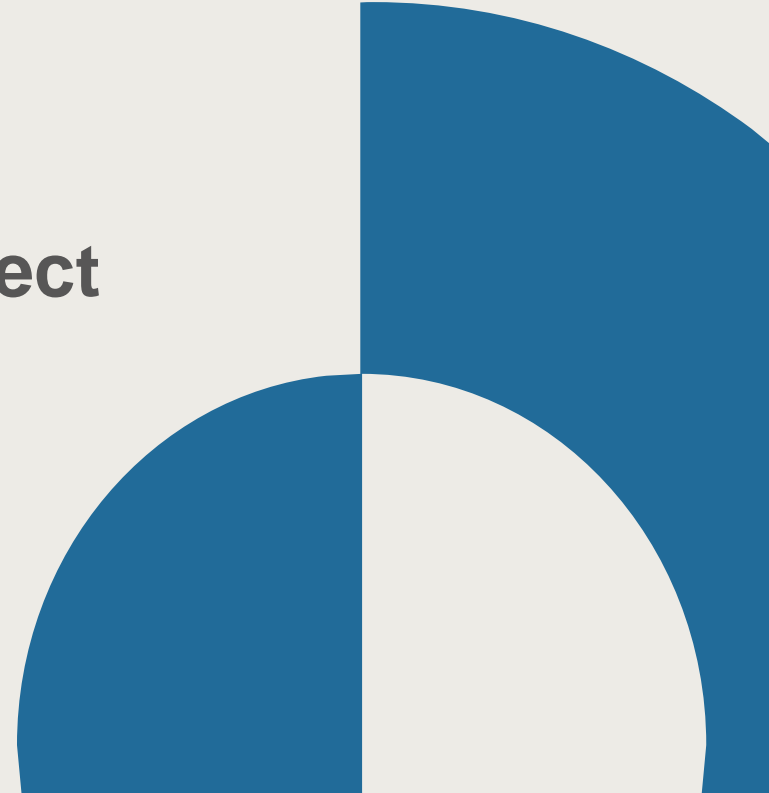




Point Hudson

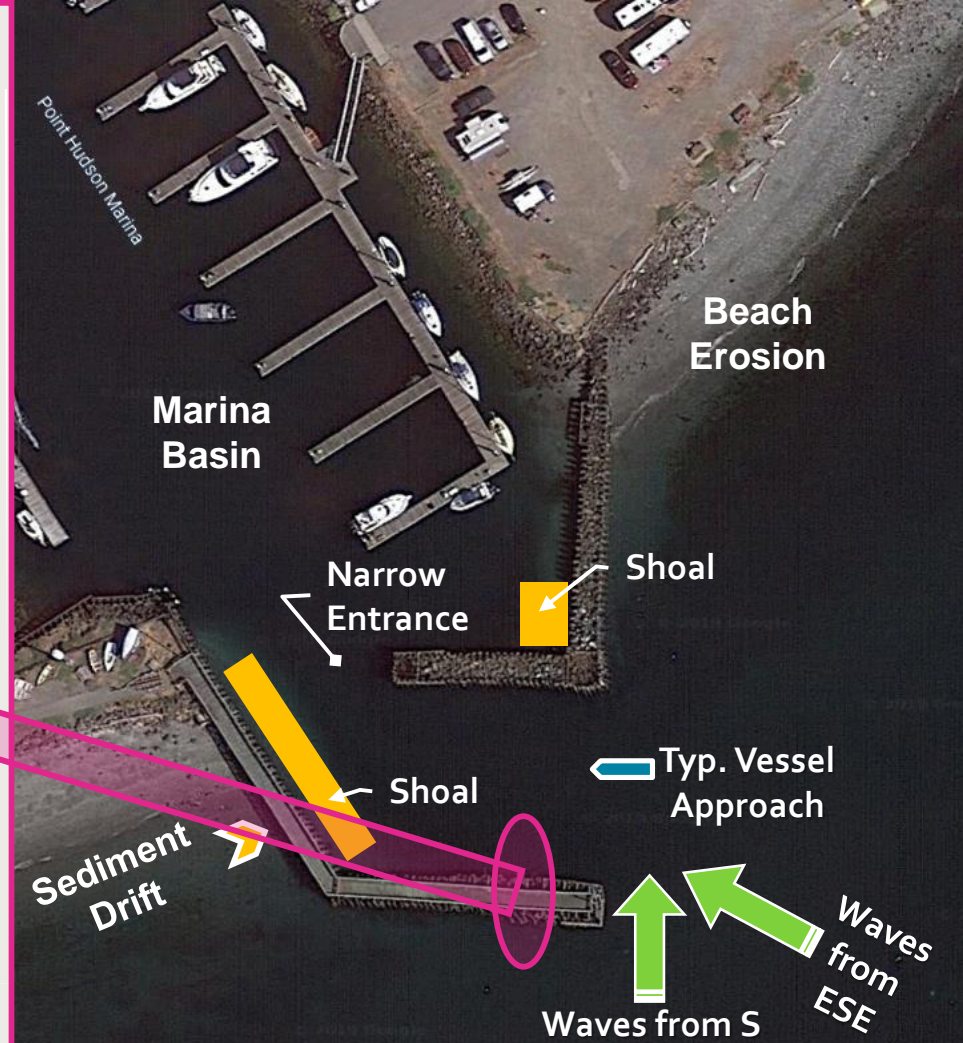
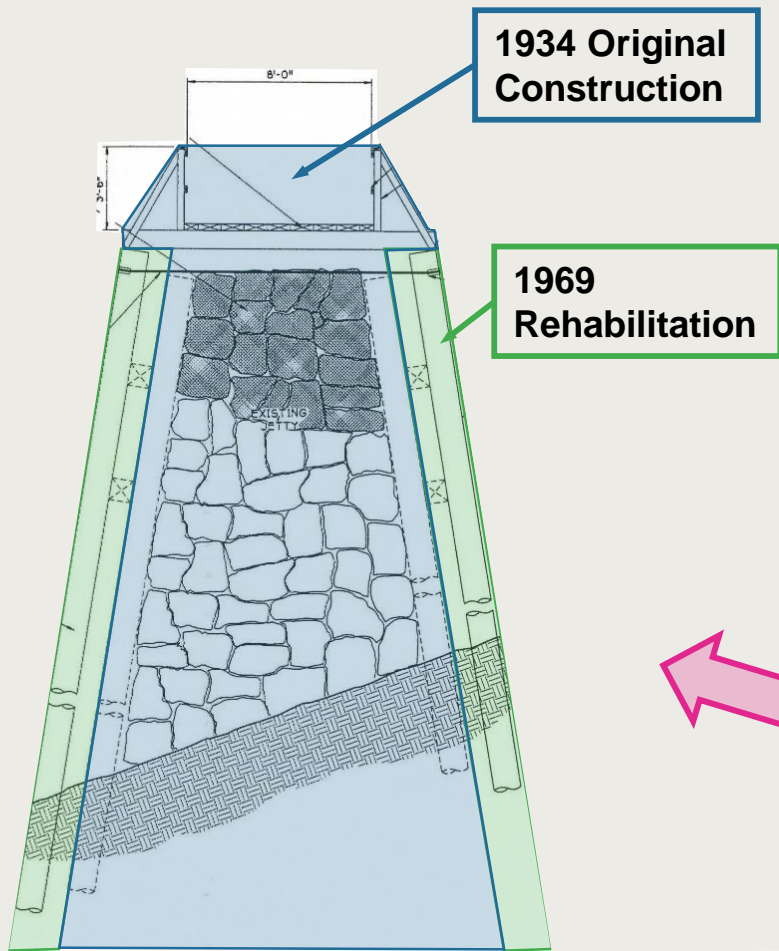
Breakwater Improvement Project

Selected Alternative
Feb 12th, 2020





Introduction & Assessment

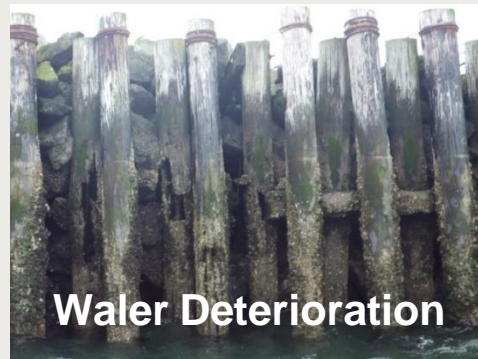


Introduction

Existing Condition

Timber piles, walers, cable tiebacks, and armor rock are at or beyond useful life. Stability of the overall structural system is compromised.

- The most advanced structural deterioration was observed at the end of the south breakwater.
- Voids in the riprap reduce the system's wave protection capability.





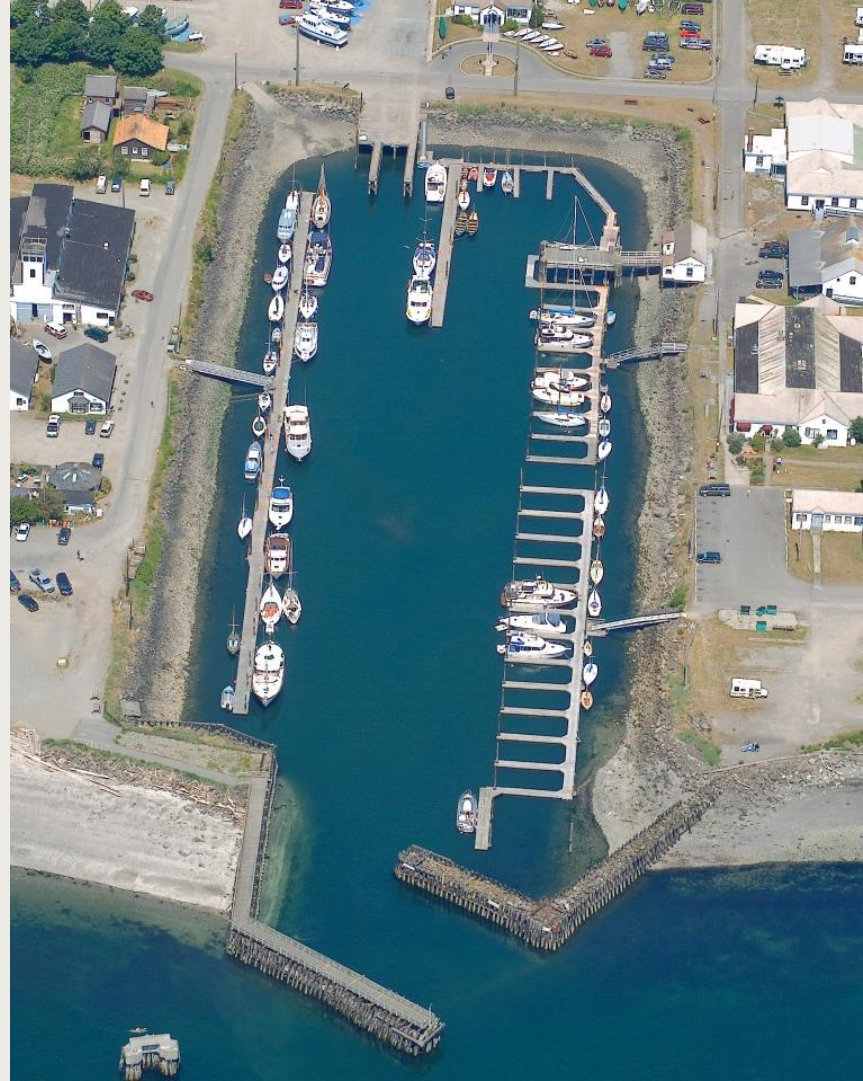
Design Objectives & Alternatives

Design Objectives

Overview

The guiding objectives are to provide a breakwater rehabilitation/replacement design that:

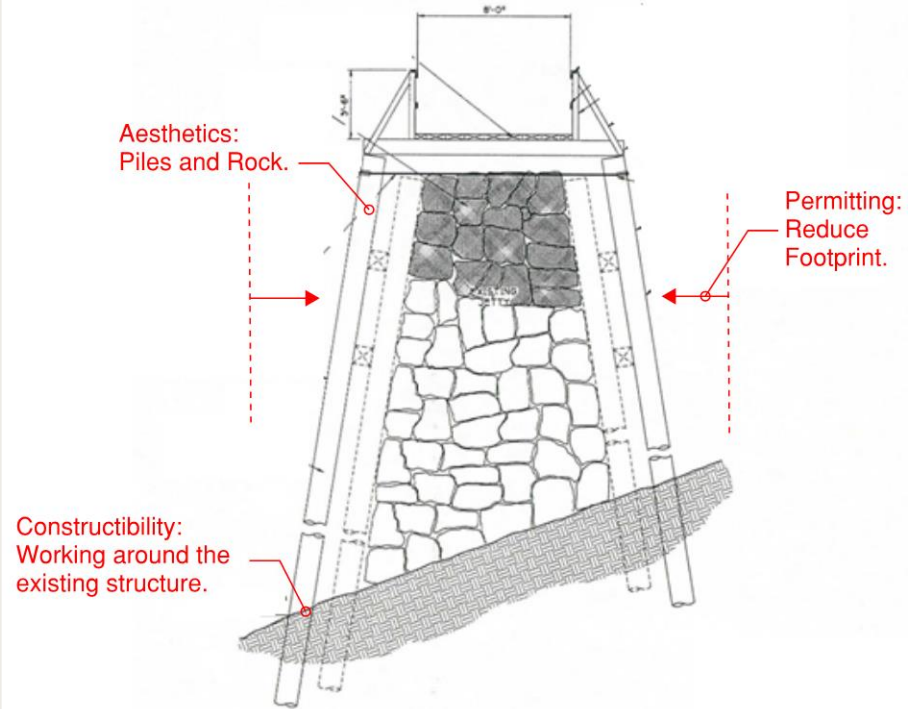
- Provides wave protection for the Point Hudson Marina for a minimum design life of 30 years.
- Responds to community concerns to maintain the aesthetic of the existing breakwater.
- Can be permitted, constructed and maintained.



Design Objectives

Considerations

- **Engineering.** Protect the existing marina and the Port operations against wind waves and vessel waves for at least the next 30 years. Considers navigation channel impacts.
- **Aesthetics.** Similar in appearance to the existing breakwater (rocks and piles) using modern materials.
- **Permitting.** Remove creosote and reduce footprint of the breakwater to minimize offsite mitigation requirements.
- **Constructability.** Minimize risks to the Port from potential cost overruns, delays, errors, and obstacles during construction.
- **Cost.** Cost efficient design that minimizes capital and maintenance costs.

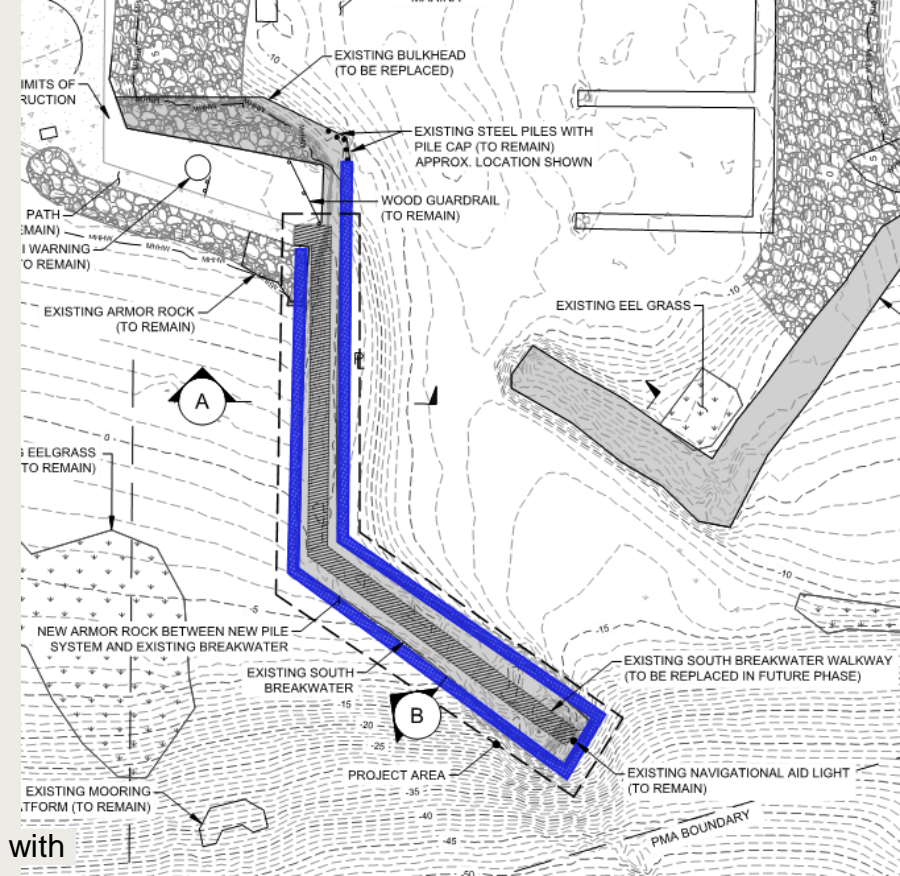
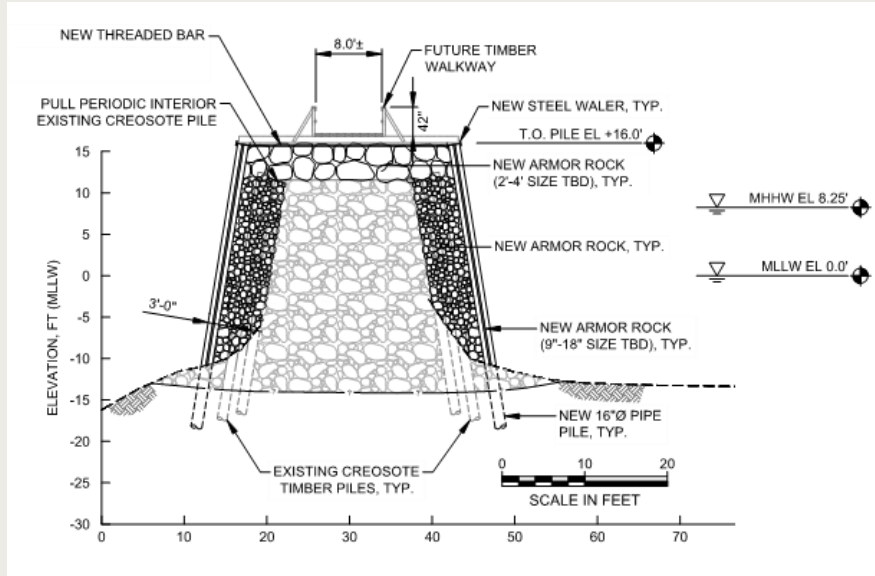


Alternatives Considered

- **Alternative 1.** Full Length Encapsulation. Entire length of the existing south breakwater leg is encapsulated with new piles, rock, and lagging.
- **Alternative 2.** Partial Replacement with Encapsulation. Partial length of the existing south breakwater leg removed and reconstructed and the remaining is encapsulated with new piles, rock, and lagging.
- **Alternative 3.** Full Replacement. Entire length of the existing south breakwater leg is removed and reconstructed with new piles, rock, and lagging.

Alternative 1

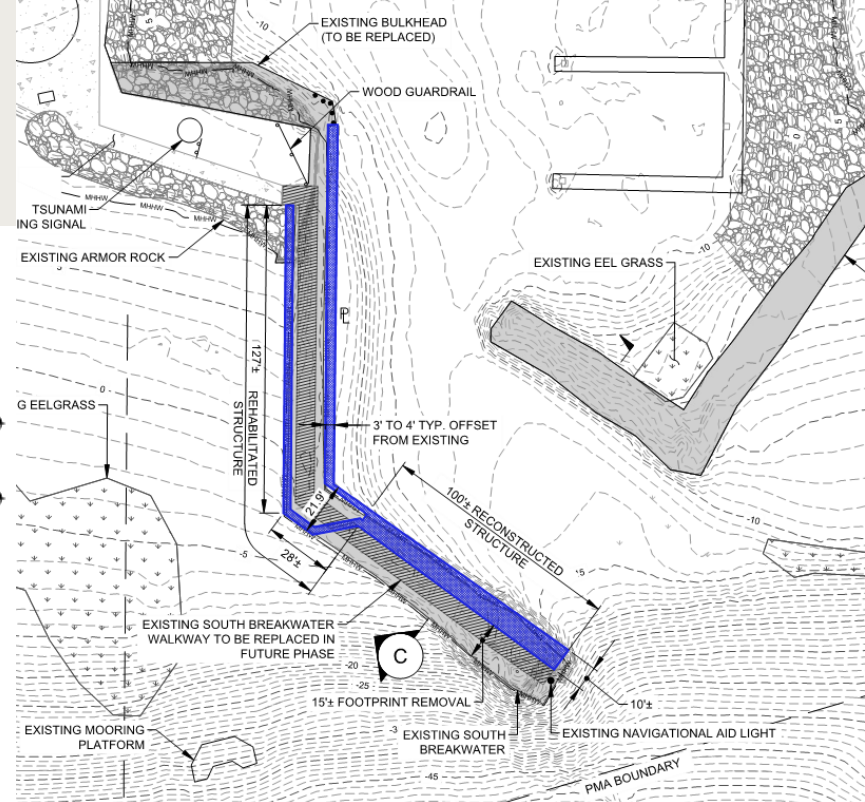
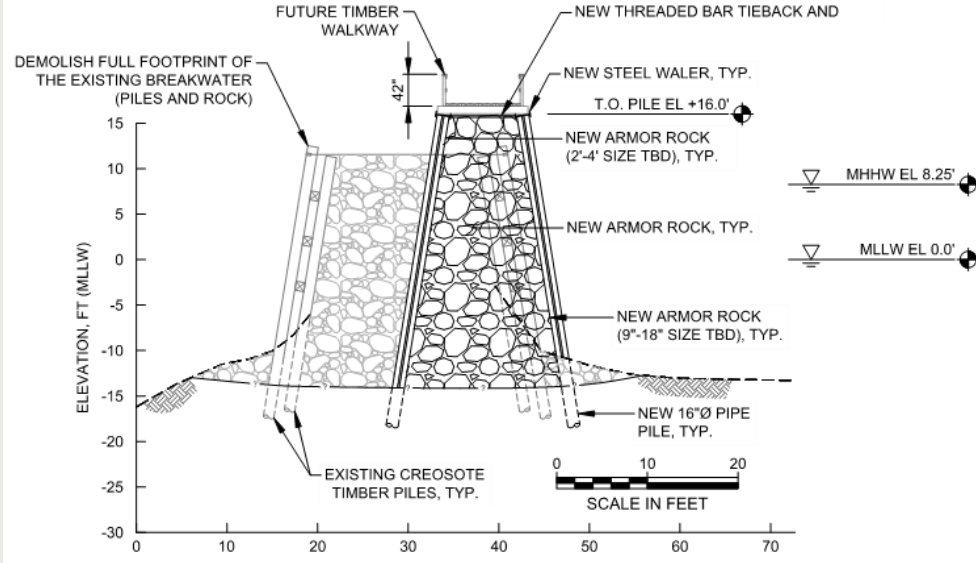
Full Length Encapsulation



- Entire length of the existing south breakwater leg is encapsulated with new piles, rock, and lagging.
- Large expansion of footprint.
- Offsite mitigation needed for expansion of area and remaining creosote.
- Narrows navigation channel width.

Alternative 2

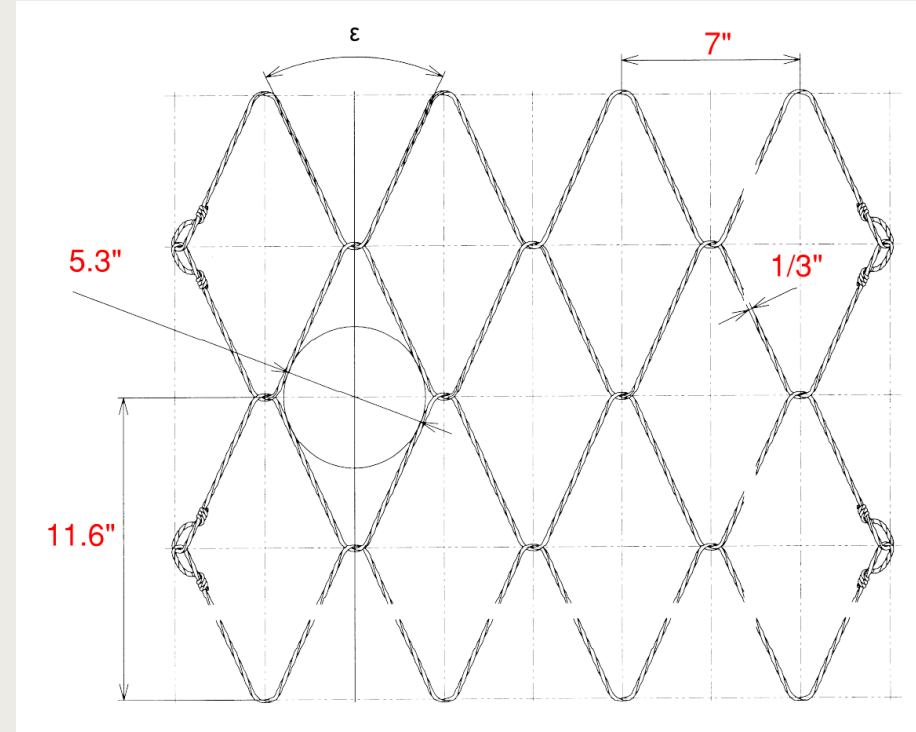
Partial Replacement with Encapsulation



- Partial length of the existing south breakwater leg removed and reconstructed and the remaining is encapsulated with new piles, rock, and lagging.
- Overall structure footprint is maintained, some creosote remains.
- Potentially self mitigating for area.
- Narrows navigation channel width.

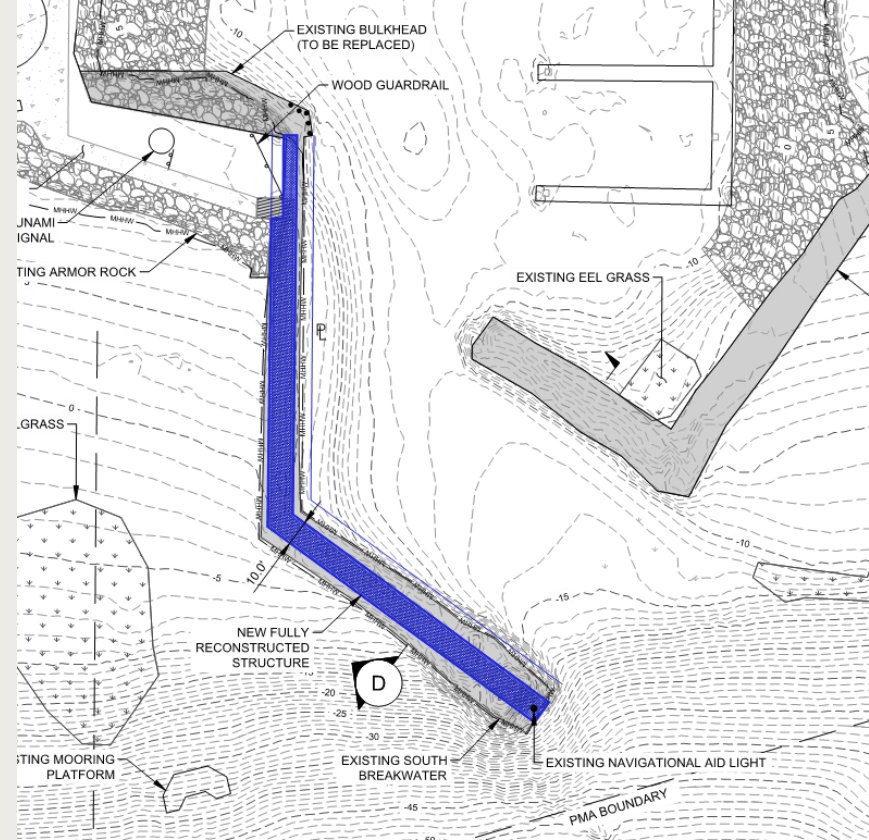
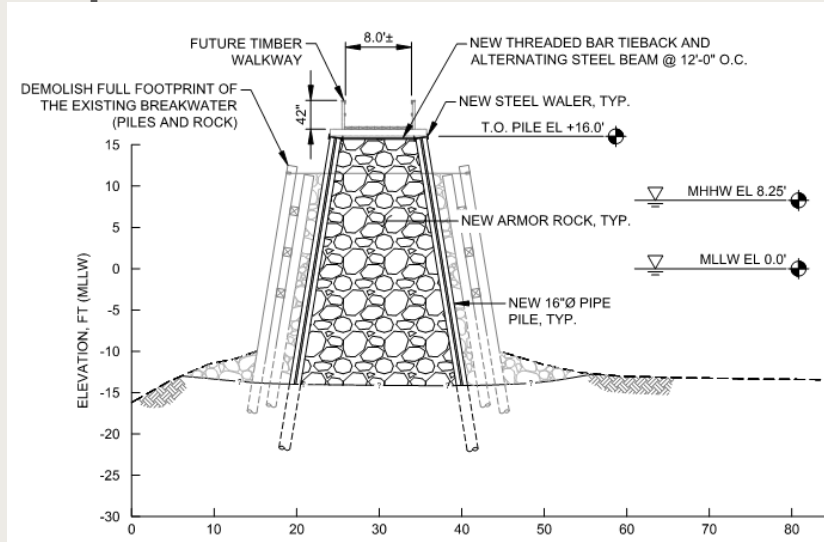
Mesh Lagging System for Encapsulation – Alternative 1 and 2

- Mesh would help retain rock between new piles.
- Mesh would be marine grade stainless steel.
- Would not be used for the reconstruction option.



Alternative 3

Full Replacement



- Entire length of the existing south breakwater leg is removed and reconstructed with new piles, rock, and lagging.
- Reduction in footprint, removal of creosote, reduction in environmental impacts.
- Self mitigating for area and creosote.
- Widens navigation channel.

Design Alternatives

Evaluation

- Several Alternatives were considered and evaluated using the design objectives and then presented to the stakeholders.

Category	Alternative 1	Alternative 2	Alternative 3
Description	<ul style="list-style-type: none">Existing structure remains and is encapsulated.	<ul style="list-style-type: none">Partial reconstruction and encapsulation.	<ul style="list-style-type: none">The entire leg to be reconstructed in a smaller footprint.
Engineering and Performance	<ul style="list-style-type: none">Challenging to design and construct around the existing structure.Reduced navigation.	<ul style="list-style-type: none">Most complex and challenging. Additional maintenance.Partially reduced navigation	<ul style="list-style-type: none">Built from ground up with most control of end product.Improved navigation
Constructability	<ul style="list-style-type: none">Difficult to install new piles and rock around existing structure, risks of slow downs and issues.	<ul style="list-style-type: none">Very challenging and risky to demolish only part of the structure.	<ul style="list-style-type: none">Lowest risk but still challenging.
Permitting	<ul style="list-style-type: none">Most challenging, requiring mitigation.	<ul style="list-style-type: none">Would likely require some mitigation.	<ul style="list-style-type: none">Seeks to be self mitigating.

- After review of the different alternatives, stakeholders selected Alternative 3 as their preferred alternative with some additional input.



Selected Breakwater Design

Breakwater Design

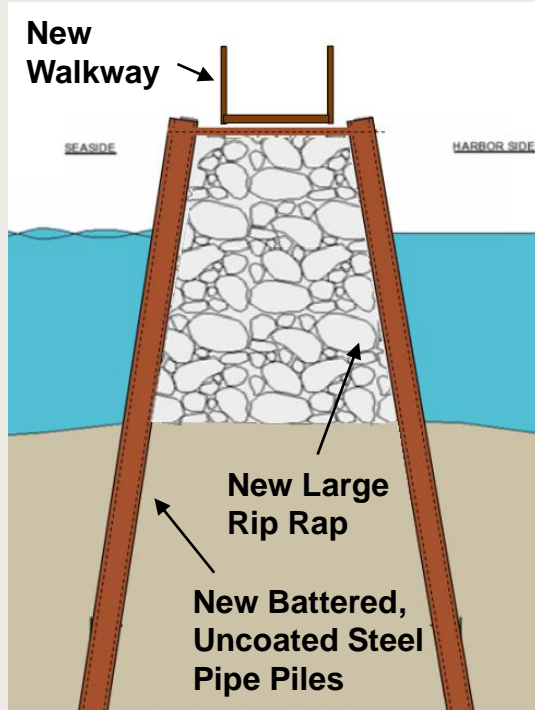
Stakeholder Input

In addition to selecting Alternative 3 as the preferred design, the stakeholders presented the following suggestions and guidance:

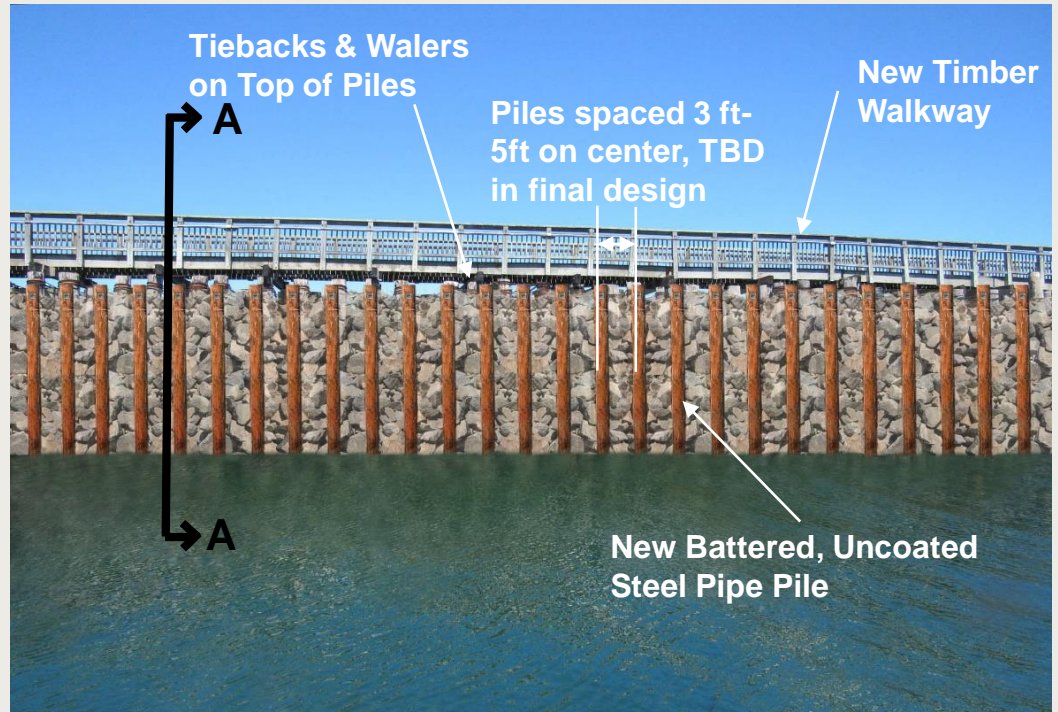
Category	Alternative 3
Pile	<ul style="list-style-type: none">• Piles should be closely spaced, similar to the existing• Piles should be uncoated steel pipe piles with sacrificial corrosion thickness, no composite piles• Piles should be battered to match existing aesthetics• Piles should be supported with tie rod cross-ties and potential walers
Breakwater Core	<ul style="list-style-type: none">• Large high quality riprap (granite)• No mesh for rock containment
Walkway	<ul style="list-style-type: none">• Design and system should allow for installation of walkway on top of the south breakwater• End of walkway waterside should incorporate a wider turnaround and look out area
Permitting	<ul style="list-style-type: none">• North and south breakwaters should be designed and permitted together

Breakwater Design

Selected Cross-Section and Elevation



Section A - A



Elevation View

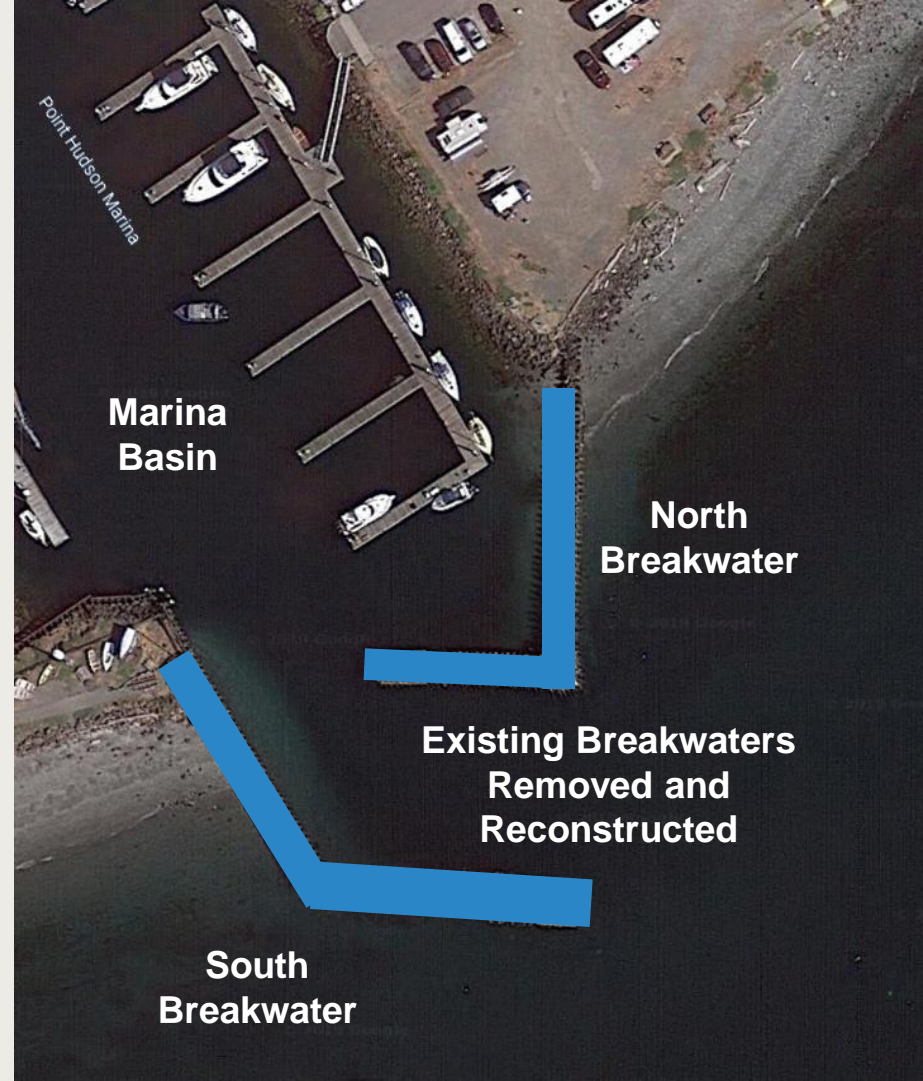


Phasing, Cost, Challenges and Next Steps

Phasing and Cost

North and South Breakwaters

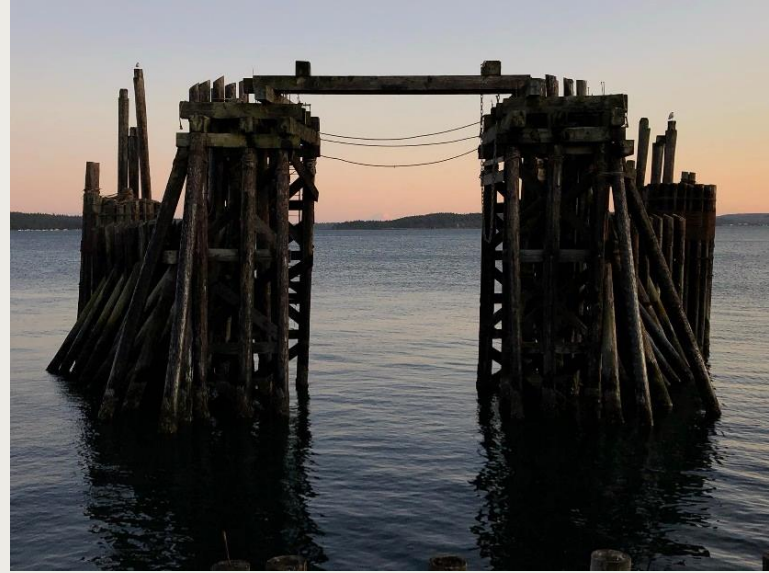
- **Condition.** North breakwater in slightly better condition than the south. Therefore, replacement of the south breakwater should occur before the north breakwater.
- **Construction Schedule.** South breakwater replacement anticipated in winter of 2021 (dependent on permitting). North breakwater to be replaced in a subsequent phase.
- **Demolition.** Demolish both structures and remove all existing timber piles and rock down to the mudline.
- **Footprint.** The new breakwater constructed within similar footprint and alignment as the original.
- **Walkway.** Walkway to be added on top of south breakwater.
- **Replacement Cost.** \$5.5M to \$6.5M (South), TBD (North). Replacement cost of north breakwater will be slightly less than the south, but depends on timing and inflation.



Upcoming Challenges

Considerations

- **Permitting.** Changing and ever more challenging permit climate is difficult to predict. May impact schedule, design and associated construction costs.
- **Environmental Impact Mitigation.** Upon permit review, agencies may still require some mitigation. Mitigation options include using plumb piles vs. batter, reducing breakwater footprint further, and/or incorporating the Quincy St. Dock creosote pile removal.
- **Replacement Design.** Replacement structure is very unique and complex to analyze and design especially with a smaller footprint. Will take time to evaluate and finalize methods and procedures for coastal analysis and design. Results have direct impacts to cost, constructability and permitability.



Quincy St. Dock

Next Steps

- **Design Refinement**
 - Permitting Outreach
 - Coastal Assessment of new design
 - Refined breakwater sizing
 - Architectural considerations
 - Constructability Review
- **60% Design / Permitting**
 - Coastal and Structural Analysis and Design
 - Architectural Design
 - Finalize Permit Drawings
- **Final Design and Bid Documents**

Questions?

