Fact Sheet

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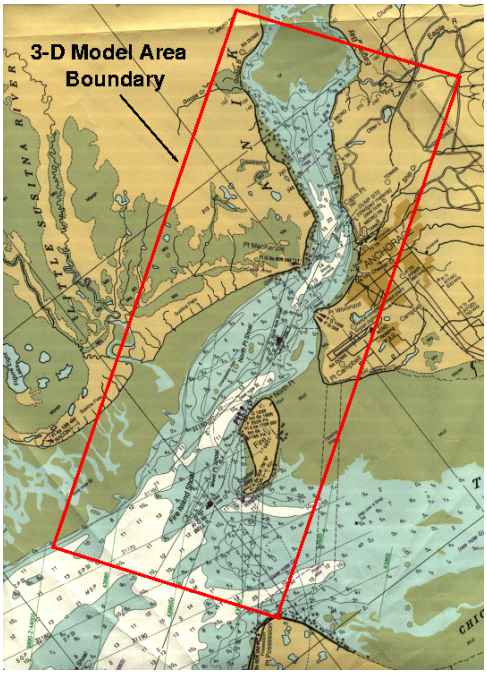
Flow Table Model of Cook Inlet, Alaska

Purpose: To describe and summarize a small-scale physical model study of tidal flow in upper Cook Inlet, Alaska. The study was conducted using the Coastal and Hydraulics Laboratory (CHL) Precision Flow Table.



Background: Shoaling at Anchorage Harbor during the summer months has required annual dredging that averages between 200,000 and 400,000 yd^3 per year with occasional larger deposition quantities between 800,000 and 1,000,000 yd^3. The tidal flow regime is characterized by a large tidal range and significant flow separation and turbulence at major headlands. The U.S. Army Engineer District, Alaska, sponsored flow table studies to determine if the turbulent flow regime could be correctly modeled using a large, distorted-scale physical model of Cook Inlet. The study also provided initial screening of the hydrodynamic flow regime in upper Cook Inlet in the vicinity of the Port of Anchorage.

Facts: Two types of flow table models were designed and constructed for this study: (a) Idealized models at two different scales with bathymetry represented as two or three horizontal terraces, and (b) a 3D model that reproduced actual bathymetry covering Cook Inlet over the 31-mile reach outlined on the photograph. The model had a horizontal length scale of 1:15,000 and a vertical length scale of 1:100 giving a model distortion of 15. The 3D model was divided into six sections over the 31-mile reach, but only four sections (about 20 miles) could be placed on the flow table at a time. By removing sections on one end and adding sections on the opposite end, different reaches of Cook Inlet to be tested with adequate upstream boundaries represented in the model.

Flow patterns were visualized and observed in both the idealized and 3D models for maximum flood and ebb flow. The flow table models helped to clarify the flow regime, which included flow separation and large vortex regions in the lee of the major headlands; and flow visualization techniques indicated that shoaling at the Port of Anchorage was enhanced by ebb tide flow separation occurring at a headland (Cairn Point) located just upstream of the Port. This particular finding had not been hypothesized prior to the flow table tests. Evidence of three-dimensional flow circulation patterns factored into the District's evaluation of more comprehensive modeling approaches. Injected dye was used to investigate how dredged sediment might move when deposited from barges at different locations during both ebb and flood flows. Depending on the flow direction and the injection point, it was not unusual to observe dye migrating back into the vicinity of the Port. These simple experiments revealed more efficient dredging and disposal practices that could substantially reduce the amount of deposited dredge material re-entering the Port area.

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