COASTAL INLET DYNAMICS FOR SOUTHERN CALIFORNIA

A Thesis

Presented to the

Faculty of

San Diego State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

in

Geography

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by

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Fall 1989

(H. Chang/Stow; R/CZ-79)

This work is a result of research sponsored in part by NOAA, National Sea Grant College Program, Department of Commerce, under grant number R/CZ-79, project number UCSG-17, through the California Sea Grant College Program, and in part by the California State Resources Agency. The U.S. Government is authorized to reproduce and distribute for governmental purposes.

Field work was made possible by the State Parks aned Recreation (thanks Paul Jorgenson), and the U.S. Fish and Wildlife Service.

ABSTRACT

This research focuses on the morphologic dynamics and stability of three small tidal inlets within southern California. These inlets were analyzed in terms of morphological response to process and material factors such as tidal currents, stormwaves, stream stormflows and bed sediment sizes.

Small tidal inlets which are typical of southern California differ from the larger, more frequently studied inlets of the U.S. East and Gulf coasts in that they are non-navigable, vulnerable to closure by wave-related sedimentation and are easily opened by episodic stormflow events. The inlets to the Tijuana and San Dieguito Rivers, and Los Penasquitos Lagoon were chosen for study because of their contrasting tidal prism volumes and sediment properties.

Field data were acquired by topographic surveying, obtaining hydraulic measurements and sediment samples, and researching existing data sources. Historical and new aerial photographs were acquired and interpreted. An existing numerical model of stream transport processes was modified to simulate processes operating within small inlets. The INLET model was calibrated with

field data and with parameters reported in the literature. It was then used to perform sensitivity analyses and to simulate a range of inlet processes.

Conclusions based on field observations and numerical modeling suggest that high magnitude flow processes, such as river stormflow, are a dominant influence on inlet morphology over long time periods. Scouring by stormflow waters delivered to the inlet by coastal streams restores and maintains inlet stability even under high energy wave conditions (as occurred on January 18, 1988).

In the absence of stormflow, short term variations in inlet morphology and stability are dependent on the magnitude of tidal currents which varies as a function of tidal range and the volume of the potential tidal prism. Inlet cross-sectional area below mean sea level at the throat section enlarges during large tidal ranges (spring tides, e.g. 659 square feet on July 12, 1987--tidal range 7.5 feet) and constricts during small tidal ranges (neap tides, e.g. 128 square feet on June 5, 1987--tidal range 3.0 feet). Tidal range also affects the location and extent of the wave breakpoint throughout the tidal cycle and consequently sedimentation within the inlet and estuary.

The study inlets became unstable and closed as a result of sedimentation by winter stormwaves. Field data and modeling results show inlets to become unstable under the influence of large wave heights and neap tide conditions. Waves cause sedimentation within an inlet by processes associated with longshore drifting and shoreward migration of a bar. They also reduce the stability of the inlet by overwashing the barrier beach and depositing sediment in the estuary/lagoon, which reduces the effective tidal prism and scouring potential of tidal flows.

Inlets with relatively large bed sediments (cobble-sized) tend to be unstable. Inlet flows were unable to scour large bed sediments at Los Penasquitos Lagoon inlet, which resulted in frequent inlet instability and closure.

The INLET model is effective for simulating many inlet processes and for predicting inlet morphology. The model was used to simulate tidal, wave and stormflow processes, and the effects of varying bed sediment sizes. The model estimated inlet cross-sectional area changes comparable to those measured in the field ($r^2 = 0.64$), when simulating tidal current processes for a number of different tidal ranges.