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**mail:**  
U.S. Department of Agriculture  
Office of the Assistant Secretary for Civil Rights  
1400 Independence Avenue, SW  
Washington, D.C. 20250-9410; or

**fax:**  
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[www.usda.gov/sites/default/files/documents/usda-program-discrimination-complaint-form.pdf](http://www.usda.gov/sites/default/files/documents/usda-program-discrimination-complaint-form.pdf), en cualquier oficina del USDA, llamando al (866) 632-9992, o escribiendo una carta dirigida al USDA. La carta debe contener el nombre, la dirección y el número de teléfono del reclamante, y una descripción escrita de la supuesta acción discriminatoria con suficiente detalle para informar al Subsecretario de Derechos Civiles (ASCR, por sus siglas en inglés) sobre la naturaleza y la fecha de la presunta violación de los derechos civiles. La carta o el formulario AD-3027 completado debe enviarse al USDA por medio de:

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Esta institución ofrece igualdad de oportunidades.



# Coastal Community Inundation: Impacts in the High Water Years 2019-2021

Mark Brederland, Sea Grant Extension

Elmwood Township Marina, May 2019

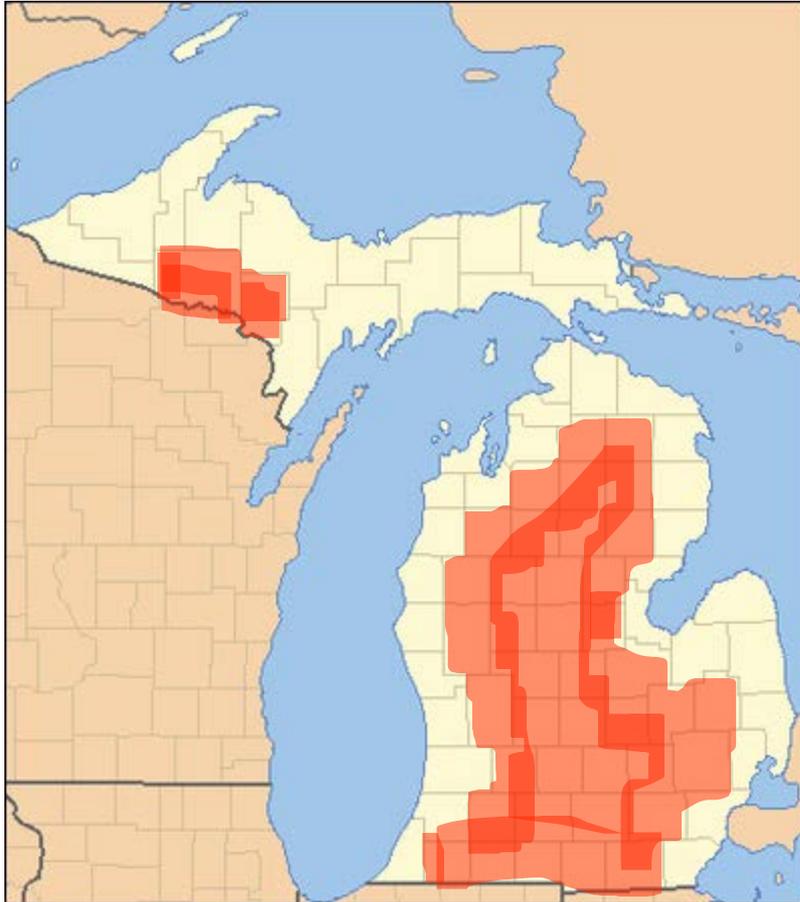
# Overview – MI Sea Grant

A collaborative effort of the University of Michigan and Michigan State University and its MSU Extension, Michigan Sea Grant is part of the NOAA-National Sea Grant network of 34 university-based programs.

Michigan Sea Grant supports research, outreach, engagement, and education to enhance sustainable use of Great Lakes resources, benefiting the environment and quality of life for Michigan, the Great Lakes, and national economy.







- **41 Coastal Counties (83 total)**
  - 13 in Upper Peninsula (only *Iron* & *Dickenson* not coastal)
  - 28 in Lower Peninsula
  - 46.9% of Michigan's 2020 Population reside in these coastal counties
  
- **All Coastal Counties Experienced Impacts from High Water Period 2019-21**

# Talk Overview: Community Impacts & Tools

- **Short-term coastal inundation** – seiches, meteorological & meteotsunami events; a chance to recover after “days”
- **Long-term coastal inundation** – rising of the “bathtub” level; hydrostatic pressures into the coastal area; low or no chance to recover until months or years later; “*when will it end?*”
  - Impacts vary due to slope, geology, and other factors
- **Computer Mapping Tools** - NOAA





Boathouse Club, Harbor Springs, MI  
June 2019



Universal Access Fishing Pier, Arcadia, MI

## Inundated sidewalks Ludington, MI





Fishtown, Leland, MI  
August, 2019



## Fishtown Multiple Shanty Lift and Reconstruction 2020 and 2021



Fishtown, Leland, MI  
August 2019







Fishtown  
March 3, 2022  
Front Page  
Leelanau Enterprise



# Boating, Marina, & Economic Impacts

Tom Renner,  
South Haven Area  
Emergency Services  
April 2020



Dock Reconstruction / Electrical Upgrades  
To prevent electroshock

Tom Renner, South Haven Area  
Emergency Services, April 2020



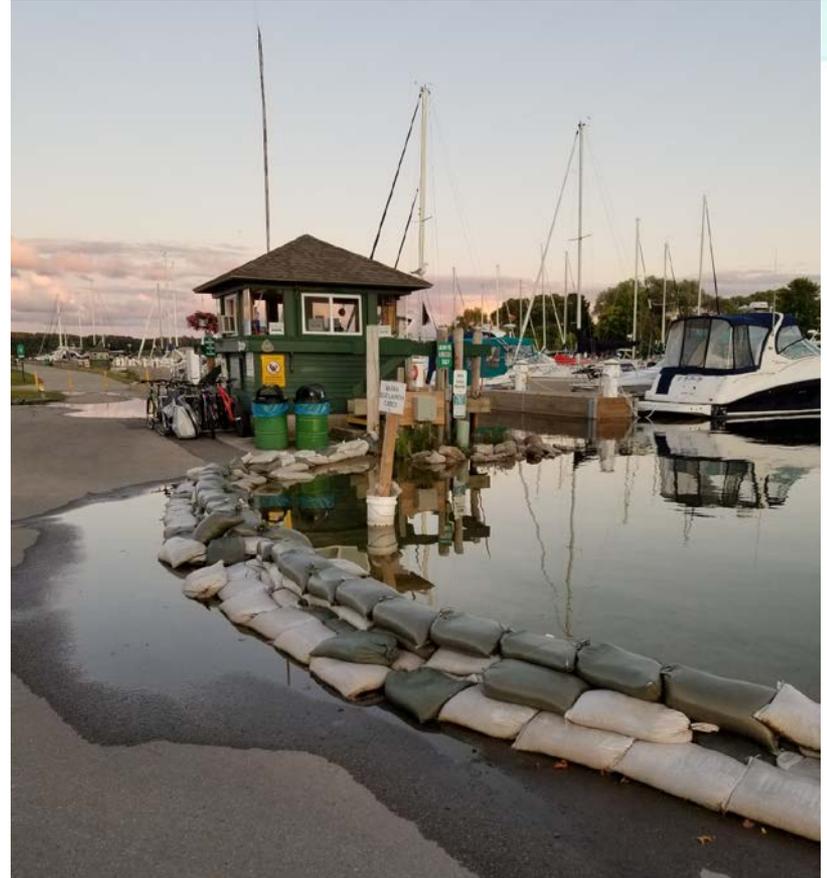
Photos courtesy of City of South Haven



Photos courtesy of City of South Haven



Elmwood Township Marina, June 2020



Suttons Bay Marina, August 2020



City of Saugatuck Public Launch Ramp  
Closed (Pictures March 2021)





## Low Areas Hit with Long-term Inundation

**St. Clair County:  
Algonac, Harsens  
Island, Clay Township**

**Wayne County:  
City of Detroit East Side**



St. Clair River / Clay Township  
Photos: The Keel Port Huron

# Long Term Inundation & Compound Effects

City of Detroit – Jefferson Chalmers area 2019



# Example Costs & Impacts

1

In 2020: St. Clair County Board of Commissioners \$100K to fund constant pumping to keep some residential streets drivable in Algonac.

2

City of Detroit: Long-term flooding of residences AND water into sewer system.

3

NOAA NWS-Detroit stopped “flood advisories” as it was constant long-term in Algonac and Detroit areas.

# Roads & Parking Inundation

- Accelerated erosion in steeper areas due to constant “wetness”



Frankfort, MI June 2019



M22, Benzie County, near Elberta, MI

# Some Ecological Positives

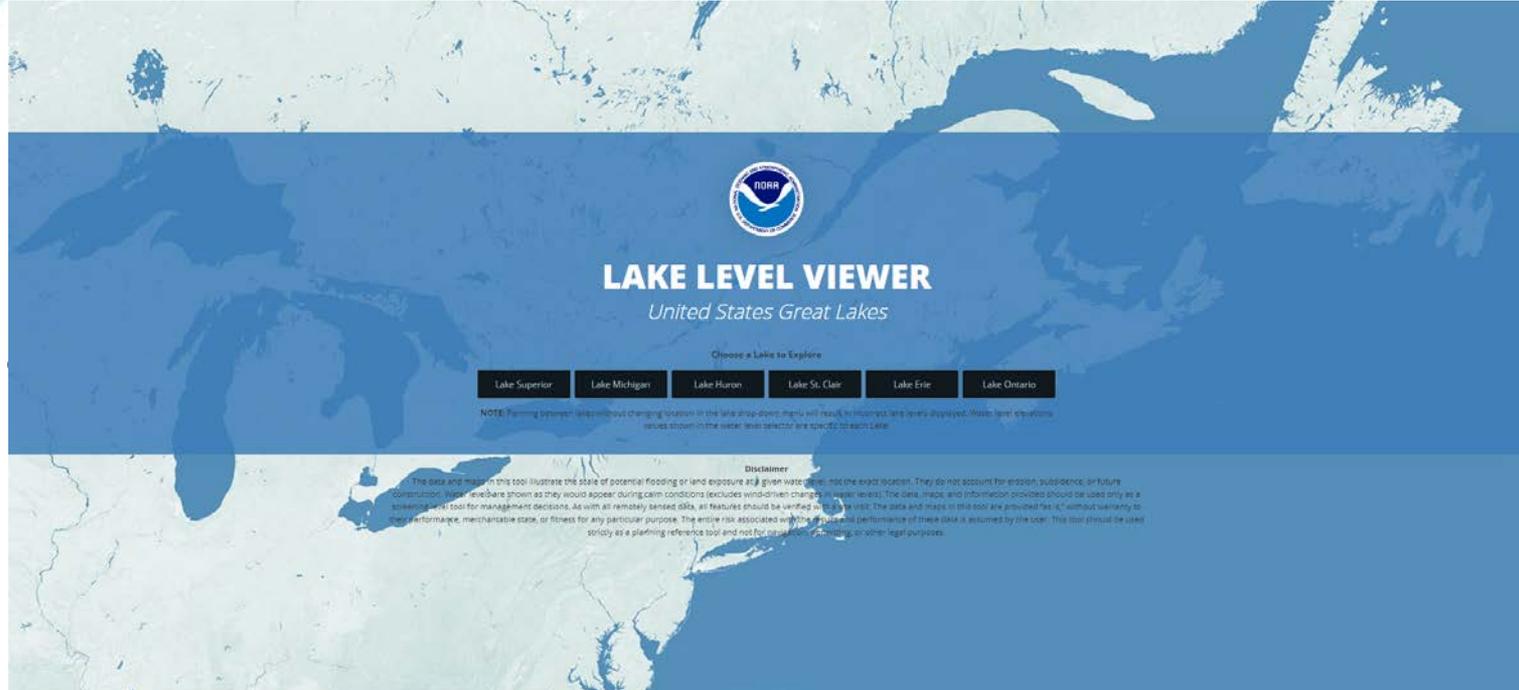
- Low lying places like Wilderness State Park (Emmet County, MI) allowed natural enhancement of large wetlands areas increasing habitat.



# Tools

- 1 | Document what happened in 2019-21
- 2 | NOAA Lake Level Viewer
- 3 | NOAA Coastal Flood Exposure Mapper





The screenshot shows the NOAA Lake Level Viewer interface. At the top center is the NOAA logo. Below it, the title "LAKE LEVEL VIEWER" is displayed in large, bold, white letters, with the subtitle "United States Great Lakes" underneath. A navigation bar contains six buttons labeled "Lake Superior", "Lake Michigan", "Lake Huron", "Lake St. Clair", "Lake Erie", and "Lake Ontario". Below the buttons, there is a "NOTE" and a "Disclaimer" section. The background of the interface is a map of the Great Lakes region.

Choose a Lake to Explore

Lake Superior Lake Michigan Lake Huron Lake St. Clair Lake Erie Lake Ontario

NOTE: Flooding between lakes without changing location in the lake drop-down menu will result in incorrect data being displayed. Water level situations are shown in the water level selector are specific to each Lake.

Disclaimer

The data and maps in this tool illustrate the state of potential flooding or land exposure at a given water level, not the exact location. They do not account for erosion, subsidence, or future construction. Water levels are shown as they would appear during calm conditions (excludes wind-driven changes in water levels). The data, maps, and information provided should be used only as a planning reference tool for management decisions. All data are remotely sensed data, so features should be verified on the ground. The data and maps in this tool are provided "as is", without warranty as to their performance, merchantable state, or fitness for any particular purpose. The entire risk associated with the use and performance of these data is assumed by the user. This tool should be used strictly as a planning reference tool and not for legal, financial, or other legal purposes.

<https://coast.noaa.gov/llv/>

Search: NOAA lake level viewer



Lake Level Viewer United States Great Lakes

Help Download FAQ Share

Lake Michigan

Lake Level Change

Mapping Confidence

Society

Business

Download

Streets

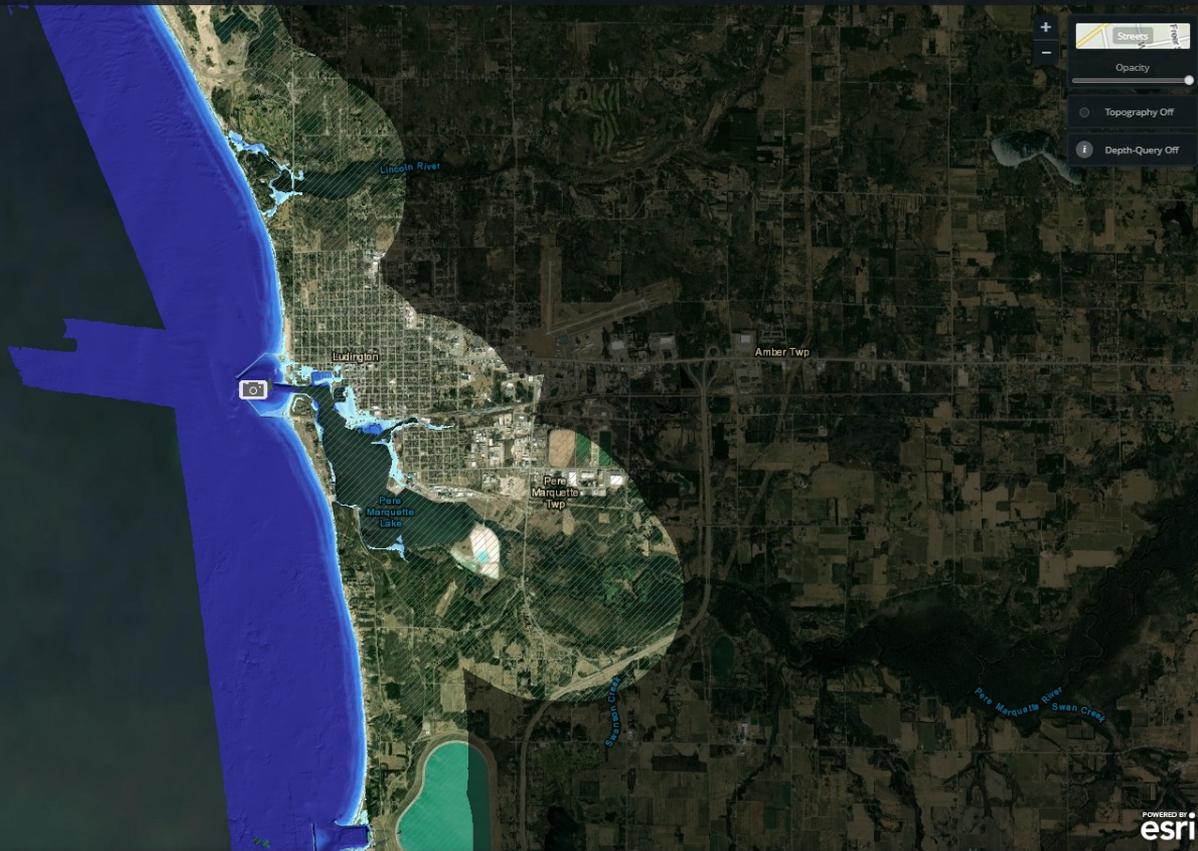
Opacity

Topography Off

Depth-Query Off

Lake Michigan Water Level

IGLD	
584.8ft	6.0ft
583.8ft	5.0ft
582.8ft	4.0ft
High (582.4 ft)	
581.8ft	3.0ft
580.8ft	2.0ft
579.8ft	1.0ft
Current (579.2 ft)	
578.8ft	Long Term Average
577.8ft	-1.0ft
576.8ft	-2.0ft
Low (576.0 ft)	
575.8ft	-3.0ft
574.8ft	-4.0ft
573.8ft	-5.0ft
572.8ft	-6.0ft



Records & Avg.  On

Units of Measure  FT  M





# Coastal Flood Exposure Mapper

[LAUNCH](#)

**GEOGRAPHY** Coastal contiguous U.S., HI, and territories

**PLATFORM** Web-based

**LEVEL OF EFFORT** Low

NOAA Office for Coastal Management

## Overview

This online visualization tool supports communities that are assessing their coastal hazard risks and vulnerabilities. The tool creates a collection of user-defined maps that show the people, places, and natural resources exposed to coastal flooding. The maps can be saved, downloaded, or shared to communicate flood exposure and potential impacts. In addition, the tool provides guidance for using these maps to engage community members and stakeholders. *The current geography includes the East Coast, West Coast, Gulf of Mexico, Great Lakes, and islands in the Pacific and Caribbean.*

## Features

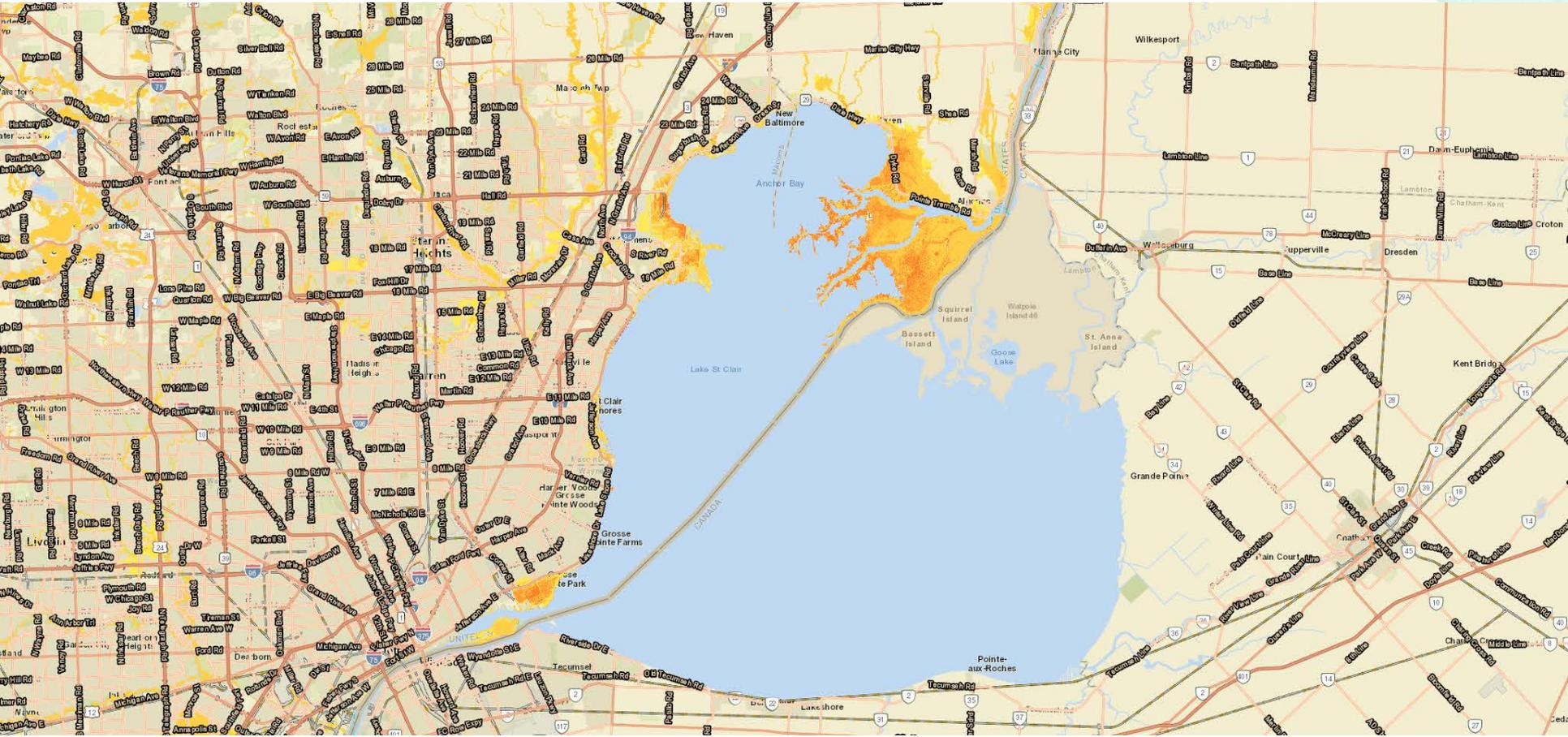
- Visualize people, places, and natural resources exposed to coastal flood hazards
- Share online maps to communicate with and engage stakeholders

Recently expanded to include entire US Great Lakes shoreline

<https://coast.noaa.gov/digitalcoast/tools/flood-exposure.html>

Search: NOAA coastal flood

# NOAA Coastal Flood Exposure Mapper Example



## Summary:

- 2019-21 High Water Years were a **complete coastal system stressor**
- Response from **short-term** inundation relatively **simple**; **long-term inundation** is **very costly, complex and perplexing**
- **NOAA** has provided some tools for planning



In our  
hearts:

**Steve Stewart**  
**Michigan Sea Grant Extension**  
**1977-2020**  
**Passed away 12/6/21**

[michiganseagrant.org](http://michiganseagrant.org)

**Questions:**  
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