

## Technical Memorandum

McGee Beach Breakwater  
Improvements (E15219)

Seawall Type A Board – Seawall  
Maintenance

Corpus Christi, Texas  
May 3, 2016



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## Executive Summary

The City of Corpus Christi is considering repairs and possible improvements to the southern portion of the breakwater adjacent to the downtown marina and McGee Beach. The initial section of the breakwater extends from the seawall as a concrete foundation supporting a dining concession and restrooms, which transitions to an elevated concrete cap extending to the rock section of the breakwater. The overall breakwater system provides wave sheltering for the marina and storm damage protection for the seawall.

Based on a preliminary site condition assessment, recommended improvements consist of the following primary elements:

- The bottom of the building foundation that supports the concession area is experiencing deterioration (spalling concrete) and should be repaired. The open space under the building foundation should be enclosed to help prevent uncontrolled/unauthorized access and vandalism.
- The existing elevated cap between the concession area and the rock breakwater is structurally deteriorating and recommended to be demolished and replaced. To replace the elevated cap, the rock breakwater and concrete cap should be extended towards the seawall to connect directly to the concession area. This will help reduce wind-blown transport of sand from McGee Beach into the marina basin.
- The concrete cap along the existing rock breakwater is recommended to be repaired/replaced, and possibly raised.

These improvements will help fortify the seawall against wave attack by preventing failure of the breakwater and reducing erosion at McGee Beach. A conceptual-level opinion of probable cost was developed for the improvements, with the construction cost estimated to be approximately \$2,770,000 and the total project cost (including engineering and permitting) estimated to be approximately \$3,706,000. These costs do not include escalation factors for future economic inflation.

Note that assessment of the existing concession building and restrooms was beyond the scope of the current effort. Although the existing building foundation appears to be relatively sound (with recommended repairs as described above), a structural assessment of the concession building and restrooms should be conducted if the City desires to explore options for replacing and/or repurposing these existing facilities.



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## Project Description

The City of Corpus Christi is considering repairs and possible improvements to the southern portion of the breakwater adjacent to the downtown marina. As shown in Figure 1, this portion of the breakwater separates the marina from McGee Beach. The initial section of the breakwater extends from the seawall as a concrete foundation supporting a dining concession<sup>1</sup> and restrooms, which transitions to an elevated concrete cap extending to the armor stone (herein referred to as “rock”) section of the breakwater (Figure 2). The initial approximate 1,800 ft of the rock section is accessible via a concrete cap that runs along the crest of the breakwater. The overall breakwater system provides wave sheltering for the marina and storm damage protection for the seawall.



Figure 1 – Project Location.

<sup>1</sup> The dining concession is currently leased as Seawall Food & Spirits.



Figure 2 – Project Features.

This report provides a preliminary condition assessment of the southern portion of the breakwater and a conceptual-level opinion of probable cost for associated repairs and/or improvements. This report updates a previous report prepared by HDR for the Type A Board (formerly 4A Board) in 2009. The Type A Board manages the Seawall Improvement Fund that is supported through a local sales tax approved in 2001. A primary purpose of the seawall improvement fund is the physical maintenance and improvements to the flood protection function of the seawall.

## 1.1 Existing Site and Facility Conditions

HDR performed a cursory (reconnaissance-level) site condition survey on February 11, 2016. The Seawall dining concession area consists of a small concrete block-wall restaurant, restrooms, and sun terrace (Figure 3) supported by a pile/column-supported concrete foundation. The foundation slab is approximately 4,800 square feet in area.



Figure 3 – Seawall Dining Concession and ADA Ramp

The condition survey included the building foundation from the top of the concrete floor slab down to the sand for the portions visible from the outside of the structure. The north row of piles/columns supporting the foundation slab is an extension of the breakwater to the seawall. Observations of the underside of the foundation slab were done from the edge of the slab; the space underneath the foundation between the sand and the slab was not accessed. An inspection of the building supported by the foundation slab was not within the scope of this condition survey. A concrete ADA ramp extends from the top of the seawall to the sand at McGee Beach and is newer than the building; this ramp was also not within the scope of this condition survey.

The foundation slab appears to be in good condition when observed from the top outside of the building. Few cracks were observed on the top of the slab. The top side of the slab was not sounded. The drainage grate and frame in the slab are severely corroded and there are cracks in the slab radiating from the grate frame (Figure 4). It appears that the grate drains water through the slab and into the sand. The City's historical record drawings show no piping from the drain. There is a lift station beneath the slab for the pumping of sewage. The hatch for the pump station was not opened and the pump station condition was not observed.



Figure 4 – Top View of Foundation Slab

Although at first glance the underside of the slab also appeared to be in good condition, there is at least one large area (approximated at 8 to 10 feet in diameter) of spalling concrete. The spalled concrete has not fallen from the slab, but is loose, and the edge of the spalled concrete appears to be hanging 2 or 3 inches from the slab (Figure 5).



Figure 5 – View of Underside of Slab

Viewed from the edge of the foundation, it was difficult to see if there were any other spalled areas. The underside of the slab was not sounded. Based on the portions of the foundation that were observed, it was estimated that approximately 30% of the overall underneath side of the slab may have areas that are spalling (not all of the slab was visible at the time of this survey).

The foundation slab to column/pile connection consists of a 4-inch thick by 3-foot square drop panel at the top of each pile/column (Figure 6).



Figure 6 – View of Column/Pile Connection Under Slab

Of those panels that were visible, no corrosion was observed. The tops of the column/piles that were visible appeared to be in good condition with the exception of one. The portion visible (top 2 feet) was observed to be in poor condition, exhibiting severe cracking (Figures 7 and 8).



Figure 7 – Column/Pile with Severe Cracking



Figure 8 –Column/Pile with Severe Cracking

A PVC water pipe under the slab was observed to have a leak at a 90 degree joint. Water was flowing from the leak and draining into the sand at the time of the site visit (Figure 9). It appeared that the line was for supply water. No apparent structural damage was observed associated with the leak.



Figure 9 – Water leaking from Pipe Under Slab

The foundation slab is connected to an elevated concrete cap that extends to the rock section of the breakwater. As previously observed during the 2009 survey, the cap structure shows signs of severe deterioration, including spalled concrete and exposed rebar, large cracks, damaged stairs and handrails (Figure 10).



Figure 10 – Damage along elevated cap extending to the rock breakwater. Also note the gap below the cap, which allows sand to be blown from McGee Beach into the marina.

In addition the lighting, lighting poles and electrical conduit is missing, as are sections of handrail and the previous fish-cleaning stand. Continued degradation of the concrete deck and foundation will eventually lead to more significant structural damage, creating a gap in the breakwater that would leave a portion of the seawall more susceptible to potential wave damage during severe storms. In addition, collapse of the cap could occur during a severe storm, causing structural debris to damage the seawall, marina, boats, and landward infrastructure.

As a secondary concern, the opening under the cap allows sand from McGee Beach to be blown into the marina. Loss of sand from McGee Beach increases exposure of the adjacent seawall (south of the breakwater) to wave impacts, increasing potential for undermining and/or damage during severe storms. In addition, loss of wind-blown sand under the cap increases the requirements for periodic renourishment of McGee Beach.

The rock breakwater extends northward from the elevated concrete cap and around the City marina. The breakwater is approximately 5,800 ft long, with the southern approximate 1,800 ft having a 4-ft wide concrete cap. Deterioration of the cap has progressed since the 2009 survey, with severe spalling, cracking, and rebar exposure over its entire length, and some sections of the cap completely missing (Figure 11). The handrails, lighting, and electrical conduit are gone, and the cap is frequently subjected to wave spray and overtopping.

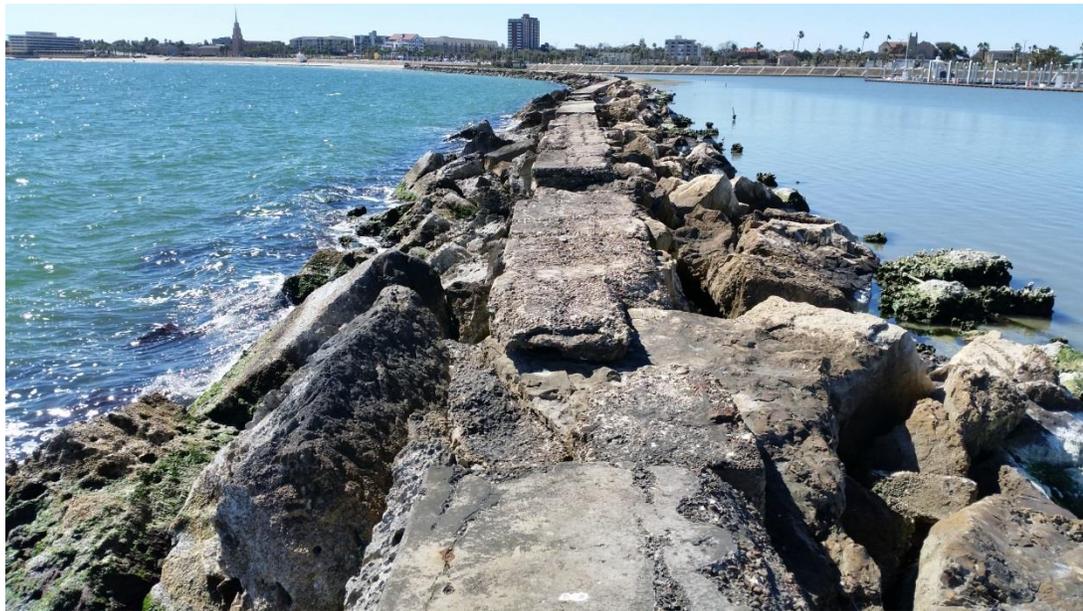


Figure 11 - Missing sections of concrete breakwater cap.

## 1.2 Proposed Improvement and Description

The proposed improvements consist of the following primary elements.

- **Building Foundation:** The bottom of the building foundation should be sounded to determine the limits of the deteriorated spalling concrete; these areas should be repaired.
- **Breakwater Extension:** The existing elevated cap is recommended to be demolished and replaced with a new rock breakwater and concrete cap.

- **Breakwater Cap:** The concrete cap along the existing rock breakwater is recommended to be repaired/replaced, and possibly raised.

These improvements will help fortify the seawall against wave attack by preventing failure of the breakwater and reducing erosion at McGee Beach. Figure 12 shows the locations of the proposed improvements.

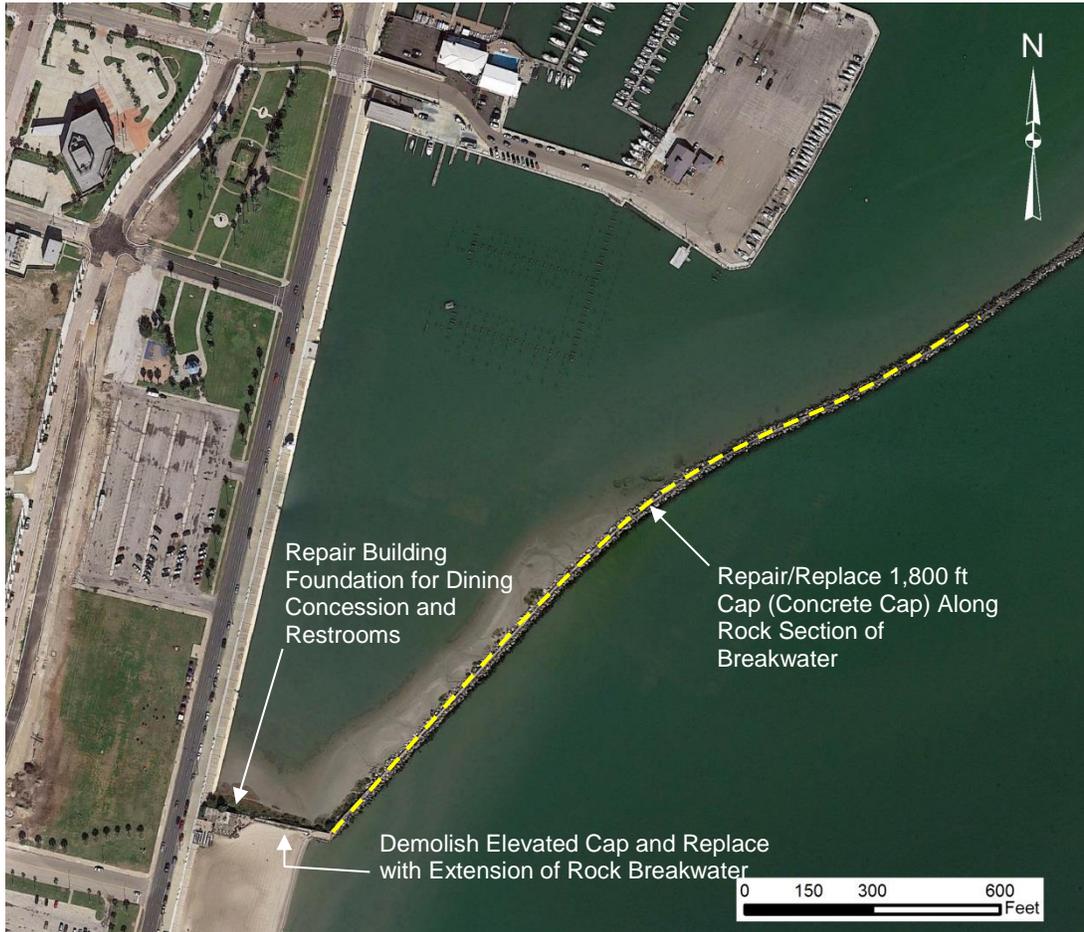


Figure 12 – Locations of Proposed Improvements

Detailed features of the proposed improvements consist of the following:

- **Building Foundation**
  - Repair the underside of the foundation slab by removing the deteriorated concrete and replacing with a corrosion resistant concrete patching material.
  - Remove deteriorated column/pile concrete top and replace with a corrosion resistant concrete patching material.
  - Replace concrete drainage grate. Further examine grate frame and, if required, remove by saw cutting the cracked concrete around the frame and replace the frame and concrete.
  - Provide a wall or other barrier along the foundation slab to lessen blowing sea air and sand from further deteriorating the underside of the foundation slab, and to

- help prevent uncontrolled/unauthorized access and associated vandalism under the foundation slab.
- Repair plumbing and electrical lines as required.
- Breakwater Extension
  - Demolish the elevated cap and concrete sheet pile from the damaged steps seaward of the building foundation to the existing rock breakwater.
  - Extend the existing rock breakwater approximately 200 ft landward to the building foundation.
  - Construct a 6-ft wide, 200-ft long concrete cap along the crest of the new breakwater.
  - Replace the steps between the breakwater and McGee Beach.
- Breakwater Cap
  - Repair/replace entire 1,800-ft concrete cap along existing rock breakwater.
  - All of the existing cap is recommended to be either partially or fully replaced. Broken sections of cap should be removed. Because it is recommended that the new cap be constructed higher and wider than the existing cap, the sound portions of the existing cap could possibly be left in place with the new sections cast over the existing sections. The viability of leaving sections of the existing cap in place depends on how soon the repairs are performed.
  - Construct/place rock ballast (smaller stones) to fill gaps between larger stone and provide a base for the new concrete cap.
  - Build new cap wider (assumed here to be 2 ft wider) and higher (assumed here to be 1 ft higher) than original. This would make the new cap approximately 6 ft wide.

### 1.3 Opinion of Probable Project Cost

Table 1 provides a conceptual level opinion of cost (cost) that was developed using conceptual level planning and estimating. As details of the project are developed and identified, more accurate costs can be established. The total project cost is estimated to be approximately \$3,706,000, with the cost for construction being approximately \$2,770,000. However, these costs can vary depending on items such as:

- Material availability and fluctuations in raw material, fuel and transportation costs.
- Construction schedules and working restraints.
- General conditions requested of the contractor / professional services by the owner.
- Economic climate at the time of bidding. Typically, when contractors are not busy, one can expect lower prices for construction projects.
- Existing conditions of the facility or location discovered during subsequent field investigations and/or more detailed engineering evaluations.



- Selected height of the concrete cap along the breakwater. For example, increasing the height of the cap from 12 inches (as assumed for the current cost estimate) to 18 inches would increase the cost by approximately \$50,000.
- Costs do not include lighting, handrails, fish-cleaning stations, or other amenities along the breakwater cap.

The costs stated above include a 25% contingency. It is recommended that contingencies not be deducted or reduced at this planning stage of the project. Key assumptions and clarifications of the cost opinion include:

1. The entire breakwater cap will need to be replaced.
2. Dining concession and restroom building does not have to be demolished.
3. Quantity take-offs based on limited available data. Accurate topographic and bathymetric data may result in substantial quantity changes.
4. Americans with Disabilities Act (ADA) compliance can be difficult to obtain for marine structures. Based on communication with the City, it is understood that the breakwater cap would not be designed as a pedestrian access feature and that ADA compliance would not be required. Limited contingency is included for design and construction of any other improvements necessary to comply with ADA standards.



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QA/QC By: M Kreiber  
Date: 5/3/2016

**TABLE 1: OPINION OF PROBABLE PROJECT COST  
McGee Beach Breakwater Improvements (E15219)**

Item Description	Quantity		Unit Cost	Minor Work Item Subtotals	Major Work Item Subtotals	Extended Total
	QTY	Unit				
<b>Item No. 1 - Mobilization/Demobilization</b>						<b>\$120,000</b>
Mobilization	1	LS	\$70,000	\$70,000	\$70,000	
Demobilization	1	LS	\$50,000	\$50,000	\$50,000	
<b>Item No. 2 - Breakwater Extension (Replace Elevated Walkway)</b>						<b>\$564,000</b>
<b>Component Description</b>					<b>\$564,000</b>	
Demolish Elevated Walkway	1	LS	\$115,000	\$115,000		
Foundation Preparation	1	LS	\$12,000	\$12,000		
Geotextile Fabric	900	SY	\$7	\$6,300		
Graded Riprap	1,700	TON	\$170	\$289,000		
Place Stone to Fill Armor Stone Voids Under Cap	200	LF	\$240	\$48,000		
Breakwater Cap	200	LF	\$425	\$85,000		
Concrete Transition	1	LS	\$9,000	\$9,000		
<b>Item No. 3 - Improve/Replace Concrete Cap Along Existing Breakwater</b>						<b>\$1,260,000</b>
<b>Component Description</b>					<b>\$1,260,000</b>	
Demolish Unsalvageable Cap	1,800	LF	\$75	\$135,000		
Construct New Breakwater Cap	1,800	LF	\$425	\$765,000		
Place Stone to Fill Voids Under New Cap	1,800	LF	\$200	\$360,000		
<b>Component Description</b>					<b>\$0</b>	
Electrical Line/Lighting Breakwater Cap (omitted)	0	LF	\$35	\$0		
Trash receptacles, signage, etc (omitted)	0	LS	\$25,000	\$0		
<b>Item No. 4 - Repair Building Foundation</b>						<b>\$272,000</b>
<b>Component Description</b>					<b>\$272,000</b>	
Building Demo (as required)	1	LS	\$50,000	\$50,000		
Repair Underside of Foundation Slab	1,440	SF	\$150	\$216,000		
Repair Pile/Column	10	LF	\$600	\$6,000		
<b>SUBTOTAL (Work Items):</b>						<b>\$2,216,000</b>
<b>25% Project Contingency:</b>						<b>\$554,000</b>
<b>SUBTOTAL (Work Items Plus Contingency):</b>						<b>\$2,770,000</b>
<b>Other Project Related Costs</b>						<b>\$936,000</b>
Surveys	1	LS	\$20,000	NA	\$20,000	
Geotechnical Investigation	NA	5.0%	NA	NA	\$139,000	
Engineering	NA	12.0%	NA	NA	\$332,000	
Permitting	NA	5.0%	NA	NA	\$139,000	
Construction Administration	NA	5.0%	NA	NA	\$139,000	
Materials Testing	NA	1.0%	NA	NA	\$28,000	
Engineering Services (City of CC)	NA	3.5%	NA	NA	\$97,000	
Bond Issuance (City of CC)	NA	1.0%	NA	NA	\$28,000	
Miscellaneous (Printing, Advertising, Etc.)	NA	0.5%	NA	NA	\$14,000	
<b>PROJECT GRAND TOTAL:</b>						<b>\$3,706,000</b>

**Notes and Assumptions:**

- Opinion of probable project cost (OPPC) is based on HDR's understanding of current labor and material costs and reasonable estimates of construction activity duration. Costs shown are based on 2016 pricing without consideration for future cost escalation.
- ADA compliance is not planned for breakwater cap.
- Cost for new breakwater cap is based on 6 ft wide by 12 inches thick concrete cap along breakwater. It was assumed that 100% (1,800 LF) of cap will be replaced.
- Cap and breakwater volumes based on limited field data. Detailed survey will be required during detailed design.
- Cost based on assumption that concession building will be demolished down to the foundation slab and that the foundation slab will require some repair. Rigorous structural investigation should be performed during detailed design.
- Connection from the breakwater extension to the concession area will include concrete transition.
- Breakwater cap will consist of small stone (approx 3 to 12 in dia) to reduce voids between armor stone, 3000 psi concrete filler with RC placed for the cap.
- Lengths are approximate based on aerial photo and limited ground measurements.
- Construction methods may employ an optional floatation channel at the Contractor's preference. Regulatory coordination is required to determine feasibility of floatation channel.
- Cost for improved breakwater cap based on \$1,500/CY concrete.
- It is assumed that existing soils are not contaminated. Material testing during the design phase will determine the suitability of the soil to be used as backfill.



## 1.4 Opinion of Project Schedule

An opinion of project schedule was developed using conceptual level planning and is provided to illustrate only the anticipated duration of the project from a start date which has not yet been determined. As details of the project are developed and identified, a more accurate schedule can be established. The duration of the project schedule is estimated to be approximately 16 months. However, this schedule can vary depending on items including, but not limited to:

- Material availability at the time of construction
- Contractor and equipment backlog and availability
- Weather conditions
- Construction schedules and working restraints
- General conditions requested of the contractor / professional services by the owner.

## 1.5 Key Project Considerations

The following key considerations were taken into account during this conceptual level study which will need to be addressed as the project develops:

- The building foundation supporting the restrooms and restaurant concession building does not have to be demolished.
- Limited topographic/bathymetric data were available for developing the project concept. Obtaining and analysis of more detailed site data may result in different requirements for the project.
- The envisioned breakwater cap would be 6 ft wide and 12 ft high. The cap would be constructed over the existing cap where possible. More rigorous assessment may result in different dimensional requirements and/or identification of additional necessary work.
- An opportunity to improve water quality within the marina may be created by this project. Water quality may be improved by installing culverts through the breakwater and/or improving existing water exchange. Water quality improvement opportunities should be investigated during preliminary design.

In addition, the following are key considerations which will need to be addressed as the project develops:

- The length of the cap (1,800 ft) in this proposed layout matches that of the existing cap. Depending on available funding, a longer or shorter cap may be opted for.
- If the project proceeds to detailed design, the effects of breakwater settlement, land subsidence, and sea level rise over the long-term life of the breakwater improvements should be carefully considered. These considerations should be applied with detailed wave calculations to assess wave runup, overtopping, and transmission for different breakwater crest, water level, and wind scenarios. In addition, the higher the cap projects above the rock, the greater the wave loads will be on the cap, so structural design of the cap will need to consider these wave loads.

- Note that assessment of the existing concession building and restrooms was beyond the scope of the current effort. Although the existing building foundation appears to be relatively sound (with recommended repairs as described above), a structural assessment of the concession building and restrooms should be conducted if the City desires to explore options for replacing and/or repurposing these existing facilities.

The overall breakwater system, for the purposes of this analysis, was primarily considered for its ability to provide increased storm damage protection to the seawall. This structure has obvious recreational benefits as well. Amenities can be added or modified to tailor the structure to the City's needs.

## 1.6 Seawall Enhancement Explanation

In this study, improvements to the seawall and flood protection system have been limited to structural strengthening or enhancements which provide additional protection to individual components of the flood protection system. This project will enhance the flood protection function of the seawall by:

1. Maintaining components of the breakwater and elevated approach cap that, if otherwise left to continue deteriorating, may result in more significant structural damage and potential failure during a severe storm. Such structural failure would essentially create a gap in the breakwater, resulting in greater exposure of the seawall to storm damage.
2. Sealing the opening under the elevated approach cap to reduce wind-blown sand transport from McGee Beach into the marina. Loss of sand at McGee Beach increases exposure of the southern portion of the seawall to undermining and wave impacts during severe storms.
3. Raising the existing breakwater crest by approximately 1 ft over the length of the cap may help improve wave attenuation during storm surges. Increasing the breakwater's ability to attenuate waves would reduce wave impacts to the seawall.