

# Coastal Engineering

## Values

Coastal areas are the world's most densely populated lands and face enormous challenges to meet the competing demands of society and the environment. Substantial challenges exist in meeting the infrastructure demands of coastal cities and ports, as well as environmental and recreational needs in coastal regions, especially in the face of climate change and resulting sea level rise. Accommodating these varied needs and addressing their impacts on natural coastlines requires a careful understanding of coastal processes.

## Services

NHC's services focus on understanding, analyzing, and designing for estuarine and coastal processes. These processes include tidal hydrodynamics, wave transformation, wave agitation in harbors, littoral currents, long-term and short-term beach stability, tidal marsh dynamics, and dispersion of sediment and thermal plumes. NHC provides planning and design services, construction administration and supervision, and documentation for tidal marsh restoration, bio-engineered and other shoreline protection, and floating and fixed breakwater structures.

### OUR SERVICES INCLUDE:

- Coastal hydraulic, geomorphologic, and sediment transport analyses
- Field surveys of bathymetry, waves, currents, salinity, and sediment characteristics
- Wave generation, refraction, diffraction, run-up, and dissipation
- Wind/wave circulation and transport modeling using SWAN, Delft 3D, MIKE 21, MIKE 3, LITPACK, WHAFIS 4.0, Telemac, Bouss-2D, ADCIRC
- Assessment of coastal/estuary flooding, wave run-up, storm surge, and sea level rise, to determine flood construction levels
- Conceptual and detailed design of foreshore erosion protection, including beach nourishment, groins, revetments, and seawalls
- Conceptual design of marinas, small harbors, and floating/fixed breakwaters
- Estuary hydrodynamics (density currents, morphodynamic modeling)
- Environmental studies: outfalls, dredging, plume dispersion/mixing, habitat, project monitoring



## Technical Approach and Capabilities

Solutions to coastal and estuarine issues require a keen understanding of the interrelated processes of wave climate, hydrodynamics, climate and sea level change, wind and wave interactions, and sedimentation processes on tidal marsh and coastal shoreline conditions. NHC has the experience, expertise, and capability to apply this understanding to determine project alternatives, assess potential impacts, and provide coastal project and mitigation designs. NHC's experience and capability to collect field data supports our coastal analysis and engineering designs.



## Experience

### ■ Tidal Marsh Geomorphology and Restoration Design

Geomorphologic modeling of tidal channel formation, marsh vegetation interactions, and sedimentation for developing tidal marsh restoration and mitigation designs. Analysis of sea level rise, sediment accretion, and bio-accretion to quantify marsh habitat evolution over various time horizons.



*Laser-based in-situ grain size measurements, Fraser River Estuary, Vancouver, BC*

### ■ Support for Infrastructure Design

Providing data and analysis to design engineers from numerical and physical modeling to assess harbor agitation, wave refraction coefficients, scour, and erosion/sedimentation. Through modeling and analysis, NHC's specialists also provide conceptual design parameters and layout optimization.



*Erosion protection, Dollarton foreshore, North Vancouver, BC*

### ■ Shoreline Erosion Protection

Reconstruction and protection of shoreline and intertidal foreshores including mitigating contaminated sediments and incorporating aquatic habitat features. Application of bio-engineering to protect against wave erosion. Detailed design, construction supervision, and repairs for riprap protection structures.



*Coastal model at Lasalle|NHC, Montreal, QC*

### ■ Coastal Geomorphology

Assessment of coastal and estuarine geomorphic, tidal, and wave effects on infrastructure development (e.g., ports) using historical data, site observations, detailed field measurements including ADCP and LISST samples, and numerical modeling of tidal currents, waves, salinity, and sediment transport.

### ■ Coastal Flood Hazard Analysis and Mapping

Development of 2D numerical models to assess flood hazards from the combined effects of tides, storm surge, wave run-up, and interactions with river flows. Flood hazard mapping using GIS and dynamic visualizations. Identification of flood vulnerability and assets at risk. Simulation of potential effects of sea level rise on coastal flooding. Planning of mitigation measures.

## Benefits

NHC's understanding of coastal environment processes, and how anthropogenic interventions affect these processes, combined with our extensive experience, assists clients in planning and designing projects that meet their technical, economic, and environmental objectives.

## Contacts

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