PEER REVIEW
OF
ECOLOGICAL & HUMAN HEALTH
RISK ASSESSMENT
COMMON & RIVERFRONT PARK AREAS

Prepared for:

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TABLE OF CONTENTS

1.0 INTRODUCTION

SENES Consultants Limited was retained by Dessau-Soprin Inc. to perform a peer review of the risk assessment for the Common & Riverfront Park Areas of Lebreton Flats Infrastructure and Remediation Project, Ottawa, Ontario.

The risk assessment document reviewed is entitled:

> *Ecological & Human Health Risk Assessment - Common & Riverfront Park Areas.* LeBreton Flats Infrastructure and Remediation Project Ottawa, Ontario. National Capital Commission. Preliminary Report (2nd Draft). December 2002.

Detailed site characterization data are provided in the following reports:

- Dessau-Soprin Inc. (DSI) 2002a. *Complementary Phase II - Environmental Site Assessment, Blocks O, U, T, X, W and Adjacent Areas* Final Report. LeBreton Flats Infrastructure and Remediation Project Ottawa, Ontario. National Capital Commission. April.
- Dessau-Soprin Inc. (DSI) 2002b. *Supplementary Phase II - Environmental Site Assessment, Lebreton Boulevard, Booth and Lloyd streets, ORP, Common, Riverfront and Sedimentation Pond Areas* Final Report. LeBreton Flats Infrastructure and Remediation Project Ottawa, Ontario. National Capital Commission. July.

The National Capital Commission (NCC) has requested that a local risk assessment be completed according to the CCME Method 3. This approach is deemed by MOE to be equivalent to the Site Specific Risk Assessment (SSRA) process with the exception of administrative requirements such as registration on title. As a component of the SSRA it is required that the risk assessment undergo an external review by a qualified party. As the CCME has no formal peer review process, this peer review was conducted in accordance with the MOE guidelines for site specific risk assessment and the "Reviewer's Checklist for Risk Assessments". This report outlines the reviewers' comments on the assessment, deficiencies and other concerns.

It should be acknowledged, that we have not attempted to verify all calculations.

1.1 TERMS OF REFERENCE

In general, the purpose of a peer review is to offer an opinion at to whether the SSRA has been undertaken competently in accordance with the MOE document entitled *Guidance for Use at Contaminated Sites in Ontario.* A peer review must also comment on whether or not the conclusions that have been reached are appropriate and defensible.

In order to carry out the terms of reference, this peer review examines the information presented in the above mentioned report prepared by Dessau-Soprin Inc. (DSI) that describes current site conditions, the relationships between current conditions and past activities or conditions, the rationale for identification of the chemicals of interest, the fate and toxicological characteristics of those chemicals, the rationale for selection of the appropriate exposure scenarios, the equations and/or models used to estimate the potential for receptors to be exposed to the chemicals, the interpretation of exposure estimates, and the subsequent conclusions and recommendations.

The following sections of this report follow the general format presented by DSI.

1.2 LIMITING CONDITIONS

This report has been prepared for Dessau-Soprin Inc. Any use which a third party makes of this report, any reliance on this report, or decisions based upon this report are the responsibility of those third parties unless authorized in writing by SENES. SENES accepts no responsibility for damages suffered by any unauthorized third party as a result of decisions made or actions taken based upon this report.

This report has been written by Harriet Phillips, Ph.D. and Stacey Fernandes, M.A.Sc., P.Eng., with input and review from Douglas Chambers, Ph.D. of SENES Consultants Limited.

2.0 INTRODUCTION

This section of the report provides a brief description of the site. This includes a brief description of the history of the site as well as the planned use complete with relevant figures. The objectives of the site specific risk assessment were summarized and are adequate.

3.0 RISK ASSESSMENT METHODOLOGIES

This section describes in general terms the human health and ecological risk assessment process. DSI states that a preliminary risk assessment (Tier 2) approach is appropriate for this site. We concur with their general descriptions. However, it is noted that a discussion of Level 1 and Level 2 risk management (as termed in the MOE risk assessment framework) has not been discussed. This is an important concept in the MOE approach and should be included.

4.0 SITE DESCRIPTION

This section provides a more detailed description of the historic use of the site and the natural environment. Relevant information regarding the physical characteristics of the site (e.g. topography, geological characteristics, surface water, groundwater) as well as the biological setting is provided.

5.0 ENVIRONMENTAL CHARACTERIZATION

This section provides a summary of the studies that have been carried out at the site.

5.1 SOIL CHARACTERIZATION

A selection of contaminants to be carried through the detailed assessment is also provided in this section. The use of MOE Table B criteria for residential/parkland landuse and coarse textured soil is appropriate considering the non-potable nature of the groundwater on-site. However in keeping with the MOE checklist, no justification was provided that the site is not a sensitive site. DSI have used the more restrictive of the MOE Table B values and CCME residential/parkland numbers but it should be noted that the CCME numbers include consideration of potable groundwater which is not the case at the site.

The screening was carried out based on the 95% upper confidence limit of the mean. Although it is appropriate to use the UCL of the mean for risk characterization, it may be prudent to conduct the screening with the upper 95th percentile of all the data rather than of the mean. A thorough screening procedure was implemented with consideration of different depths. However, it is unsure where some data are included in the breakdown between Tables 5 and 6. For example for zinc, in Table 4 (all depths) it is recorded that 193 samples were included. In Table 5 (<1 m depth), 56 samples are included and in Table 6 (>1 m depth), 83 samples are included for a total of 139 samples, leaving 54 samples unaccounted for.

10 COCs were selected based on the screening procedure used. Although it is appropriate to evaluate these 10 COCs for both an ecological and human health perspective it should be noted that the MOE allows further screening based on the breakdown of the guideline into these two components. This procedure would eliminate contaminants such as copper from being carried through the human health risk assessment as the maximum measured soil concentration of 173.3 mg/kg (Table 4) is below the human health component of both the MOE and CCME guidelines (1100 mg/kg).

The description for the elimination of TPH as a contaminant of concern is somewhat confusing. From a check of the data collected using the CCME methodology, the F2 fraction concentration of TPH at SS-5 fails the CCME criterion value for ecological concerns (1500 mg/kg vs. 150 mg/kg). This would imply that the F2 fraction should be carried through the ecological risk assessment.

5.2 GROUNDWATER CHARACTERIZATION

The discussion of groundwater contamination does not seem to correspond to the Phase II report (DSI 2002b). The risk assessment states that PAHs were found at MW-01-02 and no VOCs were detected in the groundwater at the site. From the information contained in the Phase II report, the following monitoring wells and exceedances appear to correspond with the subject site:

MW-01-00	PAHs	MW-02-125	VOCs
MW-01-01	VOCs	MW-02-128	VOCs, PAHs
MW-02-115	VOCs	MW-02-126	VOCs,PAHs
MW-02-118	VOCs, PAHs	MW-02-127	PAHs
MW-02-124	VOCs, PAHs	MW-02-131	

Thus, consideration should be made regarding groundwater issues with the inclusion of VOCs (particularily trichloroethene) in the risk assessment as well as additional PAHs.

6.0 ECOLOGICAL RISK ASSESSMENT

6.1 PROBLEM FORMULATION

The problem formulation outlined in the DSI report is appropriate. However as discussed in Section 5.2 above, the groundwater discussion may need to be modified.

The use of the CalTOX model to model the environmental fate is appropriate. In general, the physical site characterization values provided in Table 9 appear to be appropriate for the site. It is noted that the organic carbon fraction values are based on *in-situ* measurements. However, data for this could not be located in the Phase II reports (DSI 2002a, b). As this is an important variable in the calculation of chemical volatilization from soil as well as potential plant uptake it would be helpful to present this information.

It is unclear what source term was used in the assessment. On page 5-4 it states that the soil concentration used for modeling corresponds to the arithmetic mean, however on page 5-7 it states that the 95% UCL was used. From the detailed calculations it appears both are used – this should be clarified in the text.

The Phase II report (DSI 2002b) states that the management of the groundwater after the construction work should be included in the risk assessment. There is no mention of such an assessment in the DSI report. In addition, Figure 5 shows that there are two wet ponds on the site. There is no discussion on the impact of groundwater or surface runoff to these ponds and potential receptors.

For the soil contamination, the selection of receptors: ring-billed gull, groundhog, grey squirrel, terrestrial plants, soil invertebrates and soil microorganisms, is appropriate.

The discussion on page 4-5 of the report states that all 10 COCs were selected for inclusion in the assessment of groundwater. No discussion was found that explicitly addresses the potential groundwater issues.

The selection of assessment endpoints for the ecological receptors is appropriate. Note that Figure 9 does not correspond to the assessment endpoints provided on page 5-6.

6.2 ASSESSMENT METHOD

The assessment method is appropriate.

It is unclear what level of assessment is intended. Section 2.1 of the DSI report states that the ERA corresponds to a Tier 2 assessment. Section 5.2.2 of the DSI report states that the Tier 2 ERA will follow if needed.

6.3 HAZARD ASSESSMENT

Toxicity data was obtained from ORNL reports. These benchmarks for the most part are appropriate. However, the following differences should be noted:

- The MOE has toxicity benchmarks for PAHs of 40 mg/kg in soil
- The toxicity benchmark for arsenic for birds was based on copper acetoarsenite. This species is unlikely to be found in the soil, it may be more appropriate to use the benchmark for sodium arsenite in mallard ducks of 5.1 mg/kg/d. However, the benchmark used in the assessment is more cautious.
- No benchmarks are reported for chromium species in birds. While it is acknoweledged that the hexavalent species of chromium is more toxic, a benchmark is available for trivalent chromium which could be used to assess the potential impacts in birds exposed to chromium from the site.
- For lead exposure in birds, the toxicity benchmark is based on metallic lead which is not bioavailable. Another benchmark exists for lead acetate, which is more bioavailable, and should be used in the assessment. This value is 1.13 mg/kg/d and is based on a study on Japanese Quail carried out by Edens *et al*. 1976.

6.4 EXPOSURE DOSE ASSESSMENT

The equations provided to calculate dose seem appropriate. Note that the same equation ($E_{ing} = E_f + E_s$) appears twice on pages 5-10 and 5-11.

We agree with the discussion regarding the dermal contact of groundhogs. Note that some consideration may be warranted for the inhalation pathway for the groundhog, especially with respect to vapours migrating from VOCs in the groundwater, particularly while burrowing.

It would be beneficial to provide more detail on the calculation of concentration in small mammals and earthworms as only a reference was provided. Spot checks of the estimated

concentrations in small mammals and earthworms were completed to verify the values. Are the concentrations provided in Appendix 4 (Tables 4 and 5) the results of the product of 2 distributions?

6.5 RISK CHARACTERIZATION

The use of a hazard ratio to characterize risk to ecological receptors is appropriate.

The discussion of uncertainty is appropriate and addresses the major issues.

Based on the results of the ecological risk assessment it was suggested that risk management measures be implemented to reduce the risk to, earthworms and terrestrial plants. However, Section 7 of the report indicates that risk management measures are not needed since the screening index values are only slightly above 1 for plants and earthworms. From a review of the data it would appear that the UCL 95% is below the MOE ecological toxicity data for chromium and zinc and although MOE does not provide a value for lead, the UCL is below the CCME ecological value. A comparison to these criteria would provide a broader perspective to the analysis and strengthen the rationale for no mitigation measures

7.0 HUMAN HEALTH RISK ASSESSMENT

7.1 HAZARD IDENTIFICATION

The selection of receptors for the current and future scenario as local residents and potential future users is appropriate. As DSI has stated that the contamination is heterogeneous at the site. Is there any particular infrastructure planned at the site that would make part of it more attractive and thus weight the exposure time accordingly? The source characterization may not be appropriate if it is likely that more time would be spent in a specific area of the site. DSI has properly stated that groundwater is not likely to be a direct source of exposure, however, the indirect exposure of vapours from VOCs has not been addressed and should be considered for inclusion.

7.2 TOXICITY ASSESSMENT

The potential for adverse effects on the human receptors for both non-carcinogenic and carcinogenic pathways was completed and is appropriate. Some additional discussion are warranted regarding the selection of toxicity data used to assess exposure from PAHs. For example, the MOE has a dose-response document that should be discussed (MOEE 1997). As well, there is no discussion regarding the selection of data. For example, IRIS has an oral slope factor for benzo(a)pyrene yet the information from CalEPA has been used in this assessment with no rationale provided.

Additionally, it should be noted that the MOE has a toxicity value for lead (an Intake of Concern of 1.85 μg/kg/d) and the *Guidance on Site Specific Risk Assessment for Use at Contaminated Sites in Ontario* (MOEE 1996) states that this value should be used in lieu of values from other jurisdictions.

A review of the data contained in Table 15 revealed other items:

- CalEPA has inhalation toxicity data for arsenic and copper which were not included in the study
- The value of 1.0E-04 for inhalation of chromium VI is an RfC not an RfD
- There is a number of 1.3 mg/L (or 0.037 mg/kg/d) for copper in HEAST (USEPA 1997)
- There is a typographical error in the chromium VI unit risk for inhalation (should read 0.012 $(\mu g/m^3)^{-1}$), the slope factor shown is correct.

7.3 EXPOSURE ASSESSMENT

The selection of several age classes for assessment is appropriate. The choice of local population for the current scenario with exposure through soil ingestion, inhalation of vapours and particulate and dermal exposure is appropriate. However, as noted in Section 5.2 above, it would appear that the groundwater contains VOCs and the exposure to vapours should be considered.

The selection of the local population in the future scenario is appropriate although it is uncertain why the exposure time for the local population after redevelopment was reduced to 0 (Table 17). Presumably the space will be more attractive once development is complete. In addition, as the plan for LeBreton Flats includes 2500 housing units there will be a population in very close proximity that could use the area on a frequent basis. With placement of a minimum 0.3m of clean soil cover across the site it is likely that the exposure pathways of soil ingestion, particulate inhalation and dermal contact are eliminated. Thus only pathways for volatile contaminants (e.g. naphthalene in soil and VOCs in groundwater) would need to be considered.

The evaluation of the user for the post-development scenario is acceptable, however, these individuals are likely less exposed than the local population. The user, with the current configuration, may be an appropriate surrogate for a maintenance worker at the park that may come in short-term contact with the soil during maintenance activities. The DSI report states that the assumed exposure for 5 days a year corresponds to 20 site visits of 6 hours each. This is not true as soil ingestion, although expressed on a daily basis, does not occur evenly throughout a 24-hour period and thus cannot be directly scaled on an hourly basis.

The exposure parameters used in the assessment were provided in Table 17 of the report. In general, all exposure parameters are reasonable and appropriate. One parameter that was difficult to trace was skin surface area. We could not locate the values in the Richardson 1997 report. If there was some adjustment for portion of the body exposed this should be specified in the table. Some of the exposure times are unusual (e.g. it is unlikely that an infant 0-6 months of age would spend 10 hours at rest and 11.2 hours active each day). However, the assumptions regarding active and resting exposure time are conservative and unlikely to have a significant impact on the result.

The use of the CalTOX model for the exposure assessment is appropriate and major model assumptions were provided. For the purposes of this review independent calculations were made for selected receptors and conditions to check the results. One point of note is that with the use of an exposure model it is beneficial to provide more detailed output (such as predicted air concentrations) to allow the verification of results. In general, the results of the spot checks had good agreement however, a few issues were identified:

- Dermal exposure rates calculated following the methodology outlined by USEPA RAGS, also shown as equation 78 in the CalTOX Technical Manual (CalEPA 1993), with an absorption fraction of 0.03 for arsenic produced much higher dose estimates than those given in tables.
- Naphthalene exposures calculated were higher than those produced by CalTox.
- It is not obvious where the difference between the exposure estimates for the Common area and Riverfront areas are since the same source term was used for each and no indication was found regarding different exposure scenarios.

7.4 RISK CHARACTERIZATION

The risk characterization section summarizes the approach taken to estimating hazard ratios (HR) and estimates of carcinogenic risk and a risk index (RI). The use of a HR of 1 for comparison is not appropriate as the *Guidance on Site Specific Risk Assessment for Use at Contaminated Sites in Ontario* (MOEE 1996) states that to deviate from the apportionment of 20% a multi-media exposure assessment must be completed along with an assessment of exposures from other sources not associated with the site (i.e. background levels). The results provided by DSI show, however, that HRs are generally less than 0.01 and would not be considered an issue.

For the assessment of carcinogenic risk, the use of a 1E-06 as the acceptable risk is appropriate.

The calculation of an absorbed dose for dermal exposure does not preclude its inclusion in the assessment of a hazard ratio or risk. Appendix D of the MOEE (1996) provides guidance on the use of absorbed versus administered doses.

The MOE guidance requires the assessment of mixtures of contaminants that may act on the same target organ. Thus, an acknowledgment of the total risk from PAHs exposure should be incorporated.

7.5 SENSITIVITY AND UNCERTAINTY ANALYSIS

DSI conducted a sensitivity analysis using the CalTOX model to investigate the sensitivity of the results to the input parameters. There is a lack of information regarding the range of uncertainty applied to each of the input parameters that was used in the simulation however the results do seem appropriate. The uncertainty analysis focussed on the uncertainty associated with the source term. This is certainly a key area of uncertainty, although other areas that contribute to uncertainty, such as toxicity data and exposure parameters, should be discussed. Again there is a lack of information to assess the appropriateness of the Monte Carlo simulation (e.g. was only the source concentration varied, what type of distribution was used, how many runs were

completed). Considering the results of the overall analysis, the results of the Monte Carlo simulation are likely not necessary.

8.0 ECOLOGICAL AND HUMAN HEALTH RISK MANAGEMENT

In general, the risk management plan proposed for the site appears to be appropriate. A groundwater monitoring component should be incorporated into the risk management plan due to the presence of PAHs and VOCs across the site.

9.0 OVERALL OPINION

The risk assessment completed by DSI follows generally accepted practices and assumptions. In general the assumptions have been provided and documented. The purpose of a peer review is to offer an opinion as to whether or not the SSRA has been conducted in accordance with the MOE protocol discussed in the *Guideline for Use at Contaminated Sites in Ontario* and in the *Guidance on Site Specific Risk Assessment for Use at Contaminated Sites in Ontario*.

There are several areas that should be addressed to ensure the SSRA in accordance with the MOE guidelines:

- Full consideration of groundwater impacts from an ecological perspective including the presence of ponds on site
- Consideration of TPH F2 fraction from an ecological perspective
- Consideration of the vapours migrating from groundwater at the site
- Provide more detail regarding the CalTOX model, including model results
- Inclusion of discussion on issues such as assessment of Level 1 and 2 risk management, assessment of mixtures as well as other items required by MOE outlined in this review

Therefore, these items/changes/additions (as well as others mentioned throughout this peer review) must be made to the document before the Ecological & Human Health Risk Assessment of the Common & Riverfront Park Areas can be deemed to be complete.

On a minor note, the references in the document should be checked to ensure that all cited documents are present in the reference list. For example, Concannon et al. 1997 and Prescott and Richard 1996 are not present in the list of references.

REFERENCES

California Environmental Protection Agency (CalEPA) 1993. *CalTOX, A Multimedia Total Exposure Model for Hazardous Waste Sites Part III: The Multiple Pathway Exposure Model.* The Office of Scientific Affairs Department of Toxic Substances Control. December.

Ontario Ministry of Environment and Energy (MOEE) 1997. *Scientific Criteria Document for Multimedia Standards Development for Polycyclic Aromatic Hydrocarbons (PAH). Part 1: Hazard Identification and Dose-Response Assessment.* February.

Ontario Ministry of Environment and Energy (MOEE) 1996. *Guidance on Site Specific Risk Assessment for Use at Contaminated Sites in Ontario.* May.