Protecting Health: Air Quality and Land Use Compatibility

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Executive Summary

This discussion paper is intended to provide suggested directions for consideration (and possible inclusion) in the Sustainable Halton and Halton Region Official Plan Review processes. It is recognized that future public and agency consultation on this paper will take place through these processes and that some of the suggested directions fall under local municipal purview.

Introduction

There is a significant burden of illness associated with poor air quality that is commonly experienced in southern Ontario. The Ontario Medical Association estimates that in 2005 air pollution contributed to approximately 190 premature deaths, 540 hospital admissions, 2,010 emergency room visits, and one million minor illness days in Halton Region.

Air quality can vary significantly across a community and differences in air quality can have a substantial impact on human health. For example, studies conducted along high volume traffic corridors consistently report associations between proximity to traffic and at least one of the following adverse health effects: asthma and other respiratory diseases, diminished lung function, adverse birth outcomes, childhood cancer, and increased mortality risks.

It is also well understood that certain populations of people are more sensitive to the negative health impacts associated with air pollution. While poor air quality can affect all people, it is the young, the elderly, and those with existing health problems who are more likely to become ill, be hospitalized, or to die prematurely in response to poor air quality, rather than healthy adults.

Keeping sensitive populations separated from industrial facilities and high-volume traffic corridors can help reduce the negative health impacts associated with poor air quality.

Approaches to Incompatible Land Use

Many jurisdictions provide guidance on avoiding conflicts between sensitive land uses and various other land uses such as industrial facilities, transportation routes, and agricultural operations. The jurisdictions reviewed are: California (state-, air quality management district-, and city-level); Australia (state-level); England (national- and borough-level); British Columbia (provincial level); and Ontario.

Incompatible land use guidance documents prepared at the national or state/provincial level vary from the general (concepts and principles) to the specific (minimum separation distances) without actually placing legal requirements on local governments. Generic recommended separation distances

are generally consistent across jurisdictions, are not intended to address pre-existing land use conflicts, and are not intended to deal with upset conditions (for example, spills).

Some jurisdictions measure the separation distance from property line to property line while others measure from the sensitive receptor to the activity boundary, which is not necessarily the property boundary.

Most jurisdictions acknowledge that generic separation distances are a starting point only and that the best information on keeping incompatible land uses apart comes from site-specific assessments. In Ontario, the generic separation distance is referred to as the zone of influence, within which air quality impacts are expected to occur. If air studies exist that show trivial impacts, a separation distance less than the zone of influence may be used but only up to a minimum separation distance that is not to be exceeded (dependent upon class of industrial facility).

For the jurisdictions reviewed, guidance on completing site-specific assessments is widely available but some questions arise: Should background air concentrations be included when assessing the impact of a new facility? Should air emissions from other nearby facilities be included in the assessment (i.e., cumulative air emissions)? How big a difference between baseline air quality and post-development air quality is acceptable? If cumulative air impacts from several planned developments are unacceptable, how is it decided which developments are approved and which are not?

Planning and Air Quality in Halton Region

Official Plans for Halton Region and the local municipalities all include policies that refer to provincial land use guidelines. Language in the municipalities' Official Plans reflects the different stages of development and local circumstances. While noise, odour, dust and vibration are addressed in all of them, it is less clear if the requirements apply to gaseous pollutants arising from both point and area sources.

Concerns with the Ministry of the Environment (MOE) Guideline D-6 (*Compatibility Between Industrial Facilities and Sensitive Land Uses*), expressed by local planners, include difficulty meeting requirements for infill, urban redevelopment, and transition-to-mixed-use situations. Current incompatible land use guidelines work better for greenfield development, and municipalities facing build-out will find it challenging to protect sensitive receptors during infill, urban redevelopment or transition to mixed use.

When land use planning conflicts are brought to the Ontario Municipal Board for resolution, inconsistencies of interpretation arise. From a review of some recent decisions of the OMB, it appears that greater consistency in application of land

use guidelines could result if clear and explicit policies were included in Regional and Local Official Plans.

Suggested Directions for Consideration in the Sustainable Halton and Regional Official Plan Review Processes

On the basis of our review of the health literature and best practices, the Halton Region Health Department recommends that the following parameters be considered during the Sustainable Halton and Regional Official Plan Review processes, in order to protect human health, particularly sensitive receptors, from incompatible land uses:

 # 1

Recognizing maturing urban areas, particularly zones of transition and intensification, and Section 38 of the Halton Region Official Plan, Halton Region encourage the MOE to update Guidelines D-1 and D-6 to reflect the changing nature of municipalities and the requirements of the *Places to Grow Plan*. The update should include the additional experience of environmental officers and public health inspectors gained since 1995, applicable research on separation distances for incompatible land uses, more specific industrial activity classification criteria, and a clear definition of sensitive land use.

 # 2a

Halton Region develop a made-in-Halton Incompatible Land Use Guideline (as part of the Healthy Communities Guidelines) that will:

- be developed by the Health Department, in consultation with Regional and Local partners;
- be largely based on the Ministry of the Environment D-Series Guidelines;
- be supplemented with best practices from other jurisdictions, and health research on incompatible land uses;
- incorporate the Minimum Distance Separation (MDS) Formulae for agriculture;
- address both greenfields development and infill, urban re-development, and areas of transition to mixed uses;
- identify when an air study will be requested, the parameters to be included in an air study, and how the results of such a study would be interpreted;
- be updated periodically to reflect advances in understanding of human health impacts related to land uses.

 # 2b Update policies in Halton Region's current Official Plan to explicitly reference the MOE Guidelines D-1 and D-6 to be used until such time as a made-in-Halton Incompatible Land Use Guideline is developed, and to explicitly reference that MOE Guideline D-6 be used to keep rail yards and

sensitive land uses separated until such time as a made-in-Halton Incompatible Land Use guideline is available.

 # 3

Sensitive land uses not be located closer than 150 m to highways anticipated to have greater than 100,000 vehicles per day based on ultimate planned capacity. When applying this guidance, future road widening should be taken into consideration.

 # 4

Sensitive land uses not be located closer than 30 m to roads with greater than 30,000 vehicles/day annual average daily traffic (AADT) based on ultimate planned capacity. Exceptions to this guidance are condominiums and mixed-use buildings, which could locate closer than 30 m provided appropriate controls are incorporated into the building design to protect indoor air quality for the occupants. When applying this guidance, future road widening should be taken into consideration.

 # 5

Air studies for quarry applications should include:

- a modelled frequency and duration analysis, which includes $PM_{2.5}$ (to understand how frequently and how long air levels can be expected to approach the maximum air levels); and
- background air concentrations of $PM_{2.5}$ in the modelling analysis (to enable the assessment of additional emissions from the quarry and a comparison to the Canada Wide Standard which is an ambient air standard)

 # 6

For non-livestock operations, where the MDS Formulae do not apply, MOE Guideline D-6 should be used to protect agricultural operations from encroachment by sensitive land uses until such time as a made-in-Halton Incompatible Land Use Guideline is available.

 # 7

The Halton Region Official Plan should require site-specific air studies when proposed new development would potentially result in separation distances (between industrial facilities and sensitive land uses) that are less than those recommended in MOE Guideline D-6 until such time as a made-in-Halton Incompatible Land Use Guideline is available.

Glossary of Terms

Organizations and Agencies

CARB	California Air Resources Board
MMAH	Ministry of Municipal Affairs and Housing
MNR	Ministry of Natural Resources
MOE	Ministry of the Environment
MPIR	Ministry of Public Infrastructure and Renewal
OMA	Ontario Medical Association
OMB	Ontario Municipal Board
SCAQMD	South Coast Air Quality Management District (California)
SMAQMD	Sacramento Metropolitan Air Quality Management District (California)

Other Terms and Acronyms

AADT	Annual Average Daily Traffic
Area source	sources that release pollutants to the air other than from stacks or vents; these are typically, though not always, small releases from evaporative processes, leaks in plant equipment such as valves, pump seals, flanges, or sampling connections
BATEA	Best Available Technology Economically Achievable
HAP	hazardous air pollutant
HRA	Health Risk Assessment
Line source	air pollution emitted from a linear “source” or geometry, for example, a roadway
MDS	Minimum Distance Separation
OP	Official Plan
Point source	a single, identifiable source of air pollutant emissions (for example, from a stack) which may be either elevated or at ground-level
PM_{10}	particulate matter smaller than 10 microns (inhalable particulate—coarse particles which usually do not travel further than the upper airways)
$PM_{2.5}$	particulate matter smaller than 2.5 microns (respirable particulate—fine particles which can travel deep into the lungs)
PPS	Provincial Policy Statement (Ontario)
PPS23	Planning Policy Statement 23: Planning and Pollution Control (UK)
Relative risk	the risk of developing a disease relative to exposure: relative risk is the ratio of the probability of the event occurring in the exposed group versus a non-exposed group
Veh/d	vehicles per day

1. Introduction

This discussion paper is intended to provide suggested directions for consideration (and possible inclusion) in the Sustainable Halton and Halton Region Official Plan Review processes. It is recognized that future public and agency consultation on this paper will take place through these processes and that some of the suggested directions fall under local municipal purview. This paper builds on earlier reports prepared by Halton Region Health Department including the policy paper, *Air Quality, Human Health & the Built Environment: Protecting Air Quality Through the Land Use Planning Process* (February 2007) and Council Reports MO-35-07 re: "Health Department's Proposed Air Quality Program" and MO-04-08 re: "Air Quality Program – Update".

This paper focuses on the policies and practices needed to protect Halton residents from localized air pollution that can be associated with certain types of activities or land uses. Halton Region is facing considerable growth over the next couple of decades—growth that will be accommodated through intensification of the existing built up area and focused in urban growth centres, intensification corridors, major transit station areas, and brownfields and greyfields (Ontario Ministry of Public Infrastructure and Renewal, 2006). Across Halton Region, municipalities are in different phases of maturity, approaching build-out in some areas while having greenfields available for development in other areas. This diversity will create different pressures across the Region and pose challenges for managing growth while protecting human health.

1.1 Halton Region Context

Local governments play a critical role in air quality management through transportation and land use planning; bylaws; public education to promote awareness and behaviour change; and corporate emission reduction measures (Institute for Risk Research, 2007).

In 2007, the Halton Region Health Department produced a policy paper, *Air Quality, Human Health, and the Built Environment: Protecting Air Quality Through the Land Use Planning Process*, which identified actions that could be taken by the Health Department to address air quality issues associated with land use planning and development processes. Subsequent reports outlined the Health Department's program for addressing air quality issues associated with the land use planning processes in Halton Region. The program was endorsed by Council in 2007 when it approved Report MO-35-07 entitled *Health Department's Proposed Air Quality Program* and was reaffirmed in 2008 when Council approved Report MO-04-08 entitled *Air Quality Program – Update*.

Report MO-04-08 identified the need to develop a discussion paper to inform guidelines and/or policies to protect the public's health from poor air quality that can result when sensitive land uses and emission sources encroach on one another.

The objective of this discussion paper is to review how leading jurisdictions address incompatible land use problems arising from growth and development. The jurisdictions reviewed are: California (state-, air quality management district-, and city-level); Australia (state-level); England (national- and borough-level); British Columbia (provincial level); and Ontario. In Ontario, the Ministry of Natural Resources (MNR), the Ministry of Agriculture, Food and Rural Affairs (OMAFRA), and the Ministry of the Environment (MOE) all provide land use compatibility guidance which is reviewed with two exceptions. The discussion of the MOE's D-Series Guidelines is restricted to D-1 *Land Use Compatibility* and D-6 *Compatibility Between Industrial Facilities and Sensitive Land Uses*. The D-Series Guidelines also include D-2 *Compatibility Between Sewage Treatment and Sensitive Land Use* and D-4 *Land Use On or Near Landfills and Dumps*, which are not reviewed at this time.

The review does not address existing incompatible land uses, rather it focuses on how to prevent or minimize future, localized, air quality problems (noise, odour, dust, and gaseous pollutants) caused by the encroachment of sensitive land uses and emission sources on one another.

This discussion paper addresses the following actions in the 2007-2010 Strategic Plan:

> 2007: "Define, in conjunction with the development of Healthy Communities principles, a framework of policies leading to improved air quality, to be implemented through the Sustainable Halton Plan and the resulting Official Plan." (Theme 2, Goal 1, Action a)
>
> 2008: "Investigate policy tools with other partners that support the development of complete communities." (Theme 1, Goal 1, Action 1e)
>
> 2009: "Update Healthy Community policies in the Official Plan, specifically…Air Quality Guidelines – Land Use Compatibility." (Theme 1, Goal 1, Action 1g)

1.2 Incompatible Land Use, Air Quality, and Human Health

Definitions

Much has been written about incompatible land uses from planning, environmental, and human health protection perspectives, yet it is difficult to find a specific definition of incompatible, or compatible, land use. Historically, zoning has sought to prevent one landowner from harming his or her neighbour by engaging in an incompatible use (Purdue University, 2002), yet the original intent of zoning has now been far exceeded and a rigid separation of land uses makes it difficult to meet demands for more compact, walkable neighbourhoods (National Association of Local Boards of Health, 2006). For this discussion paper, incompatible/compatible land uses will refer to the relationships that exist between one land use and another, usually adjacent, land use with a focus on air quality problems.

Likewise, it is difficult to find a specific definition of sensitive land use. Many jurisdictions refer to sensitive land uses but define them by example using language such as "…may include one or a combination of…" or "…include, but are not limited to…" The jurisdictions examined for this discussion paper do not address the issue of exposure duration and in some instances this may lead to an overly restrictive definition of 'sensitive'. For example, the Ontario Ministry of the Environment Procedure D-1-3 *Land Use Compatibility: Definitions*, includes camping grounds as a sensitive land use. Common to most examples of sensitive land uses are residential uses, hospitals, schools, child care facilities, and nursing homes.

Air Quality and Human Health

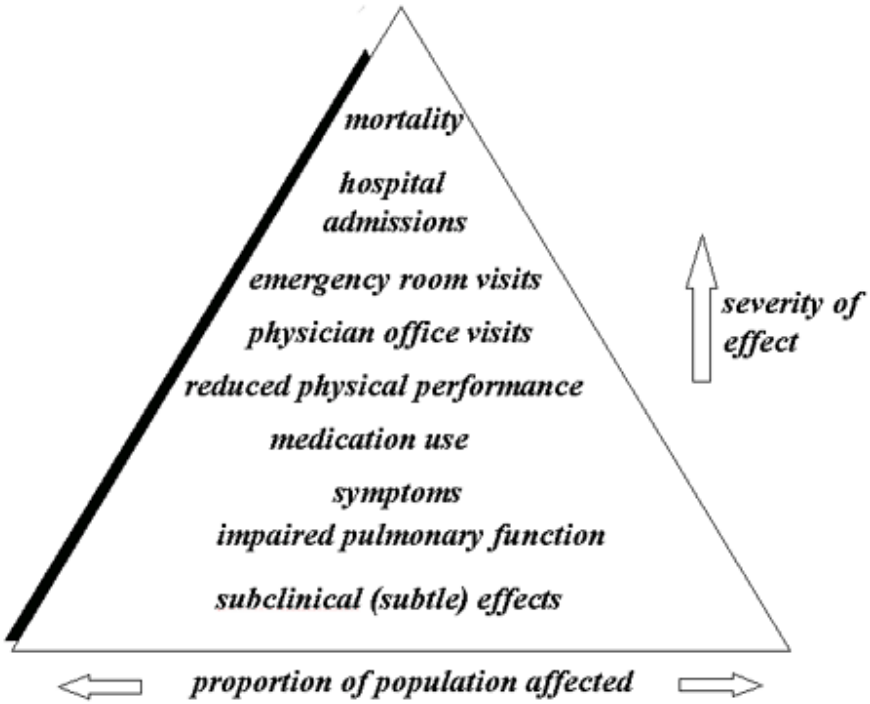
Smog and other air pollutants are caused by the burning of fossil fuels to drive our cars and trucks, and heat and cool our homes, offices, and commercial buildings. Industrial and manufacturing activities also emit smog-forming pollutants. As well, hundreds of other air pollutants, known as air toxics or hazardous air pollutants, can impact human health in some circumstances. Hazardous air pollutants can be emitted from a broad range of activities including mining, smelting, manufacturing, electricity generation, waste disposal, vehicles, and wood burning (Halton Region, 2007; Pollution Probe, 2002).

Human health impacts from air pollution are well documented and include effects related to short-term and long-term exposures. Effects related to short-term exposures include increases in non-traumatic deaths and hospital admissions for respiratory and cardiovascular conditions, increases in asthma symptoms and respiratory infections, and reductions in lung capacity. Long-term exposures are associated with reductions in

lung function in children and adults, reductions in life expectancy, increases in chronic heart diseases, and increases in respiratory diseases including asthma and chronic obstructive pulmonary disease and lung cancer (Institute for Risk Research, 2007; Boothe and Shendell, 2008; Gauderman et al., 2005).

These adverse health effects have been depicted as a pyramid (Figure 1) showing a smaller proportion of the population affected by more serious health outcomes (the top of the pyramid) and a larger proportion of the population (the bottom of the pyramid) impacted by subtler health conditions.

Figure 1. Pyramid of Health Effects from Air Pollution (From: http://www.hc-sc.gc.ca/ewh-semt/air/out-ext/effe/health_effects-effets_sante-eng.php#4, accessed December 3, 2008).



It is also well understood that certain populations of people are more sensitive to the negative health impacts associated with air pollution. While poor air quality can affect all people, it is the young, the elderly, and those with existing health problems who are more likely to become ill, be hospitalized, or to die prematurely in response to poor air quality, rather than healthy adults (World Health Organization, 2004).

Air Pollution's Impacts in Ontario and Halton Region

For 2005, the Ontario Medical Association (OMA) estimates that the five common air pollutants (ground-level ozone, fine particulate matter, sulphur dioxide, nitrogen dioxide, and carbon monoxide) contributed to about 5,800 premature deaths, almost 17,000 hospital admissions, 60,000 emergency room visits and 29 million minor illness days in Ontario. These health impacts cost Ontario almost $8 billion (Ontario Medical Association, 2005a).

The OMA estimates that in 2005 air pollution contributed to approximately 190 premature deaths, 540 hospital admissions, 2,010 emergency room visits, and one million minor illness days in Halton Region. It is estimated that these health impacts resulted in almost $17 million in health care costs and almost $13 million in lost productivity costs (Ontario Medical Association, 2005b).

Incompatible Land Use and Air Quality

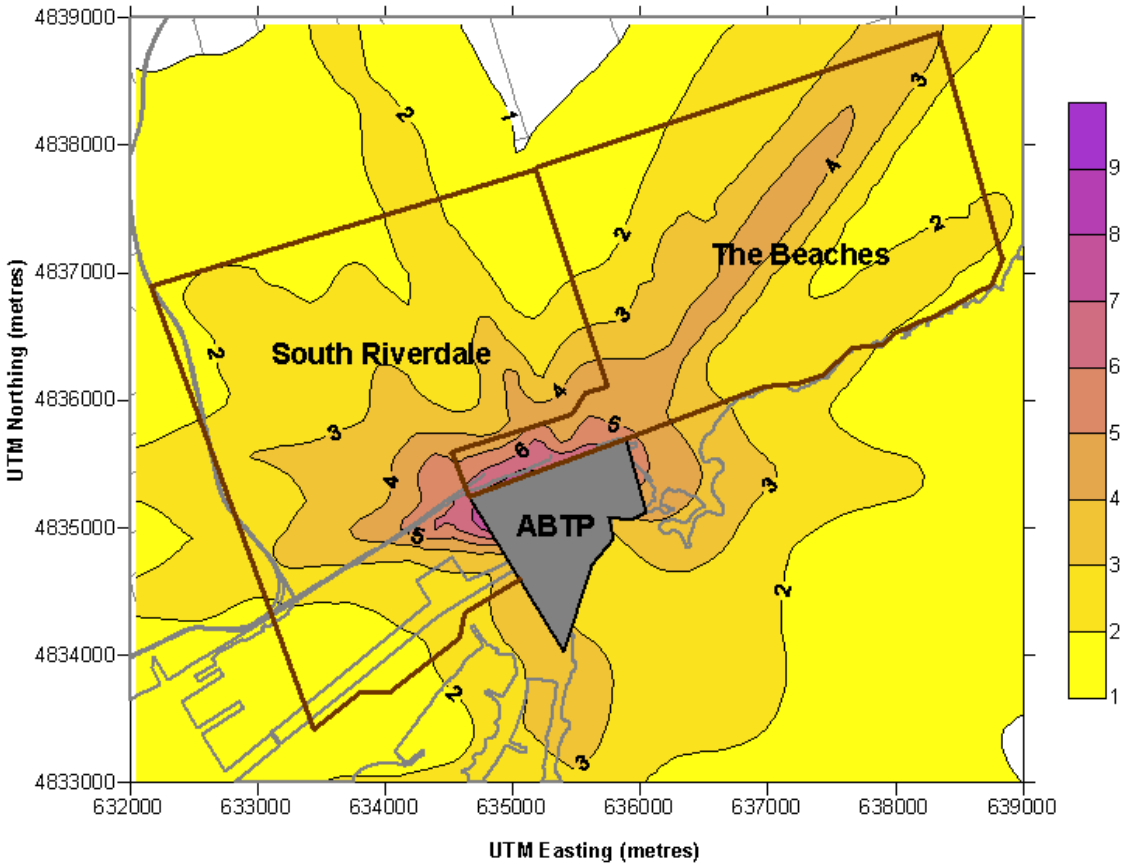
Air quality problems in southern Ontario are not only due to poor regional air quality but also to the impacts from localized pollutant emissions from point, area, and line sources (e.g., industrial facilities, quarries, traffic corridors). A growing body of research has demonstrated that air quality can vary significantly across a community and that differences in air quality can have a substantial impact on human health.

Point and Area Sources

The Ministry of the Environment has responsibility for regulating emissions associated with industrial facilities. Facilities with stacks that release emissions above ground level are generally referred to as point sources of emissions, while those that emit air pollutants at ground level are usually referred to as area sources. Many industrial facilities include both types of emissions. In both types of situations, the highest concentration of air pollutants will be in the area immediately surrounding the facility.

For example, Figures 2 and 3 show, respectively, modelled concentrations of nitrogen oxide from a wastewater treatment plant with incineration (a point source with emissions from a stack) and fine particulate matter from a quarry (an area source with ground level emissions). Both examples show higher air levels closest to the source and concentrations declining with distance away from the source.

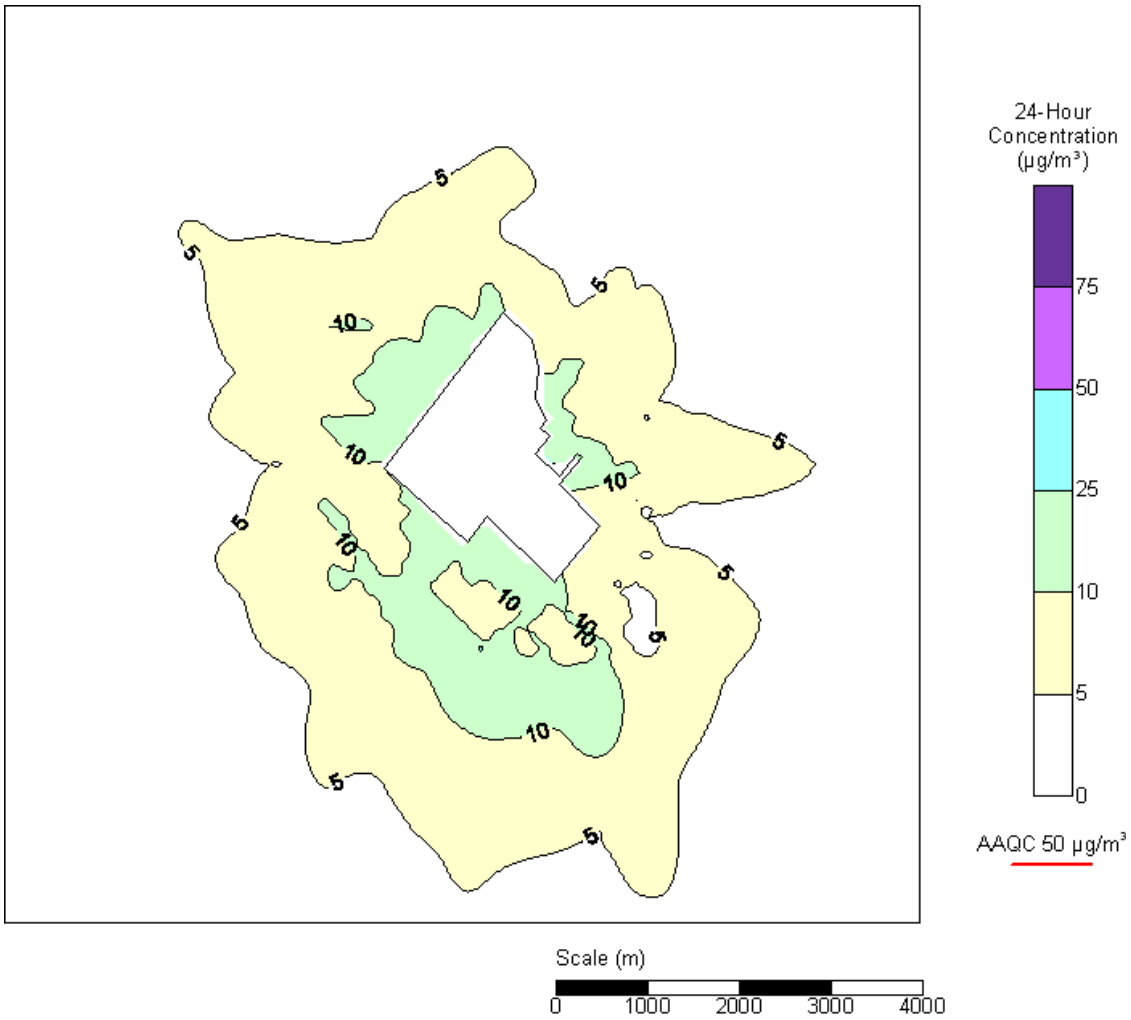
Figure 2. An Example of Scenario-Specific Modeled Nitrogen Oxide Concentrations Near a Wastewater Treatment Plant (Toronto Public Health, 2005).



The 24 hour AAQC for nitrogen oxides (NOx) is 200 ug/m3.

The 24 hour Toronto Public Health Benchmark for nitrogen oxides (NOx) is 200 ug/m3.

Figure 3. Predicted Maximum 24 Hr PM_{10} Concentration for a Proposed Future Quarry Expansion (Golder Associates, 2004).



Line Sources

Line sources are linear features associated with air pollution. Probably the best example is roadways and, over the last couple of decades, numerous health studies have been directed at traffic corridors. These studies, discussed in more detail later in this report, consistently report associations between proximity to traffic and at least one of the following negative health effects: asthma and other respiratory diseases, diminished lung function, adverse birth outcomes, childhood cancer, and increased mortality risks (Boothe and Shendell, 2008).

These findings are also supported by air studies showing that vehicle-related pollutants can be concentrated along traffic corridors. For example, Figures 4 and 5 below show, respectively, modelled particulate concentrations along a road where trucks queue near a border crossing (higher concentrations in the left of figure, declining in the downwind direction towards the right of the figure), and the influence of a highway (across the top of the figure) and a secondary road (down the middle of the figure) on modelled $PM_{2.5}$ (warmer colours indicate higher concentrations).

Figure 4. An Example of Modeled Particulate Concentrations Along a Road With Truck Queuing (Ontario Ministry of the Environment, 2005).

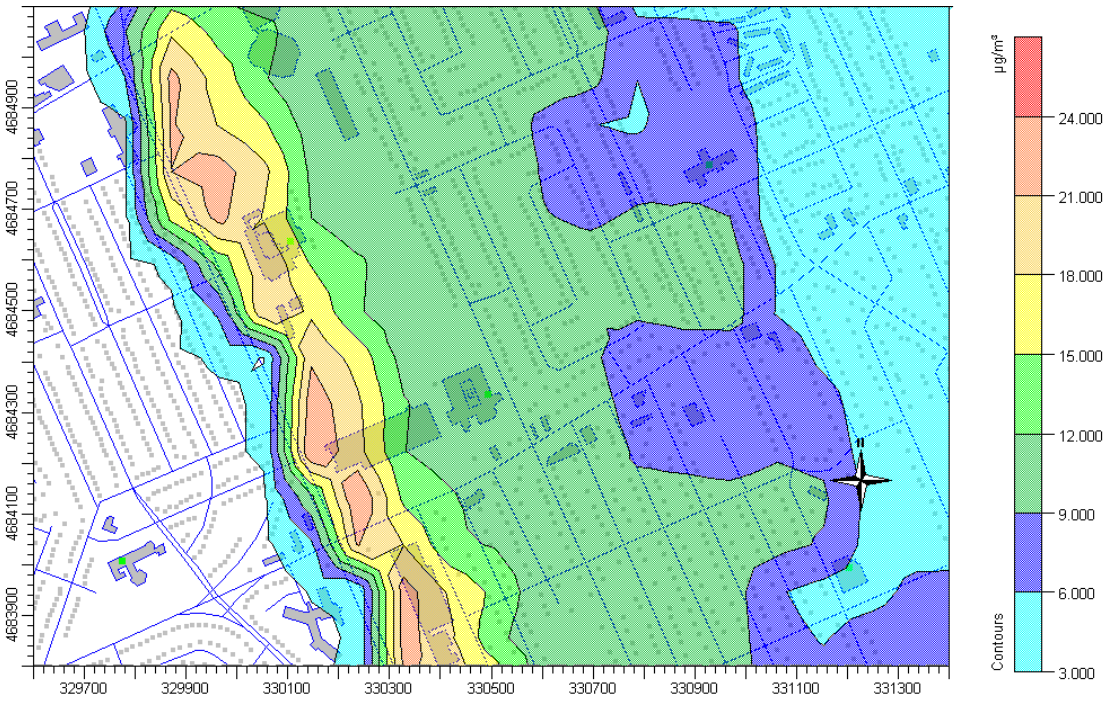
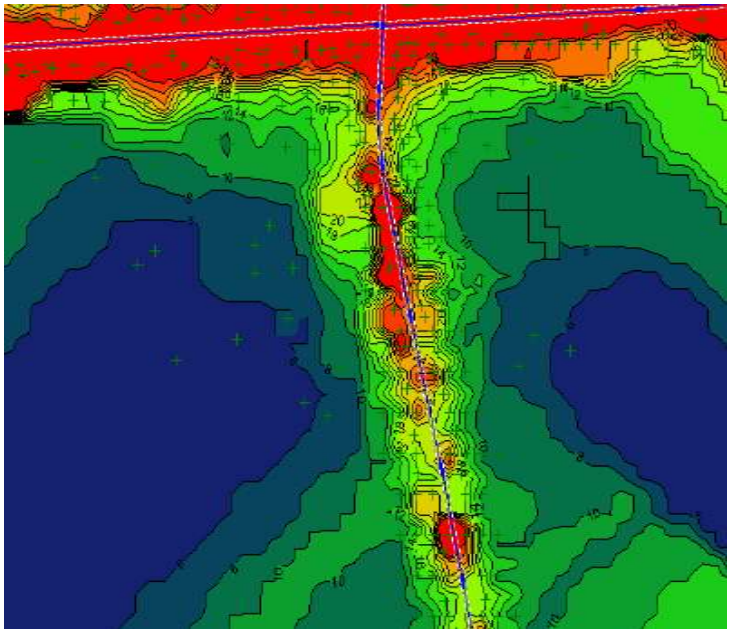


Figure 5. An Example of Modeled $PM_{2.5}$ Concentrations Showing the Influence of a Highway and a Secondary Road (University of Waterloo, undated).



Limitations of Air Standards and Permitting Programs

While pollution control regulations and programs are developed to control emissions and limit ground-level concentrations, most suffer from several shortcomings. For example, it is only recently (at least in Ontario) that air standards have been set based solely on health endpoints (O.Reg. 419). In the past, air standards reflected socio-economic and technical considerations as well as health effects, and for some pollutants, such as nitrogen oxides and fine particulate matter, this is still the practice. In these instances, permitting programs that are based on these air standards do not ensure protection for human health, particularly for the more sensitive members of the population.

In Ontario, the Ministry of the Environment has responsibility for permitting industrial facilities and issues Certificates of Approval based on the emissions from a single facility and, sometimes, on a single source within a facility. This approach does not take into consideration background concentrations (air pollution due to emission sources beyond a community's border) or cumulative impacts (air pollution from other sources from the same facility or from other, nearby, facilities). Consequently, while the Certificate of Approval process ensures that individual point or area sources do not exceed air standards, it does not ensure that air levels within a community stay below air standards.

Finally, air permitting programs are based on the assumption that operating procedures and controls adequately protect against upset conditions; they do not necessarily consider fugitive emissions from doors, diesel exhaust from trucks, or exposures that can occur in the event of the failure of an engineering control system. These shortcomings in regulatory control have been mitigated to some extent by recommending separation distances to keep industrial facilities and sensitive land uses apart.

Growth in Halton Region

In Halton Region, emissions of air pollutants are likely to increase as the Region's population is forecast to grow by 340,000 (from about 440,000 in 2006 to 780,000 by 2031) while employment is projected to grow by 140,000 (from about 250,000 in 2006 to 390,000 by 2031) (Ontario Ministry of Public Infrastructure and Renewal, 2006).

As this growth occurs, the age structure of the Region will also change. The percentage of those under 19 is projected to decline slightly while the percentage of those over 65 is projected to increase substantially. By 2031, it is estimated that there will be about 180,000 residents in Halton under the age of 19 (up from about 122,000 in 2006) and about 131,000 over the age of 65 (up from about 54,000 in 2006) (Hemson Consulting Ltd., 2007). This means that there will be a greater number of people in Halton Region who will be vulnerable to the negative health impacts associated with poor air quality.

One way to minimize the negative health impacts associated with poor air quality is to keep industrial facilities from encroaching on sensitive land uses, and vice versa.

1.3 Structure of Discussion Paper

Section 2 of this discussion paper provides an overview of how other jurisdictions approach the incompatible land use issue. Section 3 provides an overview of existing provincial guidelines addressing incompatible land uses. Section 4 looks at planning and air quality governance—how the province, the region and the local municipalities interact during development planning—and summarizes how incompatible land use guidelines are used both at the provincial and municipal levels. Section 5 explores some of the incompatible land use issues that need to be resolved and suggests recommendations for consultation.

2. Approaches to Incompatible Land Use in Other Jurisdictions

Many jurisdictions provide guidance on avoiding conflicts between sensitive land uses and various other land uses such as industrial facilities, transportation routes, and agricultural operations. The summary that follows is intended to be illustrative rather than comprehensive.

2.1 California

State-level

In 2005, the California Air Resources Board (CARB) released the *Air Quality and Land Use Handbook: A Community Health Perspective* (California Environmental Protection Agency, 2005). The guidance document is neither regulatory nor binding on local agencies but, rather, is intended to "…highlight the potential health impacts associated with proximity to air pollution sources so planners explicitly consider this issue in planning processes."

Sensitive land uses include schools and schoolyards, parks and playgrounds, daycare centres, nursing homes, hospitals and residential communities. The guidance document relies on relevant research to recommend minimum separation distances between new sensitive land uses and eight specific source categories of air pollution. The source types, recommended separation distances and the rationale for the distance recommendation are summarized in Table 1, below.

Table 1. California's Recommended Separation Distances Between Sensitive Land Uses and Eight Source Categories of Air Pollution.

Source	Separation Distance	Rationale
High traffic freeways and roads	500 feet (~150 m) for freeways, urban roads with 100,000 vehicles/day, or rural roads with 50,000 vehicles/day	Traffic studies show health risk within 1,000 feet and strongest at 300 feet. CA freeway studies show 70% drop in particulate levels at 500 feet.
Distribution centres	1,000 feet (~300 m) for more than 100 trucks/day, more than 40 trucks/day with operating transport refrigeration units (TRU) or where TRUs exceed 300 hrs/wk	Emissions and modelling analyses suggest 80% drop in pollutant concentrations at 1,000 feet.
Rail yards	1,000 feet (~300 m) for major service and maintenance rail yard; within 1 mile (~1,600 m) consider siting limitations and	Roseville Rail Yard Study showed highest impact within 1,000 feet associated with service and maintenance

	mitigation	activities. Next highest impact between half and one mile of yard dependent on wind direction and speed.
Ports	Avoid sensitive land uses immediately downwind and consult local air districts	Studies underway. Advisory is based on health impact of diesel particulate emissions.
Refineries	Avoid sensitive land uses immediately downwind and consult local air districts	Risk assessments from CA refineries show air toxics risks under 10 chances of cancer per million. Advisory based on known emissions from refineries particularly during non-routine releases.
Chrome plating facilities	1,000 feet (~300 m)	Studies show localized risk from hexavalent chromium diminishing significantly at 300 feet. Due to data limitations and the potency of hexavalent chromium, 1,000 feet is recommended as a precautionary measure.
Dry cleaners (using perchloroethylene)	300 feet (~90 m); 500 feet (~150 m) if two or more machines; Consult local air district for three or more machines; Do not site sensitive land uses in the same building as perc dry cleaning facilities	Studies show individual cancer risk reduced by up to 75% with a 300 foot separation distance from a one-machine operation. For two or more machines, 500 feet can reduce risk by over 85%.
Large gas dispensing facilities	50 feet (~15 m) for typical facility; 300 feet (~90 m) for facilities with greater than 3.6 million gallons/yr (~13.6 million litres/yr)	Based on Gasoline Service Station Industry-wide Risk Assessment Guidelines. Large facilities under rural air dispersion conditions can pose a larger risk at a greater distance.

The recommended separation distances are based on ranges of relative cancer risk—an estimate of the increased chances of getting cancer due to facility emissions over a 70-year lifetime. The relative cancer risks estimated by CARB do not take into account the regional cancer risk from air pollution (i.e., background), which in the South Coast Air Basin (Los Angeles area) is 1,000 in one million.

Minimum separation distances are problematic in cases where there is an elevated health risk over a large geographical area, for example, downwind of ports and rail yards. In these cases, CARB recommends avoiding locating sensitive land uses within the highest risk zones.

The guidance also acknowledges that local agencies must balance considerations beyond air quality, such as housing and transportation needs, economic development priorities, and other quality of life issues.

Air Quality Management Districts

There are a number of air quality management districts in California and these provide guidance to cities and counties within their jurisdiction. Guidance documents vary from the general (concepts and principles) to the specific (minimum separation distances). Local agencies may codify minimum separation distances in regulations.

For example, the Sacramento Metropolitan Air Quality Management District released, in 2004, the *Guide to Air Quality Assessment in Sacramento County*. The guide (Sacramento Metropolitan Air Quality Management District, 2004) explicitly acknowledges the linkage between land use and air quality, and land use conflicts and exposure of sensitive receptors. However, the guidance does not specify mitigation requirements, such as minimum separation distances, but instead states that early consultation between project proponents and Lead Agency staff can "avoid or minimize localized impacts to sensitive receptors."

Three years later, in 2007, that same agency released *Recommended Protocol for Evaluating the Location of Sensitive Land Uses Adjacent to Major Roadways*. In contrast to the agency's earlier guide, this protocol (Sacramento Metropolitan Air Quality Management District, 2007) provides a detailed process to evaluate the potential cancer risk posed by a project to determine if a site specific health risk assessment (HRA) is warranted. If a site specific HRA is indicated, the protocol provides guidance on how it should be performed.

The South Coast Air Quality Management District (SCAQMD) takes yet another approach. In *Guidance Document for Addressing Air Quality Issues in General Plans and Local Planning*, the SCAQMD provides some detail regarding air quality and land use, referring extensively to the CARB Air Quality and Land Use Handbook, particularly for the influence of major roadways on air quality (South Coast Air Quality Management District, 2005). However, no specific recommendations are made and the guidance provided is more good planning principles and accepted methods for reducing emissions of criteria and toxic air contaminants. The document takes pains to point out that air quality management districts can do no more: "Local governments have the flexibility to address air quality issues through ordinances, local circulation systems, transportation services, and land use. No other level of government has that authority, including the AQMD."

Absent legal authority, it is not surprising that advice from the state and air quality management districts in California ranges from the broad and generic to the specific and detailed without actually placing requirements on local governments.

Local Government

An example of a local government that has codified separation distances in regulation is the city of Alameda, California. The Municipal Code provides general guidance regarding compatible land use and allows for the issuance of Use Permits with conditions that may require, for example, open spaces, buffer strips, walls, fences and landscaping, or limits on hours of operation or time of day for the conduct of some activities. The Code is more specific for hazardous materials processing uses, requiring a buffer zone of at least 2,000 feet between the operational area of a facility and the nearest residence and a buffer zone of at least 5,000 feet between a facility and any immobile population. Immobile populations include "schools, hospitals, convalescent homes, prisons, facilities for the mentally ill, day care centers, homeless shelters, and other similar uses." These minimum distance requirements may be relaxed if the developer can demonstrate, by risk assessment, that a smaller buffer zone provides adequate protection in the event of an accident (City of Alameda, 2007).

2.2 British Columbia

In 2006, British Columbia's Ministry of the Environment released *Develop With Care: Environmental Guidelines for Urban and Rural Land Development in British Columbia* (British Columbia Ministry of the Environment, 2006). The document is intended to provide province-wide guidelines for maintaining environmental values during the development of:

- urban and rural lands;
- greenfields (land not previously built upon); and
- brownfields and greyfields (land that has been previously developed).

The guidelines do not apply to developments related to forestry, mining, or commercial agriculture within the Agricultural Land Reserve. Separate sections provide guidance for Community Planning; Site Development and Management; and Environmentally Valuable Resources.

The Community Planning section provides high-level guidance on good planning principles including the use of buffers to separate incompatible land uses. The only specific recommendations for separating sensitive land uses are provided in Section 2.7 *Guidelines for Air Quality and Climate Change* and refer to major transportation routes. The guidance suggests "…a minimum 150 m setback from busy roads for buildings such as schools, hospitals, long-term care facilities, and residences." A busy road is defined as a road with more than 15,000 vehicles/day. The guidance also recommends additional setbacks for buildings along major

truck routes. Neither “additional setback” nor “major truck routes” are defined.

The sections on Site Development and Management and Environmentally Valuable Resources also advocate the use of buffers, but it is only for environmentally valuable resources that specific separation distances are recommended. Environmentally valuable resources include “…all features, sites, and species whose presence enhances the natural biodiversity of the area…” and tables of recommended separation distances are provided for Biodiversity Conservation, Riparian Areas, and Songbirds. For some species, a breeding season ‘quiet’ buffer is added to the separation distance: for example, the target buffer distance for Great Blue Heron nests is 300 m in undeveloped areas, 200 m in rural areas, and 60 m in urban areas. An additional 200 m is required during the breeding season.

2.3 England

National Guidance

In England, the government initiated planning system reform in 2002 and subsequently issued a number of planning policy statements to provide guidance to Local Authorities. Land use planning and environmental quality are addressed in *Planning Policy Statement 23: Planning and Pollution Control* (PPS23) and an annex to PPS23 – *Annex 1: Pollution Control, Air and Water Quality* (Annex 1).

PPS23 advises that “any consideration of the quality of land, air or water and potential impacts arising from development, possibly leading to impacts on health, is capable of being a material planning consideration, in so far as it arises or may arise from or may affect any land use” (Office of the Deputy Prime Minister, 2004a). The policy statement acknowledges that development can bring environmental benefits from, for example, mixed uses, travel reductions, improvements in transport infrastructure and remediation of past contamination. However, PPS23 advises that development plan documents should consider, among other things:

- the possible impact of potentially polluting development on land use including effects on health, the natural environment or general amenity;
- the need to separate potentially polluting and other land uses in order to reduce conflicts;
- the cumulative impacts on air quality of a number of smaller developments, particularly in areas where air quality is already, or is likely to be, poor.

PPS23’s Annex 1 (Office of the Deputy Prime Minister, 2004b) provides the background on pollution control legislation, its interactions with the

planning system and how these interactions are dealt with in planning. Local Planning Authorities are required to prepare Local Development Documents (LDD) which apply national government policies to local areas. LDDs should include considerations of sensitive land uses—developments such as housing, schools and hospitals in proximity to sources of pollution such as roads and certain industrial processes.

Annex 1 also suggests that planning authorities consult with pollution control agencies when development will be sited within a radius of 500 m of a large industrial installation or 250 m of smaller industrial installations. Consultation is also recommended for specific circumstances, for example, if the development will:

- occur in areas of high background levels of air pollution;
- occur in areas which cater to those more vulnerable to pollution (e.g., the elderly, children or those with respiratory illnesses);
- attract people and traffic on a regular basis (e.g., shopping centres, entertainment complexes, offices).

Neither PPS23 nor Annex 1 provide recommended separation distances to keep sources of pollution away from sensitive land uses and vice versa.

Local Implementation

The Royal Borough of Kensington and Chelsea provides an example of how national guidance is implemented at the local level. National policies are reflected in the Royal Borough's *Unitary Development Plan* (UDP) which is the borough's principal policy document shaping decisions related to land use. To supplement the policies of the UDP, the Royal Borough has produced *Supplementary Planning Guidance-05 Air Quality* (Royal Borough of Kensington and Chelsea, 2003), hereafter referred to as SPG-05. While SPG-05 has several objectives, three are of particular interest:

- to emphasize the importance of air quality as a material planning consideration;
- to identify those circumstances where an air quality assessment would be required to accompany a development proposal; and
- to provide technical guidance relating to the provision of an air quality assessment.

Air Quality Assessments are normally required from developers for applications where the impact on air quality is likely to be significant (Royal Borough of Kensington and Chelsea, 2003). The Association of London Government has published a Technical Guidance Note with the following criteria to help assess significance:

- proposals that will result in an increase in vehicle trip generation in the local area, which result in increases in traffic volumes (Annual

Average Daily Traffic) of five per cent or more on individual road links with more than 10,000 vehicles per day;
- proposals which may result in increased congestion and lower vehicle speeds than are present on the existing local road network;
- proposals which significantly alter the composition of traffic such that adverse air quality impacts may arise;
- proposals for new developments with 300 parking spaces or more or an increase in existing parking provision of 300 spaces or more;
- proposals for coach and lorry parks;
- any development likely to have an adverse impact on air quality, particularly in sensitive areas (for example where predicted air pollution levels already exceed air quality objective levels by 10% or more); or
- proposals that have the potential to result in significant emissions of pollutants from industrial activities.

The Royal Borough will also normally require Air Quality Assessments where a proposal will require an application under the Pollution Prevention and Control regime. (This appears to be similar to Ontario's Certificate of Approval process.) Activities and installations covered include virtually all heavy industry.

Annex 2 in SPG-05 provides technical guidance for undertaking air quality assessments and two of the general principles are noteworthy:
- "An air quality impact assessment should clearly indicate the likely change in pollutant concentrations (relevant to the air quality objectives) arising from the proposed development. The factor of greatest importance will, generally, be the difference in air quality as a result of the proposed development."
- "For all developments, it is vital that air quality assessments take fully into account the cumulative air quality impacts of committed developments (i.e. proposals that have been granted planning permission at the time the assessment is undertaken)…"

While the guidance is helpful in determining when air quality assessments would normally be requested by the local authority and what an air quality assessment should include, it does not explain how an air quality assessment would be used in the planning process. For example, how big a difference between baseline air quality and post-development air quality is acceptable; if cumulative air impacts from several planned developments are unacceptable, how is it decided which developments are approved and which are not? Neither does SPG-05 provide explicit separation distances to keep industrial land uses and sensitive land uses from encroaching on each other.

2.4 Australia

Most states in Australia use separation distances to control potentially incompatible land uses during the development process. Two slightly different approaches from Western Australia and South Australia are compared. For both states, extensive tables of recommended separation distances are available though they are not reproduced here.

Western Australia

The Government of Western Australia has produced a Guidance Statement (Western Australia Environmental Protection Authority, 2005) to assist with implementation of its statutory *State Industrial Buffer Policy*. This policy is intended to provide a consistent Statewide approach to protect industrial and sensitive land uses from encroaching on each other. The Guidance Statement recognizes that "sound site-specific technical analysis is generally found to provide the most appropriate guide to the separation distance that should be maintained between an industry or industrial estate and sensitive land use." However, site-specific studies are not necessary all the time and so generic separation distances are recommended based on experience of the Department of Environment and other regulatory agencies.

The guidance document points out that the recommended separation distances do not take into account:

- cumulative impacts;
- non-typical emissions (e.g., upset conditions);
- the protection of natural resources or significant elements of the natural environment; or
- potential health impacts from emissions.

The recommended separation distances are not intended to be absolute, rather, they provide a starting point for assessing whether site-specific studies are required. There is no mention of existing or required pollution control technology and the distances provided are from property line to property line (i.e., not from sensitive use to industry).

South Australia

In South Australia, the primary role of separation distance guidelines is to serve as an aid to the assessment of development proposals (South Australia Environment Protection Authority, 2007). The guidelines are designed to be:

- simple for all parties;
- transparent;

- quick and cheap (expert air quality or noise advice should not be required);
- more conservative than separation distances predicted by air pollution or noise modelling, for a high percentage of proposals.

Comparison of Western and South Australia

The principle of keeping industrial and sensitive land uses from encroaching upon one another is the same as for Western Australia; however, there are some key differences between Western Australia and South Australia.

First, in South Australia, separation distance is measured from the boundary of the sensitive receptor to the activity boundary which is not necessarily the property boundary. In Western Australia, the measurement is from property line to property line.

Second, the separation distances in South Australia are based on the assumption that pollution control equipment that is the Best Available Technology Economically Achievable (BATEA) is implemented. This can result in shorter separation distances than in Western Australia where there appears to be no such assumption.

Third, in South Australia, factors that account for surface roughness and topography are applied to modify the recommended separation distances. As a result, a separation distance may be more or less than that recommended in the guidance document.

A final difference occurs in the factors considered for the recommended separation distance. In Western Australia any or all of five factors may influence the recommended buffer distance: gaseous, noise, dust, odour, or risk. In South Australia, the recommended distances are based almost entirely on “air” although in a few instances, a distance based on noise is given (and that distance is always higher than an air-based separation distance).

Site-specific Assessments

For some activities, although there may be a recommended separation distance, a site-specific assessment is required if the activity exceeds a certain threshold. For example, in Western Australia for metal smelting, refining, melting, casting, fusing, roasting or processing works of less than 100 tonnes per year, the separation distance is 100-200 metres; for works of between 100 and 1,000 tonnes per year the separation distance is 300-500 metres; and for works over 1,000 tonnes per year, the separation

distance is determined on a case-by-case basis and depends upon the process being used.

Sewage treatment works provide an example from South Australia: separation distances of 100, 200, or 300 metres are recommended for works serving different sized populations up to 15,000 people. For sewage treatment works serving more than 15,000 people, an individual assessment is required.

Examples From Western and South Australia

For some activities that may be relevant to Halton Region, a few Australian examples of recommended separation distances are provided in Table 2, below. The uppercase letter in brackets following the separation distance indicates the factor(s) considered: G – gaseous; N – noise; D – dust; O – odour; R – risk; A – air.

Table 2. Examples of Separation Distances from Two Australian States

Activity	Western Australia	South Australia
Asphalt Preparation	1,000 m (N,D,O)	1,000 m [1] (A)
Chemical Storage – Bulk	500-1,000 m (G,R)	500 m (A)
Electric Power Generation	3,000-5,000 m (G,N,D)	--
Vehicle Production >2,000 units/yr	--	500 m (A)
Galvanizing	500 m (G,N,D,O)	300 m (A)
Crematoria	200-300 m (G,N,R)	150 m (A)

1 Example of applying the surface roughness and terrain factors: if the proposed plant is on a slight slope within a broad valley and has heavy timber between it and the sensitive receptor, applying the surface roughness factor and the terrain factor would yield an upslope separation distance of 770 m and a downslope separation distance of 1,232 m.

3. Ontario's Approach to Land Use Compatibility

The Provincial Policy Statement (PPS) provides high-level guidance to regional and local governments on planning for growth. It states that:

> Healthy, liveable, and safe communities are sustained by…avoiding development and land use patterns which may cause environmental or public health and safety concerns – Policy 1.1.1(c); and
>
> Land use patterns within settlement areas shall be based on densities and a mix of land uses which…minimize negative impacts to air quality and climate change… – Policy 1.1.3.2(a)3 (Ontario Ministry of Municipal Affairs and Housing, 2005)

Section 4.0 of the PPS addresses implementation and interpretation and requires decisions affecting planning matters to be consistent with the Provincial Policy Statement. Furthermore, the policies of the PPS represent minimum standards and planning authorities and decision-makers may go beyond these minimum standards provided there is no conflict with any policy of the PPS (Section 4.6).

In Ontario, land use compatibility guidance is provided by the Ministry of the Environment, the Ministry of Agriculture, Food and Rural Affairs and the Ministry of Natural Resources. It is worth reviewing the Ontario guidance in some detail to inform the discussion on how land use compatibility guidance is used and where there might be room for improvement.

3.1 Ministry of the Environment

In 1995, the Ontario Ministry of the Environment (MOE) released a revised series of guidelines and procedures related to land use compatibility. The two guidelines which are the subject of this discussion paper—Guideline D-1 *Land Use Compatibility* and Guideline D-6 *Compatibility Between Industrial Facilities and Sensitive Land Uses*—were accompanied by a number of Procedures to aid with implementation. The Guidelines, intended to apply only when a change in land use is proposed, recommend separation distances and other control measures to prevent or minimize adverse effects from the encroachment of incompatible land uses.

Both guidelines apply:

- for the formulation and review of land use policies, guidelines or programs;
- for the review of municipal general plans and proposals (e.g., official plans, official plan amendments, secondary plans); and
- for the review of site-specific development plans including redevelopment and infill proposals.

Both guidelines quite clearly state that they are intended to be supplemental to (i.e., do not replace) legislated controls and that “Nothing in th[ese] guideline[s] is intended to alter or modify the definition of ‘adverse effect’ in the *Environmental Protection Act*.” The availability of the guidelines acknowledges that regulatory requirements, such as Certificates of Approval (Air) as required by the Environmental Protection Act, are not necessarily sufficient for the prevention of adverse effects.

3.1.1 Guideline D-1 *Land Use Compatibility*

Scope

The objective of Guideline D-1 is to minimize or prevent the exposure of any person, property, plant or animal life to adverse effects associated with the operation of specified facilities.

Section 2.4 of Guideline D-1 states “Depending upon the particular facility, adverse effects may be related to, but not limited to, one or more of the following:

(a) noise and vibration;
(b) visual impact (only for landfills under O. Regulation 347);
(c) odours and other air emissions;
(d) litter, dust and other particulates; and
(e) other contaminants.”

Section 4.0 of the implementation guidance (Procedure D-1-1 *Implementation*) addresses mitigation and the effectiveness of buffers for separating incompatible land uses. Specifically, the guidance points out that buffers that may work for the control of noise may not be adequate for “dust, odours, or gaseous air contaminants” and that privacy fences or narrow strips of plantings have little or no effect with regard to the reduction of noise or air pollution.

Clearly, Guideline D-1 is intended to apply not only to noise, odours, and dust, but also to air pollutants.

Exemptions and Exclusions

Guideline D-1 is not intended to apply in a number of situations, the first of which being where incompatible land uses already exist and there is no new land use proposal for which approval is being sought.

Second, the Guideline does not normally affect a change in land use, an expansion, or a new development provided the facility or sensitive land use is in compliance with existing zoning and the official plan designation. The Guideline goes on to the state that exceptions to this include plans of subdivision and condominium and/or severance in which case the MOE may require studies and mitigation measures to prevent or minimize adverse effects. This is now out of date since the memorandum of understanding of 1996 (discussed later) relieves provincial review agencies from responsibilities associated with planning applications for subdivisions and condominiums.

Third, emergency situations such as process upsets or spills are not subject to D-1 as they are dealt with through other practices.

Finally, Guideline D-1 does not normally apply to lands owned or purchased by undertakings under federal jurisdiction. So, for example, a residential development encroaching upon federally owned lands would be subject to the MOE Guidelines but activities undertaken on the federally owned lands would not. However, generally, undertakings of the federal government comply not only with federal requirements, but also with provincial and municipal requirements in the jurisdiction of the undertaking.

Examples of Compatibility

Procedure D-1-1 provides a table of simplified examples of "compatibility ratings" for different types of facilities and sensitive land uses. The examples provided are for Class I, Class II, and Class III Industrial Facilities (the subject of Guideline D-6, see below) and the "compatibility ratings" are, respectively, "not recommended", "poor", and "incompatible". This oversimplification raises more questions than it answers since the table does not address separation distances or other control measures to mitigate impacts.

Interestingly, the table also includes transportation corridors and suggests a "compatibility rating" of "possible with conditions". Transportation corridors are not mentioned anywhere else in Guideline D-1 or Guideline D-6. It is unclear if vehicle transportation corridors are included in the definition of *Facilities* which mentions, by example, airports and railways. Both airports and railways fall under federal jurisdiction; however, freeways do not. The only clue that freeways are included as transportation corridors appears in Procedure D-1-2 *Land Use Compatibility: Specific Applications*, which refers the reader to a document by another agency: *Guidelines on Noise and New Residential Development Adjacent to Freeways* (Ministry of Housing, April 1979).

Traffic Corridors

The table in Procedure D-1-1 suggests that transportation corridors are compatible with sensitive land uses "with use of buffers (e.g. noise)." However, the same document acknowledges that what works to control noise may not be adequate for dust, odour or gaseous contaminants.

Since 1995, when the D-Guidelines were last updated, a substantial body of research has developed demonstrating serious health impacts due to air pollution near highways. Depending upon traffic density and distance from roadways, health impacts include cardiovascular disease, asthma,

decreases in pediatric lung function, and cancer (Brugge et al., 2007). Some evidence also exists for adverse birth outcomes, for example preterm birth and low birth weight (Wilhelm and Ritz, 2003; Brauer et al., 2008), although the case for these health effects is less well developed (Brugge et al., 2007). Clearly, a short-coming of the D-Guidelines is their failure to address vehicle traffic corridors and proximity of sensitive land uses.

3.1.2 Guideline D-6 *Compatibility Between Industrial Facilities and Sensitive Land Uses*

Scope

Guideline D-6 is a direct application of Guideline D-1 and specifically addresses potential conflicts between industrial land uses and sensitive land uses. The guideline uses the concept of influence area and is applicable when a new sensitive land use is proposed near an existing facility and/or when a new facility is proposed near an existing sensitive land use.

Potential Area of Influence and Minimum Separation Distance

The potential influence area is the area where adverse effects are generally expected to occur and it is within this area that sensitive and industrial land uses must not encroach. However, if studies exist showing the impact from an industrial facility to be trivial, then sensitive and industrial land uses may be located within a facility's potential area of influence up to, but no closer than, a minimum separation distance. The distance is normally measured from property line to property line although other measurement points are allowed including measurement from the emitting source to the sensitive receptor. This is a reasonable approach for instances where a sensitive land use is adjacent to an industrial land use (the property line to property line distance would be zero) provided there is sufficient space for a separation distance buffer on either or both lots (though, preferably, the emitting source should provide the buffer).

Infill, Urban Re-development and/or Transition to Mixed Use

For areas of infilling, urban re-development, and/or transition to mixed use, the guideline recognizes that the recommended minimum separation distances may not be achievable. In these instances, to assess whether or not to allow a separation distance less than that recommended, the guideline requires the following:

- detailed mapping showing the area subject to the proposed development and all industrial facilities and any other sources of adverse effects;

- mapping of all vacant properties currently zoned and/or designated for industrial use including excerpts from the official plan and/or zoning by-law to indicate the full range of permitted uses;
- assessment of the types and levels of contaminant discharges being generated by current industrial facilities, including those associated with transportation facilities which serve the industries;
- identification of mitigative measures based upon technical assessments;
- an indication of how the mitigative measures will be implemented;
- where mitigative measures will be applied off-site to an existing industrial facility, the proponent must demonstrate the industrial facility has no objection to the proposed use or to the addition of the necessary mitigative measures; and
- proponents should demonstrate to the approving authority that no objections to the proposed use have been raised by area residents, industries, etc.

Application

Section 1.2.2 states "The guideline applies to all types of proposed, committed and/or existing industrial land uses which have the potential to produce point source and/or fugitive air emissions such as noise, vibration, odour, dust and others, either through normal operations, procedures, maintenance or storage activities, and/or from associated traffic/transportation." Point source emissions come from stacks and vents and are relatively easy to measure while fugitive emissions are generally associated with leaks from pipes and valves, doorways, truck bays, etc. and are much more difficult to measure or model and consequently can be grossly underestimated (Chambers, et al., 2008).

Procedure D-6-1 *Appendix A: Industrial Categorization Criteria* also makes it clear that point sources must be considered as well as fugitive emissions and this has been confirmed by the Ministry of the Environment: "…the intent of looking at the air quality issue when assessing industrial/sensitive land use interface is to have ALL sources of air emissions identified, fully described and have appropriate mitigation measures and separation distances suggested." (emphasis in original email from MOE staff to Halton Region staff, dated November 19, 2007).

Exemptions

Guideline D-6 names the following facilities to which the guideline does not apply:

- Sewage treatment facilities
- Waste management facilities that require a Waste Certificate of Approval (from the Ministry of the Environment)

- Agricultural operations
- Airports
- Railways (but it does apply to railway yards and other ancillary rail facilities)
- Pits and quarries (except in the absence of site-specific studies)

Classification of Industrial Facilities and Separation Distances

Industrial facilities to which the guideline does apply are classified, by scale of operation, into three categories. The criteria for categorizing industrial facilities are derived from experience of the Ministry of the Environment and the investigation of complaints related to industrial facilities.

A *Class I Industrial Facility* is a "place of business for a small scale, self contained plant or building which produces/stores a product which is contained in a package and has low probability of fugitive emissions. Outputs are infrequent, and could be point source or fugitive emissions for any of the following: noise, odour, dust and/or vibration. There are daytime operations only, with infrequent movement of products and/or heavy trucks and no outside storage." Examples include beverage bottling, furniture repair and refinishing, auto parts supply, and laundry and linen supply.

For Class I Industrial Facilities, the potential influence area is 70 m and a minimum separation distance of 20 m is recommended.

A *Class II Industrial Facility* is a "place of business for medium scale processing and manufacturing with outdoor storage of wastes or materials (i.e. it has an open process) and/or there are periodic outputs of minor annoyance. There are occasional outputs of either point source or fugitive emissions for any of the following: noise, odour, dust and/or vibration, and low probability of fugitive emissions. Shift operations are permitted and there is frequent movement of products and/or heavy trucks during daytime hours." Examples include magazine printing, paint spray booths, dry cleaning services, and feed packing plants.

For Class II Industrial Facilities, the potential influence area is 300 m and a minimum separation distance of 70 m is recommended.

A *Class III Industrial Facility* is a "place of business for large scale manufacturing or processing, characterized by: large physical size, outside storage of raw and finished products, large production volumes and continuous movement of products and employees during daily shift operations. It has frequent outputs of major annoyance and there is high probability of fugitive emissions." Examples include organic chemicals

manufacturing, breweries, metal manufacturing, and the manufacturing of such things as paints and varnish, resins and coatings, and soaps and detergents.

For Class III Industrial Facilities, the potential influence area is 1,000 m and a minimum separation distance of 300 m is recommended.

Sensitive Land Uses

Both Guideline D-6 and Procedure D-1-3 *Definitions* provide guidance on sensitive land use. Sensitive land uses occur where routine or normal activities, occurring at reasonably expected times, would experience one or more adverse effects from contaminant discharges from a nearby facility.

Residential land use, i.e., “residences or facilities where people sleep”, is considered sensitive 24 hours/day and may include (but is not limited to) single- and multi-unit dwellings, nursing homes, hospitals, trailer parks, and campgrounds.

Also considered potentially sensitive, but not for 24 hours/day, are facilities such as schools, churches, community centres, day care centres, some outdoor recreational facilities (e.g., picnic areas), and some agricultural operations.

Section 6.0 of the PPS defines sensitive land uses as “…buildings, amenity areas, or outdoor spaces where routine or normal activities occurring at reasonably expected times would experience one or more adverse effects from contaminant discharges generated by a nearby major facility. Sensitive land uses may be a part of the natural or built environment. Examples may include, but are not limited to: residences, day care centres, and educational and health facilities.” (Ontario Ministry of Municipal Affairs and Housing, 2005, p.35)

The definition of sensitive land use is reasonably consistent between Guideline D-6 and the PPS; however, there are a couple of differences. First, Guideline D-6 refers to “…a nearby facility” whereas the PPS refers to “…a nearby **major** facility” (emphasis added)—the word ‘major’ being subject to interpretation. Second, Guideline D-6 classifies residential use as sensitive 24 hours/day, whereas the PPS does not. On the surface, D-6 appears to be more protective but, perhaps, unnecessarily so. For example, classifying campgrounds—closed for much of the year and, generally, not occupied by the same individuals for extended periods—as sensitive 24 hours/day may need re-thinking.

Discussion of MOE Guidelines

The MOE Guidelines provide comprehensive assistance for evaluating land use planning decisions. The separation distance concept is widely used, the generic recommended separation distances are not inconsistent with those from other jurisdictions, and both new development and infill, urban re-development, and transition to mixed use are addressed.

There are, however, a number of areas for improvement. They are mentioned here briefly and discussed in more detail in Section 5.

First, and perhaps most important from a human health perspective, traffic corridors are not addressed. This is understandable given the date that the MOE Guidelines were last updated and the relatively recent literature on health impacts of vehicle emissions. Fortunately, there exists a substantial body of sound research from which to recommend a minimum separation distance to protect sensitive land uses from emissions from high-traffic corridors.

Second, Guideline D-6 recommends an area of influence but allows for a closer minimum separation distance provided studies exist showing a "trivial impact" at the closer distance. Trivial impact is defined as "Present or predictable contaminant discharges which are or are likely to be so minor that there would not be an 'adverse effect'." There is no guidance on what should be included in a study to justify use of the minimum separation distance (rather than a distance based on the potential area of influence). For example, should background air concentrations be included when assessing the impact of a new facility? Should air emissions from other nearby facilities be included in the assessment (i.e., cumulative air emissions)? Having completed a study, how should the results be interpreted? This is crucial since it is the demonstration of trivial impact which justifies the use of a minimum separation distance.

Third, while the Guidelines state that they are supplemental to legislated controls, these controls are only implemented long after land use planning decisions are made. For example, the requirement, under the *Environmental Protection Act*, for a Certificate of Approval (Air) is not triggered at the land use planning stage but some time before the facility begins operating. It is only at this later stage that an Emissions Summary and Dispersion Modelling (ESDM) Report is prepared and an assessment of facility emissions against provincial standards and guidelines can be made.

3.2 Ministry of Agriculture, Food and Rural Affairs

Scope

Beginning in 1970, minimum separation distances were recommended to keep livestock or poultry barns separate from neighbouring houses, residential zones, lot lines and roads. This early guidance used fixed separation distances and focused on keeping agricultural operations away from sensitive land uses.

The guidance was updated twice in the 1970s to introduce a two-way approach to separating livestock and poultry barns (i.e., to protect these facilities from encroaching sensitive land uses and vice versa) and to incorporate a sliding distance scale that takes into account the size and type of a farm. The most recent guidance (Ontario Ministry of Agriculture, Food, and Rural Affairs, 2006) updates the separation distance formulae slightly, but the principles upon which the guidance is based remain unchanged.

The Minimum Distance Separation I formula (MDS I) was developed to determine the minimum separation distances between proposed new development and existing livestock facilities and/or permanent manure storage. The Minimum Distance Separation II formula (MDS II) was developed to determine the minimum separation distances between proposed new, enlarged or remodeled livestock facilities and/or permanent manure storages and other existing or approved development.

Limitations

Application of the Minimum Distance Separation guidance is limited in a number of ways:

- "The objective…is to minimize nuisance complaints due to odour and thereby reduce potential land use conflicts. MDS does not account for other nuisance issues such as noise and dust." (p.2)
- the MDS is not intended to address odour issues related to the land application of manure
- the MDS applies only to livestock facilities defined as "One or more barns or permanent structures with *livestock occupied portions*, intended for keeping or housing of *livestock*. A *livestock facility* also includes all *manure* or *material storages* and *anaerobic digesters*." (p.6)
- the MDS does not apply to abattoirs, apiaries, assembly yards, fairgrounds, feed storages, field shade shelters, greenhouses, kennels, livestock facilities less than 10 m^2 in floor area, machinery sheds, mushroom farms, pastures, slaughter houses, stockyards or temporary field nutrient storage sites.

A guidance document and CD to aid MDS calculations are available from OMAFRA.

Discussion of OMAFRA MDS Formulae

The OMAFRA MDS guidance is up to date and reasonably comprehensive. The guidance does not rely on generic, fixed recommended separation distances but uses the MDS formulae to develop situation-specific separation distances that should properly protect incompatible land uses.

The limitations present some concerns: the guidance only applies to livestock operations, noise and dust are not considered, and some exclusions seem unjustified. For example, mushroom farms are excluded yet these operations can be the source of significant odours. However, in instances where the MDS formulae do not apply, it should be possible to use the MOE guidelines to ensure suitable separation distances.

3.3 Ministry of Natural Resources

Scope

Aggregate extraction activities in the province are governed by myriad legislation at both the provincial and federal levels. At the federal level, the *Fisheries Act*, the *Migratory Birds Convention Act* and the *Species at Risk Act* work to protect fish and wildlife habitat and at the provincial level, 15 acts influence extraction of aggregate from pits and quarries (http://www.mnr.gov.on.ca/en/Business/Aggregates/1ColumnSubPage/STEL02_167084.html, accessed May 1, 2008).

To provide more concise, user friendly and understandable minimum requirements for the delivery of the *Aggregate Resources Act*, MNR has produced guidance documents for 15 categories of aggregate activity. The reason for 15 categories is to reflect the types of applications that can be applied for: for example, a licence or a permit, for a pit or a quarry, removing more or less than 20,000 tonnes of aggregate annually, from above or below the water table.

Requirements for aggregate operations are explained in four sections: Site Plan Standards; Report Standards; Prescribed Conditions (which “pertain to the individual category and cannot be varied or rescinded by either the Minister or the Ontario Municipal Board”); and Notification and Consultation Standards.

In the Introduction to the Guidance documents, MNR states:

“In searching and/or preparing reports to accompany an application, reference should be made to the following documents and agencies:

a) Provincial Policy Statement and Associated Training Manuals;
b) Zoning by-law(s);
c) Official Plan(s);
d) *Environmental Protection Act*;
e) *Ontario Water Resources Act*;
f) *Conservation Authorities Act*;
g) Niagara Escarpment Commission;
h) Guide to Completion of the Compliance Assessment Report for licences and aggregate permits;
i) Flow chart for the Notification and Consultation Standards for licences, aggregate permits, wayside permits, Category 13 and the annual compliance reporting;
j) MOEE Guidelines including:
   – MOEE Guideline NPC-205, Sound Level Limits for Stationary Sources in Class 1 & 2 Areas (Urban);
   – MOEE Guideline NPC-232, Sound Level Limits for Stationary Sources in Class 3 Areas (Rural);
   – MOEE Guideline NPC-233, Information to be Submitted for Approval of Stationary Sources of Sound;
   – MOEE Guideline NPC-119, Blasting.

   The above list serves only as a guide and should not be interpreted as all-Inclusive
k) Provincial and Federal references to endangered species;
l) Federal Fisheries Act and Associated Guidelines;
m) Environmental Assessment Act and Exemptions.”

(Note: MOEE refers to the Ministry of Environment and Energy, now the Ministry of the Environment.)

Further guidance is provided in Section 2.0 which requires technical reports accompanying an application to include an assessment of whether natural environment features (e.g., significant wetlands, habitat of endangered or threatened species, significant woodlands, areas of natural or scientific interest) occur on or within 120 m of the site. If so, an impact assessment must be completed and will include proposed preventative, mitigative or remedial measures. A cultural heritage resource survey must also be completed and mitigation proposed if archaeological or other heritage resources are identified. If the extraction is below the water table, a hydrogeological study must be included.

Separation Distances

Separation distances are used to protect sensitive receptors from noise and dust. Sensitive receptors include “…residences or facilities where people sleep (nursing homes, hospitals, trailer parks, camping grounds,

etc.); schools; day-care centres." Table 3 (below) summarizes the requirements for pits and quarries.

Table 3. Noise Assessment and Dust Mitigation Requirements for Pits and Quarries.

	Pit	Quarry
Licence	Noise assessment report required if sensitive receptor within 150 m. Dust mitigation required for internal haul roads and processing areas. Processing equipment must use dust suppressing or collection devices if sensitive receptor within 300 m.	Noise assessment report required if sensitive receptor within 500 m. Dust mitigation required for internal haul roads and processing areas. Processing equipment must use dust suppressing or collection devices if sensitive receptor within 300 m.
Permit	Noise assessment report required if sensitive receptor within 2000 m. Dust mitigation required if sensitive receptor within 2000 m of permitted boundary; for internal haul roads; and processing areas if sensitive receptor within 500 m of site.	Same as for pit.

Absent site specific studies, MOE's Guideline D-6 requires pits and quarries to be considered Class III Industrial Facilities and the recommended separation distance is 1,000 m.

Discussion of MNR Guidance

The technical reports required by MNR are comprehensive although, from an air quality perspective, only noise and dust are assessed for appropriate separation distances and air studies assessing particulate matter levels off-site are not required.

It is commonly understood that there is no level of exposure to coarse (PM_{10}) or fine ($PM_{2.5}$) particulate matter that is without negative health impacts. Requiring air studies for quarry applications would allow a more complete assessment of separation distances that are protective of human health. This is discussed in more detail in Section 5.

4. Planning and Air Quality in Halton Region

"The planning system controls land use and development and is one of the main levers to reduce the environmental impacts of urban areas." (Royal Commission on Environmental Pollution, 2007)

While land use and development processes are governed by the Regional Official Plan, the planning system in Halton must be consistent with two memoranda of understanding, one between the Region and the Province and one amongst the Region, Local Municipalities, School Boards, Regional Police Services and Conservation Authorities.

Memoranda of Understanding

The *Memorandum of Understanding Between The Province of Ontario and The Regional Municipality of Halton Regarding Municipal Plan Review*, signed in 1996, sets out the framework within which the Region and the Province agree to certain roles and responsibilities for municipal plan review. Specifically, it is through this Memorandum that provincial review ministries are no longer involved in the following planning applications:

- Subdivisions;
- Condominiums;
- Consents;
- Validations of Title;
- Partlot Control Bylaws;
- Minor Variances;
- Site Plans;
- Zoning Bylaws and Amendments; and
- Site Specific Local Official Plan Amendments.

With the provincial government no longer involved in planning applications, it became necessary for regional and local municipalities to agree amongst themselves on the roles and responsibilities for doing this work.

The *Memorandum of Understanding Amongst the Regional Municipality of Halton, the City of Burlington, the Town of Oakville, the Town of Milton, the Town of Halton Hills, the Halton Regional Police Services Board, the Halton District School Board, the Halton Catholic District School Board, the Halton Region Conservation Authority, the Credit Valley Conservation Authority, and the Grand River Conservation Authority Regarding the Implementation of An Integrated Halton Area Planning System*, signed in 1999, sets out the framework for the redistribution and administration of certain planning approval authorities and responsibilities.

Part 3 of this Memorandum sets out the policy matters for which the Region is responsible (in cooperation with other Halton Planning Partners). The policy matters of specific interest to this discussion paper are listed in section 5.3 and include:

- protection of Provincial land use policy interests;
- the Halton Region Official Plan;
- housing planning;
- transportation planning and transit services;
- regional environmental planning;
- rural planning;
- mineral aggregate; and
- agricultural planning.

Halton Region Official Plan

The *Halton Region Official Plan 2006* is based on the two planning concepts of land stewardship and healthy communities and outlines a long-term vision for Halton's physical form and community character (Halton Region, 2006). The Plan sets forth goals and objectives, describes an urban structure to accommodate growth, states the policies to be followed, and outlines the means for implementing those policies.

Incompatible land uses are addressed by a number of policies in the Regional Official Plan (ROP). For example, encroachment on agricultural operations is addressed by Policy 101(2)d which requires local municipalities to apply provincially developed Minimum Distance Separation formulae in their zoning bylaws, and Policy 110(1) addresses aggregate operations by requiring local municipalities to adopt zoning bylaws to permit the operation of legally existing pits and quarries in accordance with The *Aggregate Resources Act* and protect them from new land uses incompatible with such operations.

Other policies in the ROP explicitly address noise and vibration issues arising from incompatible land uses. Policy 143(9) requires noise studies if proposed development is within 300 m of a railway right-of-way or 1,000 m of a railway yard and vibration studies if the development is within 75 m of a railway right-of-way or railway yard. The policy also requires implementation of approved recommendations including "…the restriction of new residential and other sensitive uses."

Policy 143(12) "Require[s] the proponent of land uses sensitive to noise and vibration, such as residential, outdoor recreation, hospitals and schools, in proximity to industrial and some utility facility sources of noise and vibration including railway corridors and railway yards to complete a noise and vibration study and undertake necessary mitigation actions, in

accordance with Ministry of the Environment and any other applicable guidelines."

Without explicitly naming them, Policy 143(12) appears to include, among others, Ministry of the Environment (MOE) Guidelines D-1 (*Land Use Compatibility*) and D-6 (*Compatibility Between Industrial Facilities and Sensitive Land Uses*) in the Official Plan. This interpretation seems to be supported by Policy 147(1) which "Require[s] all development to have regard to policies and guidelines of the Ministry of the Environment regarding land use compatibility."

Local Official Plans

Local Official Plans also address the incompatible land use issue. Local municipalities are at different stages of Official Plan review and some of the policies that currently appear to apply are briefly reviewed.

City of Burlington

Burlington has recently completed an Official Plan review and the policies that seem most applicable to this discussion paper are 2.7.3 n) and 2.7.3 o).

Policy 2.7.3 n) requires transportation or industrial facilities and sensitive land uses to be kept from encroaching upon each other. Separation distances and/or other means are recommended and "Provincial guidelines *shall* be referred to for direction in land use planning decisions" (emphasis in original).

Policy 2.7.3 o) allows (but does not require) the municipality to request a risk assessment from proponents of residential development or other sensitive land uses "within proximity to any existing or potential sources of man-made hazard."

Numerous other policies address incompatible land use issues. For example: air quality studies may be requested (Policy 2.12.2 g (ix)) in support of an application for a new or expanded aggregate operation; noise studies required near roadways (Policy 3.3.2 r, s, and t); noise and vibration studies required near railway lines and railway yards (Policy 3.7.2 d); risk and compatibility assessments for certain sensitive institutional uses in employment areas (Policy 4.3 d); and protection of farm operations using MDS formulae (Policy 13.3 b).

Incompatible land uses appear to be assessed with respect to noise, odour, dust or vibration and there may be situations for which a more detailed air quality study would better inform planning decisions.

Assessing gaseous air pollutants, for example, would be consistent with MOE Guideline D-6 which is, presumably, captured in Policy 2.7.3 n (above).

Town of Halton Hills

Halton Hills also has recently completed an Official Plan review and incompatible land use issues are addressed through policies such as; C11 Agricultural Operations, C14 Land Use Compatibility; and C15 Noise and Vibration.

C11 requires use of the Minimum Distance Separation formulae to keep agricultural and non-agricultural operations from encroaching on each other; C14 requires incompatible land uses to be "separated or otherwise buffered" from each other—an assessment of the proposal to be in accordance with guidelines prepared by the MOE; and C15 requires noise impact studies near industries and certain roadways, and noise and vibration studies near railway lines and rail yards.

In addition, there is guidance on requirements for day nurseries, gas stations, protection of aggregate resources, and on what constitutes compatible land uses in commercial and employment land areas.

Similar to Burlington's Official Plan, the MOE Guidelines are referred to although noise, odour, dust or vibration seem to be the dominant concern. In some instances, studies assessing air pollution could help inform development decisions.

Town of Milton

The Town of Milton's Official Plan is about 10 years old, having been updated shortly after the province updated its D-Series Guidelines. Similar to Burlington and Halton Hills, there are numerous policies addressing incompatible land uses.

Policies 2.3.3.16 to 2.2.3.23 require noise and/or vibration studies near railway lines (but rail yards are not mentioned) and noise studies for certain developments affected by excessive road noise levels. Noise sensitive uses are discouraged along provincial freeways and truck routes must have regard for the need to protect residential neighbourhoods from truck noise, pollution and hazards.

Policy 2.4.3.5 a) and b) protect agricultural land and Policy 4.1.1.15 requires new uses and lots within the Rural, Agricultural, Niagara Escarpment Plan and Parkway Belt Corridor Areas to have regard to the Minimum Distance Separation Formulae.

Policies of 4.7.3 address protection of aggregate resources and prohibit residential development within 500 m of lands designated Mineral Resource Extraction Area.

Although not as current as Burlington or Halton Hills, Milton's Official Plan addresses many aspects of incompatible land use. Areas for improvement could include specifically addressing rail yards and more explicit language in some policies. For example, "shall" do something is a clearer requirement than "having regard" for something.

Town of Oakville

The Town of Oakville's Official Plan also addresses incompatible land uses throughout and references the MOE Guidelines for appropriate guidance. For example, General Policy 10.4 allows the Town to enact by-laws to regulate land uses that may produce "inappropriate airborne emissions containing particulate or odours…" and may have an adverse effect on adjacent uses in accordance with MOE guidelines.

General Policy 10.8 addresses traffic noise and rail noise and vibration, again referring to MOE policies and guidelines and recommending minimum distances for determining noise sensitive areas.

Land Use Policies provide more specific guidance. For example, Land Use Policy 1.5 f) prohibits residential development in areas where "pollution from noise, air or water exceed Provincially recommended limits" unless mitigation measures can be incorporated into the proposed development.

New non-agricultural uses in the Agricultural designation must comply with the MDS (Land Use Policy 6.2 c) and all applications for amendment to permit a pit or quarry shall include (among other things) an Environmental Impact Statement which addresses (again, among other things) the potential effects of air pollution on nearby land uses (Land Use Policy 8.6 j).

Language in municipalities' official plans reflects the different stages of development and local circumstances. While noise, odour, dust and vibration are addressed, it is less clear that requirements for gaseous pollutants arising from both point and area sources are sufficient. It may be beneficial to include consistent language regarding incompatible land uses in the Regional and local official plans, addressing, for example, requirements for air quality studies to better determine separation distances protective of human health.

4.1 Guideline Use in Ontario, Halton Region and Local Municipalities

Although other land use guidelines (agricultural and aggregate) for Ontario have been briefly reviewed, the focus of this section is the use of Guideline D-6 to keep industrial facilities and sensitive land uses apart. This section is based on discussions with OMAFRA, MOE, and regional and local planners and on a review of some decisions of the Ontario Municipal Board in which MOE Guidelines are referenced.

In agricultural situations, the Minimum Distance Separation formulae have been found to be very helpful, particularly the use of variable separation distances, and, if the MDS is met, there should be few odour complaints (OMAFRA, personal communication), at least related to livestock operations.

For aggregates, Guideline D-6 only applies to quarries in the absence of site specific studies and regional experience is that air quality studies are always requested as part of an application for a quarry. However, there are no guidelines or terms of reference for what should be included in an air quality study and guidance of this sort would provide clear and consistent direction during the aggregate development process.

The provincial government is no longer involved in planning applications, although expertise in Guideline D-6 has not been lost and assistance with interpretation is available. From a provincial perspective, municipalities can ensure the use of Guideline D-6 by incorporating policy guidance into their official plans and by the use of zoning bylaws (Ministry of the Environment, personal communication).

While there are differences in language in local municipalities' official plans, the intent seems to be to follow provincial guidelines, particularly to address sources of noise and vibration near sensitive land uses. Some official plans go further and require incompatible land use assessments, using for guidance the MOE guidelines.

Uncertainties arise from some vagueness in Guideline D-6 in which sensitive uses are defined by example and it is unclear whether or not, for example, places of worship or outdoor recreation areas are sensitive uses. Uncertainties also arise with the classification of industrial facilities which, even though criteria are provided, may be open to interpretation.

Other concerns with the MOE guidelines, expressed by local planners, include difficulty applying them in infill, urban redevelopment, and transition-to-mixed-use situations. D-6 works better for greenfield development, and municipalities facing build-out will find it challenging to protect sensitive receptors during infill, urban redevelopment or transition

to mixed use. Recent examples include proposals for day care centres and private schools in transition areas. How can sensitive receptors be protected while the character of an area changes (often very slowly) over time?

Decisions of the Ontario Municipal Board

Decisions of the Ontario Municipal Board (OMB) seem to reflect municipal concerns with Guideline D-6 and suggest the importance of clear authority and consistency of interpretation. In a decision with respect to permitting the occupation of a place of worship in an existing industrial building across the road from Class III industries (File PL040574; Decision/Order No: 1192), the OMB accepted that "…the Guidelines have legislative authority stemming from section 2 of the *Planning Act* and section 14 of the *Environmental Protection Act*." (Ontario Municipal Board, 2006). (See Appendix 2 for the referenced sections.)

However, in another decision with respect to a proposed residential development near a railway right-of-way (File PL030635; Decision/Order No: 1815), the OMB found that "…the Ministry of Environment Land Use Compatibility Guidelines are guidelines only, and are neither law, nor regulation, nor policy and should not be considered or treated as such, *unless elements of the guidelines are incorporated into the applicable planning policies of a municipality*." (Ontario Municipal Board, 2004: emphasis added).

In a recent case (File PL080018) involving a severed parcel of land, the involved Township argued against a proposed land use citing the Township's Official Plan which requires the Township to have regard to the MOE Guidelines. The OMB found, however, that the MOE Guidelines conflicted with separation distances in the Township's Official Plan and that the Official Plan policies must govern (Ontario Municipal Board, 2008).

These decisions point to the importance of including specific land use guidance in an official plan to provide clear authority for addressing the encroachment of industrial land use on sensitive land use, and *vice versa*.

Including specific land use guidance in the official plan could also lead to more consistent application of separation distances. For example, in a decision with respect to a Class I industry (File PL000598; Decision/Order No: 1948), the OMB found for a 20 m setback (Ontario Municipal Board, 2006) but Guideline D-6 requires a 70 m separation distance (the area of influence) for Class I industries. If site specific studies are available to demonstrate that an impact is trivial at less than 70 m, then the minimum

separation distance would be 20 m. In the OMB's decision it was not apparent that such studies were provided.

In Decision/Order No: 1192 (referred to above), the OMB accepted the area of influence concept, i.e., a separation distance should not automatically 'default' to the minimum suggested in Guideline D-6: "The Board further accepts the testimony that for Class III industries the 'area of influence' is 1000 metres as defined by section 4.1 of D-6 and that the Minimum separation Distance for the same class is 300 metres as defined by section 4.3 of D-6." (Ontario Municipal Board, 2006).

In yet another decision (File PL020779; Decision/Order No: 1948), the OMB's recommendation allows for the separation distance to be measured from the sensitive use to the industrial facility (which is consistent with Section 4.4 of Guideline D-6): "The Board finds that the area zoned for the workshop and sawmill operation should be moved to the east side of the property, where it would have much less impact on the appellant's property and would provide for the separation distance to be located on the proponent's lands rather than on the appellant's." (Ontario Municipal Board, 2004).

Municipal experience interpreting and implementing Guideline D-6 and decisions of the Ontario Municipal Board suggest that it would be useful to develop consistent criteria for interpreting and applying Guideline D-6 in land use planning.

5.0 Discussion and Suggested Directions for Consideration in the Sustainable Halton and Regional Official Plan Review Processes

From the review of jurisdictional approaches to incompatible land use, an understanding of existing official plan policies and implementation challenges, and an appreciation of some of the recent decisions from the Ontario Municipal Board, it is apparent that there are several areas for improvement for separating industrial and sensitive land uses. Potential improvements and recommendations for consideration in the Sustainable Halton and Official Plan Review processes are provided below under five headings: Industrial Facilities; Traffic Corridors; Quarries; Agriculture; and Air Studies.

5.1 Industrial Facilities

The MOE D-1 and D-6 Guidelines have been discussed extensively and it is clear from policies in Halton Region's Official Plan that they are intended to apply during the planning and development process. The guidelines are broadly consistent with the separation distance approach used by other jurisdictions reviewed in this paper and provide useful generic separation distances to help keep industry and sensitive land uses apart. However, there are areas for improvement.

The guidelines are out of date and there is a certain amount of subjectivity involved when classifying industrial activities based on the MOE criteria and when determining what is a sensitive land use. Updating the guideline would bring to bear additional experience gained since 1995 and any applicable research on the use of separation distances to protect human health from incompatible land uses. Updating and clarifying the classification criteria and the definition of sensitive land use would lead to more transparent and consistent application of the guideline. Finally, updating the MOE land use compatibility guideline would assist in the implementation of the Provincial Policy Statement and Growth Plan (Ontario Professional Planners Institute, 2007).

Suggested Direction # 1 for Consideration in the Sustainable Halton and Regional Official Plan Review Processes:

Recognizing maturing urban areas, particularly zones of transition and intensification, and Section 38 of the Halton Region Official Plan, Halton Region encourage the MOE to update Guidelines D-1 and D-6 to reflect the changing nature of municipalities and the requirements of the Places to Grow Plan. The update should include the additional experience of environmental officers and public health inspectors gained since 1995; applicable research on separation distances for incompatible land uses; more specific industrial activity classification criteria; and a clear definition of sensitive land use.

Current difficulties with clear and consistent application of the guidelines, as evidenced by the discussion of decisions by the Ontario Municipal Board, need also to be addressed. For example, allowing measurement from sensitive land use to industrial activity in some circumstances (consistent with what is currently allowed by Guideline D-6) and requiring extensive impact analyses when incompatible land uses propose either to locate within the potential area of influence recommended by Guideline D-6, or, for infilling, urban redevelopment and/or transition to mixed uses, to locate within the recommended minimum separation distance.

Suggested Direction # 2a for Consideration in the Sustainable Halton and Regional Official Plan Review Processes:

For the protection of human health and sensitive receptors, Halton Region develop a made-in-Halton Incompatible Land Use Guideline (as part of the Healthy Communities Guidelines) that will:

- **be developed by the Health Department, in consultation with Regional and Local partners;**
- **be largely based on the Ministry of the Environment D-Series Guidelines;**
- **be supplemented with best practices from other jurisdictions, and health research on incompatible land uses;**
- **incorporate the Minimum Distance Separation Formulae for agriculture;**
- **address both greenfields development and infill, urban re-development, and areas of transition to mixed uses;**
- **identify when an air study will be requested, the parameters to be included in an air study, and how the results of such a study would be interpreted;**
- **be updated periodically to reflect advances in understanding of human health impacts related to land uses.**

Suggested Direction # 2b for Consideration in the Sustainable Halton and Regional Official Plan Review Processes:

Update policies in Halton Region's current Official Plan to explicitly reference the MOE Guidelines D-1 and D-6 to be used until such time as a made-in-Halton Incompatible Land Use Guideline is developed, and to explicitly reference that MOE Guideline D-6 be used to keep rail yards and sensitive land uses separated until a made-in-Halton Incompatible Land Use Guideline is available.

A specific land use of particular interest to Halton Region is railway yards. California has recommended a separation distance of 1,000 feet (about 300 m) from major service and maintenance rail yards and suggests considering siting limitations and mitigation measures within one mile (1,600 m). This guidance is broadly consistent with MOE D-6 in which rail yards would be a Class III industrial facility and subject to a potential area of influence of 1,000 m and a minimum separation distance of 300 m, provided studies supporting the shorter separation distance are available.

Finally, there are important concerns related to planning, air quality and human health which are not addressed by Guideline D-6. The influence of vehicle emissions from high-traffic corridors and the impact of cumulative air emissions both need to be considered. The California Air Resources Board addresses traffic corridors but not cumulative air emissions and

most of the guidance documents reviewed from other jurisdictions state that, while the recommended separation distances do not take into account the impact of cumulative air emissions, these impacts should be considered from both existing and new projects when making siting decisions (e.g., Sacramento Metropolitan Air Quality Management District, 2005; Office of the Deputy Prime Minister, 2004a; South Australia Environment Protection Authority, 2007).

Traffic corridors are discussed below in Section 5.2 and criteria for requesting detailed air studies, including an assessment of cumulative air impacts, are discussed in Section 5.5.

5.2 Traffic Corridors

Major traffic corridors are a category not addressed in the MOE D-series guidelines or by either of the Australian states examined. California suggests a separation distance from freeways and high traffic roads (urban roads >100,000 vehicles per day; rural roads >50,000 vehicles per day) of 500 feet (i.e., about 150 m) (California Environmental Protection Agency, 2005). British Columbia recommends a minimum setback of 150 m from busy roads (>15,000 vehicles per day) and suggests additional setbacks for sensitive uses along major truck routes, but a specific recommendation is not provided (British Columbia Ministry of the Environment, 2006).

Traffic corridor studies suggest that those who spend large amounts of time in close proximity to major roadways may be at increased risk for a range of adverse health impacts. For example:

- A study of children in grades 3-5 in San Francisco found that children living within 75 m of a freeway/highway (between 90,000 and 210,000 veh/d) are at markedly increased risk of current asthma (physician diagnosed asthma at some time in the past plus an “asthma-episode” or “wheezing” in the past 12 months). There was no clear association between current asthma or bronchitis and living within 75 m of a principal artery (~28,500 veh/d) (Kim, et al., 2008). Study results were adjusted for the following socio-economic status factors: race/ethnicity; household income; and education of the parent who completed the questionnaire.

- A study of more than 70,000 subjects in the greater Vancouver area found increased risk for low full-term birth weight and small for gestational age birth for mothers living within 50 m of an expressway or highway compared to mothers living more than 50 m from an expressway or highway (average >21,000 veh/d). No increased risk was observed for those living 150 m from a highway

or 50 m from a major road (average 15,000-18,000 veh/d) (Brauer, et al., 2008). Study results were adjusted for the following socio-economic status factors: ethnicity; neighbourhood income; and maternal education.

- A study examining the effect of motor vehicle emissions on respiratory hospitalization in southeast Toronto found that exposure to $PM_{2.5}$ had a significant effect on admission rates for a subset of respiratory diseases (asthma, bronchitis, chronic obstructive pulmonary disease, pneumonia, upper respiratory tract infection) (Buckeridge, et al., 2002). Study results were adjusted for the following socio-economic status factors: educational attainment and family structure.

- A study of respiratory symptoms in U.S. veterans found, after adjusting for cigarette smoking, occupational dust exposure and age, that subjects living within 50 m of a major roadway (>10,000 veh/d) had approximately 30% excess risk of reporting persistent wheeze compared to subjects 400 m or more away and had an elevated risk of chronic phlegm (Garshick, et al., 2003).

- A study in Hamilton of subjects living within 50 m of a major road or 100 m of a highway found, after adjusting for diagnoses of chronic respiratory and pulmonary diseases and diabetes, that subjects residing within traffic pollution buffers had elevated mortality rates regardless of whether they had been diagnosed with chronic pulmonary disease (excluding asthma) (Finkelstein, et al., 2004). Study results were adjusted for the following socio-economic status factors: household income.

- A recent review of epidemiologic evidence of cardiac and pulmonary health risks near freeways summarized pollutant gradient studies that show ultra-fine particles, black carbon, carbon monoxide, and oxides of nitrogen elevated near highways (>30,000 vehicles/day) and suggest that people living within about 30 m of highways are likely to receive much higher exposure to traffic-related air pollutants compared to residents living more than 200 m (+/- 50 m) from highways (Brugge, et al., 2007).

- In a review of the traffic corridor literature between 1999 and 2006, of 29 studies reviewed, 25 reported statistically significant associations between residential proximity to traffic and one or more of the following adverse health effects: increased prevalence and severity of symptoms of asthma and other respiratory diseases; diminished lung function; adverse birth outcomes; childhood cancer; and increased mortality risks. The majority of

studies using distance to residence as the exposure metric found adverse health effects for distances up to about 200 m but not for greater distances (Boothe and Shendell, 2008).

QEW and 400-Series Highways

The evidence suggests that it is important to use separation distances to keep sensitive uses from encroaching on high-traffic corridors. The difficulty is in selecting a separation distance that is appropriately protective of human health yet does not 'sterilize' land required to meet mixed use, higher density development targets as Halton absorbs the growth projected to 2031.

Preserving land along major traffic corridors (>100,000 vehicles/day) for employment lands may be one solution—sensitive land uses would then be 'buffered' by the employment lands (depending, of course, on what type of activities occupy the employment lands).

Suggested Direction # 3 for Consideration in the Sustainable Halton and Regional Official Plan Review Processes:

For the protection of human health and sensitive receptors, sensitive land uses not be located closer than 150 m to highways anticipated to have greater than 100,000 vehicles per day based on ultimate planned capacity. When applying this guidance, future road widening should be taken into consideration.

At present, this recommendation would only apply to the QEW and 400-series highways because no other roads in Halton Region approach this volume.

Neither the California Air Resources Board nor the review by Brugge mention explicitly where the measurement is made from; however, Brugge summarizes pollution gradient measurements between 2 m and 400 m which suggests that the measurement point should be from the edge of the roadway (as opposed to the centerline, for example) to the sensitive land use. Allowing a measurement other than property line to property line is consistent with guidance in Guideline D-6.

As Halton Region grows, it is reasonable to assume that sensitive land uses are more likely to encroach on high-traffic roadways than the other way around, and that the sensitive land use should be prepared to provide the buffer required for an appropriate separation distance.

Developments where future road widening may occur will have to be given careful consideration. For example, it may be necessary to provide a

larger separation distance for sensitive land uses in areas where highway widening is anticipated for the future.

Secondary Roads

Separation distances for sensitive land uses along secondary/regional roads present some challenges. While it is clear that health impacts can be associated with these roads, there is less clarity about the separation distances needed for varying volumes of traffic.

The approach by British Columbia, requiring 150 m from roadways of greater than 15,000 vehicles/day, could prevent the Region from achieving walkable and transit-supportive communities. While there is information to suggest that particulate pollution drops dramatically within as little as 30 m from roadways, other pollutants are also a concern. With shorter separation distances, factors such as wind speed and direction or socio-economic status (for example, is cooling provided by air conditioning or open windows?) become more important.

These studies suggest that a separation distance of 30 m should be maintained between residential developments built at ground level to protect sensitive receptors. It is possible, however, that mixed land uses could be allowed within 30 m if design and engineering controls could be used to protect occupants from localized air quality impacts (for example, air intakes on the roof, rather than lower, and high efficiency particle filters, Morawska, et al., 1999).

Suggested Direction # 4 for Consideration in the Sustainable Halton and Regional Official Plan Review Processes:

For the protection of human health and sensitive receptors, sensitive land uses not be located closer than 30 m to roads with greater than 30,000 vehicles/day annual average daily traffic (AADT) based on ultimate planned capacity. Exceptions to this guidance are condominiums and mixed-use buildings, which could locate closer than 30 m provided appropriate controls are incorporated into the building design to protect indoor air quality for the occupants. When applying this guidance, future road widening should be taken into consideration.

To get a sense of what this might mean for Halton Region, see Appendix 3: Road Classifications and Traffic Volumes in Halton Region.

5.3 Quarries

Quarries are not addressed in the California guidance but are covered in the two Australian states, which recommend separation distances of 500 m based on air (South Australia) or 1,000 m (Western Australia) to 3,000 m (South Australia) based on noise if blasting is involved. In Ontario, land use concerns for quarries are addressed by the Ministry of Natural Resources. MOE Guideline D-6 only mentions quarries in the absence of site specific studies.

In the Regional Official Plan, Policy 110(1) requires local municipalities to adopt zoning bylaws to permit the operation of legally existing pits and quarries in accordance with The *Aggregate Resources Act* and protect them from new land uses incompatible with such operations.

Quarries can be contentious and it is Halton Region experience that air quality studies are always requested as part of an application for a quarry. Although criteria for determining when to request an air study and what should be included are discussed below (Section 5.5), it is appropriate here to focus specifically on particulate matter.

Human health impacts from exposure to particulate matter (PM_{10}: particulate matter, including coarse particulate, less than 10 microns, and $PM_{2.5:}$ fine particulate matter less than 2.5 microns) are well documented (see Appendix 1) and from a health protection perspective it is important to know not just the maximum air levels, but also how frequently high levels of particulate matter occur and how long they last.

Suggested Direction # 5 for Consideration in the Sustainable Halton and Regional Official Plan Review Processes:

For the protection of human health and sensitive receptors, air studies for quarry applications should include:

- **a modelled frequency and duration analysis, which includes $PM_{2.5}$ (to understand how frequently and how long air levels can be expected to approach the maximum air levels); and**
- **background air concentrations of $PM_{2.5}$ in the modelling analysis (to enable the assessment of additional emissions from the quarry and a comparison to the Canada Wide Standard which is an ambient air standard)**

5.4 Agriculture

From the jurisdictional review conducted for this discussion paper, Ontario appears to have one of the best procedures for addressing separation distances for agricultural operations. California acknowledges that

agricultural operations are often the source of odour complaints, but makes no specific recommendations about separation distances. The two Australian states reviewed recommend generic separation distances based on the type and size of the activity. The Minimum Distance Separation Formulae used in Ontario take into account a number of factors before calculating a site-specific, and therefore variable, separation distance.

Regional and local official plans require use of the MDS formulae to protect agricultural operations from encroachment by sensitive land uses. However, the MDS formulae only apply to livestock operations and some of the excluded activities (see Section 3.2 above) may be cause for concern.

Suggested Direction # 6 for Consideration in the Sustainable Halton and Regional Official Plan Review Processes:

For the protection of human health and sensitive receptors, for non-livestock operations, where the MDS formulae do not apply, MOE Guideline D-6 should be used to protect agricultural operations from encroachment by sensitive land uses until such time as a made-in-Halton Incompatible Land Use Guideline is available.

5.5 Air Studies

In most jurisdictions, the recommended separation distances are a starting point only and "A sound site-specific technical analysis is generally found to provide the most appropriate guide to the separation distance that should be maintained between an industry or industrial estate and sensitive land use." (Western Australia Environmental Protection Authority, 2005). Jurisdictions recognize that site-specific technical analysis is expensive and time-consuming and that generic separation distances may be adequate if they are conservative. When generic separation distances are inadequate for the protection of sensitive receptors, site-specific studies must be undertaken.

Amendment No. 33 to The Regional Plan (2006) amends Part V, Implementation, Planning and Development Approval to include a new policy 187(10) which, among other things, adds 'Air Quality' to the list of other information and/or reports that the region may request to support a complete application for a Regional Official Plan Amendment, Plan of Subdivision, or Consent application (Policy 187(10)).

Site-specific air studies should be requested when a new development will result in a sensitive land use inside the potential area of influence of an industrial facility as defined in MOE Guideline D-6. This is consistent with

the current guideline but needs to be made explicit since some decisions of the Ontario Municipal Board seem to suggest that separation distances shorter than the potential area of influence are used even though there appear to be no supporting studies to justify the shorter distance.

When to request site-specific air studies for infill, urban redevelopment, and/or transition to mixed uses poses some challenges. Requesting air studies would be consistent with the current guideline which requires considerable analysis including what could be interpreted as cumulative air studies—the requirement for an assessment "…of the types and levels of contaminant discharges being generated by current industrial facilities…" (Ontario Ministry of the Environment, 1995e; Section 4.10.3). It is not clear why the guideline does not require an assessment of current industrial facilities for greenfield developments or how the requirements of Section 4.10.3 can be balanced with the goals of intensification.

Suggested Direction # 7 for Consideration in the Sustainable Halton and Regional Official Plan Review Processes:

For the protection of human health and sensitive receptors, the Halton Region Official Plan should require site-specific air studies when proposed new development would potentially result in separation distances (between industrial facilities and sensitive land uses) that are less than those recommended in MOE Guideline D-6 until such time as a made-in-Halton Incompatible Land Use Guideline is available.

The suggested directions proposed in this discussion paper are consistent with the vision and policies of the *Provincial Policy Statement* (PPS) and *Places to Grow, the Growth Plan for the Greater Golden Horseshoe* (the *Growth Plan*).

For example, Part IV of the PPS, Vision for Ontario's Land Use Planning System, speaks to efficient development patterns which, among other things, "…minimize the undesirable effects of development, including impacts on air, water and other resources." Two paragraphs later, the Vision goes on to state "It is equally important to protect the overall health and safety of the population." These concepts are captured in Policy 1.1.1c in Part V which states "Healthy, liveable and safe communities are sustained by avoiding development and land use patterns which may cause environmental or public health and safety concerns."

The *Growth Plan* provides policy direction on where and how to grow and provides six principles to guide decisions on how land is developed, resources are managed, and public dollars are invested. So although the focus is somewhat different from the PPS, it is important to note that the

Growth Plan “prevails where there is a conflict between [it] and the PPS. The only exception is where the conflict is between policies relating to the natural environment or human health. In that case, **the direction that provides more protection to the natural environment or human health prevails**.” (emphasis added).

It is also important to note that, provided there is no conflict, municipalities may have requirements that are more stringent than those of the Province.

Appendix 1: Health Impacts of Particulate Matter

It is commonly understood that there is no level of exposure to PM_{10} and $PM_{2.5}$ that is without negative health impacts.

Many health studies have demonstrated that short-term increases in air levels of PM_{10} and/or $PM_{2.5}$ are associated with an increase in a broad array of negative health impacts. For example:

- A 4% increase in heart attacks was demonstrated with a 10 µg/m^3 increase in air levels of $PM_{2.5}$ (Pope et al., 2006); and
- A 20% increase in the risk of having a more severe asthma attack was observed among children with a 10 µg/m^3 increase in daily air levels of $PM_{2.5}$ (Slaughter et al., Oct. 2003).

Several comprehensive studies have demonstrated that long-term exposure to PM_{10} and/or $PM_{2.5}$ can have a significant impact on public health. For example, a long-term study, which followed 1.2 million adults in the United States over a 16-year period, found that for every 10 µg/m^3 increase in air levels of $PM_{2.5}$ in a community:

- Deaths from all causes increased by 4%;
- Deaths from cardiopulmonary disease increased by 6%; and
- Deaths from lung cancer increased by 8% (Pope et al., 2002).

In 1999, the Canadian Federal Provincial Working Group on Air Quality Objectives and Guidelines concluded that there is clear and consistent evidence that:

- Hospital admissions increase when air levels of PM_{10} are equal to or greater than 25 µg/m^3 (24-hour); and
- Hospital admissions increase when air levels of $PM_{2.5}$ are equal to or greater than 15 µg/m^3 (24-hour) (Working Group on Air Quality Objectives and Guidelines, 1999).

Air levels of $PM_{2.5}$ present a significant public health concern in southern Ontario because they frequently exceed air levels that are known to produce significant health impacts. For example, in 2005, air levels of $PM_{2.5}$ at the Oakville and Burlington air monitoring stations:

- Exceeded 22 µg/m^3 10% of the time; and
- Exceeded the 24-hour Canada Wide Standard (CWS) of 30 µg/m^3, 10 and 11 times respectively.

Appendix 2: Section 2 of the *Planning Act* & Section 14 of the *Environmental Protection Act*

Section 2 of the Planning Act

2. The Minister, the council of a municipality, a local board, a planning board and the Municipal Board, in carrying out their responsibilities under this Act, shall have regard to, among other matters, matters of provincial interest such as,

(a) the protection of ecological systems, including natural areas, features and functions;

(b) the protection of the agricultural resources of the Province;

(c) the conservation and management of natural resources and the mineral resource base;

(d) the conservation of features of significant architectural, cultural, historical, archaeological or scientific interest;

(e) the supply, efficient use and conservation of energy and water;

(f) the adequate provision and efficient use of communication, transportation, sewage and water services and waste management systems;

(g) the minimization of waste;

(h) the orderly development of safe and healthy communities;

(h.1) the accessibility for persons with disabilities to all facilities, services and matters to which this Act applies;

(i) the adequate provision and distribution of educational, health, social, cultural and recreational facilities;

(j) the adequate provision of a full range of housing;

(k) the adequate provision of employment opportunities;

(l) the protection of the financial and economic well-being of the Province and its municipalities;

(m) the co-ordination of planning activities of public bodies;

(n) the resolution of planning conflicts involving public and private interests;

(o) the protection of public health and safety;

(p) the appropriate location of growth and development. 1994, c. 23, s. 5; 1996, c. 4, s. 2; 2001, c. 32, s. 31 (1).

Section 14 of the Environmental Protection Act

14. (1) Subject to subsection (2) but despite any other provision of this Act or the regulations, a person shall not discharge a contaminant or cause or permit the discharge of a contaminant into the natural environment, if the discharge causes or may cause an adverse effect. 2005, c. 12, s. 1 (5).

Appendix 3: Road Classifications & Traffic Volumes in Halton Region

Road Classifications

The following information is available, verbatim, from: http://www.halton.ca/ppw/roads/SystemData/default.htm (accessed 12/01/09).

Arterial Roads in Halton Region are divided into categories based on their function:

- **Provincial Highways and Freeways** serve high volume inter-regional travel demands, including truck traffic, high-order transit and HOV lanes. They connect urban areas or nodes in different regions.
- **Major Arterials** serve high volume inter-regional and regional travel demands, including truck traffic, high-order transit and HOV lanes. They connect urban areas or nodes in different municipalities and distribute traffic to and from Provincial Highways and Freeways.
- **Multi-Purpose Arterials** serve a combination of the functions of Major and Minor Arterials while connecting Major Arterials through urban areas or nodes.
- **Minor Arterials** serve moderate to high volume local traffic demands, including local truck traffic and local transit. They distribute traffic to and from Major and Multi-Purpose Arterials.

Traffic Volumes

Annual Average Daily Traffic is defined as the average 24 hour, two-way traffic for the period January 1st to December 31st (Provincial Highways Traffic Volumes 1988-2005, Ontario Ministry of Transportation, accessed 13/01/09) http://www.raqsb.mto.gov.on.ca/techpubs/TrafficVolumes.nsf/tvweb

For the QEW and Hwy 401 (ETR407 is not provincially owned and data are not available from the MTO publication) the lowest traffic volumes in 2005 were measured on Hwy 401 at the Hwy 25 interchange in Milton (95,800 vehicles/day). All other highway segments were over 100,000 vehicles per day, the highest count measured at QEW and Brant Street (175,400 vehicles/day).

For regional roads, Table 1 below shows locations of traffic counts over 30,000 vehicles/day (2007 data) and Table 2 below shows traffic counts between 20,000 and 30,000 vehicles/day. As Halton grows, the traffic counts at locations listed in Table 2 may exceed the 30,000 vehicle/day threshold.

Table 1. Annual Average Daily Traffic (AADT) Volume Greater Than 30,000 Vehicles per Day on Halton Region Arterial Roads – 2007 data (Provincial Highways and Freeways are not Included).

Location	Total Volume
Trafalgar Rd. north of QEW south of Leighland/Iroquois Shore	58,900
Trafalgar Rd. south of QEW north of Cross Ave.	53,050
Guelph Line south of Mainway north of Mountainside Dr.	50,678
Guelph Line south of train tracks north of N. Service Rd.	47,205
Dundas St. just east of Hwy 403	43,927
Brant St. just north of QEW	43,398
Dundas St. just west of Hwy 403	43,372
Winston Churchill Blvd north of train tracks south of Sheridan Garden Dr.	42,970
Trafalgar Rd. north of Leighland/Iroquois Shore south of White Oaks Blvd	42,370
Winston Churchill Blvd north of QEW south of Upper Middle/N. Sheridan Way	42,260
Guelph Line north of Mainway south of Palmer Dr.	42,046
Trafalgar Rd. south of Cross Ave north of Cornwall Rd	41,449
Dundas St. E. just east of Meadowridge Dr. (between Trafalgar and Ninth Line)	40,812
Dundas St. W. just west of Neyagawa Blvd	40,652
Appleby Line and N. Service Rd (just north of QEW)	39,981
Trafalgar Rd just south of Upper Middle Rd E.	39,437
Dundas St. E. just east of 6th Line	38,668
Guelph Line south of Upper Middle north of Palmer Dr.	37,434
Dundas St. E. just east of Trafalgar Rd	37,180
Dundas St. E. just west of Trafalgar Rd	37,136
Dundas St. W. just west of 6th Line	37,039
Ninth Line south of Upper Middle north of QEW	36,123
Appleby Line just south of Mainway	35,857
Dundas St. E. just west of Winston Churchill Blvd	35,606
Appleby Line just south of Upper Middle Rd	35,428
Winston Churchill Blvd just south of Dundas St. E.	35,024
Trafalgar Rd south of Upper Middle Rd (at Sheridan College)	34,711
Dundas St. halfway between Appleby Line and Walkers Line	34,229
Upper Middle Rd halfway between Dorval Dr. and Neyagawa Blvd	34,196
Upper Middle Rd just west of Ninth Line	33,796
Trafalgar Rd. just north of Upper Middle Rd	32,933
Trafalgar Rd. halfway between Upper Middle Rd and Dundas St.	32,780
Dundas St just east of Guelph Line	32,621
Bronte Rd (Hwy 25) just south of Hwy 401	32,352
Appleby Line north of Upper Middle Rd south of train tracks	32,306
Dundas St halfway between Bronte Rd and Tremaine Rd	31,096
Dundas St halfway between Bronte Rd and Third Line	30,977
Dundas St just west of Tremaine Road	30,226
Dundas St west of Walkers Line east of ETR407	30,116

Table 2. Annual Average Daily Traffic (AADT) Volume Greater Than 20,000 Vehicles per Day and Less Than 30,000 Vehicles per Day on Halton Region Arterial Roads – 2007 data (Provincial Highways and Freeways are not Included).

Location	Total Volume
Ford Drive at Kingsway Dr. (just south of QEW)	29,799
Dundas St halfway between Guelph Line and Cedarsprings Rd (Brant St.)	29,653
Guelph Line north of Upper Middle Rd south of ETR407	29,440
Brant St. and ETR407	28,984
Bronte Rd (Hwy 25) just north of Steeles Ave (Hwy 8)	28,550
Steeles Ave at Hwy 401	27,591
Trafalgar Rd just south of ETR407	27,354
Dorval Dr north of Speers Rd south of QEW (at train tracks)	27,083
Upper Middle Rd just east of Neyagawa Blvd (Oxford Ave)	26,978
Upper Middle Rd just west of Trafalgar Rd	26,672
Trafalgar Rd south of Britannia Rd (Hwy 6)	26,335
Dundas St between Cedarsprings Rd and Milborough Line (W. edge of Halton)	25,859
Upper Middle Rd halfway between Trafalgar Rd and Eighth Line	25,811
Upper Middle Rd halfway between Eighth Line and Ninth Line	25,792
Winston Churchill Blvd south of QEW	25,688
Trafalgar Rd north of ETR407 south of Lower Base Line Rd	25,552
Dorval Dr. north of QEW just south of N. Service Rd.	25,040
Upper Middle just east of 6th Line	24,916
Ford Dr. north of Royal Windsor Dr (at train tracks)	24,886
Trafalgar Rd just north of Hwy 401	24,846
Steeles Ave east of Bronte Rd (Hwy 25) west of Ontario St (Milton)	24,474
Upper Middle halfway between Dorval Dr and Nottinghill Gate	24,392
Upper Middle just east of Eighth Line	24,382
Trafalgar Rd north of Derry Rd (Hwy 7) south of Hwy 401	24,242
Bronte Rd (Hwy 25) just south of QEW	23,861
Ford Dr just south of Royal Windsor Dr.	23,632
Appleby Line just south of Dundas St	23,303
Bronte Rd (Hwy 25) just north of Hwy 401	22,920
Trafalgar Rd just south of Dundas St.	22,254
Upper Middle Rd just east of Ninth Line	22,245
Trafalgar Rd just north of Britannia Rd (Hwy 6)	21,102
Bronte Rd just south of Upper Middle Rd	21,072
Bronte Rd just north of Upper Middle Rd	20,947
Dorval Dr just south of Upper Middle Rd	20,812
Winston Churchill Blvd just south of Steeles Ave (Hwy 8)	20,471
Trafalgar Rd halfway between Dundas St and Burnamthorpe Rd	20,436
Steeles Ave just east of Ontario St. (Milton)	20,131

References

Boothe, V.L. and D.G. Shendell, 2008. Potential health effects associated with residential proximity to freeways and primary roads: Review of scientific literature, 1999-2006. *J. Environ. Health*, 70(8):33-41.

Brauer, M., Lencar, C., Tamburic, L., Koehoorn, M., Demers, P., and C. Karr, 2008. A cohort study of traffic-related air pollution impacts on birth outcomes. *Environ. Health Perspect.* 116(5):680-686. DOI:10.1289/ehp.10952.

British Columbia Ministry of the Environment, 2006. *Develop With Care: Environmental Guidelines for Urban and Rural Land Development in British Columbia*. British Columbia Ministry of the Environment, March 2006. Available from: http://www.env.gov.bc.ca/wld/documents/bmp/devwithcare2006/develop_with_care_intro.html

Brugge, D., Durant, J.L., and C. Rioux, 2007. Near-highway pollutants in motor vehicle exhaust: A review of epidemiologic evidence of cardiac and pulmonary health risks. *Environ. Health* 6(23). DOI:10.1186/1476-069X-6-23.

Buckeridge, D.L., Glazier, R., Harvey, B.J., Escobar, M. Amrhein, C. and J. Frank, 2002. Effect of motor vehicle emissions on respiratory health in an urban area. *Environ. Health Perspect.* 110(3):293-300.

California Environmental Protection Agency, 2005. *Air Quality and Land Use Handbook: A Community Health Perspective*. California Air Resources Board, California Environmental Protection Agency, April 2005. Available from: http://www.arb.ca.gov/ch/handbook.pdf

Chambers, A.K., Strosher, M., Wootton, T., Moncrieff, J., and P. McCready, 2008. Direct measurement of fugitive emissions of hydrocarbons from a refinery. *J. Air & Waste Manage. Assoc.* 58(8):1047-1056.

City of Alameda, 2007. Chapter XXX Development Regulations; 30-21 Variances, Use Permits: Procedure. City of Alameda California Municipal Code current as of October 16, 2007 and accessed February 12, 2008. Available from: http://www.ci.alameda.ca.us/code/_DATA/TITLE30/30_21_VARIANCES__USE_PERMITS__PROC/index.html

Finkelstein, M.M., Jerrett, M. and M.R. Sears, 2004. Traffic air pollution and mortality rate advancement periods. *Am. J. Epidemiology* 160(2):173-177.

Garshick, E., Laden, F., Hart, J.E. and A. Caron, 2003. Residence near a major road and respiratory symptoms in U.S. veterans. *Epidemiology* 14(6):728-736.

Gauderman, W.J., Avol, E., Lurmann, F., Kuenzli, N., Gilliland, F., Peters, J. and R. McConnell, 2005. Childhood asthma and exposure to traffic and nitrogen dioxide. *Epidemiology* 16(6):737-743.

Golder Associates, 2004. Air Quality Assessment Of Nelson Quarry Company Burlington Quarry Extension, Burlington, Ontario. Report submitted to Nelson Quarry Company, Golder Associates Ltd. August 2004.

Halton Region, 2006. *Halton Region Official Plan [2006]*. Regional Municipality of Halton, Office Consolidation, August 17, 2006.

Halton Region, 2007. *Air Quality, Human Health & the Built Environment*. Halton Region Health Department, Oakville, Ontario, May 2007. Available from: http://www.halton.ca/ppw/planning/SustainableHalton/Phase1.htm

Hemson Consulting Ltd., 2007. Effect of Demographic Change on Halton Region. Draft Final Background Report for the Sustainable Halton Planning Process. May 2007. Available from: http://www.halton.ca/ppw/Planning/SustainableHalton/Phase1.htm

Institute for Risk Research, 2007. *Air Pollution and Public Health: A Guidance Document for Risk Managers*. Institute for Risk Research, Waterloo, Ontario, Canada, May 2007.
Available from: http://www.irr-neram.ca/CQ5Vancouver/CQ5.html

Kim, J.J., Huen, K., Adams, S., Smorodinsky, S., Hoats, A., Malig, B., Lipsett, M. and B. Ostro, 2008. Residential traffic and children's respiratory health. *Environ. Health. Perspect.* 116(9):1274-1279.

Morawska, L., et al., 1999. A study of the horizontal and vertical profile of submicrometer particles in relation to a busy road. *Atmos. Environ.* 33:1261-1274.

National Association of Local Boards of Health, 2006. *Land Use Planning for Public Health: The Role of Local Boards of Health in Community Design and Development*. NALBOH, 2006. Available from: http://www.nalboh.org

NSCA, 2006. *Development Control: Planning for Air Quality*. Environment Protection UK, 2006. Available from: http://www.environmental-protection.org.uk/assets/library/documents/Development_Control_planning_for_air_quality.pdf

Office of the Deputy Prime Minister, 2004a. *Planning Policy Statement 23: Planning and Pollution Control*. Office of the Deputy Prime Minister, Her Majesty's Stationery Office, Government of the United Kingdom, 2004. Available from: http://www.communities.gov.uk/publications/planningandbuilding/planningpolicystatement23

Office of the Deputy Prime Minister, 2004b. *Planning Policy Statement 23: Planning and Pollution Control Annex 1: Pollution Control, Air and Water Quality*. Office of the Deputy Prime Minister, Her Majesty's Stationery Office, Government of the United Kingdom, 2004. Available from: http://www.communities.gov.uk/publications/planningandbuilding/pps23annex1

Ontario Medical Association, 2005a. *The Illness Costs of Air Pollution: 2005-2026 Health & Economic Damage Estimates*. Ontario Medical Association, June 2005. Available from: http://www.oma.org/Health/smog/index.asp

Ontario Medical Association, 2005b. *The Illness Costs of Air Pollution (ICAP) – Regional Data for 2005*. Available from: http://www.oma.org/Health/smog/index.asp

Ontario Ministry of Agriculture, Food, and Rural Affairs, 2006. *Minimum Distance Separation Formulae [MDS] Implementation Guidelines*. Ontario Ministry of Agriculture, Food and Rural Affairs, Publication 707, Queen's Printer for Ontario, 2006 Toronto, Canada.

Ontario Ministry of the Environment, 1995a. *Guideline D-1 Land Use Compatibility*. Ministry of the Environment, Government of Ontario, July 1995. Available from: http://www.ene.gov.on.ca/en/publications/forms/index.php#LandUse

Ontario Ministry of the Environment, 1995b. *Procedure D-1-1 Land Use Compatibility: Implementation*. Ministry of the Environment, Government of Ontario, July 1995. Available from: http://www.ene.gov.on.ca/en/publications/forms/index.php#LandUse

Ontario Ministry of the Environment, 1995c. *Procedure D-1-2 Land Use Compatibility: Specific Applications*. Ministry of the Environment,

Government of Ontario, July 1995. Available from: http://www.ene.gov.on.ca/en/publications/forms/index.php#LandUse

Ontario Ministry of the Environment, 1995d. *Procedure D-1-3 Land Use Compatibility: Definitions*. Ministry of the Environment, Government of Ontario, July 1995. Available from: http://www.ene.gov.on.ca/en/publications/forms/index.php#LandUse

Ontario Ministry of the Environment, 1995e. *Guideline D-6 Compatibility Between Industrial Facilities and Sensitive Land Uses*. Ministry of the Environment, Government of Ontario, July 1995. Available from: http://www.ene.gov.on.ca/en/publications/forms/index.php#LandUse

Ontario Ministry of the Environment, 1995f. *Procedure D-6-1 Appendix A: Industrial Categorization Criteria*. Ministry of the Environment, Government of Ontario, July 1995. Available from: http://www.ene.gov.on.ca/en/publications/forms/index.php#LandUse

Ontario Ministry of the Environment, 2005. *Modelling Traffic Influences on Particulate Concentration*. Queen's Printer for Ontario, December 2005, PIBs 5110e.

Ontario Ministry of Municipal Affairs and Housing, 2005. *Provincial Policy Statement 2005*. Ministry of Municipal Affairs and Housing, Government of Ontario, 2005. Available from: http://www.mah.gov.on.ca/Page1485.aspx

Ontario Ministry of Public Infrastructure and Renewal, 2006. *Growth Plan for the Greater Golden Horseshoe*. Ministry of Public Infrastructure and Renewal, Government of Ontario, 2006. Available from: http://www.placestogrow.ca/index.php?option=com_content&task=view&id=9&Itemid=14

Ontario Municipal Board, various years.
Available from:
http://www.omb.gov.on.ca/english/eDecisions/eDecisions.html

Ontario Professional Planners Institute, 2007. *Healthy Communities, Sustainable Communities: The 21st Century Planning Challenge*. OPPI, Fall 2007. Available from: http://www.ontarioplanners.on.ca

Purdue University, 2002. *The Law Behind Planning & Zoning in Indiana*. Purdue University Cooperative Extension Service, February 2002. Available from: http://www.ces.purdue.edu/extmedia/

Pollution Probe, 2002. *The Smog Primer*. Toronto, June 2002. Available from: http://www.pollutionprobe.org

Pope, C.A. III, Burnett, R.T., Thun, M.J., Calle, E.E., Krewski, D., Ito, K. and G.D. Thurston, 2002. Lung cancer, cardiopulmonary mortality and long-term exposure to particulate air pollution. *J. Am. Med. Assoc.* 287(9):1132- 1141.

Pope, C.A. III, Muhlestein, J.B., May H.T., Renlund, D.G., Anderson, J.L., and B.D. Horne, 2006. Ischemic heart disease events triggered by short-term exposure to fine particulate air pollution. *Circulation* 114:2443-2448.

Royal Borough of Kensington and Chelsea, 2003. *Supplementary Planning Guidance-05: Air Quality*. The Royal Borough of Kensington and Chelsea, September 2003. Available from: http://www.rbkc.gov.uk/Planning/UnitaryDevelopmentPlan/spg_airquality.pdf

Royal Commission on Environmental Pollution, 2007. 26th Report. *The Urban Environment*. The Royal Commission on Environmental Pollution, TSO, London.

Sacramento Metropolitan Air Quality Management District, 2007. *Recommended Protocol for Evaluating the Location of Sensitive Land Uses Adjacent to Major Roadways: Final Draft*. Sacramento Metropolitan Air Quality Management District, January 2007. Available from: http://www.airquality.org/ceqa/index.shtml#SensitiveLU

Sacramento Metropolitan Air Quality Management District, 2005. *Guidance Document for Addressing Air Quality Issues in General Plans and Local Planning*. South Coast Air Quality Management District, May 2005. Available from: http://www.aqmd.gov/prdas/aqguide/aqguide.html

Sacramento Metropolitan Air Quality Management District, 2004. *Guide to Air Quality Assessment in Sacramento County*. Sacramento Metropolitan Air Quality Management District, July 2004. Available from: http://www.airquality.org/ceqa/index.shtml#SensitiveLU

Slaughter, J.C., Lumley, T., Sheppard, L., Koenig, J., and G. Shapiro, 2003. Effects of ambient air pollution on symptom severity and medication use in children with asthma. *Annals of Allergies, Asthma and Immunology* 91(4):346-353.

South Australia Environment Protection Authority, 2007. *Guidelines for Separation Distances*. South Australia Environment Protection Authority, December 2007. Available from: http://www.epa.sa.gov.au/guidelines.html

Toronto Public Health, 2005. *Air Emissions From the Ashbridges Bay Treatment Plant*. Report prepared for Toronto Public Health by Earth Tech Canada Inc. and Golder Associates Ltd., April 2005, Appendix F Concentration Contours of Chemicals of Concern (24Hr).

University of Waterloo, undated. A Detailed Emission Factor Model (MicroFac) Combined with a Dispersion Model to Assess Human Exposure Effects of Traffic. PowerPoint presentation by R. Singh and J. Sloan, Waterloo Centre for Atmospheric Sciences, University of Waterloo.

Western Australia Environmental Protection Authority, 2005. *Separation Distances between Industrial and Sensitive Land Uses: Final Guidance No. 3*. Western Australia Environmental Protection Authority, June 2005. Available from: http://www.epa.wa.gov.au/template.asp?ID=14&area=EIA&Cat=Guidance+Statements

Wilhelm, M. and B. Ritz, 2003. Residential proximity to traffic and adverse birth outcomes in Los Angeles County, California, 1994-1996. *Environ. Health Perspect.* 111(2): 207-216. DOI:10.1289/ehp.5688.

Working Group on Air Quality Objectives and Guidelines, 1999. *National Ambient Air Quality Objectives for Particulate Matter: Addendum to The Science Assessment Document.* A report by the CEPA/FPAC Working Group on Air Quality Objectives and Guidelines. December 1997, Revised April 1999. Minister, Public Works and Government Services, Canada.

World Health Organization, 2004. *Health Aspects of Air Pollution: Results from the WHO Project "Systematic Review of Health Aspects of Air Pollution in Europe"*. World Health Organization, Regional Office for Europe, June, 2004.

World Health Organization, 1996. *Our Cities, Our Future*. Price, C. and Tsouros, A. (ed.). WHO Healthy Cities Project Office, Copenhagen, 1996.