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Great Lakes Research Center
Michigan Technological University

December 2, 2020

The Honorable Gary Howell, Committee Chair
Committee on Natural Resources and Outdoor Recreation
Michigan House of Representatives

RE: Long-Term Effects of Armoring Structures on Great Lakes Shorelines

Dear Mr. Howell:

We are researchers who have been collaborating on Great Lakes coastal shoreline dynamics and coastal shoreland management for the past several decades. In response to the Natural Resources and Outdoor Recreation Committee's scheduled hearing on Senate Bill 714, we have been asked by representatives of the Tip of the Mitt Watershed Council to summarize for your consideration the long-term effects of installing hard armoring structures, such as seawalls, groins, stone revetments, rip-rap, and so on, along Michigan's Great Lakes coasts, particularly with regard to the natural functioning of those shorelines. We do not take a position on the proposed legislation, but we hope our synthesis of the best available scientific information regarding shoreline armoring structures will be helpful to you and the committee in your deliberations.

As an initial matter, we note that at least some proponents of hard armoring structures assert that such structures, if properly designed and installed, will not cause long-term destruction or degradation of the natural beach lakeward of those structures, or adverse impacts to shorelines adjacent to them. These assertions are typically based on generalized observations about Great Lakes shoreline dynamics and theoretical predictions of the likely long-term effects of specific structures given their design features, as well as the designer's best professional judgment. We believe such assertions are unwarranted, and we believe that they should not be accepted as conclusive absent specific and scientifically valid evidence clearly demonstrating otherwise.

Rather, there now exists a substantial and compelling body of scientific evidence, both theoretically based and empirically observed, that any shoreline armoring structure, including sloped stone revetments, will almost certainly result in the long-term degradation and ultimately the loss of naturally functioning sandy beaches and dunes lakeward of those structures, as well as adverse erosional impacts to shorelines adjacent to those structures, even when Great Lakes standing water levels are low. This will be especially true given the cumulative impacts of installing multiple hard armoring structures over space and time, starving the sand sources that would otherwise be available to replenish beaches, even when lake water levels periodically drop. It will also be true so long as the

armoring structures themselves are maintained, while the impacts left by debris on the shore once those structures ultimately fail will persist for a long time afterward unless removed.

In contrast, we know of no compelling evidence clearly demonstrating that it is possible to design an engineered armoring structure, including sloped stone revetments, in such a way that the long-term loss of the natural shoreline or adverse effects on neighboring shorelines can be substantially diminished, without artificial periodic beach nourishment. It may be possible to site an armoring structure on Great Lakes shores in such a way that some portion of the natural beach might return when lake levels drop, in limited circumstances and if the conditions are just right. That outcome, however, would be a function largely of the longshore and cross-shore sediment dynamics of the full littoral cell encompassing the particular site. Knowing the comprehensive sediment budget for the full littoral cell encompassing a proposed structure, therefore, accounting especially for the cumulative impacts of multiple structures existing or proposed, is vitally important for determining conclusively what the full and long-term impacts of a structure will be. (We provide a list of representative scientific studies and reports that document these conclusions at the end of this letter.)

Given that assessment, it is our firm opinion that the weight of the available scientific evidence on the effects of hard shoreline armoring leads only to the conclusion that such structures actually yield shoreline destruction—not shoreline protection. Moreover, that evidence is now so compelling that the prudent and reasonable presumption should be that any proposed structure will result in the long-term destruction of the natural shoreline and adverse impacts to adjacent shoreline, unless compelling scientific and empirical evidence is available demonstrating that a proposed structure will clearly not have such an impact, given site conditions and the proposed structure's design. That evidence should include a comprehensive sediment budget for the full littoral cell encompassing the proposed structure, including both longshore and cross-shore sediment movement, and it should account for cumulative impacts from the effects of other existing or proposed structures, over a period of time including at least several years. Mere assertions that no harm will result, based theoretically on design features or best professional judgment alone, should not be sufficient to overcome the presumption that the structure will ultimately destroy the natural shoreline.

Finally, where there is compelling evidence that erosional processes are imminently threatening buildings on the shore, we believe that the most prudent short-term response would be to allow only the placement of large temporary sandbag systems that can be readily removed (popularly referred to as geo-tubes), or beach nourishment using sand supplies from upland sources or bottomland sources beyond the depth of closure (i.e., where harvesting those sediments will not itself result in adverse physical or ecological impacts). The goal should be to provide short-term protection of threatened buildings while other longer-term, non-destructive options are evaluated and pursued.

The State of Michigan is defined by its Great Lakes; it truly is the Great Lakes State. The great majority of the state's citizens experience the lakes along their shores. Ensuring the good conservation and stewardship of Michigan's Great Lakes shorelines is of upmost importance to all of the state's residents. Given the increased storminess, increased pressures for shoreline development, and record high water levels we are now experiencing, as well as the likelihood that those water levels will remain above long-term average for the foreseeable future, we believe the time has come to revisit a host of difficult but unavoidable questions. The most difficult of those questions include where and under what conditions hard armoring structures should be allowed, for how long they should be allowed to remain, under what conditions they should be removed, and who should carry the economic, fiscal, and ecological costs of the decisions made. There may be places and times where hardened armoring structures are warranted, such as when needed to protect vital public infrastructure, but the state's leaders and its citizens should—at the very least—fully comprehend and account for both the short- and the long-term trade-offs of the policy decisions being made.

We have been working for a number of years to identify ways in which Michigan's coastal communities, working in collaboration with the state, can become more resilient ecologically, economically, and socially given the unique coastal dynamics of our Great Lakes shorelines. That work has focused on promoting local and regional long-term planning and policy making to fully consider a host of policy options for stewarding Great Lakes shorelines, ranging from hardened armoring to managed relocation where most appropriate. Those coastal resiliency planning efforts can and should be fully coordinated and integrated with the full array of Michigan's Great Lake management efforts. We stand ready to assist you and your committee in whatever way we can toward that end. Please do not hesitate to call on us.

Sincerely,

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