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Dear Counsel:

As per your request, I have completed my initial review of the public health components of the environmental assessment (EA) filed by Waste Management in relation to the proposed expansion of the Richmond Landfill Site near Napanee.

My findings, conclusions and recommendations regarding the public health components of the EA are set out below in this opinion letter. As noted below, it is my overall conclusion that the public health components of the EA are fundamentally deficient for a variety of reasons.

PART I - INTRODUCTION

I am a scientist with over twenty-six years experience in research, publishing and consulting in the field of chemical toxicology. My research activities have focused on toxicology and the mechanisms that mediated toxicities produced by environmental chemicals. The research in my laboratory has been funded by agencies including the Canadian Institutes of Health Research, National Cancer Institute of Canada, National Institutes of Health, U.S. Environmental Protection Agency and others. In the last five years, I have been awarded funding of over 1.5 million for research into chemical toxicants. I have also been involved in the teaching of Anatomy for over twenty-eight years: five years at the Department of Anatomy, University of Toronto in Toronto, and twenty-three years in the Department of Anatomy and Cell Biology at Queen's University at Kingston. My primary appointment at Queen's University is in the Department of Anatomy and Cell Biology. I have performed risk assessments for the

U.S. Environmental Protection Agency (EPA), Health Canada and Environment Canada. I have participated in the review and preparation of a document for EPA's Integrated Risk Information System (http://www.epa.gov/iris/toxreviews/0039-tr.pdf). My laboratory has recently completed a research project on trichloroethylene in collaboration with the EPA. I have also represented the organization "Physicians for Children's Environmental Health" based in Washington, D.C. at an EPA-sponsored public review. I have peer-reviewed research grant proposals for the National Cancer Institute of Canada, Canadian Institutes of Health Research, NATO Scientific Affairs Division (Belgium), and other organizations. I am a member of the Society of Toxicology of Canada, the Society of Toxicology (USA), and the Canadian Association of Anatomy, Neurobiology and Cell Biology. In addition, I peer-review scientific articles for a variety of journals, including *Toxicological Sciences*, *Toxicology*, *International Journal of Cancer*, *Drug Metabolism and Disposition*, *American Journal of Pharmacology and Experimental Therapeutics* and *Journal of Pharmacology & Toxicology*. My full curriculum vitae is attached as Appendix A to this opinion letter.

The overall purpose of this opinion letter is to assess the adequacy of the human health risk assessment contained within the EA. In reaching my conclusions, I have reviewed and considered the approved Terms of Reference and the public health components of the EA. I have also considered the relevant health-related portions of the Discussion Papers and Background Reports which accompany the EA. For the purposes of my review, I have also inspected the landfill vicinity, contacted local health professionals, and interviewed local residents and members of the Mohawks of the Bay of Quinte. I have also consulted databases from major regulatory agencies concerned with environmental and health assessments including MOE, EPA and Agency for Toxic Substances and Disease Registry (ATSDR).

PART II – OVERALL CONCLUSIONS

For the reasons described below, it is my professional opinion that there are numerous and significant flaws, data gaps, unaddressed issues, and other problems in the human health risk assessment contained within the EA.

The main health-related deficiencies of the EA may be summarized as follows:

1. Failure to provide pertinent data for assessment of human exposures in the vicinity of Richmond Landfill and in the Tyendinaga Mohawk Reserve.

2. Failure to address potential health risk issues prevalent in the vicinity of Richmond Landfill and in the Tyendinaga Mohawk Reserve.

3. Failure to provide evidence of ability and/or commitment to address the potential adverse impacts on human health from contaminants emanating from Richmond Landfill.

PART III – DETAILED COMMENTS ON THE EA

As noted above, the overall objective of this review is to assess the adequacy of the human health risk assessment found within the EA. The issue of whether the proposed mitigation measures are effective as claimed by the proponent will be addressed in other technical reviews commissioned by the local residents and Mohawks of the Bay of Quinte.

Public Health and Safety

In the approved Terms of Reference, three general study areas were to be addressed by the proponent under the category of "Public Health and Safety": (i) impacts on-site and in the site vicinity (ii) impacts along the haul routes and iii) community impacts.

Impacts On-Site and in the Site Vicinity and Community Impacts

Exposure to Landfill Gas and Odors. Landfill gas consists of many different gases. Landfill gas contains about 45% to 60% methane, 40% to 60% carbon dioxide and 2% to 9% of other gases such as nitrogen, oxygen, ammonia, sulfides, hydrogen, carbon monoxide and non-methane organic compounds (NMOCs) (ATSDR, 2001). NMOCs include volatile organic compounds (VOCs) and by-products of combustion such as dioxins/furans and polycyclic hydrocarbon compounds. Sulfides (hydrogen sulfide, dimethyl sulfide and mercaptans) are the most common cause of landfill odors. Hydrogen sulfide is produced in landfills at the highest rates and concentrations. Ammonia and some NMOCs such as vinyl chloride and hydrocarbons may also contribute to landfill odors.

Severe odor problems are associated with the existing Richmond Landfill. Residents (including those who are located at some distance from the landfill) complain of odors that are prevalent on a daily basis. It is alleged by the proponent that there "is a negligible risk (not significant or important enough to be worth considering) of adverse health effects from exposure to landfill gas" (Cantox Report, pg. 11). In my professional opinion, all risks, whether negligible or otherwise, are worthy of consideration, and it is the responsibility of the EA to provide and to discuss the data that led to the negligible-risk conclusion. This is an illustrative example of one of the major deficiencies in the EA whereby the potential risks of residing in proximity to Richmond Landfill are dismissed or minimized by the proponent without presentation and discussion of available data.

The presence of landfill odors demonstrates that landfill gas has migrated to residential sites. Such odors act as indices or tracers for odorous and non-odorous chemicals. Chemicals that are commonly present in landfill gas include vinyl chloride, trichloroethylene, benzene, toluene, hydrogen sulfide, tetrachloroethylene, and methyl and ethyl mercaptan. Many other chemicals may also be present in landfill gas. A deficiency of the human health component of the EA is that it does not provide any data as to what chemicals are present in the landfill gas that residents are currently exposed to

from Richmond Landfill. Risks to human health from exposure to chemicals in landfill gas can only be adequately assessed when results of monitoring data in ambient air and indoor air are available both on-site, at the landfill perimeter, and in properties in the community.

Symptoms associated with landfill gas and odors include headaches, dizziness, nausea and eye and throat irritations (Shusterman et al., 1991). Landfill gas odors may also impact sensitive populations such as people with pre-existing respiratory conditions. A health study conducted in Staten Island, New York, showed an increase in reported wheezing and difficulties in breathing among asthmatics living near a landfill on days of reported odors (ATSDR, 1999). A moderate decrease in lung function was also observed on days when subjects reported experiencing odors. The results of the study suggested that odors may trigger respiratory symptoms, even though levels of hydrogen sulfide and other emissions were much lower than levels known to be associated with adverse health effects. An explanation for the health effects is that these odor-associated health symptoms may be due to an irritation threshold that may be lower than the odor threshold (Shusterman, 2001). Odors may also act as markers for toxicologically significant exposures. More recently, there is increased public concern that odors may not simply serve as a warning of potential health risk, but that odors themselves may elicit adverse health symptoms (Schiffman and Williams, 2005). These findings underscore the importance of identifying the chemicals involved, as emphasized in the preceding section.

The residents' exposure to landfill gas and odors fluctuates, and at times has been reported to be so extensive that vomiting is induced in children waiting for the school bus (Callahan Road). Children have also reported trying to sleep with blankets over their heads in attempts to minimize the odor. Many residents report significant disturbances to their sleep because of migration of gas and odors into their homes. Many residents also report the necessity of closing windows during the summer due to the presence of landfill gas and odors that can become intolerable. These reported incidents demonstrate a failure to control trespass of landfill gas and odors into surrounding properties. There is an apparent failure in the human health component of the EA to provide detailed information regarding what steps will be taken to prevent migration of landfill gas and odors outside the perimeter of the landfill. This is especially important because of the proximity of Richmond Landfill to human habitation. Landfill gas migration onto surrounding properties impacts significantly on the health and safety of the public, and produces a marked erosion of quality of life and generates considerable "environmental stress". Serious deficiencies of the human health component of the EA are that it has failed to address these issues, has not identified strategies that will be utilized to control exposure of the public to landfill gas and odors, and neglected to prevent the deleterious effects experienced currently by the residents. It is widely believed by area residents that any further expansion of the Richmond Landfill will exacerbate what is already an intolerable situation.

Explosive Hazard of Landfill Gas. Methane is an odorless and colorless gas that is highly explosive in the presence of air at a volume of 5% to 15%. The human health component of the EA is deficient in terms of specifying how methane levels will be

monitored to ensure that they are not at concentrations that will present an explosion hazard. Methane concentrations within landfill disposal areas are typically at about 50% by volume and therefore explosions are unlikely to occur within the fill boundaries of the landfill. However, as methane migrates out of the landfill and gets diluted, conditions for explosions become more prevalent. Although other landfill gases (e.g. ammonia, hydrogen sulfide and NMOCs) are unlikely to be present at explosive levels, they are flammable and will contribute to the total explosive hazard when combined with methane in a confined space. Gas migrating from landfills has caused explosions in buildings many thousands of feet from the landfill sites (Lee and Jones, 1991). In this regard, the human component of the EA is deficient in terms of identifying the areas and structures both on-site in buildings and in the residences (e.g. basements) in the vicinity of Richmond Landfill where the gas may commonly accumulate and where the measurements should be carried out. No schedule for monitoring is provided in the human health component of the EA, and no precautionary measures are identified to ensure the absence of ignition sources in on-site and off-site structures.

Asphyxiation Hazard. Another issue that is not addressed in the human health component of the EA is the asphyxiation hazard posed by landfill gas that collects in a confined space both on-site and in residences and properties in proximity to the landfill. Because it is colorless and odorless, carbon dioxide is not readily detectable. It is a gas that is denser than air and may remain for prolonged periods within a confined space. The human health component of the EA omits to identify strategies that will be utilized in order to identify areas and structures of risk, and how they will be monitored. This is a serious omission in view of the particular susceptibility of children since they are closer to the ground than adults.

Landfill Fires. In the United States, an average of 8,300 landfill fires occur each year and cause up to $8 million in property loss (U.S. Fire Administration, 2001). A landfill fire occurred in the Richmond Landfill on November 5, 1998. At the time it occurred, only a single mechanic was on the landfill site servicing trucks. One of the residents (Alan Gardiner) phoned the fire department at approximately 8:00 PM in the evening when he was alerted about a fire at the Richmond Landfill site. The fire occurred in Cell #5, a new portion of the landfill, and burned for several hours. It was put out by the Fire Department with water pumped from the Quarry, a maneuver that is likely to result in enhanced leachate production in the longer term. During the fire, there was light ash floating and swirling around in the air. No air-monitoring was carried out. No corporate officials from the proponent appeared on-site during the fire or during the fire suppression phase. The next morning, Mr. Gardiner phoned the Ministry of the Environment (MOE) and found out that MOE officials were unaware of the occurrence of a fire at the landfill site, as the proponent had apparently neglected to inform MOE about the fire. It is reported that no monitoring was carried out to ensure the safety of the public or the sole worker present at the site (who reportedly had to subsequently seek medical attention). According to Mr. Gardiner, who was at the site that morning, the investigation of this incident consisted of looking down the hole and concluding that conditions were under control and required no further action. Importantly, the liner

appeared to have been damaged by the fire but this was considered of no significance, and the hole was filled in with dirt.

In view of the previous fire, the sequence of events and the apparent lack of preparedness prevalent at the Richmond Landfill site, an expectation was that procedures would have been developed and put in place to deal with similar emergencies. There is no mention of landfill fires (or their public health implications) in the human health component of the EA, and this omission represents a significant deficiency. Since such fires are not infrequent occurrences, and since deleterious effects to health and safety on-site and in the surrounding community can potentially result in significant impacts, the lack of a plan of action and an established infrastructure for dealing with landfill fires is a serious deficiency in this EA. An additional deficiency is the lack of attention paid to what remedial action will be undertaken to deal with a damaged liner due to a fire such as occurred on November 5, 1998.

Animal and Bird Problems. The vermin that are associated with Richmond Landfill include rats, raccoons and flies. Seagulls, turkey vultures and other birds are also associated with the landfill. Seagulls are present in such large numbers that the community is adamant about their nuisance effects. "It is estimated that, on occasion, one thousand gulls are present in the landfill area" (EA, pg. 5-13). They migrate to the landfill site in the morning to feed and then return to the Bay of Quinte and Lake Ontario to roost in the evening. During their migration, they rest on the roofs of the houses in such numbers that the roof-tops are barely visible. They deposit their droppings on the roof that eventually get covered with faecal matter. They also rest on cars or other structures, all the time depositing their droppings on the surfaces. The residents and farmers find dead seagulls on their properties on a daily basis, but these are removed in the night by animals such as coyotes and raccoons and are eaten. Abundant seagull droppings have also been found on crops, and many residents have given up cultivating vegetables because of the fear of infections. In view of this scenario, this reviewer questions the accuracy of the proponent's claim that there "are relatively few opportunities for humans to come into direct contact with infected animals or their feces' (EA, Exhibit 6-4, Social and Cultural Effect Assessments).

In my professional opinion, there is potential for humans to contract disease (such as *Histoplasmosis*) due to the daily deposits of faecal matter on properties adjacent to Richmond Landfill including on vegetables and other crops that are consumed by both humans and animals. A serious concern is that children who live in the vicinity are at increased risk for contacting infections due to their vulnerability as a sensitive population. It is known that seagulls harbour microbial organisms (Muniesa et al., 1999). Another issue relating to contamination by seagulls is that they return each evening to the Bay of Quinte and Lake Ontario to roost and deposit their droppings. The faecal matter deposited into the water can lead to localized water contamination. The Mohawks of the Bay of Quinte reside along the shores of the Bay of Quinte. They are concerned about contamination of the water that will have deleterious effects on fish and other wildlife. They are also concerned that birds such as ospreys and eagles that nest in the reserve may be affected by eating contaminated fish. There is additional concern that contamination

of fish and wildlife will affect a major source of their income through tourism. Tourists come to the reserve to fish, and during their visits purchase souvenirs from the Reserve gift shops.

It has been reported that the avian influenza A viruses can infect domestic poultry and waterfowl including chickens, turkeys, ducks, geese, gulls, cormorants and others. (www.who.int/csr/don/2005_08_18/en/index.html; www.birdlife.org). Based on their pathogenicity to domestic poultry, the numerous strains (at least 135 strains are recognized) of avian influenza can be divided into two classes. Low pathogenic strains circulate in wild birds, especially waterbirds, and cause no, or only mild disease. However, strains of the H5 and H7 subtypes can occasionally become highly pathogenic following development of a specific mutation. The highly pathogenic virus, H5N1, emerged in 1997, and genetic evidence points to it as originating in domestic birds through mutation of low pathogenic subtypes of avian flu. Subsequently, H5N1 has been passed from poultry to wild birds as well as to humans and, as the disease spreads, mutations are likely to become more frequent. Transmission is promoted by contact with infected birds, their faecal matter and other secretions that contain the virus, and contaminated water. Recent outbreaks of the H5N1 virus at Lake Quinghai, China, resulted in 6,000 deaths of bar-headed geese but also of ducks, gulls and cormorants. Evidence suggests that the outbreak had its origins in domestic poultry. However, in a recent instance in Mongolia, the avian flu has been detected in wild migratory birds that had no apparent contact with domestic poultry. It is believed that the risk of a human contracting the disease from a wild bird is remote, unless there is close contact with infected birds or their excreta. Should the seagulls that scavenge at Richmond Landfill become infected, the abundant faecal matter deposited on area properties is of concern for potential viral transmission.

More recently, bears have been increasingly encountered on or near the existing Richmond Landfill. As many as six bears have been reported to be seen at one time in the landfill site. There were at least two incidents in which cars have collided with bears in the vicinity of the landfill site, and the animals had to be euthanized. There have not been any reports of bears wandering onto Highway 401 but residents believe that this is only a matter of time and the potential for vehicular accidents exists. Bears have also moved through to farm properties adjacent to the dump and have instigated attempts by cattle to break out of their fences. The potential for human encounters with bears remains a strong possibility, but is not addressed in the human health component of the EA.

Flies have also developed in the solid waste at the landfill site and pose a problem as they can transmit disease. Residents who go to Empey Hill United Church complain of the annoyance of flies landing on their hymn-books and buzzing around them during the church service.

Impacts on the health of farm and domestic animals have been reported by local residents. Reproductive effects have been manifested and have been reported by a number of residents in the proximity of Richmond Landfill. Examples include incidences

of still-born calves, foals and puppies, deformed calves and foals that fail to survive, and impaired ability to breed.

No public health surveys have been carried out by the proponent in the community and no health data have been obtained to evaluate the health impacts of the landfill site. Disease transmission such as infections and allergies are health hazards. The attraction of bears to the landfill site poses a serious threat to the residents in the adjacent properties, especially since children reside in these areas. Nuisance factors are prevalent and have contributed to erosion of quality of life in the community.

However, referring to "mitigation/impact management", the EA states that "present operational procedures involve the maintenance of a small working face, regular compaction of the waste and application of daily cover to reduce attractiveness of the site to vermin", and concludes that "no net effects are expected" (EA, Exhibit 6-2). Despite these claims, current practice has not been effective in curbing nuisance factors and potential health hazards from vermin, seagulls and other birds and animals. A serious deficiency in the human health component of the EA is that it has not addressed these important issues relating to impacts on the health and safety of the residents in the vicinity of Richmond Landfill.

Human Health Risk.

According to guidelines established by ATSDR for public health assessment, it is recommended that "the initial evaluation of the site include[s] an assessment of probable routes of public exposure/contaminant migration off site, and that the sampling *begin[s]* at the public exposure points" (http://atsdr.cdc.gov). The two main components involved in the health assessment process are: (i) exposure evaluation, and (ii) health effects evaluation. Exposure evaluation provides information about the contaminants and pathways of human exposure. Health effects evaluation provides information on rates of illness, disease and death. Therefore, the public health assessment will integrate exposure data and health outcome data to address the health implications of toxic substances released to the environment and the community.

Exposure Evaluation. The Cantox Report has identified exposure pathways as those mediated by inhalation of air, inhalation of soils and dusts, ingestion of locally grown crops, beef and dairy products, breast milk, dermal exposure to soils and dusts and consumption of wild game (Cantox Report, "Exposure Pathway Screening", pg. 19 and 20). A major deficiency is that it has failed to include a major route of exposure in the "Exposure Pathway Screening", and that is via ingestion and utilization of well water. The residents in the vicinity of Richmond Landfill derive their water from wells. They use this water for drinking, showering, bathing, washing, cleaning as well as for other household activities. Many residents, but not all, currently drink bottled water. This water is also used for irrigating crops and lawns. Farm animals also drink the well water. While the Cantox Report has not implicitly identified drinking water as an exposure pathway, it has subsequently used water samples from the Napanee Water Plant to "represent local drinking water concentrations" (Cantox Report, pg. 22 and 23). This

reviewer questions the validity of using this Napanee water as a surrogate for residential well water, and considers this approach by Cantox to be flawed. Significant concerns have been raised and continue to be raised about the quality of the water in the community including the Mohawks of the Bay of Quinte. Also of major concern, especially to the Mohawks of the Bay of Quinte, is potential contamination of surface water as the majority of drinking-water wells in the Tyendinaga Mohawk Reserve are directly impacted upon by surface water. Drinking water is an issue that has generated one of the highest levels of emotional stress and anxiety among area residents about the existing Richmond Landfill and the proposed expansion, and underscores the seriousness of the omission of drinking well water as an exposure pathway.

The Mohawks of the Bay of Quinte consume game and fish to greater extents than other area residents. Wild game and birds that are hunted and consumed include rabbits, muskrat, deer, partridges, ducks, geese and others. At the mouth of Marysville Creek, there is a provincially significant wetland that is inhabited by ducks, geese and other migratory birds at various times of the year. Fish is a staple in the diet of the Mohawks and is consumed several times a week. There are reports about significant reduction in the numbers of fish found in the Salmon River and Marysville Creek. Other changes in the environment of the Reserve included decreased weed-beds, markedly decreased sighting of bullfrogs and small green frogs that the Mohawk residents used as bait. Frogs with mutations such as creatures with "stubs" for feet are being increasingly observed. In the past, frog eggs were plentiful but they are currently scarce or absent. The Mohawks of the Bay of Quinte believe there is significant contamination of their environment from leachate emanating from the existing Richmond Landfill, are concerned about the quality of their water, are increasingly reluctant to eat fish from their rivers and creeks, and are seriously concerned about a proposal in the expansion plans to discharge leachate into the Marysville Creek (EA, pg 3-12). They are also concerned about their well water, about their wetlands, about contaminants present in the food chain (fish and game), about their sources of sustenance and income, and about their own exposures to contaminants. In this regard, there are significant concerns about the "high" incidence of disease including cancer in their community. No health surveys have to date been carried out to clarify the situation. These reports strongly suggested that the Mohawks of the Bay of Quinte are exposed to potential contaminants by various pathways, and the exposures could potentially have serious impacts on their health and quality of life. They believe that they may have already been seriously impacted by contaminants emanating from the existing Richmond Landfill, and are convinced that the adverse effects will be exacerbated by a landfill expansion.

The potential pathways of contaminant exposure included the media of soil, well water, indoor air and outdoor ambient air, in food products including vegetables, fruits and crops, milk, meat, fish and game. For exposure evaluation and subsequently health risk evaluation, ATSDR (1994) requires identification of specific contaminants, and measurements of concentrations of individual substances. Also required for each contaminant identified is information regarding the pathways of exposure (ingestion, inhalation and dermal), duration of exposure, frequency of exposure, conditions of exposure (e.g. climatic conditions) and point of exposure (location). Populations that are

potentially exposed (past, present and future) should be identified, and should include susceptible groups such as children, the elderly and those with pre-existing conditions (e.g. asthma), and the developing fetus. Conditions that increase contaminant exposures of workers due to work-related activities (e.g. work on the landfill site, work in areas containing contaminated soils or soil gas) should be identified. Workers who carry contaminants home in their shoes and clothes should also be identified because this practice could potentially increase exposure for family members.

In my professional opinion, significant deficiencies exist in the Cantox Report. A major deficiency of this report is that there are no data regarding what specific chemical contaminants, what routes of exposure and at what concentrations the area residents are potentially being exposed to. What contaminants are they being exposed to via the ingestion route through drinking well water, eating food grown on their properties and consuming meat from animals that they raise? The Mohawks of the Bay of Quinte consume game and fish on a regular basis. In my professional opinion, the use of deer as a surrogate for the total dietary intake of the Mohawks from fish and game is inaccurate because food products are derived from sources such as fish, waterfowl and other animals. In view of the reports from the residents on the Mohawk reserve, it is likely that the waters of the Salmon River and Marysville Creek are contaminated, with deleterious effects in fish and likely game. What are the contaminants that have potentially accumulated in the fish and at what concentrations? What contaminant levels are the Mohawk population potentially being exposed to in food? What are the average rates of consumption of fish and game? In this regard, this reviewer questions the accuracy of using wild game data from the EPA to "represent consumption rates of the local First Nations Community" (Cantox Report, pg. C-37).

The other major route of contaminant exposure is by inhalation. In view of the high levels of landfill gas that invade the properties of area residents, it is likely that inhalation exposures occur. What contaminants are present in indoor air and in what concentrations? It should be noted that indoor air could also receive potential contributions of contaminants from vapour from showering, dishwashers and humidifiers using contaminated water. What contaminants including landfill gas constituents are potentially present in outdoor ambient air and at what concentrations? Another potential route of exposure is dermal through contact of the skin with contaminated soil and dust and bathing. (Residents have observed an oily residue on the surface of the water in bathtubs and pools). It was estimated from human studies that "the total internal dose from a 10-min shower or a 30-min bath is greater than that from ingesting 2 l of water" (Weisel and Jo, 1996). In view of the various routes of exposure and diverse contaminants, cumulative exposures could potentially be substantial. Although the Cantox Report has alluded to the potential of additive, synergistic, or antagonistic effects of exposure to chemical mixtures (Cantox Report, pg. 10 and 11), analyses of these mechanisms for actual exposures are lacking. This is a deficiency of the EA, especially since this scenario is a likely reality in the vicinity of Richmond Landfill and in the Tyendinaga Mohawk Reserve.

In my professional opinion, the Cantox Report should have provided data regarding the above exposure parameters in the areas in proximity to Richmond Landfill, as well as within the Tyendinaga Mohawk Reserve. The report has presented results of modeling analyses that were carried out on combustion gases, particulate matter, volatile organics, metals and products of incomplete combustion. No data on actual landfill gases such as methane and carbon dioxide, which are major constituents of landfill gas, have been presented in the human component of the EA. The results of the chemical analyses were based mainly on predicted or estimated exposures and hypothetical receptors rather than actual exposures and real people. In my professional opinion, the results derived from such analyses without actual data serve no useful purpose, and represent an exercise with no relevance to the residents living in the vicinity of Richmond Landfill or in the Tyendinaga Mohawk Reserve. Hence, the conclusion that "the likelihood of adverse health impacts arising from exposure to landfill emissions" "was considered minimal" (Cantox Report, pg.ix) is, in my professional opinion, inaccurate and unjustified because there are simply no acquired data to support this conclusion.

Health Effects Evaluation. A health effects evaluation is carried out when data have been gathered regarding the nature and extent of contamination, exposure pathways and duration and frequency of exposure. During screening, levels of contaminants are compared with values provided by regulatory agencies for substance doses or concentrations. In the Cantox Report, comparison values or "exposure limits" used were from agencies including MOE, HC, WHO and the U. S. EPA (Cantox Report, pg. 6). For example, the U.S. EPA's reference doses (RfD) and reference concentrations (RfC) were used as comparison values, and cancer slope factors were applied to estimate cancer incidence. It is of interest that Cantox has used EPA's comparison values rather than ATSDR's minimum risk levels (MRL). Generally, MRL values for substances are available for three exposure periods: acute (14 days or less), intermediate or subchronic (15 to 365 days) and chronic (more than 365 days) and for inhalation and ingestion exposures (ATSDR, 1994; 1996). Although EPA and ATSDR use the same data for evaluation, EPA is focused on site remediation and ATSDR's mission is to provide "trusted health information to prevent harmful exposures and disease related to toxic substances" (ATSDR, 1994; http://www.atsdr.cdc.gov/toxpro2.html). A major goal of ATSDR is to "evaluate human health risks from toxic sites and releases and recommend timely, responsive public health actions" (ATSDR, 1994). It is intriguing that the Cantox Report makes no mention of public health assessment guidelines established by ATSDR, an agency established by the U.S Congress in 1980, and "charged with assessing the presence and nature of health hazards to communities living near Superfund sites" (ATSDR, 1994). In my professional opinion, the criteria established by ATSDR for human health risk assessment are highly appropriate for evaluation of human health risks posed by contaminants from Richmond Landfill.

Screening analyses involve identification of substances exceeding comparison values, and estimation and identification of exposure doses exceeding comparison values (ATSDR, 1994). As has been emphasized in this communication, a deficiency in the Cantox Report and in the human component of the EA is the lack of data of contaminants present in the residential environments in the vicinity of Richmond Landfill and in the

Tyendinaga Mohawk Reserve. Also deficient in these documents are the lack of data concerning direct human exposures. Hence, these major deficiencies preclude the ability to carry out screening analyses (i) to identify substances that are above comparison values, and (ii) to determine human exposure doses that are above comparison doses.

Health outcome data are existing data of disease mortality and morbidity, and analyses or reviews of these data are regarded as descriptive epidemiologic analyses (ATSDR, 1994). Initial studies are carried out to obtain a reliable estimate of the number of people exposed and the number of people in the study population. The number and proximity of members of sensitive populations are identified. Data may be obtained from birth records, death records, medical records, cancer incidence records and other sources. Demographic data (e.g. age, duration of residence, geographic location, etc.) are also pertinent. Health surveys including those addressing the health concerns of the community and potentially exposed populations can yield relevant data. Area residents are concerned about the "high" incidence of cancer in the community, but no surveys have to date been carried out. Health outcome data are not available in either the Cantox Report or the human component of the EA for residents in the vicinity of Richmond Landfill or the Tyendinaga Mohawk Reserve, and this omission represents a deficiency for assessment of human health risks.

In regard to cancer incidence, a preliminary survey of cancer incidence in four counties in proximity to Richmond Landfill (carried out by Dr. Paul Kenny, Napanee) revealed disturbing results. Hastings County has a higher cancer rate than surrounding regions; it is over 8% higher than Lennox and Addington County. Of importance are the subtypes of cancer detected. Hastings County has a much higher incidence of these cancers, compared to Lennox and Addington: lung and bronchi, bladder, thyroid, leukemia and myeloma. The statistical data were from Cancer Care Ontario, and refer to age-adjusted incidence per 100,000 from 1998-2002.

East-Kingston	400.19
Hastings	403.15
Lennox and Addington	372.12
Prince Edward	387.70

It is evident that these preliminary studies require more in-depth investigation. Nevertheless, these preliminary results are alarming, and require serious and urgent consideration by the proponent to address the question of whether contamination by leachate and landfill gas is associated with the higher incidence of cancer in Hastings County. Similar analysis of cancer incidence has not been carried out for the Mohawk community. Such health outcome data were not included and discussed in the EA or its supporting documents, and underscores the deficiency of the EA in its undertaking of health risk assessment.

The potential health effects of landfills have been investigated in a number of studies. A Montreal study found an increased incidence of low birth weight and smallness for gestational age in residents living near a municipal solid waste landfill (Goldberg et al.,

1995a). Two studies were also carried out to determine cancer incidences in areas surrounding a municipal solid waste landfill in Montreal (Goldberg et al., 1995b, 1999). The results in both studies showed an increased risk of liver cancers in high-exposure areas. In a separate study, cancer incidences were investigated in areas surrounding municipal solid waste landfills in New York State (ATSDR, 1998). This study found a significant four-fold increased risk for bladder cancer and leukemia for women living in the areas of potential exposure. The investigations in New York State are ongoing in order to determine if the original findings can be verified. Respiratory outcomes in Staten Island, New York, have also been investigated (ATSDR, 1999). The findings suggested that the "perception of odors is associated with worsening of respiratory symptoms of some people in the study group". In 1998, researchers in Europe published the results of a study that investigated the relationship between proximity to a hazardous waste landfill and birth defects (Dolk et al., 1998). The study found a small, but significant, increased risk of birth defects in babies whose mothers resided within 3 km of a hazardous waste landfill. More recent studies carried out in Great Britain have also investigated the risk of adverse birth effects in populations living near landfill sites (Elliott et al., 2001). The authors found "small excess risks of congenital anomalies and low and very low birth weight in populations living near landfill sites". Taken together, the data from these studies suggested that adverse outcomes may accrue as a result of living near landfill sites. Although these published studies are relevant to human health risk assessment in the context of landfills, these studies and their health implications were not considered or discussed in the human health component of the EA.

PART IV – SUMMARY AND RECOMMENDATIONS

In my professional opinion, in the context of human health and safety, the EA and its supporting documents are deficient in relation to the approved Terms of Reference and the purpose of the EA Act.

In summary, the EA and its supporting documents have not provided sufficient evidence to support the contention that the contaminants emanating from the existing Richmond Landfill and the proposed expansion will not pose health risks to the area residents and to the Mohawks of the Bay of Quinte.

Please contact me if you have further questions about this opinion letter.

Yours truly,

P. S. Forkert

Poh-Gek Forkert, Ph.D.

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