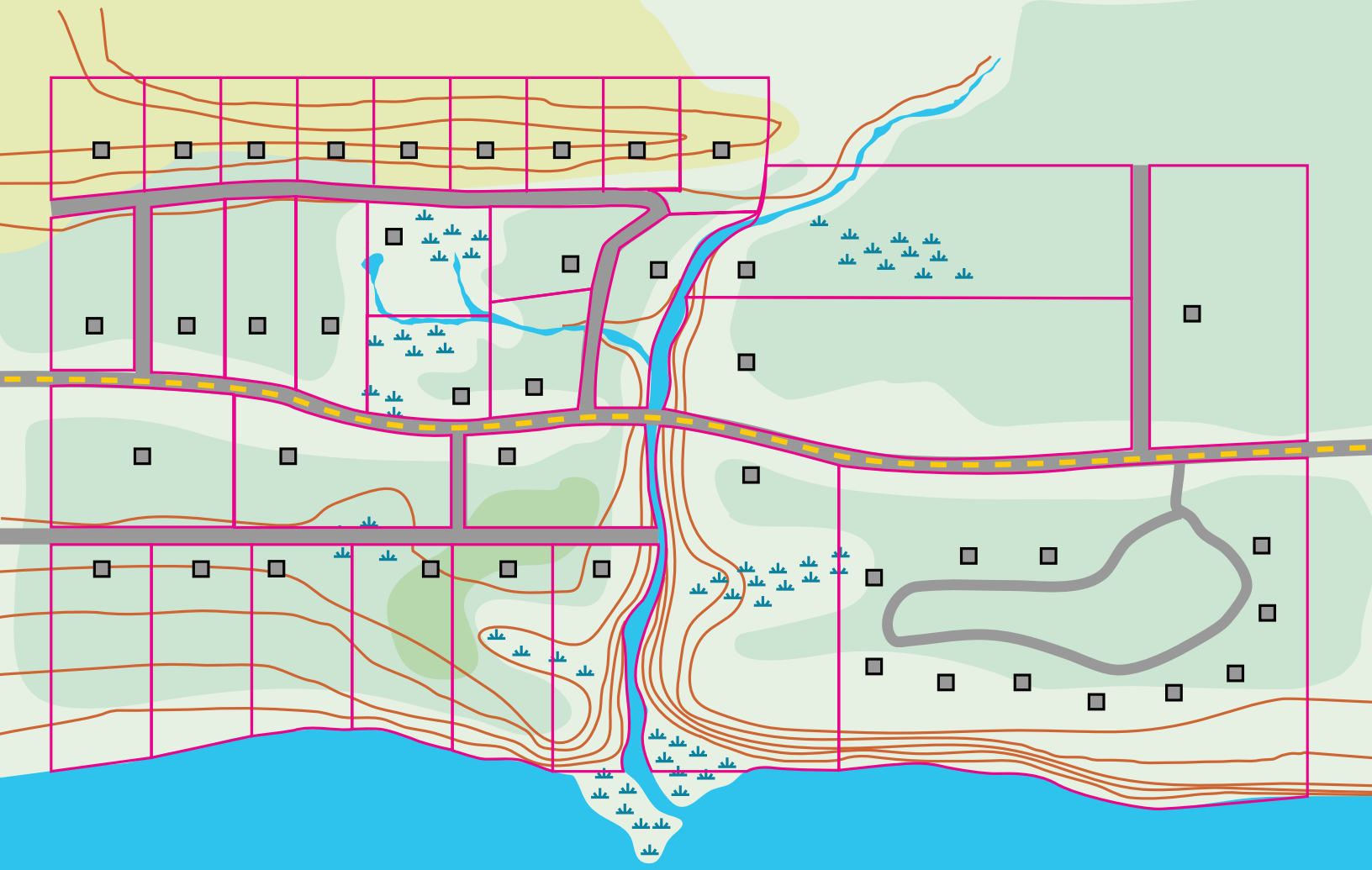
Some of the goals written to help achieve their vision included:

Goal: Promote responsible development throughout Clearwater to allow for use of the land while protecting environmental resources, green space, and quality of life.

Goal: Protect, enhance, or preserve natural areas and scenic vistas when appropriate and achievable.

Goal: Clearwater's natural, coastal, and agricultural areas are considered when development is proposed.

Their vision and goals demonstrate that this community values its natural environment and is seeking to balance economic development with maintaining a quality environment.



Build-out map over the natural features.

A Hard Question

Zoning ordinances are one of the tools communities use to achieve their visions and goals, so Clearwater leaders next examined the zoning established for this parcel (above left). The zoning map reveals a mix of potential uses, ranging from 1- to 5-acre single family lots (many without access to municipal water and wastewater collection), a small resort/commercial zone, and limited forest management lands.

Clearwater leaders asked themselves a hard question – given what they learned from the natural resource inventory about sensitive and highly valued natural features, does the existing zoning truly help meet the vision and goals in their community's comprehensive plan?

As an exercise, they pretended that a developer approached them with an intent to build the area out to capacity. They generated a map based on the maximum development Clearwater's ordinances would allow (a build-out map) and superimposed it on the natural resource inventory (above). This new map provided a way for them to look at potential environmental impacts, projected infrastructure needs, or potential impacts on viewsheds, recreational opportunities, or other characteristics the community considers important.

When they shared this map at a public meeting, almost everyone noticed the loss of access to many of the area's most prized natural features.

> "Since I was a kid I've fished that stream," said one old-timer. "Will I still have access to it? How will the development affect the trout?"
>
> "When they prepare the land for development, is there any way to keep from clearing off all the mature sugar maples that my grandparents tapped?" asked another.
>
> "That land's been managed for timber for years; will there be any left? What's going to happen to that stand of mature white pines?" inquired one other longtime resident.

Other concerns were voiced, such as possible water quality impacts, loss of scenic views of the maple–covered ridge as homes were built, loss of traditional hunting areas and trails, and erosion potential along Lake Superior and Clearwater Creek. On the other hand, community members recognized the importance of economic growth and community vitality, and they wanted their community to grow. There were questions about the tax base, the costs of providing services to this new development, and whether the existing utilities could handle the increased strain.

With the help of local natural resource experts, they found out that except for some shoreland areas, potentially all of the mature forest could be removed under existing zoning laws. In addition, impervious surfaces would increase by up to 13% in the residential areas and some of the wetlands (even though they're protected by regulations) could be lost to roads, homes, and encroaching lawns. These changes would lead to increased runoff, which would carry nutrients, sediment, and other pollutants, and potentially warm the waters of the trout streams. This, plus increased erosion from construction near streams and wetlands, could impact fish habitat in the streams and in the coastal wetlands and nearshore areas of Lake Superior. The existing high-quality forest habitats would be fragmented, reducing habitat for important local wildlife and reducing available timberlands for traditional activities such as logging, maple sugaring, hiking, and hunting. In addition, remaining open space could be limited to a 5-acre swath of public forest, there would be no access to the lakeshore, and development along ridgelines could alter views from the lake and the road.

Build-Out Results for a Few Key Indicators, by Zoning District

Zoning District	1 acre	2 acre	5 acre	Resort
# Homes	18	9	4	11
% Impervious	13%	10%	7%	4-40%+
Public Roads (ft)	1,896	1,463	637	none

Moment of Truth

As potential impacts accumulated, community leaders looked back on the question they started with:

Does the existing zoning truly help meet the vision and goals in their comprehensive plan?

For this 80-acre parcel at least, the answer was, "Maybe not."

The community concerns raised by this mapping exercise caused Clearwater leaders to modify their vision and goals, wording them to be more specific and adding action items as follows:

Vision: Clearwater desires to be a community that is well managed, oriented towards the well-being of its citizens, and ~~in balance with its many natural amenities~~ promotes economically, environmentally, and socially responsible growth, while maintaining its natural amenities and cultural resources for future generations.

Goal: Promote ~~responsible~~ innovative development throughout Clearwater to allow for responsible use of the land while protecting environmental resources, green space, and quality of life.

Action Item: Develop codes to encourage flexibility in approaches to housing (e.g., density credits, cluster developments) that will result in more green/public space while maintaining overall development densities.

Goal: Protect, enhance, or preserve important natural areas and scenic vistas ~~when appropriate and achievable~~ as each new development is considered.

Action Item: Identify priority conservation areas, considering natural, recreational, and scenic values.

Action item: Discourage development that impacts priority conservation areas, and provide incentives for development that protects these areas.

Goal: Clearwater's natural, coastal, and agricultural areas are ~~considered when development is proposed~~ preserved, protected, restored, and enhanced using principles of sustainability and sound environmental science.

Action Item: Preserve the functional integrity of all natural drainage courses from impacts due to increased stormwater runoff through acquisition of drainage easements and other interventions as needed.

With their updated vision and goals in mind, they again examined the zoning for the 80-acre parcel asking, "Is there a better way to develop this parcel? Can we protect the resources identified in the Natural Resource Inventory *and* still encourage economically viable development?"

A Fresh Look

Spurred by the action items, the leaders decided to start over, first by marking their priority conservation areas on their Natural Resource Inventory (right). They shaded in:

- areas unsuitable for development or already protected (wetlands, stream corridors, coastal wetlands, steep clay banks)
- areas difficult or expensive to develop properly (clay soils, steep slopes)
- land uses they wanted to retain (maple sugar forest, unfragmented forest for timber harvesting, recreation, and wildlife habitat)
- land that they wanted to keep accessible to everyone (bedrock cliffs overlooking Lake Superior)

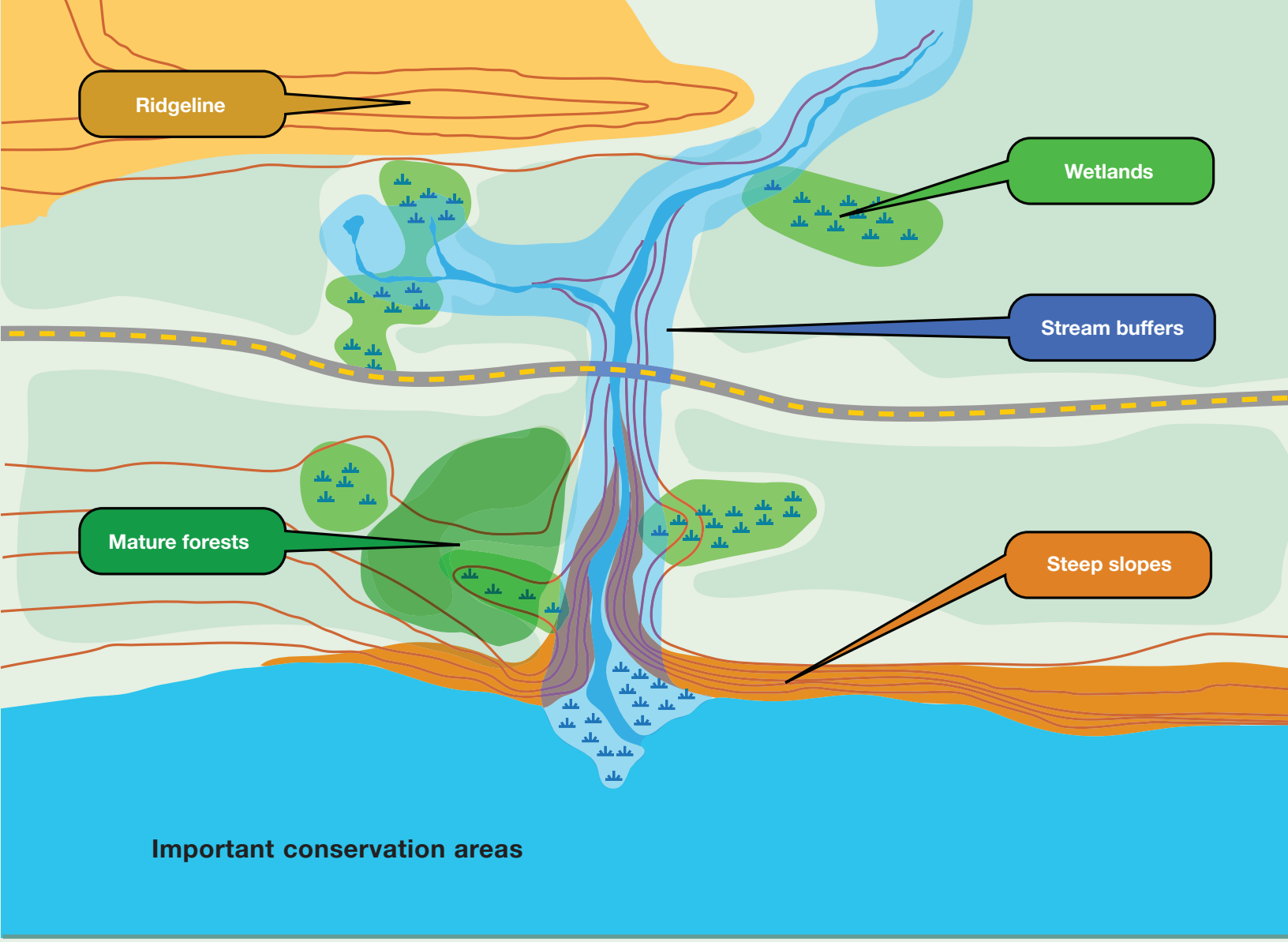
Then, they drew up a conceptual plan for the parcel. Could developers build on the parcel in such a way that they would be able to sell enough home sites to make a profit? After some careful thought, consultation with experts, and community meetings, they came up with a new plan:

1. Leave the commercial zoning in place but add additional setback requirements from the lake, limit vegetation clearing, and require additional stormwater treatment. They reasoned that these changes would still allow commercial development but limit disturbance of the sensitive clay banks on the eastern shore along Lake Superior, and would still provide the developer with prime views of the lake. They did not want to lose the economic potential that commercial zoning would bring.

2. Maintain the northeast quadrant in forest management. The community realized that retaining this whole quadrant in forests, rather than dividing it up, would meet several of their comprehensive plan goals by keeping intact a large parcel of green space, providing wildlife habitat, protecting Lake Superior water quality, and allowing for continued sustainable timber harvesting.

3. Encourage developers to use an innovative approach to laying out home sites called *conservation design.* With this approach, the same number of (or sometimes more) homes possible under the old zoning are built on smaller lots outside of the priority conservation areas. The remaining land is placed under *conservation easement* and typically managed by a homeowner's association as green space.

To meet septic requirements in the unsewered area, the use of a community septic area was proposed. By dedicating land for waste management, the developers would then have a choice of clustering individual systems or having a community treatment system installed. Either choice made it possible for individual lots to be smaller and for more efficient management of wastes. (To learn more about community septic options, see www.septic.umn.edu.)



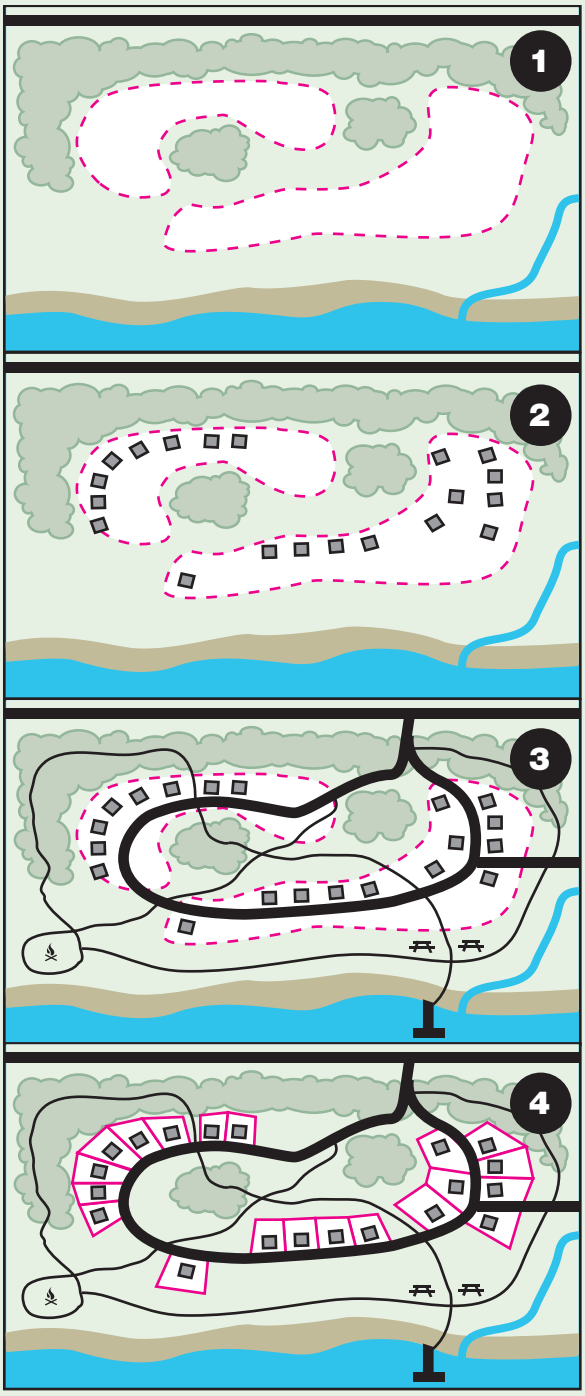
Important conservation areas

Conservation easements — legal agreements between a landowner and a land trust or government agency. The agreements allow property owners to limit or prohibit development on their land. Conservation easements are permanent and run with the title so that all future owners of the land are bound by the original agreement. Conservation easements can benefit the landowner by reducing property taxes, and can benefit the community by maintaining public amenities.

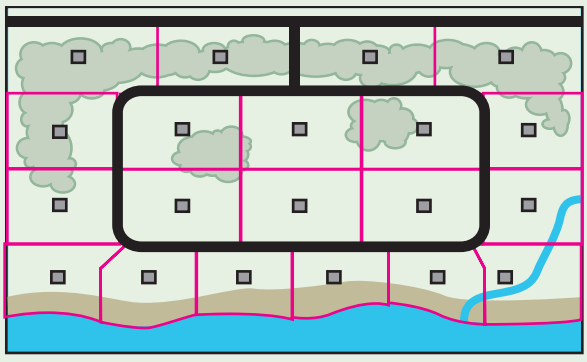
Interested in planning for your community's future? NEMO, the Nonpoint Education for Municipal Officials program, can provide you and your town with information and tools to manage development while protecting the natural resources of your community. Contact Northland NEMO: www.northlandnemo.org.

Jesse Schomberg
Minnesota Sea Grant: 218-726-6182

Sue O'Halloran
University of Wisconsin Extension: 715-394-8525



Conventional Development:



Conservation Design

Typically homes and natural features aren't the first considerations in the land development process. Developers start by drawing in roads and lot lines. When considering conservation design, outlining the natural features comes first, and finding great spots for the homes comes next. Conservation design usually follows these steps:

1. Identify open spaces to be protected. This includes primary conservation areas, such as wetlands where development is restricted, and secondary conservation areas where development is allowed but discouraged. The remaining lands are the buildable areas.

2. Locate homes within buildable areas. Although the total number of homes can be determined in several ways, it is often set by how many could be built under traditional zoning ordinances. Homes are often sited to maximize views and connections with open spaces, and also to minimize impervious surfaces.

3. Locate streets and trails. Remember to add trails! Trails can be the perfect option to connect neighborhoods, or to connect adjacent open spaces.

4. Draw lot lines around the homes. Keeping lots sizes between 1/3 to 1/2 of the base zoning's "minimum lot size" will maintain a high value for all the homes while reducing impervious surfaces, road lengths, land clearing, and utility extension costs.

To learn more about conservation design, read Randall Arendt's book "Growing Greener," and visit the Minnesota Land Trust Web site at www.mnland.org.

Economic Advantages of Conservation Design (as compared to traditional subdivision development)[14]
Construction Costs Reduced 10-33%
Lot Premiums Increased by 25-30%
Appreciation Rates have been shown to increase 12% faster over 20 years

Making It Work

Clearwater leaders had the task of ensuring that natural and community resources were protected along with economic interests. They wanted their community to grow, and now they had a plan for *how* they wanted it to grow: what were the tools they needed to make sure it happened?

- **Education –** Encouraging and teaching individuals or businesses to act consistently with the goals, and why they are important for the community.
- **Incentives –** Promote compliance with the goals by providing tax breaks, fee reductions, technical assistance, density credits, or other benefits.
- **Regulation –** Modifying land use ordinances, which require individuals or businesses to act consistently with the goal.

Clearwater decided that education would be a key component of implementing their new plan. Teaching people new ways to consider and manage their land preserves individual property rights while maintaining the quality of the resources. Education also helps residents understand why regulations are necessary to protect water quality, maintain viewsheds, etc., and can alleviate confusion over new rules.

Community leaders also looked at incentives to encourage landowners to participate. They set up technical assistance programs, started a program to *purchase development rights* in important or sensitive areas, and allowed the *transfer of development rights* from areas designated as sensitive, open space, or critical habitat to areas more suitable for development. These incentive-based programs generate community green space and unfragmented habitat, while benefiting landowners through direct compensation or tax breaks. Participants still own their land and can continue traditional uses such as logging, agriculture, or recreation.

While education and incentives go a long way in making a community's plan work, new and changed regulations were required in Clearwater. Their existing Planned Unit Development ordinance didn't adequately promote clustered development or protect important resources. Their shoreland development standards didn't include performance standards for runoff, and they had no ordinances for stormwater runoff or sediment and erosion control. Clearwater leaders wanted to make sure the rules were fair and clear.

Note that model ordinances for communities are available from Northland NEMO, along with a program to help your community understand how ordinances work, and how to make sure they're tailored to fit your community's needs. Visit www.northlandnemo.org.

Clearwater understood that they weren't the first community to face these challenges. As they looked around the region, they found examples where communities and businesses had successfully used innovative ways to deal with development concerns. Some of these examples can be found starting on page 22.

Purchased development rights (PDR) — voluntary legal agreements that allow owners of land meeting certain criteria to *sell* the right to develop their property to a governmental unit or nonprofit organization. A conservation easement is placed on this land and the agreement is recorded on the property title, limiting the future of the land to agriculture, logging, or other open space uses.

Transfer of development rights (TDR) — Rights enabled by a local or regional ordinance. TDR ordinances create a sending area, or preservation area; and a receiving, or higher density, area. Landowners in the sending area receive development right credits, which they can sell in exchange for not developing their land. Real estate developers can then purchase development right credits and use them to increase existing or planned densities in the receiving areas.

Land acquisition — Used when landowners want to conserve their land by selling or donating it outright to a public agency, and when acquisition meets a public interest need (such as public access or public management of an environmentally sensitive area). Both public and private funds are used in land acquisitions.

So how did the changes that Clearwater made affect the 80-acre parcel?

The Transfer of Development Rights Program allowed the community to maintain the entire northeast corner as forestland managed for timber, and move the three homes that could have been built there to the other side of the river, where the homes would be denser but closer to community services.

The owner of the lot between the river and the commercial area agreed to sell her development rights to the land along the river and near the coastal wetland to the community, thus protecting the steep banks along the river.

The commercial resort area remained much the same, but increased setbacks protected the shoreline. Reduced height restrictions allowed the builders to build "up" instead of "out," which reduced building footprints. A more compact design required fewer roads. Innovative stormwater approaches treated the runoff and protected the steep clay slopes from eroding.

Zoning changes de-coupled density from lot size, and required smaller lots but retained the overall number of houses. This allowed developers options in designing their sites and made it easier to protect sensitive resources.

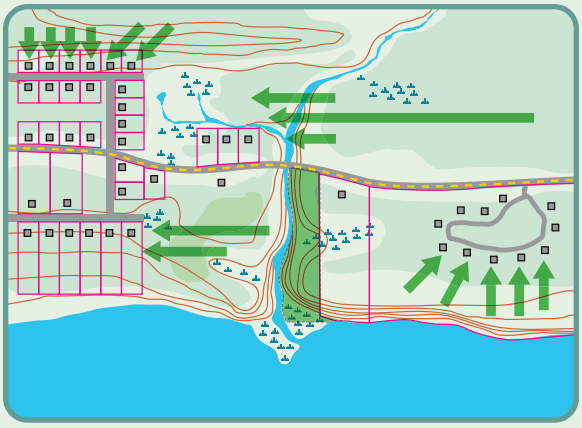
North of the road, where sewer and water systems existed, development was concentrated along the side of the ridge, so the homes would have fantastic views and the sugar maples on the ridge top would be left.

Other homes were arranged to maximize views and access to open space, and to maintain wetlands and stream buffers.

Instead of curbs and gutters, rain gardens and vegetated swales were used to treat and infiltrate the runoff on-site, making sure the wetlands and Clearwater Creek remained clean.

South of the road, a community septic area allowed the homes to be clustered on smaller lots near the road to minimize impact to the mature forest and wetlands, and avoid the steep banks along Clearwater Creek. Runoff was treated in two *bioretention areas*, to make sure that pollution and excess runoff didn't get into the creek.

In both developments, the open space was put into a conservation easement and managed by the homeowner's association.



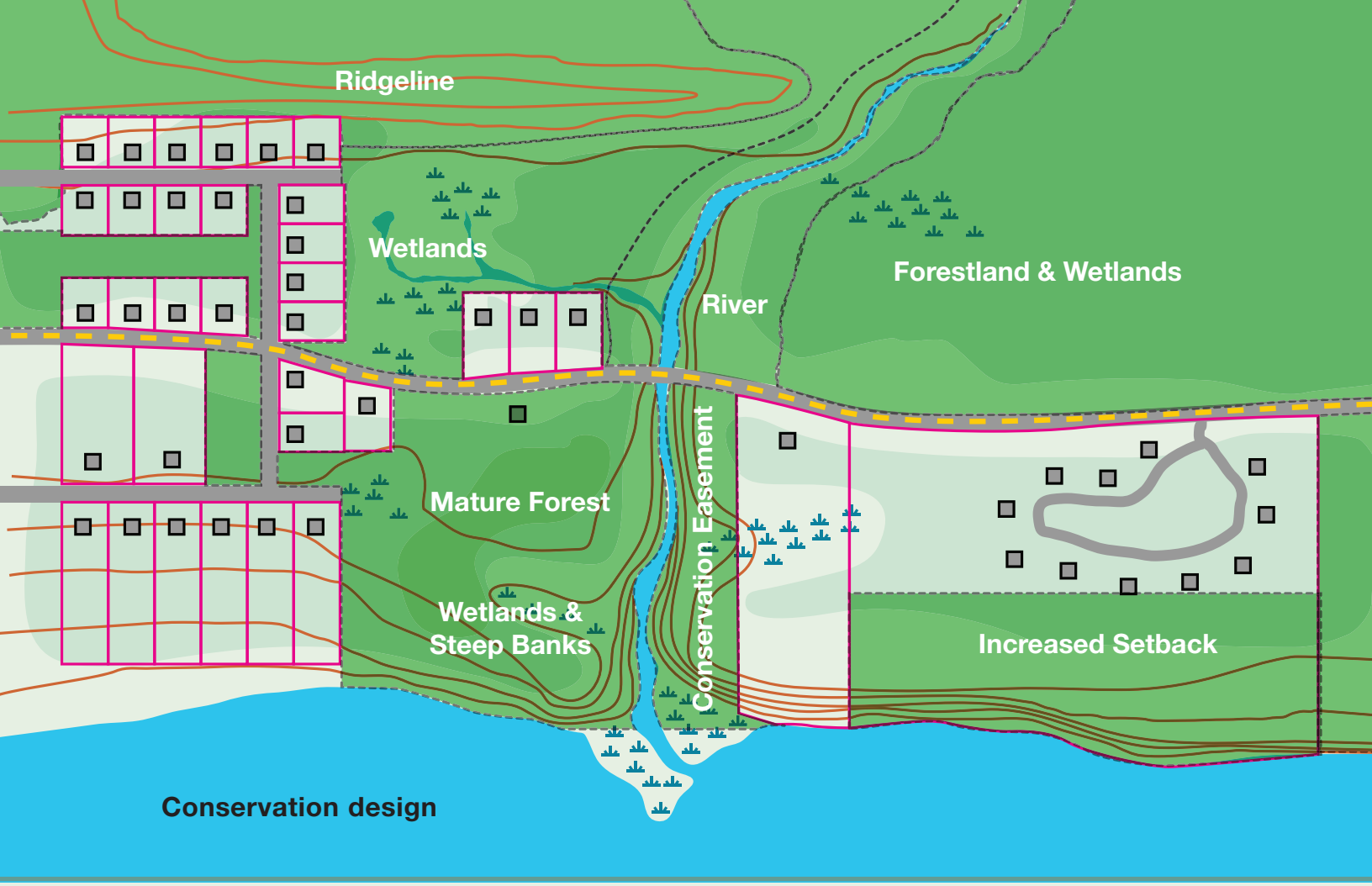
The community of Clearwater was able to conserve more of their natural resources by adjusting the land use plan.

The developers were allowed to build two additional homes in exchange for guaranteeing public access through the open spaces in the easement agreement. All Clearwater residents can have access to Lookout Rock and the lakeshore, Clearwater Creek, and Maple Ridge, which may enhance inland property values[15]. Even with the bonus lots and transfer of lots from the eastern side of the creek, the amount of impervious surface was 3-5% less by using conservation design, and 50% fewer new roads were required, reducing plowing, school bus, and maintenance costs for the community.

When the community presented this map to the public, there were still concerns (some wished for less development overall, some wanted more), but most of the issues raised previously were addressed, and the community realized that their plan, this time, would help Clearwater achieve its vision to be well managed, oriented towards the well-being of its citizens, and promoting economically, environmentally, and socially responsible growth, while maintaining its natural amenities and cultural resources for future generations.

Thanks for visiting Clearwater!

Bioretention – shallow, landscaped depressions commonly located in parking lot islands or within small pockets in residential areas that receive stormwater runoff.



Build-Out Results for a Few Key Indicators, by Zoning District

Zoning District	Residental Totals	1 acre	2 acre	5 acre	Resort
# Homes	Was: 31 **Now: 33**	Was: 18 **Now: 21**	Was: 9 **Now: 11**	Was: 4 **Now: 1**	11
% Impervious	Was: 10% **Now: 6%**	Was: 13% **Now: 9%**	Was: 10% **Now: 7%**	Was: 7% **Now: 2%**	4-40%+
Public Roads (ft)	Was: 3,996 **Now: 1,903**	Was: 1,896 **Now: 1,050**	Was:1,463 **Now: 853**	Was: 637 **Now: 0**	none

Local Examples of Innovation

- Infiltration and biofiltration projects help manage stormwater runoff
- Communities unite to protect open space
- Communities provide education to help people make better decisions about their lands
- Local business people are willing to take the extra step in making sure their properties are part of the solution

The Regional Stormwater Protection Team

In a long-term effort to promote community and individual activities to protect the waters of the region, 17 cities, townships, counties, state agencies, universities, and nonprofits in the Duluth-Superior area combined in 2003 to form the Regional Stormwater Protection Team (RSPT). Their mission: to protect and enhance the region's shared water resources through stormwater pollution prevention by providing coordinated educational programs and technical assistance. To date, they have produced radio and television commercials promoting minimized runoff, developed and distributed brochures, developed Web-based technical assistance materials, and hosted a watershed festival. By working together, they have been able to pool their resources and reach a larger audience than they would individually. Look for their mascot “Rex the Dog” at local events or on your local television station. For more information, visit www.lakesuperiorstreams.org/stormwater/rspt.html.

Glensheen

The University of Minnesota Duluth's Glensheen Mansion is both historically and environmentally important to the region. The arguably haunted manor graces the shores of Lake Superior and straddles the mouth of Tischer Creek, one of Duluth’s 12 designated trout streams. Its highly visible location along Highway 61 (London Road) and its battle with runoff made it a perfect place to showcase new techniques to protect Lake Superior’s waters.

Runoff from the parking lots was carrying sediments, road salt, and other pollutants right into the lake, and eroding the banks along the lakeshore. Pieces of the historic property were literally being washed into the lake with every rain. The South St. Louis Soil and Water Conservation District and the Minnesota Board of Water and Soil Resources joined forces with UMD to try some innovative runoff control approaches. They installed two grass swales that collect runoff from the parking lot. The swales slow the water down, allow the water to cool, filter out sediments, and infiltrate some of the runoff. Rock check dams slow and filter the water even more. There’s also a *bioretention* ponding area that collects water from over two-thirds of the parking lot and holds and filters most of the runoff, keeping that water from rushing straight into the lake. The swales are planted with native plants, which are not only beautiful, but have deep roots that help some of the water infiltrate back into the ground. The native plants also require almost no maintenance, which will save UMD money in the long run. According to Dan McClelland, former grounds manager at Glensheen, “The project prepares us for the future, when the rest of the parking lot is paved. This will make sure that we’re cleaning the additional water as well.”

Superior Rain Gardens

The red clay soils of Superior, Wisconsin, make managing stormwater a challenge that requires help from local residents. Through their rain garden demonstration program and rain barrel-making workshops, the Superior Waste Water Treatment Plant (WWTP) is providing important education, resources, and examples to local citizens to help reduce runoff and pollutants coming off rooftops, lawns, and driveways. They have planted 5 demonstration rain gardens on their property, which trap water running off roofs and lawns.

“The best place to start is our own back yard,” says Bonita Martin, who developed the rain garden demonstration project proposal that was funded by the Great Lakes Commission.

Each rain garden is designed to experiment with different sizes, placements, and construction techniques. One is sized for a residential yard; students from a nearby school helped prepare the site with shovels and rakes, and local residents got their hands dirty planting native species as part of a rain garden workshop. Native plants have deep roots that break up the soils to help the water infiltrate faster and they’re also tough: they can survive the cold winters, clay soils, and deep frost that many nonnative species can’t take.

Another successful project was Superior WWTP's rain barrel construction workshops. Participants paid a small fee to make-and-take their own barrel while learning how rain barrels can help both Lake Superior and gardens. They were able to put on 32 workshops and sold 355 rain barrels during the summer and fall of 2004, which could keep up to 18,000 gallons of water per rainfall from running off. The Superior WWTP feels it’s important to set a good example. “We ought to be practicing what we’re preaching,” said Bonita, and they’re off to a great start.

Poplar River Condominiums

Development on the thin erodible soils, bedrock, and steep slopes of the North Shore of Lake Superior can be tricky. In 2000, Scott Harrison, president of Lutsen Resort Co., was working on developing condominiums along the Poplar River and wanted to design the structures with respect to the environment.

“We’re here for the long haul,” said Scott, who contacted Wayne Seidel, with the Cook County Soil and Water Conservation District.

“I worked with Scott on the erosion and sediment control measures for the project, then known as Lutsen East (2000-2001)," said Wayne. "[Scott] was great to work with and installed many innovative measures due to the severe slopes and highly erodible soils on the site.”

So why was Scott so interested to see things done well? “It’s the right thing to do,” he said, and “If it costs a little more, that’s OK.” In addition to regular erosion control techniques, the site features include:

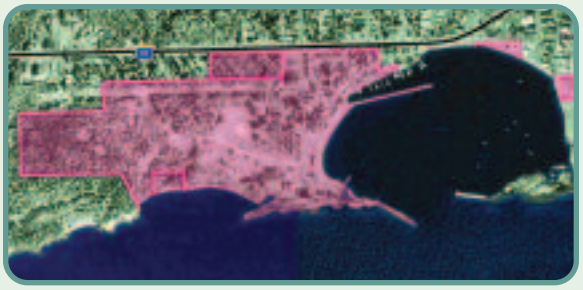
- a stormwater detention basin
- a secondary detention basin created by simply raising the inlet height of a culvert
- flow diverters and gutters on pavement to direct runoff to non-erosive outlets
- rock waterways to convey roof runoff
- a constructed wetland sewage treatment system

La Pointe Stormwater Demonstration Project

The City of LaPointe, Wisconsin, on scenic Madeline Island, has recognized the importance of addressing stormwater runoff within their community to protect their shoreline and Lake Superior. After developing a stormwater management plan for their community that emphasizes pollution prevention and best management practices, one of the first activities was developing a stormwater demonstration project at Lori's Store, a local business where stormwater needed to be dealt with. The results of the project included: developing a grassy area to filter some roof runoff, routing foot and vehicle traffic away from the grass, paving the parking area to reduce dust and sediment runoff, a rain garden that collects and infiltrates the runoff from half of the roof area, and a device called a Snout© to block debris and oils from flowing into Lake Superior.

Farmland Protection in Bayfield

In 2002, residents of the Town of Bayfield in Wisconsin voted to tax themselves to pay for a farmland preservation program that would purchase the development rights from willing farmland owners. The small but growing community was concerned about maintaining the rural characteristics and economy unique to their town. The program followed a 1995 comprehensive plan, where the first goal was to "preserve productive and potentially productive agricultural land (with special emphasis given to microclimate fruit industry) and to maintain agriculture as a major economic activity and way of life." One of the objectives was to "discourage residential development of potentially productive agricultural land." As of late 2005, the program had protected over 200 acres of farm and orchards, with about $300,000 coming from the town coffers, and a similar amount coming from grants.



Lands protected by conservation easement with the Minnesota Land Trust in Grand Marais.

Shoreline Protection in Grand Marais, Minnesota

In the late 1990's, recognizing that its harbor was a critical community asset and worried about overdevelopment, the City of Grand Marais approached the Trust for Public Land and the Minnesota Land Trust to explore ways of protecting this resource. "The City was looking ahead, and trying to protect what made them a unique community," said Jane Prohaska, Executive Director of the Minnesota Land Trust. As a result, the City was able to purchase the old Standard Oil Station and some other harbor land, and put this land, Sweetheart's Bluff, and other city-owned shoreland, into a conservation easement. Easements are designed specifically for each site, and this one allows the continuation of existing uses (including campground operations) and some expansion and rebuilding. "The city itself wanted to leave a legacy to its citizens and protect the harbor from overdevelopment," said Jane. The old gas station site is now a waterfront park and a main feature of downtown Grand Marais.

What Everyone Can Do to Reduce Stormwater Pollution

The Minnesota Pollution Control Agency suggests:

- Use fertilizer sparingly
- Never dump anything down storm drains
- Vegetate bare spots in your yard
- Compost yard wastes: don't leave grass clippings or leaves on the street
- Avoid pesticides
- Direct downspouts toward vegetated areas
- Wash your car on the lawn instead of the driveway or street
- Check your car for fluid leaks, and recycle used motor oil
- Pick up after your pet
- Have your septic tank pumped and the system inspected regularly

Conclusion

People in the Lake Superior Watershed are distinctly advantaged. Despite the sensitive nature of our environment and increasingly serious water quality problems in many areas, the abundance and quality of our water resources remain enviable. Consider: The city of Duluth has over 12 designated trout streams flowing through its boundaries! We have the opportunity to protect the integrity of natural resources that other places have lost, and maintain our reputation as a place of unsurpassed natural beauty and clear waters. We can do it, even as we grow; we can do it and promote economic growth in our communities.

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9. Verry, E.S., 2004, Land Fragmentation and Impacts to Streams and Fish in the Central and Upper Midwest, In *A Century of Forest and Wildland Watershed Lessons*, eds. G. G. Ice and J. D. Stednick, Bethesda, MD., Society of American Foresters.

10. Newman, R.M. and N.A. Hemstad, 2002, *Influence of local and landscape factors on instream habitat and fish communities*, completion report to: The Minnesota Department of Natural Resources.

11. Numerous researchers have shown the effects of storage. Two recent studies include: Detenbeck, N.E., V.J. Brady, D.L. Taylor, V.M. Snarski, and S.L. Batterman, 2005, Relationship of stream flow regime in the western Lake Superior basin to watershed type characteristics, *Journal of Hydrology* 309: 258-276 and Johnston, C.A., N.E. Detenbeck, and G.J. Neimi, 1990, The cumulative effect of wetlands on stream water quality and quantity, *Biogeochemistry* 10: 105-141.

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13. MN DNR, 2001, *Addressing Natural Resources in a Comprehensive Plan*. Available online at: files.dnr.state.mn.us/assistance/nrplanning/community/nrchecklists/compplan.pdf

14. Several studies have evaluated the economics of conservation design. For a recent review, see: Mohamed, R., 2006, The economics of conservation subdivisions, *Urban Affairs Review* 41:376-399. For a Wisconsin case study, see Farnsworth, C.B., 2003, Conservation design takes hold, *Builder Magazine*, Oct 2003, p. 244. Available online at: www.builderonline.com

15. Orr, B.D. and J.B. Pickens, 2003, Public Access to Lake Superior and Attribute Values of Proximate Non-Shoreline Property, *J. Great Lakes Res.* 29(4):616-629.

Online Resources

Natural Resource Inventories and Assessments

Guide to Using Natural Resource Information
www.dnr.state.mn.us/nrig

Natural Resources and Their Place Within Comprehensive Planning
clean-water.uwex.edu/pubs/compplan/

Planning for Growth

Northland NEMO- Nonpoint Education for Municipal Officials
www.northlandnemo.org

Under Construction – Tools and Techniques for Local Planning. 2002. Minnesota Planning.
www.mnplan.state.mn.us

Community Planning Resource
planning.lic.wisc.edu/Community_Planning_Resource/CPR_Home.htm

The U.S. Environmental Protection Agency's Smart Growth Resources
www.epa.gov/smartgrowth/

Wisconsin DNR's Smart Growth Page
dnr.wi.gov/org/es/science/landuse/smart/

The Center for Rural Planning
www.centerforruralplanning.org

Conservation Design

The Minnesota Land Trust
www.mnland.com

Greener Prospects
www.greenerprospects.com

Stormwater and Nonpoint Pollution

The Minnesota Stormwater Manual
www.pca.state.mn.us/water/stormwater/stormwater-manual.html

The Low Impact Development Center
www.lid-stormwater.net

Public Education

Regional Stormwater Protection Team:
www.lakesuperiorstreams.org/stormwater/rspt.html

Minnesota Water-Let's Keep it Clean Campaign
www.cleanwatermn.org

University of Wisconsin Extension Water Resources

clean-water.uwex.edu

Incentives: Easements, Transfer or Purchase of Development Rights

Trust for Public Land
www.tpl.org

Minnesota Land Trust
www.mnland.org

West Wisconsin Land Trust
www.wwlt.org

1,000 Friends of Minnesota Land Conservation Tools
www.1000fom.org/conservation.htm

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www.mnplan.state.mn.us

General Resources

Lake Superior Streams
www.lakesuperiorstreams.org

Minnesota Sea Grant Program
www.seagrant.umn.edu


UMD
DULUTH
Reaching higher


Sea Grant
Minnesota


NEMO
Northland


UW
Extension


MINNESOTA'S
LAKE SUPERIOR
COASTAL
PROGRAM


EPA
United States
Environmental Protection
Agency