Report To: Chair R. Anderson and Members
Committee of the Whole

Report No.: 2009-COW-01

Date: June 16, 2009

SUBJECT: EFW Risk Assessment and Environmental Surveillance

RECOMMENDATION:

That the Committee of the Whole recommends to the Regional Council that:

a) **The final Site Specific Human Health Risk Assessment (SSHHRA) for the proposed 140,000 tonnes EFW facility is accepted and submitted to the Ontario Ministry of the Environment for its review, if and when the EFW environmental assessment is approved, subject to it being in concordance with the caveats expressed in Appendix D of this report;**

b) **That if the EFW environmental assessment is approved and the proposed EFW facility is constructed, once operational, an environmental surveillance program is implemented in accordance with all applicable legislation, policies, guidelines, and instruments and the following guiding principles:**

   i. **That continuous and periodic stack testing of chemical emissions, including dioxins and furans, that meet or exceed the more stringent of the Ontario Guidelines A-7 and EU Directive chemical emissions standards forms the basis of environmental surveillance in accordance with the International Best Practices Review,**

   ii. **That stack testing be supplemented by independent ambient air and soil testing for a minimum of three years at which time its effectiveness will be evaluated,**

   iii. **That independent testing of flora and fauna be considered if in-stack, ambient air and soil test results regularly exceed levels predicted by the SSHHRA,**

   iv. **That stack testing not be supplemented by human biomonitoring,**

   v. **That the environmental surveillance results are communicated to the public in as an accessible, accurate, open, timely, transparent, and understandable a manner as possible,**

vi. That a Durham waste diversion and management advisory committee, or similar advisory group, which is appointed by and is accountable to the Regional Council, is in place to act as a forum for, and comprises Clarington and Durham residents and representatives from Clarington, the EFW facility, Ontario Ministry of the Environment (MOE), and the Region of Durham to assess, monitor, review, and advise the Region on the effectiveness of the environmental surveillance program, independent environmental testing, the quality of public reporting of environmental surveillance data, the environmental performance of the facility, and other related strategic waste diversion and management issues,

vii. That the Health Department is consulted by the MOE before it finalizes its requirements for the Region's environmental surveillance program;

c) That the Region continues to pursue the goal of 70% waste diversion and to advocate for amendments to the *Waste Diversion Act, 2002* to be enacted and implemented;

d) That the Region adequately supports the environmental surveillance program, independent environmental testing, the public reporting of environmental surveillance data, and the work of the proposed Durham waste diversion and management advisory committee;

e) That the Minister of the Environment, Durham's MPPs and municipalities, Joint Waste Management Group, Site Liaison Committee, and the Regional Municipality of York are so advised.

REPORT:

A. BACKGROUND

1. The Health Department first became involved in the EFW environmental assessment (EA) on June 20, 2007, when the Regional Council requested that the Commissioner & Medical Officer of Health (MOH) comment on the Durham/York Generic Human Health Risk Assessment (GHHRA) and review the health-related chapters of the Halton EFW Business Case.

2. Owing to the Health Department's limited in-house experience and expertise regarding this matter, the MOH commissioned Dr. Lesbia Smith, a well-recognized expert in occupational and environmental health, to review the Halton 4a Report, review the GHHRA, and provide advice on environmental surveillance.

3. Dr. Smith's main conclusions are summarized in Report #2007-MOH-20 and the Executive Summary of her report to the MOH (Appendices A & B). The key conclusions with respect to this report are as follows:

   - In essence, the Halton 4a Report concluded that EFW facilities using modern (thermal) methods and pollution control technology are not expected to pose a significant risk to the public. In addition, the Report stated that any new EFW facility should be subject to a site specific risk assessment to identify local issues and ensure that it will not pose a risk to the public.

   - The current epidemiologic literature (2000-2007) is inconclusive and does not demonstrate one way or another that modern incinerators have associated health effects on the people living around them. This conclusion is not materially different from the inference made in the Halton 4a Report.

   - Risk assessment is the only procedure that can produce quantitative estimates of predicted health effects. The GHHRA was properly carried out. The methods are clearly explained, are reproducible and err on the side of health protection or "conservatism". Any future site specific risk assessment should apply upset conditions, if situations with upset conditions are relevant to the EFW facility.

   - Epidemiology, risk assessment and biological monitoring assist regulatory and public health agencies and improve public understanding of human health and the environment. Because each method can have limits and challenges, a combination best serves public health.

   - Environmental quality oversight and health surveillance can promote engagement of communities with industry, regulatory and public health agencies and can be considered part of a responsible program for environmental monitoring.

4. In accordance with additional directions the MOH received from the Regional Council to ensure an independent peer review of the site specific human health risk assessment (SSHHRA) and to provide advice on environmental surveillance, Dr. Smith was also retained by the MOH to provide him with advice with respect to the SSHHRA for the proposed 140,000 tonnes EFW facility and the international environmental surveillance best practices review, both of which are discussed below.

B. SITE SPECIFIC HUMAN HEALTH RISK ASSESSMENT (SSHHRA)

5. The SSHHRA conducted by Jacques Whitford (JW) used the following standard framework: problem formulation, exposure assessment, hazard assessment, and risk characterization. Appendix C is SSHHRA's draft Executive Summary. Overall, the results of the SSHHRA indicate that it is not expected that the proposed EFW will lead to any adverse health risks to local residents, farmers or other receptors in the local risk assessment study area.

6. The SSHHRA was peer reviewed by Dr. Smith and her associate, Mr. Ross Wilson, an experienced risk assessor and certified toxicologist. Appendix D is their report. In summary, they support the findings of the JW SSHHRA, consider the methodology to be sound, and conclude that the proposed EFW facility should not pose unacceptable risks to persons living in the vicinity of the site.

C. ENVIRONMENTAL SURVEILLANCE

7. Environmental surveillance was explored in far more depth in the report "Review of International Best Practices of Environmental Surveillance for Energy-From-Waste Facilities" (Best Practices Review). The focus of this study was to review environmental surveillance programs at similar facilities around the world and to recommend an appropriate level of environmental surveillance for the proposed EFW facility.

8. Appendix E is the report's Executive Summary. In essence, the JW concluded that the most appropriate and scientifically justified option for environmental surveillance of the proposed Durham/York EFW facility would involve continuous and periodic stack testing of chemical emissions (Option 1). This option was found to be the most prevalent method of ensuring public and environmental health protection in Canada, the EU, and the USA. To ensure added protection, JW supported Regional Council's decision to adopt the more stringent of the Ontario Guideline A-7 and EU Directive chemical emissions standards and to implement an in-stack dioxins and furans sampling technology. These measures go beyond any requirements that would be derived from the JW's review.

9. Dr. Smith conducted an independent peer review of this study. Her advice to the MOH is found in Report #2009-J-17 (Appendix F). In essence, Dr. Smith agreed with the JW's conclusion that Option 1 is optimal and derives from the study. In her opinion, the community living outside the point of impingement and the public-at-large would not be at risk from the public health perspective if this surveillance option is chosen. Finally, Council's decision to adopt the more stringent of Guideline A-7 and EU Directive chemical emissions standards and to implement an in-stack dioxins and furans sampling

technology is concordant with a highly protective approach to health and the environment in Durham Region.

10. Both Dr. Smith and JW recommend that an independent environmental oversight committee be struck to ensure public participation in the environmental surveillance program and to evaluate its efficacy in protecting public and environmental health.

D. WASTE DIVERSION

11. During the EFW EA public consultation, considerable attention has focused on waste diversion and the concepts of "zero waste" and "extended producer responsibility." This has also been an area of intense importance, focus and activity by the Region of Durham and Province of Ontario.

12. For example, locally, on January 23, 2008, the Regional Council passed a resolution that directed the Region of Durham to aggressively pursue at least a 70% diversion rate on or before December 2010, Golder Associates was retained to investigate existing and potential options, including the enhancement of public education and engagement, and to develop a plan that will allow the Region to achieve this goal. The study's recommendations, which are summarized in Commissioner's Report #2009-WR-5, are currently being analyzed and the results will be presented in the 2010 Annual Solid Waste Servicing and Financing Study, as is the final evaluation of the Clear Bags Pilot Program that was conducted from January to April 2009 in Clarington and Pickering (Commissioner's Reports #2008-WR-20, 35, & 38 and #2009-WR-12). Finally, Works staff has prepared, for public consultation, a draft waste management by-law "to help manage the Region's standardization of solid waste collection services and to guide the service delivery on private roadways as the Region navigates towards [70%] diversion."

13. Provincially, Ontario is proposing to adopt a zero waste vision to help reduce waste, increase diversion, and build a greener economy and more sustainable society. In accordance with the *Waste Diversion Act's* (WDA's) mandatory five year review, in October 2008, the MOE released "Toward a Zero Waste Future: Review of Ontario's *Waste Diversion Act, 2002."* In the discussion paper, the MOE proposes that the first steps in striving towards zero waste should be built upon four key building blocks:

- A clear framework built upon the foundation of Extended Producer Responsibility.
- A greater focus on the first and second of the 3Rs – waste reduction, and re-use.
- Increasing reduction and diversion of waste from the industrial, commercial & institutional sectors.

- Greater clarity around roles responsibilities, and accountabilities, to ensure that all players are contributing to a common goal.

In April 2009, the proposed changes to the WDA were endorsed, in principle, by the Regional Council in accordance with Commissioner's Report #2009-WR-2.

E. DISCUSSION

a) Risk Assessment

14. Risk assessment (RA) is the only procedure that can produce quantitative estimates of predicted health effects. Moreover, RA follows a standard format, is reproducible, and errs on the side of conservatism. JW followed the methodology used in the Generic HHRA, which peer reviewers, including Dr. Smith, deemed acceptable.

15. The key findings of Dr. Smith's and Mr. Wilson's review of the JW SSHHRA can be summarized as follows:

- The key receptors, chemicals and exposure pathways have been evaluated.
- The methods used to estimate exposures are considered appropriate.
- The toxicological reference values used are reasonable and drawn from a variety of reliable international sources.
- The risk characterization results are defensible.

In other words, the SSHHRA can be considered to be satisfactory. The proposed EFW facility is not expected to cause any appreciable change in the concentrations of chemicals in air, soil, dust, water or food. If the proposed EFW facility performs as specified and assumed in the SSHHRA, it will not pose an unacceptable risk to persons in the vicinity of the site and, by extension, to residents living beyond the site. Subject to any final revisions to the exposure point concentrations having been made, the SSHHRA is ready to be submitted to the MOE for its review, if and when the EFW EA is approved.

b) Environmental Surveillance

16. In its Best Practices Review, JW was very clear that the most appropriate and scientifically justified option for environmental surveillance of the proposed EFW facility would involve continuous and periodic stack testing of emissions, including in-stack dioxins and furans sampling technology, that meet or exceed stringent chemical emissions standards (Ontario Guideline A-7 v. EU Directive). Dr. Smith concurred with this finding and concluded the community living outside the point of impingement and the public-at-large

would not be at risk from the public health perspective if this surveillance option is chosen.

17. During the EFW EA public consultation, however, a consensus has emerged that it would be beneficial to supplement stack testing with ambient air and soil monitoring, which is independently tested for a minimum period of three years in order to "ground truth" the chemical emissions predicted in the EA. This would be prudent course of action and is supported by Dr. Smith (Appendix D). Moreover, Dr. Smith advises that it would also be prudent to consider adding flora and fauna to the environmental media being independently tested if in-stack, ambient air and soil test results regularly exceed levels predicted by the SSHHRA. Finally, at the end of this three-year period, it would also be prudent to formally evaluate these additional monitoring activities to ascertain whether they are effective, useful, and if continued, what, if any, revisions need to be made. For the reasons outlined in the Best Practices Review coupled with the above supplemental testing being in place, human biomonitoring should not be used to supplement stack testing. This is also supported by Dr. Smith (Appendix D). The Health Department should be consulted prior to finalizing the environmental surveillance program and during any and all subsequent reviews.

18. The environmental performance of the proposed EFW facility should be communicated in as an accessible, accurate, open, timely, transparent, and understandable a manner as possible.

19. The environmental oversight committee recommended by Dr. Smith and JW should be independent, appointed by and accountable to the Regional Council. The Committee should be comprised of Clarington and Durham residents and representatives of the proposed EFW facility, MOE, and the Region. The Committee should assess, monitor, review, and advise the Region on the environmental surveillance program, independent environmental testing, the quality of the public reporting of emissions and environmental surveillance data, and the environmental performance of the facility. The Committee should be empowered to discuss and advise the Region on other related strategic waste diversion and management issues. Given the importance of waste diversion discussed below, consideration should be given to naming the committee the Durham waste diversion and management advisory committee.

20. In developing the proposed advisory committee's terms of reference, it may be instructive to review the mandate of the Durham Nuclear Health Committee (DNHC) which has been in place for over 12 years (Appendix G) (http://www.durham.ca/health.asp?nr=/departments/health/dnhc/dnhc.htm). Perhaps it should be noted that the concept of a DNHC originated in 1992, when its creation was recommended by the former Environmental Assessment Advisory Committee that reviewed the Ajax Water Treatment

Plant environmental assessment because local residents were concerned about the human health effects of tritiated water emitted by the nearby Pickering Nuclear Generating Station.

d) Waste Diversion

21. During the EFW EA public consultation, another consensus has emerged such that the Region of Durham should embrace and strive towards the concept of "zero waste". It is acknowledged that the Region has exceeded the long-term waste management strategy's waste diversion goal of 50%. Accordingly, Council has set a new stretch goal of 70% by December 2010 and Works staff are exploring ways and means of reaching this goal such as by retaining Golder Associates (GA) to prepare the 70% Waste Diversion Study; by implementing the Clear Bags Pilot Study in Clarington and Pickering; and by developing a draft Waste Management By-law for public consultation. Further options will be explored and included in the 2010 Annual Solid Waste Servicing and Financing Study.

22. Given Durham's ongoing population growth, it is important for the Region and its residents to embrace the concept of zero waste and for the Region to aggressively pursue a waste diversion goal of at least 70%, in accordance with all the measures cited above, with attention being paid to enhanced public education and engagement, in order to reduce the demand for waste disposal however this is managed.

23. The Region cannot achieve zero waste or a waste diversion goals >70% by itself. To this end, for example, it is important for Ontario to complete its deliberations on zero waste, amend the WDA in accordance with the discussion paper and advice received, and to implement and enforce such measures as extended producer responsibility. The Region should closely monitor this file and advocate for the proposed changes as required.

d) Regional Support

24. In order for the environmental surveillance program, independent environmental testing, public reporting of environmental surveillance data, and the work of the proposed Durham waste diversion and management advisory committee to be successful, the Region should ensure that it has sufficient internal capacity and that sufficient financial and human resources are allocated to support these measures. This issue should be addressed in the appropriate Regional business planning and budgeting exercises.

G. CONCLUSION

25. In conclusion, the following recommendations are made:

- That the final SSHHRA for the proposed 140,000 tonnes EFW facility is accepted and submitted to the MOE for its review, subject to it being in concordance with the caveats expressed in Appendix D of this report;

- That once the EFW facility is operational, an environmental surveillance program is implemented in accordance with the above recommendation b);

- That the Region continually pursues the goal of 70% waste diversion and advocates for enactment and implementation of the proposed amendments to the WDA; and

- That the Region adequately supports the environmental surveillance program, independent environmental testing, public reporting of environmental surveillance data, and the work of the proposed Durham waste diversion and management advisory committee.

H. REFERENCES

26. In addition to the reports cited above, the MOH was greatly assisted in increasing his knowledge and understanding of this matter by his reading of the following publications, in whole or in part:

- Environmental and Workplace Health. 2004. *Canadian Handbook on Health Impact Assessment.* Ottawa, ON. Health Canada.

- Goldstein BD. 2006. Advances in Risk Assessment and Communications. *Annual Review of Public Health.* 26: 141-63.

- Grandjean P. 2004. Implications of the Precautionary Principle for Primary Prevention and Research. *Annual Review of Public Health.* 25: 199-223.

- Leiss W, Chociolko C. 1994. *Risk and Responsibility.* Kingston, ON. McGill-Queen's University Press. 404 pp.

- National Research Council. 2000. *Waste Incineration & Public Health.* Washington, DC. National Academy Press. 335 pp.

- Ross W et al. 2000. *Decision-Making Framework for Identifying, Assessing, and Managing Health Risks.* Ottawa, CA. Health Canada. 75pp.

Respectfully submitted,

R.J. Kyle, MD, MHSc, CCFP, FRCPC
Commissioner & Medical Officer of Health

Report To: Chair A. Cullen and Members
Health & Social Services Committee

Report No.: 2007-MOH-20

Date: September 6, 2007

SUBJECT: Energy from Waste (EFW) Facilities

RECOMMENDATION:

That the Health & Social Services recommends that the Regional Council receives this report for information.

REPORT:

1. On June 20, 2007, the Regional Council requested that the Commissioner & Medical Officer of Health (MOH) comment on the Durham/York Generic Human Health Risk Assessment (GHHRA) and review the health-related health chapters of the Halton EFW Business Case (Halton 4a Report).

2. Owing to the limited expertise of the Health Department respecting air quality science and toxicology, the MOH commissioned Dr. Lesbia Smith to:

   - Review the Halton 4a Report, including the general conclusions of environmental epidemiologic studies of waste incinerators, and the pitfalls inherent in such studies.

   - Comment on the soundness of the Durham/York GHHRA, including any missing information that may have a bearing on either the generic or site specific HHRA.

   - Assess the extent to which Durham/York GHHRA conforms to the basic tenets of risk assessments.

   - Advise regarding best practices for establishing an environmental monitoring program.

   Dr. Smith is well-recognized in the public health community and beyond as a medical expert in occupational and environmental health. She was a reviewer of the Durham/York GHHRA. Appendix A is her report. It includes a Précis (p. 4), Executive Summary (p. 6), Main Report (p. 12) and Appendices (p, ii).

3. Dr. Smith's main conclusions are as follows:

- In essence, the Halton 4a Report concluded that EFW facilities using modern (thermal) methods and pollution control technology are not expected to pose a significant risk to the public. In addition, the Report stated that any new EFW facility should be subject to a site specific risk assessment to identify local issues and ensure that it will not pose a risk to the public.

- The current epidemiologic literature (2000-2007) is inconclusive and does not demonstrate one way or another that modern incinerators have associated health effects on the people living around them. This conclusion is not materially different from the inferences made in the Halton 4a Report.

- On the whole, the incinerator-generated contaminant load as measured in blood of residents living near-by is similar or the same as contaminant loads in other populations. The "incinerator literature" alone cannot be used to support or dismiss possible health effects from the measured levels of some of the contaminants in people living around incinerators.

- In general, the epidemiologic method is limited in that it can only indicate statistical associations between exposure and diseases, not a cause and effect relationship. A cause and effect relationship can be inferred only after careful analysis of all studies and applying appropriated criteria.

- Risk assessment is the only procedure that can produce quantitative estimates of predicted health effects. The Durham/York GHHRA was properly carried out. The methods are clearly explained, are reproducible and err on the side of health protection or "conservatism". Any future site specific risk assessment should apply upset conditions, if situations with upset conditions are relevant to the EFW facility.

- Epidemiology, risk assessment and biological monitoring assist regulatory and public health agencies and improve public understanding of human health and the environment. Because each method can have limits and challenges, a combination best serves public health.

- Environmental quality oversight and health surveillance can promote engagement of communities with industry, regulatory and public health agencies and can be considered part of a responsible program for environmental monitoring.

- Community surveillance can take the form of environmental monitoring and reporting, timely responses to health concerns, and continued community engagement throughout the life of the facility. Community health studies may have a role, but should be carefully considered with respect to objectives and methodology before undertaking them.

The Health Department has reviewed Dr. Smith's Report and concurs with her findings and conclusions.

Respectfully submitted,

R.J. Kyle, MD, MHSc, CCFP, FRCPC
Commissioner & Medical Officer of Health

Energy from Waste Facility in the Region of Durham

Prepared for:

The Medical Officer of Health
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Energy from Waste Facility in the Region of Durham

Executive Summary

This work was undertaken at the request of the Medical Officer of Health of Durham Region. Durham Region is currently undergoing a process of choosing a site for an energy-from-waste (EFW) facility within its boundaries. As part of the process of public consultation before the selection of a contractor and a specific technology, a generic risk assessment was carried out for the Region by Jacques Whitford[2]. In the course of public consultation, a number of issues arose regarding the integrity of the generic risk assessment which is of a "model" hypothetical facility. The issue of health effects from EFW facilities, formerly called "incinerators", also came under scrutiny from the review of a report of an assessment of health effects of incineration provided to a nearby jurisdiction (Halton Region). The process and conclusions of the health effects assessment including the assessment of the literature on incineration and health became issues of concern.

The Regional Municipality of Durham had undergone a process of selection which indicated that EFW as their preferred residual waste management option – that is after recycling and composting are optimized. The Region is now undertaking consultation in preparation for the selection of a provider and a technology for the chosen method to handle residual waste.

The Health Department will contribute important information to Council about the public health impacts of the introduction of such a facility into the Region. In order to evaluate current information and gather new information, the Medical Officer of Health requested an assessment of the literature of incineration-related health effects and of the reports from a neighboring health department which generated considerable public concern.

[2] Jacques Whitford. Energy From Waste Generic Risk Assessment Feasibility Study. June 14, 2007 Report # 1009497.02

Four objectives are the focus of this report as outlined in correspondence with the Durham Region Medical Officer of Health:

A. Provide advice on Section 4a & b (pages 12-15) of the Halton 4A Report[3] (the health assessment, literature search and conclusions arising)

1. What do environmental epidemiology studies of incinerators generally have to say and the pitfalls inherent in these types of studies?

B. Soundness of the Durham generic risk assessment report

1. Is there any missing information that needs to be reviewed that may have bearing on either the generic or site specific Human Health Risk Assessment (HHRA) that will be conducted? (Bioaccumulation of dioxins and furans, *etc*; greenhouse gas emissions, regulatory air quality guidelines / standards, ultra fine particles, *etc.*)

C. An independent comment on risk assessment in general and to what extent does the draft generic HHRA conform to the basic tenets of risk assessment.

D. What are best practices for establishing an environmental monitoring program?

This report addresses these questions in sequence.

The Halton Report Step 4A - Chapter 5 Health Concerns Related to EFW Systems ("Halton 4A") examines the peer reviewed epidemiologic literature and grey literature relating incineration and health effects. The authors considered original research, research reviews and governmental reports. The Halton 4A report identifies chemicals of concern. With respect to health effects in communities around incinerators, the Halton 4A authors conclude that there are potential *health concerns* with incineration but the literature they cited generally involves old incinerators which have higher emissions than retrofitted or new incinerators. The Halton 4a Report agrees with the conclusions of the DEFRA 2004 (governmental) Report and with the conclusions of other review publications that state that **EFW facilities using currently available modern (thermal) methods and pollution control technology are not expected to pose a significant risk to the public. In addition, the Halton 4A Report states that any new facility should be subject to a site specific risk assessment to identify local issues and ensure that it will not pose a risk to the public.**

This author (Dr. Smith) reviewed the current epidemiologic literature on incineration and health of communities around them. A number of new research publications were added to the body of literature considered in the Halton 4AReport. Some 17 publications were

[3] Regional Municipality of Halton, Step 4A: Identification and Description of Potential Health and Environmental Effects. 30 May 2007. (Consulting Report done under contract to Genivar, Ramboll, Jacques Whitford, Deloitte, URS).

assessed for validity in developing an opinion about incineration and health effects, including several studies that had not been considered in the Halton 4A report. **This author concludes that the current epidemiologic literature on health effects of incinerators on local communities (2000-2007) is inconclusive and does not demonstrate one way or another that modern incinerators have associated health effects on the people living around them.**

Some important new information provided greater insight into the assessment of health impacts of the new generation of incinerators. The direct testing for contaminants (biomonitoring) of people living around modern or upgraded incinerators provides a reasonably good baseline estimate of contaminant load. Such testing does not demonstrate an increased load of key contaminants emitted from incinerators. The literature does not provide any insight into the proportion of the contaminant load in people that is attributable to emissions from current modern technology incinerators.

On the whole, the incinerator-generated contaminant load as measured in blood of residents living near-by is similar to the same contaminant load in other populations. Two possible explanations are considered: 1) emissions from incinerators are considered very small for dioxins, furans, and heavy metals; and 2) sources other than incinerators generally provide a higher proportion of the total burden of exposure for these contaminants than incinerators.

The "incinerator literature" alone cannot be used to support or dismiss possible health effects from the measured load of some of the contaminants in people living around incinerators.

There are inherent pitfalls in the epidemiologic method applied to environmental settings especially because it is necessarily observational, that is, exposures are not under the control of the researcher, so that most studies have proxy or indirect measures of exposure. If a single well conducted environmental epidemiology study finds an association, this does not necessarily invoke a causal relationship between an exposure and a health effect.

Making causal links with epidemiology as the tool requires many studies examining a relationship from different perspectives. It is not the number of studies that counts, but rather the methodology and how well they are conducted, what information can be derived from them with relative certainty, and what the weight is of all of the evidence for all studies together. A systematic review of the literature provides a summary of all of the evidence. The net results of a systematic review must then be viewed with yet another lens, - application of criteria that consider consistency of associations that make sense. There are various sets of criteria used for that process, but the most commonly used for inferring causality in occupational and environmental settings are the criteria of

Bradford Hill[4,5] elaborated in Section 6. **In summary, the epidemiologic method is limited in that it can only indicate statistical associations between an exposure and an outcome and not a causal relationship. Causality can be inferred after careful systematic analysis of all studies and applying appropriate criteria.**

The generic risk assessment for the Durham EFW facility carried out by Jacques Whitford Ltd., used accepted standard methodologies, standard air dispersion and deposition models of incinerator emissions, and calculations of risk measured against current regulatory emissions standards in Ontario or health benchmarks from the literature. The study infers acceptability of risk if the net results are at or below the benchmark regulatory risk of 1 in a million for cancer, and a hazard quotient under one for non cancer health effects. However, the exposure assumptions made were extreme, and provided a conservative estimate of risks, that is, highly protective of health. As one example, the community exposure to dioxins and furans is assumed to occur for the lifetime of the person living in the area and at the concentrations in the environment at the level theoretically attained after 35 years of facility operations. The report makes assumptions of susceptibility by using the health benchmarks applicable to the most vulnerable in the community in the different scenarios. The generic risk assessment did not make calculations of risk during upset conditions. Modern incinerators are unlikely to experience these so called upset events because the system is shut off if there is a malfunction. Hence, this scenario was not considered relevant. In addition, exposures during upset conditions would tend to be very short term whereas the regulations frame risks on long term exposure to carcinogens and non-carcinogens.

The generic risk assessment of the model community is limited, as are all risk assessments, in that it did not make calculations for complex mixture exposures, unless such mixtures are already regulated as such (*i.e.*, PAHs, dioxins and furans). It did not consider particulate exposure unless the particulate is characterized and regulated (i.e., PM_{10} and $PM_{2.5}$). Hence the issue of "nanoparticles" exposure was not and could not be addressed as a regulated toxic exposure; there are no specific risk assessment techniques or sufficient toxicological information available currently to do so. Therefore this is not a failing of the risk assessment methods used or of this report *per se.*[6,7] The report does not address upset conditions and any future risk assessment should do so if such scenario applies to the technology and operations used.

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[4] Hill AB. (1965). The environment and disease: association or causation? *Proceedings of the Royal Society of Medicine*, 58, 295-300.

[5] The Bradford Hill criteria include strength and direction of an association, dose response, temporal sequence, consistency, theoretical plausibility, biologic coherence, specificity of effect, analogy and experiment.

[6] Grahame T, Schlesinger RB. Health Effects of Airborne Particulate Matter: Do we know enough to consider regulating specific particle types or sources? Inhalation Toxicology 2007;19(6):457-481.

[7] Westheit DB, Borm OA, Hennes, C, Lademann J. 2007. Testing strategies to establish the safety of nanomaterials. Conclusions of an ECETOC Workshop. Inhalation Toxicology. 19(8):631-643.

In summary, the generic risk assessment is properly carried out. The methods used were clearly explained and therefore, the entire exercise can be duplicated by other investigators. As expected, it erred on the side of health protection or "conservatism" despite its failure to assess upset conditions, a scenario which should be applied to any site specific risk assessment of EFW facility chosen for Durham Region in the future, if situations with upset conditions are relevant.

The risk assessment process can calculate health risk during regular and upset conditions, considers pathways of exposure so that interventions can occur, and can put boundaries on actions that lessen exposures to residents around the facility. **The methods for conducting a human health risk assessment are reproducible and subject to quantitative checks. With respect to the risk assessment process *per se*, it is the only procedure that can produce quantitative estimates of predicted health effects.**

Epidemiology is a complimentary method to risk assessment in managing environmental risks. Greater precision can be achieved in calculating exposure from environmental contaminants and health effects by using the risk assessment methodology coupled by information from epidemiology, and from direct measurement of exposures (biomonitoring). Biomonitoring is very useful in measuring total exposure (from all sources) and in relating these measures of exposure to health conditions in well executed and controlled epidemiological studies. **Epidemiology, risk assessment and biological monitoring methods assist regulatory bodies, support public health activities, and bring a greater understanding of the interaction of humans with their environment. Because each method can have limits and challenges, a combination best serves public health. Health studies in communities have a role, but these studies should be considered carefully before undertaking them.**

Environmental quality oversight (surveillance) is the systematic testing and reporting to regulatory bodies and to the community of emissions, upset conditions, environmental concentrations, trends, and regulatory compliance and mitigation. Environmental surveillance can also be complemented by population surveillance which is the systematic collection and evaluation of population health data, including biological measures (biomonitoring). Such surveillance programs have been instituted in Ontario in communities with other types of facilities such as nuclear energy installations or in those facilities whose emissions are of particular community concern (*e.g.*, lead smelters). Community concerns can often be addressed by the industry outside of the regulatory framework. **Environmental quality oversight and health surveillance activities constitute engagement of communities with public health agencies (health, environment) and the industry and may be considered part of a responsible program for environmental quality assurance. These surveillance activities can also be coupled with timely responses to community concerns and regular discourse throughout the life of a facility to create a climate of alertness and trust for all parties that can improve facility operations and general well being.**

REPORT

Site Specific Human Health and Ecological Risk Assessment - Technical Study Report

DURHAM YORK
RESIDUAL WASTE EA STUDY

REPORT NO. 1009497

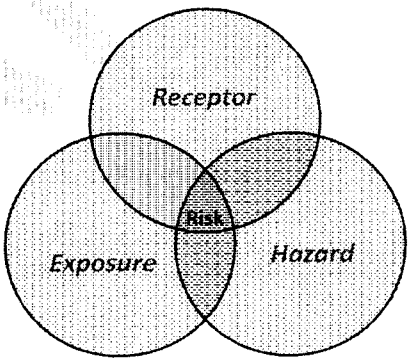
EXECUTIVE SUMMARY

Durham and York Regions (the Regions) have partnered to undertake a joint Residual Waste Planning Environmental Assessment (EA) study. Both municipalities are in need of a solution to manage the residual solid waste that remains after diversion. The Regions are working together to address the social, economic, and environmental concerns through an Environmental Assessment (EA) Study process to examine potential long-term residual waste management alternatives

Risk Assessment Framework

People are concerned with potential health and ecological effects that could arise from contact with chemicals released to the environment from a thermal treatment facility. Through many years of study and research, government agencies and scientists around the world have developed a process which allows us to understand the movement of chemicals in the environment and whether they may have an effect on people and the ecosystem. This process is called Human Health and Ecological Risk Assessment (HHERA).

All chemicals have the potential to cause effects in people and the ecosystem, but it is the level (or concentration) and the manner (the route) by which people and the ecosystem come into contact with a particular chemical that determines if it may cause harm to health. In order for there to be a potential health risk:



- people or wildlife (Receptor) must be present;
- Receptors must come into contact with chemicals emitted from a Facility (Exposure); and,
- chemicals must be emitted at a high enough level and must be able to cause some adverse health effect (Hazard).

If any one of these three components is missing then there would not be a risk to either human or ecological health.

The risk assessment framework used in this technical study follows the standard paradigm: problem formulation, exposure assessment, hazard assessment, and risk characterization (Figure 1).

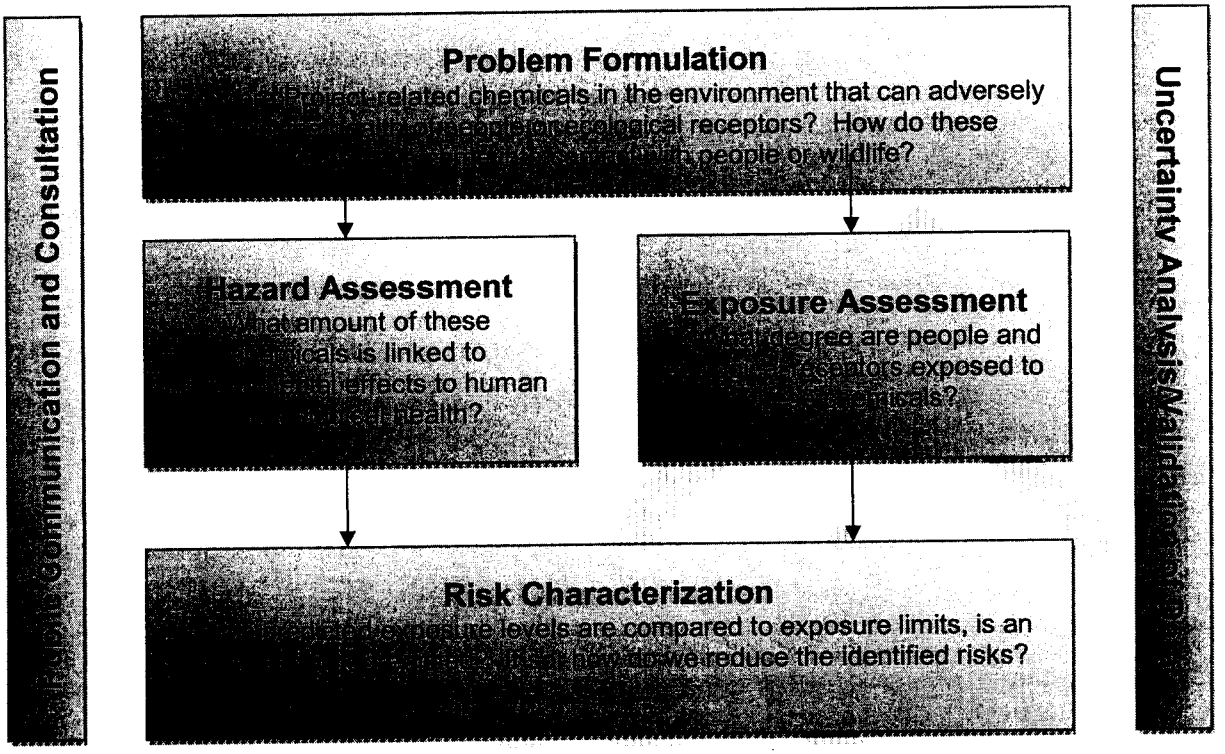


Figure - 1 Risk Assessment Framework

The Facility Risk Assessment

The risk assessment, undertaken as part of the subject EA study, examined the potential for emissions from the Proposed Thermal Treatment Facility (the Facility) to pose an unacceptable risk to human and ecological receptors in the short-term and long-term (i.e., after 30 years of operating the Facility).

The Study Area and Receptor Locations

The "Site" is the area where the Facility would be built. Currently, it is undeveloped land which is owned by the Region of Durham and located south of Highway 401 within the Municipality of Clarington. The highest level of emissions from the Facility would be deposited in the area identified as the Local Risk Assessment Study Area (LRASA). The LRASA extends approximately 10 km in all directions around the Site.

In order to assess the potential risk to humans and the environment, receptor locations (both human and ecological) within the LRASA were selected. There are a variety of land uses within the LRASA, including light industrial, agricultural, rural, urban residential and natural areas. The final list of receptor locations incorporated land use, air modeling results and input from various sources such as open houses, EA studies, official plans and online and government sources.

The primary route of human exposure to Facility-related air emissions would be through inhalation (breathing). These exposures were evaluated in the human health risk assessment at 309 locations within the LRASA.

Additional potential routes of exposure were considered for chemicals which deposit in the environment and move into other environmental media (e.g. soil, water, and food). This process is called a multi-pathway risk assessment which evaluates the potential for humans and wildlife to be exposed to chemicals from soil, water and food. One hundred and thirty-two of the 309 receptor locations were selected for use in the multi-pathway human health risk assessment. In the ecological risk assessment, 22 of the 309 receptor locations were selected for use in the multi-pathway ecological risk assessment.

Assessment Scenarios

There were 10 main project scenarios that were assessed in this HHERA as follows:

Project Scenarios	Case	Description
Existing conditions	Baseline Case	Evaluation of the Baseline Case involved the quantitative (i.e. measureable) assessment of existing conditions in the assessment area. Health risks were assessed using measured concentrations of chemicals of potential concern (COPC) in air and in other environmental media (e.g. soil, water, food). No facility-related emissions or exposures were monitored in this assessment case as this completed prior to construction and operation of the Facility.
	Baseline Traffic Case	Evaluation of the Baseline Traffic Case involved the quantification of existing offsite vehicle traffic emissions prior to the start-up of the Facility.
Construction	Construction Case	Evaluation of the Construction Case involved the qualitative (i.e. based only on qualities not numerical data) assessment of the potential health risks associated with air emissions during construction and commissioning of the Facility.
Operational Cases	Project Alone Case	Evaluation of the Project Alone Case during operation of the Facility involved the quantitative (i.e. measureable) assessment of COPC emissions from the Facility.

Project Scenarios	Case	Description
	Project Case (Baseline + Project)	Evaluation of the Project Case during operation of the Facility involved the quantitative (i.e. measureable) assessment of COPC emissions from the Facility in combination with existing/baseline conditions.
	Process Upset Case	Evaluation of the Process Upset Case involved the quantitative (i.e. measureable) assessment of COPC emissions from the Facility operating at upset conditions (i.e., facility startup and shutdown) for 20% of the year. For the remaining 80% of the year, the Facility was assumed to be operating at normal conditions.
	Process Upset Project Case (Baseline+ Upset Conditions)	Evaluation of the Process Upset Project Case involved the quantitative (i.e. measureable) assessment of COPC emissions from the Facility operating at upset conditions for 20% of the year. For the remaining 80% of the year, the Facility was assumed to be operating at normal conditions. These upset conditions were evaluated in combination with existing/baseline conditions
	Traffic Case	Evaluation of the Traffic Case involved the assessment of emissions from offsite and onsite traffic associated with the Facility and baseline traffic conditions in combination with onsite stationary source emissions for the Facility.
	Future and Existing Conditions Case	Evaluation of the Future and Existing Conditions Case involved the qualitative (i.e. based only on qualities not numerical data) evaluation of the Facility emissions in combination with future or existing sources of air emissions.
Decommissioning	Decommissioning (Closure Period) Case	Evaluation of the Decommissioning Case involved the qualitative (i.e. based only on qualities not numerical data) assessment of air emissions related to the removal of infrastructure and rehabilitation of the Site.

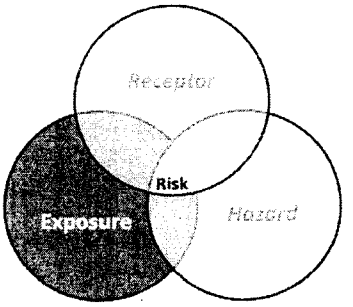
Potential Chemical Releases from the Project to Air

Eighty-seven chemicals that would be emitted from the Facility were evaluated for their potential to pose a risk to human from inhalation (breathing). Of these, 57 were carried forward to the multi-pathway risk assessment because they can persist (remain in soil) and bioaccumulate (transfer from soils to plants and animals). Following their release to air, these chemicals are deposited into the environment and their concentrations can be predicted in:

- soil;
- surface water;
- garden and farm produce and fruit;
- agricultural products (i.e., beef, chicken, pork, dairy and eggs);
- wild game;
- fish; and,
- breast milk.

Exposure Assessment

The exposure assessment predicted the degree to which people and the ecosystem would come into contact with chemicals emitted from the Facility. This human health risk assessment examined the exposure of people based on their age and physiology (e.g. body weight, breathing rate and ingestion rates), how they use the land and the behavior of the individual chemicals in the environment.



The following types of receptors were considered in the human health risk assessment.

- local residents;
- local farmer;
- daycare/school staff and pupils;
- recreation user – sport; and,
- recreation user – camping.

Two additional exposure scenarios were evaluated in the human health risk assessment, these are:

- additional exposure from swimming; and
- additional exposure from hunting and fishing.

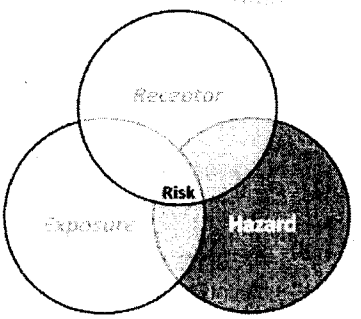
The following types of receptors were considered in the ecological risk assessment:

- mammalian receptors (e.g.,White-tailed Deer);

- avian receptors (e.g., American Robin);
- terrestrial plants (e.g., plant communities);
- soil invertebrates ; (e.g.,earthworm);
- aquatic life (e.g., fish); and
- benthic invertebrates (e.g.,crayfish).

Hazard Assessment

The hazard assessment identifies the level (concentration) at which chemicals have the potential to pose health effects. Safe levels are established by international regulatory agencies and are commonly referred to as toxicity reference values (TRVs). These agencies consider two types of chemicals:



- non-carcinogenic chemicals that have the potential to cause non-cancer effects in people and wildlife; and
- carcinogenic chemicals that have the potential to cause cancer in people.

For non-carcinogenic chemicals, if the exposure amount is less than the safe amount, then the chemical is not considered to pose a health risk.

For carcinogenic chemicals, toxicity reference values are based on the chance (probability) that exposure would cause an increased risk of cancer. Risk assessments are conducted using conservative assumptions which overestimate exposure and risk. Government agencies provide conservative benchmarks against which results are compared. Health Canada uses a benchmark that considers exposure to a carcinogen that would result in 1 additional cancer case in 100,000 people to be negligible. In comparison, the Ontario Ministry of the Environment (MOE) uses an even more conservative benchmark of 1 additional cancer case in 1,000,000 people. Both of these benchmarks are based on the idea that this rate of cancer from exposure to environmental chemical concentrations would not tip the balance of the current Canadian cancer incidence rate of approximately 0.4 (or 40%). In other words, if the Facility's air emissions were to increase the Canadian cancer incidence rate from 0.4 to 0.4000001, then the MOE would consider the facility to pose an unacceptable risk to the population.

Results of the Human Health Risk Assessment

Inhalation Assessment

The results indicate that no acute (1-hr or 24-hr) or chronic (annual average) exposures at the maximum ground level concentration exceed the regulatory benchmark for any of the 10 evaluated

cases. Additionally, no carcinogenic COPC exceed the conservative Ontario MOE regulatory cancer benchmark of 1 in 1,000,000 for all evaluated cases.

In addition to the evaluation of individual COPC, an assessment of chemical mixtures was conducted. Chemical mixtures represent groups of chemicals that act similarly on the human body (for example, a mixture of chemicals may irritate the respiratory system). There are currently no regulatory benchmarks to evaluate chemical mixtures; therefore, the exposures associated with the chemical mixtures could not be definitively stated. Furthermore, the evaluation of exposure to chemical mixtures is complicated by the narrow probability of each chemical in the mixture occurring at one specific location at the same time with a receptor also present at that location and time to be exposed to them. Regardless of these limitations chemical mixtures were evaluated for information purposes only in the risk assessment.

Multi-Pathway Assessment

The results of the multi-pathway assessment indicate that exposure to Facility-related air emissions will result in no adverse health effects to human receptors living or visiting the LRASA.

The only exceedences of regulatory benchmarks were from existing conditions in the Baseline Case. These risks were not unexpected as any urban area in Ontario would produce similar results. Although some risk was expected from existing conditions, additional exceedences were seen in the Baseline Case that were directly related to 1) the use of laboratory method detection limits as environmental media concentrations, and 2) conservative receptor characteristics used to represent toddler receptor consumption patterns of homegrown produce and agricultural products. The "method detection limit" is the smallest amount of a chemical that the laboratory instrument is able to detect and is not representative of the actual media concentration of a chemical in a sample. Using the method detection limit as an actual media concentration was a conservative assumption because media concentrations were likely much lower than the method detection limit of the instrument or not present at all. Secondly, the use of child-specific consumption rates to represent a toddler's consumption rate of homegrown produce and agricultural products in lieu of toddler-specific rates also lead to an overestimation of exposure and therefore exceedence of regulatory benchmarks.

Overall, the results of the human health risk assessment indicate that it is not expected the Facility will lead to any adverse health risks to local residents, farmers or other receptors in the Local Risk Assessment Study Area (LRASA).

Results of the Ecological Risk Assessment

The results of the ecological risk assessment indicate that exposure to Facility-related air emissions will result in no adverse health effects to ecological receptors living in the Local Risk Assessment Study Area.

As with the human health multi-pathway risk assessment the only risks in all evaluated cases were from the existing conditions in the Baseline Case. Most of the time these risks were due to the use of method detection limits that produced conservative estimates of COPC concentrations in environmental media samples.

Overall, the results of the ecological health risk assessment indicate that it is not expected the Facility will lead to any adverse health risks to ecological receptors or any species at risk in the Local Risk Assessment Study Area.

Overall Summary

Overall, the results of the Human Health and Ecological Risk Assessment indicate that there would be no adverse health effects to either human or ecological receptors exposed to emissions from the Proposed Thermal Treatment Facility.

APPENDIX D

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Environmental & Occupational Health Plus Inc.

Health Impact Evaluation and Issues Management

June 8, 2009

Dr. Robert Kyle
Commissioner & Medical Officer of Health
Durham Region Health Department
605 Rossland Road East, 2nd Floor
P.O. Box 730
Whitby, ON L1N 2B0

Re: Peer Review of the DRAFT JW SSHHRA Technical Study Report; Durham-York Residual Waste EA Study. May 2009. Report no. 1009497

Dear Doctor Kyle,

In accordance with your mandate, I am attaching the review of the Draft Jacques Whitford (JW) SSHHRA and recommendations for surveillance of the proposed facility.

The detailed review of the Site Specific Human Health Risk Assessment (SSHHRA) was carried out by Ross Wilson, experienced risk assessor and certified toxicologist of the American Board of Toxicology. Mr. Wilson and I participated in the reviewer discussions with JW staff and with other reviewers providing clarifications and justifications of the JW paper, and anticipated changes. Where specific changes were expected and agreed upon by the reviewers and JW, we assumed that these would be made in the Final SSHHRA and made our comments fit accordingly with the agreed upon changes. We also communicated with JW (Dr. Chris Ollson) on several occasions by e-mail and telephone to request additional data, graphs, and related information not available in the Draft SSHHRA report.

Mr. Wilson and I maintained a separate independent approach in carrying out this review which we believe is reflected in our communications with JW and in this report to you. Neither of us has a stated interest in the success or failure of this undertaking and thus, confirm that we do not have a conflict of interest.

Mandate and responses:

1. What are the human health risks? Are the health risks acceptable and if so, according to what standards? If the health risks are acceptable, can the proposed EFW facility be considered "safe"?

Response: Our review supports the findings of the SSHHRA. We find that the key receptors, chemicals and exposure pathways have been evaluated; the methods used to estimate exposures are appropriate; the toxicological reference values used are reasonable and drawn from a variety of reliable international sources; and the risk characterization results are defensible.

We conclude that this SSHHRA is satisfactory. Although it would be possible to use different receptor characteristics, exposure assumptions and toxicological reference values (and, thus, arrive at different Hazard Quotient and Incremental Lifetime Cancer Risk estimates), we consider it unlikely that the conclusions of the SSHHRA would change.

In most cases, we expect the proposed installation will not provide any appreciable change in the concentration of chemicals in air, soil, dust, water or food. For example, the maximum Ground Level Concentration of $PM_{2.5}$ on an annual basis under Normal Operations is expected to be increased by 0.022 $\mu g/m^3$ versus a current baseline concentration of 9.8 $\mu g/m^3$. This, in our opinion, is insignificant. Similarly, the projected increases in the concentration of metals, polycyclic aromatic hydrocarbons, dioxins/furans, polychlorinated biphenyls and other chemicals are very minor relative to current concentrations.

It is noted that specific risk estimates will vary from the draft SSHRA that we reviewed versus the final SSHRA that JW will issue in the future; however, based on our current information, it is not expected that the overall conclusions of the SSHRA will change based on the information provided to us.

Overall, this review team holds the opinion that this industrial installation, if it performs as specified and assumed in this SSHHRA, will not pose unacceptable risks to persons in the vicinity of the site, and by extension, to those residents beyond. Said differently, this installation as proposed will not pose an unacceptable public health risk.

2. Is the SSHHRA methodology sound and consistent with accepted standards such as Health Canada's Canadian Handbook on Health Impact Assessments and Environment Canada's Discussion Paper on the Precautionary Principle?

   Response: The SSHHRA used methods that are considered to be acceptable and does meet accepted standards. The SSHRA follows an accepted risk assessment

approach consistent with Health Canada risk assessment guidance provided in various documents that include but are not limited to:

- CCME (Canadian Council of Ministers of the Environment). 2006. A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines. CCME, Winnipeg, Manitoba.

- Health Canada. 2004a. Federal Contaminated Site Risk Assessment in Canada - Part I and II: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA). Health Canada, Ottawa, Ontario.

- Health Canada, 2004b. Canadian Handbook on Health Impact Assessment. Ministry of Health. Health Canada, Ottawa, Ontario.

- Health Canada. 2008. Federal Contaminated Site Risk Assessment in Canada - Part V: Guidance on Human Health Detailed Quantitative Risk Assessment of Chemicals ($DQRA_{CHEM}$). Health Canada, Ottawa, Ontario.

With respect to the *precautionary principle*, we consider that the SSHHRA meets the requirements of this approach. As noted by Environment Canada (2001)[1], the precautionary principle is "a distinctive approach to managing threats of serious or irreversible harm where there is scientific uncertainty." It represents a regulatory philosophy whereby regulatory action will be taken in the absence of full scientific certainty of risk. Although we don't know with full certainty the actual risks posed by the chemicals released, this uncertainty does not preclude use of risk assessment as part of decision-making process (i.e., it is not a reason to not complete the risk assessment).

Use of the precautionary principle is also inherently found within the methods of the SSHHRA. It can be found through the use of conservative (protective) factors to estimate risks when there is not full certainty of the input parameters (e.g., 95^{th} percentile concentrations, exaggerated time spent at the site, toxicity reference values with uncertainty factors, etc.). The implementation of an environmental surveillance program also is considered to meet the objectives of the precautionary principle.

3. What environmental surveillance program should be recommended to Regional Council and the MOE, taking into account your earliest report to me, the best practices review, and public concern?

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[1] **Environment Canada. 2001. A Canadian Perspective on the Precautionary Approach/Principle: Discussion Document. Environment Canada, Ottawa, Ontario. Available at:** http://www.ec.gc.ca/econom/discussion_e.htm

Response: The surveillance program suitable to this facility is expected to consist of facility operations monitoring, stack measurements, and environmental media measurements to confirm compliance. Specifically, there is great concern among certain members of the general public about chemicals arising from the facility operations themselves, dioxins and furans.

The standards applied for these chemicals should meet or exceed the more stringent of the Ontario Guidelines or EU directive chemical emissions standards in accordance with the JW Best Practices Review.[2]

In the case of the need for monitoring of environmental media, this is considered to be useful and is recommended. The modelers have predicted that the facility will not appreciably contribute to increased concentrations in the environment. Air and soil monitoring is recommended to ensure compliance. However, if concentrations are found to be greater than those assumed in the SSHHRA, additional flora and fauna monitoring will help to reassure that human health is protected and may also alleviate some of the concern in the general public.

4. Is there any other human health related advice I should be providing Regional Council and the MOE?

   Response: This facility is not likely to pose an unacceptable public health risk, if it functions as assumed in the JW SSHHRA Report. In addition, the environmental surveillance which is likely to be in place will ensure compliance with the emissions requirements by providing hard data to support any conclusions on environmental and health impacts.

   Notwithstanding, communities may expect that the Medical Officer of Health provide ongoing relevant health information as required by the Ontario Public Health Standards and Protocols. Details of what the public expects may be explored through community consultations or other sources of data gathering about community residents available to local public health agencies in Ontario (i.e., Rapid Surveys).

5. Is there any human health reason that the completed EA shouldn't be forwarded to the MOE to complete the process?

   Response: In our opinion, there is no reason relating to the human health impacts forecast by this SSHHRA that precludes forwarding to the MOE to complete the process, provided that the Final Report is in concordance with the caveats expressed in our review.

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[2] **Final Report: Review of International Best Practices of Environmental Surveillance for Energy-From-Waste Facilities. February 2009.**

6. Surveillance

Although the act of sampling and chemical analysis of human tissues such as blood or urine is relatively easy, there are more difficult challenges in entertaining human testing. Among these challenges are: 1. the use of humans as sentinels to test exposure hypotheses which are predicted by the SSHHRA to be below a significant signal; 2. The methodological challenges of obtaining large groups to examine given the very low level of exposure forecast; 3. the ethical issues of selective participation, individual interpretation and potential demand of the use of results for diagnostic, prognostic or therapeutic purposes. Interpretation of the significance of individual results is available for a limited number of substances and not for the vast majority of chemicals of concern. For these important reasons, ethical and medical, human biological monitoring is not recommended as a facility surveillance tool in this circumstance.

The above constitutes our team deliberations and is a summary of our report to you, attached.

ORIGINAL
SIGNED BY

Lesbia F. Smith, MD
Ross Wilson, MSc, DABT

Review of JW Site Specific Human Health Risk Assessment, May 2009 and Environmental Surveillance

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08 June 2009

Prepared by:
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Toronto, ON
M4V 2M6

Authors:

Ross Wilson, MSc, DABT
Lesbia F. Smith, MD

Table of Contents

Introduction

Dr. Lesbia F. Smith (Environmental & Occupational Health Plus Inc.) has been retained as consultant to Dr. Robert Kyle, Commissioner & Medical Officer of Health of the Region of Durham, to review documents arising from the Environmental Assessment process for an energy from waste (EFW) facility to be sited in the Region of Durham. The site selected for the facility is in Clarington. The team undertaking the current Review and development of environmental surveillance advice are Lesbia F. Smith, medical doctor and environmental health specialist, and Ross Wilson, risk assessor and diplomate of the American Board of Toxicology. The team draws its experience for this project from involvement throughout the process as external reviewer for the Generic Risk Assessment[1] (Dr. Smith), authoring the report on health effects of EFW facilities[2] (Dr. Smith), reviewing the methodology report on JW Report on Best Practices[3] (Dr. Smith), Reviewer of the JW DRAFT Best Practices Report[4] (Dr. Smith), numerous risk assessments and standard setting documents in support of risk assessment (Mr. Wilson) and public health protection (Mr. Wilson and Dr. Smith). Details of these activities are highlighted in our Curricula Vitae.

The purpose of this report is to provide Dr. Kyle with an assessment of the Draft JW Site Specific Human Health Risk Assessment, May 2009, and to update advice on environmental surveillance for the proposed facility in consideration of the various reports and public concerns.

Mandate

The specific questions posed of the review team are as follows:

1. What are the human health risks? Are the health risks acceptable and if so, according to what standards? If the health risks are acceptable, can the proposed EFW facility be considered "safe"?

2. Is the SSHHERA methodology sound and consistent with accepted standards such as Health Canada's Canadian Handbook on Health Impact Assessments and Environment Canada's Discussion Paper on the Precautionary Principle?

3. What environmental surveillance program should be recommended to Regional Council and the MOE, taking into account your earliest report to me, the best practices review, and public concern?

4. Is there any other human health related advice I should be providing Regional Council and the MOE?

5. Is there any human health reason that the completed EA shouldn't be forwarded to the MOE to complete the process?

---

[1] Smith LF. York-Durham EFW Peer Review of the Generic Risk Assessment, May 2007
[2] Smith LF. Energy from Waste Facility in the Region of Durham September 28, 2007
[3] JW. Methodology for a Review of International Best Practices of Environmental Surveillance for Energy-From-Waste Facilities. October 2008.
[4] JW. Final Report: Review of International Best Practices of Environmental Surveillance for Energy-From-Waste Facilities. February 2009

The responses to these questions arise from the review of the SSHHRA and consideration of surveillance approaches from the Best Practices Review, and relevant literature.

Review of the Site Specific Human Health Risk Assessment

Scope of the Review

The focus of the review is to examine the conclusions of the Jacques Whitford Environment Limited (JW) site specific human health risk assessment (SSHHRA) and to determine if they are scientifically-defensible and accurate. The main document considered in this review was **JW. 2009**. *Site Specific Human Health and Ecological Risk Assessment – Technical Study Report. May 2009. Draft report.* To supplement the above report, JW provided additional information on various aspects of the SSHHRA through email and telephone correspondence with the review team. This review of the SSHHRA has considered all of the above information available to June 5, 2009.

Validation of exposure point concentrations is considered to be outside of the mandate of this review. We note that this review of the SSHHRA has not evaluated the accuracy of the exposure point concentrations (from the air modelling of emissions) and thus, all of the exposure point concentrations assumed in the SSHHRA are assumed to be accurate.

Review Comments

Review comments are organized within the SSHHRA framework, by responding to a series of review questions, as provided below.

Does the SSHHRA follow the generally accepted SSHHRA framework?

The JW SSHHRA generally follows the accepted framework. The SSHHRA is presented in a straightforward and easy to follow manner. The SSHHRA is based on guidance that is consistent with Health Canada (HC), the World Health Organization (WHO) and the US Environmental Protection Agency (US EPA). These agencies provide a number of guidance documents that are useful for evaluation of health risks from such a facility. Overall, the approach used by JW is considered to follow an acceptable framework for SSHHRA.

Does the SSHHRA problem formulation identify the appropriate chemicals, receptors and exposure pathways?

The SSHHRA has identified the appropriate chemicals, receptors and exposure pathways of concern that are likely to drive human health risks and, thus, require evaluation in the risk assessment. The problem formulation identified the following chemicals requiring evaluation due to their inherent toxic potential *and* presence in stack emissions and other sources of release:

- Criteria pollutants (sulphur dioxide [SO_2], hydrogen chloride, hydrogen fluoride, nitrogen dioxide [NO_2], carbon monoxide [CO], particulate matter [as total, PM_{10} and $PM_{2.5}$] and ammonia);
- Metals and other inorganic elements;

- Polycyclic aromatic hydrocarbons (PAHs);
- Polychlorinated dibenzo-p-dioxins and furans (PCDD/Fs);
- Polychlorinated biphenyls (PCBs);
- Chlorinated monocyclic aromatics; and
- Volatile organic compounds (VOCs).

Although other chemicals may be released from the facility, the chemicals evaluated in the JW SSHHRA represent the substances of greater concern from a toxicological perspective and are typically evaluated in such an assessment. Consequently, if there are acceptable risks[5] from these chemicals, we can conclude with reasonable confidence that there will be no unacceptable risks from other chemicals not formally evaluated in the JW SSHHRA because risks would be even lower.

During our discussions with the JW team, we noted that a number of extended explanations would be required in order to fully justify the conclusions. JW committed to provide additional information in their final report on their rationale for not including ozone, dioxin-like PCBs and acrolein in the SSHHRA. In the case of ozone, JW has noted that the exclusion of ozone from such a facility is commonly accepted by air dispersion modelers at the Ontario Ministry of Environment (MOE). In the case of dioxin-like PCBs and acrolein, JW has indicated that they do not consider these chemicals to be key drivers in the SSHHRA and they will provide the justification for this conclusion.

The receptors of concern evaluated in the SSHHRA were *persons* living, working, going to school/daycare, recreating or consuming food from the area. These notional persons or receptors are considered to be representative of the *maximum exposed persons*. It is noted that Figure 3-4 (showing specific receptor locations) was omitted from the original JW SSHHRA report and was subsequently provided to the review team. Persons of all ages were considered in the SSHHRA. It is noted that pregnant women are inherently included in the assessment (i.e., TRVs are developed for protection of all receptors with special emphasis on pregnant women and their fetuses).

The exposure pathways evaluated in the SSHHRA are consistent with HC and US EPA guidance. The JW SSHHRA represented a multi-pathway analysis where the following exposures routes were considered (depending upon the receptor (*person*) of concern):

- Inhalation of air;
- Incidental ingestion and skin contact with soil/dust;
- Ingestion and skin contact with surface water;
- Consumption of plants, livestock (including beef, poultry, pork, milk and eggs), wild game and fish.

Does the SSHHRA exposure assessment accurately estimate exposures from the site?

The exposure assessment has been completed according to available guidance and has used appropriate input parameters and equations to estimate exposure. We consider that the approach used in the JW SSHHRA provides a reasonable estimate of anticipated exposures for the specific receptors. The JW SSHHRA is based on receptor characteristics and exposure equations that are consistent with HC guidance for estimation of exposures.

[5] Acceptable risks from substances emitted refer to their regulatory level of risk as calculated using methods from Health Canada, US EPA, and WHO guidance documents.

Certain issues were identified in the review of the exposure assessment as follows:

- The assumed air concentrations were not provided in the JW SSHHRA. In subsequent correspondence with JW, the assumed air concentrations for Normal Operations and Upset conditions were provided for our consideration. These were absolutely necessary to determine the integrity of the resulting calculations.
- The assumed exposure point concentrations for certain chemicals were not provided in the JW SSHHRA (e.g., many of the PAHs). In subsequent correspondence with JW, the assumed exposure point concentrations were forwarded to our team. These were absolutely necessary to determine the integrity of the resulting calculations.
- Our initial assessment of the rates of fish and wild game consumption was that they were too low. In subsequent correspondence with JW, we were informed that these have been revised and greater consumption rate has now been assumed that is more representative of upper bound consumption. JW has indicated that it is unlikely that such a revision of intake from this pathway will result in any change in conclusions about risk (i.e., risks will still be well below the acceptable level).
- Communications with JW has indicated that the potential for additional chemicals in breast milk will be discussed in the final SSHHRA.
- Communications with JW has indicated that the significance of slightly higher soil ingestion rates will be discussed in the final SSHHRA.

We note that the expected increase in the concentration of chemicals of concern in air, soil, plants and animals attributable to the proposed facility is very small and is not likely not be detectable from current background conditions. This is of particular importance when considering environmental measurements of chemicals of concern as a form of facility operations surveillance.

Overall, it appears that exposure assessment was appropriately completed and is unlikely to underestimate exposures that persons would experience from the facility. We note again that the methods used to estimate exposure point concentrations were not part of the current review. We have assumed, therefore, that the exposure point concentrations presented provide reasonable estimates of environmental concentrations. If other reviewers identify issues with the predicted exposure point concentrations, our conclusions on the adequacy of the exposure assessment would need to be re-visited.

Does the SSHHRA toxicity assessment accurately estimate the potency of the substances?

The toxicity assessment provides a reasonable estimate of the toxicological potency of the substances of concern. Many agencies provide toxicological reference values (TRVs) and for all chemicals of concern, TRVs were identified from MOE, HC, Environment Canada, Alberta Environment, US EPA, WHO, California EPA and Texas Commission on Environmental Quality, Agency for Toxic Substances and Disease Registry (ATSDR) and the Netherlands Institute of Public Health and the Environment (RIVM).

No pre-defined toxicological hierarchy was used to identify toxicological reference values (i.e., the SSHRA was not based on any predetermined rules that one health agency was preferable to another). Instead, TRVs were selected on a chemical-by-chemical basis. Where appropriate, TRVs were identified for short-term (1 hour and 24 hour exposures) and long-term (continuous exposure for a lifetime).

Emphasis was placed on use of inhalation TRVs to evaluate inhalation routes and oral TRVs to evaluate oral and dermal exposures. This is considered to be consistent with health agency guidance.
We consider the approach used by JW acceptable. Although any number of TRVs is available for the same substance, we are not aware of any other values that should have been used and that could have changed the overall conclusions. Notwithstanding the above, certain issues were identified in the review of the toxicity assessment:

- The toxicological reference value for benzene in Table 7-3 was 100 times lower than reported in the Appendix H. However, the correct value (value cited in Appendix H) was used in the JW SSHHRA calculations.
- For criteria pollutants $PM_{2.5}$, SO_2, NO_2 and CO, Health Canada (2004)[6] provides an approach for estimation of *mortality effects* rather than toxicity effects beyond a straight comparison to criteria. In subsequent correspondence, JW stated that consideration of mortality effects would not impact the SSHHRA and has indicated that the rationale for lack of consideration of such effects will be provided in a revised report.
- In some cases, acute toxicity reference values were found to be lower than chronic values (e.g., mercury); however, this was mostly due to variations in approaches by different health agencies and will not influence the SSHHRA results significantly.
- Communications with JW has indicated that the significance of the MOE reference dose for lead (1.8 µg/kg bw/day) will be discussed in the final SSHHRA; however, the conclusions of the SSHRA are not expected to change with this revision. It is also noted that the TRV for lead is currently under review by HC but to date, there is no official position from HC on this. In addition, the exposure that persons in the vicinity of the proposed facility are predicted to be very minor compared to typical non-facility sources of exposure.

Overall, we are not aware of any other TRVs that should have been used and which would have resulted in distinctly contradictory conclusions from those presented in the SSHHRA.

Does the SSHHRA risk characterization accurately represent health risks?

The results of the SSHHRA are considered to accurately represent health risks. Health risks for evaluation of non-carcinogens were presented as Hazard Quotient (HQ) values (acceptable HQ = 0.2 for most chemicals) while risks for carcinogens were provided as Incremental Lifetime Cancer Risks (acceptable Incremental Lifetime Cancer Risk of 1×10^{-6}). This is the usual technical nomenclature to express risks in SSHHRAs.

[6] Health Canada. 2004. Estimated Number of Excess Deaths in Canada Due to Air Pollution. Health Canada, Ottawa, Ontario.

Key Findings

These are the key findings of this review:

- Risk estimates appear to be accurately estimated.
- Although certain changes to certain exposure assumptions are planned for the final HHRA (e.g., rate of fish/wild game consumption) and will alter the risk estimates provided, we consider it unlikely that these changes would alter the overall conclusions of the SSHHRA.
- Although certain risk estimates in Tables 7-15 and 16 are termed "acute", JW provides some of these risk estimates for chronic exposure durations. Communications with JW indicate that these risk estimates will be revised accordingly for the final SSHHRA.
- Communication with JW indicates that the management of "upsets" (facility upset conditions) will be further discussed. We have no criticism of the resulting risks as presented.
- Communications with JW indicate that the risks from mixtures will be further discussed.
- Although *baseline risks* are elevated above HQ values of 1 and Lifetime Cancer Risk estimates of 1×10^{-6}, the increased risks that are estimated from the proposed facility are considered to be acceptable and much lower than these values. In all cases, the concentrations attributed to the project alone and the upset conditions situations scenarios forecast that exposures will be well below acceptable toxicological reference values, and therefore present no unacceptable risks.
- In some cases, HQ values from background sources are greater than 1 and Lifetime Cancer Risks are greater than 1×10^{-6}. However, such scenarios do not mean that absolutely no additional exposures can occur (at least from a regulatory perspective). Instead, health agencies and scientists tend to evaluate issues on a chemical specific "case-by-case" basis. In the case of PCDD/Fs and PCBs, these are the chemicals contributing the greatest background risks; however, the increased exposure from the facility for these chemicals is quite minor by comparison (on the order of 0.5% increase of total exposures - see Table 7-34) and such values do not increase risk significantly. From the scientific perspective, these small increased risks are considered trivial because the greatest component of risk is from non-facility sources (i.e., food).

Summary

Overall, our review supports the findings of the SSHHRA. Our key findings are highlighted below:

- The key receptors, chemicals and exposure pathways have been evaluated.
- The methods used to estimate exposures are considered appropriate.
- The toxicological reference values used are reasonable and drawn from a variety of reliable international sources.
- The risk characterization results are defensible.

Conclusions

We consider this SSHHRA satisfactory. Although it would be possible to use different receptor characteristics, exposure assumptions and toxicological reference values, we consider it unlikely that the overall conclusions of the SSHHRA would change.

In most cases, we expect the proposed installation will not provide any appreciable change in the concentration of chemicals in air, soil, dust, water or food. For example, the maximum Ground Level Concentration of $PM_{2.5}$ on an annual basis is expected to be increased by 0.022 $\mu g/m^3$ versus a current baseline concentration of 9.8 $\mu g/m^3$. This, in our opinion, is insignificant from a health risk perspective. Similarly, the projected increases in the concentration of metals, PAHs, PCDD/Fs, PCBs and other chemicals are very minor relative to current concentrations and would not result in unacceptable health risks.

In the case of the need for monitoring of environmental media, this is considered to be useful and is recommended under some circumstances. The modelers have predicted that the facility will not appreciably contribute to increased concentrations in the environment. Air and soil monitoring is recommended to ensure compliance. However, if concentrations are found to be greater than those assumed in the HHRA, additional flora and fauna monitoring will help to reassure that human health is protected and may also alleviate some of the concern in the general public.

Overall, this review team holds the opinion that this industrial installation, if it performs as specified and assumed in this SSHHRA, will not pose unacceptable risks to persons in the vicinity of the site, and by extension, to those residents beyond. Said differently, this installation as proposed is not likely to pose a public health risk.

Surveillance Issues and Recommendations

Stakeholders have different knowledge, perspectives, professional and lay opinions about what constitutes the proper oversight for an EFW facility as proposed for Durham Region and to be located in Clarington. The calls for public health surveillance once focused on "human biological monitoring". Two reports were commissioned. The first[7] was a review of health studies and potential health effects associated with energy from waste facilities derived from the published literature of studies of communities around energy from waste facilities. Results indicated that there was no evidence for or against actual impacts. The second[8] examined the surveillance practices around the world related to energy from waste facilities, and the role of biological monitoring as a surveillance tool for these facilities. Results indicated that best practices pointed to stack monitoring as the most prevalent practice, followed by environmental monitoring (air, soil), and less frequently on flora or fauna monitoring. Only one country had engaged in human biological monitoring, with some ambiguity as to

[7] Smith LF. Energy from Waste Facility in the Region of Durham September 28, 2007

[8] JW. Final Report: Review of International Best Practices of Environmental Surveillance for Energy-From-Waste Facilities. February 16, 2009

whether the objective of the human-focused programs was specifically for facility monitoring, research, or to satisfy public concern.

Regional stakeholders continue to press for additional reassurances about the health and environmental impacts of this facility. A number of environmental surveillance options have been discussed, including "ground truth" measurements of stack emissions at the pathway level (i.e., soil, air concentrations) for three years, and fauna and flora monitoring. The results of the JW Best Practices Review indicates that the most prevalent practices involve upstream monitoring of facility operations (stack and air emissions), supplemented by air, soil, and rarely, fauna and flora monitoring under some circumstances.

All considered, for this EFW facility, the recommended monitoring of stack, air, soil and environmental monitoring will provide sufficient sentinel signals to protect public health. The addition of a three year period of environmental monitoring will indicate whether new approaches should be taken for additional surveillance or for additional restrictions on the facility. As part of this additional monitoring, further checking of emissions impacts at the receptor level (i.e., flora and fauna) will not add value to the pathway level measurements unless there is evidence of repeated excursions in emissions above what the SSHHRA and the facility operator predict. The biological monitoring of fauna is the wild animal version of testing human "receptors" for chemicals emitted by the facility. If this is done as part of a planned early monitoring, then it means that there may be an expected failure of upstream monitoring of the facility itself. In similar fashion, the use of humans as sentinel monitors of facility operations represents an acceptance of failure of upstream emissions and operations monitoring. Flora and fauna, and human testing are not good sentinels of current operations.

Notwithstanding, monitoring environmental media is considered useful and is recommended under circumstances as follows. The modelers have predicted that the facility will not appreciably contribute to increased concentrations in the environment. However, if concentrations are found to be greater than those assumed in the HHRA, flora and fauna monitoring will help to reassure that human health is protected and may also alleviate some of the concern in the general public.

Although the act of sampling and chemical analysis of human tissues such as blood or urine is relatively easy, there are more difficult challenges in entertaining human testing. Among these challenges are: 1. the use of humans as sentinels to test exposure hypotheses which are predicted by the SSHHRA to be below a significant signal; 2. The methodological challenges of obtaining large groups to examine given the very low level of exposure forecast; 3. the ethical issues of selective participation, individual interpretation and potential demand of the use of results for diagnostic, prognostic or therapeutic purposes. Interpretation of the significance of individual results is available for a limited number of substances and not for the vast majority of chemicals of concern. For these important reasons, ethical and medical, human biological monitoring is not recommended as a facility surveillance tool in this circumstance.

Communities may expect the Medical Officer of Health to provide ongoing relevant health information as required by the Ontario Public Health Standards and Protocols[9]. Details of what the public expects outside the Standards may be explored through community consultations or other sources of data gathering about community residents accessible to local public health agencies or as considered appropriate by the Medical Officer of Health.

[9] Health Protection and Promotion Act, RSO 1990, c. H. 7

APPENDIX E

Jacques Whitford

FINAL REPORT

Review of International Best Practices of Environmental Surveillance for Energy-From-Waste Facilities

PROJECT NO. 1009497.06

PROJECT NO. 1009497.06

ON

Final Report

Review of International Best Practices of Environmental Surveillance for Energy-From-Waste Facilities

February 16, 2009

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STUDY SUMMARY

INTRODUCTION

Jacques Whitford Limited was retained by Durham Region to conduct a review of international best practices of environmental surveillance being undertaken at Energy-From-Waste (EFW) facilities. This study was specifically designed to address a motion made at the Durham Regional Council meeting on Wednesday, May 28th, 2008, which was carried and states in part:

> *"g) i) THAT staff review the best practices of environmental monitoring programs which include environmental surveillance, health surveys, biological monitoring, health studies, and any other pertinent studies as determined through the review and consultation regarding environmental monitoring programs; and*
>
> *ii) THAT an environmental monitoring program be developed based on best practices which will provide baseline information and ongoing studies during the life cycle of the facility";*

This project was completed in conjunction with the Durham/York Residual Waste Study, which is being completed to obtain approval to construct an EFW facility in the Municipality of Clarington, Ontario.

The focus of this study was to review environmental surveillance programs at similar facilities around the world and to recommend an appropriate level of environmental surveillance for the proposed EFW facility. This was achieved through a three pillar study approach involving - a systematic review of the scientific literature, a grey literature review and by interviewing international experts in the field of incineration environmental surveillance. The findings of each stage of the process were documented and then summarized by Country.

The objective of the Study Team is as follows:

> *"The consultant's recommended option for an environmental surveillance program for the proposed Durham/York Residual EFW facility will be based on the fundamental tenant that the program must ensure the protection of public and environmental health."*

A multidisciplinary team of professionals were assembled to undertake this study and an independent peer review of the study by Dr. Lesbia Smith was commissioned by the Region of Durham.

The consultant's recommended environmental surveillance program will ensure the protection of human and environmental health during the operation of the proposed EFW facility. In addition, recommendations for what would trigger a more resource intensive surveillance program have been included.

KEY STUDY TERMINOLOGY

Surveillance is a continuous and systematic process of collection, analysis, interpretation, and dissemination of descriptive information for monitoring health problems (Rothman and Greenland, 1998). ***Monitoring*** is the intermittent performance and analysis of routine measurements, aimed at detecting changes in the environment or health status of the population (Last, 2000). Surveillance is distinguished from monitoring by the fact that it is continuous and ongoing, whereas monitoring is intermittent or episodic. The hierarchy of environmental surveillance is provided in Figure 1.

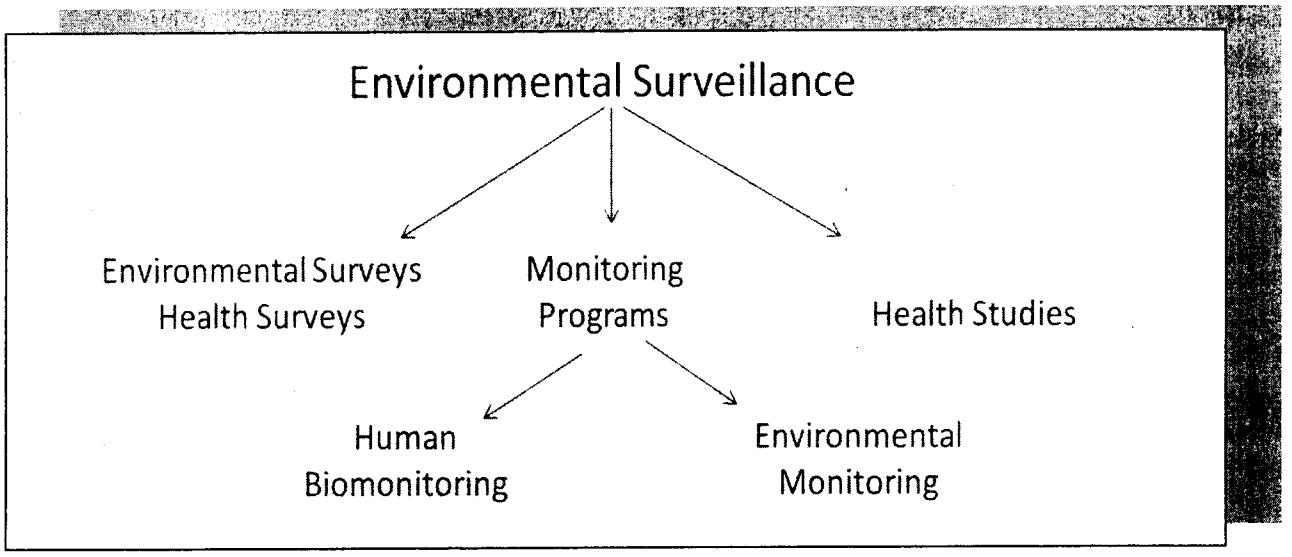


Figure 1. Environmental Surveillance Hierarchy

The following are brief descriptions of the key study terminology:

Environmental surveillance is a broad topic under which a wide range of information can be collected on emissions data, dispersion modeling, and the monitoring of air, water, soil, vegetation, wildlife and humans.

Environmental survey is an observational study of the ecosystem and its physical components to evaluate potential stressors on the environment (UN FAO, 1990). These surveys are also often referred as biophysical surveys and do not involve sampling or sacrificing flora or fauna, rather they are observational.

Health surveys collect information from participants about their health, habits and life circumstances through a variety of means, including through interviews (conducted in person or over the phone), or by self-administered questionnaires (WHO, 2008). They are often used to provide information on the health status of communities and estimates of health determinants.

Health studies differ from surveillance and monitoring programs in that they seek to identify the relationship between individual characteristics and the occurrence of disease or outcome.

Environmental monitoring involves the testing of media of ecosystem components such as soil, water, air, vegetation and fauna (*e.g.,* fish, small mammals, and birds). Stack testing of facilities emissions (whether periodic or continuous) is also considered environmental monitoring.

Human biological monitoring, more commonly known as human biomonitoring (HBM), is the measurement of specific substances in the human body, usually through the analysis of blood, urine, breast milk and tissue samples.

This study reviews best practices of environmental surveillance related to EFW facilities. However, the scientific literature on environmental surveillance options does not always distinguish between EFW and non-EFW facilities; therefore the search was appropriately widened to include all manner of incineration facilities. The Study Team distinguished between the types of incineration facilities that were studied by the researchers (e.g., municipal solid waste, hazardous waste or medical waste) throughout the report. The importance of this distinction is that the feedstock (material going into the process) contains different levels of chemicals in the material that was being incinerated.

In addition, the Study Team felt that it was important to distinguish between facilities that were built and operated with modern pollution control technology, from older facilities that may have emitted higher concentrations of chemicals than would be allowed by regulation in Ontario today.

Those facilities that were operating prior to the late 1990s were considered "older" facilities in this review as they generally emitted higher concentrations of chemicals (e.g. dioxins and furans), into the environment than would currently be allowed. It was also noted that several studies published after the late 1990s included an assessment of older facilities. The environmental surveillance programs in place for these facilities were deemed relevant to this study, but caution was applied when interpreting their findings and their applicability to the type of pollution control technology and emission standards that would be adopted for the Durham/York EFW facility.

SYSTEMATIC SCIENTIFIC LITERATURE REVIEW

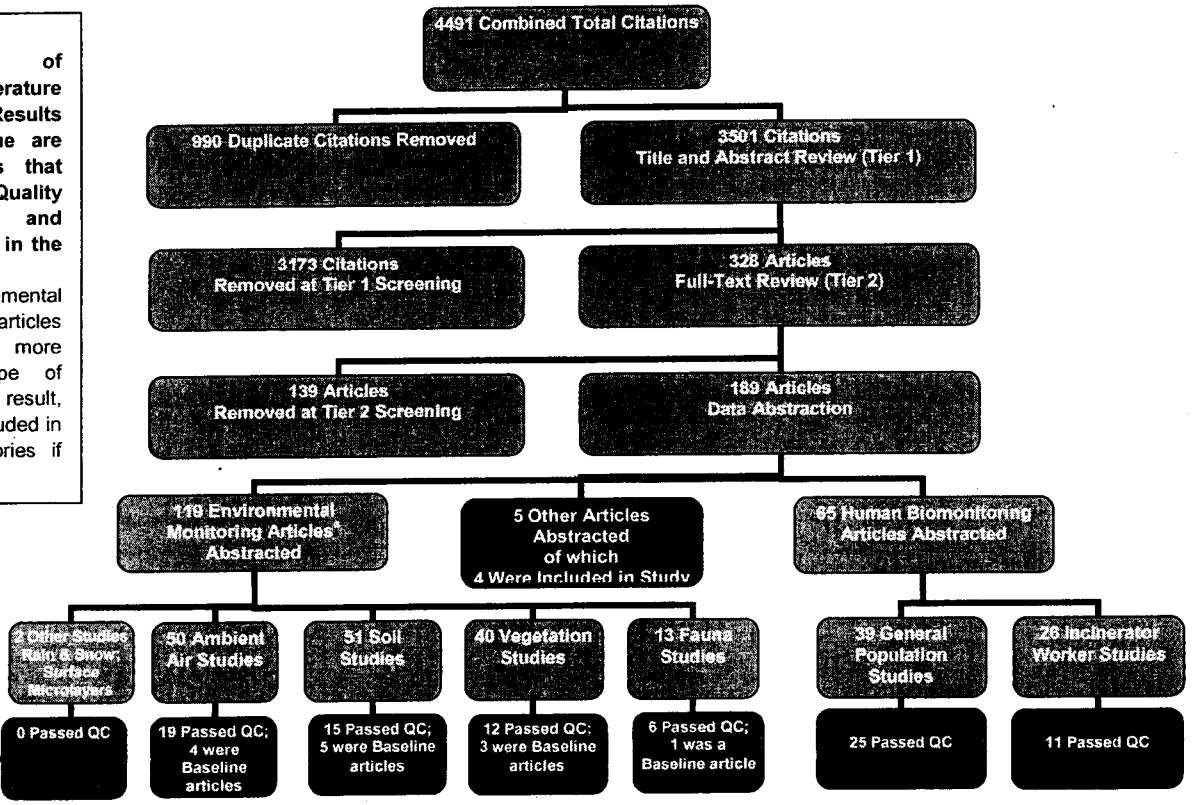
The objective of the systematic scientific literature review was to identify relevant English-language literature on the current practices employed in EFW realated environmental surveillance programs around the world, with a publication date of January 1, 1990 or later.

The systematic literature review was modelled after the Cochrane Handbook for Systematic Reviews of Interventions (Cochrane Collaboration, 2008). Cochrane reviews adhere to the principle that "science is cumulative" and by considering the available evidence, decisions can be made that reflect the best science available.

Articles Retrieved in the Systematic Literature Review

The literature search identified a total of 4,491 citations. After duplicates were removed, and screening was completed, 189 articles were retained for data abstraction and quality assessment. Sixty-six articles were categorized as human biomonitoring studies, and 119 as environmental monitoring studies. An additional 5 were categorized as "Other" because the study focus was not necessarily the description of a specific monitoring program, but the content was nevertheless relevant to the review. After the quality assessment framework was applied, 25 human biomonitoring articles of residential exposure and 59 environmental monitoring articles remained for inclusion in the study (Figure 2).

Figure 2. Summary of Scientific Literature Review Results (boxes in blue are those studies that passed Quality Assessment and were included in the review)
Note: [a] Environmental monitoring articles often involved more than one type of media and as a result, studies are included in multiple categories if appropriate.



Results of the Systematic Literature Review

Baseline Studies Conducted Prior to Operation of an Incineration Facility

Eleven of the scientific articles retrieved and included in this study were environmental baseline programs, conducted prior to an incineration facility becoming operational. These environmental baseline programs typically involved the sampling of a number of chemicals in various environmental media. The sample locations were selected through review of atmospheric dispersion modelling results, which provide the predicted zone of influence of a facility's emissions (typically within 1 km of the facility). Baseline sample medium included ambient air, soil, vegetation, and bovine milk. The authors emphasized the importance of collection of an environmental baseline, so that samples collected and analyzed in the future could be benchmarked against pre-operational conditions.

Study Team Finding

These studies illustrate the importance of conducting chemical baseline investigations prior to commissioning of an EFW facility. It forms the benchmark against which any samples collected during the facility's operation would be evaluated.

Durham and York Regions are in the process of finalizing an environmental baseline study, similar to those reported in the literature.

Ambient Air Monitoring Studies

In general, high volume air samplers were sited downwind of a facility and within its modelled chemical depositional range. In many studies, a control location was set up in an area predicted to be outside of the zone of influence of the incinerator. This allowed the researchers to compare the ground level concentrations of chemicals within the zone of influence of the facility to background conditions. Dioxins and furans, trace metals and volatile organic compounds (VOCs) were the most commonly measured chemicals.

Study Team Finding

It is concluded from the scientific literature that an ongoing ambient air monitoring program would not be required for the proposed Durham/York EFW facility to ensure the protection of human or environmental health.

This conclusion was reached on the basis that no correlation was found between chemical concentrations in ambient air and stack emissions from facilities that employ modern pollution control technology.

The literature review determined that facilities that had upgraded or modern pollution control technology do not appear to be a significant source of chemicals detected in ambient air surrounding the incineration facility. However, older MWI facilities or hazardous waste facilities appear to in some cases have been a significant contributor to ambient levels of chemicals in the air surrounding these facilities.

The zone of potential influence of the facilities studied appears to be no greater than 2 km from the stack, with the majority of research focused in areas less than 0.5 km from the facilities. Baseline or control locations formed a critical part in all of the studies.

Soil Quality Monitoring Studies

The soil monitoring programs included the analysis of chemicals in multiple samples, predominately located within the depositional zones of a waste incinerator and a comparison to either baseline or background samples. In general, soil was usually collected from the upper 5 centimetres of the soil column. The most common chemicals analyzed were dioxin and furans and metals.

Study Team Finding
It is concluded from the scientific literature that an ongoing soil monitoring program would not be required for the proposed Durham/York EFW facility to ensure the protection of human or environmental health.
This conclusion was reached on the basis that a modern incineration facility that employs current pollution control technology should not impact local soil quality.

A number of articles published on older facilities, without modern pollution control technologies, reported a significant distance-decay effect associated with soil chemical concentrations and incineration facilities. However, in most cases influences by other man made sources as contributors to could not be ruled out. There were also a number of scientific papers that showed no impact to local soil quality as a result of incinerator emissions.

Perhaps the most significant finding was that soil sampling programs surrounding older facilities were most effective when samples were collected within close proximity (<1km) of facilities. While a soil monitoring program may be beneficial in addressing public concern related to EFW facility emissions, a modern EFW facility equipped with the latest pollution control devices would be unlikely to have measurable changes in chemical concentrations in soils surrounding the facility. This is also supported by the deposition modeling that was completed in the Durham/York Residual Waste Study Generic Risk Assessment, where soil loading concentrations at the maximum deposition location were predicted to be less than 1% of background levels.

Vegetation Monitoring Programs

In general, the vegetation monitoring programs included the analysis of chemicals in multiple samples, predominately located within the depositional zones of an incinerator and a comparison to either baseline or background samples. The type of vegetation sampled varied from study to study and was heavily dependent on the type of vegetation around the site. The most common chemical concentrations quantified in vegetation samples were metals, dioxin and furans, and PCBs.

In summary, vegetation monitoring programs further support the hypothesis that incinerators with poor pollution abatement technologies tend to have a more significant effect on chemical concentrations in environmental media. In addition the vegetation monitoring programs also found that there is a distance decay effect associated with chemical concentrations. It was also determined that samples, if collected, should be taken within 1 km of a facility and only provide a good indicator of short-term chemical deposition from an EFW facility.

Study Team Finding
It is concluded from the scientific literature that an ongoing vegetation monitoring program would not be required for the proposed Durham/York EFW facility to ensure the protection of human or environmental health.

This conclusion was reached on the basis that a modern incinerator that employs current pollution control technology should not impact local vegetation quality.

Agricultural Products Monitoring Programs

There were a limited number of studies in the scientific literature that attempted to study the relationship between incineration facilities and the potential effects on agricultural products (e.g., beef, dairy, eggs, and pork). The most common chemical concentrations quantified in samples were metals and dioxins and furans.

The agricultural product studies were conducted on facilities with older pollution control technology and may not be representative of levels that may be found surrounding facilities built after the late 1990s. The media sampled were agricultural meat (poultry or beef), dairy products, and chicken. In one study, duck eggs were collected from close proximity to an incinerator. Meat, dairy and egg samples were collected directly from farms located within the depositional ranges of a waste incinerator and directly transported to the laboratory for chemical analysis.

The majority of the research studies were unable to find significant chemical concentrations in agricultural samples at levels that would adversely affect human health (consumption of the products) and ecological health. In the studies that reported significantly elevated chemical concentrations in agricultural products, the age of the incinerator and insufficient pollution control technologies were factors, which is a reoccurring trend in the environmental monitoring programs reviewed.

Study Team Finding

These studies indicate that the age of the incineration facility may affect the chemical concentrations in some agricultural products.

The study surrounding a modern incineration facility showed no significant increase of chemicals in numerous agricultural products.

Studies also indicated that samples should be taken in close proximity to the facility.

Human Biomonitoring of Residents

Twenty-five articles that involved human biomonitoring of residents living in the vicinity of an incineration facility passed the quality assurance check and were included in the study. Where multiple articles related to the same study, they were grouped and discussed as a comprehensive study.

In summary, the results of the systematic review of the scientific published literature indicate that there is not a significant relationship between exposure to chemical emissions from incinerator and measured chemical levels in human media such as blood, urine, breast milk and hair. With regard to dioxins and furans, the most commonly referenced chemical assessed in the studies, authors noted occasional differences in individual dioxin and furan congeners and measured samples. Congener analysis can be important as it may be possible to correlate a particular individual congener emitted from an EFW facility to those found in exposed residents. However, no two congeners are the same, and some are more or less toxic than others. The toxic equivalent (TEQ) is thus a useful measure, as it provides a single, cumulative number based on the relative toxicity of each congener.

Study Team Finding

It is concluded from the scientific literature that an ongoing human monitoring program would not be required for the proposed Durham/York EFW facility to ensure the protection of human or environmental health.

This conclusion was reached on the basis that there was no correlation between chemicals emitted from modern MWI facilities and those measured in the human biomonitoring programs.

The only study to identify significantly elevated dioxin and furan TEQ levels in humans were Fierens et al., 2003; Fierens et al., 2007, which identified this trend in residents of a rural area containing an older municipal waste incinerator, which for nearly 20 years emitted dioxins at levels 500 times greater than the current emissions limit in the European Union or the Ontario Guideline A-7 allowable limits. These emissions levels resulted in high levels of dioxins and furans in the local environment, which was then transferred to the local residents in the form of dietary intake, as this rural population ingested a large amount of local dairy and livestock.

GREY LITERATURE REVIEW

While the scientific literature review brought forth considerable information, most of which originates in the academic community, it was anticipated that a full and complete review of the topic would necessitate a review of the grey literature – that is, literature not produced by bodies whose sole objective is publishing or that is not indexed in a scientific database. Findings included technical reports, government publications, regulations and legislation, conference proceedings, presentations, or unfinished "working reports".

Seven documents had information that directly pertained to environmental monitoring programs. Of these, five documents described programs that were in the vicinity of a waste incineration facility. The most common environmental sample was ambient air followed by soil and vegetation and finally fauna. The chemicals of concern that were frequently studied were dioxin and furan concentrations, PCBs, and metals.

Five grey literature articles that reported on the results of human biomonitoring surrounding incineration facilities were included in this study. Age groups studied ranged from newborns to the elderly (up to age 65). Sample tissues collected included urine, blood, serum and hair. In the studies that assessed newborns and expectant mothers, breast milk and umbilical cord blood were collected. Chemicals varied by study, but included dioxins and furans, metals, PAHs, and PCBs.

The results of the grey literature review were consistent with the findings of the systematic review of the scientific published literature. The fact that both the findings of the published and unpublished literature were similar is an encouraging result. The Study Team believes it is unlikely that additional information may have been missed during this review, which would alter our findings or conclusions.

Grey Literature on National Human Biomonitoring Programs

Throughout the grey literature and external contact review, it was observed by the review team that many countries have implemented a national human biomonitoring program. These programs are aimed at understanding chemical concentrations in the general human population. This is not particularly associated with any one industry, but rather to examine the overall population level of exposure to environmental contaminants.

Studies reviewed included the Canadian Health Measures Survey (CHMS), the Canadian Maternal-Infant Research on Environmental Chemicals (MIREC) study, the United States National Health and Nutrition Examination Survey (NHANES), and the European Union Expert Team to Support Biomonitoring in Europe (ESBIO).

EXTERNAL CONTACT INTERVIEWS

Many governmental or legislated environmental surveillance programs are not published in the scientific literature, relying instead on internal or external governmental websites and documents with limited dissemination. In order to obtain a more holistic view of the practices of environmental surveillance programs associated with the energy-from-waste industry, it was essential to contact individuals in this field of work, who are directly involved with these programs.

Although many valuable contacts were made, and interviews conducted during this phase of the project, unfortunately not all of those who were contacted by the reviewers responded to our repeated inquiries. However, the reviewers believe that the information gained from respondents was sufficient to support the study findings and conclusions.

The Study Team was fortunate to be able to interview four academic / experts in the field of EFW environmental surveillance, five government employees, and two owners/operators of European Union EFW facilities. The discussions and responses to questionnaires served to reiterate the various practices of environmental surveillance surrounding incineration facilities around the world.

With the exception of Portugal, the majority of countries and regulatory bodies mandate stack testing and monitoring of chemical parameters at incineration facilities. The primary driver behind this being the belief that air dispersion modelling and human health risk assessment, in combination with stack testing/monitoring are sufficient to ensure the protection of human and environmental health. Portugal appears to be the only country that commonly mandates a more resource intensive environmental surveillance program, often in the form of human and environmental biomonitoring.

SUMMARY OF GLOBAL ENVIRONMENAL SURVEILLANCE REQUIREMENTS FOR INCINERATION FACILITIES

Though it is difficult to make generalized worldwide claims as to the practices of environmental surveillance around incineration facilities, some notable trends are apparent.

- Most countries were identified to govern incineration facilities similarly to the Canadian approach – at the regional/provincial/state level.
- In almost all cases, prior to project approval an environmental assessment is required to determine whether the facility could adversely impact air quality, human and environmental health.
- The majority of facilities around the world conduct only stack monitoring programs, with the exception of Portugal where environmental monitoring and human biomonitoring programs may be mandated under the operating permits of individual facilities (Table 1).

This review found that older incineration facilities and/or those with less advanced or no air pollution control technology may have impacted the environment immediately surrounding the facility. The study results indicate that a modern incineration facility, such as the one being proposed by the Regions of Durham and York, that employ best available control technology for air pollution, would be unlikely to impact the health of local residents or the environment.

Table 1. Summary of environmental surveillance practices on a country-by-country basis for incineration. An X was used to denote a government requirement – either legislated or as part of individual facility operating requirements.

	Municipal Waste Incinerators							
Country	Continuous Stack Monitoring	Periodic Stack Testing	Periodic Ambient Air Monitoring	Continuous Ambient Air Monitoring	Soil Monitoring	Vegetation Monitoring	Agricultural Product Monitoring	Human Biomonitoring
Canada	X	X						
Ontario	X	X			X			
United States	X	X						
European Union	X	X						
Portugal	X	X	At some locations	At some locations				At some locations
Spain	X	X	At some locations	At some locations				
Belgium	X	X						
Germany	X	X						
Italy	X	X	At some locations	At some locations				
Sweden	X	X						
Taiwan	X	X						
Korea	X	X						
Japan	X	X						
Hong Kong	x	X						

STUDY TEAM RECOMMENDATIONS FOR ENVIRONMENTAL SURVEILLANCE OF THE DURHAM/YORK EFW FACILITY

Globally the government legislative requirement for environmental surveillance of incineration facilities is continuous and periodic testing of chemical emissions at the stack. The adoption of this level of surveillance for a modern incineration facility, that would incorporate best available pollution control technology (BACT), was deemed by the Study Team to be scientifically justified to ensure the protection of both human and environmental health. Continuous stack monitoring of a limited number of chemicals (e.g., NO_x and SO_2) are used as surrogates for other chemical parameters between periodic manual stack testing events. This level of environmental surveillance ensures that the facility is operating within its purported emissions control limits for all chemicals.

In the event that continuous stack monitoring highlights an issue with the facility emissions in real-time, the source of the problem is identified. If the problem is combustion related, the operators adjust combustion parameters to correct the issue in real-time. If the problem is not combustion related, then it is possible that the unit where the problem lies can be shut-down until the problem is rectified. Exceedances of emissions limits would be required to be reported to the Ontario Ministry of the Environment (MOE). It would be the responsibility of the MOE to verify that proper steps have been taken to rectify the issue with facility operators.

The Study Team originally envisioned the inclusion of an initial cost estimate for each of the environmental surveillance options. However, it became apparent during the review process that inclusion of costs could potentially bias the selection of a scientifically-based optimal option for the protection of public and environmental health. Therefore, costs were excluded from consideration in this review and can be provided once a preferred option is adopted by Durham Regional Council.

Through the grey literature review and external contact survey, another key component to environmental surveillance of incineration facilities was reported to be the establishment of an independent facility-specific oversight committee. In 2008, as part of the Durham/York Residual Waste Study a Site Liaison Committee (SLC) was established to review and provide input on site specific studies related to the study of the proposed EFW facility. A new committee will be established once the facility is operational.

Regardless of which environmental surveillance option is ultimately put in place, it is proposed by the Study Team that this committee be charged, in part, with review of any environmental surveillance program being undertaken for the Durham/York EFW facility. This would ensure public participation in the environmental surveillance program and evaluation of its efficacy in protecting public and environmental health.

Supported by the scientific findings of our review, the Study Team recommends that the following three environmental surveillance options be considered for implementation by the Regions of Durham and York for their proposed EFW facility.

Option 1 – Chemical Emissions Stack Monitoring and Testing

Option 1 a) Compliance with Ontario Guideline A-7 Combustion and Air Pollution Control Requirements for New Municipal Waste Incinerators

This represents the minimum level of environmental surveillance and monitoring to which the EFW facility must commit. This will ensure the protection of the surrounding environment and conform to the regulatory requirements associated with the operation of such a facility in Ontario. Guideline A-7 stipulates the combustion and air pollution emissions and monitoring requirements for municipal waste incinerators operating in Ontario and forms the basis of issuing the Certificate of Approval (CofA) by the MOE.

Guideline A-7 sets out fixed emission limits for nine (9) parameters: particulate matter, cadmium, lead, mercury, dioxins and furans, hydrochloric acid, sulphur dioxide, nitrogen oxides and organic matter. The facility is required to prove compliance with the standards within six months of start-up under maximum operating feed rates, and thereafter, at a minimum of once a year. This is accomplished via annual emissions sampling at the stack, under maximum operating feed rates, in accordance with the methods and procedures documented in the Ontario Source Testing Code (Procedure A-1-1).

Continuous stack monitoring of the combustion gases CO, O_2, NO_x, HCl and SO_2 should be considered, with at a minimum annual source testing of additional contaminants such as dioxins and furans, VOCs, particulate matter, metals and PAHs. These requirements would be negotiated with the MOE and implemented through inclusion of conditions in the facility's CofA (Air).

This level of environmental surveillance allows for early detection of any potential upset conditions, which can be corrected by facility operators or result in shut-down if stack emissions are above those permitted in the CofA. A robust, continuous stack monitoring of combustion gases, in combination with annual source testing would ensure that chemical concentrations used in the risk assessment are being achieved. This level of environmental surveillance was found to be in place at all incineration facilities in the EU, US and Canada.

Option 1b) Establishment of More Stringent Stack Chemical Emissions Standards than Provided in Guideline A-7

Based on a motion passed at Durham Regional Council, the Request for Proposal (RFP) for vendors stipulates that the lower of the Ontario Guideline A-7 or EU Directive chemical emissions standards will form the basis for the proposed CofA governing emissions limits for the facility (Table 2). This level of environmental surveillance would provide an additional level of protection for humans and the environment surrounding the proposed facility.

Table 2. The Regions' air emissions criteria based upon the MOE and EU air emissions requirements

Pollutant	Units (1)	YD EFW Stack Emission Limits	Measurement Basis (see Notes)
Total Particulate Matter	mg/Rm^3	9	(2)
Sulphur Dioxide ($S0_2$)	mg/Rm^3	35	(3)
Hydrogen Chloride (HCl)	mg/Rm^3	9	(4)
Hydrogen Fluoride (HF)	mg/Rm^3	0.92	(4)
Nitrogen Oxides (NO_X)	mg/Rm^3	180	(4)
Carbon Monoxide (CO)	mg/Rm^3	45	(4)
Mercury (Hg)	$\mu g/Rm^3$	15	(2)
Cadmium (Cd)	$\mu g/Rm^3$	7	(2)
Cadmium + Thallium (Cd + Th)	$\mu g/Rm^3$	46	(2)
Lead (Pb)	$\mu g/Rm^3$	50	(2)
Sum of (As, Ni, Co, Pb, Cr, Cu, V, Mn, Sb)	$\mu g/Rm^3$	460	(2)
Dioxins	pg/Rm^3	60	(2)
Organic Matter (as CH_4)	mg/Rm^3	49	(2)

NOTES:
(1) = All units corrected to 11% O_2 and adjusted to Reference Temperature and Pressure, mg/Rm^3 = Milligrams per Reference Cubic Metre (25° C, 101.3 kPa), $\mu g/Rm^3$ = Micrograms per Reference Cubic Metre (25° C, 101.3 kPa), Pg/Rm^3 = Picograms per Reference Cubic Metre (25° C, 101.3 kPa), (2) Calculated as the arithmetic average of 3 stack tests conducted in accordance with standard methods, (3) Calculated as the geometric average of 24 hours of data from a continuous emission monitoring system, (4) Calculated as the arithmetic average of 24 hours of data from a continuous emission monitoring system

Option 1c) Inclusion of New Stack Sampling Technology for Dioxins and Furans not Routinely Implemented in Ontario EFW or Incineration Facilities

Stack emissions of dioxins and furans have historically been measured by periodic stack testing (along with other contaminants of concern). Since there is a heightened public awareness of dioxin and furan emissions from EFW facilities, a considerable amount of research has been focused on development of methods for more frequent sample collection and analysis of stack emissions of dioxins and furans.

Technology now exists for continuous sampling (not monitoring) of dioxins and furans in stacks. In-stack dioxins and furans concentrations are sampled for a period of time at regular intervals (e.g., once a month, quarterly, or semi-annually). The sample media is removed, sent for laboratory analysis of dioxins and furans and replaced in the stack. The advantage of this technology is that more frequent sampling of dioxins and furans can be achieved for an EFW facility.

Based on a motion passed at Durham Regional Council, the Request for Proposal (RFP) for vendors stipulates that some form of continuous dioxins and furans sampling and periodic analysis must be included in the design and operation of the proposed EFW facility.

Although this technology was not included as part of this review, the Study Team beleives that it would provide additional information to ensure that dioxins and furans concentrations used in the risk assessment are being achieved.

ADDITIONAL LEVELS OF ENVIRONMENTAL SURVEILLANCE NOT RECOMMENDED BY THE STUDY TEAM

Although the Study Team concluded that the most scientifically defensible environmental surveillance option to ensure the protection of public and environmental health was stack monitoring and testing (Option 1), there are additional environmental surveillance options being employed around the world at individual incineration facilities.

These options include:

- Option 2: ambient air monitoring;
- Option 3: environmental monitoring (soil, vegetation, agricultural products); and,
- Option 4: human biomonitoring.

During the review, the Study Team concluded that a modern municipal waste incinerator that would employ the best available pollution control technology (BACT), would not significantly increase contaminant levels in the environment. This was supported by the scientific literature, the grey literature and the external contact interview process.

Studies that reported significant increases of pollutants in environmental media were predominately conducted on older incineration facilities, and in many cases on those facilities that had different feedstock (e.g., hazardous waste) than would be permitted for the municipal waste incinerator proposed for Durham/York. To date, human biomonitoring studies have not reported a statistical increase in human tissue chemical concentrations as a result of exposure to a municipal waste incinerator.

The impetus for these environmental surveillance programs was reported to be a combination of academic interest and/or a heightened level of public concern surrounding an individual facility. Scientific methods used to gauge public concern surrounding these facilities were not reported, and did not appear to have been carried out by the authors or government officials. The Study Team acknowledges that these are indeed valid societal reasons for policy makers to trigger additional levels of environmental surveillance. However, we believe that it

was not appropriate for the Study Team to presuppose or gauge the level of public concern surrounding the Durham/York proposed EFW facility.

If based on perceived public concern, policy makers believe that an additional level of environmental surveillance is warranted, we recommend that this be supported through scientific means such as a polling exercise. Experts in this area of study should be retained by the Regions to develop an appropriate tool for such an assignment.

Although not recommended for implementation, the Study Team has provided a range of additional surveillance options, with each successive level also intended to include all preceding options. Recommendations for what would trigger a more resource intensive surveillance program have been also been included for consideration.

CONCLUSIONS OF THE STUDY

A considerable amount of information on best practices in environmental surveillance for incineration facilities from around the world was obtained through a systematic literature review (Section 3), grey literature search (Section 4) and external contact interview process (Section 5). The legislated or government mandated requirements of environmental surveillance were summarized in Section 6.

Overall, there was a great deal of consistency between the environmental surveillance options (Figure 2-1) reported in the scientific literature, the grey literature and through external contact interviews with experts in the field. On this basis, the Study Team believes that it is unlikely that additional information may have been missed during this review, which would alter our findings, conclusions or recommendations.

Ultimately the review determined that a modern municipal waste incinerator that would employ the best available pollution control technology (BACT) would not significantly increase contaminant levels in the environment. This was supported by the scientific literature, the grey literature and the external contact interview process.

Therefore, the most appropriate and scientifically justified option for environmental surveillance of an EFW facility to be located in the Region of Durham would involve continuous and periodic stack testing of chemical emissions (Option 1). This environmental surveillance option was also found to be the most prevalent method of ensuring public and environmental health protection in Canada, countries of the European Union, and the United States.

In addition to meeting the minimum stack emissions requirements laid out in Guideline A-7, the Study Team supports the decision of Durham Regional Council to:

- Adopt the more stringent of the Guideline A-7 and EU Directive chemical emissions standards; and,
- Implement an in-stack dioxins and furans sampling technology.

These measures go beyond any requirements that would have been derived from our review.

Another key component to environmental surveillance of incineration facilities was reported to be the establishment of an independent facility-specific oversight committee. It is proposed by the Study Team that such a committee be formed and charged, in part, with review of any environmental surveillance program being undertaken for the Durham/York EFW facility. This would in no way remove the onus of facility regulation from the Ontario Ministry of the Environment. Rather, it would ensure public participation in the environmental surveillance program and evaluation of its efficacy in protecting public and environmental health.

The findings of the review do not justify implementation of ambient air monitoring (Option 2) or environmental monitoring (soil, vegetation, agricultural products) (Option 3). In addition, we would strongly recommend that human biomonitoring (Option 4) not be adopted for the proposed Durham/York EFW facility. The Study Team does not believe that there would be any trigger that would justify the need for this level of environmental surveillance.

APPENDIX F

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Environmental & Occupational Health Plus Inc.

Health Impact Evaluation and Issues Management

March 1, 2009

Dr. Robert Kyle
Commissioner and Medical Officer of Health
Durham Region
605 Rossland Road
Whitby, ON L1N 6A3

Dear Doctor Kyle,

RE: Peer review of Final Report: Review of International Practices of Environmental Surveillance for Energy-From-Waste Facilities by Jacques Whitford; February 16, 2009

Thank you for asking me to comment on the Final Report: Review of International Practices of Environmental Surveillance for Energy-From-Waste Facilities by Jacques Whitford; February 16, 2009.

My detailed comments and annotations within the report were provided in January 2009. My current review (a reexamination of the amended report) is more focused on the changes made to accommodate my comments and on any additional analysis or new material which may have affected the final conclusions.

I found the current report a great improvement over the Draft in focus, organization and clarity. The executive summary reflects faithfully the work presented within the report. Its visual presentation is highly effective in that the insets provide a crisp summary finding of the chapter. The report now excludes redundant information which does not derive from the searches and interviews. It separates "findings" from "inferences".

It was clear to me upon reading the Draft Report (and selected references) that the literature supports that Option 1 reflects the appropriate and most prevalently practiced surveillance that protects humans and the environment. It is also concordant with Ontario regulatory requirements.

I agree with a choice of option 1 as optimal and deriving from the Jacques Whitford review. The community living around this facility and public at large would not be at risk from the public health perspective if this surveillance option were chosen.

The decision of Durham Regional Council to adopt the more stringent of the Guideline A-7 and EU Directive chemical emissions standards and to implement an in-stack PCDD/F sampling technology is concordant with a highly protective approach to health and environment in the region.

In conclusion, I agree with the final recommendations provided in this report. They are strongly supported by this comprehensive literature review, wide consultation, and by the scientific framework used in this project to ensure that humans and the environment are protected while in coexistence with a state of the art energy from waste facility such as is planned for Durham region.

Sincerely yours,

Signed copy to be sent by mail

Lesbia F. Smith, MD
Health Consultant
Environmental & Occupational Health Plus Inc.

PROJECT NO. 1009497.06

Final Report: Review of International Practices of Environmental Surveillance for Energy-From-Waste Facilities by Jacques Whitford; March 1, 2004

Comments from Lesbia F. Smith, Peer Reviewer

Introduction

This narrative comprises my review of the Final report: Review of International Practices of Environmental Surveillance for Energy-From-Waste Facilities by Jacques Whitford. A previous review of the Draft Report provided extensive comments which were incorporated into this Final Report. As they were incorporated, this review is therefore shorter and focused exclusively on this final product.

My overall reading found a few minor errors of language and spelling which are outlined at the end. These are trivial and do not take away from this report content and quality which are overall a great improvement on the draft with respect to focus, organization and clarity.

The focus was entirely the reporting of the search, analysis, and findings with selection of a preferred option that derives from the processes undertaken. The objective was to see what was done elsewhere and to find out what is the best option that is both supported by practices and state of the at science. The objective was achieved.

Structure/Organization

The organization was improved considerably with the tightening up of the options discussion and the presentation of the results of each search, interviews and supplementary information.

Report clarity, precision, language and brevity

I thought the report is very clear. Language is now precise and has been tightened considerably. The graphical presentation of summaries in a box within each section provides easy access to the content and conclusion. The presentation of tables summarizing findings is also very useful in understanding the large amount of information gathered.

Content

Methodologies

The contractors have made a colossal effort to gather information relevant to surveillance of energy from waste facilities. The authors cast a wide net in their search of the literature. The methodology is carefully outlined and followed. *Search terms* are used accurately and reflect the objectives and tasks. The "output" of the searches is very well documented. The use of material on facilities operating after 1998 is justified, but comments on the experience of older facilities were also useful.

The *assessment frameworks* for each of the publications are clear.

The search for grey literature and the verification of certificates of approval and compliance for potentially relevant Ontario facilities added a measure of completeness of the literature examination.

The *contact procedures* - methods of seeking, contacting, and following up on contacts for interview were thorough. It is not surprising that some people did not respond despite persistent attempts to contact them. This is not a failure of the authors and it is commonly the case. The authors were able to contact the most prolific contributors to the literature, as well as those involved with grey literature, so I consider this effort successful.

The use of a *standard to assess* each of the reports ensured that evidence could be classified into good quality and poor quality. Therefore, recommendations (or options) coming forward from the stronger evidence can provide a higher level of confidence that the action will do what it is supposed to do.

The evaluation of different types of studies, purely environmental, or purely human, were evaluated within a credible and well organized published framework (GRADE and the evaluation framework used in the September 2008 report[1]).

Studies were examined carefully, and conclusions from the author, additional comments, and implications for this (Durham) facility were very well incorporated.

Their final evaluation of epidemiological studies of health of communities around EFW facilities now includes a weight of evidence approach that supported options about surveillance.

As for *clarity*, the authors did well to consolidate the results of several publications which were relevant to one facility and to assess the overall results, rather than single publications in isolation. This resulted in synthesized information relevant to one facility or singular programs that better supports the options.

This level of completeness and thoroughness of assessment should be reassuring to the clients that as much literature was found as possible to shed light on the question of what

[1] L. F. Smith. Energy from Waste Facility in the Region of Durham. September 28, 2007

is the most appropriate surveillance for EFW facilities from the technical and public health perspective.

Options deriving from the review

The options offered arise from the literature and informant review. The options provided are an orderly progression from the regulatory basic requirements to more complex approaches applied to specific circumstances where public concern was a driving force.

Preferred option 1 derives clearly from the experience published in the literature presented, and is concordant with the framework of emissions and operations surveillance.

The regulatory basic option, Option 1 a - Compliance with Ontario Guideline A-7 Combustion and Air Pollution Control Requirements for New Municipal Waste Incinerators *is sound and is concordant with the literature and Ontario requirements*. That is, those EFW facilities must conform to the country's regulations (e.g., Spain, Belgium, Germany, Italy-- usually EU standards).

Option 1b- an enhanced option 1- Establishment of More Stringent Stack Chemical Emissions Standards than Provided in Guideline A-7; the specific chemicals that differ from the A-7 guideline. These may be of particular environmental concern such as mercury. This may be consideration if there is a possibility that these substances are potentially present in the waste.

Option 1c - Inclusion of New Stack Sampling Technology for Dioxin and Furans not Routinely Sampled in Ontario EFW or Incineration Facilities - is also concordant with the literature and with state of the art technology. This represents and added level of surveillance (of operations).

The added programming continuous (sampling of) stack emissions resonates with both state of the art technology and with the public's need for constant oversight. The public must understand that continuous monitoring means continuous sampling and periodic analysis, not continuous analysis and reporting.

The role of human biomonitoring is placed in perspective for its application as a research tool with stated research objectives, planning and oversight.

Some selected typos and errors:

Page 1 main report "tenant" should be "tenet"

In the summary boxes, several incidents of the word "establishing" should be "establish". All the boxes should be checked for spelling before printing.

A multidisciplinary team of professionals WAS assembled to undertake this study and an independent peer review of the study by Dr. Lesbia Smith was commissioned by the Region of Durham.

P 46 Relevance to Current Study This study did not ESTABLISH a causal link between emissions of PCDD/F from incinerators and monitored human breast milk levels.

P 49 Relevance to Current Study This study did not ESTABLISH a causal link between emissions of PCDD/F from a modern hazardous waste incineration facility and monitored human blood serum levels.

P 52 Relevance to Current Study This study shows that although PCDD/F concentrations were measurable in air after start-up of the MWI facility, the levels were not statistically significant THIS NEEDS .....different from what?

3.2.3.4 Overall Summary of Human Biomonitoring Studies
In summary, the results of the systematic review of the scientific published literature indicate that there is not a significant relationship between exposure to chemical emissions from incinerator and measured chemical levels in human media such as blood, urine, breast milk and hair. With regard to PCDD/Fs, the most commonly referenced chemical assessed in the studies, authors noted occasional differences in individual PCDD/F congeners and measured samples. Congener analysis can be important as it may be possible to correlate a particular individual congener emitted from an EFW facility to those found in exposed residents. However, no two congeners are the same, and some are more or less toxic than others. The toxic equivalent (TEQ) is thus a useful measure, as it provides a single, cumulative number based on the relative toxicity of each congener.

P 49-50 and others where fingerprint mention is made

We use the total TEQ to determine the total toxic impact. However, when a target fingerprint is the same is the fingerprint from a facility emissions and different from other target fingerprints, it has to be inferred that the impact is actually from the facility even though the total toxicity impact may be the same. The logical inference when two fingerprints match is that the source of the exposure is the facility but the total toxicity impact is null. This should be made very clear if in future there should be a request for such efforts as fingerprinting as a form of additional spot surveillance.

DURHAM NUCLEAR HEALTH COMMITTEE (DNHC)

REVISED TERMS OF REFERENCE

SCOPE

The DNHC shall act as a forum for primarily discussing and addressing radiological emissions from nuclear facilities in Durham Region to assess the potential environmental human health impacts and may include, from time to time, other related topics of mutual interest.

MANDATE

1. To review, discuss, and improve DNHC's understanding of the radiological environmental performance of nuclear facilities and nuclear waste disposal sites in Durham Region and the issues which govern them.

2. To collect, monitor, analyze, discuss, summarize and/or form opinions about available information, including that pertaining to environmental assessments, regarding the possible environmental and human health effects of the radiological emissions from the local nuclear facilities, nuclear waste disposal sites and transportation of nuclear waste and to disseminate the results of this work to the public.

3. To identify deficiencies in information about radiation and human health and to advocate for appropriate research to be conducted in order to effectively address these deficiencies.

4. To review and discuss unusual incidents at local nuclear facilities or other facilities using, generating or storing radioactive material that may have adverse environmental and human health consequences.

5. To address and resolve specific issues and concerns which may be related to, associated with, or caused by radiological emissions from the nuclear facilities and nuclear waste disposal sites that are referred to the DNHC by the public, including local governments, health professionals, etc. or otherwise comes to the DNHC's attention.

6. To maintain an awareness of new or refurbished nuclear facilities in Durham Region and their potential environmental and health effects.

7. To review, discuss, and, if necessary, advise about emerging issues that may be associated with environmental and human health.

8. To review the status of the Regional Nuclear Emergency Plan annually.

9. The following subjects shall not be components of the DNHC's mandate:

   a) Occupational health and safety
   b) Nuclear power as an energy option
   c) Major nuclear accidents

ACCOUNTABILITY

1. The DNHC shall report through the Commissioner & Medical Officer of Health to the Health & Social Services Committee and the Regional Council.

2. The Regional Council shall advocate on behalf of the DNHC and shall forward information and recommendations to other local governments, the Government of Ontario, Ontario Power Generation, and the Government of Canada (including the Canadian Nuclear Safety Commission), and other related and/or interested persons and bodies.

COMPOSITION

The DNHC shall be composed of the following representatives (or designates):

1. From the Regional Municipality of Durham:

   a) Commissioner & Medical Officer of Health
   b) Director, Environmental Health
   c) Epidemiologist

2. From Ontario Power Generation:

   Two representatives familiar with environmental and health issues at Darlington and Pickering Nuclear Generating Stations

3. From the public:

   Nine public members who reside in either Ajax, Clarington, Oshawa, Pickering, or Whitby, and, if possible, two of whom each reside in Ajax, Clarington, and Pickering.

4. From the Government of Ontario:

   One representative from the Ontario Ministry of the Environment

5. From the University of Ontario Institute of Technology

   One representative from the School of Energy Engineering and Nuclear Science

The DNHC shall also invite individuals and representatives from bodies to attend and/or participate in its meetings, including representatives from:

a) Atomic Energy of Canada Limited – Low Level Radioactive Waste Management Office
b) Canadian Nuclear Safety Commission
c) City of Pickering
d) Durham Region Emergency Management Office
e) Greenpeace Canada
f) Health Canada
g) Nuclear Waste Management Organization
h) Municipality of Clarington
i) Ontario Power Generation
j) Ontario Ministry of Energy and Infrastructure
k) Ontario Ministry of Health and Long-Term Care
l) Ontario Power Authority
m) Public Health Agency of Canada
n) Town of Ajax

MEETINGS

1. Meetings shall be chaired by the Commissioner & Medical Officer of Health or designate.

2. A quorum shall consist of nine members.

3. The DNHC shall reach decisions normally by consensus.

4. The DNHC shall establish the dates, times, and places of subsequent meetings, normally at the conclusion of each meeting. Meetings shall normally be held at least five times per year.

5. The Commissioner & Medical Officer of Health shall appoint a Secretary to the DNHC to be responsible for ensuring that agendas and minutes are recorded and distributed, a suitable meeting place is secured and speakers/presenters are confirmed.

TECHNICAL SUPPORT

1. When appropriate, the representatives of Ontario Power Generation and governmental/regulatory bodies shall ensure that all studies and other information relevant to the DNHC's mandate are made available to the DNHC.

2. When appropriate, the representatives of Ontario Power Generation shall ensure that all relevant technical reference material (e.g., nuclear and environmental performance and radiological emission data) is presented to the DNHC using a readily understandable format.

EVALUATION

The DNHC shall review its Terms of Reference and shall evaluate its effectiveness at least biennially.

NOVEMBER 2008