July 2012

NEW OAKVILLE HOSPITAL

Oakville Health Protection Air Quality By-Law Application for Approval

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REPORT

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EXECUTIVE SUMMARY

This Town of Oakville (the Town) Health Protection Air Quality By-Law (HPAQB) Application for Approval (Application) was prepared to assess the potential health risk of emissions of fine particulate matter (FPM) and its precursors from the proposed New Oakville Hospital (NOH). This Application was prepared following the Oakville document "*Guidance for Implementation of Oakville Health Protection Air Quality By-Law 2010-035, Section 5 and 6 and Approval Requirements for Major Emitters v.5 June 2011*".

The NOH will be constructed at 3000 Third Line in Oakville, Ontario to replace the existing Oakville-Trafalgar Memorial Hospital. It will provide healthcare facilities to the residents of Oakville and the surrounding area.

The primary sources of FPM from the NOH facility included in the assessment are the diesel fired emergency generators, natural gas fired boilers, and the cooling towers. To simulate the impact of the NOH,,time varying emission rates were developed based on U.S. EPA emission factors or manufacturer's data along with expected fuel consumption or operating data. These data were used with the aid of the CALPUFF modelling system to estimate the ambient level of FPM from NOH operations.

This assessment considered both average and maximum operating scenarios for the NOH steam and hot water boiler systems. As the emergency generator maintenance testing schedule does not vary from year to year, it is assumed that the generator operation remains the same in both average and maximum operating scenarios. The NOH cooling towers will generally operate during the cooling season between March 1st and September 30th. Natural gas consumption was based on an energy model completed during the design stage of the NOH. Actual consumption rates will not be available until after construction and operation of the facility.

Dispersion modelling of emissions was carried out with the aid of the CALPUFF model, although an updated version of the model was used. Modelling inputs such as meteorological data and background concentrations were provided by the Town. In addition, self-contamination of the NOH was evaluated based on the results of a previous wind-tunnel project.

Based on modelling results, the NOH facility does not significantly affect the existing airshed in Oakville or on site sensitive receptors as the facility-induced FPM concentrations for average and maximum scenarios are less than 0.2 µg/m^3 (micrograms per cubic metre) annually, a criterion defined by the HPAQB. As a result, a health risk assessment is not required.

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1.0 INTRODUCTION

The Town of Oakville (the Town) Health Protection Air Quality By-Law (HPAQB) Application for Approval (Application) was prepared to assess the potential health risk of emissions of fine particulate matter (FPM) and its precursors from the proposed New Oakville Hospital (NOH). This Application was prepared following the Town's document "*Guidance for Implementation of Oakville Health Protection Air Quality By-Law 2010-035, Section 5 and 6 and Approval Requirements for Major Emitters v.5 June 2011*".

An Environmental Compliance Approval (ECA) Application is also being prepared for submission to the Ontario Ministry of the Environment (MOE).

2.0 FACILITY DESCRIPTION

2.1 Overview

The NOH will be constructed at 3000 Third Line in Oakville, Ontario to replace the existing Oakville-Trafalgar Memorial Hospital. It will provide healthcare facilities to the residents of Oakville and the surrounding area.

2.2 Location

The following figures have been provided to detail the location of the NOH and surrounding features:

- Figure 1 – Site Location Plan;
- Figure 2 – 3 km Aerial Photograph; and
- Figure 3 – Zoning Map.

Figure 1 provides the locations of educational and healthcare facilities (obtained from Land Information Ontario, 2009) in Oakville as well as major roads and highways. Figure 2 provides an aerial view of the surrounding area. Figure 3 presents the local land use including areas zoned for residential use.

The figures provided in this Application are all geo-referenced to the Universal Transverse Mercator (UTM) North American Datum of 1983 (NAD 83) coordinate system, which shows no difference compared to the World Geodetic System of 1984 (WGS84) datum for the domain of interest. The NAD 83 system was used to enable the use of higher resolution terrain data as provided by the MOE.

2.3 Buildings

Consisting of four main sections, the NOH will have a floor area of approximately 1.6 million square feet, three times the size of the existing hospital.

The NOH will have a capacity for 457 beds with shelled in space to grow to 602 beds. The NOH buildings include four main sections; a 5-storey section for complex continuing care, rehabilitation that will also house a number of outpatient programs such as nephrology, including the mechanical penthouse; an inpatient tower section containing patient bedrooms, operating theatres, as well as pre and post-operative support functions. In addition, the NOH also includes a 4-storey therapeutic and diagnostic imaging section that houses emergency care, diagnostic imaging, ambulatory clinics, maternal/child services, adult mental health services and a penthouse. The fourth section serves as the 2-storey, main hospital entrance and connects the rehabilitation block to the inpatient tower block.

A six-level parking structure will also be located on site.

The NOH has an intricate building design and for simplicity, only the tallest and widest building tiers were considered for building downwash effects on emission release points The primary exhaust stacks also extend from these tiers. Figure 4 – Building Plan, illustrates the on-site buildings that were considered in building downwash calculations. Design drawings for the NOH are also provided in Appendix A.

Off-site buildings were not considered for building downwash as structures in the surrounding area are predominantly commercial plazas and one or two-storey residences.

2.4 Raw Materials, Products and Processes

The NOH will have no manufacturing processes on site, as it is a health care facility.

The significant atmospheric emission sources at the NOH include the following:

- Diesel fired emergency generators;
- Natural gas fired boilers; and
- Cooling towers.

A process flow diagram has not been provided as the NOH does not manufacture any products. The NOH will operate 24 hours per day, 365 days per year with only the natural gas fired boilers operating continuously. A summary of the annual operations is provided in Table 1

Table 1: Annual Operations Summary

Equipment	Annual Operating Schedule	Planned Maintenance Schedule	Fuel Consumption
Diesel fired emergency generators (A1 – A6)	Weekly maintenance testing at 30% load for one (1) hour and full load testing for two hours every year (see Appendix B for specification).	As required by manufacturer	N/A
Natural gas fired boilers (B1 – B2)	Year-round	As required by manufacturer	Natural gas consumption based on eQUEST 3.65 energy modelling completed by Enermodal Engineering.
Cooling towers (C1 – C5)	Operate during cooling season between March 1st and September 30th.	As required by manufacturer	N/A

2.5 Emission Sources and Processes

The locations of the sources are identified in Figure 5 – Dispersion Modelling Plan.

2.5.1 Sources Considered Insignificant

Some emission sources at the NOH were considered to be insignificant. The rationale for each insignificant source is provided below.

Kitchen Exhausts (D1 and D2) – The two kitchen exhausts are assumed to be sources of food odours, steam and heat from cooking. The kitchen exhausts are not expected to emit FPM or precursor compounds.

Laboratory Fume Hood Exhaust (E) – The laboratory fume hood will be used to exhaust an area where medical tests are completed. Emissions of FPM or precursor compounds are not expected.

Block A Exhausts (F) – These sources include a chemotherapy exhaust, radioactive waste storage, tech workshop and welding exhausts. As the hospital is not yet constructed, any emissions from these sources are difficult to estimate. Welding operations are assumed to occur infrequently for equipment maintenance only and were considered insignificant in the operation of the NOH. All other sources at this location are not expected to emit FPM or precursor compounds.

Pharmacy / Lab Exhaust (G) – The pharmacy / laboratory fume hood will be used to exhaust an area where medications are dispensed. Emissions of FPM or precursor compounds are not expected.

2.6 Emission Control Equipment and Procedures and Emissions Monitoring

Table 2 summarizes the emission mitigation practices to be employed at the NOH. Continuous emissions monitoring systems will not be installed at the NOH. Equipment specifications and manufacturer guarantees are provided in Appendix B.

Table 2: Emission Control Practices

Equipment	Emission Control Device	Pollution Control Practice	Control Efficiency
Diesel fired emergency generators	N/A	Generators will be purchased as packaged units meeting U.S. EPA Tier 2 emission standards for nitrogen oxides (NOx) and fine particulate matter.	Tier 2 emission standards are more stringent than Tier 1 standards, 30% lower for NOx, and 50% lower for fine particulate matter.
Natural gas fired boilers	N/A	Boilers will be purchased as packaged units with low NOx burners.	The U.S. EPA emission factor for natural gas boilers rated less than 100 million BTU with low NOx burners is 50% lower than the uncontrolled emission factor.
Cooling towers	N/A	N/A	N/A

2.7 Identification and Quantification of Substances Released to Air

Table 3 provides a listing of the total annual emissions of health-risk air pollutants emitted from the NOH. A summary of the annual average and maximum emissions of health-risk air pollutants for each source is provided in Tables 4 and 5.

Ammonia is not emitted from the NOH as it is not a product of natural gas or diesel combustion. The emergency generators and boilers do not have emission control equipment using ammonia such as selective catalytic reduction (SCR).

Detailed sample calculations are also provided in Appendix C – Emission Rate Calculations.

Table 3: Health-Risk Air Pollutant Total Annual Emissions

Pollutant	Annual Emissions [kg]	
	Average	Maximal
FPM	859.25	983.76
VOC	361.98	452.08
NO_X	4383.54	5202.69
SO_2	222.37	232.20
NH_3	0.00	0.00
Toluene	0.32	0.38
Xylene	0.07	0.07

Table 4: Annual Average and Maximum Emissions

Emission Source	Average Annual Emissions [kg]						
	FPM	VOC	NOX	SO2	NH3	Toluene	Xylene
Emergency Generators	30.85	1.55	1106.97	183.06	0.00	0.10	0.07
Boilers	498.04	360.42	3276.57	39.32	0.00	0.22	0.00
Cooling Towers	330.36	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	**859.25**	**361.98**	**4383.54**	**222.37**	**0.00**	**0.32**	**0.07**

Table 5: Maximum Emissions

Emission Source	Maximum Annual Emissions [kg]						
	FPM	VOC	NOX	SO2	NH3	Toluene	Xylene
Emergency Generators	30.85	1.55	1106.97	183.06	0.00	0.10	0.07
Boilers	622.55	450.53	4095.72	49.15	0.00	0.28	0.00
Cooling Towers	330.36	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	**983.76**	**452.08**	**5202.69**	**232.20**	**0.00**	**0.38**	**0.07**

2.7.1 Diesel Fired Emergency Generators

Manufacturer emission factors were used to estimate direct FPM and NOx emissions from the diesel fired emergency generators. Emission factors from the U.S. EPA AP-42 Chapter 3.4 Large Stationary Diesel and All Stationary Dual-fuel Engines were not used as they are not representative of the Tier 2 emissions standards for the generators. The nominal emissions profile for the diesel engines were used for the modelling assessment as these are representative of a well-maintained system (see Appendix B - Caterpillar Application and Installation Guide, 2008, p. 36). The NOH emergency generators will always be properly maintained as they are critical systems that must be operational if a power outage occurs.

The manufacturer emission factors did not include speciated volatile organic compound (VOC) emission rates. Therefore, the Chapter 3.4 U.S. EPA emission factors were used to estimate VOC emissions for these sources and are likely conservative. In addition, SO2 emissions were conservatively calculated based on a 0.5% sulphur content in fuels as diesel fuel is typically at 0.005% sulphur.

As shown in Table 1, six emergency diesel generators will be available but only one (1) unit will be tested at any time for an hour at 30% load as per CSA Standard CSA-C282 (2009), Table 3 (Appendix B). Air quality simulations were carried out on hourly testing of one unit at 30% load for six hours one (1) day per week between the hours of 0700 to 1900. The units also go through an annual test of two (2) hours per year at 100% load but this would be scheduled to minimize air quality impacts and has not been included in the assessment.

2.7.2 Natural Gas Fired Boilers

U.S. EPA AP-42 Chapter 1.4 Natural Gas Combustion emission factors for boilers with low NOx burners were used to estimate emissions from the NOH steam and hot water boilers.

Natural gas consumption was based on eQUEST 3.65 energy modelling completed by Enermodal Engineering. Inputs to the energy model included design stage structural and mechanical specifications provided by the NOH design team. A more detailed description of the model inputs is provided in Appendix D – Energy Model Report.

The annual natural gas consumption was assumed to be split evenly between the steam and hot water boilers.

2.7.3 Cooling Towers

Fine particulate emissions from the NOH cooling towers were estimated using the maximum circulating water flow rate, drift loss and total dissolved solids concentration data provided by the manufacturer (Appendix B). The Total Dissolved Solids (TDS) concentration is approximately 590 mg/L with a drift loss of 0.005%. In addition, the fans have a capacity of 120.7 m^3/s at 20 °C.

2.7.4 Equipment Maintenance

Maintenance information is not available at this time but can be provided when final equipment selection has been completed.

2.7.5 Average and Maximum Operating Scenarios

This assessment considered both average and maximum operating scenarios for the NOH steam and hot water boiler systems. The average annual natural gas fuel consumption estimate for the boilers is based on the results of an energy model for the NOH that provided monthly natural gas consumption values provided by Carillion Canada (Carillion) of Concord, Ontario. The maximum annual fuel consumption estimate is based on a 25% increase from the average values as recommended by Carillion. The 25% factor is based on the following:

- Mitigation against potential design changes;
- An adjustment for the over-optimization of energy modelling that in Carillion's past experience and knowledge can range from 10% to 25%; and
- A further mitigation against process loads (autoclaves).

As the emergency generator maintenance testing schedule does not vary from year to year, it is assumed that the generator operation remains the same in both average and maximum operating scenarios. According to the "*Guidance for Implementation of Oakville Health Protection Air Quality By-Law 2010-035, Section 5 and 6 and Approval Requirements for Major Emitters v.5 June 2011*" document, emissions due to emergency situations should not be included in the assessment. Emergency generator operations during power outages were not included in the modelling.

The cooling towers are assumed to operate continuously from 1 March to 31 September which results in 5136 hours of operation.

3.0 EVALUATION

3.1 Modelling Approach and Model Selection

Atmospheric dispersion modelling was carried out using an updated version of the CALPUFF model. The CALPUFF model has many advancements including;

The CALPUFF modelling system is made up of three main components:

- The CALMET meteorological model that generates hourly wind and temperature fields in a three dimensional gridded modelling domain;
- The CALPUFF transport and dispersion model that advects "puffs" of material emitted from sources to calculate hourly concentration/fluxes at receptors of interest; and
- CALPOST post processor (used to extract the data of interest from CALPUFF binary output files).

The default model (CALPUFF V5.8) contains an input read error that does not allow the use of PRIME building downwash, which is considered to be more accurate in predicting concentrations within the building wake zone since it takes into account the effect of vertical wind shear and the variation in wind speed deficit with downwind distance. For this reason, a later version (CALPUFF V6.263) was used, where the error was corrected. It is our understanding that the there are no fundamental differences between the models. CALPUFF V6.263 has been applied to urban airshed modelling for the City of Toronto (Reference - Dr. Christopher Morgan and Regional Municipality of Halton (Reference - Mr. Peter Steer).

The following Table 6 provides additional information as per S.3.2.1.1 of the Town guidance document.

Table 6: Additional CALPUFF Information

Name of Model Used:	**CALPUFF V6.263**
Technical Issues which warrants use of Model:	Version 5.8 has a bug with respect to using building downwash using Prime input data. Problem Area 1 -- When performing cavity sampling for PRIME downwash, restrict primary source calculations to receptors downwind of primary source and add screen for receptors located far to the side (no impact). Without this restriction, the model may halt with an attempted division by zero. Receptors upwind of the source are processed for cavity impacts starting with Version 5.8, Level 070623. Modified: CAV_SAMP The model stops executing and returns an error message when by running BPIP-Prime with CALPUFF V5.8. The error message generated is provided in Appendix E.
References:	MCB-E.txt
Website:	http://www.src.com/calpuff/calpuff1.htm
Source Code:	See Appendix F

The following models and pre- and post-processors were used in the assessment:

- CALPUFF dispersion model (V6.263, level 080827);
- CALPOST post processor (V6.223);
- BPIP building downwash pre-processor (V04274); and
- CALMET was not required in this assessment as the CALPUFF-ready meteorological data were supplied by the Town.

The Town provides all applicants with identical Town Default Inputs (TDI) data to be used with the CALPUFF model. Golder received the following data from Mr. Jeffrey Lee of the Town in September 2011.

- Model domain;
- Fine gridded receptors with 100 meter spacing over the Town;
- Pre-processed meteorology data using CALMET (2004 to 2008);
- Geophysical data;
- Terrain data;
- Land use data; and
- Coastline data;
- Background concentration data;
- Background hourly ozone data
- Background monthly ammonia data; and
- Background hourly FPM data.

3.2 Model Inputs

The CALPUFF model input and output files for the NOH have been provided on compact disc, see Appendix F.

Dispersion modelling input parameters are summarized in Table 7

Table 7: Point Source Dispersion Modelling Input Parameters

Source Identifier	Source Description	Source Parameters						Source Coordinates [m]	
		Stack Volumetric Flow Rate [Am³/s]	Stack Exit Gas Temperature [K]	Stack Inner Diameter [m]	Stack Height Above Grade [m]	Stack Height Above Roof [m]	Stack Exit Velocity [m/s]	X	Y
A1	Emergency Power Diesel Generator 1	4.1	726.6	0.46	58.30	3.50	25.2	600050.6	4811607.5
A2	Emergency Power Diesel Generator 2	4.1	726.6	0.46	58.30	3.50	25.2	600056.2	4811603.2
A3	Emergency Power Diesel Generator 3	4.1	726.6	0.46	58.30	3.50	25.2	600061.3	4811599.3
A4	Emergency Power Diesel Generator 4	4.1	726.6	0.46	58.30	3.50	25.2	600073.3	4811590.2
A5	Emergency Power Diesel Generator 5	4.1	726.6	0.46	58.30	3.50	25.2	600078.8	4811586.1
A6	Emergency Power Diesel Generator 6	4.1	726.6	0.46	58.30	3.50	25.2	600084.1	4811582.1
B1	Steam Boilers (4)	10.3	494.2	1.02	57.80	12.70	12.6	600021.0	4811615.3
B2	Hot Water Boilers (5)	12.5	461.2	1.02	57.80	12.70	15.3	600028.7	4811625.1
C1	Cooling Tower 1	120.7	ambient	3.63	54.40	9.30	11.7	600095.4	4811562.2
C2	Cooling Tower 2	120.70	ambient	3.63	54.40	9.30	11.7	600102.9	4811556.5
C3	Cooling Tower 3	120.70	ambient	3.63	54.40	9.30	11.7	600104.4	4811555.2
C4	Cooling Tower 4	120.70	ambient	3.63	54.40	9.30	11.7	600111.6	4811550.0

3.2.1 Facility Emissions Estimation Methods

Sample calculations are presented in Appendix C – Emission Rate Calculations. The methods used to calculation emissions are based on fuel usage and:

- U.S. EPA AP-42 emission factors; or
- Manufacturer's emission guarantees.

Manufacturer's emission data are provided in Appendix B – Equipment Specifications and Manufacturer Guarantees.

The operation of the boilers and the cooling towers varies throughout the year and variable emission files were used as input data into CALPUFF. Emissions from the boilers were calculated based on typical natural gas fuel consumption for each month as suggested from the energy model. Cooling towers typically operate when building cooling is required which is between March 1st and September 30th.

There is no information on the frequency that emissions reach 90 to 100% of the maximal emission scenario over the next 10 years since the facility has not been constructed. As a result, this assessment has been based on energy and fuel consumption models.

3.2.2 Model Input Options

CALPUFF dispersion modelling has been completed using the following input options summarized in Table 8.

Table 8: Model Input Options

Model Input	Default Option Used	Non-Default Option Used
Meteorological Data	Yes - TDI	
Receptor Grid	Yes - TDI	
Land Use Data	Yes - TDI	
Terrain Data	Yes - TDI	
Coastline Data	Yes - TDI	
Background Concentrations	Yes - TDI	
▪ Ozone	Yes - TDI	
▪ Ammonia	Yes - TDI	
▪ FPM	Yes - TDI	

3.2.3 Non-Default Settings

The MSPLIT default value is zero which does not allow a puff to split into smaller puffs but allows the single puff to grow to a large size. Initial runs with MSPLIT set to zero caused the model to fail, resulting in the following error message:

Fatal Error in GRISE
Computed risefac is less than 0.0

```
x,htgrise    =    92.29053      51.17833
rise,zfrise  =   -3.121667      32.32680
risefac      =  -9.6565910E-02
```

The cause is likely because of the dense size grid around the NOH and the large size of the puff. Setting MSPLIT to one (1) allowed the model to complete the calculations.

3.2.4 Coordinate System

The UTM coordinate system was used to specify model object sources and buildings. All coordinates were defined in the NAD83 datum. Data supplied by the Town (e.g., receptor grids) were provided in WGS84 datum, which shows no difference compared to NAD83 datum for the domain of interest. The NAD 83 system was used to enable the use of higher resolution terrain data as provided by the (MOE).

3.2.5 Meteorology, Land Use and Terrain Data

CALMET meteorological data supplied by the Town were used in CALPUFF for this assessment. The CALMET meteorological data set, which takes into account effects such as slope flow and terrain channelling of winds, incorporated geophysical data such as land use and terrain data when it was developed. Due to the low resolution of the Town data set, base elevations for the receptor points, stacks and buildings were determined based on terrain data obtained from the MOE. The MOE provides terrain data in the form of Digital Elevation Model (DEM) files. The DEM files used in this assessment include the following:

- 0871_1.DEM;
- 0871_2.DEM;
- 0872_1.DEM; and
- 0872_2.DEM.

3.2.6 Receptors

Two sets of receptors were used for the modelling. One set corresponded to the CALMET meteorological grid and the other set was a finer resolution set of discrete receptors within the boundaries of Oakville supplied by the Town. As mentioned in Section 3.2.4, the elevations for the discrete receptors were obtained from the higher resolution MOE DEM files.

3.2.7 Building Downwash

Building wake effects were considered in this modelling study using the U.S. EPA's Building Profile Input Program (BPIP-PRIME). The inputs into this pre-processor include the coordinates and heights of the buildings and stacks. The BPIP output is used in the CALPUFF building wake effect calculations.

The NOH has an intricate building design and for simplicity, only the tallest and widest building tiers were considered for building downwash effects on emission release points The primary exhaust stacks also extend from these tiers. Figure 4 – Building Plan, illustrates the on-site buildings that were considered in building downwash calculations. Design drawings for the NOH are also provided in Appendix A.

3.2.8 Background and Cumulative Concentrations

Hourly background ozone data and monthly background ammonia data were supplied by the Town to input into CALPUFF. Background data for FPM were also supplied by the Town. The data file contains hourly FPM data based on measurements taken at the MOE monitoring station in northeast Oakville. The hourly background FPM concentrations were added to the hourly facility-induced FPM concentrations to determine the cumulative concentrations.

3.2.9 Chemistry Models

To account for the secondary aerosol formation, the 5-species MESOPUFF chemistry and the Secondary Organic Aerosols (SOA) chemistry options were used in CALPUFF. For both options, hourly background ozone data provided by the Town were used as input into CALPUFF. The monthly background ammonia data were only used for the MESOPUFF chemistry option. These options are acceptable by the guideline.

In order for the chemistry models to provide the correct output, the number of species (NSE) variable was set to eight (8). This value accounts for the SO_2, NOx, $_{PM2.5}$ and VOCs as well as the four (4) other species (NO_3, HNO_3, NH_4 and SO_4) also considered in the chemistry computation, which have an initial emission rate of zero.

3.2.10 Species Modelled

The following species were modelled in CALPUFF: SO_2, SO_4, NO_x, HNO_3, NO_3, $PM_{2.5}$, NH_4 and VOC. Some of the sources emit toluene and xylene and separate model runs were carried out using the SOA chemistry module. For these runs, only toluene, xylene, and SOA were modelled with CALPUFF.

The concentration of facility-induced FPM was determined by summing the concentrations of directly emitted FPM ($PM_{2.5}$) and inorganic precursors including SO_4, HNO_3, and NO_3 at each receptor location. As the conversion of SO_2 or NO_x to particulate usually takes place over a long period of time, SO_2 and NO_x were not included in the total FPM for all receptors modelled. In addition, based on the modelling results, predicted SOA concentrations were approximately ten orders of magnitude lower than the concentrations of the inorganic precursors mentioned above. Therefore, SOA was excluded from the determination of FPM for this assessment.

3.3 Same Structure Contamination

The NOH will provide healthcare services, and can itself be considered a sensitive receptor. Therefore, same-structure contamination must be assessed. The assessment considered only the average case emissions as worst case conditions are not expected to occur for extended periods of time.

The same structure contamination assessment was carried out in the following steps:

- Exhaust flow rates for each source were normalized to standard temperature and pressure (20 °C and 1 atmosphere)
- An in-stack concentration (µg/m³) was calculated using the hourly emission rate of FPM from each source
- The in-stack concentration was divided by the dilution factor for each sensitive receptor location to determine the concentration at the sensitive receptor
- The averaging period conversation factor was used to convert the hourly average concentration to an annual average concentration. The conversion factor was calculated using the method described in Section 4.4 of the MOE Air Dispersion Guideline for Ontario (March 2009).
- The annual average concentration was adjusted to account for the annual operating hours for each source.
- The adjusted annual average concentrations for each sensitive receptor location were summed to determine the overall impact of the FPM at that location.

The assessment indicated that Receptors 5 (R5) and 8 (R8) are the most influenced by the emissions from the natural gas boiler exhausts B1 and B2. An analysis of the CALMET meteorology data and windrose determined that winds are only favourable for direct self-contamination from these boiler exhausts to R5 and R8 less than 40% of the time. The analysis spreadsheet and a windrose are provided in Apppendix F. The FPM concentrations from the boilers at R5 and R8 were adjusted to reflect this and are below the 0.2 µg/m³ limit.

Sample calculations for the above method are provided in Appendix G.

The dilution factors and receptor locations for this assessment were obtained from the Exhaust Re-entrainment Study completed by RWDI Inc. (Appendix F). The dilution factors are summarized in Table 9, while results of the self-contamination assessment are summarized in Table 10.

Table 9: Dilution Factors

Emission Source	ID	Receptor Location Dilution Factor			
		Air Intakes	Entrances	Terrace / Courtyard	Windows
Emergency Generators	A1- A6	1620	2500	2420	3400
Boilers	B1 - B2	750	1340	550	1790
Cooling Towers	C1 -C4	80	60	80	70

Table 10: FPM Self-Contamination Modelling Results

Emission Source	ID	Operating Hours Per Year	In-Stack Concentration [µg/m³]	Concentration at Receptor [µg/m³]			
				Air Intakes (R5)	Entrances	Terrace / Courtyard (R8)	Windows
Emergency Generators	A1	52	16465.10	0.005	0.003	0.003	0.002
	A2	52	16465.10	0.005	0.003	0.003	0.002
	A3	52	16465.10	0.005	0.003	0.003	0.002
	A4	52	16465.10	0.005	0.003	0.003	0.002
	A5	52	16465.10	0.005	0.003	0.003	0.002
	A6	52	16465.10	0.005	0.003	0.003	0.002
Boilers	B1	8760	1297.48	**0.050**	**0.076**	**0.073**	**0.057**
	B2	8760	997.72	**0.038**	**0.059**	**0.056**	**0.044**
Cooling Towers	C1	5136	37.64	0.022	0.029	0.022	0.025
	C2	5136	37.64	0.022	0.029	0.022	0.025
	C3	5136	37.64	0.022	0.029	0.022	0.025
	C4	5136	37.64	0.022	0.029	0.022	0.025
Total Concentration [µg/m³]				**0.139**	**0.182**	**0.169**	**0.139**

* Note – B1 and B2 have different concentrations as the exhausts have different flow rates and temperatures.

4.0 MAPPING

Table 8 summarizes the numeric results of the maximal total facility-induced (MTFI) and maximal cumulative (MC) FPM concentrations for both the average and maximal scenarios. The results indicate the facility does not significantly affect the existing airshed in Oakville as the facility-induced FPM concentrations for both scenarios are less than 0.2 micrograms per cubic metre annually, a criterion defined by the HPAQB.

Table 11: FPM Modelling Results

	"Average Emissions" Median Concentration ($\mu g/m^3$)		"Maximal Emissions" Concentration ($\mu g/m^3$)	
	MTFI	**MC**	**MTFI**	**MC**
Annual Value	0.054	8.97	0.070	8.98

Figures 6 and 7 show the total facility-induced FPM concentration contour maps for the average and maximal scenarios, respectively. For clarity, the contour maps have not been superimposed on a land-use planning map. Instead, a figure showing land-use is provided in Figure 3. These contour maps indicate the maximum FPM concentrations are predicted at a location approximately 50 m north of the emergency generators. The plots also indicate the FPM concentration decreases with distance from the facility.

The cumulative concentration was assessed by conservatively summing the total facility-induced FPM concentrations and the background FPM concentrations, which were provided by the Town. Figures 8 and 9 show the cumulative FPM concentration contour maps for the average and maximal scenarios, respectively. The contour maps based on cumulative concentration are similar to the contour maps based on facility-induced concentration, indicating the annual background concentrations showed minor variability for the five year period. The results also indicate that the facility-induced FPM concentrations are significantly less than the background concentrations by at least two orders of magnitude.

5.0 CONCLUSION

This HPAQB Application for Approval (Application) was prepared to assess the potential health risk of emissions of FPM and its precursors from the proposed NOH. This Application was prepared following the Town's document "*Guidance for Implementation of Oakville Health Protection Air Quality By-Law 2010-035, Section 5 and 6 and Approval Requirements for Major Emitters v.5 June 2011*".

The major sources of FPM at the proposed NOH are diesel fired emergency generators, natural gas fired boilers, and cooling towers. All of these sources were considered in this assessment. To closely reflect how the facility operates, variable emission rates, which were estimated based on U.S. EPA emission factors or manufacturer's data, were employed for the modelling assessment.

Based on modelling results, the NOH facility does not significantly affect the existing airshed in Oakville or on site sensitive receptors as the facility-induced FPM concentrations are less than 0.2 micrograms per cubic metre annually, a criterion defined by the Oakville Health Protection Air Quality By-Law. As a result, a health risk assessment is not required.

Report Signature Page

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Principal

EKL/ADC/ng;gf

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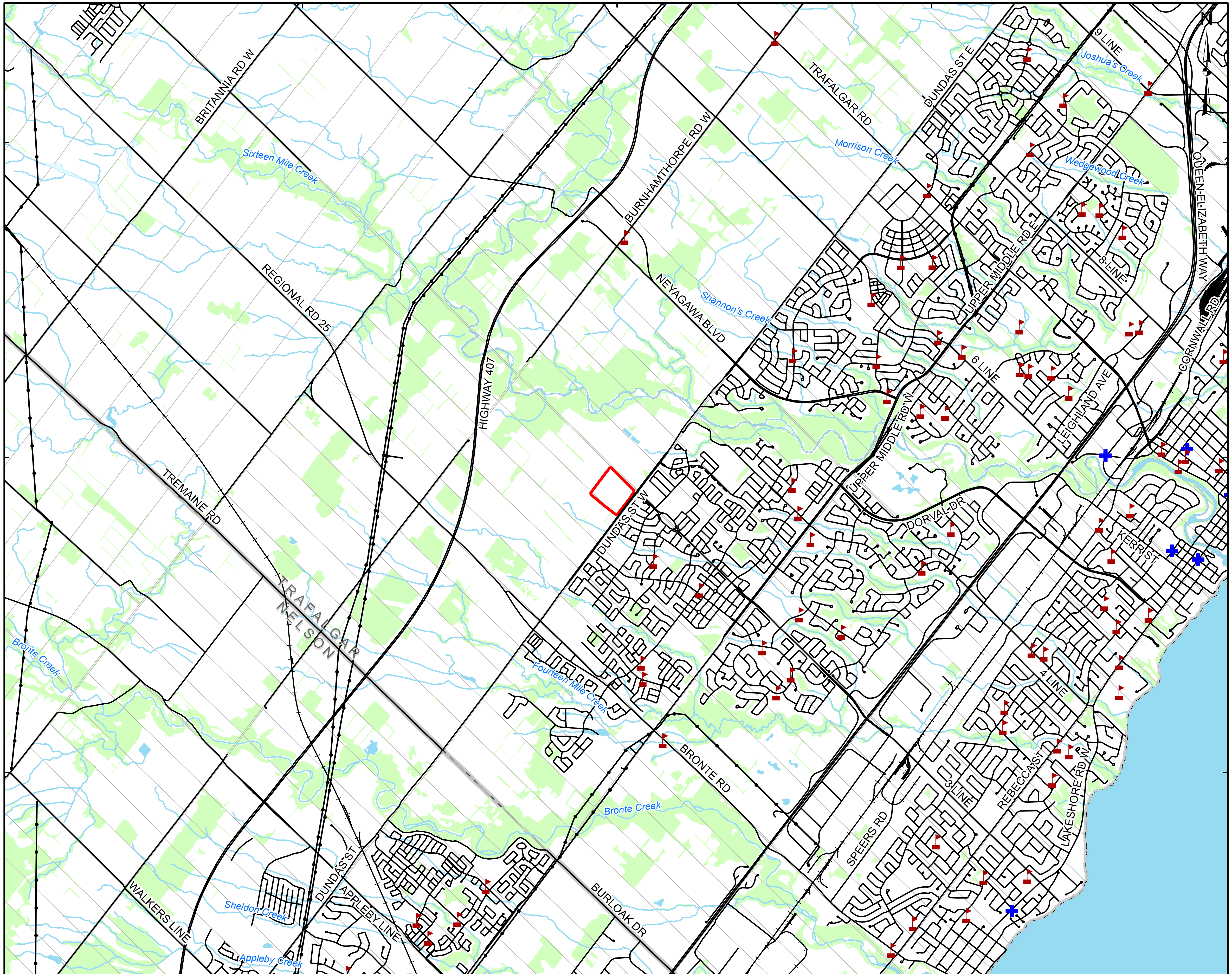
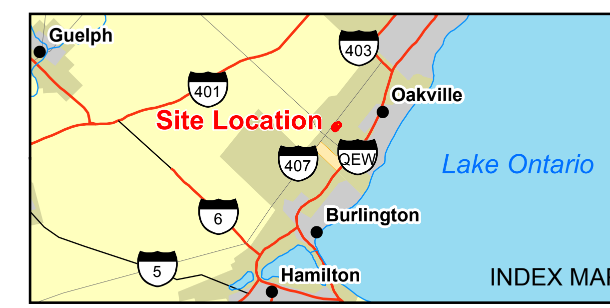
FIGURES



LEGEND

- Health Care
- Education
- Road
- Railways
- Utility Line
- Watercourse
- Waterbody
- Wetland
- Wooded Area
- Lot Fabric
- Geographic Township Boundary
- Property Boundary



REFERENCE

Base Data - MNR LIO, obtained 2009
Produced by Golder Associates Ltd under licence from
Ontario Ministry of Natural Resources, © Queens Printer 2012
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 17

0 1,000 2,000 3,000 4,000

SCALE 1:50,000 METRES

PROJECT

OAKVILLE HOSPITAL
HPAQB APPLICATION

TITLE

SITE LOCATION PLAN

Golder Associates
Mississauga, Ontario

PROJECT NO. 10-1151-0350			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	16 Jan. 2012	FIGURE: 1	
GIS	JO	15 Mar. 2012		
CHECK	KA	15 Mar. 2012		
REVIEW	EKL	15 Mar. 2012		

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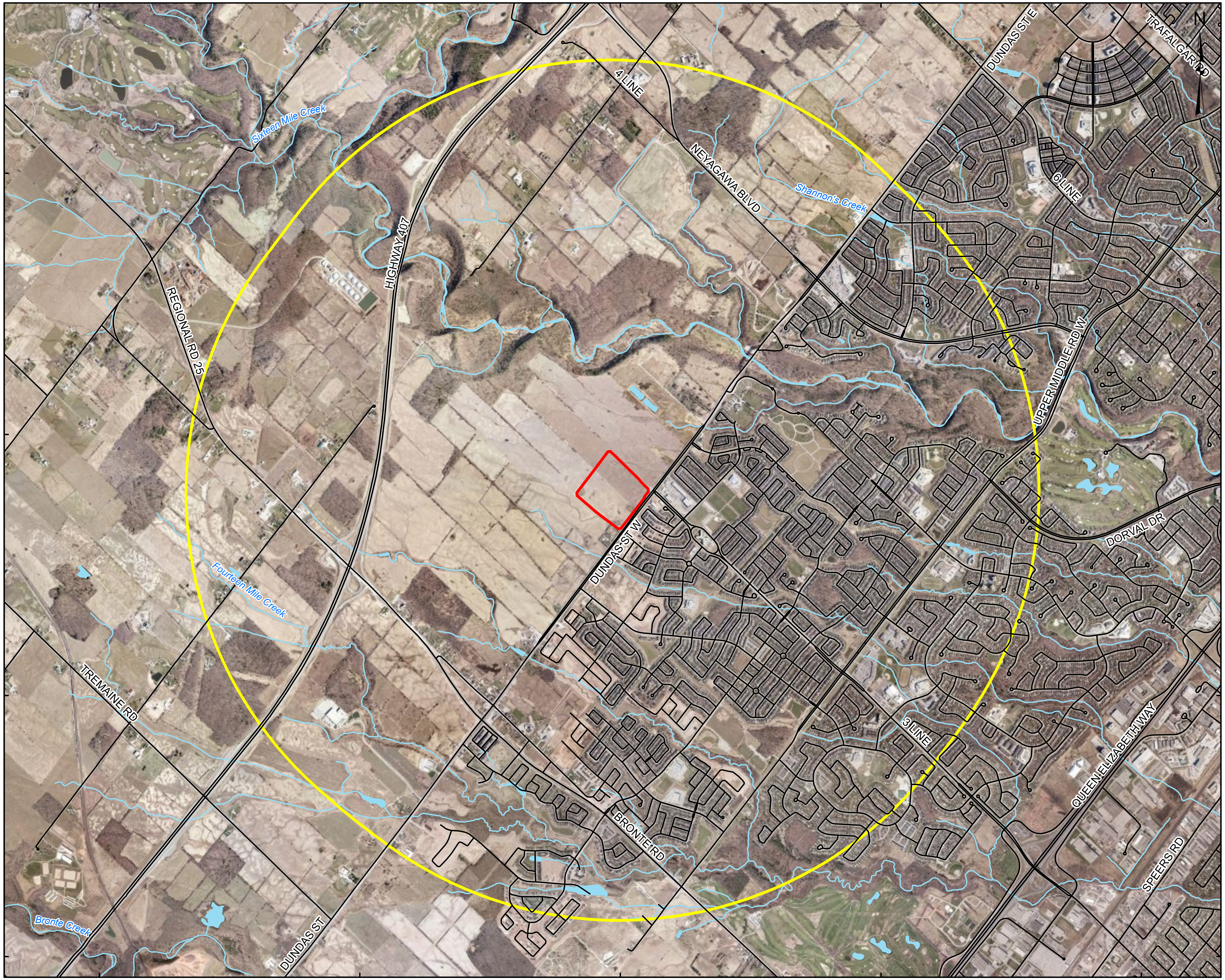

LEGEND

- Road
- Watercourse
- Waterbody
- Wetland
- 3km Radius
- Property Boundary

REFERENCE

Base Data - MNR LIO, obtained 2009
Produced by Golder Associates Ltd under licence from
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Imagery - Microsoft Bing (c) 2010 Microsoft Corporation and its data suppliers.
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 17

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SCALE 1:30,000 METRES

PROJECT

OAKVILLE HOSPITAL
HPAQB APPLICATION

TITLE

3KM AERIAL PHOTOGRAPH

Golder Associates
Mississauga, Ontario

PROJECT NO. 10-1151-0350			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	16 Jan. 2012	FIGURE: 2	
GIS	JO	15 Mar. 2012		
CHECK	KA	15 Mar. 2012		
REVIEW	EKL	15 Mar. 2012		

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