



Delta County Shoreline Recession Study 2022

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The shoreline of Delta County was studied to update the erosion rates previously determined in 1984. The high-risk shorelines were designated in 1985. The State of Michigan is required to identify changes in the long-term rate of erosion occurring along the shoreline pursuant to R 281.22(22) of the Great Lakes Shorelands Administrative Rules, promulgated pursuant to Part 323, Shorelands Protection and Management, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA). This study identifies shorelines where recession is occurring at an average annual rate of 1 foot or more per year based on a minimum period of 15 years, R 281.22(2). The purpose of identifying these shorelines is to provide setbacks for structures to lessen the risk of structural property damage and loss.

Site Description

Delta County is in the central Upper Peninsula on Lake Michigan. The county is sparsely populated, with 36,903 people (2020 census). The county has 211 miles of Lake Michigan shoreline. The coastline includes the Stonington and Garden Peninsulas. The eastern shoreline borders Green Bay and includes Escanaba and Gladstone on Little Bay de Noc. The shoreline of the Stonington Peninsula borders Little Bay de Noc on the west and Big Bay de Noc on the east. The Garden Peninsula borders Big Bay de Noc on the west and Lake Michigan on the east. The shoreline and nearshore include coastal wetlands, sand beaches, and limestone ledges.

Methods

The study area was identified for Delta County. Included were all shorelines designated in 1985, areas identified as highly erodible by the United States Army Corps of Engineers (USACE) in 1971, areas identified when viewing the 2012 USACE Oblique imagery, and recent permits. Local government officials were contacted but did not have any sites to add to the study. *(Personal communications, Sanitarian, Emergency Manager, Delta County.)*

Timing and Water Levels

Fieldwork began in 2019 with the expectation of using the 2017 modern imagery available through the Michigan Department of Technology, Management and Budget's Center for Shared Solutions (CSS) for the study. The water levels were above the ordinary high-water mark during

fieldwork and reached record highs during 2020. The COVID-19 pandemic began in March 2020 and temporarily disrupted the study. Additional fieldwork was conducted in July and October 2020. The CSS planned on flying Delta County to collect aerial imagery in 2021. As the 2021 imagery would show the impacts of the recent high-water levels, and the high risk erosion area program identifies the most at-risk shorelines, it was prudent to wait and use the 2021 imagery from CSS in the analysis. That imagery became available in 2022.

Imagery

The historic imagery used in the study was from the Michigan Department of Environment, Great Lakes, and Energy (EGLE), Water Resources Division (WRD), Aerial Imagery Archives. The available leaf-off- imagery was reviewed and selected to represent the historic endpoint for the study. Efforts were made to ensure the study period reflected water level fluctuations and storm events. Past water level data were obtained from the USACE in 2022.

The historic aerial imagery used to study Ford River Township, City of Gladstone, and Ensign Township was in color and collected in November 1983 with a scale of 1:6000. The water level was 579.95 feet International Great Lakes Datum (IGLD) 1985.

The historic aerial imagery used to study Bay de Noc Township was black and white and collected in May 1977 with a scale of approximately 1:12000. The water level was 579.3 feet International Great Lakes Datum (IGLD) 1985.

The historic aerial imagery used to study Fairbanks Township was black and white collected in June 1975 with a scale of 1:6000. The water level was 581.17 feet International Great Lakes Datum (IGLD) 1985.

All imagery was orthorectified to modern imagery collected in May 2017 with a 1-foot resolution and available through the Michigan Department of Technology, Management and Budget's Center for Shared Solutions, and a United States Geological Survey National Elevation Dataset image with a 10-meter resolution was used to provide elevation information. The water level was 580.05 feet (IGLD 1985). The error due to orthorectification was approximately 0.1 feet (1 inch) plus or minus 0.1 feet (1 inch).

Erosion Hazard Line

The erosion hazard line (EHL) as defined in R 281.21(1)(c) means the line along the shoreland that is the landward edge of the zone of active erosion or the line where the 583.7 feet (IGLD 1985) contour on Lake Michigan meets the shoreland, whichever is furthest landward. The zone of active erosion means the area of the shoreland where the disturbance or loss of soil and substrate has occurred with enough frequency to cause unstable slopes or prevent vegetation of the area [R 281.21(1)(r)]. The recession rate study compared the EHL on historic aerial photographs to the EHL on modern aerial photographs.

The historic EHL was determined by viewing the vegetation lines along the shoreline on the aerial photograph. The modern EHL was determined using the same method with the added information provided by the fieldwork. The shoreline was reviewed and the EHL was determined for all previously designated HREAs and other areas of interest. The EHLs were hand digitized.

Fieldwork

The location of the modern EHL was verified by gathering on-the-ground data using a submeter Global Positioning System (GPS) unit, Trimble Geo7x. All location data were differentially corrected. Observational and GPS data were gathered where there was public access or permission was provided by the property owner.

All data were projected to Michigan GeoRef Meters North American Datum 83.

Hazard Area Identification

Transects were drawn perpendicular to the shoreline at 150-foot intervals and recession rates calculated along the transect lines. Digital Shoreline Analysis Software was used to determine recession rates. Average recession rates were calculated within each area (Procedure WRD--SWAS--028). Parcel boundaries and owner data were received from the Delta County Equalization Department and the City of Gladstone. The current area and parcel data were compared to the 1985 designation data to determine designation changes.

Within these hazard areas, placement of new construction requires a permit and must meet setback distances based on projected recession distances when combined with the type of construction and other -site-specific conditions. The projected recession distance is the calculated rate of recession for the area over a 30-year [for readily moveable structures, as defined in R 281.21(1)(k)] or 60-year [for permanent structures, as defined in R 281.21(1)(i)] period as determined by R 281.22(2). The required setback distance is based on this rate but may be greater in areas of bluffs over 25 feet in height.

Affected parcels were classified under one of the following two categories:

New: These parcels were not designated during the previous study as being in an area of high risk erosion; however, the current study found the long-term rate of recession has increased to, or is above, the one foot per year threshold required for HREA designation. The properties are designated and subject to the regulations and permit requirements under Part 323 and the promulgated rules for high risk erosion areas.

Dedesignation: These are parcels where the average rate of recession was documented to be one foot per year or greater during the previous study; however, the current study found the long-term rate of recession has fallen below the one foot per year threshold required for HREA designation. The HREA designation is therefore removed, also eliminating the permit requirements under Part 323.

Public Notification

Letters explaining the proposed changes to the high risk erosion areas along the Lake Michigan shoreline of Delta County will be sent to property owners and local governmental agencies as required per R 281.22 (1). A virtual public meeting will be held prior to designation. The meeting information will be posted on the EGLE calendar.

Results

During the current study, 10.6 miles of shoreline were identified as needing study because it was either previously designated or there may have been recession. Fieldwork and lack of access indicated approximately five miles of shoreline warranted a digital comparison of EHLs.

Approximately 0.4 miles of shoreline in Ford River Township have receded at an average annual rate of one foot or greater per year. The study period spanned 38 years. In 1985 approximately 5.9 miles of Delta County shoreline was designated as being at high risk for erosion. None of the originally designated shorelines will remain designated as they were coastal wetland or did not continue to meet the criteria for designation. Descriptive statistics for the county and local units of government are provided in Appendix 1. An index of the study sites is in Appendix 2.

All imagery and data are in Lansing, Michigan, with EGLE, WRD, Field Operations Support Section's Great Lakes Shorelands Unit and Wetlands, Lakes, and Streams Unit. Photos taken during fieldwork are in Appendix 3. The maps of proposed changes to Delta County HREAs are in Appendix 4.

Ford River Township

The township had five HREAs designated in 1985. Areas D (Green Bay) and E (Mayville Road) were relatively flat and identified as coastal wetland in 2019. The beaches were building with sand being deposited by wave action. There was no evidence of shoreline recession typical of a high risk erosion area. They were not included in a comparison of modern and historic EHLs.

Area C (Ford River) was at the mouth of the Ford River where there is coastal wetland and a more dynamic shoreline due to the sediment coming downriver and sediment being pushed by the lake. Although C1, nearest the mouth of the Ford River, showed changes in the shoreline exceeding an average annual rate of one foot per year it is recommended to remove the designation due to this being a very changeable reach on publicly owned property.

Two areas of shoreline north of Ford River were found to be receding at an average annual rate of one foot or greater per year. The shorelines of 13 parcels were found to be receding at an average annual rate of 1.4 feet per year. This new HREA is labeled G or E M35 South. The new setback from the erosion hazard line for a readily moveable structure is 55 feet and for a permanent structure such as a septic system is 100 feet in this area. The second area, F or E M35 North, is receding at an average annual rate of 1.0 feet per year along the shorelines of nine parcels. The new setbacks are 45 feet for a readily moveable structure and 75 feet for a permanent structure. Further analysis of the shoreline between the HREAs using transects spaced 50 feet apart confirmed the location of the new HREAs.

The EHLs of Areas B and A (South of Portage Point) at the lake end of 11th Road were compared in 2022. The average annual recession rate was found to be less than one foot per year. The designations should be removed.

City of Escanaba

No HREAs were previously designated in the city, and none are proposed. Beach building was observed and recorded at Sand Point.

Wells Township

HREA B (Holly 0.6 Road) and A (P Road) were observed to be coastal wetland in 2019. These sites were not included in a comparison of modern and historic EHLs. The designations should be removed.

City of Gladstone

The city had three HREAs designated in 1985. Area C (Lakeshore Drive) designated five properties. A comparison of the historic and modern EHLs showed an average annual recession rate of less than one foot per year. The designations should be removed. Areas B and C (Saunders Point) were observed as coastal wetland. The shoreline is flat and wide without erosion typical of a high risk erosion area. This location was not included in the analysis of historic and modern EHLs.

Masonville Township

HREA A (Garth Point) and HREA B (Masonville) were observed to be low, flat coastal wetland in 2019. The shorelines are routinely raked. These sites were not included in a comparison of modern and historic EHLs. The designations should be removed.

Ensign Township

The township had five HREAs identified in 1985. Area A (County 513 T North), B (U Lane), and C (N Lakeside T.5 Drive) were studied by comparing historic and modern EHLs drawn on aerial imagery. All three areas noted average annual recession rates at less than one foot per year. The designations should be removed.

Areas D and E (Hunter's Point) were observed to be coastal wetland. They were not studied using a comparison of EHLs. Their designations should be removed.

Bay de Noc Township

No HREA's were previously designated in Bay de Noc Township, and none are proposed. Various locations along the western shoreline of the Township were observed during fieldwork in 2020, specifically the limestone bluffs. EHL lines were drawn comparing 1977 to the top of bluff data collected in 2020 and the 2021 imagery. The lines were nearly on top of each other indicating the change was minor and would not meet the one foot per year threshold.

Fairbanks Township

No HREA's were previously designated in Fairbanks Township, and none are proposed. On the Garden Peninsula, observation and location data were collected in 2020 near Fayette State Park and south along the shoreline of Sand Bay. Much of the shoreline was coastal wetland with some low sandy bluffs. Comparison of the 1977 shoreline and the 2021 shoreline using aerial imagery did not show long-term erosion.

Public Notification

A public meeting and property owner notification are required before shoreline may be designated as a high risk erosion area. A virtual public meeting will be held for Ford River Township. The meeting information will be posted on the EGLE calendar.

Public notification is not required when a designation is proposed to be removed from a property, R 281.22(1). A letter removing the high risk erosion area designation will be sent by certified mail to the property owners and local officials.

Summary

The recession rate study meets the technical requirements of Subrule 2(2). The study found two new areas of shoreline meeting the designation criteria of a high risk erosion area in Ford River Township in Delta County. The study spanned 38 years. The high risk erosion area designations should be removed from all shorelines designated in 1985 as they do not meet the requirements of a high risk erosion area. Future studies may indicate erosion is occurring and meets the statutory limits for identification as a high risk erosion area as described in Part 323 and the Great Lakes Administrative Rules.

References

United States Army Corps of Engineers. 2021. Coordinated Monthly Mean Lakewide Average Water Levels, 1918-2021. <https://www.usace.army.mil/>

United States Census Bureau. 2020. factfinder.census.gov.

WRD-SWAS-028. 2016. Department of Environmental Quality, Water Resources Division, Surface Water Assessment Section Procedure, Part 323 – Determining Recession Rates of Great Lakes Shorelines.

Appendix 1. Delta County descriptive statistics (all mileage is approximate).

Table 1. Countywide.

Year of Designation	1985	2023
Miles of shoreline in county = 221		
Miles of shoreline studied	Unknown	10.5*
Miles of shoreline designated	5.9	0.4
Miles of shoreline newly designated	5.9	0.4
Miles of shoreline that will remain designated	NA	0
Miles of shoreline with designation removed	NA	5.9
# of HREAs*	17	2
# of parcels designated	131	22
# of parcels newly designated	131	22
# of parcels remain designated	NA	0
# of parcels with designation removed	NA	147
Highest rate of recession (ft/yr) and PRDs** (ft)	5.0; 165/315	1.4; 55/100
Lowest rate of recession (ft/yr) and PRDs (ft)	1.0; 30/60	1.0; 45/75

*HREAs identified as coastal wetland in 2019 did not have EHLs drawn and compared as the hazard is inundation not erosion. Those areas are included in the number of miles of shoreline studied. Additionally, the miles of shoreline studied in Bay de Noc, Garden and Fairbanks Townships are included.

*HREA is High Risk Erosion Area per Part 323, Shorelands Protection and Management, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.

**PRD is the Projected Recession Distance (feet) at 30 years and 60 years, respectively, as referred to in Rule 281.22 of the Great Lakes Shorelands Administrative Rules.

Table 2a. Ford River Township descriptive statistics (all mileage is approximate).

Year of Designation	1985	2023
Miles of shoreline in township = 18		
Miles of shoreline studied	Unknown	4.7
Historic photo year	1939 and 1954	1983
Modern photo year	1983	2021
Number of years between historic and modern imagery	44 and 29	38
Miles of shoreline designated	2.3	.4
Miles of shoreline newly designated	2.3	.4
Miles of shoreline that will remain designated	NA	0
Miles of shoreline with designation removed	NA	2.3
# of HREAs*	7	2
# of parcels designated	44	22
# of parcels newly designated	44	22
# of parcels remain designated	NA	0
# of parcels with designation removed	NA	147
Highest rate of recession (ft/yr) and PRDs (ft)	3.2; 95/190	1.4; 55/100
Lowest rate of recession (ft/yr) and PRDs** (ft)	1.2; 35/70	1.0; 45/75

Table 2b. Ford River Township average annual recession rates and projected recession distances.

Study Site Name (HREA)	1985 Rate (ft/yr)	1985 30yrPRD (ft)	1985 60yrPRD (ft)	2023 Rate (ft/yr)	2023 30yrPRD (ft)	2023 60yrPRD (ft)	2023 HREA	2023 Update Code
South of Portage Point (A) (B)	1.2; 1.4	35; 40	70; 85	<1	NA	NA	NA	Dedesignated
Ford River (C)	1.6	45	95	Coastal Wetland	NA	NA	NA	Dedesignated
Green Bay (D)	1.5	60	105	Coastal Wetland	NA	NA	NA	Dedesignated
Mayville Road (E)	1.7	60	75	Coastal Wetland	NA	NA	NA	Dedesignated
E M35 North (F)	NA	NA	NA	1.0	45	75	F	New
E M35 South (G)	NA	NA	NA	1.4	55	100	G	New

*HREA is High Risk Erosion Area per Part 323, Shorelands Protection and Management, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.

**PRD is the Projected Recession Distance (feet) at 30 years and 60 years, respectively, as referred to in Rule 281.22 of the Great Lakes Shorelands Administrative Rules.

Table 3a. Wells Township descriptive statistics (all mileage is approximate).

Year of Designation	1985	2023
Miles of shoreline in township = 8		
Miles of shoreline studied	Unknown	0.5
Historic photo year	1939	Coastal Wetland
Modern photo year	1985	Coastal Wetland
Number of years between historic and modern imagery	44	NA
Miles of shoreline designated	0.5	0
Miles of shoreline newly designated	0.5	0
Miles of shoreline that will remain designated	NA	0
Miles of shoreline with designation removed	NA	5
# of HREAs*	2	0
# of parcels designated	5	0
# of parcels newly designated	5	0
# of parcels remain designated	NA	0
# of parcels with designation removed	NA	5
Highest rate of recession (ft/yr) and PRDs (ft)	1.3; 55/95	NA
Lowest rate of recession (ft/yr) and PRDs** (ft)	1.3; 40/80	NA

Table 3b. Wells Township average annual recession rates and projected recession distances.

Study Site Name (HREA)	1985 Rate (ft/yr)	1985 30yrPRD (ft)	1985 60yrPRD (ft)	2023 Rate (ft/yr)	2023 30yrPRD (ft)	2023 60yrPRD (ft)	2023 HREA	2023 Update Code
P Road (A)	1.3	55	95	Coastal Wetland	NA	NA	NA	Dedesignated
Holly 0.6 Lane (B)	1.3	40	80	Coastal Wetland	NA	NA	NA	Dedesignated

*HREA is High Risk Erosion Area per Part 323, Shorelands Protection and Management, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.

**PRD is the Projected Recession Distance (feet) at 30 years and 60 years, respectively, as referred to in Rule 281.22 of the Great Lakes Shorelands Administrative Rules.

Table 4a. City of Gladstone descriptive statistics (all mileage is approximate).

Year of Designation	1985	2023
Miles of shoreline in City = 5.9		
Miles of shoreline studied	5.9	0.9
Historic photo year	1939	1983
Modern photo year	1983	2021
Number of years between historic and modern imagery	44	38
Miles of shoreline designated	0.9	0
Miles of shoreline newly designated	0.9	0
Miles of shoreline that will remain designated	NA	0
Miles of shoreline with designation removed	NA	0.9
# of HREAs*	5	0
# of parcels designated	9	0
# of parcels newly designated	9	0
# of parcels remain designated	NA	0
# of parcels with designation removed	NA	11
Highest rate of recession (ft/yr) and PRDs (ft)	5.0; 165/315	NA
Lowest rate of recession (ft/yr) and PRDs** (ft)	1.4; 40/85	NA

Table 4b. City of Gladstone average annual recession rates and projected recession distances.

Study Site Name (HREA)	1985 Rate (ft/yr)	1985 30yrPRD (ft)	1985 60yrPRD (ft)	2023 Rate (ft/yr)	2023 30yrPRD (ft)	2023 60yrPRD (ft)	2023 HREA	2023 Update Code
Water Plant (A)	1.8	70	125	Coastal Wetland	NA	NA	NA	Dedesignated
Gladstone Campground (B)	3.0; 5.0; 2.4	105; 165; 85	195; 315; 160	Coastal Wetland	NA	NA	NA	Dedesignated
Lakeshore Drive (C)	1.4	40	85	<1	NA	NA	NA	Dedesignated

*HREA is High Risk Erosion Area per Part 323, Shorelands Protection and Management, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.

**PRD is the Projected Recession Distance (feet) at 30 years and 60 years, respectively, as referred to in Rule 281.22 of the Great Lakes Shorelands Administrative Rules.

Table 5a. Masonville Township descriptive statistics (all mileage is approximate).

Year of Designation	1985	2023
Miles of shoreline in township = 8.2		
Miles of shoreline studied	Unknown	.5
Historic photo year	1964	Coastal Wetland
Modern photo year	1983	Coastal Wetland
Number of years between historic and modern imagery	19	NA
Miles of shoreline designated	0.5	0
Miles of shoreline newly designated	0.5	0
Miles of shoreline that will remain designated	NA	0
Miles of shoreline with designation removed	NA	.5
# of HREAs*	2	0
# of parcels designated	20	0
# of parcels newly designated	20	0
# of parcels remain designated	NA	0
# of parcels with designation removed	NA	19
Highest rate of recession (ft/yr) and PRDs (ft)	1.7; 65/115	NA
Lowest rate of recession (ft/yr) and PRDs** (ft)	1.5; 60/105	NA

Table 5b. Masonville Township average annual recession rates and projected recession distances.

Study Site Name (HREA)	1985 Rate (ft/yr)	1985 30yrPRD (ft)	1985 60yrPRD (ft)	2023 Rate (ft/yr)	2023 30yrPRD (ft)	2023 60yrPRD (ft)	2023 HREA	2023 Update Code
Garth Point (A)	1.5	60	105	Coastal Wetland	NA	NA	NA	Dedesignated
Garth Point (B)	1.7	65	115	Coastal Wetland	NA	NA	NA	Dedesignated

*HREA is High Risk Erosion Area per Part 323, Shorelands Protection and Management, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.

**PRD is the Projected Recession Distance (feet) at 30 years and 60 years, respectively, as referred to in Rule 281.22 of the Great Lakes Shorelands Administrative Rules.

Table 6a. Ensign Township descriptive statistics (all mileage is approximate).

Year of Designation	1985	2023
Miles of shoreline in township = 7.3		
Miles of shoreline studied	7.3	1.7
Historic photo year	1938	1983
Modern photo year	1983	2021
Number of years between historic and modern imagery	44	38
Miles of shoreline designated	1.7	0
Miles of shoreline newly designated	1.7	0
Miles of shoreline that will remain designated	NA	0
Miles of shoreline with designation removed	NA	1.7
# of HREAs*	5	0
# of parcels designated	65	0
# of parcels newly designated	65	0
# of parcels remain designated	NA	0
# of parcels with designation removed	NA	59
Highest rate of recession (ft/yr) and PRDs (ft)	1.5; 60/105	NA
Lowest rate of recession (ft/yr) and PRDs** (ft)	1.0; 30/60	NA

Table 6b. Ensign Township average annual recession rates and projected recession distances.

Study Site Name (HREA)	1985 Rate (ft/yr)	1985 30yrPRD (ft)	1985 60yrPRD (ft)	2023 Rate (ft/yr)	2023 30yrPRD (ft)	2023 60yrPRD (ft)	2023 HREA	2023 Update Code
County 513 T North (A)	1.5	45	90	<1	NA	NA	NA	Dedesignated
U Lane (B)	1.4	55	100	<1	NA	NA	NA	Dedesignated
N Lakeside T.5 Drive (C)	1.3	40	80	<1	NA	NA	NA	Dedesignated
Hunter's Point (D)(E)	1.5	60	105	Coastal Wetland	NA	NA	NA	Dedesignated

*HREA is High Risk Erosion Area per Part 323, Shorelands Protection and Management, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.

**PRD is the Projected Recession Distance (feet) at 30 years and 60 years, respectively, as referred to in Rule 281.22 of the Great Lakes Shorelands Administrative Rules.

Appendix 2. Index of study sites.

Municipality	Study Site Name (HREA)	Township Range Section
Ford River Township	South of Portage Point (A)(B)	T38N R23W Sections 12,13
Ford River Township	Ford River (C)	T38N R23W Section 22
Ford River Township	Green Bay (D)	T38N R23W Sections 21, 29
Ford River Township	Mayville Road (E)	T38N R23W Section 32
Ford River Township	North of Ford River- E M35 North (F) E M35 South (G)	T38N R23W Sections 14, 15
Wells Township	P Road (A)	T39N R22W Sections 5, 6
Wells Township	Holly 0.6 Lane (B)	T39N R22W Sections 7, 8
City of Gladstone	Water Plant (A)	T40N R22W Section 22
City of Gladstone	Gladstone Campground (B)	T40N R22W Section 22
City of Gladstone	Lakeshore Drive (C)	T40N R22W Section 28
Masonville Township	Garth Point (A)	T41N R21W Section 32
Masonville Township	Garth Point (B)	T41N R21W Section 32
Ensign Township	County 513 T North (A)	T40N R21W Section 6
Ensign Township	U Lane (B)	T40N R21W Section 6, 7
Ensign Township	N Lakeside T.5 Drive (C)	T40N R22W Section 13
Ensign Township	Hunters Point (D)(E)	T40N R22W Section 23
Bay de Noc Township	Graal Shores S.5 Lane	T39N R22W Section 2
Bay de Noc Township	County 511 West	T39N R22W Section 25
Bay de Noc Township	K-Rails	T39N R22W Section 13
Garden Township	Garden Township Park	T40N R18W Section 4
Fairbanks Township	Fayette State Park	T38N R19W Section 5
Fairbanks Township	Sand Bay	T38N R19W Section 4, 9, 8, 17

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**PRD is the Projected Recession Distance (feet) at 30 years and 60 years, respectively, as referred to in Rule 281.22 of the Great Lakes Shorelands Administrative Rules.

Appendix 3. Photos.



Photo 1. Beach is building in wetland.
Ford River Township T38N R23W Section 21.
Existing HREA D, Green Bay
Propose removing designation.
October 14, 2020



Photo 2. Sandbags on beach.
Ford River Township T38N R23W Section 15.
Proposed HREA G, E M35 South
October 14, 2020



Photo 3. Coastal wetland
Wells Township T39N R22W Sections 5, 6
Existing HREA A, P Road
Propose removing designation.
July 24, 2019



Photo 4. Coastal wetland
City of Gladstone T40N R22W Section 22
Existing HREA B, Gladstone Campground
Propose removing designation.
July 24, 2019



Photo 5. Coastal wetland
City of Gladstone T40N R22W Section 22
Existing HREA B, Gladstone Campground
Propose removing designation.
July 24, 2019



Photo 6. Coastal wetland
City of Gladstone T40N R22W Section 22
Existing HREA A, Water Plant
Propose removing designation.
July 24, 2019



Photo 7. Coastal wetland
Masonville Township T41N R21W Section 32
Existing HREA A and B, Garth Point
Propose removing designation.
July 23, 2019



Photo 8. Coastal wetland
Ensign Township T40N R22W Section 23
Existing HREA D and E, Hunter's Point
Propose removing designation.
July 23, 2019



Photo 9. Looking south along the limestone bluff
Bay de Noc Township T39N R22W Section 13
No proposed designation
July 23, 2019



Photo 10. Looking north along the limestone bluff
Bay de Noc Township T39N R22W Section 13
No proposed designation
July 23, 2019



Photo 11. K-Rails
Bay de Noc Township T39N R22W Section 13
No proposed designation
July 23, 2019



Photo 12. Coastal Wetland
Garden Township T40N R18W Section 4
No proposed designation
July 23, 2019



Photo 13. Recent erosion along shoreline
Fayette State Park
Fairbanks Township T38N R19W Section 5
No proposed designation
July 22, 2019



Photo 14. Recent erosion along shoreline
Fayette State Park swimming beach
Fairbanks Township T38N R19W Section 4
No proposed designation
July 22, 2019

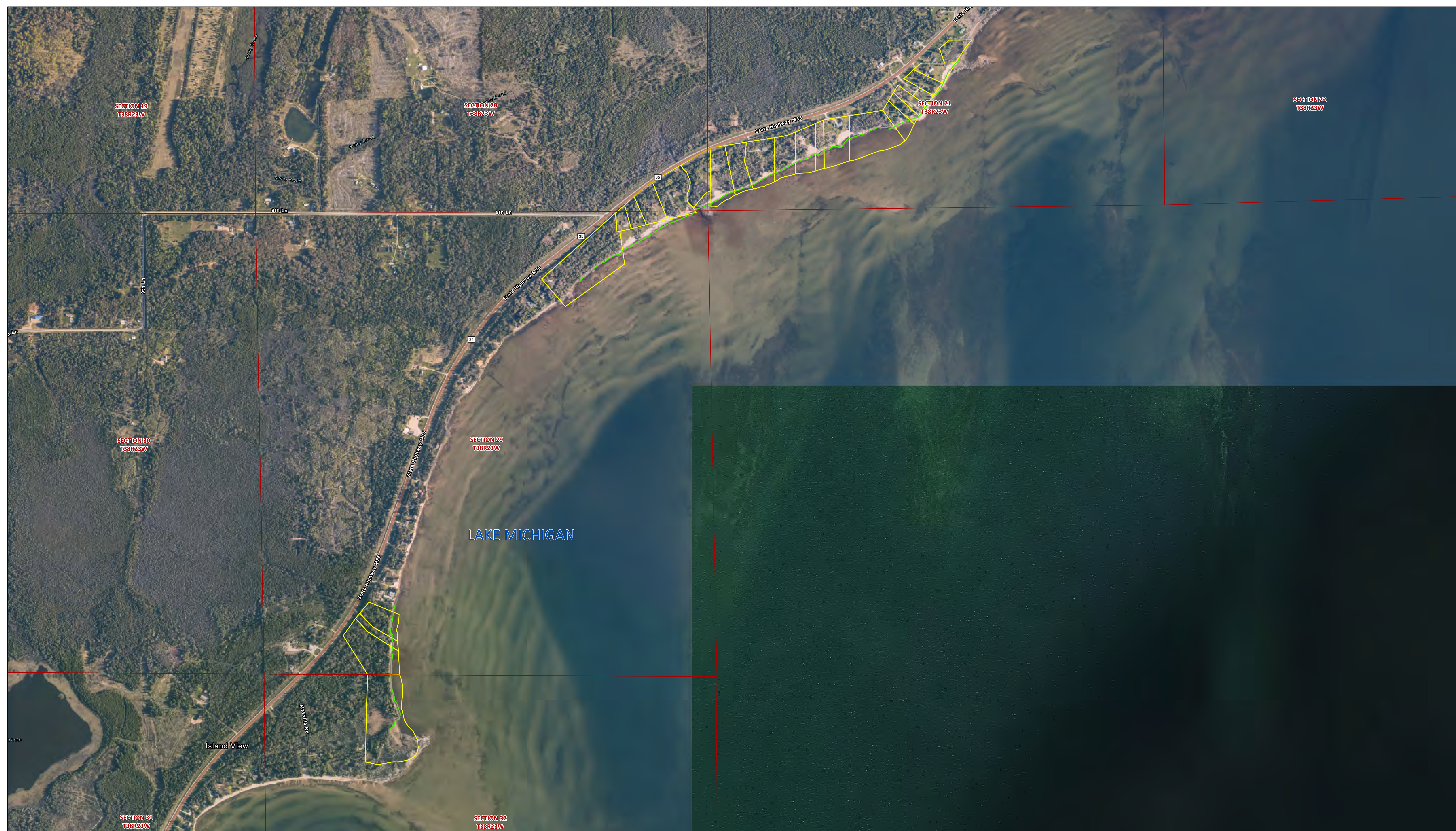


Photo 15. Sand Bay, interdunal wetland
Fairbanks Township T38N R19W Section 9
No proposed designation
July 22, 2019



Photo 16. Sand Bay, Leopard frogs
Fairbanks Township T38N R19W Section 9
No proposed designation
July 22, 2019

Appendix 4. Preliminary Maps.



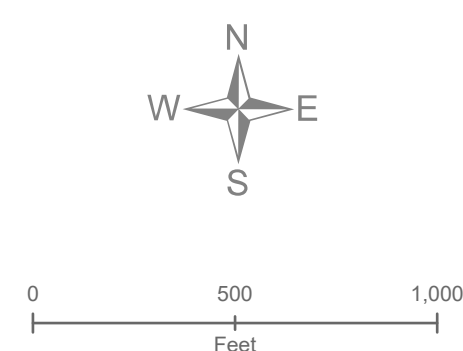
Preliminary High-Risk Erosion Area Update - 2023

Ford River Township, Delta County
T38N, R23W Sections 32, 29, and 21

High Risk Erosion Areas De-Designated Parcels

- Sections
- 1985 HREAs (approximate)
- De-Designated Parcels

Background Image: 2021

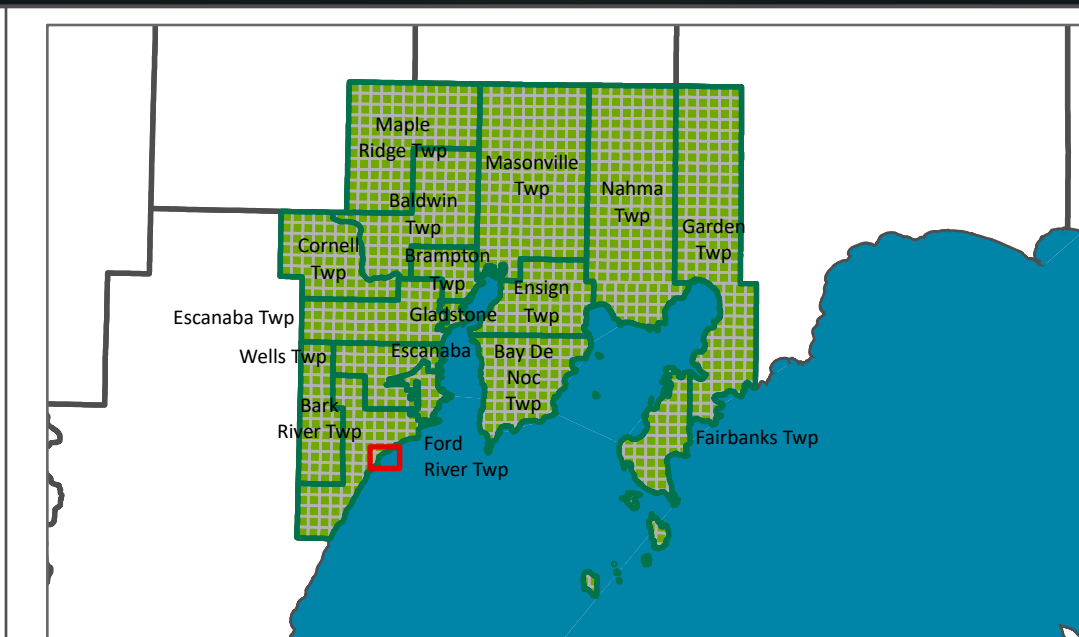


MAP INFORMATION:

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Map Created by: Jeremy Jones
Environmental Quality Analyst
Water Resources Division
Michigan Department of Environment, Great Lakes, and Energy
1/19/2023

Recession/Accretion values for each area were calculated using the Digital Shoreline Analysis System from the USGS (Thieler, E.R., Himmelstoss, E.A., Zichichi, J.L., and Ergul, Ayhan, 2009, Digital Shoreline Analysis System (DSAS) version 5.1 - An ArcGIS extension for calculating shoreline change: U.S. Geological Survey Open-File Report 2008-127)



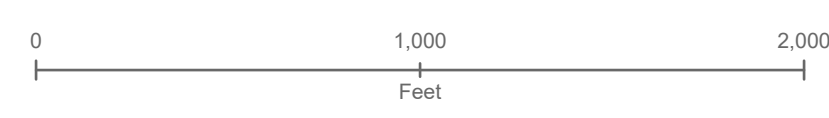
Preliminary High-Risk Erosion Area Update - 2023

Ford River Township, Delta County
T38N, R23W Sections 14, 15, and 22

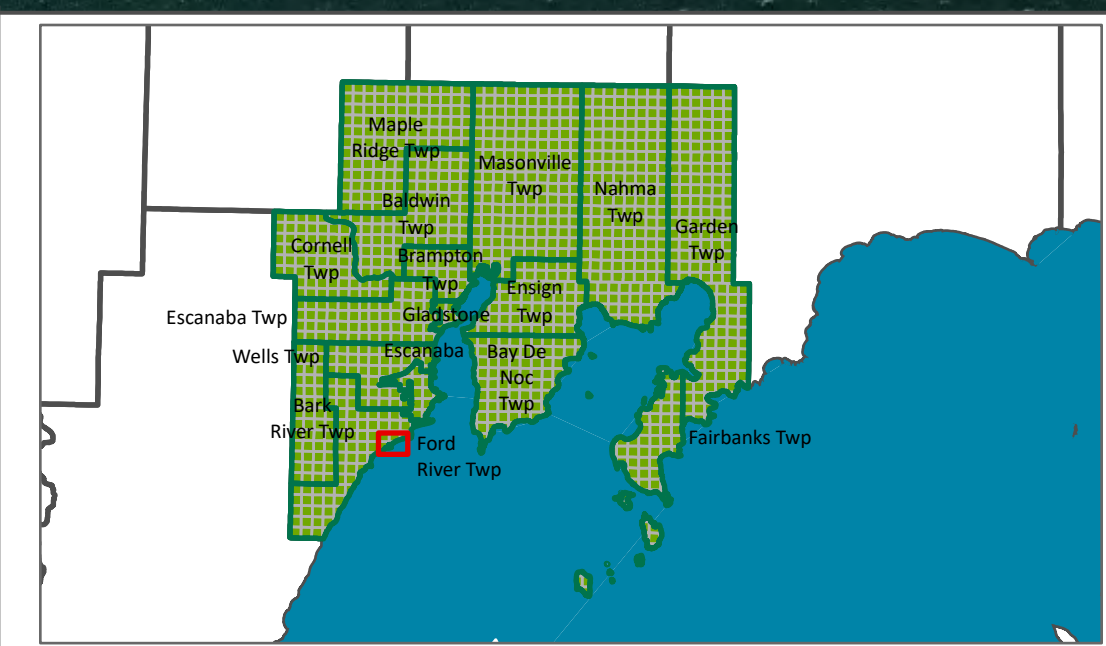
High Risk Erosion Areas

30 YR/60 YR Projected Recession Distance (Feet)
Average Annual Rate of Recession (FT/YR)

- Area F: 45'/75' (Avg. 1.0 FT/YR)
 - Area C: 55'/100' (Avg. 1.4 FT/YR)
 - Designated Parcels
 - 1985 HREAs (approximate)
 - De-Designated Parcels
 - Sections
- Background Image: 2021

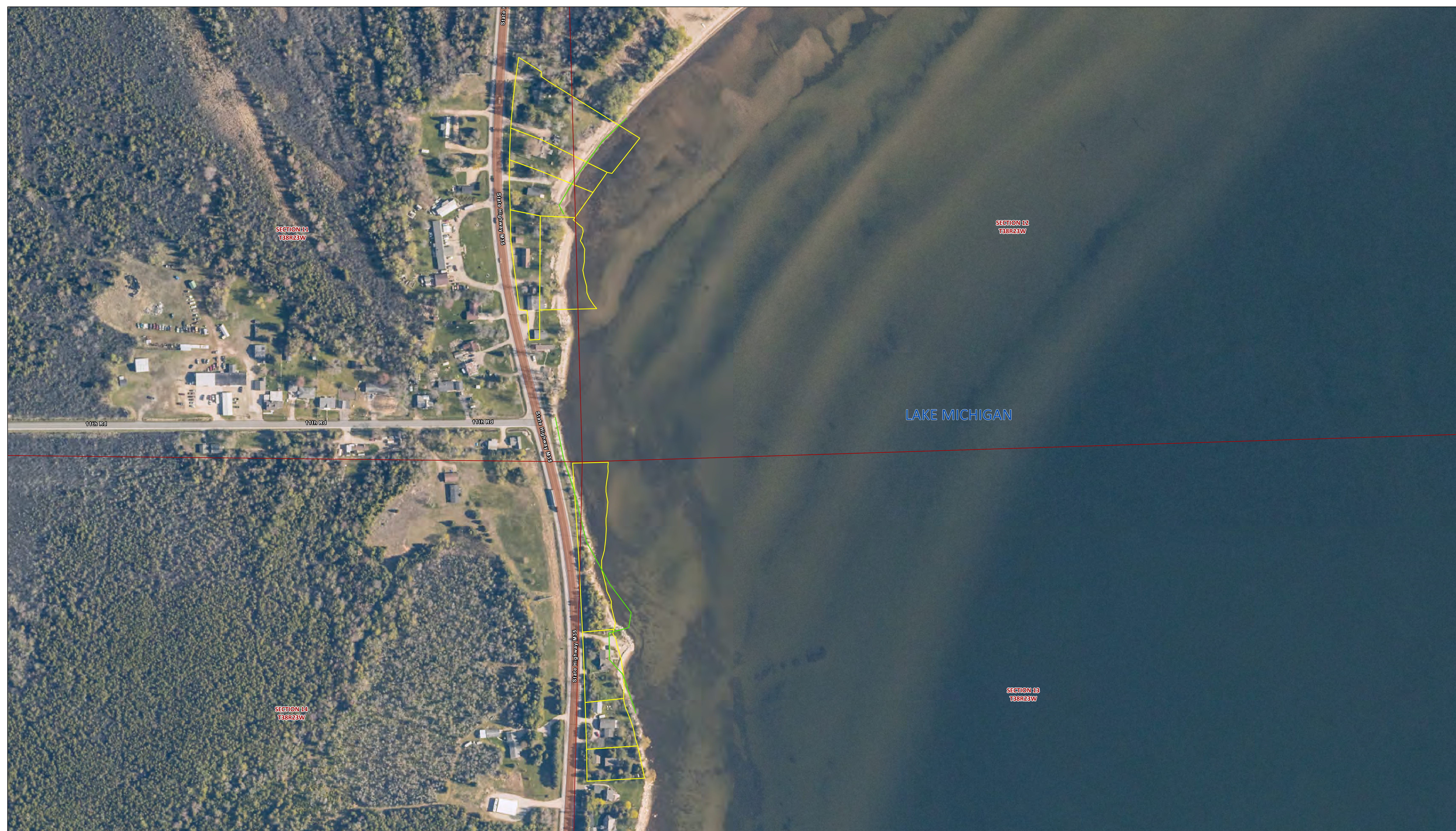


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Map Created by: Jeremy Jones
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Water Resources Division
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1/20/2023

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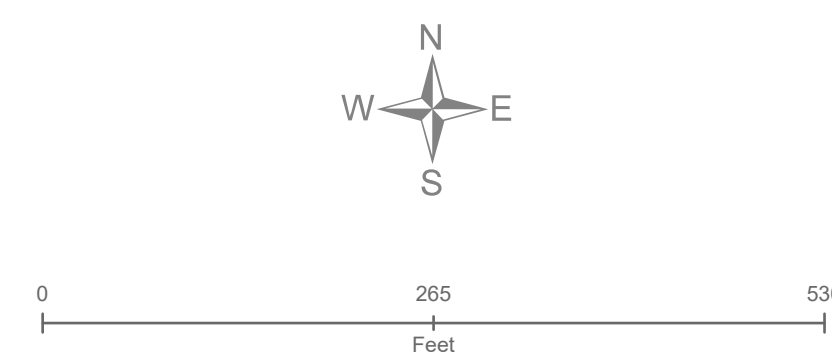
Preliminary High-Risk Erosion Area Update - 2023

Ford River Township, Delta County
T38N, R23W Sections 11, 12, 13, and 14

High Risk Erosion Areas De-Designated Parcels

- Sections
- 1985 HREAs (approximate)
- De-Designated Parcels

Background Image: 2021

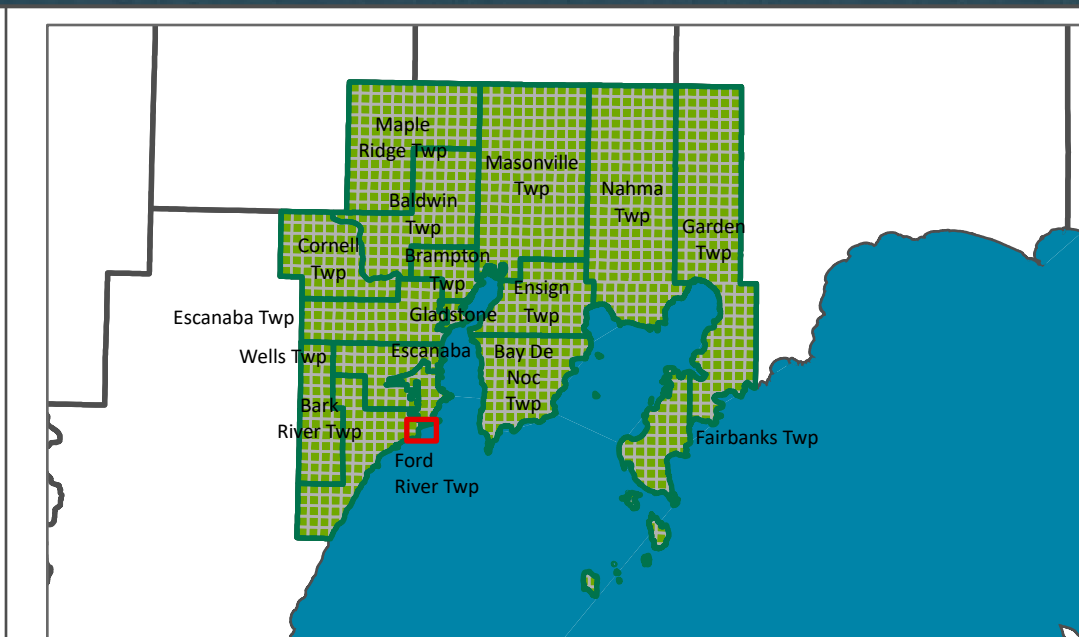


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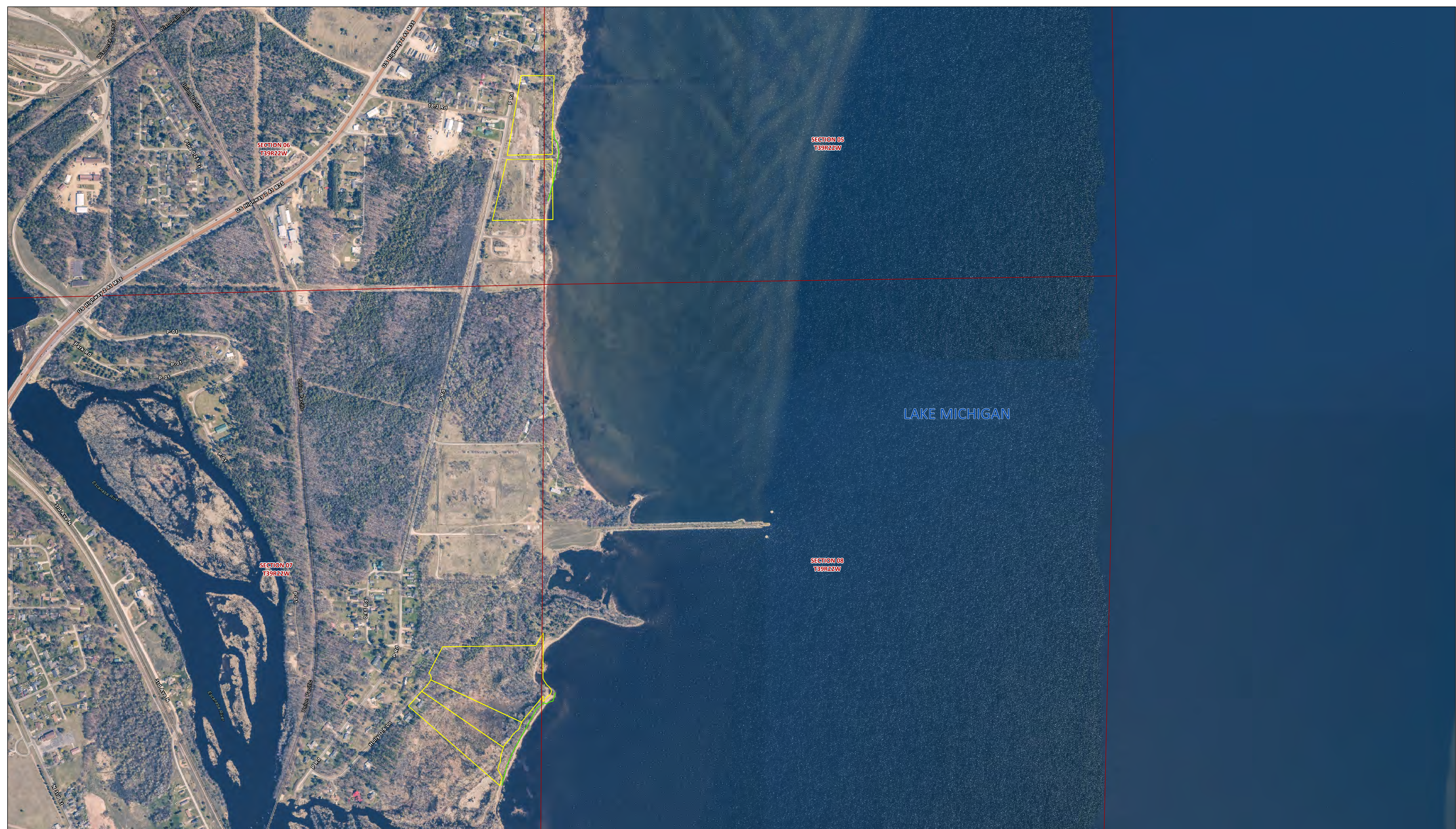
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Map Created by: Jeremy Jones
Environmental Quality Analyst
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Michigan Department of Environment, Great Lakes, and Energy
1/20/2023

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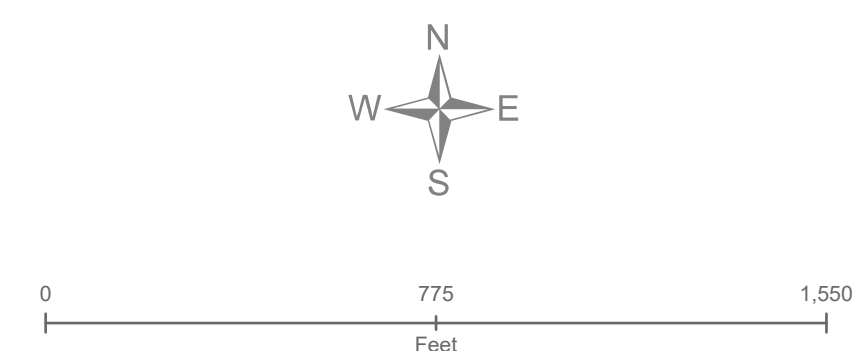


Preliminary High-Risk Erosion Area Update - 2023

Wells Township, Delta County
T38N, R22W Sections 05, 06, 07, and 08

High Risk Erosion Areas De-Designated Parcels

- Sections
 - 1985 HREAs (approximate)
 - De-Designated Parcels
- Background Image: 2021

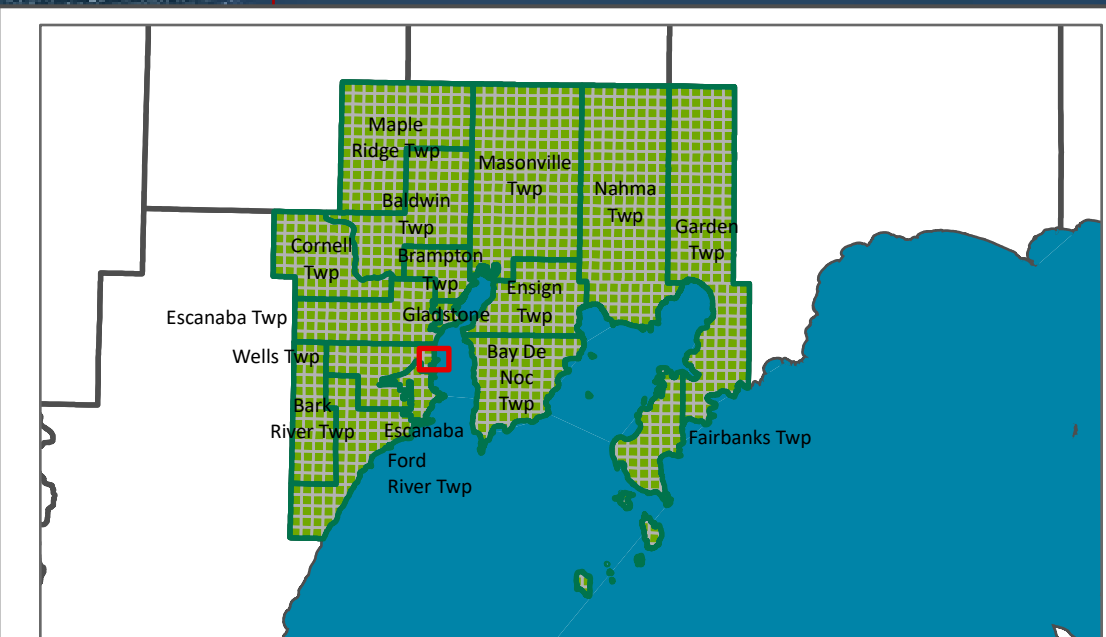


MAP INFORMATION:

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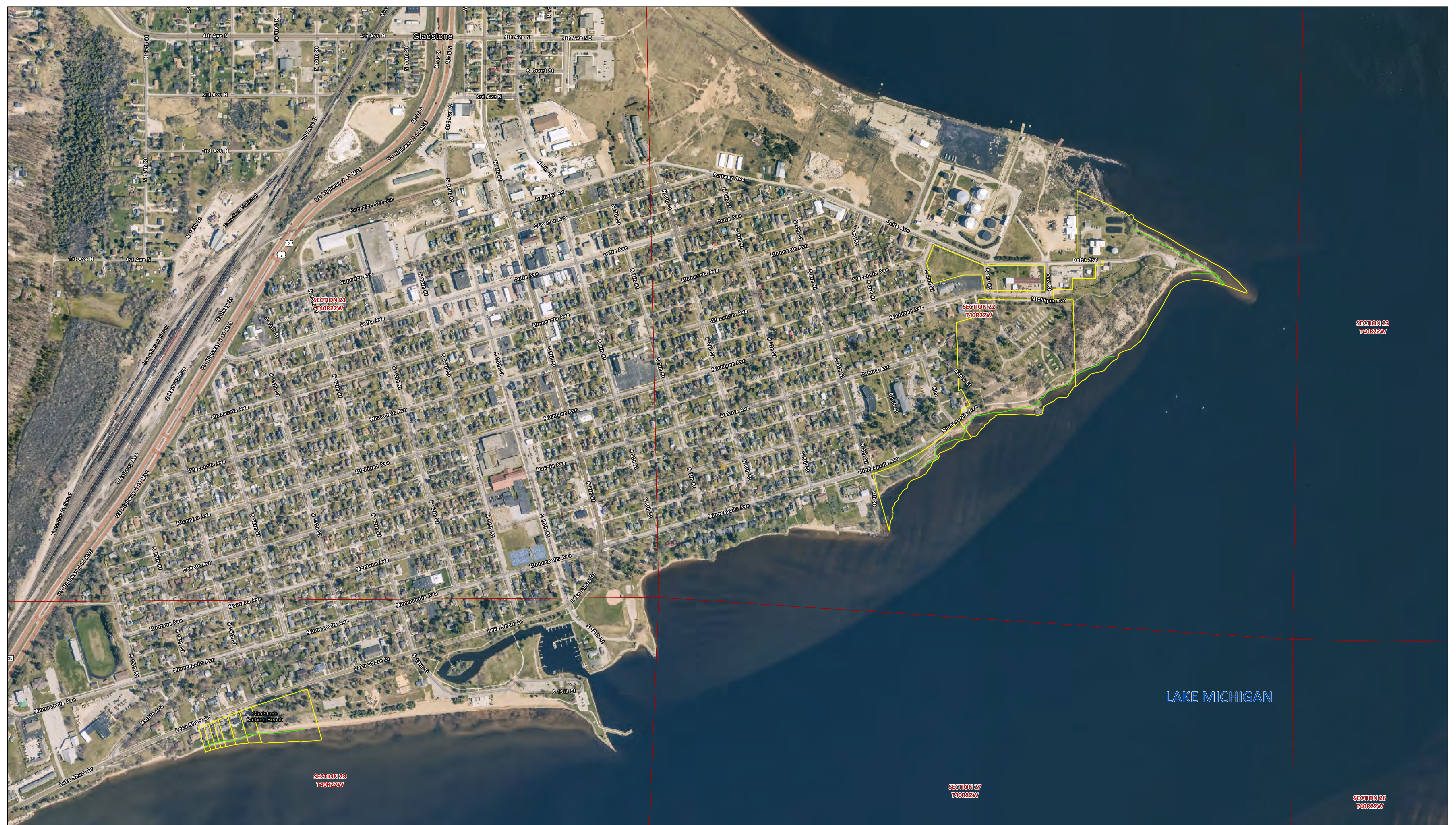
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Map Created by: Jeremy Jones
Environmental Quality Analyst
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Michigan Department of Environment, Great Lakes, and Energy
1/20/2023

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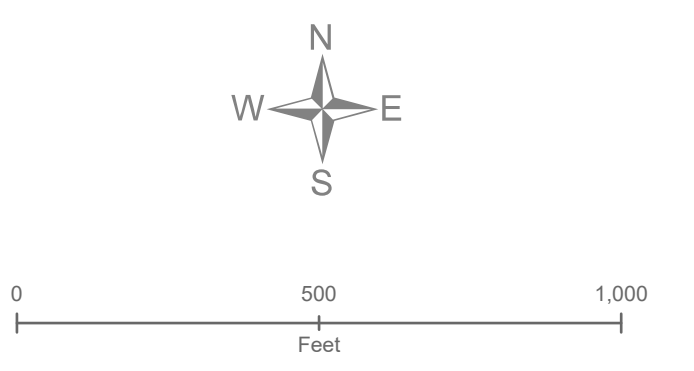


Preliminary High-Risk Erosion Area Update - 2023

City of Gladstone, Delta County
T40N, R22W Sections 28, and 22

High Risk Erosion Areas De-Designated Parcels

- Sections
 - 1985 HREAs (approximate)
 - De-Designated Parcels
- Background Image: 2021

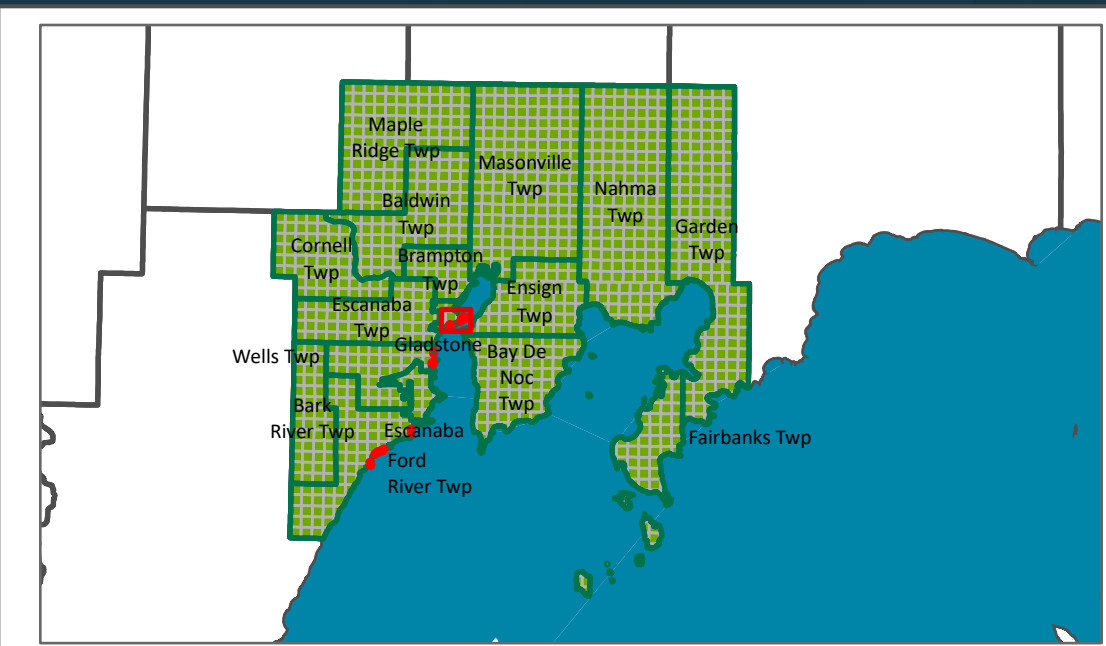


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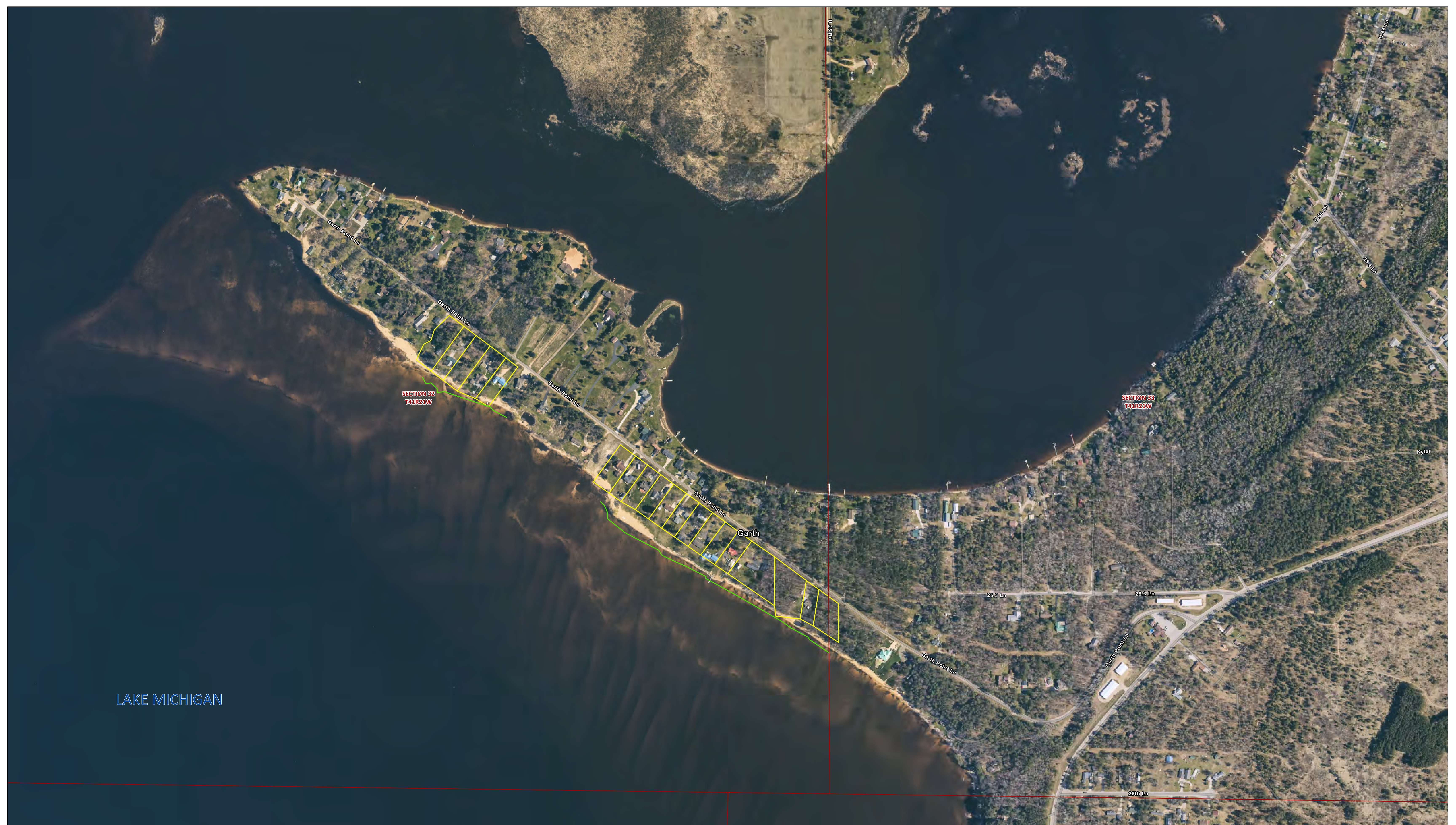
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Map Created by: Jeremy Jones
Environmental Quality Analyst
Water Resources Division
Michigan Department of Environment, Great Lakes, and Energy
1/20/2023

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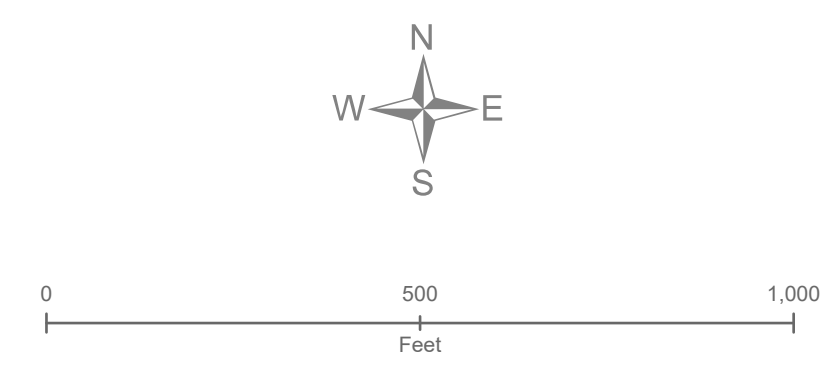
LAKE MICHIGAN

Preliminary High-Risk Erosion Area Update - 2023

Masonville Township, Delta County
T41N, R21W Sections 32, and 33

High Risk Erosion Areas De-Designated Parcels

- Sections
 - 1985 HREAs (approximate)
 - De-Designated Parcels
- Background Image: 2021

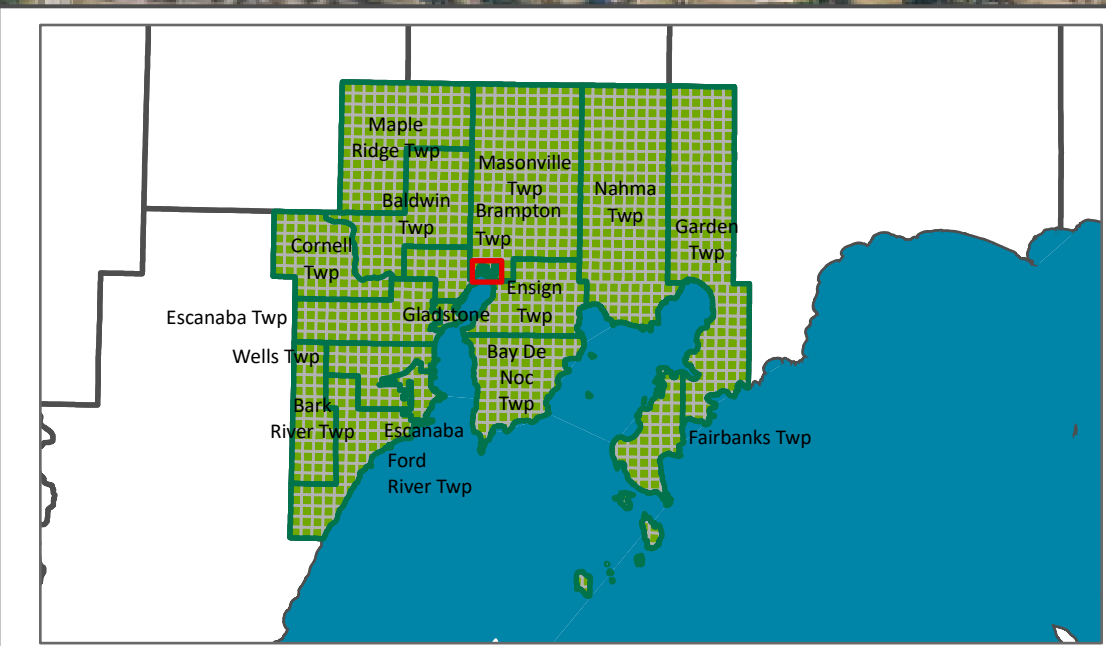


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Map Created by: Jeremy Jones
Environmental Quality Analyst
Water Resources Division
Michigan Department of Environment, Great Lakes, and Energy
1/20/2023

Recession/Accretion values for each area were calculated using the Digital Shoreline Analysis System from the USGS (Thieler, E.R., Himmelstoss, E.A., Zichichi, J.L., and Ergul, Ayhan, 2009, Digital Shoreline Analysis System (DSAS) version 5.1 - An ArcGIS extension for calculating shoreline change; U.S. Geological Survey Open-File Report 2008-127)

LAKE MICHIGAN

SECTION 01
T40R22W

SECTION 06
T40R21W

SECTION 05
T40R21W

SECTION 12
T40R22W

SECTION 07
T40R21W

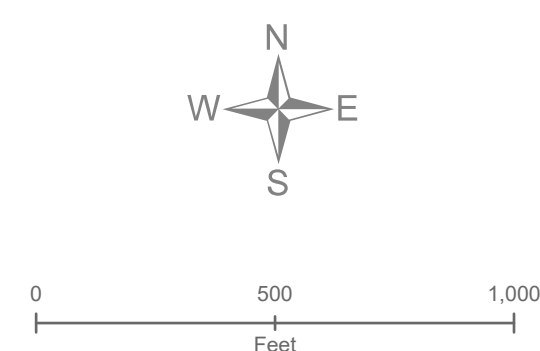
SECTION 08
T40R21W

Preliminary High-Risk Erosion Area Update - 2023

Ensign Township, Delta County
T40N, R21W Sections 06, and 07

High Risk Erosion Areas De-Designated Parcels

- Sections
 - 1985 HREAs (approximate)
 - De-Designated Parcels
- Background Image: 2021

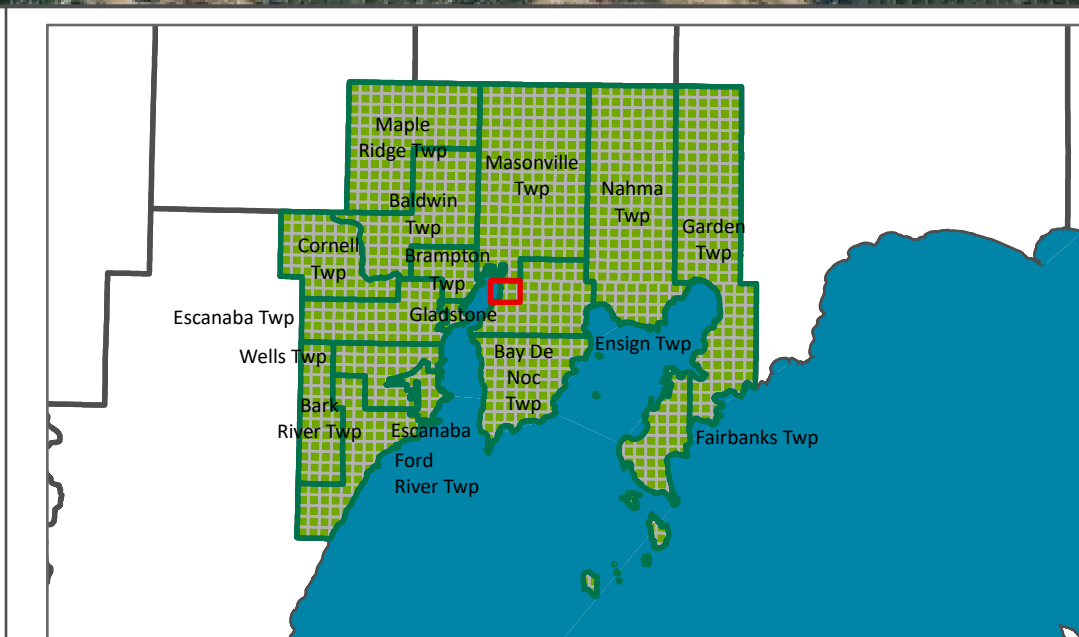


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Environmental Quality Analyst
Water Resources Division
Michigan Department of Environment, Great Lakes, and Energy
1/20/2023

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LAKE MICHIGAN

SECTION 14
T40R22W

SECTION 13
T40R22W

SECTION 18
T40R21W

SECTION 17
T40R21W

SECTION 23
T40R22W

SECTION 24
T40R22W

SECTION 19
T40R21W

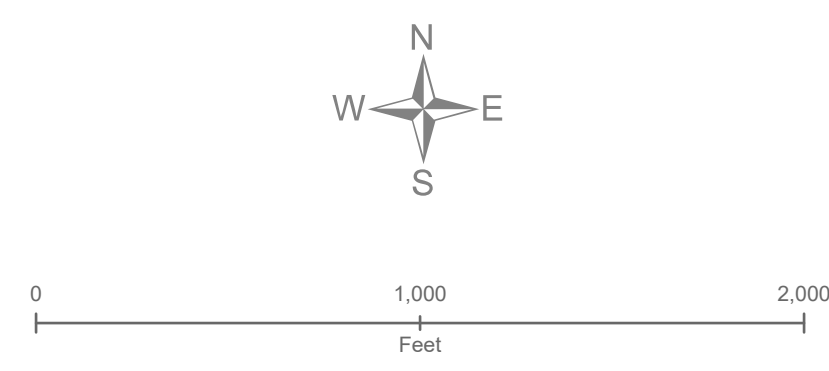
SECTION 20
T40R21W

Preliminary High-Risk Erosion Area Update - 2023

Ensign Township, Delta County
T40N, R22W Sections 13, and 23

High Risk Erosion Areas De-Designated Parcels

- 1985 HREAs (approximate)
- De-Designated Parcels
- Sections
- Background Image: 2021

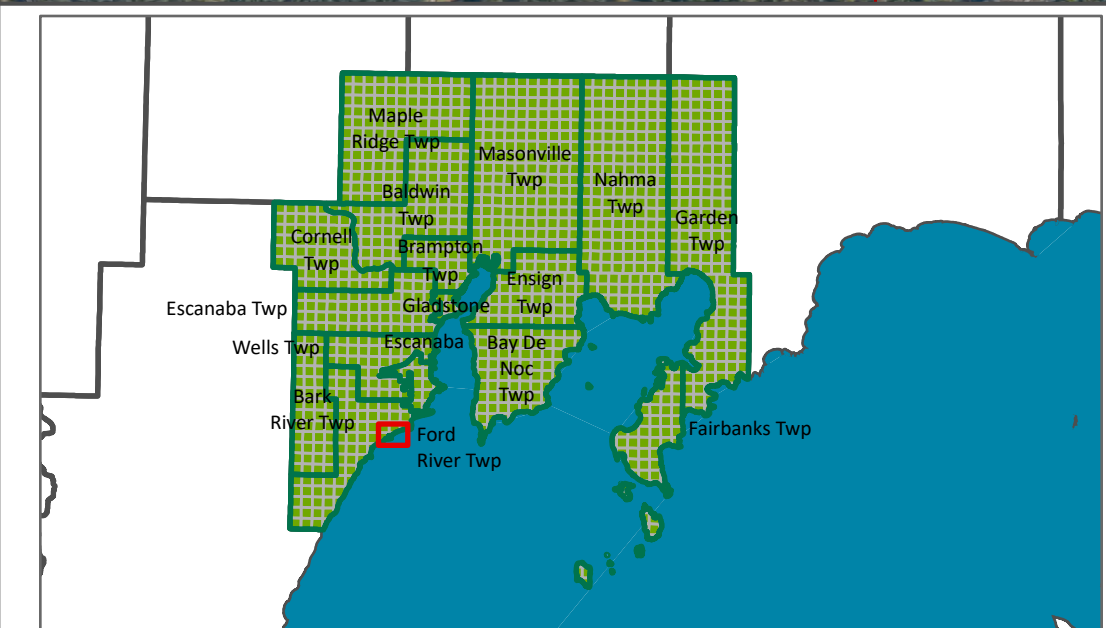


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