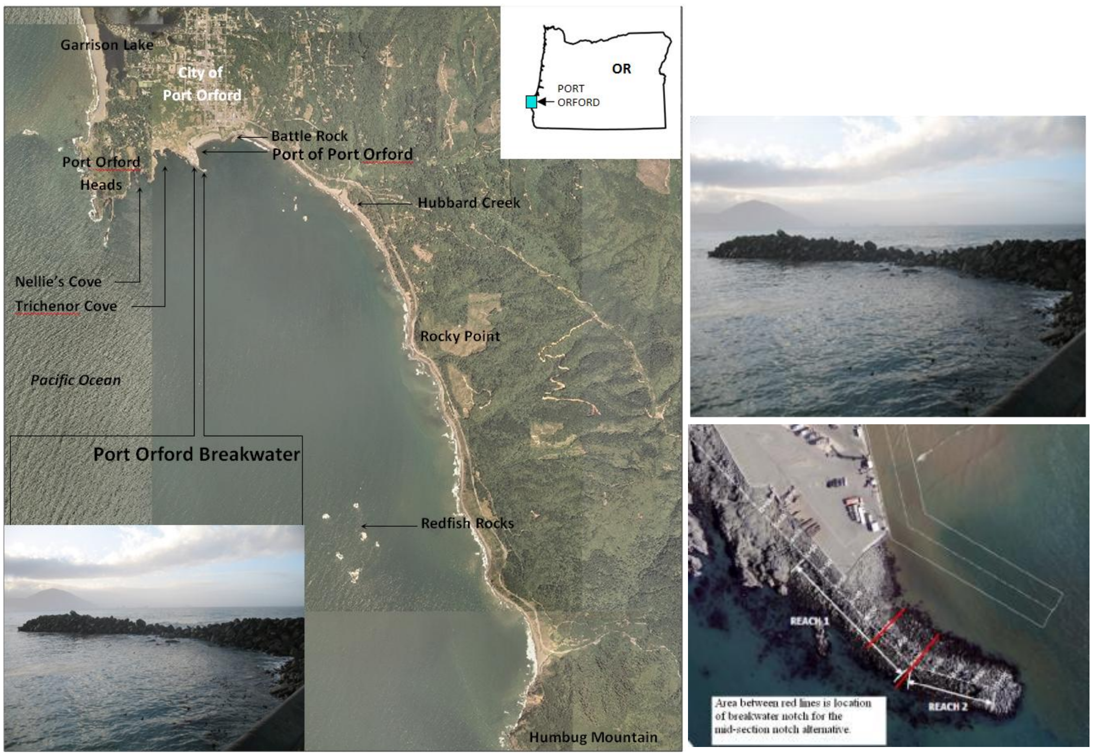
US Army Corps of Engineers®
Engineer Research and Development Center

Regional Sediment Management Program
Sedimentation at Port Orford, OR

Description

Port Orford is a small boat harbor located within a natural cove along the southern Oregon coast, approximately 50 miles south of Coos Bay and 70 miles north of the Oregon/California state line, in the County of Curry (Figure 1). In operation since the 1930s, Port Orford supports commercial fishing and serves as a critical harbor of refuge. Vessels are launched and retrieved via two cranes adjacent to the wharf and are either stored on-site on dollies or trailered off-site; there are no in-water berths.



Issue/Challenges

Determining repair/maintenance alternatives that meet the Federal object of wave attenuation while decreasing the need for annual dredging maintenance would benefit the Navigation mission and Port Orford. Even following dredging events Port Orford can receive extreme and rapid shoaling, complete infill in a single storm event. Funding for low use ports, such as Port Orford, has become a low priority. An alternative to annual dredging, given the funding climate, is needed to achieve the NWP navigation mission at Port Orford and other small coastal ports. A 2011 report has identified 6 alternatives to address a breach in the federal breakwater structure, ranging from removal to repairs. A mid-section notch in the breakwater was identified as the least cost alternative. This alternative would allow some flushing through the structure while still providing some wave attenuation. The Port has advocated for complete removal of the federal breakwater in an attempt to reduce shoaling at their dock. Identifying the shoaling pathways at Port Orford will be critical to fully developing the alternatives.

Successes Lessons Learned

Earlier studies conducted by the US Army Corps of Engineers Waterways Experiment Station (1974) studied several improvement plans to address the harbor shoaling through use of a physical model. The improvement plans included removal of portions of the existing breakwater, realignment or lengthening of the existing breakwater, and construction of new breakwater structures. Results indicated that removal of portions of the existing breakwater would slightly improve the shoaling conditions, but also inversely affected the wave climate at the dock. In 2008, a focus group comprised of coastal scientists and engineers, local fishermen, and community leaders (USACE 2011) met twice to develop recommendations for alleviating the shoaling problems at Port Orford.

Several additional studies have been conducted for the Port Orford Site, including geologic mapping, bathymetric reports, and the most recent MMR. The 2011 MMR included numerical modeling of the coastal processes to evaluate the designated alternatives. The numerical modeling approach consisted of four separate components to address various design aspects of the alternatives. The components were a spectral wave model to transform the deep water wave characteristics as represented by the offshore wave buoy to shallow water closer to the project site (Danish Hydraulic Institute (DHI) MIKE 21 Flexible Mesh Spectral Wave module (FM SW)); a hydrodynamic model to simulate the tidal and wind generated currents (MIKE 21 Flexible Mesh Hydrodynamic (FM HD) model); a transport model (MIKE 21 particle tracking model) to provide a qualitative assessment of the sediment transport and shoaling mechanisms in the vicinity of harbor; and The DHI MIKE 21 Boussinesq Wave (BW) model to provide a more rigorous formulation of the wave dynamics.

It was emphasized to the contractor that the USACE Particle Tacking Model (PTM) model had a vast array of capabilities to realistically simulate sediment in terms of its true gradation and density, and fully integrate all modes of hydrodynamic forcing for assessing sediment pathways at any coastal location, however, due to scope and execution framework limitations, the contractor was restricted from utilizing the USCE PTM model. While not the preferred model, the net wave energy flux associated with the MIKE Boussinesq wave model was used to estimate sand transport potential as an indicator of possible improvements to shoaling. This approach is qualitative in nature, but does provide some indicator of possible opportunities for reducing the shoaling in the entrance channel and along the wharf face. There were four alternatives that redirected the wave-induced transport away from the wharf face; breakwater removal, mid-section notch, modified notch, and to some degree the shortened breakwater. Of these alternatives, the mid-section notch appears to generate the greatest transport away from the wharf face. The associated high wave heights at the wharf for the breakwater removal alternative make this alternative the least attractive from a total performance perspective.

One other aspect of the sediment transport potential computed with the MIKE Boussinesq wave model is the apparent pathway of the sediment into the Port. Based on the model results, it appears that the sediment is being transported from the area to the southeast of the breakwater tip, but not necessarily along the beach face. This area is still within the littoral zone as defined by the depth of closure of 10 m to 15 m. The wave crests even for waves from the south appear to actually move sediment towards the southeast along the beach face. This apparent localized phenomenon of sediment transport at Port Orford is not consistent with the conceptual regional framework that advocates a northwest transport trend within the overall littoral cell between Humbug Mountain and Port Orford Head (figure 1). Because of the complex nature of the wave attenuation through the notch and around the breakwater tip, additional numerical studies of waves and sediment transport will provide little additional insight into the performance of the Mid-Section Notch.

Expected Products

- Conform MIKE 21 data to CMS model framework

- Apply CMS and Bouss-2D models at Port Orford
- Set-up PTM model for Port Orford using CMS forcing data
- Apply PTM model to hind cast shoaling pathways at Port Orford
- Apply PTM mode to forecast shoaling pathways at Port Orford – Present Condition
- Apply PTM mode to forecast shoaling pathways at Port Orford – Alternative Condition
- Produce Sediment Transport Pathway Assessment and Lessons Learned Report

The milestone products will produce an informed assessment of regional sediment transport pathways at Port Orford for the existing project condition, and for the least cost alternative to address poor life-cycle performance of the severely degraded federal breakwater at the port. The resultant product may be applicable to other low use ports as an alternative to annual dredging and limited funds.

Potential Users

USACE Portland District, Port of Port Orford, other low use coastal ports

Projected Benefits

This project will provide an improved definition of littoral sediment transport pathways that affect shoaling at the Port of Port Orford. Based on a fully informed assessment of shoaling pathways, USACE and the Port will be able determine the best repair/modification alternative for the existing breakwater, while minimizing risk and costs related to sediment management and wave action. The RSM study will also evaluate if dredged sediment placement at the 404 Clean Water Site is affecting the sediment shoaling within the Federal Channel. Results from this RSM study could be applied to small harbors and navigation projects facing both short and long term funding limitations.

Leveraging Opportunities

This RSM proposal builds on recently competed work to reduce project risks associated with sediment management affected wave attenuation at Port Orford, associated with modification of the federal breakwater. A 2011 Major Maintenance Report (MMR) was prepared to address a breach in the breakwater structure. Six alternatives were looked at that would maintain the wave protection function of the breakwater, while potentially alleviating the shoaling problem, or at a minimum, not exacerbating the present shoaling problem.

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