Mona Lake Watershed

Resource Atlas

This Atlas was made possible by a grant from the Charles Stewart Mott Foundation
and local support from the Community Foundation for Muskegon County

Charles Stewart Mott Foundation

community foundation℠ Muskegon County

Atlas Developed by:

Grand Valley State ANNIS WATER RESOURCES INSTITUTE Lake Michigan Center

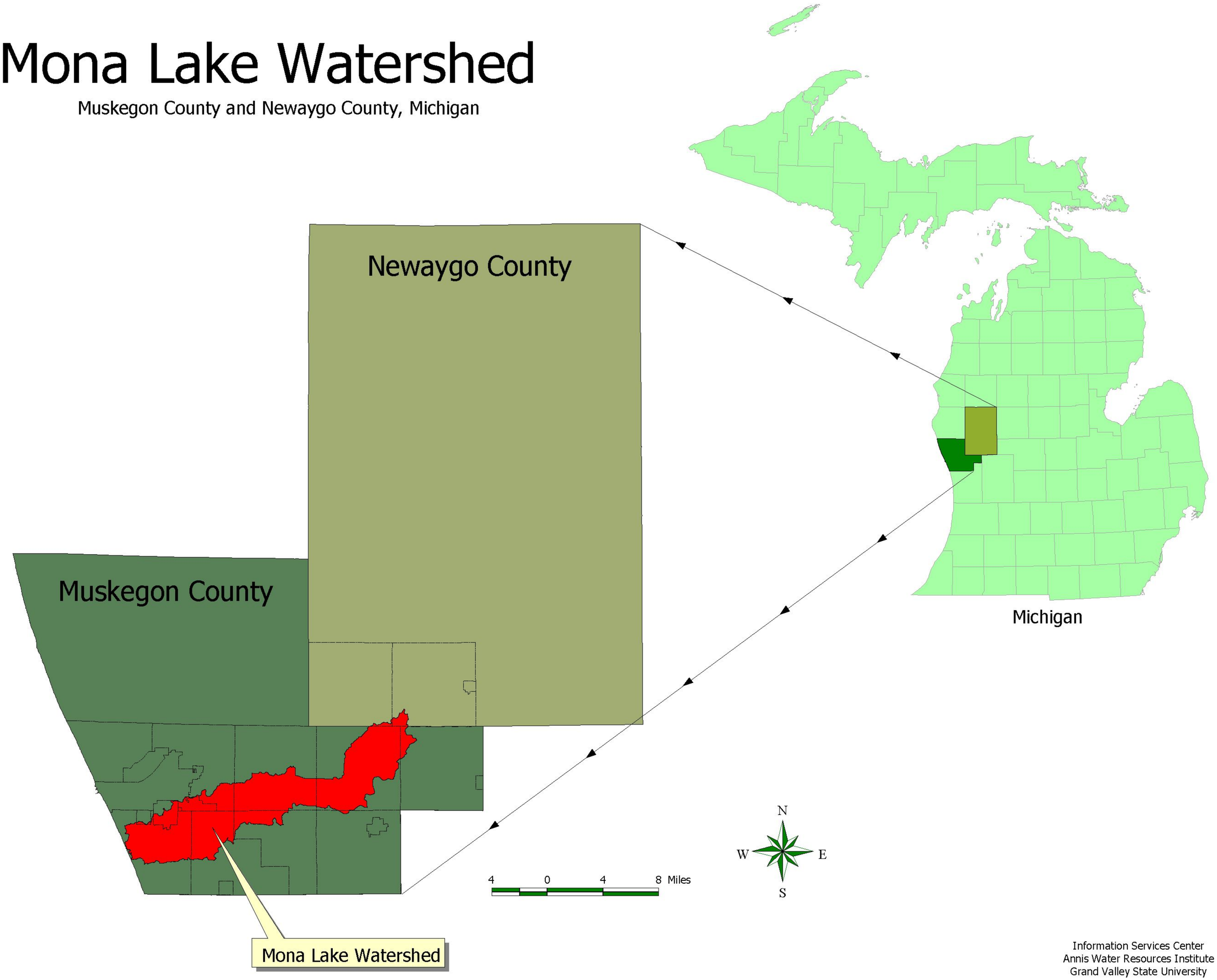
Information Services Center
January 2003
MR-2003-1

TABLE OF CONTENTS Page Number

COVER PHOTO BY: Marge Beaver www.photography-plus.com

Mona Lake Watershed

Muskegon County and Newaygo County, Michigan



Information Services Center
Annis Water Resources Institute
Grand Valley State University

Map Prepared: February 2003

Transportation System

Mona Lake Watershed

Transportation Type

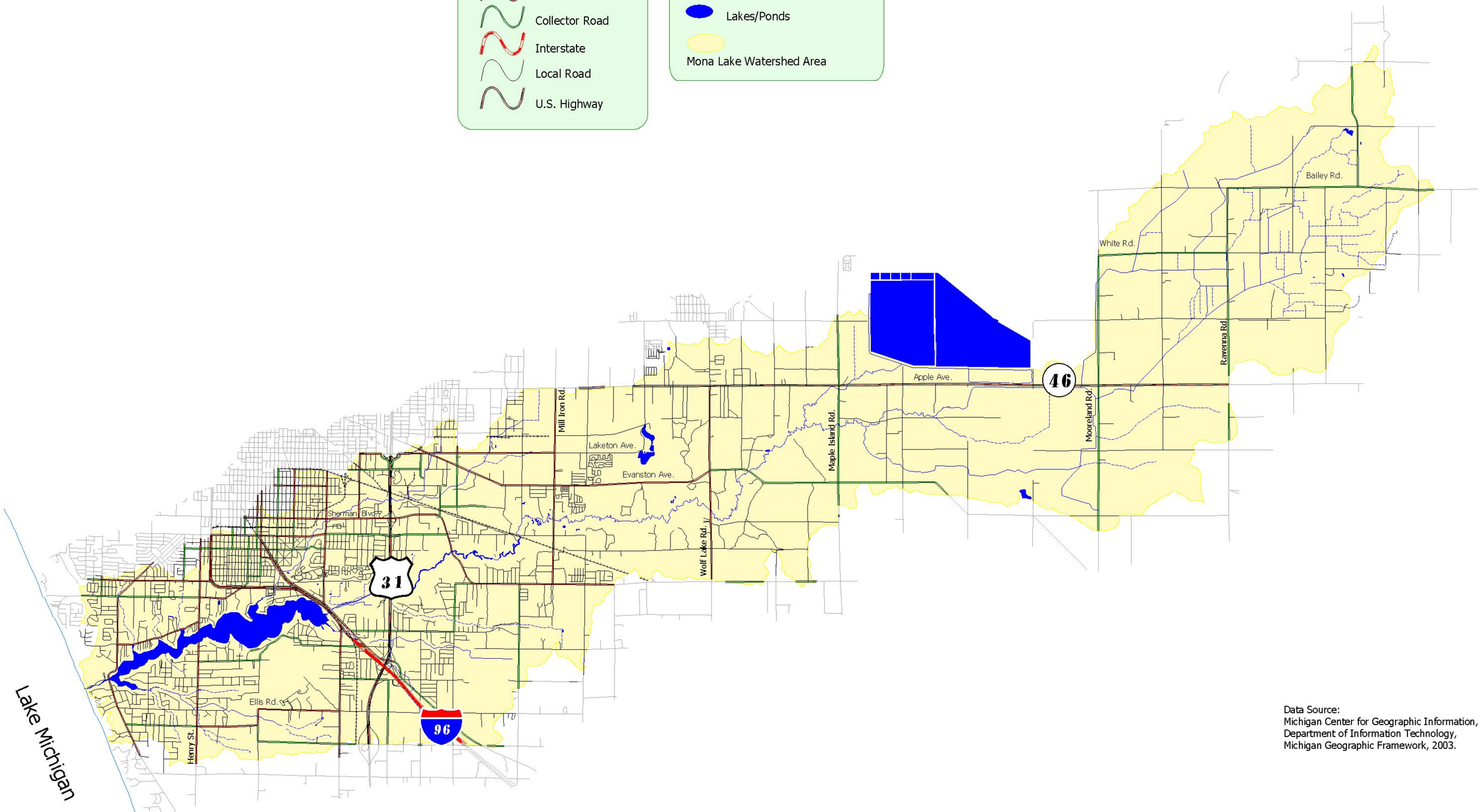
- Railroad

Roads

- Aerterial Road
- Collector Road
- Interstate
- Local Road
- U.S. Highway

Base Information

- Creek/Stream
- Intermittent Stream/Drain
- Great Lakes Shoreline
- Lakes/Ponds
- Mona Lake Watershed Area



N
W E
S

1:70000

2 0 2 4 Miles

Data Source:
Michigan Center for Geographic Information,
Department of Information Technology,
Michigan Geographic Framework, 2003.

Information Services Center
Annis Water Resources Institute
Grand Valley State University

Map Prepared: February 2003

Political Boundaries

Mona Lake Watershed

Political Limits

- Political Boundary
- Cities
- Villages

Base Information

- Creek/Stream
- Intermittent Stream/Drain
- Great Lakes Shoreline
- Lakes/Ponds
- Roads
- Mona Lake Watershed Area

Bridgeton Township

Ashland Township

NEWAYGO COUNTY

Muskegon Township

Egelston Township

Moorland Township

Casnovia Township

Muskegon

Muskegon Heights

Roosevelt Park

Lake Michigan

Sullivan Township

Ravenna Township

Fruitport Township

Norton Shores

Data Source:
Michigan Center for Geographic Information,
Department of Information Technology,
Michigan Geographic Framework, 2003.

N

W E

S

1:100000

2 0 2 4 Miles

Information Services Center
Annis Water Resources Institute
Grand Valley State University

Map Prepared: February 2003

Hydrography

Mona Lake Watershed

Statistics

45,570 acres in the watershed

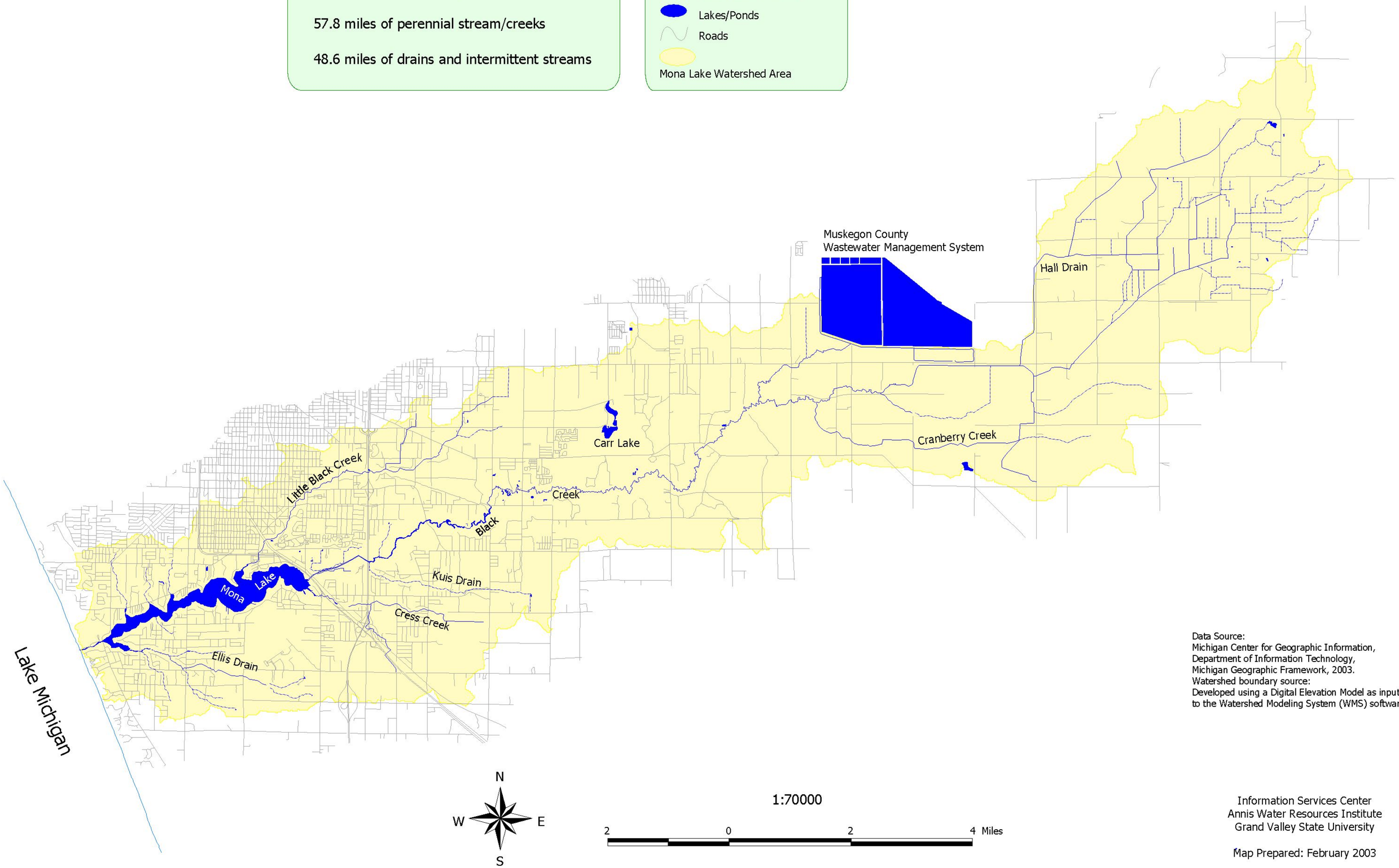
2425 acres of lake and pond surface area

57.8 miles of perennial stream/creeks

48.6 miles of drains and intermittent streams

Base Information

- Creek/Stream
- Intermittent Stream/Drain
- Great Lakes Shoreline
- Lakes/Ponds
- Roads
- Mona Lake Watershed Area



Data Source:
Michigan Center for Geographic Information,
Department of Information Technology,
Michigan Geographic Framework, 2003.
Watershed boundary source:
Developed using a Digital Elevation Model as input
to the Watershed Modeling System (WMS) software.

Information Services Center
Annis Water Resources Institute
Grand Valley State University

Map Prepared: February 2003

Subbasins

Mona Lake Watershed

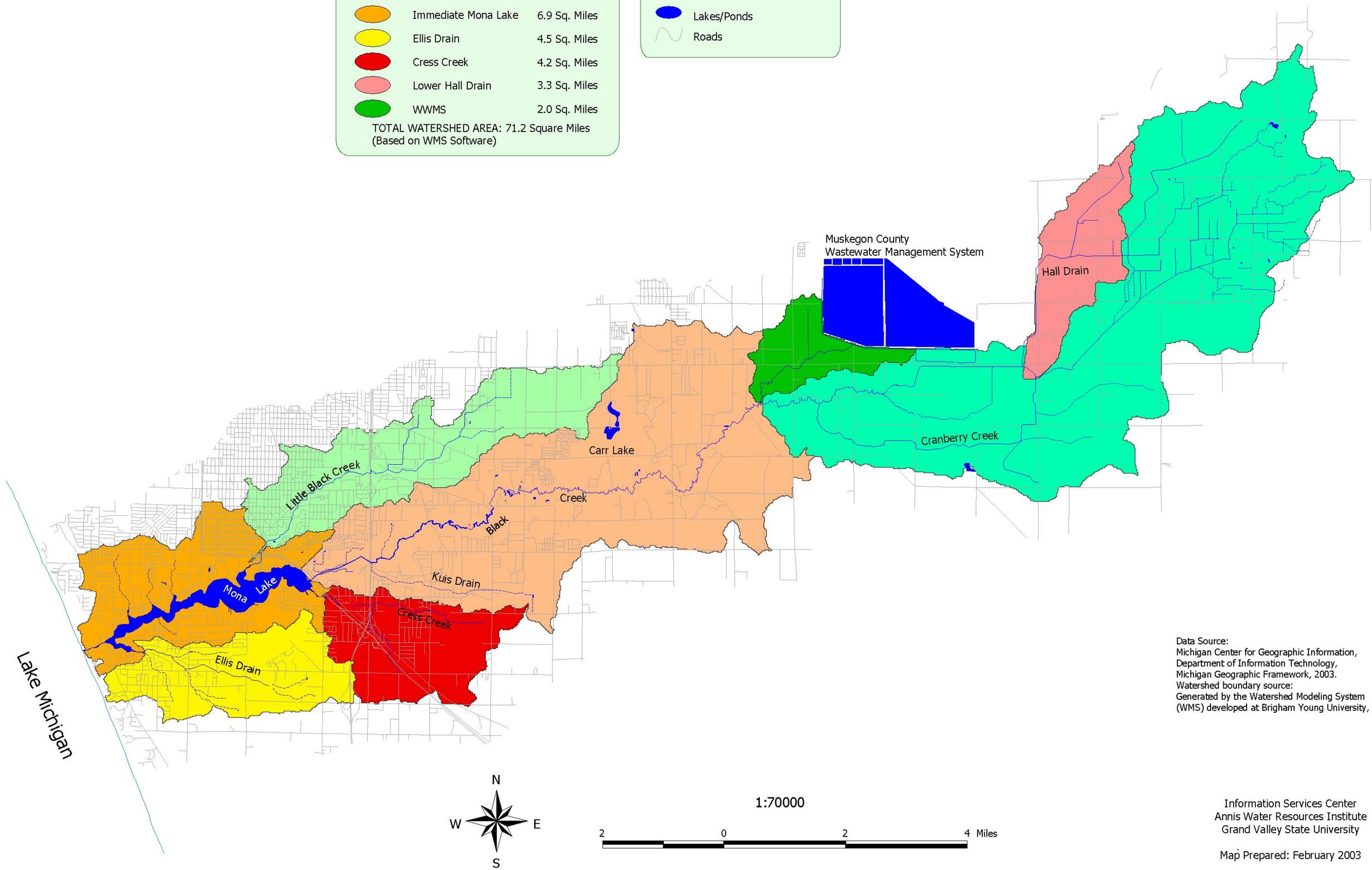
Mona Lake Watershed - Subbasins

Upper Black Creek	24.1 Sq. Miles
Lower Black Creek	19.3 Sq. Miles
Little Black Creek	6.9 Sq. Miles
Immediate Mona Lake	6.9 Sq. Miles
Ellis Drain	4.5 Sq. Miles
Cress Creek	4.2 Sq. Miles
Lower Hall Drain	3.3 Sq. Miles
WWMS	2.0 Sq. Miles

TOTAL WATERSHED AREA: 71.2 Square Miles
(Based on WMS Software)

Base Information

- Creek/Stream
- Intermittent Stream/Drain
- Great Lakes Shoreline
- Lakes/Ponds
- Roads



1:70000

2 0 2 4 Miles

Data Source:
Michigan Center for Geographic Information,
Department of Information Technology,
Michigan Geographic Framework, 2003.
Watershed boundary source:
Generated by the Watershed Modeling System
(WMS) developed at Brigham Young University, 2003.

Information Services Center
Annis Water Resources Institute
Grand Valley State University

Map Prepared: February 2003

Aerial Photo Mosaic

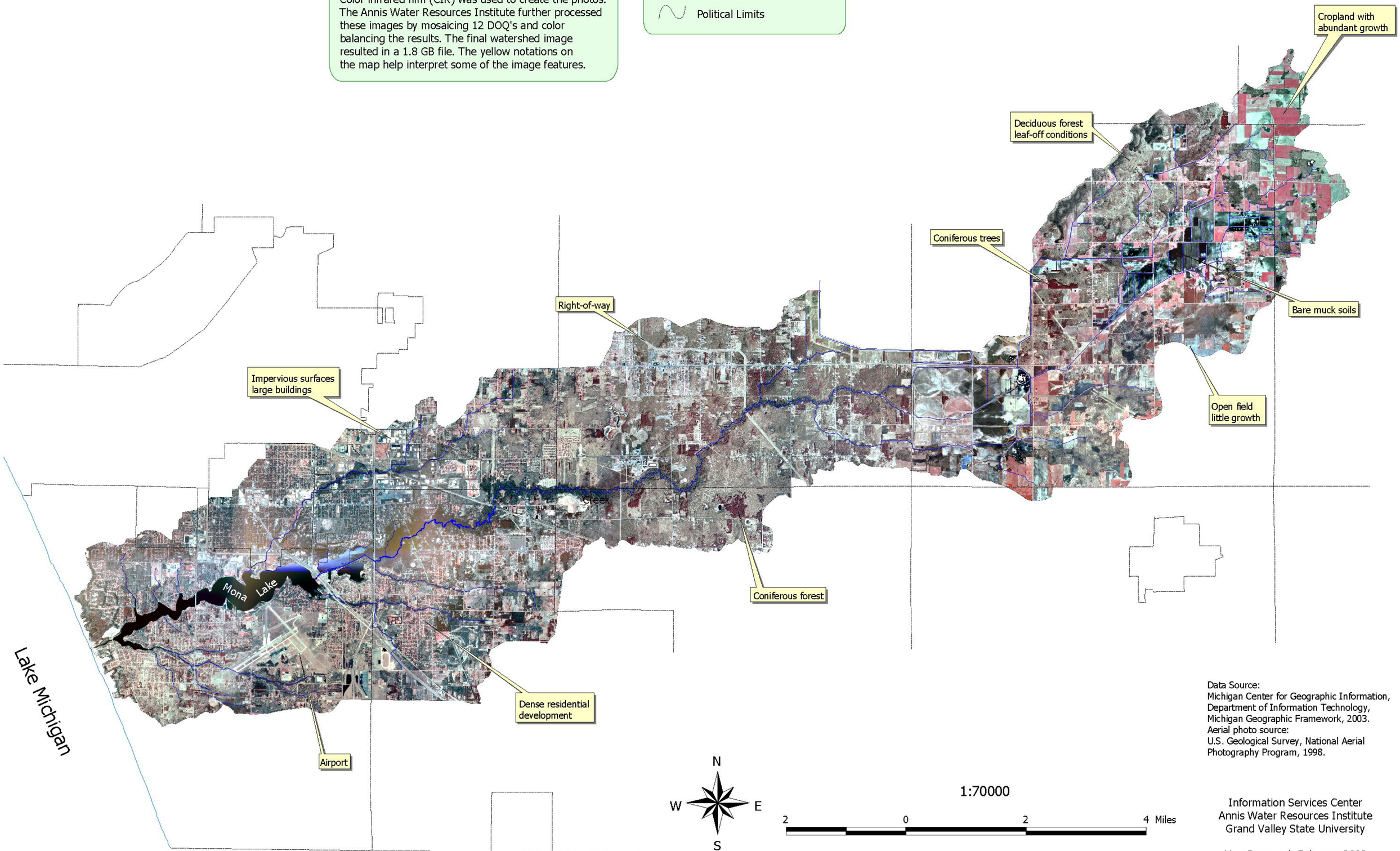
Mona Lake Watershed

ABOUT THE IMAGERY:

This image is made up of a series of aerial photos taken by the U.S. Geological Survey (USGS) in April, 1998. The USGS orthorectified (removed distortion due to collection geometry and topography) these images into Digital Orthophoto Quadrangles (DOQ). Color infrared film (CIR) was used to create the photos. The Annis Water Resources Institute further processed these images by mosaicing 12 DOQ's and color balancing the results. The final watershed image resulted in a 1.8 GB file. The yellow notations on the map help interpret some of the image features.

Base Information

- Creek/Stream
- Intermittent Stream/Drain
- Great Lakes Shoreline
- Political Limits



1:70000

2 0 2 4 Miles

Data Source:
Michigan Center for Geographic Information, Department of Information Technology, Michigan Geographic Framework, 2003.
Aerial photo source:
U.S. Geological Survey, National Aerial Photography Program, 1998.

Information Services Center
Annis Water Resources Institute
Grand Valley State University

Map Prepared: February 2003

Total Property Tax Base

Mona Lake Watershed

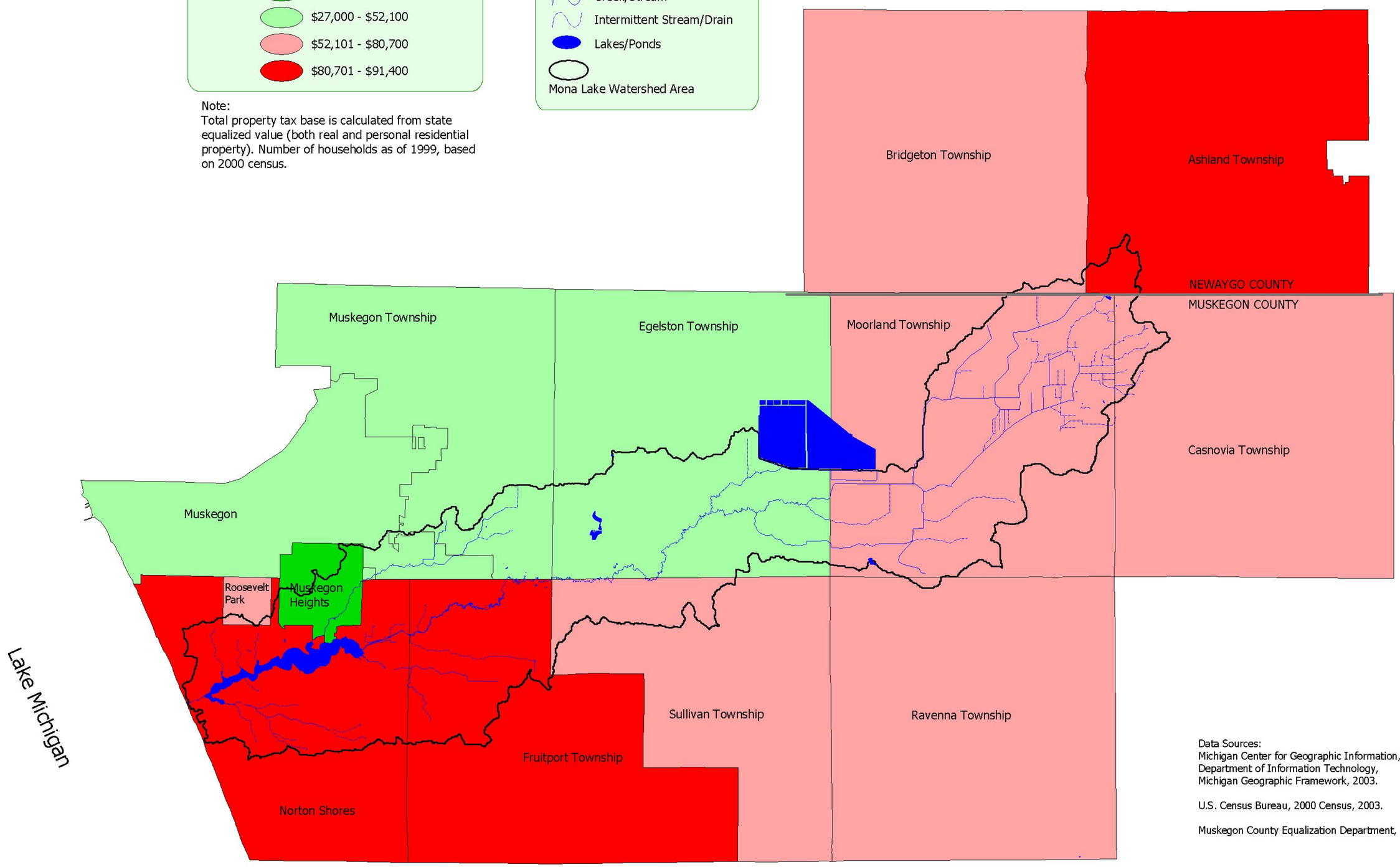
Per Household - by Municipality

- < $27,000
- $27,000 - $52,100
- $52,101 - $80,700
- $80,701 - $91,400

Note:
Total property tax base is calculated from state equalized value (both real and personal residential property). Number of households as of 1999, based on 2000 census.

Base Information

- Creek/Stream
- Intermittent Stream/Drain
- Lakes/Ponds
- Mona Lake Watershed Area



N
W E
S

1:100000

2 0 2 4 Miles

Data Sources:
Michigan Center for Geographic Information, Department of Information Technology, Michigan Geographic Framework, 2003.

U.S. Census Bureau, 2000 Census, 2003.

Muskegon County Equalization Department, 2003.

Information Services Center
Annis Water Resources Institute
Grand Valley State University

Map Prepared: October 2003

Digital Elevation Model

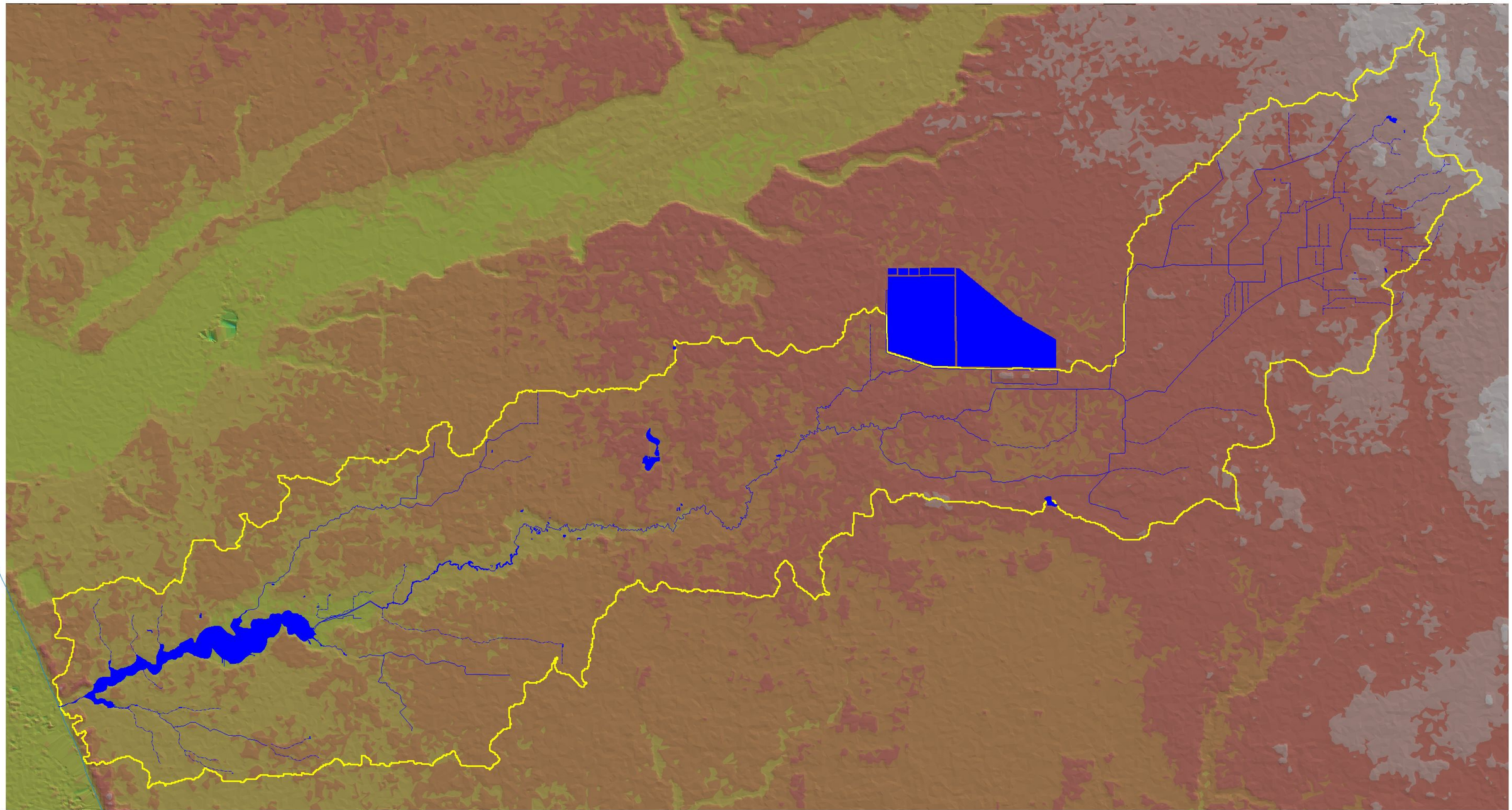
Mona Lake Watershed

Elevation Range - Meters

130 - 143	194 - 207
143 - 156	207 - 220
156 - 168	220 - 232
168 - 181	232 - 245
181 - 194	245 - 258

Base Information

- Creek/Stream
- Intermittent Stream/Drain
- Great Lakes Shoreline
- Lakes/Ponds
- Mona Lake Watershed Area



Lake Michigan

N
W E
S

1:70000

2 0 2 4 Miles

Data Source:
Michigan Center for Geographic Information, Department of Information Technology, Michigan Geographic Framework, 2003.
Elevation source:
Shuttle Radar Topography Mission (SRTM) aboard the Space Shuttle Endeavour, launched on Feb. 11, 2000. Obtained from the U.S. Geological Survey, EROS Data Center, 2003.

Information Services Center
Annis Water Resources Institute
Grand Valley State University

Map Prepared: February 2003

Land Use and Cover Classification System

RESIDENTIAL

Residential land uses range from high density, multiple-unit structures of urban cores, to low density, where houses are on lots of more than one acre on the periphery of urban expansion. Included in this category are multi-family units, single family units, duplex units, and mobile home parks.

COMMERCIAL/INSTITUTIONAL

Commercial land uses are those used predominantly for the sale of products and services. The main buildings, secondary structures, and areas supporting the basic use are all included -- office buildings, warehouses, driveways, sheds, parking lots, landscaped areas, and waste disposal areas. Education, religious, health, correctional, and military facilities are considered institutional. All buildings, grounds, and parking lots that compose the facility are included within the institutional unit.

INDUSTRIAL

Industrial areas include a wide array of uses from light manufacturing and industrial parks to heavy manufacturing plants.

OTHER DEVELOPED AREA

This land use includes areas used for transportation, communication, utilities infrastructure, extractive operations such as sand pits, and open land such as recreation facilities and cemeteries.

CROPLAND

Land used to produce crops such as small grains, hay, or row crops including vegetables.

ORCHARD OR OTHER SPECIALTY CROP

This land use includes orchards, vineyards, and bush fruits. Horticultural areas include nurseries, floricultural producers, and seed/sod producers.

CONFINED FEEDING AND PERMANENT PASTURE

Feeding operations are large, specialized livestock production facilities, chiefly beef cattle feedlots and large poultry farms. Hog and fur-bearing animal farms also are included. Permanent pasture is land that produces grasses and certain types of legumes, which are grazed by animals.

OTHER AGRICULTURAL LAND

Other agricultural land not included in the preceding three categories or combinations of agricultural land that cannot be clearly defined are included here. Land with greenhouses or land associated with agricultural production such as barns, out buildings, grain storage buildings, and the family farmhouse are in this category.

OPEN FIELD

Areas of open field support early stages of plant succession consisting of plant communities characterized by grasses or shrubs. In cases where there is obvious evidence of seeding, fertilizing, or other cultural practices, these areas are mapped as permanent pasture.

FOREST

Forest lands are lands that are at least ten percent stocked by deciduous and/or coniferous tree species.

WATER

This category includes all areas that are predominantly or persistently covered with water.

WETLAND

Wetlands are those areas where the water table is at, near, or above the land surface for a significant part of most years. The hydrologic regime is such that aquatic or hydrophytic vegetation is established.

BARREN/SAND DUNE

Barren land (non-vegetated) is land that has little or no vegetation. Types of land use/cover considered in this category include beaches, riverbanks, sand dunes, and bare exposed rock.

Land Use/Cover - 1978

Mona Lake Watershed

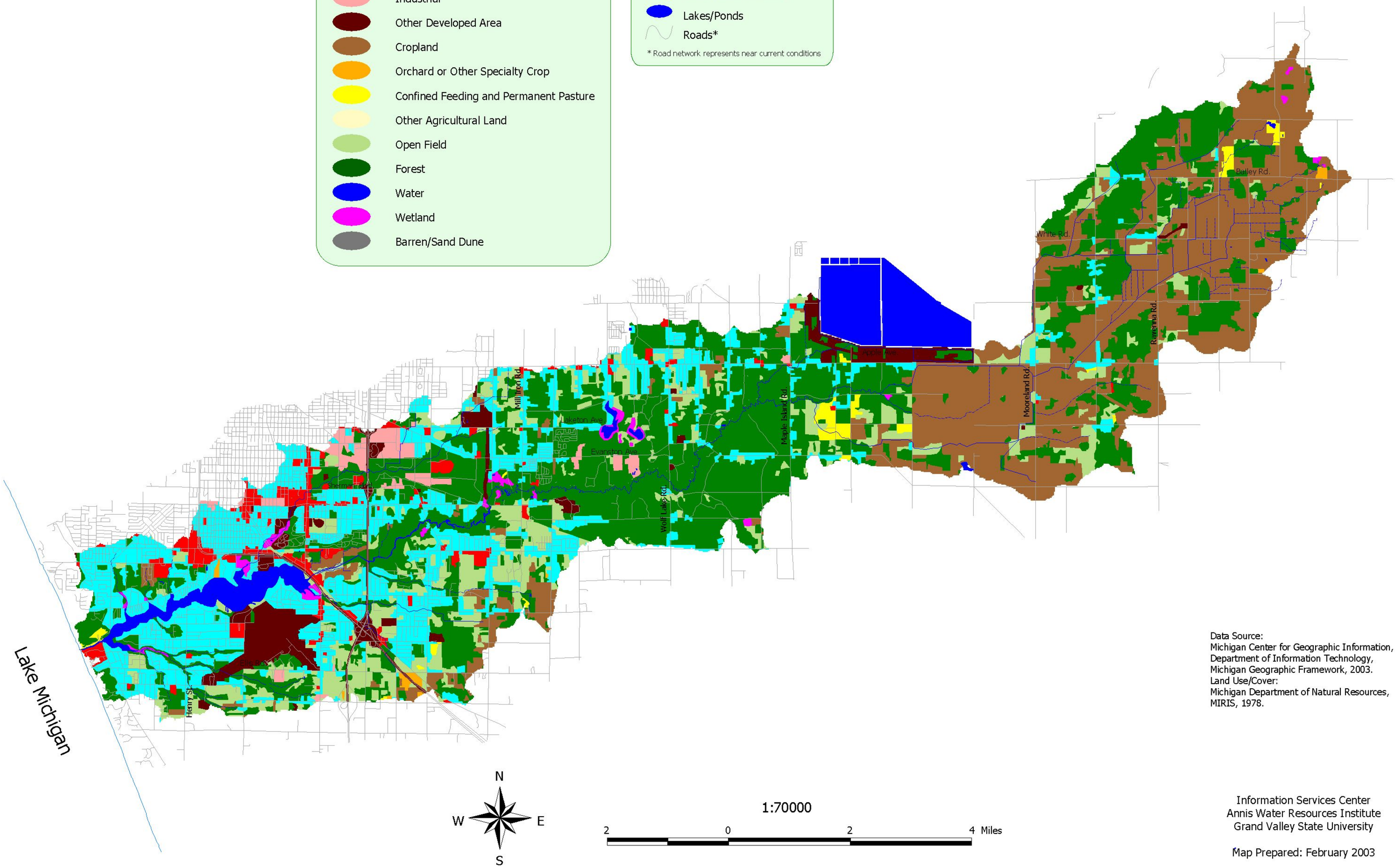
Land Use/Cover Types

- Residential
- Commercial/Institutional
- Industrial
- Other Developed Area
- Cropland
- Orchard or Other Specialty Crop
- Confined Feeding and Permanent Pasture
- Other Agricultural Land
- Open Field
- Forest
- Water
- Wetland
- Barren/Sand Dune

Base Information

- Creek/Stream
- Intermittent Stream/Drain
- Great Lakes Shoreline
- Lakes/Ponds
- Roads*

* Road network represents near current conditions



Data Source:
Michigan Center for Geographic Information, Department of Information Technology, Michigan Geographic Framework, 2003.
Land Use/Cover:
Michigan Department of Natural Resources, MIRIS, 1978.

Information Services Center
Annis Water Resources Institute
Grand Valley State University

Map Prepared: February 2003

Land Use/Cover - 1997

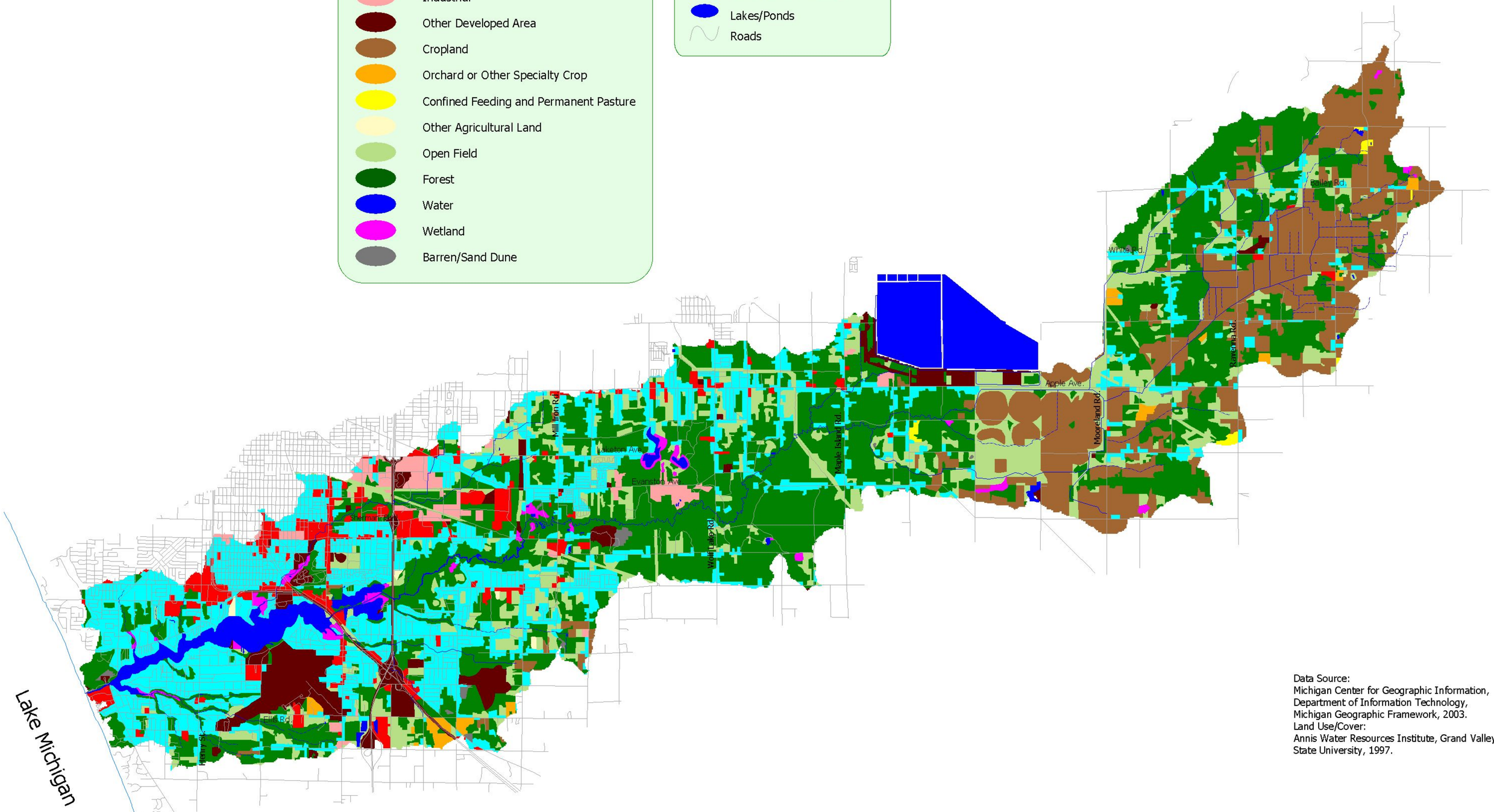
Mona Lake Watershed

Land Use/Cover Types

- Residential
- Commercial/Institutional
- Industrial
- Other Developed Area
- Cropland
- Orchard or Other Specialty Crop
- Confined Feeding and Permanent Pasture
- Other Agricultural Land
- Open Field
- Forest
- Water
- Wetland
- Barren/Sand Dune

Base Information

- Creek/Stream
- Intermittent Stream/Drain
- Great Lakes Shoreline
- Lakes/Ponds
- Roads



N
W E
S

1:70000

2 0 2 4 Miles

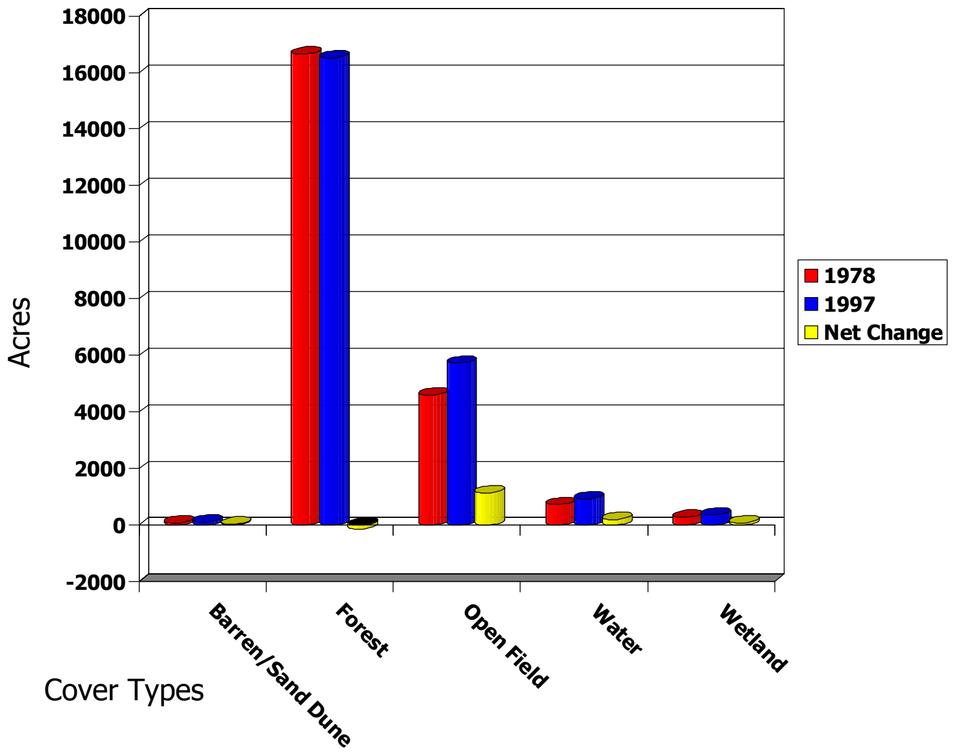
Data Source:
Michigan Center for Geographic Information, Department of Information Technology, Michigan Geographic Framework, 2003.
Land Use/Cover:
Annis Water Resources Institute, Grand Valley State University, 1997.

Information Services Center
Annis Water Resources Institute
Grand Valley State University

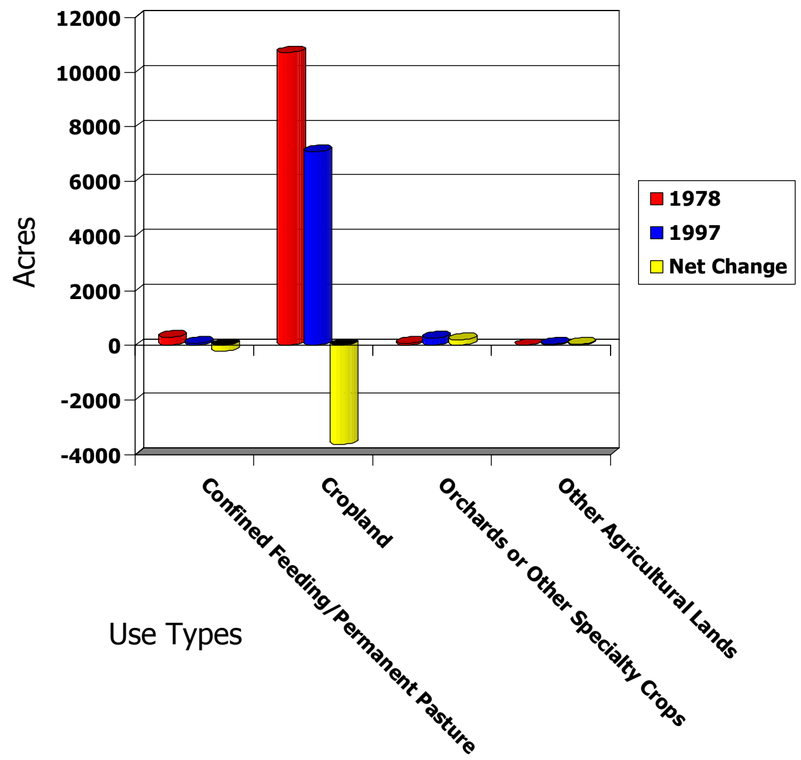
Map Prepared: February 2003

Land Use and Cover Change Analysis

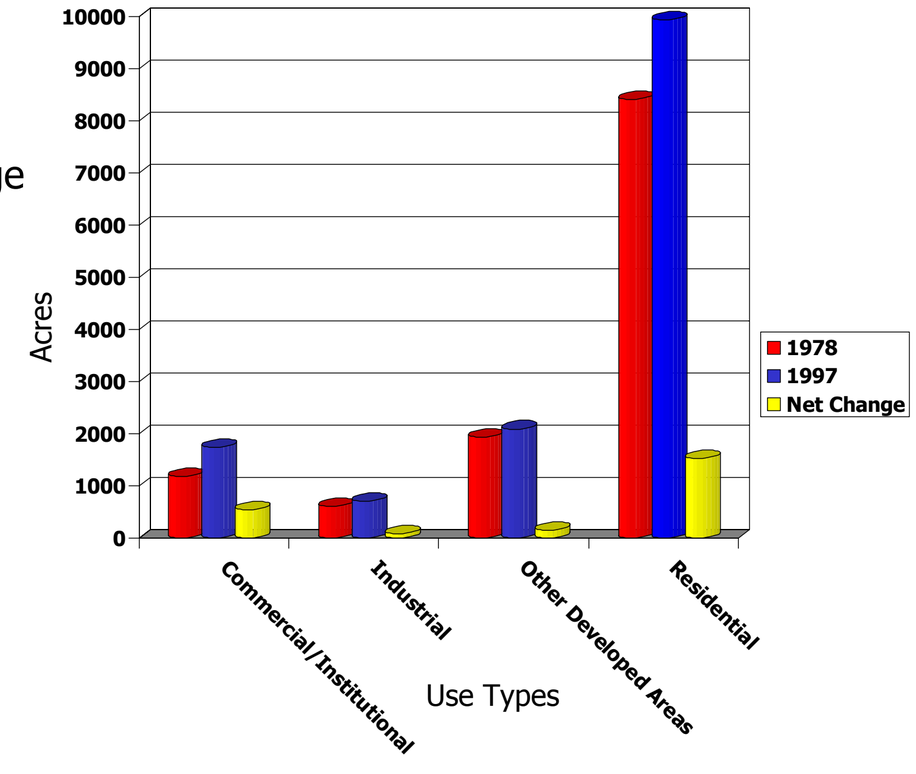
Natural Cover Change
1978 to 1997



Agricultural Use Change
1978 to 1997



Developed Use Change
1978 to 1997



Change Statistics

Natural Cover	Acres - 1978	% of Total - 1978	Acres - 1997	% of Total - 1997	Net Change (Acres)	Net Change (%)
Barren/Sand Dune	70	0.2	99	0.2	29	41
Forest	16655	36.5	16511	36.2	-144	-1
Open Field	4591	10.1	5726	12.6	1135	25
Water	725	1.6	917	2.0	192	26
Wetland	279	0.6	349	0.8	70	25
	22320	49.0	23602	51.8	1282	
Agricultural Use						
Confined Feeding or Permanent Pasture	305	0.7	82	0.2	-223	-73
Cropland	10711	23.5	7098	15.6	-3613	-34
Orchard or Other Specialty Crops	88	0.2	283	0.6	195	222
Other Agricultural Lands	0	0.0	40	0.1	40	100
	11104	24.4	7503	16.5	-3601	
Developed Use						
Commercial/Institutional	1184	2.6	1733	3.8	549	46
Industrial	614	1.3	706	1.5	92	15
Other Developed Areas	1935	4.2	2092	4.6	157	8
Residential	8413	18.5	9935	21.8	1522	18
	12146	26.6	14466	31.7	2320	
TOTAL WATERSHED ACRES	45570		45570			

Percent Impervious

Mona Lake Watershed

Percent Impervious - Subbasins

- 2 - 3.8
- 3.8 - 10.5
- 10.5 - 14.2
- 14.2 - 21.9
- 21.9 - 32.1

Base Information

- Creek/Stream
- Intermittent Stream/Drain
- Great Lakes Shoreline
- Lakes/Ponds
- Roads

Little Black Creek:
4439 Acres
1426 Impervious Acres
32.1 % Impervious Land Area

Lower Hall Drain:
2083 Acres
79 Impervious Acres
3.8 % Impervious Land Area

WWMS:
1289 Acres
136 Impervious Acres
10.5 % Impervious Land Area

Immediate Mona Lake:
4400 Acres
1331 Impervious Acres
30.3 % Impervious Land Area

Upper Black Creek:
15,399 Acres
314 Impervious Acres
2.0 % Impervious Land Area

Lower Black Creek:
12,361 Acres
1758 Impervious Acres
14.2 % Impervious Land Area

Cress Creek:
2720 Acres
596 Impervious Acres
21.9 % Impervious Land Area

Ellis Drain:
2878 Acres
583 Impervious Acres
20.3 % Impervious Land Area

Lake Michigan

Bailey Rd.
White Rd.
Ravenna Rd.
Apple Ave.
Maple Island Rd.
Mooreland Rd.
Mill Iron Rd.
Laketon Ave.
Evanston Ave.
Sherman Blvd.
Wolf Lake Rd.
Ellis Rd.
Henry St.

N
W
E
S

1:70000

2 0 2 4 Miles

Impervious surfaces are impermeable areas such as: buildings, sidewalks, driveways, parking lots, and roads.

NOTE:
Percent impervious data based on impervious coefficients for land use types taken from the USDA Natural Resource Conservation Service's report "Urban Hydrology for Small Watershed Basins, 1975." Aerial photo interpretation was used to estimate percent impervious values for areas not summarized by the USDA report.

Data Source:
Michigan Center for Geographic Information, Department of Information Technology, Michigan Geographic Framework, 2003.
Percent Impervious:
Information developed by GVSU, Annis Water Resources Institute, 2003.

Information Services Center
Annis Water Resources Institute
Grand Valley State University

Map Prepared: February 2003

Wetlands

National Wetlands Inventory

Mona Lake Watershed

Wetland Types

Aquatic Bed	3 Acres
Emergent	520 Acres
Scrub-Shrub	258 Acres
Forested	3227 Acres

Base Information

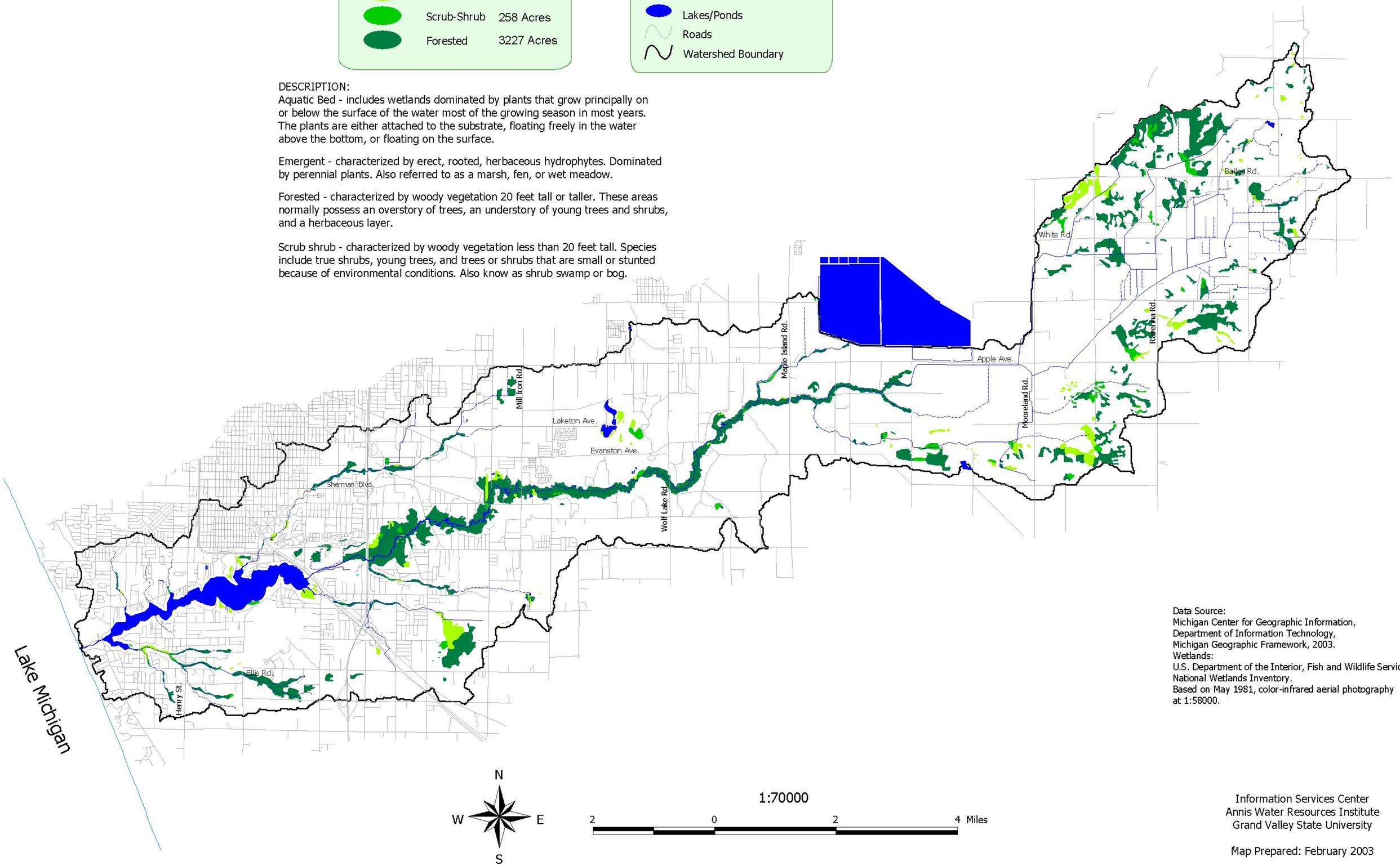
- Creek/Stream
- Intermittent Stream/Drain
- Great Lakes Shoreline
- Lakes/Ponds
- Roads
- Watershed Boundary

DESCRIPTION:
Aquatic Bed - includes wetlands dominated by plants that grow principally on or below the surface of the water most of the growing season in most years. The plants are either attached to the substrate, floating freely in the water above the bottom, or floating on the surface.

Emergent - characterized by erect, rooted, herbaceous hydrophytes. Dominated by perennial plants. Also referred to as a marsh, fen, or wet meadow.

Forested - characterized by woody vegetation 20 feet tall or taller. These areas normally possess an overstory of trees, an understory of young trees and shrubs, and a herbaceous layer.

Scrub shrub - characterized by woody vegetation less than 20 feet tall. Species include true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions. Also know as shrub swamp or bog.



Data Source:
Michigan Center for Geographic Information,
Department of Information Technology,
Michigan Geographic Framework, 2003.
Wetlands:
U.S. Department of the Interior, Fish and Wildlife Service,
National Wetlands Inventory.
Based on May 1981, color-infrared aerial photography at 1:58000.

Information Services Center
Annis Water Resources Institute
Grand Valley State University

Map Prepared: February 2003

Presettlement Landscape

Mona Lake Watershed

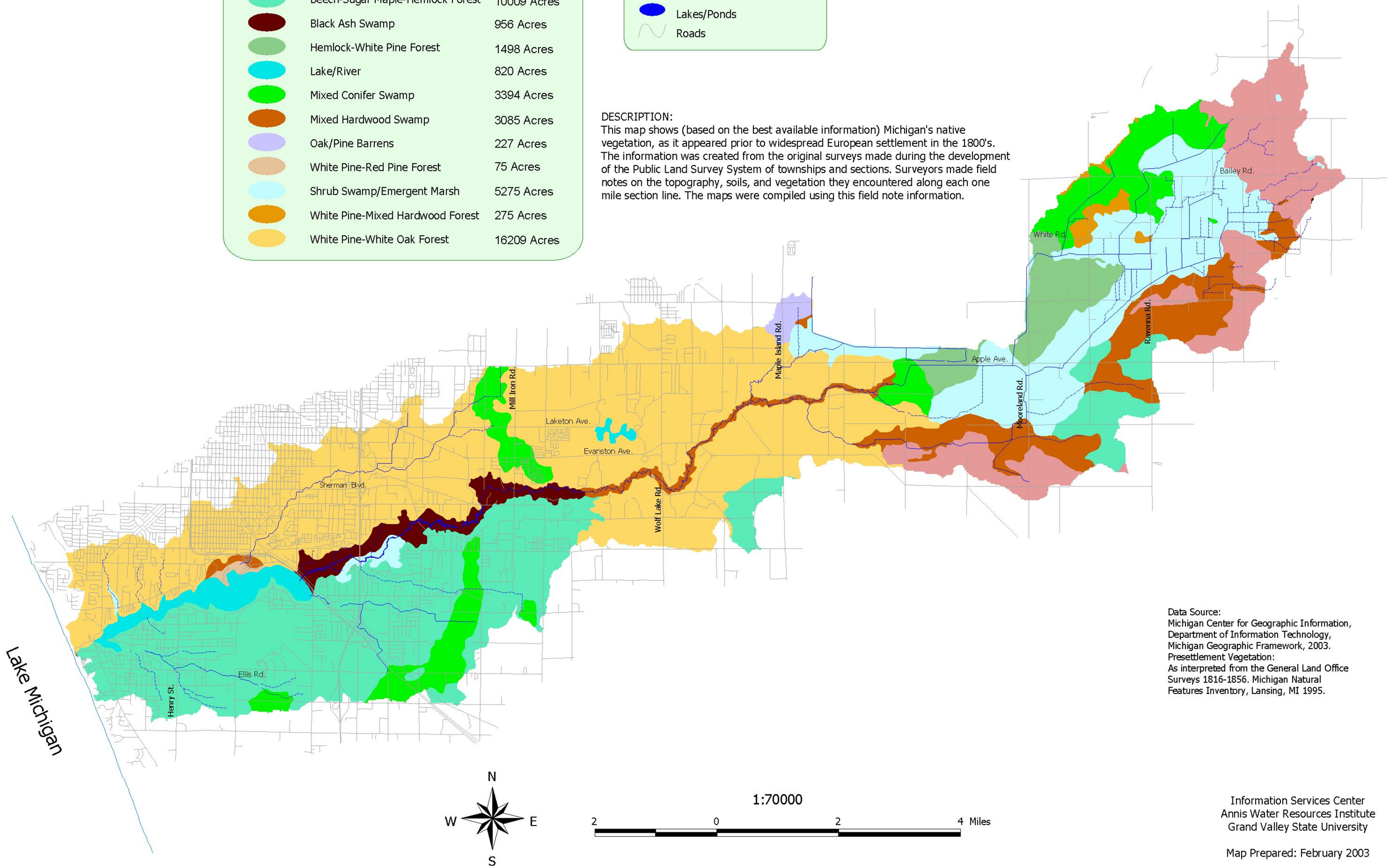
Vegetation Types

Beach, Riverbank	1 Acre
Beech-Sugar Maple Forest	3745 Acres
Beech-Sugar Maple-Hemlock Forest	10009 Acres
Black Ash Swamp	956 Acres
Hemlock-White Pine Forest	1498 Acres
Lake/River	820 Acres
Mixed Conifer Swamp	3394 Acres
Mixed Hardwood Swamp	3085 Acres
Oak/Pine Barrens	227 Acres
White Pine-Red Pine Forest	75 Acres
Shrub Swamp/Emergent Marsh	5275 Acres
White Pine-Mixed Hardwood Forest	275 Acres
White Pine-White Oak Forest	16209 Acres

Base Information

- Creek/Stream
- Intermittent Stream/Drain
- Great Lakes Shoreline
- Lakes/Ponds
- Roads

DESCRIPTION:
This map shows (based on the best available information) Michigan's native vegetation, as it appeared prior to widespread European settlement in the 1800's. The information was created from the original surveys made during the development of the Public Land Survey System of townships and sections. Surveyors made field notes on the topography, soils, and vegetation they encountered along each one mile section line. The maps were compiled using this field note information.



N
W E
S

1:70000

2 0 2 4 Miles

Data Source:
Michigan Center for Geographic Information, Department of Information Technology, Michigan Geographic Framework, 2003.
Presettlement Vegetation:
As interpreted from the General Land Office Surveys 1816-1856. Michigan Natural Features Inventory, Lansing, MI 1995.

Information Services Center
Annis Water Resources Institute
Grand Valley State University

Map Prepared: February 2003

Population Density

2000 Census

Mona Lake Watershed

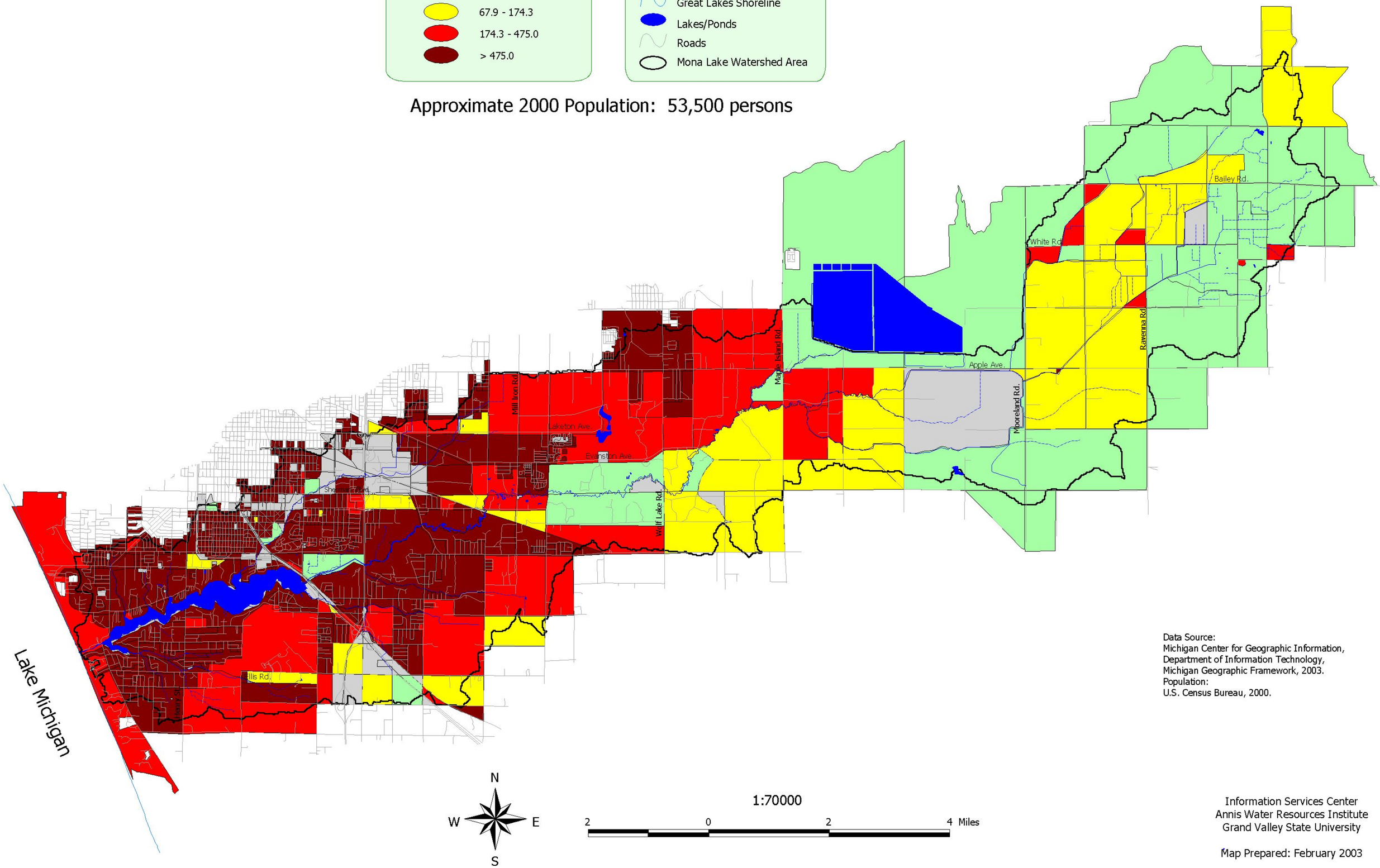
People per Square Mile
By Census Block - 2000

- 0
- 0.1 - 67.9
- 67.9 - 174.3
- 174.3 - 475.0
- > 475.0

Base Information

- Creek/Stream
- Intermittent Stream/Drain
- Great Lakes Shoreline
- Lakes/Ponds
- Roads
- Mona Lake Watershed Area

Approximate 2000 Population: 53,500 persons



Data Source:
Michigan Center for Geographic Information,
Department of Information Technology,
Michigan Geographic Framework, 2003.
Population:
U.S. Census Bureau, 2000.

Information Services Center
Annis Water Resources Institute
Grand Valley State University

Map Prepared: February 2003

Trout Streams and Lakes

Mona Lake Watershed

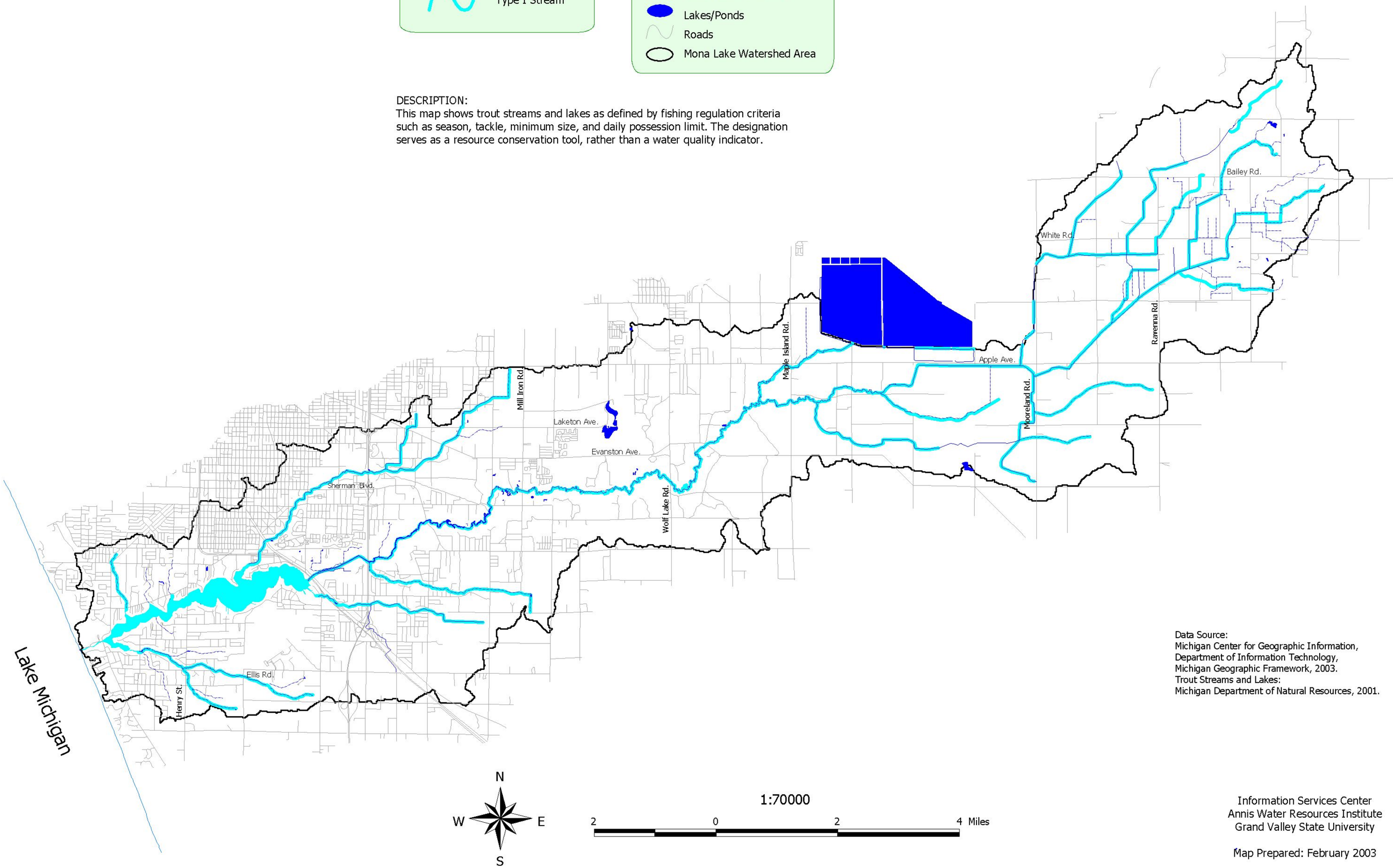
Designation

- Trout Lake
- Type I Stream

Base Information

- Creek/Stream
- Intermittent Stream/Drain
- Great Lakes Shoreline
- Lakes/Ponds
- Roads
- Mona Lake Watershed Area

DESCRIPTION:
This map shows trout streams and lakes as defined by fishing regulation criteria such as season, tackle, minimum size, and daily possession limit. The designation serves as a resource conservation tool, rather than a water quality indicator.



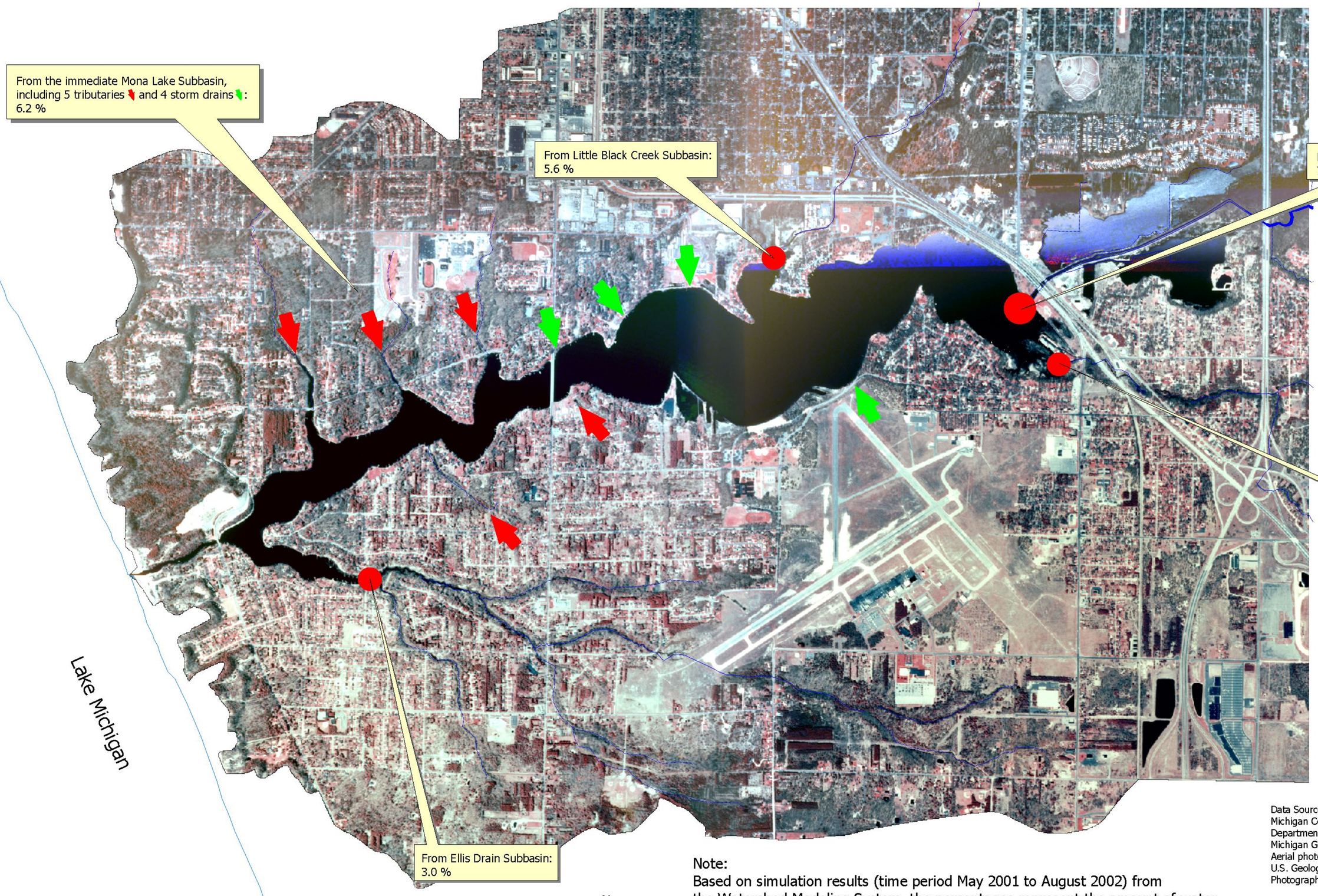
Data Source:
Michigan Center for Geographic Information,
Department of Information Technology,
Michigan Geographic Framework, 2003.
Trout Streams and Lakes:
Michigan Department of Natural Resources, 2001.

Information Services Center
Annis Water Resources Institute
Grand Valley State University

Map Prepared: February 2003

Water Sources of Mona Lake

Mona Lake Watershed



Note:
Based on simulation results (time period May 2001 to August 2002) from the Watershed Modeling System, the percentages represent the amount of water discharged into Mona Lake from the various subbasins.

N
W E
S

1:18500

0.5 0 0.5 1 Miles

Data Source:
Michigan Center for Geographic Information, Department of Information Technology, Michigan Geographic Framework, 2003.
Aerial photo source:
U.S. Geological Survey, National Aerial Photography Program, 1998.

Information Services Center
Annis Water Resources Institute
Grand Valley State University

Map Prepared: February 2003

Groundwater Stream Base Flow

Mona Lake Watershed

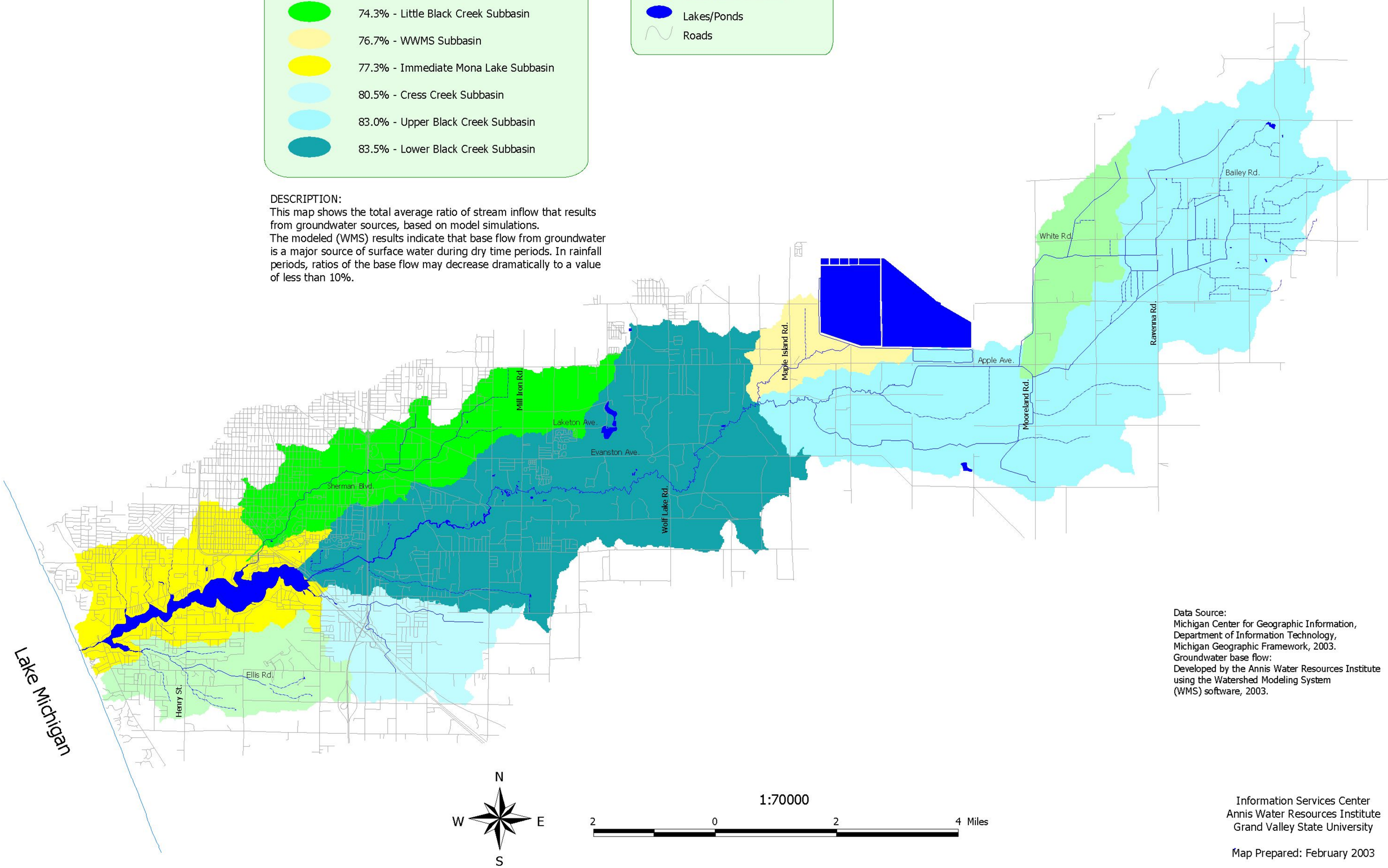
Percent of Base Flow From Groundwater

- 74.0% - Lower Hall Drain Subbasin
- 74.1% - Ellis Drain Subbasin
- 74.3% - Little Black Creek Subbasin
- 76.7% - WWMS Subbasin
- 77.3% - Immediate Mona Lake Subbasin
- 80.5% - Cress Creek Subbasin
- 83.0% - Upper Black Creek Subbasin
- 83.5% - Lower Black Creek Subbasin

Base Information

- Creek/Stream
- Intermittent Stream/Drain
- Great Lakes Shoreline
- Lakes/Ponds
- Roads

DESCRIPTION:
This map shows the total average ratio of stream inflow that results from groundwater sources, based on model simulations.
The modeled (WMS) results indicate that base flow from groundwater is a major source of surface water during dry time periods. In rainfall periods, ratios of the base flow may decrease dramatically to a value of less than 10%.



Data Source:
Michigan Center for Geographic Information, Department of Information Technology, Michigan Geographic Framework, 2003.
Groundwater base flow:
Developed by the Annis Water Resources Institute using the Watershed Modeling System (WMS) software, 2003.

Information Services Center
Annis Water Resources Institute
Grand Valley State University

Map Prepared: February 2003

Natural Runoff Potential

Mona Lake Watershed

Hydrologic Soil Groups

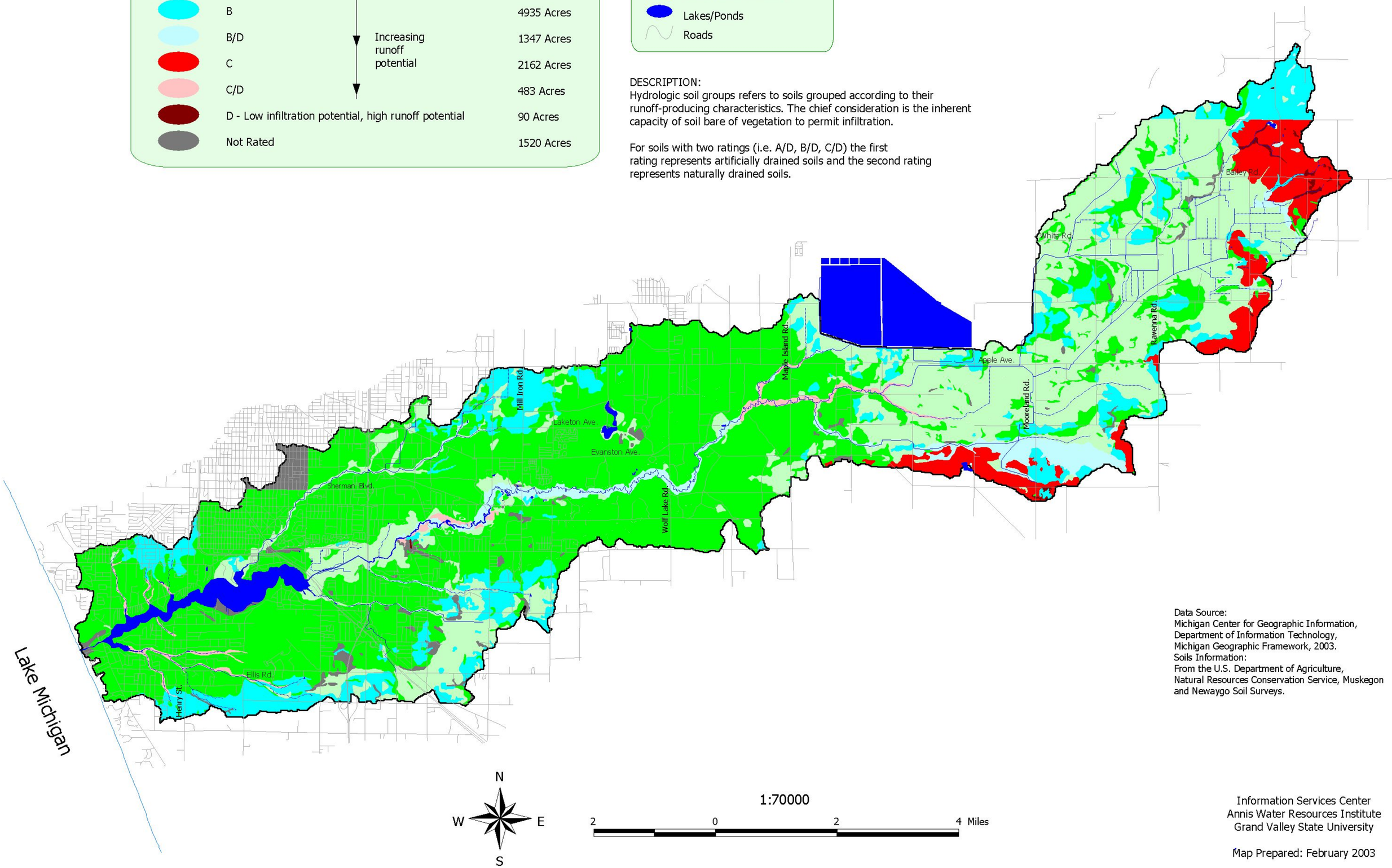
A - High infiltration potential, low runoff potential		22690 Acres
A/D - Artifically drained condition versus natural condition		12344 Acres
B		4935 Acres
B/D	Increasing runoff potential	1347 Acres
C		2162 Acres
C/D		483 Acres
D - Low infiltration potential, high runoff potential		90 Acres
Not Rated		1520 Acres

Base Information

- Creek/Stream
- Intermittent Stream/Drain
- Great Lakes Shoreline
- Lakes/Ponds
- Roads

DESCRIPTION:
Hydrologic soil groups refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration.

For soils with two ratings (i.e. A/D, B/D, C/D) the first rating represents artificially drained soils and the second rating represents naturally drained soils.



Data Source:
Michigan Center for Geographic Information, Department of Information Technology, Michigan Geographic Framework, 2003.
Soils Information:
From the U.S. Department of Agriculture, Natural Resources Conservation Service, Muskegon and Newaygo Soil Surveys.

Information Services Center
Annis Water Resources Institute
Grand Valley State University

Map Prepared: February 2003

Sheet and Rill Erosion Potential

Mona Lake Watershed

K - Factor

	0.05 - 0.26 - Low Potential	39356 Acres
	0.27 - 0.48 - Moderate Potential	1848 Acres
	Not Rated or Urban	4367 Acres

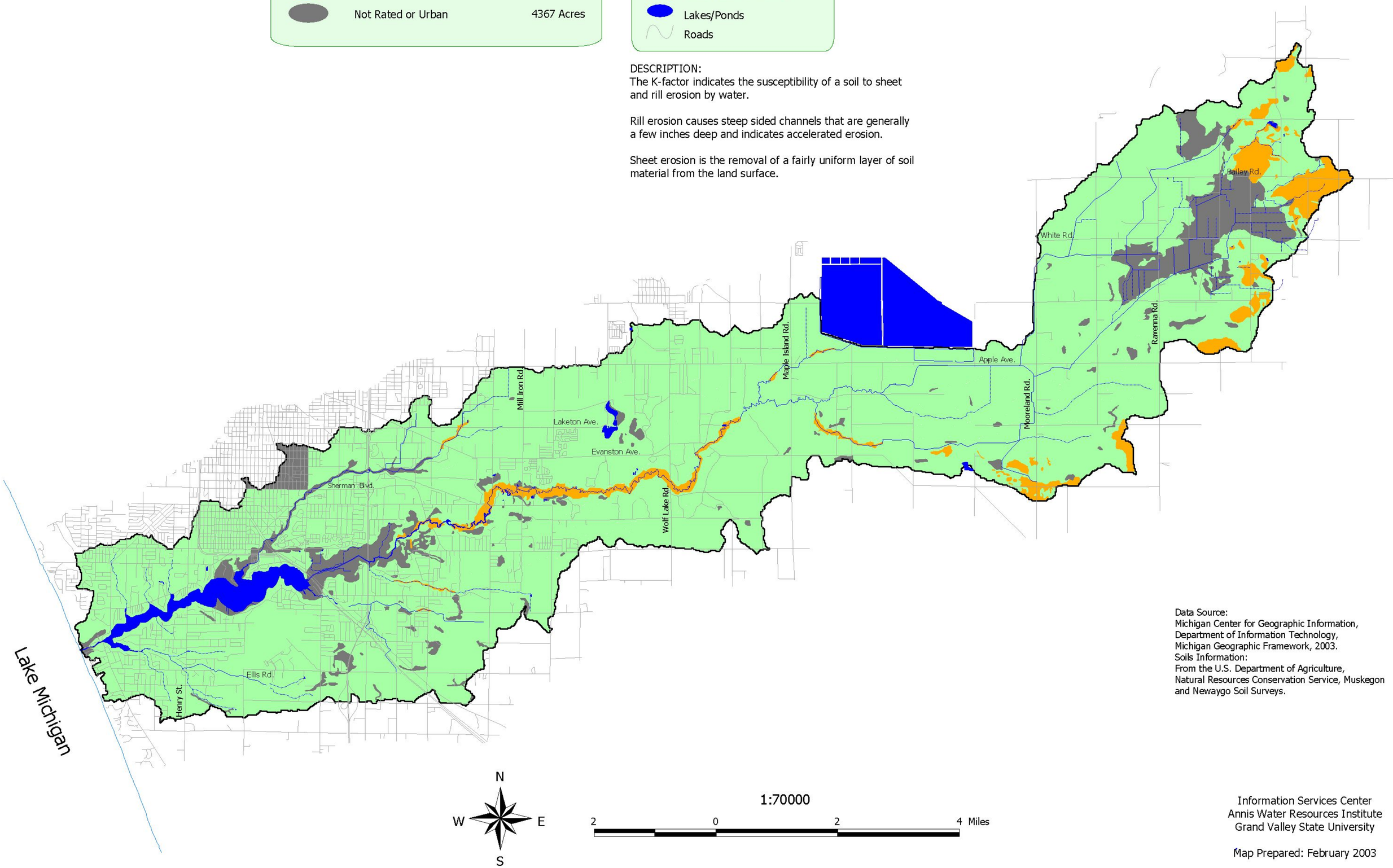
Base Information

- Creek/Stream
- Intermittent Stream/Drain
- Great Lakes Shoreline
- Lakes/Ponds
- Roads

DESCRIPTION:
The K-factor indicates the susceptibility of a soil to sheet and rill erosion by water.

Rill erosion causes steep sided channels that are generally a few inches deep and indicates accelerated erosion.

Sheet erosion is the removal of a fairly uniform layer of soil material from the land surface.



Data Source:
Michigan Center for Geographic Information, Department of Information Technology, Michigan Geographic Framework, 2003.
Soils Information:
From the U.S. Department of Agriculture, Natural Resources Conservation Service, Muskegon and Newaygo Soil Surveys.

Information Services Center
Annis Water Resources Institute
Grand Valley State University

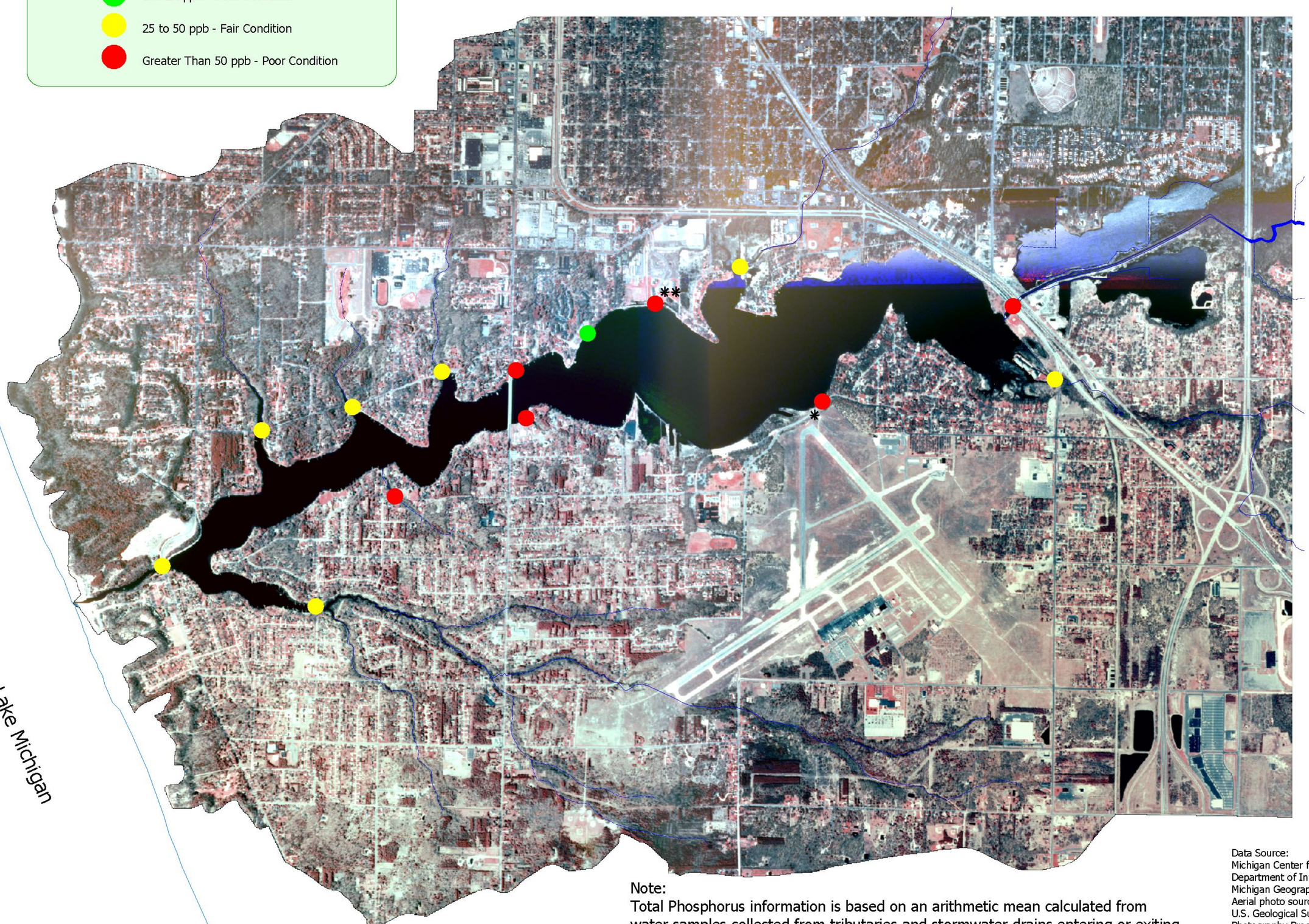
Map Prepared: February 2003

Total Phosphorus Concentration

Mona Lake Watershed

Phosphorus Concentration (Parts Per Billion)

- 1 to 24 ppb - Good Condition
- 25 to 50 ppb - Fair Condition
- Greater Than 50 ppb - Poor Condition



Note:
Total Phosphorus information is based on an arithmetic mean calculated from water samples collected from tributaries and stormwater drains entering or exiting (channel only) Mona Lake. Period of record was June 2002 to August 2003.

* Site had detectable flow on only one sampling date.
** Site had detectable flow on only four sampling dates.

N
W E
S

1:18500

0.5 0 0.5 1 Miles

Data Source:
Michigan Center for Geographic Information, Department of Information Technology, Michigan Geographic Framework, 2003.
Aerial photo source:
U.S. Geological Survey, National Aerial Photography Program, 1998.
Phosphorus data source:
GVSU, Annis Water Resources Institute, 2003.

Information Services Center
Annis Water Resources Institute
Grand Valley State University

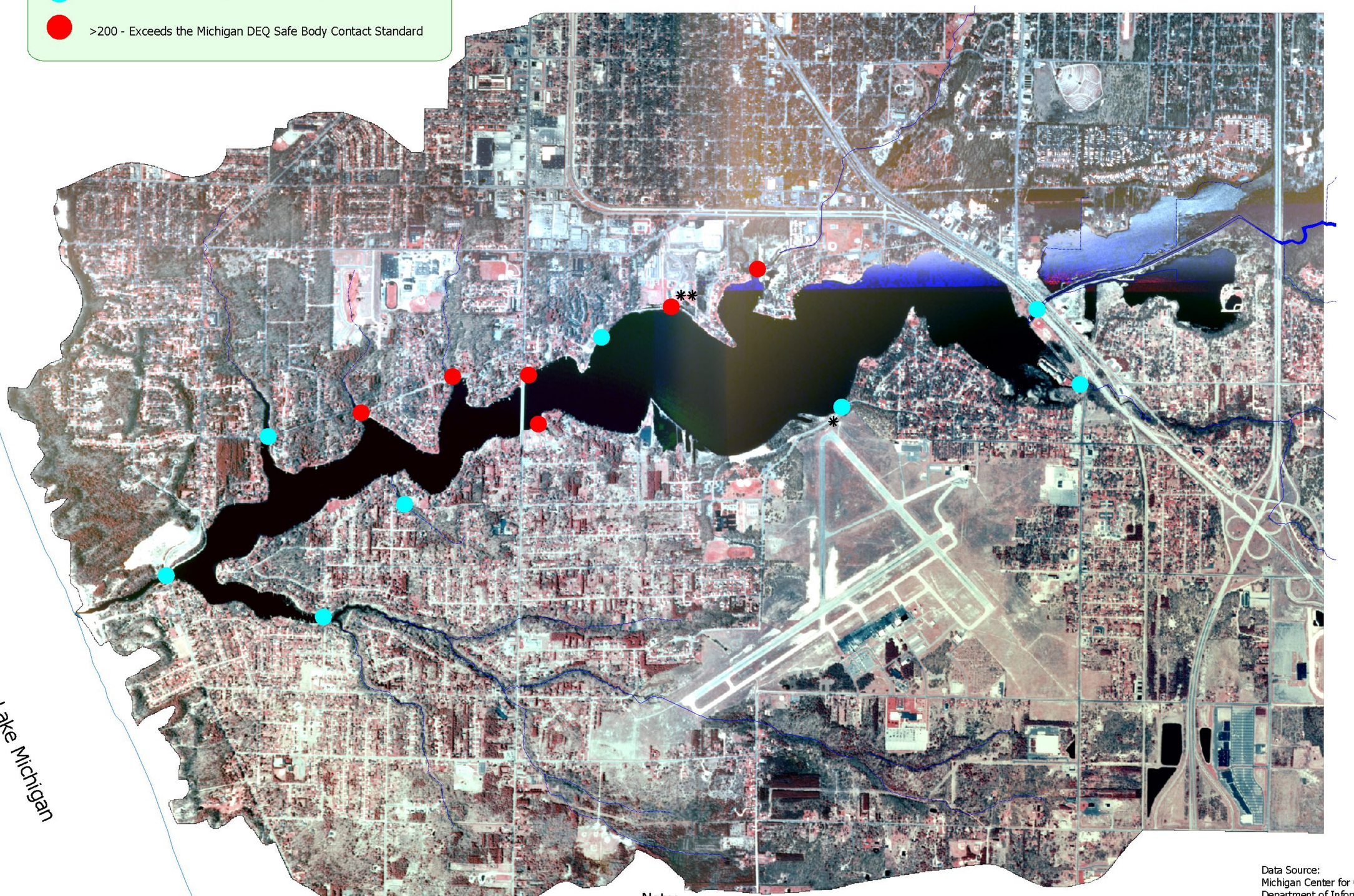
Map Prepared: October 2003

Bacterial Contamination

Mona Lake Watershed

Fecal Coliform Concentration (# of colonies/100 ml)

- < 200 - Under the Michigan DEQ Safe Body Contact Standard
- >200 - Exceeds the Michigan DEQ Safe Body Contact Standard



Note:
Fecal Coliform values are based on a geometric mean calculated from water samples collected from tributaries and stormwater drains entering or exiting (channel only) Mona Lake. Period of record was June 2002 to August 2003. The standard used in the legend is based on the Pre-1996 Michigan DEQ 200 colonies per 100 ml threshold.

*Site had detectable flow on only one sampling date.
**Site had detectable flow on only four sampling dates.

N
W E
S

1:18500

0.5 0 0.5 1 Miles

Data Source:
Michigan Center for Geographic Information, Department of Information Technology, Michigan Geographic Framework, 2003.
Aerial photo source:
U.S. Geological Survey, National Aerial Photography Program, 1998.
Bacteria data source:
GVSU, Annis Water Resources Institute, 2003.

Information Services Center
Annis Water Resources Institute
Grand Valley State University

Map Prepared: October 2003