

TIDAL INLET MORPHOLOGY CHANGE IN RESPONSE TO NAVIGATION IMPROVEMENT

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THE PROBLEM AND THE PROJECT

This paper describes accelerating morphology change within a confined tidal inlet responding to navigation channel improvement/maintenance and related hydrodynamic effects. The extent of morphology change is profound and compromises the inlet's stability, shore-based assets, and navigation features. The Ilwaco Inlet is located within the Mouth of the Columbia River (MCR), bordering the states of Washington and Oregon along the Pacific Northwest Coast of the United States. (46°15'25"N, 124°02'10"W). The Ilwaco inlet supports a regionally important waterway servicing the Port of Ilwaco (> \$20 million/yr commerce) and a US Coast Guard station (regional SAR activity & national motor lifeboat training school). The US Army Corps of Engineers is responsible for maintaining the inlet's 5 km-long federal navigation channel (45-60 m wide and -4.9 m MLLW depth) and four hydraulic control structures to support the Ilwaco FNC (pile dikes). The downstream-southern 2.5 km of the inlet (Figure 1) interacts directly with the Mouth of the Columbia River.

PROJECT EVOLUTION & MORPHOLOGY CHANGE

The Ilwaco inlet was first improved by the US Army Corps of Engineers to support navigation during 1939-1948. Prior to stabilization, the inlet's natural morphology was defined by constantly shifting broad tidal shoals and a migratory tidal channel. Construction of Jetty A (1.8 km long) in 1939 helped stabilize the northern margin of MCR and began the process of anchoring the shifting sand shoals that defined the natural condition of Ilwaco inlet. During 1946-48, four timber pile dikes (80–500 m long) were constructed along the western shore of West Sand Island to secure a consistent navigation channel within Ilwaco inlet. Pile dikes are shore-attached features having an enrockment foundation with vertical piles to create a permeable structure for re-directing flow toward a tidal channel's thalweg (reducing channel shoaling). The pile dikes established a stable FNC within the once unstable inlet and the FNC required periodic maintenance dredging of 40,000 cubic meters every 1 to 3 years. In 1974-77, pile dikes 0.28E and 0.50 were flanked as the west-shore of West Sand Island began to recede eastward. Tidal flow passing between the island and PDs 0.28E & 0.50 promoted progressive erosion of the island and disruption of other morphology within Ilwaco inlet. Progressive erosion of the inlet's morphology and deepening of tidal channels increased the inlet's hydraulic conveyance, allowing increased tidal exchange through the inlet, which accelerated loss of the inlet's morphology. After 2000, maintenance dredging increased to 60-100,000 cubic meters per year. The inlet's morphology exhibited an increased rate of change after 2010. During 2015-23, the continual loss of tidal shoals was exposing adjacent areas and infrastructure to increased wave action and currents (Figure 1). Rapid migration of tidal shoals has altered circulation patterns within the inlet inducing erosion and sedimentation problems.

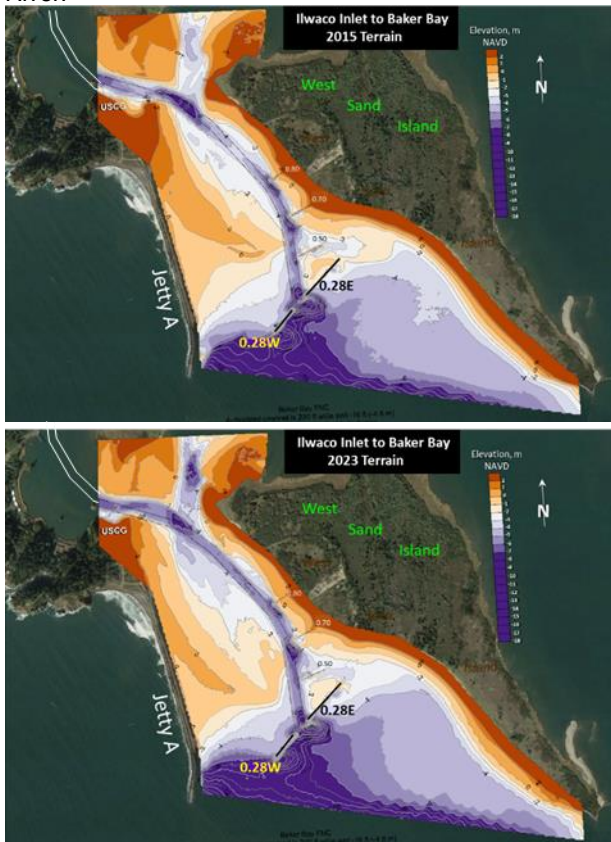


Figure 1. Comparison of 2015 and 2023 bathymetry at Baker Bay-Ilwaco inlet, Oregon and Washington, USA.

FEATURED RESULTS

The paper provides a synopsis of morphology evolution within Ilwaco inlet during 1939-2023 and links the morphology change to the inlet's tidal hydraulics. A detailed evaluation of 2015-2023 morphology change will be presented. The paper will summarize application of a 2D Adaptive Hydraulics model used to evaluate interaction of morphology, navigation features, and tidal circulation within the inlet. The paper concludes by providing the rationale for enacting a phased- intervention strategy to address morphology loss, pile dike repair, and future sustainability considerations for the inlet.

REFERENCES

US Army Corps of Engineers. 2020. "Baker Bay Pile Dike Repair, Design Documentation Report", Prepared by USACE Portland District.