Executive Summary

The Model Parameter Advisory (MPA) Sub Group was formed to review information and develop recommendations and advice for the CCME Soil Quality Guidelines Task Group with respect to model parameters and approaches used in the soil vapour and groundwater transport models for petroleum hydrocarbon contaminants in soil.

The MPA Sub Group conducted ten teleconference meetings and held one day-long meeting in Calgary, AB between August 2005 and February 2006. These meetings resulted in a number of recommendations being put forward to the CCME Soil Quality Guidelines Task Group. These recommendations are presented below with further rationale provided in the body of this report:

On use of the Johnson & Ettinger vapour transport model:
1. The full form of the Johnson & Ettinger vapour transport model should be used to represent both coarse and fine-textured soil for the Canada Wide Standard for Petroleum Hydrocarbons.

On changes to the Johnson & Ettinger vapour intrusion model for Tier 1 evaluations:
2. A combination of model parameter modifications are put forward, as summarized in Table ES-1.
3. An Adjustment Factor of 10 should be used in the model.
4. A minimum distance of 30 cm should continue to be used for diffusional path length.
5. The following soil vapour permeability values should be used: $5 \times 10^{-8}$ cm$^2$ for coarse-grained soils, and $10^{-9}$ cm$^2$ for fine-grained soils.
6. The current approach of using a soil temperature of 21°C and Henry’s Law constants upon which to base partitioning properties of PHC sub-fractions should continue to be used.
7. A value of 360 cm should be used to represent 2-storey slab-on-grade residential building height as opposed to 488 cm.
8. The following air exchange rates should be used: 0.5 ach for a residential building, and 0.9 for commercial buildings.
9. Dry soil of the same texture as that underlying a building should be used to represent the conditions of soil residing in foundation cracks for fine- and coarse-grained cases.
10. The following total soil porosity values should be used: 0.47 cm$^3$/cm$^3$ for fine-grained soils, and 0.36 cm$^3$/cm$^3$ for coarse-grained soils.
11 The current default values for building length, building width, and crack surface area ($A_{cr}$) should continue to be used; and basement wall area should be included in the calculation of building area ($A_B$).

Table ES-1  Listing of MPA Sub Group Recommendations on vapour intrusion model parameter modifications.

<table>
<thead>
<tr>
<th>Exposure scenario:</th>
<th>Residential coarse soils case</th>
<th>Residential fine soils case</th>
<th>Commercial coarse soils case</th>
<th>Commercial fine soils case</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Use of Adjustment Factor of 10:</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td><strong>Diffusional path length modification:</strong></td>
<td>no modification recommended (remains at 30 cm)</td>
<td>no modification recommended (remains at 30 cm)</td>
<td>no modification recommended (remains at 30 cm)</td>
<td>no modification recommended (remains at 30 cm)</td>
</tr>
<tr>
<td><strong>Vapour permeability modification:</strong></td>
<td>change from $10^{-8}$ to $5(10^{-8})$ cm$^2$</td>
<td>apply at Tier 1 (value remains at $10^{-9}$ cm$^2$)</td>
<td>change from $10^{-8}$ to $5(10^{-9})$ cm$^2$</td>
<td>apply at Tier 1 (value remains at $10^{-9}$ cm$^2$)</td>
</tr>
<tr>
<td><strong>Soil temperature modification:</strong></td>
<td>no modification recommended (remains at 21°C)</td>
<td>no modification recommended (remains at 21°C)</td>
<td>no modification recommended (remains at 21°C)</td>
<td>no modification recommended (remains at 21°C)</td>
</tr>
<tr>
<td><strong>Building height modification</strong></td>
<td>change from 488 to 360 cm</td>
<td>change from 488 to 360 cm</td>
<td>no modification recommended (remains at 300 cm height)</td>
<td>no modification recommended (remains at 300 cm height)</td>
</tr>
<tr>
<td><strong>Air exchange modification:</strong></td>
<td>change from 1 to 0.5 ach</td>
<td>change from 1 to 0.5 ach</td>
<td>change from 2 to 0.9 ach</td>
<td>change from 2 to 0.9 ach</td>
</tr>
<tr>
<td><strong>Modification of moisture content of soil residing in foundation cracks:</strong></td>
<td>change from coarse soil to assuming dry soil of the same texture as that underlying the building</td>
<td>change from coarse soil to assuming dry soil of the same texture as that underlying the building</td>
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<td>change from coarse soil to assuming dry soil of the same texture as that underlying the building</td>
</tr>
<tr>
<td><strong>Modification of total soil porosity:</strong></td>
<td>change from 0.4 to 0.36 cm$^3$/cm$^3$</td>
<td>change from 0.3 to 0.47 cm$^3$/cm$^3$</td>
<td>change from 0.4 to 0.36 cm$^3$/cm$^3$</td>
<td>change from 0.3 to 0.47 cm$^3$/cm$^3$</td>
</tr>
<tr>
<td><strong>Modification of building surface area, crack surface area, and $A_{cr}/A_B$ ratio</strong></td>
<td>no modifications recommended for these building parameters</td>
<td>no modifications recommended for these building parameters</td>
<td>no modifications recommended for these building parameters</td>
<td>no modifications recommended for these building parameters</td>
</tr>
<tr>
<td><strong>Implications:</strong></td>
<td>Re-calculated F1, F2 guidelines similar to current guidelines.</td>
<td>Re-calculated F1, F2 guidelines ~40% lower than current guidelines. However, ecological pathway will still drive the Tier 1 analysis.</td>
<td>Re-calculated F1, F2 guidelines similar to current guidelines.</td>
<td>Re-calculated F1 guideline similar to current guideline. Re-calculated F2 guideline ~10% lower than current guideline. However, ecological pathway will still drive the Tier 1 analysis.</td>
</tr>
</tbody>
</table>
On changes to the groundwater model for Tier 1 evaluations:

12 Solubility limits and Raoult’s Law may be appropriate to implement for Tier 2 or Tier 3 evaluation, but they should not be used in developing Tier 1 groundwater guidelines.

13 A 10-m width as opposed to the current default of 30 m should be used for groundwater source width.

14 The current model assumption of a 0-m distance offset should continue to be used for the distance to a potable water receptor.

15 The current model assumption of a 10-m distance offset should continue to be used for the distance to surface water.

16 An offset distance of 0 m (opposed to 10 m) should be used for the distance to livestock watering.

17 The livestock RfC for crude oil should be revised from 23 mg/L to 230 mg/L, resulting in daily threshold exposure doses (DTEDs) of 53 mg/L and 49 mg/L for F1 and F2, respectively.

18 A calculated mixing zone thickness should be used for both the potable water and ecological pathways.

19 While no changes should be made at Tier 1 to deal with multiple layers to represent groundwater aquifers, users should be allowed to define unsaturated zone and saturated zone conditions separately to reflect actual conditions at a contaminated site in Tier 2 evaluations.

20 The following values should be used for saturated hydraulic conductivity of fine-grained soils: 3.2 m/yr for protection of the freshwater life pathway, 32 m/yr for the drinking water pathway, and 32 m/yr for the livestock watering pathway.

21 Consistent assumptions should be used for all model parameters for the aquatic life, drinking (potable) water, and livestock watering pathways except for: (i) hydraulic conductivity for the potable water and livestock watering pathways – which should be adjusted to 32 m/yr to reflect aquifer properties required to support potable water wells and livestock dugouts, and (ii) the offset for aquatic life receptors – which should be maintained at 10 m.

22 A working group should be struck to review all aspects of the groundwater model recommended in the CCME 2005 Draft Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines. The review should include aspects of: i) simplicity, reliability, and versatility of the model currently being employed by CCME, ii) assumptions inherent to the model, and iii) appropriate parameterization to ensure accurate, reliable, and conservative estimates of risk when applied to typical sites in Canada.

On miscellaneous issues:

23 A table of soil vapour screening level values should be developed or adopted for Tier 2 and Tier 3 evaluations only. These values should be based on the source of contamination located at least 1 m below a building foundation.
24 A protocol for soil vapour sampling should be developed to support screening level values for Tier 2 and Tier 3 evaluations.

25 Absence of measurable concentrations of soil contamination at lateral distances greater than 30 m from existing or potential future buildings should be sufficient to discount the vapour transport pathway during Tier 2 or 3 evaluations, unless there are precluding factors such as a low permeability surface or significant preferential migration pathways between the contaminant source and receptor location.

26 A depleting contamination source should not be incorporated into the CWS.

27 Exposure to airborne soil particles containing PHCs are not considered important at PHC-contaminated sites.

28 There is no need to further consider fractured clay till conditions as part of the CWS guidance.

29 Not enough information is available to develop a guideline to protect buried infrastructure based on the current science.

30 There is no need to consider explosive hazards in the development of separate guidelines as part of the CWS guidance.