

PART III MINNESOTA'S LAKE SUPERIOR COAST

A. SETTING

1. Physical Environment

a. Area Geography

Lake Superior is the largest of the Great Lakes and has the greatest surface area of any freshwater lake in the world. It contains almost 3,000 cubic miles of water, an amount that could fill all the other Great Lakes plus three additional Lake Eries. This is about 10 percent of the world's fresh water. With an average depth approaching 500 feet, Lake Superior also is the coldest and deepest (1,332 feet) of the Laurentian Great Lakes. The lake stretches approximately 350 miles from the west to east, and 160 miles north to south, with a shoreline almost 2,800 miles long. The drainage basin, totaling 49,300 square miles, 89 percent of which is forested, encompasses parts of Michigan, Minnesota, Wisconsin, and Ontario (Lydecker 1976).

Figure 1. The Great Lakes and adjacent states and provinces.



Minnesota's lowest (602 feet above sea level) and highest (2,301 feet) elevations are found in the Lake Superior watershed. Within the immediate vicinity of the lake, elevations vary from 602 feet above sea level at Lake Superior to 1,770 feet near Grand Marais. A pattern emerges in elevation

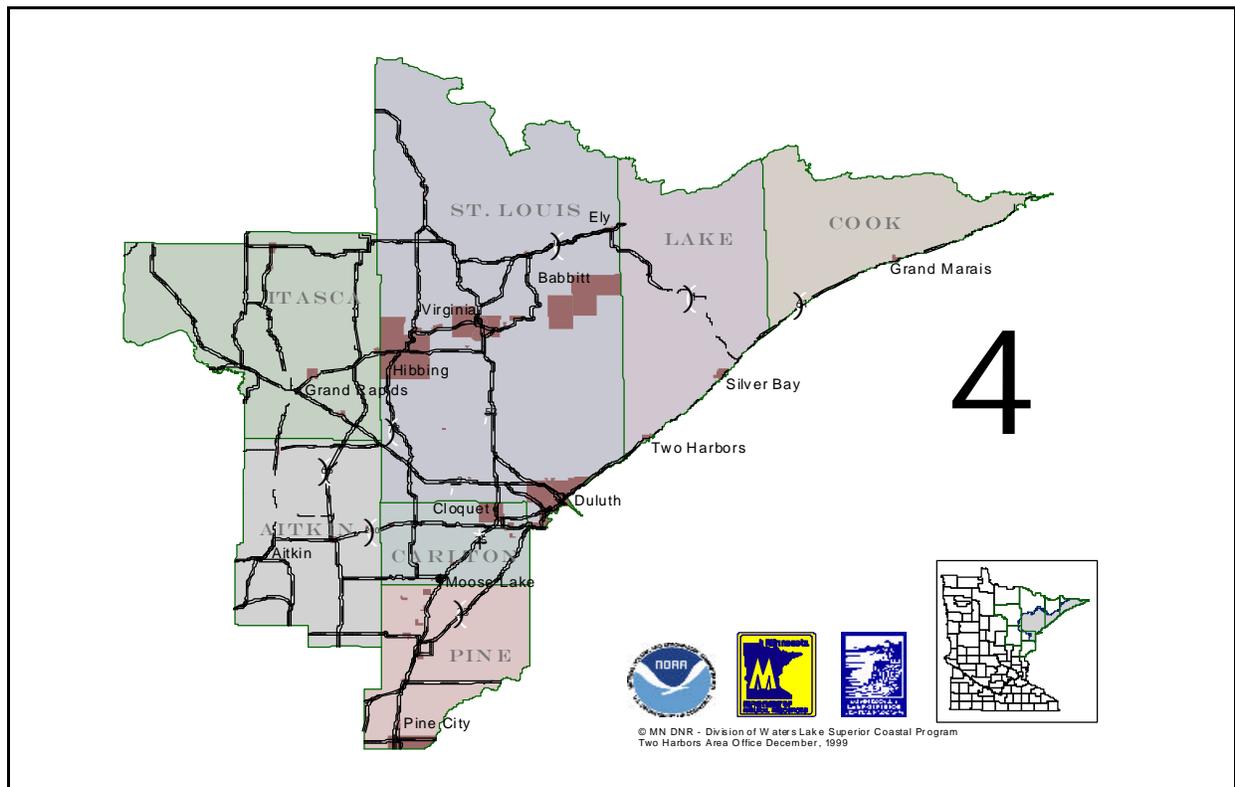
PART III

as one goes north along the shoreline. St. Louis County has, at most, an 800-foot change in elevation adjacent to the lake, while Cook County has more than a 1,100 foot change in elevation (Lydecker 1976).

Within the coastal area are 12 cities, 15 state parks, a national monument, portions of a national forest, two Indian reservations and an international seaport. Numerous unincorporated settlements are scattered through the area, most of them hugging the coast. The Minnesota coastal area is divided into four political units: St. Louis, Carlton, Lake and Cook Counties. St. Louis County comprises 80 percent of the population of the four county area, while Carlton County has 12 percent of the population. Cook and Lake Counties comprise 2 and 5 percent respectively. Just under 70 percent of the coastal area's inhabitants live in Duluth.

St. Louis, one of the largest counties in the nation, touches the Lake Superior coast in a small area comprising the city of Duluth and to the east, Lakewood and Duluth Townships. Of the 206 miles of coastline, 32 are within the city of Duluth. The southern portions of both Lake and Cook Counties border on Lake Superior. Southwest of Lake Superior is Carlton County. The St. Louis River (the largest tributary to Lake Superior in Minnesota and the United States) flows through the northeast corner of Carlton County.

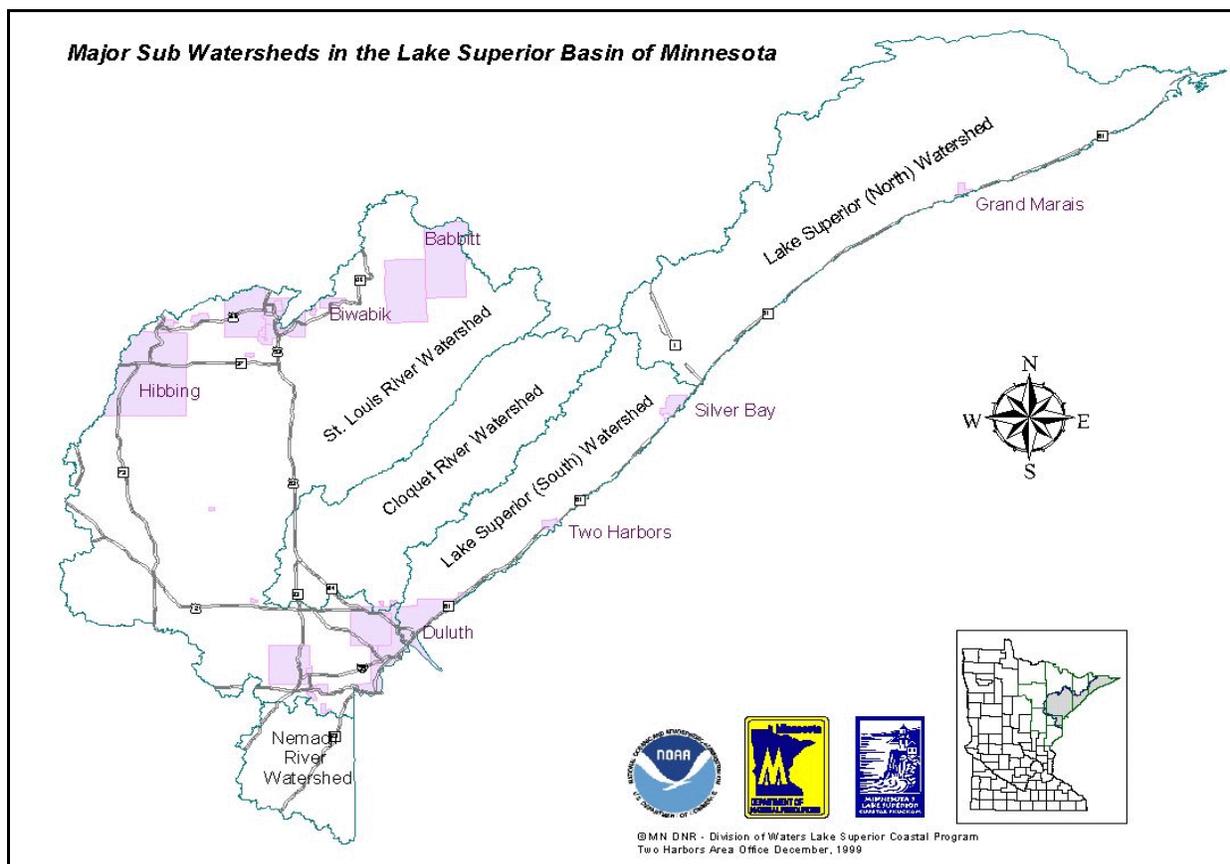
Figure 2. Minnesota's Arrowhead Region.



Minnesota is known for its wealth of lakes, but the gem may be the North Shore of Lake Superior. The North Shore is located in northeastern Minnesota, representing approximately 206 miles of shoreline extending from the St. Louis River on the south to the Pigeon River on the United States/Canadian Border. Minnesota's portion of Lake Superior is flanked by Cook, Lake, and St. Louis Counties.

The North Shore has a significant amount of scenically attractive relief, even when compared to the rest of Minnesota's Arrowhead Region. Very rugged relief occupies 5 percent of the watershed sub-basin and is concentrated along the shoreline of Cook County. Rugged areas are mainly in the northern portion of the watershed with an extension along the west border of Lake County down to the shore near Silver Bay. Rolling relief is concentrated primarily in St. Louis County along the shore, while flat and other classes are scattered throughout the watershed sub-basin. Relief in Carlton County varies from 50 feet in the south, to 550 feet in the northeastern part of the county.

Figure 3. Subwatersheds of Minnesota's Lake Superior basin.



Minnesota Point, also called Park Point, is a six-mile bay mouth sand bar that averages two to three blocks wide. Formed by wave action of Lake Superior and from silt and sand deposits of the St. Louis and Nemadji Rivers, this strip of land protects the Duluth-Superior Harbor from the strong northeast winds which blow across Lake Superior.

b. Climate

The Lake Superior region in Minnesota has a continental climate regime characterized by wide variations in temperature. Temperatures can range from more than 100 degrees in the summer to 50 degrees below zero in the winter. The climate of the areas located along the North Shore, are greatly influenced by Lake Superior. The moderating effect of the lake results in cooler summer and warmer winter temperatures. The winter warming effect lessens if the western portion of Lake Superior freezes over (St. Louis County 1991).

Average annual precipitation varies from 26 inches inland, to 28 inches along the North Shore. Though spring and fall precipitation patterns follow the rest of Minnesota, summer and winter precipitation differs as it is influenced by Lake Superior. Before the western part of Lake Superior freezes, snowfall increases near the lake. This is due to southerly and easterly winds absorbing large amounts of moisture as they cross over the open lake. When the moister air reaches land it is cooled and condenses as snow. An area of heavy snowfall generally occurs five to seven miles inland from Lake Superior. In the summer, land quickly becomes warmer than the water in Lake Superior. Air passing over the lake is ordinarily cooled and stabilized, occasionally to the point of condensation. For this reason fog is not an uncommon feature on the lake and nearby shoreline during the summer. The least amount of rain is found in the very northeast part of the state, an effect of Lake Superior and prevailing winds.

Normal summer precipitation (June, July, August) averages 10 inches. Precipitation during the growing season (May - September) averages 15-17 inches inland. Average annual runoff is between 12 and 15 inches.

The median snowfall is 70 inches. The number of days when the snow cover is greater than 12 inches varies from 65 days along Lake Superior to 100 days inland. The average date of the last frost in the spring is May 22 with the first frost occurring September 21.

c. Geology

The Lake Superior region has been affected by several major periods of volcanism, mountain-building, deformation, erosion and sedimentation throughout geologic time. Billions of years ago, intense deformation metamorphosed many of the volcanic and sedimentary rocks producing a mountainous landscape. However, by about 1.2 billion years ago, erosion had reduced the area to a low, rolling plain.

The Midcontinent Rift System is a feature that extends from the east end of Lake Superior to Duluth, then south along the Minnesota-Wisconsin border to Iowa and on into Kansas. Rifting occurred around 1.1 billion years ago as a result of the North American continent splitting apart. As the earth's crust thinned, a depression formed and fractures allowed magma to work its way to the surface to be erupted as lava flows. The lava flows are well exposed along the North Shore of Lake Superior, and their well-preserved flow features are much the same as those in modern

day volcanic rocks such as those found in Iceland and Hawaii. The Lake Superior agate, for which Minnesota is famous, originally formed as fillings in the vesicles of these volcanic basalts. The last major volcanic sequence can now be seen as the "backbone" of Isle Royale and of Keweenaw Point, far across the lake in Michigan. The rift continued to sink for a while, however, and streams washed sand, pebbles, and mud into the slowly subsiding basin. Finally, over a period of 100 million years, the crust stabilized, and the buried sediments gradually hardened into rock (Lydecker 1976).

Within the past two million years (most recently about 14,000 years ago) the Great Ice Age brought new forces shaping the landscape. Great continental glaciers, up to one or two miles thick, built up and flowed from Canada. The ice streams eroded the underlying rock, some of which had become deeply weathered. The Superior Lobe (moving southwestward) carried debris (including volcanic rocks, agates, and sandstone) from the North Shore area as far as the Twin Cities, the Minnesota River and even to Iowa. The ice eroded the sedimentary rock in the middle of the old Midcontinental Rift System relatively easily, and it excavated what was to be the Lake Superior basin well below sea level. As the glacier receded about 11,000 years ago, it uncovered this scoured out depression which filled with water. Currently, the principal geologic processes occurring in this area are:

1. Slow weathering of the surface rocks and soils.
2. Stream erosion of surface materials (mainly glacial and glacial-lake deposits, which carry the sediments downstream and into Lake Superior).
3. Erosion, transportation, deposition by wave activity of rocks and surface materials, and the building and maintaining of sand beaches. Resuspension of fine offshore sediment is also common during large storms with high waves.
4. Hydrogeological processes involving precipitation, runoff in streams, and infiltration in the subsurface as ground water. This water eventually moves downhill toward Lake Superior.

Geologic processes are constantly reworking Lake Superior and its shore. While the processes generally act very slowly to yield almost imperceivable changes, the combination of beach and bluff erosion associated with rising water levels of Lake Superior have, and will continue to cause, considerable changes along the shoreline of Lake Superior.

d. Soils

The soils within the Lake Superior watershed formed as a result of the weathering of unconsolidated materials derived from very deep to shallow glacial and organic deposits. This material has been subjected to climate and organisms as conditioned by relief over the last 14,000 years.

The relative proportions of soil types vary dramatically within the Lake Superior watershed mostly due to the depth to bedrock, slope gradient, geologic parent material and landscape

position. The following narrative is based on major soil groupings within the subwatersheds.

The major soils within the St. Louis River watershed are very deep, nearly level to sloping, on loamy glacial till moraines and nearly level silty glacial lake plains and nearly level muck and peat in bogs. They are well and moderately well drained on summits and sideslopes, somewhat poorly and poorly drained on flat areas and very poorly drained in depressions and bogs. Natural fertility is moderately high to high. The potential for surface erosion on steeper areas is high. Minor soils are on sandy glacial outwash plains.

The major soils within the Cloquet River watershed are very deep, nearly level to sloping, on sandy glacial outwash plains. They are somewhat excessively to moderately well drained on summits and sideslopes, somewhat poorly drained on flat areas and poorly or very poorly drained in depressions. Natural fertility is low to moderate. The potential for surface erosion on steeper areas is moderately high. Minor soils are on dense-loamy glacial till moraines and drumlins on the borders of the outwash plains. Other minor soils are muck and peat in bogs.

The major soils within the Lake Superior (south) and (north) watersheds above 1,000 feet elevation, are very deep to shallow over bedrock, nearly level to extremely steep, on gravelly-loamy glacial till moraines. They are well to moderately well drained on summits and sideslopes, somewhat poorly and poorly drained on flat areas and poorly or very poorly drained in depressions. Natural fertility is low to moderately high. The potential for surface erosion on steeper areas is high. Below 1,000 feet elevation, the major soils are very deep to shallow over bedrock, nearly level to steep, on clayey glacial till moraines. They are well to moderately well drained on summits and sideslopes, somewhat poorly and poorly drained on flat areas and poorly or very poorly drained in depressions. Natural fertility is high. The potential for surface erosion and soil slumping on steeper areas is high. Minor soils are on sandy glacial outwash terraces adjacent to major streams. Other minor soils are mucks and peat in bogs.

e. Physical Shoreline

The Duluth-Superior Harbor, protected by Minnesota Point, a six mile long bay mouth sand bar, covers 19 square miles of land and water that includes 17 miles of dredged channels, most with a depth of 27 feet. The Duluth-Superior Harbor receives more than 1,000 visits by lake carriers and oceangoing ships, which load or deliver some 35 million tons of bulk and packaged general cargoes annually.

Lester River is the first major stream entering Lake Superior at the eastern limits of Duluth. Nearly all agriculturally suitable land in the coastal area, with the exception of Carlton County, is between Duluth and Two Harbors. Along this twenty-five mile stretch, the land rises gently northwestward in a ten-mile wide swath composed of woods, a few lakes and little development other than rural homes and small farms.

State Highway 61 becomes a four-lane expressway between Duluth and Two Harbors, while the old Route 61 provides a scenic drive along the shore. Most of the development here is confined to private residences or tourist accommodations. At French River, the Minnesota Department of

Natural Resources operates a modern fish hatchery for sport and commercial species. Six miles beyond, at Knife River, is a modern marina which can accommodate nearly 100 boats. The Knife River is one of the North Shore's most popular trout streams.

Two Harbors, population 3,650, is primarily an ore shipping and railroad center with an excellent natural harbor, Agate Bay. To the east is the second harbor, Burlington Bay, which is not commercially developed. Two Harbors is the terminus of a mining railroad from the Iron Range and of a rail spur to Duluth. The city also has several small manufacturing plants.

East of Two Harbors, the coastal highway mounts the cliffs and tunnels through the bluffs that have made the North Shore such a popular tourist attraction. The bluffs found at Silver Creek Cliff, Split Rock, Beaver Bay, Palisade Head, and Shovel Point are composed of very hard volcanic and intrusive rock that resisted the erosion that cut down surrounding formations. Between these headlands the North Shore rivers have cut their way through the softer rock on their brief but tumultuous journeys from the upland to Lake Superior. The gorges of most of these streams cut through still more volcanic flows of varying hardness accounting for the spectacular waterfalls found along the shore on such rivers as the Gooseberry, Baptism, Manitou, Brule, and Cascade.

Gooseberry Falls State Park is one of nine state parks located in the coastal boundary. Atop a high bluff several miles to the east is Split Rock Lighthouse. Built in 1909, it is no longer used for navigation and is now a popular state park and historic site. Beyond Split Rock is Beaver Bay, the oldest town on the shore.

In sharp contrast to Beaver Bay is Silver Bay, a planned community built during the 1950s to provide housing when Reserve Mining Company began its taconite operations there. Reserve Mining Company closed in 1986. Cyprus Northshore reopened operations in 1990. After the company was acquired by Cleveland-Cliffs, the facility was renamed Northshore Mining Company in 1994. The economy of southern Lake County centers on the mining firm that mines the ore 45 miles northwest in Babbitt.

At Silver Bay and eastward to Taconite Harbor, the Lake Superior watershed widens. Beyond Shovel Point the extremely rugged character of the shore ends for quite a distance. Here the underlying lava flows were more easily eroded resulting in a plain sloping up to the highland ridge.

About two miles east of Taconite Harbor the Superior National Forest begins, and comprises the entire coastal area for 40 miles. Within the national forest are the coastal towns of Schroeder, Tofte and Lutsen. Originally commercial fishing and logging settlements, they now depend largely upon tourism.

The generally-level slope of the coast breaks at Tofte, where Carlton Peak, an outcropping of very hard rock called anorthosite, stands more than 900 feet above lake level. Beyond Tofte the coast levels out again until it rises over the basalt cliff several miles southwest of Grand Marais.

This lava flow overlies the largest of the occasional sandstone deposits found between lava flows on the North Shore.

Closely paralleling the coast in this area, the North Shore ridge becomes a jagged range called the Sawtooth Mountains. Three state parks are spread along this section of the coast. Grand Marais, the only city in Cook County, was founded as a trading post and commercial fishing center. It now hosts tourist and logging industries. The city has a population of 1,200 and is the foot of the Gunflint Trail which runs northwestward into the Boundary Waters Canoe Area. Grand Marais owes its excellent harbor to the existence of a volcanic flow of diabase rock.

The Cook County section of the coastal watershed is by far the largest along the North Shore, stretching more than 20 miles inland in some areas. The shoreland is fairly level east of Grand Marais, sloping up away from the lake to the north. However, at Hovland, the ridge formed by the eastern end of the Duluth Gabbro Complex cuts back, down to the shore.

Beyond Hovland, the shore is relatively level again until the vicinity of Grand Portage Indian Reservation. Here, dramatic results of unequal erosion and glacial action are evident in some of the shore's most spectacular scenery. Intrusive rock formations come down to the lake shore as mountains, ridges and points. These rock masses trend generally northeastward but one particularly large formation runs at almost a right angle to the ridge, jutting out into Lake Superior. This forms 700-foot Mt. Josephine and tapers down to Hat Point, dividing Grand Portage and Wauswaugoning Bays.

Grand Portage Bay is the result of erosion of a relatively soft shale and sandstone formation. From the head of the bay the historic Grand Portage Trail ascends the North Shore ridge. It is nine rugged miles to the Pigeon River and the site of Fort Charlotte, the upper staging area of the 17th and 18th century fur traders.

The U.S. National Park Service operates the Grand Portage National Monument, a replica fur company stockade. This restoration provides direct employment plus a craft outlet for the American Indians on the 45,000 acre reservation. From May to October passenger ferry service is operated from Grand Portage to Isle Royale National Park in Michigan, 18 miles offshore. This extremely rugged and scenic wilderness island is noted as a natural laboratory of the indigenous wolf packs and moose herd. Beyond Grand Portage is the Pigeon River and the international border. From the border it is 40 miles to the port city of Thunder Bay, Ontario. Thus, the North Shore highway serves not only local and tourist traffic but provides the only land route between two major commercial centers: the Twin Ports and the Canadian Lakehead.

f. Forestry

The forest cover in Minnesota, while contributing to the character of the area, also has a great impact on the economy and the environment. The timber is used for providing structure to various natural ecosystems. It is also used for lumber, pulp and as a scenic resource that adds to the recreational attraction of the area. Approximately 79 percent of the forest land in these counties is classified as timberland. Nearly two-thirds (2.9 million acres) of the timberland is publicly owned.

Of the 1.6 million acres that is privately owned, about 260 thousand is held by the forest industry, the remainder of private ownership is held by American Indians tribes, farmers who own timberland, and other individuals.

Northeastern Minnesota is the most heavily forested region of the state. Cook, Lake, St. Louis and Carlton Counties contain 6.7 million acres of land of which 5.6 million acres, or 84 percent, are forested. This area originally comprised many coniferous stands of eastern white pine, jack pine, red pine, white spruce, black spruce, northern white cedar, tamarack, and balsam fir. Disturbances from logging activities and fire have altered the composition of the forest, producing forests dominated by hardwoods and aspen. While 37 percent of Minnesota's total land area is forested, the Lake Superior watershed is 95 percent forested. The land adjacent to Lake Superior has a forest mix of aspen-birch, spruce-fir, maple-yellow birch, and white-red-jack pine. The aspen-birch extends the entire length of the North Shore. Spruce-fir forests are concentrated in Cook County, and maple-yellow birches are concentrated in Lake County. The intermixing of the yellow aspens with the bright red maples and green conifers enhances the recreational attraction of the North Shore in the fall (Minnesota DNR 1997).

g. Wetlands

In the Lake Superior watershed, greater than 90 percent of the presettlement wetlands remain. Wetland management in Minnesota, including the coastal area, strives to achieve a "no net loss" of wetland values. The preservation of wetlands is necessary to preserve the multitude of public benefits they provide: floodwater and storm water retention, including reducing the potential for flooding in the watershed; water quality benefits, including filtering of pollutants out of surface water and ground water, using nutrients that would otherwise pollute public waters, trapping sediments, protecting shoreline, and recharging ground water supplies; public recreation and education benefits, including hunting and fishing areas, wildlife viewing areas, and nature areas; commercial benefits, including wild rice and cranberry growing areas and aquaculture areas; fish and wildlife habitat; low-flow augmentation benefits during times of drought; and other public uses. Because of the large amount of wetland losses statewide, Minnesota has placed a high priority on the need to preserve, restore, and enhance wetlands. Wetland protection at the state level is accomplished primarily through the Wetland Conservation Act. Approximately 90 percent of the total wetland acreage in the coastal area is affected under the auspices of the act (Minnesota DNR 1997).

The St. Louis River, Cloquet River, Nemadji River, and the various North Shore river watersheds are rich in wetlands and water bodies. Table 1 summarizes the information on wetland and lake coverage using the National Wetland Inventory.

Table 1. Wetland Coverage in Lake Superior's Major Minnesota Watersheds.

Coverage (acres)	North Shore	St. Louis	Cloquet	Nemadji	Total
Wetlands	256,752	752,035	170,346	41,653	1,220,786
Deepwater habitat	61,499	34,350	22,682	1,451	119,982
Total watershed	1,424,091	1,825,257	507,844	177,767	3,934,959
Percent wetlands	18%	41.2%	33.5%	23.4%	31%
Percent lake area	4.3%	1.9%	4.5%	0.8%	3%

h. Water Quality

Minnesota's wealth of high quality surface and ground water offer immense benefits to the state's overall economy. The state boasts some 25,000 miles of fishable streams, 15,000 lakes (more than 10 acres in size), 10 million acres of wetlands, and vast quantities of ground water that support a multitude of uses, including shipping, recreation, industry, domestic water supply, irrigation, and hydropower generation. As abundant as these waters may seem, they are not evenly distributed throughout the state, therefore competition for available supplies can impact both the quantity and quality of available water.

By virtue of the geologic makeup of the coastal area, sewage disposal is a very real problem and a threat to water quality. Because of the impermeability of the predominantly clay soils, and in some cases, the lack of soils, the typical residential septic system is regarded as unsuitable for the majority of installations.

In 1979 the Western Lake Superior Sanitary District (WLSSD) began operations of treating 43 million gallons of wastewater per day. The plan was the first total-concept facility in the nation. The processing facility currently converts solid waste to refuse-derived fuel to incinerate sewage sludge, thereby conserving energy and fossil fuel resources. This \$125 million advanced co-disposal system serves a 500 square mile area, encompassing Carlton and southern St. Louis Counties. Future plans for WLSSD include converting from incineration to a system of land application of bio-solids.

Water quality investigations of many northeastern Minnesota lakes have revealed the presence of heavy metal and chemical contamination. The levels of such contaminants as mercury, copper, lead, DDT, and PCBs (polychlorinated biphenyls) in Lake Superior appear to be the lowest in the Great Lakes. In an attempt to ensure the health of Minnesota anglers the Department of Natural Resources and the Minnesota Pollution Control Agency collaborate annually to test the water quality of lakes in Minnesota (MPCA 1997). The Minnesota Department of Health then publishes the Minnesota Fish Consumption Advisory booklet to illustrate guidelines for how often fish can be eaten safely. The advisory is not intended to discourage anglers from eating fish, but is used as

a guideline for choosing fish which are low in contaminants. There are fish consumption advisories for Lake Superior, the St. Louis River, and about 145 lakes in the drainage basin.

In 1991 various governments, including the State of Minnesota, accepted “zero discharge” into Lake Superior, under the Lake Superior Binational Program. This concept was designated to achieve zero discharge and zero emission of certain designated persistent, bioaccumulative toxic substances which may degrade the ecosystem of the Lake Superior basin. These toxic substances have long-term health implications making it important to work toward zero discharge from every source.

The Duluth-Superior Harbor and the lower St. Louis River have a history of water quality problems resulting primarily from municipal and industrial discharges. The lower St. Louis River, including the Duluth-Superior Harbor, has been classified by the International Joint Commission as an Area of Concern owing to impaired water resources. Water quality has improved markedly in recent years with improved wastewater treatment at and upstream from Duluth (MPCA 1997).

Table 2. Critical Pollutants in Lake Superior (Minnesota Pollution Control Agency).

Management Approach	Chemicals
Virtual Elimination	chlordane DDT and metabolites dieldrin/aldrin dioxin mercury octachlorostyrene PCBs toxaphene
Lakewide Remediation	PAHs alpha-BHC cadmium heptachlor/heptachlor epoxide
Local Remediation	metals (including aluminum, arsenic, chromium, copper, iron, lead, manganese, nickel and zinc)

Bottom sediments in the harbor, which consist of silts, sands, and clays, have contaminant concentrations that reflect past conditions in the harbor. Periodic maintenance dredging has removed some of the historic contamination. Analytical results from comprehensive sampling of the federal navigation channels in 1994 and 1995 show that the contaminant character of the channel sediments throughout the harbor is moderate and comparable to background levels in the harbor vicinity. In an effort to characterize the nature of sediment contamination in the lower St. Louis River, the U.S. Environmental Protection Agency and the MPCA have undertaken a series of investigations. These investigations identified a number of sites where sediments are polluted with oil and grease, polynuclear hydrocarbons (PAHs), trace metals, and cyanide. These sites include Slip C and Minnesota Slip in Superior Bay. The sediment studies are summarized reports such as the *Sediment Assessment of Hotspot Areas in the Duluth/Superior Harbors (1997)*.

In Carlton County, the Nemadji River contributes the highest sediment load per drainage area of the tributaries to Lake Superior averaging 131,000 tons per year.

i. Fish and Wildlife Habitat

Fisheries: The Lake Superior fish community has undergone dramatic changes since the mid-1900s due to over-fishing, introduction of nonnative species, pollution and land use changes in the watershed. Before 1950, the community was a relatively simple one with lake trout, siscowet, lake whitefish, brook trout, lake sturgeon and walleye as the top native predators. Rainbow trout was intentionally introduced in the late 1800's and quickly established self-reproducing populations throughout the lake. The major species of prey fish were lake herring, chubs and sculpins.

Since the 1950s, the Lake Superior fish community has become much more complex, and is now composed of both native and nonnative species. Introductions of nonnative species were both intentional and unintentional. Introduced game fish species include chinook salmon, coho salmon, pink salmon, Atlantic salmon, brown trout, and a variety of rainbow trout strains. The introduced nonnative rainbow smelt population increased dramatically in importance for commercial use and as a prey species by most game fish. Populations have since fallen in Lake Superior and are less important today commercially or as a forage species. The most devastating introduction to the Lake Superior community has been the sea lamprey, which virtually eliminated the lake trout in all but a few isolated areas of Lake Superior. More recently there has been a flurry of unwanted introductions from Europe that include ruffe, zebra mussel, and the spiny water flea. Since the 1960s, rehabilitation efforts, including sea lamprey control, harvest regulations and stocking programs, along with stricter pollution standards and best management practices for land use have led to partial restoration of healthy fish stocks.

Wildlife: The ecology of this area, while heavily forested, has been vastly altered due to logging and forest fires during presettlement. Present logging will keep a great deal of the forest in a early successional phase and there is a concern for animal species that require large blocks of older forests. Habitat loss or alteration and changes in biological communities are important factors threatening the survival of threatened and endangered species. A significant portion of the Lake Superior Watershed is habitat for the following federally listed threatened species: gray wolf, bald eagle, and the endangered peregrine falcon. Other large mammals species include white-tailed deer, black bear and moose. The main furbearers are bobcat, coyote, red fox, fisher, pine marten, beaver, otter, mink, muskrat, and raccoon. Small mammals of the forest include porcupine, snowshoe hare, striped skunk, red squirrel, chipmunk and several kinds of mice, shrews and bats. Common birds of this forest include: ruffed grouse, spruce grouse, woodcock, common raven, American crow, several species of hawks and owls and many species of songbirds, common loon, red-winged blackbird, mallard, blue-winged teal, and wood duck. Reptiles and amphibians found in the coastal area include many frogs and salamanders that breed in the wetlands. The blue spotted salamander, red-backed salamander, spring peeper, green frog, leopard frog, chorus frog, wood frog, common garter snake, snapping turtle, red bellied snake and painted turtle may be found in the coastal watershed.

No discussion of the environmental quality of Lake Superior would be complete without considering the impact of zebra mussels and other exotic species.

j. Aquatic Nuisance Species

Zebra mussels are small, fingernail-sized mollusks native to the Caspian Sea region of Asia. They were discovered in Lake St. Clair near Detroit in 1988. Tolerant of a wide range of environmental conditions, zebra mussels have now spread to parts of all the Great Lakes and the Mississippi River and are also showing up in inland lakes. Zebra mussels clog water intake systems of power plants and water treatment facilities, and the cooling systems of boat engines. They have severely reduced, and may eliminate native mussel species. Zebra mussels are believed to have entered the lower Great Lakes basin in 1986 through the discharge of ship ballast water.

The **Ruffe**, a native of the perch family, is also an invader species. The Ruffe is a small but aggressive fish species native to Eurasia. It was also introduced into Lake Superior in the mid-1980s in the ballast water of an ocean-going vessel. Because the Ruffe grows very fast, has a high reproductive capacity, and adapts to a wide variety of environments, it is considered a serious threat to commercial and sport fishing. It also has the potential to seriously disrupt the delicate predator/prey balance vital to sustaining a healthy fishery.

The **Spiny Tailed Bythotrephes** is an invertebrate that will also pose a threat to the ecosystem of the Great Lakes. A native of Great Britain and northern Europe east to the Caspian Sea, the animal was first found in Lake Huron in 1984, likely from ballast water of an ocean-going vessel. The water flea is a predator on other macro invertebrates and can produce up to 10 offspring every two weeks. It competes directly with young perch and other small fish for food.

The **Sea Lamprey** is an aggressive parasite equipped with a tooth-filled mouth that flares at the end of its eel-like body. The lamprey is an ocean fish that has adapted to the Great Lakes and spawns in fresh water streams. It poses a threat mostly to lake trout and salmon by attaching itself to their bodies.

Purple Loosestrife is a wetland plant from Europe and Asia. It was introduced on the east coast of North America in the 1800s. First spreading along roads, canals and drainage ditches, then later, it was distributed as an ornamental. This plant is in 40 states and all of the Canadian border provinces. The plant can form dense, impenetrable stands that are unsuitable as cover, food, or nesting sites for a wide range of native wetland animals including ducks, geese, rails, bitterns, muskrats, frogs, toads and turtles. One plant can disperse 2 million seeds annually.

k. Land Use

Major industrial and manufacturing uses of the coastal area occur primarily in the Duluth-Superior metropolitan area, Wrenshall, Two Harbors, Silver Bay, Taconite Harbor, and along the St. Louis River in Cloquet. Other minor industrial activities occur in scattered locations throughout the coastal area and include sawmills and logging operations, salvage yards, gravel pits, and equipment storage areas.

Commercial development in the coastal area is confined mainly to the Highway 61 corridor. Most commercial development that is located in the rural area is highway-orientated, service/commercial uses that cater to the traveling public and resort industry. More conventional types of commercial activity are found in the major urban communities, particularly Duluth and to a lesser degree, Cloquet, Two Harbors, Silver Bay, and Grand Marais. Such uses consist of department stores, food outlets, offices, etc.

The majority of the North Shore residents reside within the corporate boundaries of existing communities, however, there is scattered residential development in a narrow band immediately adjacent to the shore and Highway 61. The development outside municipal boundaries has required numerous points of access to Highway 61 be constructed, thus decreasing the carrying capacity and safety of the roadway. In addition, this residential development is almost impossible to serve with public sewer and water because of its linear development and the rocky nature of the substratum in the area.

Land use in Carlton County consists mainly of agricultural and forestry activities. Table 5 shows agriculture data from all counties in the Lake Superior watershed.

l. Minerals

The mineral resources of the coastal counties include iron ore, copper, nickel, other base metals, platinum group elements, clay, peat, sand, and gravel. The most important mineral is iron ore which provided the original basis for the area's growth and has been a mainstay of the economy since the late nineteenth century. As a result of a variety of economic reasons, the mining industry has switched to the concentration of lower grade taconite ore. Estimates of the untapped deposits of the ore resources accessible by open pit mining run as high as 27 billion tons, excluding potential for underground mining.

The major potential for an expanded mineral extractive industry exists in the Duluth Gabbro Complex, which lies north of Duluth. The U.S. Bureau of Mines considers the Duluth Gabbro Complex, which contains copper and nickel, and platinum group elements, as the largest known nickel sulfide resource in the country (Minnesota DNR 1997).

m. Submerged Lands

The State of Minnesota owns all submerged lands in the Minnesota portion of Lake Superior including the Minnesota portion of the Duluth-Superior Harbor below the ordinary low water mark. The state owns beds of navigable water beyond the low water mark in trust for people for public uses.

2. Socioeconomic Characteristics

a. Demographics

One reason that the water quality in the Lake Superior basin, and in the coastal area, is good overall is that the area is not densely populated. Population is clustered in three areas.

- , The lower St. Louis River area, which is the Area of Concern described by the St. Louis River System Remedial Action Plan, includes the cities of Cloquet and Duluth, as well as a number of smaller communities in St. Louis and Carlton Counties.
- , The Iron Range in St. Louis County is another population center, although some Range communities straddle the watershed divides between Lake Superior, the Rainy River and the Mississippi River.
- , Although the North Shore of Lake Superior has long stretches of undeveloped shoreline, there are a number of small communities and some cities near the shore. Most of the population of Lake and Cook Counties live along the North Shore.

b. Population

In the 1980s, St. Louis County went through a downturn in the taconite and shipping industries that led to a decrease in population and jobs (McMurry et al., 1993). Lake County experienced a similar downturn. More recently, however, the population in Carlton, Cook, and Lake Counties has increased, particularly in Cook County, which has the sixth highest growth rate in Minnesota (Skog and Lincoln, 1997). Table 3 shows the difference between the 1990 census figures and the 1996 population estimates. The increases are due to a solid economy and the job market, but tourism, lower crime rates and wilderness appeal are also part of the reason for the upswing.

Table 3. Change in Population in the Lake Superior Basin Counties, 1990-1996.

County	1990 Census	1996 Estimate	Percent change 1990-1996
Carlton	29,259	30,426	4.0%
Cook	3,868	4,688	24.2%
Lake	10,415	10,707	2.8%
St. Louis	198,213	196,414	-0.9%

c. Commerce and Industry

Job growth between 1988 and 1993 (illustrated in Table 4) shows an increase in the four major counties. Casinos in Carlton and Cook Counties have contributed to job growth in those counties and job growth in Lake County is linked to the partial recovery of the taconite industry. Another factor in job growth in Cook County is the popularity of the region with retirees and tourists.

During a peak tourist season, this county can expect an average of 15,000 visitors per day (Buchta 1995). Within the next 10 years, more than 3,400 jobs in the taconite industry are expected to open up as the work force approaches retirement (Bloomquist 1997). In addition, Iron Range cities are expanding their economic base to include a variety of other employers. In the last 20 years, employment in the Iron Range taconite mines has been reduced from 13,500 to 6,000, while overall employment has increased from 113,000 to 127,500 (Phillips 1997).

Table 4. Job Growth in Lake Superior Basin Counties, 1988-1993.

County	1988	1993	Percent change 1990-2020
Carlton	12,833	14,913	16.2%
Cook	2,281	3071	34.6%
Lake	4,095	5,303	29.5%
St. Louis	96,154	105,167	9.4%

Data from McMurry, 1996.

Mineral Extraction: The DNR Division of Minerals is responsible for managing more than 12 million acres of state-owned mineral rights, three million acres of peat lands, and surface rights for industrial and construction materials on three million acres of state land.

Minnesota's iron ore and taconite industry has had significant impact on the region and state. Iron ore and taconite pellets are currently shipped from ports in Duluth, Two Harbors (Agate Bay), Silver Bay (Beaver Bay), and Schroeder (Taconite Harbor). Total tonnage is approximately 8 million net tons. Although the iron ore and taconite industry is the major mineral industry in the watershed, there are other nonferrous metallic minerals with potential for development, including the base metals such as copper, nickel, platinum group elements, lead, zinc, gold, chromium, cobalt, and titanium. While no minable deposits have been developed, mining activity contributes millions of dollars each year to Minnesota's economy.

Current iron ore/taconite mining activities in the near coastal area include the unloading/loading facilities at ports in Duluth, Two Harbors, Silver Bay, and Schroeder. Northshore Mining operates a power plant at Silver Bay, and LTV Steel Mining Company owns and operates a 225-megawatt power plant at Schroeder producing power primarily for its own use in its Hoyt Lakes

mining/beneficiating facility. Taconite (crude ore) and/or pellets are shipped by rail from mining operations on the "Iron Range" and loaded on ships with destination points being the steel producing plants in the lower Great Lakes states of Ohio, Indiana, and Pennsylvania (Lydecker 1976).

Agriculture: Only a small portion of the land in the four major Lake Superior basin counties is occupied by farms. Table 5 illustrates the amount of land used in different farming practices. Carlton County, with 26.9 percent of its area occupied by agricultural lands, is obviously more agriculturally orientated than Cook, Lake, and St. Louis, where the percent of agricultural land ranges from 0.2 to 4.9 percent. St. Louis County, however, has more total agricultural land area, due to the large size of the county. Table 6 summarizes some additional data from the agricultural census.

Despite its smaller size, Carlton County is similar in the number of farms and size of farms to St. Louis County (Lake County Soil and Water 1997).

Table 5. Agricultural Land Areas in Lake Superior Basin Counties, 1992.

Coverage (acres)	Carlton	Cook	Lake	St. Louis	Total
Total Area	552,800	903,800	1,313,700	3,919,900	6,690,200
Total Cropland	61,392	715	1,530	80,397	144,034
Pastureland	14,453	181	432	16,523	31,589
Total Agricultural Land	148,976	1,591	6,573	193,526	350,666
% Agricultural Land	26.9%	0.2%	0.5%	4.9%	5.2%

Table 6. Summary of Agricultural Data From the Lake Superior Basin, 1992.

Item	Carlton	Cook	Lake	St. Louis
Number of Farms	509	7	35	677
Average Size	223	178	150	226
Market Value of Agricultural Goods Sold	\$9.4M	\$44,000	\$114,000	\$13.3M

d. Recreation and Tourism

The coastal area of Duluth and the North Shore are key to Minnesota's tourism and recreation industry and contribute \$110 million in revenue and provide more than 11,200 jobs to the area (Kreag and Moe 1995). The combination of significant areas of diverse, undeveloped wilderness, much of which is publicly accessible, and moderate climate, is attractive to residents and visitors alike. Opportunities and facilities, both public and private, abound and provide for a multitude of styles to enjoy the area's resources. Many of the state's programs that provide for the development, use and conservation of natural and cultural resources of the coastal area are described in Part V, Chapter 4. Coastal resources are, however, protected, interpreted, accessed, and developed through a number of programs managed by federal, state and local agencies, private individuals and organizations. Following, are natural and cultural resources of statewide or nationwide significance in the coastal area.

State Parks and State Wayside Parks: Preserving natural and cultural resources for present and future generations, yet providing access and recreational opportunities; nine state parks and six state wayside parks are located within the coastal area. They include:

State Parks

- C Cascade River
- C George Crosby Manitou
- C Gooseberry Falls
- C Grand Portage
- C Jay Cooke
- C Judge C. R. Magney
- C Split Rock Lighthouse
- C Temperance River
- C Tettegouche

State Wayside Parks

- C Caribou Falls
- C Cross River
- C Devil Track
- C Flood Bay
- C Kadunce
- C Ray Berglund

National Forests - Superior National Forest

The Superior National Forest was designated in 1909 by proclamation (848) by Theodore Roosevelt. Spanning 150 miles of the United States/Canadian border from Grand Portage to Rainy Lake, the Superior National Forest contains some of the most beautiful land in the Great Lakes region. Dotted with hundreds of lakes surrounded by majestic forest, the area is a magnet for campers, canoeists, hunters, backpackers, and anglers. To preserve the pristine nature of some of the forest's most attractive areas, the Superior Roadless Primitive Area was established in 1938. It was essentially this area within Superior National Forest that was to become the Boundary Waters Canoe Area (BWCA). The Wilderness Act of 1964 designated the BWCA as a unit of the National Wilderness Preservation System and recognized the unique history and character and provided for special management considerations. The BWCA Wilderness Act of 1978 added the "W" and created the BWCAW. The BWCAW is not within the boundary of Minnesota's Lake Superior Coastal Program, therefore, the program will not affect the current BWCAW management, except in the case of federal activities that may have indirect impacts on the coastal area (See Chapter 6, Federal Coordination and the National Interest).

The Forest Service is committed to multiple use management approach balancing forest resources and recreational use of the forest. The Superior National Forest also provides about 2.4 million recreation visitor days on its lands outside the wilderness. The Superior National Forest also plays a major role in maintaining wildlife habitat, hosting about 155 breeding species of birds with many more migrants, 52 species of mammals and 18 species of Herpetofauna. The Superior National Forest annually produces wood for Minnesota's forest-based industries on more than 1.2 million acres available for timber harvesting.

Regional Trail Systems: There are many opportunities for trail use along the North Shore of Lake Superior. Even so, there is growing competition from the multiple users and efforts are coordinated in order to create additional linkages with existing trail systems and provide other uses through the establishment of new systems. Regional trail systems are described in more detail in Part V, Chapter 4.

Lake Superior Water Trail: The trail will be created along the Lake Superior shoreline from the St. Louis River in Duluth to the border with Canada and primarily developed for sea kayakers, using existing public lands for designated rest areas. The trail, when completed, will be part of the Lake Superior Water Trail encircling all of Lake Superior.

North Shore State Trail (NSST): The NSST is used primarily by snowmobilers and hikers, but also by backpackers, horseback riders, hunters, dog sledgers, skiers and mountain bikers. The trail extends from Duluth to Grand Marais along the North Shore of Lake Superior, a distance of approximately 235 miles.

Superior Hiking Trail: The Superior Hiking Trail, now a national recreation trail, will extend from Duluth to the Canadian border, a trail distance of nearly 300 miles, when complete. The trail is narrow and rugged, and is designed for hiking only.

Willard Munger State Trail/Carlton-West Duluth Segment: This 14.5 mile segment of the Willard Munger State Trail runs along a ridge from the town of Carlton, along the border of Jay Cooke State Park, through a forest of aspen, birch, maple and pine, to the west end of Duluth. Near Carlton, it passes over an old railroad bridge across the cascades of the St. Louis River. From its height, the trail provides great views of miles of rolling forest and the Duluth Harbor, with its distinctive aerial lift bridge. Although the trail is relatively level, there is a light (one percent) grade uphill for nine miles from the Duluth end.

Other Hiking Trails:

- | | |
|------------------------|--|
| C Border Route Trail | C Lake Superior Vista Trail |
| C Eagle Mountain Trail | C Oberg and Leveaux Mountains National Recreation Trails |
| C Grand Portage Trail | |
| C Mount Rose | |

Other Ski Trails:

- | | |
|---------------------------------------|---------------------------------|
| C Deer Yard Lake | C Northwoods Ski Touring Trails |
| C North Shore Mountain Ski Trails | C Korkki Nordic Ski Trails |
| C North Shore Mountains Ski Beartrack | C Two Harbors Ski Trail |

PART III

- C Lookout Mountain X/C Ski Trail
- C City of Duluth

- C Pincushion Mountain

Other Snowmobile Trails:

- C Moose Run
- C Lutsen
- C Tofte
- C Finland (Sawtooth)
- C City of Duluth

- C Silver Bay (Red Dot)
- C Tomahawk
- C Two Harbors
- C Hermantown

Biking Trails:

- C North Shore Touring Trail

Historical Sites and Structures: Minnesota's Lake Superior area is steeped in history, reflecting times past when the Chippewa tribe inhabited the North Shore, when the first white man saw the Lake Superior region, when voyagers capitalized on the European craze for fashionable fur hats, and finally when settlers arrived to make the area their permanent home. History continued to enrich the North Shore area with the emergence of commercial fishing, timber, mining, and a thriving shipping industry on Lake Superior. This history is revealed by the abundance of historic and archaeological sites within the coastal area.

National Register of Historic Places

Currently, there are 66 sites within the coastal area which are on the National Register of Historic Places. They are:

- | | |
|--|--|
| C Aerial Lift Bridge | C Duluth South Breakwater Inner Lighthouse |
| C Amboy and George Spencer Shipwrecks | C Duluth State Normal School Historic District |
| C Bally Blacksmith Shop | C Duluth Union Depot |
| C Bridge No. L-6007 | C Dwan, John, Office Building |
| C Carlton County Courthouse | C Endion School |
| C Chester Terrace | C Fire House No. 1 |
| C Church of St. Francis Xavier (Catholic) | C Fitger's Brewing Company |
| C Cloquet City Hall | C Gooseberry Falls State Park CCC Structures/Rustic Style Historic Resources |
| C Cloquet-Northern Office Building | C Grand Portage of the St. Louis River |
| C Congdon, Chester and Clara, Estate (Glensheen) | C Grand National Portage Monument |
| C Cook County Courthouse | C Hartley Building |
| C DeWitt-Seitz Building | C Hesper Shipwreck |
| C District No. 4 School | C Irving School |
| C Duluth Central High School | C Jay Cooke State Park CCC/WPA/Rustic Style Historic District |
| C Duluth Civic Center Historic District | C Jay Cooke State Park CCC/WPA/Rustic Style Picnic Grounds |
| C Duluth and Iron Range Depot | |
| C Duluth Missabe and Iron Range Depot (Endion) | |
| C Duluth Public Library | |

- | | |
|--|---|
| C Jay Cooke State Park CCC/WPA Rustic Style Service Yard | C St. Mark's African Methodist Episcopal Church |
| C Kitchi Gammi Club | C Samuel P. Ely Shipwreck |
| C Lake County Courthouse and Sheriff's Residence | C Schroeder Lumber Company Bunkhouse |
| C Lindholm Oil Company Service Station | C Scott, Jim, Fishhouse |
| C Madeira Shipwreck | C Shaw Memorial Library |
| C Mattson, Edward and Lisa, House and Fish House | C Split Rock Lighthouse |
| C Minnesota Point Lighthouse | C Tettegouche Camp |
| C Moe, Bergetta, Bakery | C Thomas Wilson Shipwreck |
| C Munger Terrace | C Traphagen, Oliver G., House |
| C Naniboujou Lodge | C Tugboat Edna G. |
| C Niagara Shipwreck | C Two Harbors Carnegie Library |
| C Northeastern Hotel | C Two Harbors Light Station |
| C North Superior Lifeboat Station | C U.S. Army Corps of Engineers Duluth Vessel Yard |
| C Lightkeeper's House | C U.S. Fisheries Station-Duluth |
| C Onoko Shipwreck | C U.S.S. Essex Shipwreck |
| C Park Place Historic District | C William A. Irvin (Freighter) |
| C Sacred Heart Cathedral and Cathedral School | C Wirth Building |

State Historic Sites Registry

There are six sites within the coastal area which are on the State Historic Sites Registry. They are:

- | | |
|-----------------------------------|------------------------------|
| C Duluth Ship Canal | C Minnesota Point Lighthouse |
| C Duluth Union Depot | C Split Rock Light Station |
| C Grand Portage National Monument | C Witch Tree |

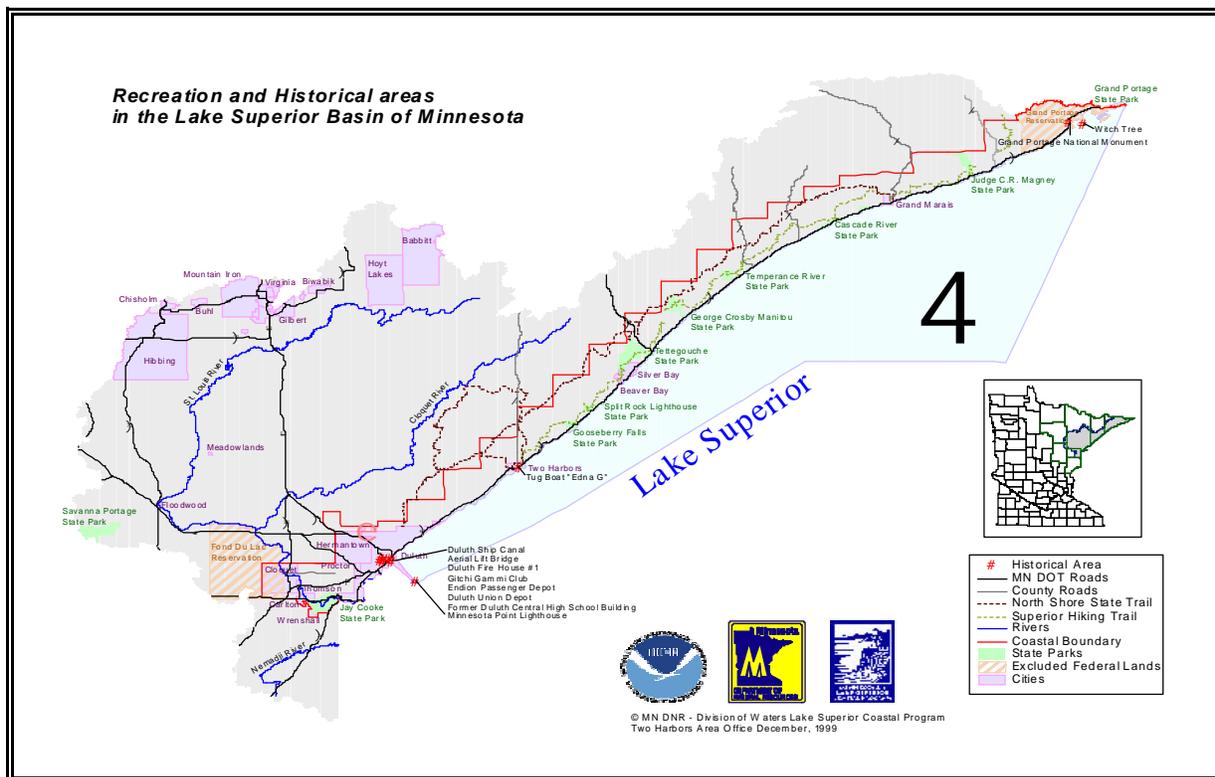
Minnesota Inventory of Prehistoric and Historic Places

Twenty-four historic resources located on the Minnesota Inventory of Prehistoric and Historic Places include:

- | | |
|----------------------------------|---------------------------------|
| C Brewer House | C Jefferson School |
| C Cotton House | C Mallet Locomotive |
| C Crosby House | C Meyers House |
| C Cutter House | C Morgan Park Historic District |
| C Duluth Board of Trade Building | C Olcutt House |
| C First Presbyterian Church | C Ordean House |
| C Fish Lake Dam | C Parkerville Ghost Town |
| C Fond du Lac Historic District | C Patrick House |
| C Glen Avon Station | C Sellwood Hall |
| C Holy Rosary Church & Cemetery | C Thomsonsite Beach |
| C House, F. E., Residence | C Three Spot Locomotive & Cars |
| C Hunter House | C William Crooks Locomotive |

Grand Portage National Monument: Grand Portage National Monument is located in the heart of the Grand Portage Reservation and was authorized by legislation enacted by Congress in 1958. The 710 acre site was established for the purpose of “preserving an area containing unique historical value”. The dominant American history theme, for which Grand Portage Monument is significant, is associated with the fur trade in the Old Northwest, 1731-1822. The monument includes the stockade site on Grand Portage Bay, the 8.5 mile Grand Portage, and the site of Fort Charlotte on the Pigeon River.

Figure 4. Partial Listing of the Recreation and Historic Sites Within the Coastal Area.



Hunting and Fishing: Hunting and fishing in Minnesota has been a source of life and livelihood on the Minnesota coast throughout recorded history. The first commercial fishing operations, conducted by the American Fur Company, ceased in 1840 (NOAA 1976). The commercial catch on Lake Superior is mostly lake herring, roughly 85 percent, and smelt about 15 percent, they bring an estimated \$230,000 annually to the North Shore economy (Geving 1997). Minnesota Sea Grant estimates that the Lake Superior sport fishery is worth about \$9.4 million annually (Sea Grant). Hunters, both resident and nonresident totaled 458,000, and contributed \$290 million to the Minnesota economy in 1990 (Minnesota DNR 1991).

B. COASTAL RESOURCE AND DEVELOPMENT ISSUES

In January 1994, Minnesota Sea Grant sponsored a forum entitled "Lake Superior's Future".

The vision suggested at the workshop as the goal for Lake Superior's future was "To maintain or restore the beauty and health of the environment, the health of the economy, and the stability of communities in the Lake Superior Region".

Participants were asked at the beginning of the workshop to complete a survey on the goals and strategies for the Minnesota Lake Superior region. Issues that participants provided input on are listed in Table 7. Education to increase appreciation of the area, improve sewage and septic systems, streamlining of management and regulatory programs, and improve water quality were goals for which there was greatest agreement. The results also indicated that citizen participation, education and land use planning were the best strategies for achieving their shared vision for the Lake Superior region.

Table 7. Goals for the North Shore - 1994 Survey Results (Sea Grant unpublished 1997).

Specific Goals	Agree	Disagree	No opinion/response
Use education to increase appreciation of the area	94.0%	.7%	5.3%
Work on sewage and septic system problems	91.4%	1.3%	7.3%
Do a better job of streamlining existing management and regulatory programs	90.7%	.7%	8.6%
Improve current water quality	87.4%	2%	10.6%
Seek increased funding to control erosion	74.2%	6.6%	19.2%
Maintain current water quality	67.5%	21.2%	11.3%
Promote additional tourism and recreation opportunities	57.6%	23.2%	19.2%
Develop stronger regulations	57%	25.2%	17.9%
Seek economic growth	56.3%	24.5%	19.2%
Limit growth and development	54.3%	26.5%	19.2%
Increase shoreline access	49%	34.4%	16.6%
Limit tourism and recreation opportunities	29.1%	45.7%	25.2%
Keep the management measures we have now	25.2%	47.0%	27.8%

Recent efforts to revise county comprehensive land use plans have included surveys of and public meetings with residents and seasonal land owners regarding their issues and concerns and their vision for the future. Cook County conducted a survey of residents and land owners in late 1995. Lake County conducted public visioning meetings during the spring of 1996.

Significant in the results of the Cook County survey was that physical characteristics, most notably Lake Superior, define the positive quality of the county. Degradation of natural features and the loss of quiet were seen as negative forces. With respect to economic conditions, increasing property taxes, lack of affordable housing and rising property values were of greatest concern. The large amount of public land was generally seen as positively contributing to the character of the county and to its economic base, though this issue was also seen as a potential constraint to economic development. Survey responses confirmed continued support for the concept of nodal development along the shore with the majority supporting a slow population growth rate (Cook County Comprehensive Land Use Plan 1997).

Another survey conducted in 1996 by The Nature Conservancy, also asked residents to rank issues that were important to them. The issues listed were broad in nature and included economic, social, and resource related issues. The top two issues within Lake Superior's North Shore, were "protecting Minnesota's environment" (18 percent) and "the quality and cost of public elementary and high school education" (17 percent). Of the environmental issues, "water quality" ranked of greatest importance, with "clean air" ranking second (The Nature Conservancy unpublished 1996).

An interest in addressing water quality issues has resulted in a variety of plans including: initiation of a Lake Superior basin plan by the Minnesota Pollution Control Agency, county water plans, watershed and sub-watershed plans. Water plans developed by each of the four Lake Superior counties (Cook County Water Plan, Lake County Water Plan, St. Louis County Water Plan, and Carlton County Water Plan) have identified a number of common issues including:

- C Protecting water quality
- C Protection of ground water recharge areas
- C Improper use and disposal of pesticides, fertilizers and hazardous waste
- C Air pollution
- C Failing septic systems and inadequate municipal waste water treatment
- C Conserving soil from erosion
- C Fish contamination

Additional issues were identified in a survey conducted in 1997 for the Minnesota Pollution Control Agency (MPCA 1997). Respondents rated the following nine issues on a scale between 1 and 5, with 5 being very serious and 1, not serious.

Dumping garbage/hazardous wastes	4.49
Mercury Contamination	4.13
Sewage overflows	4.11
Air pollution	3.38

Florescent disposal	3.63
Water contamination	3.59
Failing septics	3.54
Odors	3.47
Development	3.28

Issues such as those listed by surveys and water plans go beyond political boundaries. They are related to the geology, climate, and economics of the area. Identifying and addressing the issues requires a regional approach to be most effective. As developed, Minnesota's Lake Superior Coastal Program, at the lead of the Coastal Council, will work with agencies, government bodies, and local citizenry to evaluate the major issues and prioritize needs approximately every three to five years. Funds through this program will be directed at addressing these needs.

REFERENCES

- Anderson, H.A., J. F. Amrhein, P. Shubat and J. Hesse. Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory. Great Lakes Sport Fishery Advisory Task Force, 1993.
- Beeton, Alfred M. Great Lakes Environmental Research Laboratory Yearly Report FY93. 1994.
- Beeton, Alfred M. Great Lakes Environmental Research Laboratory Yearly Report FY94. 1995.
- Beeton, Alfred M. Great Lakes Environmental Research Laboratory Yearly Report FY95. 1996.
- Bloomquist, L. Rich Vein of Mining Jobs Near Duluth. Duluth News-Tribune. February 9, 1997.
- Buchta. Spotlight on Cook County. Minneapolis Star Tribune. July 1, 1995.
- Carlton County. Carlton County Water Management Plan. Carlton County, 1990.
- Cook County. Cook County Water Management Plan. Cook County, 1995.
- Geving, Steve. Commerical Fishing Summary, Minnesota Waters of Lake Superior. Minnesota Department of Natural Resources, 1997.
- Hunst, Michael, and Howse, George. Minnesota Agriculture Statistics. 1997.
- International Joint Commission. Great Lakes Diversions and Consumptives Uses. 1985.
- International Joint Commission. Pollution in the Great Lakes Basin From Land Use Activities. 1980.
- Klaers, Powers and Associates. Port of Duluth Superior Economic Impact for the 1994 Shipping Season. Seaway Port Authority, 1994.
- Kreag, Glenn and Jennifer Moe. Trends in Tourism Visitation, Duluth Minnesota 1980-1994. 1995.
- Lake County. Lake County Comprehensive Water Management Plan. Lake County, 1992.
- Lydecker, Ryck. The Edge of the Arrowhead. Minnesota Marine Advisory Service, 1976.
- McMurry, M. Population Notes. Minnesota Planning, 1996
- McMurry, M. Population Notes (June 1996 Volume). OSD 96-79. Minnesota Planning, St. Paul, Minnesota pp. 108.

- Minnesota Department of Agriculture. County Data. 1992.
- Minnesota Department of Health. Minnesota Fish Consumption Advisory. 1996.
- Minnesota Department of Natural Resources. Exotic Species Field Guide. 1997.
- Minnesota Department of Natural Resources. Wetland Types and Definitions in Minnesota. 1992.
- Minnesota Department of Natural Resources. Hunting and Fishing Expenditures. 1991.
- Minnesota Department of Transportation. Ports and Waterways Environmental Impacts of a Model Shift. 1997.
- Minnesota State Planning Agency. North Shore Data Atlas, Minnesota Coastal Zone.
- National Oceanic and Atmospheric Administration. Minnesota Coastal Zone Management Program, Public Hearing, Draft. 1978.
- North Shore Management Board. North Shore Management Plan. 1988.
- Minnesota Pollution Control Agency. Remedial Action Plan. Lake Superior Basin Information Document. 1997.
- Minnesota Pollution Control Agency. Lake Superior Basin Information Document. 1997.
- Phillips, M. M. Renewal on the Range. Duluth News-Tribune. January 26, 1997.
- St. Louis County. St. Louis County Comprehensive Water Management Plan. St. Louis County, 1991.
- Seaway Port Authority. North America's Interior Seaport. Seaway Port Authority, 1994.
- Skog, J and C. Lincoln. Most of Region's Counties Grow. Duluth News Tribune, March 23, 1997.
- Superior Hiking Trail Association. Guide to the Superior Hiking Trail. Ridgeline Press, 1993.
- U.S. Department of Agriculture. Ecoregions and Subregions of the United States. 1994.
- U.S. Army Corps of Engineers. Duluth Superior Harbor, Minnesota and Wisconsin. 1996.
- Van Dusen, Larry. Worlds Largest Inland Port. 1977.
- Western Lake Superior Sanitary District. Clean Water. 1995.