

Framework Foundation and Guidance for Tier 2 Site-Specific Development of Soil Contact Cleanup Standards for PHC-contaminated sites

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In June 2001, the Canadian Council of Ministers of the Environment (CCME) released the new Canada-wide Tier 1 Standards for petroleum hydrocarbons (PHCs) in soils. These standards serve as soil quality criteria to assist with the management of site soils contaminated with petroleum hydrocarbons. The ultimate goal of these standards is the protection of human health and the environment. The assessment and management of petroleum hydrocarbons in soils in Canada are the result of the implementation of a three-tiered framework. The objective of this document is to provide a framework for site-specific development of Tier 2 soil contact remedial standards for PHC-contaminated sites, in the event that Tier 1 screening levels are exceeded.

This project was divided into two phases. Phase 1, of

which the results are discussed here, comprises a comprehensive review of the existing literature regarding: the fate of PHCs in soil, including specific characteristics that influence bioavailability; the sequestration of different PHC fractions in soil; the tools used to measure bioavailability of PHCs in soil; and, the relationship between acute and chronic estimations of toxicity for soil invertebrates exposed to PHC fractions of crude oil. Phase 2 comprises the development of guidance for a Tier 2 ecotoxicity assessment of site soils and includes guidance for the collection of soil samples for toxicity assessments; a toxicity assessment framework for contaminated site soils; a recommended test battery (test species and methods); procedures to deal with potential PHC mixtures in soil; and, because of the paucity of data, it does not include a discussion of the use of crop yields as an assessment endpoint for development of Tier 2 soil standards. The guidance for Phase 2 is presented in a companion report titled, "Framework and Guidance for Tier 2 Site-specific Development of Soil Contact Standards for PHC-contaminated Sites: Ecotoxicity Assessment". Therefore, the deliverables for this study are two reports that will serve as a framework for the development of a cost-effective approach to a Tier 2 assessment of site soils contaminated with petroleum hydrocarbons.

Derivation of the ecological benchmarks for the soil contact exposure pathway in the development of the

Canada-wide (CW) Standards for Petroleum Hydrocarbons in Soil (PHC CWS) was based primarily on data from controlled laboratory ecotoxicity tests with fresh product (e.g., crude oil and three fractions of crude oil). As with other benchmark values, the derivation process for the CW Tier 1 soil contact standards for the petroleum hydrocarbons in soil assumes 100% bioavailability of the product as determined by the total soil concentration of each petroleum hydrocarbon (PHC) fraction measured in soil, using standardized procedures involving solvent extraction techniques. These benchmarks are useful as a “worse-case” scenario and, if these values are met, the risk associated with the contamination at the site is considered acceptable (i.e., minimal). However, the toxicity of fresh product to terrestrial organisms is a function of exposure concentration, exposure duration, and the bioavailability of the PHC constituents comprising the contamination. These benchmarks might overestimate the risk associated with the PHCs in soil at historically contaminated sites simply because the PHCs present in soils at these sites might not be bioavailable. Because the bioavailability of various PHCs can be affected by both “weathering” and “aging” processes, as well as the physico-chemical properties of soil, bioavailability is a key consideration in the context of the standards applicable at higher tiers of the assessment framework.

Final Report