TORONTO

STAFF REPORT
ACTION REQUIRED

Air Quality Impact Assessment – Metrolinx Georgetown South Service Expansion and Union-Pearson Rail Link

Date:	June 3, 2009
To:	Board of Health
From:	Medical Officer of Health
Wards:	All
Reference Number:	

SUMMARY

In response to requests from the Board of Health and the Parks and Environment Committee, Toronto Public Health (TPH) undertook a review of the health-related studies under preparation by Metrolinx' consultants for the proposed Georgetown South Service Expansion and Union-Pearson Rail Link. The scope of this review was dependent on the availability of data from Metrolinx.

The Medical Officer of Health (MOH) and City Council support enhancements to public transit such as those proposed by Metrolinx. However, the potential health impacts associated with diesel exhaust from increased train traffic are cause for concern. Diesel exhaust and many of its component pollutants are associated with significant health impacts. In addition, certain residential neighbourhoods through which the trains will pass have lower socioeconomic status than the average for the City and, therefore, are particularly vulnerable to any health impacts that may occur.

This report recommends improvements to Metrolinx' assessment of its proposed project, including a health impact assessment and changes in scope to better estimate exposure and health effects. Electrification of the Georgetown GO Line and Union-Pearson Rail Link should be undertaken as soon as possible, and several health-protective practices should be implemented in the interim.

RECOMMENDATIONS

The Medical Officer of Health recommends that:

1. The Board of Health request Metrolinx to do the following as part of its assessment of the proposed Georgetown South Service Expansion and Union-Pearson Rail Link:

    a. Make the following additions to the consultants' risk assessment studies:
        i. Estimate particulate deposition to soil, and evaluate skin contact and ingestion exposures to these particulates;
        ii. Evaluate diesel exhaust both as a whole and as a mixture of individual components;
        iii. Undertake an ultrafine particulate matter ($PM_{0.1}$) monitoring program to characterize baseline concentrations and concentration gradients;

    b. Conduct a health impact assessment (HIA) study, in consultation with the Medical Officer of Health, to examine the distribution in the community of risks and benefits from the proposed Georgetown South Service Expansion and Union-Pearson Rail Link;

    c. Estimate the contribution of each train line operating on the Georgetown South Corridor to total, annual diesel exhaust emissions, and thereby predict the emissions reductions achievable through electrification of GO Georgetown services and the Union-Pearson Rail Link; and,

    d. Make the above information available in a way that allows the public sufficient time to review and comment before Metrolinx finalizes its Environmental Project Report.

2. The Board of Health request the Medical Officer of Health to review the risk assessment reports, air quality impact mitigation strategy and health impact assessment when they are released by Metrolinx, and provide input to Metrolinx and the public through the Environmental Bill of Rights Registry.

3. The Board of Health request Metrolinx to:

    a. Electrify the Georgetown South Service Expansion and the Union-Pearson Rail Link as soon as possible;

    b. Apply the following good practices for the protection of public health to the Georgetown South Service Expansion and the Union-Pearson Rail Link until such time as electrification is in place:
        i. Select hybrid locomotives with on-board rechargeable energy storage systems and regenerative braking;

ii. Select new locomotives and remanufacture systems of the best available technology, which may be more advanced than that required by the current US EPA emissions standards for line-haul locomotives;
iii. Use ultra low-sulphur diesel (ULSD, 15 ppm);
iv. Ensure that idle control systems are in place, and develop and implement idling reduction policies; and,
v. Regularly assess and maintain tracks and locomotives to maintain emissions performance at or above the relevant emissions standards;
vi. Develop a detailed mitigation strategy to manage the residual human health risks;

c. Collaborate with Toronto Public Health, City Planning, and Transportation Services to ensure that the stations on the Georgetown South Corridor are developed into connected "mobility hubs" where residents can live, shop, eat, work, play, and connect to active transportation and public transit.

4. The Board of Health request Metrolinx to apply the good practices for the protection of public health requested above to all non-electrified GO transit rail services that pass through residential neighbourhoods in the City of Toronto.

5. The Board of Health forward this report to Canadian National Railway, Canadian Pacific Railway and Via Rail Canada, and request that they apply the good practices for the protection of public health requested above to their services that pass through residential neighbourhoods in the City of Toronto.

6. The Board of Health forward this report to the:

a. Clean Train Coalition, Environmental Health Association of Ontario, Mount Dennis Community Association and Weston Community Coalition;

b. Toronto District Catholic School Board and Toronto District School Board;

c. Medical Officers of Health for Halton and Peel Regions;

d. Ontario Minister of the Environment; and,

e. Federal Ministers of the Environment and Transportation.

7. The Board of Health forward this report and the Board of Health's decision to the Parks and Environment Committee for its June 16, 2009 meeting.

Financial Impact
There are no financial impacts of these recommendations.

DECISION HISTORY
On April 20, 2009, the Board of Health and the Parks and Environment Committee separately requested that the Medical Officer of Health (MOH) study the health impacts of Metrolinx' proposed service expansion on the Georgetown South Corridor ("Georgetown Expansion") and the Union-Pearson Rail Link ("Air-Rail Link"). This report was written in response to those requests. The wording of the requests is as follows:

> The Board of Health requested *that the Medical Officer of Health conduct an independent assessment of the health impacts of the proposed Union-Pearson Rail line on the local air shed and report back to the Board of Health on his findings.*
>
> The Parks and Environment Committee requested *the Medical Officer of Health to conduct an environmental health impact assessment study in the Georgetown rail line with attention to the issue of diesel vs. electric power and report back to the Parks and Environment Committee.*

At its meeting on January 27 and 28, 2009, City Council adopted the following motion regarding the Metrolinx Georgetown South/Air Rail Link Project:

1. *City Council oppose any road closures along the route.*
2. *City Council support the addition of new stops, including a stop in Weston.*
3. *Public transit alternatives in the Georgetown corridor and serving the airport be a component of any service improvements.*
4. *Metrolinx be requested to employ electric vehicles.*
5. *City Council reaffirm its strong interest in seeing the West-Toronto Railpath (bike trail) project accommodated adjacent to the tracks between Dundas Street West and Strachan Avenue.*

ISSUE BACKGROUND

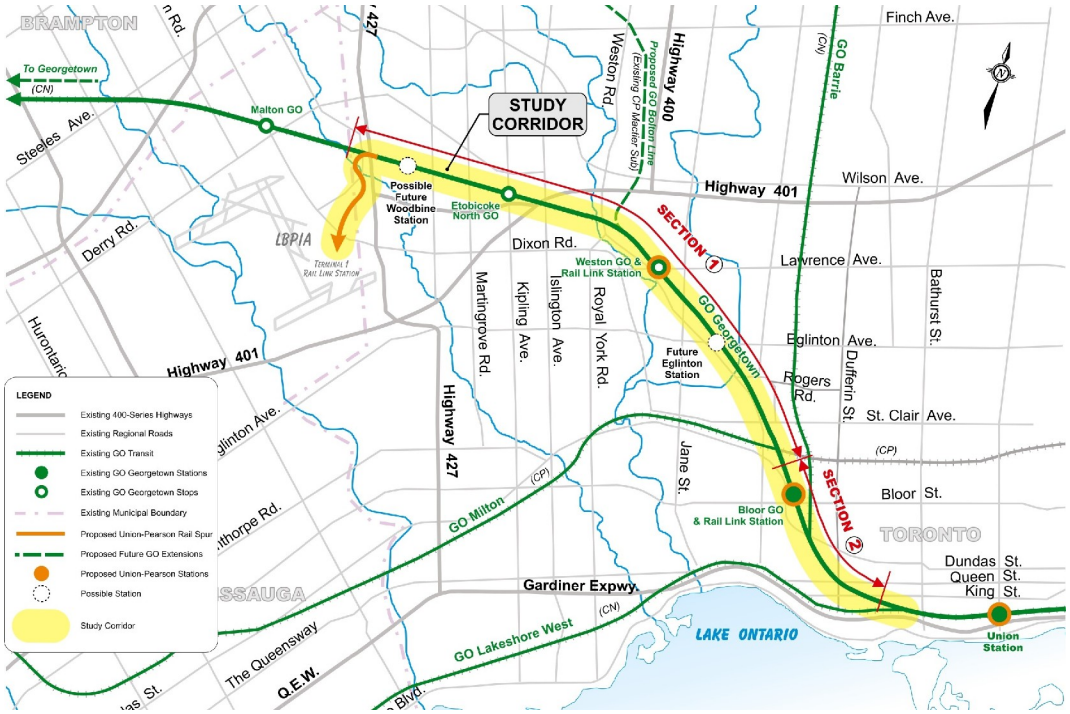
The Proposed Transit Project
The transit project proposed by Metrolinx consists of a number of improvements to the GO Georgetown South corridor that will permit all-day, two-way express, as well as local service. The two main elements of the project, as shown in Figure 1, are:

- A Georgetown Expansion, which will enhance tracks to accommodate increased rail traffic from the GO Barrie, Bolton, Georgetown and Milton lines; and
- A separate, private spur line to the airport, which will be used to provide the Air-Rail Link service between Pearson Airport and Union Station.

The Georgetown North Corridor runs from Georgetown, through Brampton and North Mississauga. Section 1 of the Georgetown South Corridor begins just west of Highway 427, and continues into Toronto between the airport and Woodbine Racetrack. It then runs parallel to Weston Road through the neighbourhoods of West and Mount Dennis, to the Junction. Section 2 continues from the Junction neighbourhood and runs diagonally through Brockton and Liberty Village to meet the Lakeshore line, and into Union Station. The Air-Rail Link spur line is a 3 kilometre section of privately owned track that will connect Section 1 of the Georgetown South Corridor to the airport.

Expanded service on the Georgetown corridor and the Air-Rail Link is expected to begin in 2013. The Georgetown Expansion, Air-Rail Link, plus existing train traffic are projected to result in approximately 250 to 450 diesel trains per day on the corridor (Tables 1 and 2). Metrolinx has indicated that it expects expanded services will begin at lower train frequencies than the opening day projections, and may not reach full expansion for more than 25 years.

Figure 1: Map of Georgetown Expansion and Air-Rail Link



Source: Metrolinx 2009

Table 1: Section 1 – Projected Train Volumes on the Georgetown South Corridor

	Existing (trains/day)	Projected (trains/day)	
		Opening Day[a]	Long Range[b]
Via	6	12	12
GO Georgetown	19	59	112
CN	4	4	4
CP	21	21	21
GO Bolton	–	8	12
Air-Rail Link	–	140	140
Section 1 Total	**50**	**244**	**301**

a Official train volume projections for opening day, which is planned for 2013.
b Official long-range projections from the 25-year plan for 2031.
Source: Metrolinx Open House display panels

Table 2: Section 2 – Projected Train Volumes on the Georgetown South Corridor

	Existing (trains/day)	Projected (trains/day)	
		Opening Day[a]	Long Range[b]
Section 1 trains	50	244	301
GO Milton	12	53	97
GO Barrie	8	47	87
CP	-21[c]	-21[c]	-21[c]
Section 2 Total	**49**	**323**	**464**

a Official train volume projections for opening day, which is planned for 2013.
b Official long-range projections from the 25-year plan for 2031.
c CP trains enter and exit the corridor at the "West Toronto Diamond" near the intersection of Dupont and Dundas Street West.
Source: Metrolinx Open House display panels

Table 3: Projected Train Length and Engine Power

	Approximate Train Length (number of cars per train)	Engine Power (HP)
Via	5	3,000
GO (all lines)	12	4,000
Freight (CN and CP)	Not available	3,000-5,000
Air-Rail Link	3	1,200-1,800[a]

a Air-Rail Link trains will be three-car "consists," with each car self-propelled by its own 400-600 HP engine.
Source: 1, 2,3

Train length and engine horsepower will vary among the services on the line (Table 3), as will air quality and noise impacts.

The Metrolinx project does not include electrification at this time. The regional transportation plan prepared by Metrolinx (*The Big Move*[4]) lays out plans for future electrification (within 15 years) of specific corridors, including Georgetown. Metrolinx recently announced its intention to begin a study this year that will examine the electrification of the entire GO Transit rail system[5]. In the meantime, the Georgetown corridor is being planned now to allow for electrification in the future.

Community Concerns

Several community groups, including the Clean Train Coalition, the Environmental Health Association of Ontario, the Mount Dennis Community Association and the Weston Community Coalition, have expressed concerns over the proposed Georgetown Expansion and Air-Rail Link. In particular, the community is concerned about the potential health impacts of diesel exhaust from increased train traffic through residential neighbourhoods and near sensitive receptors such as schools. Members of the community have called for electrification of the line to mitigate diesel emissions.

A number of the residential neighbourhoods through which the trains will pass have lower socioeconomic status than the average for the City. In *The Big Move*, Metrolinx identifies the communities neighbouring the Georgetown South Corridor (from the 401 south to Union Station) as having higher than average social need[6]. From a transportation planning perspective, this means that for many residents there is a lack of affordable transportation options, and that access to frequent, fast and affordable public transit is essential to provide equitable access to transportation. There is a clear link between health and income in the City of Toronto (*The Unequal City: Income and Health Inequalities in Toronto*[7]), which suggests that neighbourhoods along the rail corridor with lower socioeconomic status are already burdened with greater risk factors for illness, higher rates of disease and death at an earlier age. Any increase in local air concentrations of diesel exhaust will act as an additional stressor in communities already burdened with a higher than average incidence of ill health.

COMMENTS

Scope of This Report

In response to the requests for study from the Board of Health and the Parks and Environment Committee, Toronto Public Health (TPH) undertook an independent review of the health-related studies under preparation by Metrolinx consultants. This report is the result of that review; however, the scope of this report is limited to a summary of the available information, a review of the key issues, and a series of recommendations for the health-related studies and the proposed project. The scope of this review is limited by the data available from Metrolinx at this time. The full studies commissioned by Metrolinx to assess the human health risk of living near the proposed Georgetown Expansion and Air-Rail Link were not available at the time this report was prepared.

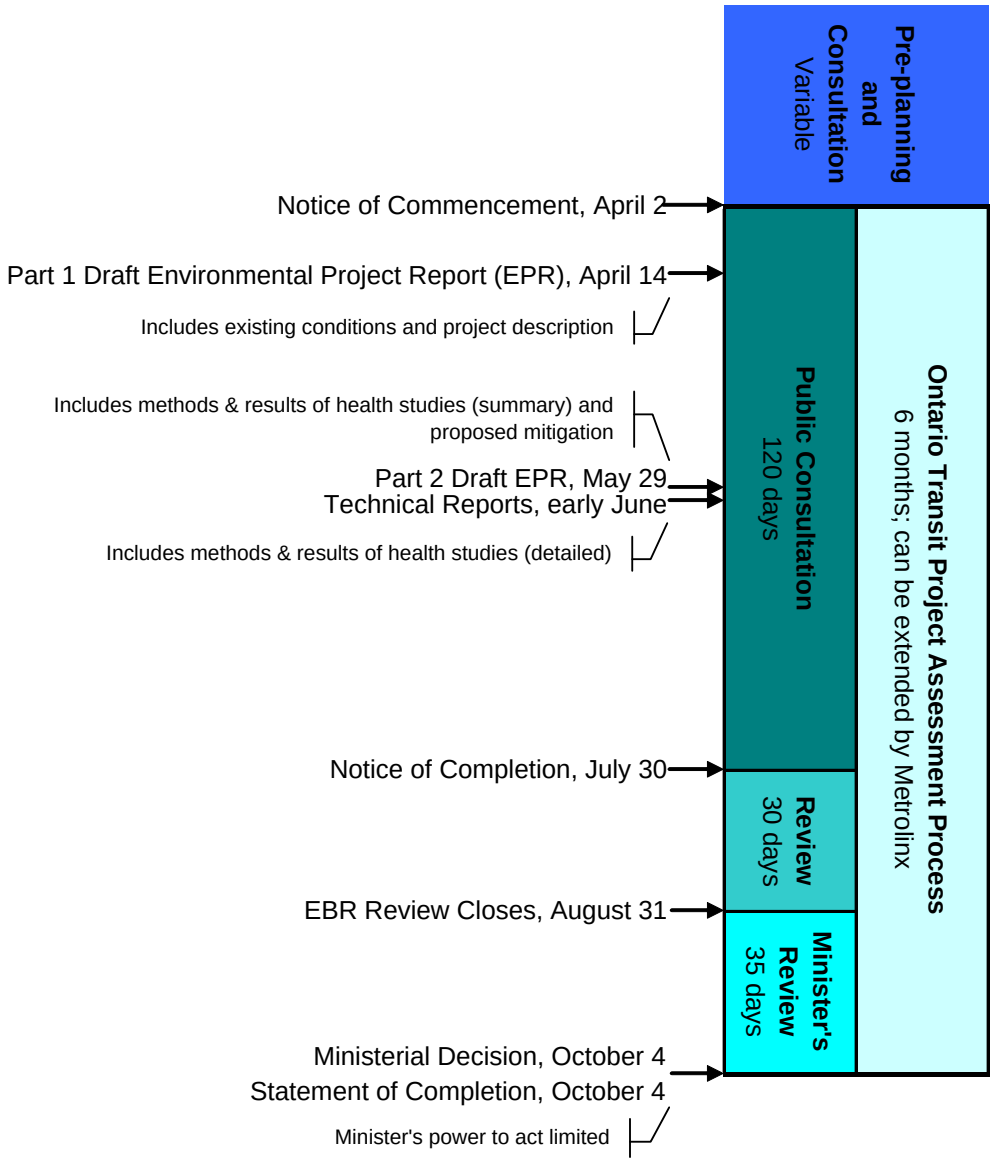
Limited Information for Adequate Public Review

The environmental impact of the project is being assessed under Ontario's new Transit Project Assessment Process. This is a streamlined process in which the assessment of environmental effects and decision-making can be completed within a six-month timeframe[8]. Figure 2 illustrates this process.

Metrolinx has not yet provided sufficient information to enable adequate public review of the project. To date, Metrolinx has released Parts One and Two of its Draft

Environmental Project Report (EPR). Part One consists of a description of the project and current environmental conditions. Part Two includes summaries of the air quality and human health risk assessment, and cursory information on proposed air quality mitigation measures. Metrolinx has also provided projected train volumes and other information such as corridor plans, at public open houses. The detailed air quality and human health risk assessment is targeted for release in early June.

Figure 2: Approval Process for Metrolinx Project, Timeline for Release of Project Information



An effective public consultation process can result in improvements to a proposed project which provide benefits to the proponent and stakeholders. Public support for a project can be built through an effective public consultation process as stakeholders shape the final

outcome to include desirable elements for all parties. Such a process would include public consultation while the impact assessments were underway so that the opinions of the affected residents, local government and the scientific community could influence what is assessed. The process would also include a second round of public consultation on the results of the impact assessments and proposed mitigation.

The Metrolinx project is also being assessed under the Federal Environmental Assessment (EA) process. A Notice of Commencement for the Federal EA was posted on March 8, 2009. It appears that Metrolinx has not begun work on the Federal EA at this point. The project is also expected to be subject to additional permits and approvals from various agencies.

Building a Sustainable Transportation Framework

Scientific evidence from around the world links air pollution at levels commonly experienced in major urban centres to significant adverse impacts on health. Most affected are seniors and people of all ages with underlying respiratory and heart problems. Vehicles are an important source of air pollutants in urban areas, and hence a major contributor to health problems. Traffic pollution from on-road vehicles such as cars, trucks and buses, gives rise to about 440 premature deaths and 1,700 hospitalizations per year in Toronto. Toronto Public Health's 2007 study, *Air Pollution Burden of Illness from Traffic in Toronto*[9], estimated that mortality-related costs associated with traffic pollution in Toronto are $2.2 billion each year. A 30% reduction in motor vehicle emissions in Toronto could save nearly 200 lives and result in $900 million in health benefits annually.

In addition to the direct health impacts caused by smog and air toxics, secondary effects such as global warming and climate disruption caused by greenhouse gases also have the potential to cause premature deaths. The transportation sector contributes about 35% of total greenhouse gases emitted in Toronto. Of the greenhouse gases emitted by vehicles, 75% are generated by personal vehicles (cars and light trucks).

The Big Move is the Regional Transportation Plan for the Greater Toronto and Hamilton Area adopted by Metrolinx. The plan outlines a vision for the future that includes a high quality of life in communities that support healthy and active lifestyles, and many options of getting around quickly, reliably, conveniently, comfortably and safely. The plan includes strategies to enhance and expand active transportation, and to build communities that are pedestrian, cycling and transit-supportive. Actions such as planning and implementing complete walking and cycling networks with bike-sharing programs, and creating a system of connected mobility hubs are called for to help realize that vision.

Mobility hubs are a strong feature of *The Big Move*. More than just "stations," these hubs are places of connectivity between regional rapid transit services, and also places where different modes of transportation, including active transportation, come together seamlessly. They have an intensive concentration of employment, living, shopping and enjoyment around a major transit station.

TPH recommends that all of the existing, proposed and possible stations in the Georgetown South Corridor be developed into mobility hubs. These stations have the potential to enable greater use of public transit and to promote active transportation. They also have the potential to provide employment, recreation and shopping opportunities. The existing, proposed and possible stations recommended for development into mobility hubs are:

- Pearson Airport Terminal 1 – proposed terminus of the Air-Rail Link.
- Woodbine Station – possible future station to serve Woodbine Race Track. The current project will be designed so as not to preclude this station, but the station is not included in the current project.
- Etobicoke North GO Station – existing GO station. Metrolinx proposes to expand the station and shift it closer to the existing parking area.
- Weston GO and Rail Link Station – existing GO stop, proposed GO and Air-Rail Link station. The proposed, full GO station will be expanded from the existing GO stop and shifted 330 m to the east. A pedestrian access is planned.
- Eglinton GO Station – proposed GO station and mobility hub. The current project will be designed so as not to preclude this mobility hub, but the station is not included in the current project.
- Bloor GO and Rail Link Station – existing GO station, proposed Air-Rail Link station and mobility hub. Metrolinx proposes to expand this station and add a covered walkway from Dundas St. West to provide pedestrian access. The West Toronto Railpath goes past this station.
- Union Station – existing TTC and GO station, and proposed terminus of the Air-Rail Link. Union Station is already a mobility hub serving local and regional transit.

Health Impacts of Diesel Exhaust

Diesel exhaust is a complex mixture of particles and gases. It contains several hundred different organic and inorganic components, including many substances that have been designated as toxic chemicals. While the specific components of diesel exhaust depend on factors such as the age and type of diesel vehicle, many of the constituents of diesel exhaust, such as particulate matter, nitrogen oxides, and air toxics, are common to all diesel vehicles and are similar to those emitted from other vehicles.

Emissions from both diesel and gasoline vehicles contribute to air pollution that already exists in Toronto. Some pollutants such as nitrogen oxides also contribute to formation of smog. Toronto Public Health's 2007 report, *Air Pollution Burden of Illness from Traffic in Toronto*, highlighted health effects from traffic-related air pollution including a broad range of respiratory and cardiovascular effects, cancer, and hormonal and reproductive effects[10].

Compared to emissions from gasoline vehicles, diesel exhaust is thought to be particularly harmful to health. Some of the scientific information available about diesel

exhaust describes the impacts of the mixture as a whole. Other evidence addresses the health impacts of individual components of the exhaust mixture.

Diesel Exhaust as a Whole Mixture

There is increasing evidence that diesel emissions are associated with the development of cancer, particularly lung cancer[11]. The International Agency for Research on Cancer classified it as a probable carcinogen in humans[12], the US Environmental Protection Agency (US EPA) concluded that lung cancer is included in the health risks from exposure to diesel exhaust[13], and the US National Institute for Occupational Safety and Health (NIOSH) concluded that diesel exhaust is a potential human carcinogen[14]. A 2002 review by Toronto Public Health concluded that diesel exhaust likely contributes to the burden of cancer in Toronto[15].

While the evidence supporting a link between diesel exhaust and cancer is most clear for lung cancer, some studies also suggest that diesel exhaust could be linked to other types of cancer. For example, a study in Finland found that occupational exposures to diesel exhaust were associated with ovarian cancer[16].

A review conducted by the US EPA concluded that health risks from exposure to diesel exhaust also include acute exposure-related symptoms and chronic exposure-related noncancer respiratory effects[17]. For example, short-term exposures to diesel exhaust are associated with irritation and inflammation of the eye, nose, and throat[18]. A 2009 review of noncancer effects suggests that exposure to diesel exhaust may also worsen allergies[19]. Chronic exposures to diesel exhaust are strongly linked with lung injury in animal studies, and the U.S. EPA concluded that diesel exhaust poses a risk to respiratory health for humans[20].

Diesel Particulate Matter (DPM)

Diesel engines emit two sizes of particles – fine particles ($PM_{2.5}$), which are those less than 2.5 micrometres in diameter, and ultrafine particles ($PM_{0.1}$) which are those less than a millionth of a metre in diameter. A variety of substances can become attached to the exterior of the particles, including air toxics and metals that are both linked to health outcomes such as cancer[21]. These substances are then inhaled into the lung along with the particles.

Until recently, most research focussed on the health impacts of $PM_{2.5}$. $PM_{2.5}$ is a common air pollutant that contributes to smog. These small particles can be respired deep into the human lung, causing lung irritation in healthy people, and exacerbating asthma and other respiratory illnesses in at-risk groups such as children, the elderly and those with pre-existing illness. Strong evidence links $PM_{2.5}$ to cardiovascular and respiratory mortality and morbidity. Recent epidemiological evidence also suggests an association between exposure to smog pollutants such as fine particles, and increased mortality from lung cancer[22].

There is also increasing concern about the smallest particles in diesel emissions, the "ultrafine" $PM_{0.1}$. Ultrafines make up 50-90% of the particles in diesel exhaust.

Preliminary evidence suggests that these extremely small particles may be associated with many of the same type of health effects as larger particles. However, they seem to cause more inflammation and damage in the lungs than larger particles with the same chemical makeup. As well, because they are so small, they can easily move out of the lung and enter the bloodstream. This allows them to move to other parts of the body. Animal research suggests that these particles are able to move across important tissue barriers in the body, entering areas such as the brain and reproductive organs. The implications of this for human health are not yet well understood.

Individual Air Toxics in Diesel

While hundreds of different air toxics may be present in the gas phase of diesel exhaust, some of the most commonly identified are formaldehyde, benzene, 1,3-butadiene, and polycyclic aromatic hydrocarbons (PAHs):

- Formaldehyde is carcinogenic to humans. It is also a highly reactive substance that can be irritating to the nose, eyes, skin, throat and lungs at fairly low levels of chronic exposure.
- Benzene is considered to be carcinogenic to humans. Chronic exposure to benzene leads primarily to disorders of the blood.
- 1,3-Butadiene is linked to cancers of the blood and lymph systems, including leukemia. It has also been linked to disorders of the heart, blood and lungs, and to reproductive and developmental effects.
- Some PAH are carcinogenic to humans. Because this group of compounds covers a wide range of physical-chemical properties, some PAH are found in air on particles while others are gaseous. PAH of both forms may be deposited in the lung.

Each of these substances is identified as a priority for reduction in Toronto based on health impacts: they were identified in the 2002 TPH report entitled *Ten Key Carcinogens in Toronto Workplaces and Environment*[23], and are also included in the list of substances that will be reported under Toronto's new Environmental Reporting, Disclosure and Innovation Program[24].

Vulnerable groups who are especially at risk from traffic-related air pollution include children, pregnant women, and the elderly. Research suggests that people who work outdoors or exercise near areas of high traffic density are also at increased risk for the health effects of air pollution from vehicles.

Health Impacts of Residential Proximity to Transportation Corridors and Hubs

There is substantial evidence that shows that people living or working close to high-traffic areas experience more adverse effects than people who are further away. The combustion of gasoline or diesel fuel in the engines of cars, trucks, trains and/or ships is a significant source of pollution in high traffic areas. Numerous recent studies have shown that those who live near busy transportation corridors and hubs (e.g., major highways, railyards and ports) are at significantly greater risk of adverse health impacts than the

general population. The health impacts observed include increased prevalence and severity of asthma and other respiratory diseases, diminished lung function, adverse birth outcomes, childhood cancer, and increased mortality. Those who live near major regional transportation routes can be identified as a highly susceptible population, subject to adverse health effects from transportation-related pollution.

Studies of the health impacts of living close to highways, railyards and ports can be used to suggest potential health impacts from a busy diesel rail line. However, direct comparisons cannot be made, due to differences in engine types, operating conditions and traffic volumes. For example, railyards experience constant locomotive activity, while rail lines experience locomotive activity every few minutes, and the daily volumes and emissions profiles of automobile and truck traffic on a highway are very different from what is expected of a rail corridor. The Metrolinx study of this project's health impacts can clarify the actual and predicted health effects of living near a diesel rail line.

For highways, evidence indicates that residential proximity to traffic can be associated with the adverse health effects described above[25, 26]. Steep concentration gradients for several traffic-related pollutants may exist near highways. The results of these gradients is that adverse health impacts are found at distances up to 200 m, but generally not more[27]. A second important factor controlling traffic exposure, and hence, adverse health impacts is traffic density. Adverse effects have been reported for highway traffic densities as low as 5,500-9,000 vehicles/day[28]. Effects are more serious and more frequently reported at greater traffic densities, and have not been reported at lower traffic densities.

The California Air Resources Board has completed health risk assessments of the PM component of diesel exhaust from several railyards. Railyards experience constant locomotive activity from moderately high numbers of visiting locomotives (e.g., >30,000/year at the J.R. Davis Yard in Roseville), each spending 10 hours or more at the railyard[29]. Locomotive operations at the J.R. Davis Yard in Roseville emitted an estimated 23 tonnes of diesel PM in 2000, approximately 50% from moving locomotives, 45% from idling and 5% from testing. Emission factors used to estimate PM emissions range from 0.14 to 9.12 g/bhp-hr, indicating a wide range of engine technologies and operating conditions. Health impacts resulting from these emissions were predicted for the entire greater Roseville area. Based on these results, the California Air Resources Board determined that both long and short-term mitigation measures were needed to reduce diesel PM emissions from the Yard.

Toronto Public Health Review of Metrolinx' Workplans for Health Impact Studies

Metrolinx has commissioned Intrinsik Environmental Sciences Inc. and RWDI Inc. to evaluate the air-related health impacts of the proposed Georgetown Expansion and Air-Rail Link. The summary results of these assessments are available in Part 2 of the Draft Environmental Project Report. The summary results do not contain all of the technical details of the assessments, and limited time was available prior to publication of this report; therefore, TPH has not completed a critical review of the summary results. When

the full technical reports for these studies are released, TPH will review them and provide comments. On request, Metrolinx provided TPH with the consultants' work plans, which were not publicly available at the time of preparing this report. The work plans describe the following study approaches:

Air Quality Assessment – According to the work plans, RWDI will use air dispersion modelling to estimate the changes in air concentrations under the proposed project of selected diesel exhaust components. RWDI will establish existing ambient air quality, predict future local air quality and predict future regional air quality. RWDI will also compare the predicted air concentrations to applicable government air quality standards. The chemicals to be assessed are:

- Combustion gases – carbon monoxide, nitrogen dioxide and sulphur dioxide;
- Particulate matter – respirable ($PM_{2.5}$) and inhalable (PM_{10});
- Volatile organic compounds (VOCs) – formaldehyde, acetaldehyde, 1,3-butadiene, benzene and acrolein;
- Total polycyclic aromatic hydrocarbons (PAHs); and
- Greenhouse gases – carbon dioxide, methane and nitrous oxide.

Human Health Risk Assessment – According to its work plan, Intrinsik will complete a human health risk assessment, using RWDI's modelling results to predict human exposure and the resulting health risks. Two scenarios will be evaluated: 1) Future No Build, which will evaluate the potential health impacts related to air quality in 2025 in the absence of the proposed project; and 2) Future Build, which will evaluate the potential health impacts related to air quality in 2025 assuming that the proposed project goes forward. The 2025 horizon roughly corresponds to the service levels identified in the Regional Transportation Plan's 15 year plan. Over 100 receptor locations corresponding to some of the parks, schools, child care centres, hospitals, long term care homes and private residences that are located closest to the rail line will be evaluated through modelling. The principal exposure pathway to be evaluated is inhalation. The work plan suggests that skin contact and ingestion exposures to particles deposited on soil will also be considered. The assessment will evaluate the hazard associated with both acute and chronic exposure durations. Cancer and non-cancer risks will be evaluated.

TPH Review – The full health-impact related studies commissioned by Metrolinx are not yet available for review. The comments and recommendations below are based on the work plans for these studies. When the full technical reports for these studies are released, TPH will review them and provide comments. In general, the planned studies appear to be quite detailed and technically advanced. However, TPH recommends three additions to the planned studies:

1. **That RWDI estimate particulate deposition to soil, and that Intrinsik evaluate skin contact and ingestion exposures to these particulates.** TPH supports urban gardening and active recreation. Given the social and health benefits of gardening and play activities in Toronto parks, backyards and other green spaces, it is important that potential exposures associated with these activities be assessed. Many outdoor activities can result in skin contact with contaminated soil. Contaminated soil may

also be incidentally ingested, or food grown in contaminated soil may become contaminated and be consumed.

2. **That Metrolinx undertake an ultrafine particulate matter ($PM_{0.1}$) monitoring program to characterize dispersion into adjacent neighbourhoods, and model future $PM_{0.1}$ levels in the local airshed.** Diesel exhaust is a known source of $PM_{0.1}$, but it is not clear how far into adjacent neighbourhoods ultrafine particles will disperse; therefore, it is important to develop baseline information on $PM_{0.1}$. The health effects of $PM_{0.1}$ are not well understood, but the scientific community has expressed concern over the potential health impacts of $PM_{0.1}$, and scientific knowledge is rapidly evolving.

3. **That the risk assessment commissioned by Metrolinx evaluate diesel exhaust both as a whole mixture and as the sum of the individual components listed above.** The data available to support each type of evaluation are different, and the final evaluations have different strengths. Diesel has been evaluated as a whole mixture in epidemiological and occupational exposure studies. These studies capture any synergistic effects of the diesel exhaust mixture that might not be predicted based on the toxicological characterization of the individual components of diesel exhaust. However, it can be very difficult to derive a reliable estimate of toxicity from these studies. Assessments of diesel exhaust as a whole tend to examine only the critical effect that occurs at the lowest diesel exhaust exposure levels (i.e., lung cancer). Many of the components of diesel exhaust are toxic by themselves. The toxicities of these compounds and classes of compounds have been characterized individually, and these characterizations can be applied to the assessment of diesel exhaust. This strategy enables the assessor to examine more of the many effects of the diesel exhaust mixture, but it assumes that synergistic effects are not present and does not address every component of diesel exhaust.

Metrolinx' final air quality assessment is expected to provide essential predictions of air quality with future expansion in train use. The risk assessments will integrate those data with toxicological information to predict adverse health effects. The results of quantitative risk assessments, as being undertaken by Metrolinx, are essential; however, risk assessments address only a narrow portion of the spectrum of health impacts associated with a project. Quantitative risk assessments are not designed to consider either the negative or the beneficial impacts on the determinants of health of a proposed project, nor do they address the distribution of those impacts. Health impact assessment, as discussed later in this report, is designed to address these issues. Health impact assessment can also involve the community in the process of achieving a more equitable distribution of positive and negative impacts through mitigation measures.

Predicted Air-related Health Effects of the Proposed Project

Metrolinx' proposed Georgetown Expansion and Air-Rail Link transit project will reduce current and future expansion of on-road traffic and has the potential to result in overall improvements in air quality for the City of Toronto. However, this transit project will also result in increased diesel exhaust emissions along the Georgetown South Corridor,

and increased diesel exhaust concentrations in the local air shed. The summary results of the air quality assessment commissioned by Metrolinx indicate that local air concentrations of all the chemicals modelled are predicted to increase, although some of the predicted increases are negligible[30].

Based on studies in the scientific literature, ambient air concentrations of diesel exhaust such as those found near transportation corridors and hubs are associated with adverse health effects in nearby residents. Based on this knowledge, it is likely that the Georgetown Expansion and Air-Rail Link planned by Metrolinx will burden local residents with some degree of adverse health impacts. The summary results of the human health risk assessment commissioned by Metrolinx indicate that acute and chronic non-cancer risks are predicted for both the baseline and cumulative future build scenarios from exposures to nitrogen oxides and VOC (specifically acrolein)[31]. An enhanced risk of cancer is predicted from the project-related emissions of another VOC (1,3-butadiene).

These health impacts will be an additional stressor to communities already burdened with a greater than average prevalence of ill health. The emissions and local air quality impacts of the proposed project should be minimized using all reasonable means.

Health Impact Assessment

The World Health Organization describes health impact assessment (HIA) as "a combination of procedures, methods and tools by which a policy, program or project may be judged as to its potential effects on the health of a population, and the distribution of these effects within the population." Health impact assessment considers how a proposal or policy might affect determinants of health in order to assess the likely impact on the well-being of people. This tool has been used to review proposed projects in the transportation and other sectors.

Health impact assessment can be used to predict the health impacts of a project and the distribution of impacts. Based on these predictions, the health impact assessment can inform or influence the decision-making process, and mitigate any health impacts. The process can also provide an opportunity for affected stakeholders to contribute to the assessment, and to make recommendations that will enhance a proposal.

TPH recommends that, in addition to the quantitative risk assessment underway, Metrolinx complete a health impact assessment of the proposed Georgetown Expansion and Air-Rail Link in consultation with the Medical Officer of Health. Health impact assessment works best when there is sufficient time to perform the assessment well, when multiple disciplines are involved, and if various options to be compared have been developed.

Health Protective Practices for Urban Rail Lines

There are various practices that Metrolinx could implement for the Georgetown Expansion and Air-Rail Link that would increase fuel efficiency and/or reduce emissions. These practices would have the effect of reducing the public health impact of the proposed project. The most health protective option is electrification.

Electrification – Electrification of the Georgetown South Corridor would eliminate the diesel exhaust emissions associated with GO and Air-Rail Link train traffic on the corridor. Electric trains do not produce any direct emissions. However, the emissions associated with generating electricity to run electric trains do have the potential to cause adverse health impacts in the communities downwind of the power plants that generate electricity. Green energy sources, such as wind and solar power, would not create potential downwind health impacts. In addition to not producing direct emissions, electric trains tend to be more efficient than diesel and have the potential for much greater speed. These attributes can make electric trains more suitable than diesel for high-speed commuter service. However, there are significant additional infrastructure, safety and planning requirements involved in electrifying a rail line.

Electrification of the Georgetown Corridor is not part of Metrolinx' immediate plans, but is part of Metrolinx' 15-year plan. They are accommodating some infrastructure needs of electrification in the current construction to expand the corridor. The other services on the line (Canadian National Railway, Canadian Pacific Railway and Via Rail Canada) are unlikely to ever be electrified due to lower train volumes and the difficulties of electrifying very long routes. TPH supports the electrification of the Georgetown Expansion and Air-Rail Link.

Until such time as electrification is in place, the following good practices can be applied for the protection of public health.

Hybrid locomotives – The on-board rechargeable energy storage systems of hybrid locomotives store excess energy from the diesel engine and energy from regenerative braking. The stored energy is used to boost the power from the diesel engine during acceleration. This reduces energy consumption as well as emissions of diesel exhaust. The cycle of braking, idling and acceleration of commuter trains at each stop can be inefficient and highly polluting. On-board rechargeable energy storage systems can mitigate some of the inefficiency and emissions associated with every station stop by storing the kinetic energy that would otherwise be lost with braking, and using it to supplement the diesel engine so that it does not have to operate at a high throttle to achieve acceleration.

Emission control technologies – Various emission control technologies can be applied to diesel locomotives to control emissions of individual components of diesel exhaust. Some of these technologies can result in decreased fuel efficiency and/or increased emissions of another exhaust component, and they must be carefully selected[32]. The US EPA's Tier 2 and 3 emission standards for line-haul locomotives represent currently available technologies to reduce PM and nitrogen oxides emissions[33]. See Table 4. (Note that Tier 2 and 3 emissions standards are identical.) The US EPA's more stringent and health protective Tier 4 emission standards represent state of the art emissions reduction technologies that must be in use on all new line-haul locomotives in the US by 2015[34]. Adoption of Tier 4 technologies requires the use of ultra low-sulphur diesel fuel (ULSD, 15 ppm)[35, 36].

Metrolinx has indicated that the Air-Rail Link trains will be pulled by new locomotives that meet Tier 3 standards. GO Transit is in the process of replacing its fleet with remanufactured locomotives that will meet Tier 2 standards. Given that expanded GO service and the Air-Rail Link are not scheduled to begin until 2013, locomotives to meet Tier 4 standards may be available by the time service begins. Canadian National Railway, Canadian Pacific Railway and Via Rail Canada locomotives operating in the Georgetown South Corridor use older technology that meets US EPA's less stringent Tier 0, 1 or 2 standards.

Table 4: US EPA 2008 Emissions Standards for Line-haul Locomotives[a]

	Locomotive Build Date	Phase-in Date for Standards	Emission Standards (g/bhp-hr)[b]		
			PM[c]	NO_x[c]	HC[c]
Tier 0	1973-2001	2010[d]	0.22	8.0	1.00
Tier 1	2002-2004	2010[d]	0.22	7.4	0.55
Tier 2	2005-2011	2013[d]	0.10	5.5	0.30
Tier 3	2012-2014	2012[e]	0.10	5.5	0.30
Tier 4	2015+	2015[e]	0.03	1.3	0.14

a Canada and Ontario do not have emissions standards for locomotives, and the US EPA's standards do not apply to Canadian rail in a jurisdictional sense. Instead, the Railway Association of Canada has adopted a voluntary cap on aggregate greenhouse gas emissions for the sector[37]. They have also committed to buy and refurbish locomotives to meet applicable US EPA emissions standards.

b Emissions standards for locomotives are expressed in units of grams per brake horsepower-hour.

c PM: particulate matter; NO_x: nitrogen oxides; HC: hydrocarbons.

d Certified remanufacture systems (i.e., retrofitting kits) must be available by this date, but are likely to be available for some locomotive models earlier. Tier 0, 1 and 2 emission standards apply to locomotives remanufactured using certified systems as those systems become available

e Tier 3 and 4 emissions standards apply to newly built locomotives.

Source: [38]

Idling control – Avoidance of unnecessary idling of locomotives along the corridor reduces fuel consumption and diesel exhaust emissions. Idling control benefits the rail operator because it results in fuel savings[39]. In addition to the general fuel savings and emissions reductions, avoidance of prolonged idling prevents the creation of localized areas of highly concentrated air pollution. Automatic Engine Stop/Start Systems shut the locomotive down after no more than 30 continuous minutes of idling[40]. These systems are required on all new or remanufactured locomotives in the US[41]. In addition, US EPA expects rail operators to develop appropriate policies detailing when it is acceptable to idle a locomotive to heat or cool the cab[42].

Ultra low-sulphur diesel – The use of ultra low-sulphur diesel (ULSD, 15 ppm) reduces emissions of sulphur oxides and PM[43]. Controlling the fuel quality is the primary means by which sulphur oxide emissions from locomotives are reduced. The current limit for sulphur content in rail diesel in Canada is 500 ppm[44]. The use of ULSD in locomotives will be required in Canada by June 2012[45]. In addition to reducing sulphur oxide and PM emissions, the use of ULSD will also permit the application of the high-efficiency catalytic aftertreatment technology needed to meet US EPA's Tier 4 emission standards[46].

GO Transit currently uses ULSD in its locomotives. The use of ULSD will be required by law before the Georgetown Expansion and Air-Rail Link are scheduled to begin service.

Regular track and locomotive maintenance – Regular maintenance of the track and locomotives has the potential to increase fuel efficiency and thereby reduce emissions. Regular upkeep on tracks may include assessment and maintenance of the alignment, gauge and curvature of the track. For locomotives, emission-related maintenance includes regular replacement of fuel injectors and air filters, and frequent inspection of other emission-related components to ensure proper functioning[47]. Any maintenance that is reasonably expected to adversely affect the emissions performance of the locomotive should not be performed.

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