2003 Toxicity of Petroleum Hydrocarbons to Soil Organisms and the Effect on Soil Quality, Field Studies, Phase 2

This report represents the culmination of a four year field study that was initiated in 1999 and terminated in 2003. During this time, the degradation and ecotoxicity of fresh Alberta Federated crude oil, applied to sandy loam field plots at 1.2% (w:w) and to clay loam field plots at 1.7% and 3.7% (w:w), were monitored with the following objectives:

- to determine the degradation patterns of crude oil petroleum hydrocarbons (PHCs) in fine- and coarse-textured soils using analytical and soil respiration methods.
- to identify the length of time required for crude oil PHCs to achieve a stable degradation endpoint, and to determine the concentrations of PHC residuals in each of the two soil types when a stable endpoint was achieved.
- to monitor changes in ecotoxicity as fresh crude oil degrades in coarse- and fine-textured surface soils using standardized laboratory

bioassays and field assessments for measuring the effects of PHCs on plants, macrofauna, mesofauna and microbial processes.

- to evaluate the environmental risks associated with PHC residuals remaining in coarse- and fine-textured surface soils following an extended period (three to four years) of weathering.

Degradation patterns were obtained by measuring PHCs (Fractions 1, 2, 3, 4 as per CCME 2001) and soil respiration for 0, 3, 9, 12, 24, 32 and 36 months after application of fresh crude oil to the two soil types. Environmental risk was evaluated by conducting laboratory bioassays (plants, earthworms, springtails, MicrotoxTM) at the same times as the PHC analyses, and by performing crop assessments and macrofauna/mesofauna assessments in the field during the 0-12 month and 24-36 month periods of the study. In the case of the sandy loam soil, additional PHC, crop and mesofauna measurements were conducted 42-48 months after oil application.

The main findings and the relevance of the ecotoxicity measurements to the Canada-wide Standards for Petroleum Hydrocarbons (PHC) in Soil released by the Canadian Council of Ministers of the Environment in 2001(CCME 2001), and the Alberta Soil Quality and Water Quality Guidelines for Hydrocarbons at Upstream Oil and Gas Facilities released by Alberta Environment in 2001 (Alberta Environment 2001) are summarized

below. The Guidelines are subsequently referred to as CCME/ASWQ guidelines.

2003 Matrix and Stantec_Petroleum Hydrocarbons to Soil Organisms_Phase 2 Field Studies
2003 Matrix and Stantec_Toxicity and Guideline Development for Crude Oil_Phase 2 and 3_Presentation
2003 Matrix_Petroleum Hydrocarbons to Soil Organisms_Phase 3 Final Report
2003 EBA_Environmentally Acceptable Endpoints for F3 Presentation