Illinois Department of Natural Resources, Office of Water Resources

Public Notice

Proposed Breakwater and Boat Launch Ramp construction in Lake Michigan at 525 Sheridan Road, Kenilworth, IL 60043.

Joakim Weidemanis, 525 Sheridan Road, Kenilworth, IL 60043 has applied for an Illinois Department of Natural Resources, Office of Water Resources permit for the construction of a breakwater and boat ramp in Lake Michigan at 525 Sheridan Road, Kenilworth, IL 60043.

The applicant’s current shore protection consists of a concrete gravity seawall and quarry stone revetment. The applicant proposes to place a longshore parallel breakwater and install a steel frame boat ramp. A 75.5 ft long breakwater will be constructed approximately 105 ft from the existing toe of the bluff. The breakwater will have a crest elevation of approximately 582.5 ft. A 28 ft. long new shore-connected steel frame boat ramp will be installed on steel piles driven into the lakebed. The new boat ramp will have a crest elevation of 582.5 ft tapering down to 577.09 ft at the lakeward end. The existing quarry stone revetment will be adjusted as needed to accommodate the boat ramp. The crest elevation of the existing revetment will remain at approximately 588.7 ft. Approximately 228 cubic yards of premitigational sand will be placed. All elevations are in International Great Lakes Datum – 1985 adjusted. The proposed project will be reviewed using the Department’s Part 3704 Rules. A location map and plans are attached to this notice.

No work is to start on this project unless and until such a time that the permit is issued.

Plans for the work may be seen at the Office of Water Resources, Chicago Office, 100 W. Randolph Street 15th floor, Chicago, Illinois 60601. Inquiries and requests to review the plans may be directed to Venkata Jyothula of the Chicago Office at (312) 814-6264 or Venkata.Jyothula@illinois.gov. An expanded version of the public notice can be viewed at http://www.dnr.illinois.gov/WaterResources/Pages/PublicNotices.aspx. You are invited to send comments regarding the work to the Chicago Office by July 26, 2022.

June 27, 2022
TAMCOR, LTD.  
SHORE PROTECTION CONSULTANTS

April 20, 2022

Ms. Kathleen Chernich  
Senior Project Manager  
U.S. Army Corps of Engineers  
Chicago District Regulatory Branch  
231 South LaSalle Street  
Suite 1500  
Chicago, IL 60604

Mr. Darren Gove  
Illinois Environmental Protection Agency  
Division of Water  
1021 North Grand Avenue East  
Springfield, IL 62794

Mr. J. Kessen  
Illinois Department of Natural Resources  
Office of Water Resources  
Lake Michigan Management Section  
160 N LaSalle Street  
Suite S-703  
Chicago, IL 60601

Subject: Request for Permit to Construct a Lakeshore Breakwater Project  
Lake Michigan at 525 Sheridan Rd, Kenilworth IL  
IDNR Navigable Waterway and USACE Section 404/401 Permit Applications

We are transmitting herewith a Joint Application Form and supporting documents for an Individual Permit request to allow the construction of a nearshore rubblemound breakwater consisting of approximately 490 cu.yds. of quarystone, 228 cu.yds. of torpedo sand for beach nourishment, and a 10 ft wide X 28 ft long steel boat ramp to facilitate launching small watercraft with the aid of a beach launcher vehicle. Lake levels, while lower than record high water elevations, are still capable of allowing energetic storms to impact shore protection structures.

A permit check in the amount of , made out to the Illinois Department of Natural Resources, is being sent via USPS Certified mail under separate cover.

Sincerely,

Carl Kupfer, P.E.  
President  
Tamcor, Ltd.  
300 Marquardt Dr.  
Wheeling, IL 60090

cc: Joakim Weidemanis

Illinois  
300 Marquardt Dr. Wheeling, IL 60090

Wisconsin, IL 60090  
740 Waters Edge Rd., Racine, WI 53402  
tamcorconsulting@gmail.com

www.tamcorconsulting.com  
ph. 847-404-1868
JOINT APPLICATION FORM FOR ILLINOIS

1. Application Number

2. Date Received

3. and 4. (SEE SPECIAL INSTRUCTIONS) NAME, MAILING ADDRESS AND TELEPHONE NUMBERS

<table>
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<tr>
<th>3a. Applicant's Name:</th>
<th>3b. Co-Applicant/Property Owner Name (if needed or if different from applicant):</th>
</tr>
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<tbody>
<tr>
<td>Joakim Weidemanis</td>
<td>Company Name (if any):</td>
</tr>
<tr>
<td>Company Name (if any):</td>
<td>Address:</td>
</tr>
<tr>
<td>Address:</td>
<td>525 Sheridan Road</td>
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<tr>
<td>Kenilworth, IL 60043</td>
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<td>Email Address:</td>
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<thead>
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<th>4. Authorized Agent (an agent is not required):</th>
</tr>
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<tbody>
<tr>
<td>Carl Kupfer, P.E.</td>
</tr>
<tr>
<td>Company Name (if any):</td>
</tr>
<tr>
<td>Tamcor, Ltd.</td>
</tr>
<tr>
<td>Address:</td>
</tr>
<tr>
<td>300 Marquardt Dr.</td>
</tr>
<tr>
<td>Suite 102</td>
</tr>
<tr>
<td>Wheeling, IL 60090</td>
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<tr>
<td>Email Address:</td>
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STATEMENT OF AUTHORIZATION

I hereby authorize [agent’s name] to act in my behalf as my agent in the processing of this application and to furnish, upon permit application. 4-24-2022 Date

5. ADJOINING PROPERTY OWNERS (Upstream and Downstream of the water body and within Visual Reach of Project)

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<td>c.</td>
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<td>d.</td>
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6. PROJECT TITLE:

Breakwater Improvements

7. PROJECT LOCATION:

925 Sheridan Rd., Kenilworth, IL 60043

LATITUDE: 42.09537 N

LONGITUDE: -87.71081 W

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| IN OR NEAR CITY OF TOWN (check appropriate box) |
| Municipality Name |
| Kenilworth |

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Revised 2010

☐ Corps of Engineers ☐ IL Dep’t of Natural Resources ☐ IL Environmental Protection Agency ☐ Applicant’s Copy
8. PROJECT DESCRIPTION (Include all features):
Install a nearshore quarystone breakwater with a crest length of 75.5 feet approximately 105 ft. from shore; 228 cu.yds. sand fill in the breakwater lee; install a shore-connected steel frame boat ramp, approx. 28 ft. in length and 10 feet in width.

9. PURPOSE AND NEED OF PROJECT:
Beach development; shore protection

COMPLETE THE FOLLOWING FOUR BLOCKS IF DREDGED AND/OR FILL MATERIAL IS TO BE DISCHARGED

10. REASON(S) FOR DISCHARGE:
to construct a nearshore quarystone breakwater

11. TYPE(S) OF MATERIAL BEING DISCHARGED AND THE AMOUNT OF EACH TYPE IN CUBIC YARDS FOR WATERWAYS:
TYPE: clean approved quarystone (490 cu.yds.) and torpedo sand (228 cu.yds.)
AMOUNT IN CUBIC YARDS:

12. SURFACE AREA IN ACRES OF WETLANDS OR OTHER WATERS FILLED (See Instructions)
3200 sq. ft. (0.073 ac.)

13. DESCRIPTION OF AVOIDANCE, MINIMIZATION AND COMPENSATION (See instructions)
The breakwater footprint is at a minimum needed for robust shore protection, and minimizes impact on the aquatic environment. The lee nearshore will be nourished with sand to offset withdrawals from the littoral drift.

14. Date activity is proposed to commence
Spring 2023
Date activity is expected to be completed
Summer 2023

15. Is any portion of the activity for which authorization is sought now complete?  Yes ☐  No ☒
Month and Year the activity was completed

16. List all approvals or certification and denials received from other Federal, interstate, state, or local agencies for structures, construction, discharges or other activities described in this application.

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<tr>
<th>Issuing Agency</th>
<th>Type of Approval</th>
<th>Identification No.</th>
<th>Date of Application</th>
<th>Date of Approval</th>
<th>Date of Denial</th>
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17. CONSENT TO ENTER PROPERTY LISTED IN PART 7 ABOVE IS HEREBY GRANTED. ☒  No ☐

18. APPLICATION VERIFICATION (SEE SPECIAL INSTRUCTIONS)
Application is hereby made for the activities described herein. I certify that I am familiar with the information contained in the application, and that to the best of my knowledge and belief, such information is true, complete, and accurate. I further certify that I possess the authority to undertake the proposed activi

________________________________________
Signature of Applicant or Authorized Agent

Date

________________________________________
Signature of Applicant or Authorized Agent

Date

☐ Corps of Engineers  ☐ IL Dept’t of Natural Resources  ☐ IL Environmental Protection Agency  ☐ Applicant’s Copy

Revised 2010

SEE INSTRUCTIONS FOR ADDRESS
LOCATION MAP

see construction plans - Attachment A, Exhibit B
see construction plans - Attachment A, Exhibit B
Attachment A to Joint Application Form

PROJECT REPORT
FOR
A NEARSHORE QUARRYSTONE BREAKWATER

525 Sheridan Road
Kenilworth, Illinois

April 18, 2022

Project # 20750A

Prepared By:
Tamcor, Ltd.
300 Marquardt Dr
Wheeling, IL 60090
OUTLINE

1. Background
   a. Location
   b. Existing shoreline conditions
2. Lake Level Variability and Storm Impacts
   a. Water surface elevations
3. Proposed Shore Improvements
4. Proposed Boat Ramp
5. Proposed Improvement Design and Construction
6. Construction Access

EXHIBITS

A. Design Considerations and Protection Elevation Determination
   A1. Design Report
   A2. Nearshore Bathymetry Grid
   A3. Bathymetry Tabulation
   A4. Wave Protection Height Calculations
B. Construction Plans
1. Background

a. Location of Property

The subject property is located at 525 Sheridan Rd, Kenilworth, IL. Refer to Exhibit B, the construction plans, including location and area maps.

b. Existing Shoreline Conditions

The shoreline consists of a concrete gravity seawall and quarrystone revetment extending the length of the property’s lake frontage. The adjacent property to the north has recently been armored with quarrystone up to the common property line. The adjacent property to the south is protected by a concrete gravity seawall. The water elevation observed by the surveyor on 9-30-2020 was 581.9 (IGLD85). Current water levels are averaging 580.0, but are expected to rise due to typical spring rains throughout Lake Michigan’s drainage basin.

2. Lake Level Variability and Storm Impacts

a. Water Surface Elevations

Lake water surface elevations along the shore experience short term and long-term variations. Short-term factors include changes in barometric pressure, wind-driven waves, and storm setups. Longer term variations (year-to-year) are attributable to snow and rainfall-induced runoff; overlake precipitation and evaporation; the extent and duration of ice cover; the rates inflow from Lake Superior, and outflows through Lake St. Clair into Lake Erie.

The highest water surface elevation was recorded in October of 1986 at 582.35 International Great Lakes Datum (IGLD 85), while the lowest elevation occurred in January 2013, dropping to 576.0. The difference between low and high water surface levels is in excess of 6 feet. In 2020, high monthly mean water elevations persisted through much of the summer and fall, setting new records.
3. Proposed Shore Improvements

The shoreline is proposed to be improved by placing a quarystone breakwater located a maximum distance of 105 ft. to lakeward of the existing revetment. Approximately 228 cu. yds of sand that includes a surplus of 20% will be placed in the lee of the breakwater to nourish the nearshore, enhance shore protection, and encourage development of a bathing beach.

We are recommending a breakwater based on the following parameters. Refer to Exhibit A for design considerations and crest elevation determination.

a. Design Water Level – 20 year recurrence interval using Corps of Engineers standard criteria and water elevations (including storm surge), Design Water Level Determinations on the Great Lakes, USACE, Detroit, MI, September 1993, interpolated to the project location.

b. Wave runup and crest elevation determinations based on a storm event with a 2% probability of occurrence in any given year (the “50-yr storm”).

4. Proposed Boat Ramp

A steel frame boat ramp is proposed to facilitate launching and retrieving small watercraft using a Beach Launcher from shore to the water. Refer to Exhibit B, the Construction Plans, for location and configuration.

5. Proposed Improvement Design and Construction

The Construction Plans, Exhibit B, depict the proposed improvements in detail.

6. Construction Access

Access for breakwater construction will be from the water side.
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Blue - Corrected elevation data
## WAVE PROTECTION HEIGHT CALCULATION SUMMARY

**Datum:** IGLD85 (IGLD85 = NAV88 minus 0.53 ft)  
**Date:** 4/18/2022  
**Project No.:** 20750A  
**Location:** 525 Sheridan Rd, Kenilworth, IL

### Revetment Section
- Proposed Lakeshore Breakwater Improvements

### Project Details
- **Latitude:** 42.0951  
- **Longitude:** -87.7105

### Parameter

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### Expressions and Formulas
- *Design Water Level Determinations on the Great Lakes, USACE, Detroit MI September 1993
- Hm0 = Hs
- Hs = 0.031* Ua* SQRT (F)
- T = 2* SQRT (Hs)
- Ds = SWL - Et
- Rmax = Hb* (a*Sp)/(1+(b*Sp))
- **Hb calculated using Fig. 2-2 in USACE Shore Protection Manual EM 1110-2-1614
- Sp = tan theta /SQRT(2* pi*Hs/gTSQ)
- Hs for Milwaukee from USACE publication ERDC/CHL TR-12-23, Wave Heights and Water Level Variations on Lake Mich, 2012
Attachment B to Joint Application Form

PROPOSED NEARSHORE BREAKWATER

525 Sheridan Rd., Kenilworth, IL
Tamcor, Ltd. Project #20750A

IDNR/OWR Section 3704.80(a) and USACE RP-11 Compliance Responses

Background and Project

Project: Proposed Lakeshore Breakwater

The project consists of placing an 75.5 foot long shore-parallel breakwater a distance of 105 feet from the seawall utilizing 1-6 ton armorstone and quarry-run corestone to augment existing shore protection; placing 228.4 cu. yds. of sand fill placed in the lee of the breakwater to minimize littoral drift diversion and develop a protective beach; and setting a steel frame boat ramp to facilitate transporting small watercraft from shore to the water.

A. Section 3704.80(a) Compliance

The proposed activity must not:

1. Cause an obstruction to, or interfere with the navigability of a public body of water-
   The proposed work will take place within 80 feet of the shoreline and well within steel sheetpile groins which extend approximately along the property lines to lakeward. Also, nearshore depths are too shallow for navigational purposes.

2. Result in an encroachment on a public body of water-
   The encroachment will be minimal, totaling around 490 c.y. core and armorstone.

3. Cause an impairment of any rights, interests and usage of any public water of water or to its natural resources-
   No impairment of rights, interests, usage of public waters and impacts on natural resources are expected.

4. Cause bank or shoreline instability on other properties-
   The proposed work is not expected to impact banks and shores of other properties since activities are confined to the nearshore boundaries of the subject property

Additional Guidance For Shore-Parallel Revetments and Bulkheads

Not applicable
Breakwater Design Parameters

Construction will be carried out from the lake side. Refer to the Project Report for design parameters.

Scaled Vicinity Map

Vicinity and location maps, showing location of the properties, nearby harbors, community borders, existing lakeshore structures, and roadways are included in the plans. A scaled Vicinity map is shown on the cover sheet of the plans. Refer to the construction plans.

Updrift and Downdrift Landowners

Names and contact information are given in Attachment C to the Joint Application Form.

B. Item list under RP 11 e.

1. Photo images are included on the construction plans;
2. Please refer to the attachment which states project purpose and need;
3. Please refer to the plans for existing shoreline conditions and bathymetry of the nearshore;
4. Please refer to the plans for proposed conditions cross-sections and related work;
5. The OHWM is at elevation 585.0+- an occurs in the vertical plane of the seawall/revetment;
6. Approximately 490 cu.yds. of core and armorstone fill will be placed below the OHWM; Lakebed coverage of stone fill is 3,200 sq.ft., or 0.073 ac.
7. Access is limited to the water side. Equipment and materials will be delivered to the site using an excavator hauled by tug and barge. The barge will extend spuds onto the lakebed for safe unloading and operation;
8. Dig-in to the site is not likely to occur since the equipment to be used is shallow-draft, drawing approximately 5 ft. at the point of stone placement. If dig-in is required, the material will be removed by excavator situated on the barge to remove only sand which would be cast downdrift of the site.

Shore protection projects on Lake Michigan shall not:

1. The subject property’s shoreline is less than 300 ft in length.
2. There are no waterways within 200 ft. of the project site that discharge into Lake Michigan;
3. This project is not attempting to regain land lost to erosion
4. Dredged lakebed materials will be removed by barge. Fill materials consist of approved quarry stone;
5. The completed shoreline improvements will not diminish public access.

All conditions have been met and/or will be complied with.
1. Description of existing site conditions:

   a. On-site man-made structures, such as piers, revetments, breakwaters. The shoreline at the subject property consists of a quarrrystone revetment placed in 2021; the adjacent property to the north is likewise armored with a quarrrystone revetment placed in 2020; the adjacent southerly property has a concrete gravity seawall along its shoreline terminating at a sheet steel groin. All shore protection features are in good condition.

   b. Assessment of shoreline morphology including shoreline orientation, condition and description of shoreline (ex. beach, bluff, maintained turf lawn, recent erosion, existing vegetation), and any other relevant features; Please refer to the photo gallery in the construction plans. Refer also to the description of shore features in para.1a. above.

   c. Applicable site history such as past permits, recent changes in site conditions or water levels, etc. Describe any significant recent storm events that may have influenced site conditions and the date that the qualitative assessment (item 6 below) was completed; A permit was issued in 2021 for the construction of a quarrrystone revetment; no significant storms have occurred since the completion of the revetment installation.

2. Qualitative assessment of the habitat near the project area: Due to the nature of existing shore structures, existence of aquatic and terrestrial habitat adjacent to and on the site is unlikely.

   d. Describe substrate composition, basic description of aquatic and terrestrial vegetation, and any other habitat features observed or known/documentated; clay lakebed with shallow littoral sand and gravel veneer; there is no terrestrial vegetation in the vicinity of the shore.
e. Distance from, and location of, nearest tributary, ravine, or other aquatic resource;

None in proximity of the subject property.

f. Distance from, and location of, nearest known reef/shoal or other habitat feature; and to our knowledge there are no reefs or shoals in proximity to the subject property

g. Bathymetric survey conducted within the last 12 months. Included in the Plans as sheet 2.

3. A discussion of the measures taken to avoid and minimize impacts to aquatic resources on the project site; The proposed activities are not expected to impact aquatic resources, if even present (see paragraph 3 response above)

4. Address the following special conditions for Activity 4:

a. Acceptable materials to be used include poured (formed) concrete, clean quarried stone, fabric-formed concrete, gabions, steel (piling), and clean recycled concrete chunks with the reinforcement steel removed. Rubble, asphalt, pavement, debris, and other waste products may not be used for shore protection; Clean quarrystone only

b. Shoreline structures must be designed to withstand the expected wave forces of the lake. Steepening of stone structure faces that include a stone toe design may be allowed by this office on a case-by-case basis; The improvements have been designed accordingly

c. For shoreline protection structures consisting of steel, the addition of stone may be required to reduce erosion of adjacent shorelines from reflected waves or induced eddies at the end of structures; Not applicable.

d. A construction sequence describing how access to the site will be accomplished. Water-based access is limited to the use of barges for the transport of heavy equipment and construction materials; Refer to sheet 8 of the Plans for the construction sequence.
e. A contingency plan for temporary “dig-in” and sidecasting of lake substrate for access to the work area by barge. If temporary “dig-in” is needed, you must provide notification to this office of the change prior to sidecasting and relocating the substrate; **A contingency plan note has been added to sheet 8 of the Plans.**

f. Revetments must be the minimum width below the OHWM necessary for completing the work and for structural integrity of the proposed design; **not applicable**

g. Groins and breakwaters must be situated within 125 feet of the toe of the bluff, as determined by this office. A variance in the maximum offshore distance of a structure may be granted for public facilities. All variances must be approved by this office on a case-by-case basis; **The Plans comply with these limitations.**

h. Pre-fill sand at a volume of 120% of the calculated capture volume of the proposed structure(s) must be provided in conjunction with the construction of the structure. A pre-construction bathymetric survey must be completed within one (1) month of the start of construction to recalculate the pre-fill sand volume to account for changes in site conditions since the original survey. Surveys more than one (1) month old will be considered if the start of construction is delayed due to weather conditions. A copy of the survey and final pre-fill sand volume must be provided to this office prior to the start of construction activities; **So noted.**

i. Structures must provide reasonable accommodations, as determined by this office, to maintain public access to the shoreline. **The proposed improvements will not interfere with public access opportunities. The existing longshore concrete deck/walk is available for public access.**

Your notification will not be processed under the LMRGP until you submit the above information to this office. If you choose not to furnish this information, you may request in writing that your project be reviewed through the Individual Permit (IP) process. The IP process, which normally takes about 90 to 120 days to complete, requires the same information requested above and the issuance of a public notice. If you do not respond to this letter within thirty (30) days of the date of this letter providing either the necessary information, a request for additional time to gather the information, or a request that your project be reviewed through the IP process, your application will be withdrawn.
1. Model Introduction

In this study, XBeach model was employed to simulate wave transformation, sediment transport and beach evolution. XBeach is an open-source numerical model which is developed to simulate hydrodynamic and morphodynamic processes and impacts on sandy coasts. The model includes the hydrodynamic processes of short-wave transformation (refraction, shoaling and breaking), long wave (infragravity wave) transformation (generation, propagation and dissipation), wave-induced setup and unsteady currents, as well as overwash and inundation. The morphodynamic processes include bed load and suspended sediment transport, dune face avalanching, bed update and breaching. Effects of vegetation and of hard structures have been included. The model has been validated with a series of analytical, laboratory and field test cases using a standard set of parameter settings. The development of the model has been funded by the U.S. Corps of Engineers and the U.S. Geological Survey.

2. Model Setup

The computation domain stretched about 610 m in the cross-shore direction and 80 m in the long shore direction. The domain was discretized by 2 m * 2 m grids. The simulation time was 10 hours. Directional wave spectrum was specified at the offshore boundary with the design wave height and wave period. The offshore breakwater configuration was as follows.

- **breakwater length** Ls = 23 m (about 75.46 ft) at the top of the breakwater
- **alongshore location** centered at y = 40 m
- **offshore distance** from the seawall is about 26 m (85.30 ft).
- **crest elevations**: 582.0 ft, 582.5 ft, 583.0 ft, 583.5 ft
- **beach response index** Is = exp(1.72-0.41*Ls/Y) = 3.88 (well-developed salient or subdued salient is expected without beach nourishment)

The design conditions:

- **50-yr design wave conditions**: Hs = 6.37 m (20.9 ft), Tp = 9.14 sec
- **20-yr SWL (still water level)**: 583.06 IGLD85 (monthly mean plus surge)

Five numerical experiments (baseline – no breakwater, 3 crest elevation scenarios with 20-yr design water levels, and beach nourishment) were conducted:

**Case 0**: Baseline simulation with existing conditions without a breakwater

**Case 1**: Breakwater crest elevation: 582.0 ft, 20-yr design water level 583.06 ft
Case 2: Breakwater crest elevation: 582.5 ft, 20-yr design water level 583.06 ft

Case 3: Breakwater crest elevation: 583.0 ft, 20-yr design water level 583.06 ft

Case 4: Breakwater crest elevation: 583.5 ft (emergent under 20-yr design water level 583.06 ft)

Case 5: beach nourishment behind the breakwater, sand volume 420 cubic yards

3. Model Results

3.1 Case 0: Existing Conditions Without the Breakwater

Figure 1. Wave height distributions under a 20-yr design water level without a breakwater
Figure 2. Depth contours before (dashed contours) and after (red solid contours) the storm.

Figure 3. Beach profile evolutions at two transects. Upper: $y = 40$ m (across the revetment); lower: $y = 20$ m (open coast).
3.2 Case 1: Offshore Breakwater with a Crest Elevation of 582.0 ft (1.06 ft submerged)

Figure 4. Wave height distributions in the lee of the breakwater under a 20-yr design water level

Figure 5. Sediment erosion and accretion in the lee of the breakwater by the end of the storm
Figure 6. Depth contours before (dashed contours) and after (red solid contours) the storm

Figure 7. Beach profile evolutions at two transects. Upper: \( y = 40 \) m (across the revetment); lower: \( y = 20 \) m (open coast)
3.3 Case 2: Offshore Breakwater with a Crest Elevation of 582.5 ft (0.56 ft submerged).

Figure 8. Wave height distributions in the lee of the breakwater under a 20-yr design water level.

Figure 9. Sediment erosion/deposition in the lee of the breakwater by the end of the storm.
Figure 10. Depth contours before (dashed contours) and after (red solid contours) the storm

Figure 11. Beach profile evolutions at two transects. Upper: $y = 40$ m (across the revetment); lower: $y = 20$ m (open coast)
3.4 Case 3: Offshore Breakwater with a Crest Elevation of 583.0 ft (0.06 ft submerged)

Figure 12. Wave height distributions in the lee of the breakwater under a 20-yr water level

Figure 13. Sediment erosion and accretion in the lee of the breakwater by the end of the storm
Figure 14. Depth contours before (dashed contours) and after (red solid contours) the storm

Figure 15. Beach profile evolutions at two transects. Upper: $y = 40$ m (across the revetment); lower: $y = 20$ m (open coast)
3.5 Case 4: Offshore Breakwater with a Crest Elevation of 583.5 ft (0.46 ft emergent)

Figure 16. Wave height distributions in the lee of the breakwater under a 20-yr water level

Figure 17. Sediment erosion and accretion in the lee of the breakwater by the end of the storm
Figure 18. Depth contours before (dashed contours) and after (red solid contours) the storm

Figure 19. Beach profile evolutions at two transects. Upper: $y = 40$ m (across the revetment); lower: $y = 20$ m (open coast)
3.6 Comparisons of Different Breakwater Designs

Figure 20. Accumulative sediment erosion/deposition volumes in the lee of the breakwater with different breakwater crest elevations

Figure 21. Comparisons of significant wave heights in the lee of the breakwater with different crest elevations (y = 40 m)
3.7 Wave runups on the revetment

The wave runups on the revetment in the lee of the breakwater are predicted by the FUNWAVE-TVD model, which is a high-order fully nonlinear Boussinesq equation model capable of simulating nearshore wave processes including wave dispersion, shoaling, refraction, diffraction and breaking. FUNWAVE-TVD was developed at the Center for Applied Coastal Research at University of Delaware. It has been recognized as a reliable coastal community model for simulating phase-resolving wave processes. For more information of the model, refer to [https://fengyanshi.github.io/build/html/index.html](https://fengyanshi.github.io/build/html/index.html). In this project, the revetment was modeled by a source term that dissipates wave energy. A coefficient in the source term which determines the amount of energy dissipation needs to be calibrated. The coefficient is chosen as 0.2 as used in the wave runup calculations on the revetment without offshore breakwater. To simulate wave diffraction around the breakwater, 2D model simulations were conducted. The revetment slope is 0.67. The computed wave runups are summarized below.

### 50-yr Design Storm:

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</table>

Note: $R_{u2\%}$ is the 2% wave runup, which is usually used as a design wave runup level without wave overtopping. $R_{us}$ is the significant wave runup.

Same as the previous table, but in ft

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<th>582.5 ft</th>
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<td>$R_{us}$</td>
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### 100-yr Design Storm:

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<td>$R_{u2%}$</td>
<td>2.39 m</td>
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<td>$R_{us}$</td>
<td>1.63 m</td>
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Note: $R_{u2\%}$ is the 2% wave runup, which is usually used as a design wave runup level without wave overtopping. $R_{us}$ is the significant wave runup.

Same as the previous table, but in ft

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3.8 Discussions and Conclusions:

- To evaluate the effects of breakwater crest elevation on waves and depositional feature in the lee of the breakwater, four numerical experiments were conducted with different crest breakwater elevations: 582.0 ft, 582.5 ft, 583.0 ft and 583.5 ft, respectively. Under the 20-yr design water level, the prior three breakwater designs are submerged, while the last breakwater design is emergent.

- For comparison purposes, figures 1-4 show the model results from a baseline simulation with the existing conditions, i.e., no offshore breakwater is constructed. Note that the shoreline is armored and there are no beaches in the study domain. There is a continuous quarystone revetment from $y = 0$ to $y = 58.5$ m where it tapers back to a near-vertical concrete seawall that terminates at a steel sheetpile groin at $y = 85.0$ m.

- The baseline simulation shows that the wave heights during a storm event are broken and limited by water depth. The wave height at the toe of revetment is about 2.2 m, which may cause significant wave runup on the revetment and scour at the toe of the revetment.

- Sections 3.2-3.5 present the model results from simulations with increasing crest breakwater elevations. It is quite clear that a higher crest elevation would result in smaller wave heights right behind the breakwater by reducing the overtopped waves, which is more clearly shown in figure 21. The offshore breakwater can reduce the wave height from 2.33 m (baseline simulation) to 1.18 m, 0.96 m, 0.78 m, 0.72 m behind the breakwater with crest elevations of 582.0 ft, 582.5 ft, 583.0 ft and 583.5 ft, respectively.

- However, due to wave diffraction, the influence of crest elevation on wave height at the toe of the revetment (around $x = 590$ m) is less significant. The wave heights at the toe are 1.46 m, 1.39 m, 1.35 m and 1.30 m with crest elevations of 582.0 ft, 582.5 ft, 583.0 ft and 583.5 ft, respectively.

- Wave runups are computed using the FUNWAVE-TVD model. To simulate wave diffraction around the offshore breakwater, 2D model simulations were conducted for different crest elevations. It was found that the breakwater does not reduce the 2% wave runups significantly, however, could reduce the significant wave runups. The reason is that, 2% wave runup accounts for the highest wave runups generated by large waves that can overtop the breakwater and cause significant onshore transport of water, resulting in higher mean water level and wave setup in the lee of the breakwater, diminishing the effects of breakwater on reducing the wave runup. On the other hand, the breakwater can significantly reduce the wave runups generated by relatively small waves, resulting in smaller significant wave runups with increasing crest elevations.

- Compared to the baseline simulation results, it is found that the impacts of the offshore breakwater on the adjacent coasts are limited. The wave height in the open nearshore is slightly increased due to the wave diffraction processes. This increase is the most significant near the heads of the breakwater. A bulbous configuration of the breakwater head might be used to reduce these impacts and better resist wave impact damage.

- With an offshore breakwater, a depositional feature will be formed in the lee of the breakwater. With an offshore distance of 26 m and a breakwater length of 23 m, the
beach response index is calculated to be 3.88. A well-develop salient or subdued salient is expected to be developed without beach nourishment.

- The changes of sediment deposition volumes for different cases are demonstrated in figure 20. From the model simulations, sediments tend to deposit in the lee of the breakwater in the beginning of the storm event. The maximum volumes of sediment deposition are estimated to be $104.15 \text{ m}^3$, $135.75 \text{ m}^3$, $149.35 \text{ m}^3$, $158.20 \text{ m}^3$ with crest elevations of 582.0 ft, 582.5 ft, 583.0 ft and 583.5 ft, respectively. As the crest elevation becomes higher than 582.5 ft, the effect of the crest elevation on the leeside sediment deposition becomes less significant. From a perspective of a balanced (or optimized) design (cost & damage/functioning), a 582.5 ft crest elevation can be considered.

- A continuous storm wave attack constrains the development of a salient in the lee of the breakwater. Sediment deposition will be finally eroded by the storm as shown in figure 20. Although sediment deposition is not significant during the storm event, it is expected that more sediment accumulation would occur during calm conditions when onshore sediment transport dominates.

**Reference**

Appendix Combined Breakwater and Beach Nourishment

Case 5: Breakwater design is the same as in case 1, beach nourishment in the lee of the breakwater, sand fill volume = 145.5 m³ = 190.3 yard³

The nourished beach width is about 3 m with a mean elevation of 582.4, with the breakwater crest set at 582.5.

Figure 22. Beach nourishment design in the lee of the breakwater, indicated by the difference between the red and blue lines.
Figure 23. Wave height distributions in the lee of the breakwater under a 20-yr water level

Figure 24. Sediment erosion and accretion in the lee of the breakwater by the end of the storm
Figure 25. Depth contours before (dashed contours) and after (red solid contours) the storm.

Figure 26. Beach profile evolutions at two transects. Upper: $y = 40$ m (across the revetment); lower: $y = 20$ m (open coast).
* CONSTRUCTED PER IOWA/DAIRY PERMIT DTD 7/8/2001 AND 
USAGE PERMIT # LRD-2002 - 00253

[Diagram of a breakwater and related geological features]

LOCATION:
525 SHERIDAN ROAD
KENILWORTH, IL

PROJECT:
PROPOSED NEARSHORE BREAKWATER

SHEET NAME:
PROPOSED CONDITIONS SECTION VIEWS;
BREAKWATER GEOMETRIC DETAILS

PLAN DATE:
4/18/2022

TAMCOR, LTD.
300 MARQUARDT DR
WHEELING, ILLINOIS 60090
www.tamcorconsulting.com
PHONE: 847-544-1600

© SHEET 5 OF 6
A. DESCRIPTION OF THE BREAKWATER WORK

1.0 The work under this scope of work covers:

1.1 Monkeys by benches or other means the limits of the breakwater work area;

1.2 Placement of new core and armor stone to construct the breakwater;

1.3 Placement of fill sand.

2.0 Contractor's Scope:

2.1 The work to be done by the Contractor under this Contract shall include the furnishing of all equipment, materials, labor, spoilage, Allowance, and all things necessary for any incidental to the satisfactory performance and completion of all work as specified herein. All work to be done in accordance with details shown on the accompanying plans as specified herein.

B. DEFINITIONS

1.0 The word "provide" means 'supply and install'.

1.2 For purposes of this contract, "Owner's Representative", and "Engineer" shall have the same meaning.

C. WORK SCHEDULE

1.0 Provide within 10 working days after Contract award, schedule showing anticipated progress slags and fixed completion of work within time period required by contract documents.

2.0 Work sequence:

2.1 Before work is undertaken, ensure that all materials and tasks required are available to finish work in an as short a period as possible.

2.2 Delivery of all equipment and materials shall be by large. The beach is available for equipping stone and sand, and for temporary parking of construction equipment. For further access is available.

2.3 Contractor to work in the location and in the manner described in these plans.

2.4 Removal of equipment, spoilage materials and debris of completion of operations. The condition of the site shall be adjusted to or better than that which existed before the start of construction.

D. BREAKWATER SPECIFICATIONS

1.0 Measurement Specifications

1.1 Core and armor stone shall be measured in ton of material supplied and placed to the finished dimensions indicated on the plans.

1.2 Material Specifications:

1.2.1 Armor stone sizes shall be shown on the plan details, ranging from one to six tons in size. Stone shall be fractured and angular, free from ore, scoria, seams, large caps, and other defects which may impair durability.

1.2.2 Quarry-run core stone sizes shall be shown on the plan details, ranging from 200 to 1000 lbs. in size, by weight, with 80 percent of the total volume to be at the midpoint of the specified size range. No more than a maximum of 5 percent may be smaller than 12 inches in diameter.

1.2.3 Fill sand shall be clean "sandy" sand meeting DOT PA-12 grading.

1.2.4 Quarry-run Quality Criteria: - refer to the table below.

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Table 1. Criteria for Stone Quality

<table>
<thead>
<tr>
<th>Test Method</th>
<th>Test Procedure</th>
<th>Acceptance Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM C 127</td>
<td>26.0 to 3.0</td>
<td>&lt; 2 percent</td>
</tr>
<tr>
<td>ASTM D 5969</td>
<td>42.0 to 2.0</td>
<td>&lt; 20 percent loss after 600 revolutions</td>
</tr>
<tr>
<td>ASTM D 5353</td>
<td>40.0 to 2.0</td>
<td>&lt; 20 percent loss after 60 cycles</td>
</tr>
<tr>
<td>ASTM D 5545</td>
<td>42.0 to 2.0</td>
<td>&lt; 20 percent loss after 100 cycles</td>
</tr>
<tr>
<td>ASTM D 5791</td>
<td>40.0 to 2.0</td>
<td>&lt; 20 percent loss after 100 cycles</td>
</tr>
<tr>
<td>ASTM D 5969</td>
<td>42.0 to 2.0</td>
<td>&lt; 20 percent loss after 60 cycles</td>
</tr>
<tr>
<td>ASTM D 6092</td>
<td>42.0 to 2.0</td>
<td>&lt; 20 percent loss after 60 cycles</td>
</tr>
<tr>
<td>ASTM D 6099</td>
<td>42.0 to 2.0</td>
<td>&lt; 20 percent loss after 60 cycles</td>
</tr>
<tr>
<td>ASTM D 6240</td>
<td>42.0 to 2.0</td>
<td>&lt; 20 percent loss after 60 cycles</td>
</tr>
</tbody>
</table>

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LOCATION: 525 SHERIDAN ROAD
KENILWORTH, IL

PROJECT: PROPOSED NEARSHORE BREAKWATER

SHEET NAME: GENERAL CONSTRUCTION NOTES AND SPECIFICATIONS

PLAN DATE: 4/18/2022

TAMCOR, LTD.
305 MARQUONET DRIVE
WHEELING, ILLINOIS 60090

PROJECT NO. 20750A

DATE BY REVISION: 20750A