REDEFINE THE DRIVE

NORTH DUSABLE LAKE SHORE DRIVE

NORTH DUSABLE LAKE SHORE DRIVE STUDY SPOTLIGHT

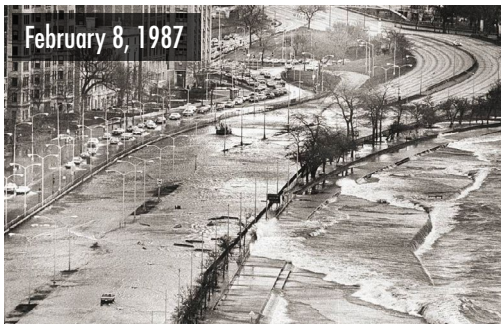
SHORELINE PROTECTION

General Project Information

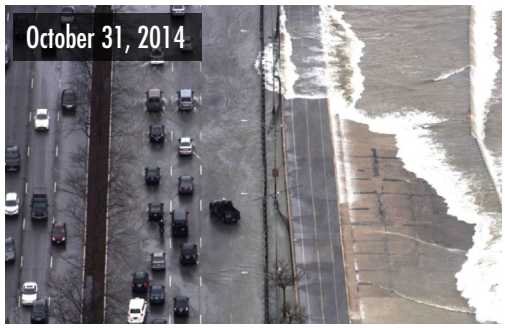
February 2023

The North DuSable Lake Shore Drive (NDLSD) Phase I Study is currently evaluating the five remaining NDLSD Build Alternatives ("Level 3 Screening"). As part of this evaluation, nearly 30 different criteria are being considered, including Performance, Social, Economic and Environmental factors. The project team has separated criteria into two categories: 1) Distinguishing criteria contain results that vary amongst alternatives, and 2) Non-distinguishing criteria contain results that are the same or similar amongst alternatives. This Study Spotlight addresses shoreline protection, a non-distinguishing Level 3 Screening criteria associated with each of the remaining alternatives under consideration. For additional details regarding the overall Phase I Study, please visit the project website at northdusablelakeshoredrive.org.

HISTORICAL BACKGROUND



Credit: John Chuckman

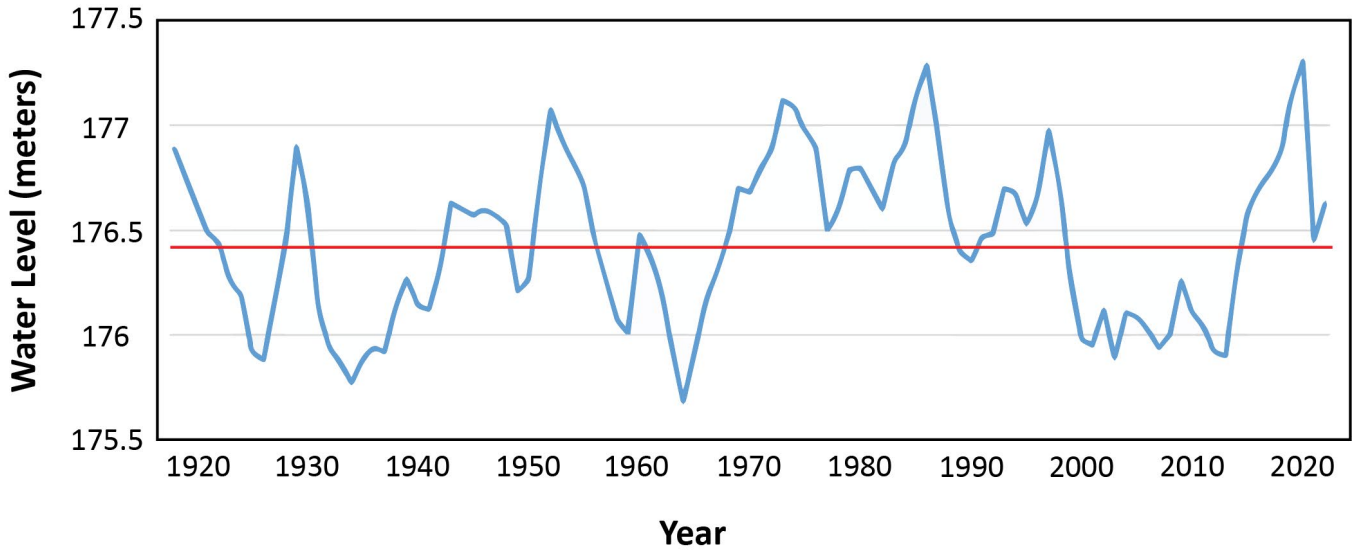


Credit: ABC 7 News

Credit: Matt Zuro

During storm events and in times of high water levels on Lake Michigan, wave overtopping causes flooding of the Lakefront Trail and in some instances NDLSD itself between Oak Street and North Avenue beaches. This critical zone has the lowest roadway elevation and narrowest setback from Lake Michigan. Strong storms have resulted in road and trail closures and storm damage. Historic water levels on Lake Michigan vary by as much as 6 ½ feet. The recent period of high lake water levels has increased the frequency of flooding along this portion of the lakefront.

Historic Lakes Michigan-Huron Water Levels (1918-2022)



Illinois Department of Transportation

CDOT Chicago Department of Transportation

IMPROVEMENT NEEDS

Proposed improvements to NDLSD will increase the space between Inner and Outer Drives from Ohio Street to LaSalle Drive. Flattening the Oak Street curve along Outer Drive will require shifting Oak Street Beach further to the east and north.

Some sections of Outer Drive and certain park paths will need to be aligned below the Lake Michigan water level to accommodate grade separation between east-west streets & paths and the Outer Drive & Lakefront Trail. It will be necessary to prevent any overtopping waves during severe storms from reaching these facilities, so the proposed shoreline protection systems in this area will need to be somewhat higher above the water level than they are today. However, iconic views of the lakefront from the urban edge and along DuSable Lake Shore Drive will also need to be preserved.

Climate Resiliency and NDLSD

The NDLSD project is taking into account climate resiliency by designing for the most severe storm on record coincident with a 200-year high lake water level. Read more about Climate Change and Environment in this Study Spotlight (Fall 2020).

WHAT ARE SHORELINE PROTECTION TECHNIQUES?

Shoreline protection techniques are used to safeguard shoreline facilities from strong waves during large storm events and will be implemented as part of this project to prevent overtopping waves from reaching the Outer Drive and at least one of the Lakefront Trail paths. A variety of techniques may be employed, such as seawalls or revetments, beaches, offshore breakwaters, and nearshore reefs or shoals.

The shoreline protection concepts developed for NDLSD employ a combination of these techniques. The concepts are designed to minimize the amount of lake fill that would be required, to preserve important sight lines from the urban edge and the Outer Drive, and to ensure that critical infrastructure is protected from large waves during severe storms. Similar shoreline protection techniques will be used along the north lakefront regardless of the final roadway design alternative.

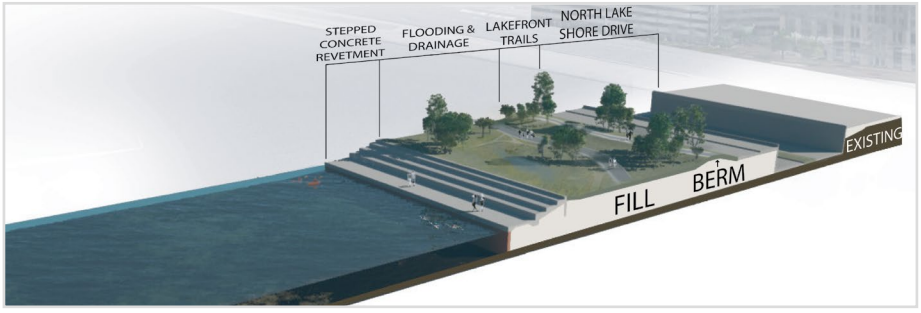
SHORELINE DESIGN TREATMENTS

The selected shoreline protection measures will need to satisfy the competing needs of containing overtopping waves during severe storms when lake water levels are high while also preserving important viewsheds. Two primary shoreline design concepts were investigated for this part of the lakefront: stepped revetment wall and continuous beach. Both concepts feature increased space between the shoreline and critical infrastructure. This space provides a landscaped buffer zone and backshore berm that will contain and control flooding and drainage associated with overtopping waves.

What is a backshore berm?

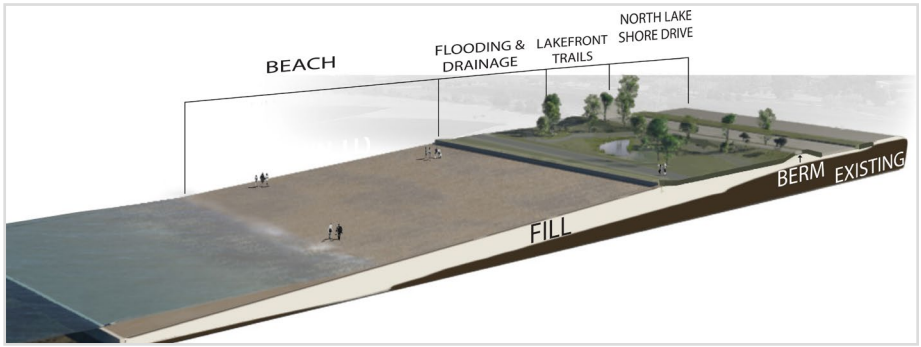
A backshore berm is a low earth embankment or levee located behind a seawall or beach that is the last line of defense to contain the largest overtopping waves, preventing them from reaching critical infrastructure.

TREATMENT 1 – STEPPED REVETMENT WALL



This treatment would construct a stepped concrete revetment wall along the shoreline together with a landscaped buffer zone and a backshore berm. The crest of the stepped revetment would be low enough to minimize overtopping from typical waves during periods of high lake water levels. Flooding from wave overtopping during extreme storm events would be contained within the landscaped buffer zone and conveyed back to the lake. A backshore berm would prevent the most severe lake-induced flooding from reaching critical infrastructure. The Lakefront Trail bike path would be located atop or behind the backshore berm, protecting it from any wave action and flooding. The Lakefront Trail pedestrian path would be located within the landscaped buffer zone and may be subject to occasional flooding.

TREATMENT 2 – BEACH



This treatment would utilize the gradual flat slope and width of a sand beach to dissipate normal wave action along with a landscaped buffer zone and backshore berm to control flooding and protect critical infrastructure from wave overtopping during extreme events. While both Treatment 1 and 2 will successfully protect against severe waves, Treatment 2 also provides a larger and more flexible recreational space during good weather and an increased ability to maintain viewsheds, as a beach allows for lower crest and berm elevations than the stepped revetment option.

SHORELINE MODELING

Modeling the performance of shoreline protection measures is a complex undertaking that must consider interactions between key variables including lake water levels, water depths, storm surge, and wave heights, frequency and direction. This project's modeling efforts started with the use of both empirical and numerical (computer) models of the shoreline to assess wave conditions, overtopping, flooding and drainage. Two different damage thresholds were analyzed for overtopping wave conditions – a wave flow rate that would cause damage to only landscaped surfaces and a rate that would also cause damage to paved surfaces. A physical model of the most vulnerable stretch of shoreline was then constructed within a wave basin laboratory. More than 100 simulations were run in the laboratory to evaluate water levels up to the 200-year peak level, which is more than one foot above the historic high Lake Michigan water level.

Physical Model of Existing Conditions with Measurement Devices

Physical Model of Stepped Revetment Wall Treatment

Physical Modeling in Wave Tanks

Computer modeling results were verified and refined through physical modeling in wave tanks. The testing program for physical modeling started with modeling existing conditions between East Lake Shore Drive and LaSalle Drive in a 100 ft. by 150 ft. wave basin (1:50 scale model). The project team simulated several of the most significant historic storms on record to ensure the physical model waves and flooding /overtopping measurements accurately reflected the conditions known to have occurred in those historic events. After the models were calibrated, stepped revetment wall and beach treatments were modeled and their performance was assessed under extreme storm and lake level conditions.

SHORELINE DESIGN CONCEPTS SUMMARY

The physical modeling showed that the water level (lake level plus storm surge) is the critical and controlling variable for wave action at the shoreline, including wave overtopping and flooding. The modeling confirmed that designing to protect critical infrastructure from a severe storm at a 200-year water level will provide a high level of protection from the effects of climate change in this section of Lake Michigan. It is possible to provide this level of protection using both stepped revetment wall and beach treatments.

NEXT STEPS

The project team will also develop a 3D design of NDLSD, lakefront access facilities and the shoreline between Grand and Fullerton. This will allow detailed analyses of impacts to shoreline viewsheds from the urban edge and along Outer Drive.