



KINDER MORGAN CANADA EMERGENCY MANAGEMENT PROGRAM: Research Initiatives

The Kinder Morgan Canada Inc. (KMC) Emergency Management (EM) Program is based on a system of continual improvement. Avenues to identify improvements include:

- Natural evolution of industry Emergency Management practices
- Feedback from Operations staff and emergency exercises
- Input for consideration from Aboriginal communities and stakeholders
- Regulatory changes
- National Energy Board (NEB) and British Columbia Environmental Assessment Office (BC EAO) condition requirements
- New technologies and research findings

Trans Mountain emergency response plans and strategies currently meet, and often exceed Regulatory requirements. Research findings are directed towards further improvements.



BC EAO Condition 35 – Fate and Behaviour of Bitumen Research

Trans Mountain must provide a report regarding the current and future research programs it is leading, jointly-leading, supporting or otherwise involved in regarding the behaviour and recovery of heavy oils spilled in fresh water and the marine aquatic environment.

The condition includes potential research topics on the different physical and chemical properties of the oil and other products intended to be shipped from the Westridge Marine Terminal, product weathering, dispersion and oil/sediment interactions, product submergence, product behaviour and cleanup following in-situ burning, and cleanup and remediation options for sediments and shoreline. Additionally, the condition requires Trans Mountain to report how it is incorporating any applicable research results into its emergency preparedness and

response plans; and that Trans Mountain will work with spill responders to support the incorporation of the results of the research into its emergency preparedness plans and programs.

Trans Mountain must provide the report to Aboriginal groups and to the BC Environment Assessment Office (BC EAO), Ministry of Environment (MoE), Ministry of Natural Gas Development (MNGD) and Oil and Gas Commission (OGC); and federally, the Environment and Climate Change Canada (ECCC), National Energy Board (NEB) and the Canadian Coast Guard (CCG), prior to the commencement of Project operations and must provide progress updates one year and five years, after commencement of operations.

Trans Mountain is currently conducting and funding research in support of BC EAO Condition 35 and to improve spill response. This includes:

National study to compare the Fate and Behaviour of Crude Oils on Water

An independent, science-based multi-million-dollar study was commissioned by the Canadian Energy Pipeline Association (CEPA) and the Canadian Association of Petroleum Producers (CAPP). The study is designed to evaluate and compare the physical and chemical properties of various types of crude oil that move in North America. More than 10 types of crude oil, including several diluted bitumen products are undergoing a number of tests to determine how the fresh and weathered oils behave in various marine, estuarine and freshwater settings, under different environmental conditions.

A scientific advisory committee was established to provide the technical knowledge and guidance necessary to facilitate the study. The committee members are from Environment and Climate Change Canada, Fisheries and Oceans Canada, the National Energy Board, Natural Resources Canada and include a world-renowned independent spill response expert.

The study is in progress and results will be publicly available at the end of 2018.

Examining the potential effects of controlled spills of diluted bitumen and conventional heavy crude oil

Trans Mountain is supporting the International Institute for Sustainable Development-Experimental Lakes Area Program. This unique multi-year industry and government collaborative program is examining the fate and behavior of diluted bitumen and conventional heavy crude oil in a freshwater shoreline environment. Baseline chemical and biological information was collected in 2017 for a natural lake study site using an actual Canadian lake.

In 2018, the International Institute for Sustainable Development will be conducting a controlled spill of oil to quantify the efficiency of immediate product recovery and further analysis of residual oil constituents. Potential impacts will be evaluated for 16 weeks. The information from this portion of the project will be used to determine if degradation is significantly different for diluted bitumen and conventional heavy crude oil, and if wave energy has a significant effect on oil degradation rates in the freshwater shoreline environment. The program will also compare cleanup methods for the oil spilled.

A scientific advisory committee is expected to be established for this project in 2018; invitations to participate will be extended to ECCC, DFO and the NEB among others.

ENHANCEMENT OF THE EMERGENCY MANAGEMENT PROGRAM

Trans Mountain will assess the findings from all the stated studies to identify opportunities to improve spill response strategies.

Findings from the Spill Response Technology Review Study has already led to improvements in the KMC Emergency Management Program and response strategies, including, however not limited to, the purchase of specialized equipment and the development of a Sunken and Submerged Oil Plan.



Underwater Seabed Cleanup and Assessment Technique Guide

Support was provided by Trans Mountain for the development of an Underwater Seabed Cleanup and Assessment Technique Guide (uSCAT), together with Western Canada Marine Response Corporation (WCMRC), CCG, NRCan and DFO.

The guide will specify common language, identify strategies for searching for sunken oil and describe techniques for documenting and communicating its distribution.

As part of this research, an uSCAT science advisory committee was established including representatives from ECCC, DFO, CCG, NRCan and independent spill experts to provide guidance and feedback on the direction of this initiative.

Trans Mountain Financial Contributions

Trans Mountain has allocated more than \$2 million dollars thus far to research into the fate and behaviour of bitumen.

Spill Response Technology Review Study

Trans Mountain participated in a joint industry project including the governments of British Columbia (BC Oil and Gas Commission) and Alberta to independently evaluate and review current inland spill response technologies focusing on diluted bitumen. The purpose of the Inland Spill Response Joint Industry Program was to conduct a comprehensive review of the current technology that exists for inland spill response oil recovery; apply the existing technology to four scenarios; identify suitable technologies; and identify gaps in the existing current technology. The review focused on diluted bitumen.

The study was completed in 2017.

The intent of further research is to add to the pool of knowledge about oil fate and behaviour that can be used to support decision-making during a response and to improve oil spill response overall.



Other Completed Research

Salish Sea Oil Spill Trajectory

Trans Mountain supported the evaluation of spilled hydrocarbon fate and behavior, and the associated effects at five representative sites along the shipping route in the Salish Sea. Modelling at these sites predicted spill trajectories, probability of shoreline oiling and a number of additional variables, based on measured crude oil properties and more than 360 simulations. The modelling considered season-specific behaviour (wind direction and speed, temperature, etc.), trajectories and oil fate.

The modelling demonstrated that a single spill scenario evaluation should not be assumed, nor be expected, to predict actual outcomes at a particular site, or for particular resources of interest. From a practical perspective, the models indicated where spilled oil could go in the event of an accident. WCMRC used the findings to decide on the planning standards for selecting the location of new response bases and for equipment with improved response times.

Oil Mineral Aggregates Formation Mechanisms for the Salish Sea and the Lower Fraser River

Building upon the research and observations characterizing the behavior of diluted bitumen in aquatic environments, Trans Mountain supported an investigation to better understand the potential interaction between oil and sediment, in the Lower Fraser River and the Salish Sea. The research findings were presented at the Arctic and Marine Oilspill Program (AMOP) Technical Seminar, Environment and Climate Change Canada in Ottawa, Ontario in 2016.

The research outcomes showed the results were aligned with previous studies, describing the conditions required for oil mineral aggregates to

form. Findings regarding oil behaviour on water, particularly the factors influencing the submergence and sinking of oil, influenced the selection and design of response strategies in Trans Mountain's response plans. The findings were shared with WCMRC for consideration in its enhancement of response plans and in the development of its Geographic Response Strategies (GRS).

Gainford Studies

Trans Mountain, together with WCMRC, completed field scale research in 2012. The team evaluated the fate and behavior of representative samples of dilbit discharged into a water environment similar to that of Burrard Inlet, BC and subjected it to various conditions of weathering. The study also assessed the performance of the equipment currently stockpiled by North American oil spill recovery organizations, including WCMRC, and found that spilled diluted bitumen can be successfully removed from the surface of the water using traditional mechanical response equipment.

Research conclusions published in 2016 by Biochemistry PhD, Dr. Heather Dettman of Natural Resources Canada's CanmetENERGY Laboratory in Devon, Alberta supports the results from Gainford. Dr. Dettman observed that diluted bitumen floats when exposed to water at temperatures up to 25 degrees C, and displays similar behaviour as other heavy crude oils when exposed to fresh water. In the unlikely event of a spill, it is amenable to conventional recovery measures such as the use of booming and skimmers.

For more information about research or other aspects of the Trans Mountain Emergency Management Program, please contact:

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