

Coastal Land Cover Change and Analysis in the Great Lakes

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NOAA Office for Coastal Management



OFFICE FOR COASTAL MANAGEMENT

DIGITAL COAST

C-CAP Regional Land Cover and Change

coast.noaa.gov/digitalcoast/data/ccapregional

- NOAA maps 25% of the contiguous U.S. + Hawaii and Caribbean
 - Coastal expression of the National Land Cover Database
 - Added focus on wetland detail
 - (modeling effort part of 2010 update)
 - 25 land cover categories at 30 meter resolution
 - Updated every five years
 - (1996, 2001, 2006, 2010)
- *Some areas go further back



Historic Dates of C-CAP and Data Partnerships

1992 Era

Mid-Atlantic (DE, VA, MD)

Chesapeake Bay Program Office (CBPO)

Washington State

WA Department of Ecology funded

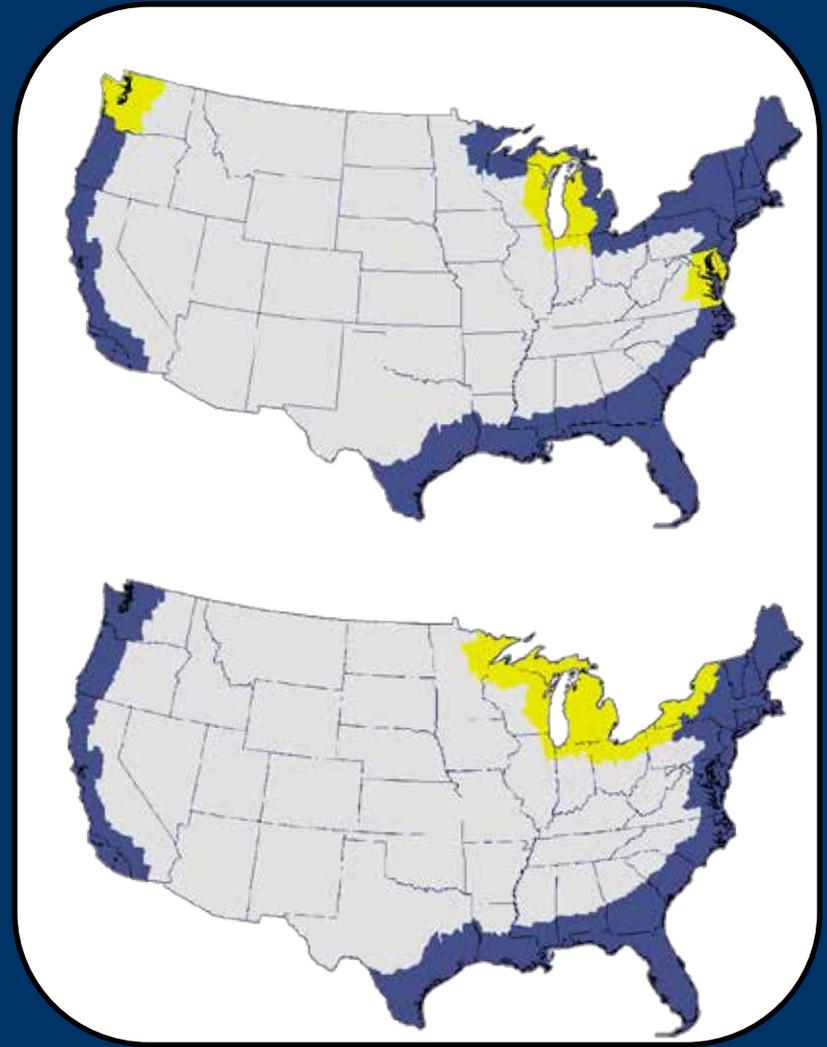
Lake MI Basin

GLRI funded

1985 and 1975 Eras

Great Lakes Restoration Initiative

GLRI funded for both dates



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Currently Funded 2015/2016 Updates



planning to complete full CONUS area by the fall-winter of 2018



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The Coastal 25 Percent

Accounts for 41% of developed land

Shoreline Counties = 39% of total population even though it is < 10% of the CONUS area

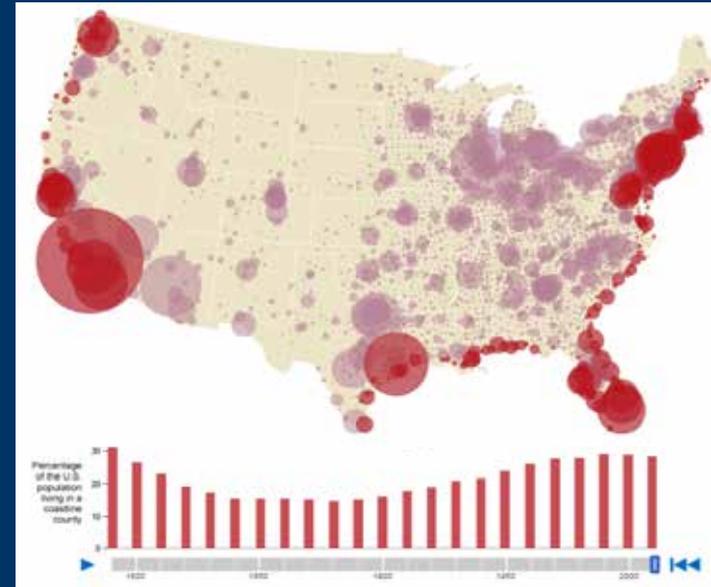
Accounts for 67% of NLCD wetlands

From 1996 to 2010, coastal wetlands decreased by ~1,535 sq miles

A trend counter to that seen in the country as a whole (which saw a net increase in wetlands over the same time frame).

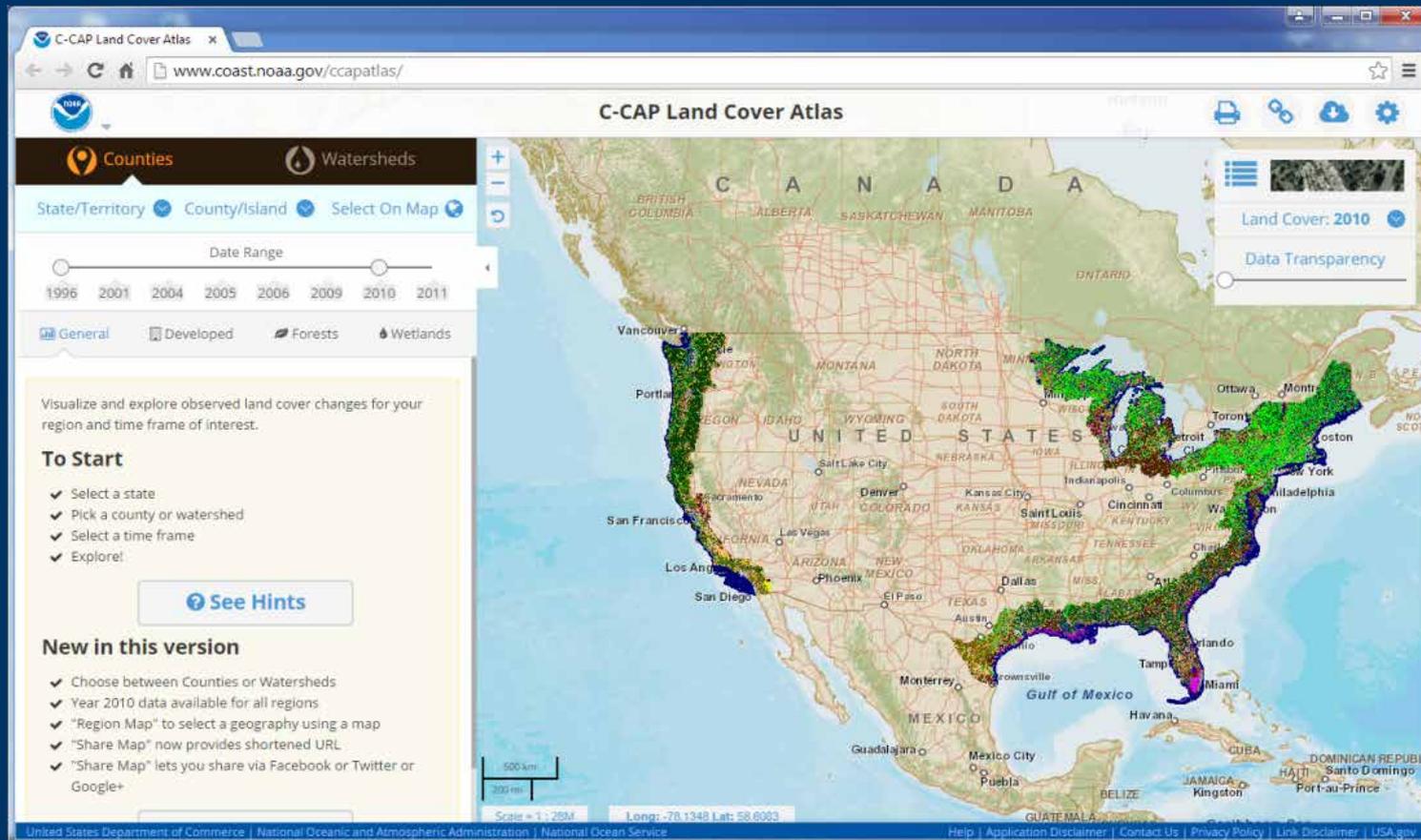
Accounted for 44% of all change (2001 to 2010)

Plus change in C-CAP classes that are not mapped in NLCD



Land Cover Atlas

coast.noaa.gov/digitalcoast/tools/lca

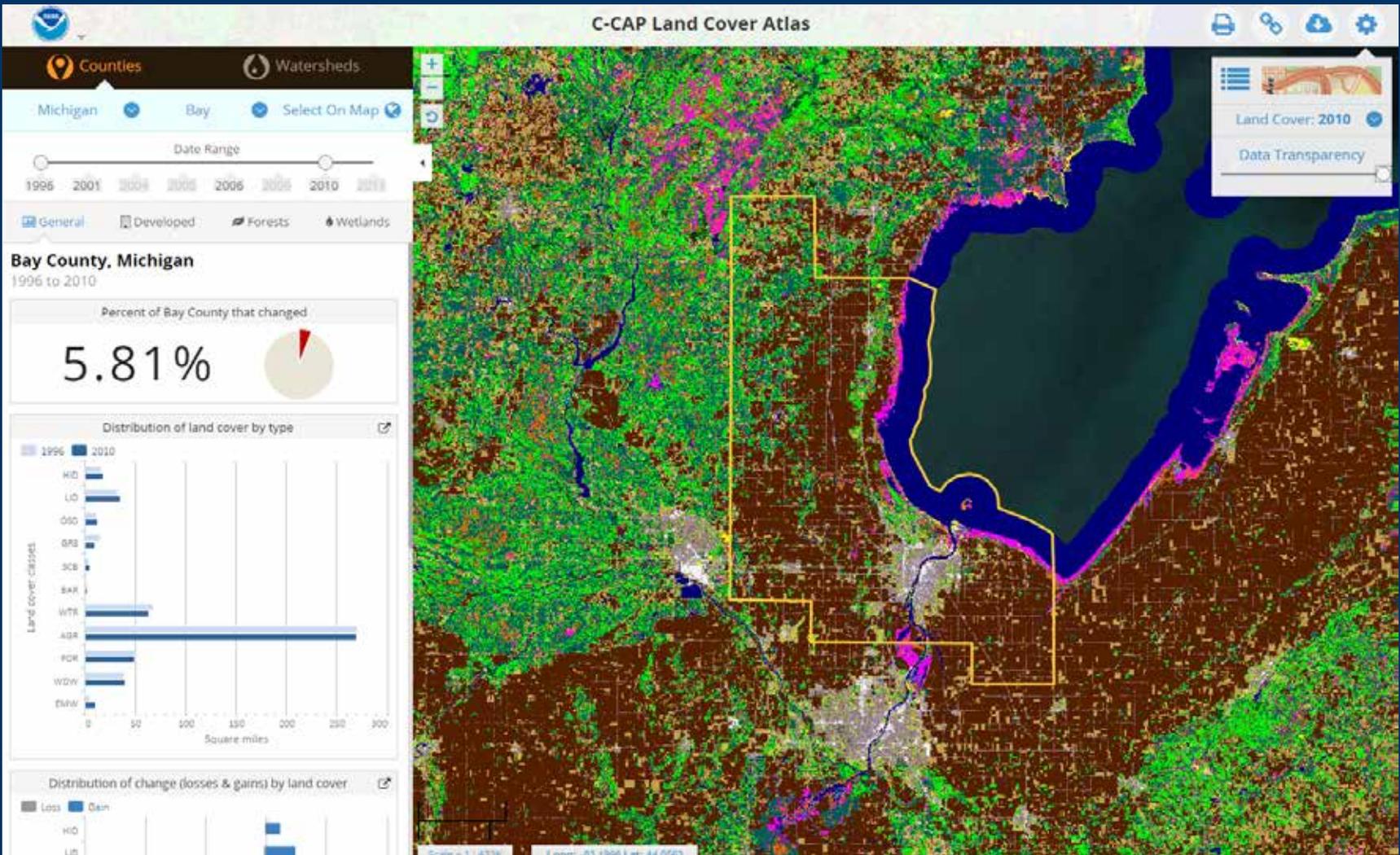


Online data viewer
User-friendly access
Summarizes general land change trends

Allows for custom analysis
No need for desktop software or
advanced expertise



Land Cover Atlas



Land Cover Atlas

C-CAP Land Cover Atlas

Counties Watersheds

Michigan Bay Select On Map

Date Range: 1996 2001 2004 2005 2006 2008 2010 2011

General Developed Forests Wetlands

Bay County, Michigan
1996 to 2010

Percent of Bay County that changed
5.81%

Distribution of land cover by type

Land cover classes	1996 (Square miles)	2010 (Square miles)
HD	~5	~5
LD	~5	~5
CD	~5	~5
GRS	~5	~5
SCB	~5	~5
BAR	~5	~5
WTS	~5	~5
ADR	~250	~250
FOR	~5	~5
WDW	~5	~5
EMW	~5	~5

Distribution of change (losses & gains) by land cover

Land cover classes	Loss (Square miles)	Gain (Square miles)
HD	~5	~5
LD	~5	~5

Scale = 1:433K Long: -84.4789 Lat: 43.5540



Land Cover Atlas

C-CAP Land Cover Atlas

Counties | Watersheds

Michigan | Bay | Select On Map

Date Range: 1996 2001 2004 2005 2006 2009 2010 2011

General | Developed | Forests | Wetlands

Bay County, Michigan
1996 to 2010

Percent of Bay County that is developed

Year	Percentage
1996	11.61%
2010	12.57%

Percent of Bay County impervious surface area

Year	Percentage
1996	4.05%
2010	4.36%

Percent net increase in developed area: 8.23% ↑

Percent net increase in impervious surface area: 7.63% ↑

Distribution of developed change by developed type

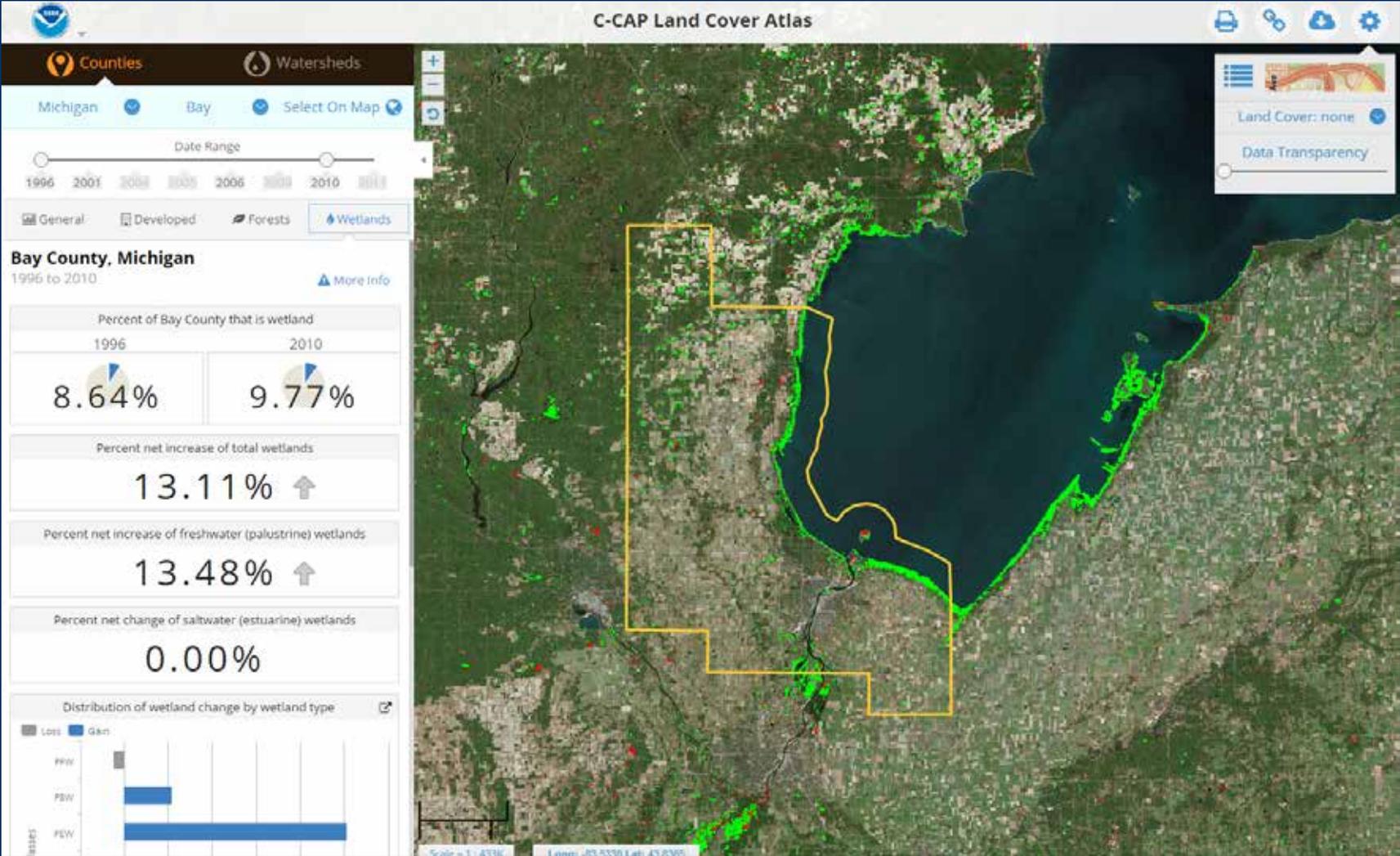
Loss Gain

Scale = 1:4336 | Long: -83.7476 | Lat: 43.8467

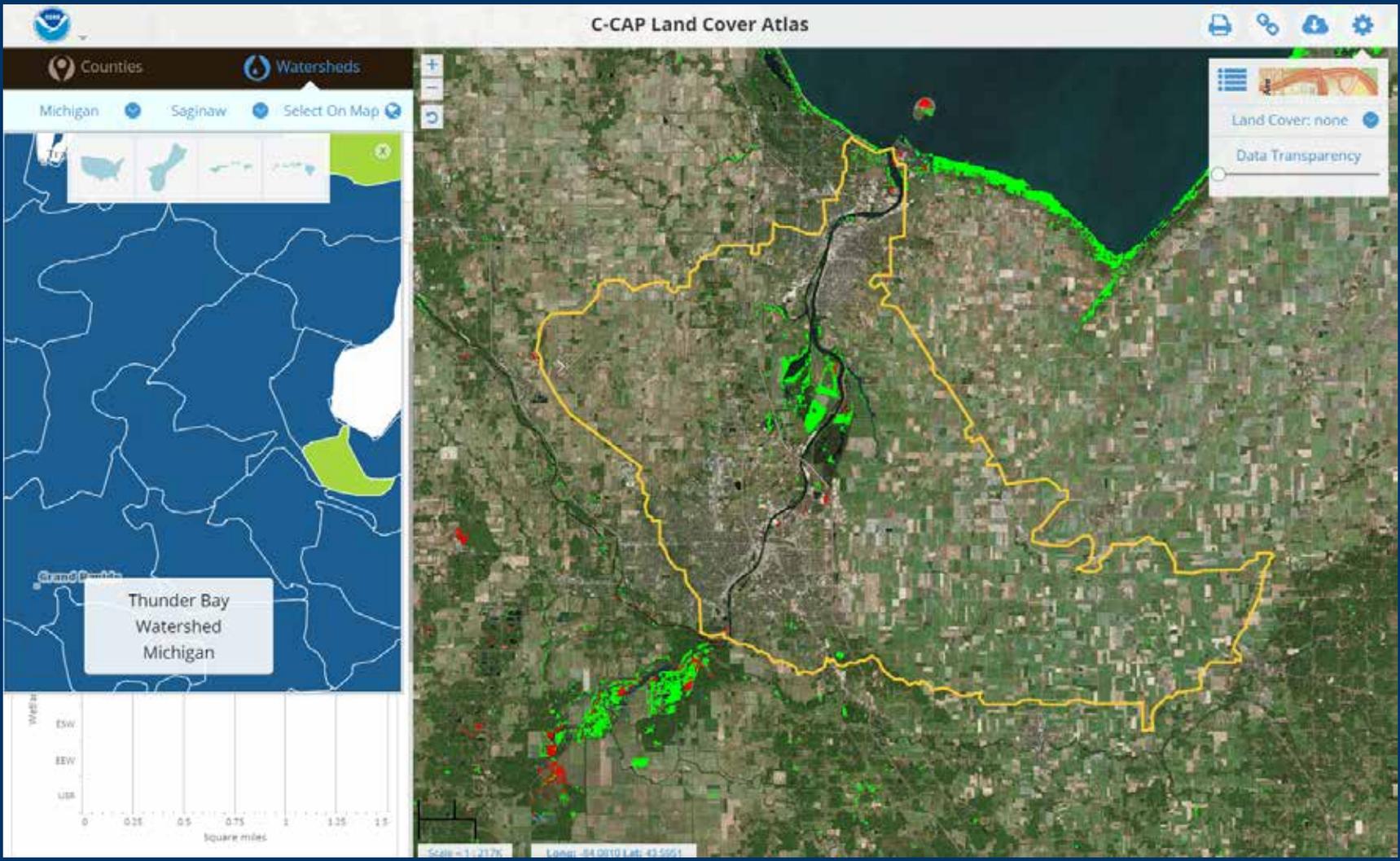
United States Department of Commerce | National Oceanic and Atmospheric Administration | National Ocean Service | Help | Application Disclaimer | Contact Us | Privacy Policy | Link Disclaimer | USA.gov



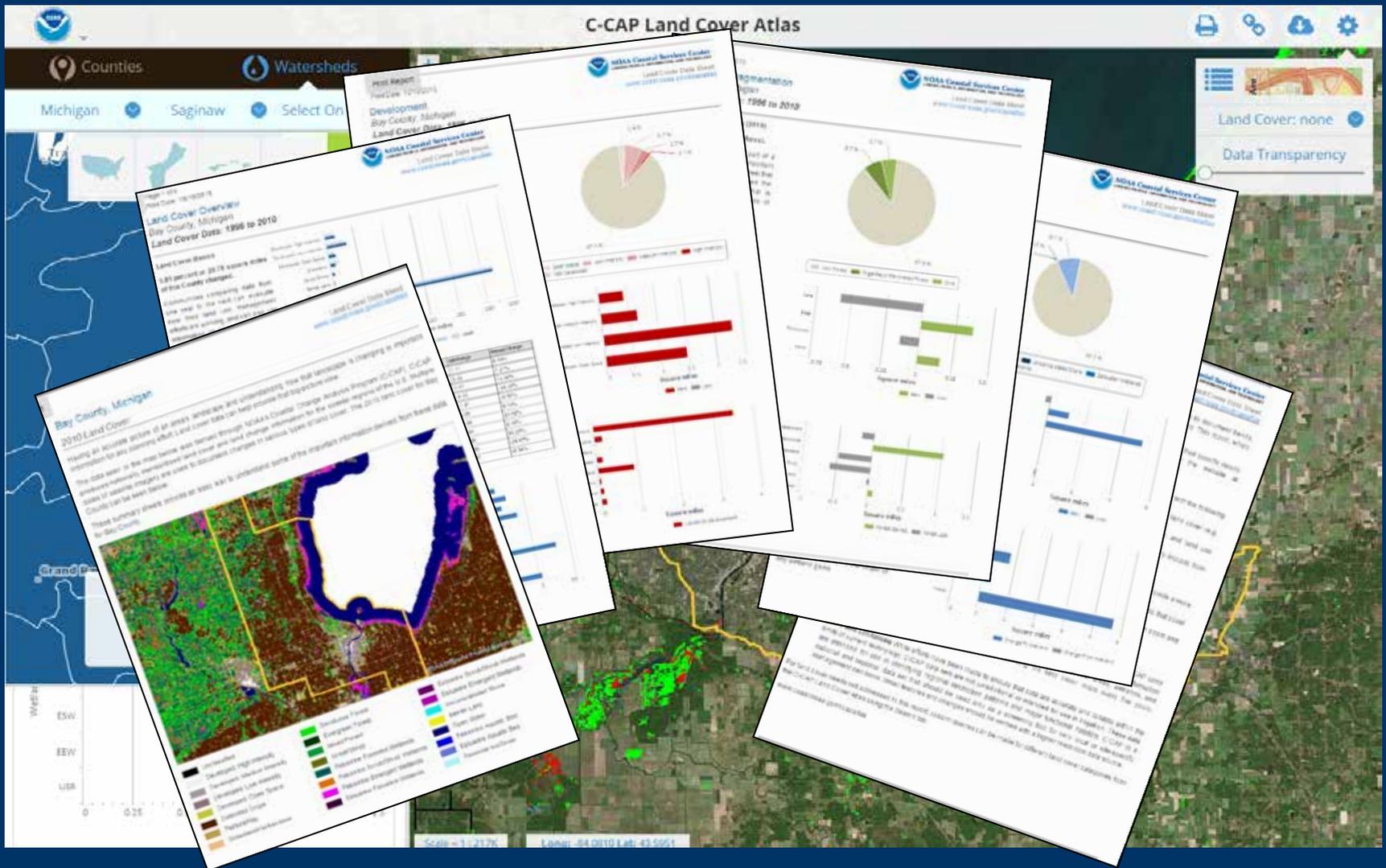
Land Cover Atlas



Land Cover Atlas

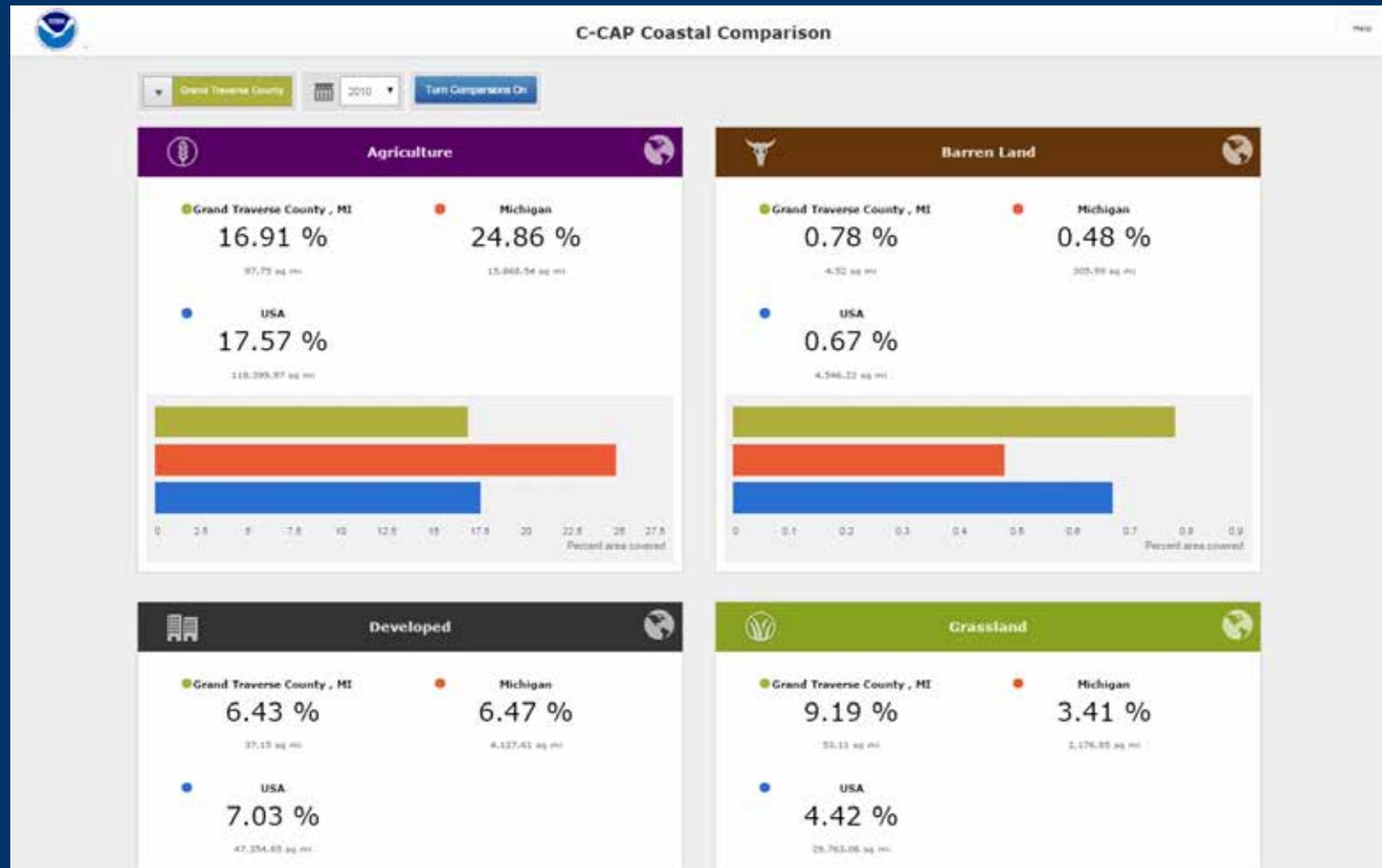


Land Cover Atlas



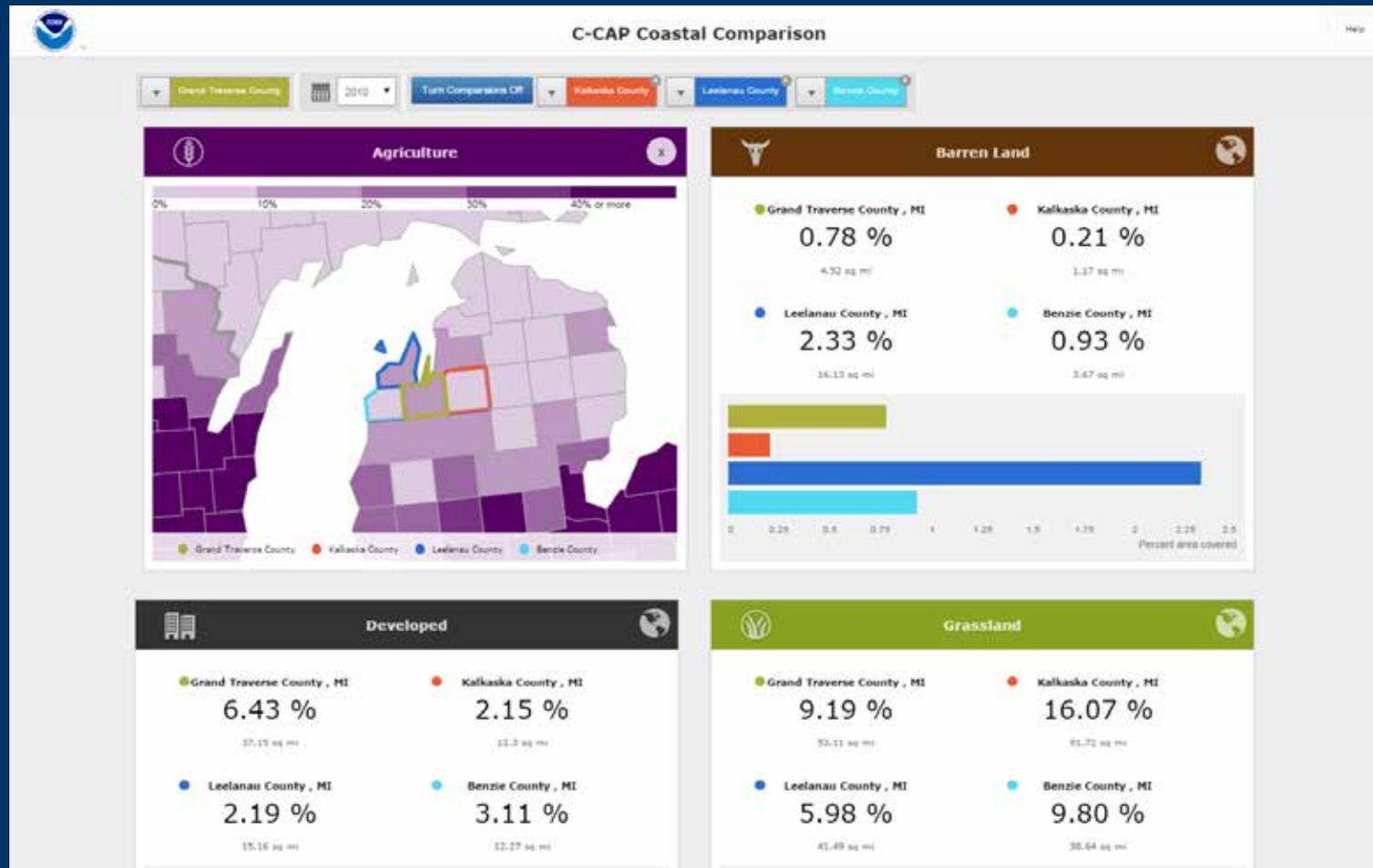
C-CAP Coastal Comparison

coast.noaa.gov/ccap-comparison



C-CAP Coastal Comparison

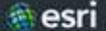
coast.noaa.gov/ccap-comparison



Story Maps

coast.noaa.gov/dataregistry/search/collection/info/ccapregional

How To Use Land Cover Data as a Water Quality Indicator

A story map    

1 Identify Potential Impacts from Impervious Surfaces

Impervious surfaces and other forms of development reduce the infiltration of water into the ground. Impervious surfaces often contribute to higher storm water runoff, greater sediment yields, and increased pollutant loads, all of which can degrade water quality. Sensitive streams, for instance, can be impacted by as little as 5 to 10 percent impervious surface area, with greater impairments expected when rates exceed 20 to 25 percent.

How much impervious surface is too much? This map highlights the thresholds for anticipated impacts. Zoom to see your community.

Click [here](#) to read more about the analysis performed to produce this map.

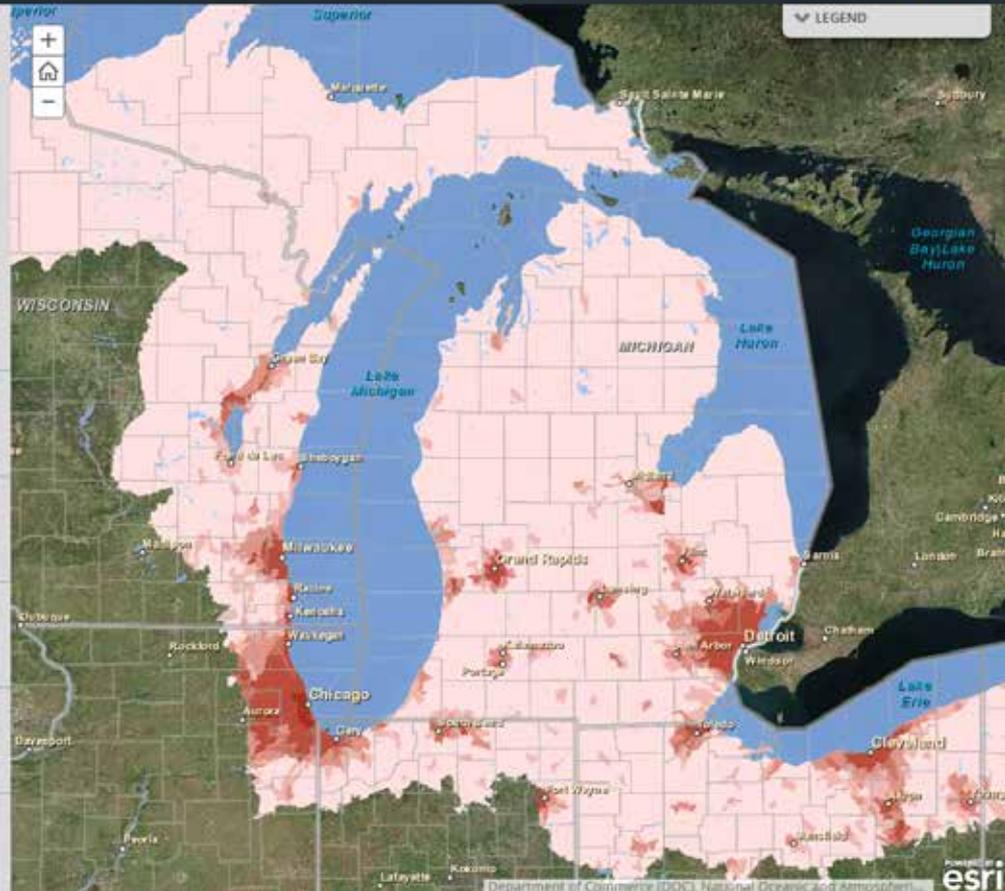
2 Identify Potential Effects of Forest Cover

3 Examine Relationship of Forest Cover to Impervious Area

4 Identify Whether Developed Grasses Could be a Factor

5 Examine Riparian Buffers

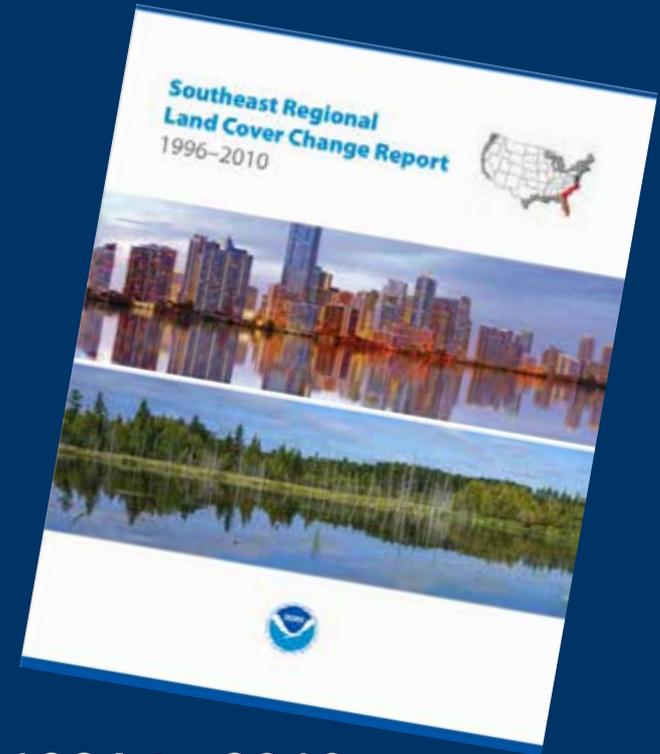
6 Examine Other Potential Water Quality Factors



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Regional Land Cover Change Reports

coast.noaa.gov/digitalcoast/publications/regional-land-cover-change



Summary of C-CAP changes 1996 to 2010
Five regions in Contiguous U.S.
National Level Summary



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Lake Michigan Basin Land Cover Change Report 1985–2010



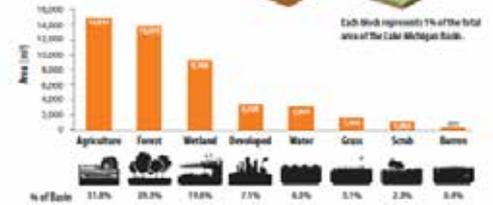
NOAA Coastal Services Center
LINKING PEOPLE, INFORMATION, AND TECHNOLOGY

LAND COVER



- Developed, High Intensity
- Developed, Medium Intensity
- Developed, Low Intensity
- Developed, Open Space
- Cultivated Crops
- Pasture/Hay
- Non-forested/shrub/scrub areas
- Black/White Forest
- Emergent Forest
- Wood/Pond
- Shrub/Scrub
- Palustrine Forested Wetland
- Palustrine Scrub/Shrub Wetland
- Palustrine Emergent Wetland
- Palustrine Forested Wetland
- Palustrine Shrub/Scrub Wetland
- Palustrine Emergent Wetland
- Shrub/Scrub
- Barren Land
- Open Water

In 2010, AGRICULTURE (20%) AND FOREST (21%) were the most common categories of land cover in the Basin, accounting for more than half the area. The areas most common were wetlands (20%), developed (7%), and water (6%). Less than 6% of the area was classified as grass, scrub, or barren.

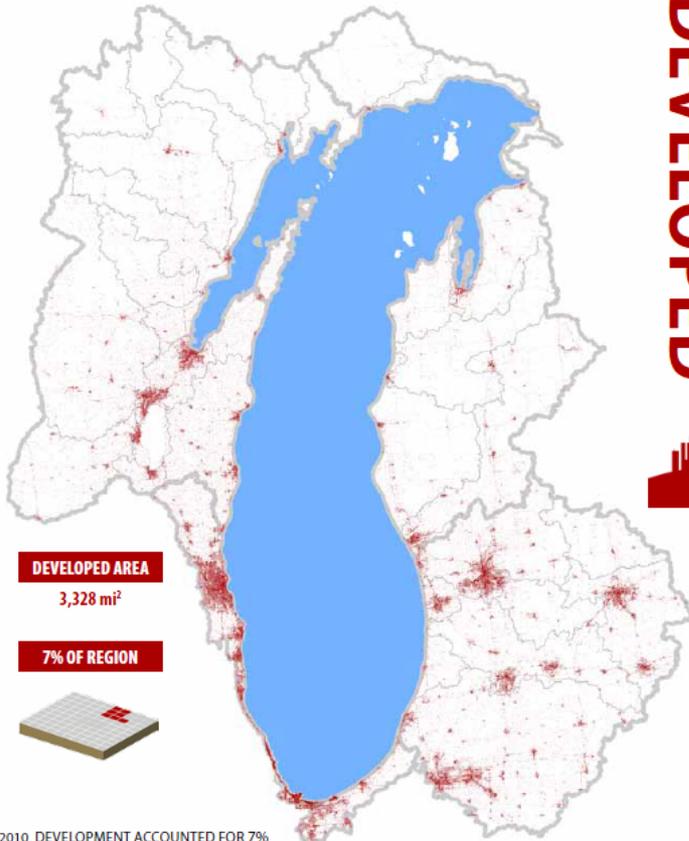


The 18 land cover classes in the Lake Michigan Basin have been grouped into 8 major categories that are displayed in the bar graphic to highlight their relative distribution in 2010. More detailed information about these 8 categories is displayed in the bar chart.



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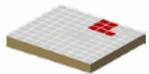
DEVELOPED



DEVELOPED AREA

3,328 mi²

7% OF REGION

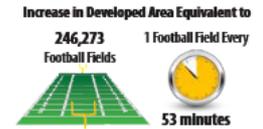
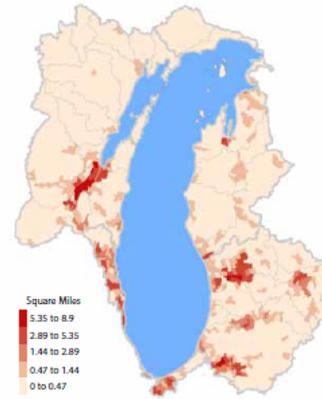


IN 2010, DEVELOPMENT ACCOUNTED FOR 7% of the Lake Michigan Basin. This development was concentrated in southern sections of the Lake Michigan Basin around the major metropolitan centers of Green Bay and Appleton, Wisconsin; Milwaukee, Wisconsin; Chicago, Illinois; South Bend, Indiana; Grand Rapids, Michigan;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

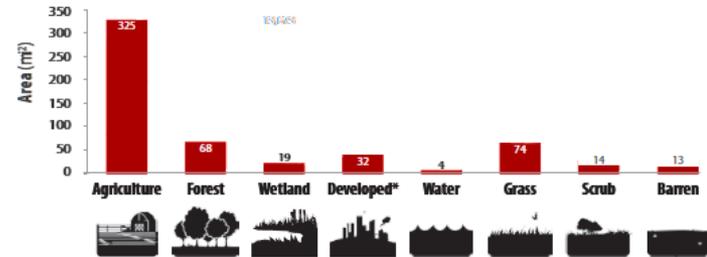
INCREASE IN DEVELOPED AREA



FROM 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.

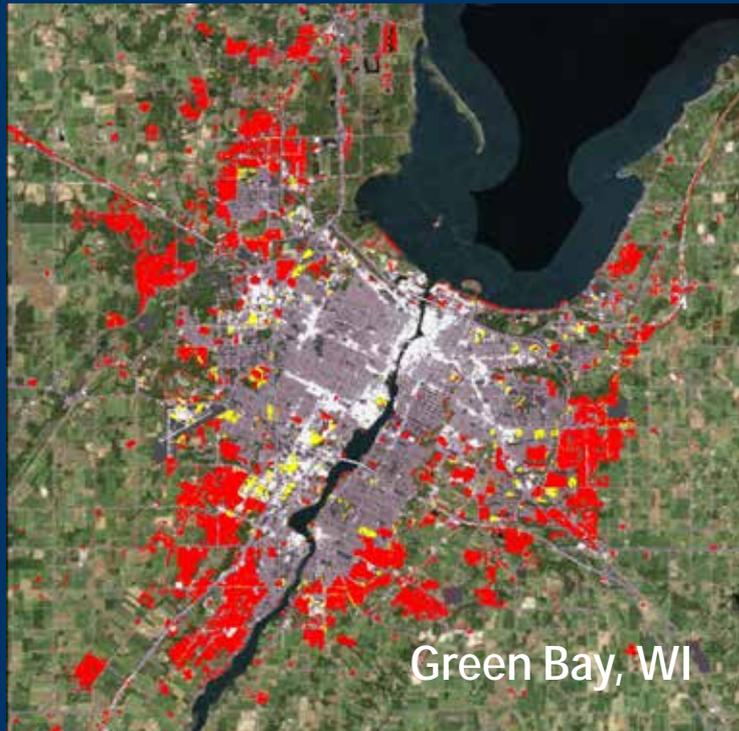
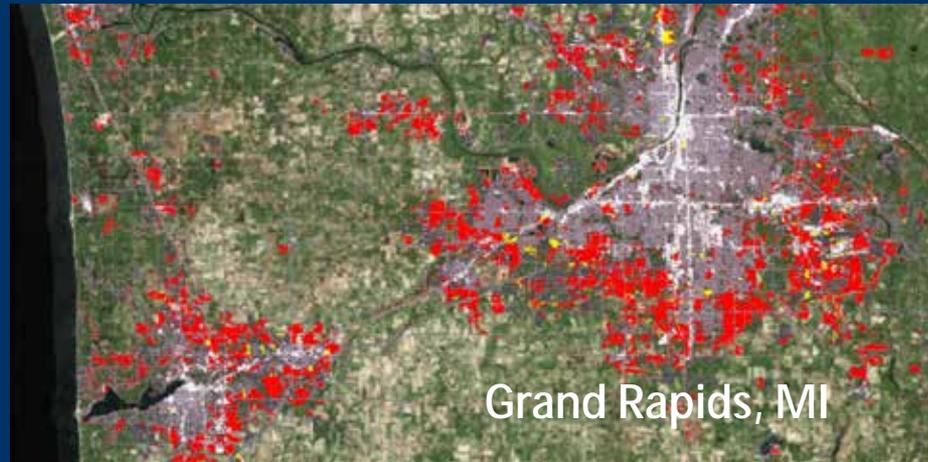
LAND COVER CONVERTED TO DEVELOPED AREA



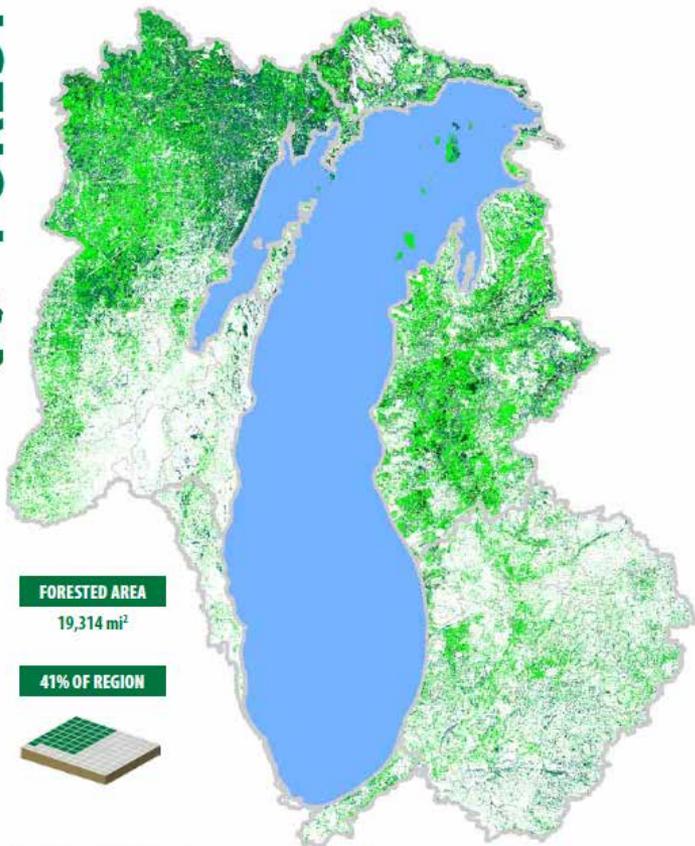
This bar graph shows the area of each land cover that was converted to development between 1985 and 2010. * Increases in development intensity



Developed



FOREST



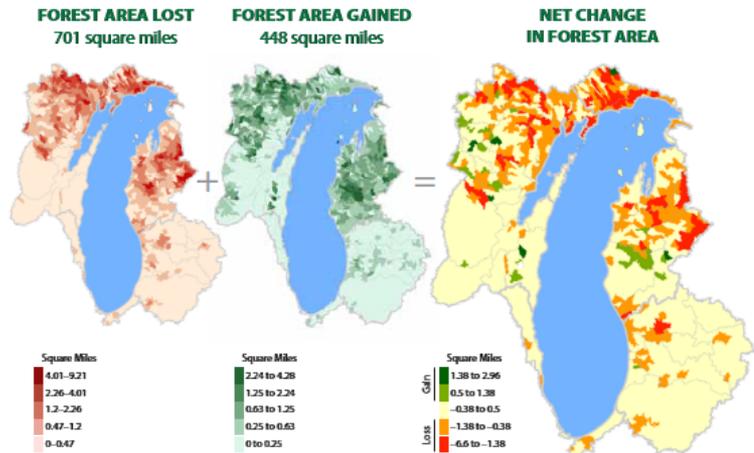
FORESTED AREA
19,314 mi²

41% OF REGION

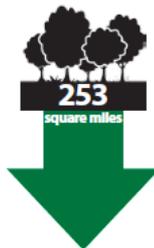
IN 2010, FOREST COVERED 41% OF THE Lake Michigan Basin, including 29% upland forest and 12% wetland forest. The landscape was more heavily forested in northern areas and away from major metropolitan areas.

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

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



FROM 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).

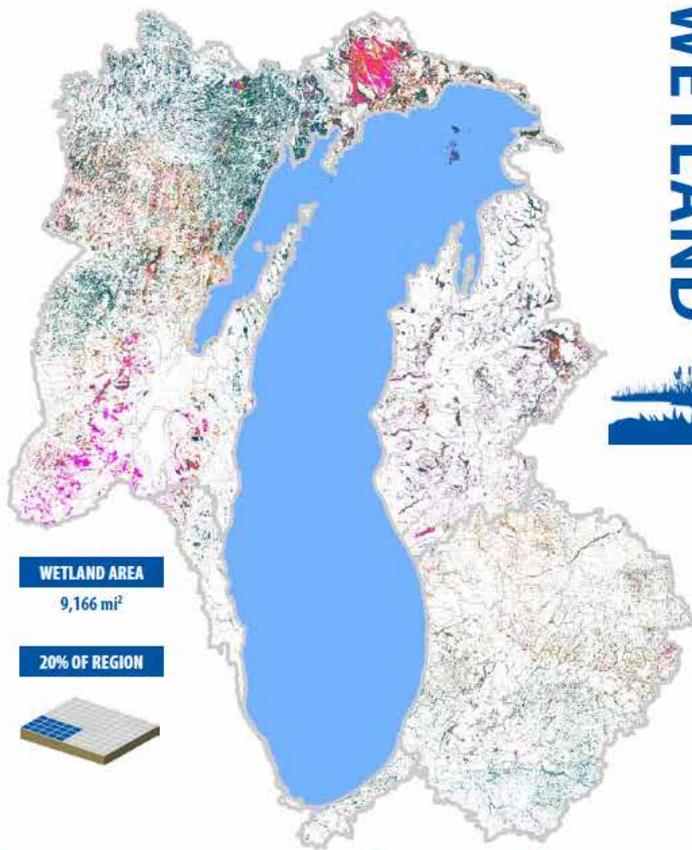


Forest in the Lake Michigan Basin. © Alamy Stock/Shutterstock.com

Decrease in Forest Area Equivalent to
121,968 Football Fields
1 Football Field Every 1 hr. 47 min.



WETLAND



WETLAND AREA

9,166 mi²

20% OF REGION



APPROXIMATELY 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.

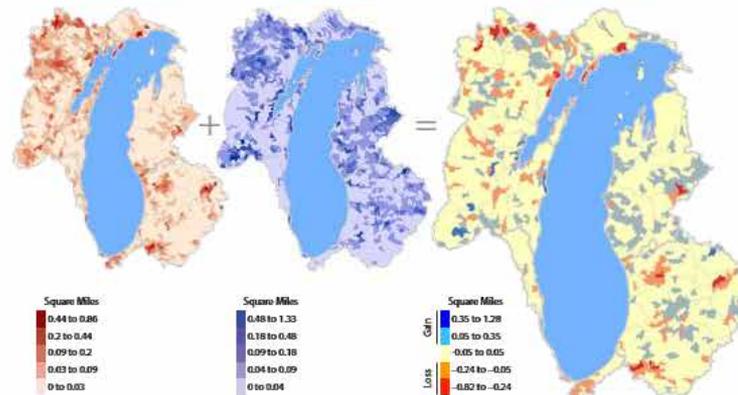
- Palustrine forested
- Palustrine scrub/shrub
- Palustrine emergent
- Unconsolidated shore

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



TOTAL 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.

© Dony Lombar/Shutterstock.com



Digital Coast

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What is the Digital Coast?

This NOAA-sponsored website is focused on helping communities address coastal issues and has become one of the most-used resources in the coastal management community. The dynamic Digital Coast Partnership, whose members represent the website's primary user groups, keeps the effort focused on customer needs.

Learn more in our [About](#) section, or just dive in. And please provide feedback as often as possible. Hearing from you is what makes the Digital Coast work.

Top: [Data](#) [Tools](#) [Training](#) [Stories](#)

- 1 [Coastal Lidar](#)
- 2 [Coastal Change Analysis Program](#)
- 3 [Economics: National Ocean Watch](#)
- 4 [Electronic Nautical Charts](#)
- 5 [Emergency Response Imagery](#)



C-CAP Data Access

coast.noaa.gov/dataregistry/search/collection

The screenshot displays the Digital Coast Data Registry interface. At the top, the Digital Coast logo is on the left, and navigation links for Data, Tools, Training, Stories, Topics, and GeoZone Blog are in the center. A search bar is on the right. Below the navigation, there are tabs for 'VIEW BY' with 'Collection' and 'Dataset' selected, and a 'My Map' button. On the left side, there is a map of the United States with a search box for location and a 'Clear All' button. Below the map is a 'Data Type' filter menu with 'Land Cover' selected. The main content area is titled 'Explore the Data Registry' and features a search bar with the text 'Search by dataset, collection or keyword'. Below this, there are 10 dataset entries, each with a title, a NOAA logo, and a set of icons for actions like download, share, and print. The datasets listed are: 1975 C-CAP Regional Land Cover, 1975-1985 C-CAP Regional Land Cover Change, 1975-1996 C-CAP Regional Land Cover Change, 1975-2001 C-CAP Regional Land Cover Change, 1975-2006 C-CAP Regional Land Cover Change, 1975-2010 C-CAP Regional Land Cover Change, 1985 C-CAP Regional Land Cover, 1985-1996 C-CAP Regional Land Cover Change, 1985-2001 C-CAP Regional Land Cover Change, and 1985-2006 C-CAP Regional Land Cover Change.



C-CAP Data Access

coast.noaa.gov/ccapftp

The screenshot shows a web browser window with the URL coast.noaa.gov/ccapftp/#/. The browser's address bar and tabs are visible at the top. The main content area features a map of the United States with a blue overlay representing the coastal zone. In the center of the map is the NOAA logo, followed by the text "C-CAP FTP TOOL" and "A Graphical Interface for Downloading Land Cover Data." Below this text is a dropdown menu titled "Choose a State/Territory" with a list of options: Alabama, American Samoa, California, Commonwealth of the Northern Mariana Islands, Connecticut, Delaware, Florida, Georgia, Guam, Hawaii, Illinois, Indiana, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, and Mississippi. The "Michigan" option is currently selected and highlighted in blue.



coast.noaa.gov/ccapftp/#/

Apps OCM Login Page Documents - All Do... IME :: NOAA Coastal... Deltek Time & Expe... Custom size outdoo...

NOAA

C-CAP FTP TOOL

Michigan



About Data Type

These nationally consistent, raster based products provide individual dates of land cover inventories. Up to 25 classes of land cover are mapped. Data is based upon 30 meter Landsat imagery.

Regional Dates

- [Regional Change](#)
- [Wetland Potential](#)

- [Michigan 2010](#)
- [Michigan 2006](#)
- [Michigan 2001](#)
- [Michigan 1996](#)
- [Michigan 1985](#)
- [Michigan 1975](#)



C-CAP Regional Land Cover

coast.noaa.gov/dataregistry/search/collection/info/ccapregional

Digital Coast

← Return To Search

Coastal Change Analysis Program Regional Land Cover and Change

NOAA OFFICE FOR COASTAL MANAGEMENT | NOAA

View Datasets

DATE(S) AVAILABLE
Updated every five years

RESOLUTION
30-meter resolution

CLASSIFICATION
Up to 25 classes mapped

About this Collection

These nationally standardized, raster-based inventories cover coastal intertidal areas, wetlands, and adjacent uplands for the coastal U.S. Data are derived from the analysis of multiple dates of remotely sensed Landsat imagery. There are two types of files available: individual dates of land cover that supply a wall-to-wall map for each area, and change files that compare one date to another in order to highlight where and what type of land cover change occurred between those dates. These data products are updated every five years and are produced through documented, repeatable procedures using standardized data and methods to ensure consistency through time and across geographies. These Land cover and land change products are produced as part of NOAA's Coastal Change Analysis Program (C-CAP). C-CAP data contribute the "coastal expression" of the National Land Cover Database (NLCD) and the A-16 land cover theme of the National Spatial Data Infrastructure.

Limitations and Notes



C-CAP Regional Land Cover

coast.noaa.gov/dataregistry/search/collection/info/ccapregional

Featured Resources

Regional Land Cover Change Reports

Summarizes land cover status in 2010 and land cover changes over the previous decade and a half (from 1996 to 2010).

C-CAP Land Cover Classification Story Map

This interactive story map provides examples of locations and photographs for each of the C-CAP land cover types.

How To Use Land Cover Data As A Water Quality Indicator

What happens on the land impacts the watershed. With this how to, users will be shown how land cover data can be used to assess several water quality indicators.

C-CAP Product Page

Presents basic information about the data and tools associated with C-CAP.

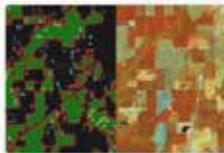
Coastal Change Analysis Program (C-CAP) Classification Scheme And Class Definitions

Provides a description of land cover classes mapped in Regional Land Cover products.

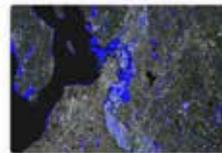
Here are some collections you may be interested in



Coastal Change Analysis Program High Resolution Land Cover and Change



Coastal Change Analysis Program Regional Forest Fragmentation



Coastal Change Analysis Program Wetland Potential Layer



Landsat Satellite Imagery

Here are some tools you may be interested in



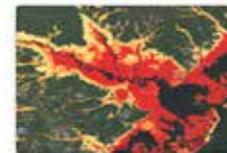
OpenNSPECT



Coastal County Snapshots



C-CAP Coastal Comparison Tool



Coastal Flood Exposure Mapper



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C-CAP Regional Land Cover

coast.noaa.gov/dataregistry/search/collection/info/ccapregional

Other Documents and Resources

Getting The Most Out Of Your Land Cover Mapping Dollars

Discusses how the State of Maine leveraged C-CAP work to develop data to suit its needs (Coastal Connections, August/September, 2006).

Lake Michigan Basin Land Cover Change Report

Summarizes land cover status in 2010 and land cover changes over the previous decades using maps and graphics.

Land Cover Data Goes Coast-To-Coast

Discusses the benefits of a nationally standardized land cover, through C-CAP, and the data's value in addressing a wide range of coastal ecosystem issues in the Great Lakes (Coastal Connections).

Original C-CAP Guidance For Regional Implementation

Provides technical and historical background on C-CAP. Changes in methodologies and C-CAP's classification scheme have occurred since the publication date, but the document remains useful to understand

Show More

Stories from the Field

Adapting to Sea Level Rise in Miami-Dade County, Florida

Advancing Restoration in the Great Lakes Region

Analyzing Sedimentation Processes to Guide Conservation in Oregon

Analyzing the Impacts of Hurricane Katrina on Forest Ecosystem Services

Assessing Fire Hazard Risk in Southern California

Assessing Hazard Vulnerability and Resilience in Coastal Communities of the Delaware Bay

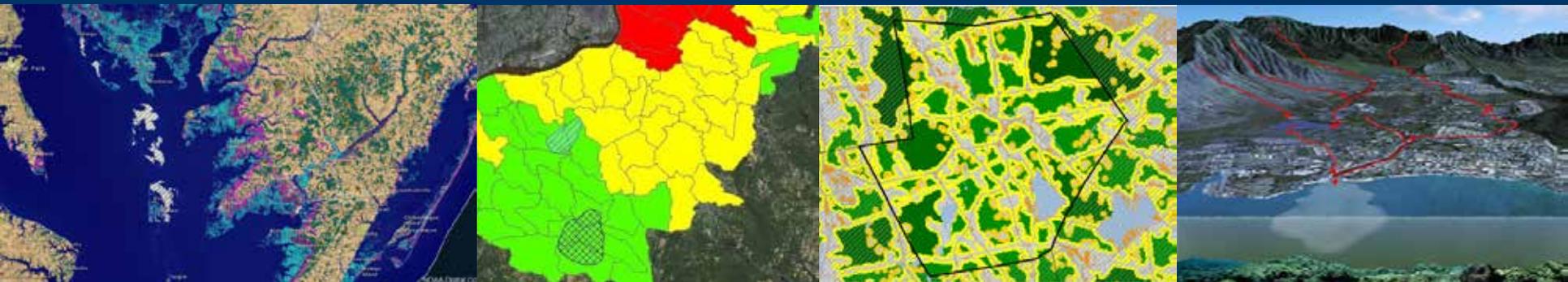
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Related Tools Available on the Digital Coast



- Sea Level Rise and Coastal Flooding Impacts Viewer
- Coastal County Snapshots
- Flood Exposure Mapper
- Habitat Priority Planner (HPP)
- Impervious Surface Analysis Tool (ISAT)
- Landscape Fragmentation Tool*
- OpenNSPECT



*Landscape Fragmentation Tool has been developed by the University of Connecticut's Center for Land Use Education & Research (CLEAR)



Questions?

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