

# Lake Michigan Basin Land Cover Change Report 1985–2010



**NOAA Coastal Services Center**  
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## About This Report

The *Lake Michigan Basin Land Cover Change Report, 1985–2010* is a special basin-focused edition in a series of regional reports that summarize land cover status in 2010 and land cover changes over the previous decades. Published in February 2013, this report provides an overview of key findings via reader-friendly maps and graphics.

## About the Coastal Change Analysis Program

Satellite imagery is a great way to get a big-picture view of the cumulative impacts of changes along our nation's coasts. The Coastal Change Analysis Program (C-CAP) within the National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center produces nationally standardized land cover and land cover change information for coastal regions of the United States, including the Great Lakes, using multiple dates of satellite imagery. C-CAP's data products provide inventories of coastal intertidal areas, wetlands, and adjacent uplands at approximately five-year intervals. This information helps to support decision making about coastal resources and communities. The raster-based maps generated by C-CAP serve as a baseline for studies of coastal changes and evaluations of past or future management actions.

To learn more about the C-CAP data products used in this report and to access the data sets, please visit [www.csc.noaa.gov/digitalcoast/data/ccapregional](http://www.csc.noaa.gov/digitalcoast/data/ccapregional).

## About the NOAA Coastal Services Center

The NOAA Coastal Services Center provides data, tools, training, expertise, and technical assistance to support state and local entities devoted to the wise management of our nation's coastal resources. To learn about available products and services, visit [www.csc.noaa.gov](http://www.csc.noaa.gov).

**Editorial & Design Consultant** Peter Taylor, Waterview Consulting

**Cover Photographs** *Upper:* Lake Michigan shoreline in northern Michigan. © Alexey Stiop/Shutterstock.com  
*Lower:* A distant view of downtown Milwaukee. © Henryk Sadura/Shutterstock.com



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# INTRODUCTION

The Lake Michigan Basin is composed of four major drainages, indicated on the map by colors. Thin gray lines indicate boundaries of smaller watersheds.



THE LAKE MICHIGAN BASIN COVERS MORE THAN 46,000 SQUARE MILES, including parts of Wisconsin, Illinois, Indiana, and Michigan. Rivers and streams within this land area flow into Lake Michigan. The Lake Michigan Basin is biologically diverse with habitats such as coastal marshes, prairies, savannas, forests, and freshwater sand dunes and beaches supporting rare plants and animals.

Eleven million people rely on the Basin for commercial and recreational fishing, agriculture, mining, recreation, and drinking water. A portion of Chicago—the nation’s third-largest population center—lies in the Lake Michigan Basin. Lake Michigan is considered “an outstanding natural resource of global significance, under stress and in need of special attention.” Notable threats to the health of the Basin are increased development, pollution, invasive species, and climate change.<sup>1</sup>

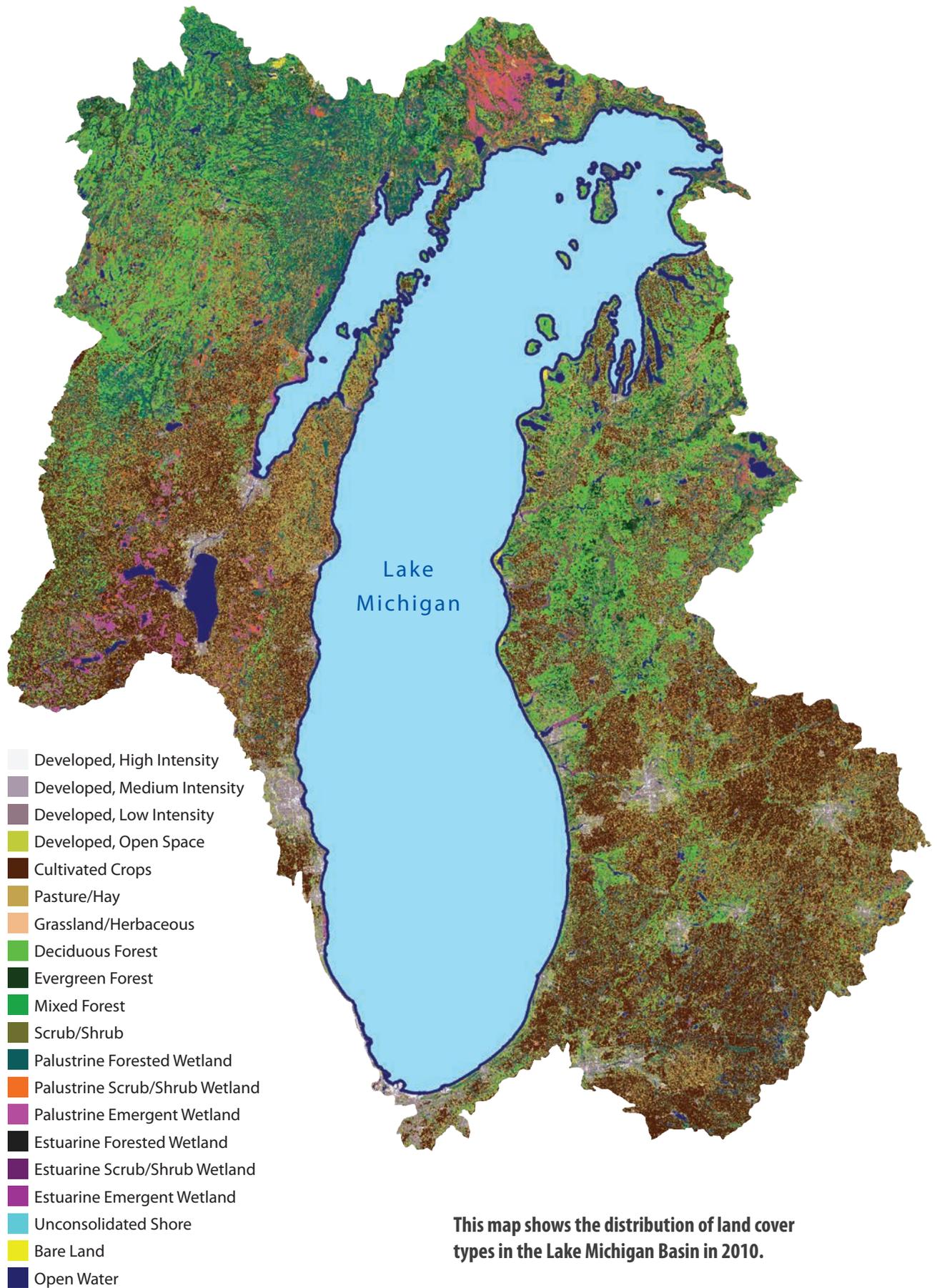


Location of the Lake Michigan Basin (red) and C-CAP’s coverage area (dark gray) in the contiguous United States.

Many types of land cover, such as forest, wetland, and agriculture, occur in the Basin, and the amount of each land cover changes over time. Using images and data collected by satellites, the NOAA Coastal Services Center’s Coastal Change Analysis Program (C-CAP) measured the area of each land cover type gained or lost from 1985 to 2010. In this report, 18 land cover classes are grouped into eight general categories: developed, agriculture, grass, scrub, forest, wetland, barren, and water.

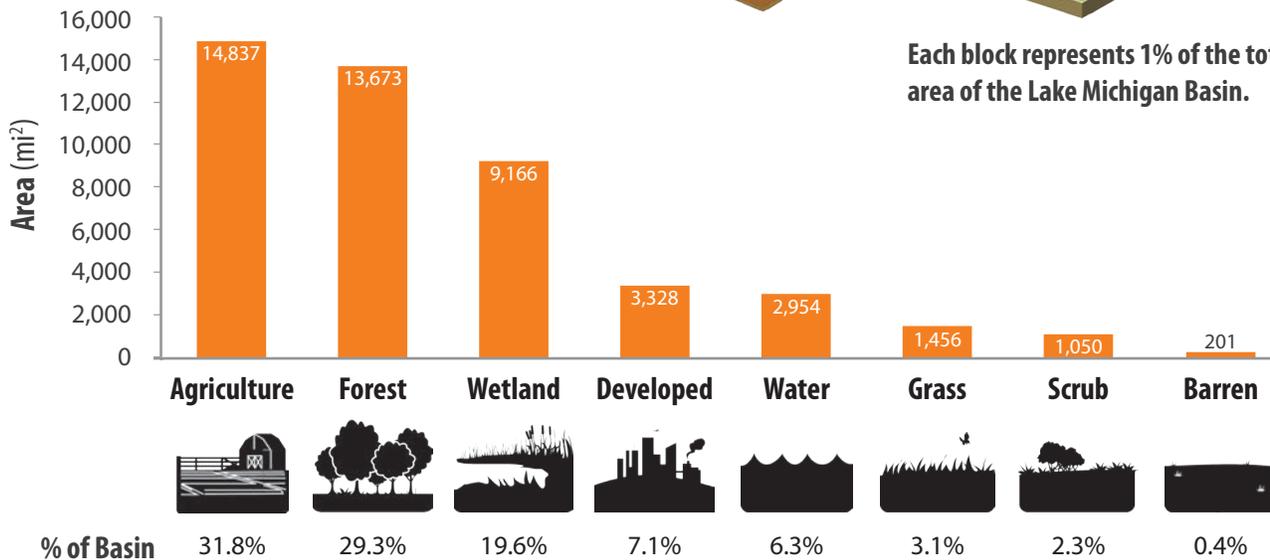
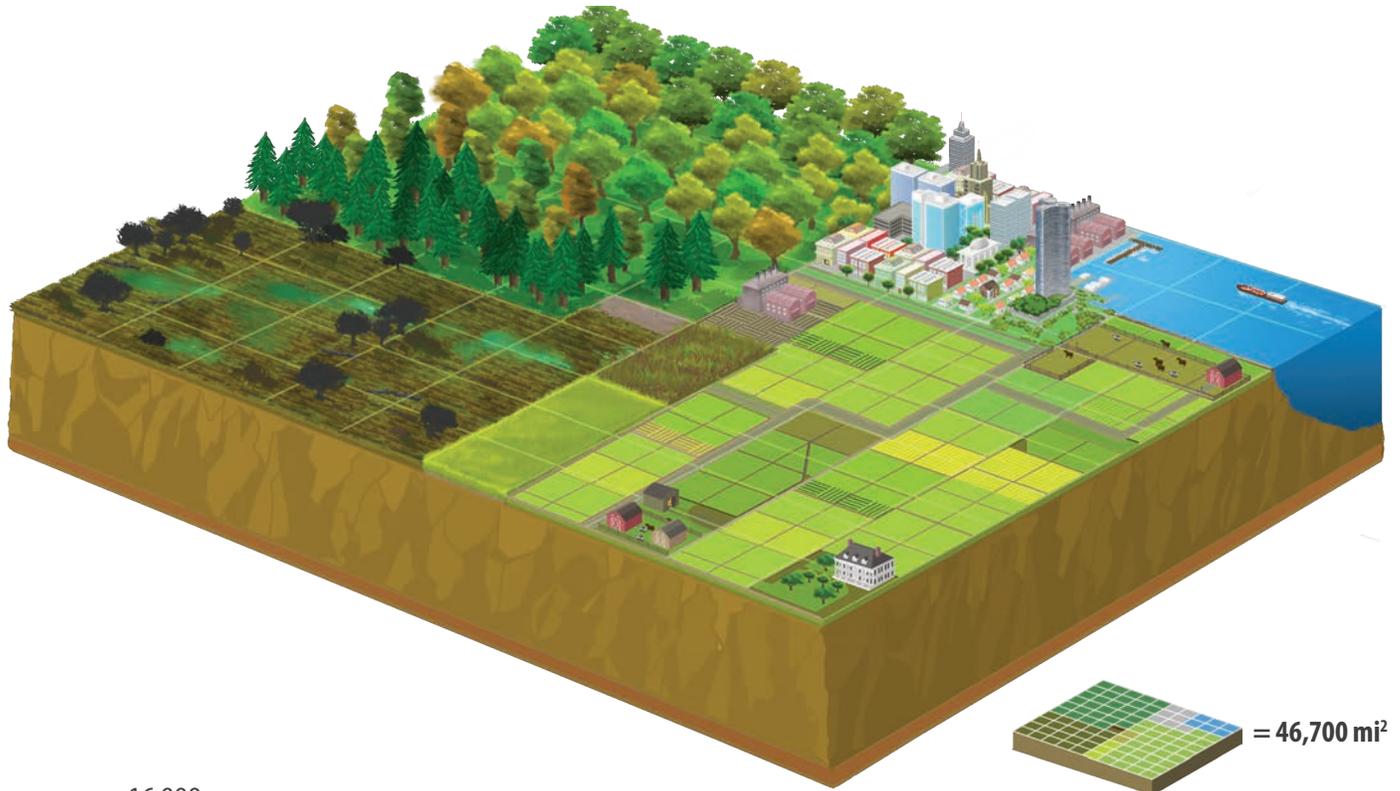
<sup>1</sup> U.S. Environmental Protection Agency. Lake Michigan Lakewide Management Plan; 2008 Status Update, 2011 Annual Report

# LAND COVER



This map shows the distribution of land cover types in the Lake Michigan Basin in 2010.

**I**N 2010, AGRICULTURE (32%) AND FOREST (29%) were the most common categories of land cover in the Basin, accounting for more than half the area. The next most common were wetlands (20%), development (7%), and water (6%). Less than 6% of the area was classified as grass, scrub, or barren.



Each block represents 1% of the total area of the Lake Michigan Basin.

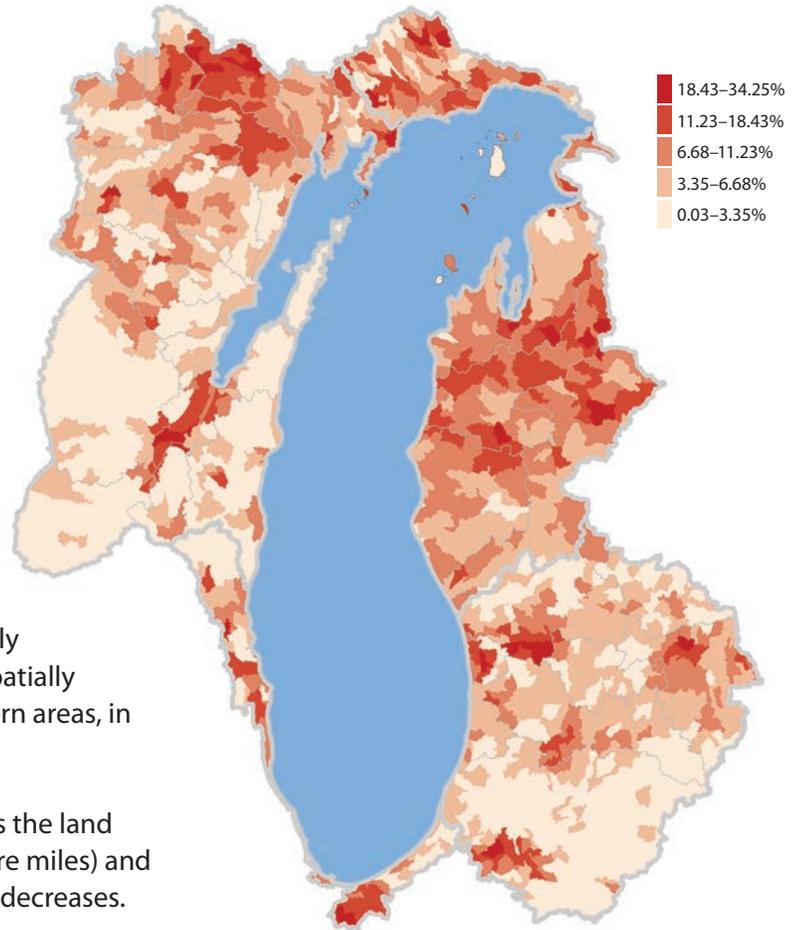
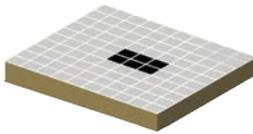
The 18 land cover classes in the Lake Michigan Basin have been grouped into 8 major categories that are displayed in the top graphic to highlight their relative distribution in 2010. More detailed information about these 8 categories is displayed in the bar chart.

### TOTAL CHANGE IN LAND COVER

**AREA OF CHANGE**

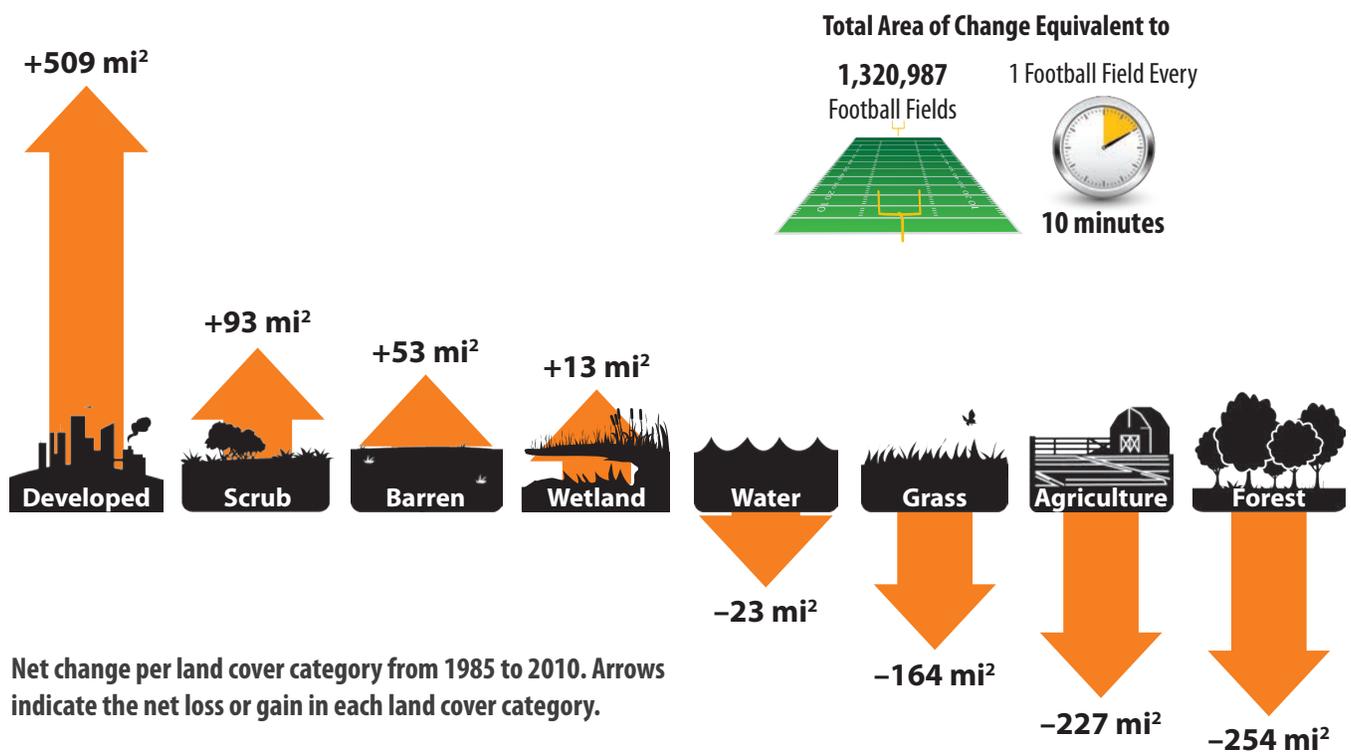
2,729 mi<sup>2</sup>

**6% OF REGION**



**F**ROM 1985 TO 2010, land cover changed on 2,729 square miles, or 6%, of the Lake Michigan Basin. Large amounts of change were common across northern areas of the Basin, mostly associated with timber management activities. Spatially intensive changes in land cover within the southern areas, in contrast, were concentrated around urban areas.

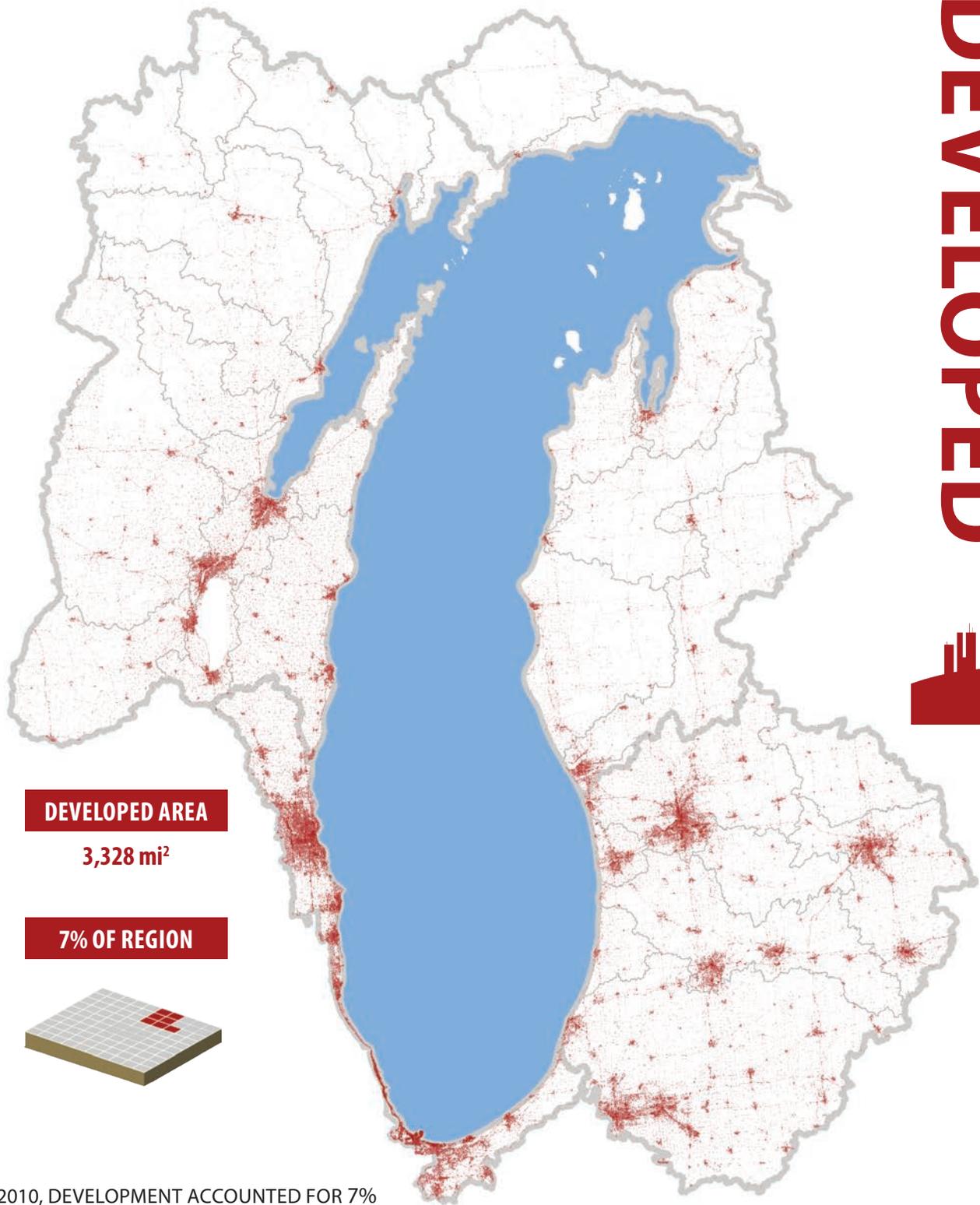
With a gain of 509 square miles, development was the land cover with the greatest increase. Forest (254 square miles) and agriculture (227 square miles) had the largest net decreases.



Net change per land cover category from 1985 to 2010. Arrows indicate the net loss or gain in each land cover category.



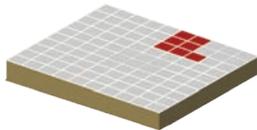
# DEVELOPED



**DEVELOPED AREA**

**3,328 mi<sup>2</sup>**

**7% OF REGION**

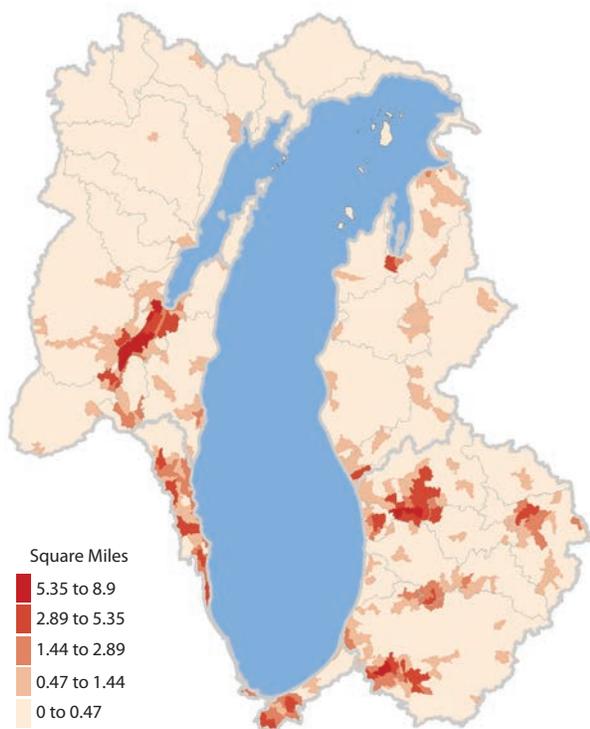


**I**N 2010, DEVELOPMENT ACCOUNTED FOR 7% of the Lake Michigan Basin. This development was concentrated in southern sections of the Lake Michigan Basin around the major metropolitan centers of Green Bay and Appleton, Wisconsin; Milwaukee, Wisconsin; Chicago, Illinois; South Bend, Indiana; Grand Rapids, Michigan; and others.

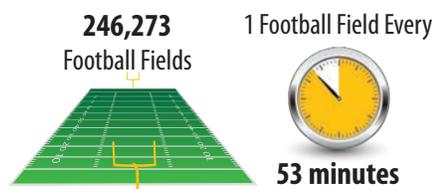
- Developed, High Intensity
- Developed, Medium Intensity
- Developed, Low Intensity
- Developed, Open Space

**2010 development map for the Lake Michigan Basin. This map depicts intensity of development.**

### INCREASE IN DEVELOPED AREA



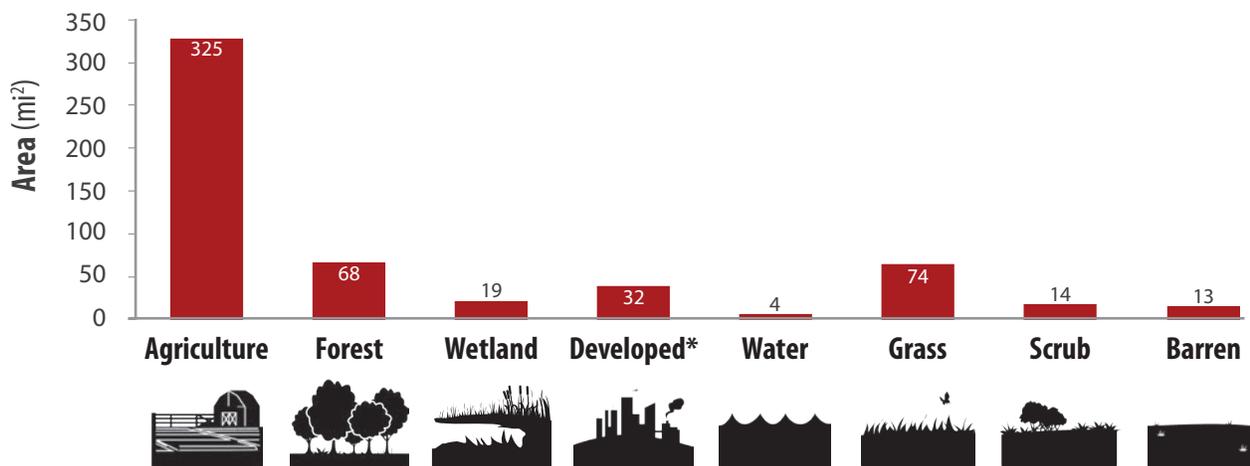
#### Increase in Developed Area Equivalent to



**F**ROM 1985 TO 2010, THE AMOUNT OF DEVELOPED AREA increased by 509 square miles, or 1.1% of the Basin’s total area. Three-quarters of the new development was classified as low intensity and open space developed, which typically includes suburban and rural features such as parks, golf courses, and housing with large lawns. Michigan, which contains the most development, added the greatest area of new development during this time period.

Across the Lake Michigan Basin during the 25-year time period, 63% (325 square miles) of development occurred on land previously categorized as agriculture. Development intensity increased on 32 square miles of already developed land; this type of change is commonly associated with increasing density of housing or infill development within city limits.

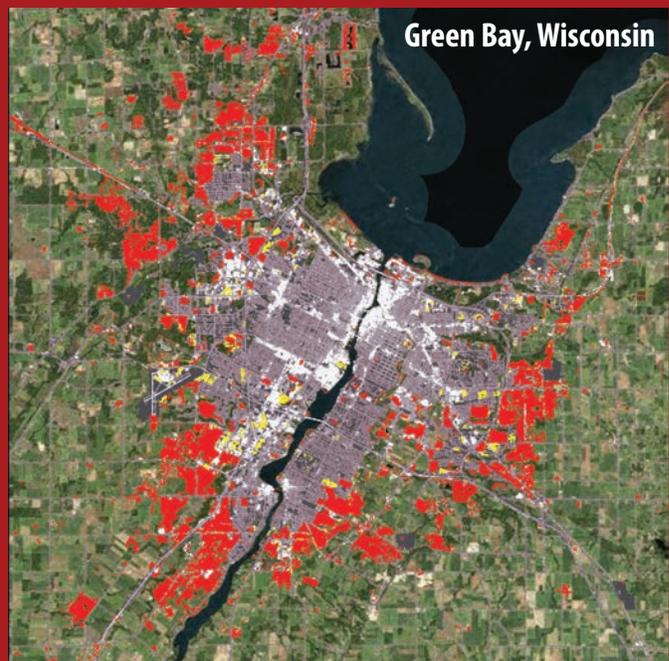
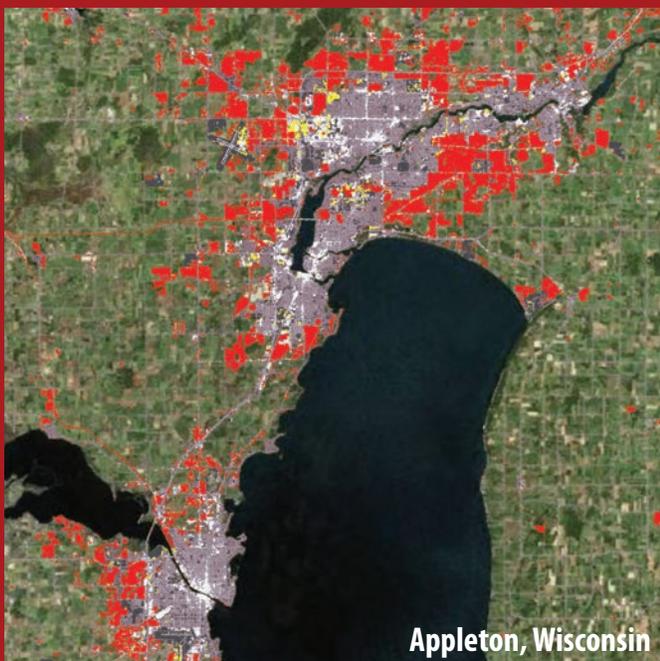
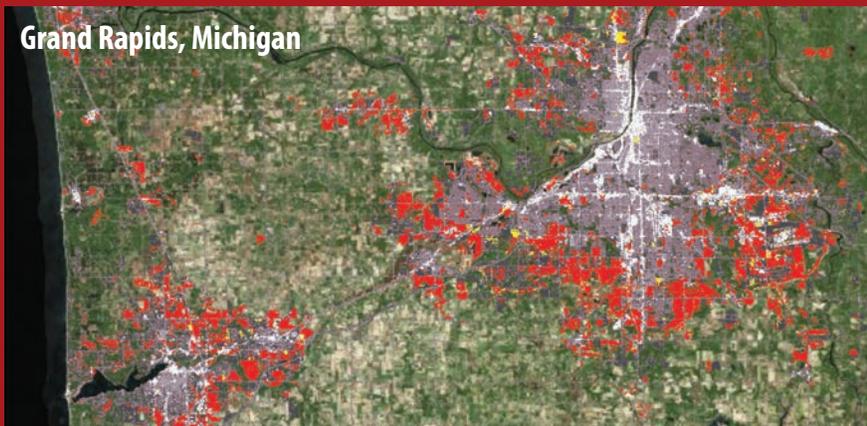
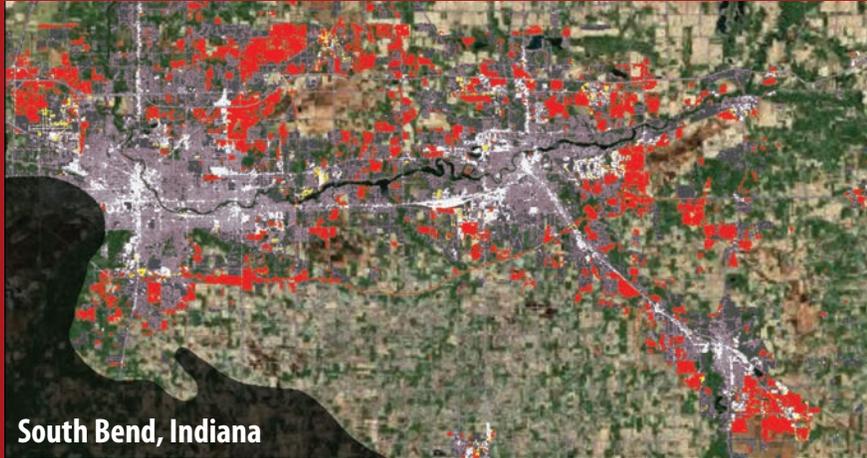
### LAND COVER CONVERTED TO DEVELOPED AREA



This bar graph shows the area of each land cover that was converted to development between 1985 and 2010.

\* Increases in development intensity

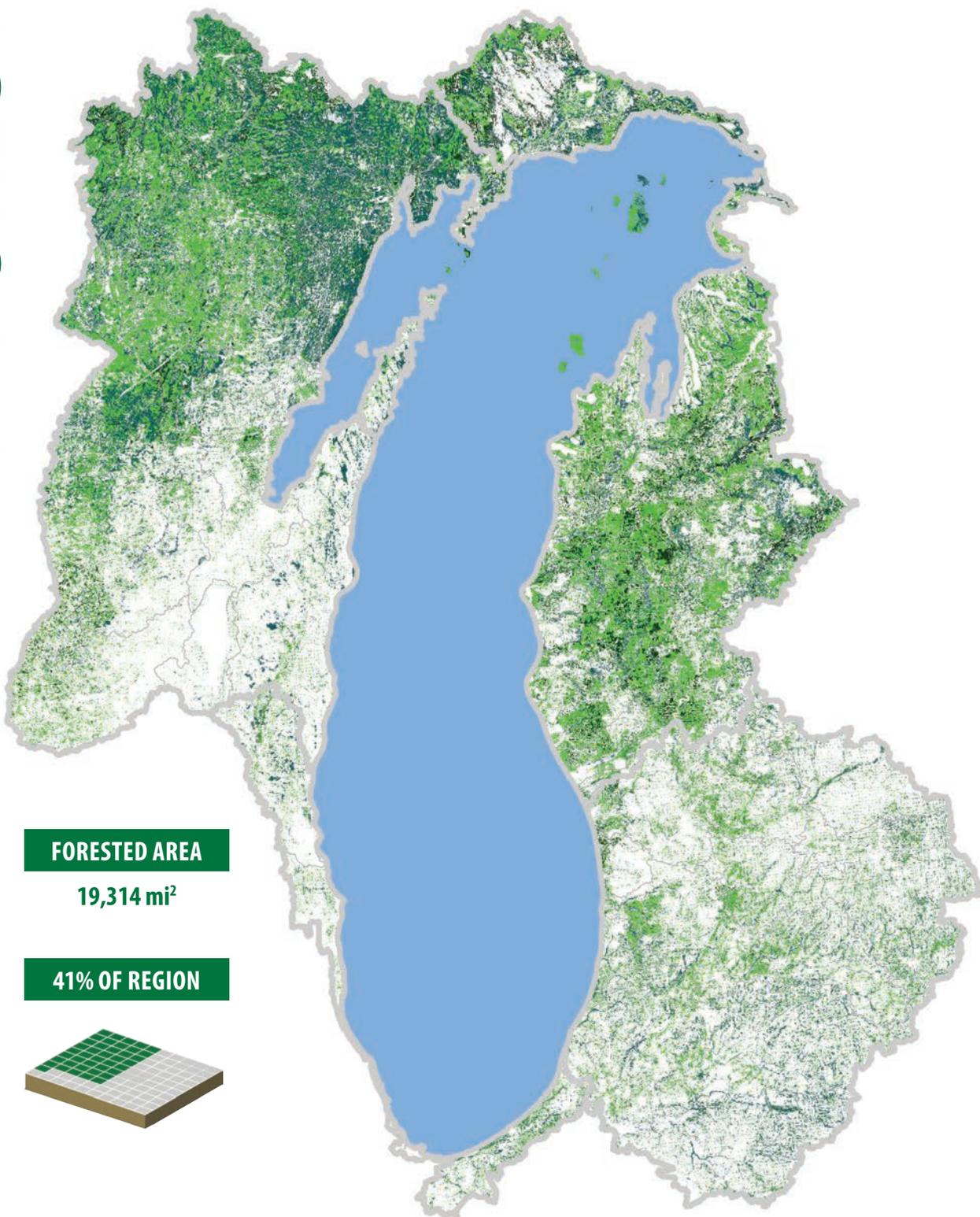
## HIGHLIGHT: METROPOLITAN DEVELOPMENT TRENDS



■ Pre-1985 High Intensity   ■ Pre-1985 Moderate Intensity   ■ Increased Intensity   ■ New Development

These images of large metropolitan areas within the Lake Michigan Basin show patterns of new development (red) and increased density or infill development (yellow). As can be seen here, this development often forms a halo pattern around a pre-existing city core. These changes reflect the expansion of major roads and population growth away from downtown. *Background images: USDA National Agricultural Imagery Program*

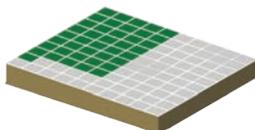
# FOREST



**FORESTED AREA**

**19,314 mi<sup>2</sup>**

**41% OF REGION**



**I**N 2010, FOREST COVERED 41% OF THE Lake Michigan Basin, including 29% upland forest and 12% wetland forest. The landscape was more heavily forested in northern areas and away from major metropolitan areas.

- Deciduous Forest
- Mixed Forest
- Evergreen Forest
- Palustrine Forested Wetland

**2010 forest map for the Lake Michigan Basin. This map depicts three upland forest categories and one wetland forest category.**

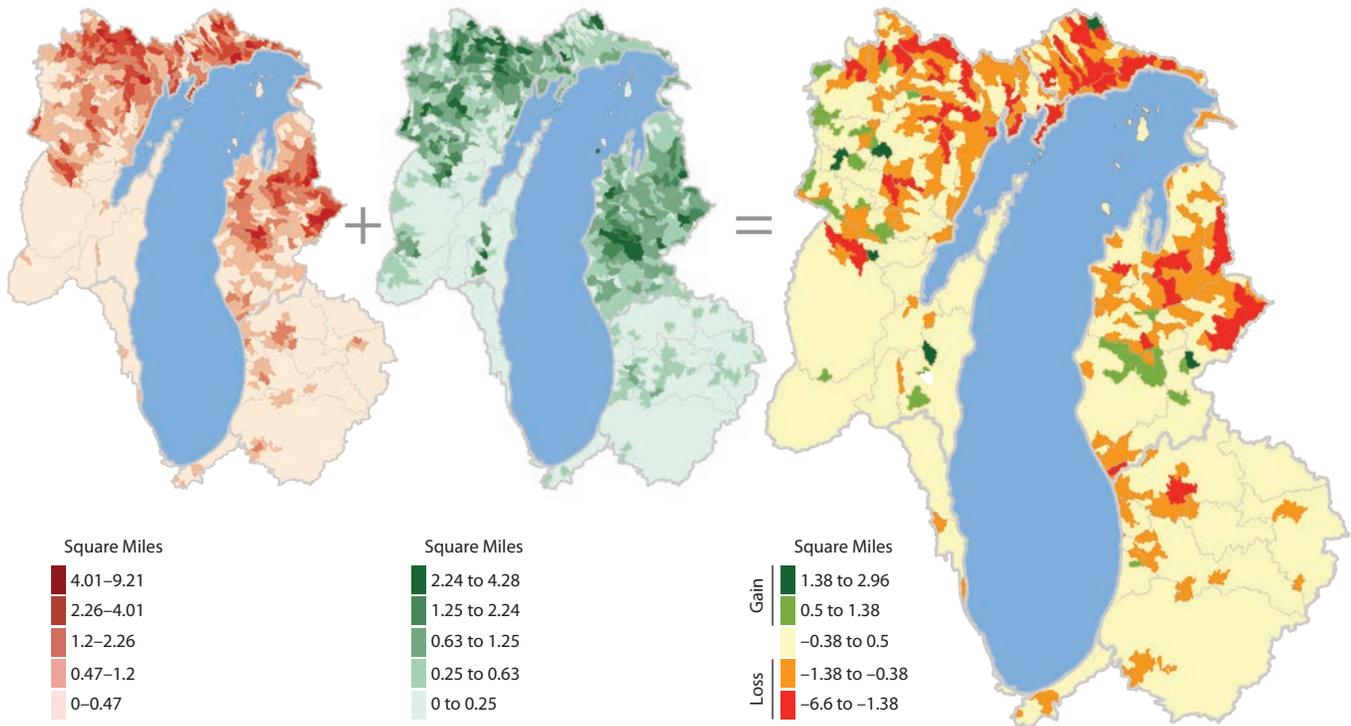
**FOREST AREA LOST**

701 square miles

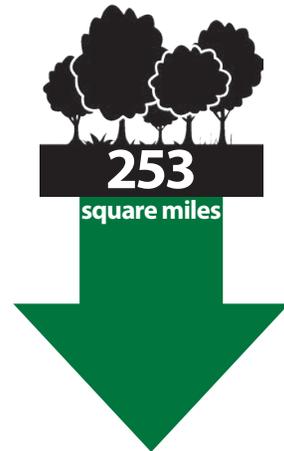
**FOREST AREA GAINED**

448 square miles

**NET CHANGE  
IN FOREST AREA**



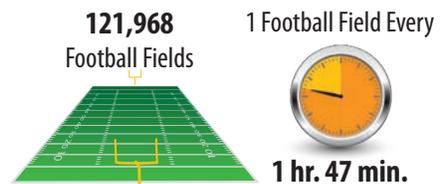
**F**ROM 1985 TO 2010, 701 SQUARE MILES OF FOREST changed to other types of land cover (above left), and 448 square miles of other land covers changed to forest (above center). The result was a net loss of 253 square miles of forest, with most of these changes concentrated in the northern sections of the watershed (above right).

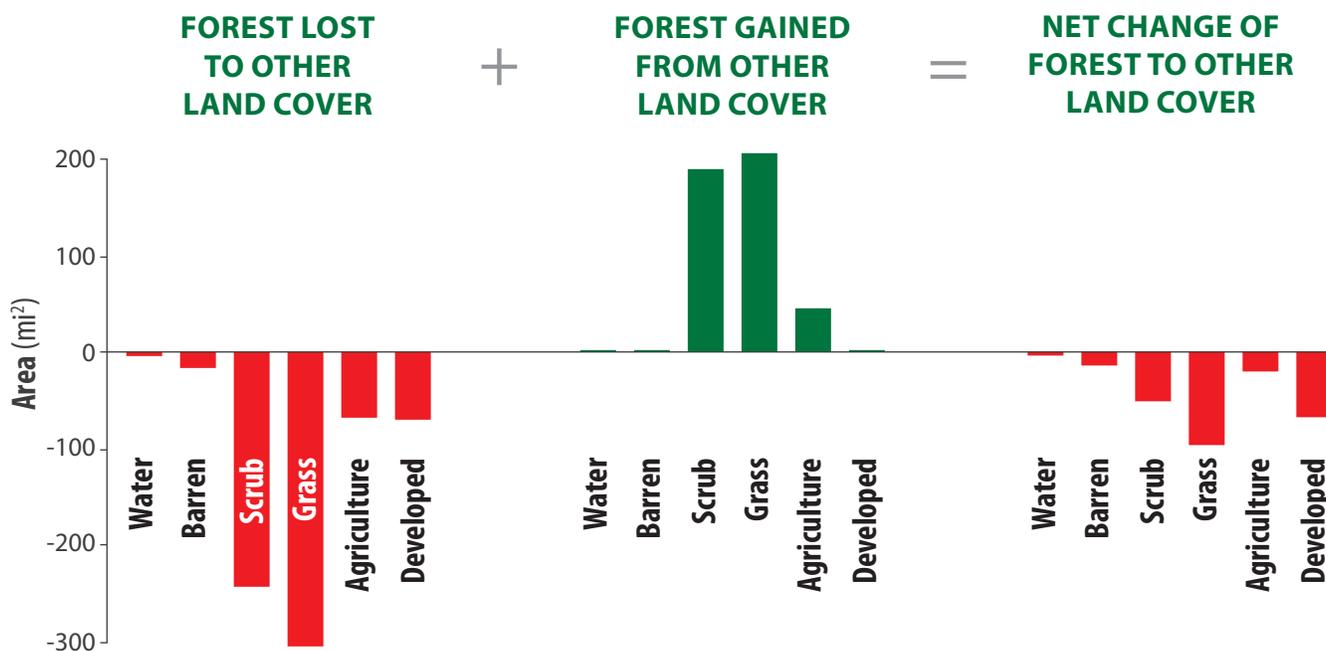


Forest in the Lake Michigan Basin.

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**Decrease in Forest Area Equivalent to**





These graphs show the categories of land cover that forests were lost to or gained from, along with the resulting net change between each of these categories and forests between 1985 and 2010.

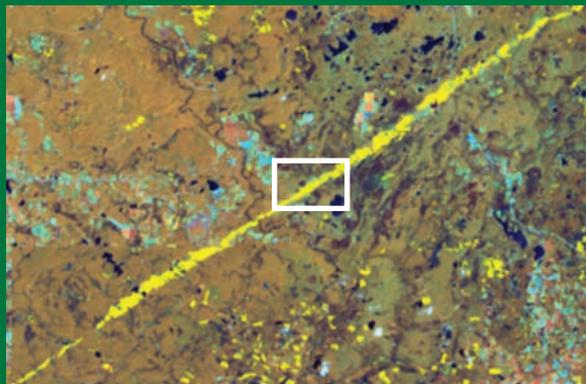
**M**OST OF THE LOSSES IN FOREST LAND COVER consisted of changes from forest to grass or scrub. At the same time, most gains came from areas that formerly were grass or scrub and changed to forest. This pattern suggests that many of the Basin's forested areas are undergoing transitions that do not result in permanent loss. However, losses of forest to development are more likely to be permanent. Approximately 77 square miles of forest were lost to development during the study period, accounting for 17% of the net losses.

### HIGHLIGHT: TORNADO REDUCES FOREST LAND COVER

On June 7, 2007, several tornados touched down across Central and Northeast Wisconsin.

*Below left:* Landsat data from 2010 reveal a tornado scar more than 50 miles long.

*Below right:* This aerial photograph shows a section (white box) of the 14,000 acres of trees that were snapped or flattened. The tornado-scarred areas are now classified as grass and emergent wetland.



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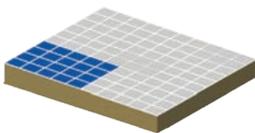
# WETLAND



**WETLAND AREA**

9,166 mi<sup>2</sup>

**20% OF REGION**



**A**PPROXIMATELY 20% OF THE LAKE MICHIGAN Basin was covered by freshwater wetlands in 2010. Wetlands were most prominent in the northwestern portion of the Basin in the Upper Peninsula of Michigan and along the Wisconsin border.

- Palustrine forested
- Palustrine scrub/shrub
- Palustrine emergent
- Unconsolidated shore

**2010 wetland map for the Lake Michigan Basin. This map depicts four wetland categories.**



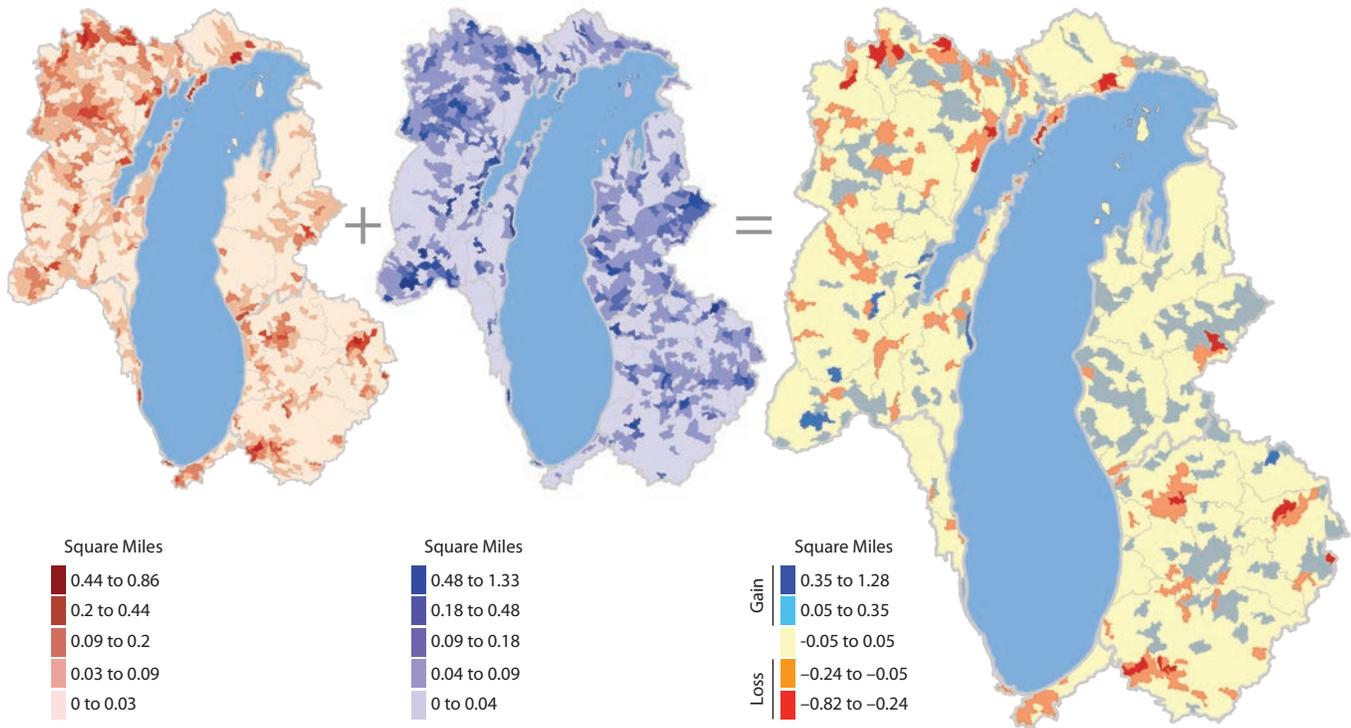
**WETLAND AREA LOST**

38 square miles

**WETLAND AREA GAINED**

50 square miles

**NET CHANGE  
IN WETLAND AREA**



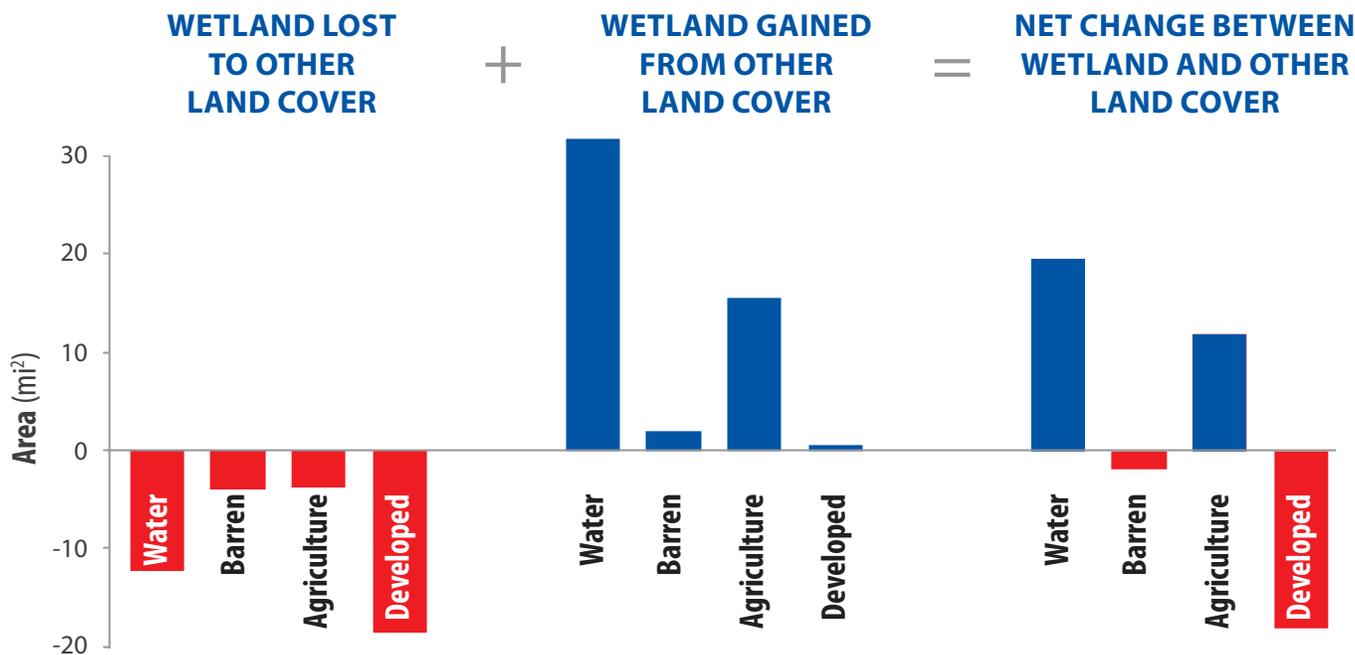
**T**OTAL WETLAND AREA REMAINED RELATIVELY STABLE over the 25-year period. There was a loss of 38 square miles (above left) and a gain of 50 square miles (above center). Some areas had a net gain and others had a net loss (above right). The overall net change was an increase of 12 square miles, or less than 1%.

Forested wetlands such as hardwood swamp and spruce/fir/white cedar are the most common type (62%) of wetland. The short growing season and prevalence of mineral-poor soils of the Great Lakes region contribute to the large proportion (25%) of scrub wetland in the basin. Thirteen percent of the Basin’s wetlands are emergent wetlands, including bogs.



Wetland that developed along the shoreline of Grand Traverse Bay as water level receded.

© Doug Lemke/Shutterstock.com

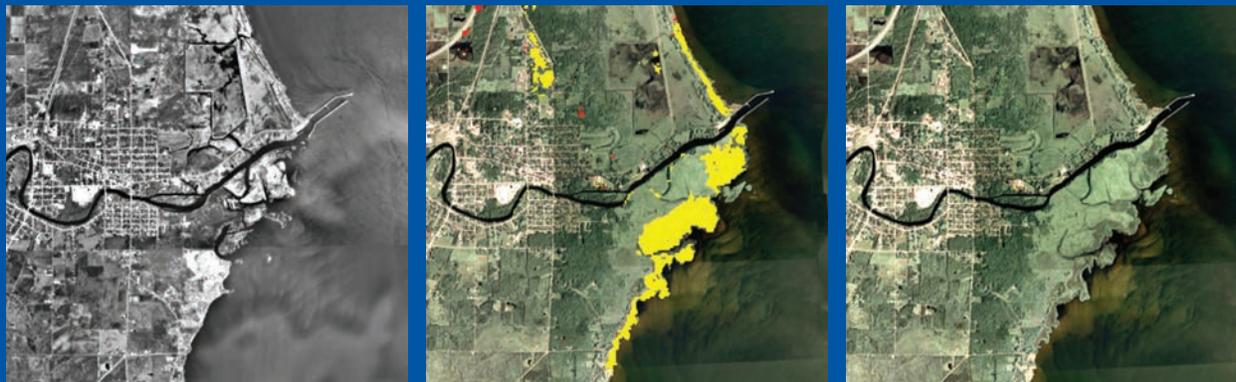


These graphs show the categories of land cover that wetlands were lost to or gained from, along with the resulting net change between each of these categories and wetlands between 1985 and 2010.

**W**ETLANDS IN THE LAKE MICHIGAN BASIN were primarily lost to development (48% of all wetlands lost) and open water (32%). Nearly two-thirds (63%) of wetlands gained came from open water. These gains appear to be attributable to the lowering of water levels in lakes and ponds, which exposed new growing areas for wetland plant species. New wetlands were also gained from formerly agricultural features (31%). The gains may have resulted from restoration or management activities that allowed these areas to revert back to a more natural condition.

**HIGHLIGHT: A WETLAND EXPANDS WITH LOWER LAKE LEVELS**

Oconto Marsh is a large wetland complex of mostly sedge meadow and emergent marsh on the lower Green Bay shoreline of Wisconsin. *Below left:* The wetland area was smaller in 1985. *Below center and right:* New areas of marsh (highlighted in yellow) developed as water level dropped. This analysis of land cover supports the finding by the Wisconsin Department of Natural Resources that long-term changes in water levels (as tracked by the U.S. Army Corps of Engineers) have affected the extent and composition of wetlands in this important breeding ground for migratory birds.



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