

Natural attenuation of hydrocarbon impacts in a cold weather climate, Sable Island, Nova Scotia, Canada

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Sable Island, located approximately 300 kilometres (km) east of Halifax, Nova Scotia, is notorious for the number of shipwrecks which have occurred along its coastline. The island is also well known for the Sable Island wild horses. The island has been used as a light and weather station, as a base for scientific studies, and as a support base for the off-shore oil industry. It is also in close proximity to the Sable Offshore Energy Project. Sable Island is a crescent shaped series of sand bars and dunes, with the main body of the island approximately 27 km long and is defined by two well developed systems of sand dunes paralleling the north and south beaches. The geology of Sable Island is unique to Nova Scotia in that the complete sequence of surficial materials are sand sized particles. The groundwater present under Sable Island is reportedly unconfined and extends the entire length of the island.

The island, although not an arctic site, routinely records sub-zero temperatures during the winter months. The open island environment, island geology and severe winter conditions result in frozen soil conditions that will affect the use of natural attenuation for treating subsurface impacted soils and groundwater.

In 1995, an environmental site assessment on the island identified soil and groundwater impacts resulting from diesel and gasoline releases. The soil and groundwater impacts were identified at locations on the island where hydrocarbon products were either stored and/or consumed. A follow up study was completed in 1996 with the installation of monitor wells for groundwater sampling. During 1995/1996 investigations, baseline soil and groundwater conditions were determined along with a number of natural attenuation indicators, such as dissolved oxygen, inorganic parameters etc.

On determining the extent and severity of soil and groundwater impacts; the second objective of the study was to determine options for the remediation of the identified impacts. A variety of passive and active remedial options were screened for cost, effectiveness and applicability. Based on the unique habitat associated with the island, it was deemed necessary to remediate the site using a non-intrusive approach. The non-intrusive approach selected was natural attenuation. However, little was known on whether the unique geological conditions and severely cold seasonal weather conditions of the island could support natural attenuation.

The natural attenuation program commenced in 1998 with the collection of two rounds of soil and groundwater samples. The soil and groundwater samples were tested for natural degradation chemical indicators. The chemistry results indicate that natural attenuation is taking place in this unique island environment. In addition, the chemistry results were evaluated using several natural attenuation models to predict a future endpoint for the natural attenuation program.