June 5, 2017
CT12438.00

City of Toronto
Facilities Management Division
Metro Hall, 2nd Floor
55 John Street
Toronto, Ontario
M5V 3C6

Attention: Ms. Janice Green, C.E.T.

Re: Proposed Soil Management Plan
West Toronto Railpath

Dear Ms. Green:

At the request of the City of Toronto, Facilities Management Division (the City), Terrapex Environmental Ltd. (Terrapex) is pleased to provided herein a proposed Soil Management Plan for the West Toronto Railpath, a 2.56 km former rail corridor running from Dundas Street West to Cariboo Avenue that has been redeveloped as a paved pathway for bicycle, pedestrian, and similar traffic (the site).

BACKGROUND

A number of environmental site assessment and remedial activities have been undertaken at or in the immediate vicinity of the site by various third parties to identify and address / manage environmental contaminants in soil and groundwater, including a risk assessment for the site itself. As the risk assessment identified a number of potentially unacceptable risks associated with exposures to contaminants at the site, the risk assessment proposed to establish a number of risk management measures to mitigate or block exposure pathways.

The City has requested Terrapex to prepare a clear, easy to understand Soil Management Plan to guide maintenance / construction activity that will or may involve contact with or disturbing soils at the site to ensure the ongoing integrity of risk management measures established at the site, and ensure that persons involved in maintenance or construction activity are adequately protected from exposures to environmental contaminants at the site.

At the request of the City, the Soil Management Plan has been structured to address three work scenarios:

- Activities undertaken by stewardship volunteers (i.e., members of the general public, including potentially children);
- Activities undertaken by City of Toronto staff; and,
- Activities undertaken by construction contractors retained by the City.

Individual Soil Management Plans for each of these scenarios is presented in Attachments A, B, and C, respectively. Details regarding the development of the individual Soil Management Plans are provided below.

EXPOSURE SCENARIOS

Stewardship Volunteers

It is understood that local residents and community groups have expressed interest in becoming involved in stewardship activities at the site that do not involving heavy equipment or mechanical excavating equipment. Information provided by City staff indicates that these activities would likely comprise:

- Hand-pulling and cutting weeds;
- Pruning;
- Perennial native planting;
- Bare-root tree planting; and,
- Mulching / spreading growing medium (e.g., topsoil).

With the exception of bare-root tree planting, these activities would not be expected to generate excess soils requiring relocation / disposal, nor would they involve significant excavation at the site. For example, pruning, mulching, and the spreading of growing medium would be expected to be confined to surface elevations, while perennial planting and hand-pulling of weeds would be expected to only involve contact with soils at or above the root zone (i.e., depths no greater than 200 mm or 300 mm below ground surface).

Based on information provided by City staff, bare-root tree planting could involve excavating soils to depths as great as 750 mm below surface. Because of the anticipated depth of excavation, **the Soil Management Plan specifically recommends that stewardship volunteers be prohibited from engaging in bare-root tree planting activities or similar activities involving excavation deeper than 500 mm (Attachment A).**

Further discussion regarding this recommendation is provided below.

City of Toronto Staff

Information provided by City staff indicates that City of Toronto staff activities at the site would likely comprise:

- Caliper tree planting;
- Asphalt and concrete repair;
- Installation and removal of site furniture; and,
- Excavation and installation of park programming fixtures such as signs, light standards, water fountains, etc.

Because the Soil Management Plan is recommending that stewardship volunteers be prohibited from engaging in bare-root tree planting, this activity would also be expected to be completed by City staff.

The range of potential excavation activity at the site that may be completed by City of Toronto staff would be expected to include excavation up to depths approaching 1500 mm (i.e., to establish foundations, water lines, or other services below frost elevations)[1] and would also be associated with the generation of excess soils requiring relocation and/or off-site disposal.

As outlined below, the range of activities at the site anticipated for City staff may involve excavation below risk management "caps" established at the site. Accordingly, the Soil Management Plan establishes more stringent health and safety and excavation spoils management requirements for City of Toronto staff (Attachment B) than those associated with stewardship volunteers.

Third Parties (Construction Contractors)

From time to time the City may retain third parties to undertake excavation works at the site for activities related to major infrastructure installation, maintenance, or replacement such as utilities, bridges, or other capital works. These activities could potentially involve significant excavation efforts (e.g., well beyond the 1500 mm maximum depth anticipated for City staff), and may also involve significant volumes of excess soils requiring relocation and/or off-site disposal.

Like City staff, construction contractors and other third parties retained by the City may be involved in work below risk management "caps". Consequently, the Soil Management Plan establishes

[1] Excavation efforts for caliper and bare-root tree planting would not be expected to extend below depths of 1000 mm and 750 mm, respectively, while installation of site furniture and repair of asphalt, concrete, and similar surface materials would generally be restricted to surface or near surface soils (i.e., less than 300 mm below grade).

health and safety and excavation spoils management for third parties undertaking intrusive works at the site (Attachment C) similar to those associated with City of Toronto staff.

To ensure the ongoing integrity of the risk management measures established at the site, the Soil Management Plan also requires third parties to retain a “Qualified Person” to document the make-good of any risk management “caps” disturbed or altered by the intrusive works, and to submit this documentation to the City.

DOCUMENTATION PROVIDED FOR REVIEW

The following documents have been provided to Terrapex by the City of Toronto:

- *Preliminary Site Specific Risk Assessment, CP Rail Systems, P.S. Lead, Mile 0.00 to Mile 1.59 (Project No. 970028CP).* Excerpts from a report to the Corporation of the City of Toronto prepared by CH2M Gore & Storrie Limited, January 1998.
- *Supplementary Phase II Environmental Site Investigation of CP Rail Systems P.S. Lead Mile 0.00 to 1.59 (Project No. 970028CP).* Excerpts from a report to the Corporation of the City of Toronto prepared by CH2M Gore & Storrie Limited, August 1999.
- *Risk Assessment and Risk Management Plan, City of Toronto Property Located at CP Rail P.S. Lead mile 0.00 to 1.59 off mile 5.43 of the North Toronto Subdivision.* Final report to the City of Toronto prepared by CH2M Hill, May 2007.
- Thirty-four (34) drawings, apparently prepared in 2009, that purport to illustrate “as built” conditions of the risk management measures stipulated within the Site Specific Risk Assessment
- *Report of the Phase One Environmental Site Assessment of 26 Ernest Avenue, Toronto, Ontario*. Report to Montevallo Developments Limited prepared by Candec Engineering Consultants Inc., June 7, 2013.
- *Report of the Phase Two Environmental Site Assessment of 26 Ernest Avenue, Toronto, Ontario*. Report to Montevallo Developments Limited prepared by Candec Engineering Consultants Inc., November 28, 2013.
- 182 pages of tabulated laboratory analytical results apparently pertaining to soil samples recovered from the site (undated).
- 19 page of tabulated laboratory analytical results apparently pertaining to groundwater samples recovered from the site (undated).

Other than what is identified above, Terrapex has not been provided with any other documentation relating to the site, nor have we undertaken any intrusive investigation of the site ourselves. As noted above, some of the documentation provided for review was incomplete. In particular, no

drawings or similar information relating to the locations of the 201 pages of soil and groundwater sampling data were provided to Terrapex.

Consequently, the development of the Soil Management Plan has relied upon certain assumptions regarding current site conditions, as outlined below. These assumptions are considered reasonable based on our understanding of the site history and our experience in the types of activities apparently described in the documents / partial documents referenced above. Nonetheless, it should be recognized that there remains some inherent uncertainty associated with the incomplete nature of site documentation. Should additional information regarding the site be obtained (whether it be additional intrusive testing undertaken at the site, or more complete copies of one or more of the partial documents identified above), it is recommended that the potential implications on the Soil Management Plan be considered, and that any appropriate amendments to the Soil Management Plan associated with the additional information be enacted going forward.

CURRENT SITE CONDITONS

Soil Contaminants

From the documentation provided for review (see above), it is understood that the site soils have been impacted by a variety of contaminants:

- Various metallic parameters, including, but not necessarily limited to, arsenic, barium, cadmium, copper, lead, and zinc;
- Various polycyclic aromatic hydrocarbons (PAHs), including, but not necessarily limited to, benzo(a)pyrene, benzo(b)fluoranthene, and dibenz(a,h)anthracene;
- Polychlorinated biphenyls (PCBs);
- Various volatile organic compounds (VOCs); and,
- Petroleum hydrocarbons (PHCs).

These impacts are understood to be associated with both the environmental quality of fill materials historically imported to and placed at the site (particularly from its former use as a railway corridor) as well as activities on neighbouring properties, including various above ground and underground storage tanks and industrial (manufacturing) activity. Broadly speaking, one or more of these contaminants are (or were) present across virtually the entirety of the site.

The documentation provided for review also indicates that significant remedial excavation efforts have been undertaken at the site. However, because the available documentation regarding environmental site assessment and remedial efforts is incomplete, it has not been possible to confirm that all of the identified soil contaminants at the site have been removed.

Nonetheless, the various as built drawings provided for review include several notations of "remove contaminated soils to 600 mm below finished grade", while the May 2007 Risk Assessment and Risk Management Plan report describes a need to establish risk management barriers ("contaminant barrier") to site soils. The May 2007 report also indicates that a comprehensive review of documented site conditions ("data gap analysis") was completed. It is therefore presumed that the 600 mm deep excavations documented on the as-built drawings represented areas of the site which the data gap analysis indicated soil contaminants were present at the site within 600 mm of finished grade elevation at the time of the risk assessment. It is also presumed that, at the conclusion of the site development and related activities documented on the as-built drawings, the environmental quality of site soils within 600 mm of ground surface was acceptable.

The implications of these presumptions is that contaminated soils are or may be present at the site at depths greater than 600 mm of ground surface, but would not be expected at shallower depths. Consequently, the Soil Management Plan must assume that any activity involving disturbance or contact with site soils at or below a depth of 600 mm will involve contaminated materials.

Groundwater Contaminants

The documentation provided for review suggests that groundwater at the site has been impacted by various PAH and VOC contaminants (including, but not necessarily limited to, benz(a)anthracene, phenanthrene, and trichloroethylene), and possibly PHCs as well. It appears that these impacts are not broadly distributed across the site, but are associated with point sources of contaminants. Evidence of light, non-aqueous phase liquid (LNAPL) has also been reported at the site in the vicinity of the adjacent Algoods property.

Although remedial excavation efforts could have involved the removal of sources of groundwater impact, it does not appear that any post-remedial groundwater sampling was completed, and it is consequently unclear what, if any, reduction in groundwater impacts resulted from the remedial excavation efforts. Nonetheless, it is unlikely that groundwater impacts have been fully addressed at the site, since the documentation provided for review suggests that at least some of the identified groundwater impacts at the site are actually associated with off-site sources. As a result, the Soil Management plan must assume that any site activity involving disturbance or contact with groundwater will involve contaminated materials[2].

[2] The depth to groundwater at the site is not available from the documentation provided for review; however, documentation corresponding to the adjacent 26 Ernest Avenue property (the November 28, 2013 Phase Two ESA report) suggests that groundwater is generally located between 2 and 3 m below ground surface at the property, with the shallowest apparent depth being 0.8 m below ground surface. On this basis, it has been presumed that activity undertaken at the site by stewardship volunteers – being restricted to depths no more than 500 mm below grade – would not involve contact with groundwater.

RISK MANAGEMENT REQUIREMENTS

May 2007 Risk Assessment and Risk Management Report

The May 2007 Risk Assessment and Risk Management report determined problematic exposure pathways for human health to comprise the direct contact pathways; specifically, dermal (skin) contact with PAH-contaminated soils and incidental ingestion of contaminated soils (e.g., hand to mouth transfer).

The risk management requirements outlined in the May 2007 report include:

- Establishing a barrier overtop contaminated soils to block direct contact exposure pathways, except in the cases of excavation works; and,
- Prior to initiating excavation works, developing and implementing a site specific health and safety plan that takes into account the presence of contaminated soils at the site.

As noted above, it is presumed that a barrier comprising a thickness of at least 600 mm is currently present at the site.

The May 2007 report identified the following necessary components of the required site specific health and safety plan:

- Providing education / awareness program for health effects associated with PAHs in soil.
- Proscribing personal protective equipment (PPE) to mitigate dermal contact with contaminated soils. (Gloves were specifically identified as appropriate PPE.)
- Requiring hand washing facilities to be available on-site during construction programs.

The May 2007 report also identifies a need to maintain the barrier overtop contaminated soils indefinitely (i.e., construction works that involve a complete or partial penetration of barrier must also include restorations of the barrier; if soils from beneath the barrier are excavated or otherwise disturbed, appropriate measures must be taken to ensure soils from beneath the barrier are not placed above the base of the barrier).

Additional Considerations

The May 2007 Risk Assessment and Risk Management report did not include a quantitative assessment of risk associated with contact with contaminated groundwater; however, the report did qualitatively recognize the potential for unacceptable risks to result should excavation works intersect areas of contaminated groundwater. Outside of incorporating potential concerns into the site specific health and safety plan, controls to mitigate human health exposures to groundwater contaminants were not provided in the report. Nonetheless, the Soil Management

Plans provided herein provide various measures intended to mitigate potential direct contact with contaminated groundwater.

While the risk management requirements outlined in the May 2007 Risk Assessment and Risk Management report are not considered to be especially complex or onerous to implement, it would be unreasonable to expect stewardship volunteers to fully appreciate the need to conduct their activities in what is perceived to be an unconventional manner (e.g., special PPE, segregating soils recovered from depth). Therefore activities undertaken by stewardship volunteers must be constrained to areas of the site where special precautions are not required (within the uncontaminated top 600 mm depth, with an additional 100 mm limitation as a factor of safety). This would therefore preclude the involvement of stewardship volunteers in any activity involving excavation below 500 mm, or any activity in which soil from below a depth of 500 mm might be brought to surface, such as bare root tree planting.

This restriction is also expected to ensure that stewardship volunteers would not be exposed to contaminated groundwater during their volunteer activities at the site.

CLOSURE

The work program documented herein was conducted in accordance with the terms of reference for this undertaking, agreed upon by the City of Toronto and Terrapex Environmental Ltd.

Terrapex Environmental Ltd. has exercised due care, diligence, and judgement in the performance of the peer review; however, studies of this nature have inherent limitations. Terrapex Environmental Ltd. has not undertaken any intrusive assessment of the site, and our comments, conclusions, and recommendations are based solely on the observations and data documented by third parties. By necessity, except where explicitly noted, we have relied upon the accuracy and completeness of information presented by said third parties, regardless of any disclaimers regarding reliance provided in the documentation subjected to peer review. Terrapex Environmental Ltd. does not assume any responsibility for errors, omissions, or other limitations pertaining to third party work programs.

This report has been prepared for the sole use of the City of Toronto. Terrapex Environmental Ltd. accepts no liability for claims arising from the use of this report, or from actions taken or decisions made as a result of this report, by parties other than the City of Toronto.

We trust this letter meets your current requirements. However, should you have any questions or require clarification, please do not hesitate to contact the undersigned.

Sincerely,
TERRAPEX ENVIRONMENTAL LTD.

Peter Sutton, P.Eng.
“Qualified Person” per Sec. 5 & 6, O. Reg. 153/04

attach.

ATTACHMENT A
SOIL MANAGEMENT PLAN – STEWARDSHIP VOLUNTEERS

INFORMATION FOR STEWARDSHIP VOLUNTEERS

West Toronto Railpath, Toronto, Ontario

The following document outlines important information relating to the presence of environmental contaminants at the West Toronto Railpath. It is intended to provide guidance to stewardship volunteers at the West Toronto Railpath who may be involved in activities such as:

- *Hand-pulling and cutting weeds;*
- *Pruning;*
- *Perennial native planting; and*
- *Mulching / spreading growing medium such as topsoil.*

INTRODUCTION

Environmental contaminants are known to be present within soil at the West Toronto Railpath (WTR). These contaminants generally comprise fill materials historically imported to and placed at the WTR lands and can be found across the entirety of the WTR.

Following an evaluation of potential risk to human health associated with the contaminated soils at the WTR by CH2M Hill (May, 2007), a barrier to the contaminated soils was constructed at the WTR comprising either hard surfacing underlain by granular materials and uncontaminated soil, or planting media (e.g., topsoil) underlain by uncontaminated soils has been established at the WTR. The thickness of the barrier is such that stewardship volunteers, engaging in basic maintenance / landscaping activities involving no more than shallow excavation of soils, would not come into contact with contaminated soils.

SOIL MANAGEMENT PLAN REQUIREMENTS

Stewardship volunteer activities cannot include activities involving excavation to depths greater than 50 cm below ground surface.

No other restrictions or requirements are required.

ATTACHMENT B
SOIL MANAGEMENT PLAN – CITY OF TORONTO WORKERS

INSTRUCTIONS FOR CITY STAFF

West Toronto Railpath, Toronto, Ontario

The following document is intended for provide health and safety and soil and groundwater management to City of Toronto staff working at the West Toronto Railpath. In addition to grass cutting, litter removal, and similar activities, this document presumes City staff may be involved in activities that result in contact or disturbance of site soils, such as:

- *Caliber and bare-root tree planting;*
- *Asphalt / concrete repair;*
- *Installation / removal of site furniture; and,*
- *Excavation and installation of park programming features such as signs, light standards, water fountains, etc.*

This document is not intended to be applicable to work programs undertaken by independent contractors, or by West Toronto Railpath stewardship volunteers.

INTRODUCTION

Environmental contaminants are known to be present within soil at the West Toronto Railpath (WTR). These contaminants are generally fill materials historically imported to and placed at the WTR lands and, consequently, are considered to be present across the entirety of the WTR. However, a barrier comprising either hard surfacing underlain by granular materials and uncontaminated soil, or planting media (e.g., topsoil) underlain by uncontaminated soils has been established at the WTR.

The minimum thickness of the barrier to contaminated soils is approximately 600 mm; however, the barrier does not include a warning layer or other visual indicator to indicate when the barrier has been breached. Consequently, City staff should anticipate potentially encountering contaminated soils within any excavation extending more than approximately 0.5 m below established grade.

Environmental contaminants are also known to be present within groundwater in some locations of the WTR. While groundwater impacts are not ubiquitous, the distribution of these impacts is uncertain. Consequently, City staff should assume that any groundwater encountered during excavation at the WTR is potentially contaminated.

The following provisions are required to mitigate potential risks associated with environmental contaminants to City staff involved in excavation activity at the WTR, and to ensure that the established barriers are restored at the conclusion of excavation activities.

It should be noted that for the purpose of this document “excavation” includes auger holes, test pits, or similar means of advancing into the subsurface.

WORKER EDUCATION – POTENTIALLY CONTAMINATED MATERIALS

Nature of Contaminants

Contaminants in soil are generally associated with fill materials of poor environmental quality that have been historically imported to and placed at the site, including slag, fly ash, and soil mixtures containing these materials. Contaminants in groundwater are generally associated with current and historical industrial activity in the vicinity of the WTR as well as historical railway operations at the WTR lands.

Potential Routes of Exposure

An evaluation of potential risk to human health associated with contaminated soils at the WTR by CH2M Hill (May, 20078) concluded that direct contact with soils contaminated with polycyclic aromatic hydrocarbons (or PAHs) are the most significant potential exposure pathways for workers during excavation works. Direct contact pathways include (dermal (skin) contact with contaminated soils and incidental ingestion of contaminated soils (for example, incidental soil transfer to mouth).

Incidental inhalation of contaminated materials (particulate) is also a potential direct contact pathway, but is considered an insignificant contributor to contaminant exposure, particularly when standard dust control measures are exercised during construction works.

Direct contact pathways are also considered to the most significant potential exposure pathways for workers who may encountered (potentially contaminated) groundwater.

Information related to Polycyclic Aromatic Hydrocarbons (PAHs) obtained from the Agency for Toxic Substances and Disease Registry (a federal public health agency of the United States Department of Health and Human Services) is attached to this document.

SHALLOW EXCAVATIONS / ACTIVITIES NOT INVOLVING EXCVATION

No special precautions are required for activities that do not involve excavation, or that do not involve excavation more than 500 mm below existing grade, as these activities would not involve penetrating the existing barrier at the WTR.

DEEPER EXCAVATIONS

The range of potential excavation activity at the WTR that may be completed by City of Toronto staff would be expected to include excavation up to depths approaching 1500 mm (i.e., to establish foundations, water lines, or other services below frost elevations) and would also be associated with the generation of excess soils requiring relocation and/or off-site disposal.

Where excavations will or may extend to depths more than 500 mm below existing grade, it will be necessary to undertake a number of additional precautions to:

- Ensure the health and safety of City staff;
- Ensure that soil excavation and related activities do not result in the inadvertent migration of contaminated materials to other properties;
- Ensure that any contaminated or potentially contaminated soils excavated from the site are managed / disposed of in an appropriate manner; and,
- Ensure that the existing barrier to contaminated materials is reinstated at the conclusion of the excavation works.

Health and Safety Provisions

The following provisions are meant to augment existing City of Toronto health and safety requirements, and do not replace standard or task-specific health and safety requirements.

- Long-sleeve and long pants shall be required for all workers at the job site.
- Gloves appropriate to task shall be donned during any task involving or potentially involving physical contact with soil at the WTR.
- To the extent practical, hand washing facilities or equivalent are to be available during the work program, and all workers shall be encouraged to adopt appropriate hygiene practices.
- Eating, smoking, and drinking shall not be permitted at the job site; alternatively, such activity shall be confined to an appropriate area where inadvertent / incidental dermal or oral exposure to contaminated materials would not be expected (e.g., an area well outside the excavation or inside a construction trailer).

Soil Management Provisions

- If work involves vehicular traffic at the WTR, mud matts or similar provisions shall be established at exits so as to mitigate potential tracking of contaminated soils from the site;
- Standard dust suppression techniques shall be employed so as to mitigate potential wind-blown movement of contaminated soils (particulate) from the site; and,
- All excavated soils shall be removed from the site and replaced, as necessary, with materials imported to the site directly from commercial suppliers. It should be noted that excavated soils may be contaminated, and may need to be disposed of at a licensed waste receiving facility.

As an alternative to removing and replacing excavated soils during deeper excavation works, City staff may arrange for excavation works to be overseen by a "Qualified Person" per the definition of Section 5 (2) of O. Reg. 153/04 (a "QP_{ESA}"), or by a person supervised by a Qualified Person.

The Qualified Person shall ensure that appropriate testing is completed to ensure that soils placed within 600 mm of final grade do not exceed the generic Site Condition Standards applicable for parkland property use and coarse textured soils that are set out in Table 3 of the *Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act* document dated April 15, 2011.

The testing program undertaken by the Qualified Person shall include the following parameters, as defined in the *Protocol for Analytical Methods Use in the Assessment of Properties under Part XV.1 of the Environmental Protection Act* document dated March 9, 2004, amended July 1 2011:

- Petroleum hydrocarbons (PHCs)
- Polychlorinated Biphenyls (PCBs)
- Volatile Organic Compounds I (VOCs)
- Volatile Organic Compounds II: Benzene, Toluene, Ethylbenzene, Xylene (BTEX)
- Metals
- Metals, Hydride-Forming (As, Se and Sb)
- Electrical conductivity
- Hexavalent chromium
- Mercury
- Sodium adsorption ratio (SAR)

Groundwater with Excavations

Appropriate waterproof or water-resistant clothing (including gloves, where applicable) should be worn by City staff involved in tasks involving or potentially involving contact with groundwater at the WTR.

Should it be necessary to remove accumulated water within an excavation, this removal should be completed by a licensed waste carrier under waste classification code 221 L. If non-aqueous phase liquids are encountered (NAPL, also occasionally referenced as “free phase product” or “liquid petroleum hydrocarbon”), these liquids should be removed under waste classification 221 I.

PUBLIC HEALTH STATEMENT
POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)

Division of Toxicology **August 1995**

This Public Health Statement is the summary chapter from the Toxicological Profile for Polycyclic Aromatic Hydrocarbons (PAHs). It is one in a series of Public Health Statements about hazardous substances and their health effects. A shorter version, the ToxFAQs™, is also available. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present. For more information, call the ATSDR Information Center at 1-888-422-8737.

This statement was prepared to give you information about polycyclic aromatic hydrocarbons (PAHs) and to emphasize the human health effects that may result from exposure to them. The Environmental Protection Agency (EPA) has identified 1,408 hazardous waste sites as the most serious in the nation. These sites make up the National Priorities List (NPL) and are the sites targeted for long-term federal clean-up activities. PAHs have been found in at least 600 of the sites on the NPL. However, the number of NPL sites evaluated for PAHs is not known. As EPA evaluates more sites, the number of sites at which PAHs are found may increase. This information is important because exposure to PAHs may cause harmful health effects and because these sites are potential or actual sources of human exposure to PAHs.

When a substance is released from a large area, such as an industrial plant, or from a container, such as a drum or bottle, it enters the environment. This release does not always lead to exposure. You can be exposed to a substance only when you come in contact with it. You may be exposed by breathing, eating, or drinking substances containing the substance or by skin contact with it.

If you are exposed to substances such as PAHs, many factors will determine whether harmful health effects will occur and what the type and severity of those health effects will be. These factors include the dose (how much), the duration (how long), the route or pathway by which you are exposed (breathing, eating, drinking, or skin contact), the other chemicals to which you are exposed, and your individual characteristics such as age, sex, nutritional status, family traits, lifestyle, and state of health.

1.1 WHAT ARE PAHs?

PAHs are a group of chemicals that are formed during the incomplete burning of coal, oil, gas, wood, garbage, or other organic substances, such as tobacco and charbroiled meat. There are more than 100 different PAHs. PAHs generally occur as complex mixtures (for example, as part of combustion products such as soot), not as single compounds. PAHs usually occur naturally, but they can be manufactured as individual compounds for research purposes; however, not as the mixtures found in combustion products. As pure chemicals, PAHs generally exist as colorless, white, or pale yellow-green solids. They can have a faint, pleasant odor. A few PAHs are used in medicines and to make dyes, plastics, and pesticides. Others are contained in asphalt used in road construction. They can also be found in substances such as crude oil, coal, coal tar pitch, creosote, and roofing tar. They are found throughout the environment in the air, water, and soil. They can occur in the air, either

attached to dust particles or as solids in soil or sediment.

Although the health effects of individual PAHs are not exactly alike, the following 17 PAHs are considered as a group in this profile:
acenaphthene
acenaphthylene
anthracene
benz[a]anthracene
benzo[a]pyrene
benzo[e]pyrene
benzo[b]fluoranthene
benzo[g,h,i]perylene
benzo[j]fluoranthene
benzo[k]fluoranthene
chrysene
dibenz[a,h]anthracene
fluoranthene
fluorene
indeno[1,2,3-c,d]pyrene
phenanthrene
pyrene
These 17 PAHs were chosen to be included in this profile because (1) more information is available on these than on the others; (2) they are suspected to be more harmful than some of the others, and they exhibit harmful effects that are representative of the PAHs; (3) there is a greater chance that you will be exposed to these PAHs than to the others; and (4) of all the PAHs analyzed, these were the PAHs identified at the highest concentrations at NPL hazardous waste sites.

1.2 WHAT HAPPENS TO PAHs WHEN THEY ENTER THE ENVIRONMENT?

PAHs enter the environment mostly as releases to air from volcanoes, forest fires, residential wood burning, and exhaust from automobiles and trucks. They can also enter surface water through discharges from industrial plants and waste water treatment plants, and they can be released to soils at hazardous waste sites if they escape from storage containers. The movement of PAHs in the environment depends on properties such as how easily they dissolve in water, and how easily they evaporate into the air. PAHs in general do not easily dissolve in water. They are present in air as vapors or stuck to the surfaces of small solid particles. They can travel long distances before they return to earth in rainfall or particle settling. Some PAHs evaporate into the atmosphere from surface waters, but most stick to solid particles and settle to the bottoms of rivers or lakes. In soils, PAHs are most likely to stick tightly to particles. Some PAHs evaporate from surface soils to air. Certain PAHs in soils also contaminate underground water. The PAH content of plants and animals living on the land or in water can be many times higher than the content of PAHs in soil or water. PAHs can break down to longer-lasting products by reacting with sunlight and other chemicals in the air, generally over a period of days to weeks. Breakdown in soil and water generally takes weeks to months and is caused primarily by the actions of microorganisms.

1.3 HOW MIGHT I BE EXPOSED TO PAHs?

PAHs are present throughout the environment, and you may be exposed to these substances at home, outside, or at the workplace. Typically, you will not be exposed to an individual PAH, but to a mixture of PAHs.

In the environment, you are most likely to be exposed to PAH vapors or PAHs that are attached to dust and other particles in the air. Sources include

cigarette smoke, vehicle exhausts, asphalt roads, coal, coal tar, wildfires, agricultural burning, residential wood burning, municipal and industrial waste incineration, and hazardous waste sites. Background levels of some representative PAHs in the air are reported to be 0.02–1.2 nanograms per cubic meter (ng/m³; a nanogram is one-millionth of a milligram) in rural areas and 0.15–19.3 ng/m³ in urban areas. You may be exposed to PAHs in soil near areas where coal, wood, gasoline, or other products have been burned. You may be exposed to PAHs in the soil at or near hazardous waste sites, such as former manufactured-gas factory sites and wood-preserving facilities. PAHs have been found in some drinking water supplies in the United States. Background levels of PAHs in drinking water range from 4 to 24 nanograms per liter (ng/L; a liter is slightly more than a quart).

In the home, PAHs are present in tobacco smoke, smoke from wood fires, creosote-treated wood products, cereals, grains, flour, bread, vegetables, fruits, meat, processed or pickled foods, and contaminated cow's milk or human breast milk. Food grown in contaminated soil or air may also contain PAHs. Cooking meat or other food at high temperatures, which happens during grilling or charring, increases the amount of PAHs in the food. The level of PAHs in the typical U.S. diet is less than 2 parts of total PAHs per billion parts of food (ppb), or less than 2 micrograms per kilogram of food (µg/kg; a microgram is one-thousandth of a milligram).

The primary sources of exposure to PAHs for most of the U.S. population are inhalation of the compounds in tobacco smoke, wood smoke, and ambient air, and consumption of PAHs in foods. For some people, the primary exposure to PAHs occurs in the workplace. PAHs have been found in coal tar production plants, coking plants, bitumen and asphalt production plants, coal-gasification sites, smoke houses, aluminum production plants, coal tarring facilities, and municipal trash incinerators. Workers may be exposed to PAHs by inhaling engine exhaust and by using products that contain PAHs in a variety of industries such as mining, oil refining, metalworking, chemical production, transportation, and the electrical industry. PAHs have also been found in other facilities where petroleum, petroleum products, or coal are used or where wood, cellulose, corn, or oil are burned. People living near waste sites containing PAHs may be exposed through contact with contaminated air, water, and soil.

1.4 HOW CAN PAHs ENTER AND LEAVE MY BODY?

PAHs can enter your body through your lungs when you breathe air that contains them (usually stuck to particles or dust). Cigarette smoke, wood smoke, coal smoke, and smoke from many industrial sites may contain PAHs. People living near hazardous waste sites can also be exposed by breathing air containing PAHs. However, it is not known how rapidly or completely your lungs absorb PAHs. Drinking water and swallowing food, soil, or dust particles that contain PAHs are other routes for these chemicals to enter your body, but absorption is generally slow when PAHs are swallowed. Under normal conditions of environmental exposure, PAHs could enter your body if your skin comes into contact with soil that contains high levels of PAHs (this could occur near a hazardous waste site) or with used crankcase oil or other products (such as creosote) that contain PAHs. The rate at which PAHs enter your body by eating, drinking, or

through the skin can be influenced by the presence of other compounds that you may be exposed to at the same time with PAHs. PAHs can enter all the tissues of your body that contain fat. They tend to be stored mostly in your kidneys, liver, and fat. Smaller amounts are stored in your spleen, adrenal glands, and ovaries. PAHs are changed by all tissues in the body into many different substances. Some of these substances are more harmful and some are less harmful than the original PAHs. Results from animal studies show that PAHs do not tend to be stored in your body for a long time. Most PAHs that enter the body leave within a few days, primarily in the feces and urine.

1.5 HOW CAN PAHs AFFECT MY HEALTH?

PAHs can be harmful to your health under some circumstances. Several of the PAHs, including benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[j]fluoranthene, benzo[k]fluoranthene, chrysene, dibenz[a,h]anthracene, and indeno[1,2,3-c,d]pyrene, have caused tumors in laboratory animals when they breathed these substances in the air, when they ate them, or when they had long periods of skin contact with them. Studies of people show that individuals exposed by breathing or skin contact for long periods to mixtures that contain PAHs and other compounds can also develop cancer.

Mice fed high levels of benzo[a]pyrene during pregnancy had difficulty reproducing and so did their offspring. The offspring of pregnant mice fed benzo[a]pyrene also showed other harmful effects, such as birth defects and decreased body weight. Similar effects could occur in people, but we have no information to show that these effects do occur.

Studies in animals have also shown that PAHs can cause harmful effects on skin, body fluids, and the body's system for fighting disease after both short- and long-term exposure. These effects have not been reported in people.

The Department of Health and Human Services (DHHS) has determined that benz[a]anthracene, benzo[b]fluoranthene, benzo[j]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, dibenz[a,h]anthracene, and indeno[1,2,3-c,d]pyrene are known animal carcinogens. The International Agency for Research on Cancer (IARC) has determined the following: benz[a]anthracene and benzo[a]pyrene are probably carcinogenic to humans; benzo[b]fluoranthene, benzo[j]fluoranthene, benzo[k]fluoranthene, and indeno[1,2,3-c,d]pyrene are possibly carcinogenic to humans; and anthracene, benzo[g,h,i]perylene, benzo[e]pyrene, chrysene, fluoranthene, fluorene, phenanthrene, and pyrene are not classifiable as to their carcinogenicity to humans. EPA has determined that benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, dibenz[a,h]anthracene, and indeno[1,2,3-c,d]pyrene are probable human carcinogens and that acenaphthylene, anthracene, benzo[g,h,i]perylene, fluoranthene, fluorene, phenanthrene, and pyrene are not classifiable as to human carcinogenicity. Acenaphthene has not been classified for carcinogenic effects by the DHHS, IARC, or EPA.

1.6 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO PAHs?

In your body, PAHs are changed into chemicals that can attach to substances within the body. The presence of PAHs attached to these substances can

then be measured in body tissues or blood after exposure to PAHs. PAHs or their metabolites can also be measured in urine, blood, or body tissues. Although these tests can show that you have been exposed to PAHs, these tests cannot be used to predict whether any health effects will occur or to determine the extent or source of your exposure to the PAHs. It is not known how effective or informative the tests are after exposure is discontinued. These tests to identify PAHs or their products are not routinely available at a doctor's office because special equipment is required to detect these chemicals.

1.7 WHAT RECOMMENDATIONS HAS THE FEDERAL GOVERNMENT MADE TO PROTECT HUMAN HEALTH?

The federal government has set regulations to protect people from the possible health effects of eating, drinking, or breathing PAHs. EPA has suggested that taking into your body each day the following amounts of individual PAHs is not likely to cause any harmful health effects: 0.3 milligrams (mg) of anthracene, 0.06 mg of acenaphthene, 0.04 mg of fluoranthene, 0.04 mg of fluorene, and 0.03 mg of pyrene per kilogram (kg) of your body weight (one kilogram is equal to 2.2 pounds). Actual exposure for most of the United States population occurs from active or passive inhalation of the compounds in tobacco smoke, wood smoke, and contaminated air, and from eating the compounds in foods. Skin contact with contaminated water, soot, tar, and soil may also occur. Estimates for total exposure in the United States population have been listed as 3 mg/day.

From what is currently known about benzo[a]pyrene, the federal government has developed regulatory standards and guidelines to protect people from the potential health effects of PAHs in drinking water. EPA has provided estimates of levels of total cancer-causing PAHs in lakes and streams associated with a risk of human cancer development. If the following amounts of individual PAHs are released to the environment within a 24-hour period, EPA must be notified: 1 pound of benzo[b]fluoranthene, benzo[a]pyrene, or dibenz[a,h]anthracene; 10 pounds of benz[a]anthracene; 100 pounds of acenaphthene, chrysene, fluoranthene, or indeno[1,2,3-c,d]pyrene; or 5,000 pounds of acenaphthylene, anthracene, benzo[k]fluoranthene, benzo[g,h,i]perylene, fluorene, phenanthrene, or pyrene.

PAHs are generally not produced commercially in the United States except as research chemicals. However, PAHs are found in coal, coal tar, and in the creosote oils, oil mists, and pitches formed from the distillation of coal tars. The National Institute for Occupational Safety and Health (NIOSH) concluded that occupational exposure to coal products can increase the risk of lung and skin cancer in workers. NIOSH established a recommended occupational exposure limit, time-weighted average (REL-TWA) for coal tar products of 0.1 milligram of PAHs per cubic meter of air (0.1 mg/m^3) for a 10-hour workday, within a 40-hour workweek. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends an occupational exposure limit for coal tar products of 0.2 mg/m^3 for an 8-hour workday, within a 40-hour workweek. The Occupational Safety and Health Administration (OSHA) has

established a legally enforceable limit of 0.2 mg/m³ averaged over an 8-hour exposure period.

Mineral oil mists have been given an IARC classification of 1 (sufficient evidence of carcinogenicity). The OSHA Permissible Exposure Limit (PEL) for mineral oil mist is 5 mg/m³ averaged over an 8-hour exposure period. NIOSH has concurred with this limit, and has established a recommended occupational exposure limit (REL-TWA) for mineral oil mists of 5 mg/m³ for a 10-hour work day, 40-hour work week, with a 10 mg/m³ Short Term Exposure Limit (STEL).

1.8 WHERE CAN I GET MORE INFORMATION?

If you have any more questions or concerns, please contact your community or state health or environmental quality department or:

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road NE, Mailstop F-32
Atlanta, GA 30333

Information line and technical assistance:

Phone: 888-422-8737
FAX: (770)-488-4178

ATSDR can also tell you the location of occupational and environmental health clinics. These clinics specialize in recognizing, evaluating, and treating illnesses resulting from exposure to hazardous substances.

To order toxicological profiles, contact:

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Phone: 800-553-6847 or 703-605-6000

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 1995. Toxicological profile for polycyclic aromatic hydrocarbons (PAHs). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Polycyclic Aromatic Hydrocarbons (PAHs) - ToxFAQs™

This fact sheet answers the most frequently asked health questions (FAQs) about polycyclic aromatic hydrocarbons (PAHs). For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to polycyclic aromatic hydrocarbons usually occurs by breathing air contaminated by wild fires or coal tar, or by eating foods that have been grilled. PAHs have been found in at least 600 of the 1,430 National Priorities List (NPL) sites identified by the Environmental Protection Agency (EPA).

What are polycyclic aromatic hydrocarbons?

(Pronounced pŏl′ĭ-sī′klĭk ăr′ə-măt′ĭk hī′drə-kar′bənz)

Polycyclic aromatic hydrocarbons (PAHs) are a group of over 100 different chemicals that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat. PAHs are usually found as a mixture containing two or more of these compounds, such as soot.

Some PAHs are manufactured. These pure PAHs usually exist as colorless, white, or pale yellow-green solids. PAHs are found in coal tar, crude oil, creosote, and roofing tar, but a few are used in medicines or to make dyes, plastics, and pesticides.

What happens to PAHs when they enter the environment?

- PAHs enter the air mostly as releases from volcanoes, forest fires, burning coal, and automobile exhaust.
- PAHs can occur in air attached to dust particles.
- Some PAH particles can readily evaporate into the air from soil or surface waters.
- PAHs can break down by reacting with sunlight and other chemicals in the air, over a period of days to weeks.
- PAHs enter water through discharges from industrial and wastewater treatment plants.
- Most PAHs do not dissolve easily in water. They stick to solid particles and settle to the bottoms of lakes or rivers.
- Microorganisms can break down PAHs in soil or water after a period of weeks to months.
- In soils, PAHs are most likely to stick tightly to particles; certain PAHs move through soil to contaminate underground water.
- PAH contents of plants and animals may be much higher than PAH contents of soil or water in which they live.

How might I be exposed to PAHs?

- Breathing air containing PAHs in the workplace of coking, coal-tar, and asphalt production plants; smokehouses; and municipal trash incineration facilities.
- Breathing air containing PAHs from cigarette smoke, wood smoke, vehicle exhausts, asphalt roads, or agricultural burn smoke.
- Coming in contact with air, water, or soil near hazardous waste sites.
- Eating grilled or charred meats; contaminated cereals, flour, bread, vegetables, fruits, meats; and processed or pickled foods.
- Drinking contaminated water or cow's milk.
- Nursing infants of mothers living near hazardous waste sites may be exposed to PAHs through their mother's milk.

Polycyclic Aromatic Hydrocarbons

How can PAHs affect my health?

Mice that were fed high levels of one PAH during pregnancy had difficulty reproducing and so did their offspring. These offspring also had higher rates of birth defects and lower body weights. It is not known whether these effects occur in people.

Animal studies have also shown that PAHs can cause harmful effects on the skin, body fluids, and ability to fight disease after both short- and long-term exposure. But these effects have not been seen in people.

How likely are PAHs to cause cancer?

The Department of Health and Human Services (DHHS) has determined that some PAHs may reasonably be expected to be carcinogens.

Some people who have breathed or touched mixtures of PAHs and other chemicals for long periods of time have developed cancer. Some PAHs have caused cancer in laboratory animals when they breathed air containing them (lung cancer), ingested them in food (stomach cancer), or had them applied to their skin (skin cancer).

Is there a medical test to show whether I've been exposed to PAHs?

In the body, PAHs are changed into chemicals that can attach to substances within the body. There are special tests that can detect PAHs attached to these substances in body tissues or blood. However, these tests cannot tell whether any health effects will occur or find out the extent or source of your exposure to the PAHs. The tests aren't usually available in your doctor's office because special equipment is needed to conduct them.

Has the federal government made recommendations to protect human health?

The Occupational Safety and Health Administration (OSHA) has set a limit of 0.2 milligrams of PAHs per cubic meter of air (0.2 mg/m^3). The OSHA Permissible Exposure Limit (PEL) for mineral oil mist that contains PAHs is 5 mg/m^3 averaged over an 8-hour exposure period.

The National Institute for Occupational Safety and Health (NIOSH) recommends that the average workplace air levels for coal tar products not exceed 0.1 mg/m^3 for a 10-hour workday, within a 40-hour workweek. There are other limits for workplace exposure for things that contain PAHs, such as coal, coal tar, and mineral oil.

Glossary

Carcinogen: A substance that can cause cancer.

Ingest: Take food or drink into your body.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1995. Toxicological profile for polycyclic aromatic hydrocarbons. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636.

ToxFAQs™ Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp.

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATTACHMENT C
SOIL MANAGEMENT PLAN – THIRD PARTY CONTRACTORS

INSTRUCTIONS FOR CONTRACTORS UNDERTAKING EXCAVATION WORKS

West Toronto Railpath, Toronto, Ontario

The following document is intended for provision to contractors / potential contractors who may engage in intrusive works at the West Toronto Railpath such as major infrastructure installation, maintenance, or replacements (e.g., bridges, utilities), or other capital works.

INTRODUCTION

Environmental contaminants are known to be present within soil at the West Toronto Railpath (WTR). These contaminants are generally fill materials historically imported to and placed at the WTR lands and, consequently, are considered to be present across the entirety of the WTR. However, a barrier comprising either hard surfacing underlain by granular materials and uncontaminated soil, or planting media (e.g., topsoil) underlain by uncontaminated soils has been established at the WTR.

The minimum thickness of the barrier to contaminated soils is approximately 600 mm; however, the barrier does not include a warning layer or other visual indicator to indicate when the barrier has been breached. Consequently, contractors should anticipate potentially encountering contaminated soils within any excavation extending more than approximately 0.5 m below established grade.

Environmental contaminants are also known to be present within groundwater in some locations of the WTR. While groundwater impacts are not ubiquitous, the distribution of these impacts is uncertain. Consequently, contractors should assume that any groundwater encountered during excavation at the WTR is potentially contaminated.

The following provisions are required to mitigate potential risks associated with environmental contaminants to workers involved in excavation activity at the WTR, and to ensure that the established barriers are restored at the conclusion of excavation activities.

It should be noted that for the purpose of this document “excavation” including auger holes, test pits, or similar means of advancing into the subsurface.

HEALTH AND SAFETY PROVISIONS

The following provisions are meant to augment contractor health and safety planning, documentation, and record keeping requirements. It is expected that contractors will have their

own preferred format for health and safety planning, documentation, and record keeping; the items listed below.

Worker Education – Potentially Contaminated Materials

In keeping with the general intent of federal and provincial workplace safety legislation, workers should be informed of the presence of contaminated materials at the work site, and provided with appropriate information to assist them in understanding the potential risks associated with encountering contaminated materials.

Nature of Contaminants: Contaminants in soil are generally associated with fill materials of poor environmental quality that have been historically imported to and placed at the site, including slag, fly ash, and soil mixtures containing these materials.

Contaminants in groundwater are generally associated with current and historical industrial activity in the vicinity of the WTR as well as historical railway operations at the WTR lands.

Potential Routes of Exposure: An evaluation of potential risk to human health associated with contaminated soils at the WTR by CH2M Hill (May, 2007) concluded that direct contact with soils contaminated with polycyclic aromatic hydrocarbons (or PAHs) are the most significant potential exposure pathways for workers during excavation works. Direct contact pathways include (dermal (skin) contact with contaminated soils and incidental ingestion of contaminated soils (for example, incidental soil transfer to mouth).

Incidental inhalation of contaminated materials (particulate) is also a potential direct contact pathway, but is considered an insignificant contributor to contaminant exposure, particularly when standard dust control measures are exercised during construction works.

Direct contact pathways are also considered to the most significant potential exposure pathways for workers who may encountered (potentially contaminated) groundwater.

Information related to Polycyclic Aromatic Hydrocarbons (PAHs) obtained from the Agency for Toxic Substances and Disease Registry (a federal public health agency of the United States Department of Health and Human Services) is attached to this document.

Specific Health and Safety Provisions

To mitigate exposures of on-site workers via direct contact pathways, the following provisions are recommended for incorporation into the overall Health and Safety Plan. It is expected that these measures would be applicable for the entirety of the excavation works:

- Long-sleeve and long pants shall be required for all workers at the job site.

- Gloves appropriate to task shall be donned during any task involving or potentially involving physical contact with soil at the WTR.
- Appropriate waterproof or water-resistant clothing (including gloves, where applicable) shall be worn by workers involved in tasks involving or potentially involving contact with groundwater at the WTR.
- Hand washing facilities are to be provided for the job site, and all workers shall be encouraged to adopt appropriate hygiene practices.
- Eating, smoking, and drinking shall not be permitted at the job site; alternatively, such activity shall be confined to an appropriate area where inadvertent / incidental dermal or oral exposure to contaminated materials would not be expected, such as an area well outside the excavation or inside a construction trailer.

SOIL MANAGEMENT PROVISIONS

Prior to the commencement of any excavating activity, the contractor shall have prepared and implement a written Soil Management Protocol in accordance with the requirements outlined below.

The Soil Management Protocol should be prepared by or under the supervision of a "Qualified Person" per the definition of Section 5 (2) of O. Reg. 153/04 (a "QP_{ESA}") and be intended to meet the following objectives:

i. Ensuring that the soil excavation and related activities do not result in the migration of contaminated materials to other properties (other than the disposal of such materials at appropriately licensed waste receiving facilities).

ii. Ensuring that soils excavated from the site are managed / disposed of in a manner consistent with the requirements of the Ontario *Environmental Protection Act* and associated regulations, including the *General – Waste Management* regulation (O. Reg. 347); and,

iii. Ensuring that the existing barrier to contaminated materials is reinstated at the conclusion of the excavation works.

The Soil Management Protocol would address excavation, stockpiling, sorting, characterization, disposal and record keeping requirements, including but not limited to:

- Dust control measures and prevention of soil tracking by vehicles and personnel from the Site, including wetting of soil with potable water, reduced speeds for on-Site vehicles, tire washing stations, and restricting working areas in high wind conditions;

- Management of excavated materials including cleaning equipment, placement of materials for stockpiling on designated areas lined and covered with polyethylene sheeting, bermed and fenced to prevent access, runoff control to minimize contact and provisions for discharge to sanitary sewers or other approved treatment;
- Characterization of excavated material to determine if materials exceed the applicable generic Site Condition Standards (see below);
- The sampling and laboratory analyses of all soils placed within 600 mm of final grade, with sampling completed in accordance with the frequency and similar requirements set out in Section 34 of Schedule E of O. Reg. 153/04; and,
- Record keeping, including dates and duration of work, weather and Site conditions, location and depth of excavation activities, dust control measures, stockpile management and drainage, all material characterization results, names of the Qualified Person, contractors, haulers and receiving locations for any materials removed from the Site, and any complaints received relating to Site activities.

The environmental quality of soils placed within 600 mm of final grade shall not exceed the generic Site Condition Standards for parkland property use and coarse textured soils that are set out in Table 3 of the *Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act* document dated April 15, 2011.

The testing program undertaken by the Qualified Person shall include the following parameters, as defined in the *Protocol for Analytical Methods Use in the Assessment of Properties under Part XV.1 of the Environmental Protection Act* document dated March 9, 2004, amended July 1 2011:

- Petroleum hydrocarbons (PHCs)
- Polychlorinated Biphenyls (PCBs)
- Volatile Organic Compounds I (VOCs)
- Volatile Organic Compounds II: Benzene, Toluene, Ethylbenzene, Xylene (BTEX)
- Metals
- Metals, Hydride-Forming (As, Se and Sb)
- Electrical conductivity
- Hexavalent chromium
- Mercury
- Sodium adsorption ratio (SAR)

For projects that will or may also include encountering groundwater, the Soil Management Protocol shall also describe requirements relating to:

- Management of groundwater removals, including temporary containment, environmental quality characterization, treatment, and final disposition requirements; and,

- Record keeping, including dates and duration of work, weather and Site conditions, location and depth of water extractions, names of the Qualified Person(s), contractors, waste haulers and receiving locations for any waters removed from the Site, and any complaints received relating to Site activities.

Implementation of the Soil Management Protocol shall be supervised by the Qualified Person who prepared by the plan. Upon completion of the excavation works, the Qualified Person shall prepare a report documenting the implementation of the Soil Management Protocol, including sampling and laboratory analytical results, and plan view and cross section view drawings that illustrates the lateral and vertical extent of the excavation works and the reinstated barriers to contaminated soils.

PUBLIC HEALTH STATEMENT
POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)

Division of Toxicology **August 1995**

This Public Health Statement is the summary chapter from the Toxicological Profile for Polycyclic Aromatic Hydrocarbons (PAHs). It is one in a series of Public Health Statements about hazardous substances and their health effects. A shorter version, the ToxFAQs™, is also available. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present. For more information, call the ATSDR Information Center at 1-888-422-8737.

This statement was prepared to give you information about polycyclic aromatic hydrocarbons (PAHs) and to emphasize the human health effects that may result from exposure to them. The Environmental Protection Agency (EPA) has identified 1,408 hazardous waste sites as the most serious in the nation. These sites make up the National Priorities List (NPL) and are the sites targeted for long-term federal clean-up activities. PAHs have been found in at least 600 of the sites on the NPL. However, the number of NPL sites evaluated for PAHs is not known. As EPA evaluates more sites, the number of sites at which PAHs are found may increase. This information is important because exposure to PAHs may cause harmful health effects and because these sites are potential or actual sources of human exposure to PAHs.

When a substance is released from a large area, such as an industrial plant, or from a container, such as a drum or bottle, it enters the environment. This release does not always lead to exposure. You can be exposed to a substance only when you come in contact with it. You may be exposed by breathing, eating, or drinking substances containing the substance or by skin contact with it.

If you are exposed to substances such as PAHs, many factors will determine whether harmful health effects will occur and what the type and severity of those health effects will be. These factors include the dose (how much), the duration (how long), the route or pathway by which you are exposed (breathing, eating, drinking, or skin contact), the other chemicals to which you are exposed, and your individual characteristics such as age, sex, nutritional status, family traits, lifestyle, and state of health.

1.1 WHAT ARE PAHs?

PAHs are a group of chemicals that are formed during the incomplete burning of coal, oil, gas, wood, garbage, or other organic substances, such as tobacco and charbroiled meat. There are more than 100 different PAHs. PAHs generally occur as complex mixtures (for example, as part of combustion products such as soot), not as single compounds. PAHs usually occur naturally, but they can be manufactured as individual compounds for research purposes; however, not as the mixtures found in combustion products. As pure chemicals, PAHs generally exist as colorless, white, or pale yellow-green solids. They can have a faint, pleasant odor. A few PAHs are used in medicines and to make dyes, plastics, and pesticides. Others are contained in asphalt used in road construction. They can also be found in substances such as crude oil, coal, coal tar pitch, creosote, and roofing tar. They are found throughout the environment in the air, water, and soil. They can occur in the air, either

attached to dust particles or as solids in soil or sediment.

Although the health effects of individual PAHs are not exactly alike, the following 17 PAHs are considered as a group in this profile:
acenaphthene
acenaphthylene
anthracene
benz[a]anthracene
benzo[a]pyrene
benzo[e]pyrene
benzo[b]fluoranthene
benzo[g,h,i]perylene
benzo[j]fluoranthene
benzo[k]fluoranthene
chrysene
dibenz[a,h]anthracene
fluoranthene
fluorene
indeno[1,2,3-c,d]pyrene
phenanthrene
pyrene
These 17 PAHs were chosen to be included in this profile because (1) more information is available on these than on the others; (2) they are suspected to be more harmful than some of the others, and they exhibit harmful effects that are representative of the PAHs; (3) there is a greater chance that you will be exposed to these PAHs than to the others; and (4) of all the PAHs analyzed, these were the PAHs identified at the highest concentrations at NPL hazardous waste sites.

1.2 WHAT HAPPENS TO PAHs WHEN THEY ENTER THE ENVIRONMENT?

PAHs enter the environment mostly as releases to air from volcanoes, forest fires, residential wood burning, and exhaust from automobiles and trucks. They can also enter surface water through discharges from industrial plants and waste water treatment plants, and they can be released to soils at hazardous waste sites if they escape from storage containers. The movement of PAHs in the environment depends on properties such as how easily they dissolve in water, and how easily they evaporate into the air. PAHs in general do not easily dissolve in water. They are present in air as vapors or stuck to the surfaces of small solid particles. They can travel long distances before they return to earth in rainfall or particle settling. Some PAHs evaporate into the atmosphere from surface waters, but most stick to solid particles and settle to the bottoms of rivers or lakes. In soils, PAHs are most likely to stick tightly to particles. Some PAHs evaporate from surface soils to air. Certain PAHs in soils also contaminate underground water. The PAH content of plants and animals living on the land or in water can be many times higher than the content of PAHs in soil or water. PAHs can break down to longer-lasting products by reacting with sunlight and other chemicals in the air, generally over a period of days to weeks. Breakdown in soil and water generally takes weeks to months and is caused primarily by the actions of microorganisms.

1.3 HOW MIGHT I BE EXPOSED TO PAHs?

PAHs are present throughout the environment, and you may be exposed to these substances at home, outside, or at the workplace. Typically, you will not be exposed to an individual PAH, but to a mixture of PAHs.

In the environment, you are most likely to be exposed to PAH vapors or PAHs that are attached to dust and other particles in the air. Sources include

cigarette smoke, vehicle exhausts, asphalt roads, coal, coal tar, wildfires, agricultural burning, residential wood burning, municipal and industrial waste incineration, and hazardous waste sites. Background levels of some representative PAHs in the air are reported to be 0.02–1.2 nanograms per cubic meter (ng/m³; a nanogram is one-millionth of a milligram) in rural areas and 0.15–19.3 ng/m³ in urban areas. You may be exposed to PAHs in soil near areas where coal, wood, gasoline, or other products have been burned. You may be exposed to PAHs in the soil at or near hazardous waste sites, such as former manufactured-gas factory sites and wood-preserving facilities. PAHs have been found in some drinking water supplies in the United States. Background levels of PAHs in drinking water range from 4 to 24 nanograms per liter (ng/L; a liter is slightly more than a quart).

In the home, PAHs are present in tobacco smoke, smoke from wood fires, creosote-treated wood products, cereals, grains, flour, bread, vegetables, fruits, meat, processed or pickled foods, and contaminated cow's milk or human breast milk. Food grown in contaminated soil or air may also contain PAHs. Cooking meat or other food at high temperatures, which happens during grilling or charring, increases the amount of PAHs in the food. The level of PAHs in the typical U.S. diet is less than 2 parts of total PAHs per billion parts of food (ppb), or less than 2 micrograms per kilogram of food (µg/kg; a microgram is one-thousandth of a milligram).

The primary sources of exposure to PAHs for most of the U.S. population are inhalation of the compounds in tobacco smoke, wood smoke, and ambient air, and consumption of PAHs in foods. For some people, the primary exposure to PAHs occurs in the workplace. PAHs have been found in coal tar production plants, coking plants, bitumen and asphalt production plants, coal-gasification sites, smoke houses, aluminum production plants, coal tarring facilities, and municipal trash incinerators. Workers may be exposed to PAHs by inhaling engine exhaust and by using products that contain PAHs in a variety of industries such as mining, oil refining, metalworking, chemical production, transportation, and the electrical industry. PAHs have also been found in other facilities where petroleum, petroleum products, or coal are used or where wood, cellulose, corn, or oil are burned. People living near waste sites containing PAHs may be exposed through contact with contaminated air, water, and soil.

1.4 HOW CAN PAHs ENTER AND LEAVE MY BODY?

PAHs can enter your body through your lungs when you breathe air that contains them (usually stuck to particles or dust). Cigarette smoke, wood smoke, coal smoke, and smoke from many industrial sites may contain PAHs. People living near hazardous waste sites can also be exposed by breathing air containing PAHs. However, it is not known how rapidly or completely your lungs absorb PAHs. Drinking water and swallowing food, soil, or dust particles that contain PAHs are other routes for these chemicals to enter your body, but absorption is generally slow when PAHs are swallowed. Under normal conditions of environmental exposure, PAHs could enter your body if your skin comes into contact with soil that contains high levels of PAHs (this could occur near a hazardous waste site) or with used crankcase oil or other products (such as creosote) that contain PAHs. The rate at which PAHs enter your body by eating, drinking, or

through the skin can be influenced by the presence of other compounds that you may be exposed to at the same time with PAHs. PAHs can enter all the tissues of your body that contain fat. They tend to be stored mostly in your kidneys, liver, and fat. Smaller amounts are stored in your spleen, adrenal glands, and ovaries. PAHs are changed by all tissues in the body into many different substances. Some of these substances are more harmful and some are less harmful than the original PAHs. Results from animal studies show that PAHs do not tend to be stored in your body for a long time. Most PAHs that enter the body leave within a few days, primarily in the feces and urine.

1.5 HOW CAN PAHs AFFECT MY HEALTH?

PAHs can be harmful to your health under some circumstances. Several of the PAHs, including benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[j]fluoranthene, benzo[k]fluoranthene, chrysene, dibenz[a,h]anthracene, and indeno[1,2,3-c,d]pyrene, have caused tumors in laboratory animals when they breathed these substances in the air, when they ate them, or when they had long periods of skin contact with them. Studies of people show that individuals exposed by breathing or skin contact for long periods to mixtures that contain PAHs and other compounds can also develop cancer.

Mice fed high levels of benzo[a]pyrene during pregnancy had difficulty reproducing and so did their offspring. The offspring of pregnant mice fed benzo[a]pyrene also showed other harmful effects, such as birth defects and decreased body weight. Similar effects could occur in people, but we have no information to show that these effects do occur.

Studies in animals have also shown that PAHs can cause harmful effects on skin, body fluids, and the body's system for fighting disease after both short- and long-term exposure. These effects have not been reported in people.

The Department of Health and Human Services (DHHS) has determined that benz[a]anthracene, benzo[b]fluoranthene, benzo[j]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, dibenz[a,h]anthracene, and indeno[1,2,3-c,d]pyrene are known animal carcinogens. The International Agency for Research on Cancer (IARC) has determined the following: benz[a]anthracene and benzo[a]pyrene are probably carcinogenic to humans; benzo[b]fluoranthene, benzo[j]fluoranthene, benzo[k]fluoranthene, and indeno[1,2,3-c,d]pyrene are possibly carcinogenic to humans; and anthracene, benzo[g,h,i]perylene, benzo[e]pyrene, chrysene, fluoranthene, fluorene, phenanthrene, and pyrene are not classifiable as to their carcinogenicity to humans. EPA has determined that benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, dibenz[a,h]anthracene, and indeno[1,2,3-c,d]pyrene are probable human carcinogens and that acenaphthylene, anthracene, benzo[g,h,i]perylene, fluoranthene, fluorene, phenanthrene, and pyrene are not classifiable as to human carcinogenicity. Acenaphthene has not been classified for carcinogenic effects by the DHHS, IARC, or EPA.

1.6 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO PAHs?

In your body, PAHs are changed into chemicals that can attach to substances within the body. The presence of PAHs attached to these substances can

then be measured in body tissues or blood after exposure to PAHs. PAHs or their metabolites can also be measured in urine, blood, or body tissues. Although these tests can show that you have been exposed to PAHs, these tests cannot be used to predict whether any health effects will occur or to determine the extent or source of your exposure to the PAHs. It is not known how effective or informative the tests are after exposure is discontinued. These tests to identify PAHs or their products are not routinely available at a doctor's office because special equipment is required to detect these chemicals.

1.7 WHAT RECOMMENDATIONS HAS THE FEDERAL GOVERNMENT MADE TO PROTECT HUMAN HEALTH?

The federal government has set regulations to protect people from the possible health effects of eating, drinking, or breathing PAHs. EPA has suggested that taking into your body each day the following amounts of individual PAHs is not likely to cause any harmful health effects: 0.3 milligrams (mg) of anthracene, 0.06 mg of acenaphthene, 0.04 mg of fluoranthene, 0.04 mg of fluorene, and 0.03 mg of pyrene per kilogram (kg) of your body weight (one kilogram is equal to 2.2 pounds). Actual exposure for most of the United States population occurs from active or passive inhalation of the compounds in tobacco smoke, wood smoke, and contaminated air, and from eating the compounds in foods. Skin contact with contaminated water, soot, tar, and soil may also occur. Estimates for total exposure in the United States population have been listed as 3 mg/day.

From what is currently known about benzo[a]pyrene, the federal government has developed regulatory standards and guidelines to protect people from the potential health effects of PAHs in drinking water. EPA has provided estimates of levels of total cancer-causing PAHs in lakes and streams associated with a risk of human cancer development. If the following amounts of individual PAHs are released to the environment within a 24-hour period, EPA must be notified: 1 pound of benzo[b]fluoranthene, benzo[a]pyrene, or dibenz[a,h]anthracene; 10 pounds of benz[a]anthracene; 100 pounds of acenaphthene, chrysene, fluoranthene, or indeno[1,2,3-c,d]pyrene; or 5,000 pounds of acenaphthylene, anthracene, benzo[k]fluoranthene, benzo[g,h,i]perylene, fluorene, phenanthrene, or pyrene.

PAHs are generally not produced commercially in the United States except as research chemicals. However, PAHs are found in coal, coal tar, and in the creosote oils, oil mists, and pitches formed from the distillation of coal tars. The National Institute for Occupational Safety and Health (NIOSH) concluded that occupational exposure to coal products can increase the risk of lung and skin cancer in workers. NIOSH established a recommended occupational exposure limit, time-weighted average (REL-TWA) for coal tar products of 0.1 milligram of PAHs per cubic meter of air (0.1 mg/m^3) for a 10-hour workday, within a 40-hour workweek. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends an occupational exposure limit for coal tar products of 0.2 mg/m^3 for an 8-hour workday, within a 40-hour workweek. The Occupational Safety and Health Administration (OSHA) has

established a legally enforceable limit of 0.2 mg/m³ averaged over an 8-hour exposure period.

Mineral oil mists have been given an IARC classification of 1 (sufficient evidence of carcinogenicity). The OSHA Permissible Exposure Limit (PEL) for mineral oil mist is 5 mg/m³ averaged over an 8-hour exposure period. NIOSH has concurred with this limit, and has established a recommended occupational exposure limit (REL-TWA) for mineral oil mists of 5 mg/m³ for a 10-hour work day, 40-hour work week, with a 10 mg/m³ Short Term Exposure Limit (STEL).

1.8 WHERE CAN I GET MORE INFORMATION?

If you have any more questions or concerns, please contact your community or state health or environmental quality department or:

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road NE, Mailstop F-32
Atlanta, GA 30333

Information line and technical assistance:

Phone: 888-422-8737
FAX: (770)-488-4178

ATSDR can also tell you the location of occupational and environmental health clinics. These clinics specialize in recognizing, evaluating, and treating illnesses resulting from exposure to hazardous substances.

To order toxicological profiles, contact:

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Phone: 800-553-6847 or 703-605-6000

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 1995. Toxicological profile for polycyclic aromatic hydrocarbons (PAHs). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Polycyclic Aromatic Hydrocarbons (PAHs) - ToxFAQs™

This fact sheet answers the most frequently asked health questions (FAQs) about polycyclic aromatic hydrocarbons (PAHs). For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to polycyclic aromatic hydrocarbons usually occurs by breathing air contaminated by wild fires or coal tar, or by eating foods that have been grilled. PAHs have been found in at least 600 of the 1,430 National Priorities List (NPL) sites identified by the Environmental Protection Agency (EPA).

What are polycyclic aromatic hydrocarbons?

(Pronounced pŏl′ĭ-sī′klĭk ăr′ə-măt′ĭk hī′drə-kar′bənz)

Polycyclic aromatic hydrocarbons (PAHs) are a group of over 100 different chemicals that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat. PAHs are usually found as a mixture containing two or more of these compounds, such as soot.

Some PAHs are manufactured. These pure PAHs usually exist as colorless, white, or pale yellow-green solids. PAHs are found in coal tar, crude oil, creosote, and roofing tar, but a few are used in medicines or to make dyes, plastics, and pesticides.

What happens to PAHs when they enter the environment?

- PAHs enter the air mostly as releases from volcanoes, forest fires, burning coal, and automobile exhaust.
- PAHs can occur in air attached to dust particles.
- Some PAH particles can readily evaporate into the air from soil or surface waters.
- PAHs can break down by reacting with sunlight and other chemicals in the air, over a period of days to weeks.
- PAHs enter water through discharges from industrial and wastewater treatment plants.
- Most PAHs do not dissolve easily in water. They stick to solid particles and settle to the bottoms of lakes or rivers.
- Microorganisms can break down PAHs in soil or water after a period of weeks to months.
- In soils, PAHs are most likely to stick tightly to particles; certain PAHs move through soil to contaminate underground water.
- PAH contents of plants and animals may be much higher than PAH contents of soil or water in which they live.

How might I be exposed to PAHs?

- Breathing air containing PAHs in the workplace of coking, coal-tar, and asphalt production plants; smokehouses; and municipal trash incineration facilities.
- Breathing air containing PAHs from cigarette smoke, wood smoke, vehicle exhausts, asphalt roads, or agricultural burn smoke.
- Coming in contact with air, water, or soil near hazardous waste sites.
- Eating grilled or charred meats; contaminated cereals, flour, bread, vegetables, fruits, meats; and processed or pickled foods.
- Drinking contaminated water or cow's milk.
- Nursing infants of mothers living near hazardous waste sites may be exposed to PAHs through their mother's milk.

Polycyclic Aromatic Hydrocarbons

How can PAHs affect my health?

Mice that were fed high levels of one PAH during pregnancy had difficulty reproducing and so did their offspring. These offspring also had higher rates of birth defects and lower body weights. It is not known whether these effects occur in people.

Animal studies have also shown that PAHs can cause harmful effects on the skin, body fluids, and ability to fight disease after both short- and long-term exposure. But these effects have not been seen in people.

How likely are PAHs to cause cancer?

The Department of Health and Human Services (DHHS) has determined that some PAHs may reasonably be expected to be carcinogens.

Some people who have breathed or touched mixtures of PAHs and other chemicals for long periods of time have developed cancer. Some PAHs have caused cancer in laboratory animals when they breathed air containing them (lung cancer), ingested them in food (stomach cancer), or had them applied to their skin (skin cancer).

Is there a medical test to show whether I've been exposed to PAHs?

In the body, PAHs are changed into chemicals that can attach to substances within the body. There are special tests that can detect PAHs attached to these substances in body tissues or blood. However, these tests cannot tell whether any health effects will occur or find out the extent or source of your exposure to the PAHs. The tests aren't usually available in your doctor's office because special equipment is needed to conduct them.

Has the federal government made recommendations to protect human health?

The Occupational Safety and Health Administration (OSHA) has set a limit of 0.2 milligrams of PAHs per cubic meter of air (0.2 mg/m^3). The OSHA Permissible Exposure Limit (PEL) for mineral oil mist that contains PAHs is 5 mg/m^3 averaged over an 8-hour exposure period.

The National Institute for Occupational Safety and Health (NIOSH) recommends that the average workplace air levels for coal tar products not exceed 0.1 mg/m^3 for a 10-hour workday, within a 40-hour workweek. There are other limits for workplace exposure for things that contain PAHs, such as coal, coal tar, and mineral oil.

Glossary

Carcinogen: A substance that can cause cancer.

Ingest: Take food or drink into your body.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1995. Toxicological profile for polycyclic aromatic hydrocarbons. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636.

ToxFAQs™ Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp.

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.