

**Memorandum – Coastal Engineering Review
SLBE Sleeping Bear Dunes National Lakeshore Adjacent Revetment
(Leelanau and Benzie counties, Michigan)
TAR 15529**

4 December 2020

Review Request Summary

SLBE - Coastal Engineering Review of Permitted and In-Construction Revetment and Seawall Project Adjacent to Sleeping Bear Dunes National Lakeshore

Introduction and Background

This memorandum is a follow up to the EA memorandum draft memorandum dated November 20, 2020 and presents comments regarding the evaluation of estimated longshore transport at Sleeping Bear Dunes National Lakeshore (SLBE) and surrounding areas, and discusses how the under construction revetment may change the sediment transport processes in the immediate area. This analysis was completed using publicly available data, which will either be linked in the comments or included as an attachment.

For this second review, which intends to provide NPS with the likelihood the under construction revetment structure will impact SLBE, it should be first noted that the comments are based only from the referenced public studies and information. EA was not tasked with nor did the team review calculations or other background design information in detail but has performed a cursory review to ascertain the likelihood of negative impacts to SLBE from the seawall and revetment structures.

Based upon this limited information review, EA is providing initial technical observations in the comments section below.

Comments:

1. USACE staff informed NPS via email dated November 19, 2020, that the permitted activities are currently under construction. Based upon this information, NPS staff took the following photo (Figure 1) of the activity from adjacent public property on November 24, 2020. Initial observations from this photo indicate the following:
 - Based upon the permit drawings/specifications of a rock size between 1 and 3 feet, the width of the revetment appears to exceed the maximum permitted 10 feet.

Recommendation:

- While it is very difficult to gauge distances from a photo, it is recommended that NPS request a site visit with USACE to confirm dimensions of the installed stone revetment.



Figure 1: Revetment Construction Conditions (11/24/2020)

2. There are two primary ways a revetment or a seawall structure can impact erosion. The first is through energy reflections, where wave energy impacts the structure and is reflected to increase waves striking a nearby area. Typically reflected energy only impacts areas within a 45-degree arc from normal along the shoreline, and revetment structures reflect much less energy than seawall structures. The second method is by removing a source of sediment from the overall longshore sediment transport for a section of shoreline by not allowing a region to erode. While a revetment may allow some small amount of finer sediments to move through it, a seawall typically prohibits all sediment from moving from the protected shoreline. These factors are why localized hotspots of erosion can form downstream of these hardened erosion protection measures.

Analysis: The placement of this segment of shoreline armoring is such that no NPS lands are directly within the 90-degree window of potential energy reflections, so this method of erosion can be discounted. The most effective way to analyze potential downstream impacts is to review historic aerial photographs and see if the region being armored shows signs of significant shoreline movement, refer to Comment 3.

3. Google Earth has aerial images of the subject location ranging from 1993 to 2018. Several of the images are of poor quality, but the entire set of imagery was reviewed, and the shoreline morphology was reviewed visually.

Analysis: Changes in the shoreline are observed, with areas alternating being wet or dry depending on the variation of Lake Michigan water levels. In reviewing permanent structures, such as the timber stairs leading down from the house in the photo above and trees along the

shoreline, there does not appear to be significant changes to the shoreline based upon this visual analysis.

4. From the paper *Mean Circulation in the Great Lakes* by D. Beletsky, J. Saylor, and D Schwab published in the International Association Great Lakes Resources, 1999, it is concluded that the mean circulation pattern near SLBE is south to north (refer to Figure 2). It should be noted that this study was based upon data from 1960s through the 1980s.

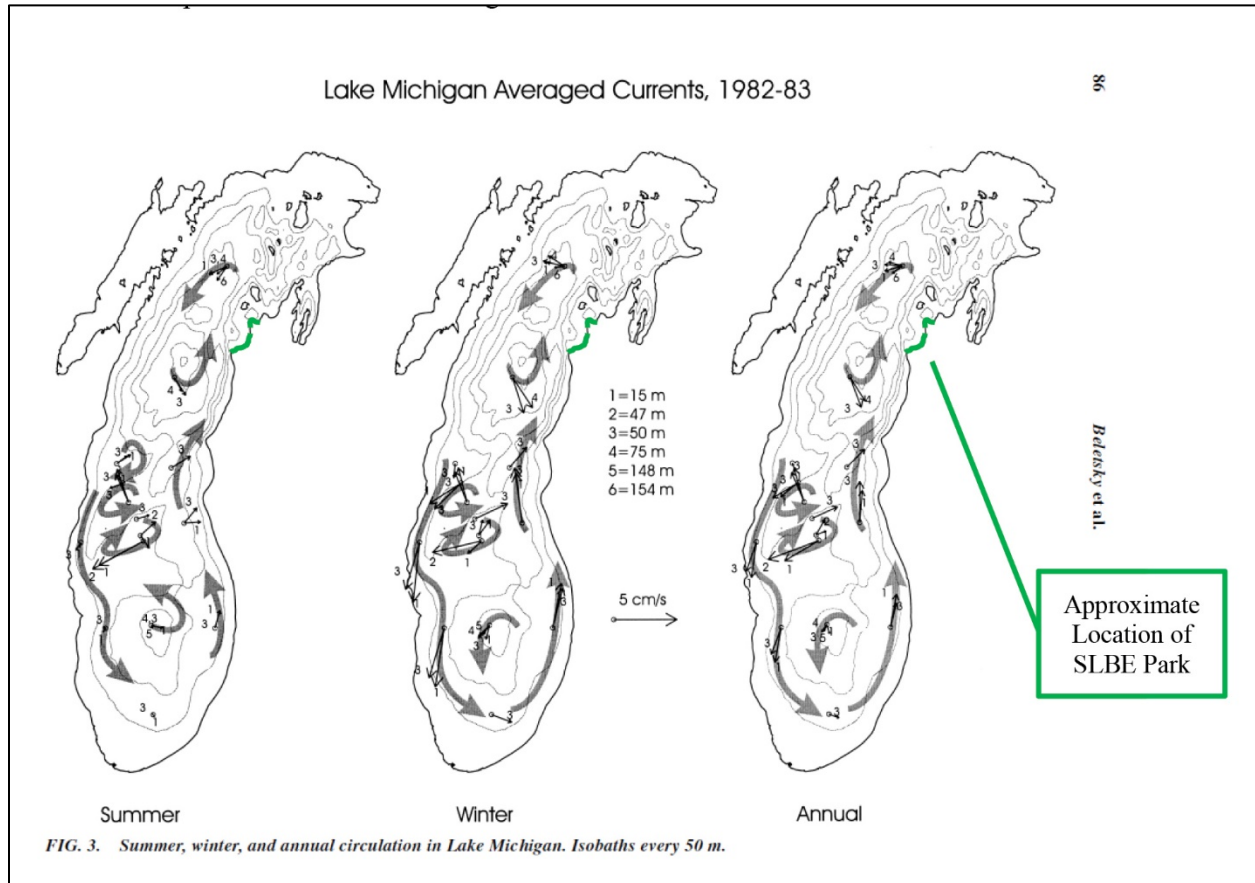


Figure 2: Lake Michigan Circulation Map (1999)

Analysis: This south to north current circulation observed in the paper would indicate a south to north sediment transport for SLBE. While individual storm events may cause localized erosion and temporarily move sediment in other directions, the average transport is most likely south to north. The proposed shoreline armoring would likely have little impact to the southern SLBE unit based upon this.

5. In recent years both USACE and the EPA have identified the need for a current study to identify overall sedimentation for the Great Lakes to inform immediate and future development. The USACE presentation on this is <https://cdn2.cloud1.cemah.net/wp-content/uploads/sites/39/2017/11/Hoxie-GL-Sedimentation-Workshop-2017.pdf> from 2017. The EPA recently solicited applications for a data collection program for the coming years <https://www.epa.gov/great-lakes-funding/great-lakes-sediment-surveillance-program-2020-rfa> in February 2020.

Analysis: The 1999 paper is the most recent study completed and the best available public data for review.

6. Reviewing published literature on the overall Lake water level and observable trends, there are numerous projections on what the future levels will be. Currently these projections differ significantly, with some studies claiming an overall decrease in lake water elevation should be expected while others project water elevations to increase.

Recommendation: With the vast array of information and no clear agreement between the studies, lake levels should be assumed to fluctuate, and any analysis is recommended to use a conservative assumption.

7. USACE in their email dated November 19, 2020 stated that a segment of the originally requested armor structure was not authorized. This segment is an approximately 760-foot-long parcel of land currently undeveloped by the homeowner's association.

Analysis: This 760-foot region will provide SLBE with a buffer area should any storms cause temporary disturbances south of the new revetment. Such disturbances are likely to correct naturally due to the prevailing currents as discussed in Comment 5.

8. A portion of the SLBE unit can be found north of the armored area. This segment of SLBE is located approximately 6,000 feet north (just north of South Bar Lake).

Analysis: The small segment of armoring that is occurring is not expected to have any impacts this far north, as the intervening segment of shoreline already includes a small, armored revetment section at the parking lot (refer to image below). This section of revetment begins approximately 800 feet north of the new armoring and is also visible in the 1998 Google Earth imagery. This segment of revetment has had no known impact to the northern SLBE unit and shows no sign of movement in the visual analysis completed in Comment 3.



Conclusions

Based on our initial review, the averaged sediment transport direction is South to North, meaning this shoreline armoring is likely to have little or no direct impact upon SLBE.

References

Dmitry Beletsky, James H. Saylor, David J. Schwab, Mean Circulation in the Great Lakes, Journal of Great Lakes Research, Volume 25, Issue 1, 1999, Pages 78-93, ISSN 0380-1330, [https://doi.org/10.1016/S0380-1330\(99\)70718-5](https://doi.org/10.1016/S0380-1330(99)70718-5) (https://www.sciencedirect.com/science/article/pii/S0380133099707185).

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