Jefferson County Marine Resources Committee

County: Jefferson
Grant No: G1000023

PROJECT TITLE: Northwest Straits Project: Marine Resources Committee Administration & Action Project

PROGRESS REPORT: [] FINAL REPORT [✓]

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DATE SUBMITTED: June 15, 2011

Attachments: Task 5 Deliverables – Fort Worden State Park Marine Science Center Pier & Boat Ramp Facilities – Preliminary Level Coastal Processes Assessment

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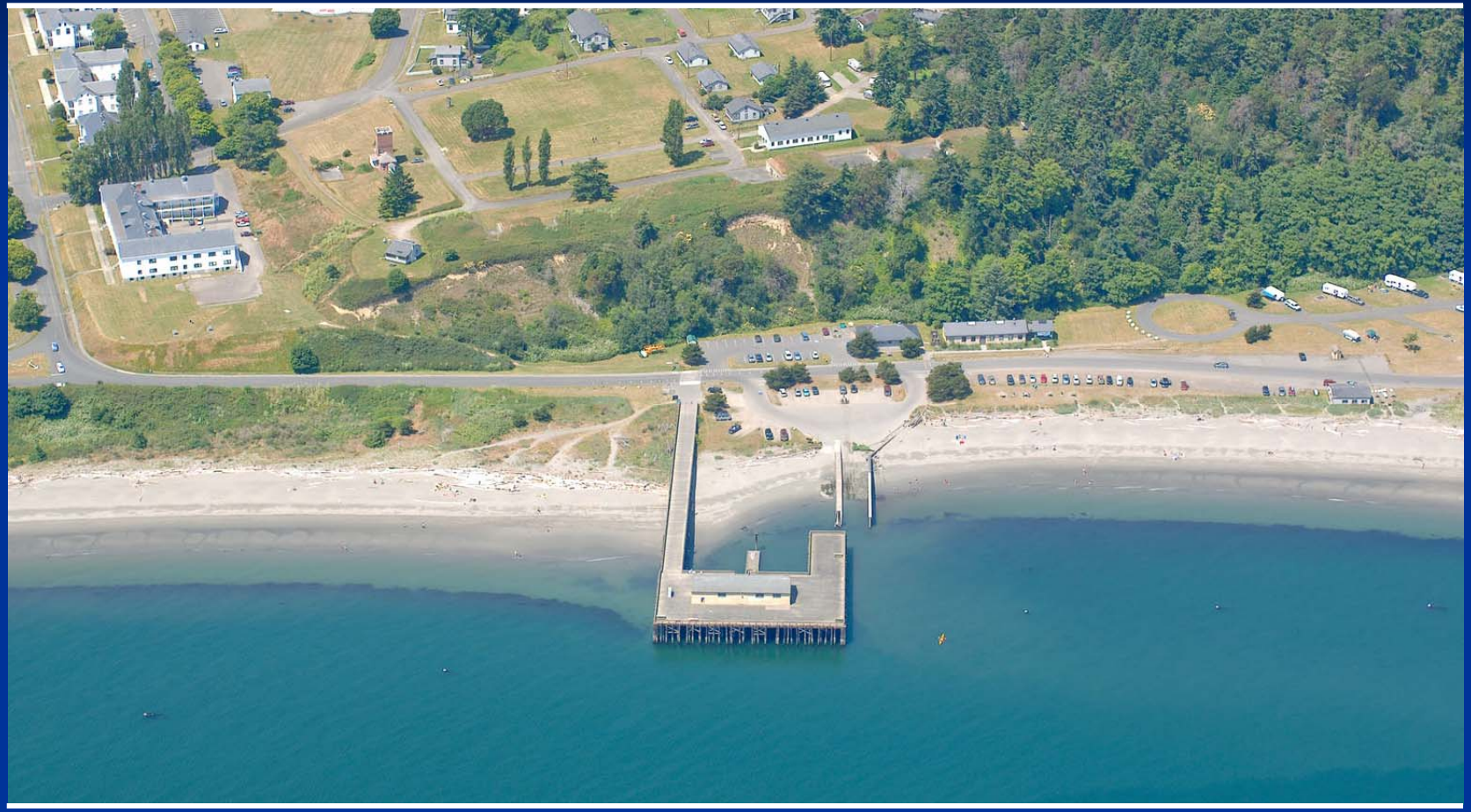
The views expressed herein are those of the author(s) and do not necessarily reflect the views of NOAA or any of its sub-agencies.

Jefferson County
Marine Resources Committee

FORT WORDEN STATE PARK

Marine Science Center Pier & Boat Ramp Facilities



Preliminary Level Coastal Processes Assessment

COAST & HARBOR ENGINEERING

June 15, 2011

Table of Contents

Objectives

- Overview
  - Develop additional understanding of project site conditions and conduct more detailed evaluation using more comprehensive data set and results from 2009 pre-feasibility assessment work.
- Evaluate Physical Processes
  - Evaluate nearshore beach and coastal processes as they relate to sediment transport, existing pier structure and boat ramp structure
- Identify Restoration Opportunities
  - Evaluate restoration opportunities relative to physical processes
- Develop Potential Improvement Alternatives
  - Restore nearshore beach processes
  - Improve existing boating facility
- Biological benefits and functions not considered in this study

Timeline of Site Development

1879 - Original Pt. Wilson lighthouse

1900 - Original rail wharf built*

1904 - Shoreline armoring at Pt. Wilson*

1914 - Current lighthouse

1943 - Existing dock constructed*

1950 - Removal of old wharfs*

1973 - Boat ramp and float constructed

1998 - Boat ramp repairs

2011 - Current Study

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*Dates are approximate and suitable for long-term shoreline change analysis

Data Summary

- Detailed compilation of historical data
  - WA Parks, Fort Worden Museum, Public Archives
- Historical Charts & Maps
- Bathymetric and topographic surveys
- Engineering drawings and plans
- Aerial photographs
- Ground level and oblique photos
- Site observations
- Discussions with locals and Parks staff
- CHE wave model database
- Other nearby studies

SITE PHOTOGRAPHS

Historical Ground Level Photographs

Circa 1910

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Recent Ground Level Photographs

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Recent Ground Level Photographs

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View of pier & dock from the south

Recent Ground Level Photographs

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Along south side of pier, facing east

Recent Ground Level Photographs

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Beneath pier facing east

Recent Ground Level Photographs

From pier facing north

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Recent Ground Level Photographs

From pier facing south

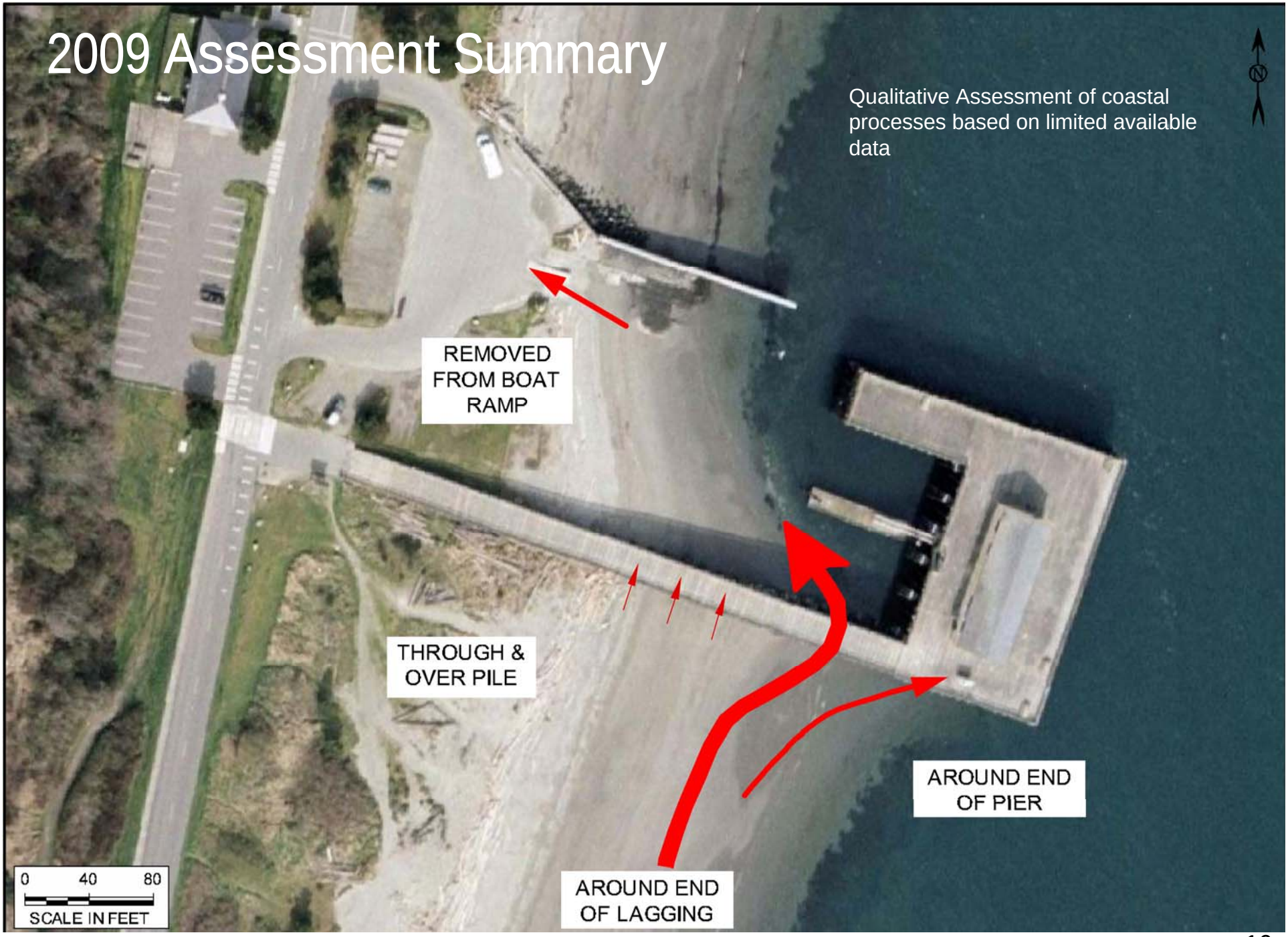
Recent Ground Level Photographs

From ramp facing east

From dock facing west

PREVIOUS PHASE WORK SUMMARY

2009 Assessment Summary



SHORELINE CHANGE ANALYSIS

Shoreline Analysis Approach

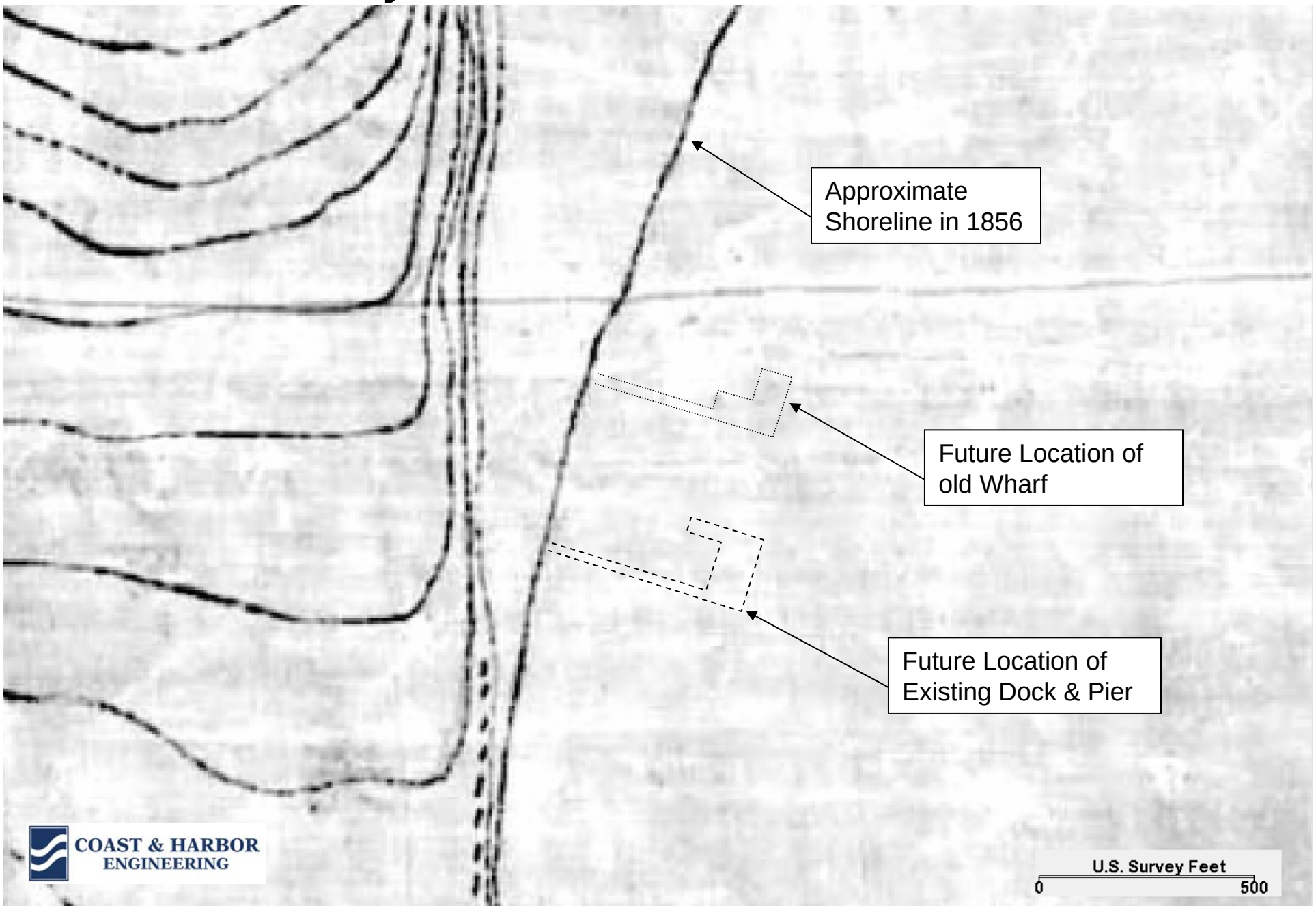
- Shoreline position was evaluated to infer long term geomorphic trends and short term adjustment of shoreline to alterations
- Compiled an historic spatial database and georeferenced more than 30 images/maps.
- Mapped shoreline using debris lines and other visual signals as possible near the high tide line of the beach
- Shoreline positions are approximate and useful for visualizing long term and large scale trends only
- Some images and maps could not be precisely scaled or referenced due to low quality images, lack of reference points, and scale distortions.

Aerial, Chart, Map & Survey Database

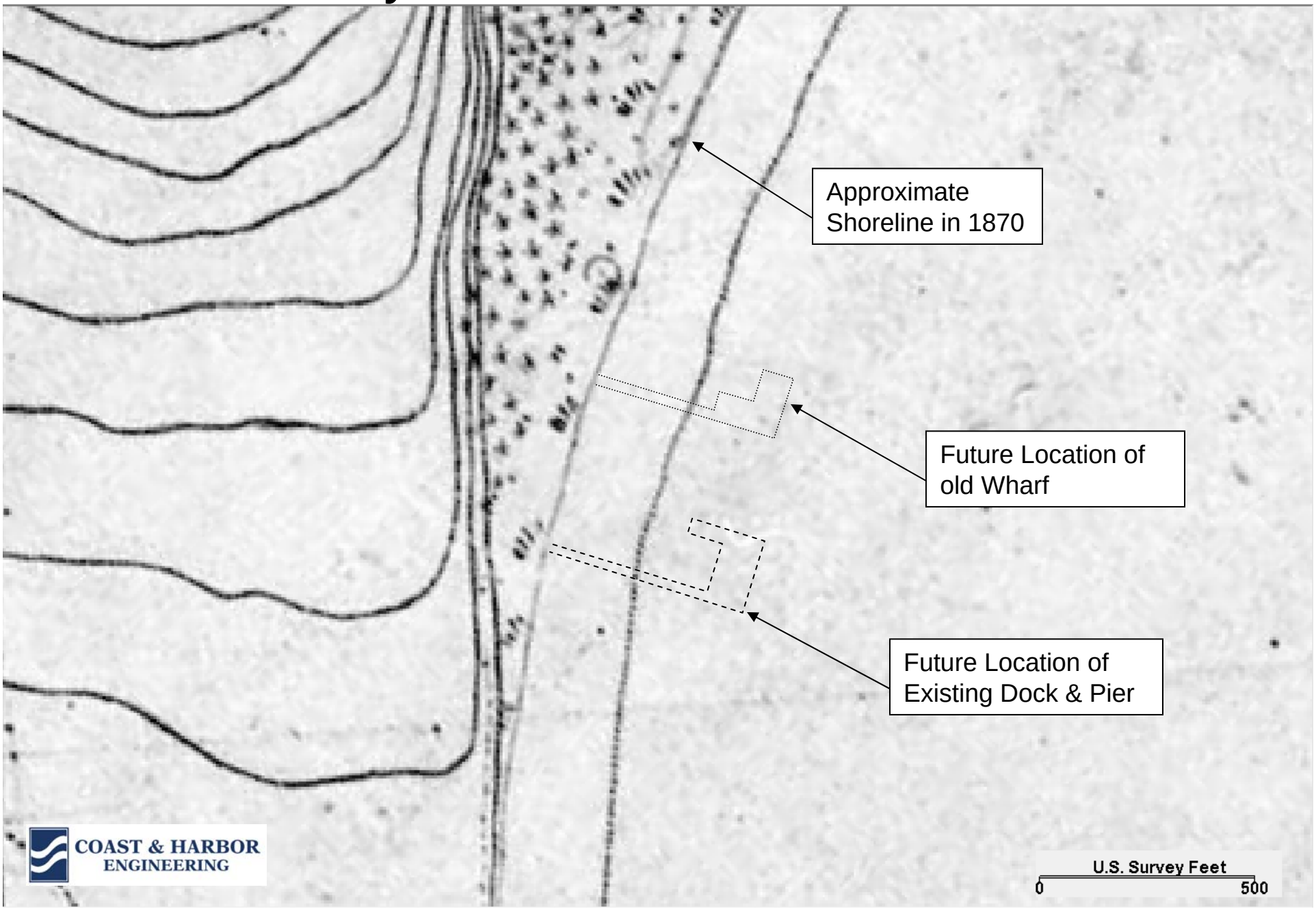
	Type			Coverage	
Description	Topography	Bathymetry	Shoreline	Pt. Wilson	Site
1854 US Navy Chart		✓	✓	✓	✓
1856 USCGS T-Sheet			✓	✓	✓
1870 USCGS T-Sheet			✓	✓	✓
1883 US Navy Chart		✓		✓	✓
1908 US Army Map	✓	✓	✓	✓	✓
1933 US Army Map	✓			✓	✓
1935 Engr. Drawing			✓		✓
1940 Aerial Photo			✓	✓	✓
1942 Aerial Photo			✓	✓	✓
1943 Aerial Photo			✓		
1943 Navy Survey		✓		✓	✓
1951 Land Use Map		✓		✓	✓
1957 Aerial Photo			✓	✓	✓
1965 Aerial Photo			✓		✓
1973 Engr. Drawing	✓		✓		✓
1977 Aerial Photo			✓		✓
1985 Aerial Photo			✓		✓
1997 Aerial Photo			✓	✓	✓
1998 State Parks Engr. Drawing	✓	✓	✓		✓
2002 NOAA Multibeam Survey		✓		✓	✓
2002 LiDAR Survey	✓			✓	✓
2005 Aerial Photo			✓		✓
2006 Aerial Photo			✓		✓
2008 Master Plan	✓		✓	✓	✓
2009 Aerial Photo			✓	✓	✓
2011 Recon. Survey		✓			✓

Shoreline Analysis - 2009

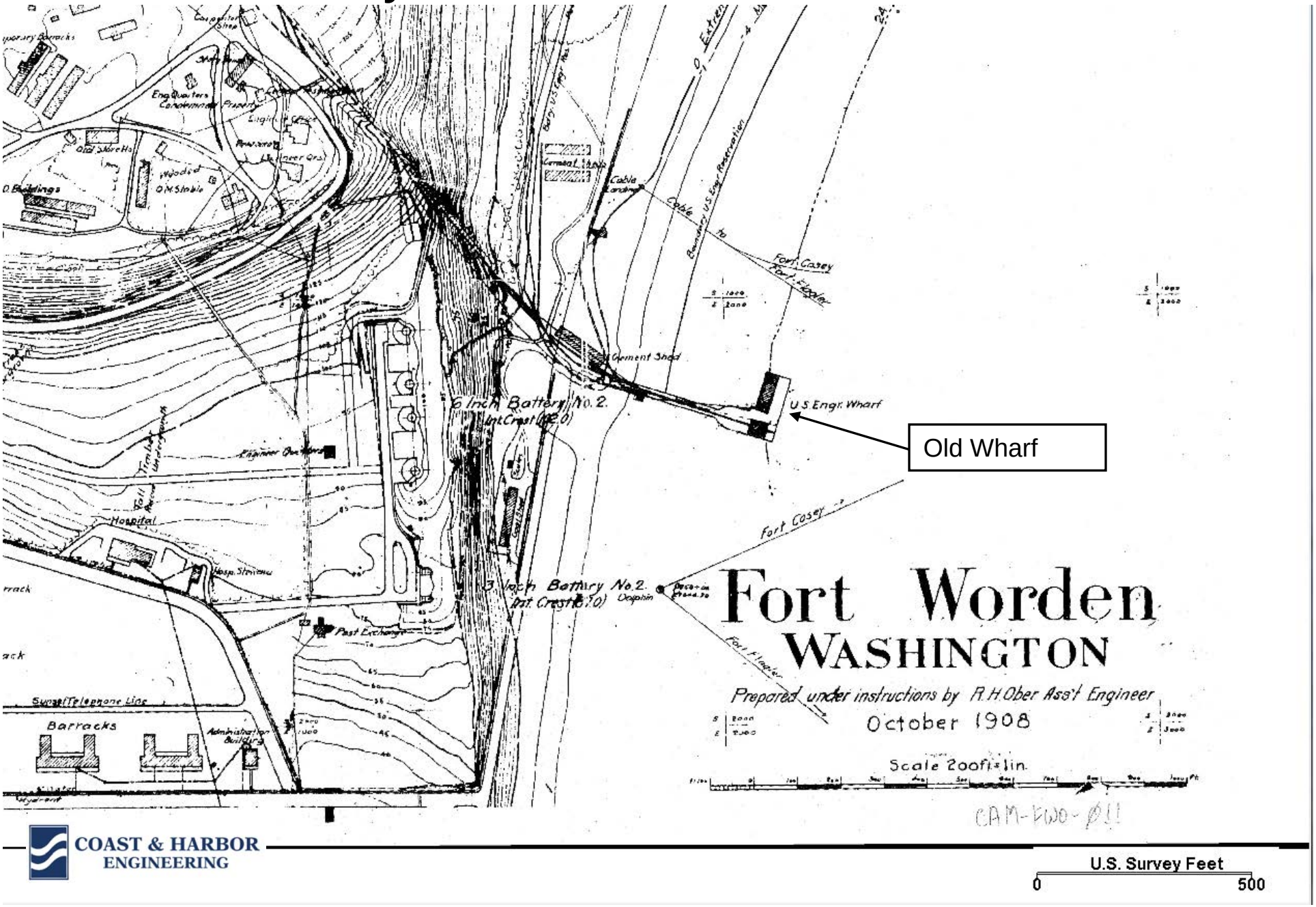
Shoreline Analysis - 1856



Shoreline Analysis - 1870



Shoreline Analysis - 1908



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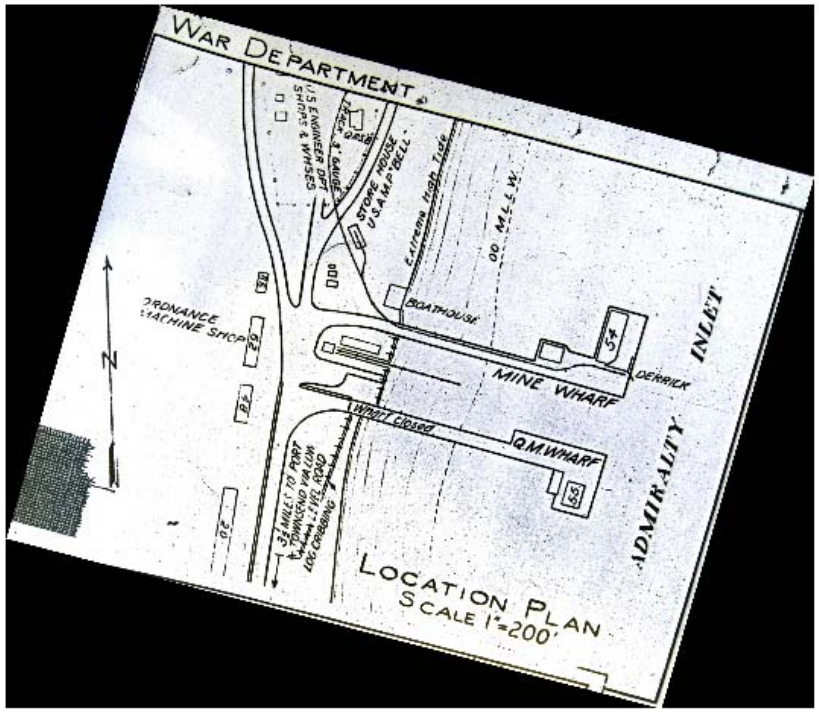
U.S. Survey Feet

0 500

Shoreline Analysis – circa 1920



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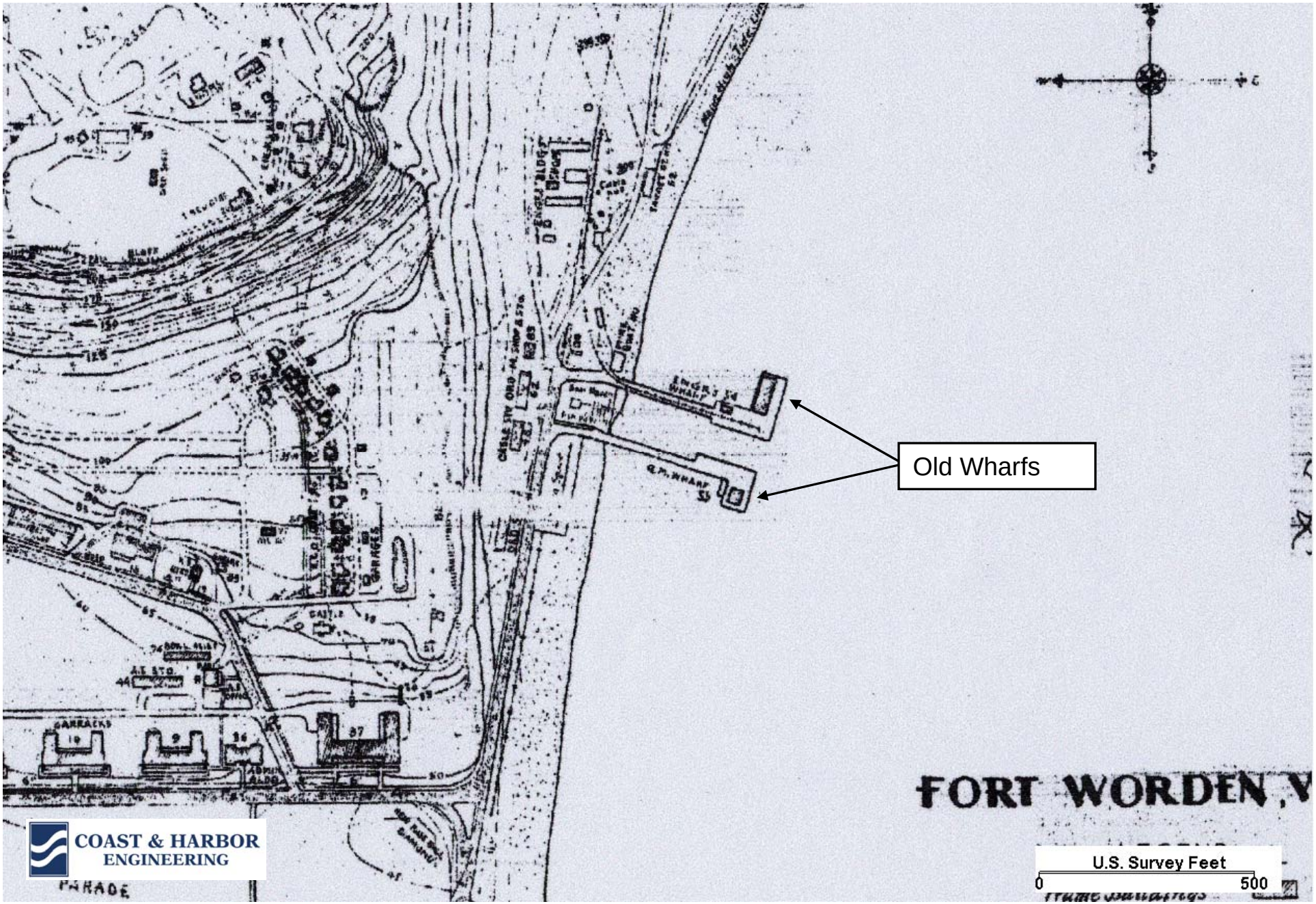
U.S. Survey Feet

0 500

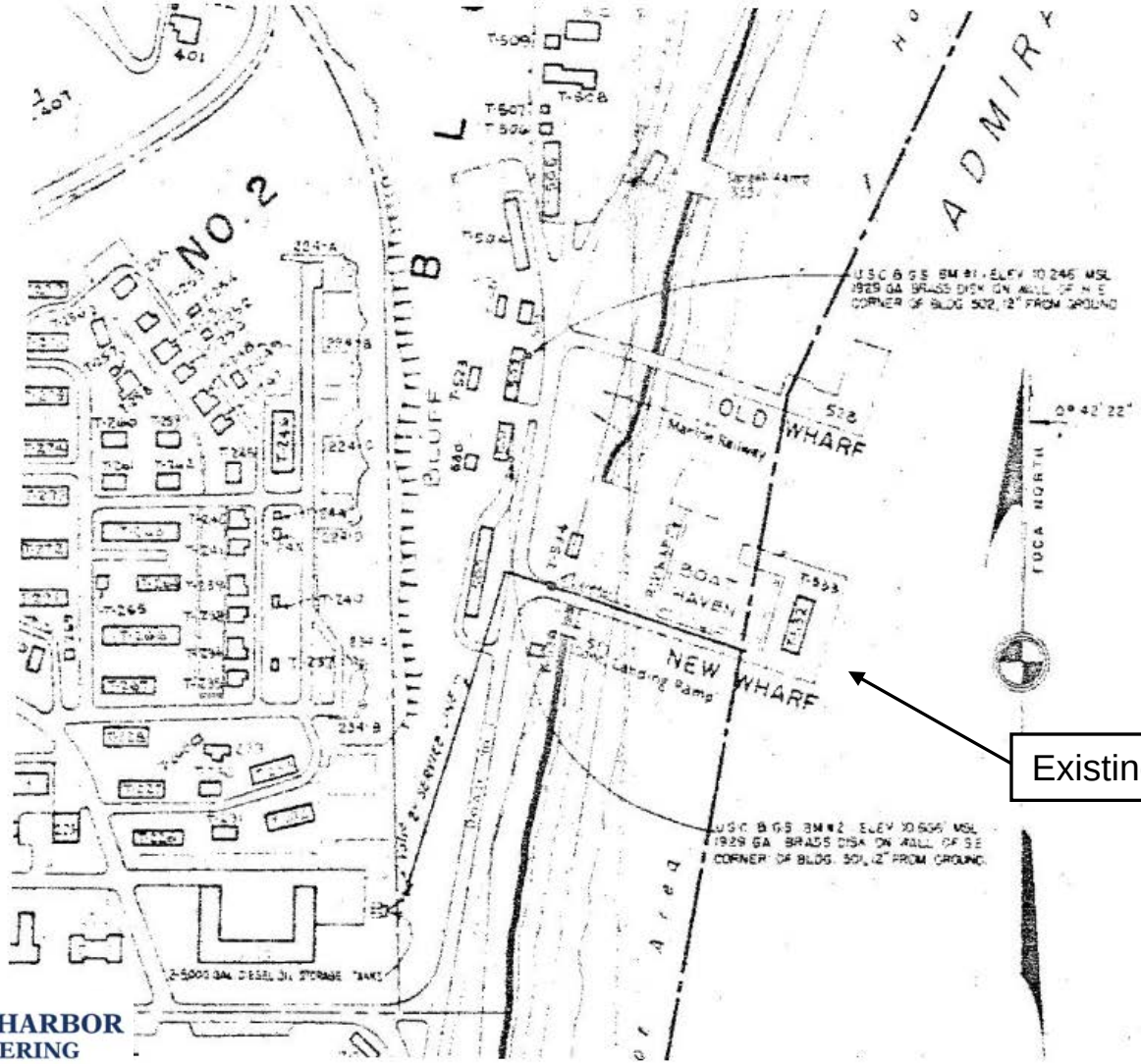
Shoreline Analysis - 1933



Shoreline Analysis - 1940

Shoreline Analysis - 1943

Shoreline Analysis - 1951



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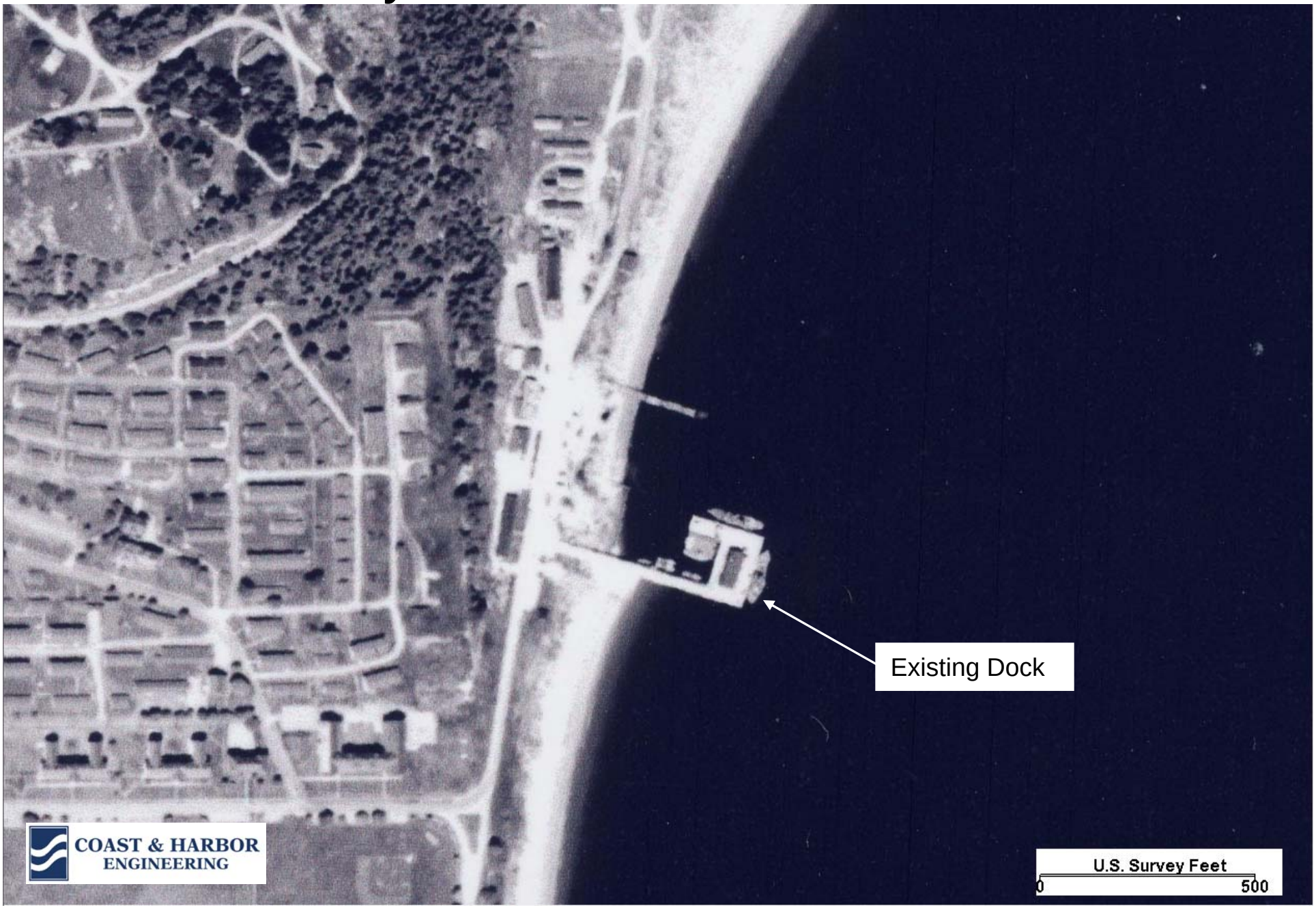
U.S. Survey Feet
0
500

Shoreline Analysis - 1957



Shoreline Analysis - 1965

Shoreline Analysis - 1977

Shoreline Analysis - 1985

Shoreline Analysis - 1997

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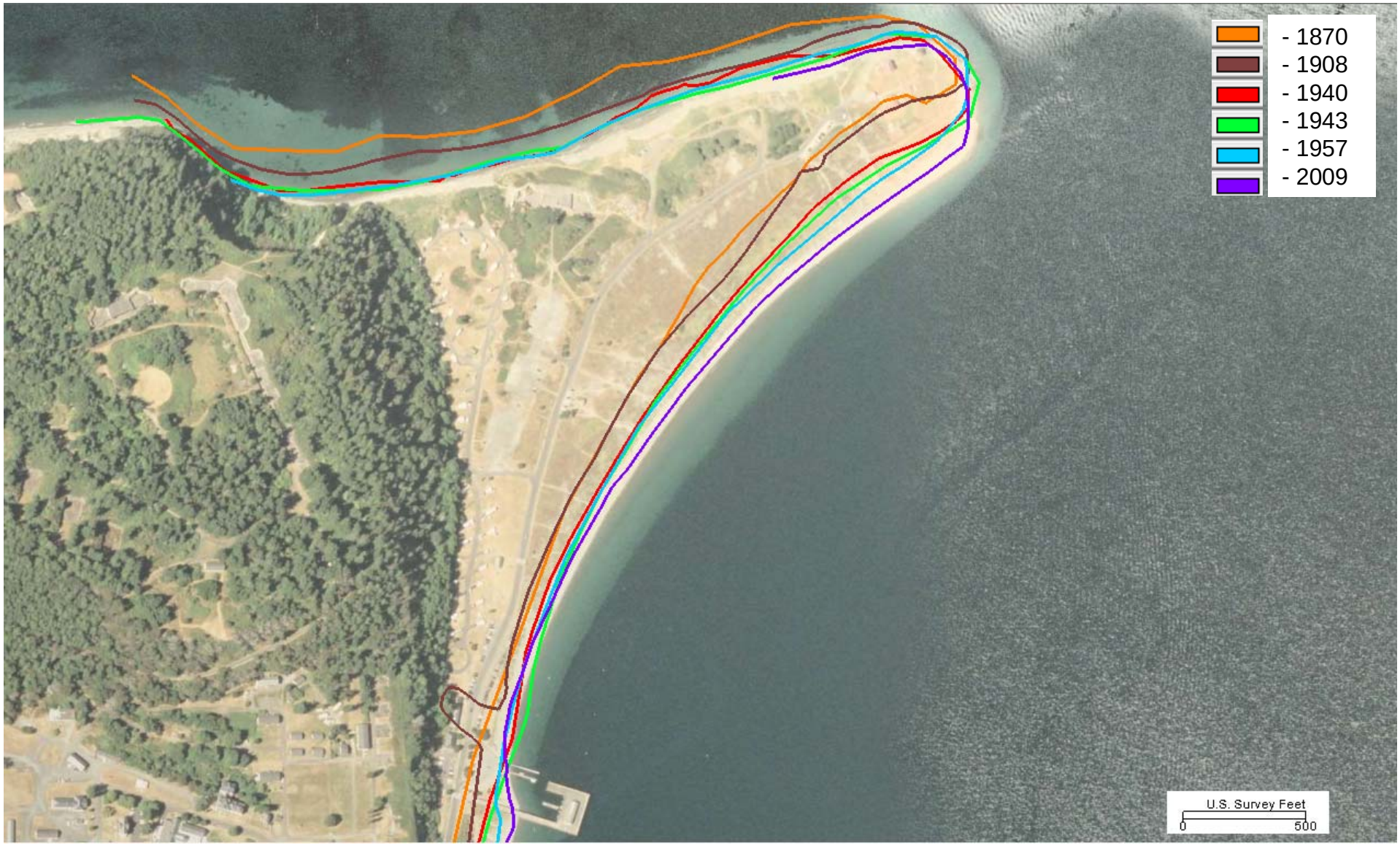
Shoreline Analysis - 2005

Shoreline Analysis - 2006

Shoreline Analysis - 2008

Shoreline Analysis - 2009

Historical Shoreline Positions – Pt. Wilson to Dock



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Historic shoreline positions are approximate and useful for evaluation of shoreline trends, not precise shoreline location

Historical Shoreline Positions – Dock Vicinity

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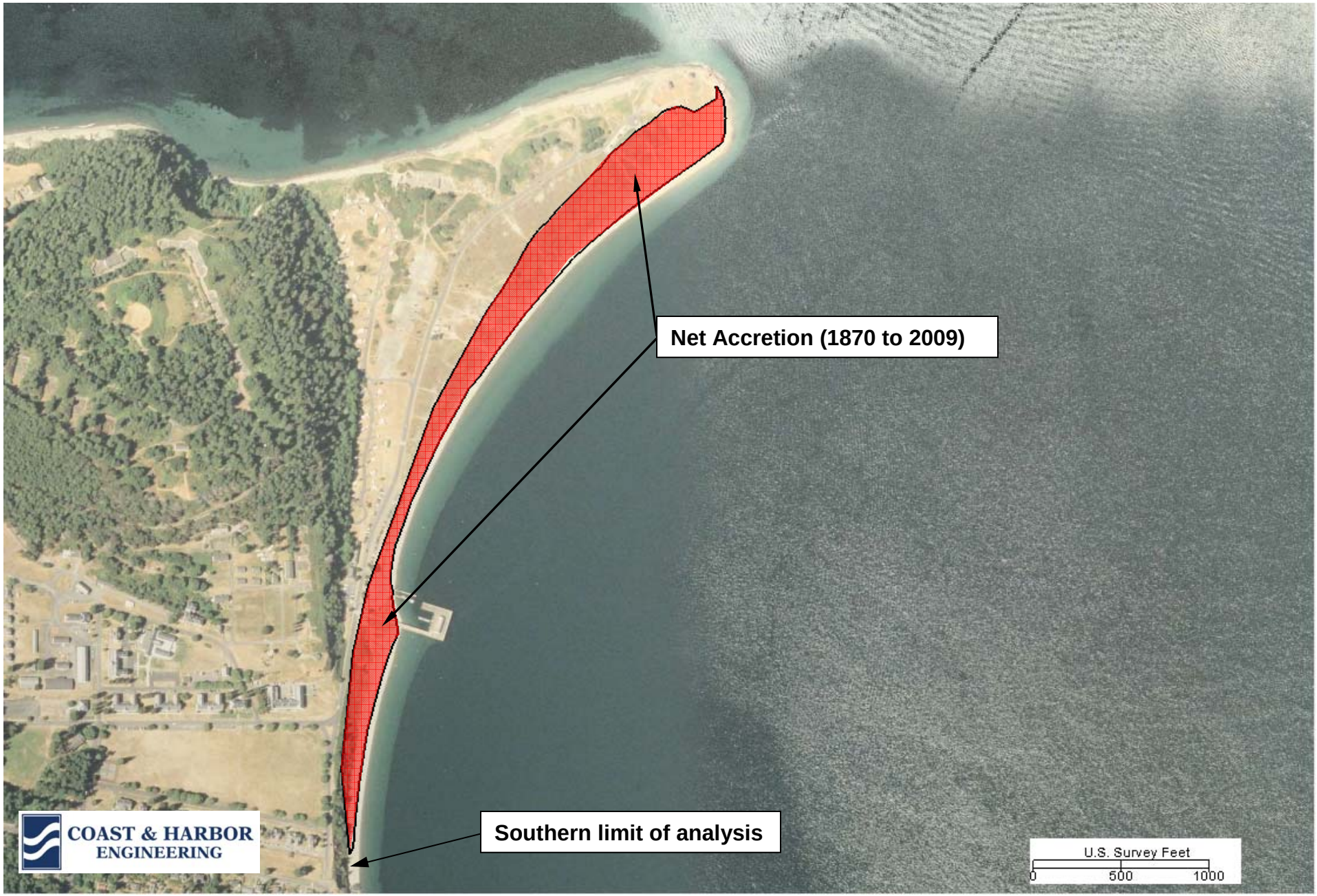
Historic shoreline positions are approximate and useful for evaluation of shoreline trends, not precise shoreline location

Historical Accretion in Drift Cell – 1870 to 2009



Shoreline Analysis Summary - 1850 to 1900

- Minimal development or shoreline alterations prior to year 1900
- Shoreline retreat (erosion) at Pt. Wilson on north side already apparent by 1904
- Shoreline accretion at Pt. Wilson on south side occurred as north side eroded
- Limited charts and maps available for site

Shoreline Analysis Summary - 1900 to 1950

- Erosion on north shore of Pt. Wilson continues, USCG armors the shoreline with rock in 1904
- Rail wharfs constructed in 1900 north of existing dock, shoreline responds with local accretion in the lee of the wharf (s)
- Shoreline pocket dredged or modified for source of fill material per 1908 map
- Shorelines trend of accretion from project site to south side of Pt. Wilson between 1908 and 1950
- Construction of new dock in 1943, shoreline rapidly responds with accretion fillet to south and erosion near old wharfs to north

Shoreline Analysis - 1950 to 2011

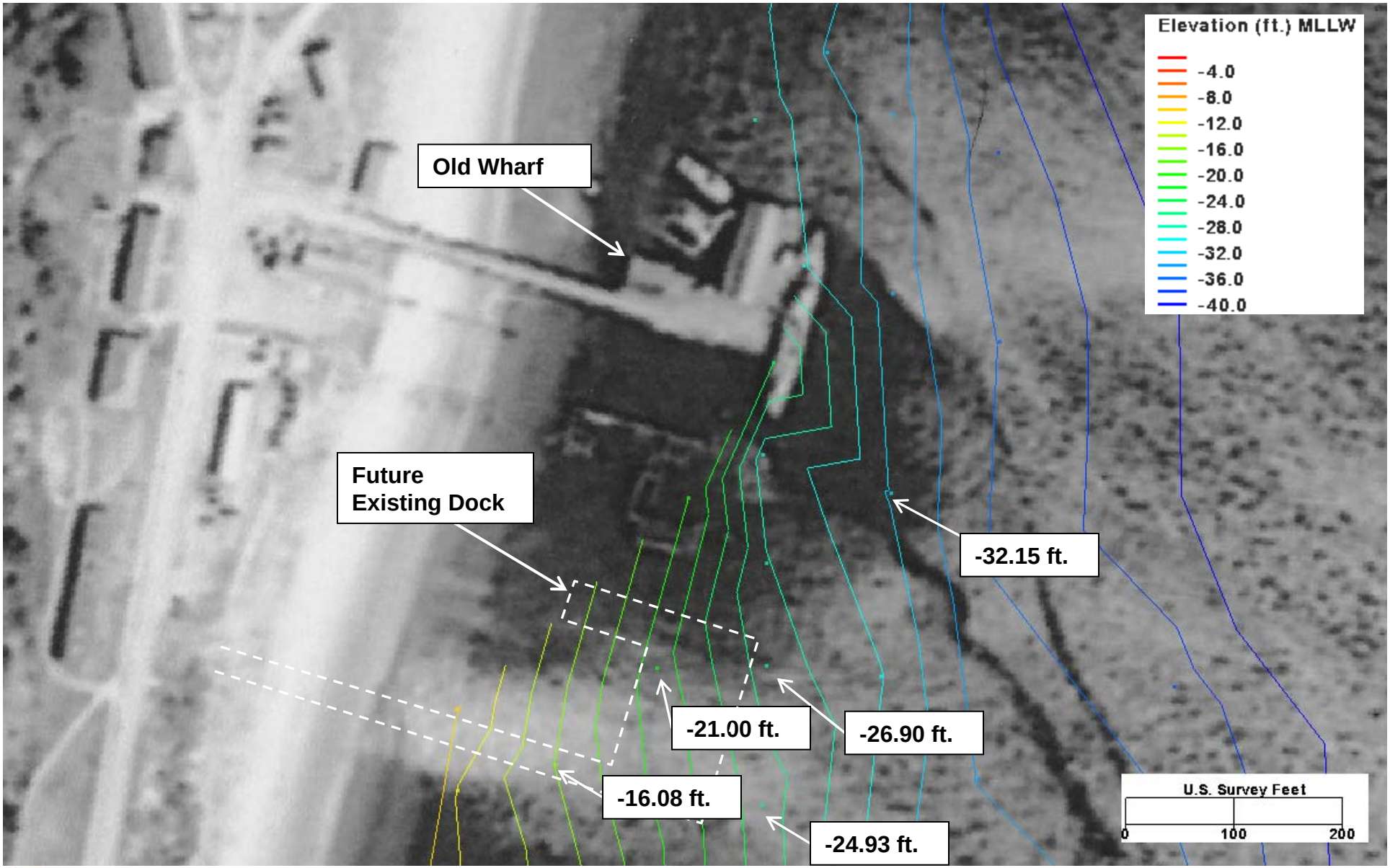
- 1970s parking lot, pile breakwater armoring, and fill causes shoreline change north of wharf
- Large fillet of accumulated sediment to the south persists and sediment continues to accumulate beneath the dock through 2011
- Overall long-term trend of accretion observed both to the north and south of existing dock

BATHYMETRIC CHANGE ANALYSIS

Bathymetric Change Analysis Approach

- Historic bathymetry data were analyzed to detect changes to the low intertidal and subtidal beach areas below the water line near the dock
- Bathymetry analysis provided quantitative estimates of sedimentation thickness and trends below the water line
- Sparse bathymetry data were compared between 1943, 1998, 2002, and 2011
- The 1998 and 2002 data sets were compared and then combined because they represent essentially the same bathymetric condition
- Sparse spatial and temporal data limited the analysis and required interpretation of trends

Bathymetry – 1943 US Navy Survey



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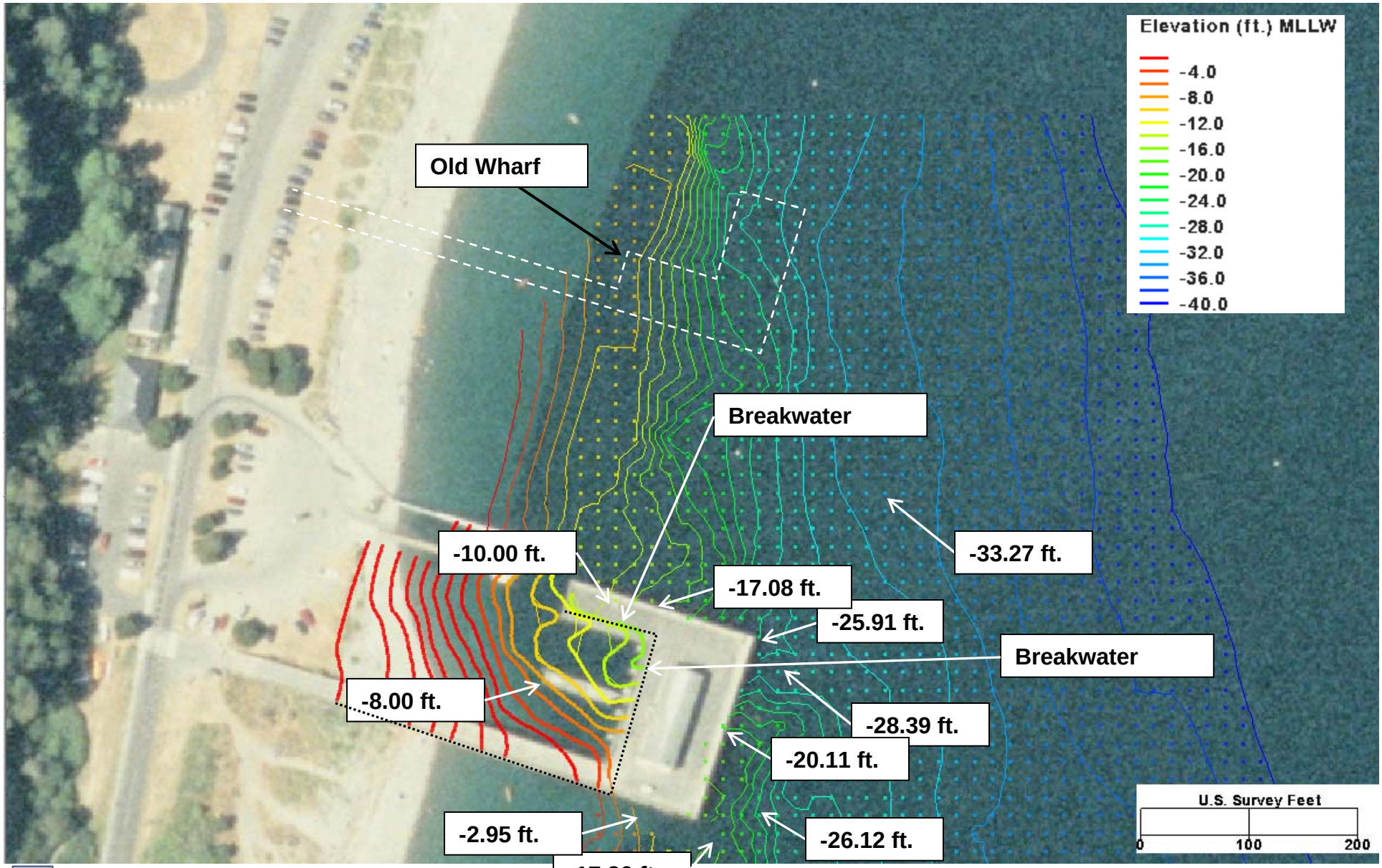
* Note that only very sparse data are available

Bathymetry – 1998 Parks & 2002 NOAA Survey



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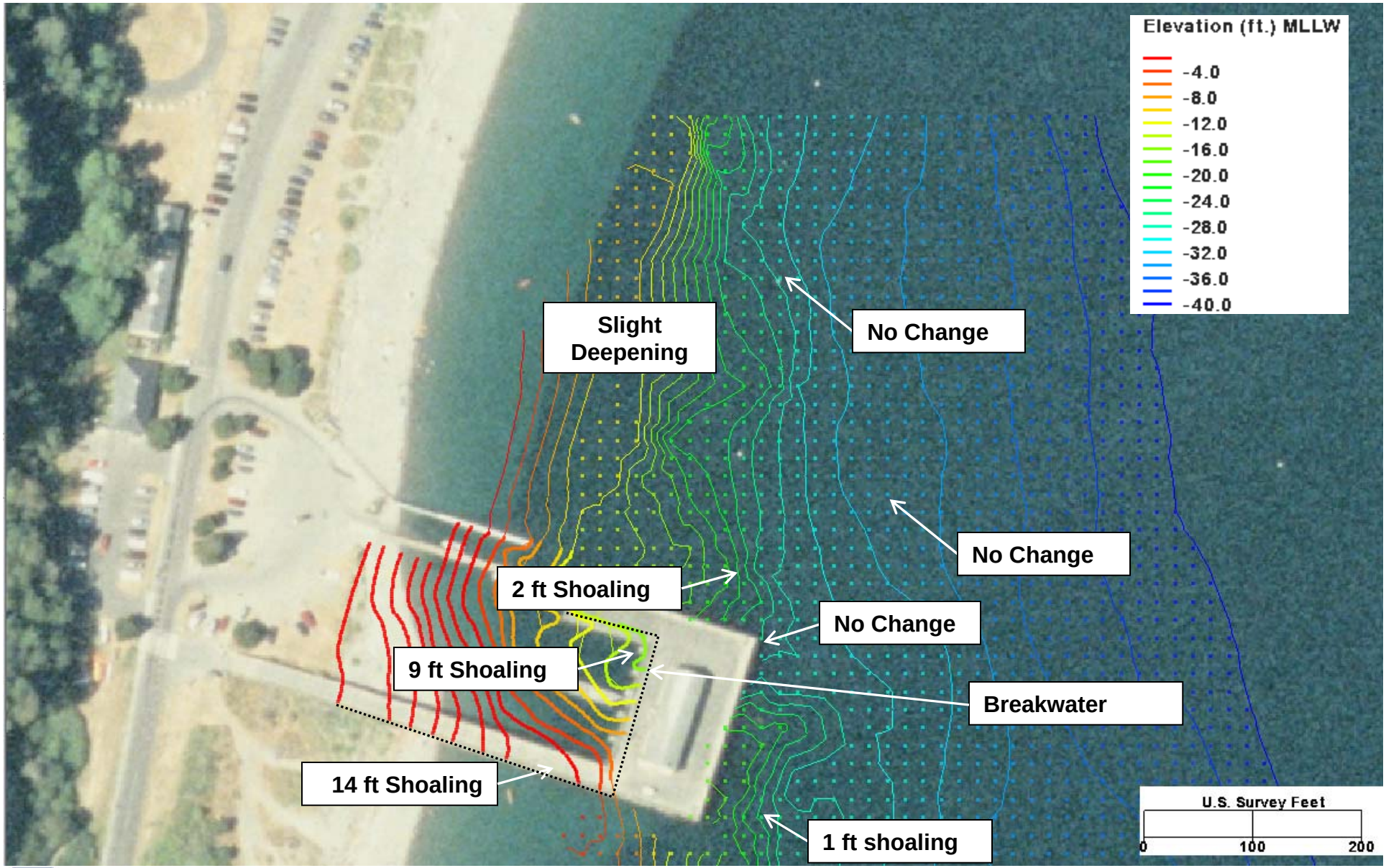
Bathymetric Trend – 1943 to [1998 & 2002]



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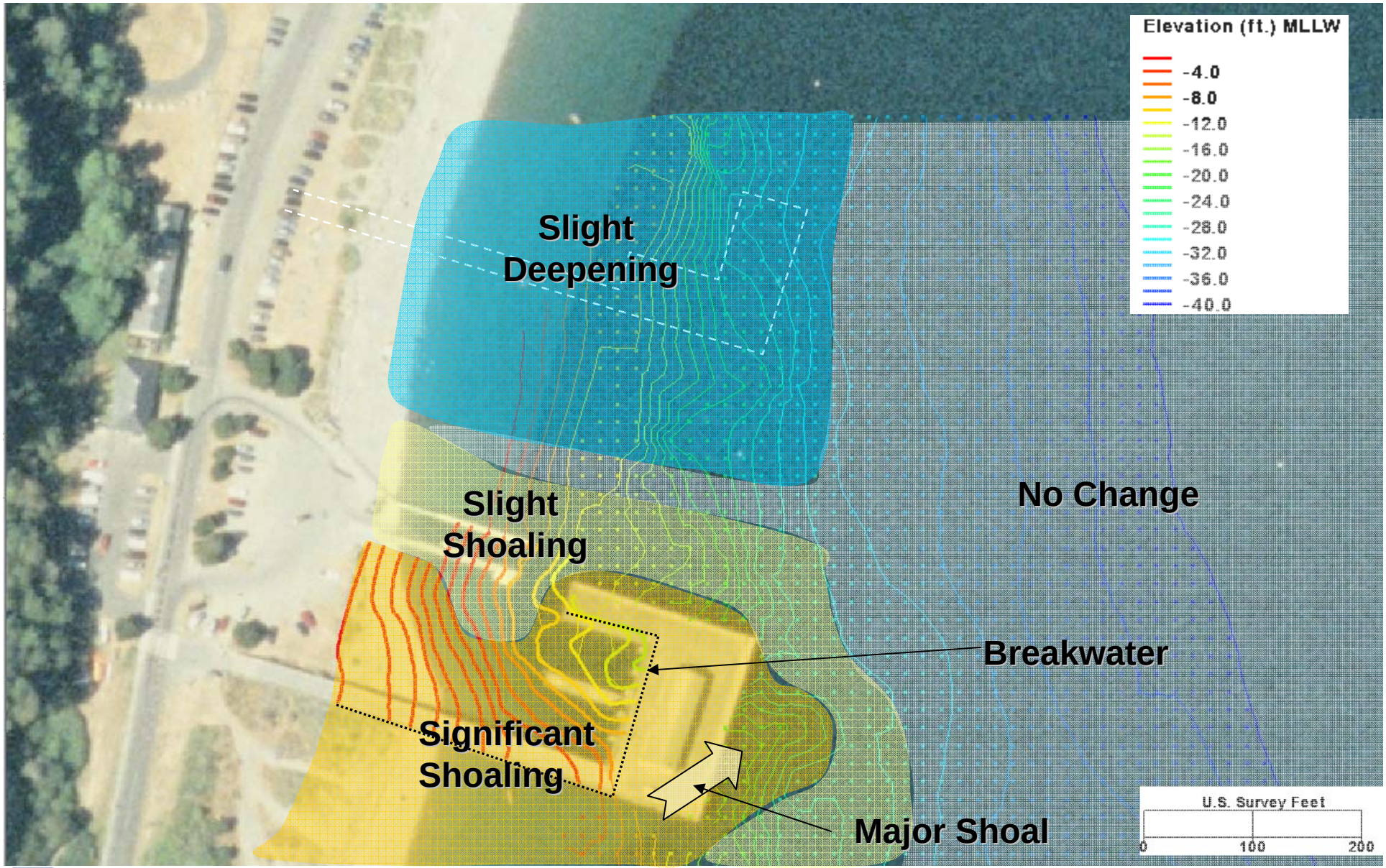
Bathymetric Interpretation – 1943 to [1998 & 2002]



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Bathymetry – 2011 Lead Line Survey (by T. Petrillo)

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Bathymetric Trend – [1998 & 2002] to 2011

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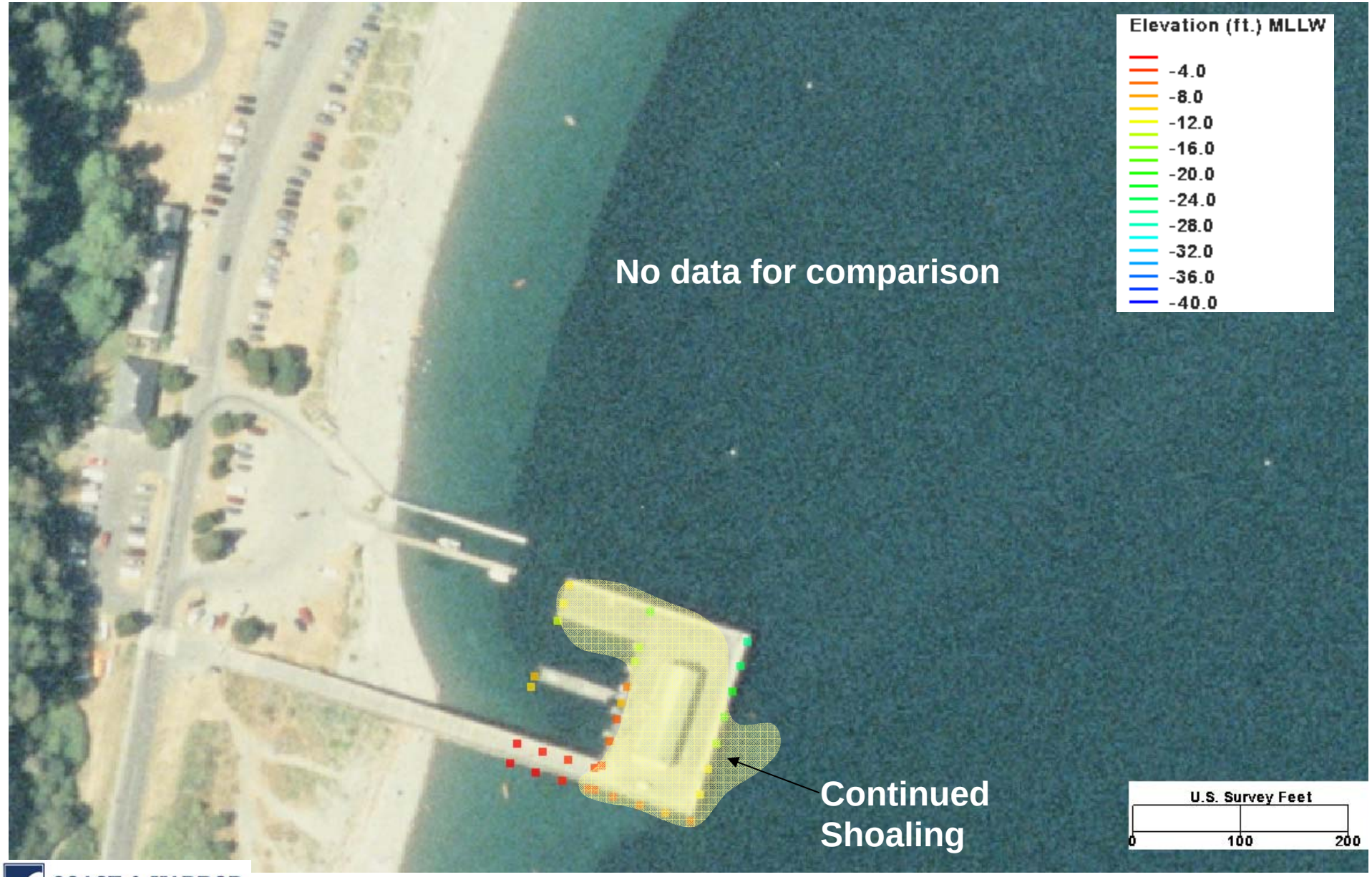
Bathymetric Interpretation – [1998 & 2002] to 2011



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Bathymetric Change Analysis - 1943 to 2011

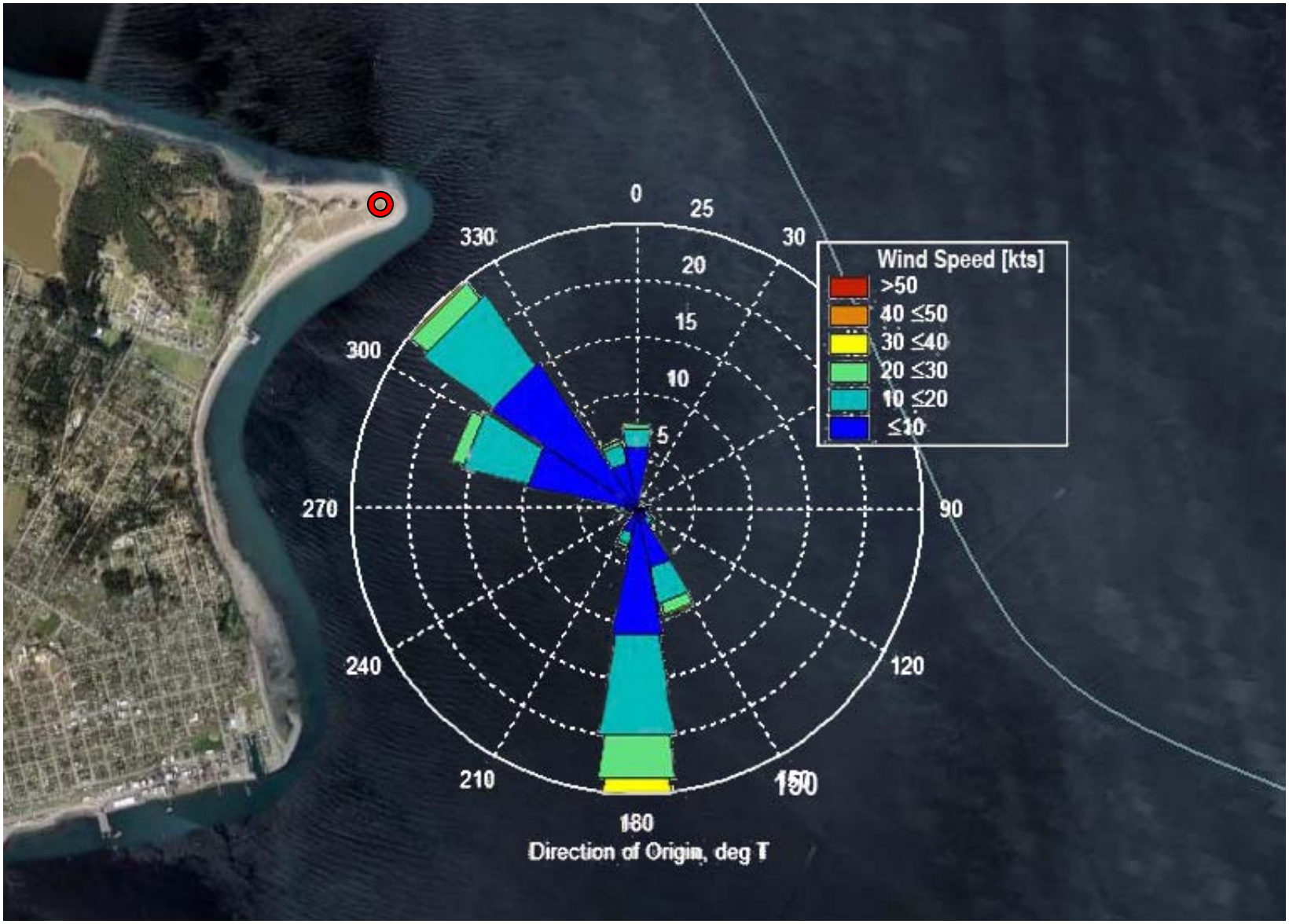
- Large fillet of accumulated sediment to the south persists and sediment continues to accumulate in formerly deep water at the dock
- Bathymetry near old wharf deepened after wharf was removed in 1950s
- Shoaling by as much as 15 ft is observed on the south side of the existing pier breakwater
- Existing rates of shoaling are likely less than initial rates due to accretion beyond east face of breakwater
- Shoaling beneath the dock likely continues, due to growth of fillet and redirection of sediment east by the breakwater and then north by the waves
- Data for comparison are lacking and full bathymetric survey is needed beneath pier and offshore

REVIEW OF WAVE CONDITIONS

Wave Conditions (Qualitative Assessment for Project Site Location)

- No new wind or wave modeling was conducted
- Wind & wave data were obtained from nearby previous CHE coastal projects at Keystone Harbor & Downtown Port Townsend.
- Previous large scale Puget Sound model wind statistics and wave results were assembled and analyzed to represent storm conditions at project site for waves from the east and south.
- Waves analysis is supplemental for evaluating coastal processes and not intended for use in any design efforts.
- Additional site specific wind and wave analysis needs to be performed to review the performance and design for any proposed alternative in the future

Wind Rose for Point Wilson



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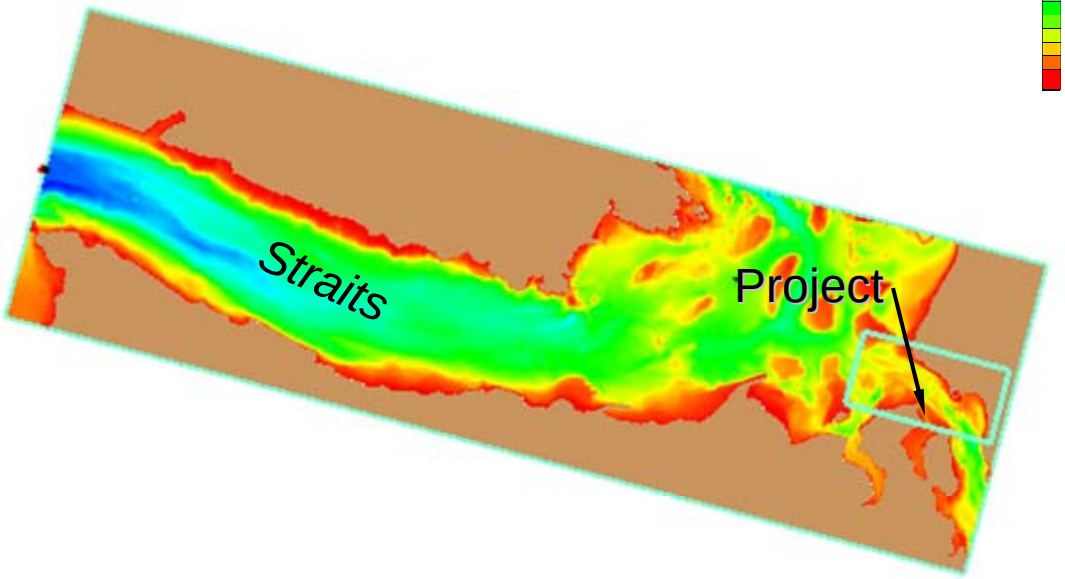
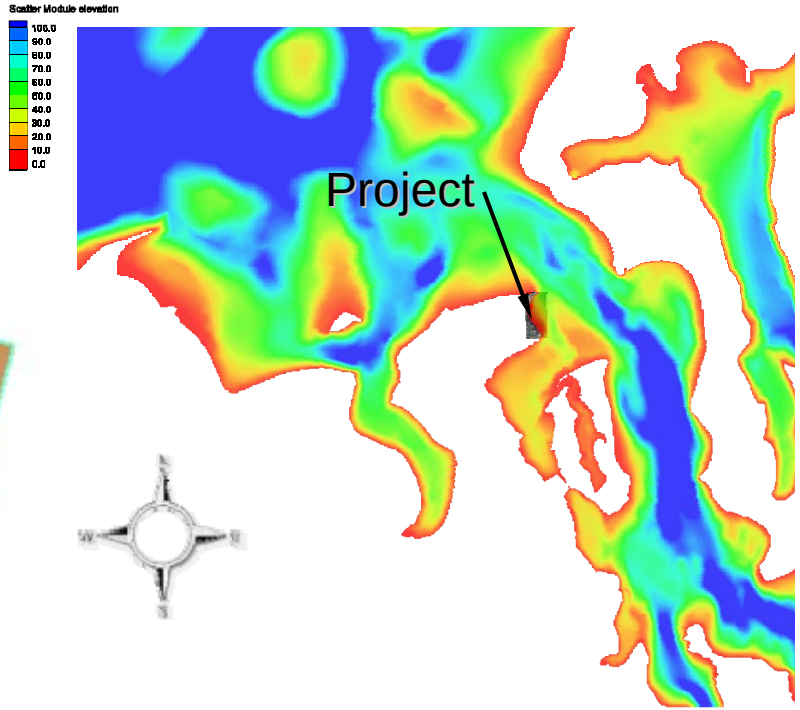
Previous Wave Analysis

- Long period waves from the Straits
- Local wind-waves from Puget Sound



Straits Wave Model



Puget Sound WAVE Model

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Interpretation of Long Period Waves (from 2006 Aerial Photo)

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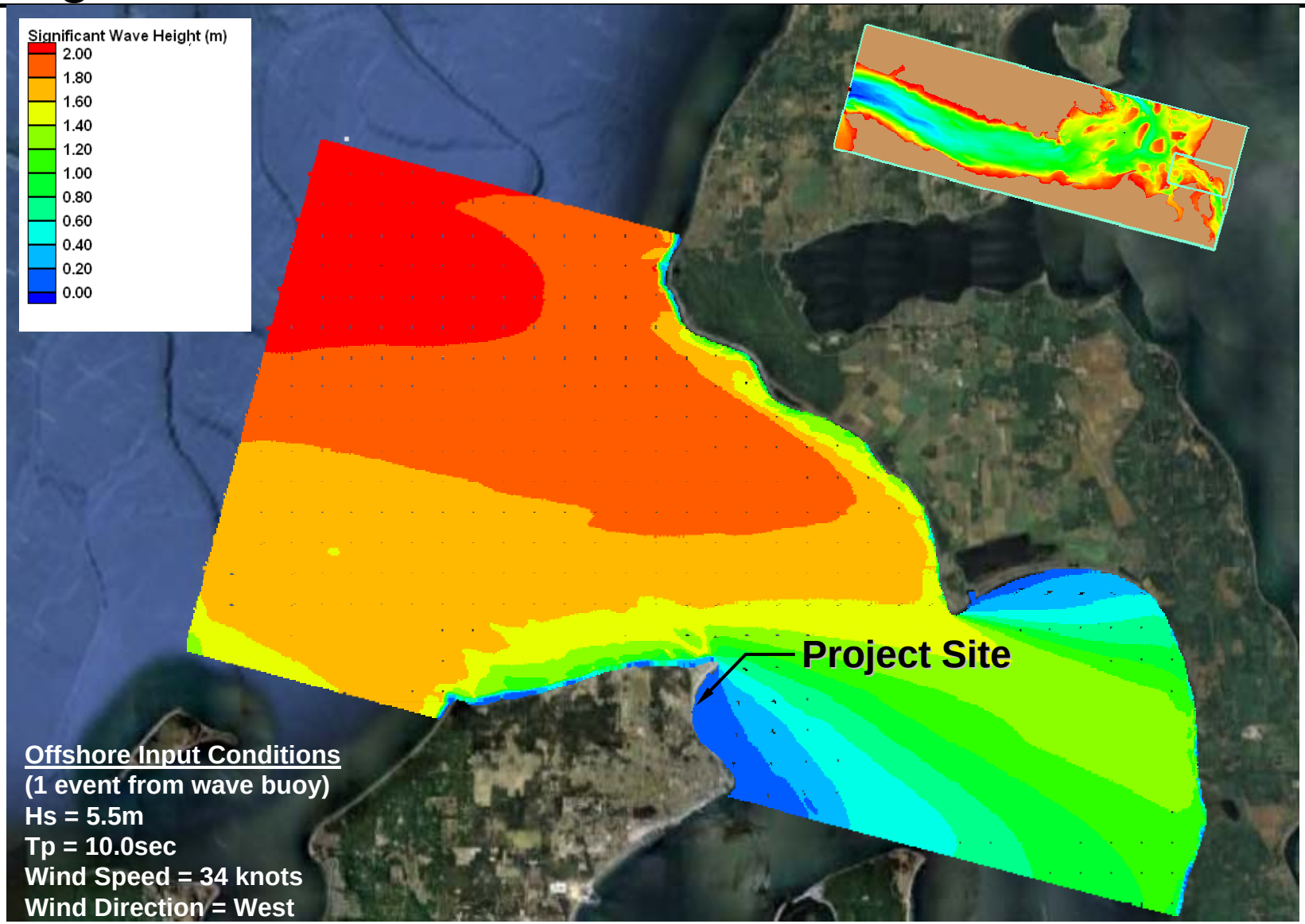
Large Scale Wave Model (Example Offshore Swell & West Wind Waves)



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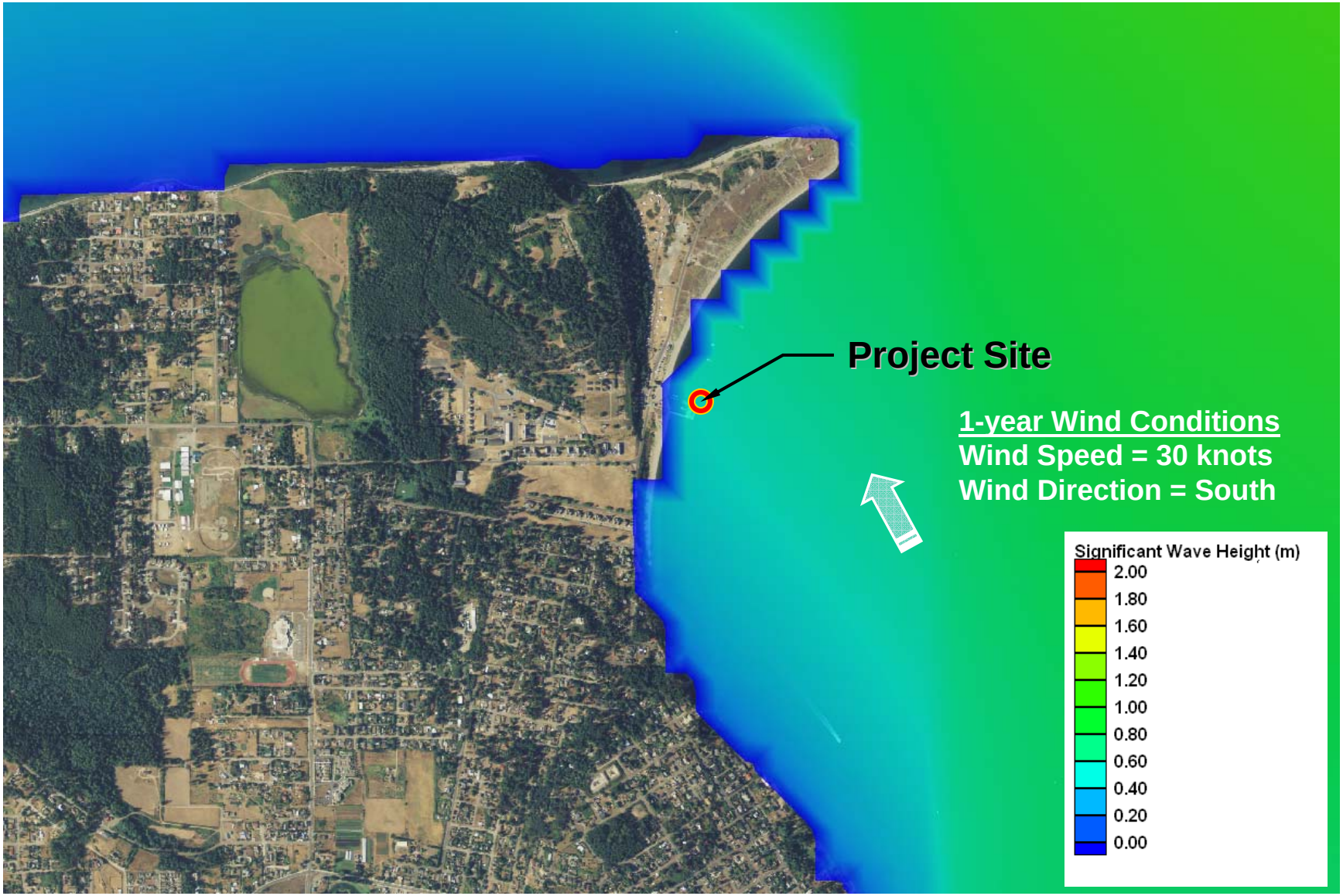
Local Wind Wave Model (Example South Wind Waves)



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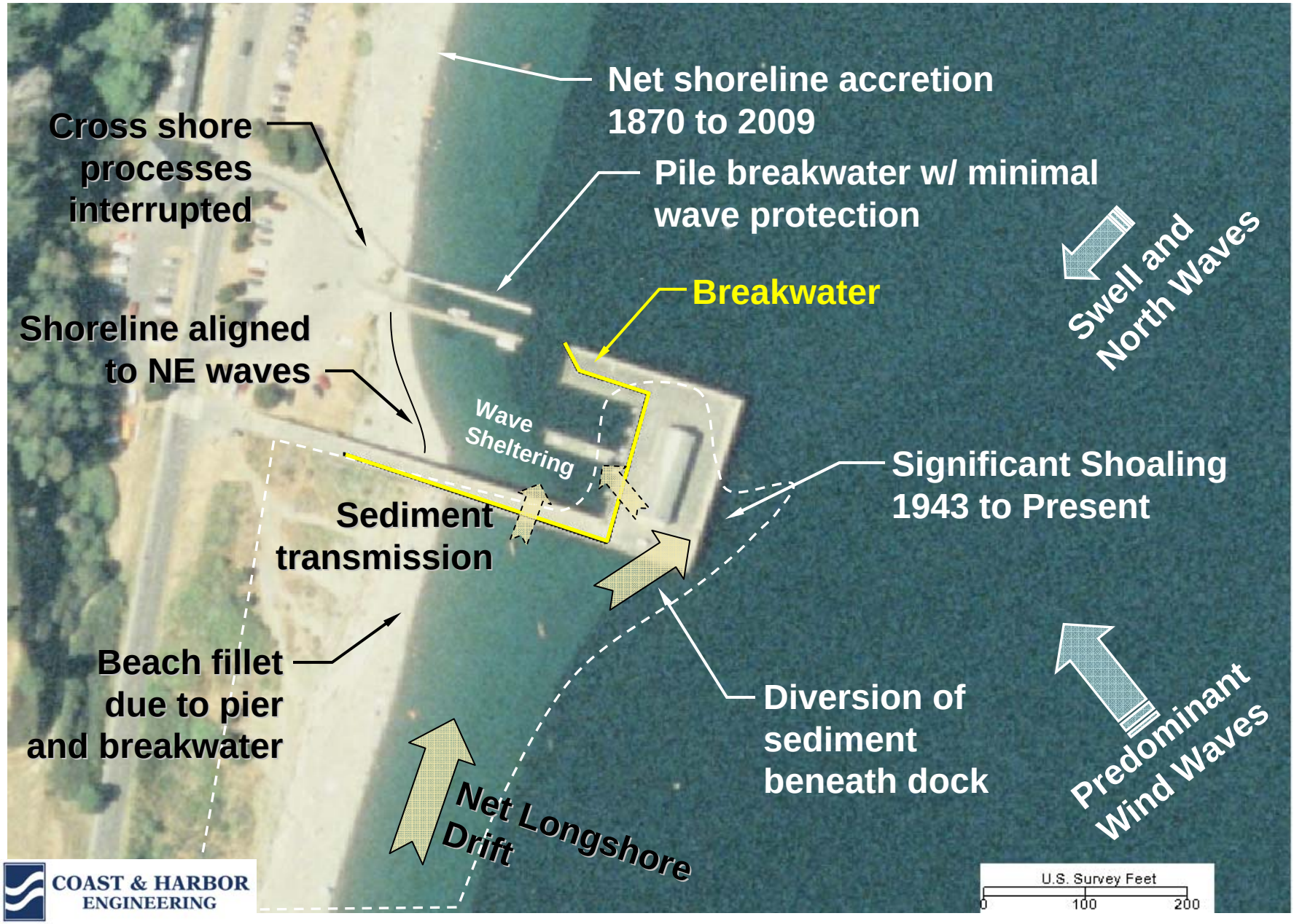
Summary of Wave Analysis

- Predominant wind waves are from south with remotely generated wind waves from the Straits propagating to the site depending on wind conditions.
- Typical annual storm wave height from the south is approximately 2 to 3 feet
- Extreme storm wave height from south may exceed approximately 4 to 5 feet
- Longer period swell propagate from the north around Pt. Wilson to the project site, but height is greatly attenuated and direction of approach is from NE.
- Existing timber pile breakwater beneath Pier & Dock attenuates waves approaching from east through south.
- Existing breakwater north of ramp provides minimal wave sheltering.
- Wave climate appears to require the breakwater for maintaining a functional and operational boat launch

COASTAL PROCESSES SUMMARY

Summary of Coastal Processes



Summary of Coastal Processes

- Bluffs to the south actively supply sediment to the drift cell beaches including the dock and areas to the north at Point Wilson
- Predominant waves are from south with prevailing winds driving net sediment transport to the north
- Longer period waves propagate from the north around Pt. Wilson to the project site, but wave height is greatly attenuated and direction is from NE
- Historical erosion at north side of Pt. Wilson was accompanied by accretion on south side of Pt. Wilson and at the project site
- The overall shoreline trends indicate net accretion in the drift cell, including in the immediate project vicinity

Summary of Coastal Processes (cont.)

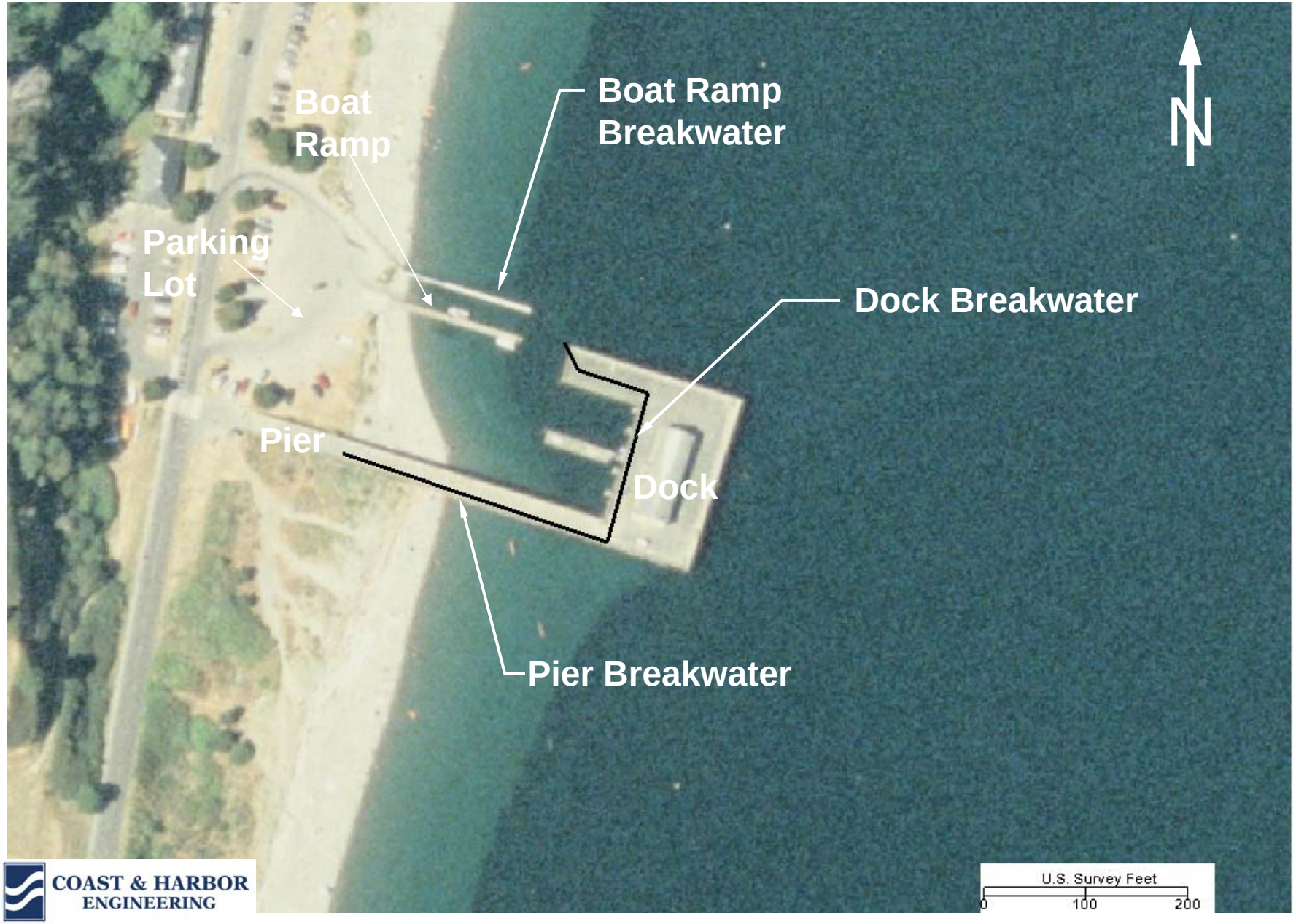
- Existing timber pile breakwater beneath pier passes some sediment through but diverts significant sediment to offshore and beneath the dock
- Sediment delivered to area beneath dock results in some sediment transported by waves landward through breakwater and some sediment remaining in growing shoal
- Contours inside launch are oriented to waves from the northeast
- North pile breakwater and parking lot disrupt cross shore beach processes north of the ramp
- The dock creates an artificial salient that controls shoreline position updrift (south) and downdrift (north)

ALTERNATIVES

Alternatives - Introduction

- Understanding of coastal processes was developed.
- Conceptual alternatives were developed and analysis conducted to develop a range of potential nearshore restoration and boating facility improvements.
- Detailed engineering analysis and design not conducted; development and review of alternatives limited to available information presented in this document.
- Alternatives need to be developed to match project goals and desired improvements for boating facility and restoration.

Alternatives (Existing Project Site Features)



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Alternatives Discussion Overview

- Overview
  - Modifications to the existing pier/dock facility for the purpose of restoring nearshore processes will be dependent on the requirements for future use, service and operations of a boating facility at this location
- Potential Nearshore Processes Restoration Elements
  - Modify breakwater beneath pier (reduce, re-design, remove)
  - Modify breakwater beneath dock (reduce, re-design, remove)
  - Modify existing boat ramp and float (elevate)
  - Modify north pile jetty/breakwater (reduce, re-design, remove)
  - Modify parking area (setback, re-design)
- Potential Boating Facility Modifications
  - Elevate and re-align boat launch
  - Modify launch use to hand launch vessels or small vessels only
  - Relocate boat ramp facility to offsite location
  - Add detached breakwater for wave protection

Considerations – Boating Facility

- Could existing launch be converted to hand launch and small vessels and still meet Parks recreational requirements for the Ft Worden Park?
- Is Day Use moorage a requirement for the boat basin inside the breakwaters?
- Elevated ramp would need sufficient freeboard above existing beach to ensure free movement of sediment below ramp structure, resulting in ramp shifting out waterward approximately 30 ft.
- Elevated ramp is likely not feasible within the available space without modifying the ramp toe elevation (to a higher level to reduce ramp length) which would result in a reduction in usability due to loss of launching at lower tides.
- Is a trailerable boat launch required at this facility if equivalent new capacity were provided elsewhere in Port Townsend?

Considerations – Restoration

- Depends on the scope of the boating facility operational requirements at the site.
- Partial removal of offshore dock breakwater will allow sediment movement into basin thereby reducing sediment accumulation offshore but will also increase wave energy into the boat basin.
- Modifications to the south pier breakwater could have an affect on shoreline position on beach south and north of pier. Additional analysis of both updrift and downdrift affects to shoreline position will be needed.

Alternatives Discussion – Nearshore Restoration

- Modify breakwater beneath pier (remove piles)
  - Improved long shore sediment processes by opening up solid breakwater for passage of sediment from offshore shoal up into the nearshore zone
  - Potential for changes to shoreline position south of pier (more detailed analysis would be required)
- Modify breakwater beneath dock (remove piles)
  - Improved long shore sediment processes by opening up solid breakwater for passage of sediment from offshore shoal up into the nearshore zone
  - Lower level or improvement of sediment processes than pier breakwater modification
- Modify existing boat ramp and float (elevate)
  - Allows sediment processes to occur without
  - High cost of constructing new ramp.
- Modify north pile jetty/breakwater (partial removal)
  - Improved long shore sediment processes
  - Length of structure removal to be determined to minimize potential for impact to upland parking lot

Alternatives Discussion – Boating Facility Modifications

- Elevate & Re-align boat launch
  - New elevated ramp installed at location waterward of existing beach to ensure sufficient freeboard is maintained for sediment movement under ramp.
  - Shortened ramp would be required to fit the site geometry resulting in reduction in operability (elimination of lower tide level launching capability).
  - High cost of constructing a pile supported elevated launch
  - May require installation of new offshore breakwater depending on desired operability
  - Parking space not available for improved launch
- Modified Use for Hand launch only
  - Requires relocating trailerable boat launch to another site outside of park property
  - Provides continued hand launch facility
- Offsite New Boat Ramp
  - Could be installed at more desirable location with improved coastal environment (improved wave conditions and lower sedimentation)
  - Easier access for boaters, improved upland parking at correct location

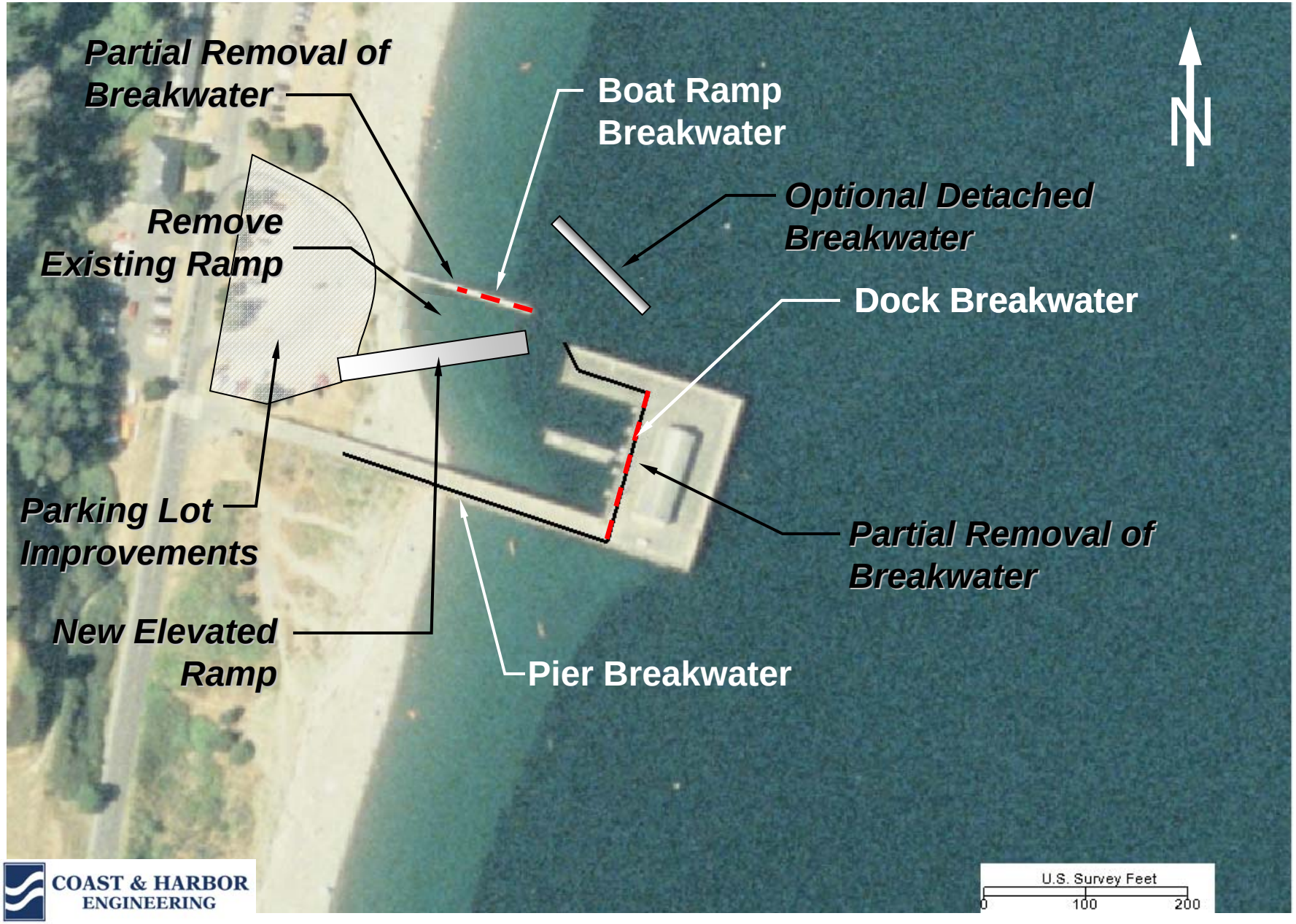
Alternatives

- Alternative Scoping
  - Two potential alternatives were selected for consideration. Final determination of scope of alternatives is dependant on desired future boating facility requirements, biological criteria and other stakeholder input.
- Alternative 1 – Maintain Existing Boating Facility
  - Modify breakwater beneath dock (reduce number of piles)
  - Modify existing boat ramp and float (elevated ramp)
  - Remove Boat Ramp Breakwater
  - Modify parking area (setback, re-design)
  - Install new offshore Breakwater
- Alternative 2 – Modified Boating Facility
  - Modify breakwater beneath dock (reduce, re-design, remove)
  - Modified use (Hand Launch Only, With Moorage)
  - Relocate trailerable boat launching to facility offsite
  - Partial removal of boat ramp breakwater

Alternative 1 – Maintain Existing Boating Facility

- Description
  - Remove portions of existing dock breakwater to provide greater porosity for sediment movement through breakwater from deepwater to shoreline areas
  - Remove existing at-grade ramp & and a portion of boat ramp breakwater to allow sediment to freely move from boat basin.
  - Install new elevated ramp to allow sediment to move under ramp without impacting ramp operations and need for ongoing maintenance.
  - Possible new offshore breakwater to protect boat basin from north waves.
- Pros
  - Improves longshore sediment processes and minimizes material deposited into offshore shoal.
  - Maintains trailerable boat launch at facility
  - Reduced maintenance of boat launch
- Cons
  - High Capital Cost
  - Reduced Operability (due to shortened boat ramp), increased wave action in boat basin due to increased breakwater porosity
  - Parking limitations (25 to 50 spaces is typical recommendation)
- Cost
  - Cost of building new elevated ramp, breakwater modification, new breakwater and upland parking lot improvements would likely range between $850,000 and $1,700,000.

Alternative 1



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Alternative 2 – Modify Boating Facility to Hand Launch

- Description
  - Remove portions of existing dock breakwater to provide greater porosity for sediment movement through breakwater from deepwater to shoreline areas.
  - Remove existing ramp floats & a portion of the boat ramp breakwater to allow sediment to freely move from boat basin.
- Pros
  - Improves longshore sediment processes and minimizes material deposited into offshore shoal.
  - Maintains hand launch capability
  - Lower costs
- Cons
  - Requires building additional ramp capacity elsewhere in Port Townsend and cost associated with offsite development
  - Removes trailerable boat launch capability from Park property
- Cost
  - Cost of improvements would likely range between $125,000 and $250,000.
  - Does not include the cost of installing a boat launch at another location.

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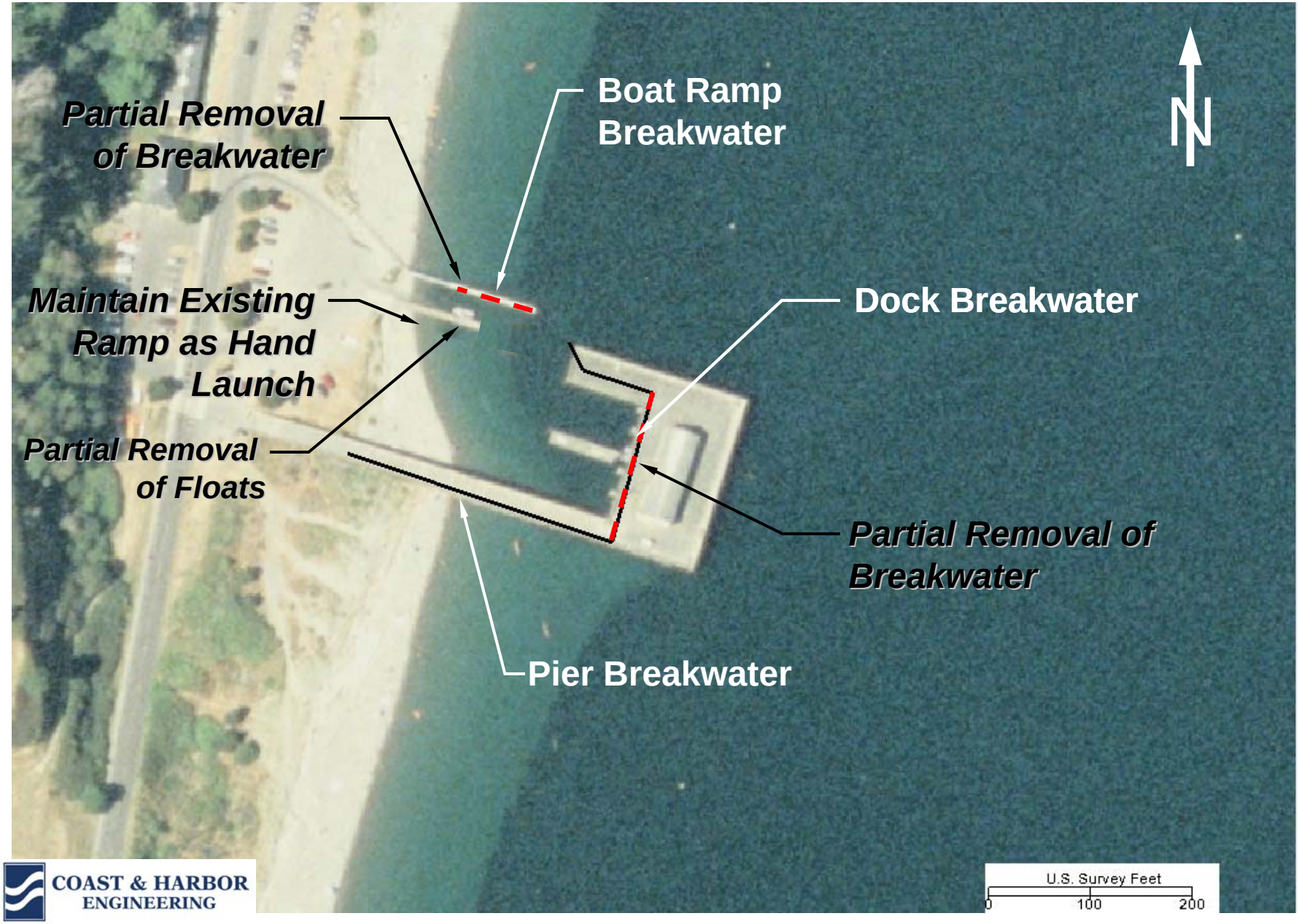
Alternative 2



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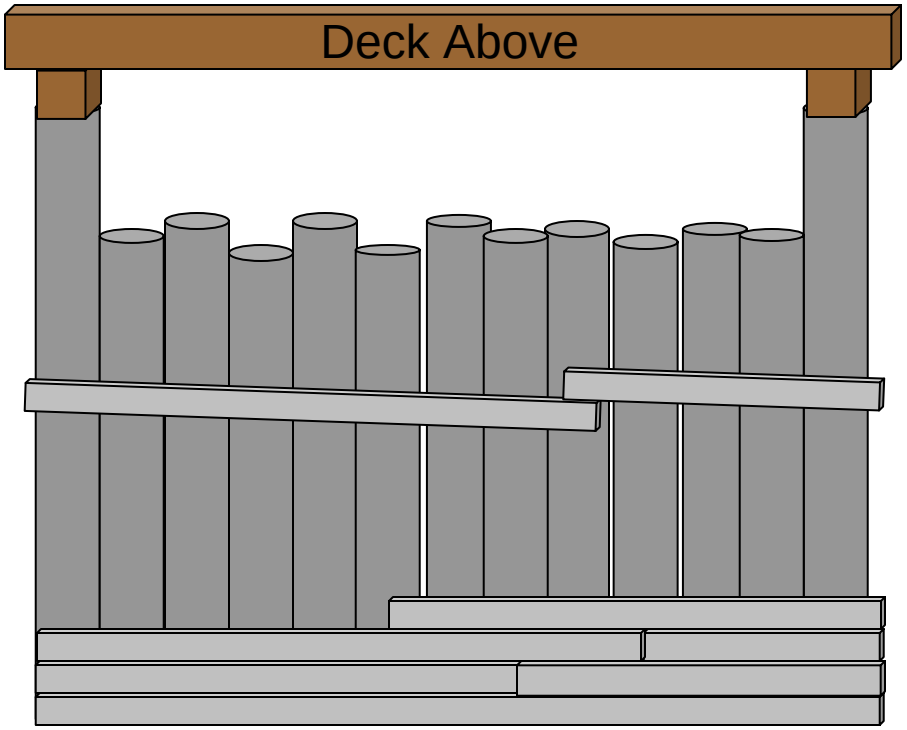
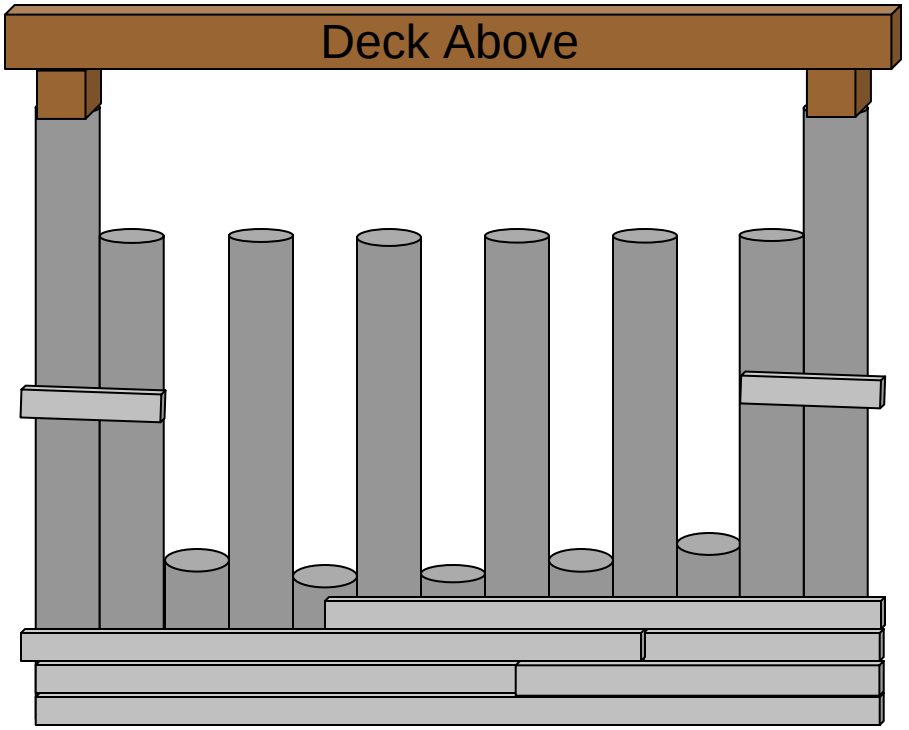
Alternatives – Pile Breakwater Along Pier & Dock



EXISTING



MODIFIED w/ SMALL GAPS

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NEXT STEPS

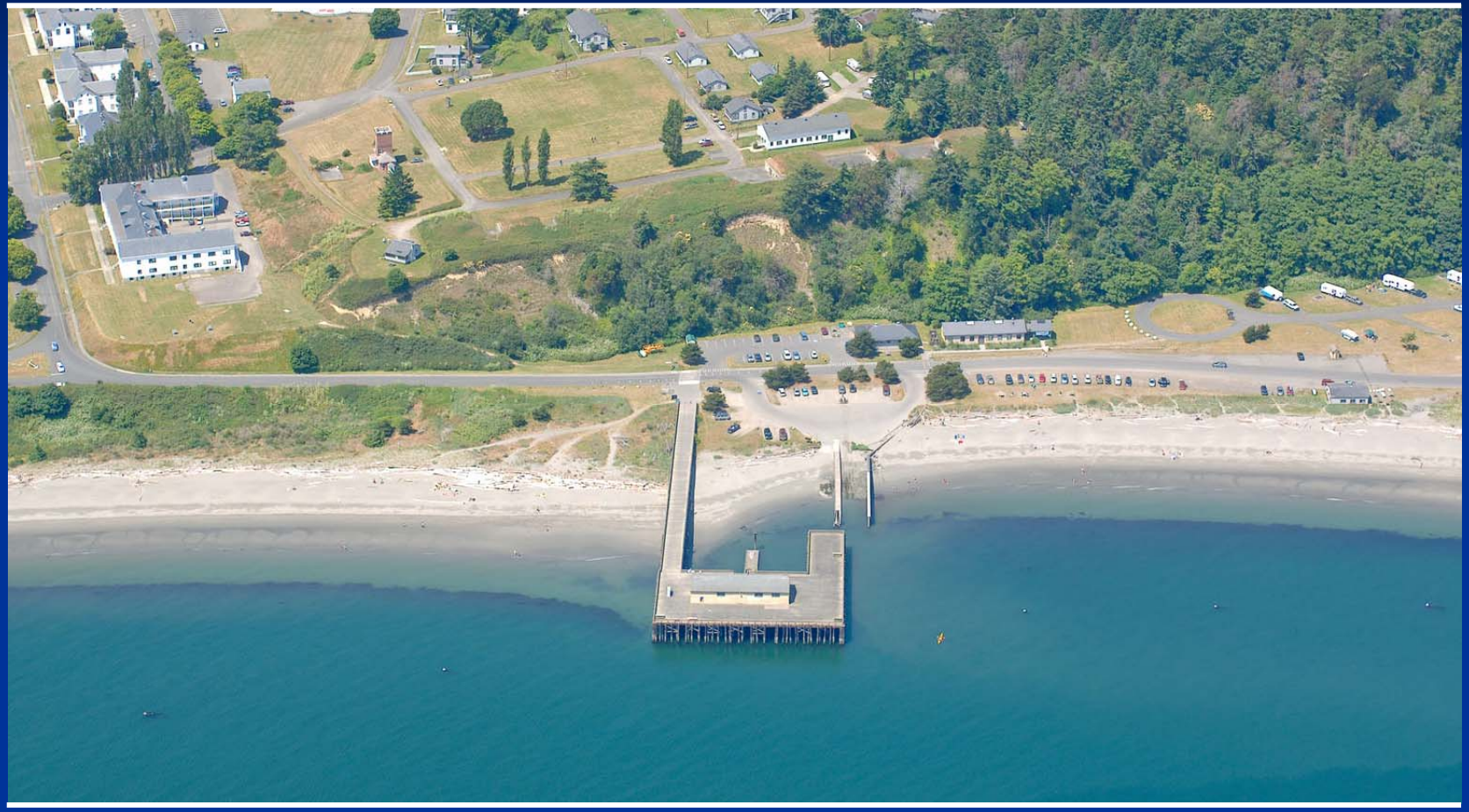
Next Steps

- Stakeholder Coordination
  - Coordination between JCMRC, Parks, Port, Recreational Boating Interests, City, and others
- Biological & Environmental Conditions
  - Identify baseline conditions for habitat conditions
- Restoration Project Scoping
  - Define goals and objectives of restoration project based on site physical and biological conditions which meet the proposed future use of facility
- Engineering Analysis & Data Collection
  - If further investigation is desired, the following elements should be conducted as a next step:
    - Hydrographic survey of the pier, dock and boat ramp areas for finalizing analysis and evaluation of alternatives
    - Detailed wave and sediment transport analysis with the new data
    - Evaluation of design alternatives
- Regulatory Permitting
  - Review local Shoreline Master Program and Critical Areas Ordinances for proposed project scope
  - Review proposed project scope with state and federal regulatory agency personnel

Jefferson County
Marine Resources Committee

FORT WORDEN STATE PARK

Marine Science Center Pier & Boat Ramp Facilities



Preliminary Level Coastal Processes Assessment

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June 15, 2011