**THE CITY OF HURON, OHIO**
**Huron Safety Committee**
**Meeting Minutes**
**April 15, 2020 – via Webex Teleconference 5:00p.m.**

A meeting of the Council Safety Committee was called to order by Christine Crawford on Wednesday, April 15, 2020, at 5:00 p.m. via Webex teleconference. Committee members in attendance: Sam Artino, Monty Tapp and Christine Crawford. The members agreed that Christine Crawford will continue to act as Committee Chair.

Staff in attendance: Interim City Manager Michael Spafford, Police Chief Robert Lippert, Fire Captain Doug Nash, City Engineer/Zoning Inspector Doug Green, Parks & Recreation Operations Manager Doug Steinwart, Water Superintendent Jason Gibboney and Executive Administrative Assistant /Clerk of Council Terri Welkener.

Others in attendance: Mark Cencer of KS Associates Ltd.

**New Business**

**Nickel Plate Beach – KS Associates Report**
Mr. Spafford introduced Mr. Cencer of KS Associates. He has lived in Huron for the last 10 to 11 years and is familiar with the shoreline conditions. He is not sure how deep we want to go into the engineering side. A month or so ago he had a Powerpoint prepared, but doesn't want to drag the meeting on forever. Ms. Crawford said that she would like him to give 5 or 20 minutes of what he thinks is important to know.

Mr. Cencer said the first thing to point out is that beaches are always changing, and can never really be safe. The goal is not necessary to make the beach safe, but to reduce risks and provide information for guests to make an informed decision about swimming. You are never going to have a completely safe environment - the goal is to reduce risks by getting a good idea of what the actual conditions are. The next step was to research available standards for what lower risk swim conditions would be at recreational business. Next was an oceanographic analysis. Based on those comparisons, we could come up with recommendations.

Mr. Cencer discussed, in some detail, the Nickel Plate Beach Swim Study prepared by KS Associates Ltd., a copy of which is attached as Exhibit "A and incorporated herein by reference.

Mr. Spafford asked if anyone had any questions and wanted to go through the draft policies and procedures document provided to committee members. This document was drafted in conjunction with police, fire and parks and recreation. Mr. Spafford stated that we are trying to mitigate risk, but open water swim areas are never "safe". A lot of mitigation efforts are just risk reduction to improve the safety of the beach, but there is no 100% safe open swim area. The alert system contacts are Mr. Steinwart, Chief Lippert, the Fire Captains and the officer on duty. The designated swim area depth will not exceed 4 feet. Utilizing the map within the swim study, a swim area was established that follows the exhibit within the study and would eventually be attached to this document as well. The swim area is located 200' off the East pier. The outward limit would initially be set per the study, but it could change when the buoys are set. The buoys will be in the water from Memorial Day through Labor Day. Weather conditions of 15mph or greater winds coming out of the north or northeast or a National Weather Service report or warning would set off an alert. Even of the alert systems hasn't been tripped, the Action and Response Team would be able to make a determination independent of the automatic system.

The warning system at Nickel Plate Beach includes a red flag system in addition to an electronic weather monitoring system with wind meter able to detect speed and direction. That electronic system will distribute a local warning and notify the Action and Response Team. There would be a light fixture that would blink as well as a speaker notifying swimmers of dangerous conditions and asking them to exit the water. Public outreach will include live feed video to allow public and City emergency services to access live video at the beach. This live feed will be available on the City's website, along with a site dedicated to Nickel Plate Beach and beach safety with current conditions and the County Health Department's weekly microbial assessment. Procedures for issuing the red flag are spelled out for times 9am to 6pm when beach is manned by Parks and Recreation employees.

A secondary discussion is what the procedure would be when conditions are lifted - working through what the reopening of the swim area would look like. Mr. Spafford said that closing the swim area doesn't mean the park will close, unless necessary. The police are able to enforce the no swim alert.

With the ongoing COVID-19 situation, we are not sure what the opening date for the beach will be. From a construction standpoint and cost standpoint, we expect to be ready to open on Memorial Day. .Fire Department has ordered buoys and will use for training for dive team to set buoys.

**COVID-19**

Mr. Spafford said that he doesn't want to sound too optimistic, but the City seems to have weathered the storm so far. The Health Department is coordinating with all confirmed cases. We have our first case within Huron or Huron Township.

Mr. Nash says the Fire Department gets the name and address of the person, but they are restricted in releasing any additional information. We have a confirmed case, not a death, and he did not know if that person had been admitted to the hospital. Mr. Nash says that it is good to have an address in case the ambulance has to go to that address, so that they can take extra precautions. Overall, there has been a decline in calls because no one wants to go to the hospital. Ms. Crawford says that she is glad they have that information.

The secondary impact is in programming with Parks and Recreation, primarily with the schools closed. ***Mr. Spafford left the meeting at 6:05pm***. Chief Nash said they are sitting okay on supplies, and are monitoring those constantly. They have received small amounts of PPE from Erie County, but have been advised that they would not be receiving any additional. Firelands has started doing cleaning of PPE, but we are only stockpiling if used or dirty at this time – they don't want to reuse that stuff if they don't have to. He was unsure how long it would be before more will have to be ordered.

Monty Tapp asked police how they are doing with PPE. Chief Lippert answered they they are not going on rescue calls unless it's a life-threatening situation. They do wear face masks, which are N95 masks.

Christine Crawford asked Mr. Steinwart about the new signage at Nickel Plate. Mr. Steinwart said that the new gate is going to help this year. There were three red flag events last year, and there was one event where police had to evacuate the beach. From the Parks and Recreation Department's perspective, we don't want to kick everyone out of the park when there is an alert. We have run through all of the different scenarios to work it out. New signage was in place when they reopened last year, and those will be supplemented with the new KS recommendations. They have applied for the life jacket grant, but have not heard back. They are on hold with Paddle Shack with everything that is going on. A pole has been installed for the audio component of the sytem. We are looking for a couple of options for announcements, along with tones. There is one box installed in the changing room, and they will have to run underground conduit to those. They will conduct test runs in mid-May.

Asked if he has spoken with anyone regarding the wind monitoring system, Mr. Steinwart said they have been working with Vasu, but were unable to find exactly what they were looking for. There is no one else out there with a system like this in place. Vasu is building a custom system for Nickel Plate Beach. People may be looking to the City of Huron for this type of thing. Most of the other beaches that have some sort of monitoring system are private beaches and monitoring is left to the lifeguard. This is new, certainly, to this area. They will practice with it once it is up and running.

The Mayor thanked Mr. Cencer for speaking to the committee.

**Motion by Mr. Tapp to accept the minutes of the September 19, 2019 minutes, seconded by Mr. Artino. Ms. Crawford asked for revision to minutes to correct spelling of Mr. Steinwart's name. Minutes were unanimously approved with corrections to spelling of Mr. Steinwart's name.**

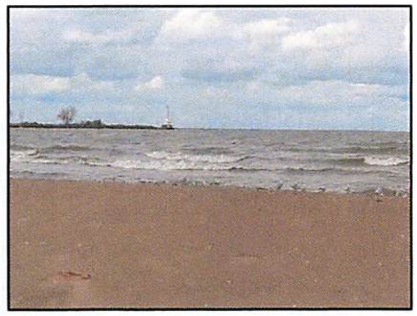
Mr. Green mentioned that he was very impressed by Mr. Cencer's report, to which Ms. Crawford agreed.

There being no further business to come before the Safety Committee, **Mr. Tapp made a motion to adjourn the meeting at 6:20pm**. All in favor, meeting adjourned at 6:20pm.

Terri S. Welkener
Clerk of Council

# Nickel Plate Beach
# Swim Area Assessment

1 Nickel Plate Drive, Huron, Ohio 44839



City of Huron
417 Main Street
Huron, Ohio 44839

KS ASSOCIATES

Civil Engineers + Surveyors

260 Burns Road, Suite 100
Elyria, Ohio 44035
P 440 365 4730
F 440 365 4790
www.ksassociates.com

Mark Cencer, P.E. No. 74234
KS Project No. 19192

# Contents

# Executive Summary

Nickel Plate Beach is located immediately east of the Huron Harbor breakwaters along the shore of Lake Erie in Huron, Ohio. Nickel Plate Beach has a history of safety concerns due to waves and wave-driven currents. Recent high lake levels have increased risks to beach visitors, particularly during storms or significant wave events. In response, the City of Huron engaged KS Associates to study the conditions along the shore and provide recommendations to help reduce risks to beach users.

KS's approach to the study included researching and compiling data about the existing site conditions, researching guidance for acceptable conditions for swimming at recreational beaches, comparing conditions at Nickel Plate Beach to guidance available for swim areas, and providing recommendations to help reduce the risk of swim hazards at the beach.

Figure 1: Nickel Plate Beach

Based on the guidance available, certain areas in the nearshore at Nickel Plate Beach meet the criteria for acceptable swim conditions during typical wind and wave conditions, while risks are greater in other areas or during storm conditions. Considering the results of the study, KS recommends the following measures to help reduce risks to swimmers at Nickel Plate Beach:

A. Install buoys to designate a swim area within the boat exclusion area at Nickel Plate Beach.
B. Perform periodic inspections to identify signs that rip currents may be present (such as newly formed or well-defined beach cusps, visible areas of scour in the nearshore, noticeable variability in nearshore sand bars, or visible cross-shore flow). If signs of rip currents are observed, the City may consider placing flags or signage on the beach to warn visitors that a rip current may be present in the area or closing the swim area.
C. Develop a system to monitor wind and wave conditions and provide a warning to beach users of increased risk during moderate or severe wind and wave events.
D. Install additional signage warning of the risk of rip currents, particularly in areas where rip currents are anticipated to form.

Many of the risks associated with entering the water in a dynamic nearshore system are related to natural processes and cannot be eliminated. Nickel Plate Beach is exposed to a wide variety of water levels, winds and wave conditions that often result in strong currents. Risks to beach users will also be dependent on air and water temperatures and the physical abilities of the swimmer. The recommendations provided in this report are intended to help manage risks at Nickel Plate Beach. The recommendations are not to be interpreted as safety measures and will not result in a "safe" beach. There are inherent risks associated with entering the water in a dynamic beach environment. In many cases, the risks associated with swimming in the nearshore environment attract visitors to beaches. In other instances, beach visitors may not be aware of the risks. In either case, the City may consider limiting access to the water in areas or during times when the risks are greatest. Educating beach visitors to increase their understanding of nearshore processes will also help them make informed decisions regarding the risks they are accepting when entering the water.

# Project Overview

Nickel Plate Beach is located immediately east of the Huron Harbor breakwaters along the shore of Lake Erie in Huron, Ohio. The beach included in Erie County parcel 42-90051.000 owned by Norfolk & Western Railroad Company and leased to the City of Huron. Nickel Plate Beach is a popular recreational beach but has a history of safety concerns due to waves and wave-driven currents. Recent high lake levels and storm events have resulted in hazardous conditions for swimming along the shore. In response, the City of Huron engaged KS Associates to study the conditions along the shore and provide recommendations to help reduce risks to beach users.

The purpose of the project is to perform an assessment of the existing beach morphology and make recommendations to reduce the risk of using the beach for recreation. Coastal morphology refers to the formation of sand beaches and changes to the sand shapes over time. The scope of services for the contract includes a topographic and hydrographic survey, performing a visual inspection of the beach, preparing a metocean analysis (an analysis of the meteorological and oceanographic conditions), preparing recommendations, preliminary sketches and cost opinions for improvements to the beach, and preparing a condition assessment report. The study area includes approximately 1,000 feet of beach extending east from the Huron Harbor east breakwater.

KS's approach to the study includes the following steps:

1. Research and compile background information about the beach, including historical aerial permits, previous erosion studies, and historical records or permits (if available).
2. Perform a site visit to review current conditions along the shore of Nickel Plate Beach.
3. Perform a topographic survey of the beach and hydrographic survey of the nearshore lakeward of the beach as a basis for developing wave conditions and wave driven currents at the beach.
4. Research available standards, recommendations and guidance for acceptable conditions for swimming at recreational beaches.
5. Perform an analysis of the meteorological and oceanographic conditions affecting Nickel Plate Beach (metocean analysis), including water levels, wind conditions, wave parameters, and wave driven currents.
6. Compare the conditions at Nickel Plate Beach to the recommended conditions for recreational beaches in the published standards and guidance.
7. Provide recommendations to help reduce the risk of swim hazards at the beach.

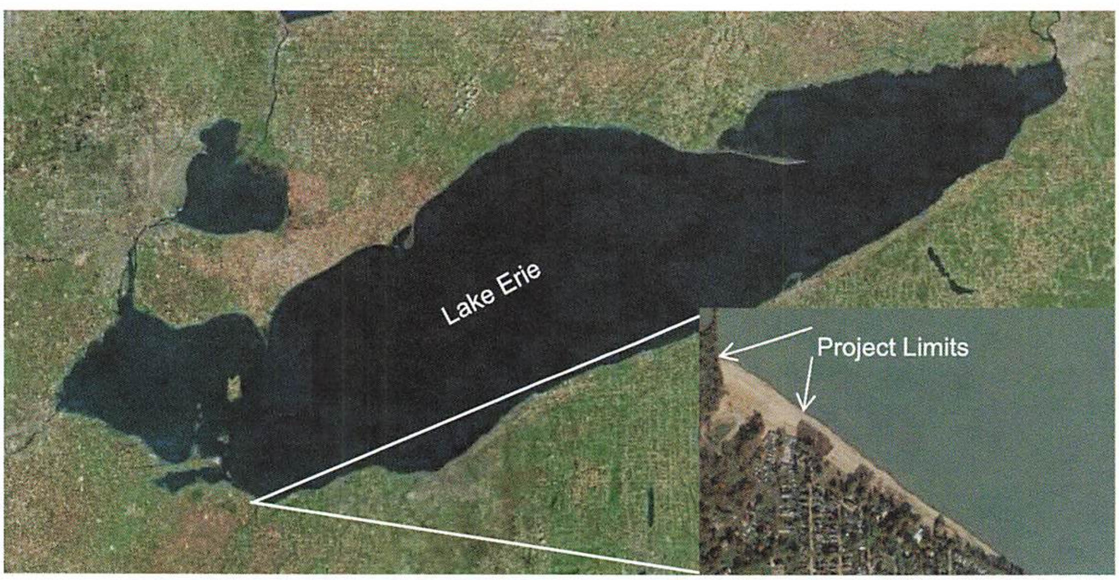



**Figure2: Site Location (Google Earth)**

# Background

KS Associates compiled the following background information about the project site to aid in the assessment of the conditions at Nickel Plate Beach.

## Historic Aerial Photography

Historical aerial photography showing the area of Nickel Plate Beach is available from the Ohio Department of Natural Resources (ODNR) dating back to 1949. The historic photos show land use, gradual development and changes to the coastline over time. The Huron Harbor breakwaters were originally constructed between 1827 and 1831 and were lengthened in 1908 and between 1933 and 1935. The breakwater structures are visible in aerial photos dating back to 1949. The eastern breakwater has supported a relatively stable beach since the first aerial photograph. The outfall pipe near the center of the parcel appears to have been constructed between 1956 and 1968. A gravel/sand path was used for beach access until the roadway and parking lot were constructed between 1997 and 2003.

Beach cusps, or ridges of sand in the beach profile, can be a sign of rip currents. Beach cusps are visible in many of the historical aerial photographs. This suggests that Nickel Plate Beach likely has a history of rip currents.

Copies of the historical aerial photos provided by ODNR are included in Attachment A.

## Coastal Erosion Area Maps

The ODNR Division of Geological Survey has studied erosion and recession along the shore of Lake Erie dating back to the earliest survey records in 1877. Draft Open File Report 96-xxx provides erosion data from 1877 to 1973 and ODNR Coastal Erosion Area (CEA) Maps provide shoreline recession data from 1973 to 1990, from 1990 to 2004 and from 2004 to 2015. The shore at the project site experienced gradual accretion as sand accumulated updrift of the Huron Harbor breakwaters from 1877 to 1973. The CEA maps show that the shore of Nickel Plate Beach has experienced very little recession or erosion since 1973. The average recession rate over all three time periods is 0.0 feet per year, although recession up to 0.5 feet per year was measured at the ditch crossing the beach between 1973 and 1990. Based on the current 2018 mapping (comparing the recession features from 2004 to 2015), the beach is not located in a designated Coastal Erosion Area. Copies of the CEA maps are included in Attachment B.

## Additional Records

KS Associates contacted the U.S. Army Corps of Engineers (USACE) and Ohio Department of Natural Resources for additional data to assist with the beach assessment. A review of available records did not result in any additional data relevant to the beach assessment. There are no records of previous permits at the project site.

KS also reviewed navigation charts available from the National Oceanographic and Atmospheric Administration (NOAA) for nearshore water depths lakeward of the hydrographic survey area. A navigation chart showing the project area is included in Attachment C.

# Site Inspection

KS Associates visited the project site on October 4, October 7, and October 17, 2019 to inspect the conditions at Nickel Plate Beach. The October 4, 2019 site visit included a general walk-through to collect initial photos and make general observations about the beach and nearshore. KS returned to the project site on October 7, 2019 to perform a detailed inspection of the beach. The purpose of the October 17, 2019 site inspection was to observe the site during a period with north winds and moderate wave action. The following data was collected during the site inspections:

- Photographs were obtained showing details of the beach.
- KS documented visual observations of the beach profile and nearshore, including the presence of berms, beach cusps, and sand bars.
- The inclination of the beach was measured at approximately 100-foot intervals using a digital level.
- Sand samples were obtained from near the water's edge in three locations along the beach.
- KS also recorded meteorological conditions, water levels and wave conditions at the time of each site visit.

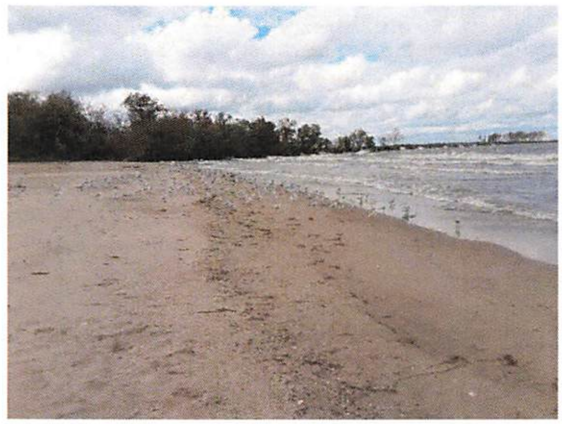


**Figure 3: Beach conditions on October 4, 2019.**

The scope of services for the inspection does not include in-water diving inspections, destructive testing, geotechnical investigations or any sub-surface condition assessments.

**Figure 4: Beach conditions on October 4, 2019.**

# Topographic and Hydrographic Survey

KS Associates performed a topographic survey of the beach on October 15, 2019 and a hydrographic survey of the nearshore lakeward of the project site on October 23, 2019. The hydrographic survey was performed using a Seafloor HydroLite Echosounder to collect depths at intervals of 5 feet. The survey extends approximately 1,000 feet east from the Huron Harbor east breakwater and 1,300 feet lakeward from the shoreline. The topographic survey was performed for the same 1,000 feet of beach and extends approximately 100 feet landward from the shoreline. A detailed drawing showing the beach and nearshore contours generated from the survey data is included in Attachment D.

**Figure 5: Topographic and Hydrographic Survey**

For the purpose of this report, all elevations are reference to the International Great Lakes Datum of 1985 (IGLD 1985). IGLD 1985 is a vertical elevation datum created to express the height equivalent of the Great Lakes in relation to mean sea level.

# Review of Guidance for Recreational Beaches

The selection of criteria for conditions conducive to swimming at recreational beaches is dependent on a variety of factors, including water depths, wind speed and direction, wave heights, current velocities, nearshore slopes, lakebed materials, water temperatures, and the physical abilities of the beach users. A single reference is not available with recommendations for conditions that would be applicable to Nickel Plate Beach. In order to establish criteria for acceptable conditions for swimming at Nickel Plate Beach, KS researched available recommendations and guidance from the following standards and publications:

1. *EM 1110-1-400 Recreational Facility and Customer Service Standards*, U.S. Army Corps of Engineers (2004)
2. *Methods of Assessing Instream Flows for Recreation*, U.S. Fish & Wildlife Service (1978)
3. *Flood Plain Planning Policy Statement*, The Canadian Ministry of Natural Resources (1988)
4. *Waterfront Developments in Harmony with Nature*, Karsten Mangor, Ida Broker, Peter Rand and Dan Haslov, Coastal and Ocean Engineering Practice (2008)
5. *Morphodynamic variability of surf zones and beaches*, L. Donelson Wright and Andrew Short, Journal of Marine Geology (1984)
6. *Rip Currents and Beach Hazards: Their Impact on Public Safety and Implications for Coastal Management*, Andrew Short and C.L. Hogan, Journal of Coastal Research (1994)
7. Ohio Department of Natural Resources and Ohio Department of Health Beach Monitoring

The U.S. Army Corps of Engineers releases Engineering Manuals (EM) to provide guidance with the design and construction of waterfront structures and facilities. EM 1110-1-400 provides guidance for recreational areas and facilities. Although developed for inland bodies of water with minimal waves, Section 5.4.4.2 Swim Area Design and Safety provides useful information for reducing risk at beaches.

**Table 1: USACE Swim Area Delineation and Safety Table**

| **Delineation & Safety** (Drawing G-3) | |
|---|---|
| A minimum of two depth markers (delineating each 1-ft (0.3-m) change in water depth) installed in the designated swimming area. The number of depth markers installed adequate for all water users to determine the water depth (Photo O-1) | Required |
| The recommended water depth within the delineated swim area is 3-ft (0.9-m), and should not exceed 5-ft (1.5-m) | Recommended |
| A minimum of 2 "Boats Keep Out" buoys installed not less than 100-ft (30.5-m) beyond the delineated swim area | Required |
| Water safety, emergency phone numbers, and Title 36 regulations posted on protected bulletin boards that are located so that swimmers see them before entering the area | Required |
| An effective means of communication for emergency services such as a nearby pay phone or call box provided at each designated swim area | Recommended |
| Life-saving devices such as a ring buoy and line, and/or a 10- to 12-ft (3- to 3.7-m) pole (shepherd's hook) may be located at designated swim areas | Optional |

In general, the USACE recommends that underwater gradients should be smooth and constant at an average slope of 2 to 5% (but not exceeding 10%) without sudden changes in grade or drop-offs in depths of zero to five feet.

The USACE manual recommends a maximum water depth of 5 feet in recreational swim areas. The USACE does not provide criteria for maximum wave heights or current velocities. The USACE also requires a constant slope within the swim area, which is difficult to obtain considering the littoral processes in a dynamic nearshore system like Nickel Plate Beach.

The United States Fish & Wildlife Service's *Methods of Assessing Instream Flows for Recreation* indicates that the maximum acceptable current velocity for swimming in recreational areas is two feet per second. It should be noted that this current velocity is recommended for streams and rivers without significant wave action. The combination of wave forces and currents, particularly wave driven currents, would increase the potential for swim hazards.

The *Flood Plain Planning Policy Statement* published by the Canadian Ministry of Natural Resources provides recommendations for current velocities and water depths for safe transit across floodplains. The recommendations are for walking through water (wading) rather than swimming but can be cautiously applied to recreational swim areas. The Canadian MNR suggests acceptable velocities of about 1 to 2 feet per second at a depth of 4 feet, with safe velocities decreasing as the water depth increases. The Canadian MNR study warns of the risk of entering water that exceeds chest level under any current conditions due to buoyancy. For example, the document indicates that depths in excess of 3.3 feet would be sufficient for a young school aged child to begin to float and lose footing, while depths in excess of 4.6 feet would put most teenagers and average adults at risk. The Canadian MNR notes that the subgrade material will also affect footing for safe transit when stronger currents are encountered. It should be noted that this reference also does not take wave action into account.

Swimming conditions at recreational beaches are addressed in *Waterfront Developments in Harmony with Nature* published in the journal of Coastal and Ocean Engineering Practice (2008). The study relates swim safety to the occurrence and type of breaking waves and wave generated currents in the breaking wave zone. Maximum wave heights for acceptable swim conditions are limited to a range from about 2.6 feet to about 3.9 feet. The lower end of the range is applicable for long period waves such as ocean waves and the higher end of the range is recommended for the shorter period, steeper, wind driven waves common in Lake Erie. The study warns that rip currents generated as a result of the presence of coastal structures can be very dangerous. The recommendations provided in the study are generally qualified as there are no internationally agreed upon criteria relating wave height and wave generated currents to acceptable bathing conditions.

Studies performed by L. Donelson Wright, Andrew Short and C.L. Hogan can be combined to provide useful recommendations for acceptable swim conditions at recreational beaches. In *Morphodynamic variability of surf zones and beaches* published in the journal of Marine Geology (1984), Wright and Short provide a model to classify six different types of beaches. In *Rip Currents and Beach Hazards: Their Impact on Public Safety and Implications for Coastal Management* published in the Journal of Coastal Research (1990), Short and Hogan identified the hazards associated with six distinct beach types and rated them on a scale of 1 to 10, with a rating of 1 being the least risky and 10 being the most.

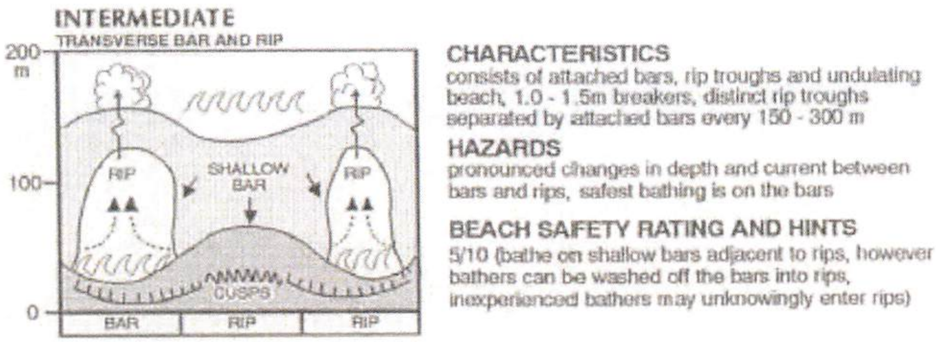



**Figure 6: Beach Type, Hazards and Safety Rating from *Rip Currents and Beach Hazards: Their Impact on Public Safety and Implications for Coastal Management* (1990)**

Based on the classification proposed by Wright and Short, Nickel Plate Beach would be categorized as an "Intermediate Traverse Bar and Rip" beach. This type of beach and nearshore system consists of an undulating beach with cusps along the shoreline and frequent sand bars with rip troughs in the nearshore. Short and Hogan give this type of beach a 5/10 safety rating in waves less than 3.3 feet in height.

**Table 2: Swim-Safety Rating Table vs. Incident Wave Height from Rip Currents and Beach Hazards: Their Impact on Public Safety and Implications for Coastal Management (1990)**

| BEACH STATE \ WAVE HEIGHT | < 0.5 (m) | 0.5 (m) | 1.0 (m) | 1.5 (m) | 2.0 (m) | 2.5 (m) | 3.0 (m) | > 3.0 (m) |
|---|---|---|---|---|---|---|---|---|
| Dissipative | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 10 |
| Long Shore Bar Trough | 4 | 5 | 6 | 7 | 7 | 8 | 9 | 10 |
| Rhythmic Bar Beach | 4 | 5 | 6 | 6 | 7 | 8 | 9 | 10 |
| Transverse Bar Rip | 4 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Low Tide Terrace | 3 | 3 | 4 | 5 | 6 | 7 | 8 | 10 |
| Reflective | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 10 |

| BEACH SAFETY RATING | KEY TO HAZARDS |
|---|---|
| Safest: 1 - 3 | Water depth and/or weak currents |
| Moderately safe: 4 - 6 | Shorebreak |
| Low safety: 7 - 8 | Rips and surfzone currents |
| Least safe: 9 - 10 | Rips, currents and large breakers |

Water temperature and the potential for contamination should also be taken into consideration when selecting appropriate conditions for swimming at recreational beaches. The Ohio Department of Health, monitors beaches around Ohio for the development of algal blooms and E. Coli bacteria. The state requires that flags be erected to educate swimmers when these events are occurring.

ODNR lists Nickel Plate Beach as Erie County public access ER28 to Lake Erie. ODNR describes the beach as having natural sand containing only minor amounts of shell fragments and small stones, an extensive sandbar system, and foot-friendly sand that extends into the water. ODNR monitors the beach using their Beach Guard, Nowcast, and Algae Awareness 101 programs.

The following table summarizes the guidance available for acceptable conditions for swimming from the references described above:

**Table 3: Guidance summary**

| Summary of Guidance for Swim Conditions | | | | | |
|---|---|---|---|---|---|
| | **USACE** | **USFWS** | **Canadian MNR** | **Mangor et al** | **Wright, Short & Hogan** |
| **Nearshore Slope** | **2% to 5%** | Not addressed | Not addressed | Not addressed | Not addressed |
| **Water Depth** | < 6 feet | Not addressed | < 4 feet | < 5 feet* | < 4.2 feet* |
| **Wave Height** | Not addressed | Not addressed | Not addressed | < 3.9 feet | < 3.25 feet |
| **Current Velocity** | Not addressed | 2 feet/second | 1-2 feet/second | Not addressed | Not addressed |
| *Water depths assume depth-limited wave conditions | | | | | |

# Metocean Analysis

In addition to the guidance describe above, recommendations to reduce potential swim hazards must also take into account the conditions at Nickel Plate Beach. This requires an analysis of the meteorological and oceanographic factors that affect conditions at Nickel Plate Beach (Metocean Analysis). Factors to be considered include water levels, wind speed and direction, wave heights and wave induced currents.

Site conditions developed from the Metocean Analysis are typically based on return periods. In this case, return period is referring to the average length of time between occurrences. The return periods considered for the study were selected with consideration of the relative importance and risks to persons or property in the event the design conditions are exceeded.

With consideration of the range of return periods that may be required, KS Associates performed the following Metocean Analysis. A summary of the calculations performed for the metocean analysis is included in Attachment E.

## Design Water Levels

Lake Erie water levels are influenced by long-term variations, seasonal changes and short-term storm conditions. Long-term and seasonal changes are generally considered variations in the static water level, while short term changes are the result of local storm surge, wind setup, or seiching (the oscillation of water within a basin). The static water level is typically represented by Monthly Mean Water Levels. The monthly mean is commonly considered an adequate time scale to account for hydrological factors while averaging out short term variations due to localized storm conditions. Historical Lake Erie water levels are available from the National Oceanographic and Atmospheric Administration (NOAA). The nearest gauge station to the project site is at the Marblehead Coast Guard Station just west of the mouth of Sandusky Bay. Monthly mean water levels are available for Marblehead dating back to 1959 are shown in the Figure below.

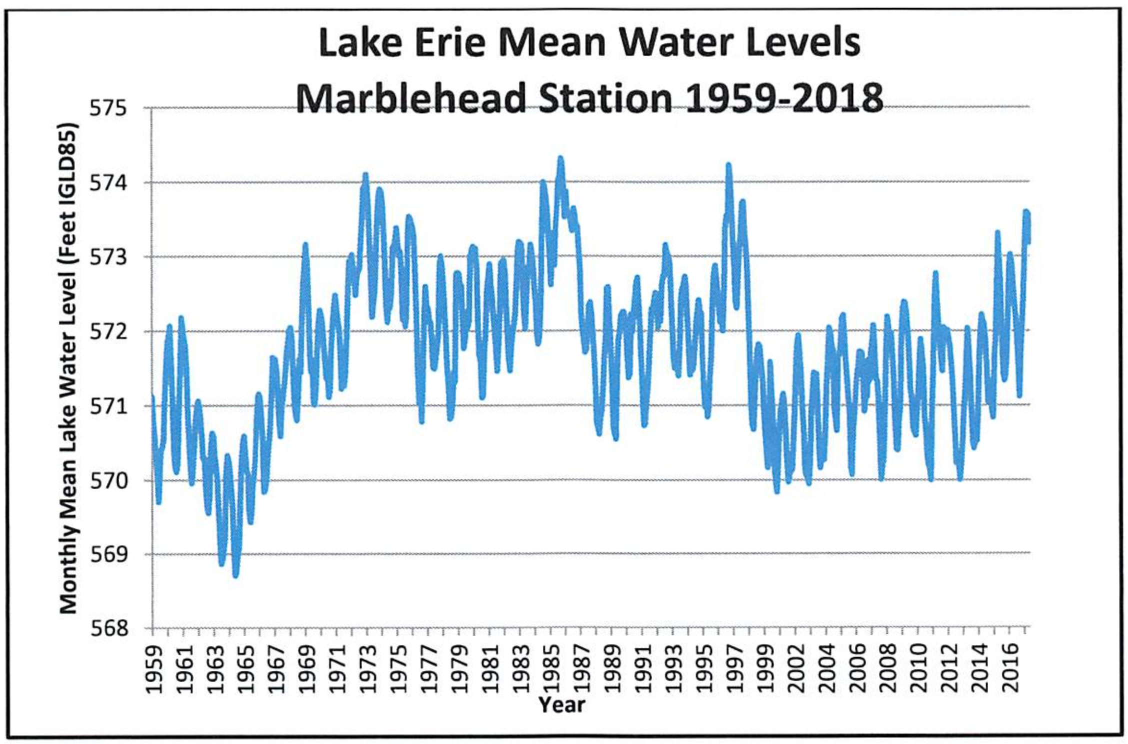



**Figure 7: Verified Monthly Mean Water Levels (NOAA Marblehead Station).**

The average water level over the recorded 58-year period is 571.7 feet IGLD 1985. The highest monthly mean water level to date was 574.7 feet IGLD 1985 (recorded in June 2019). The lowest monthly mean water level to date was 568.7 feet IGLD 1985 (recorded in February 1932). Please keep in mind that these are the extreme monthly mean water levels (averaging out the effects of storm conditions) not the highest or lowest water levels that occurred during this time period. In order to account for short term water level variations a smaller time scale must be considered.

The U.S. Army Corps of Engineers have published several documents presenting both short-term and long-term water level conditions along the shore of Lake Erie. USACE's 1998 *Revised Report on Great Lakes Open Coast Flooding* provides an analysis of monthly-mean and hourly-instantaneous water level data from the National Ocean Services and Canadian Hydrographic Service from 1960 to 1986. A Pearson Type III frequency distribution is used to estimate flood levels based on a variety of return periods. Flood levels for the shore of Huron, Ohio (Reach W) are shown in the table below.

**Table 4: Open Coast Flood Levels—Revised Report on Great Lakes Open Coast Flooding (USACE, 1988)—Converted to IGLD 1985**

| Open Coast Flood Levels | |
|---|---|
| **10-year return period** | 575.5 feet IGLD 1985 |
| **50-year return period** | 576.6 feet IGLD 1985 |
| **100-year return period** | 577.0 feet IGLD 1985 |
| **500-year return period** | 578.1 feet IGLD 1985 |

The USACE published revised design water levels as a basis for the design of coastal structures along the Great Lakes in 1993. The study described in *Design Water Level Determination on the Great Lakes* used Hydstat model software to plot design water level curves from Pearson Type III frequency distribution points. Water level records ranging from 32 to 75 years, leading up to 1989, were analyzed. The analysis combined frequency curves for adjusted monthly mean water levels and maximum storm rise, obtained from hourly maximums, to produce final frequency curves representing design water levels for a range of return periods. Design water levels for the shore of Huron are shown in the table below.

**Table 5: Design Water Levels—Design Water Level Determination on the Great Lakes (USACE, 1993)—Converted to IGLD 1985**

| Design Water Levels | |
|---|---|
| **10-year return period** | 575.7 feet IGLD 1985 |
| **30-year return period** | 576.3 feet IGLD 1985 |
| **50-year return period** | 576.6 feet IGLD 1985 |
| **100-year return period** | 576.9 feet IGLD 1985 |

KS Associates also calculated design water levels based on the combined probability of occurrence of high static lake levels and local storm surge. The statistical analysis was based on verified monthly mean water levels obtained from the NOAA Marblehead Gauge Station from 1959 to 2018.

**Table 6: Design Water Levels—NOAA Marblehead Buoy (1959-2018)**

| Design Water Level | |
|---|---|
| **2-year return period** | 573.4 feet IGLD 1985 |
| **5-year return period** | 574.2 feet IGLD 1985 |
| **10-year return period** | 574.7 feet IGLD 1985 |
| **25-year return period** | 575.3 feet IGLD 1985 |
| **50-year return period** | 575.8 feet IGLD 1985 |
| **100-year return period** | 576.2 feet IGLD 1985 |

It should be noted that the maximum recorded water level at the Marblehead Gauge Station was 576.21 feet IGLD 1985 (occurring January 1, 1987).

Based on the review of the historic water level information and statistical analysis described above, a design high water level of 576.0 feet (IGLD 1985) has been selected for Nickel Plate Beach. This water level is considered a reasonable estimate for 25-50-year return period conditions. The design water levels based on varying return periods are summarized in the figure below

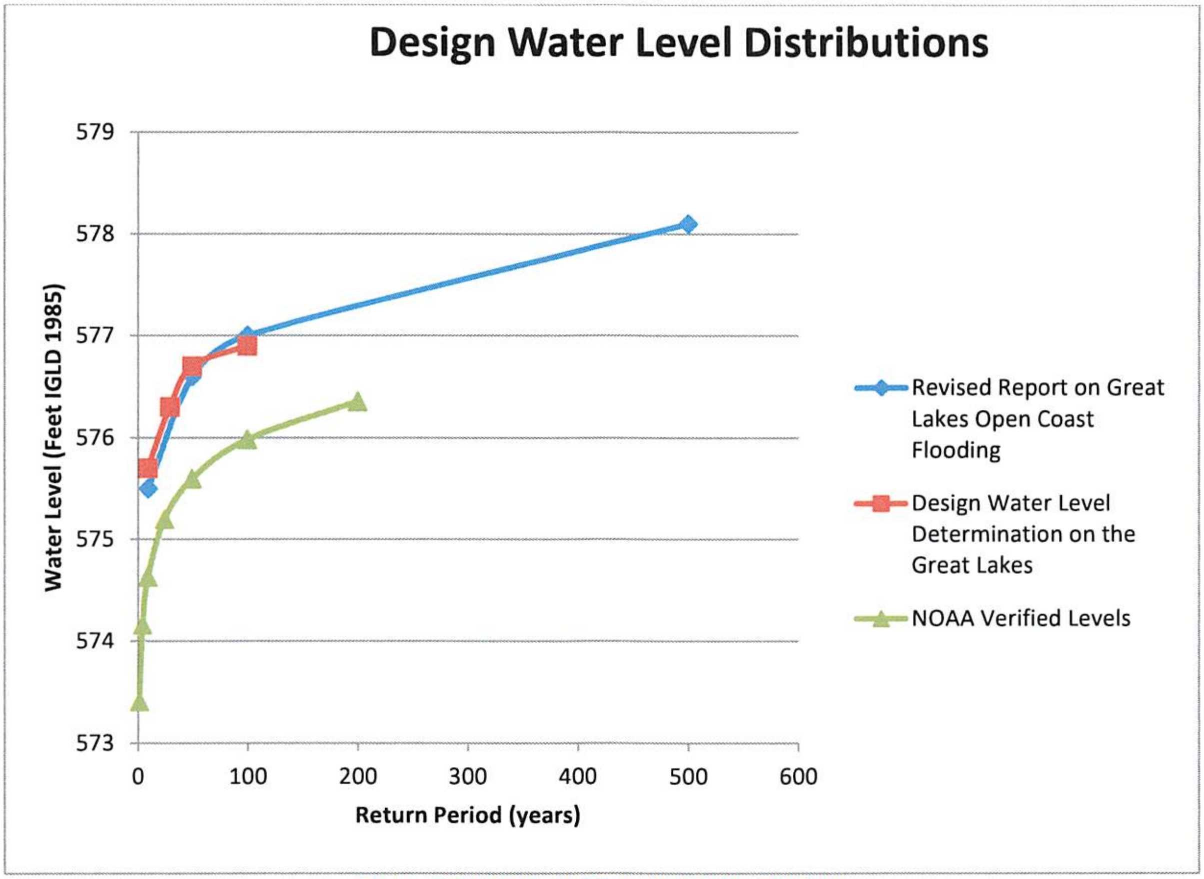



**Figure 8: Water Level Frequency Distribution**

Design low water levels were calculated using the Marblehead Buoy data assuming a Gaussian distribution with a calculated steepness. Design minimum water levels are shown below for a variety of return periods.

**Table 7: Design Low Water Levels**

| Design Low Water Level | |
|---|---|
| **2-year return period** | 571.5 feet IGLD 1985 |
| **5-year return period** | 570.7 feet IGLD 1985 |
| **10-year return period** | 570.3 feet IGLD 1985 |
| **25-year return period** | 569.7 feet IGLD 1985 |
| **50-year return period** | 568.9 feet IGLD 1985 |
| **100-year return period** | 568.6 feet IGLD 1985 |

## Wave Height

The largest Lake Erie waves are typically generated by wind across the lake. These are known as wind induced or wind driven waves. Due to the long fetch (distance of open water the wind blows across) and relatively shallow water depths in Lake Erie, wind driven waves can build quickly in the open lake. As the waves move closer to shore, the wave height and steepness increases until the waves break in the nearshore or on the beach (or on coastal structures). Because of this, wave heights along the shore of Lake Erie are generally either depth limited or fetch limited. It is also prudent to review the largest recorded waves in the area of the project site to determine the frequency that depth or fetch limited conditions are reached. The study of wave heights for the shore of Nickel Plate Beach considers the following three cases:

1. Depth limited waves - Depth limited waves are generally the largest waves that can reach the shore as larger waves would break farther offshore.
2. Fetch limited waves - Fetch limited waves are limited by either the wind speed or fetch distance available for wave generation.
3. Wave hindcast data – This is a study of the largest waves recorded in the area of the project site.

### Case 1: Depth-Limited Waves

Nearshore waves will generally break when the wave height reaches about 78% of the water depth. Therefore, the largest waves that can reach the shore of Nickel Plate Beach are limited by the water depth in the nearshore or a sand bar, if one exists. It is assumed that larger waves will break farther offshore, dissipating wave energy and reducing wave heights. Nearshore wave heights at various water depths are shown in the figure below:

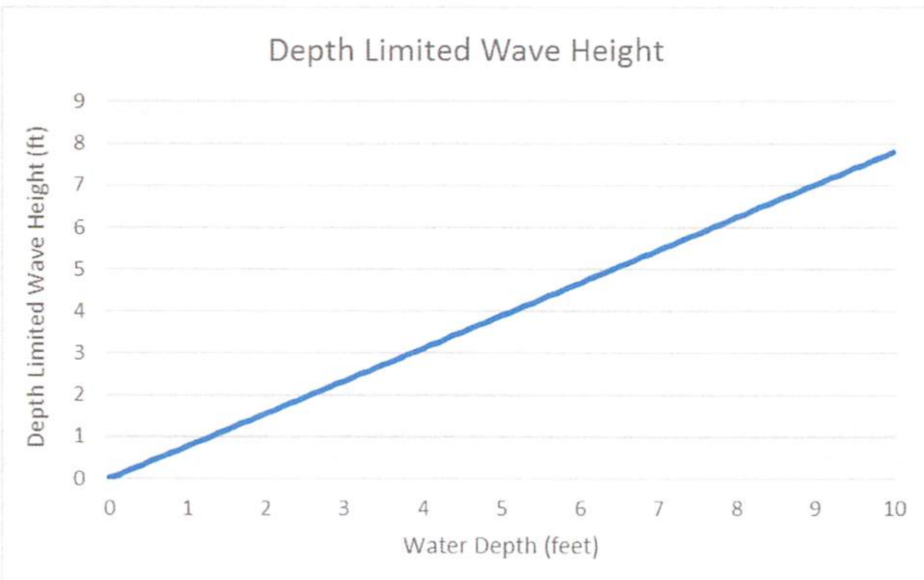



**Figure 9: Depth limited wave heights based on wave breaking criteria.**

### Case 2: Fetch-Limited Waves

The shore of Nickel Plate Beach is exposed to open-lake wave action with a maximum fetch of about 215 miles at an angle of about 60 degrees east of north. Based on historical wind data obtained from WIS Station 92088, winds from this direction, varying 10 degrees in either direction, are expected to occur approximately 4% of the time with wind speeds ranging from about 22 to 34 miles per hour.

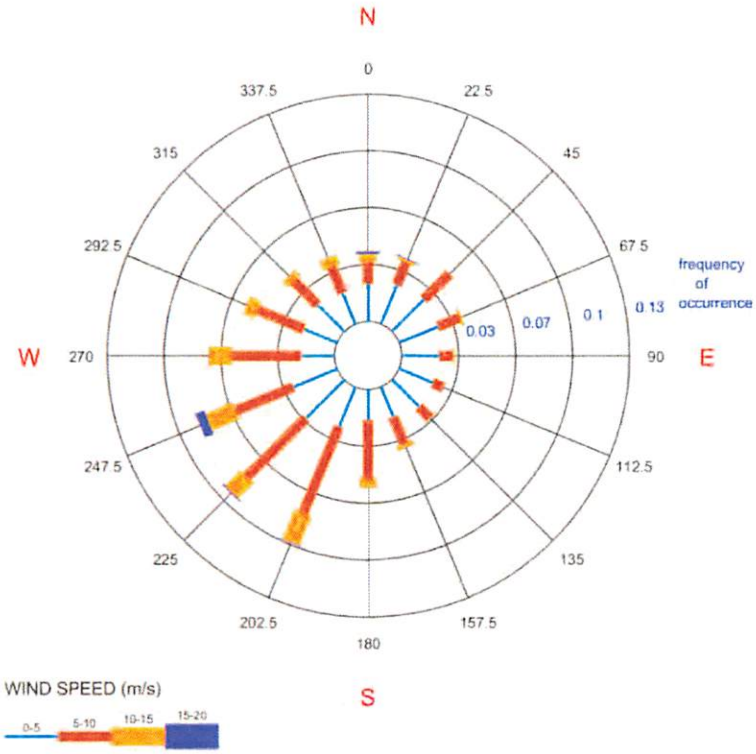



**Figure 10: Wind Rose—WIS Station 92088 (USACE)**

A more conservative estimate of wind speeds is presented in the American Society of Civil Engineers design standards. A design wind speed of 90 miles per hour is specified by ASCE 7-05 for a latitude of 41.5 degrees north. For the purpose of this assessment, fetch-limited waves can be estimated from Figures 3-24 and 3-25 in the U.S. Army Corps of Engineers Shore Protection Manual. A design wind speed of 90 miles per hour over a fetch of 215 miles results in a wave with a 10.1-foot height and 8.4 second period in an average of 31 feet of water (average water depth of Lake Erie).

This should be considered a conservative estimate. The observed wind speed listed in ASCE 7-05 is for a 3 second gust at 33 feet above ground at Exposure C. The method presented in the U.S. Army Corps of Engineers Shore Protection Manual is based on a duration-averaged 1-hour wind speed.

## Case 3: WIS Buoy Data

Theoretical wave heights for depth and fetch-limited waves should be compared to the observed wave data. Historical wind and wave data are available through the USACE's Wave Information Study. The nearest USACE measurement buoy is Lake Erie Station 92088--approximately 5 miles north of the project area (in Lake Erie). The wave rose below displays frequency of occurrence for significant wave heights in open-lake conditions by direction based on record data.

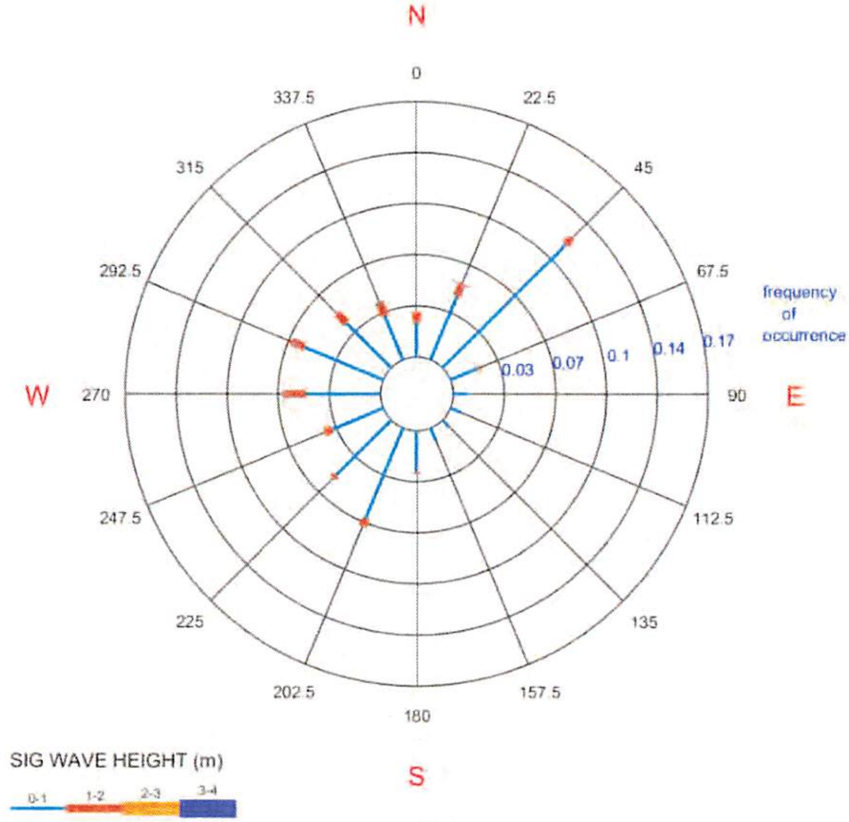



Figure 11: Wave Rose—WIS Station 92088 (USACE)

A linear regression of extreme wave events is also provided in the figure below.

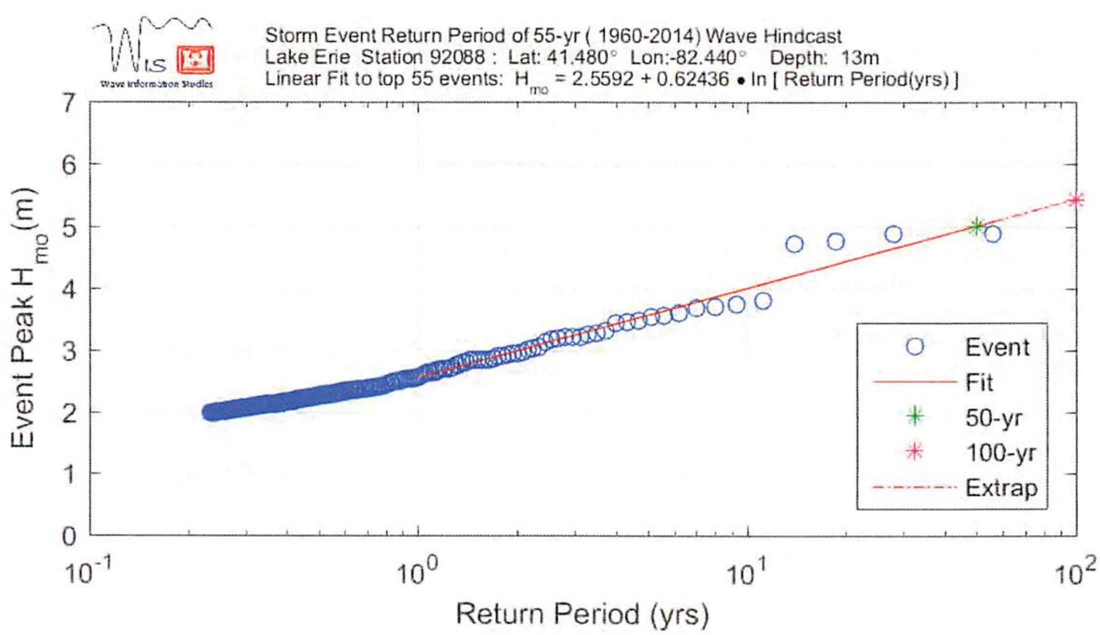



Figure 12: WIS Buoy 92088 Wave Hindcast Data (USACE 1960-2014)

### Wave Height Summary

The depth-limited case is lower than the fetch-limited or waves from the historical record (WIS data). Therefore, the largest waves developed by the selected wind conditions over the available fetch distance will break in the nearshore lakeward of the beach and wave conditions at Nickel Plate Beach are depth limited. These depth limited waves occur an average of about 30 days per year based on the WIS data.

The most common wave approaching the beach from the WIS data has a wave height of 1 to 3 feet and a period of 3.0 to 4.9 seconds. These waves should be considered for most daily operating conditions at the beach.

**Table 8: Percent Occurrence of Waves by Height and Period (2014)**

| Percent Occurrence | | | | | | |
|---|---|---|---|---|---|---|
| **Wave** | Wave Period (Seconds) | | | | | |
| **Height** | < 3 | 3 to 4 | 4 to 5 | 5 to 6 | 6 to 7 | 7 to 8 |
| **< 4"** | 28.94 | | | | | |
| **4" to 1.5'** | 26.89 | 11.04 | 2.59 | 0.21 | | |
| **1.5' to 3'** | 2.87 | 13.71 | 4.10 | 0.96 | 0.03 | |
| **3' to 4.5'** | | 1.44 | 4.13 | 0.91 | 0.08 | 0.01 |
| **4.5' to 6'** | | | 0.90 | 0.75 | 0.11 | 0.03 |
| **6' to 7.5'** | | | 0.01 | 0.07 | 0.08 | |
| **>7.5'** | | | | | 0.02 | 0.11 |

## Rip Current Velocities

Rip currents are defined as narrow, fast moving channels of water that start near the beach and extend outward through breaking waves. Rip currents are caused by waves and wind pushing water toward shore. This is called wave or wind setup and results in a slightly higher water elevation along the shore. The additional water then flows along the shoreline and eventually offshore forming rip currents. Wind and wave driven currents (both along the shore and cross-shore) are known as littoral currents and are generally responsible for sediment transport along the shore.

Strong rip currents can affect beach morphology as sand is scoured from areas with high energy and deposited in areas with lower energy. This can cause beach cusps to form along the water's edge. A review of historical aerial photography suggests rip currents have been common at Nickel Plate Beach since the earliest available aerial photograph in 1949.

Rip currents can be generated or increased by artificial structures that disrupt natural nearshore processes. The Huron Harbor breakwaters and drainage ditch likely contribute to the rip currents at Nickel Plate Beach. The net direction of littoral current along the shore of Huron is from east to west. The Huron Harbor breakwater disrupts the flow of littoral currents and causes water and wave energy to accumulate updrift of the structure (at the west end of Nickel Plate Beach). This is also the cause of the long-term accretion of sand at Nickel Plate Beach. Water and wave energy built up in the corner of the beach adjacent to the breakwater will only have one outlet: along the structure. It is expected that strong rip currents frequently form in this area.

**Figure 13: Rip currents likely form along the harbor breakwater at Nickel Plate Beach.**

If not forced along artificial structures, the built-up water from wind and wave setup along the shore will generally find the path of least resistance to flow offshore. A previously scoured channel would provide a path of least resistance. The nearshore showed signs of scour in the area of the drainage ditch in the 2019 hydrographic survey performed by KS. It is likely that rip currents also form in this area.

**Figure 14: Rip currents likely form adjacent to the drainage ditch at Nickel Plate Beach.**

The figure below shows the approximate location of rip currents from a survey performed in 2019. The exact location of currents will change based on the wave height and direction, the movement of sand in the nearshore and the formation or movement of sand bars offshore.

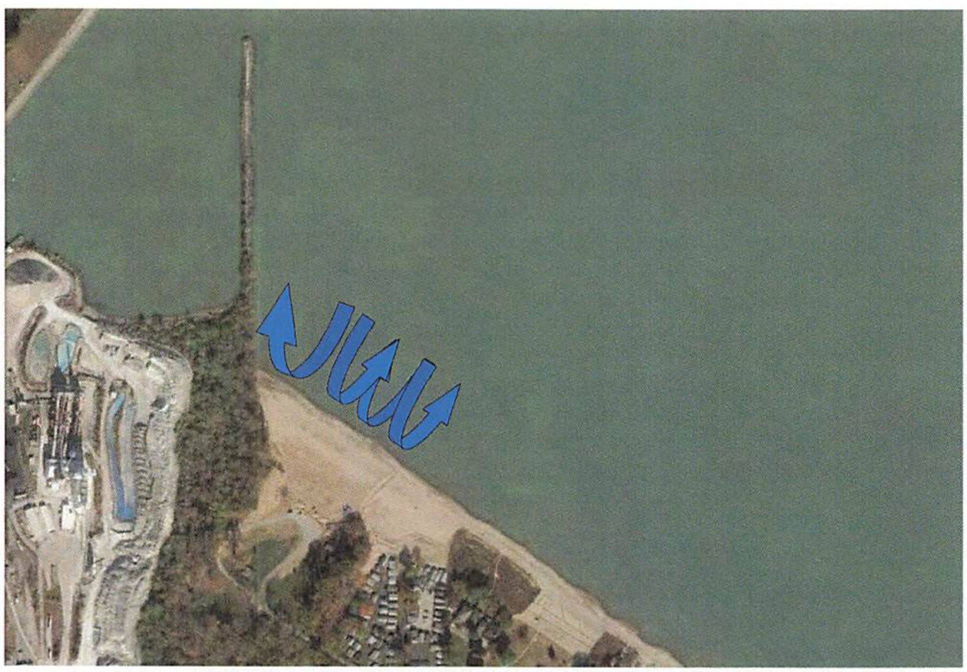


**Figure 15: Approximate locations of rip currents at the time of the hydrographic survey in 2019.**

Rip currents can reach 8 to 9 feet per second, faster than an Olympic swimmer, in high energy coastal environments. These velocities can be further increased by artificial structures, resulting in significant hazards at recreational beaches.

Rip current velocities can be estimated using a mean current-velocity that arises from straight, parallel waves approaching the shoreline. This current is called Stokes Drift and is categorized by the wave height, wave period, and wavelength. The mean current over the area between beach cusps can be compared to the approximate width of individual cusps to obtain a current velocity.

KS considered current velocities based on a number of conditions. In the table below, current velocities are calculated based on the average spacing of beach cusps in historical aerial photos provided by ODNR at a range of periods consistent depth limited wave conditions.

**Table 9: Rip Current Velocities at Based on Historical Beach Profiles**

| Rip Current Velocities | | | | | |
|---|---|---|---|---|---|
| | Beach Cusp (ft) | | Rip Current Velocity (ft/s) for 3.25 ft Wave Height | | |
| Year | Spacing | Width | 3 second | 4 second | 5 second |
| 1949 | 458 | 106 | 3.62 | 1.78 | 1.08 |
| 1956 | 204 | 98 | 1.75 | 0.86 | 0.52 |
| 1968 | 395 | 91 | 3.65 | 1.80 | 1.08 |
| 1973 | 293 | 121 | 2.02 | 1.00 | 0.60 |
| 1980 | 236 | 103 | 1.93 | 0.95 | 0.57 |
| 1986 | 482 | 177 | 2.29 | 1.13 | 0.68 |
| 1993 | 169 | 49 | 2.91 | 1.43 | 0.87 |
| 2003 | 228 | 74 | 2.59 | 1.28 | 0.77 |
| 2011 | 113 | 42 | 2.24 | 1.10 | 0.67 |
| 2019 | 270 | 70 | 3.24 | 1.59 | 0.96 |
| Avg | 285 | 93 | 2.62 | 1.29 | 0.78 |

It should be noted that, as wave period at a set wave height increases, the rip current velocity decreases. When the wave period is held constant and the wave height increases, rip current velocity increases.

For the sake of this analysis, a cusp width was averaged to 93 feet using 10 measurements from 1949-2019. Respectively the same number or corresponding rip current velocities were averaged for a comparison between the effect of wave height and period to rip current velocity. As wave height was held at 2.5 feet, the rip current velocity approximately was halved over a 2 second increase in period. Contrarily, when period was held at 4 seconds, the rip current velocity was nearly five times larger with an approximate 2.3 feet increase of wave height. These scaling sizes should not be used as predictive analysis, rather should be used for explanation of relationship between wave height and period to the correlating rip current velocity.

## Wind Velocities

The rip current velocities are dependent on wave conditions at the beach, which are dependent on the wind velocity and direction. Wind approaching from the west, south, and east generally produces favorable swimming conditions at Nickel Plate Beach as low wave heights would be generated. The Huron Harbor breakwaters also provide protection from wind/waves approaching from the west.

The swim area is generally exposed to open-lake waves from about 355 to 115 degrees true north. Wind from the east-northeast has the longest fetch distance and will generate the largest waves. The greatest fetch for wave generation is over 200 miles at an angle of about 190 to 200 degrees true north. A 15 mile per hour wind would be sufficient to produce depth limited wave conditions over a 200-mile fetch. The fetch distance for winds approaching from the north is about 50 miles, requiring a 20 mile per hour wind to produce depth limited wave conditions.

Based on the calculated wave celerity, waves generated at the east end of Lake Erie take approximately 20 hours to reach the project site. Therefore, it is important to consider wind conditions from the previous day when considering wave conditions at Nickel Plate Beach. Comparing fetch lengths, waves from the northwest would take up to 11 hours to propagate from the western end of Lake Erie and waves from the north have a propagation time of 4 hours.

## Comparison of Conditions to Guidance for Swim Conditions

In general, the following may be considered as relatively conservative criteria for selecting an area of Nickle Plate Beach that may be acceptable for recreational swimming:

1. A relatively consistent nearshore slope without sudden changes in grade or drop-offs.

   Sudden changes in grade or drop offs were not evident in the beach or nearshore based on the survey performed by KS Associates in 2019.

2. Nearshore slopes ranging from 2% to 5%.

   The current condition of the beach from the hydrographic survey shows approximately a 1 to 50 slope which is within the 2 to 5% range suggested by the U.S. Army Corps of Engineers.

3. Water depths less than 4 feet at anticipated average water levels.

   Buoys or markers delineating a swim area are not typically installed at Nickel Plate Beach. Buoys are installed demarking a boating exclusion area. This may be interpreted by beach users as an area with conditions acceptable for swimming, rather than an area where boating is prohibited. The City may consider delineating a swim area within the boating exclusion area. In this case, the swim area could be limited to an area with less than 4-foot water depths at anticipated lake levels.

4. Wave Heights less than 3.25 feet.

   Based on historical wave records, waves within the boating exclusion area would exceed 3.25 feet approximately 9% of the time. Limiting the swim area to an area with water depths less than 4 feet would reduce the wave heights to 3.25 feet or less based on depth-limited wave breaking criteria. These waves could be generated by winds of only 15 to 20 miles per hour from the northeast or north.

5. Current velocities less than 1 to 2 feet per second in the swim area.

   Currents within the current boating exclusion area will frequently exceed the 1 to 2-foot per second recommendation from the Canadian Ministry of Natural Resources. Limiting the swim area to water depths less than 4 feet would help reduce risk from rip currents by limiting the wave energy to depth-limited conditions. The Huron Harbor breakwater and drainage ditch likely exacerbate rip currents. Further limiting swimming to avoid these potential hazards would also help reduce the risk of encountering strong rip currents.

# Recommendations

There are inherent risks associated with entering the water in a dynamic beach environment. In many cases, the risks associated with swimming in the nearshore environment attract visitors to beaches. In other instances, beach visitors may not be aware of the risks. In either case, the City may consider limiting access to the water in areas or during times when the risks are greatest. Educating beach visitors to increase their understanding of nearshore processes will also help them make informed decisions regarding the risks they are accepting when entering the water.

Many of the risks associated with entering the water in a dynamic nearshore system are related to natural processes and cannot be eliminated. Nickel Plate Beach is exposed to a wide variety of water levels, winds and wave conditions that often result in strong currents. Risks to beach users will also be dependent on air and water temperatures and the physical abilities of the swimmer. The recommendations provided below are intended to help manage risks at Nickel Plate Beach. The recommendations are not to be interpreted as safety measures and will not result in a "safe" beach.

KS recommends the following measures to help reduce risks to swimmers at Nickel Plate Beach:

A. Install buoys to designate a swim area within the boat exclusion area at Nickel Plate Beach. Based on the guidance for swim areas and metocean analysis presented above, KS recommends limiting the swim area to water depths less than 4 feet at anticipated lake levels. The swim area should be further limited to avoid areas at risk of rip currents or at risk of increased current velocities, such as adjacent to the Huron Harbor breakwater and the existing drainage ditch. A drawing delineating a swim area meeting these criteria is included in Attachment F.

   KS recommends removing the swim area buoys and closing the swim area when water temperatures are not conducive for swimming. This will also prevent damage by ice forces. The City may also consider removing the buoys and closing the swim area if a significant period of strong winds is forecasted to prevent the buoys from washing up onshore or being lost offshore.

   The swim area buoys will be placed in a dynamic nearshore environment. The buoys should be expected to encounter considerable forces from breaking waves and will required frequent monitoring, maintenance and replacement (if damaged or lost).

B. Rip currents may still form within the swim area shown in Attachment F. KS recommends periodic inspections by an observer with experience identifying signs that rip currents may be present (such as newly formed or well-defined beach cusps, visible areas of scour in the nearshore, noticeable variability in nearshore sand bars, or visible cross-shore flow). If signs of rip currents are observed, the City may consider placing flags or signage on the beach to warn visitors that a rip current may be present in the area or closing the swim area.

C. Develop a system to monitor wind and wave conditions and provide a warning to beach users as conditions approach depth-limited waves. Installing wave gauges can be difficult in shallow nearshore waters due to the breaking wave forces. Instead, the City may consider installing an anemometer to record and track wind speed, direction and duration. Several commercial options are available that can measure wind speed and direction and provide a visible or audible signal if wind conditions that would generate depth-limited waves are present.

D. Install additional signage warning of the risk of rip currents, particularly in areas where rip currents are anticipated to form (along the harbor breakwater and near the drainage ditch).

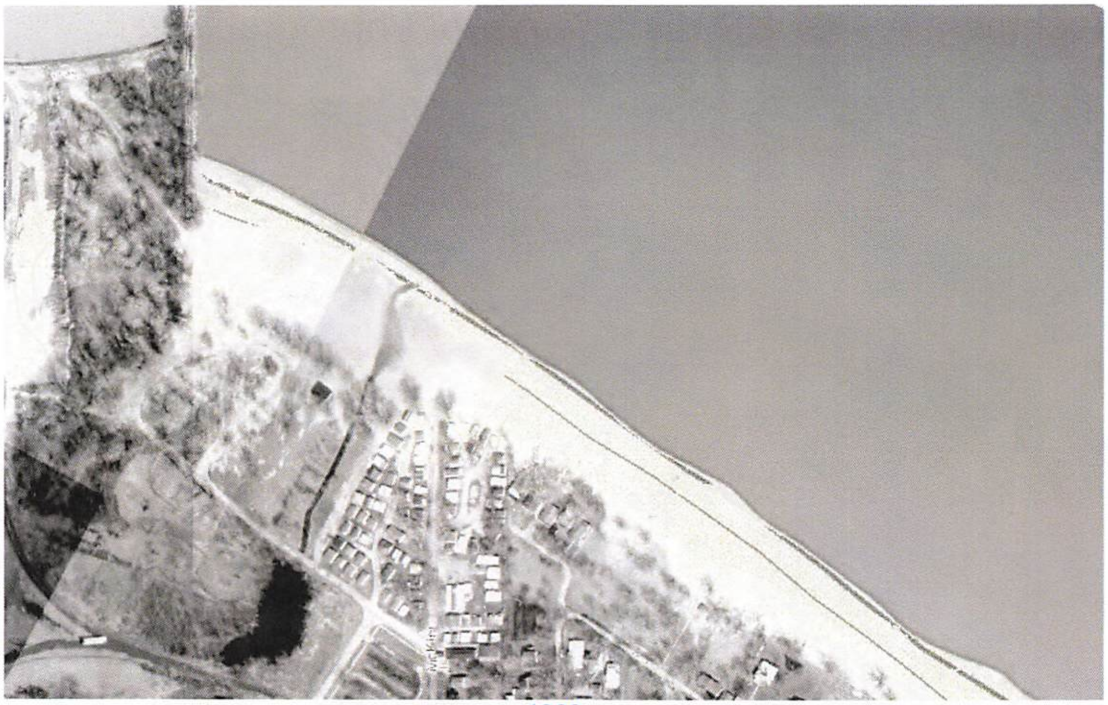
These recommendations are in addition to the signage and safety equipment already in place at Nickel Plate Beach.

In addition to the recommendations above, KS also considered the potential for development of additional structures along the beach or in the nearshore to influence the wave and current conditions at Nickel Plate Beach. KS considered the potential impacts of constructing an extension to the Huron Harbor breakwater, new detached breakwaters, new groins, or a jetty to control flow from the drainage ditch. After consideration of several alternatives, KS does not recommend the development of new structures. While structures can be designed to reduce wave energy and currents at certain water levels and wave/wind conditions, the structures would further channel the flow of water and wave energy. This could potentially increase nearshore currents, particularly in conditions that differ from the design conditions for the structures.

# Attachment A – ODNR Historic Aerial Photographs


1949

1956



1968

1973

1980

1986

1989

1993

1997

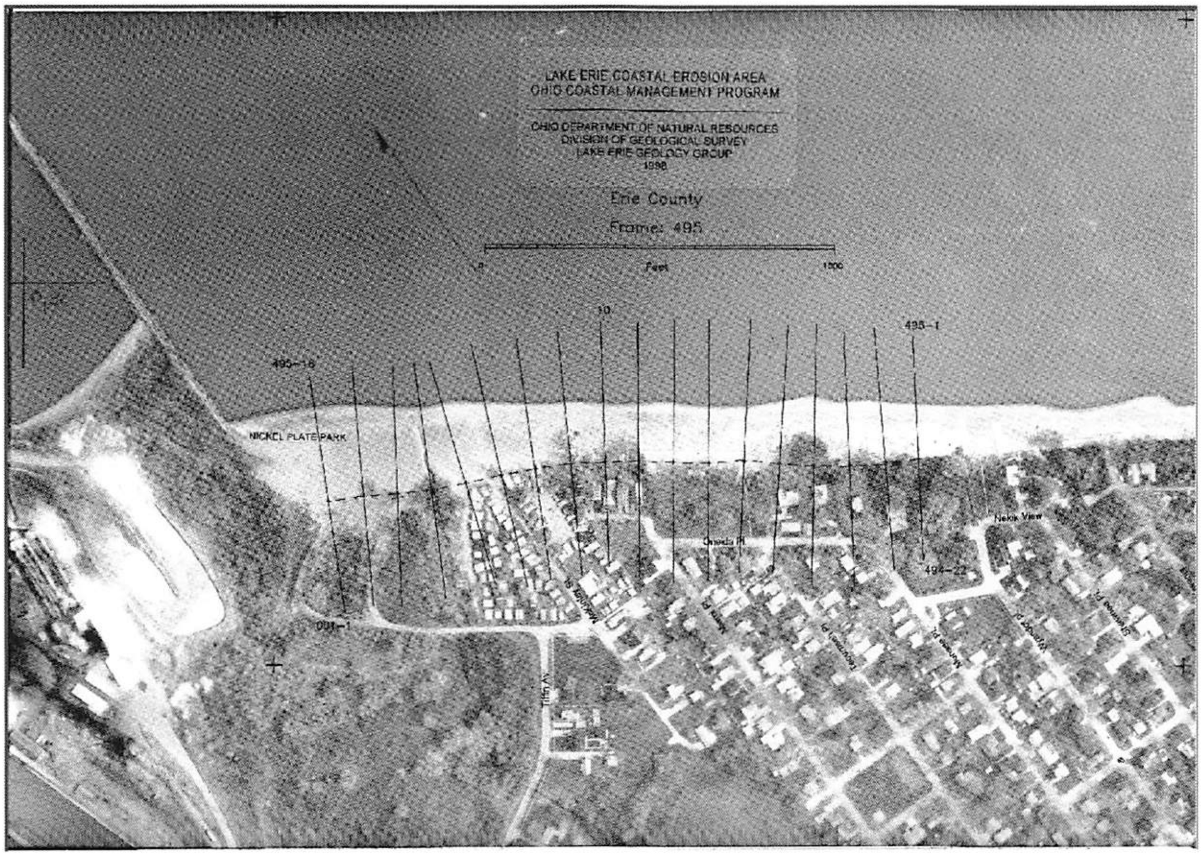
2003

2004

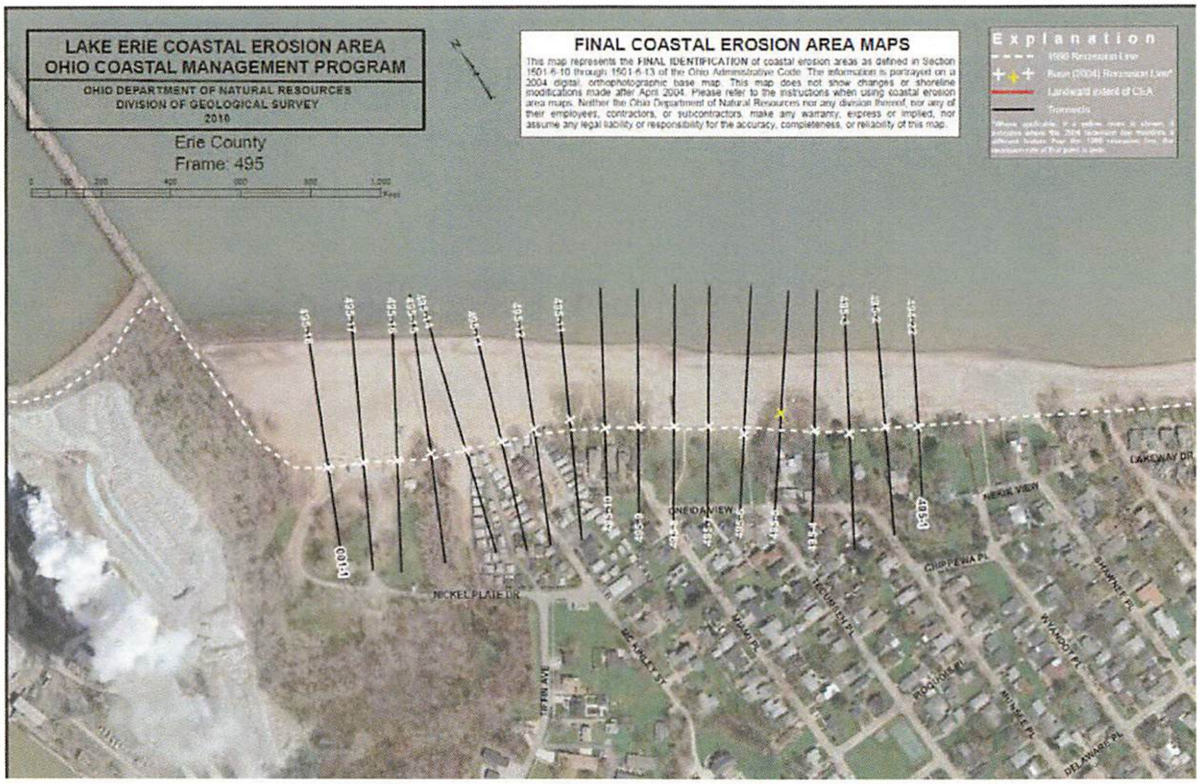
2006

2011

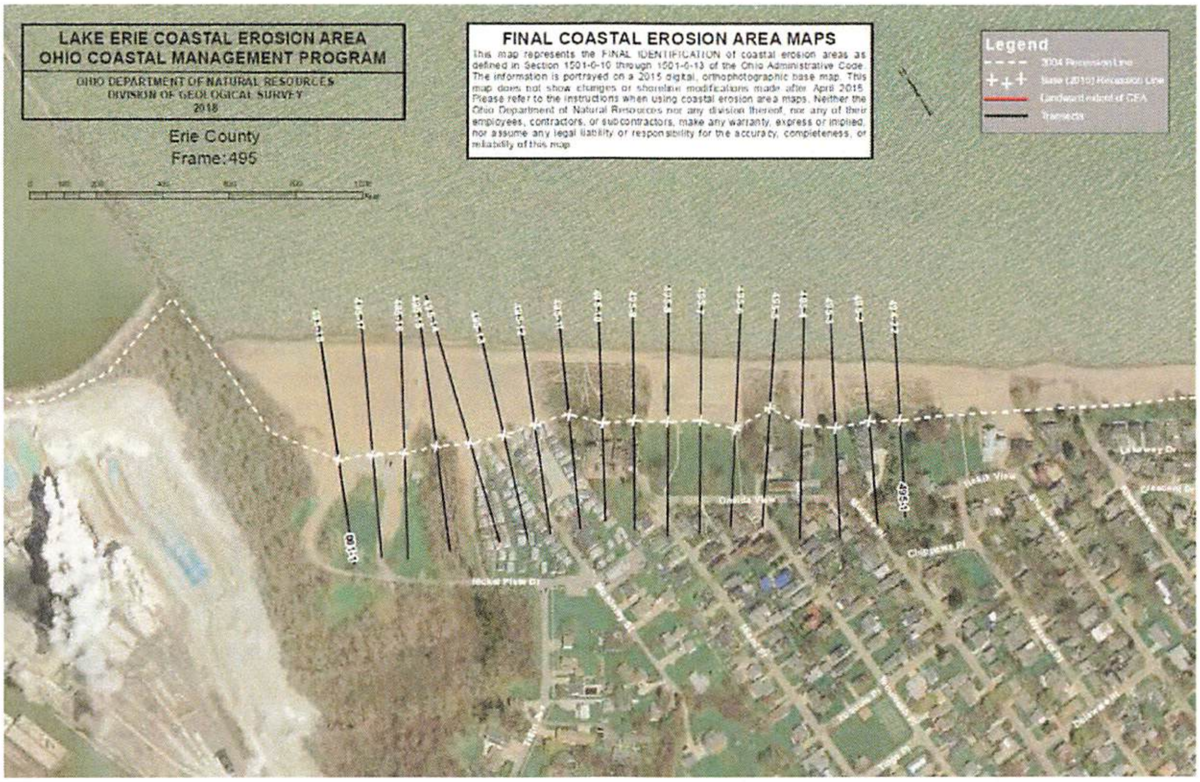
# Attachment B – ODNR Coastal Erosion Area Maps


LAKE ERIE COASTAL EROSION AREA
OHIO COASTAL MANAGEMENT PROGRAM
OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL SURVEY
LAKE ERIE GEOLOGY GROUP
Erie County
Frame: 495
Feet
NICKEL PLATE PARK

1998


LAKE ERIE COASTAL EROSION AREA
OHIO COASTAL MANAGEMENT PROGRAM
OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL SURVEY
2010
Erie County
Frame: 495
FINAL COASTAL EROSION AREA MAPS
This map represents the FINAL IDENTIFICATION of coastal erosion areas as defined in Section 1501-6-10 through 1501-6-13 of the Ohio Administrative Code. The information is portrayed on a 2004 digital orthophotographic base map. This map does not show changes or shoreline modifications made after April 2004. Please refer to the instructions when using coastal erosion area maps. Neither the Ohio Department of Natural Resources nor any division thereof, nor any of their employees, contractors, or subcontractors, make any warranty, express or implied, nor assume any legal liability or responsibility for the accuracy, completeness, or reliability of this map.
Explanation
NICKEL PLATE DR
ONEIDA VIEW
CHIPPEWA PL
LAKEWAY DR

2010


LAKE ERIE COASTAL EROSION AREA
OHIO COASTAL MANAGEMENT PROGRAM
OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL SURVEY
2018
Erie County
Frame: 495
FINAL COASTAL EROSION AREA MAPS
This map represents the FINAL IDENTIFICATION of coastal erosion areas as defined in Section 1501-6-10 through 1501-6-13 of the Ohio Administrative Code. The information is portrayed on a 2015 digital, orthophotographic base map. This map does not show changes or shoreline modifications made after April 2015. Please refer to the instructions when using coastal erosion area maps. Neither the Ohio Department of Natural Resources nor any division thereof, nor any of their employees, contractors, or subcontractors, make any warranty, express or implied, nor assume any legal liability or responsibility for the accuracy, completeness, or reliability of this map.
Legend

2018

## ERIE COUNTY

**FRAME:** ERI495
**NO. OF PROFILES:** 18

| FRAME | TRANS | MEAS DIST | RECESS RATE | ANTICIPATED DIST | STATUS | OFFSET |
|---|---|---|---|---|---|---|
| ERI495 | 495- 1 | .0 | .0 | .2 | NO CEA | .0 |
| ERI495 | 495- 2 | .0 | .0 | .1 | NO CEA | .0 |
| ERI495 | 495- 3 | .0 | .0 | .0 | NO CEA | .0 |
| ERI495 | 495- 4 | .0 | .0 | .4 | NO CEA | .0 |
| ERI495 | 495- 5 | .2 | .0 | 1.0 | NO CEA | .0 |
| ERI495 | 495- 6 | 2.1 | .1 | 1.5 | NO CEA | .0 |
| ERI495 | 495- 7 | .0 | .0 | 1.0 | NO CEA | .0 |
| ERI495 | 495- 8 | .0 | .0 | .8 | NO CEA | .0 |
| ERI495 | 495- 9 | 1.3 | .1 | 1.0 | NO CEA | .0 |
| ERI495 | 495-10 | .0 | .0 | .9 | NO CEA | .0 |
| ERI495 | 495-11 | 1.0 | .1 | .8 | NO CEA | .0 |
| ERI495 | 495-12 | .0 | .0 | .4 | NO CEA | .0 |
| ERI495 | 495-13 | .0 | .0 | 1.3 | NO CEA | .0 |
| ERI495 | 495-14 | .0 | .0 | 3.7 | NO CEA | .0 |
| ERI495 | 495-15 | 5.9 | .5 | 6.5 | NO CEA | .0 |
| ERI495 | 495-16 | .4 | .0 | 4.9 | NO CEA | .0 |
| ERI495 | 495-17 | 2.6 | .2 | 3.1 | NO CEA | .0 |
| ERI495 | 495-18 | .0 | .0 | 1.1 | NO CEA | .0 |

**DATE:** 2/25/1998

**FRAME:** Frame number of aerial photograph
**TRANS:** Transect number
**MEAS DIST:** Recession distance (feet) between 1973 and 1990
**RECESS RATE:** Recession rate (feet per year) between 1973 and 1990
**ANTICIPATED DIST:** Recession (feet) anticipated during next 30 years
**STATUS:** Indicates presence or absence of Coastal Erosion Area (CEA)
**OFFSET:** Offset (feet) due to artificial grading of the slope
**DATE:** Production date for table

22

1998

# ERIE COUNTY

**Frame: 495**
Number of Profiles: 18

| TRANS | MEAS DIST | RECESS RATE | ANTICIPATED DIST | STATUS |
|---|---|---|---|---|
| 495-1 | 1.9 | 0.1 | 1.6 | NO CEA |
| 495-2 | 0.0 | 0.0 | 1.0 | NO CEA |
| 495-3 | 0.0 | 0.0 | 0.3 | NO CEA |
| 495-4 | 0.0 | 0.0 | 0.0 | NO CEA |
| 495-5 | 0.0 | 0.0 | 0.0 | NO CEA |
| 495-6 | 0.0 | 0.0 | 0.0 | NO CEA |
| 495-7 | 0.0 | 0.0 | 0.0 | NO CEA |
| 495-8 | 0.0 | 0.0 | 0.0 | NO CEA |
| 495-9 | 0.0 | 0.0 | 0.0 | NO CEA |
| 495-10 | 0.0 | 0.0 | 0.0 | NO CEA |
| 495-11 | 0.0 | 0.0 | 0.0 | NO CEA |
| 495-12 | 0.0 | 0.0 | 0.0 | NO CEA |
| 495-13 | 0.0 | 0.0 | 0.0 | NO CEA |
| 495-14 | 0.0 | 0.0 | 0.0 | NO CEA |
| 495-15 | 0.0 | 0.0 | 0.0 | NO CEA |
| 495-16 | 0.0 | 0.0 | 0.0 | NO CEA |
| 495-17 | 0.0 | 0.0 | 0.0 | NO CEA |
| 495-18 | 0.0 | 0.0 | 0.0 | NO CEA |

**FRAME:** Frame number of aerial photograph
**TRANS:** Transect number
**MEAS DIST:** Recession distance (feet) between 1990 and 2004
**RECESS RATE:** Recession rate (feet per year) between 1990 and 2004
**ANTICPATED DIST:** Recession (feet) anticipated during the next 30 years
**STATUS:** Indicates presence or absence of Coastal Erosion Area

*Wednesday, November 17, 2010* *Page 1 of 1*

2010

## Final 2018 CEA Map Data Sheet

**Frame: 495** **ERIE COUNTY**
**Number of Profiles: 18**

| TRANS | MEAS DIST | RECESS RATE | ANTICIPATED DIST | STATUS |
|---|---|---|---|---|
| 495-1 | 0.0 | 0.0 | 0.0 | NO CEA |
| 495-2 | 0.0 | 0.0 | 0.0 | NO CEA |
| 495-3 | 0.0 | 0.0 | 0.0 | NO CEA |
| 495-4 | 0.0 | 0.0 | 0.0 | NO CEA |
| 495-5 | 0.0 | 0.0 | 0.0 | NO CEA |
| 495-6 | 0.0 | 0.0 | 0.0 | NO CEA |
| 495-7 | 0.0 | 0.0 | 0.0 | NO CEA |
| 495-8 | 0.0 | 0.0 | 0.0 | NO CEA |
| 495-9 | 0.0 | 0.0 | 0.0 | NO CEA |
| 495-10 | 0.0 | 0.0 | 0.0 | NO CEA |
| 495-11 | 0.0 | 0.0 | 0.0 | NO CEA |
| 495-12 | 0.0 | 0.0 | 0.0 | NO CEA |
| 495-13 | 0.0 | 0.0 | 0.0 | NO CEA |
| 495-14 | 0.0 | 0.0 | 0.0 | NO CEA |
| 495-15 | 0.0 | 0.0 | 0.0 | NO CEA |
| 495-16 | 0.0 | 0.0 | 0.0 | NO CEA |
| 495-17 | 0.0 | 0.0 | 0.0 | NO CEA |
| 495-18 | 0.0 | 0.0 | 0.0 | NO CEA |

**FRAME:** Frame number of aerial photograph
**TRANS:** Transect number
**MEAS DIST:** Recession distance (feet) between 2004 and 2015
**RECESS RATE:** Recession rate (feet per year) between 2004 and 2015
**ANTICPATED DIST*** Recession (feet) anticipated during the next 30 years
**STATUS:** Indicates presence or absence of Coastal Erosion Area

* Due to averaging, may not equal RECESS RATE times 30

*Rev. 19007* *1 of 1*

2018

# Attachment C – NOAA Navigation Chart

# Attachment D – Topographic & Hydrographic Survey

C:\Users\cencerm\Desktop\19192\CIVIL 3D 2014\CURRENT DRAWINGS\SHEETS\19192-1 Swim Area Delineation.dwg, Plotted: Feb 16, 2020 - 8:42pm

PRELIMINARY DRAWINGS
NOT FOR CONSTRUCTION

TOPOGRAPHIC & HYDROGRAPHIC SURVEY

100 0 100
SCALE IN FEET


| | |
|---|---|
| SHEET 1 OF 1 | JOB NO. 19192 |

TOPOGRAPHIC & HYDROGRAPHIC SURVEY
NICKEL PLATE BEACH
SWIM CONDITION EVALUATION
CITY OF HURON
1 NICKEL PLATE DRIVE,
HURON, OHIO 44839

KS ASSOCIATES

KS Associates, Inc.
260 Burns Road, Suite 100
Elyria, OH 44035
P 440 365 4730
F 440 365 4790
www.ksassociates.com

DATE: 1/23/2020
DRAWN BY: DAP
CH'D BY: MPC
DWG. NAME: SWIM AREA
PATH: CIVIL 3D
F.B.

| REVISIONS DATE | BY |
|---|---|
| – | |

| ADJACENT PROPERTY OWNERS |
|---|
| NORFOLK SOUTHERN COMBINED RAILROAD HURON, OHIO 44839 |
| OLD HOMESTEAD ON THE LAKE ASSOCIATION BEACH, HURON, OHIO 44839 |

DATUM: 0.0 LWD = 569.2 FEET IGLD 1985

# Attachment E – Metocean Calculations

KS ASSOCIATES
KS Associates, Inc.
260 Burns Road, Suite 100
Elyria, OH 44035
P 440 365 4730
F 440 365 4790
www.ksassociates.com



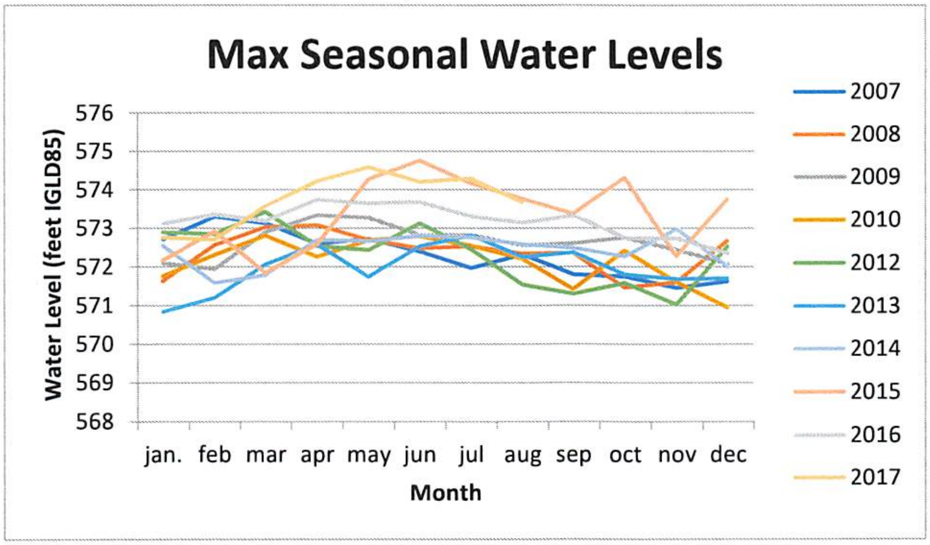
A. Water Level Determination

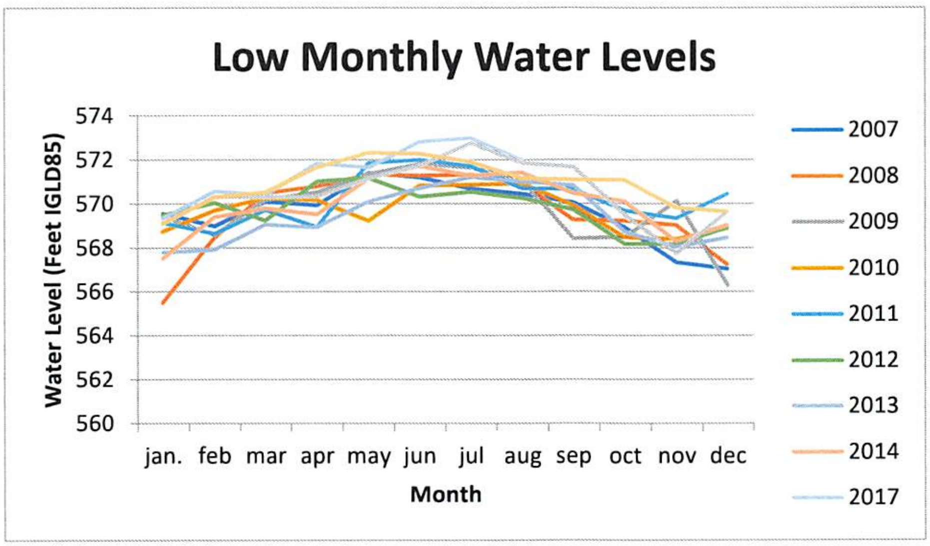
NOAA Marblehead Buoy (Station: 92093)

Monthly Mean Data (1959-2018)

| | |
|---|---|
| Average Mean | 571.7197 ft |
| Lowest Mean | 568.704 ft |
| Highest Mean | 574.318 ft |
| Max Mean Recorded | 575.574 ft |

Seasonal Water Levels (2007-2017)




Ordinary High Water: 573.4 ft IGLD 1985

Long Term Average: 517.7 ft IGLD 1985

Low Water Datum: 569.2 ft IGLD 1985

KS ASSOCIATES
KS Associates, Inc.
260 Burns Road, Suite 100
Elyria, OH 44035
P 440 365 4730
F 440 365 4790
www.ksassociates.com



Water Levels based on Return Period

| Return (yr) | High Water (ft IGLD) | Low Water (ft IGLD) |
|---|---|---|
| 2 | 573.38 | 571.50 |
| 5 | 574.19 | 570.75 |
| 10 | 574.71 | 570.28 |
| 25 | 575.33 | 569.72 |
| 50 | 575.77 | 569.32 |
| 100 | 576.19 | 568.94 |
| 200 | 576.61 | 568.57 |

B. Wave Heights

Depth Limited

| | | | |
|---|---|---|---|
| H = 0.78*d | | | *H is wave height, d is design water depth |
| Height | 7.8 | ft | Eqn. 2-72a SPM |

Fetch Limited

| | | | |
|---|---|---|---|
| gravity | 32.174 | ft/s^2 | |
| Fetch | 1130900 | ft | *distance for wind to blow over the water |
| U | 25 | mph | *wind velocity (from AASHTO standards) |
| UA | 30.9 | | Eqn. 3-28a SPM (Shore Protection Manual) |
| Depth | 31 | ft | *average depth over fetch distance |
| Height | 5.317 | ft | Eqn. 3-39 SPM |
| Period | 5.241 | s | Eqn. 3-40 SPM |

Boat Wake

| | | | |
|---|---|---|---|
| Height | 2.098 | ft | *boat wake calculated assuming 10 mph/8.8 knot boats |
| Period | 2.40 | s | |

Design Height & Period

| | | | |
|---|---|---|---|
| Height | 5.317 | ft | Waves are depth limited |
| Period | 5.241 | sec | |

C. Rip Current Speeds & Determination

| | | | |
|---|---|---|---|
| Spacing | 270 | ft | *spacing of beach cusps from survey (2019) |
| Width | 70 | ft | *assumed rip current width from survey (2019) |
| w | 1.20 | rad/s | *angular wave frequency |
| L | 88.35 | ft | *wave length |
| k | 0.07 | rad/ft | *wave number |
| a | 2.66 | ft | *wave amplitude |
| | | | |
| us | 0.60 | ft/s | *stokes drift |
| urc | 2.32 | ft/s | *rip current velocity |

KS ASSOCIATES
KS Associates, Inc.
260 Burns Road, Suite 100
Elyria, OH 44035
P 440 365 4730
F 440 365 4790
www.ksassociates.com



Historic Rip Current Velocity Table

| | Beach Cusp (ft) | | Rip Current Velocity (ft/s) for 3.25 ft Wave Height | | |
|---|---|---|---|---|---|
| Year | Spacing | Width | 3 second | 4 second | 5 second |
| 1949 | 458 | 106 | 3.62 | 1.78 | 1.08 |
| 1956 | 204 | 98 | 1.75 | 0.86 | 0.52 |
| 1968 | 395 | 91 | 3.65 | 1.80 | 1.08 |
| 1973 | 293 | 121 | 2.02 | 1.00 | 0.60 |
| 1980 | 236 | 103 | 1.93 | 0.95 | 0.57 |
| 1986 | 482 | 177 | 2.29 | 1.13 | 0.68 |
| 1993 | 169 | 49 | 2.91 | 1.43 | 0.87 |
| 2003 | 228 | 74 | 2.59 | 1.28 | 0.77 |
| 2011 | 113 | 42 | 2.24 | 1.10 | 0.67 |
| 2019 | 270 | 70 | 3.24 | 1.59 | 0.96 |
| Avg | 285 | 93 | 2.62 | 1.29 | 0.78 |

WIS Data (Wave Percent Occurance Table, All Directions, 2014)

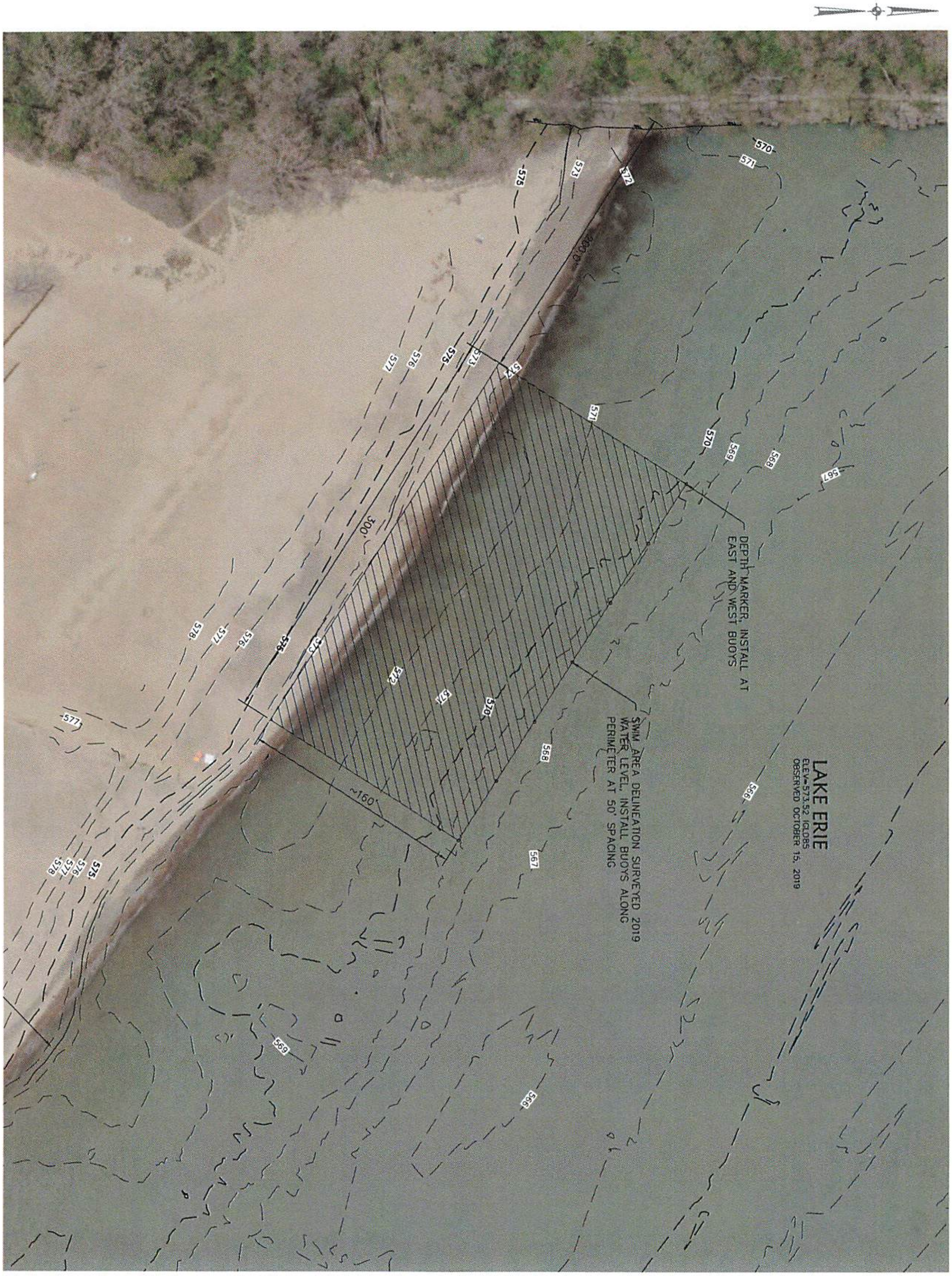
| Wave | Wave Period (Seconds) | | | | | |
|---|---|---|---|---|---|---|
| Height | < 3 | 3 to 4 | 4 to 5 | 5 to 6 | 6 to 7 | 7 to 8 |
| < 4" | 28.94 | | | | | |
| 4" to 1.5' | 26.89 | 11.04 | 2.59 | 0.21 | | |
| 1.5' to 3' | 2.87 | 13.71 | 4.10 | 0.96 | 0.03 | |
| 3' to 4.5' | | 1.44 | 4.13 | 0.91 | 0.08 | 0.01 |
| 4.5' to 6' | | | 0.90 | 0.75 | 0.11 | 0.03 |
| 6' to 7.5' | | | 0.01 | 0.07 | 0.08 | |
| >7.5' | | | | | 0.02 | 0.11 |

# Attachment F – Conceptual Drawings of Recommendations

C:\Users\cencerm\Desktop\19192\CIVIL 3D 2014\CURRENT DRAWINGS\SHEETS\19192-1 Swim Area Delineation.dwg, Plotted: Feb 19, 2020 - 10:47am

PRELIMINARY DRAWINGS
NOT FOR CONSTRUCTION

SWIM AREA DELINEATION
100 0 100
SCALE IN FEET




SHEET 1 OF 1

JOB NO. 19192

SITE PLAN
NICKEL PLATE BEACH
SWIM CONDITION EVALUATION
CITY OF HURON
1 NICKEL PLATE DRIVE,
HURON, OHIO 44839

KS ASSOCIATES

KS Associates, Inc.
260 Burns Road, Suite 100
Elyria, OH 44035
P 440 365 4730
F 440 365 4790
www.ksassociates.com

DATE: 1/23/2020
DRAWN BY: DAP
CH'D BY: MPC
DWG. NAME: SWIM AREA
PATH: CIVIL 3D
F.B.

REVISIONS

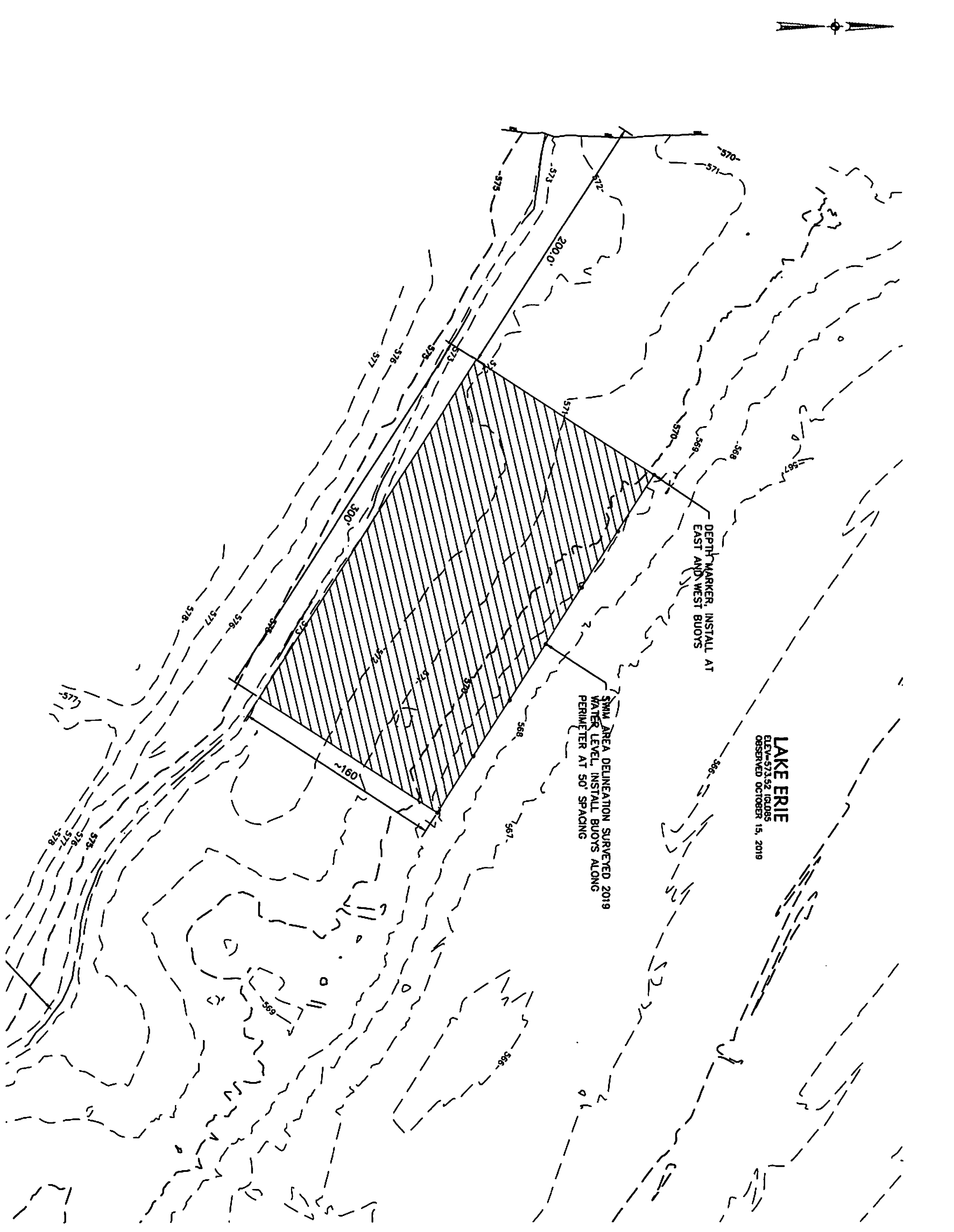
| DATE | BY | |
| --- | --- | --- |
| – | | |

ADJACENT PROPERTY OWNERS
NORFOLK SOUTHERN COMBINED RAILROAD
HURON, OHIO 44839
OLD HOMESTEAD ON THE LAKE ASSOCIATION
BEACH, HURON, OHIO 44839

DATUM: 0.0 LWD = 569.2 FEET IGLD 1985

R:\19000\19192\CIVIL 3D 2014\CURRENT DRAWINGS\SHEETS\19192-1 Swim Area Delineation_Final.dwg, Plotted: Feb 24, 2020 - 3:01pm

REPORT DRAWINGS
NOT FOR CONSTRUCTION




| SHEET 1 OF 1 | SITE PLAN | KS Associates, Inc. | DATE: [illegible] | REVISIONS | DATE | BY | ADJACENT PROPERTY OWNERS |
|---|---|---|---|---|---|---|---|
| JOB NO. 19192 | NICKEL PLATE BEACH<br>SWIM CONDITION EVALUATION | 260 Burns Road, Suite 100<br>Elyria, OH 44035 | DRAWN BY: DAP | | - | | NORFOLK SOUTHERN COMBINED RAILROAD<br>HURON, OHIO 44839 |
| | CITY OF HURON<br>1 NICKEL PLATE DRIVE,<br>HURON, OHIO 44839 | P 440 365 4730<br>F 440 365 4790 | CHK'D BY: MPC<br>DWG. NAME: SWIM AREA | | | | OLD HOMESTEAD ON THE LAKE ASSOCIATION<br>BEACH, HURON, OHIO 44839 |
| | | KS ASSOCIATES www.ksassociates.com | PATH: CIVIL 3D<br>F.B. | | | | DATUM: 0.0 LWD = 569.2 FEET IGLD 1985 |