http://www.pac.dfo-mpo.gc.ca/sci/osap/projects/qci/qci.htm), indicating the importance of the Cape to regional circulation patterns. Evidence also exists for a re-circulation of water in the region to the east of the Cape (Crawford *et al.* 1995).

In comparison with other regions of Canada, where offshore hydrocarbon exploration and development activities are currently underway, the ocean currents and circulation patterns in the northern waters of British Columbia are complex and highly variable. Associated with this complexity is a high degree of uncertainty, particularly with respect to predicting the fate of contaminants discharged to the marine environment. This complexity and variability is a consequence of several factors, but is strongly related to the combination of complex bathymetry (Figure 4.2) and large tidal exchanges.

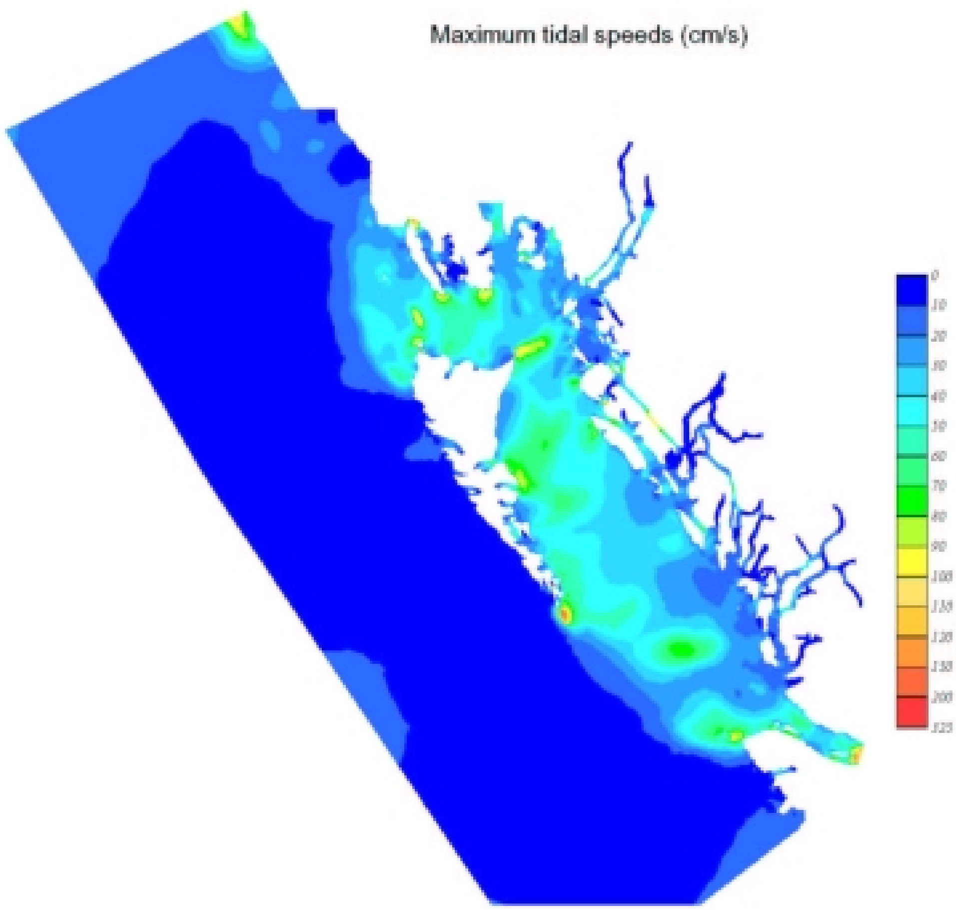

Figure 4.4 Maximum tidal current speeds in northern British Columbia water (courtesy of M. Foreman, Fisheries and Oceans Canada).

4.4 Storm Events

The normal climatic conditions described in Section 4.2 are routinely disrupted by storm events associated with eastward-migrating low pressure centres. These depressions follow two major tracks: one group originates in the northwest Pacific and moves northeastward along the Aleutian Islands, reaching the Alaska coast as fully-developed cyclones; while the second group originates in mid-ocean and reaches the coast of British Columbia at the height of storm development, causing severe winter gales.

The storm activity off the British Columbia coast is distinctly seasonal, with most summer storms following the northern track to the Alaska coast. In October, storm frequency and intensity increase rapidly with more storms following the southerly track. Throughout the winter months, storms regularly reach the coast at two- to three-day intervals. There is a gradual decrease in storm activity through April and May as the storm pattern, frequency and intensity return to summer conditions (Petro-Canada 1983).

Strong winds, high seas and strong currents are produced by storm events. These factors typically determine the maximum environmental loads on marine structures and thus the safety of various structural elements, but also limit the conditions under which various drilling-related operations can proceed. Knowledge of the wind, wave and current conditions at a proposed drilling site is required to choose safe equipment for that site and to select the most effective equipment to maximize the efficiency of drilling operations.

Table 4.1 Design Parameters For Typical Drilling Units (Petro-Canada 1983)

Drilling Unit	Operating Limits	Survival Limits
Drillship		
wind speed (kmh^{-1})	90	185
current speed (cms^{-1})	80	100
wave height (m)	10	30
wave period (s)	<10	>10
Semisubmersible		
wind speed (kmh^{-1})	110	185
current speed (cms^{-1})	100	100
wave height (m)	15	30
wave period (s)	<14	>14

Note: To restrict drilling activities, operating limits for wind, current and sea state must be exceeded concurrently.

Table 4.1 shows the design parameters and operating limits of a typical drillship and semi-submersible, circa 1980 (from Petro Canada 1983). These limits should be considered only as a general guide, since available equipment is continuously evolving with both development of new types of drilling units together with refined designs for existing platform types (see Section 5.2). Bottom-founded drilling units such as jack-up platforms and gravity-based structures (e.g. Hibernia) do not have the same limitations.

From an environmental perspective, storm-driven currents may be the most significant factor impacting the fate and dispersal of contaminants discharged to the marine environment, while sea state parameters will influence the design and effectiveness of oil spill contingency plans and equipment.

In addition to defining the wind, wave and current conditions to be expected during a storm event, the speed during which storms can cause operating conditions to deteriorate is a significant aspect of determining routine environmental safety (WCOEEAP 1986). In its report, the Environmental Assessment Panel concluded that six hours notice of impending storms is the minimum time required to temporarily cease operations, make the drillstring secure and safely disconnect from the wellhead. The Panel recommended that approval for exploratory drilling not be given until the Atmospheric Environment Service of Environment Canada is satisfied that the capability exists to provide a minimum of six hours advance warning of severe storms.

While storms are of significant concern, the predictable storm events off the British Columbia coast are of lower intensity than those faced by offshore structures in other areas of the world (see Section 4.4.1).

4.4.1 Winds

The waters surrounding the Queen Charlotte Islands are commonly reported as the windiest in Canada, with severe winds more common than in other areas (WCOEEAP 1986). The strongest wind ever recorded for Cape St. James is 177 kmh^{-1}, recorded during a storm in January 1951. At that time, winds were recorded only every six hours; the lighthouse keeper estimated that winds had reached a steady 200 kmh^{-1} with gusts to 225 kmh^{-1} during the peak of the storm (Petro-Canada 1983).

Extreme wind speeds are typically estimated from long-term data records in the area of interest. In addition to the land-based climatological stations discussed in Section 4.2, the Atmospheric Environment Service and DFO together maintain a set of marine weather buoys in northern waters. The marine weather buoys were installed between 1987 and 1993, providing roughly 10 years of historical data for wind-over-water conditions. Station locations are shown in Figure 4.5, and parameters measured at each type of station are given in Table 4.2. The MAREP station shown on Figure 4.5 reports the same data as the climatological stations, identified as marine weather reporting stations on Figure 4.5. However, the MAREP station also reports weather information on VHS radio.