TORONTO STAFF REPORT

March 27, 2006

To: Board of Health

From: Dr. David McKeown, Medical Officer of Health

Subject: The Impacts of Traffic on Health

Purpose:

This reports provides a summary of the potential impacts of traffic on health.

Financial Implications and Impact Statement:

There are no financial impacts arising from the adoption of this report.

Recommendations:

It is recommended that:

(1) the Medical Officer of Health, in collaboration with the Executive Director of Technical Services, estimate the burden of illness and economic impact attributable to air pollution from traffic in Toronto and report back to the Board;

(2) the Board of Health request the Chief Planner, the General Manager of Transportation Services and the Executive Director of Technical Services to consider the impacts of traffic on health in their decision-making regarding transportation matters, and consult with the Medical Officer of Health as appropriate; and,

(3) the appropriate City Officials be authorized and directed to take the necessary action to give effect thereto.

Background:

At its meeting of July 12, 2004, the Board of Health received a report "Air Pollution Burden of Illness in Toronto: 2004 Summary" which estimated that air pollution in Toronto contributes to approximately 1,700 premature deaths and 6,000 hospital admissions each year. The Board requested the Medical Officer of Health to report on an estimate of the number of people who are getting sick and/or dying due to the problems caused by the transportation system, including fossil-fuelled vehicles, and to include comment on the emerging data related to transportation corridors.

This report was prepared in consultation with City Planning, Technical Services and Transportation Services. It summarises the current knowledge on the adverse impact of roadway traffic on human health by its influence on air quality, traffic collisions, physical activity, environmental noise and social cohesion in our communities and identifies some of the current initiatives in Toronto that mitigate these impacts.

Comments:

The Transportation Sector in Toronto:

Transport plays a central role in the economy; it facilitates access to jobs, education, markets, leisure and other services. As a transportation hub, Toronto is home to a regional airport, an international shipping port, several marinas, and train and bus stations for regional, national and international travel. While Toronto's transportation system includes trains, planes, boats, bicycles and pedestrians, this report focuses on the health effects associated with roadway traffic.

Toronto is serviced by about 5,400 kilometres of roads (including provincial highways) that are used by residents, commuters, businesses and visitors. With about 1.2 million vehicles registered to Toronto addresses, and another 1.2 million cars and trucks entering and leaving Toronto daily, it is estimated that between 1.5 and 2 million vehicles travel Toronto's roads each day (Toronto Transportation Services, 2005). GO Transit transports about 170,000 riders per day into Toronto by rail or bus, while the Toronto Transit Commission (TTC) transports another 1.4 million riders per day through the City by subway, streetcar or bus (Toronto Public Health, 2004b).

Older areas of Toronto, which were built and developed before the car was the dominant form of transportation, are characterized by a greater mix of land uses, more diverse housing, compact urban form, and are well serviced by public transit, local businesses, schools and community centres. However, in many cases, these neighbourhoods were not designed to accommodate the large number of motor vehicles that now use their roadways.

Other areas of Toronto, which were built around the use of cars, are characterized by more homogenous land uses, "garden path" roadways, and sprawled development where job, stores, schools and recreation centres are more distant from homes. While this pattern of development

can provide some residents with spacious homes and quiet streets for children, it increases the reliance upon motorized vehicles.

Health Impacts from Traffic-Related Air Pollution:

Over the last few decades, a large body of evidence has accumulated which confirms that air pollution at the levels experienced in major urban centres such as Toronto, adversely affects human health. Short-term exposures to air pollution have been linked to increases in respiratory symptoms, infections, acute bronchitis, emergency room visits, hospital admissions, and premature deaths. They have also been associated with reduced lung function and aggravation of asthma symptoms (Toronto Public Health, 2004a).

More recent studies have demonstrated that long-term exposure to air pollution can reduce life expectancy and increase the risk of developing respiratory and cardiopulmonary diseases including lung cancer (Pope, 2002; Pope, 2004). Some long-term studies of children suggest that air pollution may also lead to the development of asthma in children (McConnell, 2002). In addition, a few studies have suggested that air pollution may contribute to adverse reproductive outcomes such as low birth weights and birth defects (Sram, 2005; Toronto Public Health 2004a).

Roadway traffic is a significant source of the air pollution that affects human health in Toronto. Road traffic emits pollutants at ground level in close proximity to people. In some instances, buildings can also trap these emissions to create higher than normal pollution concentration levels along city streets (Chan et al., 2001; 2003). Estimates provided by Environment Canada suggest that on-road vehicles, off-road equipment, and "road dust" are responsible for about two thirds of the nitrogen oxides (NO_x) (which are also precursors of ground-level ozone), one third of the sulphur oxides (SO_x), one quarter of the fine particulate matter ($PM_{2.5}$), and three quarters of the carbon monoxide (CO) emitted within the City's boundaries (Environment Canada, 2002; Toronto Public Health, 2004b). While not addressed in this report, vehicular emissions also contribute to greenhouse gasses and thus to climate change. People are also exposed to air pollutants while in their cars. Data collected along downtown city streets by Technical Services in 2003 showed in-vehicle daytime concentrations of fine particulates to be consistently higher than 24-hour AAQC levels and that curb lane measurements for cyclists and sidewalk measurements for pedestrians were even higher.

Over the last decade, studies have looked at the exposures and health impacts associated with major roads and highways (traffic corridors). Exposure studies show that concentrations of air pollutants such as coarse particulate matter (PM_{10}) can be much higher along busy roadways than in other parts of a community. For example, the Office of Environmental Health and Safety for the Los Angeles Unified School District estimated that, at four schools in East Los Angeles located in close proximity to busy roads, 24-hour average concentrations of PM_{10} were about 6 to 15 ug/m^3 higher than the levels measured in the general ambient air (Korenstein & Piazza, 2002).

Health studies directed at traffic corridors suggest that populations living, working and/or going to school in close proximity to busy roads are at greater risk for adverse health outcomes than others in the community. Studies suggest that the health risk can be 50 percent greater for those

who live or work near busy traffic corridors (World Health Organization, 2000). A few of these studies are highlighted below.

A study in the Netherlands found that reduced lung function in children was associated with truck density along nearby roadways with the association strongest in children living closest (less than 300 metres) to the roadways (Brunekreef, 1997). A study of children in New York State found (after adjusting for socio-economic status) that children hospitalized for asthma were more likely to live within 200 metres of roads with the highest vehicle miles travelled, and/or more likely to live within 200 metres of roads travelled by trucks, than children who were hospitalized for non-respiratory ailments (Lin et al, 2002).

In a study of people over 60 years old in Montreal, researchers found a greater rate of hospital admissions for, and premature deaths from, respiratory conditions among those whose homes are situated on roads with higher traffic density (greater than 3160 vehicles during morning peak hours) than among those whose homes are situated on roads with lower traffic density. The risks remained elevated after adjustments for socio-economic status (Smargiassi, 2005). Researchers in the Netherlands found (after adjusting for factors such as socio-economic status) that rates of cardio-pulmonary deaths among people 55 to 69 years in age were associated with residence near a major road (Hoek, 2002).

A study conducted in England and Wales found (after adjusting for factors such as socio-economic status) that stroke mortality was seven percent higher among men and four percent higher among women living within 200 metres of a main road than it was among those living 1000 metres or more away from a main road. These elevated risks (which were statistically significant) diminished with increasing distance from main roads (Maheswaran, 2003).

A study conducted in Los Angeles County found higher rates of low birth weight babies among women with the greatest exposure to traffic-related air pollutants (risk ratio of 1.08) using proximity of residence to roads and volume of traffic on those roads as the indicators of exposure (Wilhelm, 2003). Researchers in Italy found that the risk of childhood leukemia was significantly higher (relative risk of 3.91) among children who lived in homes subjected to high levels of traffic-related air pollution (greater than 10 ug/m^3 of benzene) than among children who lived in homes subjected to low levels of traffic-related air pollution (less than 0.1 ug/m^3 of benzene). Concentrations of benzene, derived with dispersion modeling, were used as indicators of exposure (Crosignani, 2004).

In a Danish study, the researchers found that the risk of developing cancer was 1.6 times greater for taxi drivers than for men who were not professional drivers, 1.3 times greater for truck drivers, and 1.4 times greater for unspecified drivers. They found that these differences in risk could not be explained by smoking habits or socio-economic status. They also found that risk of lung cancer increased significantly with increasing duration of employment (Hansen, 1998).

The World Health Organization has estimated that in Europe about one half of the deaths caused by air pollution can be attributed to traffic sources (World Health Organization, 2000). While Toronto Public Health is not able to estimate the health impacts specifically related to air emissions from traffic in Toronto at this time, new tools are being developed that could assist in

this task. Toronto Public Health will collaborate with Technical Services to estimate the impact of road traffic on air quality in Toronto. Using these estimates it will be possible to use the Air Quality Benefits Assessment Tool (AQBAT) being developed by Health Canada to assess the health impacts and the economic costs associated with air pollution from traffic in Toronto. It is recommended that the Medical Officer of Health, in collaboration with the Executive Director of Technical Services, report back to the Board on the outcome of this assessment.

Minimizing Air Pollution Impacts on Health by Reducing Roadway Traffic:

While technological advances in vehicle technologies and fuels are expected to reduce emissions from vehicles in the coming years, it is generally recognized that these advances will not be sufficient to protect human health, given the growing volume of traffic on roadways, particularly in large urban centres. Organizations such as the World Health Organization have concluded that policy efforts must also be directed at controlling the growth of traffic volume as well (World Health Organization, 2000).

A few situations have provided researchers with the opportunity to determine if policy interventions that reduce traffic flow and increase a shift towards public transit can improve health outcomes in a community. For example, the implementation of an alternative transportation strategy designed to reduce congestion in downtown Atlanta City during the 1996 summer Olympics provided researchers with the opportunity to demonstrate that a modal shift away from single-use vehicles towards public transit improved air quality and human health in that community. Relative to the weeks leading up to the Olympics, during the Olympics, the research team found the following: peak weekday traffic counts were reduced by 22 percent; peak daily ozone concentrations were reduced by 28 percent; and the number of children requiring medical attention for acute asthma symptoms was reduced by between 11 and 44 percent at four different medical institutions (Friedman, 2001).

A drop in total traffic at the Peace Bridge between Buffalo, New York, and Fort Erie, Ontario, after September 11, 2001, provided researchers with another opportunity to examine how a reduction in traffic flow might benefit human health. There was a 50 percent drop in total traffic at the Bridge border crossing after September 11, 2001. When researchers compared the weekly respiratory hospital admissions with the weekly traffic volumes for the Bridge, they found that the drop in total traffic volume in 2001 was accompanied by a drop in hospitalizations for respiratory diseases (Lwebuga-Mukasa, 2003).

The introduction of a Congestion Charging Scheme in London, England in 2003 reduced traffic congestion and reduced emissions of air pollutants and greenhouse gases. The scheme, which applies to a central area of London about 20 square kilometres in size, involves charging each vehicle a flat fee to enter the charging zone between 7 am and 6:30 pm on weekdays. A study of the impact of this policy (Beevers, 2004) found the following: an increase of 20 percent in vehicle kilometres travelled by buses and a 13 percent increase by taxis within the charging zone; a decrease in vehicle-kilometres travelled by cars (29 percent) and heavy goods vehicles (11 percent) within the charging zone; an increase in the use of buses (25 percent), light-duty vehicles (8 percent) and heavy-duty vehicles (5 percent) on the inner ring road that feeds the

charging zone; and an increase in the mean daily speed in the charging zone from 19 to 23 km/hour (Beevers, 2004).

The reductions in vehicle kilometres travelled and increase in speed in the charging zone were found to reduce overall emissions of nitrogen dioxides (NO_x) by 12 percent, particulate matter (PM_{10}) by about 12 percent and carbon dioxide (CO_2) by about 19 percent. The small impact of buses on the emissions in the charging zone reflects the fact that the additional bus service was provided by new buses outfitted with diesel particulate filters that are very effective at reducing emissions of particulate matter (Beevers, 2004).

While the inner ring road saw an increase in vehicle kilometres travelled, the increase in speed along the road lessened the impact of the larger traffic volume. It was associated with a small increase (1.5 percent) in emissions of nitrogen oxides, a small decrease (1.4 percent) in emissions of particulate matter and no change in emissions of carbon dioxide. This analysis suggests that the scheme has resulted in an overall decrease in emissions from traffic in central London (Beevers, 2004).

These examples demonstrate that reducing traffic can have a positive impact on air quality and health. Improvements will depend on a number of factors, including the following: the use of new and less polluting public transit vehicles, increased public transit ridership by those currently using private vehicles, and the extent to which new private vehicle users replace those who have switched to public transit. A combination of expanded public transit provision and reduced private vehicle use is needed to reduce emissions from traffic on city streets. It is also possible to reduce the effect of traffic pollution on road users and adjacent residents and workers by designing buildings in a way that facilitates the dispersion of pollutants away from the street.

Traffic Collisions:

In Ontario, unintentional injury ranks fourth among the leading causes of death, after cancer, circulatory system and respiratory diseases (Ministry of Health and Long-Term Care, 2002). Based on 1996 data, it is estimated that these injuries cost Ontario nearly $3 billion in direct (health care) and indirect (social and economic productivity losses) costs. In 2003-4, about 11 percent of injury-related hospitalisations and seven percent injury-related deaths in Ontario were due to vehicle collisions (Canadian Institute for Health Information, 2006). The proportion of major injuries due to vehicle collisions is much higher: nearly half (Canadian Institute for Health Information, 2005b).

While there have been significant increases in population size and vehicle kilometres travelled in Canada, improvements in vehicle safety technologies (such as airbags and seatbelts) and road systems (such as limited access highways) have reduced traffic-related deaths and injuries. Data from Ontario show that from 1995 to 2004, the number of serious injuries decreased by 36.1 per cent, and minor injuries by 12.9 per cent (Ministry of Transportation, 2005). In Toronto, the total number of reportable collisions averaged 66,000 per year for the 10-year period from 1995 to 2004. Over that same time, the number of injuries averaged about 23,000 per year, and deaths averaged about 75 per year (Toronto Police Service, 2001; 2005).

The number of deaths from vehicle-related collisions in Ontario was 7.3 for every 100,000 people in 2002. Drivers and passengers accounted for most of those deaths, while pedestrians accounted for about 15 percent and cyclists for about 2.3 percent (Ministry of Transportation, 2004). Toronto's traffic-related fatality rate is about 3 per 100,000 people, which is about 60 percent lower than the provincial rate (Toronto Transportation Services, 2005). These statistics are consistent with studies that indicate that traffic fatality rates (including automobile, transit and pedestrian death) tend to decline as transit ridership increases in a community. This positive trend is attributed to several factors: reduced vehicle kilometres travelled by individuals living in communities that have efficient public transit systems, lower average traffic speeds in higher-density areas, and reduced driving by higher-risk motorists such as teenagers and impaired drivers because public transit provides a viable alternative (Litman, 2005).

While the overall rate of vehicle-related deaths is lower in Toronto than in the rest of Ontario, the distribution of people affected is different. Pedestrians account for a larger proportion of vehicle-related deaths in Toronto – about 49 percent compared to 15 percent province-wide. This is likely due to higher pedestrian volumes on many of Toronto's streets as compared to other communities in Ontario. Cyclists in Toronto account for about two percent of vehicle-related deaths each year (Toronto Transportation Services, 2005).

Factors that Influence Injuries and Death Related to Collisions:

Various factors influence the rate of collisions, injuries and fatalities on roads. For example vehicle speed has an impact on the severity of injuries experienced by pedestrians in collisions. One study in the United Kingdom found that pedestrians have a 45 percent chance of being seriously injured or killed when struck by a car traveling 30 miles per hour (mph) or 48 km/hr and a five percent chance of serious harm or death when struck by a car traveling at 20 mph or 32 km/hr. It also found that 20 mph zones reduced actual vehicle speeds by about 9 mph or 15 km/hr, all traffic collisions by 60 percent, and traffic collisions involving child pedestrians or cyclists by 67 percent (Pilkington, 2000).

In New Zealand, studies have found that the risk of injury to child pedestrians was strongly associated with traffic volume, curb parking, and traffic speed. In one study, the risk of vehicle-related injury to children was found to be 14 times higher on the busiest street relative to the least busy street, 8 times higher on streets with curb parking than on those without, and 2.7 times higher on streets with mean speeds over 40 km/hr than on streets with speeds under 40 km/hr (Roberts, 1995).

Sports utility vehicles (SUVs) represent a vehicle design that increases the severity of injuries for pedestrians. An analysis of fatal collisions in the United States found that, for the same collision speed, pedestrians struck by SUVs are twice as likely to die as pedestrians struck by passenger cars. Other studies have demonstrated higher rates (up to four times greater) of severe injury and death among pedestrians involved in collisions with SUVs. This increase in risk is attributed to the height of the front end of an SUV, which directs the primary impact of the vehicle into the more vulnerable central body region rather than to the lower legs. SUVs and light trucks also present an increased risk of injury to children in driveways, which is likely explained by their

increased height that makes it more difficult for drivers to see things around the vehicle (Simms, 2005).

Driver impairment due to alcohol or other substance use contributes to rates of collisions, injuries and fatalities on roads. The number of severe trauma cases has increased by 9 percent in Ontario over the 3-year period from April 1999 to March 2003 (Canadian Institute for Health Information, 2005b). Motor vehicle collisions are responsible for nearly half of these cases. More than half of cases of severe trauma involved alcohol consumption in Canada during 2002-03 (Canadian Institute for Health Information, 2005a). In Toronto, over the 10 year period between 1995 and 2005, there was an average of 12 alcohol-related fatalities per year that involved a drunk driver, or about 15 percent of collision-related deaths (Toronto Transportation Services, 2006).

Reducing Traffic-Related Injuries and Deaths:

Graduated licensing and reduced blood alcohol levels have been two measures that have helped reduce traffic fatalities and injuries in Canada (Beirness et al., 2003; Mayhew et al., 2005). To reduce traffic-related deaths and injuries, the World Health Organization has concluded that a multi-pronged approach is required, including the following: a need to shift attitudes and behaviour of the public toward safer travel on roadways (which includes impaired driving related to alcohol and drug use); reduced speed of travel on roadways through lower posted speed limits; improved police enforcement; the use cameras to monitor infractions; traffic-calming designs; higher use of public transit and alternate modes of transportation to reduce the volume of traffic on roadways; and, rethinking the way that we design our communities (World Health Organization, 2000).

The U.S. National Research Council and the U.S. National Transport Board have identified a number of steps that can be taken to enhance pedestrian safety on roadways including the use of wide, well-lit sidewalks and crosswalks and “traffic calming” measures that reduce the speed of traffic on local roads (NRC, 2002). Pedestrian protection can also be achieved with the following measures: separation of vehicles from pedestrians with physical barriers or space; reduced vehicle speeds; “smart vehicles” that avoid collisions; and, changes in vehicle design to reduce injuries to pedestrians (Simms, 2005).

While it is recognized that safety is the prime concern, many essential safety-enhancement measures such as traffic lights, stop signs and speed bumps can result in an increase of traffic-related emissions (UK Department for Transport, 2005; VTPI, 2005). As such, an appropriately balanced compromise has to be sought and achieved. Strictly enforced low, uninterrupted and constant speed traffic movements along city roads may be an approach that deserves further evaluation to maximize safety while minimizing pollution.

Health Impacts from Traffic Noise:

The transportation sector is a common source of chronic noise exposure. In one study, it was determined that most of the urban population in industrial countries are exposed to outdoor

sound levels greater than 50 dB(A) because of roads, railways and airplanes, while rural populations are exposed to outdoor sound levels less than 50 dB(A) (Passicheir-Vermeer, 2000).

While hearing loss does not usually occur with long-term exposures below a 24-hour average of 80 dB(A), psychological and physical well-being can be affected by much lower noise levels. A few short-term studies found that 35 to 40 percent of office workers were "highly annoyed" by noise levels ranging from 55 to 60 dB(A), while long-term studies have demonstrated that people exposed to road traffic noise experience increases in hypertension at sound levels above 70 dB(A) (Passichier-Vermeer, 2000). While no data were found on the extent of the impact of noise in Toronto, it has been estimated that about 65 percent of the population living in Europe is exposed to noise levels leading to serious annoyance, speech interference and sleep disturbance (World Health Organization, 2000).

Less is known about the impact of noise from road traffic than from airports. Studies have found increased signs of psychological and physical stress among children exposed to noise associated with traffic and airports. For example, elevated systolic and diastolic blood pressures were measured among children exposed to very high road traffic noise levels. The higher blood pressures were observed among children exposed to sound levels greater than 60 dB(A). Similar results were found for children exposed to environmental noise from an airport (Passichier-Vermeer, 2000).

Other studies have found that performance in school of children can be affected by exposure to environmental noise. For example, in one study, reading comprehension and long-term memory were impaired in children attending a school located around the old Munich airport. Reading comprehension improved among these children when the school was relocated, but deteriorated among the children who attended the school located beside the new airport (Evans, 1997; Passichier-Vermeer, 2000). Another study involving children attending 89 schools in three different countries in Europe found a clear correlation between exposure to chronic aircraft noise and impairment of reading comprehension and recognition memory (Stansfeld, 2005).

Reducing Traffic-Related Noise:

There are a number of technological measures that can be taken to reduce noise from roadways (such as improvements in vehicle design and road surfaces) and to reduce noise exposures inside buildings (e.g. improvements in sound insulation in building design). However, the World Health Organization has noted that technological improvements have not, to date, been able to offset the increases in noise associated with the growth of traffic and spread of roadways in urban communities (World Health Organization, 2000). The World Health Organization has concluded that the most effective way to reduce environmental noise associated with traffic is to reduce the volume of traffic in our communities.

Physical Activity in Relation to Vehicle Use:

In recent years, the public health sector has noted how a "culture of inactivity" in North America is contributing to chronic disease among Canadians and Americans. Canadian researchers have determined that physically inactive people are 90 percent more likely to acquire coronary artery

disease, 60 percent more likely to suffer from osteoporosis, and 40 percent more likely to experience a stroke, hypertension, colon cancer or type-2 diabetes (Spence, 2001; Toronto Public Health, 2003).

Studies indicate that the majority of Ontario residents are not physically active enough for optimal health. About 55 percent of adults and 57 percent of youth 12 to 19 years in age were found to get less physical exercise than is necessary for healthy growth and development. National data indicate the same about Canadian children aged 5 to 12 years in age. The problem of inactivity is greater in Toronto. The 2000-2001 Canadian Community Health Survey found that only 33 percent of Toronto residents are physically active. This rate is significantly lower than Canadian and Ontario rates which are both 43 percent. In fact, Toronto's rate of activity is among the lowest for public health units in Ontario (Toronto Public Health, 2003).

This culture of inactivity is attributed to a number of factors including: a physical environment dominated by motor vehicle use; growing reliance on labour saving devices; pressing work and family schedules; diminishing and sedentary leisure time; and a decreasing sense of neighbourhood safety. Neighbourhood characteristics such as road traffic, sidewalk safety, air quality, bike paths, proximity to parks and playgrounds, and neighbourhood safety can either support, or create barriers to, physical activity (Toronto Public Health, 2003).

The long distances between homes, jobs and services that make it inconvenient to get to places without the use of motorized vehicles may reduce physical activity. While in areas of Toronto where development is more sprawled distances between facilities may discourage physical activity, in denser areas, safety concerns along busy streets may limit outdoor play among children and reduce opportunity for physical activity.

Increasing Physical Activity:

The World Health Organization has concluded that the most effective way to increase the physical activity of citizens in industrialized countries is to promote and encourage walking and cycling as modes of transport for trips shorter than five kilometres. It has identified the need for policy-makers to build recognition of the many benefits associated with walking and cycling as modes of transportation into the assessment processes used for planning decisions (World Health Organization, 2000).

Impact of Traffic on Social Cohesion and Mental Health:

Roadway traffic can have a substantial impact on the mental health of the public. Traffic noise, as discussed earlier, can lead to nervousness, depression, sleeplessness and irritability (World Health Organization, 2000). The survivors of vehicle-related collisions can experience long-term psychological effects even when they have sustained little, if any, physical injury. Traffic congestion can create stress for commuters, impair work performance, and negatively affect one's overall view of life. It can also lead to aggressive behaviour, including "road rage", which increases the likelihood of a collision (World Health Organization, 2000).

Roadway traffic can also have a significant impact on mental health by affecting the social cohesion of our communities. Social support networks can have a protective effect on health, especially for the more vulnerable members of a community such as children and the elderly. The lack of social support has been linked to a two-fold increase in death rates and a four-fold increase in the incidence of coronary heart disease (World Health Organization, 2000).

Transportation systems can support or diminish a sense of community by encouraging or discouraging social interaction and a sense of belonging (NRC, 2002). Communities characterized by urban sprawl and dependence upon cars can diminish social cohesion by reducing the opportunities and time for social interaction. If there are no local schools, stores or community centres, there are few opportunities for unplanned meetings. When people spend long hours commuting to and from work, there is little time and energy for community involvement. In well designed communities with compact urban form and mixed land uses where people can easily walk to places, there are more opportunities to meet one's neighbours (World Health Organization, 2000; National Research Council, 2002; Ontario College of Family Physicians, 2005).

If children are deprived of the opportunity to walk or cycle short distances because of parent worries about vehicle collisions, they become more dependent and less physically active. Not only does this situation result in greater stress on parents, the decrease in physical activity can affect a child's stamina, alertness at school and academic performance, in addition to longer-term effects on physical well-being (World Health Organization, 2000).

The negative health effects of car-centred communities fall disproportionately on poorer socio-economic groups, women, children and the elderly. Transportation systems built around cars alone can deny many members of society important opportunities for employment, social interaction and civic engagement. A car-centred transportation system can limit access to work, services, cheaper foods and other goods for these sub-populations. For example, inadequate access to transportation has been identified as a barrier to employment among welfare recipients in the U.S. (NRC, 2002; World Health Organization, 2000; Smith Nightingale, 1997).

Improving Social Cohesion and Mental Health:

Balanced transportation systems which provide a variety of modes of transportation ensure opportunities and services that are accessible to all members of society. Efficient public transit systems, bike paths and safe walkways can make community services and opportunities more accessible to those who do not drive or who cannot afford cars. There is evidence to suggest that the quality of life or liveability of neighbourhoods can improve when traffic speeds are lowered with traffic calming measures. This includes improved safety for pedestrians and cyclists, benefits for families with children, and greater independent mobility for children, especially for those between seven and nine years of age (World Health Organization, 2000).

Some Current Initiatives to Mitigate Traffic Impacts in Toronto:

While it is recognized that an efficient and effective transportation system is an essential part of a healthy city, it is important to recognize and minimize the wide-ranging negative impacts of

traffic on health. Addressing these impacts is a long-term and multi-pronged effort. Toronto already has many initiatives that can help address the negative impacts mentioned in this report. However, it is crucial that these initiatives be widely supported, expanded and strengthened.

The City has already recognized the need to reduce urban sprawl and automobile-dependency by encouraging alternative modes of transportation. Toronto's Official Plan stipulates, among other things, concentrating jobs and people in areas well served by transit and promoting mixed-use development to increase opportunities for living closer to work and encouraging walking and cycling. The Plan encourages a more balanced transportation network within the City. Priority is to be given to improving public transit (TTC and GO) access to the downtown while discouraging the expansion of automobile commuting and all-day parking. The Plan suggests giving priority to surface transit vehicles on key streets, particularly those with streetcars. It also suggests that a program should be developed for street improvements that will enhance the pedestrian environment and make it safer to walk and cycle in the downtown. Walking and cycling are to be encouraged by creating safer and more attractive street conditions.

Various other programs and initiatives such as those mentioned below help reduce air pollution, collisions and noise associated with road traffic and encourage physical activity and social cohesion in Toronto neighbourhoods.

(a) With a renewed investment in public transit, the City is working to reduce the volume of traffic on Toronto's roads by increasing transit ridership. The Toronto Transit Commission (TTC) is implementing its Ridership Growth Strategy that seeks to increase ridership by 45 to 50 million riders per year through increased service, access and convenience. With the introduction of right-of-way lanes for TTC vehicles, the City hopes to improve the speed and reliability of transit service.

(b) The City has also helped to establish the Smart Commute Initiative that is developing and implementing transportation demand management programs such as car-pooling to reduce the number of commuters who drive in cars alone across the greater Toronto area (GTA). The City has also initiated and continues to participate in the 20/20 Campaign – a social marketing campaign which encourages citizens across the GTA to reduce their vehicle use by 20 percent.

(c) City Council has also adopted the "Toronto Bike Plan" which establishes the long-term goal of making bike paths accessible to every Toronto resident, while establishing the mid-term goal of doubling the number of bicycle trips made in the City by 2011, while reducing the number of bicycle collisions and injuries.

(d) The Green Fleet Transition Program aims to accelerate the acquisition of a less polluting vehicles (compressed natural gas [CNG] and hybrid electric vehicles) and fuels, such as biodiesel. As well, the City uses low-sulphur diesel in its off-road vehicles. Other initiatives to reduce the impact of emissions from City vehicles include the TTC's purchase of 150 hybrid buses for delivery in 2006, testing of biodiesel fuel in 180 TTC buses, and use of electrical streetcars to reduce emissions of air pollutants along traffic corridors throughout the City.

(e) Transportation Services provides "Transit Priority" at many traffic control signals to reduce transit delays and emissions, and uses intelligent transportation systems (ITS) to detect disruptions on major routes, improve traffic flow and reduce congestion, delay and unnecessary idling.

(f) The City increasingly promotes and enforces its Anti-Idling By-Law. Transportation Services and Technical Services are implementing the Clean Roads to Clean Air program that will improve air quality along traffic corridors by using high efficiency street sweepers to remove particulate matter from roads.

(g) Transportation Services is developing a Noise Abatement Policy for traffic-related noise in areas where traffic contributes to excessive noise levels.

(h) Transportation Services will be developing a Pedestrian Master Plan in 2007. The City has recently approved a policy which improves minimum standards for sidewalks in new subdivisions. The City's Traffic Safety Bureau monitors Safety Performance Indices to identify and target high-risk locations for safety improvements. The City has a Traffic Calming Policy that is used to reduce speeds along local and collector roads identified as a concern. In partnership with Green Communities Canada and Toronto Police, Transportation Services and Toronto Public Health encourage school communities to use active transportation (for example cycling and walking) for the daily trip to and from school through the Active and Safe Routes to Schools Program.

(i) Toronto Public Health works with high schools to deliver the "In the Driver's Seat" program, a peer-focused initiative to reduce impaired driving, including impairment by drugs, alcohol and distractions such as music and cell phone use. Various wheel safety initiatives with younger children, such as "Can Bike" courses, promote safe cycling and the use of bike helmets.

As well, Toronto's Comprehensive Air Quality Strategy is an ongoing initiative within the City to achieve improvements in Toronto air quality through the assessment of existing programs, identification of priorities and targets and creating opportunities for innovative responses to air quality problems, including those associated with traffic in the City. To ensure that future initiatives minimize the impacts on health, it is recommended that the Chief Planner, the General Manager of Transportation Services and the Executive Director of Technical Services consider the impacts of traffic on health in their decision-making regarding transportation matters, and consult with the Medical Officer of Health as appropriate.

Conclusions:

While the transportation sector plays an essential role in the economy and facilitates access to jobs, services, education, products and leisure activities, a car-centred transportation system can produce many adverse health impacts in the community. Deaths and injuries from collisions are the most readily recognised health impact of roadway traffic. Traffic is a major source of

environmental noise in urban environments. While the health impacts of traffic noise are still not clear, excessive noise can result in stress, disturbed sleep and reduced school performance. There is data to suggest that neighbourhoods designed to favour car use can lead to a decrease in physical activity and social cohesion by making walking and cycling less attractive.

Vehicles are a major source of air pollution in Toronto and contribute to a significant proportion of the approximately 1,700 premature deaths and 6,000 hospitalizations that are related to air pollution, which residents of Toronto experience every year. Studies throughout the world show that people who live near heavy traffic are at greater risk of the negative impacts of traffic-related pollution. Work is underway by Technical Services staff to model emission sources and pollutant dispersion as they relate to air quality in Toronto. Public Health staff are building enhanced capacity to apply new health and economic modelling tools developed by Health Canada. It is, therefore, recommended that the Medical Officer of Health continue to collaborate with the Executive Director of Technical Services to estimate the burden of illness and economic impacts associated with air pollution emissions from vehicles in Toronto.

The City has already adopted policies and developed programs that will help reduce the negative impact of road traffic on health. For example, Toronto's Official Plan recognizes the need to encourage compact and mixed-use development and alternative modes of transportation. The City needs to continue the many efforts that are underway to improve public transit, improve cycling infrastructure, create a safer walking environment and reduce the impact of traffic noise. It is recommended that the Chief Planner, the General Manager of Transportation Services and the Executive Director of Technical Services consider the impacts of traffic on health in their decision-making regarding transportation matters, in consultation with the Medical Officer of Health when appropriate.

Contact:

Monica Campbell
Manager, Environmental Protection Office
Toronto Public Health
Tel: 416-338-8091
Fax: 416-392-7418
Email: mcampbe2@toronto.ca

Barbara Macpherson
Acting Manager, Urban Issues
Toronto Public Health
Tel: 416-338-2074
Fax: 416-338-0921
Email: bmacpher@toronto.ca

Fran Scott
Director, Planning & Policy and
Associate Medical Officer of Health
Toronto Public Health
Tel: 416-392-7463
Fax: 416-392-0713
Email: fscott@toronto.ca

Dr. David McKeown
Medical Officer of Health

References:

Beevers, Sean and David Carslaw. (2005). "The impact of congestion charging on vehicle emissions in London", Atmospheric Environment. Vol 39: 1-5.

Beirness, D.J., Simpson, H.M. and K. Desmond (2003) The Road Safety Monitor 2003: Drinking and Driving. Traffic Injury Research Foundation, Ottawa.

Brunekreef, B. et al. (1997). Air pollution from truck traffic and lung function in children living near motorways. Epidemiology. Vol. 8:298-303.

Canadian Institute for Health Information (CIHI) (2005). Canadian Institute for Health Information, News, June 22, 2005. http://secure.cihi.ca/cihiweb/dispPage.jsp?cw_page=media_22jun2005_e (Accessed January 19, 2006)

Canadian Institute for Health Information (CIHI) (2005). Ontario Trauma Registry Report: Major Injury in Ontario, 2003/2004, Executive Summary. http://secure.cihi.ca/cihiweb/dispPage.jsp?cw_page=AR24_2005sum_e (Accessed 21 March 2006)

Canadian Institute for Health Information (CIHI) (2006). Ontario Trauma Registry 2005 Injury Hospitalizations Highlights Report. The Institute, Ottawa.

Chan, Andy T. et al. (2001). Strategic guidelines for street canyon geometry to achieve sustainable street air quality. Atmospheric Environment. Vol. 35: 5681-5691.

Chan, Andy T. et al. (2003). Strategic guidelines for street canyon geometry to achieve sustainable street air quality - Part II " Atmospheric Environment. Vol. 37: 2761-2772.

Crosignani, P. et al. (2004). Childhood leukemia and road traffic: A population-based case-control study. International Journal of Cancer. Vol. 108:596-599.

Deputy City Manager (DCM), 2005. Update on Toronto's Comprehensive Air Quality Strategy, Report to the Board of Health, September 6, 2005.

Environment Canada, National Pollutant Release Inventory (NPRI website), 2002 data. 1995 Criteria Air Contaminants Inventory for Toronto, Postal Code "M".

Evans, G.W. & L. Maxwell. (1997). "Chronic Noise Exposure and reading deficits: The mediating effects of language acquisition". Environment and Behaviour. Vol.29:638-656

Friedman, M. S. et al. (2001). "Impact of changes in transportation and commuting behaviours during the 1996 Summer Olympic Games in Atlanta on air quality and childhood asthma", Journal of the American Medical Association. Vol. 285: 897-905.
Hansen, J. et al. (1998). "Increased risk of lung cancer among different types of professional drivers in Denmark", Occupational and Environmental Medicine. Vol. 55: 115-118.

Health Canada. (2005). AQBAT Workshop in Toronto. Barry Jessiman. December 2005.

Hoek, G. et al. (2002). "Association between mortality and indicators of traffic-related air pollution in the Netherlands: a cohort study". Lancet. Vol. 360: 1203-1209.

Korenstein, S. & B. Piazza. (2002). "An Exposure Assessment of PM_{10} from a Major Highway Interchange: Are Children in Nearby Schools at Risk?", Journal of Environmental Health. Sept, Vol.54. No.2:9-20.

Lin, S. et al. (2002). "Childhood asthma hospitalization and residential exposure to state route traffic", Environmental Research. Vol. 88: 73-81.

Litman, Todd. (2005). "Terrorism, Transit and Public Safety – Evaluating the Risks". Victoria Transport Policy Institute.

Lwebuga-Mukasa, J. S., Ayirookuzhi, S. J., and A. Hyland. (2003). "Traffic volumes and respiratory health care utilization among residents in close proximity to the Peace Bridge before and after September 11, 2001", Journal of Asthma. Vol. 40: 855-864.

Maheswaran, R., and P. Elliott. (2003). "Stroke mortality associated with living near main roads in England and Wales: A geographical study". Stroke. Vol. 34: 2776-2780.

Mayhew, D.R., Simpson, H.M. and D. Singhal. (2005) Best practices for graduated driver licensing in Canada Traffic Injury Research Foundation, Ottawa.

McConnell, R. et al. (2002). "Asthma in exercising children exposed to ozone: a cohort study", The Lancet. February, Vol 359: 386-391.

McMillan, U.W. and D.M. Chavis. (1986). "Sense of Community: A definition and theory", American Journal of Community Psychology. Vol. 14: 6-23

Ministry of Health and Long-term Care (MOHLTC). (2002) Injury: Predictable and Preventable, 2002 Chief Medical Officer of Health Report. The Ministry, Toronto.

Ministry of Transportation (MTO). (2004). 2002 Ontario Road Safety Annual Report.

Ministry of Transportation (MTO). (2005). 2003 Ontario Road Safety Annual Report.

National Highway Traffic Safety Association (NHTSA). (2002). Traffic Safety Facts 2002: Rural/Urban Comparison. U.S. DOT-HS-809-739.

National Research Council (NRC) and Transportation Research Board. (2002). Community and Social Benefits of Transportation Investment. NCHRP Project 8-36 Task 22, January 2002.
Ontario College of Family Physicians (OCFP). (2005). Report on Public Health and Urban Sprawl in Ontario. January 2005.

Ontario Ministry of Public Infrastructure Renewal. (2005). Places to Grow: Better Choices. Brighter Future. Proposed Growth Plan for the Greater Golden Horseshoe. November 2005.

Pan American Health Organization. (2004). "Deaths from Motor Vehicle Traffic Accidents in Selected Countries of the Americas, 1998-2001". Epidemiological Bulletin. Vol. 25. No.1, March 2004.

Passchier-Vemeer W. & Passichier. W.F. (2000). "Noise Exposures and Public Health". Environmental Health Perspectives. Vol 108 (Supplement 1): 123-131

Pilkington, Paul. (2000). "Reducing the Speed Limit to 20 mph in urban areas", British Medical Journal. Vol. 320.

Pope, C.A. III, Burnet, R.T., et al. (2004). "Cardiovascular Mortality and Long-Term Exposure to Particulate Air Pollution: Epidemiological Evidence of General Pathophysiological Pathways of Disease", Circulation. Vol.109:71-77 .

Pope, A. et al., (2002). "Lung Cancer, Cardiopulmonary Mortality and Long-term Exposure to Fine Particulate Air Pollution". Journal of American Medical Association. Vol.287, No.9:1132-1141.

Roberts, I. et al. (1995). "Effect of environmental factors on risk of injury of child pedestrians by motor vehicles: a case-control study", BMJ. January, Vol. 310: 81-94.

Simms, C. and D. O'Neill. (2005). "Sports utility vehicles and older pedestrians", British Medical Journal. October 9, Vol. 331:787-788.

Smargiassi, A. et al. (2005). "Traffic Intensity, dwelling value and hospital admissions for respiratory disease among the elderly in Montreal (Canada): a case-control study". (Pre-published copy).

Smith Nightingale, D. (1997). Transportation Issues in Welfare Reform. Prepared by the Urban Institute for the U.S. Dept. of Labor. http://www.urban.org/urlprint.cfm?ID=7457 (Accessed 30 October 2005)

Spence, J. (2001). Compilation of Evidence of Effective Active Living Interventions: A Case Study Approach. A report submitted to Health Canada on behalf of the Canadian Consortium of Health Promotion Research.

Sram, R.J., et al. (2005). "Ambient air pollution and pregnancy outcomes: a review of the literature", Environmental Health Perspectives. April, 113 (4):375-382.

Stansfeld, S.A., et al. (2005). "Aircraft and road traffic noise and children's cognition and health: a cross-national study", The Lancet. June, Vol.365:1942-1949, Issue 9475.

Toronto Police Service (2001). Statistical Report 2000.

Toronto Police Service (2005). 2004 Annual Statistical Report.

Toronto Public Health (TPH). (2004a), Air Pollution Burden of Illness in Toronto: 2004 Summary. July 2004.

Toronto Public Health (TPH). (2004b). Agenda for Action on Air & Health, July 2004.

Toronto Public Health (TPH). (2003). Physical Activity and Public Health: A Call to Action, June 2003.

Toronto Public Health (TPH). (2000). Health Effects of Noise. March 2000.

Toronto Transportation Services (TTS). (2005). Personal Communication, Blair Lagden. Traffic Data Centre & Safety Bureau, City of Toronto. October 2005.

Toronto Transportation Services (TTS). (2005a). Traffic Management Centre, Traffic Data Centre & Safety Bureau, "Fatal Collision Summary". August, 2005.

Transportation Services (TTS). (2006). "Fatal Collision Summary 2005", City of Toronto Traffic Management Centre Traffic Data Centre & Safety Bureau.

Toronto Urban Development Services. (2002). Toronto Official Plan. City Planning Division. Adopted by City Council, November 2002.

Transport Canada. (2003). Road Safety in Canada. Prepared for the Canadian Council of Motor Transportation Administrators.

UK Dept. for Transport, Air and Environment Quality Division. (2005) Traffic management and emissions, Traffic Advisory Leaflet 04/96, modified October 11, 2005. Dept. for Transport, London.

VTPI. (2005). Traffic Calming - Roadway Design to Reduce Traffic Speeds and Volumes. In TDM Encyclopedia. Victoria Transport Policy Institute, Victoria B.C. Updated December 14, 2005. Http://www.vtpi.org/tdm/tdm4.htm. (Accessed, 2 March 2006)

Wilhelm, M., & B. Ritz. (2003). Residential proximity to traffic and adverse birth outcomes in Los Angeles County, California, 1994-1996. Environmental Health Perspectives. Vol. 111: 207-216.

World Health Organization. (2000). Transport, Environment and Health. Ed. C. Dora and M. Phillips. WHO Regional Publications.