Comments on Gagetown 3A1-Tier III Draft Report
Prepared by: Health Canada

ISSUE SPECIFIC COMMENTS

Hazard Assessment:

- The contractor states (e.g., section 3.3) that duration and route of exposure are important considerations for this risk assessment and that "where available, route-specific and duration-specific" toxicity reference values were used (page 11). However, all of the contractor's risk estimates appear to be based on a chronic or acute oral reference dose (RfD). Their chronic RfD is usually based on an oral lifetime acceptable daily intake (ADI; the dose considered acceptable on a daily basis for a lifetime) while their acute RFD is usually based on an oral acute reference dose (ARD; the maximum dose considered acceptable in a single day). In some cases the contractor's rationale for selecting a particular reference dose is not clear (e.g, selecting older rather than more recent US EPA values).

  In many cases an ARD was unavailable and therefore the contractor based both the acute and chronic assessments on the ADI. There does not appear to have been any attempt to distinguish between situations where the reviews cited deemed an ARD to be unnecessary (*i.e.* the compound was determined to be non-toxic for the acute duration), versus where one was truly not available (*i.e.* no suitable acute studies available). In many cases, the reviews cited by the contractor deemed an ARD to be unnecessary because acute toxicity is low and therefore peak acute exposures are not considered to be of concern.

  Neither the ARD or ADI may be the most appropriate reference doses for short and intermediate term non-dietary risk assessment. Many of the reviews cited by the contractor specify reference doses for dermal and inhalation exposures over short and/or intermediate terms. Additional European data is available from the UK Product Safety Directorate Database (https://secure.pesticides.gov.uk/TEAWeb/intro.asp).

  Examples of the types of RfD information that has not been utilised by the contractor, along with some discrepancies noted between Appendix B and Table 6-1, are summarised in Appendix I. Appendix I is not intended to be either comprehensive or prescriptive. It is only intended to show the types of available toxicity data that could be utilised and that could potentially change many of the risk profiles to better reflect the exposures that may have occurred.

Exposure Assessment - Application Rates:

- It is not clear how application rates (Tables 4-1, 5-10, etc.) were calculated. Table 5-10 and 4-1 should be checked for consistency. Generally, the

contractor appears to have derived the application rate ranges from the Task 2A database by dividing the total amount applied by the total area treated for each application year. However, the calculations are difficult to replicate. As well, the calculation methodology used by the contractor assumes that there are no outliers or anomalies in the Task 2A report.

The average application rates generally appear to be reasonable, but many of the ranges span more than 2 orders of magnitude. This is unlikely, given that the available product labels support a much narrower range. Appendix II illustrates the types of application rate information that can be derived from the herbicide labels that were provided to the contractor. It is also noted that Task 2A concluded that all applications of registered herbicides were made at registered label rates.

As application rates are important parameters in all the exposure calculations, it is recommended that the contractor consider all sources of relevant information, including any available information from product labels. If, after re-examination, the contractor still supports the range of application rates presented, then this should be discussed in Section 8.1 as a source of significant uncertainty.

Exposure Assessment –Chronic Mixer/Loader, Applicator, and Flagger:

- It appears that the contractor evaluated chronic exposure estimates for all active ingredients based on 30 days of activity. This is considered by HC a reasonable approach to screen out chemicals for which there is very little likelihood of adverse risk (*i.e.*, an HQ <1). However, for those chemicals with a resulting HQ>1, the plausibility of this duration should be compared to the historical use records for each active ingredient, and the exposure calculations refined accordingly. For example, a total of 16.3 kg of dinosep was applied at the base, therefore only the acute exposure scenario would be expected.

Exposure Assessment- Acute Assessment – Brush Clearers:

- The acute scenario assumes that brush clearers worked in areas where herbicide application had occurred the previous day. HC agrees that for the "worst-case" acute scenario, it is plausible that brush clearers were working under these circumstances. However, if the "Mean" scenario is meant to represent a typical occurrence, it is suggested that clearing brush immediately after herbicide application would not be considered common practice. Mean and minimum estimates could factor in a reasonable delay based on common practices, and the subsequent dislodgeable residue dissipation that would occur during that period.

Exposure Assessment – Chronic Assessment - Scouts and Brush Clearers:

- It appears that the contractor evaluated chronic exposures to scouts and brush clearers for each active ingredient based on 30 and 90 days of activity for each

active ingredient. In addition, the exposures calculated were based on the assumption that every day these activities were conducted in areas where application had occurred the previous day. This is considered by HC a reasonable approach to screen out chemicals for which there is very little likelihood of adverse risk (*i.e.*, an HQ <1). However, for those chemicals with a resulting HQ>1, the plausibility of this duration should be compared to the historical use records for each active ingredient, and the exposure calculations refined accordingly.

- The chronic assessment for brush clearers utilizes a transfer coefficient which represents very high contact with treated foliage. While HC agrees that for the "worst-case" acute scenario, it is plausible that brush clearers were working under these circumstances, some consideration should be given for what the typical activity for brush clearers would be under a chronic scenario. It seems unlikely that brush clearers would be routinely sent out to clear brush that had just been treated with a herbicide. A more realistic scenario would be that the clearers would be sent out to remove brush that had been defoliated by the herbicide. For the majority of herbicides, treated foliage would fall within days to weeks after treatment and there would be limited foliar contact from this point on. Therefore, for many of the days in which brush clearing was conducted there would be very little contact with treated foliage. As such the predicted DFR and TC would be expected to be much lower for the chronic than for the acute scenario.

- The contractor used the US EPA default dislodgeable residue value of 20% to estimate dislodgeable foliar residue (DFR) values. However, in several cases chemical-specific data are available that could be used to refine the assessment (see examples below).

2,4-D

Transferable turf residues (TTR) would provide an appropriate estimate of dislodgeability of 2,4-D from forestry foliage. TTR values for 2,4-D on day zero are less than 5% of the application rate (0.35% -2.63%) (PMRA PACR 2005-01) www.pmra-arla.gc.ca/english/pdf/pacr/pacr2005-01-e.pdf

Dicamba

US EPA RED (www.epa.gov/oppsrrd1/REDs/dicamba_red.pdf) for dicamba identifies transferable turf residues from turf for dicamba. This provides an appropriate estimate of dislodgeability of dicamba from forestry foliage. Based on values given in Table 6 of the RED document, a DFR value, as % of application rate, was calculated to be 0.53%.

Mecoprop

In the public literature, two DFR studies were located for mecoprop; both indicate a DFR value of day zero of less than 1% [; and] Cooper *et. al.* (1995) USGA Green Section Record, Jan/Feb. 1995

(http://turf.lib.msu.edu/1990s/1995/950119.pdf) showed a value of 0.10% DFR, as per cent of application rate after 8 hours post-application. A University of Massachusetts New England Regional Turfgrass Foundation (NERFT) study progress report (2005) (Clark, J.M. and J. Doherty, 2005 (www.nertf.org/17.pdf)) showed a DFR value of 0.312 μg/cm^2 one hour post-application. The application rate was not specified; but based on an application rate of 2.0 lbs a.i./A (22.7 μg ai/cm^2) from the Cooper et al (1995) study, this equates to a DFR value of 0.65%.

Glyphosate

No dislodgeable/transferable residue data is available but the US EPA RED cites a forest dissipation study in which residues in foliage immediately post-treatment averaged 652-1273 ppm. Half-life was less than 1 day at a Michigan site and less than 14 days at a Georgia site.

- As noted in Section 5.5.2, the US EPA and Health Canada assume a default DFR dissipation rate of 10% per day in the absence of chemical-specific dissipation data and this should be incorporated into the chronic post application exposure assessment All non-acute assessments should factor in a dislodgeable residue dissipation rate of at least the default rate of 10% per day. The text on page E-39 indicates that this dissipation rate of 10% per day was used, but this is not identified in the equation on page E-40. Similar to as discussed for the initial DFR value, chemical specific dislodgeable residue dissipation data may be available, or may be justified on the basis of chemical properties or environmental fate data.

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Exposure Assessment - Mixer/Loader/Applicator:

- Was any consideration given to what was PPE (clothing) was/is specified on pesticide labels? This information may in some cases be difficult to obtain for the 1950s to1970s, but modern labels clearly specify PPE and almost always specify chemical resistant gloves for mixer/loaders. It should be acknowledged that the high exposure estimates are not relevant to the more recent years, unless the applicators were violating label conditions.

Exposure Assessment – Calculation of Concentrations of COCs in Soil :

- The maximum estimated soil concentration of COCs in soil does not appear to factor in 'gaps' in the application timeline where a particular COC was not applied in certain years, but applied in others. For repeat applications, the year to year geographic distribution of the spray locations was also not considered. The equation to calculates the steady state concentration (Cs) over a time period and takes into consideration the degradation (ks) in soil over time. The 'tD' term (time period over which deposition occurs (yr)) must be consecutive years or the 'Cs' term is not valid.

  The use of the "high" soil concentration to calculate the "high" steady

state soil concentration after repeat years of application is not logical for compounds applied for more than 1 year, as the "high" rate would have been the maximum calculated for a single year. For example, glyphosate application rates are cited as 1.62, 2.76 and 14.1 for minimum, average and maximum, respectively (Page E-6). Although the maximum application rate of 14.4 Kg/ha was applied in only one of 7 years, this value is used to determine the "high" soil concentration (Cs) over a continuous use 7 year period (tD in equation on Page E-19).

- The exposure via soil pathways, both directly and indirectly does not consider the historical records as to the geographic location of the applications, and amount of area treated. For example, non-occupational HQs >1 were determined for paraquat, even though this compound was only applied 1 year to 7 hectares of land during the 1967 US trials.

While the approach taken by the contractor is considered by HC a reasonable approach to screen out chemicals for which there is very little likelihood of adverse risk (i.e., an HQ <1), for those chemicals with a resulting HQ>1, the plausibility of these assumptions should be compared to the historical use records for each active ingredient, and the exposure calculations refined accordingly.

Exposure Assessment - Environmental Media:

- It is difficult to reconcile the large differences between the HQs for a flagger vs. a bystander at the edge of field (page 93, Table 7-1 and Page 101, Table 7-9. For example, glyphosate maximum HQs are 0.64 vs. 33**.** This likely reflects the differences between the measured data (PHED for flaggers) and some of the assumptions inherent to the modeled data used for calculating bystanders exposure. For example, the predicted spray drift concentration at 1.5 m (close to the ground) assumes no vegetation. Spray drift concentrations would be considerably lower if the target area was forested. This should be noted in the discussion of results.

- The uncertainties section (page 104) should also include a discussion about canopy interception. The unpublished document cited by the contractor (now published) to support the deposit fraction reviewed the aerial deposit of forest insecticides. Insecticides are applied at fine droplet sizes to maximize their penetration into the upper canopy. On the other hand, herbicides are applied with medium to very coarse droplet sizes with the intent of penetrating to the lower canopy and/or the forest floor. The percent deposit values for herbicides could therefore be underestimated. This should be noted in the discussion of results.

Exposure Estimates - Estimated Daily Intake (EDI) Values:

- It is not clear how the EDI values have been utilised in the contractor's overall assessment. If the intent is to estimate background (or non-site related) exposure, the EDIs should represent typical rather extreme exposure situation. However, in many cases acute dietary estimates (e.g. tebuthiuron) or bounding estimates for drinking water exposure are used (e.g. picloram, based on contaminated site data).

  US EPA RED documents are often used as a source of information and, in many cases the EPA values represent screening level assessments that were conducted to generate a bounding estimate. If this upper bound value is acceptable, no further refinement of the exposure estimate is made, but this type of estimate is not intended to represent the level of exposure in a population.

  As well, care needs to be exercised in extrapolating US estimates to the Canadian situation. As Canada is an importer of foods from the US, the dietary exposure information is usually relevant. However, drinking water data is only relevant if it is based on similar use patterns and geographic regions. Modelled drinking water estimates are extremely sensitive to geographic regions (soil, climate) and use pattern (crop, application rates.

  It is recognized that the Edits are intended to replicate historical as well as more recent potential exposures. However, it should be noted that estimated daily intake values cited from older reviews published in the 1980's and 1990's may not reflect current and available information regarding potential dietary or drinking water exposure. For example, dinoseb has been phased out in both Canada and US and there are no maximum residue limits (Canada) or tolerances (US) for dinoseb.

  For illustrative purposes, some compound specific comments regarding EDI are appended (Appendix III).

Risk Characterization:

- Table 9-1 should either be removed or expanded to cover each of the COCs. The summary and discussion of any risks need to be framed in terms of each specific active ingredients, the types of effects seen in the toxicology studies upon which the reference doses are based, and the major assumptions employed in the specific risk assessment (e.g., using an ADI for all routes and durations of exposure).

- The authors have flagged all HQ values greater than 1 as "indicative of potential risks". Given the many conservative assumptions made on both the exposure and toxicology sections of the assessment, this statement may lead to a misinterpretation of the risk assessment. The uncertainty and safety factors factored into the assessment should be clearly discussed as part of the risk

characterization. Product usage should also be better characterized, especially where risks are identified (years of use, areas treated, quantities used, etc.).

- The introductory paragraph to the Conclusions (p. 106) states that the high exposure estimates are an extreme worst case, but does not discuss how to interpret the low and "med" estimates. A discussion on this should be included. Also note that "med" is not defined, and previous tables used "central". In the next sentence, "It is therefore likely that exposure and risk estimates were much lower than those estimated" - it is unclear which estimates this applies to – all three (low, central, high), or just high?

Section 4.1.2 - Formulants:

- This section notes that "Formulants classified as List 1 or 2 were retained for further evaluation as they are considered to be of significant concern to human health." A reference should be provided for the PMRA ranking of formulants (Regulatory Directive DIR2006-02). PMRA defines List 1 as Formulants of Toxicological Concern and List 2 as potentially toxic formulants with a high priority for testing. Diesel Oil/Fuel Oil/Oil fall into List 2 and are best characterized as "potentially toxic formulants". While the contractor concluded that diesel and fuel oil need "further evaluation", their assessment could not be found in the report. Given the relatively large amounts of diesel and fuel oils used at the base in the herbicide spray program, HC recommends that a risk assessment be undertaken for these products.

PAGE SPECIFIC COMMENTS

Note: Insert words in italics, remove words with strike through

List of Tables and Figures,

- Table 4-1 is listed twice.

Page 1 & throughout document:

- The description of the assessment period is inconsistent, i.e., 1952 - 2004 versus 1952 - to the present. It is noted the herbicide application database prepared under Task 2A only goes to through 2004. Pages 6 and 22 indicate that no herbicides were applied after 2004; this needs to be clarified.

Page 2 (Introduction), paragraph below risk formula:

- Sentence 2: "… if there is no exposure, ~~than~~ *there* can be no risk."

Page 3, Paragraph 2:

- Transfer and contact with "contaminants". An alternate term, such as herbicides or chemicals of concern is suggested, to avoid confusion with the use of the term contaminants in previous reports to refer to the micro-contaminants or

manufacturing impurities in herbicides. Similar comment applies to page 29 last sentence, page 30, Section 4.4 and elsewhere.

Page 3, Appendix A:

- A footnote to explain 'Not Applicable' would be helpful.

Page 8, Section 2.0, Description of Tier 3, Application Methods:

- Paragraph 3, first sentence: "At the time of application, applicators should have *used the* best practices of the time when mixing,…"

Page 13, Section 3.4.1, Evaluation of Hazard Quotient and Cancer Risk Levels:

- Paragraph 4, first sentence: "…rather are ~~indicated~~ *indicative* of potential risks…"

Page 14, Section 3.4.2, Assessment of Short-Term (Acute) Exposures:

- Paragraph 4, sentence 4, "…the acute duration TRVs established where ~~avialable~~ *available*".

Page 14, Section 3.4.4, Cumulative Exposures/Risks:

- Paragraph 1, sentence 4, "…combinations and permutations that could be ~~consider~~ *considered*".

Page 17, Table 4-1:

- Application values given in the History of Pesticide Use Database for 1966-1967 (US Applications) are given in US G… please indicate how these volumes were converted to kg.
- Table endnote B – "For two of the four years tebuthiuron ~~wasapplied~~ *was applied*…"

Page 19, Table 4-2:

- Line 5 (Dicamba), Chronic Reference Dose = 0.0125 (Health Canada 2004b).

Page 22, Table 4-3:

- Endnote – should all be in a reduced font.
- First line" Grey scale ~~and bold~~ indicates that the formulants…"

Page 23, Table 4-4:

- Title: "Final list of Active Ingredients *and Formulants* to be Retained as COCs for the Tier 3 Assessment".

Page 25, Section 4.2 Selection of Historical Spray areas of Concern, SA 6 – Static Range Impact:

- Sentence 3: "This area was identified as a distinct area to reflect the limited access to *the* area by soldiers…"

Page 27, Page 41-42:

- "…. Many active ingredients reach a steady state shortly after the initial spray event. Therefore, concentrations of active ingredients in environmental media would not be significantly different following 30 years of spraying than they would be following a single application event." HC notes that unless the a.i. is persistent, the soil concentration would almost always be less than that immediately following a single spray event.

Page 28, Flagger.

- Are flaggers a realistic receptor for herbicides applied outside of the 1966 and 1967 spray campaigns?

Page 29, Bystanders:

- This receptor group is not clearly defined and the term is used inconsistently throughout the report. The end of this paragraph (and the next one) refers to "Bystanders and civilians" which implies that bystanders are not civilians. Note that the conceptual model in Fig. 4-2 groups together as one the receptors "Civilian/Residential/Bystander". A clear and consistent definition of Bystander should be presented.

Page 31, Volatilization Following Application:

- The rationale for why this pathway was not considered could be strengthened, for example, by referring to the appropriate phys-chem properties (vapour pressure, Henry's Law constant).

Page 34, Paragraph 3:

- Citation Bush et al. (1987), which appears three times, is not in the references. There is a Bush et al. (1998) in the references.

Page 36, Figure 4-2:

- The angler is identified as a receptor, with viable pathways, however, exposure is not assessed.
- Should the civilian and bystander pathways be presented separately on this table?
- The flagger is not identified in this table as a receptor.

Page 40, Section 4.5.7, Sentence 2 :

- The adult is discussed as the receptor; however, in tables 35-47 and Appendix E (p.42), the toddler is considered as the receptor.

Page 40, Section 4.5.8, Hunter/Angler:

- As fish consumption was not considered, it would be more accurate to simply call this receptor group "Hunter." This would be consistent with the definition of this receptor group on page 29, where it is simply called Hunter.

Page 42-43, Table 5-1:

- Title: Estimated Daily Intake Rates ~~fo~~ *for* the General Population.

- Endnote: Comment [L]: Please verify parameter values are consistent throughout report.
- Not all EDI in Appendix C are reported in this table.

Page 43, Section 5.2, Characterization of Potential Receptors of Concern:
- Paragraph 1, sentence 1: "… on information ~~gather~~ *gathered* from Task 2B…"

Page 44, Table 5-2:
- Receptor characteristics are not given for the Occupational Receptors.

Page 45, Section 5.2.1, Physiological Receptor Characteristics, Paragraph 4, Sentence 1:
- "… the mixer/loader, applicator, and flagger ~~make these individuals~~ are particularly susceptible to exposure…"

Page 46, Table 5-3:
- Number of days per year units should be *day/yr* not ~~day/hr~~
- ~~Acitivity~~ *Activity*, ~~cacinognes~~ *carcinogens* , ~~non-carcinogneic~~ *non-carcinogenic*

Page 48, Intercept fractions:
- What are described as intercept fractions are actually deposit fractions. Note that the Kreutzweiser and Nicholson work is now published in J. Env. Sci. Health and should be cited as such (rather than Health Canada, pers. comm).

Page 48, Table 5-4:
- It is not clear how the range of soil half-lives was derived, (*i.e.*, which values are from the Task 2A report, and which values are from Mackay *et al.*) For example, the range of half-lives cited for paraquat is 1.4, 5.4 and 13 yr. JW (2006a) provided a soil biotransformation DT50 of 1000 days, which is 2.7 yr, so it is unclear how the range was derived. A rationale should be provided for the selection of the range of half-lives from the various references. Mackay *et al*. cited in footnote is not found in the references.
- In footnote, the citation JW, 2006 should be JW, 2006a

Page 49, Equation 6:
- Description of parameter "t": Amount of time ~~in~~ exposed skin is in contact with contaminant

Page 50, Table 5-7
- Average - Single layer with gloves scenario: Should total dermal exposure be *4.9E-03* not ~~4.8E+00~~ ?

Page 51, 52, Table 5-10:
- Please indicate how application rates were determined for the 1966-1967 military trials were determined (conversion of US G to kg).

Page 51, Citations:

- JW (2006) should be JW (2006a)

Page 53, Section 5.5.1, Occupational Receptors Directly Involved with Herbicide Application:

- Paragraph 1, Sentence 3: "…considered to be 67 ha (or 168 acres*)*. Please close bracket.

Page 54, Table 5-11:

- For the aerial application, the Mass AI handled per day appears to have been calculated with partial days for all applications requiring more than 1 day. If this is correct, please reflect these partial days in the column "Minimum Number of Application Days".
- For the Ground Application, the Mass AI handled per day could not be reproduced. Please verify that the values are correct.

Page 60, Equations 10a and 10b:

- These equations should be #10 and 11, to be consistent with the rest of the document.

Page 60, Table 5-12:

- Applicator Acute exposure: it appears that the medium and maximum EU values (PHED table 5-7) were interchanged – the medium Dermal Unit Exposure value was used to calculate the high exposure, the high Dermal Unit Exposure value was used for the medium exposure.

Page 60, Table 5-13:

- All exposure values were calculated using mass AI handled/day values that appear to be incorrect (table 5-11).
- Applicator Acute Exposure: it appears that the medium and maximum EU values (PHED table 5-7) were interchanged – the medium Dermal Unit Exposure value was used to calculate the high exposure, the high Dermal Unit Exposure value was used for the medium exposure.

Page 61, Section 5.4.1.5, Chronic Exposure Estimates of the Mixer/Loader, Applicator and Flagger:

- Paragraph 2, Sentence 2: "For the purpose of the chronic exposure ~~esimates~~ *estimates*,…"

Page 64, Section 5.5.2, Individuals with Post Application Activities:

- Paragraph 3, Sentence 3: It appears that µg is written as ug twice in this sentence (ug/hour and ug/cm^2).

Page 65, Equation 18:

- Reference to application rate of contaminant should be removed.

Page 68, Equation 20:

- The Conversion Factor (CF) indicated appears to be incorrect; 1 kg/ha = 10^2 mg/m^2.

Page 68, concentration in the top 2cm of soil:

- A 2 cm soil depth was used to estimate exposures from incidental soil ingestion and dermal contact. The concentration remaining in 2 cm of soil over a period of time depends on the physical-chemical (solubility) and mobility (k_d) properties of the a.i. It is likely that concentrations and exposures for highly mobile pesticides are overestimated. It is recommended that this conservatism be noted when discussing the results.
- "As per US EPA (2005) a soil mixing zone of 2 cm was assumed...for direct contact" In the Tier 2 report, the contractor stated "As per U.S. EPA (2005), a soil mixing zone of 1 cm was assumed... for direct contact" Please clarify.

Page 70, Table 5-18:

- Please change titles to *Annual Deposition Term – Direct Contact (mg/kg/yr)* ~~Annual Deposition Term – (mg/kg/yr)~~ and *Annual Deposition Term – Plant Uptake (mg/kg/yr)* ~~Annual Deposition Term – (mg/kg/yr)~~.
- Values could not be reproduced for some soil and wild berry concentrations (e.g., Minimum Soil Concentration; Dicamba, Picloram). Please verify all values.

Page 73, Equation 26:

- The bioavailabitity of the active ingredient (unitless) should be added to the nominator, as well as the description of parameters (see Appendix E, p.E-37).

Page 76, Equation 30:

- Please specify the origin of EXP_{total} (*i.e.* = EXP_{forage} + EXP_{soil}).

Page 77, Table 5-20:

- Values could not be reproduced for some forage concentrations (e.g. Min; 2,4,5-T, Dicamba, Picloram, Mecoprop). Please verify all values.

Page 79, Table 5-21 and Table 5-22:

- Values could not be reproduced for some forage concentrations (e.g., Adult Civilian Resident, Minimum; Dicamba, Picloram). Please verify all values.
- Hunter chronic exposure values given in table 5-21 could not be reproduced. Please verify all values.

Page 80:

- "Direct Inhalation from Over-Spray" ,"Direct Dermal Contact from Over-Spray" Replace "Over-Spray" with "Spray Drift"

Page 82, Table 5-23:

- It appears that the conversion to mg/m^2 is incorrect. Please verify.
- Mean and Maximum dermal exposure estimates appear to have been calculated using the minimum deposition rates.

Page 84, Section 6.2 Summary of COCs and TRV Derivation 2,4,5-T:

- Second Paragraph, Sentence 4: "…was observed in rats at ~~the~~ doses lower than 60 mg/kg/day."

Page 89, Section 6.2, Summary of COCs and TRV Derivation, Dinoseb:

- Third Paragraph, Sentence 1: "~~Dineseb~~ *Dinoseb* is highly acutely toxic…"

Page 93, Table 7-1:

- Certain values could not be reproduced (e.g. Applicator, High: 2,4,5-T, Dicamba, Fosamine Ammonium). Please verify all values.

Page 93, Table 7-2:

- The Ground Application HQs could not be reproduced. Please verify all values.

Page 94, Table 7-3:

- Certain values could not be reproduced (e.g. Applicator, Central; Picloram, Mecoprop, Bromacil, Triclopyr). Please verify all values.

Page 94, Table 7-4:

- The Ground Application HQs could not be reproduced. Please verify all values.

Page 95, Section 7.1.1, Acute Hazard Quotient – Mixer/Loaders, Applicators, and Flaggers; Acute Ground-based Herbicide Applications:

- The discussion of results of this paragraph appears to be inconsistent with the presented data:
    - The applicator has the largest number of HQ values exceeding a value of 1.0.
    - Only 2,4,5-T, mecoprop and fosamine ammonium central HQ estimates are greater than 1.0 for the Mixer/Loader.
    - All central HQ estimates for the Applicator are above 1.0, with the exception of dichloroprop, dicamba, and paraquat.

Page 95, Section 7.1.1 Acute Hazard Quotient – Mixer/Loaders, Applicators, and Flaggers, Chronic Ground-based Herbicide Applications:

- The discussion of results of this paragraph appears to be inconsistent with the presented data:
    - The applicator has the largest number of HQ values exceeding a value of 1.0.
    - All HQ values, except paraquat and dinoseb, are above 1.0 for the central scenario for the applicator.
    - 2,4,5-T, 2,4-D, dichloroprop, dicamba, diuron, bromacil, and fosamine ammonium HQ values are above 1.0 for the central scenario for the applicator.

Page 96, Table 7-5

- Certain values could not be reproduced. Please verify all values.

Page 96, Bottom of Page:

- Paragraph 1, Sentence 5, parenthesis: (~~including~~ 2,4,5-T, mecoprop, diuron, fosamine ammonium *and dinoseb*)

Page 96, Table 7-6:

- Certain values could not be reproduced. Please verify all values.

Page 99, Table 7-7

- Certain values could not be reproduced. Please verify all values.

Page 99, Table 7-8

- Certain values could not be reproduced. Please verify all values.

Page 100, Section 7.3.3, By-Stander and/or Off-Site Civilians Exposure Scenario:

- Paragraph 2, indicates that ground-level air concentrations were calculated at 1.5 m above ground surface. It was HC's understanding that the REMSpC report values were calculated at 2 m above ground surface. Please verify.
- HC recommends that the potential risks via spray drift to receptors other than toddlers be evaluated, given that several Acute HQ estimates to the toddler were greater than 1 (Table 7-9).
- Paragraph 5: ~~Dinseb~~ should be *Dinoseb*. Also on page 108.

Page 101, Table 7-9:

- It appears that average and maximum dermal exposure were calculated using the minimum deposition rate which is reflected in values given in table 7-9.

Page 104, Section 8.3

- Bullet 5 should be deleted, as contaminant concentrations in fish were not determined.

Page 106, Section 9.1, Summary of Results, Individuals Involved with Herbicide Applications, Acute Scenarios, Ground Applications:

- "~~Consistent with the aerial application assumptions, the mixer/loader~~ *The applicator* had the largest number of HQ values exceeding acceptable levels (greater than 1.0). Elevated central HQ estimates for the applicator were observed *for all active ingredients except* ~~2,4,5-T,~~ Dichloroprop, Dicamba, and Paraquat ~~Picloram, Mecoprop, and Dinoseb~~. *HQ estimates for the mixer/loader were evaluated above 1 for ,2,4,5-T, Mecoprop and Fosamine Ammonium.*"

Page 107, Section 9.1, Summary of Results, Individuals Involved with Herbicide Applications, Chronic/Cumulative Scenarios, Ground Applications:

- "Under the assumption of ground application methods, high-end chronic health risks for the mixer/loader were evaluated for *all active ingredients* ~~2,4,5-T, 2,4-D, Dichloroprop, Picloram, Mecoprop and Dinoseb~~. ~~But low and central~~ *Central*

chronic estimates for the mixer loader were associated with HQ ~~value~~ *values* ~~less~~ *more* than 1.0 for *all* active ingredients of concern *except for Picloram, Glyphosate, Mecoprop, Paraquat, Trycloropyr and Dinoseb*. High-end risks for the ground-based applicator were elevated for *all active ingredients* 2~~,4,5-T, 2,4-D, Picloram, Mecoprop and Dinoseb~~*; central estimates to the applicator were above 1.0 for all products, except Paraquat.*"

Page 107, Section 9.1, Summary of Results, Individuals Involved with Post Application Activities, Acute Scenarios:

- Paragraph 1, Sentence 5: "Although scouting related risks were lower than those of the brush clearer, ~~five~~ *six* active ingredients (including 2,4,5-T, *2,4-D*, mecoprop, diuron, fosamine ammonium, *and dinoseb*) had central HQ values greater than 1.0."

Page 108, Section 9.1, Summary of Results, Individuals Not Directly Involved in Herbicide Spray Activities, Acute Scenarios, Bystander and Off-Site Civilian:

- Paragraph 2, Sentence 1: "At 800 meters downwind from the initial spray block edge, only four active ingredients were associated with HQ values greater than 1.0, including: 2,4,5-T, mecoprop, fosamine ammonium, and dinoseb ~~eight active ingredients were associated with HQ values less than 1, including: 2,4-D, Dichloroprop, Dicamba, Picloram, Glyphosate, Paraquat, and Tryclopyr~~."

Page 109, Section 9.2, Conclusion :

- Second bullet, centre of page: change via the ~~durmal~~ route to *dermal route.*

APPENDIX B

Page B22-1, Table B22-1:

- Diesel/Fuel Oil/Oil Fuel Application Rate is equal to Total Area Treated.

APPENDIX C

Page C6, Table C3.1.1 :

- Subpopulations are reversed for Adults 50+ and Females 13-49.

APPENDIX E

Page E-1, Section E-1.0, Introduction:

- Paragraph 3 (below bullets), Sentence 2: "… including a maximum, minimum and ~~averagel~~ average estimate."

Page E-3, Section E-2.1 Receptor Selection – Civilian Spouses/Other Family Members

- Bullet 10, Sentence 1: "…Spouses and families of military and spray ~~personal~~ *personnel* may have came into contact with the COCs through contact with clothing brought home ~~by military personnel~~ following spray activities."

Page E-4, Table E-1, Wild berry consumption, Hunter:

- Throughout the main report and this appendix, it is unclear whether or not the hunter ingests wild berries. If they do, the ingestion rate (2g/day) should be included in this table.

Page E-5, Table E-2:

- Time activity patterns of the occupational receptor should also be listed/detailed in a similar table.

Page E-5, Table E-3:

- Note that 4 applications recorded in the database were not included in this report [2004; Lawfield (9 ha), Argus (1.5 ha), Hersey(2.5 ha), Greenfield (4ha)]. Please include or provide rationale for exclusion, and confirm all other COCs.

Page E-16, Table E-12 :

- The number of spray days reported for ground application could not be reproduced.

Page E-17, Section E-3.2.1 Calculations of Concentrations of COCs in Soil

- Ds Calculation Box: The Conversion Factor (CF) indicated appears to be incorrect; 1 kg/ha = 10^2 mg/m^2.
- Text below calculation box: "…were predicted to be ~~$2.7x10^{-2}$ and $2.7x10^{-3}$ mg/kg~~ *$2.7x10^{1}$ and 2.7 mg/kg*, respectively."

Page E-18, Table E-13 :

- The formula is not given for dust concentration calculations; nor do these numbers appear to be used in any subsequent calculations.

Page E-18, Table E-14:

- Several values could not be reproduced, please verify Moose and Deer tissue concentrations.

Page E-19:

- Reference in first paragraph to Table E-14 should be Table E-13.
- Calculation of soil concentrations: The equation provided is cited in US EPA (2005a) as being for non-carcinogens only. A different equation is provided for carcinogens. In addition, the values cited in the text (4.7×10^{-3} and 4.7×10^{-4}) do not match those in Table E-13 (4.6×10^{-3},4.6×10^{-4}).

Page E-24, Table E-15:

- Most deer tissue concentrations could not be reproduced, please verify these calculations.

Page E-26, Section, E-4.1 Estimates of Exposure to the Mixer/Loader:

- Text below MHPD and DR calculations: Please verify values.."

Page E-29, Table E-17 :

- Average and maximum Total Dermal Exposure values appear to be interchanged:
  - Average = 4.87E-03
  - Maximum = 4.38E-03
- Please also reflect this change in $_{\text{EXPDermal Routine}}$ calculation (EU_{Dermal}), page E-30, and associated text.

Page E 53, Section E-4.2, Estimate to the Flagger:

- Text below Chronic EXPDermal Routine calculation: "Therefore the estimated ~~acute~~ *chronic* dermal exposure to 2,4-D…"

Page E-34, Table E-20 :

- The first receptor ~~Soldier~~, should be *Military Trainee.*

Page E-36, Section E-4.3, Estimate of Non-occupational Receptors Exposure:

- EXP_{dermal} calculation: Please add body weight (BW) in parameters description.

Page E-37, Section E-4.3, Estimate of Non-occupational Receptors Exposure:

- $EXP_{berries}$ calculation: There is no conversion factor defined.

Page E-41, Section E-4.5, Estimates of Bystander Exposure to Spray Drift:

- Paragraph 2, Sentence 3: "…multiplying the unitized deposition ~~rate~~ *factor* by the active ingredient application rates."

Page E-41, Table E-21 :

- Title: 2,4-D Deposition Rates ~~(mg/m^3)~~ *(mg/m^2)* at CFB Gagetown.
- Header row: 2,4-D Deposition Rates ~~(mg/m^3)~~ *(mg/m^2).*
- It appears that the conversion from L/ha to mg/m^2 applied to these values is incorrect, the correct CF would be 1L/ha = 1kg/ha = 10^2 mg/m^2.

Page E-41, Table E-22:
Title: One Hour air Concentrations ~~(µg/m3)~~ *($\mu g/m^3$)* at CFB Gagetown

- Header row: 1-hr [air] ~~µg/m3~~ *$\mu g/m^3$*.
- There appears to be a transcription error between this table and table E-36 for the minimum and average air concentrations.

Page E-42, Section E-4.5, Estimates of Bystander Exposure to Spray Drift:

- EXP_{Dermal} Calculation: the 2,4-D deposition (AR) given is for min. deposition, not max deposition. Replace ~~$8.0x10^1$ mg/m^2~~ with *$1.7x10^3$ mg/m^2*.
- Replace associated text: "…exposed to over spray was ~~$2.2x10^2$ µg/kg/day~~ *$4.8x10^3$ µg/kg/day*".

PageE-45, Table E-23:

- Maximum Dermal Exposure values appear to be the Maximum Inhalation Exposure values.

PageE-45, Table E-24:

- Average and Maximum Dermal Exposure Estimates appear to be calculated with interchanged EU_{Dermal}. This is also reflected in the Total Exposure estimates.

Pages E-51 to E-55, Tables E-35 to E-47:

- All deposition rates are 1 order of magnitude too large; the conversion factor applied appears to be incorrect (~~CF=1000mg/kg*ha/m^2~~ should be CF=100 mg/kg*ha/m^2).
- All Dermal Exposure average and maximum values appear to have been calculated using the minimum deposition rate (instead of average and maximum deposition rates respectively), the minimum Dermal exposure values as well as the recalculated average and maximum values will be affected by the change in order of magnitude of the deposition rate.

Page E-51, table E37 :

- All values are missing at 800m from spray block.

Appendix I. Some examples of additional toxicity data

Appendix I is not intended to be either comprehensive or prescriptive. It is only intended to show the types of available toxicity data that could be utilised for short[a] and intermediate[a] term exposures, particularly those by the dermal or inhalation routes.

Active Ingredient	CANTOX Assessment	Additional Data
Bromacil	Chronic RfD (ADI) = 0.1 mg/kg bw/day (US EPA RED 1996)) used for all routes and durations of exposure	US EPA RED 1996: - Acute RfD (ARD) not required due to low acute toxicity - RfD for short and intermediate term dermal or inhalation exposures = 0.2 mg/kg bw/day
Dinoseb	Chronic RfD (ADI) = 0.001 mg/kg (US EPA 1989; Health Canada 2004) used for all routes and durations of exposure	
Picloram	Chronic RfD (ADI) = 0.07 mg/kg bw/day (US EPA 1992) used for all routes and durations of exposure (discrepancy - Appendix B lists chronic RfD as 0.07, while Table 6-1 lists as 0.02 mg/kg/d).	US EPA RED 1995: - Acute RfD (ARD) not required due to low acute toxicity (no acute toxicological endpoints of concern). - RfD for short term dermal or inhalation exposures not required (no short-term toxicological endpoints of concern) - RfD for intermediate term dermal or inhalation exposures = 5 mg/kg bw/day - Chronic RfD (ADI) = 0.2 mg/kg bw/day
Dicamba	Chronic RfD (ADI) = 0.0125 mg/kg bw/day (Health Canada 2004) Acute RfD (ARD) = 1.0 mg/kg bw/day (US EPA RED 2006) (discrepancy - appendix B lists chronic RfD as 0.0125, while Table 6-1 lists it as 0.03 mg/kg/d)	US EPA RED 2006: - RfD for short and intermediate term dermal and inhalation exposures = 0.45 mg/kg bw/day - Chronic RfD (ADI) = 0.45 mg/kg bw/day

Active Ingredient	CANTOX Assessment	Additional Data
Fosamine Ammonium Salt	Chronic RfD (ADI) = 0.01 mg/kg bw/day (US EPA RED 1995) used for all routes and durations of exposure	US EPA RED 1995: - No RfD required for all durations of dermal or inhalation exposure: "no known acute or chronic toxicological endpoints that warrant the establishment of risk mitigation measures to any category of handlers of the pesticide."
Triclopyr	Chronic RfD (ADI) = 0.05 mg/kg/d (US EPA RED1998) Acute RfD (ARD; (females 13+ years) = 0.05 mg/kg bw/day (US EPA RED 2002) (discrepancy - Appendix B also lists acute RfD for the general population = 1.0 mg/kg/d (US EPA RED 2002)	US EPA RED 1998: - RfDs not-required for short- or intermediate-term dermal exposures due to low toxicity in a 21-day dermal toxicity study in rabbits - RfD not required for any duration of inhalation exposure due to low toxicity via inhalation route - RfD = 0.05 mg/kg/d (same as ADI) for long term dermal exposure
Glyphosate	Chronic RfD (Chronic NDI) = 0.03 mg/kg (Health Canada, 1987 and 2004) (clarification – what is the source reference for the Chronic RfD in the Health Canada documents cited?)	US EPA 1993: - Acute RfD (ARD) not required due to low acute toxicity. - RfDs not-required for any duration of dermal or inhalation exposure, since no significant toxicology end-points via these routes - Chronic RfD (ADI) = 2.0 mg/kg/d UK Product Safety Directorate Database: - Acute RfD (ARD) not required - Short term RfD (Acceptable Operator Exposure Limit (AOEL)) - 0.2 mg/kg/d - Chronic RfD (ADI) = 0.3 mg/kg/d WHO 2004: - Chronic RfD (ADI) = 1.0 mg/kg/d

Active Ingredient	CANTOX Assessment	Additional Data
Diuron	Chronic RfD (ADI) = 0.0156 mg/kg bw/d (Health Canada 2004) Acute RfD (ARD) = 0.16 mg/kg bw/day (US EPA, 1999) (clarification – what is the source reference for the Chronic RfD in the Health Canada document cited?)	US EPA RED 2003: - Acute RfD (ARD) not established due to low acute toxicity - No RfD required for short or intermediate-term dermal exposure as no hazard identified - RfD for short-term inhalation or incidental oral exposure = 0.1 mg/kg bw/day - RfD for intermediate-term inhalation or incidental oral exposure = 0.01 mg/kg bw/day - RfD for long-term dermal or inhalation exposure = 0.003 mg/kg bw/day - Chronic RfD (ADI) = 0.003 mg/kg bw/day
Paraquat	Chronic RfD (ADI) = 0.0045 mg/kg bw/day (US EPA 2001) Acute RfD (ARD) = 0.0125 mg/kg bw/day (US EPA 2001)	US EPA 1997: - RfD for short or intermediate term dermal exposure = 0.03 mg/kg bw/day - RfD for short or intermediate term inhalation exposure = 0.00003 mg/kg bw/day (NOEL= 0.01 µg/L and SF = 100)
Dichloroprop	Chronic RfD (ADI) = 0.0364 mg/kg bw/day (WHO 1996) Acute RfD (ARD) = 0.5 mg/kg bw/day (EFSA 2005)	UK Product Safety Directorate Database: - Short term RfD (Acceptable Operator Exposure Limit (AOEL)) - 0.35 mg/kg/d (data for dichloprop-P)
Mecoprop	Chronic RfD (ADI) = 0.001 mg/kg bw/d (US EPA 1989)	UK Product Safety Directorate Database: - Acute RfD (ARD) not required - Short term RfD (Acceptable Operator Exposure Limit (AOEL)) - 0.04 mg/kg/d

Active Ingredient	CANTOX Assessment	Additional Data
2,4-D	Chronic RfD (ADI) = 0.01 mg/kg bw/day (Health Canada 2004) Acute RfD (ARD females 13+ yrs) = 0.08 mg/kg bw/day (PMRA 2005) (discrepancy - appendix B also lists ARD for general population) as 0.25 mg/kg bw/day (PMRA 2005))	PMRA 2005: Some RfDs are specific to the form of 2,4-D: - RfD for short term dermal, inhalation and incidental oral exposure for children and the general population is 0.04 mg/kg/d for all 2,4-D forms. - RfD for short term dermal and inhalation exposure for females 13+ is 0.03 mg/kg/d for most 2,4-D forms. For BEE, it is 0.01 mg/kg/d. Additional route and duration specific RfD values cited in US EPA RED 2005.
2,4,5-T	Chronic RfD (ADI) = 0.01 mg/kg bw/day (US EPA 1989)	

[a] Specific definitions for exposure durations vary, but short-term exposures are generally defined as daily exposures for durations of up to about a week, intermediate term exposures as daily exposures for durations of several weeks, and chronic exposures as daily exposures for several months or longer.

Appendix II: Label Application Rates Derived from Product Labels

Active Ingredient	PCP; Product # uses (dates)	Minimum Rate (kg-ai/ha)	Maximum Rate (kg-ai/ha)
2,4-D	14796; Silvaprop 3 (1984-1985)	1.97 (350 g/L: 7.5L/1000L; 750 L/ha)	5.25 (350 g/L: 10L/1000L; 1500 L/ha)
	11547; Dicleer 26 (1978-1994)	1.43 (382 g/L; 5L/1000L; 750L/ha)	5.73 (382 g/L; 10L/1000L; 1500L/ha)
	9560; Esteron 1 (1969)	2.9 (96oz/gal; 0.66gal/100gal; 750L/ha)	5.9 (96oz/gal;0.66gal/100gal;750L/ha)
	9007; Tordon 101 74 (1965 - 1993)	4.32 (240 g/L; 18 L/ha)	8.4 (240 g/L; 35 L/ha)
Dicamba	11547; Dicleer 26 (1978-1994)	0.75 (200 g/L; 5L/1000L; 750L/ha)	3.00 (200 g/L; 10L/1000L; 1500L/ha)
Dichloroprop	14796; Silvaprop 3 (1984-1985)	1.97 (350 g/L: 7.5L/1000L; 750 L/ha)	5.25 (350 g/L: 10L/1000L; 1500 L/ha)
Glyphosate	13644; Roundup 7 (1989-1996)	1.07 (356 g/L; 3 L/ha)	2.14 (356 g/L; 6 L/ha)

Picloram	9003; Tordon 10K 45 (1972 - 1982)	6.7 (10%; 67 kg/ha)	9.5 (10%; 95 kg/ha)
	9007; Tordon 101 74 (1965 - 1993)	1.17 (65 g/L; 18 L/ha)	2.28 (65 g/L; 35 L/ha)
Triclopyr	21053; Garlon 37 (1991-2000)	1.92 (480 g/l; 4 L/ha)	3.84 (480 g/l; 8 L/ha)

Appendix III: Compound specific comments regarding EDI

The following comments are included only for illustrative purposes. They are intended to be exhaustive.

Bromacil; As noted above, model EECs for Florida citrus use were used. Table 5.1 cites 4 μg/L, while the footnote states 100 ppb for DW. On examination of the source document (EPA RED), 100 μg/L represents exposure at 4% of the US EPA RfD. Note that other crops and water estimates are cited, which may be more representative of Canada or NB.

Imazapyr: EDI based on EPA RED. Of note, the US use pattern is significantly different than in Canada, with crop, residential, homeowner and direct aquatic uses registered. In Canada use is restricted to commercial applicators on non-crop and non-residential areas.

For Imazapyr (and in some other instances) exposure estimates were taken directly from EPA REDs. Using the published 'food only' and 'food plus water' exposure estimates, the contractor then back-calculated the drinking water exposure. This is a misrepresentation of the source information, as the RED indicated that a single point estimate was used for the drinking water estimates. By reporting the water-only exposure by sub-population, the impression is made that the data is significantly more robust (distributional) than it is.

Tebuthiuron: Several estimates are presented in appendix, including acute dietary and water residues from spills. No integrated exposure conclusions are made.

Pentachlorophenol: Again, several estimates are presented in the appendix. No attempt was made to reconcile the various estimates, or to recommend an integrated EDI.

Picloram: Inconsistently cites a Health Canada water quality guideline report (1988 and 1998). The EDI estimates proposed in Table 5.1 are: food at 0.28 μg/kg/day, cited from HC. Appendix C reports as 0.28 mg/kg/day (units error).
The source document reports a theoretical maximum daily intake of 0.02 μg/per person /per day. Using a 70 kg bw as per footnote L, this becomes 0.0002857 μg/L. Incorrect treatment of units; further, the value was incorrectly rounded to 0.28 rather than 0.29.
Water at 17 μg/L: Footnote G reports this as the maximum value reported in wells, but fails to note this was a contaminated dump site. Further, acute estimates are not appropriate estimators of typical exposure. The text cited in the appendix characterizes levels in water at much lower or not detected values.

Dinoseb: There appears to be a misquote from the HC document. The 0.1 GMRL (which is frequently cited in the HC water guideline reports) is described as the '100 mg/L negligible residue limit established by NH&W for crops treated with dinoseb'. As noted above, dinoseb is no longer registered in North America. Table 5.1 cites a range of DW estimates without stating which is used. By back-calculation it appears the highest value observed is used, even though non-detects in other studies range from 100%, 99% and

85%

Diquat: Not summarized in table 5.1. Quotes without attribution that 'few data are available on actual levels of diquat found in foodstuffs in Canada', without considering the rich body of data available from the 1995 EPA RED and 2002 EPA TRED. The HC water guideline doc reports a theoretical max daily intake of 0.03 mg/day, or 0.000428 mg/kg-day. The value calculated by the contractor is 0.00428 mg/kg-day (out by a factor of 10).

Triclopyr**:** Appendix C reports the model estimate (GENEEC) in DW as 223 µg/L while the source document reads 233 µg/L. Cannot locate reference in EPA RED to an estimated DW concentration of 0.43 µg/kg/day. Not clear if this is an interpreted value or is misquoted from elsewhere in the RED (triclopyr solubility 430 mg/L, used for environmental EEC; 43 ppm in fish tissue). The EPA determine the risk from the GENEEC bounding estimate, reported as an MOE to determine acceptability.