

9. CONCLUSIONS

9.1 Study Overview

This report assessed the potential risks to people and to the environment associated with the use of biosolids pellets in the City of Toronto and landfill topdressing. The study considered the potential exposure to metals (i.e., arsenic, cadmium, cobalt, chromium III, copper, mercury, molybdenum, nickel, lead, selenium and zinc) and selected organic chemicals (polychlorinated biphenyls or PCBs, dioxins and furans) to people in Toronto under several conditions:

- Application of pellets to City-owned recreational areas such as parks and golf courses;
- Application of topdressing containing pellets to landfills to facilitate seeding; and,
- Home use of pellets by residents as fertilizer on lawns and gardens.

The potential for health effects resulting from the presence of micro-organisms and other biological agents in the pellets was qualitatively reviewed. A discussion was presented on emerging issues. As well, the assessment looked at the potential for adverse impacts on mammals including pets (cats and dogs) and wildlife and birds. Plants and soil micro-organisms were reviewed qualitatively.

Inherent to the risk assessment process, several assumptions were made which tend to overestimate risks. Multiple conservative assumptions in an assessment generally lead to estimates of risk that are conservative and may overstate the actual risk.

9.2 Summary of Findings

9.2.1 Human Health Risks from Non-Carcinogenic Effects

The study estimated potential exposures to metals and other pollutants and compared them with health benchmarks for non-cancer effects. In all scenarios considered the hazard quotient was less than the MOE's benchmark of 0.2. This indicates that potential exposures to these substances are below the health benchmark, and thus not expected to result in adverse non-cancer effects.



9.2.2 Human Health Risks from Carcinogenic Effects

The study assessed the potential human health risks from carcinogenic effects of those entities of potential concern that are known or probable carcinogens. Exposure ratios were calculated for Health Canada and Ontario Ministry of Environment (MOE) benchmarks of one in one hundred thousand and one in one million cancer risk levels, respectively. The results are as follows:

- All exposure ratios were below one for the City Parks Worker Scenario;
- All exposure ratios were below one for the City Landfill Worker Scenario;
- All exposure ratios were below one for the Recreational Use Scenario;
- Exposure ratios were below one for the Home Use Scenario for all chemicals except arsenic;
- The arsenic exposure ratio for the Home Use Scenario was below one for the Health Canada benchmark;
- The arsenic exposure ratio for the Home Use Scenario was greater than one for the MOE benchmark; and,
- When background concentrations of arsenic in soil are excluded from the calculation, the arsenic exposure ratio is equal to one, indicating an acceptable incremental risk from arsenic based on the MOE benchmark.

To understand the importance to health of the Home Use Scenario exposure ratio estimate, several factors should to be considered including the following:

- Many fertilizers contain traces of arsenic; the levels of arsenic in the biosolids pellets are below allowable limits for fertilizers.
- The concentration of arsenic in pellets was estimated to be below Ontario background soil concentrations.
- The calculated risk was within the range of uncertainty generally associated with risk assessments; the many assumptions used in the calculations tend to overestimate the risk, meaning the actual risk may be overstated.
- The MOE benchmark is based on incremental risk and the analysis excluding background thus demonstrates an acceptable level of risk based on the MOE benchmark.

9.2.3 Biological Agents

There are no well-developed guidelines available for conducting assessments of biological risks. In addition, quantified levels of biologics were not available for Toronto biosolids. There are also no available guidelines on the acceptability of different risk levels for environmental pathogens and the science of assessing such risks is underdevelopment; therefore, conclusions

regarding the acceptability of pellet use scenarios based on potential biological risks cannot be made. This assessment was therefore limited to examining the potential for biological entities to be present in biosolids or to be destroyed in the pelletization process. The major findings are as follows:

- The pelletizer manufacturer asserts that the pelletization process at ABTP is equivalent to that required by the US EPA for Class A biosolids.
- The process information and limited analytical data available indicate that the biosolids pellets from the ABTP pelletizer are likely of similar quality to those that meet the US EPA definition of Class A biosolids and exceptional quality biosolids which can be distributed in the United States without restriction.
- The literature data suggest a minimum process time of 60 to 90 minutes at a temperature of 80°C to effectively destroy most pathogens.
- Some biological entities in the biosolids pellets may not be deactivated by the pelletization process. Exposure to such entities increase with frequency and duration of handling, as well as quantities used and therefore exposure would be greater for workers than for residents.
- Confirmatory testing of pellet quality with respect to biological entities is limited.
- No confirmatory testing is known to have been undertaken to validate the temperature and residency times achieved by the pelletizer or the humidity within the pelletizer.
- Some biological entities may enter the sewage treatment system via the direct discharge of untreated blood products to the sewers which is currently permitted in the City of Toronto.
- There is currently no evidence of any outbreak of prion-related disease in Toronto and the diseases are extremely rare. Although the pelletization process may not effectively deactivate prions, the potential risk of exposure to these biological entities through biosolids pellets is very low.

9.3 Ecological Risks

A preliminary screening was done for potential ecological effects on plants and soil organisms. The levels that may accumulate in the top 5-cm of soil after 25 years of pellet application were compared to Canadian Council of the Ministers of the Environment (CCME) and Ministry of the Environment (MOE) ecotoxicity values for plants and soil organisms. The results included:

- No risks to plants or soil organisms were identified when pellets were used in landfill topdressing;
- No risks to plants or soil organisms were identified for arsenic, cadmium, cobalt, chromium III, mercury, molybdenum, nickel, lead, PCBs, dioxins and furans;



- The estimated concentrations of selenium and zinc were less than the corresponding MOE values but slightly higher than CCME ones. The results indicate that no risk to plants or soil organisms is expected due to selenium or zinc.
- Levels of copper were estimated slightly higher than the MOE toxicity value and about four times higher than the CCME ecotoxicity value. Copper levels were also higher than CCME ecotoxicity values when pellets were assumed to be mixed within the top 15-cm of soil.

The qualitative screening assessment performed for plants and soil organisms is considered sufficient to identify areas where closer analysis may be worthwhile and for what compounds it is not warranted. The analysis is not sufficient to conclude whether or not adverse effects on plants or soil organisms may actually occur. Further evaluation using toxicity values based on plants most commonly found in Toronto parks and gardens and considering the potential for reduced bioavailability of metals in biosolids-amended soils would be required to conclude whether or not plants or soil organisms may be at any risk from copper in pellets applied to lawns, gardens or City lands.

In looking at the potential impacts on wildlife, potential exposures to the meadow vole, masked shrew, racoon, red fox, American robin, and red-tailed hawk, were considered. After 25 years of use, when pellets were incorporated into the top 5-cm of the soil, the following hazard quotients were estimated:

- Hazard quotients were less than the benchmark of one for the meadow vole, masked shrew, racoon, red fox, and red-tailed hawk for all chemicals evaluated;
- Hazard quotients were less than one for the American robin exposure to arsenic, cadmium, cobalt, copper, mercury, molybdenum, nickel, lead, selenium, zinc, PCBs, dioxins and furans; and,
- The hazard quotient for the American robin exposure to chromium III was three, compared to the benchmark of one.

The assumptions used in the calculations tend to overestimate the levels of exposure and therefore overstate the potential risks. The hazard quotient greater than one does not imply a risk, but rather it indicates that a risk cannot be ruled out by the analysis performed. If the robin is considered to migrate out of the Toronto area for approximately half of each year, unless pellets are applied to more than 60% of the robin population's home range, the hazard quotient for chromium III can be considered to be less than one and hence no effects to robins would be expected.



Potential risks to pets as individuals were quantitatively evaluated. The results were as follows:

- Hazard quotients were less than the benchmark of one for cats and dogs exposed to cadmium, chromium III, cobalt, copper, mercury, molybdenum, nickel, lead, selenium, zinc, and PCBs;
- The hazard quotient was less than one for dogs exposed to dioxins and furans;
- The hazard quotient for cats exposed to dioxins and furans was estimated at one; and,
- The hazard quotient for cats and dogs exposed to arsenic was estimated at one.

Given that the evaluation of pets is based on the use of no observed adverse effects levels (NOAELs), no risk to pets is expected for a hazard quotient of one.

