Mapping and Understanding YOUR LAKE'S WATERSHED

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What is a Watershed?

A watershed is the land area surrounding a lake from which water drains to the lake. The imaginary line that defines a watershed is the watershed boundary, or is sometimes called the drainage divide (Figure 1). A watershed can be big or small, and the size and shape depends on the "lay of the land" and the number and length of tributary streams.

When precipitation (rain or snow) falls on the land, it absorbs into the ground and becomes groundwater, or it washes over the land as "runoff." As runoff moves over the land, it can pick up pollutants that can be transported to the lake. As development in a watershed increases, there is often a concurrent increase in the amount of runoff. Lake water quality is often a reflection of land use (i.e., urban, forested, agricultural, wetland) in the watershed. Lakes in highly developed watersheds tend to have poorer water quality than lakes in less developed watersheds.

Mapping and understanding your watershed can help identify problem areas and management opportunities, and foster awareness about watershed issues. This article examines various watershed characteristics and how these factors may influence water quality.

Watershed Mapping

A watershed boundary can be delineated by connecting points of high ground on a U.S. Geological Survey topographic map. Watershed mapping for a number of Michigan lakes was included in *Michigan Inland Lakes and Their Watersheds: An Atlas* published by Marsh and Borton in 1974. The atlas is an excellent reference and contains information on lake and watershed size, lake to watershed ratios and other information. More recently, the Michigan Department of Environmental Quality mapped major watersheds and drainage divides throughout the state.

Most watershed analyses today are performed with geographic information system (GIS) computer software. GIS programs can be used for various types of spatial analyses and to generate high-quality maps and graphics.

Watershed Features

How water moves within a watershed is influenced by land cover, slope, soil types and other factors. The following series of maps illustrate various features of the Silver Lake watershed in Oceana County.

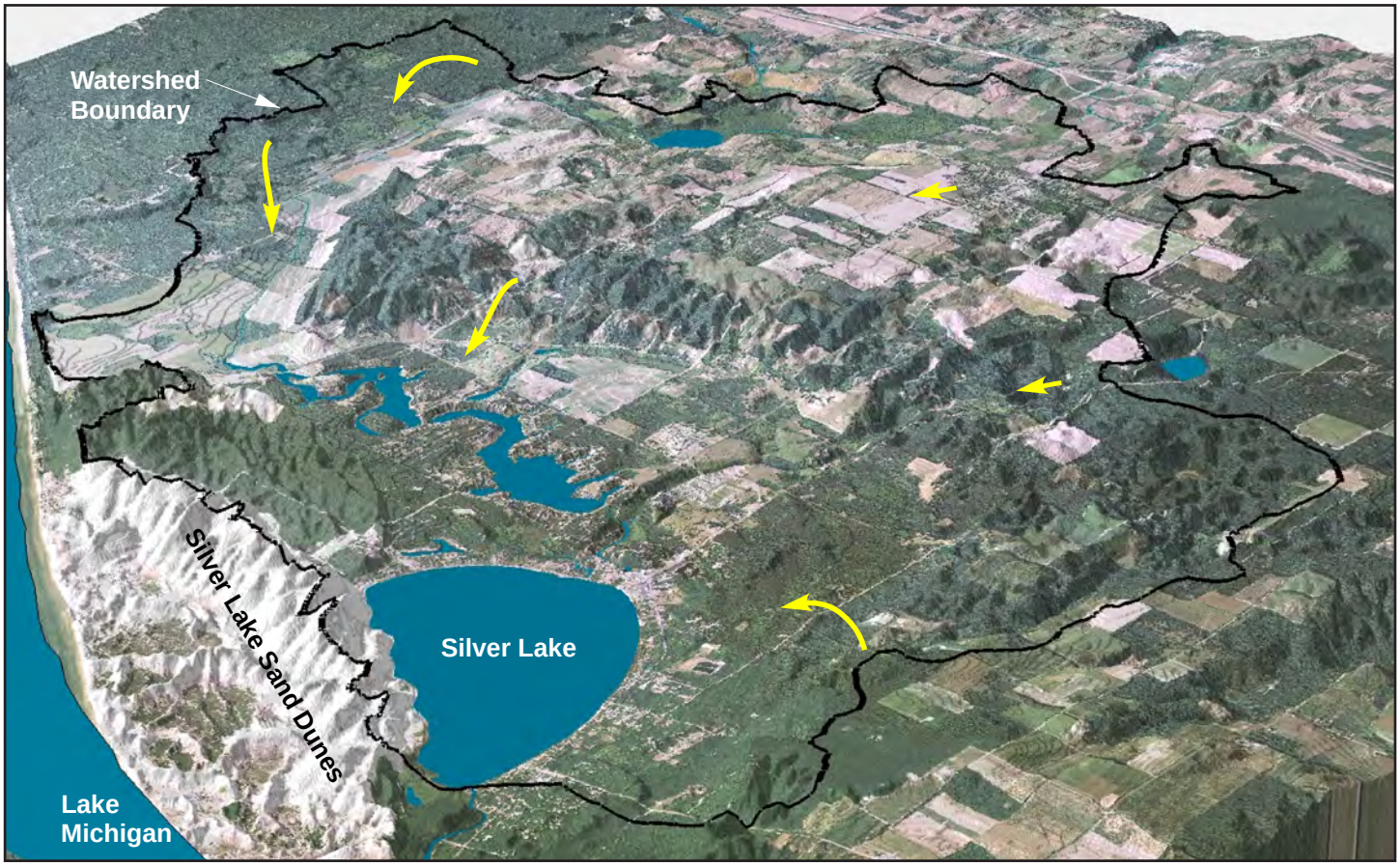

Figure 1. Watershed map. Precipitation that falls within the watershed boundary eventually drains to Silver Lake. Yellow arrows show direction of flow. Three-dimensional modeling software was used to create this map. The vertical axis was exaggerated to show elevation differences.

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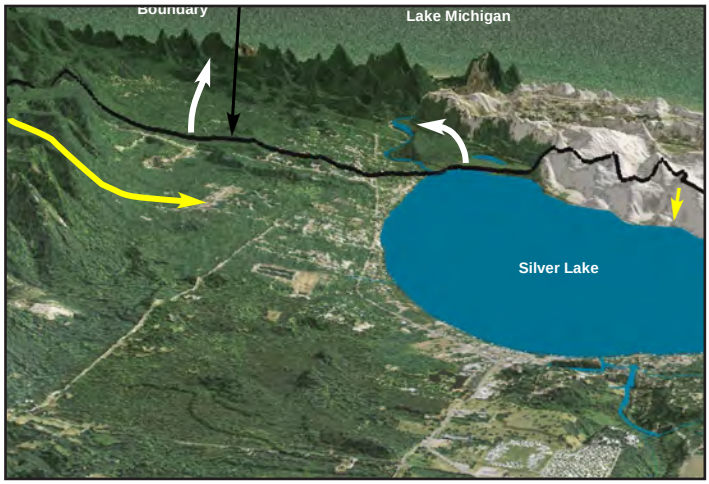
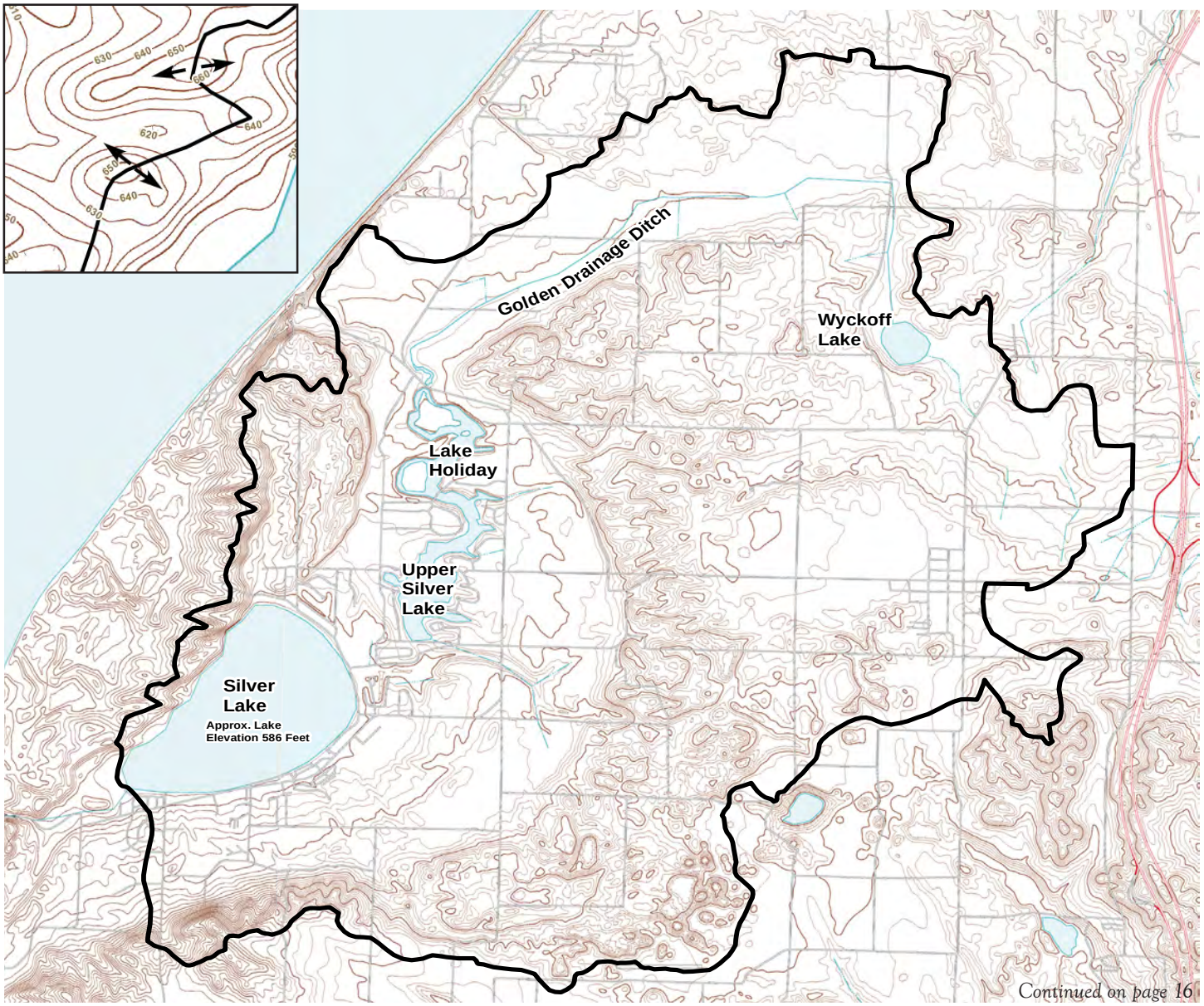
Topography U.S. Geological Survey topographic maps are often used to delineate watershed boundaries. Each line on the map represents an elevation, and a line can be drawn through areas of high ground to define a watershed boundary. Computer software can be used to view a watershed in three dimensions. By exaggerating the vertical scale on a three-dimensional image, topographical features are readily apparent and much easier to visualize. The Silver Lake watershed is about 22 square miles (14,108 acres), a land area 21 times larger than the lake itself.

Below: A two-dimensional topographic map uses contour lines to show changes in elevation. In this case, brown-colored contour lines are drawn at 10-foot elevation intervals. Dark brown lines show the 50-foot contours. Water flows over the land from higher elevation to lower elevation in a direction perpendicular to the contour lines. This principle is used to delineate the watershed boundary on a two-dimensional map.

Inset: Detail of two-dimensional topographic map. In this example, water flows in all directions away from the peaks at the 640-, 650-, and 660-foot elevations. The watershed boundary passes through these peaks to demarcate runoff toward and away from Silver Lake.



Above: A three-dimensional watershed map can be used to help delineate the watershed boundary. Arrows show the direction of runoff. Yellow arrows show flow within the watershed and toward Silver Lake; white arrows show flow outside the watershed away from Silver Lake.



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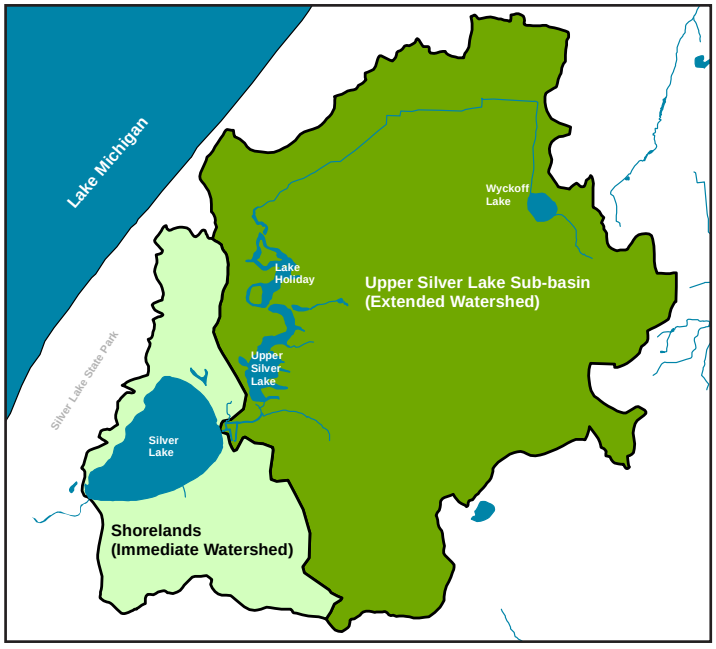
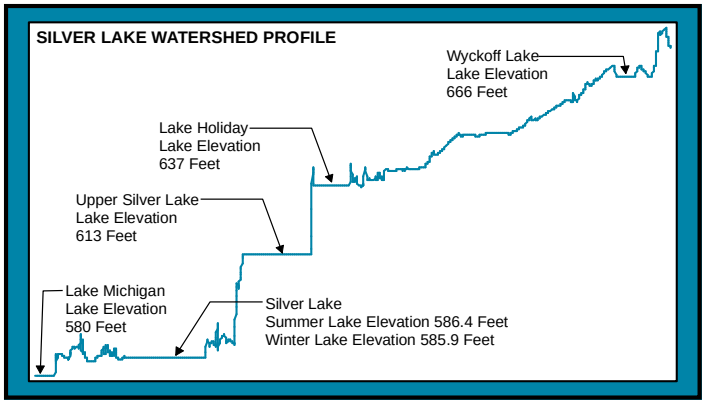
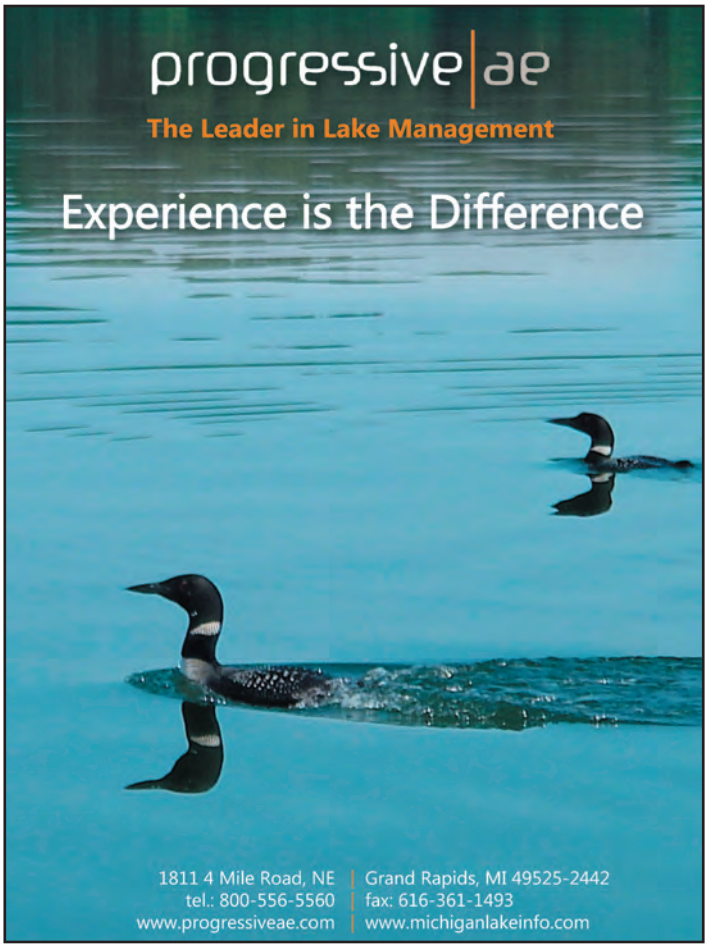
Water Features: The portion of a watershed that drains directly to the lake is referred to as the "immediate watershed." The "extended watershed" includes areas that drain to the lake through tributary creeks and streams. Often, immediate watersheds are referred to as "shorelands" and the extended watershed areas are called "sub-basins."

Water draining from the upper portions of the Silver Lake watershed (i.e., the extended watershed) flows through Lake Holiday and Upper Silver Lake before discharging to Silver Lake which, in turn, flows to Silver Creek and Lake Michigan. There is an approximate 80-foot elevation difference between Wyckoff Lake in the upper portion of Silver Lake's extended watershed and Silver Lake, and an approximate 6-foot elevation difference between Silver Lake and Lake Michigan. The levels of Lake Holiday, Upper Silver and Silver Lakes are controlled by dams, and Lake Holiday and Silver Lake have court-ordered lake levels.







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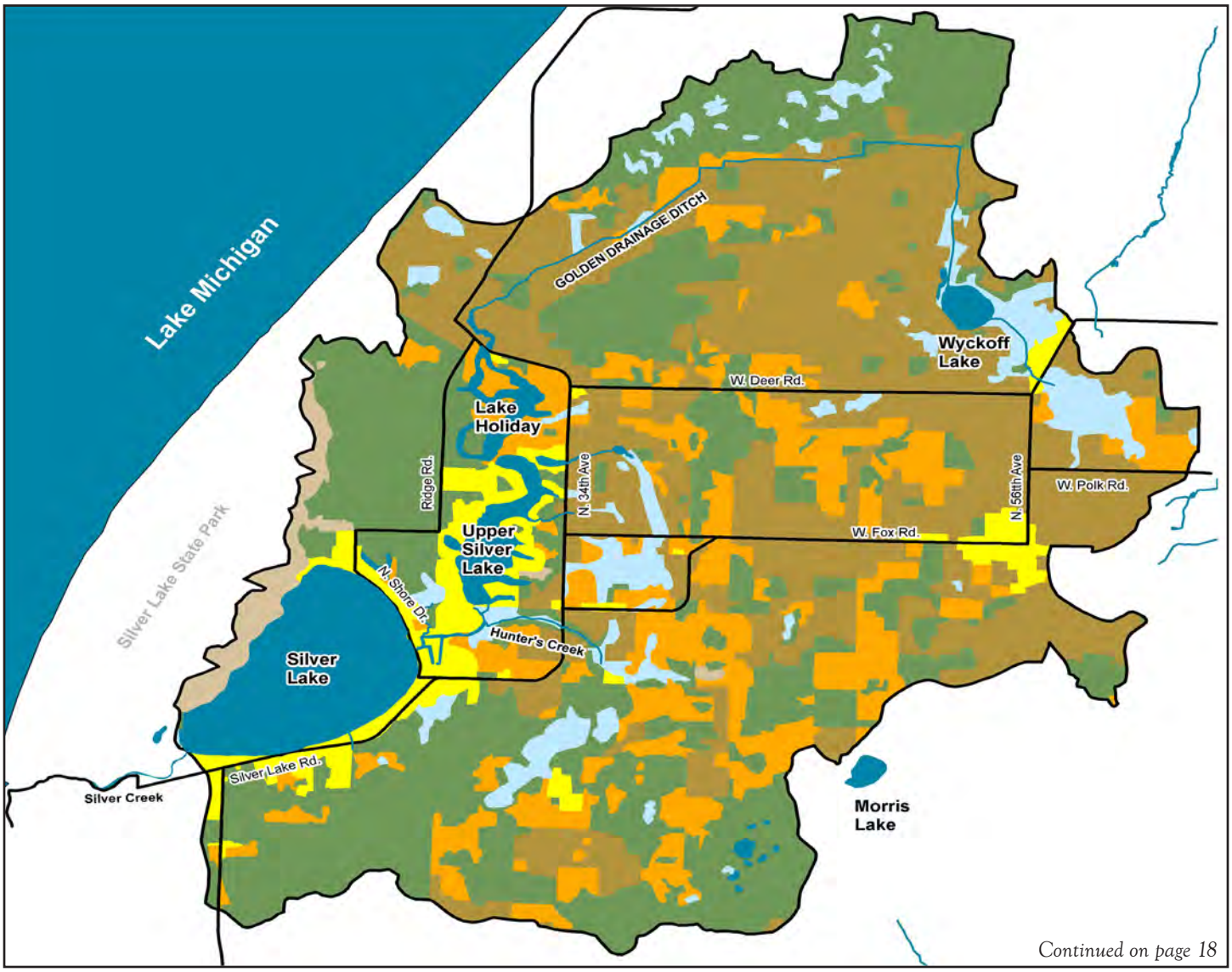
Land Cover: Land cover data derived from aerial photography (Michigan Resource Information System, MIRIS, 1978) is available for the entire state through the Michigan Geographic Data Library. With this data set, various land use classifications can be combined to show the generalized land cover in a watershed. The historical land cover data can then be compared to more recent aerial photography to evaluate changes in land cover over time. In the Silver Lake watershed about half of the land is forested and wetland, about one-third is agricultural and the remainder is urbanized, with most of the development concentrated around the lakes in the watershed. Most of the agricultural land in the watershed is located within the extended watershed and does not drain directly to Silver Lake.

One type of land cover that is often given special attention is wetland. In addition to fish and wildlife habitat, wetlands help filter pollutants, minimize flood potential and perform other important functions. Wetland inventory maps are available for much of the state through the Michigan Geographic Data Library. These maps were created by combining information from the U.S. Fish and Wildlife Service National Wetland Inventory, MIRIS land cover, and hydric soils data from the U.S Department of Agriculture Natural Resources Conservation Service. These maps can be used to identify the generalized location of wetlands throughout a watershed. Over 2,000 acres of the Silver Lake watershed is classified as wetland.

Land Cover Map Legend

- Residential
- Open Space
- Agriculture
- Forested
- Wetland
- Barren
- Water



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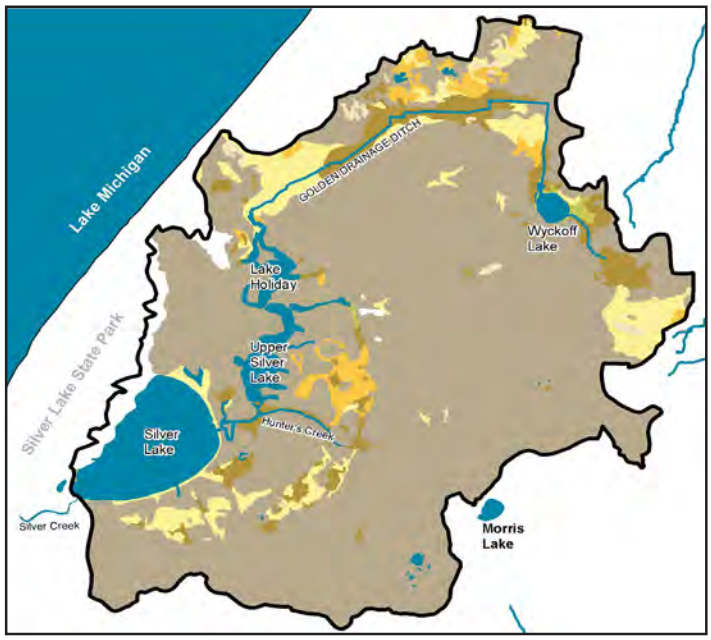
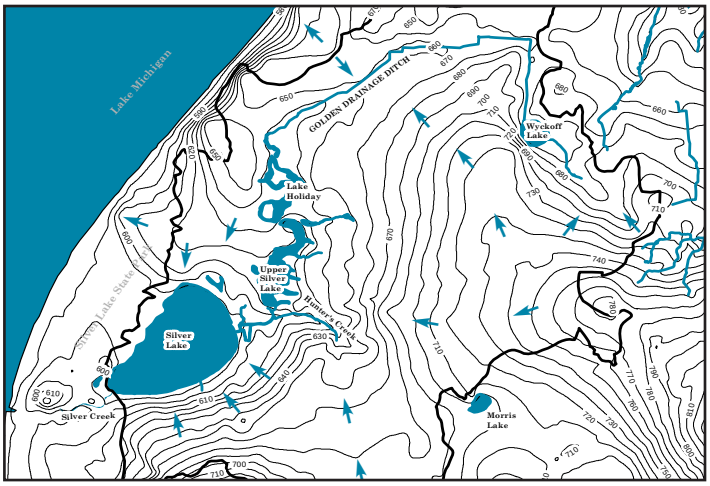
Hydrologic Soil Groups: Hydrologic soil classifications can be useful in evaluating runoff potential in a watershed. Soils that are predominately sandy tend to have a high infiltration rate and low runoff potential. By contrast, loam and clay soils tend to have a low infiltration rate and a higher runoff potential. Most of the soils in the Silver Lake watershed are sandy and have a high infiltration rate and low runoff potential.



Groundwater Contours: Generalized mapping of groundwater elevations in the state has been compiled by the Michigan Department of Environmental Quality in collaboration with the U.S. Geological Survey, Michigan State University and others. Groundwater flow within Silver Lake's extended watershed is intercepted by the Golden Drainage Ditch, while much of the groundwater in the immediate watershed flows directly toward the lake.



Similar to the topographic map, this map uses contour lines to show groundwater elevation. Arrows were added to show the direction of groundwater flow.

Hydrologic Soils Map Legend

Low Runoff Potential

- **A** — Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.
- **B** — Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.
- **C** — Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.
- **D** — Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.
- **A/D** — If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas.
- **B/D** — If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas.
- Unclassified

High Runoff Potential