APPENDIX F

Designated Substance Report

DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS ASSESSMENT
SPECIFIC TO THE POTENTIAL DECOMMISSIONING AND DEMOLITION PROJECT

Junction Street Pumping Station
2137 Lakeshore Road
Burlington, Ontario
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Prepared for:

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Date of Issue: December 29th, 2016

SEL Project Number 193716

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EXECUTIVE SUMMARY

Safetech Environmental Limited (SEL) was commissioned by Black & Veatch, to conduct a designated substances and hazardous materials assessment within project specific work areas of the Junction Street Pumping Station, located at 2137 Lakeshore Road, Burlington, Ontario.

The objective of our assessment was to determine the presence, location, condition and quantities of designated substances and other hazardous materials within the project specific work areas that have the potential to be disturbed as part of planned renovation activities (i.e. the Potential Decommissioning and Demolition Project) so that appropriate control measures can be implemented to protect workers during the renovation.

A summary of our assessment results and general recommendations based on our findings are provided in the following Table. This Table should be considered a summary only. Please refer to the Results (Section 3) and Conclusions and Recommendations (Section 4) of our report for additional details.

Designated Substance	Findings	Recommendations
Asbestos	No Asbestos-containing materials were identified within the areas assessed as part of the Potential Decommissioning and Demolition Project.	No action required.
Lead	Varying concentrations of lead were identified in paints associated with the wooden ceiling. Other paints not sampled (that are not expected to be disturbed as part of the planned renovation project) are also suspected to contain varying quantities of lead.	Work involving the disturbance of a lead-containing paint should follow the procedures outlined in the Ministry of Labour *"Lead on Construction Projects"* guideline. Type 1 operations are expected to be necessary based on the type of work to be conducted. Lead-containing wastes should be recycled if practicable or handled and disposed of according to O.Reg. 347.

Lead	Lead may be a component of solder in pipe fittings and electrical equipment but is not expected to be a hazard as a result of the planned renovation project.	No action required.
Mercury	Mercury vapour is expected to be present within High Intensity Discharge lamps.	Handle lamps with care and keep intact. All waste lamps are recommended to be sent to a lamp recycling facility.
Silica	Building materials identified that are suspected to contain crystalline silica and may be disturbed as part of the planned renovation project include concrete and block surfaces.	Any work involving the disturbance of silica-containing materials should follow the procedures outlined in the Ministry of Labour *"Silica on Construction Projects"* guideline.
Other Designated Substances	No other designated substances are expected to be present in any significant quantities or in a form that would represent an exposure concern.	No protective measures or procedures specific to acrylonitrile, arsenic, benzene, coke oven emissions, ethylene oxide, isocyanates, and vinyl chloride are considered necessary.

Other Hazardous Materials	Findings	Recommendations
Urea Formaldehyde Foam Insulation	No UFFI was identified or is suspected within the areas assessed.	No action required.
Mould Contamination	No visible mould growth was observed within the areas assessed.	No action required.
Polychlorinated Biphenyls	No equipment suspected of containing PCB's was observed within the areas assessed.	No action required.
Ozone Depleting and Global Warming Substances	No equipment suspected of containing ozone depleting or global warming substances was observed within the areas assessed.	No action required.

This assessment satisfies the Owner's requirements under Section 30 of the Ontario Occupational Health and Safety Act (OHSA), Revised Statues of Ontario 1990, as amended.

Should you have any questions regarding the information contained in the report, please contact our office.

Safetech Environmental Limited

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December 29th, 2016

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Attention: **Mr. Rob Lewtas, PMP, CEng., C.WEM**
Regional Leader, Planning and Asset Management

RE: **Designated Substances and Hazardous Materials Assessment**
Specific to the Potential Decommissioning and Demolition Project
Junction Street Pumping Station
2137 Lakeshore Road, Burlington, Ontario

1.0 INTRODUCTION

1.1 Background and Objectives

Safetech Environmental Limited (SEL) was commissioned by Black & Veatch, to conduct a designated substances and hazardous materials assessment within the project specific work areas of the Junction Street Pumping Station, located at 2137 Lakeshore Road, Burlington, Ontario. The objective of our assessment was to determine the presence, location, condition and quantities of designated substances and other hazardous materials within the project specific work areas that have the potential to be disturbed as part of planned renovation activities (i.e. Potential Decommissioning and Demolition Project) so that appropriate control measures can be implemented to protect workers during the renovation.

This assessment satisfies the Owner's requirements under Section 30 of the Ontario Occupational Health and Safety Act (OHSA), Revised Statues of Ontario 1990, as amended. Section 30(1) requires a building owner to determine if there are any designated substances present at a project site prior to construction or demolition activity. Sections 30(2), (3) and (4) require the Owner and constructors for a project to provide the findings in this report as part of the tendering information for any tendered project or to prospective contractors (and subcontractors) of a project before entering into a binding contract.

This report documents findings of our on-site inspection that was conducted on December 20th, 2016 and provides conclusions and recommendations based on our findings and knowledge of the planned Potential Decommissioning and Demolition Project.

1.2 Scope of Work

In accordance with our fee proposal document our scope of work included the following activities:

- A review of existing documents, including renovation documents and drawings, floor plans and existing environmental assessment reports, etc., where available.

- A visual assessment of the accessible area(s) specific to The Potential Decommissioning and Demolition Project to identify the presence, location, condition and quantities of designated substances and other hazardous materials.

- Collection, analysis and interpretation of representative bulk samples of suspect asbestos-containing building materials for the determination of asbestos content and material classification.

- Collection, analysis and interpretation of representative paint chip samples for the determination of lead content.

- Preparation of a report to document findings and provide recommendations regarding control measures and/or special handling procedures for designated substances or specific hazardous materials that may be disturbed as part of planned renovation activities.

This assessment only identified designated substances and hazardous materials that were deemed to be part of the building or somehow otherwise incorporated into the building structure and its finishes. Assessing occupant items such as stored products, furnishings, items and materials used or produced as part of a manufacturing process, etc. were beyond the scope of this assessment. In addition, our assessment did not include an investigation for underground materials or equipment (vessels, drums, underground storage tanks, pipes, cables, etc.). Furthermore, this assessment was limited to the areas investigated, and more specifically, to those materials that may be disturbed as part of the planned renovation work, as described in Section 1.3.

1.3 Description of Area(s) Assessed

The area investigated included all accessible project specific locations as indicated in the project email. The areas were observed to be constructed with precast concrete slab floors, cinderblock walls and concrete and wooden ceiling.

2.0 METHODOLOGY

The presence of hazardous materials was assessed by visual inspection. For the purpose of this assessment and this document, hazardous materials include designated substances as well as other chemical, biological and environmental hazards as defined below:

- **Designated Substances (as prescribed by Ontario Regulation 490/09):**
  - Acrylonitrile, Arsenic, Asbestos, Benzene, Coke Oven Emissions, Ethylene Oxide, Isocyanates, Lead, Mercury, Silica and Vinyl Chloride.

- **Other Hazardous Materials:**
  - ***Chemical Hazards*** – Urea Formaldehyde Foam Insulation (UFFI)
  - ***Biological Hazards*** – Mould Contamination and Pest Infestation
  - ***Environmental Hazards*** – Polychlorinated Biphenyls (PCBs) and Ozone Depleting & Global Warming Substances

For background information regarding the above hazardous materials, please refer to Appendix E.

Destructive testing was not conducted as part of this assessment. Concealed locations such as above solid plaster or drywall ceilings, within plaster or drywall wall cavities, enclosed mechanical/pipe shafts and bulkheads, etc. were not investigated. Similarly, motors, blowers, electrical panels, etc., were not de-energized or disassembled to examine concealed conditions. Building materials that are not detailed within this assessment due to inaccessibility at the time of our site visit and/or uncovered during renovation/demolition activities should be assessed by a qualified person prior to their disturbance.

Bulk sampling followed by laboratory analysis was also conducted to confirm the presence/absence of selected hazardous materials. Bulk sampling was limited to asbestos in building materials and lead in paint on building finishes. All other hazardous materials were identified by visual inspection only. Where possible, observations regarding the location, quantity and condition of the hazardous materials identified were made in order to determine the potential for exposure and provide appropriate recommendations for remedial action, if necessary. Specific methodology for each individual hazardous material assessed is further detailed below.

2.1 Designated Substances

2.1.1 Asbestos

A visual inspection for the presence of both friable and non-friable asbestos-containing material (ACM) was performed within the assessment area(s). The condition of ACM was rated as Good, Fair or Poor based on our assessment criteria provided in Appendix A.

Although destructive testing was not conducted, details regarding the possible presence of ACM in enclosed locations were provided on a case-by-case basis where our visual inspection indicated this possibility. Materials that may be present in the surveyed area(s) that were not tested intrusively should be considered asbestos-containing until proven otherwise. This includes materials such as refractory brick in boilers and incinerators, fire door cores, elevator brakes, roofing felts, mastics, high voltage wiring, mechanical packing and gaskets, vermiculite inside wall cavities or inaccessible ceiling spaces and underground services or piping. These materials are recommended to be sampled immediately prior to renovation or demolition work if they are to be removed or have a potential to be disturbed.

If an existing asbestos survey was available for review, SEL relied on the information present. Building materials that were visually similar to materials previously tested and that were confirmed to be either ACM or non-ACM were considered to have consistent content and were not re-sampled. Additional sampling was only conducted where the investigator believed a need existed.

Bulk samples of building materials suspected to contain asbestos were retrieved by SEL only for materials that were deemed to have a potential to be disturbed as part of The Potential Decommissioning and Demolition Project. Other suspect materials were noted but were not sampled. Bulk samples were retrieved in accordance with Section 3 and Table 1 of Ontario Regulation 278/05, *"Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations"*. The number of samples collected for each material was based on the type and quantity of the material present within the area(s) investigated. Each individual sample was placed in a labeled zip-lock bag for transportation to an independent laboratory (EMSL). EMSL is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) for bulk asbestos fiber analysis.

Analysis for asbestos content was performed by the independent laboratory in accordance with the U.S. Environmental Protection Agency (EPA) Test Method EPA/600/R-93-116:Method for the Determination of Asbestos in Bulk Building Materials. June 1993. This method identifies the asbestos fibre content of building materials using polarized light microscopy (PLM) analytical techniques, with confirmation of presence and type of asbestos made by dispersion staining optical microscopy. This analytical method meets the requirements set forth in Section 3 of O.Reg. 278/05.

In accordance with O. Reg. 278/05, an asbestos-containing material is defined as material that contains 0.5 per cent or more asbestos by dry weight. The laboratory was instructed to conduct "stop-positive" analysis for all materials. If a sample was found to be asbestos-containing no further analysis was conducted for samples taken from the same homogeneous material. The Laboratory Certificate of Analysis is included in Appendix B.

Locations where ACM have been identified are detailed in this report. Recommendations pertaining to ACM were made based on the friability, accessibility and condition of the material in conjunction with the potential for the planned renovation work to disturb the ACM.

2.1.2 Lead

An assessment for lead in paint was conducted by retrieving paint chip samples from representative surfaces within the area(s) assessed that were deemed to have a potential to be disturbed as part of the planned renovation activities. The condition of painted surfaces from which samples were taken were also visually assessed for signs of deterioration such as cracking, chipping, flaking, bubbling and deterioration due to friction. The condition of these surfaces was assessed as good, fair or poor based on the degree and extent of deterioration.

The number of paint chip samples retrieved for analysis was based on the number of surface colours observed and the approximate surface area of the paint. Samples were not retrieved from paint finishes with limited application while additional samples were retrieved for paints covering greater surface areas to better account for possible variances in lead concentration due to underlying paints (if present). All paint chip samples were retrieved by scraping the paint down to the base material substrate to ensure collection of all layers of paint. Care was taken to avoid collection of the underlying substrate to reduce analytical substrate matrix interference.

Upon completion of our assessment, paint chip samples were submitted to an independent laboratory (EMSL) for the determination of lead content. This laboratory participates in and is accredited by the EPA (U.S. Environmental Protection Agency) for analysis of lead in paint chips through the American Industrial Hygiene Association (AIHA) Environmental Lead Laboratory Accreditation Program (ELLAP). Analysis was conducted by the laboratory following the EPA "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods" (SW-846), Method 7000B "Flame Atomic Absorption Spectrophotometry". Results of analysis were reported by the laboratory as the percentage of lead by weight of the total sample (% by wt.). The Laboratory Certificate of Analysis is included in Appendix C.

The presence of lead in other materials, such as lead sheeting, pigmented mortar, lead piping, lead solder, etc. were noted where observed but were not sampled to verify lead content. Lead can be present in these materials to varying degrees, depending on their

age of application (refer to Appendix E for additional details) and should be considered lead-containing until proven otherwise.

2.1.3 Mercury

The type, quantity and location of mercury-containing equipment and devices within the area(s) assessed were determined by visual inspection based on appearance, age and knowledge of historical uses. Sampling for mercury-containing building materials and dismantling of suspect mercury-containing equipment was not performed. Where possible, attempts were made to verify the presence/absence of mercury by gathering additional information such as equipment model number, serial number, etc.

2.1.4 Silica

The presence of crystalline silica in building materials was determined through visual inspection of building materials only, based on knowledge of the historic use of silica-containing materials in certain building materials. Sampling to verify the presence/absence of silica in building materials was not performed.

2.1.5 Other Designated Substances

Other designated substances (i.e. acrylonitrile, arsenic, benzene, coke oven emissions, ethylene oxide, isocyanates, and vinyl chloride) are typically not expected to be encountered in building materials as significant constituents or in a form that would represent an exposure concern. These substances were not included in our assessment unless specific information regarding their use (e.g. in a manufacturing process) was provided to us. Please refer to Appendix E for information regarding where these designated substances are typically found or used. No sampling for these designated substances was performed.

2.2 Other Hazardous Materials

2.2.1 Chemical Hazards

<u>Urea Formaldehyde Foam Insulation (UFFI)</u>

A visual inspection to evaluate the possible presence of Urea Formaldehyde Foam Insulation (UFFI) was conducted within the area(s) assessed. Our visual inspection was limited to looking for evidence of possible UFFI installation (i.e. repaired nozzle holes in walls) and overspray at wall/ceiling joints, etc. No destructive testing or material sampling was conducted as part of our assessment.

2.2.2 Biological Hazards

Mould Contamination

A visual inspection to determine the possibility of mould growth was conducted within the area(s) assessed. Our assessment was limited to looking for evidence of mould growth and water damage (staining, material deterioration, efflorescence, etc.) on the surface of building materials, which may be an indicator of hidden mould growth. No moisture content readings of building materials were taken to determine their current condition. Additionally, destructive testing to confirm the presence/absence of hidden mould growth and material sampling to verify the presence/absence of mould on suspect surfaces was beyond the scope of this assessment.

Pest Infestation

The presence and extent of pest infestation within the area(s) assessed was based on visually inspecting for evidence of significant pest activity, including signs of nesting, droppings/fecal accumulation, dead insects/carcass accumulation, etc. Evidence of minor pest presence was not considered to be indicative of pest infestation.

2.2.3 Environmental Hazards

Polychlorinated Biphenyls (PCBs)

The presence of PCB-containing electrical equipment within the area(s) assessed was identified through visual inspection and knowledge of the timeline of historical use.

For stand-alone transformers and capacitors, information from the manufacturer nameplate (such as the date of manufacture, dielectric fluid trade name or "Type Number", etc.) was gathered, where possible, to further evaluate if the equipment may contain PCBs. This information was then compared to the information provided in the Environment Canada document entitled "*Handbook on PCB's in Electrical Equipment*" (Third Edition, April 1988) to aid in identification. Transformers and capacitors confirmed to be manufactured after 1979 were assumed to not contain PCBs. If appropriate information could not be obtained it was assumed that the transformer or capacitor contained PCBs.

For fluorescent light ballasts, a representative number of fixtures were inspected, if possible, for assessment areas that were constructed prior to 1980 and where there was no history or evidence of a complete lighting retrofit. The light fixtures were examined by removing any lenses and ballast covers to expose the ballast and identify information such as ballast make, model number, serial number, and date code. This information was then compared to the information provided in the Environment Canada document entitled *"Identification of Lamp Ballasts Containing PCBs" (Report EPS 2/CC/2 (revised) August 1991)* to aid in identification. Ballasts that could not be confirmed Non-PCB-containing

were assumed to contain PCBs. The light fixtures were not de-energized and ballasts were not removed to obtain manufacturer information that may be on the back of the ballast. If visual confirmation of ballast type could not be made it was assumed that light fixtures in areas constructed prior to 1980 that have not undergone a complete lighting retrofit have PCB-containing ballasts until proven otherwise.

No sampling of materials or fluids within equipment was conducted to verify the presence/absence of PCBs. Inspection and testing of other materials for PCB content, including (but not limited to) caulking, asphalt, oil-based paint, plastics, switches, electric cables and hydraulic fluids was beyond the scope of our assessment.

Ozone Depleting and Global Warming Substances

The presence of fixed equipment likely to contain ozone-depleting substances (ODS) and/or global-warming substances (GWS) was identified through visual inspection and knowledge of the timeline of historical use. This included equipment such as chillers, air-conditioners, walk-in refrigeration and freezer units and fixed dry-chemical fire extinguishers, where chemicals such as hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs) or halons may be present. Where possible, information regarding the type and quantity of refrigerant present was obtained from the manufacturer nameplate. Our visual assessment was limited to fixed equipment within the area(s) assessed and did not include portable equipment such as stand-alone refrigerators, freezers, water coolers, air-conditioners and fire extinguishers, etc.

3.0 RESULTS

Results of our visual assessment and bulk sample analytical findings are summarized in the sections below.

3.1 Designated Substances

3.1.1 Asbestos

Results of bulk sample analysis for the determination of asbestos content are summarized in Table 1. Materials have been classified as “ACM”, “Non-ACM”, “Suspected ACM” or “Presumed Non-ACM” based on analytical results. Materials classified as Suspected ACM or Presumed Non-ACM may require further analysis (depending on site-specific conditions) to verify whether the material should be classified as ACM or Non-ACM. Please refer to the Limitations section of this report (Section 5.0) for additional details. The Laboratory Certificate of Analysis is included in Appendix B.

TABLE 1
Bulk Sample Analytical Results for Determination of Asbestos Content
Potential Decommissioning and Demolition Project – Junction Street Pumping Station
2137 Lakeshore Road, Burlington, Ontario
Sample Collection Date: December 20th, 2016

Sample No.	Material Description	Sample Location	Asbestos Content	Material Classification
1a	Sprayed Fireproofing	Junction Street Pumping Station	None Detected	Non-ACM
1b				
1c				
2a	Parging Cement on Mechanical Pipe		None Detected	Non-ACM
2b				
2c				
3a	Exterior Brick Mortar		None Detected	Non-ACM
3b				
3c				
4a	Exterior Window Caulking		None Detected	Non-ACM
4b				
4c				
5a	Exterior Door Sealer		None Detected	Non-ACM
5b				
5c				

As per O.Reg. 278/05, ACM contains ≥0.5% asbestos by dry weight.

Materials assessed for asbestos content are summarized in Table 2 based on the type/use of the material. The condition and friability of materials confirmed or suspected to be asbestos-containing (based on our visual assessment, results of bulk sample analysis or from a review of previous analytical results) is provided. Condition (Cond.) ratings are provided as Good (G), Fair (F) or Poor (P) based on our Assessment Criteria provided in Appendix A. Estimates of quantity have only been provided for confirmed or suspected asbestos-containing materials that were deemed to have a potential to be disturbed as part of The Potential Decommissioning and Demolition Project. Any quantities provided should be considered rough estimates only and should not be relied upon for bidding purposes. It is the responsibility of the selected Contractor to obtain actual quantities.

TABLE 2
Results of Assessment for Asbestos-Containing Materials
Potential Decommissioning and Demolition Project - Junction Street Pumping Station
2137 Lakeshore Road, Burlington, Ontario
Sample Collection Date: December 20th, 2016

Sprayed and Loose Fill Insulating Materials	Location/Description	Cond.	Est. Quantity	Friability
Sprayed Fireproofing	Sprayed fireproofing within the assessed areas was sampled and no asbestos was detected (refer to Samples set 1 in Table 1) and is therefore presumed to be non-asbestos-containing.	N/A	N/A	N/A
Sprayed Insulation	None identified in area(s) assessed.	N/A	N/A	N/A
Loose Fill / Vermiculite Insulation	None identified in area(s) assessed. Interior portions of concrete block walls could not be assessed. However, it is not expected that these walls are insulated with loose fill or vermiculite insulation	N/A	N/A	N/A
Thermal System Insulation	**Location/Description**	**Cond.**	**Est. Quantity**	**Friability**
Mechanical Pipe Insulation (straights, elbows, valves, tees, hangars, etc.)	Parging cement on mechanical pipe within the assessed areas was sampled and no asbestos was detected (refer to Samples set 2 in Table 1) and is therefore presumed to be non-asbestos-containing.	N/A	N/A	N/A
	Remaining mechanical pipe insulation were observed to either be insulated with non-asbestos fiberglass or non-insulated.	N/A	N/A	N/A
HVAC Duct Insulation	None identified in area(s) assessed.	N/A	N/A	N/A
Breeching / Exhaust Insulation	None identified in area(s) assessed.	N/A	N/A	N/A
Tank Insulation	None identified in area(s) assessed.	N/A	N/A	N/A
Boiler Insulation	None identified in area(s) assessed.	N/A	N/A	N/A
Architectural Finishes & Finishing Materials	**Location/Description**	**Cond.**	**Est. Quantity**	**Friability**
Sprayed Texture / Stucco Finishes	None identified in area(s) assessed.	N/A	N/A	N/A

Plaster Finishes	None identified in area(s) assessed.	N/A	N/A	N/A
Drywall Joint Compound	None identified in area(s) assessed.	N/A	N/A	N/A
Ceiling Tiles	**Location/Description**	**Cond.**	**Est. Quantity**	**Friability**
Lay-in Acoustic Ceiling Tiles	None identified in area(s) assessed.	N/A	N/A	N/A
Glued-on Acoustic Ceiling Tiles	None identified in area(s) assessed.	N/A	N/A	N/A
Transite Ceiling Panels	None identified in area(s) assessed.	N/A	N/A	N/A
Flooring	**Location/Description**	**Cond.**	**Est. Quantity**	**Friability**
Vinyl Floor Tiles	None identified in area(s) assessed.	N/A	N/A	N/A
Vinyl Sheet Flooring	None identified in area(s) assessed.	N/A	N/A	N/A
Asbestos Cement Products	**Location/Description**	**Cond.**	**Est. Quantity**	**Friability**
Piping	None identified in area(s) assessed.	N/A	N/A	N/A
Roofing, Siding, Wallboard	None identified in area(s) assessed.	N/A	N/A	N/A
Other Cement Products	None identified in area(s) assessed.	N/A	N/A	N/A
Misc. Materials	**Location/Description**	**Cond.**	**Est. Quantity**	**Friability**
Brick Mortar	Exterior brick mortar within the assessed areas was sampled and no asbestos was detected (refer to Samples set 3 in Table 1) and is therefore presumed to be non-asbestos-containing.	N/A	N/A	N/A
Window Caulking	Exterior window caulking within the assessed areas was sampled and no asbestos was detected (refer to Samples set 4 in Table 1) and is therefore presumed to be non-asbestos-containing.	N/A	N/A	N/A
Door Sealer	Exterior door sealer within the assessed areas was sampled and no asbestos was detected (refer to Samples set 3 in Table 1) and is therefore presumed to be non-asbestos-containing.	N/A	N/A	N/A
Other Materials	No other materials suspected to contain asbestos were observed within the areas assessed.	N/A	N/A	N/A

Notes: N/A=Not Applicable; N/D=Not Determined

3.1.2 Lead

Laboratory analytical results for paints tested to determine lead content are summarized below in Table 3. The Laboratory Certificate of Analysis is included in Appendix C. Refer to Section 4.1.2 of this report for recommended lead abatement procedures (if any) that correspond to the type of proposed construction, renovation, or demolition work.

TABLE 3
Results of Paint Condition and Lead Content Assessment
Potential Decommissioning and Demolition Project – Junction Street Pumping Station
2137 Lakeshore Road, Burlington, Ontario
Sample Collection Date: December 20th, 2016

Sample No.	Location	Surface	Paint Colour	Condition	Lead Conc. (% by wt.)
L-01	Pumping Station	Wood Ceiling	White	Fair	0.59%

Results of paint chip analysis for the determination of lead content confirmed that the white paint on the wooden ceiling within the survey area has a lead concentration above 0.0090%, which is considered as lead containing.

Other potential lead-containing materials suspected to be present within the investigated areas that are not suspected to be disturbed as part of the Renovation Project or considered to be present in insignificant amounts include the following:

- Additional paint surfaces not sampled
- A component of solder in pipe fittings and electrical equipment.

3.1.3 Mercury

Mercury is present within the area(s) assessed in the form of vapour within High Intensity Discharge (HID) lamps.

3.1.4 Silica

A number of building materials were identified within the surveyed area(s) that are suspected to contain crystalline silica. This includes the following materials:

- Concrete

3.1.5 Other Designated Substances

Acrylonitrile, arsenic, benzene, coke oven emissions, ethylene oxide, isocyanates, and vinyl chloride were not included in our assessment as these substances are not expected to be a significant component of building materials or present in a form that would represent an exposure concern. Additionally, no specific information regarding their use was provided to us.

3.2 Other Hazardous Materials

3.2.1 Chemical Hazards

No visible evidence of UFFI installation (i.e. injection openings) or overspray of foam insulation at wall/ceiling joints was identified. In addition, due to the age of construction and use of the building the presence of UFFI insulation within wall cavities is not suspected.

3.2.2 Biological Hazards

Mould Contamination

There was no visible evidence of obvious mould growth on building finishes within the surveyed area(s) at the time of our assessment.

Pest Infestation

There was no visible evidence of any significant pest infestation within the surveyed area(s).

3.2.3 Environmental Hazards

Polychlorinated Biphenyls (PCBs)

No light fixtures or other electrical equipment (such as transformers and capacitors) present within the area(s) assessed is expected to contain PCBs based on the age of building construction.

Ozone Depleting and Global Warming Substances

No fixed equipment suspected to contain ODS/GWS were observed in the area(s) assessed.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 Designated Substances

4.1.1 Asbestos

Results of our assessment indicated that no asbestos-containing materials are present within the surveyed areas as per the Potential Decommissioning and Demolition Project.

4.1.2 Lead

Results of paint chip analysis for the determination of lead content indicated that varying concentrations of lead were identified in the paints sampled. As current studies have shown a poor correlation between paint lead concentrations and worker exposures the Ontario Ministry of Labour (MOL) has not established a threshold concentration or action level for lead in paint below which worker protection and/or control measures during the disturbance of lead-containing paints are considered unnecessary. The type of work being conducted and the method/degree of disturbance of the paint appear to play a larger role in worker exposure than the concentration of lead in the paint.

Given the poor correlation between lead paint concentrations and worker exposure it is recommended that any work involving the disturbance of a lead-containing paint follow the procedures outlined in the MOL *"Lead on Construction Projects"* guideline (April 2011). The extent of procedures (or Type of operation) necessary depends on the type of work to be conducted.

At this time the method of disturbance, if any, of lead-containing paints is unknown. It is recommended that any contractor whose work requires lead-containing paints to be disturbed consult the MOL guideline prior to the start of work to determine the Type of operation(s) and the corresponding control measures (engineering controls, work/hygiene practices, protective clothing and equipment and worker training) necessary to conduct the work in a manner that will prevent worker overexposure to lead.

Additional suspect lead-containing products not anticipated to be disturbed as part of The Potential Decommissioning and Demolition Project include paints on various surfaces and solder on pipe fittings and electrical components. Future testing of these materials and specific handling/disposal requirements may be necessary if/when these materials are to be disturbed.

If practicable, all bulk lead waste materials should be separated from other wastes and sent to a recycling facility. If not practicable, lead-containing waste should be handled and disposed of according to Ontario Regulation 347 (O.Reg. 347), *"General – Waste Management"*, made under the Environmental Protection Act. Under this regulation (and

depending on the quantity of waste generated) the waste may be subject to analysis following the Toxicity Characteristic Leaching Procedure (TCLP) to determine if it is a "leachate toxic waste" based on the leachate quality criteria provided in Schedule 4 of the regulation. Such wastes must meet specific treatment requirements (Schedule 5) or undergo alternative treatment for hazardous debris (Schedule 8) prior to land disposal.

4.1.3 Mercury

Fluorescent lamps that require removal should be handled with care and kept intact to avoid potential exposure to mercury vapour present within the lamps. Under O.Reg. 347, waste mercury produced in amounts less than 5 kilograms (kg) in any month or otherwise accumulated in an amount less than 5 kg are exempt from hazardous waste registration, treatment and disposal requirements and can be disposed of in landfill as regular waste. Larger quantities of waste mercury must be treated and disposed of in accordance with the requirements of O.Reg. 347. To prevent the release of mercury into the environment it is recommended that all waste lamps are sent to a lamp recycling facility and are not disposed of in landfill.

Although no mercury was visibly identified in other equipment, dismantling of equipment was not conducted to verify the presence/absence of mercury. It is cautioned that thermometers, barometers and other measuring devices (pressure gauges/sensors, vacuum gauges, manometers, etc.), thermostats and a variety of other electrical switches (temperature sensitive, tilt switches, float switches, etc.) may contain mercury that may not be visible without dismantling the equipment. Such devices should be assumed to contain mercury until proven otherwise and similar precautions to those outlined above should be taken if any of these items are to be disturbed or taken out of service in the future.

4.1.4 Silica

Suspect silica-containing materials were identified to be present within the project-specific work area. In their current state, building materials containing silica do not represent a risk to building occupants or construction workers. Risks associated with exposure to silica arise during demolition activities that cause silica dust to be created (particularly grinding, drilling or cutting operations and during major demolition), resulting in a crystalline silica inhalation hazard.

If any materials suspected to contain silica are to be removed or otherwise disturbed as a result of renovation/demolition activities it is recommended that procedures be put in place to control the generation of dust (such as routine water misting) and thus reduce the potential for worker exposure. Workers that have the potential to be exposed to airborne silica should also wear appropriate protective clothing and respiratory protection.

Any work involving the disturbance of silica-containing materials should follow the procedures outlined in the MOL *"Silica on Construction Projects"* guideline (April 2011).

The appropriate engineering controls, work practices, hygiene practices, personal protective measures and training necessary to conduct the work in a safe manner are provided in this guideline. The general measures and procedures (or Type of operation) necessary depends on the type of work to be conducted.

4.1.5 Other Designated Substances

No other designated substances are expected to be a component of building materials within the surveyed area(s) in a form that would represent an exposure concern. Therefore, no protective measures or procedures specific to acrylonitrile, arsenic, benzene, coke oven emissions, ethylene oxide, isocyanates, and vinyl chloride are considered necessary.

4.2 Other Hazardous Materials

4.2.1 Chemical Hazards

As no UFFI was identified or is suspected to be present within the surveyed area(s) no further action is required. However, given that no destructive testing was conducted, there is a remote possibility that UFFI could be hidden within locations such as exterior wall cavities. If suspect foam insulation is identified during renovation/demolition activities work should be stopped and the area should be re-assessed to evaluate conditions and determine appropriate control measures and worker protection, if necessary.

4.2.2 Biological Hazards

Mould Contamination

No mould contamination was identified in the surveyed area(s) and therefore no further action is required at this time. Although no obvious mould contamination or evidence to suggest possible hidden mould contamination was visibly identified within the surveyed area(s) there is still a potential for hidden mould growth to exist behind or underneath building finishes. Should suspect mould growth be discovered during the course of renovation or demolition work it is recommended that all work stop so that the area can be assessed to evaluate proper control measures and remediation protocols in order to avoid worker exposure to mould and possible contamination of adjacent areas.

Pest Infestation

No visual evidence of any significant pest infestation was observed within the area(s) assessed. Therefore, no additional precautionary measures are deemed necessary for protection against biological contaminants potentially associated with pest infestation.

4.2.3 Environmental Hazards

Polychlorinated Biphenyls (PCBs)

No equipment suspected to contain PCB's was observed in the area(s) assessed.

Ozone Depleting and Global Warming Substances

No equipment suspected to contain ozone depleting and/or global warming substances was observed in the area(s) assessed.

5.0 LIMITATIONS

The information and recommendations detailed in this report were carried out by trained professional and technical staff in accordance with generally accepted environmental and industrial hygiene work practices and procedures. Recommendations provided in this report have been generated in accordance with accepted industry guidelines and practices. These guidelines and practices are considered acceptable as of the date of this report.

In preparation of this report, Safetech Environmental Limited (SEL) relied on information supplied by others, including without limitation, information pertaining to the history and operation of the site, test results and reports of other consultants and testing services provided by independent laboratories. Except as expressly set out in this report, SEL has not made any independent verification of information provided by independent entities.

The collection of samples at the location noted was consistent with the scope of work agreed-upon with the person or entity to whom this report is addressed and the information obtained concerning prior site investigations. As conditions between samples may vary, the potential remains for the presence of unknown additional contaminants for which there were no known indicators.

The analytical method used for determination of asbestos content meets the requirements of O.Reg. 278/05. However, small asbestos fibres may be missed by PLM due to resolution limitations of the optical microscope. Interfering binder/matrix and/or low asbestos content may also hinder positive identification by PLM. These conditions are common for vermiculite attic insulation (VAI) and non-friable organically bound (NOB)

materials such as vinyl floor tiles, roofing materials, mastics and caulking and can lead to "false negative" results. If PLM analytical results for these types of materials indicate no asbestos detected they have been reported as "Presumed Non-ACM". Due to limitations of the analytical method we cannot confirm that low quantities of asbestos are not present in these samples using solely PLM analysis. Additional analytical procedures should be considered for such materials to rule out false negative results.

Conclusions are based on site conditions at the time of inspection and can only be extrapolated to an undefined limited area around inspected locations. The extent of the limited area depends on building construction and conditions. Building materials that are not detailed within this survey due to inaccessibility during the time of survey and/or are uncovered during renovation/demolition activities should be properly assessed by a qualified person prior to their disturbance. SEL cannot warrant against undiscovered environmental liabilities. If any information becomes available that differs from the findings in this report, we request that we be notified immediately to reassess the conclusions provided herein.

No other person or entity is entitled to use or rely upon this report without the express written consent of Safetech Environmental Limited and the person or entity to who it is addressed. Any use that a third party makes of this report, or any reliance based on conclusions and recommendations made, are the responsibility of such third parties. SEL accepts no responsibility for damages suffered by third parties as a result of actions based on this report.

Appendix A

Condition Assessment Criteria for Asbestos-Containing Materials

The condition of asbestos-containing materials identified within the surveyed area(s) was assessed as Good (G), Fair (F) or Poor (P). The assessment criteria used to determine condition is dependent on material characteristics, such as friability. The following Table summarizes the criteria used by SEL to evaluate the condition of ACM.

Condition Assessment Criteria for Asbestos-Containing Materials

Sprayed Fireproofing, Sprayed Insulation and Sprayed Texture Finishes	
Good	• Surface shows no significant signs of damage, deterioration, or delamination (i.e. <1%). • Unencapsulated or unpainted fireproofing or texture finishes, where no delamination or damage is observed. • Encapsulated fireproofing or texture finishes where encapsulation applied after damage or fallout.
Fair	• Not utilized as part of condition assessment for these materials.
Poor	• Greater than 1% damage, delamination, or deterioration to surface.
In areas where damage exists in isolated locations, both Good and Poor may be applicable.	
Mechanical Insulation (boilers, breeching, ductwork, piping, tanks, equipment, etc.)	
Good	• Insulation completely covered in jacketing and exhibits no evidence of damage or deterioration. • Jacketing may have minor damage (i.e. scuffs or stains), but is not penetrated.
Fair	• Minor penetrating damage to jacketed insulation (cuts, tears, nicks, deterioration or delamination). • Undamaged insulation that had never been jacketed. • Insulation is exposed but not showing surface disintegration. • Extent of missing insulation ranges from minor to none. • Damage that can be repaired.
Poor	• Original insulation jacket is missing, damaged, deteriorated, or delaminated. • Insulation is exposed and significant areas have been dislodged. • Damage that cannot be easily repaired.
Non-Friable and Potentially Friable Materials (includes materials such as plaster finishes, drywall compound, ceiling tiles, asbestos cement products, vinyl asbestos tile and asbestos paper backed vinyl sheet flooring, etc., which have the potential to become friable when handled)	
Good	• No significant damage. • Material may be cracked or broken but is stable and not likely to become friable upon casual contact. • No friable debris present
Fair	• Not utilized as part of condition assessment for these materials.
Poor	• Material is severely damaged. • Debris is present or binder has disintegrated to the point where the material has become friable.
Asbestos-Containing Debris (noted separately from the presumed source material)	
Poor	• Debris is always considered to be in Poor condition.

Appendix B

Laboratory Certificate of Analysis - Asbestos

EMSL Canada Inc.

2756 Slough Street Mississauga, ON L9T 5N4
Phone/Fax: 289-997-4602 / (289) 997-4607
http://www.EMSL.com / torontolab@emsl.com

EMSL Canada Order 551613534
Customer ID: 55SELI62
Customer PO: 193716
Project ID:

Attn: Stephen Choi
Safetech Environmental
3045 Southcreek Road
Unit 14
Mississauga, ON L4X 2X7

Phone: (905) 624-2722
Fax: (905) 624-4306
Collected: 12/20/2016
Received: 12/20/2016
Analyzed: 12/22/2016

Proj: 193716 - JUNCTION STREET PUMPING STATION DSS PROJECT

Test Report: Asbestos Analysis of Bulk Materials for Ontario Regulation 278/05 via EPA600/R-93/116 Method

Client Sample ID: 1a **Lab Sample ID:** 551613534-0001
Sample Description: Sprayed Fireproofing

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	12/22/2016	White	85%	15%	None Detected	

Client Sample ID: 1b **Lab Sample ID:** 551613534-0002
Sample Description: Sprayed Fireproofing

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	12/22/2016	White	85%	15%	None Detected	

Client Sample ID: 1c **Lab Sample ID:** 551613534-0003
Sample Description: Sprayed Fireproofing

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	12/22/2016	White	85%	15%	None Detected	

Client Sample ID: 2a **Lab Sample ID:** 551613534-0004
Sample Description: Mag Block Parging Cement on Mechanical Pipe

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	12/22/2016	Gray	45%	55%	None Detected	

Client Sample ID: 2b **Lab Sample ID:** 551613534-0005
Sample Description: Mag Block Parging Cement on Mechanical Pipe

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	12/22/2016	Gray	43%	57%	None Detected	

Client Sample ID: 2c **Lab Sample ID:** 551613534-0006
Sample Description: Mag Block Parging Cement on Mechanical Pipe

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	12/22/2016	Gray	25%	75%	None Detected	

Client Sample ID: 3a **Lab Sample ID:** 551613534-0007
Sample Description: Exterior Brick Mortar

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	12/22/2016	Gray/Black	0%	100%	None Detected	

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EMSL Canada Order 551613534
Customer ID: 55SELI62
Customer PO: 193716
Project ID:

Test Report: Asbestos Analysis of Bulk Materials for Ontario Regulation 278/05 via EPA600/R-93/116 Method

Client Sample ID: 3b **Lab Sample ID:** **551613534-0008**
Sample Description: Exterior Brick Mortar

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	12/22/2016	Gray/Black	0%	100%	None Detected	

Client Sample ID: 3c **Lab Sample ID:** **551613534-0009**
Sample Description: Exterior Brick Mortar

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	12/22/2016	Gray	0%	100%	None Detected	

Client Sample ID: 4a **Lab Sample ID:** **551613534-0010**
Sample Description: Exterior Window Caulking

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	12/22/2016	White	5%	95%	None Detected	

Client Sample ID: 4b **Lab Sample ID:** **551613534-0011**
Sample Description: Exterior Window Caulking

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	12/22/2016	White	6%	94%	None Detected	

Client Sample ID: 4c **Lab Sample ID:** **551613534-0012**
Sample Description: Exterior Window Caulking

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	12/22/2016	White	7%	93%	None Detected	

Client Sample ID: 5a **Lab Sample ID:** **551613534-0013**
Sample Description: Exterior Door Sealer

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	12/22/2016	Brown	0%	100%	None Detected	

Client Sample ID: 5b **Lab Sample ID:** **551613534-0014**
Sample Description: Exterior Door Sealer

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	12/22/2016	Brown	0%	100%	None Detected	

Client Sample ID: 5c **Lab Sample ID:** **551613534-0015**
Sample Description: Exterior Door Sealer

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	12/22/2016	Gray	0%	100%	None Detected	

EMSL Canada Inc.

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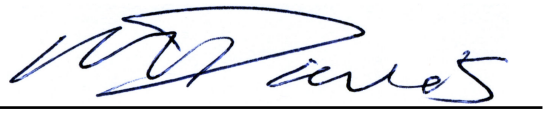
EMSL Canada Order 551613534
Customer ID: 55SELI62
Customer PO: 193716
Project ID:

Test Report: Asbestos Analysis of Bulk Materials for Ontario Regulation 278/05 via EPA600/R-93/116 Method

Analyst(s):

Natalie D'Amico PLM (10)
Romeo Samson PLM (5)

Reviewed and approved by:



Matthew Davis
or Other Approved Signatory

None Detected = <0.1%. EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client. Samples received in good condition unless otherwise noted. This report must not be used to claim product endorsement by NVLAP of any agency of the U.S. Government.

Samples analyzed by EMSL Canada Inc. Mississauga, ON NVLAP Lab Code 200877-0

Initial report from: 12/22/201613:49:25

Appendix C

Laboratory Certificate of Analysis - Lead

EMSL Canada Inc.
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http://www.EMSL.com torontolab@emsl.com

EMSL Canada Or	551613538
CustomerID:	55SELI62
CustomerPO:	193716
ProjectID:	

Attn: **Stephen Choi**
Safetech Environmental
3045 Southcreek Road
Unit 14
Mississauga, ON L4X 2X7

Phone:	(905) 624-2722
Fax:	(905) 624-4306
Received:	12/20/16 3:24 PM
Collected:	12/20/2016

Project: **193716- JUNCTION STREET PUMPING STATION DSS PROJECT**

Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

Client Sample Description	*Lab ID*	*Collected*	*Analyzed*	*Lead Concentration*
L-01	*551613538-0001*	12/20/2016	12/21/2016	0.59 % wt
	Site: WHITE PAINT ON WOOD CEILING			

Rowena Fanto, Lead Supervisor
or other approved signatory

*Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.010 % wt based on the minimum sample weight per our SOP. Unless noted, results in this report are not blank corrected. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities. Samples received in good condition unless otherwise noted. "<" (less than) result signifies that the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. The QC data associated with the sample results included in this report meet the recovery and precision requirements unless specifically indicated otherwise. Definitions of modifications are available upon request.

Samples analyzed by EMSL Canada Inc. Mississauga, ON A2LA Accredited Environmental Testing Cert #2845.08

Initial report from 12/22/2016 09:15:47

Appendix D
Site Photographs

P1 – Junction Street Pumping Station

View of non-asbestos containing sprayed fireproofing that was observed and sampled.

P2 – Junction Street Pumping Station

View of non-asbestos containing parging cement on mechanical pipe that was observed and sampled.

Appendix E

Background Information on Designated Substances and Other Hazardous Materials

DESIGNATED SUBSTANCES

The Occupational Health and Safety Act of Ontario (OHSA) allows for certain toxic substances to be especially designated. The OHSA defines a designated substance as "a biological, chemical or physical agent or combination thereof prescribed as a designated substance to which the exposure of a worker is prohibited, regulated, restricted, limited or controlled." Ontario Regulation 490/09 - Designated Substances (O.Reg. 490/09), made under the Occupational Health and Safety Act outlines required steps to control exposure of workers to designated substances. Under O.Reg. 490/09 there are eleven (11) designated substances; acrylonitrile, arsenic, asbestos, benzene, coke oven emissions, ethylene oxide, isocyanates, lead, mercury, silica and vinyl chloride. This regulation applies to every employer and worker at a workplace where the designated substances are present, produced, processed, used, handled or stored and at which a worker is likely to be exposed to the designated substance.

Section 14 of O.Reg. 490/09 exempts an employer and the workers of an employer who engage in construction from the requirements of the regulation. However, designated substances are still required to be identified prior to the beginning of a demolition or renovation project to ensure that construction workers (and potentially building occupants) are adequately protected from the hazards posed by the presence of these materials if the planned work may cause them to be disturbed. Accordingly, under Section 30 of the OHSA building owners are required to perform an assessment to determine whether any designated substances are present at the project site before the beginning of the project. The owner is also required to prepare a list of designated substances that are present at the site and provide this list to prospective constructors before entering into a binding contract with the constructor. This way, contractors and construction workers are made aware of designated substances present within the work area so that appropriate measures can be taken during the work to limit exposure to these substances.

Designated Substances and Hazardous Materials Assessments are conducted to conform to the requirements of Section 30 of the OHSA. The assessments are performed to identify designated substances (and other hazardous materials) within the work area that may present a hazard to workers if disturbed. These substances are commonly a component of building materials or equipment found in buildings. Additional information regarding the eleven designated substances including their properties, uses and health effects are provided below.

Acrylonitrile

Acrylonitrile (ACN) is a clear, colourless or pale yellow liquid with a pungent onion- or garlic-like, irritating odour. It is highly flammable and as such is a severe fire and explosion hazard.

Acrylonitrile is used mainly as a monomer or comonomer in the production of acrylic fibres, plastics, resins and nitrile rubbers. Historically, a mixture of acrylonitrile and carbon tetrachloride was used as a pesticide; however, all pesticide uses have stopped. Based on its use as a chemical intermediate, exposure to acrylonitrile is primarily occupational, via inhalation during its manufacture and use. Therefore, this designated substance is not expected to be encountered in buildings where it is not either produced or used in a manufacturing process.

Acute (short-term) exposure of workers to acrylonitrile has been observed to cause mucous membrane irritation, headaches, dizziness, and nausea. More significant exposures may lead to symptoms such as limb weakness, labored and irregular breathing, impaired judgment, cyanosis, collapse, and convulsions. Exposure of the skin to high concentrations of acrylonitrile in the air may irritate the skin and cause it to turn red while direct skin contact with acrylonitrile may cause the skin to blister and peel. The International Agency for Research on Cancer (IARC) concluded that there is inadequate evidence in humans for the carcinogenicity of acrylonitrile, but has classified it as possibly carcinogenic to humans (Group 2B).

Arsenic

Arsenic is a naturally occurring mineral, widely distributed in the earth's crust. Elemental arsenic (sometimes referred to as metallic arsenic) is a silver-gray or white brittle metal. However, arsenic is usually found in the environment combined with other elements such as oxygen, chlorine, and sulfur to form inorganic arsenic compounds. Arsenic has no odor and is almost tasteless.

Arsenic and its compounds have a variety of commercial uses. Inorganic arsenic compounds are mainly used as a wood preservative. Copper chromated arsenic (CCA) is used to make "pressure-treated" lumber. CCA-treated wood is no longer used for residential applications but may still be used in industrial applications. Arsenic is also used in metallurgy for hardening copper, lead and certain metal alloys, in pigment production, in the manufacture of certain types of glass, and in semiconductors and light-emitting diodes. Inorganic arsenic compounds are no longer used as pesticides in agriculture; however, organic arsenic compounds, namely cacodylic acid, disodium methylarsenate (DSMA), and monosodium methylarsenate (MSMA), are used, as yet, as pesticides – principally on cotton.

Today, workplace exposure to arsenic may still occur in some occupations that use arsenic, such as copper or lead smelting, wood treating, or pesticide application. Exposure to arsenic within buildings other than where it is used as part of the manufacturing process is unlikely and therefore arsenic is not expected to be encountered as part of a routine hazardous building materials assessment.

Human exposure to arsenic can cause both short and long term health effects. Short-term or acute effects can occur within hours or days of exposure. If you breathe high levels of inorganic arsenic, then you are likely to experience a sore throat and irritated lungs. Longer exposure at lower concentrations can lead to skin effects (such as darkened patches of skin and areas of thickened skin), and also to circulatory and peripheral nervous disorders. An important concern is the ability of inhaled inorganic arsenic to increase the risk of cancer. Long term exposure to arsenic has been linked to cancer of the bladder, lungs, skin, kidneys, nasal passages, liver and prostate. The IARC classifies arsenic and arsenic compounds as "carcinogenic to humans" (Group 1).

Asbestos

Asbestos is the name given to a number of naturally occurring fibrous minerals found in the environment. Ontario Regulation 490/09 (Designated Substances) defines asbestos as any one of the following fibrous silicates: actionlite; amosite; anthophyllite; chrysotile; crocidolite; and tremolite. Asbestos fibres have several desirable characteristics such as high textile strength, the ability to be spun and woven, and resistance to heat and most chemicals. These characteristics have resulted in the historical use of asbestos in a wide variety of building materials and other manufactured goods. Examples of products where asbestos has been used include roofing shingles, ceiling and floor tiles, insulation, sprayed fireproofing, gaskets, and friction products such as automotive brakes and clutches.

The peak years for asbestos use were in the 1960s and early 1970s. Therefore, asbestos is commonly found in building materials of this era. The use of asbestos in building materials and other products has decreased significantly since this time. Friable asbestos-containing materials (material that when dry can be crumbled, pulverized or powdered by hand pressure), such as sprayed fireproofing and sprayed insulation, ceased use circa 1973. Mechanical thermal system insulation ceased use circa 1981 while sprayed acoustic texture coat finishes ceased use circa 1982. Non-friable asbestos-containing materials were generally manufactured for a longer period of time (with the exception of plaster finishes which ceased use circa 1960's). Asbestos-containing drywall joint compound ceased use circa 1980. Vinyl floor tiles, vinyl sheet flooring and acoustic ceiling tile ceased use 1982. Other non-friable materials continued to be produced into the 1990's, including roofing materials (ceased use circa 1991) and floor adhesives (ceased use circa 1992). Today, asbestos is a controlled substance, and is banned for use in most products sold in Canada under the Hazardous Products Act (with the exception of certain roof shingles, clutch facings and brake linings).

Potentially harmful exposure to asbestos occurs through inhalation of air containing asbestos fibres. The greatest risk for workplace exposure to airborne asbestos is in occupations that produce and use asbestos, such as in mining and milling operations or in the manufacture of products containing asbestos. Exposure to airborne asbestos fibres may also occur to construction workers, trades people, maintenance workers and other building occupants in buildings constructed with asbestos-containing materials; especially during building renovations or repairs or if the materials are in poor condition or are otherwise disturbed.

Health risks associated with asbestos exposure are dependent on several factors such as the type and airborne concentration of asbestos, and period of exposure. In general, the greater the exposure to asbestos, the greater the chance of developing harmful health effects. Typically, chronic, daily exposure to elevated airborne concentrations of asbestos over a period of years is required for health effects to eventually manifest themselves. Health effects associated with exposure to asbestos can result in asbestosis (a scarring of the lungs which makes breathing difficult), mesothelioma (a rare cancer of the lining of the chest or abdominal cavity) and lung cancer. The link between exposure to asbestos and other types of cancers and health effects is less clear.

Benzene

Benzene is a clear, colourless liquid with a characteristic, sweet or aromatic hydrocarbon odour. It is a liquid at room temperature but evaporates into the air very quickly, making it a highly flammable vapour as well as an extremely flammable liquid.

Benzene is formed from both natural processes and human activities. Natural sources of benzene include volcanoes and forest fires. Benzene is also a natural part of crude oil, gasoline, and cigarette smoke. It is produced from petroleum and coal sources and is used mainly in the manufacture of other chemicals which are used to make plastics, resins, and nylon and synthetic fibers. Benzene is also used to make some types of rubbers, lubricants, dyes, detergents, drugs, and pesticides.

Exposure to pure benzene within buildings other than where it is produced or used as part of a manufacturing process is unlikely. Therefore benzene is not expected to be encountered as part of a routine hazardous building materials assessment.

Exposure to benzene primarily occurs through inhalation of airborne vapours. Short-term (acute) health effects associated with overexposure to benzene vapours can result in symptoms such as headache, nausea, dizziness, drowsiness and confusion, with unconsciousness or even death at very high levels. Long-term (chronic) exposure to Benzene may cause blood and bone marrow effects which can lead to anemia and leukemia (cancer of the blood-forming organs) as well as cause damage to the immune

system, increasing the chance for infection. The IARC classifies benzene as "carcinogenic to humans" (Group 1).

Coke Oven Emissions

Coke Oven Emissions refers to the benzene soluble fraction of total particulate matter emitted during the destructive distillation or carbonization of coal for the production of coke (pure carbon). These emissions are a mixture of coal tar, coal tar pitch, volatiles (including benzene, toluene and xylene), creosote, polycyclic aromatic hydrocarbons (PAHs – including benzo(a)pyrene, benzanthracene, chrysene and phenanthrene), and metals (including cadmium, arsenic, beryllium and chromium). Condensed coke oven emissions are a brownish, thick liquid or semisolid with a naphthalene-like odor, while uncondensed coke oven emissions are vapors that escape when the ovens are changed and emptied and are a component of fugitive emissions.

The coke produced is used as a component in the manufacturing of iron and steel. Coke is also used to synthesize calcium carbide and to manufacture graphite and electrodes. Additional chemicals recovered from the coke oven emissions (such as benzene, toluene, naphthalene, sulfur, and ammonium sulfate) are used as raw materials for plastics, solvents, dyes, drugs, waterproofing, paints, pipecoating, roads, roofing, insulation, and as pesticides and sealants.

Coke oven emissions would only be present within facilities producing or using coke as part of the manufacturing process and thus occupational exposure is limited to those workers in the aluminum, steel, graphite, electrical, and construction industries. Therefore, coke oven emissions are not a contaminant of concern during a routine hazardous building materials assessment.

Chronic (long-term) exposure to coke oven emissions can result in chronic bronchitis (particularly those who smoke) and additional health effects such as conjunctivitis, severe dermatitis, and lesions of the respiratory system and digestive system. However, the greatest concern regarding chronic exposure to coke oven emissions is the increased risk of cancer. The IARC classifies coke production as "carcinogenic to humans" (Group 1). The site at which excess cancer rates have been identified most commonly among workers in coke production is the lung. Excess risk for kidney cancer has also been associated with work in coke plants. Additional studies have also reported excess risks for other types of cancers such as cancer of the large intestine and pancreas.

Ethylene Oxide

Ethylene oxide is colourless gas with a somewhat sweet odour. It is extremely flammable and also dangerously reactive. Ethylene oxide exists as a compressed gas that has been produced since the early 1900s. It is used primarily as a chemical intermediate in the production of ethylene glycol, glycol ethers, nonionic surfactants and other industrial chemicals. Much smaller amounts are used as a non-explosive mixture with nitrogen or carbon dioxide for sterilizing medical instruments and supplies in hospitals and industrially for the fumigation of spices.

Most people are not likely to be exposed to ethylene oxide because it is not commonly found in the environment. Exposure to ethylene oxide is generally limited to those facilities where it is made or used. Therefore, ethylene oxide is not a contaminant of concern during a routine hazardous building materials assessment, although the presence of it should be determined in buildings such as hospitals if construction activities are to occur in or adjacent to areas where it is used or stored.

Exposure to ethylene oxide can result in irritation to the skin or eyes; however, the greatest risk for health effects is through inhalation. This can result in irritation to the nose, throat and respiratory tract, with damage to the central nervous system at higher concentrations. Exposure to high concentrations may cause headache, nausea, dizziness, drowsiness, and incoordination. Exposure to ethylene oxide is also a cancer hazard and possible reproductive hazard. In epidemiological studies of exposure to ethylene oxide, the most frequently reported association has been with lymphatic and haematopoietic cancer. The IARC has concluded that there is limited evidence for the carcinogenicity of ethylene oxide in humans and sufficient evidence for carcinogenicity in experimental animals, classifying ethylene oxide as “carcinogenic to humans” (Group 1).

Isocyanates

Isocyanates are a family of highly reactive, low molecular weight, manufactured chemicals containing one or more isocyanate groups (-NCO). An isocyanate that has two isocyanate groups is known as a diisocyanate, which are the most common type of isocyanates used for manufacturing other products. The most commonly used diisocyanates include methylene diphenyl diisocyanate (MDI), toluene diisocyanate (TDI), and hexamethylene diisocyanate (HDI).

When isocyanates are combined with other compounds that contain free hydroxyl functional groups (i.e. –OH) they react and begin to form polyurethane polymers. These polyurethanes find significant application in the manufacture of rigid and flexible foams. Flexible foam is primarily used for cushioning, while rigid foam is used mainly for insulation. Polyurethanes are also used in the production of adhesives, elastomers, and coatings and are increasingly used in the automobile industry, autobody repair, and building insulation materials.

This diversity of applications means that exposures to isocyanates can occur in a broad range of production facilities from small workshops to automated production lines. Jobs that may involve exposure to isocyanates include painting, foam-blowing, and the manufacture of many polyurethane products. Exposure to isocyanates within buildings where it is not produced or used as part of manufacturing is unlikely, as products such as rigid foam insulation that may be used in buildings has already undergone the curing process. Completely cured products are fully reacted and therefore are considered to be inert and non-toxic. However, some products such as spray foams, coatings, sealants and adhesives may be sold and used in an uncured form. An example would be an adhesive, which is sold to be initially applied in an uncured form and as it cures (hardens), bonds two pieces of wood together. Such products can provide potential exposure to building occupants and construction workers during the application and use of these products. However, for the purposes of a routine hazardous building materials assessment, products that may have contained isocyanate as part of the manufacturing process (e.g. rigid foam) or during the application/installation process (e.g. spray foam, adhesives and sealants) are assumed to be fully cured and would no longer contain free isocyanate.

Direct skin contact with isocyanates can cause marked skin irritation, resulting in reddening, swelling and blistering. However the greatest route of exposure to isocyanates is through inhalation of fine vapours or droplets. Airborne exposure to isocyanates can result in irritation to the mucous membranes of the eyes and respiratory tracts. This results in symptoms such as excessive tear secretion, dry throat, dry cough, chest pains and difficulty in breathing. Isocyanates are also a major cause of work-related asthma worldwide. Increased exposure to isocyanates can lead to sensitization. Once sensitized, individuals are subject to severe asthma attacks (which in some cases has been reported to result in death) if they are re-exposed.

Lead

Lead is a naturally occurring metal found in small amounts in the earth's crust. It is usually found in ore with zinc, silver and (most abundantly) copper, and is extracted together with these metals. Metallic lead is bluish-white in colour but soon tarnishes to a dull grey when exposed to air. When melted into liquid form it has a shiny chrome-silver appearance.

Lead is soft, dense, highly malleable and resistant to corrosion, with poor electrical conductivity as compared to most other metals. Such properties have resulted in lead being used in many applications, including products and materials commonly found in buildings. It is present as a component of lead-acid batteries, ammunition, PVC plastics, and older brass and chrome-plated brass faucets. As a building component, lead has been used in water distribution piping, as an alloy in solder, in electrical conduits, roofs and roofing details, and as an additive to paints, ceramic glazes and mortars as pigments

or for anti-corrosion properties. Lead has also used as sheeting inside buildings for shielding X-rays and for sound attenuation.

Exposure to lead can occur for workers in workplaces that produce the above materials but also to construction workers, building maintenance personnel and the general population due to the widespread historical use of lead in building materials and consumer products. Most exposure to lead occurs through ingestion or inhalation, with the health effects being the same. Overexposure to lead can result in damage to nervous connections and can cause blood and brain disorders, severe damage to the kidneys and ultimately death. Infants and young children are especially vulnerable to the health effects of lead, as overexposure has been proven to result in the permanent reduction in cognitive capacity. In pregnant women, high levels of exposure to lead may cause miscarriage. The IARC has concluded that lead and inorganic lead compounds are “possibly carcinogenic to humans” (Group 2B).

The known serious health effects associated with lead exposure has brought about widespread reduction in its use. The use of lead in building materials and consumer products has decreased substantially since the 1970s to where lead is no longer being used in building materials and consumer products or is present at significantly lower concentrations. For example, unleaded gasoline was introduced in Canada in 1975, after which leaded gasoline was phased out and banned in 1990. Lead-based solder has been banned since the1980s and most solder used today is either lead-free or has very low lead concentrations. Up until the 1960s, lead was added to paints in significant quantities. Since that time, the concentration of lead in paint has decreased. The federal government began reducing the amount of lead allowed in interior paint in 1976 (to 0.5% by weight). By 1991, paint manufacturers in Canada and the U.S. voluntarily stopped adding lead to paint, reducing lead concentrations to background levels. In 2005 the *Surface Coating Materials Regulations* came into effect to limit the concentration of lead in paint (to 0.06% by weight) for both interior and exterior paints sold to consumers. This was since amended in 2011 to further reduce the allowable lead limit (to 0.009% by weight) and extended to include all consumer paints and coatings.

Mercury

Mercury is a naturally occurring element found in the earth's crust, with natural deposits generally found as a vermilion red ore called cinnabar. Mercury can exist as metallic mercury, organic mercury or inorganic mercury. Metallic or elemental mercury has unique properties as compared to other metals. It is the only pure metal that is a liquid at room temperature, having a silvery-white, shiny appearance. Mercury is the densest liquid known, which produces a colourless, odourless vapour at room temperature.

The unique properties of mercury have resulted in it being used in a wide variety of applications. Properties such as its coefficient of expansion and ability to conduct electricity has resulted in mercury being used in thermometers, barometers and other

measuring devices (blood pressure gauges, vacuum gauges, manometers, etc.), thermostats and a variety of other electrical switches (temperature sensitive, tilt switches, float switches, etc.). Mercury is also used in antifouling paints, dry cell or button batteries and numerous lighting products, including fluorescent lamps and a variety of High Intensity Discharge (HID) lamps such as mercury vapor, metal halide and high pressure sodium lamps. HID lamps are used for street lights, floodlights and industrial lighting applications. Because of the wide variety of uses mercury can be found as a component of machinery, equipment and lighting within buildings; although many of its uses have been phased out over the years.

The health effects of mercury exposure depend on its chemical form (elemental, inorganic or organic), the route of exposure (inhalation, ingestion or skin contact), and the level of exposure. Vapours from liquid elemental mercury and methyl mercury are more easily absorbed than inorganic mercury salts and can, therefore, cause more harm. Exposure to mercury occurs mainly from breathing contaminated air or ingesting contaminated water and food. Mercury is a neurotoxin, which means it can adversely affect the central nervous system. Upon exposure, mercury tends to accumulate quickly in the brain where it tightly binds with the tissue and is released at a very slow rate. The nervous system effects of mercury toxicity are sometimes referred to as "Mad Hatter's Disease" since mercurous nitrate was used in making felt hats. High levels of exposure to mercury can also lead to harmful effects on the digestive and respiratory systems, and the kidneys. Many mercury compounds may also be teratogenic or capable of causing birth defects.

Mercury compounds can also be toxic at low levels in the environment. The characteristics of mercury that make it an environmental problem are its toxicity and persistence in the environment, and its ability to accumulate and bioconcentrate as methyl mercury in fish and fish-eating predators such as large fish or loons. Therefore, proper disposal of mercury-containing materials is essential. The improper disposal of mercury-containing products such as fluorescent light bulb tubes, high intensity discharge lamps, mercury vapour lamps, mercury thermometers and thermostats can lead to the release of mercury from municipal landfills. Used fluorescent and HID lamps may be classified as hazardous waste due to their mercury content and should be recycled if possible rather than being disposed of in landfill.

Silica

Silica (silicon dioxide) is the name of a group of minerals that contain silicon and oxygen in a chemical combination and have the general formula SiO_2. It is one of the most common minerals in the earth's crust. Silica can be present as crystalline silica (free silica) or amorphous silica (combined silica), and exists in many forms. The three most common crystalline forms of silica encountered in the workplace environment are quartz, tridymite, and cristobalite. Quartz is by far the most common crystalline silica found in nature, being abundant in most rock types, notably granites, sandstones, quartzites and in sands and soils. Cristobalite and tridymite are found in volcanic rocks. Amorphous

silica is found in nature as biogenic silica and as silica glass of volcanic origin. One form of biogenic silica, diatomaceous earth, originates from the skeletons of diatoms deposited on sea floors. From a health perspective it is the crystalline silica forms that raise the biggest concerns.

Silica is present in numerous building materials and products, including concrete, brick, stone, terrazzo, refractory brick, etc. Low concentrations of silica are also possible in plaster, drywall, acoustical ceiling tiles, drywall joint compound, mortars and adhesives. Because of the wide usage of quartz-containing materials, workers may be exposed to crystalline silica in a large variety of industries and occupations. Occupational exposure to silica dust occurs in cement and brick manufacturing, asphalt pavement manufacturing, china and ceramic manufacturing and the tool and die, steel and foundry industries. Exposure to silica also occurs during many different construction and maintenance activities. The most severe exposures to crystalline silica result from abrasive blasting activities using silica sand. Other activities that may produce crystalline silica dust include jack hammering, rock/well drilling, concrete mixing, concrete drilling, tuck pointing, and brick and concrete block cutting and sawing. Additionally, crystalline silica exposures occur in the maintenance, repair and replacement of refractory brick furnace linings.

Adverse health effects associated with silica exposure result from inhalation of the respirable fraction of crystalline silica, which can arise from many of the activities outlined above. The main health effects associated with silica exposure are lung cancer and silicosis. The IARC has concluded that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is “carcinogenic to Humans” (Group 1). Silicosis is caused by scarring of the lung tissue from breathing in silica dust. This scarring is permanent and causes a reduction in the lungs’ ability to take in oxygen, making it difficult to breathe and in severe cases can be disabling, or even fatal. Since silicosis affects lung function, it also makes one more susceptible to lung infections like tuberculosis.

Vinyl Chloride

Vinyl chloride is a manufactured substance that does not occur naturally. It is used as a chemical intermediate and not an end product. Vinyl chloride exists in liquid form if kept under high pressure or at low temperatures. At room temperature, it is a colourless gas. It burns easily and is not stable at high temperatures.

Most of the vinyl chloride produced is used to make a polymer called polyvinyl chloride (PVC). PVC is used to make a variety of plastic products including pipes, wire and cable coatings, vinyl flooring, vinyl wallpaper and window frames. It is also used to make furniture, upholstery and packaging materials. One of the concerns regarding PVC is that upon burning it will emit toxic fumes. Contaminants emitted when PVC is burned include hydrochloric acid, carbon monoxide and carbon dioxide, along with lesser amounts of dioxin and furan.

Vinyl chloride is reported to be slightly irritating to the eyes and respiratory tract in humans. Central nervous system effects (including dizziness, drowsiness, fatigue, headache, visual and/or hearing disturbances, memory loss, and sleep disturbances) as well as peripheral nervous system symptoms (peripheral neuropathy, tingling, numbness, weakness, and pain in fingers) have been reported in workers exposed to vinyl chloride. Short-term (acute) exposure to extremely high levels of vinyl chloride has also reportedly caused loss of consciousness, lung and kidney irritation, and inhibition of blood clotting in humans. The most significant health effect associated with exposure to vinyl chloride is that it is a known human carcinogen that causes a rare cancer of the liver. It has been classified by the IARC as “carcinogenic to humans” (Group 1). Brain cancer, lung cancer, and some cancers of the blood also may be connected with breathing vinyl chloride over long periods.

OTHER HAZARDOUS MATERIALS

CHEMICAL HAZARDS

Urea Formaldehyde Foam Insulation

Urea-formaldehyde foam insulation (UFFI) was developed in as an improved means of insulating difficult-to-reach cavities. It was typically made at the construction site from a mixture of urea-formaldehyde resin, a foaming agent and compressed air. When the mixture is injected into the wall, urea and formaldehyde unite and "cure" into an insulating foam plastic. Its appearance is like ordinary shaving cream. Dry, it can be a white or tan colour, and fluffy like styrofoam. Over time UFFI shrinks significantly and may begin to degrade due to its crumbly texture.

UFFI was installed primarily in wall cavities during the 1970's as an energy conservation measure. The insulation was used most extensively from 1975 to 1978, during the period of the Canadian Home Insulation Program (CHIP), when financial incentives were offered by the government to upgrade home insulation levels. In addition to detached homes it can be found in common areas and walls of semi-detached homes, apartment buildings and condominiums. UFFI was also used to a lesser degree in some commercial and industrial buildings.

UFFI installation has been banned in Canada under the Hazardous Products Act (HPA) since December, 1980 due to concerns regarding the health effects of exposure to formaldehyde. Formaldehyde is a colourless, pungent-smelling gas. Health effects include eye, nose, and throat irritation; wheezing and coughing; fatigue; skin rash; nausea; headache; dizziness; and severe allergic reactions.

Sometimes, a slight excess of formaldehyde was often added to ensure complete "curing" with the urea to produce the urea-formaldehyde foam. The excess formaldehyde was given off after installation during the initial curing process, which typically took a few days to a week to complete. UFFI was sometimes improperly installed or used in locations where it should not have been, resulting in continued off-gassing of formaldehyde past the initial curing stage. Since UFFI was last installed in 1980, it should have little effect on indoor formaldehyde levels today. However, if UFFI comes in contact with water or moisture, it could begin to break down. Due to the age of the insulation UFFI may also begin to degrade and crumble into a fine powder. Under these conditions UFFI may release more formaldehyde and consideration should be given to removing the material using properly trained remediation personnel.

BIOLOGICAL HAZARDS

Mould

Mould is part of the fungi kingdom, which also includes mushrooms and yeasts. They are a naturally occurring and essential part of our environment since they break down dead organic material in the outdoor environment (such as leaves, wood and other plant debris), which they use as a food source.

Mould reproduces by means of tiny spores that are so small they can't be seen by the naked eye. Because of their small size mould spores easily become airborne and can travel long distances, entering indoor environments through ventilation systems, open windows or doors, or tracked in on footwear. Therefore, mould spores are a commonly detected in indoor air and as a component of settled dust.

Under normal conditions, the presence of indoor mould is not an issue. However, if conditions exist that allow it to grow and multiply indoors it can become a potential hazard. Several factors will affect what moulds will grow within a building and how fast they will grow. This includes parameters such as temperature, airflow, and the pH (i.e. acidity/alkalinity) of the food substrate. However, the most important parameter affecting mould growth is water availability, as all moulds need some amount of moisture for them to be able to grow. Buildings that have had a history of water damage are at greater risk of indoor mould growth.

Indoor mould growth may present a risk to the building structure itself through decomposition of building materials. Health risks to building occupants may also occur as a result of indoor mould growth. Construction or renovation work which disturbs mould-contaminated materials increases this risk of exposure to building occupants and the construction workers themselves. Health effects associated with exposure to mould most commonly results in allergic type reactions such as runny nose, cough, congestion, eye irritation and aggravation of asthma, headache and fatigue. Exposure to very high

concentrations of airborne mould spores (such as those that may be observed during disturbance of mould-contaminated building materials) can result in more serious health effects such as Organic Dust Toxic Syndrome (ODTS) or Hypersensitivity Pneumonitis (HP), where flu-like symptoms (fever, chills, cough, fatigue, shortness of breath, body aches, etc.) are exhibited. The chronic form of HP may occur from long-term exposure to lower levels of mould and results in a continued worsening in shortness of breath or cough. A variety of species of mould have also been documented to cause serious invasive infections, which are generally limited to individuals whose immune systems are already somehow compromised.

Pest Infestation

Areas currently or previously infested by pests (including birds, bats, rodents, raccoons, cockroaches, etc.) can result in potential exposure to numerous biological hazards that can be viral, bacterial, fungal or parasitic in nature. This can occur through exposure to their droppings, urine or saliva.

Bird and bat droppings should be presumed to be contaminated with the fungi Histoplasma capsulatum and/or Cryptococcus neoformans. These fungi grow well in the high nutrient content of accumulated bird and bat excrement and can cause respiratory infections in workers exposed during construction or maintenance activities that cause the droppings to be disturbed and the fungi to become airborne.

Histoplasmosis is an infectious disease caused by inhaling the spores of Histoplasma capsulatum. After an exposure, how ill a person becomes varies greatly and most likely depends on the number of spores inhaled and a person's age and susceptibility to the disease. The mildest form of histoplasmosis produces no signs or symptoms, but severe infections can cause serious problems throughout your body as well as in your lungs. Otherwise healthy people who've had intense exposure to H. capsulatum may experience a form of the disease known as acute symptomatic pulmonary histoplasmosis. Typical symptoms include fever, muscle aches, headache, dry cough, chest pain, sweating and loss of appetite.

Cryptococcosis is an infectious disease caused by inhaling the spores of Cryptococcus neoformans. Once inhaled, infection with cryptococcosis may go away on its own, remain in the lungs only, or spread throughout the body. Most cases occur to people with a weakened immune system, such as those with HIV infection, taking high doses of corticosteroid medications, cancer chemotherapy, or who have Hodgkin’s disease. In people with a normal immune system, the lung (pulmonary) form of the infection may have no symptoms. In people with weakened immune systems, the cryptococcus organism may spread to the brain. Most people with this infection have meningoencephalitis (swelling and irritation of the brain and spinal cord) when they are diagnosed.

Rodents such as deer mice may be infected with Hantavirus, which can be shed in their urine, saliva and droppings. Exposure to Hantavirus can result in a serious respiratory illness called hantavirus pulmonary syndrome (HPS). Initially, infected individuals exhibit flu-like symptoms, including fever and body aches which progresses to shortness of breath and coughing which rapidly becomes more severe. Exposure to Hantavirus in Canada is rare and Health Canada has only found the virus in a very small percentage of deer mice tested in Northern Ontario.

A raccoon latrine (i.e. an area where they repeatedly deposit fresh feces on top of old feces) may contain microscopic roundworm (*Baylisascaris procyonis*) eggs that can potentially be hazardous to human health. Once deposited in the environment, the eggs develop into an infectious form; and if inadvertently ingested by humans, the larvae hatch out of the eggs and may penetrate the body's organs. Larvae travel through the body and may cause serious eye disease, spinal cord or brain damage or death. Raccoon roundworm disease is not contracted by inhalation nor has any case of inhalation of roundworm eggs been documented.

Exposure to animal dander, scales, fur, urine, feces and saliva can also result in exposure to certain proteins that can act as allergens and can also cause asthmatic reactions. Some common sources of pest-related allergens include cockroaches, dust mites and rodents. The protein in urine from rats and mice is a potent allergen. Cockroach allergens are also potent and are derived from several sources, such as saliva, fecal material, secretions, cast skins, debris, and dead bodies. Allergic reactions occur when sensitized persons inhale, swallow or touch traces of the allergen, resulting in an exaggerated reaction of the body's immune system to the foreign protein. Typical allergic reactions result in nasal, eye, and throat irritation as well as possible skin hives. These proteins may also trigger asthma attacks when sensitive individuals inhale the proteins, resulting in symptoms such as coughing, wheezing, chest tightness, and breathing difficulties.

ENVIRONMENTAL HAZARDS

Polychlorinated Biphenyls

Polychlorinated biphenyls (PCBs) are a class of man-made organic chemicals known as chlorinated hydrocarbons. They vary in consistency from thin, light-coloured liquids to yellow or black waxy solids. They were manufactured in the United States from 1929 until their manufacture was banned in 1979. Although PCBs were not manufactured in Canada, they were imported from the U.S. over the years. Canada banned the import, manufacture and sale of PCBs in 1977.

PCBs are non-flammable, chemically stable over a wide range of temperature and physical conditions, not soluble in water, unaffected by acids, base or corrosive chemicals, and have a high dielectric or electrical insulating capacity. Due to these unique

properties PCBs were used in hundreds of industrial and commercial applications, most commonly in electrical transformers and capacitors, including those capacitors found in light ballasts. They were also used as coolants, fire retardants and as insulation and in a number of other commercial applications including carbonless copy paper, dust suppressors for roads, hydraulic fluids, caulking compounds, plasticizers and lubricating oils and heat-transfer applications.

Although PCBs were found to be extremely useful in many industrial and commercial applications some of their chemical properties also made them an environmental and health hazard. PCBs are nearly indestructible and therefore persist if released into the natural environment. Their high fat and low water solubility result in a build-up (bioaccumulation) of PCBs in the fatty tissue of animals and humans if ingested/inhaled. Because PCBs persist in the fatty tissue of animals their concentration will tend to increase the higher up the food chain.

Most of what is known about the human health effects of PCBs is based on exposures due to accidental releases or job-related activities. These exposures are much higher than the levels normally found in the environment. The adverse health effects include a severe form of acne (chloracne), swelling of the upper eyelids, discolouring of the nails and skin, numbness in the arms and/or legs, weakness, muscle spasms, chronic bronchitis, and problems related to the nervous system. The International Agency for Research on Cancer (IARC) classifies PCBs as “probably carcinogenic to humans” (Group 2A) based on limited evidence that long-term, high-level occupational exposure can lead to increased incidence of liver and kidney cancers. The long-term impact of low-level exposures to PCBs that is common in the general population is unclear. The current state of knowledge suggests that low-level exposures to PCBs are unlikely to cause adverse health effects. However, people eating large amounts of certain sports fish, wild game and marine mammals are at increased risk for higher exposures and possible adverse health effects.

Ozone Depleting and Global Warming Substances

There are several different types of chemicals that are being or have been used as refrigerants in commercial, home and vehicle air conditioners and refrigerators or as fire extinguishing agents in portable and fixed fire extinguishing equipment. This includes groups of chemical compounds known as chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs) and halons. Some of these chemicals have also been used as foam blowing agents, as cleaning solvents for electrical components, as aerosol spray propellants, and in hospital sterilization procedures. Fixed halon fire extinguishing systems have historically been used in areas such as data centers, IT rooms, museums, libraries, surgical suites, and other locations where use of water-based suppressants could irreparably damage electronics or vital archival collections. There is a large number of halon fire extinguishing systems still in service in Canada.

The concern regarding past and present use of many of the chemicals used as refrigerants or fire extinguishing agents is that they are ozone-depleting substances (ODS). When released into the environment these chemicals break down in the stratosphere and release chlorine or bromine, which destroy the stratospheric ozone layer. The ozone layer screens the earth from some of the sun's harmful ultraviolet rays (UVB). As the ozone layer is depleted, higher UVB levels reach the earth, resulting in increased exposure to UVB. Increased exposure to UVB can cause skin cancer and plays a major role in malignant melanoma development. It can also increase the likelihood of cataracts and may also suppress proper functioning of the body's immune system and the skin's natural defences.

CFCs, HCFCs and halons are also known to be greenhouse gases and contribute to global warming due to the build-up of these heat-trapping gases in the atmosphere. Hydrofluorocarbons (HFCs) are a common replacement chemical for CFC and HCFC refrigerants; and although they do not have any ozone depleting potential they are a potent greenhouse gas.

Due to the ozone-depleting potential and/or global warming potential of CFCs, HCFCs, HFCs and halons it is important to control their use and emission into the environment. The manufacture and use of CFCs has stopped while transitional refrigerants (HCFCs) are scheduled to be phased out of production. No phase-out dates are currently planned for any HFCs. In Ontario, Regulation 463/10, “Ozone Depleting Substances and Other Halocarbons” (made under the Environmental Protection Act) enhances the control and management of substances that deplete the ozone layer and contribute to global warming. This regulation has requirements to prevent or minimize ozone-depleting substances and other halocarbons emissions, which serves a dual environmental benefit of lowering emissions that destroy the ozone layer and contribute to climate change.