APPENDIX D

Air Quality Assessment of Proposed Expansion to Billy Bishop Toronto Centre Airport

November 2013

PROPOSED BILLY BISHOP AIRPORT EXPANSION HEALTH IMPACT ASSESSMENT

Air Quality Assessment

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REPORT

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Table of Contents

TABLES

FIGURES

APPENDICES

APPENDIX D
Annual and 24-hr 95th %-ile Concentrations per Ward

APPENDIX E
Annual & 24-hr 95th-%ile Concentration Isopleths –

NO_2, PM_{10}, $PM_{2.5}$, Chromium and Cadmium

ACRONYMS

AAQC	Ambient Air Quality Criteria
AQHI	Air Quality Health Index
BBTCA	Billy Bishop Toronto City Airport
B[A]P	Benzo(a)pyrene
CAC	Criteria Air Contaminant
CWS	Canada Wide Standard
EDMS	Emissions and Dispersion modelling Software
EEO	Energy and Environment Office
EPA	Environmental Protection Agency
EMCH	Emissions Modelling Clearinghouse
FAA	Federal Aviation Administration
GSE	Ground Support Equipment
GTA	Greater Toronto Area
HIA	Health Impact Assessment
ICAO	International Civil Aviation Organization
MOE	Ministry of Environment
NEI	National Emission Inventory
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
NPRI	National Pollutant Release Inventory
PM_{10}	Particulate matter with diameter less than 10 microns
$PM_{2.5}$	Particulate matter with diameter less than 2.5 microns
TPA	Toronto Port Authority
TPH	Toronto Public Health
PAC	Priority Air Contaminant
PAH	Polycyclic Aromatic Hydrocarbon
ppa	Passengers Per Annum
ppb	Parts Per Billion
SCC	Source Classification Code
TPA	Toronto Port Authority
VOC	Volatile Organic Compound

1.0 INTRODUCTION

The Billy Bishop Toronto City Airport (BBTCA) is considering an expansion to the existing services which could allow jet aircraft to operate at the airport. The introduction of jets to the airport could cause a potential change to the local environment including air quality and noise. To address these changes, a rapid Health Impact Assessment (HIA) was initiated by the Toronto Public Health (TPH) to provide Toronto's Medical Officer of Health with sufficient evidence to advise on the potential health impacts and reduction of health risks associated with the potential expansion of service.

The air quality assessment includes simulating cumulative conditions; namely,

1) Background conditions only (without BBTCA operations)
2) Existing operations based on 3.8 million passengers per annum (ppa) and 202 commercial movements per day with Bombardier Q400 (turboprop aircraft) plus background
3) Proposed future scenario based on 4.3 million ppa and 202 commercial movements per day with Bombardier Q400 (75%) and CS100 or similar jets (25%) plus background

Background air quality will be simulated from previous air quality modelling work carried out for the City's Energy and Environment Office (EEO). This scenario removes all BBTCA operations, including vehicular transportation activity along Eireann Quay, from the background dataset. The existing operation will be based on the operation of the Bombardier Q400 turboprop aircraft only with a maximum annual passenger capacity of 3.8 million. The proposed future scenario will address two potential jets operating at BBTCA, namely the Boeing 737-700 and the Bombardier CS100 which represent a range of potential jets that could operate at the BBTCA (AirBiz, 2013). In the proposed future scenario, it is assumed that 25% of the total movements are jets and 75% of the movements are Q400 aircraft which would result in a maximum annual capacity of 4.3 million passengers. In both scenarios, the number of commercial movements is capped at 202 per day. City of Toronto staff specified 202 commercial movements per day as the total maximum slot capacity for all commercial aircraft operations for the purposes of this HIA. In addition, in discussions with Bombardier it was determined that the Q400 and the CS100 or Boeing 737 uses the same fuel and that the number of above ground tanks remains the same.

These changes will cascade into other operations or activities such as:

- Take-off, landing, queuing times;
- Transportation to and from the island;
- Taxi, personal and bus drop-off and pick-up; and
- Fuel storage.

The following sections describe the methodology and assumptions used to simulate the change in air quality at the near-by wards.

2.0 METHODOLOGY

The simulation of air quality requires knowledge of a number of physical parameters such as the prevailing geographical and meteorological conditions which transport and disperse air pollutants as well as the activities which generate the emissions released into the atmosphere. Air quality models predict air quality in terms of the concentration of specified pollutants in the air at a specified place and time. All air quality models need two kinds of input:

- information about the release of pollutants into the atmosphere from one or more sources; and
- information about factors that influence the dispersion and transport of pollutants through the air such as wind speed and direction, solar radiation, topography, etc.

The models use this information to mathematically calculate and simulate how pollutants are transported, mixed and spread to give estimates of pollutant concentrations at specific places and times. Some models are very simple, while others are more complex, such as those that include ground level elevation data and chemical reactions taking place in the atmosphere that change the concentration of pollutants in the air. Increased complexity offers the advantages of more precise modelling results and ability to extract detailed information from the model about relative importance of each input. As the complexity increases so does the computer hardware capabilities, modelling time and financial resources.

An advantage of air quality modelling is not only that it allows extrapolation to areas distant from air quality monitoring stations, but that, unlike air quality monitoring, it permits the identification of the sources which contribute to the community air quality. Modelling also allows the impact of proposed future changes in the sources to be predicted and indeed also permits specified improvement solution scenarios to be tested.

2.1 Approach

To address the changes to air quality from the existing airport operations and any potential changes from proposed operations at BBTCA, three scenarios are simulated including:

- Background conditions without BBTCA operations;
- Existing operations based on 3.8 million ppa and 202 commercial movements per day with Bombardier Q400 (turboprop aircraft); and
- Proposed future scenario based on 4.3 million ppa and 202 commercial movements per day with Bombardier Q400 (75%) and CS100 or similar jets (25%).

City of Toronto staff specified 202 commercial movements per day as the total maximum slot capacity for all commercial aircraft operations for the purposes of this HIA. The approach includes the cumulative change in air quality by combining the background air quality with either the current maximum (without jets) or the future maximum (with jets).

2.1.1 Airport Emissions

The impact of atmospheric emissions released from airport activities is modelled with the aid of the FAA recommended modelling system, Emissions and Dispersion Modeling System (EDMS). The model consists of two modules, an emission tool and a dispersion modelling module. The emission module includes aircraft engine emission factors from the International Civil Aviation Organization (ICAO) Engine Exhaust Emissions Data Bank as well as a vehicle emission factors from the EPA MOBILE6 model. The emission module generates emissions data for criteria air contaminants (CACs) as well as speciated organic compounds (e.g., benzene. The EDMS can generate emission data for the following aviation sources:

- Aircraft;
- Auxiliary power units;
- Ground support equipment;
- Ground access vehicles; and
- Stationary sources.

EDMS prepares the input files for the transport and dispersion module which is the USEPA AERMOD dispersion model. In addition to the emission source data files, the AERMOD model also requires pre-processed hourly meteorological data as well as landuse/terrain data. The time-averaged concentrations at specified locations are predicted by AERMOD at an hour time stamp. Daily averages are the composite of 24 one hour averages at the specified location.

Although AERMOD is an accepted and practical model for evaluating regulatory compliance, the TPH and EEO elected to migrate the EDMS emission and source characterization to the CALPUFF model which has been used to evaluate local air quality in Toronto. This allows the use of existing airshed modelling for the City of Toronto to be included in the study, which is used to determine the background concentrations.

2.1.2 Background Air Quality

In 2011, the EEO commissioned the development of the Toronto Airshed Model "*An All Sources Cumulative Air Quality Impact Study of South Riverdale - Leslieville – Beaches"* (Golder, 2011) which addressed the transport and dispersion of long-range, regional and local emissions on the Toronto airshed. This study included a wide range of sources from the US, southern Ontario and Toronto, namely:

- Industrial;
- Residential and Commercial;
- Transportation (Road and Non-Road); and
- Biogenic & Agricultural.

The combination of emissions, meteorology and the geophysical environment influences the actual air quality in any airshed. An advanced air quality modelling system is required which includes a meteorological component to provide accurate weather data, a representative and well-founded emission database which covers a wide-range of anthropogenic and biogenic emissions as well a reliable transport and dispersion model. The CALPUFF modelling system, coupled with the Penn State MM5 mesocale meteorological model, was selected to simulate the local source and the transboundary contributions, respectively. Thirty Priority Air Contaminants (PACs) as presented in Table 1 were selected by TPH to be considered in the modelling.

The Toronto Airshed Model includes time-varying emissions to accurately estimate the change in activities on hourly, weekday/weekend and monthly basis. The temporal variation of activity is important as this provides a truer realization of conditions rather than using the average condition.

Table 1: Priority Air Contaminants

Acetaldehyde	1,2-Dichloroethane	Particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) *
Acrolein	Dichloromethane	Tetrachloroethylene
Benzene	Ethylene dibromide	Toluene
1,3-Butadiene	Formaldehyde	Trichloroethylene
Cadmium	Lead	Vinyl Chloride
Carbon tetrachloride	Manganese	Carbon Monoxide
Chloroform	Mercury	Particulate matter less than 10 microns in diameter (PM_{10})
Chloromethane	Nickel Compounds	Sulphur dioxide
Chromium	Nitrogen oxides *	Volatile organic compounds (VOC) (Anthropogenic/Biogenic)
1,4-Dichlorobenzene	Polycyclic aromatic hydrocarbons (PAHs) as benzo(a)pyrene(B[a]Ps)	Ozone *

* Criteria Air Contaminants (CACs) included in the Air Quality Health Index (AQHI)

2.1.3 Locations/Receptors

Cumulative air quality of the two operational airport scenarios is modelled with the aid of the CALPUFF modelling system. Modelling results are realized at a 200 m spacing in the following wards:

- Ward 19/20 - Trinity-Spadina;
- Ward 27/28 - Toronto Centre-Rosedale;
- Ward 30 - Toronto-Danforth; and
- Ward 32 - Beaches-East York.

The locations are points in the modelling domain where the model calculates the airborne concentrations from the various sources. Figure 1 shows the density and location of the modelling grid used to evaluate the concentrations at the various receptor locations.

Hourly concentrations are realized at each location for each PAC over the domain. The hourly concentrations are summed over a year (8,760 hrs) to generate an annual average at each receptor for each PAC. Similarly, the hourly concentrations at a location are summed over a 24-hour period (daily) to generate a daily average concentration. At each location, the 24-hr maximum, 95th and 75th highest concentrations are selected for further evaluation.

2.2 Processing Emissions

An emission inventory in a specified area is a compilation of sources of air pollution for a specified time period based on anthropogenic and/or natural activities. Accurate emission estimates are critical for planning purposes as well as for setting ambient air quality standards. Different emission sources can be categorized as point, area, mobile and/or biogenic sources, etc. Source categories used for the study are presented in Table 2.

Table 2: Emission Source Classification

Tier 1	Tier II / Tier III	Definition
Industrial	Industrial Points	➢ Elevated stacks
	Industrial Areas	➢ Industrial areas, industrial natural gas usage
Commercial and Residential	Commercial and Residential	➢ Natural gas usage, autobody shops, dry cleaners, commercial solvents, other residential heating sources
Mobile	Mobile	➢ On-road vehicles (trucks, cars, motorcycles)
Non-road	Non-road	➢ Airport, marine, rail, lawn mowers, agricultural vehicles
Biogenic (1)	Biogenic and Agricultural	➢ Non-anthropogenic activities

Note: (1) – Usable landuse data could not be found to model emissions.

Transboundary sources refer to non-City of Toronto sources including those that originate elsewhere in the GTA (Halton, Mississauga, etc.), Southwestern Ontario and the United States. To address the contribution from transboundary sources to the local airshed, a multi-tier approach was used to segregate the emissions by geographic location. The computational domain is shown on Figure 2. Three emission regions or tiers of modelling domains have been selected, namely:

- United States (Tier I - at 36km x 36 km grid resolution);
- Ontario (Tier II - at 12 km x 12 km grid resolution); and
- Toronto only (Tier III - at 1 km x 1 km grid resolution).

The Tier I emissions are comprised strictly of US emissions which were developed from the US 2002 National Emission Inventory (NEI). These emissions were processed on a 36 km grid resolution (i.e., using a 36 km x 36 km gridded domain) over the entire computational domain with US emissions only (i.e., Canadian emissions were blanked out) to avoid double counting.

The Tier II (Ontario) emissions were built on 12 km grid domain (i.e., using a 12 km x 12 km gridded domain). The emissions include the same source categories as listed for Toronto to ensure consistency. Industrial, major highway and biogenic / agricultural emissions were calculated from available activity data such as traffic counts and vegetation cover. Residential and commercial emissions for urban areas (i.e., London, Hamilton, etc.) were estimated from the Toronto urban profile developed in Tier Ill using either population data or the number of households as factors of equivalence.

The Tier III (Toronto) emissions were built up on a 1 km grid resolution (i.e., using a 1 km x 1 km gridded domain). The emissions from Toronto, as well as Ontario (Tier II) include National Pollutant Release (NPRI) data of industrial emissions sources for 2006, City of Toronto Employment Survey data of commercial activities, Enbridge gas consumption data, and emissions representing the complete road network (except back lanes and alleyways) in Toronto. For those commercial or industrial sources which may release PACs that were not publicly reported to NPRI because the amounts fell below reporting thresholds, emissions estimates were theoretically developed using publicly available data and emissions factors.

Emission sources vary spatially and temporally. To accurately reflect the time-varying changes in emissions, temporal profiles based on Source Classification Codes (SCCs) were used to develop time dependent release rates (SCCs were used to classify different types of anthropogenic emission activities).

An SCC identifies the monthly, weekly and diurnal temporal profiles (i.e., change in the level of activity per time of day, day of week and month of year) such that hourly emissions can be estimated from annual emissions. The annual emissions were converted into hourly emissions using the following three steps:

- allocate the emissions to the monthly profile;
- allocate the emissions to the weekly profile; and
- allocate the emissions to the diurnal profile.

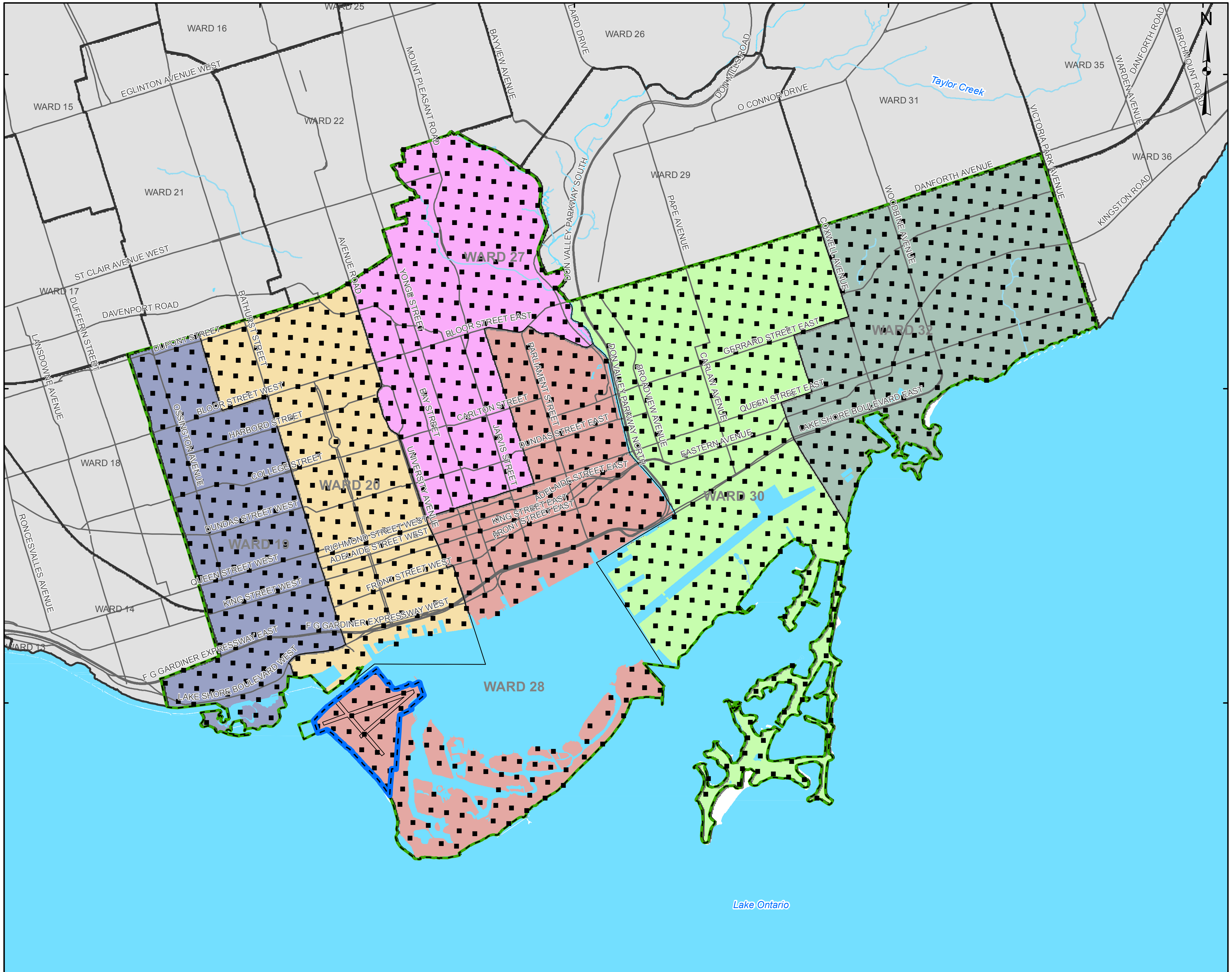
For Industrial, Residential and Mobile source emissions, temporal allocation files were obtained from the U.S. EPA Technology Transfer Network Clearinghouse (EMCH) for Inventories and Emission Factors and applied to the emissions inventory data of Tier II and Tier III.

Further information on the Tier I, II and III emission inventories can be found in the *An All Sources Cumulative Air Quality Impact Study of South Riverdale - Leslieville – Beaches"* (Golder, 2011)

2.3 Ambient Air Quality Criteria and Standards

The Province of Ontario has legislated Ambient Air Quality Criteria (AAQC) as a guide for good air quality for residents of Ontario (Table 3). These limits address the combination of locally generated and as background levels (i.e., cumulative levels). In November 2005, the Ontario Regulation 419/05, Air Pollution - Local Air Quality, was introduced to better protect local communities from the impacts of air pollution. The intent of the new regulation is to promote development of health-based standards. In addition, the AAQCs have been periodically updated to reflect new data on air quality limits.

There are no AAQCs specified for PM_{10} or $PM_{2.5}$. There is, however, a proposed (federal) Canada-Wide Standard (CWS) for $PM_{2.5}$, (30 µg/m^3 over 24 hours) and an Ontario Ministry of the Environment (MOE) interim guideline for PM_{10} (50 µg/m^3 over 24 hours). Ozone also has a CWS based of 65 ppb (130 µg/m^3) over 8-hours which would be the average daylight hours.



LEGEND

- Major Roads
- Watercourse
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

Wards

- Beaches-East York (32)
- Toronto Centre-Rosedale (27)
- Toronto Centre-Rosedale (28)
- Toronto-Danforth (30)
- Trinity-Spadina (19)
- Trinity-Spadina (20)
- Other

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

500 250 0 500 1,000 1,500
SCALE 1:50,000 METRES

PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

TITLE
Receptor Grid for Air Quality

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008	FIGURE: 1	
GIS	JO	5 Nov. 2013		
CHECK	GD	5 Nov. 2013		
REVIEW	TRS	5 Nov. 2013		

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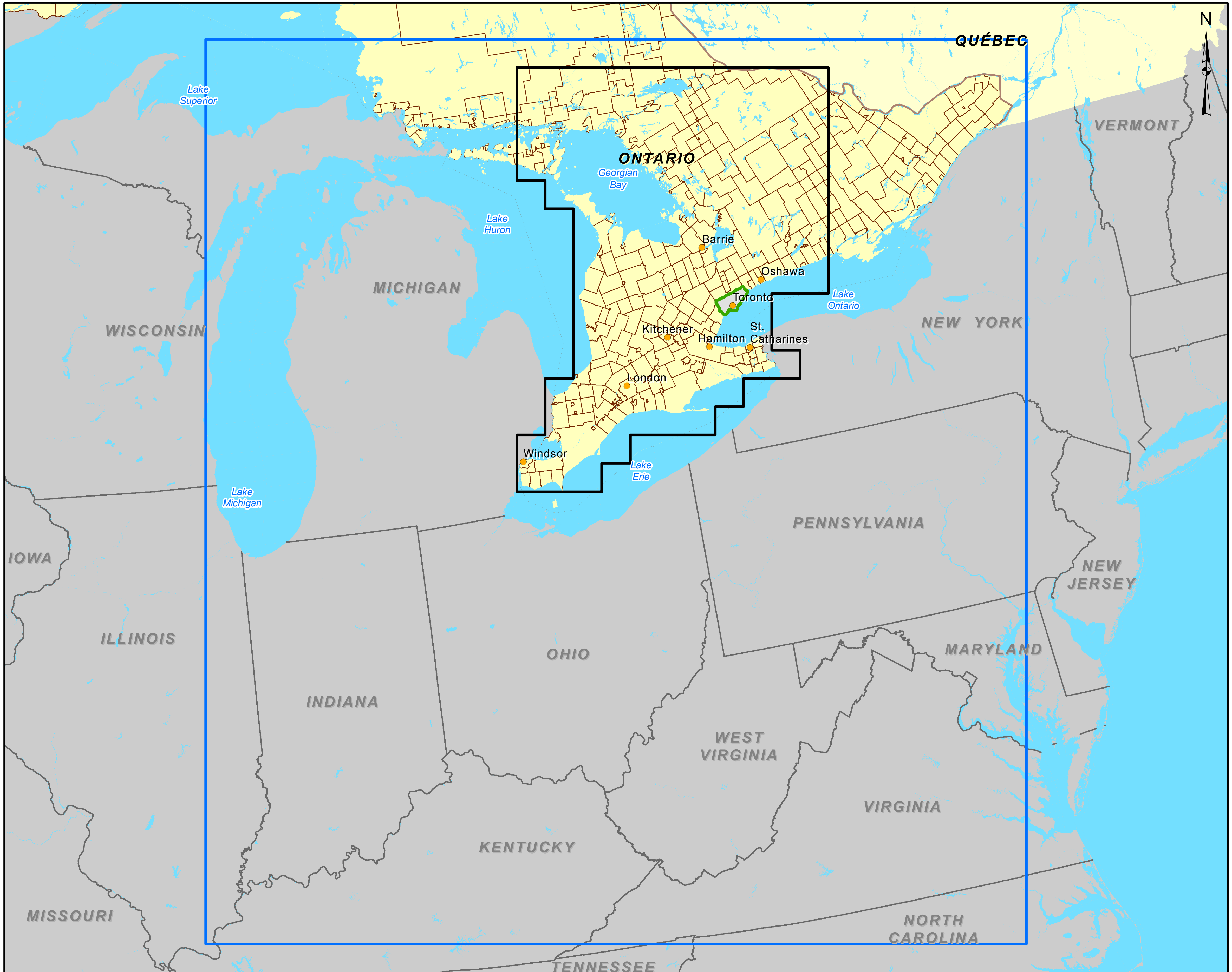

LEGEND

- Tier 1 (36km) Grid Outline
- Tier 2 (12km) Grid Outline
- Tier 3 (2km) Grid Outline

REFERENCE

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

50 25 0 50 100 150
SCALE 1:5,000,000 KILOMETERS

PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

TITLE
Computational Domain for Tier I, Tier II and Tier III

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008	**FIGURE: 2**	
GIS	JO	7 Nov. 2013		
CHECK	KSA	7 Nov. 2013		
REVIEW	AC	7 Nov. 2013		

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Table 3: Applicable Air Quality Criteria

ID	PAC	CAS	Annual AAQC ($\mu g/m^3$)	24-hr AAQC ($\mu g/m^3$)
Aromatics	PAHs (as B[a]Ps)	50-32-8	0.00001	0.00005
Aromatics	Toluene	108-88-3	-	2000
Aromatics	1,4-Dichlorobenzene	106-46-7	-	95
CAC	Carbon Monoxide	630-08-0	-	15700
CAC	Nitrogen Oxides (1)	10102-44-0	-	200
CAC	Ozone (2)	10028-15-6		
CAC	PM_{10} (3)	NA - M10	-	50
CAC	$PM_{2.5}$ (4)	NA - M09	-	30
CAC	Sulphur Dioxide	7446-09-5	55	275
CAC	VOCs	NA - M16	-	N/A
Ethane Halogens	1,2-Dichloroethane	107-06-2	0.4	2
Ethane Halogens	Ethylene dibromide	106-93-4	-	3
Ethane Halogens	Tetrachloroethylene	127-18-4	-	360
Ethane Halogens	Trichloroethylene	79-01-6	2.3	12
Ethane Halogens	Vinyl Chloride	75-01-4	0.2	1
Metals	Cadmium	7440-43-9	0.005	0.025
Metals	Chromium	7440-47-3	-	0.5
Metals	Mercury	7439-97-6	-	2
Metals	Manganese	7439-96-5	-	0.4
Metals	Nickel compounds	7440-02-0	0.04	0.2
Metals	Lead	7439-92-1	0.2	0.5
Methane Halogens	Carbon tetrachloride	56-23-5	-	2.4
Methane Halogens	Chloroform	67-66-3	0.2	1
Methane Halogens	Chloromethane	74-87-3	-	320
Methane Halogens	Dichloromethane	75-09-2	44	220
Mobile Toxics	Acetaldehyde	75-07-0	-	500
Mobile Toxics	Acrolein	107-02-8	-	0.4
Mobile Toxics	Benzene	71-43-2	0.45	2.3
Mobile Toxics	1,3-Butadiene	106-99-0	2	10
Mobile Toxics	Formaldehyde	50-00-0	-	65

Note: [1] Reported as NO_2.
[2] Canada Wide Standard of 65 ppb (130 $\mu g/m^3$) over 8-hours
[3] Interim Ontario Standard
[4] Canada Wide Standard

3.0 BACKGROUND AIR QUALITY

Background air quality is determined with the aid of the existing Toronto Airshed Model (Golder, 2011). The model results include sources from the US, southwestern Ontario as well as local Toronto sources such as transportation, industry, residential and biogenic. The original comprehensive report included a contribution from operations at the BBTCA based on 2007 operations. For the current study, the contribution of BBTCA was removed from the emission inventory and the modelling for Wards 19, 20, 28, 28, 30 and 32 was carried out with the aid of the CALPUFF modelling system.

3.1 Emissions

As described above, background air quality in the six wards includes contributions from local and transboundary sources, respectively. Transboundary sources refer to activities outside of Toronto (e.g., US and southwestern Ontario) while local sources refer to activities within Toronto (Tier III). The transboundary emissions for the 30 PACs were not remodelled as they remained fixed. The US emission sources (Tier I) are based on the US 2002 national emission inventory while the Ontario emissions are based on 2006/2007 available data. A summary of transboundary and local annualized emissions are presented in Table 4.

As mentioned earlier, these emissions were allowed to vary according to time of day, day of week and month of year as well as per grid cell.

3.2 Background Concentrations

The off-airport modelling results without the BBTCA present are presented in Table 5. Further detailed concentrations per Ward are found in APPENDIX D. On an annual average, the PAHs and benzene were found to be above the MOE criteria with the remaining PACs below the regulator limit. The 95th percentile of 24-hr averages is presented and compared to the MOE criteria. Similar to the annual results, PAH and Benzene are above their respective criteria as well as NO_x (as NO_2) and PM_{10}.

Annual and 24-hr concentration isopleths of NO_x, PM_{10}, $PM_{2.5}$, cadmium and chromium are found in APPENDIX E for an area of about 2 km from the BBTCA. As the contours show, the highest concentrations are found around the major roadways.

Table 4: Summary of 2006 TIERS I, II & III Emissions by Category (Tonnes/yr)

PAC	TIER I Emission Rates (Tonne/yr)	TIER II Emission Rates (Tonne/yr)	TIER III Emission Rates (Tonne/yr)	Total Emission Rates (Tonne/yr)
PAHs (as B[a]Ps)	2,026	10	2.6	2,039
Toluene	364,190	8,345	3,429	375,964
1,4-Dichlorobenzene	1,147	123	123	1,393
Carbon Monoxide	19,840,437	837,860	194,197	20,872,494
Nitrogen Oxides	4,480,321	412,834	54,902	4,948,057
PM_{10}	1,844,860	66,964	10,542	1,922,366
$PM_{2.5}$	804,313	24,633	3,162	832,108
Sulphur Dioxide	5,313,322	412,324	1,063	5,726,709
VOCs	3,278,038	411,545	24,499	3,714,082
1,2-Dichloroethane	37	0.52	0.016	38
Ethylene dibromide	5.6	—	—	6
Tetrachloroethylene	7,369	328	318	8,015
Trichloroethylene	2,825	379	2.1	3,206
Vinyl Chloride	230	5.1	—	235
Cadmium	18	3.6	0.088	22
Chromium	256	7.5	0.51	264
Mercury	32	0.68	0.022	33
Manganese	1,112	32	0.26	1,144
Nickel compounds	258	123	0.19	381
Lead	442	37	0.37	479
Carbon tetrachloride	44	0.001	0.000001	44
Chloroform	1,406	3.5	3.5	1,413
Chloromethane	51	199	0	250
Dichloromethane	9,431	186	178	9,795
Acetaldehyde	32,601	5,59	96	32,697
Acrolein	1,321	96	12	1,429
Benzene	73,211	2,239	493	75,943
1,3-Butadiene	6,069	300	57	6,426
Formaldehyde	58,794	1,556	244	60,594
Total	**36,124,165**	**2,180,694**	**293,322**	38,597,623

Note: NO_x emissions represented as NO_2 equivalent.
$PM_{2.5}$ emissions are included in PM_{10} emissions since they are a fine fraction (i.e., less than 2.5 µm)
Tier I emissions are based on 2002 US NPI inventory.
Tier III emissions exclude emissions from BBTCA

Table 5: Annual and 24-hr Background Concentrations

	Annual		24-hr	
Contaminant	**AAQC** ($\mu g/m^3$)	**Maximum** ($\mu g/m^3$)	**AAQC** ($\mu g/m^3$)	**95th %ile** ($\mu g/m^3$)
PAHs (as B[a]Ps)	0.00001	0.009	0.00005	0.022
Toluene	-	6.4	2000	15.61
1,4-Dichlorobenzene	-	0.28	95	0.72
Carbon Monoxide	-	389.6	15700	881.9
Nitrogen Oxides (1)	-	76.6	200	212.6
Ozone (4)	-	82.55	-	-
PM_{10} (3)	-	26.1	50	54.9
$PM_{2.5}$ (2)	-	9.7	30	20.5
Sulphur Dioxide	55	24.5	275	67.1
VOCs	-	49.4	N/A	278.8
1,2-Dichloroethane	0.4	0.00033	2	0.00094
Ethylene dibromide	-	0.00002	3	0.00006
Tetrachloroethylene	-	0.59	360	1.80
Trichloroethylene	2.3	0.08	12	0.22
Vinyl Chloride	0.2	0.0009	1	0.003
Cadmium	0.005	0.00	0.025	0.001
Chromium	-	0.002	0.5	0.004
Mercury	-	0.0002	2	0.0005
Manganese	-	0.004	0.4	0.013
Nickel compounds	0.04	0.002	0.2	0.004
Lead	0.2	0.002	0.5	0.005
Carbon tetrachloride	-	0.0001	2.4	0.0004
Chloroform	0.2	0.01	1	0.026
Chloromethane	-	0.002	320	0.007
Dichloromethane	44	0.35	220	0.87
Acetaldehyde	-	0.33	500	0.80
Acrolein	-	0.04	0.4	0.09
Benzene	0.45	1.09	2.3	3.06
1,3-Butadiene	2	0.12	10	0.29
Formaldehyde	-	0.73	65	1.70

Note: 1 Reported as NO_2.
2 Canada Wide Standard
3 Interim Ontario Standard
4 Canada Wide Standard of 65 ppb (130 $\mu g/m^3$) over 8-hours

4.0 EXISTING OPERATIONS

The City of Toronto, Toronto Port Authority (TPA) and federal Ministry of Transportation entered into a "Tripartite Agreement" for the lease of the airport lands in 1983 for a 50 year term. In 2010, the TPA carried out a capacity study (Billy Bishop Toronto City Airport Capacity Report, February 2010) to determine the daily number of commercial aircraft movement that could be accommodated at BBTCA which would allow the facility to meet the noise limits set out in the agreement. The results determined that 202 daily slots for scheduled commercial aircraft arrivals and departures could be accommodated.

The number of scheduled commercial flights varies by the day of the week and holidays. Typically, weekday demand is about 97% of capacity while on Sundays and holidays this is reduced to about 70% and further reduced to about 50% on Saturdays (AirBiz, 2013). This amounts to about 62,500 flights per year or about 3.8 million passengers per year (Table 6) travelling through the airport. The maximum number of flights per year, based on a 202 slot cap, would be 73,730 flights per year. For comparison, in 2012, the annual total was about 1.9 million passengers, roughly half of the estimated maximum capacity.

As there is variability in the number of aircraft per day, there is also variability in hourly aircraft movements. Figure 3 presents the weekday running hourly departures/arrivals and total movements based on the 2013 schedule for BBTCA. As shown on Figure 3, there are a number of peaks in the hourly movements occurring during the day and there are no scheduled commercial aircraft movements between 23:00 and 06:45 (nighttime).

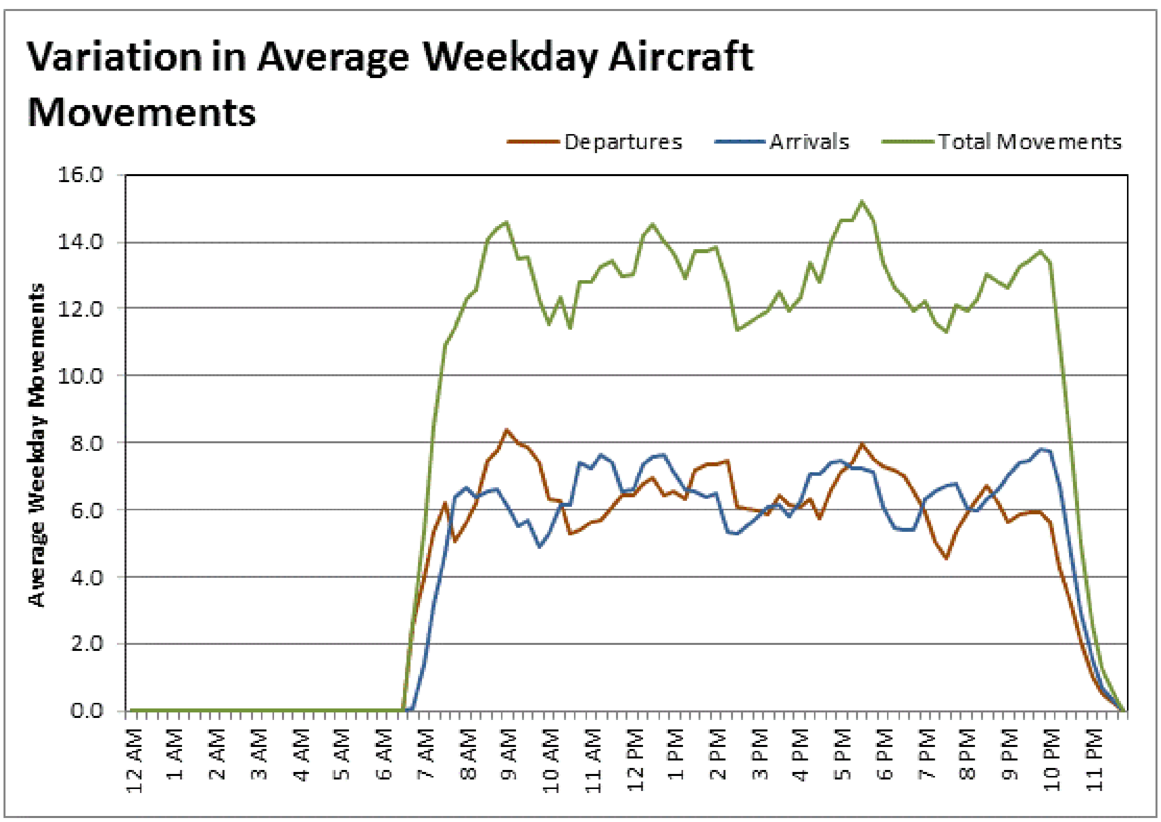

Figure 3: Variation in Average Weekday Aircraft movements

As shown on Figure 3, the peak number of Q400 flights per hour is about 16 flights per hour based on a 10 aircraft gate layout which would generate between 870 to 930 passengers per hour with an 85% aircraft capacity. In addition it is assumed that 25% of passengers (1 million/yr) transfer to another flight while the remaining 75% (2.8 million/yr) move from the island to the mainland. On a peak hour, the number of passengers accessing the mainland would be 650 to 700 passengers/hr and a similar amount moving from the mainland to the island via the ferry. Once at the mainland, passengers would have various options for travel to their final destinations include automobile, transit or airport shuttle as presented in Table 7. A similar distribution is assumed for arriving passengers.

Another activity is the transport of fuel and storage of aviation fuel for BBTCA. Currently, the fuel is stored in five above ground storage tanks with a total capacity of 225,000 litres. Fuel is transported to the tanks four times a day via double tanker transport trucks on the ferry.

The BBTCA consists of the number of buildings and structures as well as runways. Figure 4 presents the existing facilities at the airport. The BBTCA currently accommodates one type of commercial aircraft namely the Bombardier Q400 (or similar) which can carry about 70 passengers per flight.

The above information is used to set up the emission model for EDMS. EDMS provides emission rates for criteria air compounds and speciated VOCs. Emission rates for metallic compounds are not provided as an output of the EDMS model and were therefore calculated as a fraction of $PM_{2.5}$ emissions. Metal speciation data for jet fuel combustion was taken from the California Environmental Protection Agency Air Resources Board Database (December, 2012). Metal speciation data for diesel combustion was taken from 'Measurement of Emissions from Air Pollution Sources 2. C1 through C30 Organic Compounds from Medium Duty Diesel Trucks.' (Schauer et al, 1999).

4.1 Emission Inventory – Existing Operations

Emissions from aircraft and ancillary activity were developed with the aid of the FAA EDMS modelling system for the maximum activities mentioned above. The emissions and basic parameters are described in the following sections.

4.1.1 Aircraft Activities

Under the existing operations, a maximum of 202 movements per day with only the Q400 were assumed to occur 365 days of the year. No reduction for weekend or holiday schedule was assumed which is a conservative assumption. However, the hourly emissions were adjusted to reflect the hourly schedule for departures and arrivals as shown on Figure 3. The following aircraft activities were modelled to represent emissions from the airport:

- Taxiing to/from the runway (including queuing time);
- Runway travel; and
- Take-off/Landing at Billy Bishop.

Aircraft emissions for each of the above activities were calculated by EDMS using Q400 emission data (APPENDIX A) with travel times and surface routes provided by the carriers. The airport has 10 gates and two runways which are used by commercial aircraft, namely Runway 08 and Runway 26. The two runways have glide slopes of 4.8% and 6.3% respectively. Based on available data for the airport, approximately 29.1% of commercial aircraft depart from Runway 08 and 70.9% from Runway 26. Comparatively, 29.07% of commercial aircraft arrive on Runway 08 and 70.93% arrive on Runway 26.

The annual maximum emissions data for each activity and compound is present in Table 8. Taxiing generates the greatest emissions of all the activities. Carbon monoxide is the largest quantity emitted, followed by nitrogen oxides which are both products of combustion.

Table 6: Estimated Maximum Existing Annual Distribution of Flights and Passengers at BBTCA

w/o Jets	Days	Max per Day	Max Flights/ year	Utiliz-ation	Avg Flight/ day	Q400	CS100	Total Flights/ year	% Q400	% CS100	Cap/ Flt Q400	Cap/Flt CS100	Q400 Passengers	CS100 Passengers	Total
Weekdays	236	202	47,672	97%	196	46,242	-	46,242	100%	-	85%	-	2,751,389	-	2,751,389
Holidays	25	202	5,050	71%	143	3,586	-	3,586	100%	-	85%	-	213,337	-	213,337
Sat	52	202	10,504	48%	97	5,042	-	5,042	100%	-	85%	-	299,994	-	299,994
Sun	52	202	10,504	73%	147	7,668	-	7,668	100%	-	85%	-	456,241	-	456,241
Sum/Avg	365	202	73,730	85%	171	62,537	-	62,537	100%	-	85%	-	3,720,962	-	3,720,962

Table 7: Transportation Mode Split at BBTCA – Existing Operations

	Percentage
Drive Themselves	5%
Take a Taxi	46%
3rd Party Drop off/Pick up	14%
Transit	10%
Airport Shuttle	25%
Total	100%

LEGEND

- Gates
- Deicing
- Fuel Farm
- Road
- Ferry
- Taxi Route
- Car Park

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

100 50 0 100 200 300
SCALE 1:6,000 METRES

PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

TITLE
Current Airport Layout

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008	FIGURE: 4	
GIS	JO	5 Nov. 2013		
CHECK	GD	5 Nov. 2013		
REVIEW	TRS	5 Nov. 2013		

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\1311510215HIA005.mxd

Table 8: Annual Emissions from Q400 Aircraft Activities – Existing Operations

Contaminant	Maximum Annual Emission Rate [Tonne/year]				
	Taxi Out	Takeoff	Climb Out	Approach	Taxi In
PAHs (as B[a]Ps)	—	—	—	—	—
Toluene	0.0228	0.0076	0.0083	0.0003	0.0194
1,4-Dichlorobenzene	—	—	—	—	—
Carbon Monoxide	36.35	12.05	13.24	0.4	30.93
Nitrogen Oxides	9.74	3.07	3.32	0.1	8.27
PM_{10}	0.136	0.05	0.05	0	0.114
$PM_{2.5}$	0.136	0.05	0.05	0	0.114
Sulphur Dioxide	2.22	0.71	0.77	0.02	1.88
VOCs	3.54	1.18	1.29	0.04	3.02
1,2-Dichloroethane	—	—	—	—	—
Ethylene dibromide	—	—	—	—	—
Tetrachloroethylene	—	—	—	—	—
Trichloroethylene	—	—	—	—	—
Vinyl Chloride	—	—	—	—	—
Cadmium	6.80E-05	2.50E-05	2.50E-05	0.00E+00	5.70E-05
Chromium	7.48E-04	2.75E-04	2.75E-04	0.00E+00	6.27E-04
Mercury	—	—	—	—	—
Manganese	—	—	—	—	—
Nickel	6.80E-05	2.50E-05	2.50E-05	0.00E+00	5.70E-05
Lead	7.48E-04	2.75E-04	2.75E-04	0.00E+00	6.27E-04
Carbon tetrachloride	—	—	—	—	—
Chloroform	—	—	—	—	—
Chloromethane	—	—	—	—	—
Dichloromethane	—	—	—	—	—
Acetaldehyde	0.152	0.05	0.055	0.002	0.129
Acrolein	0.087	0.029	0.032	0.001	0.074
Benzene	0.06	0.02	0.022	0.001	0.051
1,3-Butadiene	0.06	0.02	0.022	0.001	0.051
Formaldehyde	0.439	0.146	0.16	0.005	0.373

Note: — means unavailable or unknown
Based on 202 flights per day using Q400 aircraft
NO_x emissions represented as NO_2 equivalent.
$PM_{2.5}$ emissions are included in PM_{10} emissions since they are a fine fraction (i.e., less than 2.5 µm)

The maximum hourly emission rate from these activities is presented in APPENDIX B. Hourly variability in aircraft movements was applied to the emission rates using the current average daily arrival and departure aircraft movement schedule described above.

Each of the aforementioned aircraft activities was modelled as a series of area sources. The source parameters used in the model were calculated by the EDMS model and are tabulated in Table 9, below.

Table 9: Modelling Source parameters for Aircraft Movements – Existing Operations

Aircraft Movement Type	Source Type	Width [m]	Length [m]	Height above Ground [m]	Initial Vertical dispersion [m]
Taxiways	64 Area Sources covering the taxi routes between each gate and each runway	36	Various, depending on runway vertices	12	4.1
Runways	50 area sources covering arrival and departure from each runway	20	48.62	12	4.1
Take-off and Landings	391 Area sources covering the climb after take-off or descent before landing	20	200	Various ranging from 22 to 619.2m	4.1

4.1.2 On-Site Ground Support Equipment

The airport uses various ground support equipment to support aircraft operations. Information regarding the quantity, fuel and operating times of this equipment were provided by the carriers and Toronto Port Authority. A list of the equipment Ground Support Equipment (GSE) included in the modelling is provided in APPENDIX C. Annual emissions from the operation of the on-site equipment are presented on Table 10.

The GSE were modelled as volume sources located at each of the gates. For the purpose of this assessment, it was assumed that the equipment could be used at any of the 10 gates. The parameters for the equipment are presented in Table 11.

Table 10: Annual Emissions from On-site Ground Support Equipment – Existing Operations

Contaminant	Maximum Annual Emission Rate [Tonne/year]
	Ground Support Equipment
PAHs (as B[a]Ps)	7.80E-07
Toluene	0.014
1,4-Dichlorobenzene	—
Carbon Monoxide	11.95
Nitrogen Oxides	13.17

Contaminant	Maximum Annual Emission Rate [Tonne/year]
	Ground Support Equipment
PM_{10}	0.948
$PM_{2.5}$	0.919
Sulphur Dioxide	0.075
VOCs	1.452
1,2-Dichloroethane	—
Ethylene dibromide	—
Tetrachloroethylene	—
Trichloroethylene	—
Vinyl Chloride	—
Cadmium	5.51E-04
Chromium	9.19E-05
Mercury	—
Manganese	9.19E-05
Nickel	—
Lead	9.19E-05
Carbon tetrachloride	—
Chloroform	—
Chloromethane	—
Dichloromethane	—
Acetaldehyde	0.031
Acrolein	—
Benzene	0.008
1,3-Butadiene	—
Formaldehyde	0.091

Note: — means unavailable or unknown
Based on 202 flights per day using Q400 aircraft
NO_x emissions represented as NO_2 equivalent.
$PM_{2.5}$ emissions are included in PM_{10} emissions since they are a fine fraction (i.e., less than 2.5 µm)

Table 11: Modelling Parameters for the Ground Support Equipment – Existing Operations

Source	Source Type	Height [m]	Initial lateral dispersion [m]	Initial Vertical dispersion [m]
GSE	10 volume sources covering each gate	1.5	16	3.0

4.1.3 Stationary Sources

The BBTCA includes a number of stationary emission sources including heating/cooling equipment, stand-by generators and fuel tanks (APPENDIX C). BBTCA has over 25 natural gas boilers or heaters on site which operate over the year representing over 3MW of equivalent power production. The tank farm has a total capacity of 225,000 L over five tanks and an annual throughput of 42,753,000 L of fuel. The jet fuel (JetA) specifications are presented in APPENDIX C. Additionally aircraft engine testing and de-icing were also taken into consideration. Emission profiles were applied to the de-icing activities to represent them only occurring in winter months (December to February). All other stationary sources were assumed to be operational during airport operational hours. Annual emissions from this equipment are listed in Table 12. The gas-fired combustion equipment is the dominant source in this grouping.

The Stationary sources were modelled as volume sources at their respective locations as presented in Table 13.

4.1.4 Transportation

Transportation to/from the airport was also included in the model. Sources included were the ferry, transporting passengers from the mainland to the island airport, the roads between the intersection of Bathurst and Queens Quay to the airport and the airport car parks. Although a passenger tunnel to the airport is currently under construction, the ferry schedule is expected to remain unchanged following its completion. The ferry will still be needed to transport vehicles and fuel to the airport.

Traffic data was based on the annual number of passengers and the current modal split of transportation taken from the traffic report. Of the 3.8 million passengers, it is reported that 25% take connecting flights. The remaining 2.9 million passenger movements were calculated using the current modal split of transportation (Table 14). It was assumed that for passengers arriving by car, there are approximately two passengers per vehicle. The number of shuttle buses and ferries was assumed to be constant at 76 per day. Vehicle idling from Taxi queuing and car park activities were also taken into consideration. Parked cars were prorated between the four car parks by the number of spaces available. Annual maximum emissions from this equipment are listed in Table 15. As shown, the ferry, which is powered by two 385 HP diesel engines (APPENDIX C) is the dominant transportation source. Each of the roads, car parks and the ferry path were modelled as a series of area sources as presented in Table 16.

Table 12: Annual Emissions from Stationary Sources – Existing Operations

Contaminant	Maximum Annual Emission Rate [Tonne/year]			
	Fuel Tanks	De-icing Activities	Engine Testing	Other
PAHs (as B[a]Ps)	—	—	—	6.16E-06
Toluene	0.046	—	—	0.06
1,4-Dichlorobenzene	—	—	—	—
Carbon Monoxide	—	—	0.012	4.46
Nitrogen Oxides	—	—	0.009	5.856
PM_{10}	—	—	—	0.428
$PM_{2.5}$	—	—	—	0.428
Sulphur Dioxide	—	—	0.009	0.065
VOCs	0.318	0.004	0.006	0.636
1,2-Dichloroethane	—	—	—	—
Ethylene dibromide	—	—	—	—
Tetrachloroethylene	—	—	—	—
Trichloroethylene	—	—	—	—
Vinyl Chloride	—	—	—	—
Cadmium	—	—	—	—
Chromium	—	—	—	—
Mercury	—	—	—	—
Manganese	—	—	—	—
Nickel	—	—	—	—
Lead	—	—	—	—
Carbon tetrachloride	—	—	—	—
Chloroform	—	—	—	—
Chloromethane	—	—	—	—
Dichloromethane	—	—	—	—
Acetaldehyde	—	—	—	—
Acrolein	—	—	—	—
Benzene	0.01	—	—	0.038
1,3-Butadiene	5.39E-05	—	1.02E-06	2.99E-04
Formaldehyde	—	—	—	0.053

Note: — means unavailable or unknown
Based on 202 flights per day using Q400 aircraft
NO_x emissions represented as NO_2 equivalent.
$PM_{2.5}$ emissions are included in PM_{10} emissions since they are a fine fraction (i.e., less than 2.5 µm)

Table 13: Modelling Source Parameters for Stationary Sources –Existing Operations

Source	Source Type	Height [m]	Initial lateral dispersion [m]	Initial Vertical dispersion [m]
Fuel Tanks	Each tank is modelled as a volume source	2.49	2.23	1.16
De-icing	Volume Source	4.2	6.6	1.95
Engine Testing	Volume source	4.2	6.6	1.95
Other	Volume source	7.5	16.28	3.49

Table 14: Estimated Vehicle Count Data – Existing Operations

Mode of Transport	Number of Passengers	Number of vehicles (one-way)
Drive and Park	142,500	71,250
Taxi	1,311,000	655,500
Drop off	399,000	199,500
Bus	712,500	27,740
Walk/Transit	285,000	0
TOTAL	2,850,000	953,990

Table 15: Annual Emission Data for Transportation – Existing Operations

Contaminant	Maximum Annual Emission Rate [Tonne/year]		
	Roads	Car Parks	Ferry
PAHs (as B[a]Ps)	1.53E-07	1.13E-08	2.83E-06
Toluene	3.33E-04	2.45E-05	6.16E-03
1,4-Dichlorobenzene	—	—	—
Carbon Monoxide	3.85	0.203	14.26
Nitrogen Oxides	0.336	0.014	66.2
PM_{10}	0.008	—	4.7
$PM_{2.5}$	0.005	—	4.7
Sulphur Dioxide	0.003	—	4.38
VOCs	0.285	0.021	5.27
1,2-Dichloroethane	—	—	—
Ethylene dibromide	—	—	—
Tetrachloroethylene	—	—	—
Trichloroethylene	—	—	—
Vinyl Chloride	—	—	—
Cadmium	3.00E-06	—	2.82E-03
Chromium	5.00E-07	—	4.70E-04
Mercury	—	—	—
Manganese	5.00E-07	—	4.70E-04
Nickel	—	—	—
Lead	5.00E-07	—	4.70E-04
Carbon tetrachloride	—	—	—
Chloroform	—	—	—
Chloromethane	—	—	—
Dichloromethane	—	—	—
Acetaldehyde	0.003	—	0.056
Acrolein	—	—	—
Benzene	0.01	9.55E-04	0.185
1,3-Butadiene	0.001	—	0.019
Formaldehyde	0.004	—	0.074

Note: — means unavailable or unknown
Based on 202 flights per day using Q400 aircraft
NOx emissions represented as NO_2 equivalent.
$PM_{2.5}$ emissions are included in PM_{10} emissions since they are a fine fraction (i.e., less than 2.5 µm)

Table 16: Modelling Source Parameters for Transportation Sources – Existing Operations

Transportation Mode	Source Type	Width [m]	Length [m]	Height above Ground [m]	Initial Vertical dispersion [m]
Roads	161 area sources covering Eireann Quay, the pick-up/drop off loops, taxi loop and the ferry entrance	13.4	Various depending on road vertices	0	3
Car Parks	4 area sources representing the two mainland and two island car parks	Various depending on car park dimensions	Various depending on car park dimensions	0	3
Ferry	1 area source covering the ferry path	12.5	182	5	4.67

4.2 Summary of Emissions

A summary of existing emissions are provided in Table 17. As illustrated, the Q400 aircraft and transportation sources represent 49% and 38% of the total emissions related to airport activities. The transportation emissions are dominated by the diesel fired ferry which represents over 60% of the NO_x emissions and over 75% of the PM emissions as well as 75% of the PAH emissions. The Q400 aircraft represents the largest source of CO, toluene, metals and aldehydes as well as virtually all the acrolein.

Table 17: Summary of Existing Emissions

Contaminant	Aircraft Q400	Transportation	Stationary	Ground	Total
	Tonne/year				
PAHs (as B[a]Ps)	—	3.00E-06	6.2E-06	8E-07	9.9E-06
Toluene	0.058	0.0065	0.11	0.01	0.18
1,4-Dichlorobenzene	—	—	—	—	—
Carbon Monoxide	93	18.3	4.5	12	127.7
Nitrogen Oxides	24.5	66.6	5.9	13.2	110.1
PM_{10}	0.35	4.7	0.4	0.9	6.4
$PM_{2.5}$	0.4	4.7	0.4	0.9	6.4
Sulphur Dioxide	5.6	4.4	0.1	0.1	10.1
VOCs	9.1	5.6	1	1.5	17.1
1,2-Dichloroethane	—	—	—	—	—
Ethylene dibromide	—	—	—	—	—
Tetrachloroethylene	—	—	—	—	—
Trichloroethylene	—	—	—	—	—
Vinyl Chloride	—	—	—	—	—
Cadmium	0.0002	0.0028	—	0.0006	0.0036
Chromium	0.0019	0.0005	—	0.0001	0.0025
Mercury	—	—	—	—	—
Manganese	—	0.0005	—	0.00009	0.0006
Nickel	0.000175	—	—	—	0.000175
Lead	0.0019	0.0005	—	0.0001	0.002471
Carbon tetrachloride	—	—	—	—	—
Chloroform	—	—	—	—	—
Chloromethane	—	—	—	—	—
Dichloromethane	—	—	—	—	—
Acetaldehyde	0.39	0.06	—	0.03	0.48
Acrolein	0.223	—	—	—	0.223
Benzene	0.15	0.2	0.05	0.01	0.41
1,3-Butadiene	0.15	0.02	—	—	0.17
Formaldehyde	1.12	0.08	0.05	0.09	1.35

Note: — means unavailable or unknown
Based on 202 flights per day using Q400 aircraft
NOx emissions represented as NO_2 equivalent.
$PM_{2.5}$ emissions are included in PM_{10} emissions since they are a fine fraction (i.e., less than 2.5 µm)

4.3 Concentrations

The maximum off-property annual and 95th %ile concentrations under the existing operations scenario are presented in Table 18 and Table 19, respectively. The PAC concentrations per Ward are in APPENDIX D. On an annual basis, the background levels represent about 90% of the concentrations while the Q400 aircraft and transportation contribute about 6% and 4%, respectively. Transportation sources contribute significantly to NO_2 and PM levels while the aircraft have a substantial contribution to NO_2, some metals and the aldyhes as well as arcolein. There is no change in PAH or benzene levels on an annual basis.

On a 24-hr basis, the contribution of BBTCA to levels is presented in Table 19 which shows about a 15% increase over background levels with specific contributions to NO_2, PM and acrolein as well as some metals. As with the background only, PAH, NO_2, PM_{10} and benzene 24-hr standards are exceeded at the 95th %-ile.

Annual and 24-hr concentration isopleths of NO_x, PM_{10}, $PM_{2.5}$, cadmium and chromium are found in APPENDIX E for an area of about 2 km from the BBTCA. As the contours show, the highest concentrations are found around the major roadways as well as a hot-spot on the airport property.

Table 18: Annual Maximum Concentration and Contribution - Existing Operations

Contaminant	AAQC	Maximum	Background	Aircraft	Transportation	GSE & Stationary Sources
	(µg/m³)					
PAHs (as B[a]Ps)	0.00001	0.009	0.009	—	0.0000001	0.0000002
Toluene	-	6.75	6.75	0.0002	0.00002	0.001
1,4-Dichlorobenzene	-	0.294	0.294	—	—	—
Carbon Monoxide	-	394.30	384.33	6.97	1.71	1.29
Nitrogen Oxides (1)	-	106.05	66.16	4.76	31.97	3.16
Ozone (4)	-	78.90	N/A	N/A	N/A	N/A
PM_{10} (3)	-	26.21	26.06	0.02	0.10	0.03
$PM_{2.5}$ (2)	-	10.00	7.52	0.07	2.19	0.23
Sulphur Dioxide	55	28.26	28.08	0.13	0.05	0.002
VOCs	-	136.06	136.04	0.02	0.007	0.003
1,2-Dichloroethane	0.4	0.0003	0.0003	—	—	—
Ethylene dibromide	-	0.00002	0.00002	—	—	—
Tetrachloroethylene	-	0.77	0.770	—	—	—
Trichloroethylene	2.3	0.076	0.076	—	—	—
Vinyl Chloride	0.2	0.0009	0.0009	—	—	—
Cadmium	0.005	0.0005	0.0002	0.00004	0.00025	0.00003
Chromium	-	0.0023	0.0012	0.0006	0.0002	0.0003
Mercury	-	0.0002	0.0002	—	—	—
Manganese	-	0.0038	0.0036	—	0.0002	0.0000003
Nickel compounds	0.04	0.0021	0.0021	—	—	—
Lead	0.2	0.0025	0.0019	0.0004	0.0002	0.000002
Carbon tetrachloride	-	0.0001	0.0001	—	—	—
Chloroform	0.2	0.012	0.012	—	—	—
Chloromethane	-	0.0015	0.0015	—	—	—
Dichloromethane	44	0.37	0.37	—	—	—
Acetaldehyde	-	0.40	0.30	0.09	0.001	0.008
Acrolein	-	0.078	0.029	0.050	0.0001	—
Benzene	0.45	1.47	1.47	0.0007	0.00008	0.0013
1,3-Butadiene	2	0.14	0.12	0.016	0.0002	0.0002
Formaldehyde	-	0.79	0.72	0.061	0.001	0.01
Average Contribution			89.6%	5.6%	3.8%	1.0%

Note: [1] Reported as NO_2.
[2] Canada Wide Standard
[3] Interim Ontario Standard
[4] Canada Wide Standard of 65 ppb (130 µg/m³) over 8-hours
[5] Concentrations are representative of off-airport locations

Table 19: Daily 95th %-ile Concentrations - Existing Operations

Contaminant	AAQC	Maximum	Background	% Change
	(µg/m³)			
PAHs (as B[a]Ps)	0.00005	0.022	0.022	0%
Toluene	2000	15.6	15.6	0%
1,4-Dichlorobenzene	95	0.72	0.72	0%
Carbon Monoxide	15700	885.2	881.9	0%
Nitrogen Oxides (1)	200	343.9	212.6	62%
PM_{10} (3)	50	55.2	54.9	1%
$PM_{2.5}$ (2)	30	24.4	20.5	19%
Sulphur Dioxide	275	70.9	67.1	6%
VOCs	N/A	278.8	278.8	0%
1,2-Dichloroethane	2	0.00094	0.00094	0%
Ethylene dibromide	3	0.00006	0.00006	0%
Tetrachloroethylene	360	1.80	1.80	0%
Trichloroethylene	12	0.22	0.22	0%
Vinyl Chloride	1	0.003	0.003	0%
Cadmium	0.025	0.002	0.001	93%
Chromium	0.5	0.005	0.004	34%
Mercury	2	0.0005	0.0005	0%
Manganese	0.4	0.013	0.013	0%
Nickel compounds	0.2	0.004	0.004	0%
Lead	0.5	0.005	0.005	2%
Carbon tetrachloride	2.4	0.0004	0.0004	0%
Chloroform	1	0.026	0.026	0%
Chloromethane	320	0.007	0.007	0%
Dichloromethane	220	0.87	0.87	0%
Acetaldehyde	500	0.91	0.80	14%
Acrolein	0.4	0.21	0.09	141%
Benzene	2.3	3.06	3.06	0%
1,3-Butadiene	10	0.30	0.29	7%
Formaldehyde	65	1.80	1.70	6%
Average Change (%)				15%

Note: [1] Reported as NO_2.
[2] Canada Wide Standard
[3] Interim Ontario Standard
[4] Canada Wide Standard of 65 ppb (130 µg/m³) over 8-hours
[5] Concentrations are representative of off-airport locations

5.0 PROPOSED FUTURE SCENARIO

The BBTCA is considering expanding the airport to accommodate the jet aircraft which are similar to the Bombardier CS100 which is still under development. The introduction of jet aircraft will require a number of infrastructure changes include the lengthening of Runway 08-26 by 200 m (Figure 5) in both directions (i.e., 400 m total). The introduction of jet aircraft will require a change to the tripartite agreement.

The CS100 and similar jets are larger and can carry a large payload as well as passengers. This will require the extension of the runways from 1,215.5 m to 1,737.5 m. It is assumed that the runways can be extended to accommodate this requirement. It has also been identified that only four of the 10 gates at BBTCA can accommodate jets due to their increased size compared to the Q400s. No other changes to the buildings and structures have been identified including the number of above ground fuel storage tanks. It is expected that the number of above ground fuel tanks does not change but there may be a change in the number of deliveries. In addition, it is assumed that the jets can use the same aviation fuel as the Q400s.

In addition, the number of slots would remain fixed at 202 flights per day but approximately 25% of all slots would be utilised by jets and the remaining 75% would be Q400. Further, the number of passengers per jet aircraft would be about 100 passengers while the Q400 would remain at 70 passengers. It is expected that the utilization will change as shown in Table 20 with an overall increase of 90% from 85%. The change is primarily attributed to an increased usage of the Q400s. The average number of daily flights would also increase from 171 to 183 per day which is a 7% increase. Assuming an 85% seat capacity, the annual number of passengers would increase to 4.3M or 16% increase over the current maximum scenario.

The peak number of Q400 and jets aircraft flights per hour would be still remain at about 16 flights per hour based on a 10 aircraft gate layout with four gates allocated to jets and six allocated to Q400. This would generate about 1,240 passengers per hour with an 85% aircraft capacity. On an annual basis, it is assumed that 25% of passengers (1.08 million/yr) transfer to another flight while the remaining (3.3 million/yr) move from the island to the mainland via ferry or tunnel. Similar to the existing operations, passengers would have various options for travel to their final destinations include automobile, transit or airport shuttle (Table 21) but it is assumed that passengers would use more transit and shuttle services. A similar distribution is assumed for arriving passengers.

To evaluate the variety of jets which could land at the airport, two jet aircraft have been modelled, namely the Bombardier CS100 and the Boeing 737-700 series which represent a range of existing and future jets. The Boeing 737 jets are similar in size and dimension to the CS100s but are slightly older and are anticipated to have larger emissions. Emission data on the CS100 (APPENDIX A) was provided by Bombardier directly but has not been certified or 3rd party verified. The Q400 and Boeing 737-700 data can be found within the EDMS database which has been certified.

The above information is used to set up the emission model for EDMS.

LEGEND

- Gates
- Deicing
- Fuel Farm
- Road
- Ferry
- Taxi Route
- Car Park
- Future Runway Expansion

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

100 50 0 100 200 300

SCALE 1:6,000 METRES

PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

TITLE
Future Airport Layout

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008	FIGURE: 5	
GIS	JO	5 Nov. 2013		
CHECK	GD	5 Nov. 2013		
REVIEW	TRS	5 Nov. 2013		

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Table 20: Estimated Annual Distribution of Flights and Passengers at BBTCA – Proposed Future Scenario

with Jets (low forecast)	Days	Max per Day	Max Flights/ year	Utiliz- ation	Avg Flight/ day	Q400	CS100	Total Flights/ yr	% Q400	% CS100	Cap/Flt Q400	Cap/Flt CS100	Q400 Passengers	CS100 Passengers	Total
Weekdays	236	202	47,672	100%	202	39,896	7,776	47,672	83.7%	16.3%	85%	85%	2,373,812	707,227	3,081,039
Holidays	25	202	5,050	83%	167	3,567	600	4,166	85.6%	14.4%	85%	85%	212,237	54,570	266,807
Sat	52	202	10,504	57%	114	5,093	857	5,945	85.7%	14.4%	85%	85%	303,034	77,944	380,978
Sun	52	202	10,504	85%	172	7,642	1,286	8,928	85.6%	14.4%	85%	85%	454,699	116,962	571,661
Sum/Avg	365	202	73,730	90%	183	56,198	10,519	66,717	84.2%	15.8%	85%	85%	3,343,781	956,703	4,300,484

Table 21: Transportation Mode Split at BBTCA – Proposed Future Scenario

	Percentage
Drive Themselves	2.5%
Take a Taxi	36%
3rd Party Drop off/Pick up	12%
Transit	15%
Airport Shuttle	35%
	100%

5.1 Emission Inventory – Proposed Future Scenario

Emissions from aircraft and ancillary activity were developed with the aid of the FAA EDMS modelling system for the maximum activities mentioned above. The emissions and basic parameters are described in the following sections.

As the number of flights remains constant between scenarios, the emissions from the ground support equipment and stationary equipment was assumed not to change.

5.1.1 Aircraft Activities - Proposed Future Scenario

As per the existing operations, the following aircraft activities at the airport were modelled:

- Taxiing to/from the runway (including queuing time);
- Runway travel; and
- Take-off/Landing at BBTCA.

Aircraft emissions for each of the above activities were calculated by EDMS using data on the gate, taxi and runway locations. Information on glideslope and runway utilisation was kept consistent with the current operations. Runway length was increased however to represent the increased runway length needed for take-off and landing of the jets. It was assumed that 25% slot usage (or 18,433 flights per year) was evenly divided between the four gates which can accommodate jet aircraft. The remaining 55,298 Q400 annual flights were divided amongst the remaining gates to allow each gate to be used for 10% of the total number of slots. The slot cap was maintained at 202 flights per day.

The CS100 emission data was provided by Bombardier while the Q400 and Boeing 737 emission data were available through the EDMS model. The combined (Q400 and jet aircraft) annual emissions data for each activity is provided in Table 22 and Table 23 for the Boeing 737 and CS100 jet aircraft, respectively. A comparison between existing operations and the two future jet scenarios annual emissions is provided in Table 24. A comparison between the 737/Q400 and CS100/Q400 scenarios shows that the CS100/Q400 is about 9% lower in overall emissions than the 737/Q400, with $PM_{2.5}/PM_{10}$ emissions showing the greatest reduction (37%). Although the Q400 represent 75% of the movements, their emissions represent 90% or 98% of the total for either the 737/Q400 or CS100/Q400 scenarios, respectively. This is not unexpected as the Q400 is an older class of plane and is not as efficient as the jets.

Hourly variability in aircraft movements was applied to the emission rates using the current average daily arrival and departure aircraft movement schedule described above.

Each of the aforementioned aircraft activities was modelled as a series of area sources. The source parameters used in the model are tabulated in Table 25. In comparison with the existing operations, the number of runway areas has increased to 70 from 50 representing the increase in runway lengths as well as the number of landing and take-off sources (i.e., 391 to 739) to account for the introduction of jets.

Table 22: Annual Emissions from Q400 and Boeing 737 Aircraft Activities – Proposed Future Scenario

Contaminant	Maximum Annual Emission Rate [Tonne/year]				
	Taxi Out	Takeoff	Climb Out	Approach	Taxi In
PAHs (as B[a]Ps)	–	–	–	–	–
Toluene	0.022	0.007	0.007	0.004	0.019
1,4-Dichlorobenzene	–	–	–	–	–
Carbon Monoxide	32.26	9.78	10.46	6.01	27.81
Nitrogen Oxides (1)	8.23	32.69	23.33	6.2	7.69
PM_{10} (3)	0.115	0.19	0.126	0.036	0.102
$PM_{2.5}$ (2)	0.115	0.19	0.126	0.036	0.102
Sulphur Dioxide	1.9	2.22	1.76	0.89	1.7
VOCs	3.38	1.04	1.08	0.57	2.89
1,2-Dichloroethane	–	–	–	–	–
Ethylene dibromide	–	–	–	–	–
Tetrachloroethylene	–	–	–	–	–
Trichloroethylene	–	–	–	–	–
Vinyl Chloride	–	–	–	–	–
Cadmium	5.75E-05	9.50E-05	6.30E-05	1.80E-05	5.10E-05
Chromium	6.33E-04	1.05E-03	6.93E-04	1.98E-04	5.61E-04
Mercury	–	–	–	–	–
Manganese	–	–	–	–	–
Nickel compounds	5.75E-05	9.50E-05	6.30E-05	1.80E-05	5.10E-05
Lead	6.33E-04	1.05E-03	6.93E-04	1.98E-04	5.61E-04
Carbon tetrachloride	–	–	–	–	–
Chloroform	–	–	–	–	–
Chloromethane	–	–	–	–	–
Dichloromethane	–	–	–	–	–
Acetaldehyde	0.145	0.045	0.046	0.025	0.124
Acrolein	0.083	0.026	0.027	0.014	0.071
Benzene	0.057	0.017	0.018	0.01	0.049
1,3-Butadiene	0.057	0.018	0.018	0.01	0.049
Formaldehyde	0.418	0.128	0.134	0.071	0.358

Note: — means unavailable or unknown
Based on 202 flights per day using Q400 aircraft
NOx emissions represented as NO_2 equivalent.
$PM_{2.5}$ emissions are included in PM_{10} emissions since they are a fine fraction (i.e., less than 2.5 µm)

Table 23: Annual Emissions from Q400 and CS100 Aircraft Activities – Proposed Future Scenario

Contaminant	Maximum Annual Emission Rate [Tonne/year]				
	Taxi Out	Takeoff	Climb Out	Approach	Taxi In
PAHs (as B[a]Ps)	–	–	–	–	–
Toluene	0.02	0.01	0.01	0	0.01
1,4-Dichlorobenzene	–	–	–	–	–
Carbon Monoxide	28.79	9.47	10.43	2.56	24.97
Nitrogen Oxides	8.19	31.16	24.08	8.33	7.88
PM_{10}	0.11	0.1	0.08	0.03	0.1
$PM_{2.5}$	0.11	0.1	0.08	0.03	0.1
Sulphur Dioxide	1.83	1.86	1.57	0.89	1.64
VOCs	2.6	0.93	1.02	0.04	2.26
1,2-Dichloroethane	–	–	–	–	–
Ethylene dibromide	–	–	–	–	–
Tetrachloroethylene	–	–	–	–	–
Trichloroethylene	–	–	–	–	–
Vinyl Chloride	–	–	–	–	–
Cadmium	5.35E-05	4.95E-05	3.95E-05	1.65E-05	4.80E-05
Chromium	5.89E-04	5.45E-04	4.35E-04	1.82E-04	5.28E-04
Mercury	–	–	–	–	–
Manganese	–	–	–	–	–
Nickel	–	–	–	–	–
Lead	5.89E-04	5.45E-04	4.35E-04	1.82E-04	5.28E-04
Carbon tetrachloride	–	–	–	–	–
Chloroform	–	–	–	–	–
Chloromethane	–	–	–	–	–
Dichloromethane	–	–	–	–	–
Acetaldehyde	0.112	0.04	0.044	0.002	0.097
Acrolein	0.064	0.023	0.025	0.001	0.056
Benzene	0.044	0.016	0.017	0.001	0.038
1,3-Butadiene	0.044	0.016	0.017	0.001	0.038
Formaldehyde	0.322	0.115	0.126	0.005	0.28

Note: — means unavailable or unknown
Based on 202 flights per day using Q400 aircraft
NOx emissions represented as NO_2 equivalent.
$PM_{2.5}$ emissions are included in PM_{10} emissions since they are a fine fraction (i.e., less than 2.5 µm)

Table 24: Comparison of Annual Aircraft Emissions from Existing Operations and Proposed Future Jet Scenario

Contaminant	Maximum Annual Emission Rate [Tonne/year]		
	Existing	737/Q400	CS100/Q400
PAHs (as B[a]Ps)	—	—	—
Toluene	0.058	0.058	0.044
1,4-Dichlorobenzene	—	—	—
Carbon Monoxide	92.96	86.32	76.21
Nitrogen Oxides	24.5	80.67	79.64
PM_{10}	0.35	0.57	0.41
$PM_{2.5}$	0.35	0.57	0.41
Sulphur Dioxide	5.6	8.47	7.8
VOCs	9.07	8.96	6.85
1,2-Dichloroethane	—	—	—
Ethylene dibromide	—	—	—
Tetrachloroethylene	—	—	—
Trichloroethylene	—	—	—
Vinyl Chloride	—	—	—
Cadmium	1.75E-04	2.85E-04	2.07E-04
Chromium	1.93E-03	3.13E-03	2.28E-03
Mercury	—	—	—
Manganese	—	—	—
Nickel	1.75E-04	2.85E-04	2.07E-04
Lead	1.93E-03	3.13E-03	2.28E-03
Carbon tetrachloride	—	—	—
Chloroform	—	—	—
Chloromethane	—	—	—
Dichloromethane	—	—	—
Acetaldehyde	0.389	0.385	0.294
Acrolein	0.223	0.221	0.169
Benzene	0.102	0.151	0.116
1,3-Butadiene	0.153	0.152	0.116
Formaldehyde	1.122	1.109	0.848

Note: — means unavailable or unknown
Based on 202 flights per day using Q400 aircraft
NOx emissions represented as NO_2 equivalent.
$PM_{2.5}$ emissions are included in PM_{10} emissions since they are a fine fraction (i.e., less than 2.5 µm)

Table 25: Modelling Source Parameters for Aircraft Movements – Proposed Future Scenario

Aircraft Movement Type	Source Type	Width [m]	Length [m]	Height above Ground [m]	Initial Vertical dispersion [m]
Taxiways	64 Area Sources covering the taxi routes between each gate and each runway	36	Various, depending on taxiway vertices	12	4.1
Runways	70 area sources covering arrival and departure from each runway	20	49.64	12	4.1
Take-off and Landings	739 Area sources covering the climb after take-off or descent before landing	20	200	Various ranging from 22 to 619.2m	4.1

5.1.2 Transportation

Both the Boeing 737 and CS100 have a higher passenger capacity than Q400 turboprops and the number of passengers per annum is assumed to increase in the expansion scenarios to 4.3 million (Table 20). City of Toronto has also indicated that they expect that the mode of traffic will be more sustainable with an increase in shuttle and transit usage to help handle the increase in passenger movement. Consequently, it is still assumed that 25% of passengers take connecting flights and that the amount of ferries and shuttle buses remain constant. The modal splits used for these scenarios are given in Table 26. It expected that the passenger tunnel to the airport will be completed but the ferry schedule remain unchanged to accommodate passengers and vehicle transport to the airport.

It was assumed that for passengers arriving by car, there are approximately two passengers per vehicle. The number of shuttle buses and ferries was assumed to be constant at 76 per day as per the existing operations. Vehicle idling from Taxi queuing and car park activities were also taken into consideration. Parked cars were prorated between the four car parks by the number of spaces available. Annual emissions from traffic related activities are listed in Table 27 and a comparison with existing is presented in Table 28. Although the number of passengers has increased, the change in transportation mode is sufficient to reduce the impact of transportation emissions. The hourly emissions are presented in APPENDIX B. Note that the ferry is the dominant source of transportation emissions at BBTCA. Each of the roads, car parks and the ferry path were modelled as a series of area sources as presented in Table 16.

Table 26: Vehicle Count Estimation Data – Proposed Future Scenario

Mode of Transport	Number of Passengers	Number of vehicles (one-way)
Drive and Park	80625	40,313
Taxi	1,161,000	580,500
Drop off	387,000	193,500
Bus	1,128,750	27,740
Walk/Transit	483,750	0
TOTAL	3,241,125	842,053

Table 27: Annual Emission Rates from Traffic Sources – Proposed Future Scenario

Contaminant	Maximum Annual Emission Rate [Tonne/year]		
	Roads	Car Parks	Ferry
PAHs (as B[a]Ps)	1.35E-07	6.45E-09	2.83E-06
Toluene	2.94E-04	1.40E-05	6.16E-03
1,4-Dichlorobenzene	—	—	—
Carbon Monoxide	3.418	0.115	14.3
Nitrogen Oxides	0.299	0.008	66.2
PM_{10}	0.008	—	4.7
$PM_{2.5}$	0.004	—	4.7
Sulphur Dioxide	0.001	—	4.38
VOCs	0.252	0.012	5.27
1,2-Dichloroethane	—	—	—
Ethylene dibromide	—	—	—
Tetrachloroethylene	—	—	—
Trichloroethylene	—	—	—
Vinyl Chloride	—	—	—
Cadmium	2.40E-06	—	2.82E-03
Chromium	4.00E-07	—	4.70E-04
Mercury	—	—	—
Manganese	4.00E-07	—	4.70E-04
Nickel	—	—	—
Lead	4.00E-07	—	4.70E-04
Carbon tetrachloride	—	—	—
Chloroform	—	—	—
Chloromethane	—	—	—
Dichloromethane	—	—	—
Acetaldehyde	0.002	—	0.056
Acrolein	—	—	—
Benzene	0.009	5.46E-04	0.185
1,3-Butadiene	0.001	—	0.019
Formaldehyde	0.004	—	0.074

Note: — means unavailable or unknown
Based on 202 flights per day using Q400 aircraft
NOx emissions represented as NO_2 equivalent.
$PM_{2.5}$ emissions are included in PM_{10} emissions since they are a fine fraction (i.e., less than 2.5 µm)

Table 28: Comparison of Annual Emission Rates from Traffic Sources

Contaminant	Maximum Annual Emission Rate [Tonne/year]	
	Existing	Future
PAHs (as B[a]Ps)	2.99E-06	2.97E-06
Toluene	0.007	0.006
1,4-Dichlorobenzene	—	—
Carbon Monoxide	18.32	17.83
Nitrogen Oxides	66.55	66.51
PM_{10}	4.71	4.71
$PM_{2.5}$	4.70	4.70
Sulphur Dioxide	4.38	4.38
VOCs	5.58	5.53
1,2-Dichloroethane	—	—
Ethylene dibromide	—	—
Tetrachloroethylene	—	—
Trichloroethylene	—	—
Vinyl Chloride	—	—
Cadmium	2.82E-03	2.82E-03
Chromium	4.71E-04	4.70E-04
Mercury	—	—
Manganese	4.71E-04	4.70E-04
Nickel	—	—
Lead	4.71E-04	4.70E-04
Carbon tetrachloride	—	—
Chloroform	—	—
Chloromethane	—	—
Dichloromethane	—	—
Acetaldehyde	0.059	0.058
Acrolein	—	—
Benzene	0.196	0.194
1,3-Butadiene	0.02	0.02
Formaldehyde	0.078	0.078

Note: — means unavailable or unknown
Based on 202 flights per day using Q400 aircraft
NOx emissions represented as NO_2 equivalent.
$PM_{2.5}$ emissions are included in PM_{10} emissions since they are a fine fraction (i.e., less than 2.5 µm)

5.2 Concentrations

The off-airport annual concentrations from the 737/Q400 and CS100/Q400 scenarios are presented in Table 29 and Table 30, respectively. There is little difference between the two scenarios on an annual timescale showing that background represents the highest proportion of concentrations in the area but BBTCA with jet aircraft represents 10% of the contributions. There is very little difference between the Boeing 737 and CS100 scenarios as they only represent a 25% change in fleet at BBTCA.

Transportation sources contribute significantly to NO_2 and PM levels while aircrafts contribute significantly to NO_2, some metals, aldehydes as well as acrolein. There is no change in PAH or benzene levels on an annual basis.

On a 24-hr basis, the contribution of BBTCA to levels is presented in Table 31 and Table 32 for the 737/Q400 and CS100/Q400 aircraft. The two scenarios are about 16% and 13% above background levels with specific contributions to NO_2, PM and acrolein as well as some metals. As with the background only, PAH, NO_2, PM_{10} and benzene 24-hr standards are exceeded at the 95th %-ile.

Annual and 24-hr concentration isopleths of NOx, PM_{10}, $PM_{2.5}$, cadmium and chromium are found in APPENDIX E for an area of about 2 km from the BBTCA. As the contours show, the highest concentrations are found around the major roadways as well as a hot-spot on the airport property.

Table 29: Annual Maximum Concentration and Contribution- Future 737/Q400 Scenario

Contaminant	AAQC	Maximum	Background	737/Q400 Aircraft	Transportation	GSE & Stationary Sources
	(μg/m³)					
PAHs (as B[a]Ps)	0.00001	0.009	0.009	—	0.00000001	0.00000017
Toluene	-	6.75	6.75	0.0002	0.00002	0.001
1,4-Dichlorobenzene	-	0.29	0.29	—	—	—
Carbon Monoxide	-	394.71	380.47	9.96	2.29	2.00
Nitrogen Oxides (1)	-	111.32	71.43	4.76	31.97	3.16
Ozone (4)	-	78.96	N/A	N/A	N/A	N/A
PM_{10} (3)	-	26.22	26.07	0.02	0.10	0.03
$PM_{2.5}$ (2)	-	10.02	7.53	0.07	2.19	0.23
Sulphur Dioxide	55	28.33	28.08	0.20	0.05	0.002
VOCs	-	136.06	136.04	0.01	0.01	0.003
1,2-Dichloroethane	0.4	0.0003	0.0003	—	—	—
Ethylene dibromide	-	0.00002	0.00002	—	—	—
Tetrachloroethylene	-	0.77	0.77	—	—	—
Trichloroethylene	2.3	0.076	0.076	—	—	—
Vinyl Chloride	0.2	0.0009	0.0009	—	—	—
Cadmium	0.005	0.0005	0.0002	0.00005	0.0003	0.00003
Chromium	-	0.0025	0.0012	0.0008	0.0002	0.0003
Mercury	-	0.0002	0.0002	—	—	—
Manganese	-	0.0038	0.0036	—	0.0002	0.0000
Nickel compounds	0.04	0.0021	0.0021	0.00001	—	—
Lead	0.2	0.0026	0.0019	0.0004	0.0002	0.0000
Carbon tetrachloride	-	0.00010	0.00010	—	—	—
Chloroform	0.2	0.012	0.012	—	—	—
Chloromethane	-	0.0015	0.0015	—	—	—
Dichloromethane	44	0.37	0.37	—	—	—
Acetaldehyde	-	0.39	0.30	0.083	0.001	0.008
Acrolein	-	0.076	0.029	0.047	0.0001	—
Benzene	0.45	1.47	1.47	0.0007	0.0001	0.0013
1,3-Butadiene	2	0.14	0.12	0.015	0.0002	0.0002
Formaldehyde	-	0.78	0.63	0.12	0.005	0.025
Average Contribution (%)			89%	6%	4%	1%

Note: 1 Reported as NO_2.
2 Canada Wide Standard
3 Interim Ontario Standard
4 Canada Wide Standard of 65 ppb (130 μg/m³) over 8-hours
5 Concentrations are representative of off-airport locations

Table 30: Annual Maximum Concentration and Contribution- Proposed Future CS100/Q400 Scenario

Contaminant	AAQC	Maximum	Background	CS100/Q400 Aircraft	Transportation	GSE & Stationary Sources
	(µg/m3)					
PAHs (as B[a]Ps)	0.00001	0.009	0.009	—	0.0000001	0.0000002
Toluene	-	6.75	6.75	0.0002	0.00002	0.0014
1,4-Dichlorobenzene	-	0.29	0.29	—	—	—
Carbon Monoxide	-	393.66	383.61	6.40	1.64	2.00
Nitrogen Oxides (1)	-	110.34	64.61	10.76	31.81	3.16
Ozone (4)	-	78.98	N/A	N/A	N/A	N/A
PM_{10} (3)	-	26.22	26.06	0.02	0.10	0.03
$PM_{2.5}$ (2)	-	10.00	7.52	0.07	2.19	0.23
Sulphur Dioxide	55	28.31	28.07	0.19	0.05	0.00
VOCs	-	136.06	136.04	0.02	0.01	0.00
1,2-Dichloroethane	0.4	0.0003	0.0003	—	—	—
Ethylene dibromide	-	0.00002	0.00002	—	—	—
Tetrachloroethylene	-	0.77	0.77	—	—	—
Trichloroethylene	2.3	0.076	0.076	—	—	—
Vinyl Chloride	0.2	0.0009	0.0009	—	—	—
Cadmium	0.005	0.00052	0.00020	0.00004	0.00025	0.00003
Chromium	-	0.0023	0.0012	0.0006	0.0002	0.0003
Mercury	-	0.0002	0.0002	—	—	—
Manganese	-	0.0038	0.0036	—	0.00022	0.0000003
Nickel compounds	0.04	0.0021	0.0021	0.000004	—	—
Lead	0.2	0.0025	0.0019	0.00036	0.0002	0.000002
Carbon tetrachloride	-	0.0001	0.0001	—	—	—
Chloroform	0.2	0.012	0.012	—	—	—
Chloromethane	-	0.0015	0.0015	—	—	—
Dichloromethane	44	0.37	0.37	—	—	—
Acetaldehyde	-	0.39	0.30	0.084	0.001	0.008
Acrolein	-	0.077	0.029	0.048	0.0001	0.0000
Benzene	0.45	1.47	1.47	0.0007	0.0001	0.0013
1,3-Butadiene	2	0.14	0.12	0.015	0.0002	0.0002
Formaldehyde	-	0.78	0.70	0.057	0.001	0.025
Average Contribution (%)			89.5%	5.6%	3.8%	1.1%

Note: 1 Reported as NO_2.
2 Canada Wide Standard
3 Interim Ontario Standard
4 Canada Wide Standard of 65 ppb (130 µg/m^3) over 8-hours
5 Concentrations are representative of off-airport locations

Table 31: Daily 95th %-ile Concentrations – Proposed Future 737/Q400 Scenario

Contaminant	AAQC	Maximum	Background	% Change
	(µg/m^3)			
PAHs (as B[a]Ps)	0.00005	0.022	0.022	0%
Toluene	2000	15.61	15.61	0%
1,4-Dichlorobenzene	95	0.72	0.72	0%
Carbon Monoxide	15700	885.2	881.9	0%
Nitrogen Oxides (1)	200	358.8	212.6	69%
PM_{10} (3)	50	55.2	54.9	1%
$PM_{2.5}$ (2)	30	24.5	20.5	20%
Sulphur Dioxide	275	72.0	67.1	7%
VOCs	N/A	278.8	278.8	0%
1,2-Dichloroethane	2	0.00094	0.00094	0%
Ethylene dibromide	3	0.00006	0.00006	0%
Tetrachloroethylene	360	1.80	1.80	0%
Trichloroethylene	12	0.22	0.22	0%
Vinyl Chloride	1	0.003	0.003	0%
Cadmium	0.025	0.002	0.001	116%
Chromium	0.5	0.006	0.004	42%
Mercury	2	0.0005	0.0005	0%
Manganese	0.4	0.013	0.013	0%
Nickel compounds	0.2	0.004	0.004	0%
Lead	0.5	0.006	0.005	5%
Carbon tetrachloride	2.4	0.0004	0.0004	0%
Chloroform	1	0.026	0.026	0%
Chloromethane	320	0.007	0.007	0%
Dichloromethane	220	0.87	0.87	0%
Acetaldehyde	500	0.89	0.80	12%
Acrolein	0.4	0.20	0.09	128%
Benzene	2.3	3.06	3.06	0%
1,3-Butadiene	10	0.30	0.29	5%
Formaldehyde	65	1.81	1.70	6%
Average Change (%)				16.0%

Note: [1] Reported as NO_2.
[2] Canada Wide Standard
[3] Interim Ontario Standard
[4] Canada Wide Standard of 65 ppb (130 µg/m^3) over 8-hours
[5] Concentrations are representative of off-airport locations

Table 32: Daily 95th %-ile Concentrations – Proposed Future CS100/Q400 Scenario

Contaminant	AAQC	Maximum	Background	% Change
	($\mu g/m^3$)			
PAHs (as B[a]Ps)	0.00005	0.022	0.022	0%
Toluene	2000	15.61	15.61	0%
1,4-Dichlorobenzene	95	0.72	0.72	0%
Carbon Monoxide	15700	885.2	881.9	0%
Nitrogen Oxides (1)	200	358.0	212.6	68%
PM_{10} (3)	50	55.2	54.9	1%
$PM_{2.5}$ (2)	30	24.4	20.5	19%
Sulphur Dioxide	275	71.0	67.1	7%
VOCs	N/A	278.8	278.8	0%
1,2-Dichloroethane	2	0.00094	0.00094	0%
Ethylene dibromide	3	0.00006	0.00006	0%
Tetrachloroethylene	360	1.80	1.80	0%
Trichloroethylene	12	0.22	0.22	0%
Vinyl Chloride	1	0.003	0.003	0%
Cadmium	0.025	0.002	0.001	91%
Chromium	0.5	0.005	0.004	34%
Mercury	2	0.0005	0.0005	0%
Manganese	0.4	0.013	0.013	0%
Nickel compounds	0.2	0.004	0.004	0%
Lead	0.5	0.005	0.005	2%
Carbon tetrachloride	2.4	0.0004	0.0004	0%
Chloroform	1	0.026	0.026	0%
Chloromethane	320	0.007	0.007	0%
Dichloromethane	220	0.87	0.87	0%
Acetaldehyde	500	0.90	0.80	13%
Acrolein	0.4	0.20	0.09	130%
Benzene	2.3	3.06	3.06	0%
1,3-Butadiene	10	0.30	0.29	5%
Formaldehyde	65	1.81	1.70	6%
Average Change (%)				13.2%

Note: 1 Reported as NO_2.
2 Canada Wide Standard
3 Interim Ontario Standard
4 Canada Wide Standard of 65 ppb (130 $\mu g/m^3$) over 8-hours
5 Concentrations are representative of off-airport locations

6.0 SUMMARY

The two major BBTCA activities relevant to air quality are the aircraft activities and the transportation which are summarized in Table 33. As shown, a number of PACs increase such as NO_x, SO_2, PM, metals and benzene but a number of PACs also decrease including VOCs, CO, toluene and aldehydes. The largest increase is with respect to NO_x emissions which increase by a factor of 2.5 but the CS100 has a smaller increase than the Boeing 737. The 25% change in aircraft fleet would result in a 39% and 28% increase in total emissions.

A comparison of the PAC concentrations on an annual and 24-hr basis is presented in Table 34 and Table 35, respectively. In general, there are about 14 to 13 changes in concentrations, with some PACs having a larger change than others. There are noticeable changes (greater than 20%) in annual ambient concentrations for NO_x, cadmium, chromium and acrolein and minor changes in $PM_{2.5}$ and lead. On a 24-hr basis the NOx, $PM_{2.5}$, cadmium, chromium and acrolein concentration have noticeable changes.

Table 33: Comparison of Existing Operations and Proposed Future Aircraft and Transportation Emissions

Contaminant	Q400 Only Aircraft	737/Q400 Aircraft	CS100/Q400 Aircraft	Existing Transportation	Future Transportation
	tonne/year	tonne/year	tonne/year	tonne/year	tonne/year
PAHs (as B[a]Ps)	—	—	—	2.99E-06	2.97E-06
Toluene	0.058	0.058	0.044	0.007	0.006
1,4-Dichlorobenzene	—	—	—	—	—
Carbon Monoxide	92.96	86.32	76.21	18.32	17.8
Nitrogen Oxides	24.5	80.67	79.64	66.55	66.5
PM_{10}	0.35	0.57	0.41	4.71	4.71
$PM_{2.5}$	0.35	0.57	0.41	4.7	4.7
Sulphur Dioxide	5.6	8.47	7.8	4.38	4.38
VOCs	9.07	8.96	6.85	5.58	5.54
1,2-Dichloroethane	—	—	—	—	—
Ethylene dibromide	—	—	—	—	—
Tetrachloroethylene	—	—	—	—	—
Trichloroethylene	—	—	—	—	—
Vinyl Chloride	—	—	—	—	—
Cadmium	1.75E-04	2.85E-04	2.07E-04	2.82E-03	2.82E-03
Chromium	1.93E-03	3.13E-03	2.28E-03	4.71E-04	4.70E-04
Mercury	—	—	—	—	—
Manganese	—	—	—	4.71E-04	4.70E-04
Nickel	1.75E-04	2.85E-04	2.07E-04	—	—
Lead	1.93E-03	3.13E-03	2.28E-03	4.71E-04	4.70E-04
Carbon tetrachloride	—	—	—	—	—
Chloroform	—	—	—	—	—
Chloromethane	—	—	—	—	—
Dichloromethane	—	—	—	—	—
Acetaldehyde	0.389	0.385	0.294	0.059	0.058
Acrolein	0.223	0.221	0.169	—	—
Benzene	0.102	0.151	0.116	0.196	0.185
1,3-Butadiene	0.153	0.152	0.116	0.02	0.02
Formaldehyde	1.122	1.109	0.848	0.078	0.074
Average Change	-	39%	28%	-	-1%

Note: — means unavailable or unknown
Based on 202 flights per day using Q400 aircraft
NO_x emissions represented as NO_2 equivalent.
$PM_{2.5}$ emissions are included in PM_{10} emissions since they are a fine fraction (i.e., less than 2.5 µm)

Table 34: Comparison of Annual Concentrations

Contaminant	AAQC	No Aircraft Background	Existing Q400 Only	Future 737/Q400	Future CS100/Q400
	($\mu g/m^3$)				
PAHs (as B[a]Ps)	0.00001	0.009	0.009	0.009	0.009
Toluene	-	6.75	6.75	6.75	6.75
1,4-Dichlorobenzene	-	0.3	0.3	0.3	0.3
Carbon Monoxide	-	390	394	395	394
Nitrogen Oxides (1)	-	77	106	111	110
Ozone (4)		82.6	78.9	79.0	79.0
PM_{10} (3)	-	26.1	26.2	26.2	26.2
$PM_{2.5}$ (2)	-	9.7	10.0	10.0	10.0
Sulphur Dioxide	55	28.1	28.3	28.3	28.3
VOCs	-	136	136	136	136
1,2-Dichloroethane	0.4	0.00034	0.00034	0.00034	0.00034
Ethylene dibromide	-	0.00002	0.00002	0.00002	0.00002
Tetrachloroethylene	-	0.77	0.77	0.77	0.77
Trichloroethylene	2.3	0.0756	0.0756	0.0756	0.0756
Vinyl Chloride	0.2	0.001	0.001	0.001	0.001
Cadmium	0.005	0.0004	0.001	0.001	0.001
Chromium	-	0.0017	0.0023	0.0025	0.0023
Mercury	-	0.0002	0.0002	0.0002	0.0002
Manganese	-	0.004	0.004	0.004	0.004
Nickel compounds	0.04	0.002	0.002	0.002	0.002
Lead	0.2	0.0022	0.0025	0.0026	0.0025
Carbon tetrachloride	-	0.0001	0.0001	0.0001	0.0001
Chloroform	0.2	0.012	0.012	0.012	0.012
Chloromethane	-	0.0015	0.0015	0.0015	0.0015
Dichloromethane	44	0.37	0.37	0.37	0.37
Acetaldehyde	-	0.34	0.40	0.39	0.39
Acrolein	-	0.04	0.08	0.08	0.08
Benzene	0.45	1.47	1.47	1.47	1.47
1,3-Butadiene	2	0.12	0.14	0.14	0.14
Formaldehyde	-	0.73	0.79	0.78	0.78
Average Change (%)		-	12.7%	13.3%	12.7%

Note: [1] Reported as NO_2.
[2] Canada Wide Standard
[3] Interim Ontario Standard
[4] Canada Wide Standard of 65 ppb (130 $\mu g/m^3$) over 8-hours
[5] Concentrations are representative of off-airport locations

Table 35: Comparison of 24-hr 95th %-ile Concentrations

Contaminant	AAQC	No Aircraft Background	Existing Q400 Only	Future 737/Q400	Future CS100/Q400
	($\mu g/m^3$)				
PAHs (as B[a]Ps)	0.00005	0.022	0.022	0.022	0.022
Toluene	2000	15.61	15.6	15.61	15.61
1,4-Dichlorobenzene	95	0.72	0.72	0.72	0.72
Carbon Monoxide	15700	881.9	885.2	885.2	885.2
Nitrogen Oxides (1)	200	212.6	343.9	358.8	358.0
PM_{10} (3)	50	54.9	55.2	55.2	55.2
$PM_{2.5}$ (2)	30	20.5	24.4	24.5	24.4
Sulphur Dioxide	275	67.1	70.9	72.0	71.0
VOCs	N/A	278.8	278.8	278.8	278.8
1,2-Dichloroethane	2	0.00094	0.00094	0.00094	0.00094
Ethylene dibromide	3	0.00006	0.00006	0.00006	0.00006
Tetrachloroethylene	360	1.80	1.80	1.80	1.80
Trichloroethylene	12	0.22	0.22	0.22	0.22
Vinyl Chloride	1	0.003	0.003	0.003	0.003
Cadmium	0.025	0.001	0.002	0.002	0.002
Chromium	0.5	0.004	0.005	0.006	0.005
Mercury	2	0.0005	0.0005	0.0005	0.0005
Manganese	0.4	0.013	0.013	0.013	0.013
Nickel compounds	0.2	0.004	0.004	0.004	0.004
Lead	0.5	0.005	0.005	0.006	0.005
Carbon tetrachloride	2.4	0.0004	0.0004	0.0004	0.0004
Chloroform	1	0.026	0.026	0.026	0.026
Chloromethane	320	0.007	0.007	0.007	0.007
Dichloromethane	220	0.87	0.87	0.87	0.87
Acetaldehyde	500	0.80	0.91	0.89	0.90
Acrolein	0.4	0.09	0.21	0.20	0.20
Benzene	2.3	3.06	3.06	3.06	3.06
1,3-Butadiene	10	0.29	0.30	0.30	0.30
Formaldehyde	65	1.70	1.80	1.81	1.81
Average Change (%)			12.7%	14.1%	12.5%

Note: [1] Reported as NO_2.
[2] Canada Wide Standard
[3] Interim Ontario Standard
[4] Canada Wide Standard of 65 ppb (130 $\mu g/m^3$) over 8-hours
[5] Concentrations are representative of off-airport locations

7.0 REFERENCES

Golder, 2011. "*An All Sources Cumulative Air Quality Impact Study of South Riverdale - Leslieville – Beaches"*,

Airbiz Aviation Strategies (Airbiz), 2013. Billy Bishop Toronto City Airport, Porter Airlines Proposal Review, Interim Results / Findings. June 26, 2013.

Aircraftcompare.com, 2013. Bombardier C Series CS100 and Bombardier Q400. Accessed at www.aircraftcompare.com on November 4th, 2013.

BA Group, 2013. DRAFT Billy Bishop Toronto City Airport Transportation Assessment of Proposed Jet Activity. Executive Summary and Key Findings. Preliminary Draft – Version 1. October 2013.

California Environmental Protection Agency Air Resources Board Speciation Profile Database, December 12, 2012 http://www.arb.ca.gov/ei/speciate/speciate.htm (accessed September 26, 2013)

Dillon Consulting Limited, 2013. Porter Airlines Inc. BBTCA Traffic Diversion Assessment. November 6, 2013.

Doncaster Health Authority and Doncaster Metropolitan Borough Council, 2000. Health Impact Assessment, Finningley Airport. Abdel Aziz, M.I., Radford, J., McCabe, J. September 2000.

Dorman, K., R. Pellizzari, M. Rachlis, S. Green, 2013. Why poverty is a medical problem. Ontario Medical Review, October 2013.

HLT Advisory, 2013. DRAFT Economic Impact Considerations of an Expanded Billy Bishop Toronto City Airport. Draft for Discussion – Interim Findings, June 26, 2013.

Schauer, J.J., M.J. Kleeman, G.R. Cass and B.R.T. Simoneit, Measurement of Emissions from Air Pollution Source 2. C1 through C30 Organic Compounds from Medium Duty Diesel Trucks. Environmental Science and Technology 33: 1578-1587. April 13, 1999.

Report Signature Page

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APPENDIX A

Aircraft Emission Data

Aircraft	Q400
Engine	PW150A
Number of Engines	2

Mode	Time (mins)	Emissions [g/sec]				
		CO	HC	NOx	PM	Smoke number
Taxi Out (2%)	9	0.95	0.402	0.11	ND*	
Take off (90%)	0.5	0.25	0.110	5.29	ND*	6.3
Climbout (80%)	2.2	0.20	0.099	4.29	ND*	
Approach (17%)	4.5	0.30	0.120	1.14	ND*	
Taxi In (2%)	4	0.95	0.402	0.11	ND*	

Note: PW150A power levels are shown for operation at Billy Bishop Airport

Aircraft	CS100	Jet Engine Parameters	
Engine	PW1500G	Bypass Ratio	12.5
Number of Engines	2	Rated Thrust per Engine	97.72

Mode	Time (mins)	Emissions [g/sec]				
		CO	HC	NOx	PM	Smoke number
Taxi Out (7%)	9	1.01	0.003	0.42	ND*	
Take off (100%)	0.7	0.17	0.017	16.43	ND*	2.0
Climbout (85%)	2.2	0.16	0.011	11.03	ND*	
Approach (30%)	4	0.55	0.003	2.03	ND*	
Taxi In (7%)	4	1.01	0.003	0.42	ND*	

Note: Standard ICAO Landing Take-Off cycle power levels used for emissions specification.

Aircraft	737-700	**Jet Engine Parameters**	
Engine	CFM56-7B20	**Bypass Ratio**	5.4
Number of Engines	2	**Rated Thrust per Engine**	0

Mode	Time (mins)	Emissions [g/sec]				
		CO	HC	NOx	PM	Smoke numbers
Taxi Out (7%)	9	2.59	0.31	0.43	ND*	
Take off (100%)	0.7	0.55	0.091	18.66	ND*	11.4
Climbout (85%)	2.2	0.38	0.076	13.22	ND*	8
Approach (30%)	4	0.86	0.027	2.57	ND*	
Taxi In (7%)	4	2.59	0.31	0.43	ND*	

No data available, PM emissions are calculated using secondary formation algorithms

APPENDIX B

Hourly Emission Rates

Table B1: Maximum Hourly Emission Rates from Aircraft Movements – Existing Operations

Contaminant	Maximum Hourly Emission Rate [g/s]						
	Taxiing to/from the runway	Runway Landing	Runway Take-off	Climbing after Take-off from Runway 26	Descent to Runway 26	Climbing after Take-off from Runway 08	Descent to Runway 08
PAHs (as B[a]Ps)	—	—	—	—	—	—	—
Toluene	4.31E-03	5.22E-06	1.62E-04	9.35E-04	2.10E-07	4.02E-04	3.51E-05
1,4-Dichlorobenzene	—	—	—	—	—	—	—
Carbon Monoxide	6.88E+00	8.33E-03	2.59E-01	1.49E+00	3.36E-04	6.42E-01	5.60E-02
Nitrogen Oxides	2.84E+00	3.27E-03	9.37E-02	5.71E-01	1.38E-04	2.34E-01	1.96E-02
PM_{10}	3.99E-02	5.04E-05	1.69E-03	1.06E-02	2.91E-05	6.40E-03	2.55E-04
$PM_{2.5}$	3.85E-02	4.84E-05	1.44E-03	9.91E-03	2.91E-05	4.75E-03	2.10E-04
Sulphur Dioxide	5.31E-01	6.06E-04	1.82E-02	1.09E-01	2.57E-05	4.47E-02	3.80E-03
VOCs	6.72E-01	8.12E-04	2.52E-02	1.46E-01	3.27E-05	6.26E-02	5.46E-03
1,2-Dichloroethane	—	—	—	—	—	—	—
Ethylene dibromide	—	—	—	—	—	—	—
Tetrachloroethylene	—	—	—	—	—	—	—
Trichloroethylene	—	—	—	—	—	—	—
Vinyl Chloride	—	—	—	—	—	—	—
Cadmium	1.93E-05	2.42E-08	7.22E-07	4.95E-06	1.46E-08	2.38E-06	1.05E-07
Chromium	2.12E-04	2.66E-07	7.95E-06	5.45E-05	1.60E-07	2.61E-05	1.15E-06
Mercury	—	—	—	—	—	—	—
Manganese	—	—	—	—	—	—	—
Nickel	1.93E-05	2.42E-08	7.22E-07	4.95E-06	1.46E-08	2.38E-06	1.05E-07
Lead	2.12E-04	2.66E-07	7.95E-06	5.45E-05	1.60E-07	2.61E-05	1.15E-06
Carbon tetrachloride	—	—	—	—	—	—	—
Chloroform	—	—	—	—	—	—	—
Chloromethane	—	—	—	—	—	—	—

Contaminant	Maximum Hourly Emission Rate [g/s]						
	Taxiing to/from the runway	Runway Landing	Runway Take-off	Climbing after Take-off from Runway 26	Descent to Runway 26	Climbing after Take-off from Runway 08	Descent to Runway 08
Dichloromethane	—	—	—	—	—	—	—
Acetaldehyde	2.88E-02	3.49E-05	1.08E-03	6.25E-03	1.41E-06	2.69E-03	2.34E-04
Acrolein	1.65E-02	2.00E-05	6.20E-04	3.58E-03	8.05E-07	1.54E-03	1.34E-04
Benzene	1.14E-02	1.37E-05	4.27E-04	2.46E-03	5.54E-07	1.06E-03	9.24E-05
1,3-Butadiene	1.14E-02	1.37E-05	4.27E-04	2.46E-03	5.54E-07	1.06E-03	9.24E-05
Formaldehyde	8.31E-02	1.01E-04	3.12E-03	1.80E-02	4.05E-06	7.75E-03	6.76E-04

Table B2: Hourly Emissions from on-site Ground Support Equipment – Existing Operations

Contaminant	Maximum Hourly Emission Rate [g/s]
	Ground Support Equipment
PAHs (as B[a]Ps)	4.30E-08
Toluene	7.72E-04
1,4-Dichlorobenzene	—
Carbon Monoxide	6.59E-01
Nitrogen Oxides	7.26E-01
PM_{10}	5.23E-02
$PM_{2.5}$	5.07E-02
Sulphur Dioxide	4.12E-03
VOCs	8.01E-02
1,2-Dichloroethane	—
Ethylene dibromide	—
Tetrachloroethylene	—
Trichloroethylene	—
Vinyl Chloride	—
Cadmium	3.04E-05
Chromium	5.07E-06
Mercury	—
Manganese	5.07E-06
Nickel	—
Lead	5.07E-06
Carbon tetrachloride	—
Chloroform	—
Chloromethane	—
Dichloromethane	—
Acetaldehyde	1.71E-03
Acrolein	—
Benzene	4.41E-04
1,3-Butadiene	—
Formaldehyde	5.02E-03

Table B3: Hourly Emissions from Stationary Sources – Existing Operations

Contaminant	Maximum Hourly Emission Rate [g/s]
	Stationary Sources
PAHs (as B[a]Ps)	4.60E-08
Toluene	3.33E-03
1,4-Dichlorobenzene	—
Carbon Monoxide	7.30E-01
Nitrogen Oxides	8.40E-01
PM_{10}	6.07E-02
$PM_{2.5}$	5.99E-02
Sulphur Dioxide	6.21E-03
VOCs	8.56E-02
1,2-Dichloroethane	—
Ethylene dibromide	—
Tetrachloroethylene	—
Trichloroethylene	—
Vinyl Chloride	—
Cadmium	5.99E-06
Chromium	—
Mercury	—
Manganese	—
Nickel	—
Lead	—
Carbon tetrachloride	—
Chloroform	—
Chloromethane	—
Dichloromethane	—
Acetaldehyde	—
Acrolein	—
Benzene	2.09E-02
1,3-Butadiene	1.45E-05
Formaldehyde	6.36E-03

Table B4: Hourly Emission Rates for Transportation Sources – Existing Operations

Contaminant	Maximum Hourly Emission Rate [g/s]		
	Roads	Car Parks	Ferry
PAHs (as B[a]Ps)	8.45E-09	6.40E-10	1.28E-07
Toluene	1.84E-05	1.39E-06	2.78E-04
1,4-Dichlorobenzene	—	—	—
Carbon Monoxide	2.12E-01	1.12E-02	6.48E-01
Nitrogen Oxides	1.85E-02	7.65E-04	3.01E+00
PM_{10}	5.26E-04	1.81E-05	2.13E-01
$PM_{2.5}$	2.97E-04	1.02E-05	2.13E-01
Sulphur Dioxide	1.30E-04	4.45E-06	1.99E-01
VOCs	1.57E-02	1.19E-03	2.40E-01
1,2-Dichloroethane	—	—	—
Ethylene dibromide	—	—	—
Tetrachloroethylene	—	—	—
Trichloroethylene	—	—	—
Vinyl Chloride	—	—	—
Cadmium	1.78E-07	6.12E-09	1.28E-04
Chromium	2.97E-08	1.02E-09	2.13E-05
Mercury	—	—	—
Manganese	2.97E-08	1.02E-09	2.13E-05
Nickel	—	—	—
Lead	2.97E-08	1.02E-09	2.13E-05
Carbon tetrachloride	—	—	—
Chloroform	—	—	—
Chloromethane	—	—	—
Dichloromethane	—	—	—
Acetaldehyde	1.66E-04	—	5.21E-04
Acrolein	0.00E+00	—	6.28E-05
Benzene	5.52E-04	5.42E-05	6.34E-04
1,3-Butadiene	5.52E-05	—	2.66E-05
Formaldehyde	2.21E-04	—	8.01E-04

Table B5: Maximum Hourly Emission rates from Q400 and Boeing 737 Aircraft Activities – Proposed Future Scenario

Contaminant	Maximum Hourly Emission Rate [g/s]						
	Taxiing to/from the runway	Runway Landing	Runway Take-off	Climbing after Take-off from Runway 26	Descent to Runway 26	Climbing after Take-off from Runway 08	Descent to Runway 08
PAHs (as B[a]Ps)	—	—	—	—	—	—	—
Toluene	3.89E-03	4.41E-05	4.94E-04	9.13E-04	4.94E-04	2.92E-04	3.79E-04
1,4-Dichlorobenzene	—	—	—	—	—	—	—
Carbon Monoxide	7.31E+00	7.46E-02	1.03E+00	1.67E+00	1.03E+00	8.43E-01	8.09E-01
Nitrogen Oxides	3.21E+00	2.20E-01	9.30E-01	8.55E+00	9.30E-01	5.03E+00	7.12E-01
PM_{10}	3.47E-02	1.12E-03	5.57E-03	4.14E-02	5.57E-03	1.97E-02	4.32E-03
$PM_{2.5}$	3.47E-02	1.12E-03	5.57E-03	4.14E-02	5.57E-03	1.97E-02	4.32E-03
Sulphur Dioxide	5.81E-01	2.09E-02	1.34E-01	5.15E-01	1.34E-01	2.50E-01	1.03E-01
VOCs	6.01E-01	6.82E-03	7.63E-02	1.41E-01	7.63E-02	4.51E-02	5.86E-02
1,2-Dichloroethane	—	—	—	—	—	—	—
Ethylene dibromide	—	—	—	—	—	—	—
Tetrachloroethylene	—	—	—	—	—	—	—
Trichloroethylene	—	—	—	—	—	—	—
Vinyl Chloride	—	—	—	—	—	—	—
Cadmium	1.74E-05	5.58E-07	2.79E-06	2.07E-05	2.79E-06	9.83E-06	2.16E-06
Chromium	1.91E-04	6.14E-06	3.06E-05	2.28E-04	3.06E-05	1.08E-04	2.38E-05
Mercury	—	—	—	—	—	—	—
Manganese	—	—	—	—	—	—	—
Nickel	1.74E-05	5.58E-07	2.79E-06	2.07E-05	2.79E-06	9.83E-06	2.16E-06
Lead	1.91E-04	6.14E-06	3.06E-05	2.28E-04	3.06E-05	1.08E-04	2.38E-05
Carbon tetrachloride	—	—	—	—	—	—	—
Chloroform	—	—	—	—	—	—	—

Contaminant	Maximum Hourly Emission Rate [g/s]						
	Taxiing to/from the runway	Runway Landing	Runway Take-off	Climbing after Take-off from Runway 26	Descent to Runway 26	Climbing after Take-off from Runway 08	Descent to Runway 08
Chloromethane	—	—	—	—	—	—	—
Dichloromethane	—	—	—	—	—	—	—
Acetaldehyde	2.58E-02	2.93E-04	3.28E-03	6.06E-03	3.28E-03	1.94E-03	2.52E-03
Acrolein	1.48E-02	1.68E-04	1.88E-03	3.48E-03	1.88E-03	1.11E-03	1.45E-03
Benzene	1.01E-02	1.15E-04	1.29E-03	2.38E-03	1.29E-03	7.61E-04	9.88E-04
1,3-Butadiene	1.02E-02	1.16E-04	1.29E-03	2.39E-03	1.29E-03	7.66E-04	9.94E-04
Formaldehyde	7.44E-02	8.44E-04	9.45E-03	1.75E-02	9.45E-03	5.59E-03	7.25E-03

Table B6: Maximum Hourly Emission rates from Q400 and CS100 Aircraft Activities – Proposed Future Scenario

Contaminant	Maximum Hourly Emission Rate [g/s]						
	Taxiing to/from the runway	Runway Landing	Runway Take-off	Climbing after Take-off from Runway 26	Descent to Runway 26	Climbing after Take-off from Runway 08	Descent to Runway 08
PAHs (as B[a]Ps)	—	—	—	—	—	—	—
Toluene	4.04E-03	1.52E-05	5.64E-04	1.30E-03	1.35E-05	5.64E-04	3.53E-05
1,4-Dichlorobenzene	—	—	—	—	—	—	—
Carbon Monoxide	6.20E+00	4.27E-02	8.85E-01	2.03E+00	3.93E-01	8.85E-01	3.94E-01
Nitrogen Oxides	2.25E+00	2.57E-01	3.97E+00	7.27E+00	1.17E+00	3.97E+00	1.05E+00
PM_{10}	3.24E-02	7.87E-04	1.15E-02	1.95E-02	4.57E-03	1.15E-02	4.11E-03
$PM_{2.5}$	3.21E-02	7.82E-04	9.61E-03	1.95E-02	4.57E-03	9.61E-03	4.11E-03
Sulphur Dioxide	5.38E-01	2.02E-02	2.05E-01	3.93E-01	1.21E-01	2.05E-01	1.08E-01
VOCs	6.29E-01	2.37E-03	8.79E-02	2.02E-01	2.10E-03	8.79E-02	5.50E-03
1,2-Dichloroethane	—	—	—	—	—	—	—
Ethylene dibromide	—	—	—	—	—	—	—
Tetrachloroethylene	—	—	—	—	—	—	—
Trichloroethylene	—	—	—	—	—	—	—
Vinyl Chloride	—	—	—	—	—	—	—
Cadmium	1.61E-05	3.91E-07	4.81E-06	9.75E-06	2.28E-06	4.81E-06	2.06E-06
Chromium	1.77E-04	4.30E-06	5.29E-05	1.07E-04	2.51E-05	5.29E-05	2.26E-05
Mercury	—	—	—	—	—	—	—
Manganese	—	—	—	—	—	—	—
Nickel	1.61E-05	3.91E-07	4.81E-06	9.75E-06	2.28E-06	4.81E-06	2.06E-06
Lead	1.77E-04	4.30E-06	5.29E-05	1.07E-04	2.51E-05	5.29E-05	2.26E-05
Carbon tetrachloride	—	—	—	—	—	—	—
Chloroform	—	—	—	—	—	—	—

Contaminant	Maximum Hourly Emission Rate [g/s]						
	Taxiing to/from the runway	Runway Landing	Runway Take-off	Climbing after Take-off from Runway 26	Descent to Runway 26	Climbing after Take-off from Runway 08	Descent to Runway 08
Chloromethane	—	—	—	—	—	—	—
Dichloromethane	—	—	—	—	—	—	—
Acetaldehyde	2.70E-02	1.02E-04	3.77E-03	8.68E-03	9.02E-05	3.77E-03	2.36E-04
Acrolein	1.55E-02	5.84E-05	2.17E-03	4.99E-03	5.19E-05	2.17E-03	1.36E-04
Benzene	1.06E-02	4.01E-05	1.49E-03	3.42E-03	3.56E-05	1.49E-03	9.31E-05
1,3-Butadiene	1.06E-02	4.01E-05	1.49E-03	3.42E-03	3.56E-05	1.49E-03	9.31E-05
Formaldehyde	7.78E-02	2.93E-04	1.09E-02	2.50E-02	2.60E-04	1.09E-02	6.81E-04

Table B7: Hourly Emission Rates from Transportation Sources – Proposed Future Scenario

Contaminant	Maximum Hourly Emission Rate [g/s]		
	Roads	Car Parks	Ferry
PAHs (as B[a]Ps)	7.48E-09	3.62E-10	1.28E-07
Toluene	1.63E-05	7.88E-07	2.78E-04
1,4-Dichlorobenzene	—	—	—
Carbon Monoxide	1.89E-01	6.35E-03	6.48E-01
Nitrogen Oxides	1.65E-02	4.33E-04	3.01E+00
PM_{10}	4.69E-04	1.02E-05	2.13E-01
$PM_{2.5}$	2.65E-04	5.79E-06	2.13E-01
Sulphur Dioxide	1.16E-04	2.52E-06	1.99E-01
VOCs	1.39E-02	6.75E-04	2.40E-01
1,2-Dichloroethane	—	—	—
Ethylene dibromide	—	—	—
Tetrachloroethylene	—	—	—
Trichloroethylene	—	—	—
Vinyl Chloride	—	—	—
Cadmium	1.59E-07	3.47E-09	1.28E-04
Chromium	2.65E-08	5.79E-10	2.13E-05
Mercury	—	—	—
Manganese	—	—	—
Nickel	—	—	—
Lead	2.65E-08	5.79E-10	2.13E-05
Carbon tetrachloride	—	—	—
Chloroform	—	—	—
Chloromethane	—	—	—
Dichloromethane	—	—	—
Acetaldehyde	1.10E-04	—	5.21E-04
Acrolein	—	—	6.28E-05
Benzene	4.97E-04	—	6.34E-04
1,3-Butadiene	5.52E-05	—	2.66E-05
Formaldehyde	2.21E-04	—	8.01E-04

APPENDIX C

Ground Service and Stationary Equipment

Table C1: List of Ground Support Equipment

Type	Quantity	Fuel (e.g., Gasoline/ CNG/ Diesel etc.)	Model	Rated Power [hp]	Annual Operating Time [hrs]
Catering Isuzu 600	1	Diesel	Isuzu NPR	95hp	465
Catering Tiger 601	1	Diesel	Tesco Tiger	90hp	465
Catering Tiger 602	1	Diesel	Tesco Tiger	90hp	465
Kubota 500	1	Diesel	RTV 900	21.6hp	183
Ford	1	Gas	Ford F250 Pick Up	240hp	243
Chevrolet	1	Diesel	Chevy Silverado 3500	200hp	243
Chevrolet	1	Gas	Chev/Geo Express 36N	220hp	1825
GMC	1	Gas	Safari	210hp	365
GMC	1	Gas	Yukon Denali	220hp	365
GMC	1	Gas	Express 2500	220hp	730
GMC	1	Gas	Express 3500	220hp	730
Davco Air Cart	2	Diesel	20TDE-H		2190
JBT AeroTech Air Cart	8	Diesel	MPC 3013-112-40-25		8760
Ford	1	Gas	F350	150	547.5
Kubota ATV	1	Diesel	RTV900	22	4380
Cochran Belt Loader	1	Gas	N/A	150	182.5

Table C2: List of Stationary Heating Equipment at the Airport

Type	Quantity	Fuel (e.g., Gasoline/ CNG/ Diesel/ Electric etc.)	Rated Thermal Heat Input[BTU/hr]	Annual Operating Time [hrs]
Boilers	1	Natural gas	3,753,000	1779.375
Boilers	1	Natural gas	3,753,000	1779.375
RTU	1	Natural gas	384,000	5475
	1	Natural gas	400,000	5475
	1	Natural gas	125,000	5475
	1	Natural gas	400,000	5475
	1	Natural gas	400,000	5475
	1	Natural gas	125,000	5475
Furnace/AC	1	Natural gas	64,000	3650
RTU	1	Natural gas	108,000	5475
Tuber Heaters	4	Natural gas	360,000	21900
Tuber Heaters	4	Natural gas	360,000	21900
RTU	1	Natural gas	142,000	5475
Tuber Heaters	4	Natural gas	360,000	21900
Furnace	1	Natural gas	80,000	5475
RTU	1	Natural gas	245,000	5475
RTU	1	Natural gas	245,000	5475

Toronto Port Authority | Administration Portuaire de Toronto

TO: Gene Cabral
TPA Executive Vice President

FROM: Pat Fagnano
Manager Airside Operations
Billy Bishop Toronto City Airport

DATE: Friday, October 25, 2013

RE: City of Toronto Information Request – Ferry Operations

As requested, please see below the operating information for ***The Marilyn Bell 1*** our primary ferry as part of the City of Toronto's request for information.

<u>The Marilyn Bell 1:</u>

<u>Marine Engine Technical Information:</u>

2 CATERPILLAR Engines, Engine Model:	C-12
Engine family file:	ACPXW12.0PA2
SERIAL NUMBER:	NFL02292
BARE ENGINE HIGH IDLE RATE:	1890 RPM
HORSE POWER PER ENGINE:	385 RPM
BRAKE HORSE POWER (BHP):	287 RPM
BkW:	1800 RPM

Marilyn Bell Scheduled Trips: First trip from Mainland is at 05:15. Last trip from Airport is at 00:07.
<u>Total scheduled round trips = 76</u>

Fuel Type:	Diesel
Average Daily Fuel Usage:	397.3 litres
Average Weekly Fuel Usage:	2,780.8 litres

Engine Oil:	1,500 litres per year
Average daily burn:	4.10 litres per day
Yearly Amount of Oil filters Used:	90
Yearly Crankcase filters used:	50
Yearly Air Filters:	24
Yearly Generator Fuel Pumps	3
Yearly fuel filters:	24
Yearly Rolls Royce Filters:	8

PETRO-CANADA

Material Safety Data Sheet

WHMIS (Pictograms)	WHMIS (Classification)	Protective Clothing	TDG (pictograms)
	B-3, D-2B		

Section 1. Chemical Product and Company Identification

Product Name	**DIESEL FUEL**	**Code**	W104 SAP: 120, 121, 122, 287
Synonym	Diesel 50, Diesel 50 LS, #1 Diesel , #1 Diesel LS, Diesel LC, Seasonal Diesel, Seasonal Diesel LS, Diesel AA, Domestic Marine Diesel, International marine Diesel, Seasonal Diesel Locomotive, Domestic Marine diesel LS, diesel -20°C (LS), LSD, Low Sulphur Diesel, dyed diesel, marked diesel, coloured diesel, Naval Distillate.	**Validated on**	**3/2/2001.**
Manufacturer	PETRO-CANADA P.O. Box 2844 Calgary, Alberta T2P 3E3	**In case of Emergency**	Petro-Canada: 403-296-3000 Canutec Transportation: 613-996-6666 Poison Control Centre: Consult local telephone directory for emergency number(s).
Material Uses	Diesel fuels are distillate fuels suitable for use in high and medium speed internal combustion engines of the compression ignition type.		

Section 2. Composition and Information on Ingredients

			Exposure Limits (ACGIH)		
Name	**CAS #**	**% (V/V)**	**TLV-TWA(8 h)**	**STEL**	**CEILING**
1) Diesel oil. 2) Proprietary additives. 3) Aromatic content is 50% maximum (benzene: nil). 4) * Notice of Intended Change (2000): 100 mg/m³, skin, A3.	68334-30-5 Not available	>99.9 <0.1	Not established* Not established	Not established Not established	Not established Not established

Manufacturer Recommendation Not applicable

Other Exposure Limits Consult local, state, provincial or territory authorities for acceptable exposure limits.

Section 3. Hazards Identification.

Potential Health Effects Eye contact may cause mild eye irritation. Skin contact can cause moderate to severe irritation and produce drying, cracking, or defatting dermatitis. Inhalation of vapours can cause CNS depression with symptoms of nausea, headaches, vomiting, dizziness, fatigue, light-headedness, reduced coordination, unconciousness and possibly death. Inhalation can also cause irritation of nose and throat. Aspiration of liquid drops into the lungs may produce potentially fatal chemical pneumonitis (fluid in the lungs), severe lung damage, or respiratory failure. For more information, refer to Section 11.

Section 4. First Aid Measures

Eye Contact	IMMEDIATELY flush eyes with running water for at least 15 minutes, keeping eyelids open. Seek medical attention.
Skin Contact	Remove contaminated clothing - launder before reuse. Wash gently and thoroughly the contaminated skin with running water and non-abrasive soap. Seek medical attention.
Inhalation	Evacuate the victim to a safe area as soon as possible. If the victim is not breathing, perform artificial respiration. Allow the victim to rest in a well ventilated area. Seek medical attention.
Ingestion	DO NOT induce vomiting because of danger of aspirating liquid into lungs. Seek medical attention.
Note to Physician	Not available

Section 5. Fire-fighting Measures

Flammability	Class II - combustible liquid (NFPA).	**Flammable Limits**	LOWER: 0.7%, UPPER: 6%
Flash Points	Diesel Fuel: Closed Cup: >40ºC (>104ºF) Marine Diesel Fuel: Closed Cup: >60ºC (>140ºF)	**Auto-Ignition Temperature**	225ºC (437ºF)
Fire Hazards in Presence of Various Substances	Flammable in presence of open flames, sparks, or heat. Vapours are heavier than air and may travel considerable distance to sources of ignition and flash back. This product can accumulate static charge and ignite. May accumulate in confined spaces.	**Explosion Hazards in Presence of Various Substances**	Containers may explode in heat of fire. Do not cut, weld, heat, drill or pressurize empty container. Vapour explosion hazard indoors, outdoors or in sewers. Runoff to sewer may create fire or explosion hazard.

Products of Combustion Carbon oxides (CO, CO2), nitrogen oxides (NOx), sulphur oxides (SOx), sulphur compounds (H2S), water vapour (H2O), smoke and irritating vapours as products of incomplete combustion.

Continued on Next Page

Fire Fighting Media and Instructions	NAERG96, GUIDE 128, Flammable liquids (Non-polar/Water-immiscible). CAUTION: This product has a moderate flash point above 40ºC: Use of water spray when fighting fire may be inefficient. If tank, rail car or tank truck is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also consider initial evacuation for 800 meters (1/2 mile) in all directions. SMALL FIRES: Dry chemical, CO2, water spray or regular foam. LARGE FIRES: Water spray, fog or regular foam. Do not use straight streams. Move containers from fire area if you can do it without risk. Fires Involving Tanks or Car/Trailer Loads: Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in case of rising sound from venting devices or any discolouration of tank. ALWAYS stay away from the ends of tanks. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible withdraw from area and let fire burn. Wear positive pressure self-contained breathing apparatus (SCBA). Structural firefighters' protective clothing will only provide limited protection.

Section 6. Accidental Release Measures

Material Release or Spill	NAERG96, GUIDE 128, Flammable Liquids (Non-polar/ Water-immiscible). ELIMINATE ALL IGNITION SOURCES. Avoid contact. Stop leak if without risk. Contain spill. Absorb with inert absorbents, dry clay, or diatomaceous earth. Avoid inhaling dust of diatomaceous earth for it may contain silica in very fine particle size, making this a potential respiratory hazard. Place used absorbent in closed metal containers for later disposal or burn absorbent in a suitable combustion chamber. DO NOT FLUSH TO SEWERS, STREAMS OR OTHER BODIES OF WATER. Check with applicable jurisdiction for specific disposal requirements of spilled material and empty containers. Notify the appropriate authorities immediately.

Section 7. Handling and Storage

Handling	Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk. DO NOT reuse empty containers without commercial cleaning or reconditioning. Ground/bond line and equipment during pumping or transfer to avoid accumulation of static charge. DO NOT ingest. Do not breathe gas/vapour/spray. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately. Avoid contact with skin and eyes. Practice good personal hygiene. Wash hands after handling and before eating. Launder work clothes frequently. Discard saturated leather goods.
Storage	Store in tightly closed containers in cool, dry, isolated, well-ventilated area, and away from incompatibles. Ground all equipment containing material.

Section 8. Exposure Controls/Personal Protection

Engineering Controls	For normal application, special ventilation is not necessary. If user's operations generate vapours or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit. Make-up air should always be supplied to balance air removed by exhaust ventilation. Ensure that eyewash station and safety shower are close to work-station.
Personal Protection -	***The selection of personal protective equipment varies, depending upon conditions of use.***
Eyes	Eye protection (i.e., safety glasses, safety goggles and/or face shield) should be determined based on conditions of use. If product is used in an application where splashing may occur, the use of safety goggles and/or a face shield should be considered.
Body	Wear appropriate clothing to prevent skin contact. As a minimum long sleeves and trousers should be worn.
Respiratory	Where concentrations in air may exceed the occupational exposure limits given in Section 2 (and those applicable to your area) and where engineering, work practices or other means of exposure reduction are not adequate, NIOSH approved respirators may be necessary to prevent overexposure by inhalation.
Hands	Wear appropriate chemically protective gloves. When handling hot product ensure gloves are heat resistant and insulated.
Feet	Wear appropriate footwear to prevent product from coming in contact with feet and skin.

Section 9. Physical and Chemical Properties

Physical State and Appearance	Bright oily liquid.	**Viscosity**	1.3-4.1 cSt @ 40ºC (104ºF)
Colour	Clear to yellow / brown. Low sulphur diesel fuels (<0.05 wt % sulphur) are colourless to light yellow (and may be dyed red for taxation purposes). Regular sulphur diesel fuels (0.05-0.50 % sulphur) may be colourless to yellow / brown and are usually dyed red for taxation purposes.	**Pour Point**	Variable, 0ºC to -50ºC (32ºF to -58ºF)
Odour	Petroleum oil like.	**Softening Point**	Not applicable.
Odour Threshold	Not available	**Dropping Point**	Not applicable.
Boiling Point	150-371ºC (302-700ºF)	**Penetration**	Not applicable.
Density	0.85 kg/L @ 15ºC (Water = 1).	**Oil / Water Dist. Coefficient**	Not available
Vapour Density	4.5 (Air = 1)	**Ionicity (in water)**	Not applicable.

Continued on Next Page

Vapour Pressure	1.0 kPa @ 20ºC (7.5 mmHg @ 68ºF).	**Dispersion Properties**	Not available
Volatility	<0.1 (Butyl acetate = 1), less than gasoline.	**Solubility**	Insoluble in cold water, soluble in non-polar hydrocarbon solvents.

Section 10. Stability and Reactivity

Corrosivity	Not available		
Stability	The product is stable under normal handling and storage conditions.	**Hazardous Polymerization**	Will not occur under normal working conditions.
Incompatible Substances / Conditions to Avoid	Reactive with oxidizing agents and acids.	**Decomposition Products**	May release COx, NOx, SOx, H_2S, H_2O, smoke and irritating vapours when heated to decomposition.

Section 11. Toxicological Information

Routes of Entry	Skin contact, eye contact, inhalation, and ingestion.
Acute Lethality	Acute oral toxicity (LD50): 7500 mg/kg (rat).
Chronic or Other Toxic Effects	
Dermal Route:	Skin contact may cause moderate to severe irritation. Repeated exposure would produce drying and cracking or defatting dermatitis.
Inhalation Route:	Inhalation of vapours can cause CNS depression with symptoms of nausea, headaches, vomiting, dizziness, fatigue, light-headedness, reduced coordination, unconciousness and possibly death. Inhalation can also cause irritation of nose and throat.
Oral Route:	Aspiration of liquid drops into the lungs may produce potentially fatal chemical pneumonitis (fluid in the lungs), severe lung damage, or respiratory failure.
Eye Irritation/Inflammation:	Eye contact may cause mild irritation, but no permanent damage.
Immunotoxicity:	Not available
Skin Sensitization:	This product is not expected to be a skin sensitizer, based on the available data and the known hazards of the components.
Respiratory Tract Sensitization:	This product is not expected to be a respiratory tract sensitizer, based on the available data and the known hazards of the components.
Mutagenic:	This product is not expected to be a mutagen, based on the available data and the known hazards of the components.
Reproductive Toxicity:	This product is not expected to be a reproductive hazard, based on the available data and the known hazards of the components.
Teratogenicity/Embryotoxicity:	This product is not expected to be a teratogen or an embryotoxin, based on the available data and the known hazards of the components.
Carcinogenicity (ACGIH):	ACGIH Notice of Intended Changed (2000): proposed A3: animal carcinogen. [Diesel oil]
Carcinogenicity (IARC):	This product is not known to contain any chemicals at reportable quantities that are listed as group 1, 2A or 2B carcinogens by IARC.
Carcinogenicity (NTP):	This product is not known to contain any chemicals at reportable quantities that are listed as carcinogens by NTP.
Carcinogenicity (IRIS):	Not available
Carcinogenicity (OSHA):	This product is not known to contain any chemicals at reportable quantities that are listed as carcinogens by OSHA.
Other Considerations	No additional remark.

Section 12. Ecological Information

Environmental Fate	Not available	**Persistance/ Bioaccumulation Potential**	Not available
BOD5 and COD	Not available	**Products of Biodegradation**	Not available
Additional Remarks	No additional remark.		

Section 13. Disposal Considerations

Waste Disposal	Preferred waste management priorities are: (1) recycle or reprocess; (2) incineration with energy recovery; (3) disposal at licensed waste disposal facility. Ensure that disposal or reprocessing is in compliance with government requirements and local disposal regulations. Consult your local or regional authorities.

Section 14. Transport Information

TDG Classification	Diesel Fuel UN1202 3 III	**Special Provisions for Transport**	Not applicable.

Section 15. Regulatory Information

Other Regulations

This product is acceptable for use under the provisions of WHMIS-CPR. All components of this formulation are listed on the CEPA-DSL (Domestic Substances List).

All components of this formulation are listed on the US EPA-TSCA Inventory.

All components of this product are on the European Inventory of Existing Commercial Chemical Substances (EINECS).

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

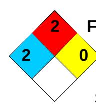
Please contact Product Safety for more information.

DSD/DPD (Europe)	Not evaluated.	**HCS (U.S.A.)**	CLASS: Irritating substance. CLASS: Target organ effects. CLASS: Combustible liquid having a flash point between 37.8°C (100°F) and 93.3°C (200°F).
ADR (Europe) (Pictograms)	NOT EVALUATED FOR EUROPEAN TRANSPORT NON ÉVALUÉ POUR LE TRANSPORT EUROPÉEN.	**DOT (U.S.A) (Pictograms)**	

HMIS (U.S.A.)

Health Hazard	2*
Fire Hazard	2
Reactivity	0
Personal Protection	H

NFPA (U.S.A.)



Fire Hazard

Health

Reactivity

Specific hazard

Rating	
0	Insignificant
1	Slight
2	Moderate
3	High
4	Extreme

Section 16. Other Information

References

Available upon request.
* Marque de commerce de Petro-Canada - Trademark

Glossary

ACGIH - American Conference of Governmental Industrial Hygienists
ADR - Agreement on Dangerous goods by Road (Europe)
ASTM - American Society for Testing and Materials (
BOD5 - Biological Oxygen Demand in 5 days
CAN/CGA B149.2 Propane Installation Code
CAS - Chemical Abstract Services
CEPA - Canadian Environmental Protection Act
CERCLA - Comprehensive Environmental Response, Compensation and Liability Act
CFR - Code of Federal Regulations
CHIP - Chemicals Hazard Information and Packaging Approved Supply List
COD5 - Chemical Oxygen Demand in 5 days
CPR - Controlled Products Regulations
DOT - Department of Transport
DSCL - Dangerous Substances Classification and Labeling (Europe)
DSD/DPD - Dangerous Substances or Dangerous Preparations Directives (Europe)
DSL - Domestic Substance List
EEC/EU - European Economic Community/European Union
EINECS - European Inventory of Existing Commercial Chemical Substances
EPCRA - Emergency Planning and Community Right to Know Act
FDA - Food and Drug Administration
FIFRA - Federal Insecticide, Fungicide and Rodenticide Act
HCS - Hazardous Communication System
HMIS - Hazardous Material Information System
IARC - International Agency for Research on Cancer
IRIS - Integrated Risk Information System
LD50/LC50 - Lethal Dose/Concentration kill 50%
LDLo/LCLo - Lowest Published Lethal Dose/Concentration
NAERG'96 - North American Emergency Response Guide Book (1996)
NFPA - National Fire Prevention Association
NIOSH - National Institute for Occupational Safety & Health
NPRI - National Pollutant Release Inventory
NSNR - New Substances Notification Regulations (Canada)
NTP - National Toxicology Program
OSHA - Occupational Safety & Health Administration
PEL - Permissible Exposure Limit
RCRA - Resource Conservation and Recovery Act
SARA - Superfund Amendments and Reorganization Act
SD - Single Dose
STEL - Short Term Exposure Limit (15 minutes)
TDG - Transportation Dangerous Goods (Canada)
TDLo/TCLo - Lowest Published Toxic Dose/Concentration
TLm - Median Tolerance Limit
TLV-TWA - Threshold Limit Value-Time Weighted Average
TSCA - Toxic Substances Control Act
USEPA - United States Environmental Protection Agency
USP - United States Pharmacopoeia
WHMIS - Workplace Hazardous Material Information System

For Copy of MSDS
Fuels & Solvents:
Western Canada, telephone: 403-296-4158; fax: 403-296-6551
Ontario & Central Canada, telephone: 1-800-668-0220; fax: 1-800-837-1228
Quebec & Eastern Canada, telephone: 514-640-8308; fax: 514-640-8385

For Product Safety Information: (905) 804-4752

Prepared by Product Safety - TAR on 3/2/2001.

Data entry by Product Safety - JDW.

To the best of our knowledge, the information contained herein is accurate. However, neither the above named supplier nor any of its subsidiaries assumes any liability whatsoever for the accuracy or completeness of the information contained herein. Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

MATERIAL SAFETY DATA SHEET

1. Product and Company Identification

Product Name	**Irving Jet Fuel A-1**
Synonym(s)	Aviation turbine fuel Distillate fuel oils, light
CAS #	Mixture
Product use	Fuel
Manufacturer	Irving Oil Refining G.P. Box 1260 Saint John, NB E2L 4H6 CA Phone: (506) 202-2000 Refinery: (506) 202-3000 Emergency Phone: 1-800-424-9300 (CHEMTREC)

2. Hazards Identification

Emergency overview

WARNING
COMBUSTIBLE LIQUID AND VAPOR.
CAUSES SKIN IRRITATION. CAUSES EYE IRRITATION.
MAY CAUSE RESPIRATORY TRACT IRRITATION.

Potential short term health effects

Routes of exposure Eye, Skin contact, Skin absorption, Inhalation, Ingestion.

Eyes Causes irritation.

Skin Causes irritation. May be absorbed through the skin.

ACGIH - Threshold Limit Values - Skin Notations

Benzene	71-43-2	Skin - potential significant contribution to overall exposure by the cutaneous route
Kerosene	8008-20-6	Skin - potential significant contribution to overall exposure by the cutaneous route

Inhalation Excessive intentional inhalation may cause respiratory tract irritation and central nervous system effects (headache, dizziness).

Ingestion Harmful if swallowed. Aspiration of material into lungs can cause chemical pneumonitis. Ingestion of high levels may produce kidney damage.
May cause stomach distress, nausea or vomiting.

Target organs Eyes. Respiratory system. Skin.

Chronic effects Prolonged or repeated exposure to dilutions can cause drying, defatting and dermatitis.

Signs and symptoms Symptoms may include redness, edema, drying, defatting and cracking of the skin. Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting.

OSHA Regulatory Status This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

Potential environmental effects See section 12.

3. Composition / Information on Ingredients

Ingredient(s)	CAS #	Percent
Kerosene	8008-20-6	60 - 100
Benzene	71-43-2	< 0.1

Composition comments

*Jet fuel is a complex mixture of hydrocarbons. Its exact composition depends on the source of the crude oil from which it was produced and the refining methods used. Jet fuel contains hundreds of individual organic chemicals. This section identifies only some of the well-known chemical constituents.

*Sulphur: <0.3%
*Mercaptan sulphur: <0.003%
*Hydrogen sulphide: Nil

4. First Aid Measures

First aid procedures

Eye contact	Flush with cool water. Remove contact lenses, if applicable, and continue flushing. Obtain medical attention if irritation persists.
Skin contact	Flush with cool water. Wash with soap and water. Obtain medical attention if irritation persists.
Inhalation	If symptoms develop, move victim to fresh air. If symptoms persist, obtain medical attention. If breathing has stopped, trained personnel should administer CPR immediately.
Ingestion	Do not induce vomiting. If vomiting occurs naturally, have victim lean forward to reduce risk of aspiration. Never give anything by mouth if victim is unconscious, or is convulsing. Obtain medical attention.
Notes to physician	Symptoms may be delayed.
General advice	Keep away from sources of ignition. No smoking. If you feel unwell, seek medical advice (show the label where possible). Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. Show this safety data sheet to the doctor in attendance. Avoid contact with eyes and skin. Keep out of reach of children.

5. Fire Fighting Measures

Flammable properties	Combustible by WHMIS/OSHA criteria. Vapors may travel to a source of ignition and flash back.
Extinguishing media	
Suitable extinguishing media	Carbon dioxide. Dry chemical. Foam.
Unsuitable extinguishing media	Not available
Protection of firefighters	
Specific hazards arising from the chemical	Container may explode in heat of fire. Vapors are heavier than air and may travel along the ground to some distant source of ignition and flash back. Cool containers with flooding quantities of water until well after fire is out.
Protective equipment for firefighters	Firefighters should wear full protective clothing including self contained breathing apparatus. Cool containers with flooding quantities of water until well after fire is out.
Hazardous combustion products	May include and are not limited to: Oxides of nitrogen. Oxides of carbon. Aromatic hydrocarbons.
Explosion data	
Sensitivity to mechanical impact	Not expected to be sensitive to mechanical impact.
Sensitivity to static discharge	Vapor: Yes.

6. Accidental Release Measures

Personal precautions	Keep unnecessary personnel away. Do not touch or walk through spilled material. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Keep people away from and upwind of spill/leak.
Environmental precautions	Do not discharge into lakes, streams, ponds or public waters.
Methods for containment	Stop leak if you can do so without risk. Prevent entry into waterways, sewers, basements or confined areas. This material is a water pollutant and should be prevented from contaminating soil or from entering sewage and drainage systems and bodies of water.
Methods for cleaning up	Remove sources of ignition. Before attempting clean up, refer to hazard data given above. Small spills may be absorbed with non-reactive absorbent and placed in suitable, covered, labelled containers. Prevent large spills from entering sewers or waterways. Contact emergency services and supplier for advice. Absorb with earth, sand or other non-combustible material and transfer to containers for later disposal.
Other information	Keep unnecessary personnel away.

7. Handling and Storage

Handling	Use good industrial hygiene practices in handling this material. Non-sparking equipment. Explosion-proof ventilation. Intrinsically safe electrical equipment. Ground and bond containers when transferring material. Have clean emergency eye wash and shower available in work area. When using do not eat or drink. Avoid contact with skin and clothing. Avoid contact with eyes. Keep container tightly closed. Use only with adequate ventilation. Wash thoroughly after handling. Avoid breathing vapors or mists of this product.
Storage	Keep out of reach of children. Containers should be vented and equipped with a flame arrester. Store in a cool, dry, well-ventilated place. Keep away from heat, open flames or other sources of ignition. Shipping: Stable during transport. May be transported hot.

8. Exposure Controls / Personal Protection

Exposure limits

Ingredient(s)	Exposure Limits
Benzene	**ACGIH-TLV** TWA: 0.5 ppm STEL: 2.5 ppm **OSHA-PEL** TWA: 10 ppm STEL: 5 ppm Ceiling: 25 ppm
Kerosene	**ACGIH-TLV** TWA: 200 mg/m3 Skin: 100 mg/m3 **OSHA-PEL** Not established

Engineering controls	Mechanical ventilation should be used when handling this product in enclosed spaces. Local exhaust ventilation may be necessary.
Personal protective equipment	
Eye / face protection	Face shield or chemical goggles. Eye wash fountain is recommended.
Hand protection	Nitrile rubber Viton™. Polyethylene.
Skin and body protection	Use of protective coveralls and long sleeves is recommended. If clothing or footwear becomes contaminated with the product, remove it and completely decontaminate it before re-use, or discard it.
Respiratory protection	For confined spaces, wear a NIOSH-approved (or equivalent) full-facepiece airline respirator in the positive pressure mode with emergency escape provisions. Respirator should be selected by and used under the direction of a trained health and safety professional following requirements found in OSHA's respirator standard (29 CFR 1910.134), CAN/CSA-Z94.4 and ANSI's standard for respiratory protection (Z88.2).
General hygiene considerations	Handle in accordance with good industrial hygiene and safety practice. When using do not eat or drink. Wash hands before breaks and immediately after handling the product.

9. Physical and Chemical Properties

Appearance	Clear
Color	Colorless
Form	Liquid
Odor	Kerosene
Odor threshold	0.55 mg/m3 for sulphur free product
Physical state	Liquid

pH	Not applicable
Melting point	Not available
Freezing point	-52.60 - -76.00 °F (-47 - -60 °C)
Boiling point	314.60 - 572.00 °F (157 - 300 °C)
Pour point	Not available
Evaporation rate	Not available
Flash point	100.40 - 161.60 °F (38 - 72 °C) Closed Cup
Auto-ignition temperature	410.00 °F (210 °C)
Flammability limits in air, lower, % by volume	0.7 %
Flammability limits in air, upper, % by volume	5 %
Vapor pressure	10.5 mmHg @ 38°C
Vapor density	4.5 (Air=1)
Specific gravity	0.775 - 0.840 @ 15°C
Octanol/water coefficient	3.3 To > 6 (log Poct)
Solubility (H2O)	Not available
VOC (Weight %)	Not available
Viscosity	2.0 - 8.0 cST @ -20°C
Percent volatile	Not available

10. Stability and Reactivity

Reactivity	This product may react with strong oxidizing agents.
Possibility of hazardous reactions	Hazardous polymerization does not occur.
Chemical stability	Stable under recommended storage conditions.
Conditions to avoid	Heat, open flames, static discharge, sparks and other ignition sources. Avoid high temperatures. Do not mix with other chemicals.
Incompatible materials	Acids. Oxidizers.
Hazardous decomposition products	May include and are not limited to: Oxides of carbon. Oxides of nitrogen. Aromatic hydrocarbons.

11. Toxicological Information

Component analysis - LC50

Ingredient(s)	LC50
Benzene	13700 ppm rat; 13700 mg/l/4h rat
Kerosene	5.2801 mg/m3 rat

Component analysis - Oral LD50

Ingredient(s)	LD50
Benzene	690 mg/kg rat; 4700 mg/kg mouse
Kerosene	5000 mg/kg rat; 16300 mg/kg guinea pig

Effects of acute exposure

Eye Causes irritation.

Skin Causes irritation. May be absorbed through the skin.

ACGIH - Threshold Limit Values - Skin Notations

Benzene	71-43-2	Skin - potential significant contribution to overall exposure by the cutaneous route
Kerosene	8008-20-6	Skin - potential significant contribution to overall exposure by the cutaneous route

Inhalation Excessive intentional inhalation may cause respiratory tract irritation and central nervous system effects (headache, dizziness).

Ingestion Harmful if swallowed. Aspiration of material into lungs can cause chemical pneumonitis.
Ingestion of high levels may produce kidney damage.
May cause stomach distress, nausea or vomiting.

Sensitization Non-hazardous by WHMIS/OSHA criteria.

Chronic effects Blood and nervous system disorders may occur after prolonged skin contact.

Carcinogenicity Contains potential carcinogens.
Benzene and certain polycyclic aromatic hydrocarbons (PAHs) are known carcinogens.

ACGIH - Threshold Limit Values - Carcinogens

Benzene	71-43-2	A1 - Confirmed Human Carcinogen
Kerosene	8008-20-6	A3 - Confirmed Animal Carcinogen with Unknown Relevance to Humans

IARC - Group 1 (Carcinogenic to Humans)

Benzene	71-43-2	Monograph 100F [in preparation]; Supplement 7 [1987]; Monograph 29 [1982]

NTP (National Toxicology Program) - Report on Carcinogens - Known Human Carcinogens

Benzene	71-43-2	Known Human Carcinogen

U.S. - California - Proposition 65 - Carcinogens List

Benzene	71-43-2	carcinogen, initial date 2/27/87

Mutagenicity Non-hazardous by WHMIS/OSHA criteria.

Reproductive effects Non-hazardous by WHMIS/OSHA criteria.

Teratogenicity Non-hazardous by WHMIS/OSHA criteria.

Name of Toxicologically Synergistic Products Other CNS depressants can be expected to produce additive or synergistic effects. May increase the photosensitizing ability of certain chemicals, such as dinitrochlorobenzene (DNCB).

12. Ecological Information

Ecotoxicity Components of this product have been identified as having potential environmental concerns.

Ecotoxicity - Freshwater Algae - Acute Toxicity Data

Benzene	71-43-2	72 Hr EC50 Pseudokirchneriella subcapitata: 29 mg/L

Ecotoxicity - Freshwater Fish - Acute Toxicity Data

Benzene	71-43-2	96 Hr LC50 Pimephales promelas: 10.7-14.7 mg/L [flow-through]; 96 Hr LC50 Oncorhynchus mykiss: 5.3 mg/L [flow-through]; 96 Hr LC50 Lepomis macrochirus: 22.49 mg/L [static]; 96 Hr LC50 Poecilia reticulata: 28.6 mg/L [static]; 96 Hr LC50 Pimephales promelas: 22330-41160 µg/L [static]; 96 Hr LC50 Lepomis macrochirus: 70000-142000 µg/L [static]

Ecotoxicity - Water Flea - Acute Toxicity Data

Benzene	71-43-2	48 Hr EC50 Daphnia magna: 8.76 - 15.6 mg/L [Static]; 48 Hr EC50 Daphnia magna: 10 mg/L

Persistence / degradability Non-persistent/ Group 1

Bioaccumulation / accumulation Not available

Mobility in environmental media Not available

Environmental effects Not available

Aquatic toxicity Not available

Partition coefficient 3.3 To > 6 (log Poct)

Chemical fate information Not available

Other adverse effects Not available

13. Disposal Considerations

Disposal instructions Review federal, provincial, and local government requirements prior to disposal.

Waste from residues / unused products Not available

Contaminated packaging Not available

14. Transport Information

U.S. Department of Transportation (DOT)

Basic shipping requirements:

Proper shipping name Fuel, aviation, turbine engine

Hazard class 3

UN number UN1863

Packing group III

Additional information:

Special provisions 144, B1, IB3, T2, TP1

Packaging exceptions 150

ERG number 128

Transportation of Dangerous Goods (TDG - Canada)

Basic shipping requirements:

Proper shipping name FUEL, AVIATION, TURBINE ENGINE

Hazard class 3

UN number UN1863

Packing group III

Additional information:

Special provisions 17,82

15. Regulatory Information

Canadian federal regulations This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Products Regulations.

Canada - CEPA - Schedule I - List of Toxic Substances

Benzene	71-43-2	Present

Canada - WHMIS - Ingredient Disclosure List

Benzene	71-43-2	0.1 %

WHMIS status Controlled

WHMIS classification Class B - Division 3 - Combustible Liquid, Class D - Division 2B

WHMIS labeling

Occupational Safety and Health Administration (OSHA)

29 CFR 1910.1200 hazardous chemical Yes

US Federal regulations	This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

U.S. - CERCLA/SARA - Hazardous Substances and their Reportable Quantities

Benzene	71-43-2	10 Lb final RQ (received an adjusted RQ of 10 lbs based on potential carcinogenicity in an August 14, 1989 final rule); 4.54 kg final RQ (received an adjusted RQ of 10 lbs based on potential carcinogenicity in an August 14, 1989 final rule)

U.S. - CERCLA/SARA - Section 313 - Emission Reporting

Benzene	71-43-2	0.1 % de minimis concentration

U.S. - CWA (Clean Water Act) - Hazardous Substances

Benzene	71-43-2	Present

U.S. - CWA (Clean Water Act) - Priority Pollutants

Benzene	71-43-2	Present

U.S. - CWA (Clean Water Act) - Toxic Pollutants

Benzene	71-43-2	Present

CERCLA (Superfund) reportable quantity

Benzene: 10.0000

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories	Immediate Hazard - Yes Delayed Hazard - No Fire Hazard - Yes Pressure Hazard - No Reactivity Hazard - No
Section 302 extremely hazardous substance	No
Section 311 hazardous chemical	Yes

Clean Air Act (CAA)	Not available
Clean Water Act (CWA)	Not available

State regulations WARNING: This product contains a chemical known to the State of California to cause cancer and birth defects or other reproductive harm.

U.S. - California - 8 CCR Section 339 - Director's List of Hazardous Substances

Benzene	71-43-2	Present

U.S. - California - Proposition 65 - Carcinogens List

Benzene	71-43-2	carcinogen, initial date 2/27/87

U.S. - California - Proposition 65 - Developmental Toxicity

Benzene	71-43-2	developmental toxicity, initial date 12/26/97

U.S. - California - Proposition 65 - Reproductive Toxicity - Male

Benzene	71-43-2	male reproductive toxicity, initial date 12/26/97

U.S. - Connecticut - Carcinogenic Substances

Benzene	71-43-2	Present

U.S. - Illinois - Toxic Air Contaminant Carcinogens

Benzene	71-43-2	ACGIH Carcinogen; IRIS A Carcinogen; NTP Known Carcinogen

U.S. - Illinois - Toxic Air Contaminants

Benzene	71-43-2	Present

U.S. - Louisiana - Reportable Quantity List for Pollutants

Benzene	71-43-2	10 Lb final RQ (received an adjusted RQ of 10 lb based on potential carcinogenicity in an August 14, 1989 final rule); 4.54 kg final RQ (received an adjusted RQ of 10 lb based on potential carcinogenicity in an August 14, 1989 final rule)

U.S. - Massachusetts - Right To Know List

Benzene	71-43-2	Carcinogen; Extraordinarily hazardous
Kerosene	8008-20-6	Present

U.S. - Michigan - Critical Materials List

Benzene	71-43-2	100 Lb Annual usage threshold

U.S. - Minnesota - Hazardous Substance List

Benzene	71-43-2	Carcinogen

U.S. - New Jersey - Right to Know Hazardous Substance List

Benzene	71-43-2	sn 0197
Kerosene	8008-20-6	sn 1091

U.S. - New York - Reporting of Releases Part 597 - List of Hazardous Substances

Benzene	71-43-2	10 Lb RQ (air); 1 lb RQ (land/water)

U.S. - North Carolina - Control of Toxic Air Pollutants

Benzene	71-43-2	0.00012 mg/m3 (carcinogens)

U.S. - Pennsylvania - RTK (Right to Know) - Special Hazardous Substances

Benzene	71-43-2	Present

U.S. - Pennsylvania - RTK (Right to Know) List

Benzene	71-43-2	Environmental hazard; Special hazardous substance
Kerosene	8008-20-6	Present

U.S. - Rhode Island - Hazardous Substance List

Benzene	71-43-2	Toxic (skin); Flammable (skin); Carcinogen (skin)
Kerosene	8008-20-6	Flammable

Inventory name

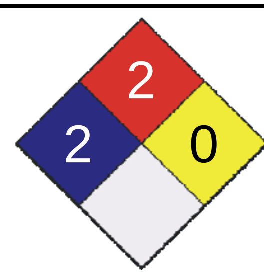
Country(s) or region	Inventory name	On inventory (yes/no)*
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)

16. Other Information

LEGEND HMIS/NFPA	
Severe	4
Serious	3
Moderate	2
Slight	1
Minimal	0

Health	/	2
Flammability		2
Physical Hazard		0
Personal Protection		X



Disclaimer	The information contained in this form is based on data from sources considered to be reliable but Irving Oil Refining G.P. does not guarantee the accuracy or completeness thereof. The information is provided as a service to the persons purchasing or using the material to which it refers and Irving Oil Refining G.P. expressly disclaims all liability for loss or damage including consequential loss or for injury to persons including death. The information shall not be reproduced, published or distributed in any manner without prior consent in writing of Irving Oil Refining G.P.
Issue date	21-Aug-2012
Effective date	31-Oct-2012
Expiry date	31-Oct-2015
Prepared by	Dell Tech Laboratories Ltd. (519) 858-5021
Other information	For an updated MSDS, please contact the supplier/manufacturer listed on the first page of the document. This MSDS conforms to the ANSI Z400.1/Z129.1-2010 Standard.

Irving Jet Fuel A-1

Combustible liquid. Eye and skin irritant.

Keep away from sources of ignition. No smoking. Avoid contact with eyes and skin. Wear rubber gloves and safety glasses with side shields. Keep out of reach of children.

EYE: Flush with cool water. Remove contact lenses, if applicable, and continue flushing. Obtain medical attention if irritation persists.

SKIN: Flush with cool water.   Wash with soap and water. Obtain medical attention if irritation persists.

INHALATION: If symptoms develop, move victim to fresh air. If symptoms persist, obtain medical attention. If breathing has stopped, trained personnel should administer CPR immediately.

INGESTION: Do not induce vomiting. If vomiting occurs naturally, have victim lean forward to reduce risk of aspiration. Never give anything by mouth if victim is unconscious, or is convulsing. Obtain medical attention.

READ MATERIAL SAFETY DATA SHEET BEFORE USING PRODUCT

===

Liquide combustible. Irritant pour les yeux et la peau.

Conserver à l'écart de toutes sources d'ignition. Ne pas fumer. Éviter le contact avec les yeux et la peau. Porter des gants en caoutchouc et des lunettes de sécurité pourvues de protections latérales. Tenir hors de la portée des enfants.

YEUX: Rincer à grande eau froide. Enlever les verres de contact, le cas échéant, et continuer à rincer. Obtenir de l'attention médicale si l'irritation persiste.

PEAU: Rincer à grande eau froide. Laver à l'eau et au savon. Obtenir de l'attention médicale si l'irritation persiste.

INHALATION: En cas de symptômes, placer la victime à l'air frais. Si les symptômes persistent, obtenir de l’attention médicale. Si la victime ne respire pas du personnel qualifié devrait immédiatement commencer la réanimation cardio-pulmonaire.

INGESTION: Ne pas provoquer le vomissement. Si le vomissement se produit spontanément, incliner la victime vers l'avant pour réduire le risque d'inhalation. Ne jamais rien faire boire ou avaler à une victime inconsciente, ou si la victime a des convulsions. Appeler un médecin.

LIRE LA FICHE SIGNALÉTIQUE AVANT D'UTILISER CE PRODUIT

Irving Oil Refining G.P.

APPENDIX D

Annual and 24-hr 95th %-ile Concentrations per Ward

Table D1: 95th %ile 24 hour Averaged Concentrations by Ward in µg/m³ - Baseline Conditions

Contaminant	Ward					
	28	19	30	20	27	32
PAHs (as BAP)	0.021	0.021	0.020	0.022	0.021	0.019
Toluene	15.35	14.45	14.25	14.83	15.61	14.57
1,4 Dichlorobenzene	0.69	0.63	0.56	0.65	0.72	0.52
Carbon monoxide	873.93	875.95	772.36	881.93	802.39	597.71
Nitrogen Oxides (as NO_2)	212.64	175.14	160.60	198.16	190.30	126.87
PM_{10}	54.05	47.67	45.50	54.90	51.14	39.69
$PM_{2.5}$	20.42	17.34	17.84	20.46	20.28	17.46
Sulphur dioxide	67.13	62.58	66.42	66.80	63.00	61.09
VOC	118.43	124.80	270.64	114.04	115.82	278.79
1,2 Dichloroethane	9.42E-04	9.35E-04	6.71E-04	9.36E-04	9.42E-04	6.64E-04
Ethylene dibromide	6.20E-05	6.20E-05	6.20E-05	6.20E-05	6.20E-05	6.20E-05
Tetrachloroethylene	1.46	1.46	1.32	1.70	1.80	1.58
Trichloroethylene	0.22	0.22	0.18	0.22	0.22	0.18
Vinyl chloride	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033
Cadmium	0.0009	0.0006	0.0005	0.0008	0.0009	0.0005
Chromium	0.0040	0.0040	0.0034	0.0040	0.0040	0.0032
Mercury	0.0005	0.0004	0.0004	0.0005	0.0005	0.0004
Manganese	0.013	0.013	0.012	0.013	0.013	0.012
Nickel	0.0043	0.0039	0.0037	0.0043	0.0044	0.0037
Lead	0.0053	0.0052	0.0042	0.0053	0.0054	0.0045
Carbon Tetrachloride	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004
Chloroform	0.025	0.024	0.022	0.024	0.026	0.021
Chloromethane	0.007	0.007	0.007	0.007	0.007	0.007
Dichloromethane	0.828	0.839	0.708	0.814	0.869	0.648
Acetaldehyde	0.712	0.797	0.651	0.721	0.642	0.523
Acrolein	0.09	0.09	0.07	0.09	0.09	0.06
Benzene	2.39	2.27	2.98	2.39	2.26	3.06
1,3- butadiene	0.27	0.28	0.23	0.29	0.27	0.19
Formaldehyde	1.70	1.54	1.47	1.70	1.57	1.20

Table D2: Maximum Annual Concentrations by Ward in µg/m³ - Baseline Conditions

Contaminant	Ward					
	28	19	30	20	27	32
PAHs (as BAP)	0.009	0.009	0.009	0.009	0.009	0.008
Toluene	6.42	6.21	6.14	6.29	6.75	6.33
1,4 Dichlorobenzene	0.28	0.25	0.22	0.26	0.29	0.21
Carbon monoxide	389.64	374.43	328.11	384.34	350.08	267.22
Nitrogen Oxides (as NO_2)	76.64	60.99	56.34	68.11	62.55	41.31
Ozone (ppb)	42.05	41.25	41.01	41.62	41.32	40.23
PM_{10}	26.06	23.07	20.52	25.18	22.79	18.60
$PM_{2.5}$	9.66	7.79	8.20	9.11	8.73	8.38
Sulphur dioxide	24.47	19.19	28.07	22.22	19.01	19.50
VOC	49.43	60.02	129.73	48.96	48.96	136.03
1,2 Dichloroethane	3.34E-04	3.30E-04	2.34E-04	3.31E-04	3.36E-04	2.33E-04
Ethylene dibromide	1.63E-05	1.63E-05	1.63E-05	1.63E-05	1.63E-05	1.63E-05
Tetrachloroethylene	0.59	0.58	0.55	0.67	0.77	0.73
Trichloroethylene	0.08	0.07	0.06	0.08	0.08	0.06
Vinyl chloride	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009
Cadmium	0.0004	0.0002	0.0002	0.0004	0.0004	0.0002
Chromium	0.002	0.002	0.001	0.002	0.002	0.001
Mercury	0.0002	0.0002	0.0002	0.0002	0.0002	0.0001
Manganese	0.004	0.004	0.004	0.004	0.004	0.004
Nickel	0.002	0.002	0.002	0.002	0.002	0.002
Lead	0.002	0.002	0.002	0.002	0.002	0.002
Carbon Tetrachloride	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Chloroform	0.01	0.01	0.01	0.01	0.01	0.01
Chloromethane	0.002	0.002	0.002	0.002	0.002	0.002
Dichloromethane	0.35	0.34	0.28	0.34	0.37	0.27
Acetaldehyde	0.33	0.34	0.34	0.33	0.27	0.22
Acrolein	0.04	0.03	0.03	0.04	0.04	0.02
Benzene	1.09	1.03	1.41	1.08	0.99	1.47
1,3- butadiene	0.12	0.12	0.10	0.12	0.11	0.08
Formaldehyde	0.73	0.66	0.71	0.73	0.64	0.50

Table D3: 95th %ile 24 hour Averaged Concentrations by Ward in µg/m³ - Existing Operations

Contaminant	Ward					
	28	19	30	20	27	32
PAHs (as BAP)	0.021	0.021	0.020	0.022	0.021	0.019
Toluene	15.35	14.45	14.25	14.83	15.61	14.57
1,4 Dichlorobenzene	0.69	0.63	0.56	0.65	0.72	0.52
Carbon monoxide	881.63	876.02	772.84	885.24	806.47	598.40
Nitrogen Oxides (as NO_2)	223.53	239.84	167.76	343.88	197.74	127.97
PM_{10}	54.05	49.84	45.50	55.20	51.15	39.83
$PM_{2.5}$	21.03	19.99	17.94	24.44	20.40	17.59
Sulphur dioxide	67.57	65.86	66.61	70.92	63.16	61.15
VOC	118.66	125.11	270.64	114.44	116.03	278.80
1,2 Dichloroethane	9.42E-04	9.35E-04	6.71E-04	9.36E-04	9.42E-04	6.64E-04
Ethylene dibromide	6.20E-05	6.20E-05	6.20E-05	6.20E-05	6.20E-05	6.20E-05
Tetrachloroethylene	1.46	1.46	1.32	1.70	1.80	1.58
Trichloroethylene	0.22	0.22	0.18	0.22	0.22	0.18
Vinyl chloride	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033
Cadmium	0.0009	0.0009	0.0006	0.0017	0.0009	0.0005
Chromium	0.0048	0.0044	0.0034	0.0054	0.0044	0.0032
Mercury	0.0005	0.0004	0.0004	0.0005	0.0005	0.0004
Manganese	0.013	0.013	0.012	0.013	0.013	0.012
Nickel	0.0043	0.0039	0.0038	0.0043	0.0044	0.0037
Lead	0.0054	0.0053	0.0042	0.0055	0.0054	0.0045
Carbon Tetrachloride	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004
Chloroform	0.025	0.024	0.022	0.024	0.026	0.021
Chloromethane	0.007	0.007	0.007	0.007	0.007	0.007
Dichloromethane	0.83	0.84	0.71	0.81	0.87	0.65
Acetaldehyde	0.79	0.82	0.69	0.91	0.66	0.53
Acrolein	0.21	0.13	0.08	0.20	0.10	0.06
Benzene	2.40	2.30	2.98	2.39	2.27	3.06
1,3- butadiene	0.29	0.29	0.24	0.30	0.27	0.19
Formaldehyde	1.78	1.59	1.48	1.80	1.62	1.20

Table D4: Maximum Annual Concentrations by Ward in µg/m³ - Existing Operations

Contaminant	Ward					
	28	19	30	20	27	32
PAHs (as BAP)	0.009	0.009	0.009	0.009	0.009	0.008
Toluene	6.42	6.21	6.14	6.29	6.75	6.33
1,4 Dichlorobenzene	0.28	0.25	0.22	0.26	0.29	0.21
Carbon monoxide	393.67	380.12	328.69	394.30	352.71	267.71
Nitrogen Oxides (as NO_2)	109.41	100.80	78.98	142.53	88.39	56.38
Ozone (ppb)	39.44	39.73	40.05	39.67	39.93	40.19
PM_{10}	26.21	23.73	20.55	25.61	22.89	18.62
$PM_{2.5}$	9.81	8.45	8.23	10.00	8.83	8.40
Sulphur dioxide	24.69	20.34	28.26	22.95	19.24	19.56
VOC	49.61	60.30	129.75	49.40	49.02	136.06
1,2 Dichloroethane	3.34E-04	3.30E-04	2.34E-04	3.31E-04	3.36E-04	2.33E-04
Ethylene dibromide	1.63E-05	1.63E-05	1.63E-05	1.63E-05	1.63E-05	1.63E-05
Tetrachloroethylene	0.59	0.58	0.55	0.67	0.77	0.73
Trichloroethylene	0.075	0.075	0.060	0.075	0.076	0.059
Vinyl chloride	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009
Cadmium	0.0004	0.0003	0.0003	0.0005	0.0004	0.0002
Chromium	0.002	0.002	0.001	0.002	0.002	0.001
Mercury	0.0002	0.0002	0.0002	0.0002	0.0002	0.0001
Manganese	0.004	0.004	0.004	0.004	0.004	0.004
Nickel	0.002	0.002	0.002	0.002	0.002	0.002
Lead	0.002	0.002	0.002	0.002	0.002	0.002
Carbon Tetrachloride	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Chloroform	0.01	0.01	0.01	0.01	0.01	0.01
Chloromethane	0.002	0.002	0.002	0.002	0.002	0.002
Dichloromethane	0.35	0.34	0.28	0.34	0.37	0.27
Acetaldehyde	0.40	0.35	0.35	0.39	0.28	0.22
Acrolein	0.08	0.05	0.03	0.08	0.04	0.02
Benzene	1.10	1.04	1.41	1.10	0.99	1.47
1,3- butadiene	0.13	0.13	0.10	0.14	0.12	0.08
Formaldehyde	0.76	0.69	0.72	0.79	0.65	0.50

Table D5: 95th %ile 24 hour Averaged Concentrations by Ward in µg/m³ - Proposed Future Scenario with 25% Boeing 737-700s

Contaminant	Ward					
	28	19	30	20	27	32
PAHs (as BAP)	0.021	0.021	0.020	0.022	0.021	0.019
Toluene	15.35	14.45	14.25	14.83	15.61	14.57
1,4 Dichlorobenzene	0.69	0.63	0.56	0.65	0.72	0.52
Carbon monoxide	882.04	876.03	772.88	885.21	806.71	598.48
Nitrogen Oxides (as NO_2)	237.25	262.46	171.37	358.82	202.33	130.22
PM_{10}	54.05	49.90	45.50	55.22	51.15	39.84
$PM_{2.5}$	21.07	20.07	17.95	24.49	20.40	17.60
Sulphur dioxide	67.83	66.64	66.68	72.00	63.29	61.17
VOC	118.65	125.10	270.64	114.42	115.99	278.80
1,2 Dichloroethane	9.42E-04	9.35E-04	6.71E-04	9.36E-04	9.42E-04	6.64E-04
Ethylene dibromide	6.20E-05	6.20E-05	6.20E-05	6.20E-05	6.20E-05	6.20E-05
Tetrachloroethylene	1.46	1.46	1.32	1.70	1.80	1.58
Trichloroethylene	0.22	0.22	0.18	0.22	0.22	0.18
Vinyl chloride	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033
Cadmium	0.0010	0.0010	0.0006	0.0019	0.0009	0.0005
Chromium	0.0050	0.0045	0.0035	0.0057	0.0045	0.0032
Mercury	0.0005	0.0004	0.0004	0.0005	0.0005	0.0004
Manganese	0.013	0.013	0.012	0.013	0.013	0.012
Nickel	0.0044	0.0039	0.0038	0.0043	0.0044	0.0037
Lead	0.0054	0.0053	0.0043	0.0056	0.0055	0.0045
Carbon Tetrachloride	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004
Chloroform	0.025	0.024	0.022	0.024	0.026	0.021
Chloromethane	0.007	0.007	0.007	0.007	0.007	0.007
Dichloromethane	0.83	0.84	0.71	0.81	0.87	0.65
Acetaldehyde	0.78	0.81	0.68	0.89	0.66	0.53
Acrolein	0.20	0.12	0.08	0.18	0.10	0.06
Benzene	2.40	2.29	2.98	2.39	2.27	3.06
1,3- butadiene	0.29	0.29	0.24	0.30	0.27	0.19
Formaldehyde	1.78	1.59	1.48	1.81	1.62	1.20

Table D6: Maximum Concentrations by Ward in µg/m³ - Proposed Future Scenario with 25% Boeing 737-700s

Contaminant	Ward					
	28	19	30	20	27	32
PAHs (as BAP)	0.009	0.009	0.009	0.009	0.009	0.008
Toluene	6.42	6.21	6.14	6.29	6.75	6.33
1,4 Dichlorobenzene	0.28	0.25	0.22	0.26	0.29	0.21
Carbon monoxide	393.89	380.47	328.73	394.71	352.86	267.75
Nitrogen Oxides (as NO_2)	107.40	92.38	78.01	111.32	86.92	56.21
Ozone (ppb)	39.56	39.82	40.17	39.77	39.97	40.23
PM_{10}	26.22	23.74	20.56	25.62	22.90	18.62
$PM_{2.5}$	9.82	8.46	8.23	10.02	8.84	8.40
Sulphur dioxide	24.79	20.62	28.33	23.47	19.32	19.59
VOC	49.60	60.28	129.75	49.37	49.01	136.06
1,2 Dichloroethane	3.34E-04	3.30E-04	2.34E-04	3.31E-04	3.36E-04	2.33E-04
Ethylene dibromide	1.63E-05	1.63E-05	1.63E-05	1.63E-05	1.63E-05	1.63E-05
Tetrachloroethylene	0.59	0.58	0.55	0.67	0.77	0.73
Trichloroethylene	0.08	0.07	0.06	0.08	0.08	0.06
Vinyl chloride	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009
Cadmium	0.0004	0.0003	0.0003	0.0005	0.0004	0.0002
Chromium	0.002	0.002	0.001	0.002	0.002	0.001
Mercury	0.0002	0.0002	0.0002	0.0002	0.0002	0.0001
Manganese	0.004	0.004	0.004	0.004	0.004	0.004
Nickel	0.002	0.002	0.002	0.002	0.002	0.002
Lead	0.003	0.002	0.002	0.003	0.002	0.002
Carbon Tetrachloride	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Chloroform	0.011	0.011	0.010	0.011	0.012	0.009
Chloromethane	0.002	0.002	0.002	0.002	0.002	0.002
Dichloromethane	0.35	0.34	0.28	0.34	0.37	0.27
Acetaldehyde	0.39	0.35	0.35	0.38	0.28	0.22
Acrolein	0.08	0.05	0.03	0.07	0.04	0.02
Benzene	1.09	1.04	1.41	1.10	0.99	1.47
1,3- butadiene	0.13	0.13	0.10	0.14	0.12	0.08
Formaldehyde	0.75	0.69	0.72	0.78	0.65	0.50

Table D7: 95th %ile 24 hour Averaged Concentrations by Ward in µg/m³ - Proposed Future Scenario with 25% CS100s

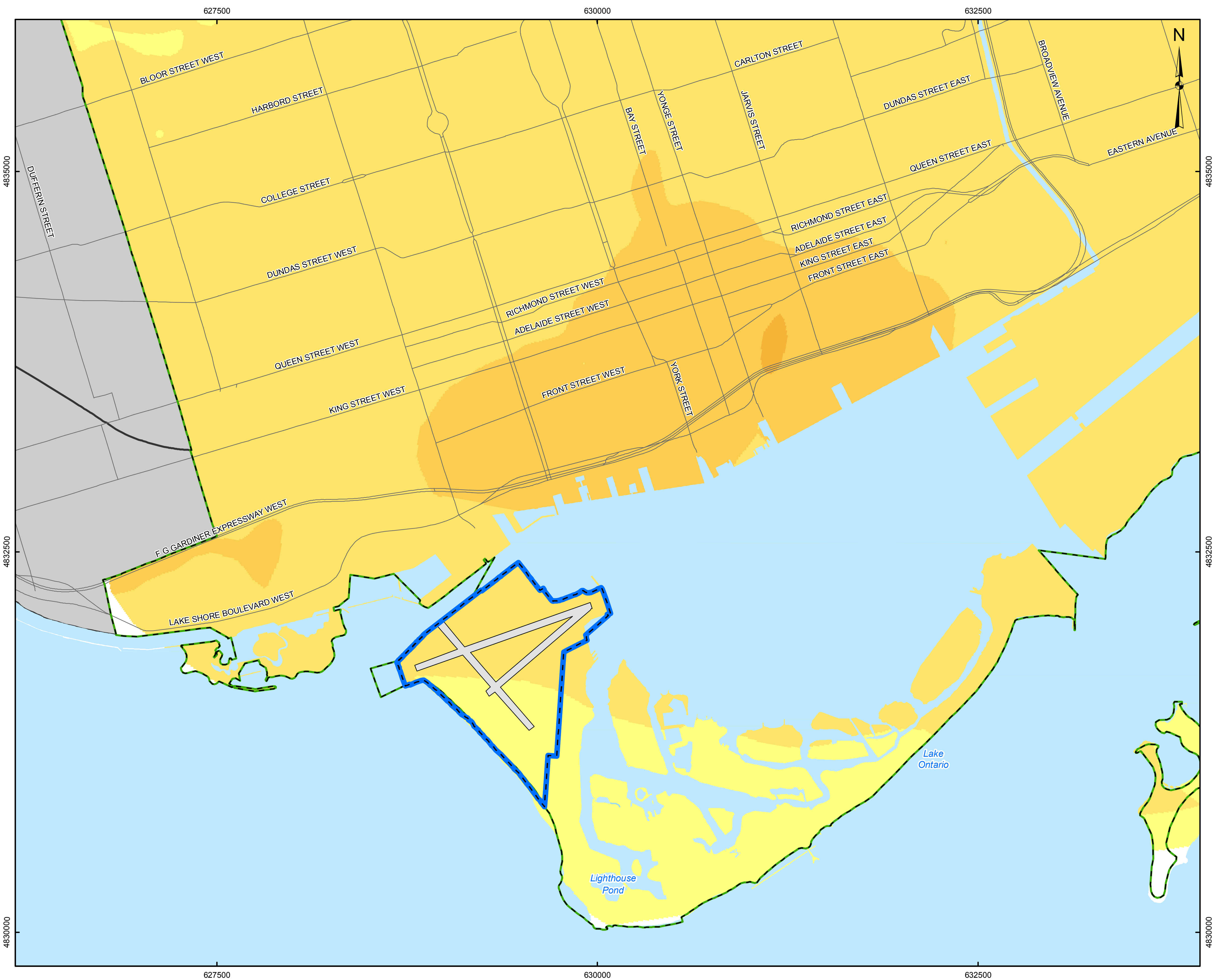
Contaminant	Ward					
	28	19	30	20	27	32
PAHs (as BAP)	0.021	0.021	0.020	0.022	0.021	0.019
Toluene	15.35	14.45	14.25	14.83	15.61	14.57
1,4 Dichlorobenzene	0.69	0.63	0.56	0.65	0.72	0.52
Carbon monoxide	881.25	876.02	772.82	885.20	806.26	598.35
Nitrogen Oxides (as NO_2)	234.51	258.58	171.00	358.01	201.80	130.17
PM_{10}	54.05	49.84	45.50	55.20	51.15	39.83
$PM_{2.5}$	21.03	20.01	17.94	24.44	20.40	17.59
Sulphur dioxide	21.03	20.01	17.94	24.44	20.40	17.59
VOC	118.65	125.10	270.64	114.43	116.01	278.80
1,2 Dichloroethane	9.42E-04	9.35E-04	6.71E-04	9.36E-04	9.42E-04	6.64E-04
Ethylene dibromide	6.20E-05	6.20E-05	6.20E-05	6.20E-05	6.20E-05	6.20E-05
Tetrachloroethylene	1.46	1.46	1.32	1.70	1.80	1.58
Trichloroethylene	0.22	0.22	0.18	0.22	0.22	0.18
Vinyl chloride	0.003	0.003	0.003	0.003	0.003	0.003
Cadmium	0.001	0.001	0.001	0.002	0.001	0.000
Chromium	0.005	0.004	0.003	0.005	0.004	0.003
Mercury	0.0005	0.0004	0.0004	0.0005	0.0005	0.0004
Manganese	0.013	0.013	0.012	0.013	0.013	0.012
Nickel	0.004	0.004	0.004	0.004	0.004	0.004
Lead	0.005	0.005	0.004	0.005	0.005	0.004
Carbon Tetrachloride	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004
Chloroform	0.025	0.024	0.022	0.024	0.026	0.021
Chloromethane	0.007	0.007	0.007	0.007	0.007	0.007
Dichloromethane	0.83	0.84	0.71	0.81	0.87	0.65
Acetaldehyde	0.78	0.81	0.69	0.90	0.66	0.53
Acrolein	0.20	0.12	0.08	0.19	0.10	0.06
Benzene	2.40	2.29	2.98	2.39	2.27	3.06
1,3- butadiene	0.29	0.29	0.24	0.30	0.27	0.19
Formaldehyde	1.78	1.59	1.48	1.81	1.62	1.20

Table D8: Maximum Concentrations by Ward in μg/m³ - Proposed Future Scenario with 25% CS100s

Contaminant	Ward					
	28	19	30	20	27	32
PAHs (as BAP)	0.009	0.009	0.009	0.009	0.009	0.008
Toluene	6.42	6.21	6.14	6.29	6.75	6.33
1,4 Dichlorobenzene	0.28	0.25	0.22	0.26	0.29	0.21
Carbon monoxide	393.46	379.79	328.67	393.66	352.55	267.70
Nitrogen Oxides (as NO+)	107.22	91.86	77.91	110.34	86.80	56.18
Ozone (ppb)	39.58	39.83	40.18	39.78	39.98	40.23
PM_{10}	26.22	23.73	20.56	25.61	22.89	18.62
$PM_{2.5}$	9.81	8.45	8.23	10.00	8.84	8.40
Sulphur dioxide	24.76	20.53	28.31	23.22	19.30	19.58
VOC	49.61	60.29	129.75	49.38	49.01	136.06
1,2 Dichloroethane	3.34E-04	3.30E-04	2.34E-04	3.31E-04	3.36E-04	2.33E-04
Ethylene dibromide	1.63E-05	1.63E-05	1.63E-05	1.63E-05	1.63E-05	1.63E-05
Tetrachloroethylene	0.59	0.58	0.55	0.67	0.77	0.73
Trichloroethylene	0.08	0.07	0.06	0.08	0.08	0.06
Vinyl chloride	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009
Cadmium	0.0004	0.0003	0.0003	0.0005	0.0004	0.0002
Chromium	0.002	0.002	0.001	0.002	0.002	0.001
Mercury	0.0002	0.0002	0.0002	0.0002	0.0002	0.0001
Manganese	0.004	0.004	0.004	0.004	0.004	0.004
Nickel	0.002	0.002	0.002	0.002	0.002	0.002
Lead	0.002	0.002	0.002	0.002	0.002	0.002
Carbon Tetrachloride	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Chloroform	0.01	0.01	0.01	0.01	0.01	0.01
Chloromethane	0.002	0.002	0.002	0.002	0.002	0.002
Dichloromethane	0.35	0.34	0.28	0.34	0.37	0.27
Acetaldehyde	0.39	0.35	0.35	0.39	0.28	0.22
Acrolein	0.08	0.05	0.03	0.08	0.04	0.02
Benzene	1.10	1.04	1.41	1.10	0.99	1.47
1,3- butadiene	0.13	0.13	0.10	0.14	0.12	0.08
Formaldehyde	0.75	0.69	0.72	0.78	0.65	0.50

APPENDIX E

Annual & 24-hr 95th-%ile Concentration Isopleths – NO_2, PM_{10}, $PM_{2.5}$, Chromium and Cadmium



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

Nitrogen Oxides ($\mu g/m^3$)

- 180 - 200
- 160 - 180
- 140 - 160
- 120 - 140
- 100 - 120
- 80 - 100
- 60 - 80
- 40 - 60

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

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

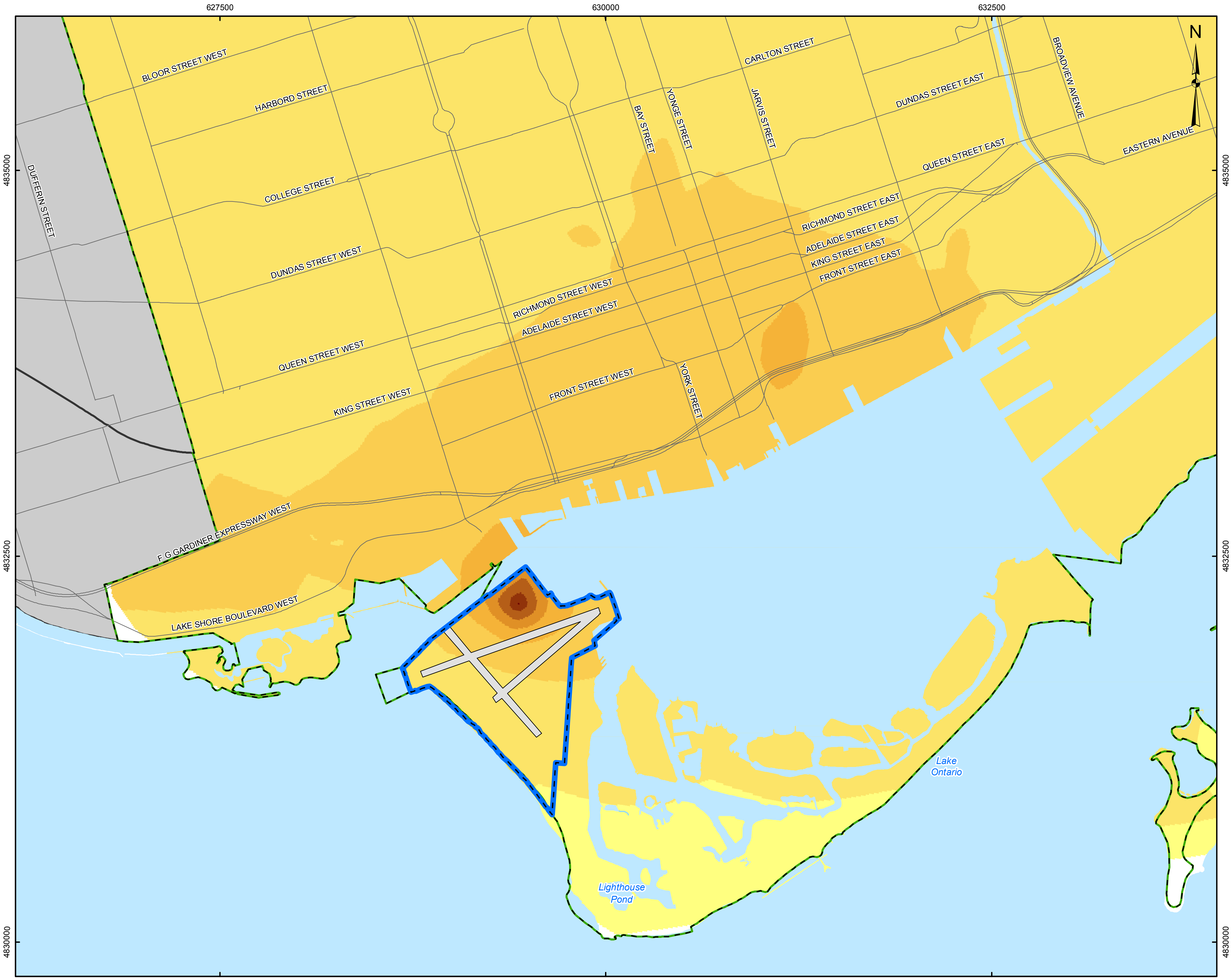
TITLE
Nitrogen Oxides (as NO_2) - Maximum Annual Concentrations - Baseline

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008		
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

FIGURE: 1

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 1 Nitrogen Oxides - Maximum Annual Concentrations - Baseline.mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

Nitrogen Oxides (µg/m³)

- 180 - 200
- 160 - 180
- 140 - 160
- 120 - 140
- 100 - 120
- 80 - 100
- 60 - 80
- 40 - 60

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

250 125 0 250 500 750 1,000 1,250

SCALE 1:25,000 METRES

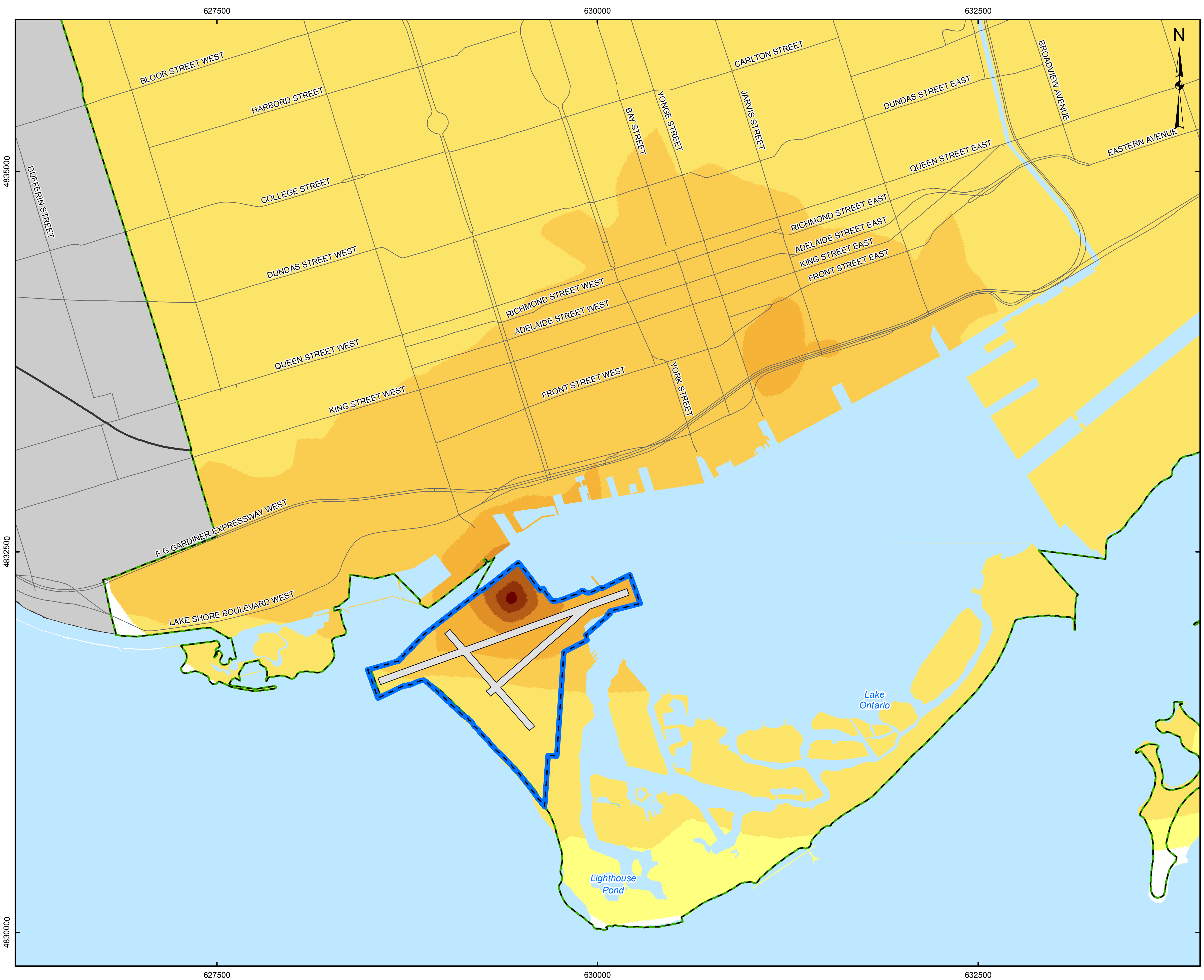
PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

TITLE
Nitrogen Oxides (as NO_2) - Maximum Annual Concentrations - Current Airport Operations (Q400s only)

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008	**FIGURE: 2**	
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 2 Nitrogen Oxides - Maximum Annual Concentrations - Current Airport Operations (Q400s only).mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

Nitrogen Oxides (µg/m³)

- 180 - 200
- 160 - 180
- 140 - 160
- 120 - 140
- 100 - 120
- 80 - 100
- 60 - 80
- 40 - 60

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

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

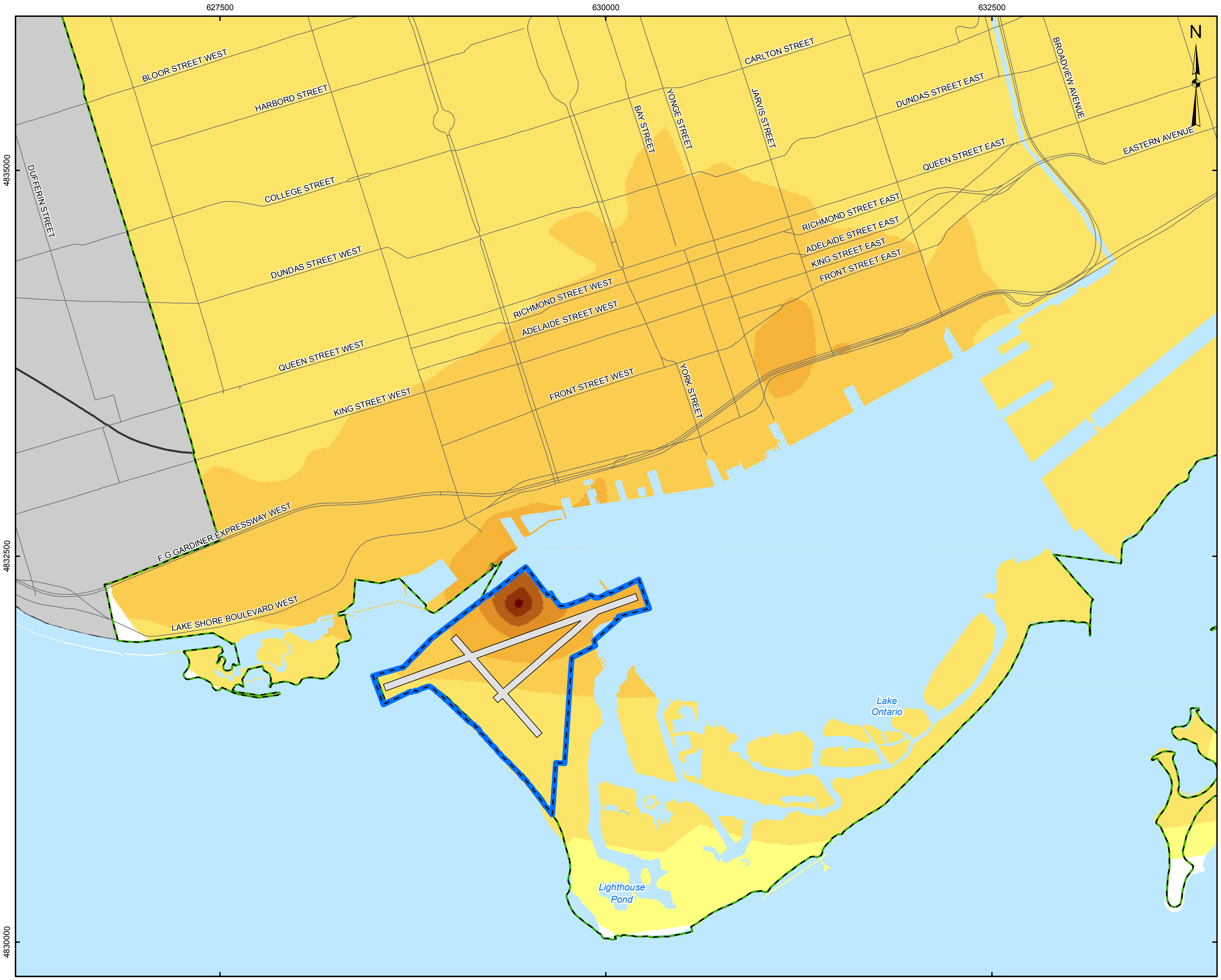
TITLE
Nitrogen Oxides (as NO_2) - Maximum Annual Concentrations - Future Scenario (737s and Q400s)

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008		
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

FIGURE: 3

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 3 Nitrogen Oxides - Maximum Annual Concentrations - Future Scenario (737s and Q400s).mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

Nitrogen Oxides (µg/m³)

- 180 - 200
- 160 - 180
- 140 - 160
- 120 - 140
- 100 - 120
- 80 - 100
- 60 - 80
- 40 - 60

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

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

TITLE
Nitrogen Oxides (as NO_2) - Maximum Annual Concentrations - Future Scenario (CS100ss and Q400s)

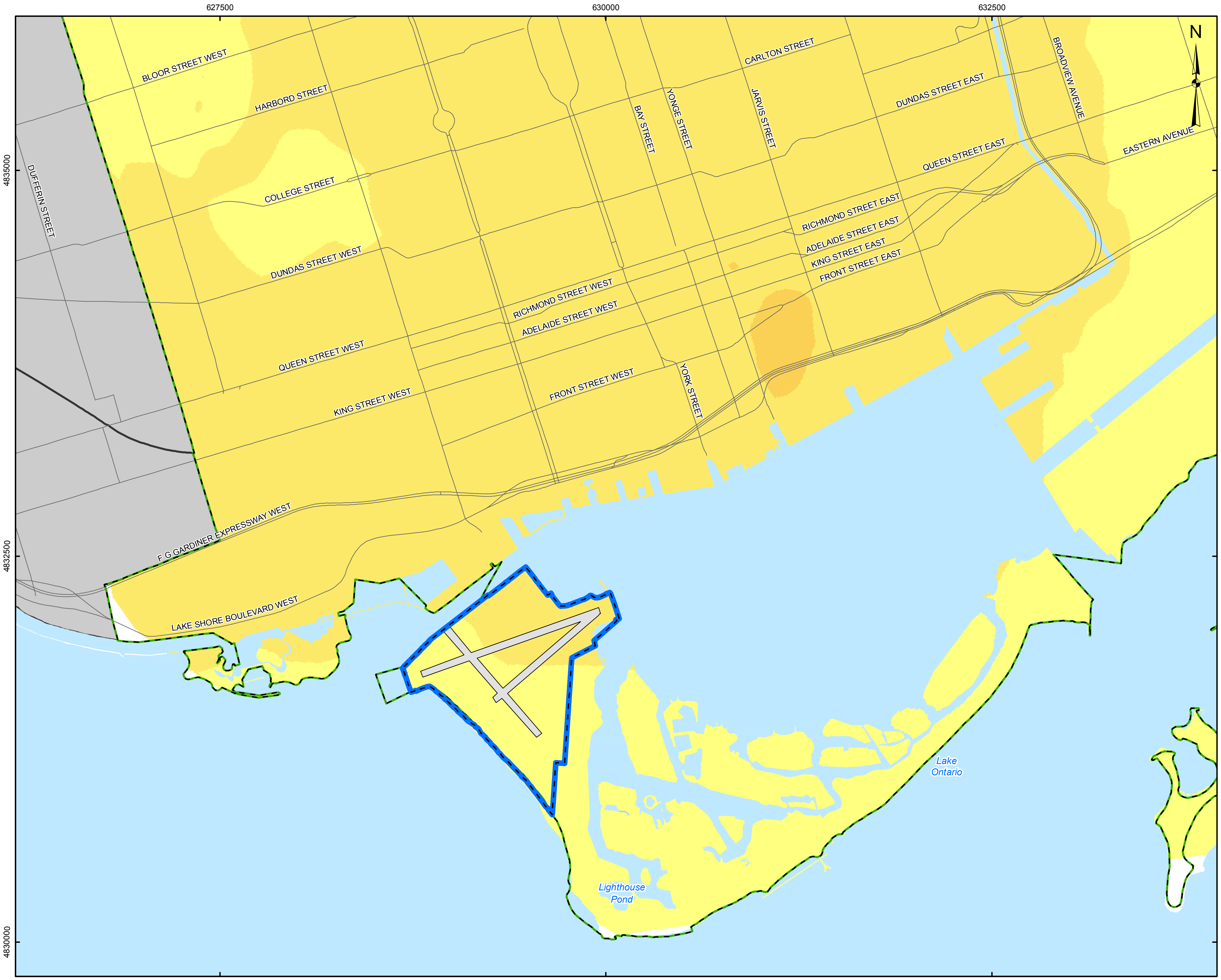
Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215		
DESIGN	JO	14 Nov. 2008
GIS	JO	16 Nov. 2013
CHECK	KSA	16 Nov. 2013
REVIEW	AC	16 Nov. 2013

SCALE AS SHOWN | REV. 0.0

FIGURE: 4

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 4 Nitrogen Oxides - Maximum Annual Concentrations - Future Scenario (CS100ss and Q400s).mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

Nitrogen Oxides (µg/m³)

- 500 - 550
- 450 - 500
- 400 - 450
- 350 - 400
- 300 - 350
- 250 - 300
- 200 - 250
- 150 - 200
- 100 - 150

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

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

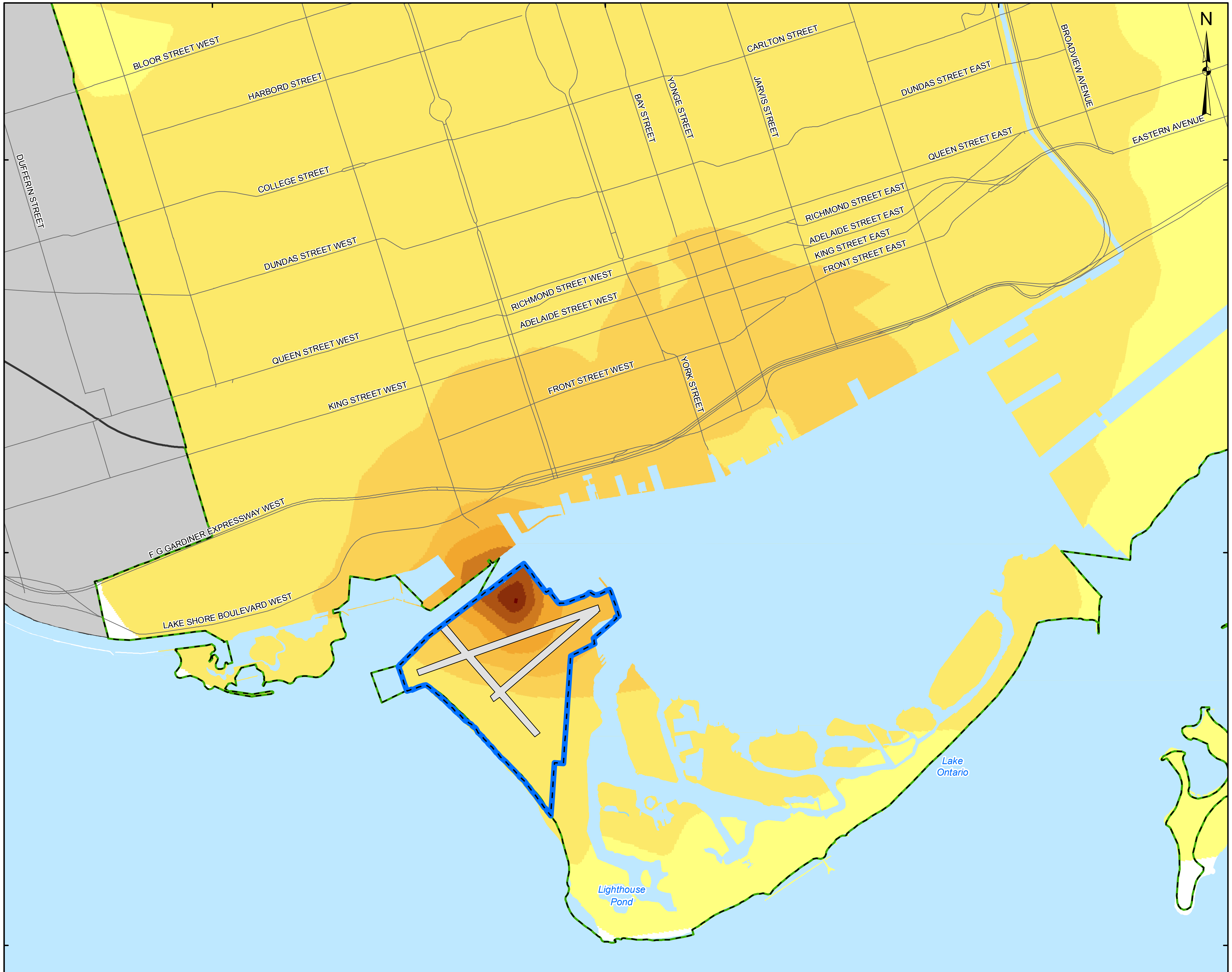
TITLE
Nitrogen Oxides (as NO_2) - 95%ile 24 hour Averaged Concentrations - Baseline

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008		
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

FIGURE: 5

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 5 Nitrogen Oxides - 95ile 24 hour Averaged Concentrations - Baseline.mxd



LEGEND

Major Roads

Waterbody

Billy Bishop Toronto City Airport

Air Quality Assessment Study Area

Nitrogen Oxides (µg/m³)

- 500 - 550
- 450 - 500
- 400 - 450
- 350 - 400
- 300 - 350
- 250 - 300
- 200 - 250
- 150 - 200
- 100 - 150

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

250 125 0 250 500 750 1,000 1,250

SCALE 1:25,000 METRES

PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

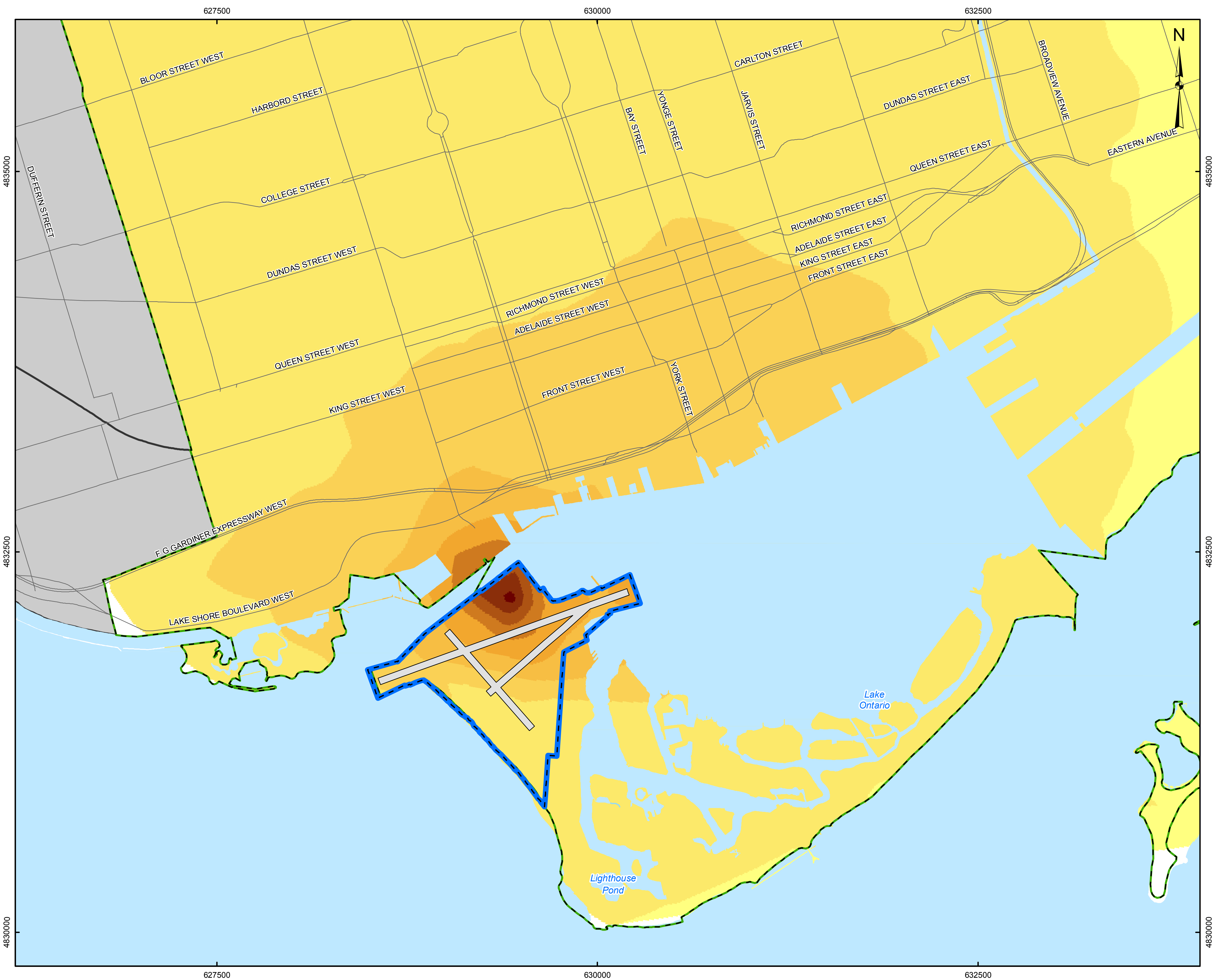
TITLE
Nitrogen Oxides (as NO_2) -
95%ile 24 hour Averaged Concentrations -
Current Airport Operations (Q400s only)

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008		
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

Golder Associates
Mississauga, Ontario

FIGURE: 6

G:\CLIENTS\CITY_OF_TORONTO\BBTCA99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 6 Nitrogen Oxides - 95%ile 24 hour Averaged Concentrations - Current Airport Operations (Q400s only).mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

Nitrogen Oxides (µg/m³)

- 500 - 550
- 450 - 500
- 400 - 450
- 350 - 400
- 300 - 350
- 250 - 300
- 200 - 250
- 150 - 200
- 100 - 150

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

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

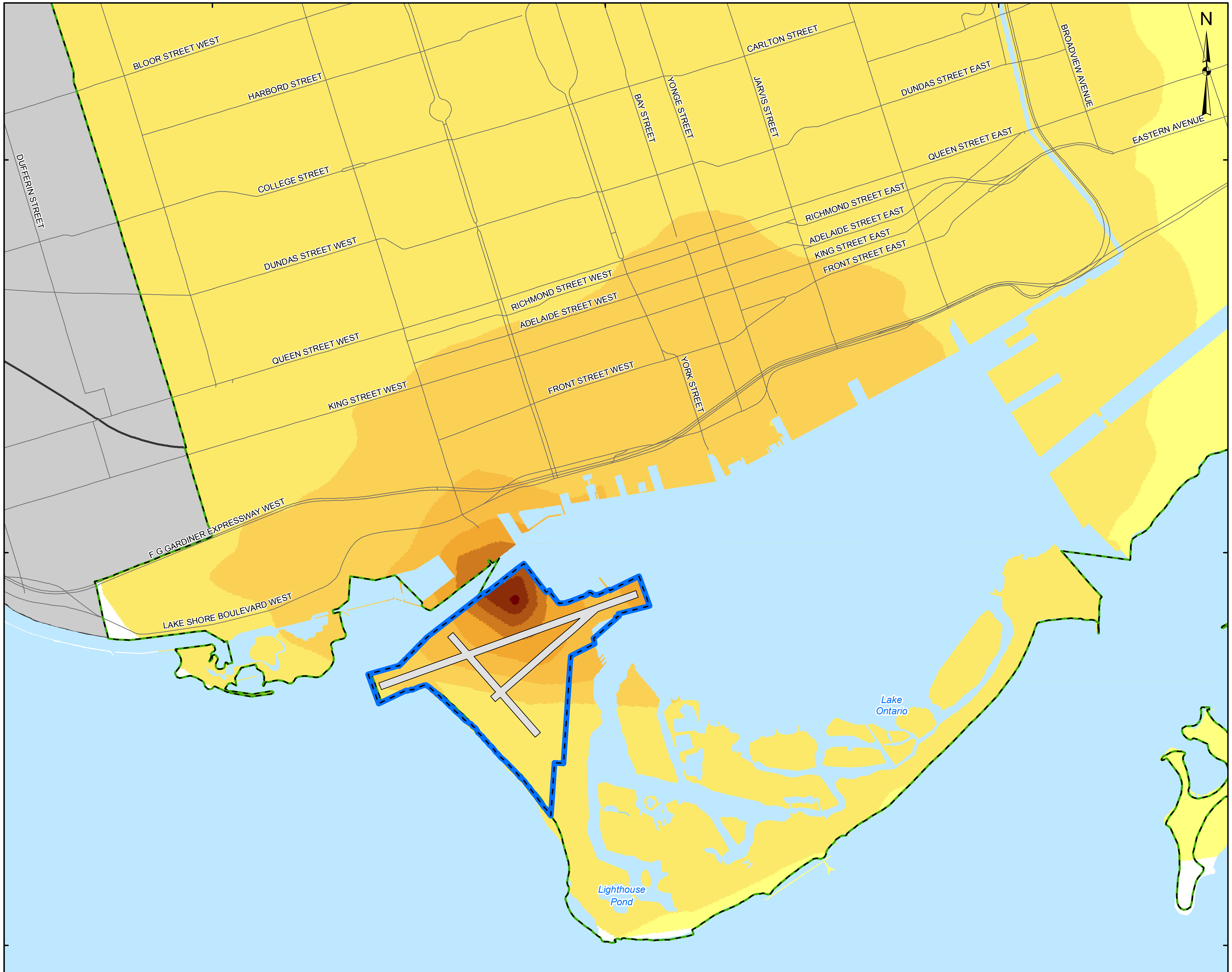
TITLE
Nitrogen Oxides (as NO_2) - 95%ile 24 hour Averaged Concentrations - Future Scenario (737s and Q400s)

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008		
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

FIGURE: 7

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 7 Nitrogen Oxides - 95%ile 24 hour Averaged Concentrations - Future Scenario (737s and Q400s).mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

\Nitrogen Oxides (µg/m³)

- 500 - 550
- 450 - 500
- 400 - 450
- 350 - 400
- 300 - 350
- 250 - 300
- 200 - 250
- 150 - 200
- 100 - 150

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

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

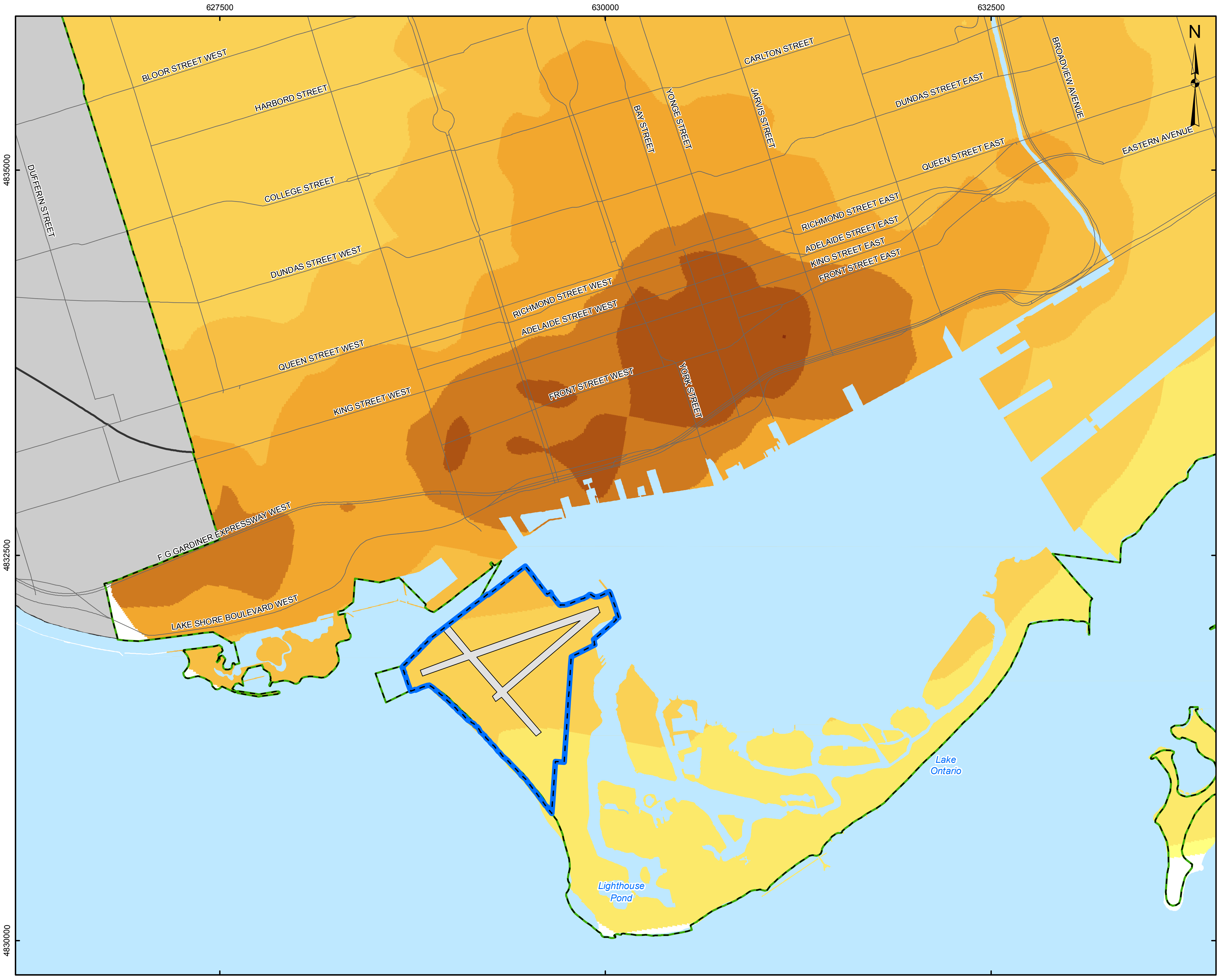
PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

TITLE
Nitrogen Oxides (as NO_2) - 95%ile 24 hour Averaged Concentrations - Future Scenario (CS100ss and Q400s)

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008		
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

FIGURE: 8



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

PM_{10} (µg/m³)

- 28 - 30
- 26- 28
- 24 - 26
- 22 - 24
- 20 - 22
- 18 - 20
- 16 - 18
- 14 - 16
- 12 - 14

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

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

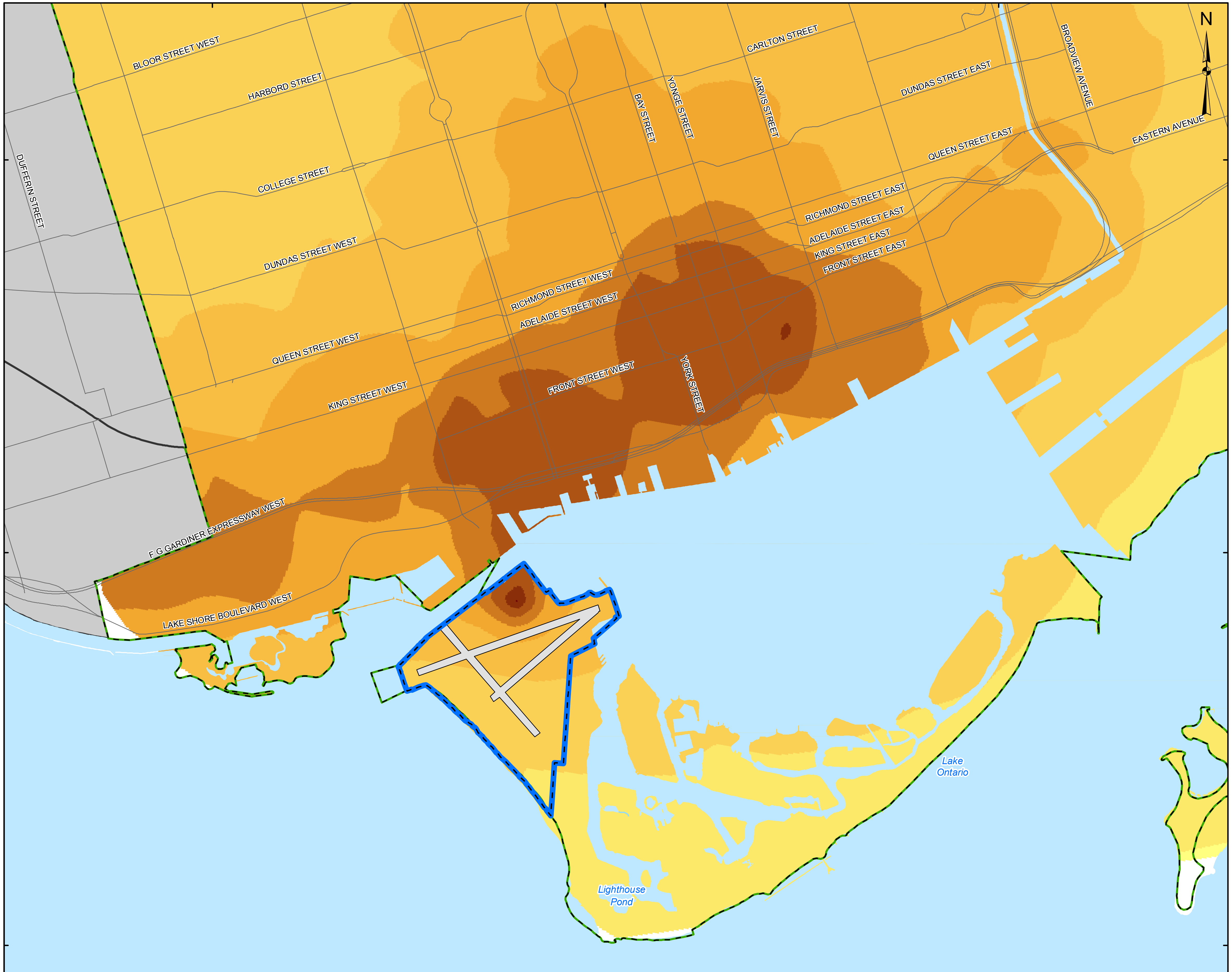
TITLE
PM_{10} -
Maximum Annual Concentrations -
Baseline

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008		
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

FIGURE: 9

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 9 PM10 - Maximum Annual Concentrations - Baseline.mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

PM_{10} (µg/m³)

- 28 - 30
- 26- 28
- 24 - 26
- 22 - 24
- 20 - 22
- 18 - 20
- 16 - 18
- 14 - 16
- 12 - 14

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

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

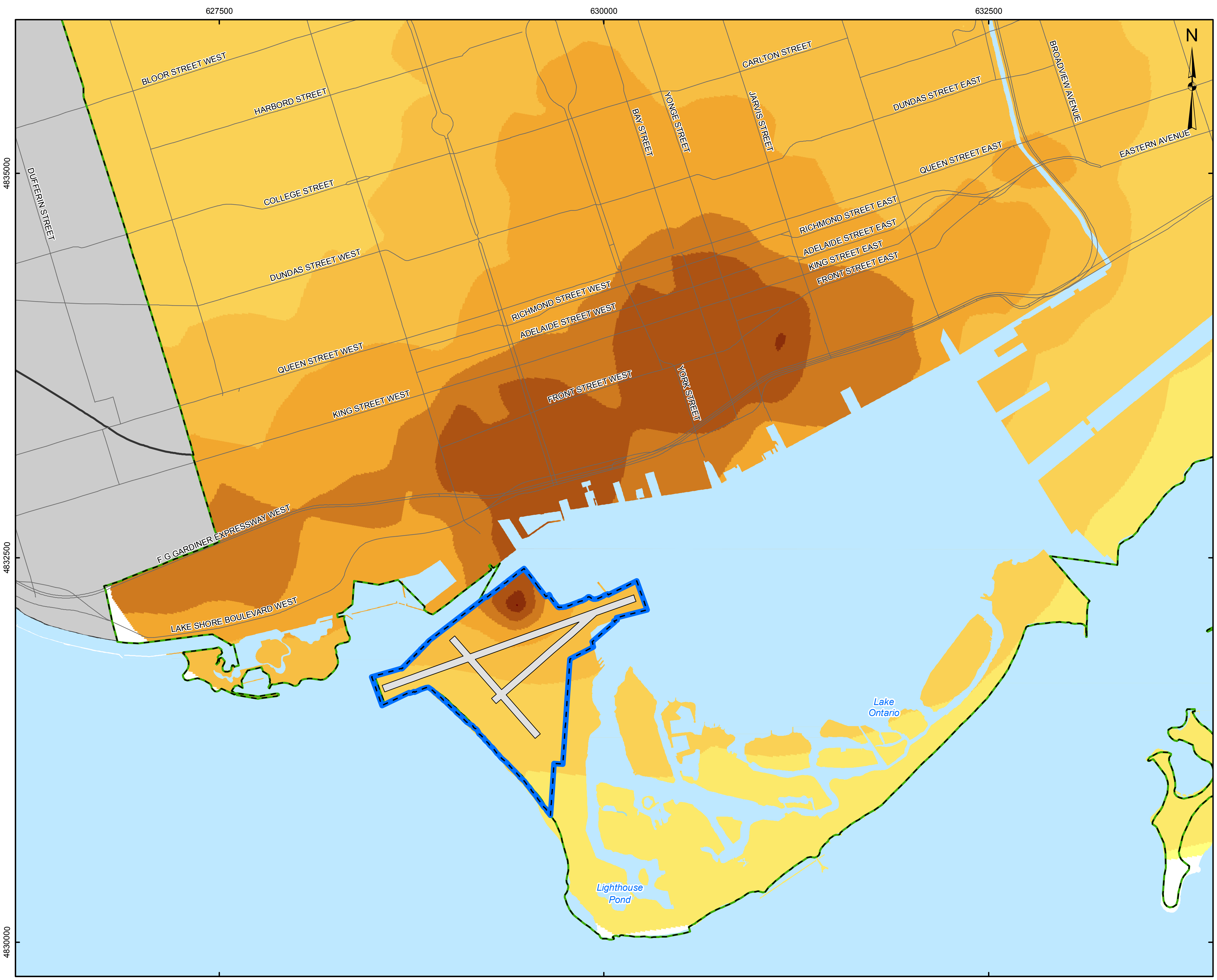
PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

TITLE
PM_{10} -
Maximum Annual Concentrations -
Current Airport Operations (Q400s only)

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008	**FIGURE: 10**	
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 10 PM10 - Maximum Annual Concentrations - Current Airport Operations (Q400s only).mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

PM_{10} ($\mu g/m^3$)

- 28 - 30
- 26- 28
- 24 - 26
- 22 - 24
- 20 - 22
- 18 - 20
- 16 - 18
- 14 - 16
- 12 - 14

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

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

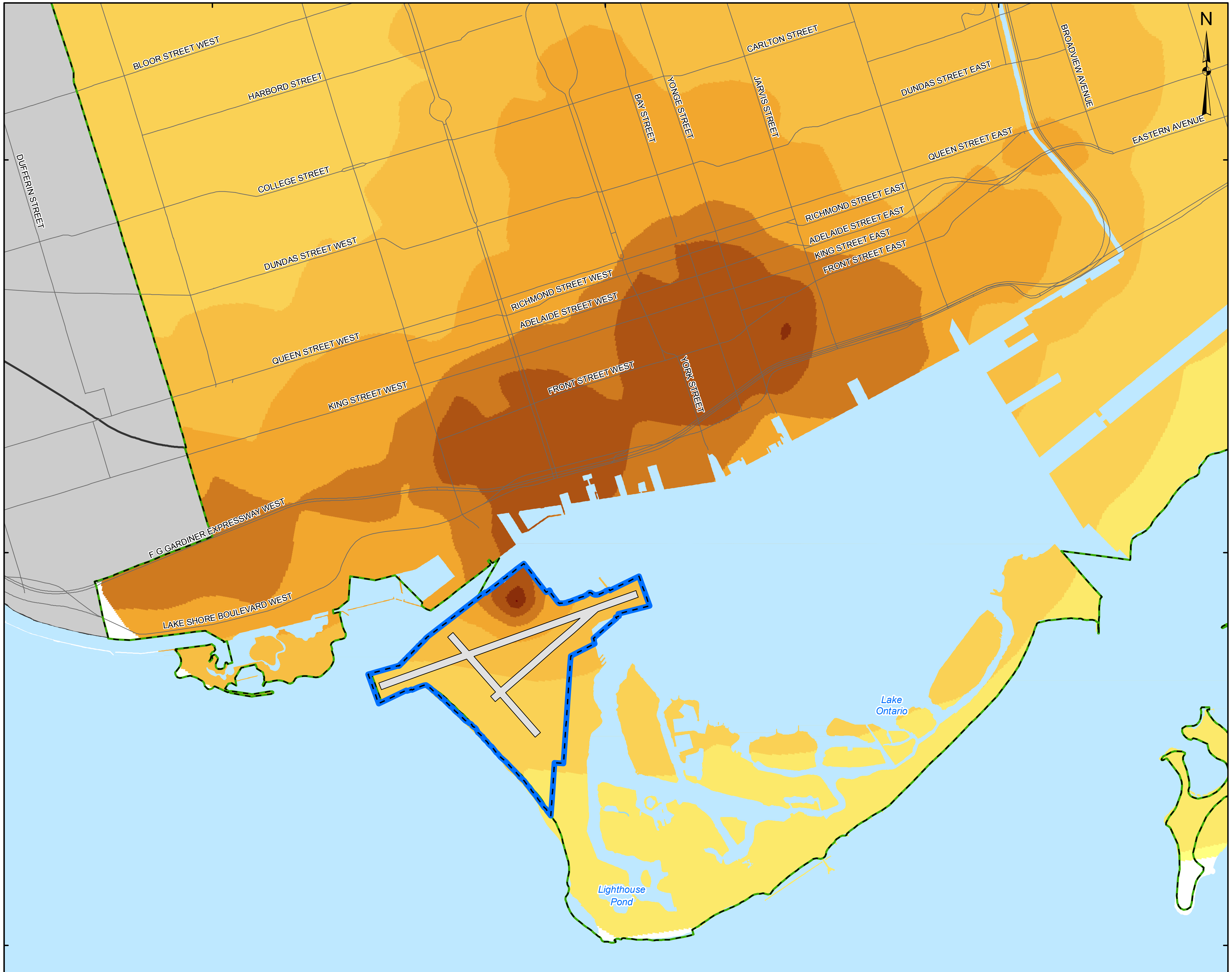
TITLE
PM_{10} -
Maximum Annual Concentrations -
Future Scenario (737s and Q400s)

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008		
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

FIGURE: 11

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 11 PM10 - Maximum Annual Concentrations - Future Scenario (737s and Q400s).mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

PM_{10} ($\mu g/m^3$)

- 28 - 30
- 26- 28
- 24 - 26
- 22 - 24
- 20 - 22
- 18 - 20
- 16 - 18
- 14 - 16
- 12 - 14

REFERENCE

Base Data - MNR LIO, obtained 2009
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Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 17

250 125 0 250 500 750 1,000 1,250

SCALE 1:25,000 METRES

PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

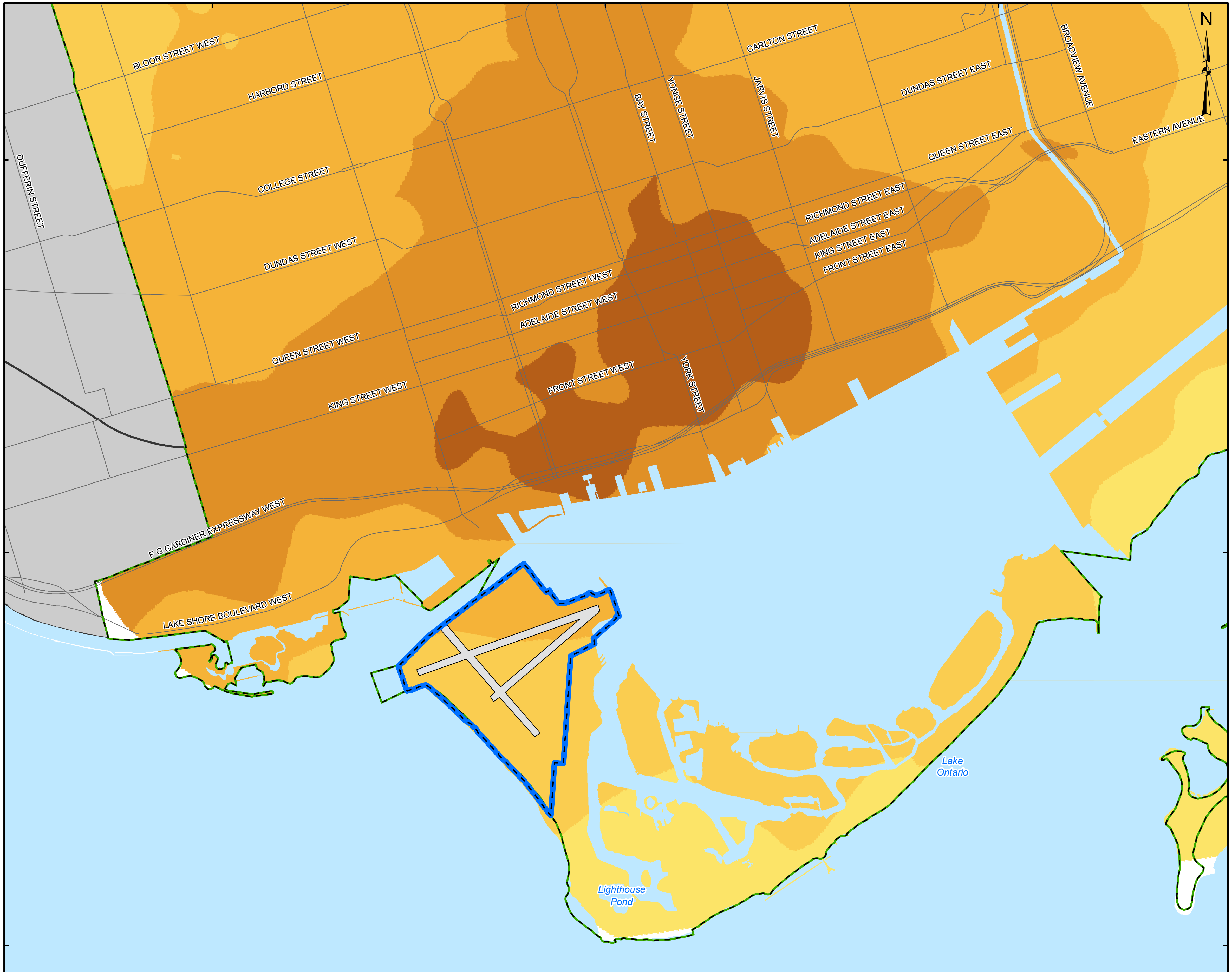
TITLE
PM_{10} -
Maximum Annual Concentrations -
Future Scenario (CS100ss and Q400s)

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008		
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

FIGURE: 12

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 12 PM10 - Maximum Annual Concentrations - Future Scenario (CS100ss and Q400s).mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

PM_{10} ($\mu g/m^3$)

- 60 - 65
- 55 - 60
- 50 - 55
- 45 - 50
- 40 - 45
- 35 - 40
- 30 - 35
- 25 - 30

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

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

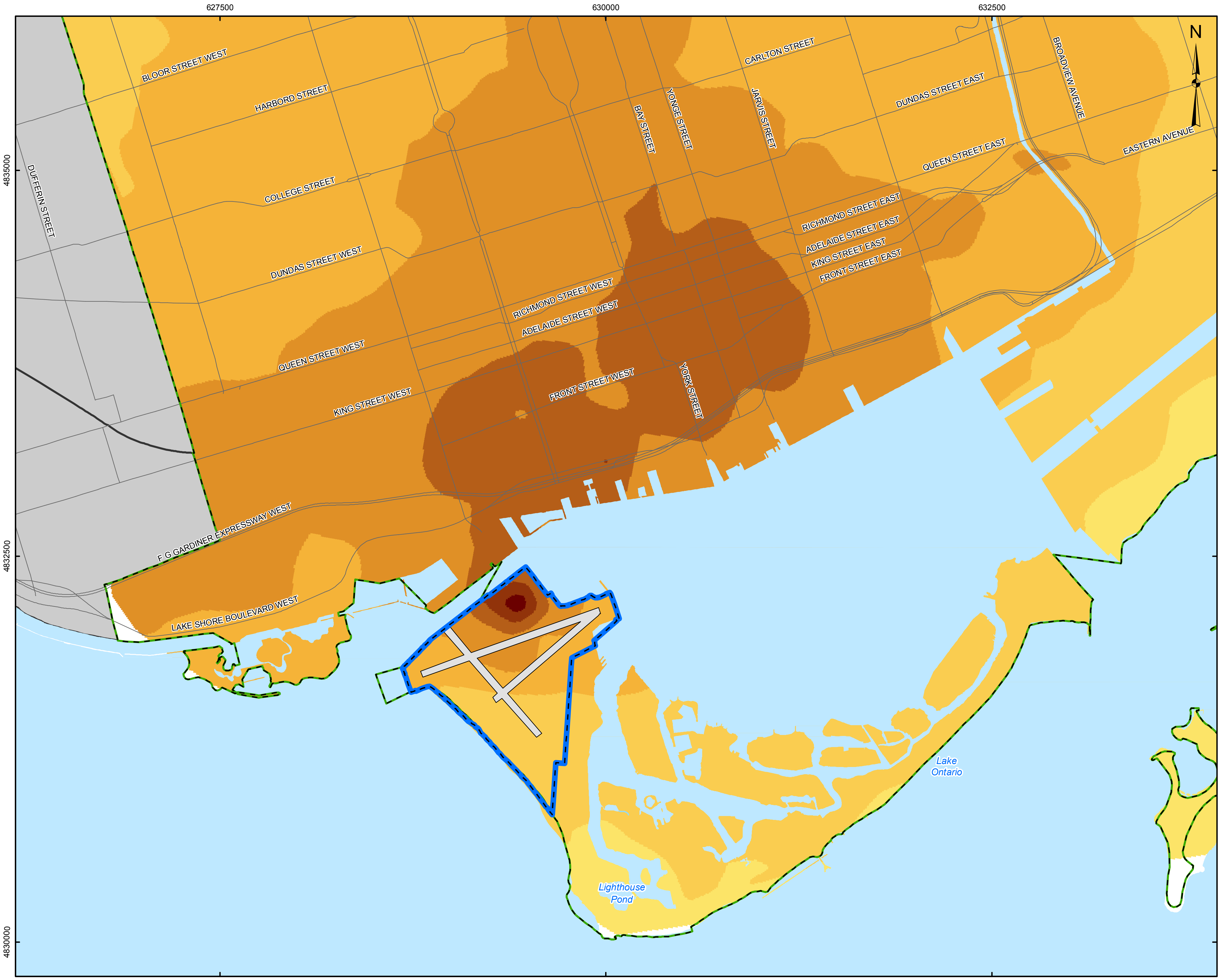
TITLE
PM_{10} -
95%ile 24 hour Averaged Concentrations -
Baseline

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008		
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

FIGURE: 13

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 13 PM10 - 95%ile 24 hour Averaged Concentrations - Baseline.mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

PM$_{10}$ (µg/m³)

- 60 - 65
- 55 - 60
- 50 - 55
- 45 - 50
- 40 - 45
- 35 - 40
- 30 - 35
- 25 - 30

REFERENCE

Base Data - MNR LIO, obtained 2009
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Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 17

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

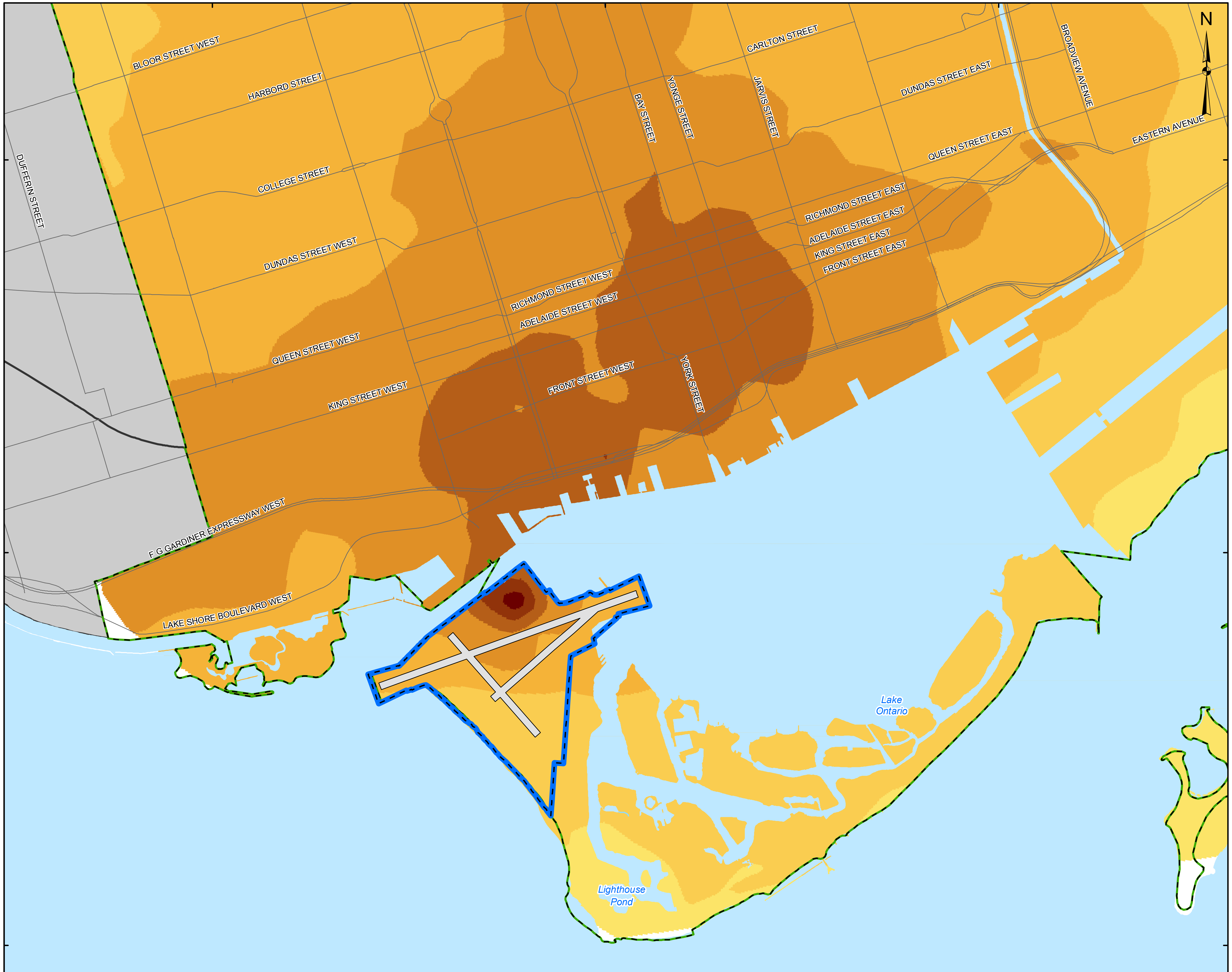
TITLE
PM$_{10}$ -
95%ile 24 hour Averaged Concentrations -
Current Airport Operations (Q400s only)

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008		
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

FIGURE: 14

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 14 PM10 - 95%ile 24 hour Averaged Concentrations - Current Airport Operations (Q400s only).mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

PM_{10} ($\mu g/m^3$)

- 60 - 65
- 55 - 60
- 50 - 55
- 45 - 50
- 40 - 45
- 35 - 40
- 30 - 35
- 25 - 30

INDEX MAP

REFERENCE

Base Data - MNR LIO, obtained 2009
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Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 17

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

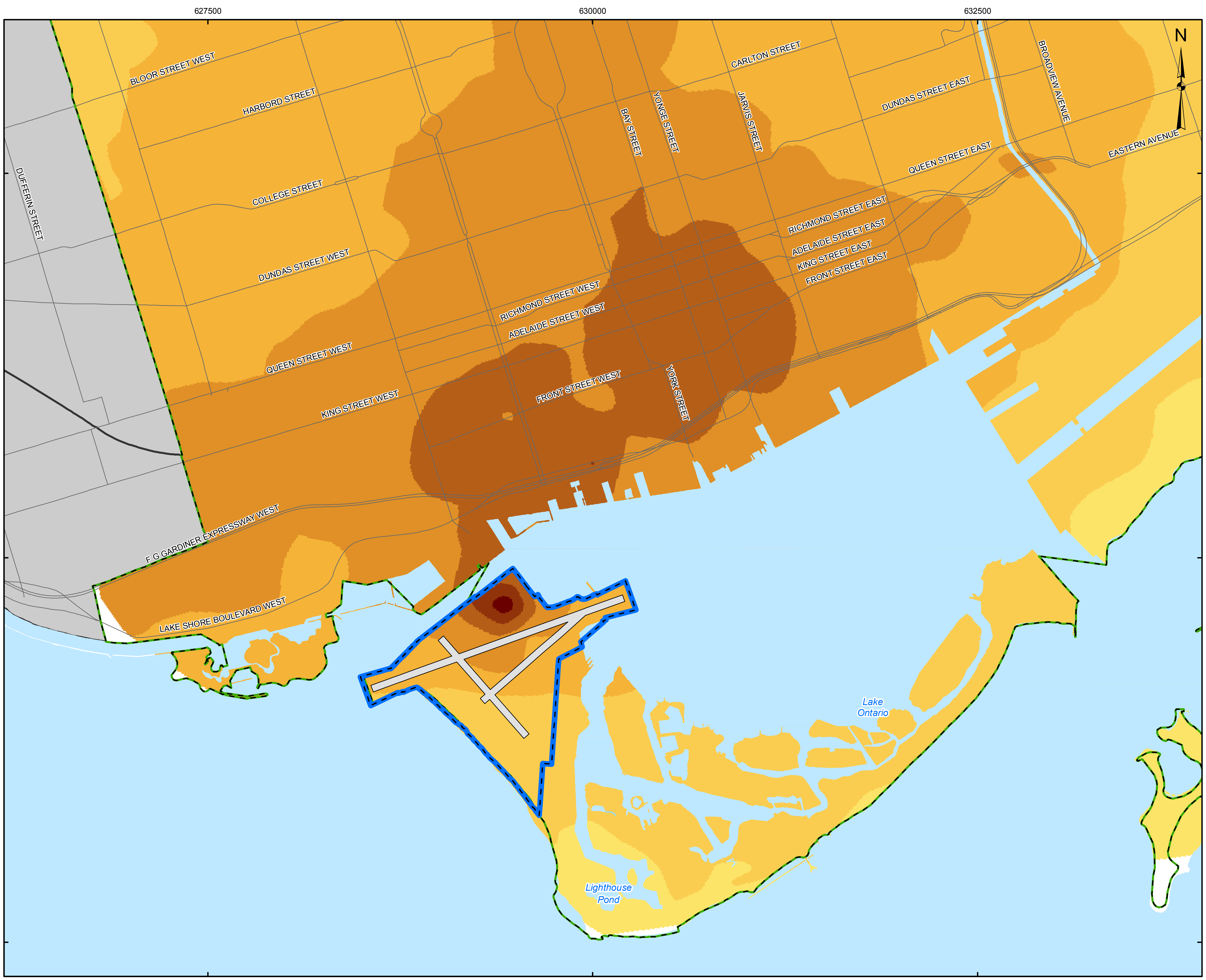
PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

TITLE
PM_{10} - 95%ile 24 hour Averaged Concentrations - Future Scenario (737s and Q400s)

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008		
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

FIGURE: 15



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

PM_{10} ($\mu g/m^3$)

- 60 - 65
- 55 - 60
- 50 - 55
- 45 - 50
- 40 - 45
- 35 - 40
- 30 - 35
- 25 - 30

REFERENCE

Base Data - MNR LIO, obtained 2009
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Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 17

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

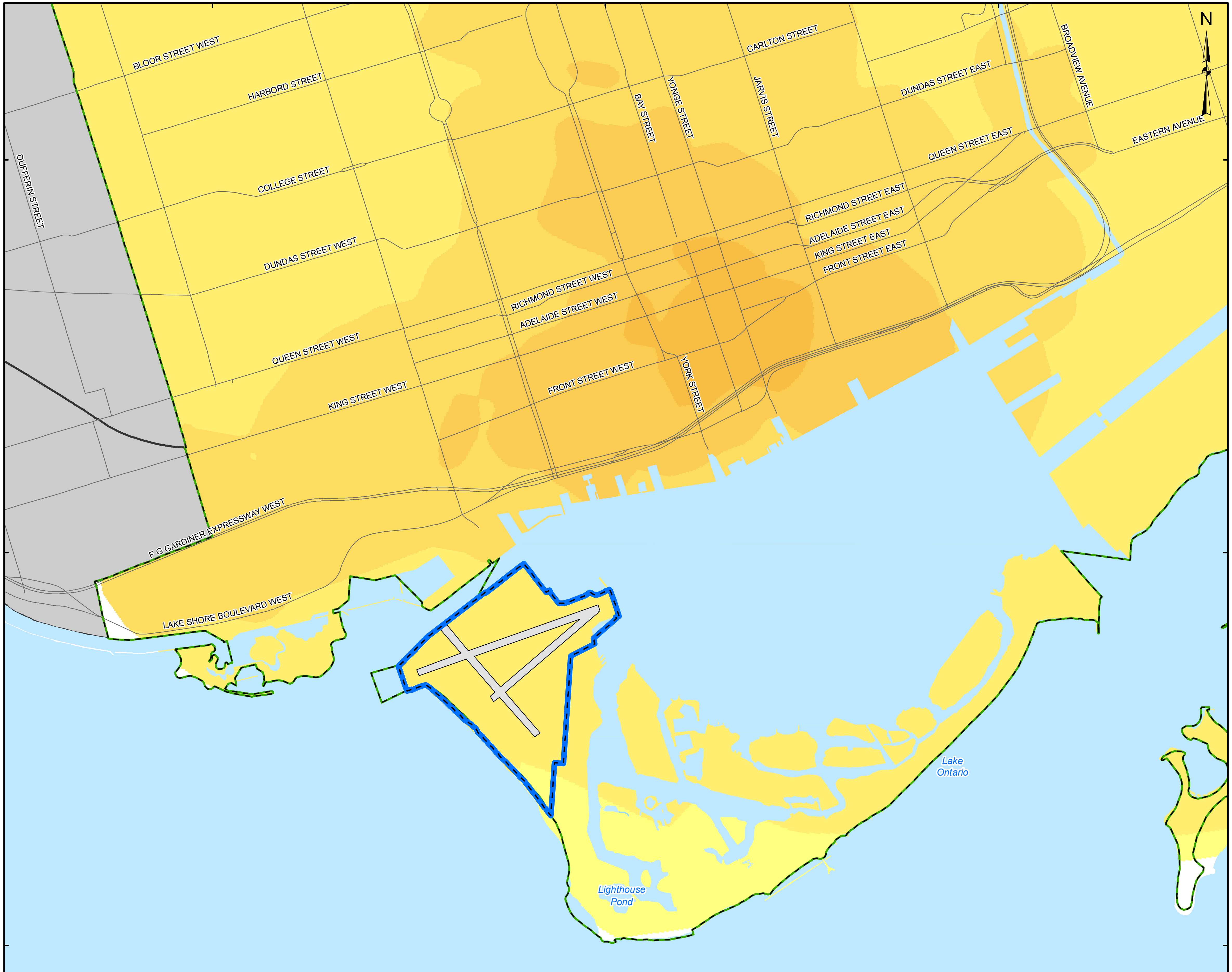
TITLE
PM_{10} -
95%ile 24 hour Averaged Concentrations -
Future Scenario (CS100ss and Q400s)

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008		
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

FIGURE: 16

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 16 PM10 - 95ile 24 hour Averaged Concentrations - Future Scenario (CS100ss and Q400s).mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

$PM_{2.5}$ ($\mu g/m^3$)

- 16 - 17
- 15 - 16
- 14 - 15
- 13 - 14
- 12 - 13
- 11 - 12
- 10 - 11
- 9 - 10
- 8 - 9
- 7 - 8
- 6 - 7
- 5 - 6

REFERENCE

Base Data - MNR LIO, obtained 2009
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Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 17

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

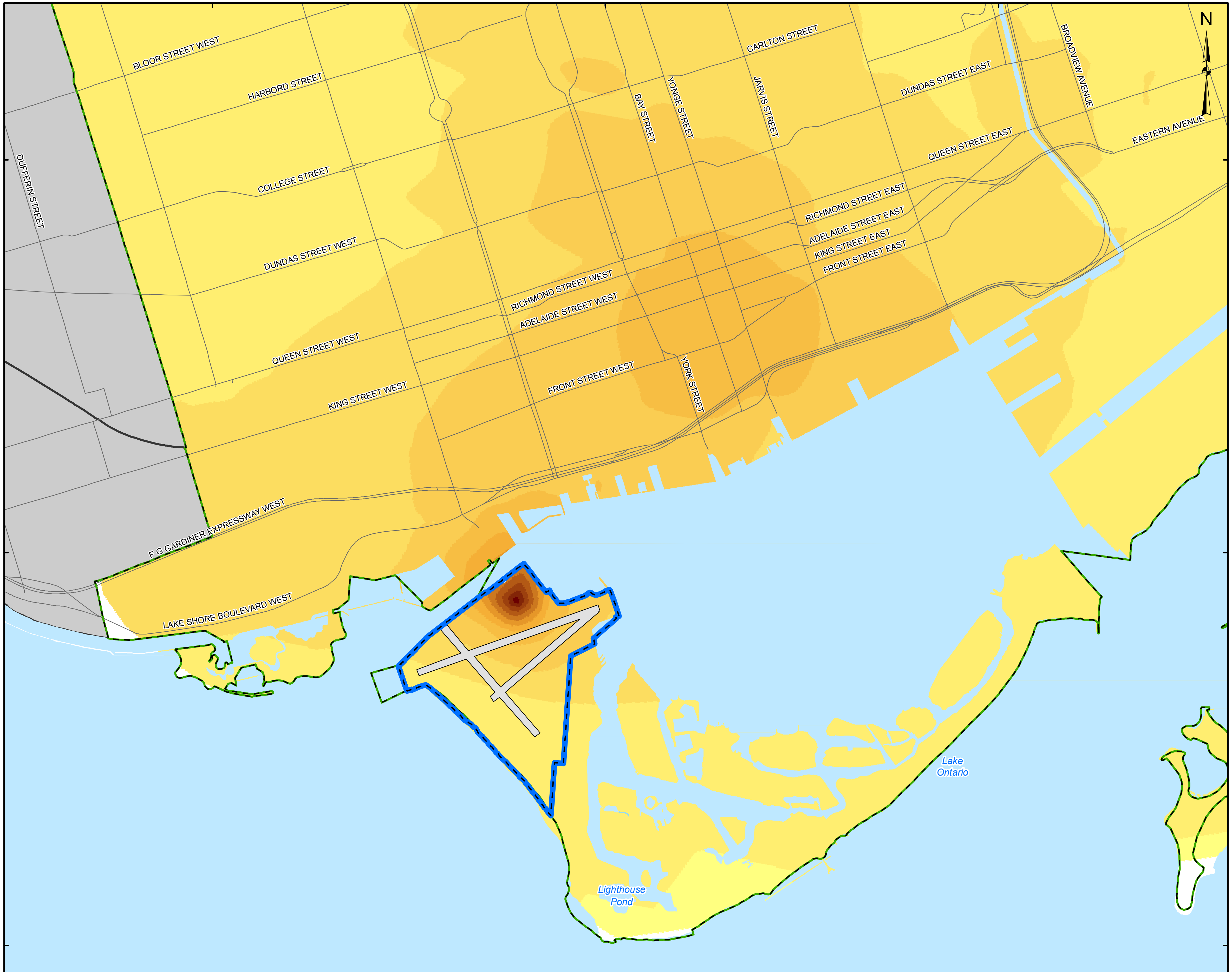
PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

TITLE
$PM_{2.5}$ -
Maximum Annual Concentrations -
Baseline

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008	**FIGURE: 17**	
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 17 PM2_5 - Maximum Annual Concentrations - Baseline.mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

$PM_{2.5}$ (µg/m³)

- 16 - 17
- 15 - 16
- 14 - 15
- 13 - 14
- 12 - 13
- 11 - 12
- 10 - 11
- 9 - 10
- 8 - 9
- 7 - 8
- 6 - 7
- 5 - 6

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

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

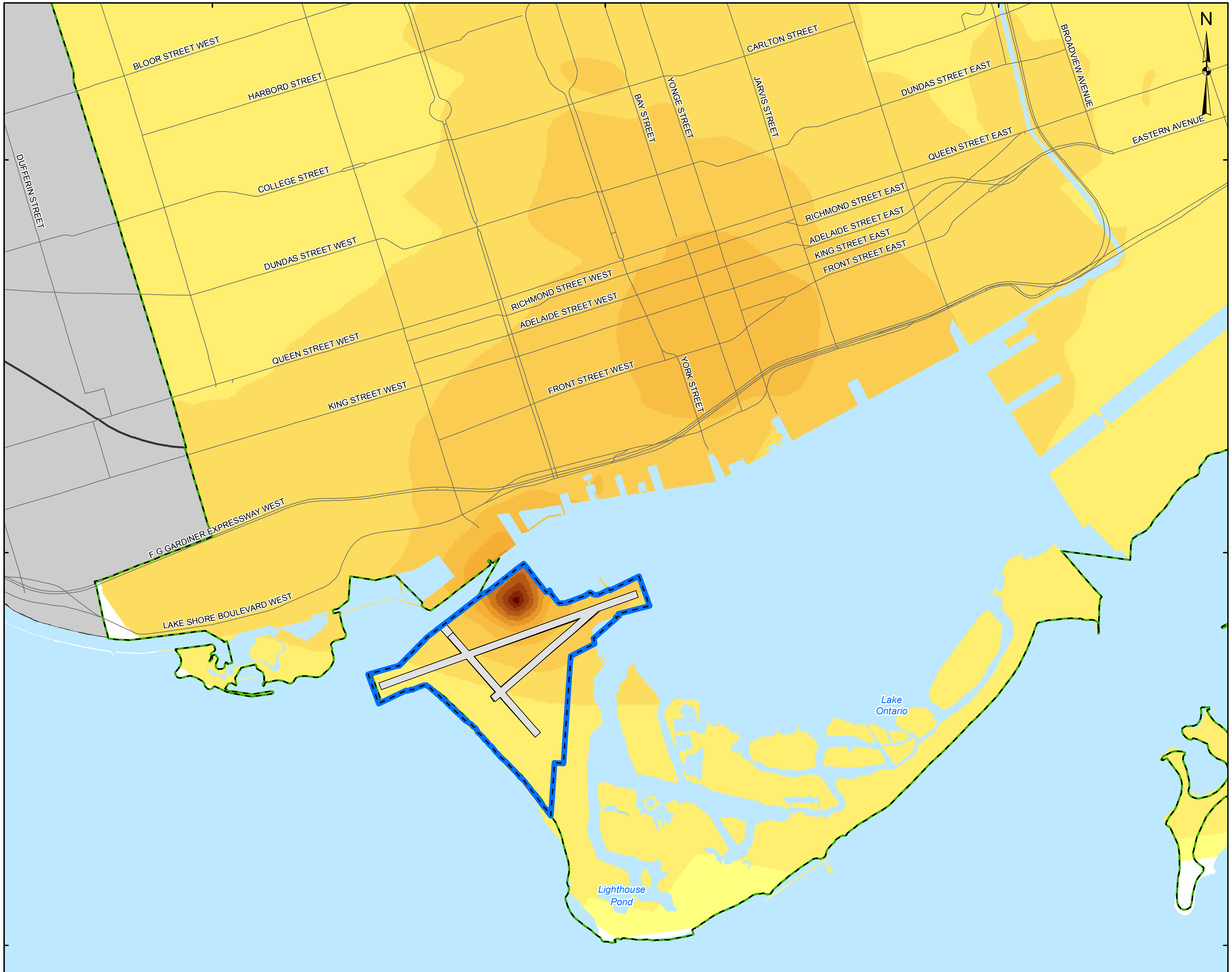
TITLE
$PM_{2.5}$ - Maximum Annual Concentrations - Current Airport Operations (Q400s only)

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008		
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

FIGURE: 18

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 18 PM2_5 - Maximum Annual Concentrations - Current Airport Operations (Q400s only).mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

$PM_{2.5}$ ($\mu g/m^3$)

- 16 - 17
- 15 - 16
- 14 - 15
- 13 - 14
- 12 - 13
- 11 - 12
- 10 - 11
- 9 - 10
- 8 - 9
- 7 - 8
- 6 - 7
- 5 - 6

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

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

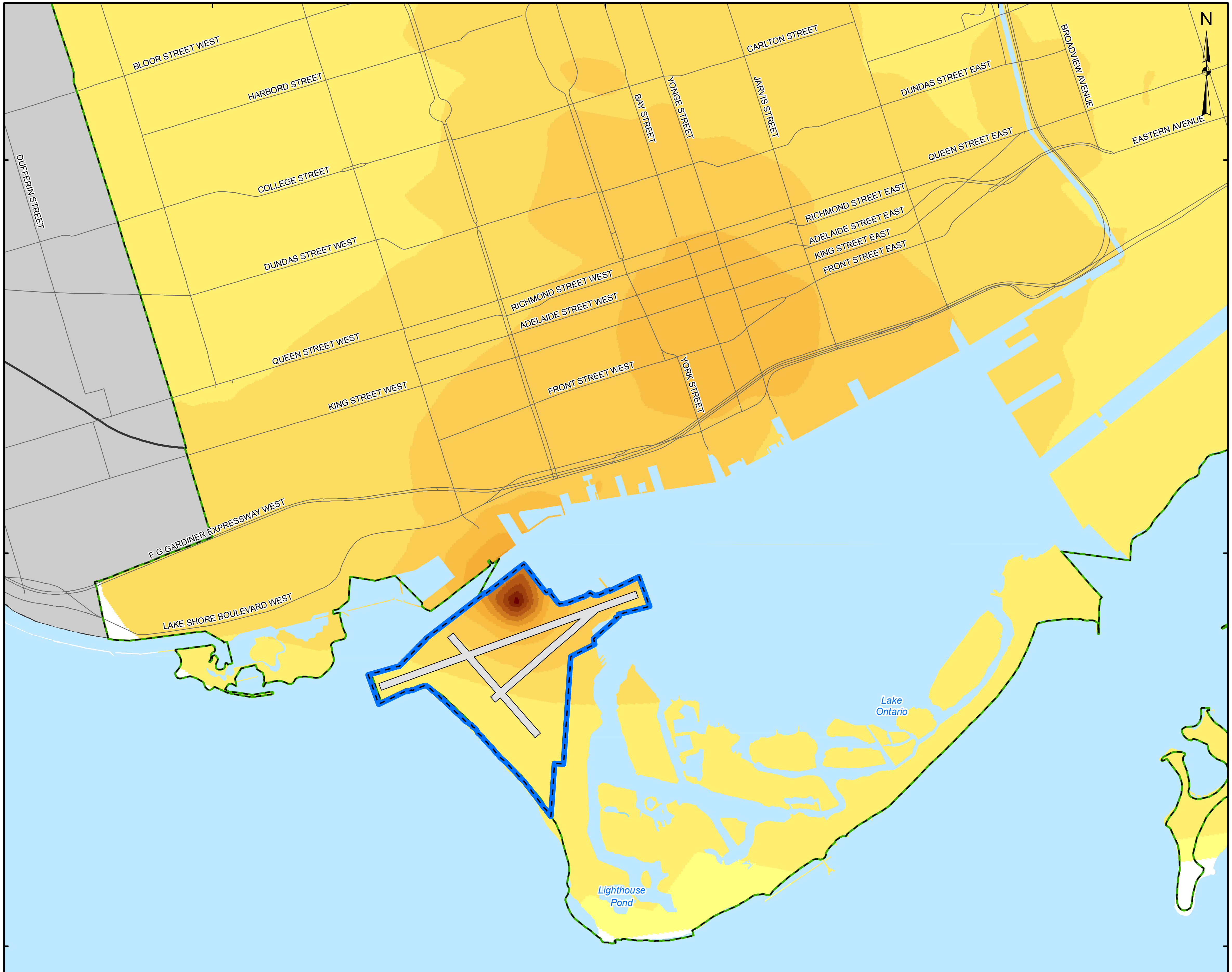
PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

TITLE
$PM_{2.5}$ -
Maximum Annual Concentrations -
Future Scenario (737s and Q400s)

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008		
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

FIGURE: 19



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

$PM_{2.5}$ (µg/m³)

- 16 - 17
- 15 - 16
- 14 - 15
- 13 - 14
- 12 - 13
- 11 - 12
- 10 - 11
- 9 - 10
- 8 - 9
- 7 - 8
- 6 - 7
- 5 - 6

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

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

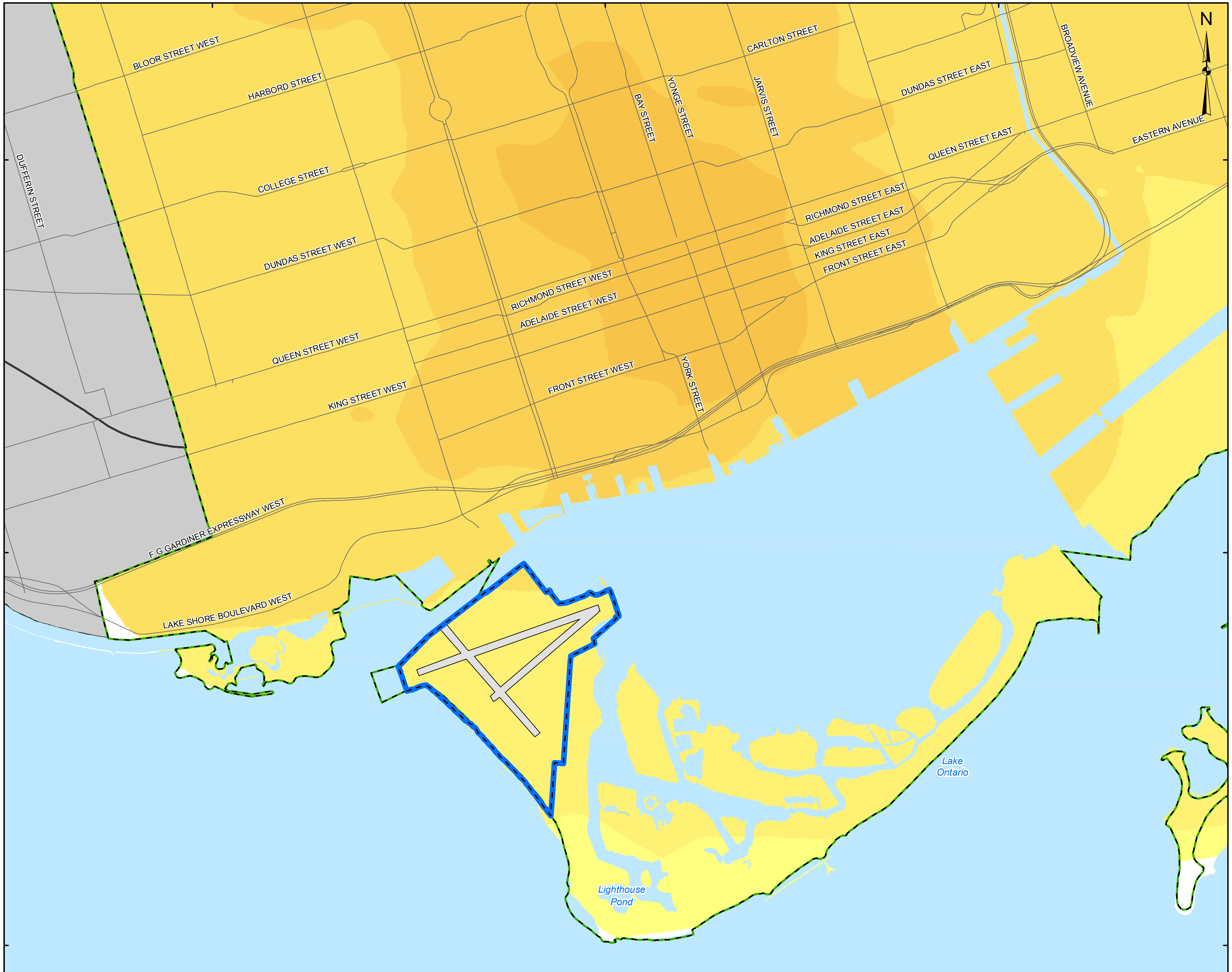
PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

TITLE
$PM_{2.5}$ -
Maximum Annual Concentrations -
Future Scenario (CS100ss and Q400s)

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008		
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

FIGURE: 20



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

$PM_{2.5}$ (µg/m³)

- 35 - 37
- 33 - 35
- 31 - 33
- 29 - 31
- 27 - 29
- 25 - 27
- 23 - 25
- 21 - 23
- 19 - 21
- 17 - 19
- 15 - 17
- 13 - 15
- 11 - 13

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

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

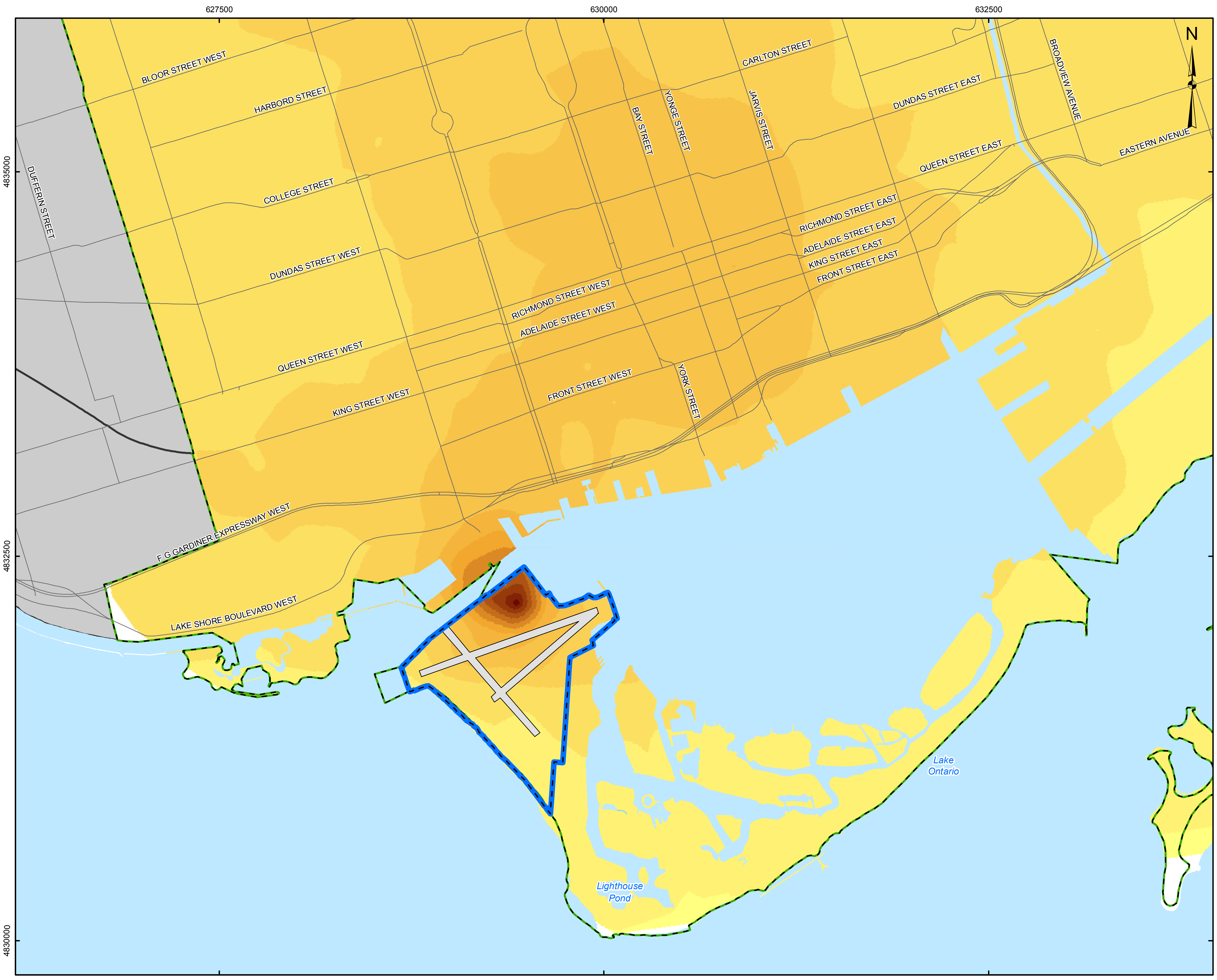
TITLE
$PM_{2.5}$ -
95%ile 24 hour Averaged Concentrations -
Baseline

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008		
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

Golder Associates
Mississauga, Ontario

FIGURE: 21

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 21 PM2_5 - 95ile 24 hour Averaged Concentrations - Baseline.mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

$PM_{2.5}$ ($\mu g/m^3$)

- 35 - 37
- 33 - 35
- 31 - 33
- 29 - 31
- 27 - 29
- 25 - 27
- 23 - 25
- 21 - 23
- 19 - 21
- 17 - 19
- 15 - 17
- 13 - 15
- 11 - 13

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

250 125 0 250 500 750 1,000 1,250

SCALE 1:25,000 METRES

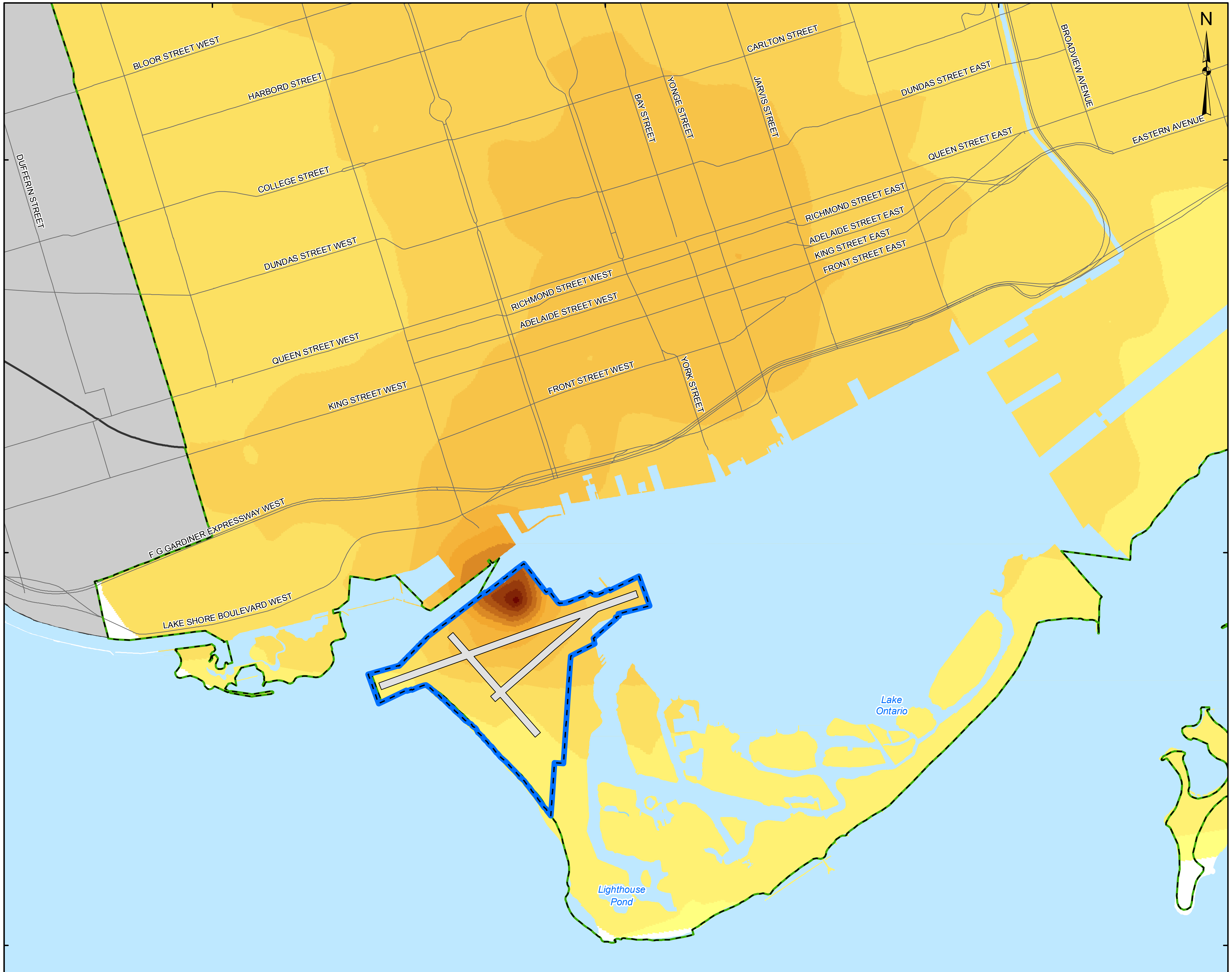
PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

TITLE
$PM_{2.5}$ -
95%ile 24 hour Averaged Concentrations -
Current Airport Operations (Q400s only)

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008	FIGURE: 22	
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 22 PM2_5 - 95ile 24 hour Averaged Concentrations - Current Airport Operations (Q400s only).mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

$PM_{2.5}$ (µg/m³)

- 35 - 37
- 33 - 35
- 31 - 33
- 29 - 31
- 27 - 29
- 25 - 27
- 23 - 25
- 21 - 23
- 19 - 21
- 17 - 19
- 15 - 17
- 13 - 15
- 11 - 13

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

250 125 0 250 500 750 1,000 1,250

SCALE 1:25,000 METRES

PROJECT

CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

TITLE

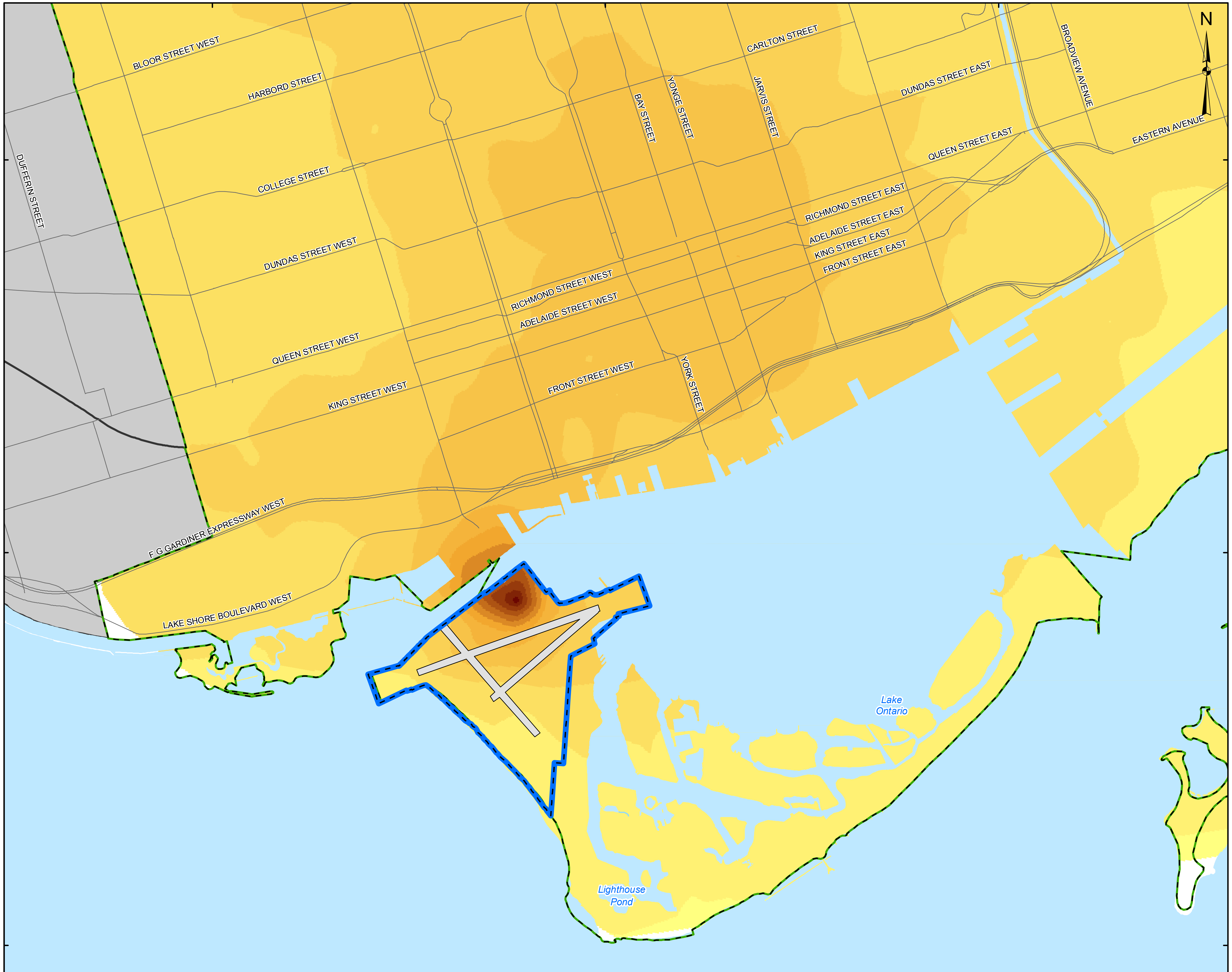
$PM_{2.5}$ - 95%ile 24 hour Averaged Concentrations - Future Scenario (737s and Q400s)

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008		
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

Golder Associates
Mississauga, Ontario

FIGURE: 23

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 23 PM2_5 - 95ile 24 hour Averaged Concentrations - Future Scenario (737s and Q400s).mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

$PM_{2.5}$ (µg/m³)

- 35 - 37
- 33 - 35
- 31 - 33
- 29 - 31
- 27 - 29
- 25 - 27
- 23 - 25
- 21 - 23
- 19 - 21
- 17 - 19
- 15 - 17
- 13 - 15
- 11 - 13

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

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

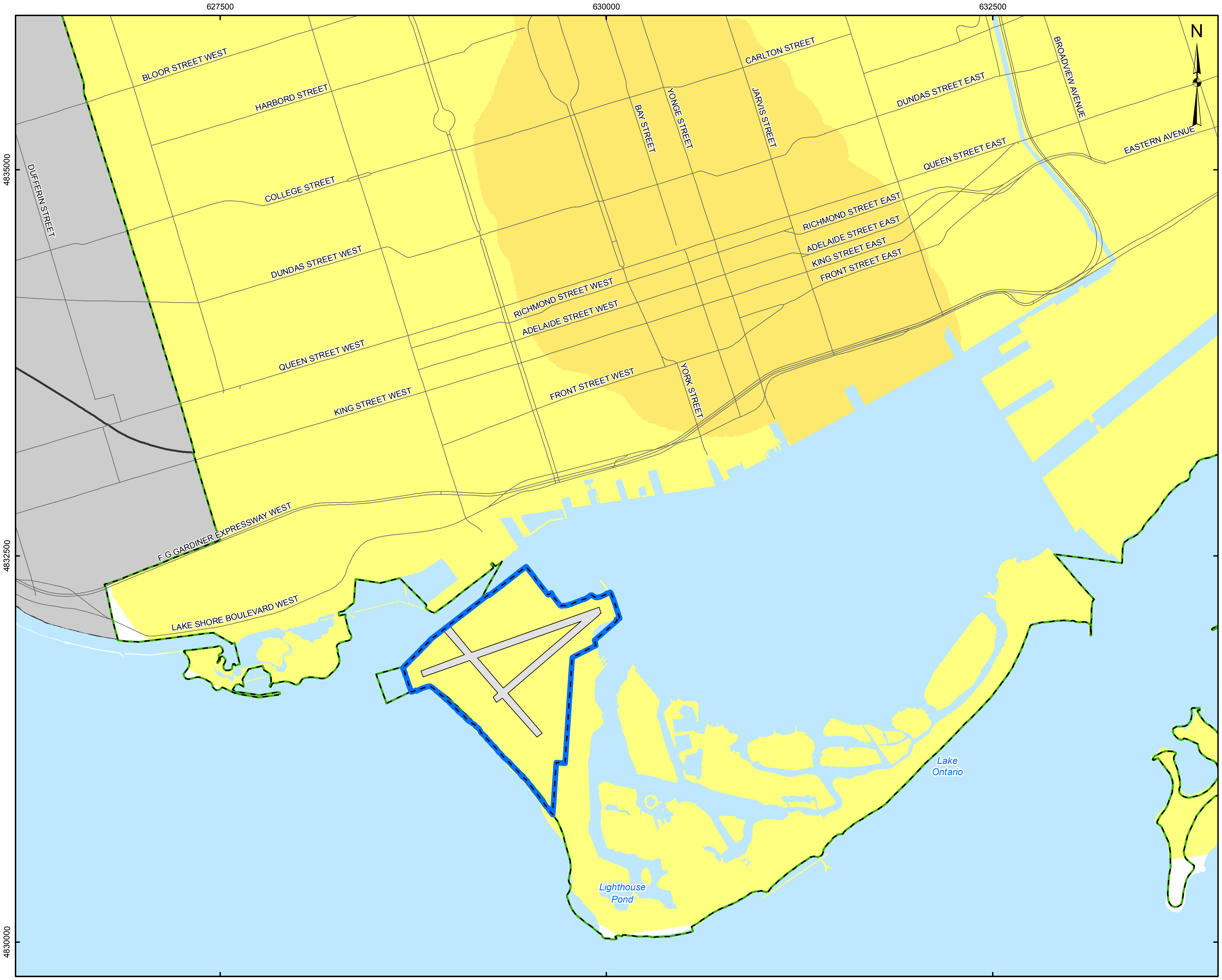
TITLE
$PM_{2.5}$ - 95%ile 24 hour Averaged Concentrations - Future Scenario (CS100ss and Q400s)

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008		
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

FIGURE: 24

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 24 PM2_5 - 95ile 24 hour Averaged Concentrations - Future Scenario (CS100ss and Q400s).mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

Cadmium (µg/m³)

- 0.0014 - 0.00154
- 0.00126 - 0.0014
- 0.00112 - 0.00126
- 0.00098 - 0.00112
- 0.00084 - 0.00098
- 0.0007 - 0.00084
- 0.00056 - 0.0007
- 0.00042 - 0.00056
- 0.00028 - 0.00042
- 0.00014 - 0.00028

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

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

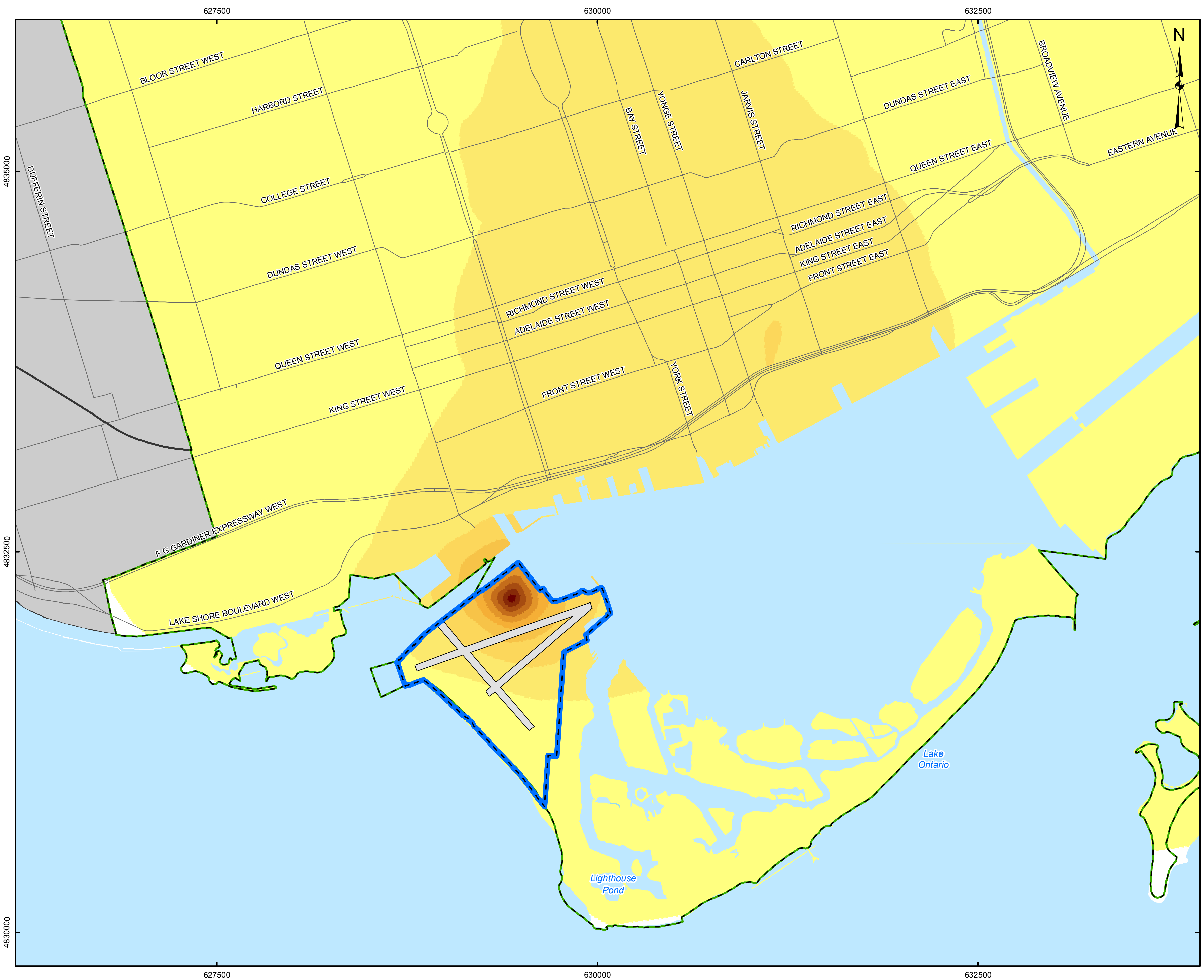
TITLE
Cadmium - Maximum Annual Concentrations - Baseline

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008		
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

FIGURE: 25

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 25 Cadmium - Maximum Annual Concentrations - Baseline.mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

Cadmium (µg/m³)

- 0.0014 - 0.00154
- 0.00126 - 0.0014
- 0.00112 - 0.00126
- 0.00098 - 0.00112
- 0.00084 - 0.00098
- 0.0007 - 0.00084
- 0.00056 - 0.0007
- 0.00042 - 0.00056
- 0.00028 - 0.00042
- 0.00014 - 0.00028

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

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

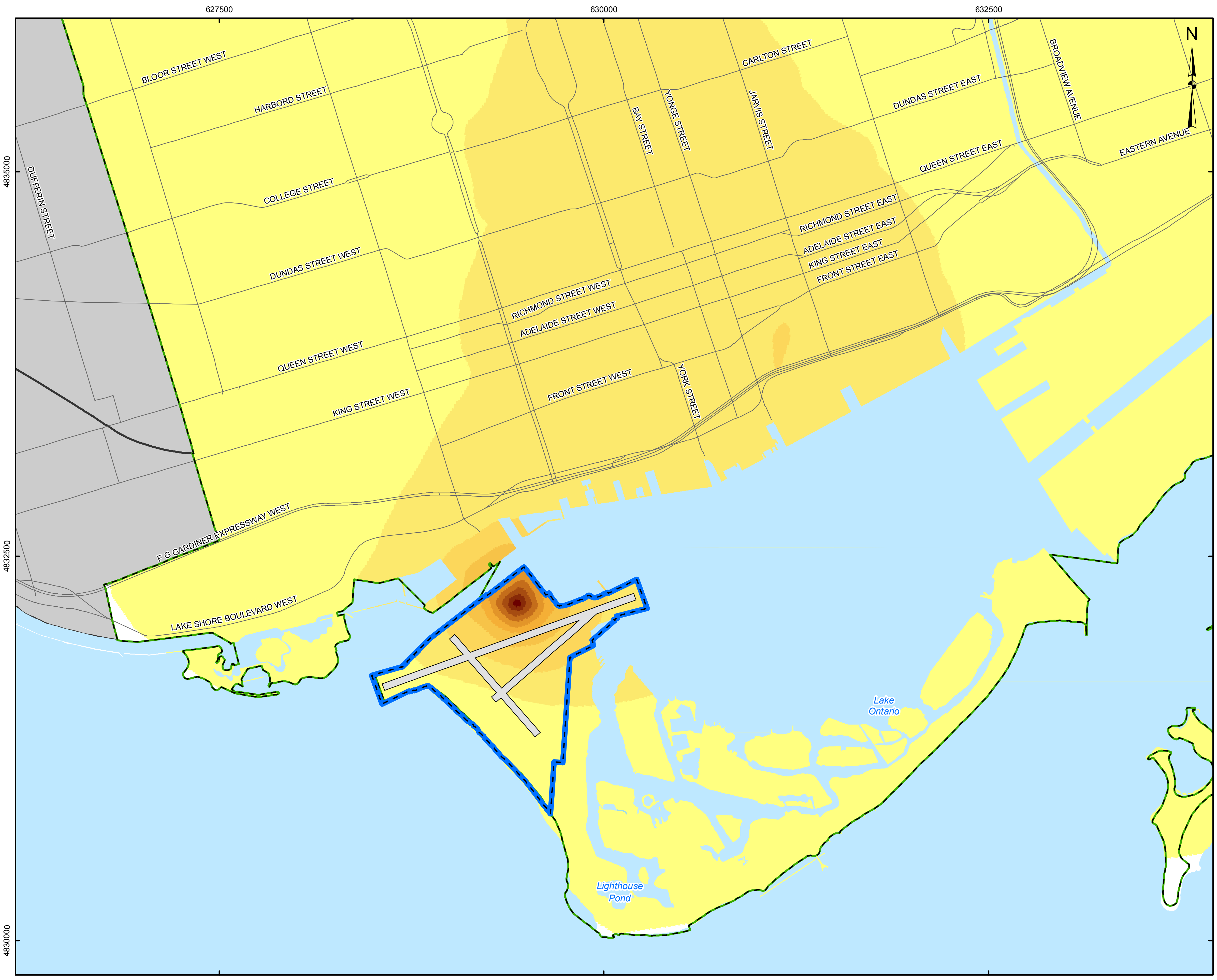
TITLE
Cadmium - Maximum Annual Concentrations - Current Airport Operations (Q400s only)

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008		
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

Golder Associates
Mississauga, Ontario

FIGURE: 26

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 26 Cadmium - Maximum Annual Concentrations - Current Airport Operations (Q400s only).mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

Cadmium (µg/m³)

- 0.0014 - 0.00154
- 0.00126 - 0.0014
- 0.00112 - 0.00126
- 0.00098 - 0.00112
- 0.00084 - 0.00098
- 0.0007 - 0.00084
- 0.00056 - 0.0007
- 0.00042 - 0.00056
- 0.00028 - 0.00042
- 0.00014 - 0.00028

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

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

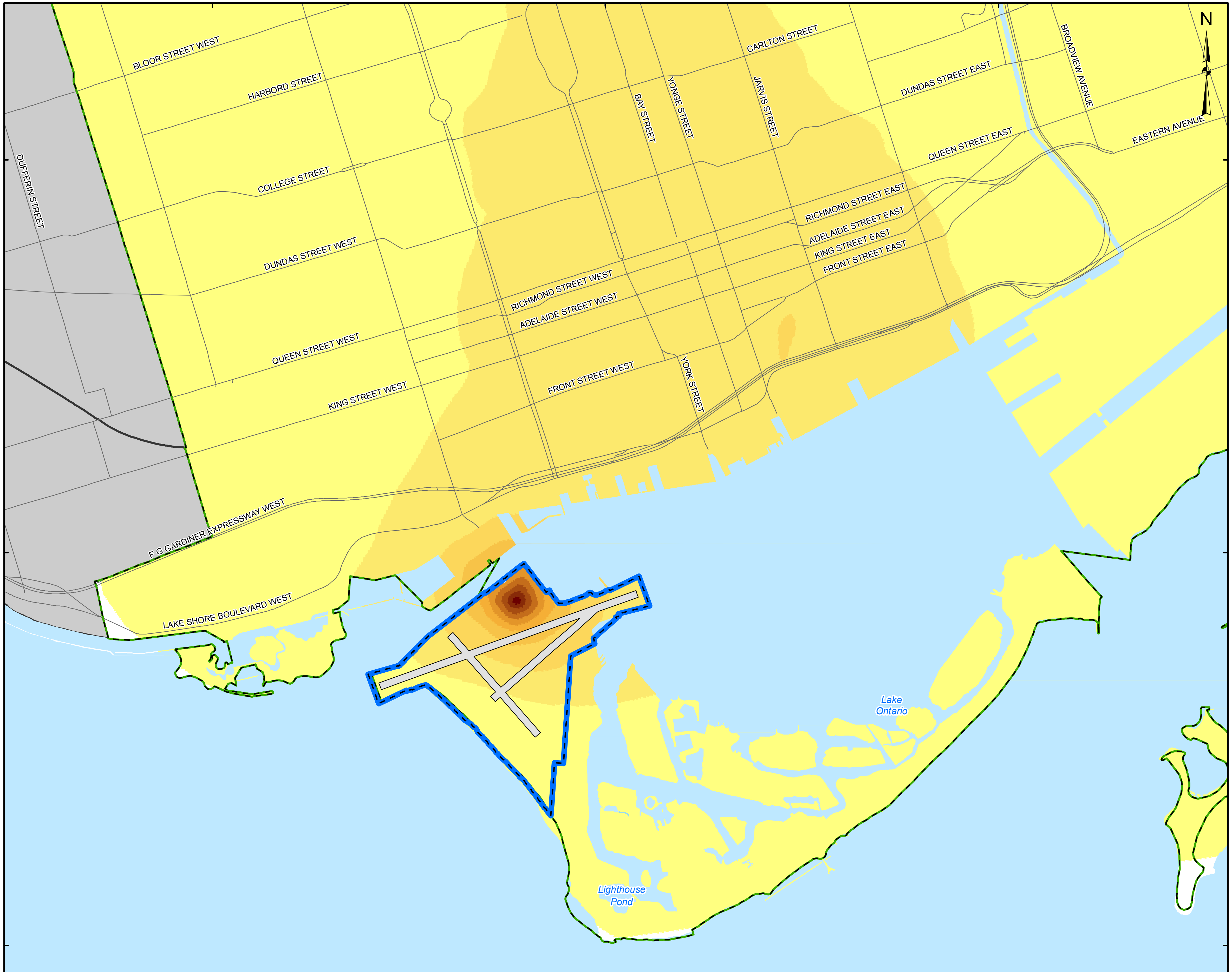
TITLE
Cadmium - Maximum Annual Concentrations - Future Scenario (737s and Q400s)

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008		
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

Golder Associates
Mississauga, Ontario

FIGURE: 27

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 27 Cadmium - Maximum Annual Concentrations - Future Scenario (737s and Q400s).mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

Cadmium (µg/m³)

- 0.0014 - 0.00154
- 0.00126 - 0.0014
- 0.00112 - 0.00126
- 0.00098 - 0.00112
- 0.00084 - 0.00098
- 0.0007 - 0.00084
- 0.00056 - 0.0007
- 0.00042 - 0.00056
- 0.00028 - 0.00042
- 0.00014 - 0.00028

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

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

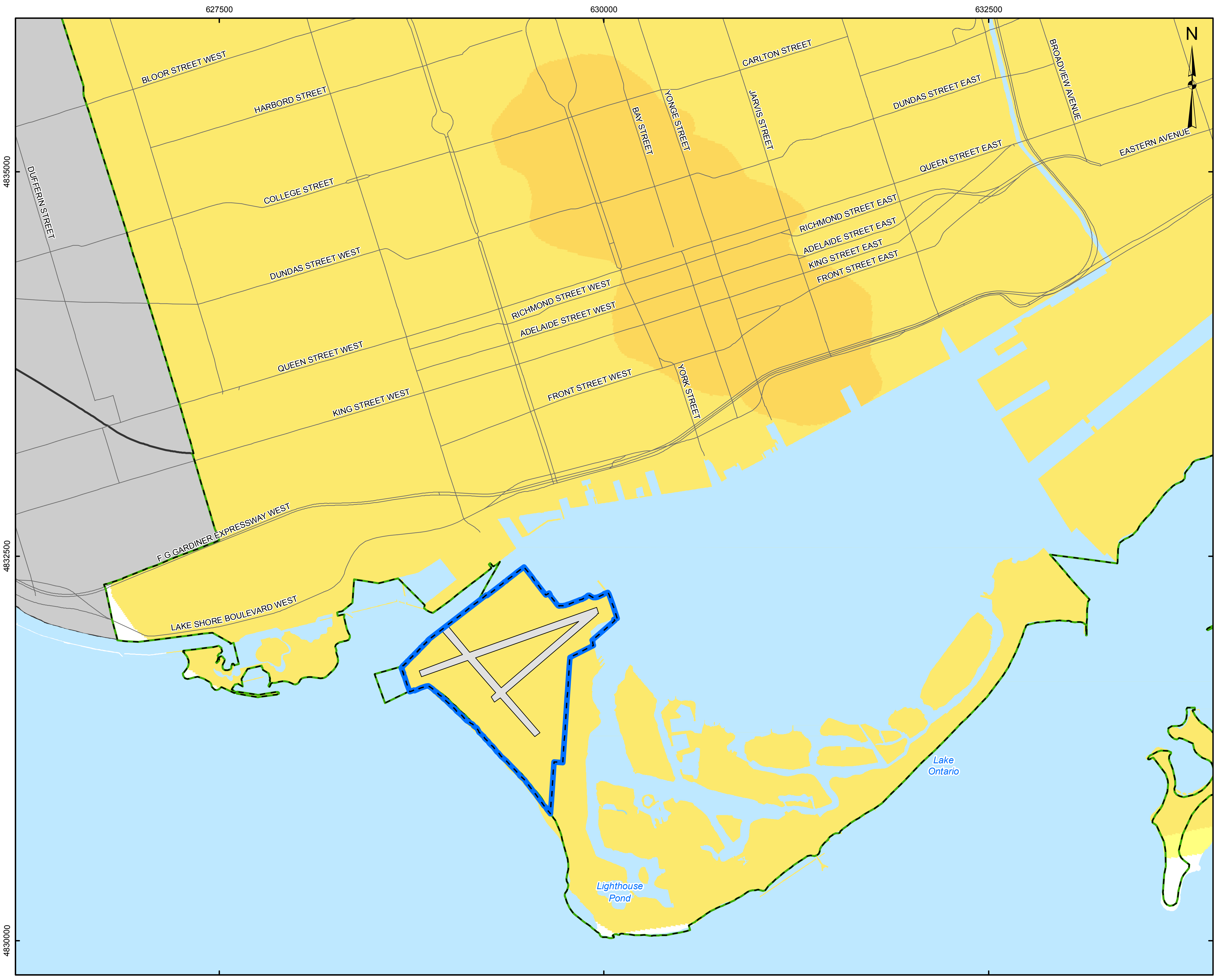
PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

TITLE
Cadmium -
Maximum Annual Concentrations -
Future Scenario (CS100ss and Q400s)

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008	**FIGURE: 28**	
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 28 Cadmium - Maximum Annual Concentrations - Future Scenario (CS100ss and Q400s).mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

Cadmium (µg/m³)

- 0.003375 - 0.00375
- 0.003 - 0.003375
- 0.002625 - 0.003
- 0.00225 - 0.002625
- 0.001875 - 0.00225
- 0.001500 - 0.001875
- 0.001125 - 0.0015
- 0.000750 - 0.001125
- 0.000375 - 0.00075
- 0.000341 - 0.000375

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

250 125 0 250 500 750 1,000 1,250

SCALE 1:25,000 METRES

PROJECT

CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

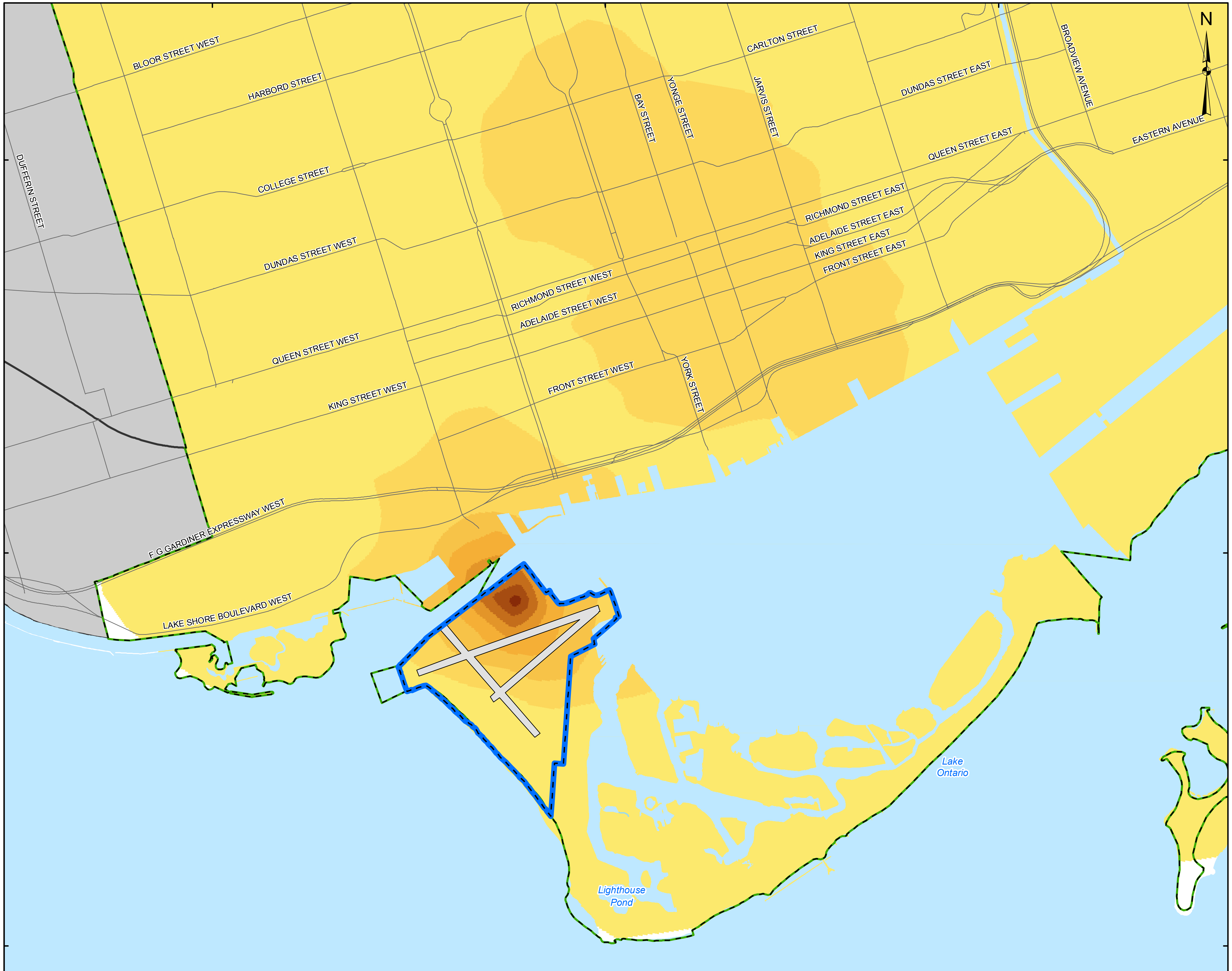
TITLE

Cadmium -
95%ile 24 hour Averaged Concentrations -
Baseline

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008	**FIGURE: 29**	
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

G:\CLIENTS\CITY_OF_TORONTO\BBTCA99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 29 Cadmium - 95ile 24 hour Averaged Concentrations - Baseline.mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

Cadmium (µg/m³)

- 0.003375 - 0.00375
- 0.003 - 0.003375
- 0.002625 - 0.003
- 0.00225 - 0.002625
- 0.001875 - 0.00225
- 0.001500 - 0.001875
- 0.001125 - 0.0015
- 0.000750 - 0.001125
- 0.000375 - 0.00075
- 0.000341 - 0.000375

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

250 125 0 250 500 750 1,000 1,250

SCALE 1:25,000 METRES

PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

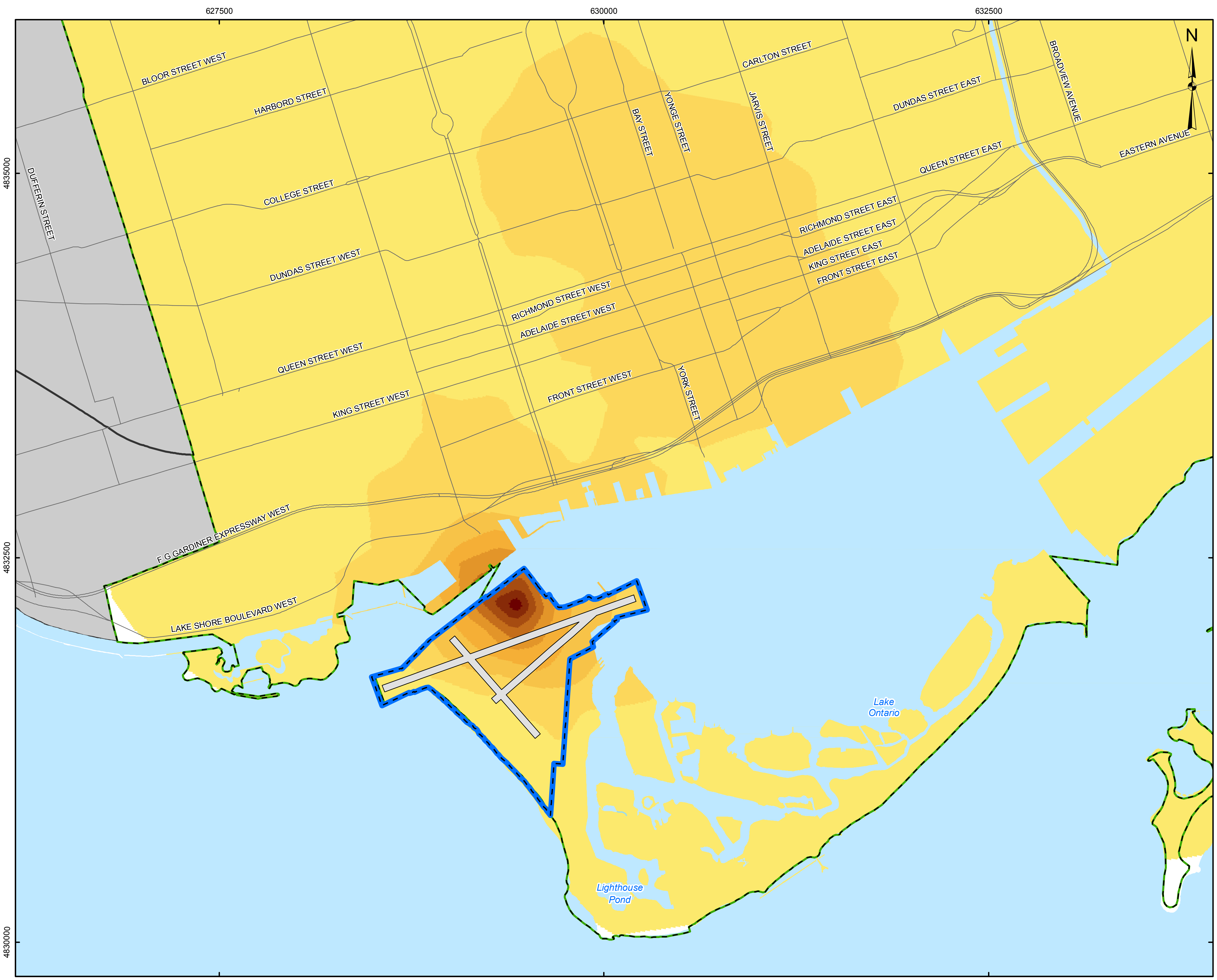
TITLE
Cadmium -
95%ile 24 hour Averaged Concentrations -
Current Airport Operations (Q400s only)

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008		
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

FIGURE: 30

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 30 Cadmium - 95%ile 24 hour Averaged Concentrations - Current Airport Operations (Q400s only).mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

Cadmium (µg/m³)

- 0.003375 - 0.00375
- 0.003 - 0.003375
- 0.002625 - 0.003
- 0.00225 - 0.002625
- 0.001875 - 0.00225
- 0.001500 - 0.001875
- 0.001125 - 0.0015
- 0.000750 - 0.001125
- 0.000375 - 0.00075
- 0.000341 - 0.000375

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

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

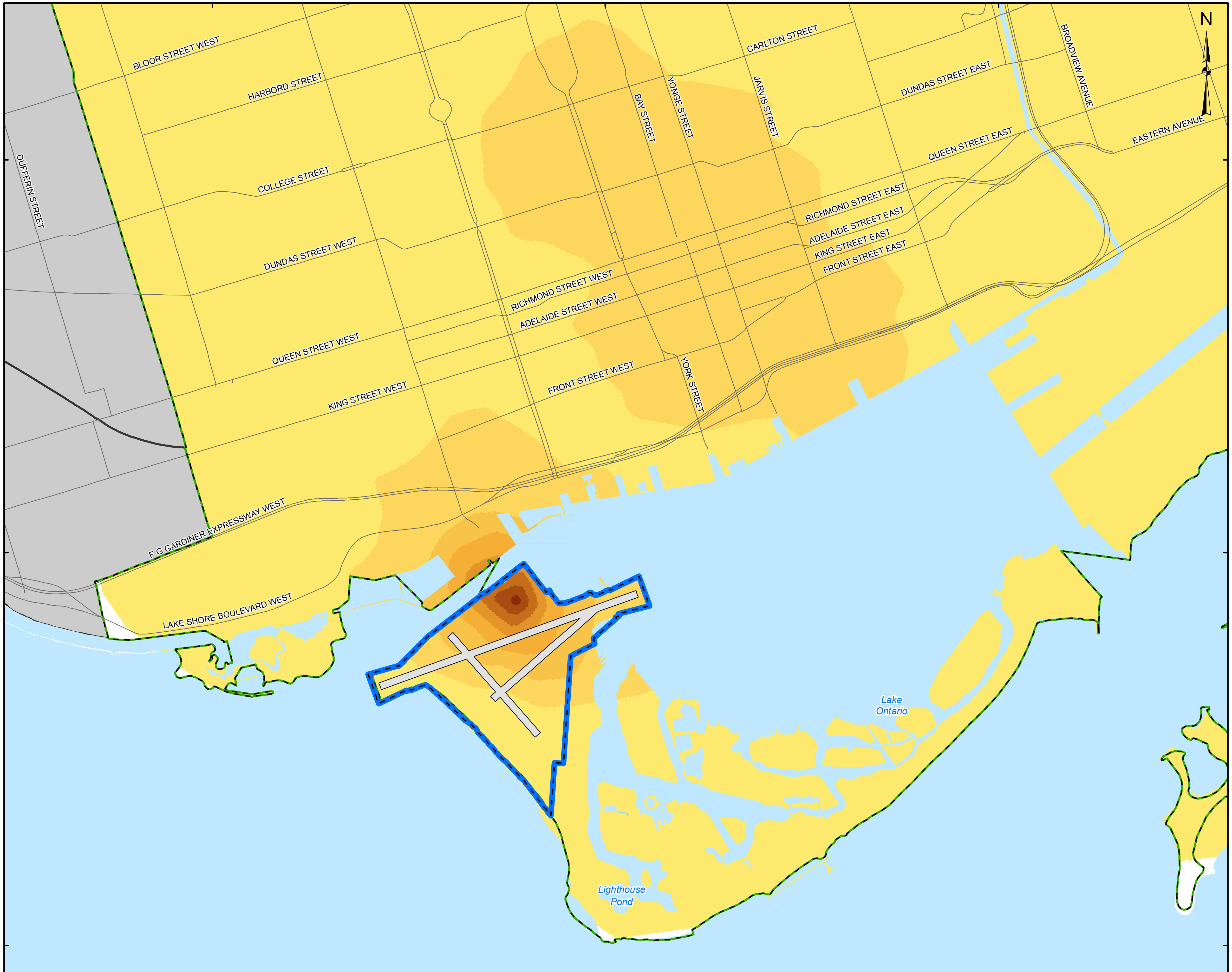
PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

TITLE
Cadmium -
95%ile 24 hour Averaged Concentrations -
Future Scenario (737s and Q400s)

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008	**FIGURE: 31**	
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 31 Cadmium - 95%ile 24 hour Averaged Concentrations - Future Scenario (737s and Q400s).mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

Cadmium (µg/m³)

- 0.003375 - 0.00375
- 0.003 - 0.003375
- 0.002625 - 0.003
- 0.00225 - 0.002625
- 0.001875 - 0.00225
- 0.001500 - 0.001875
- 0.001125 - 0.0015
- 0.000750 - 0.001125
- 0.000375 - 0.00075
- 0.000341 - 0.000375

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

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

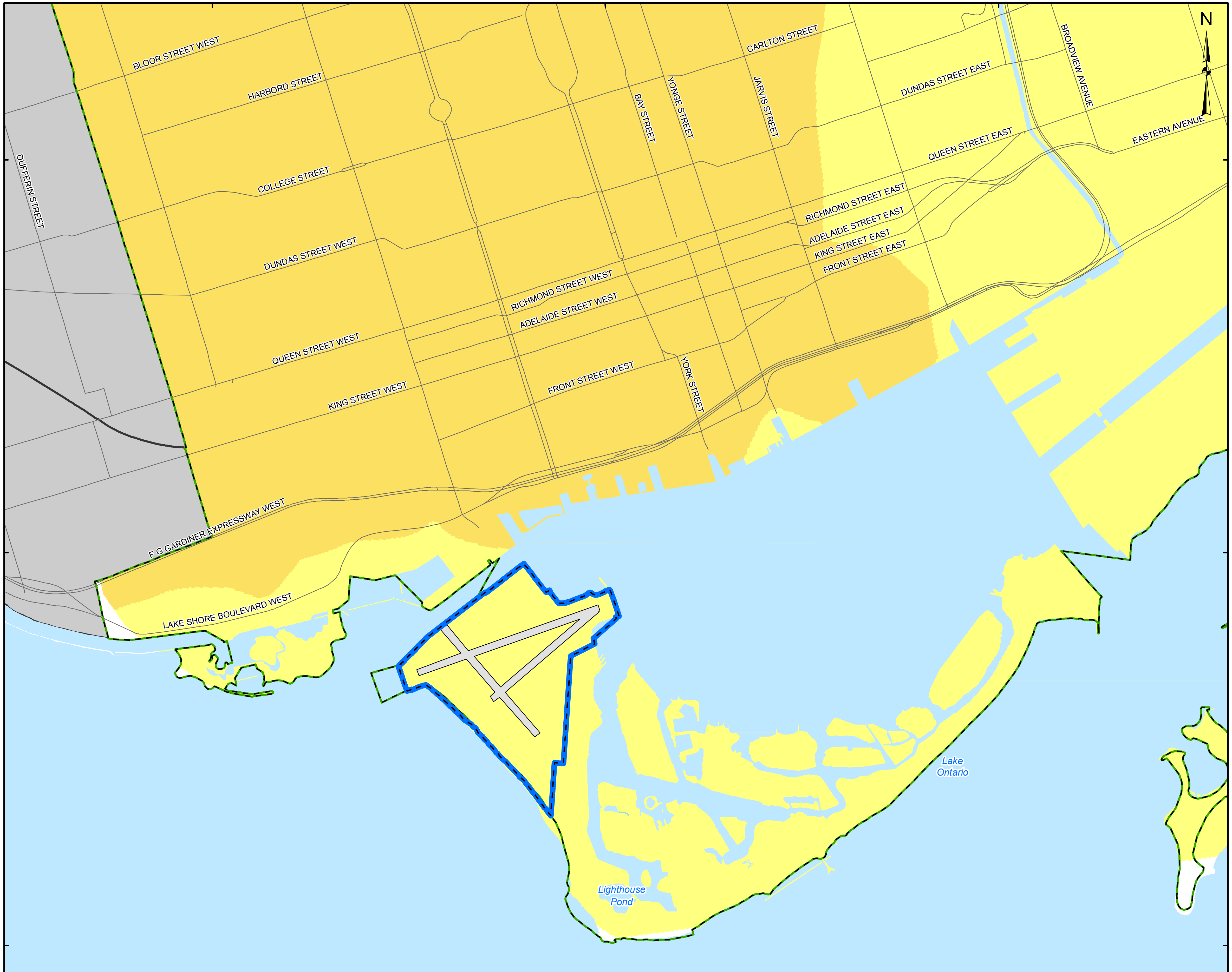
TITLE
Cadmium -
95%ile 24 hour Averaged Concentrations -
Future Scenario (CS100ss and Q400s)

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008		
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

FIGURE: 32

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 32 Cadmium - 95ile 24 hour Averaged Concentrations - Future Scenario (CS100ss and Q400s).mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

Chromium (µg/m³)

- 0.004 - 0.0045
- 0.0035 - 0.004
- 0.003 - 0.0035
- 0.0025 - 0.003
- 0.002 - 0.0025
- 0.0015 - 0.002
- 0.001 - 0.0015

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

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

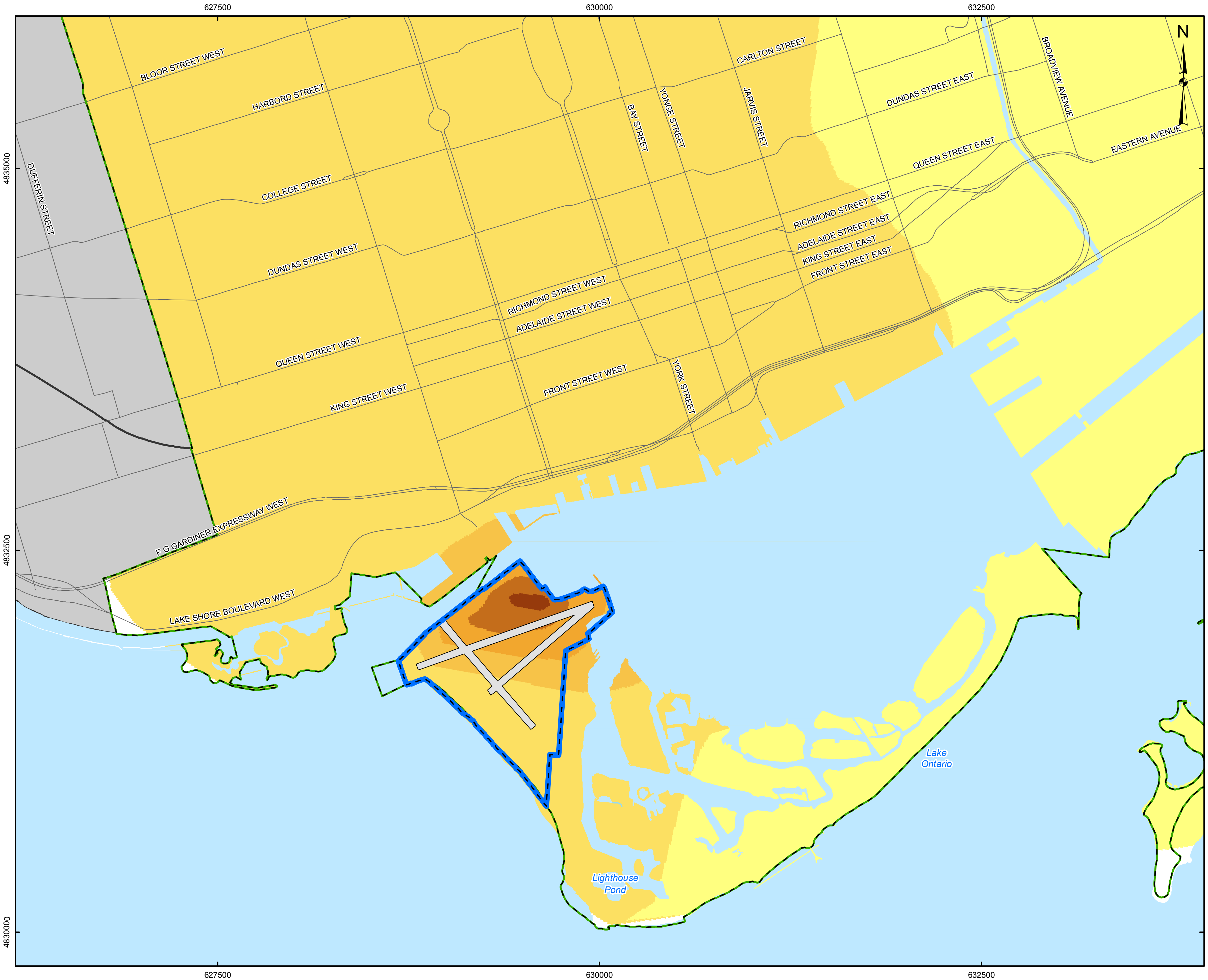
TITLE
Chromium - Maximum Annual Concentrations - Baseline

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008		
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

FIGURE: 33

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 33 Chromium - Maximum Annual Concentrations - Baseline.mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

Chromium (µg/m³)

- 0.004 - 0.0045
- 0.0035 - 0.004
- 0.003 - 0.0035
- 0.0025 - 0.003
- 0.002 - 0.0025
- 0.0015 - 0.002
- 0.001 - 0.0015

REFERENCE

Base Data - MNR LIO, obtained 2009
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Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 17

250 125 0 250 500 750 1,000 1,250

SCALE 1:25,000 METRES

PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

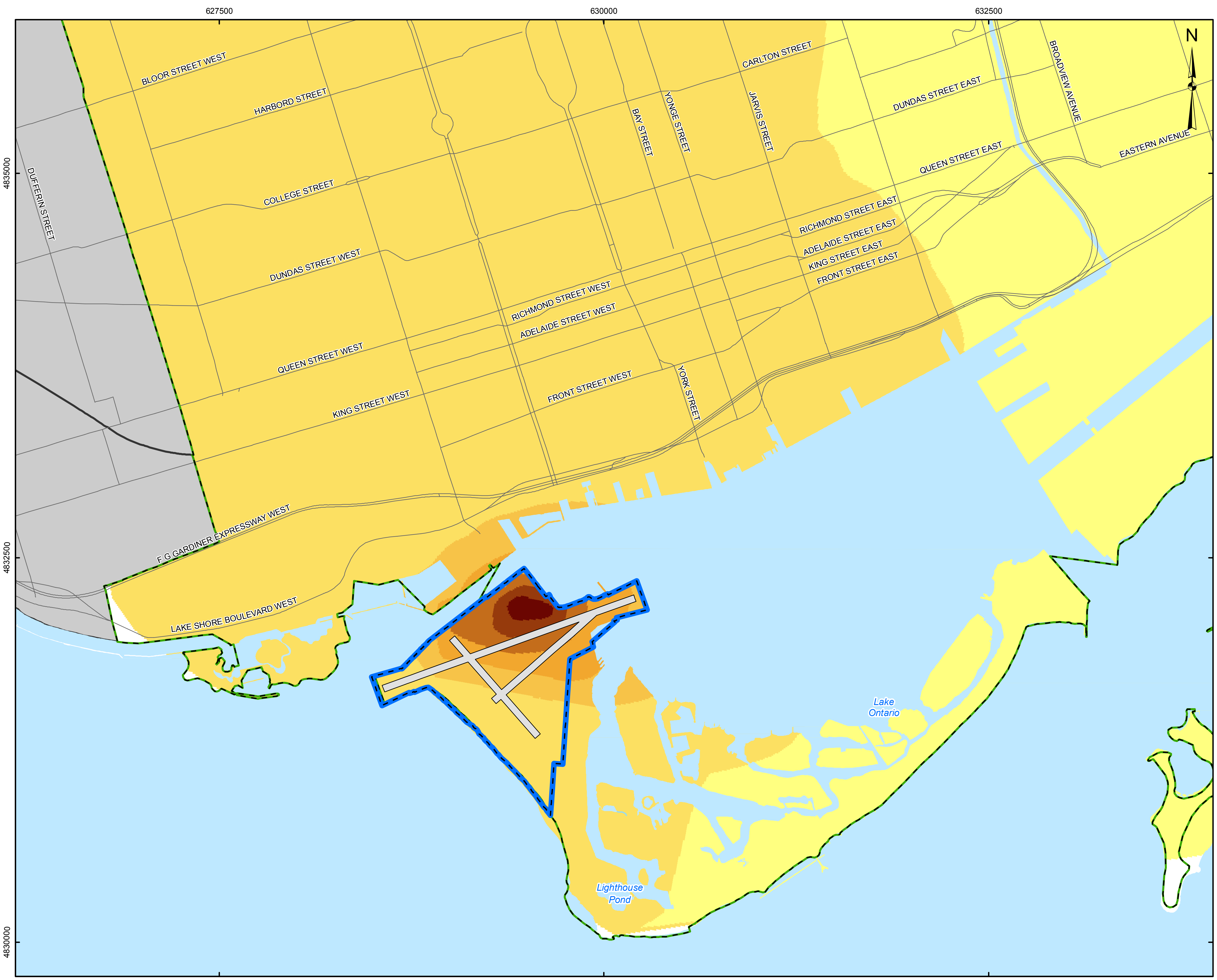
TITLE
Chromium -
Maximum Annual Concentrations -
Current Airport Operations (Q400s only)

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008		
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

Golder Associates
Mississauga, Ontario

FIGURE: 34

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 34 Chromium - Maximum Annual Concentrations - Current Airport Operations (Q400s only).mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

Chromium (µg/m³)

- 0.004 - 0.0045
- 0.0035 - 0.004
- 0.003 - 0.0035
- 0.0025 - 0.003
- 0.002 - 0.0025
- 0.0015 - 0.002
- 0.001 - 0.0015

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

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

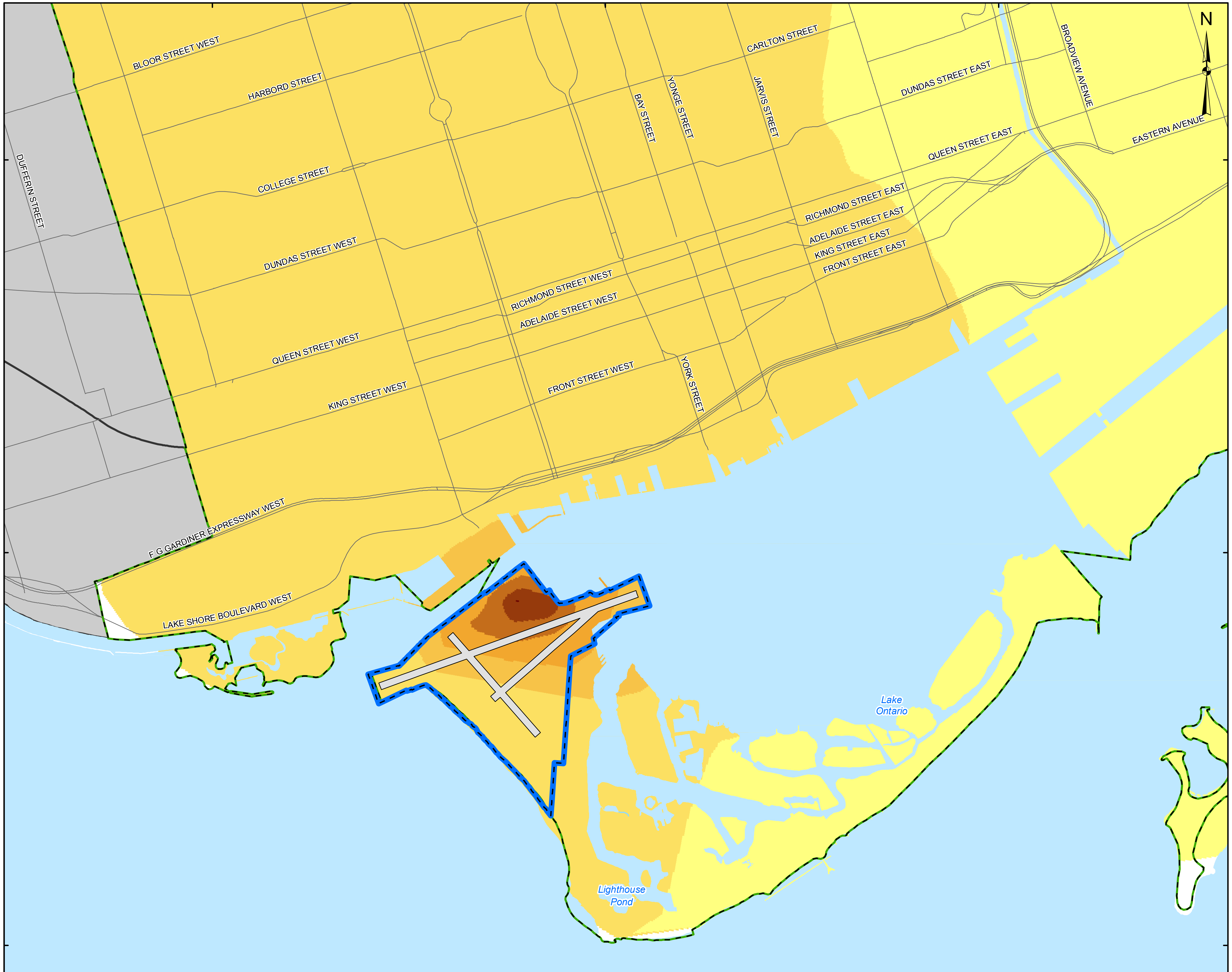
TITLE
Chromium - Maximum Annual Concentrations - Future Scenario (737s and Q400s)

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008		
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

FIGURE: 35

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 35 Chromium - Maximum Annual Concentrations - Future Scenario (737s and Q400s).mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

Chromium (µg/m³)

- 0.004 - 0.0045
- 0.0035 - 0.004
- 0.003 - 0.0035
- 0.0025 - 0.003
- 0.002 - 0.0025
- 0.0015 - 0.002
- 0.001 - 0.0015

REFERENCE

Base Data - MNR LIO, obtained 2009
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Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 17

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

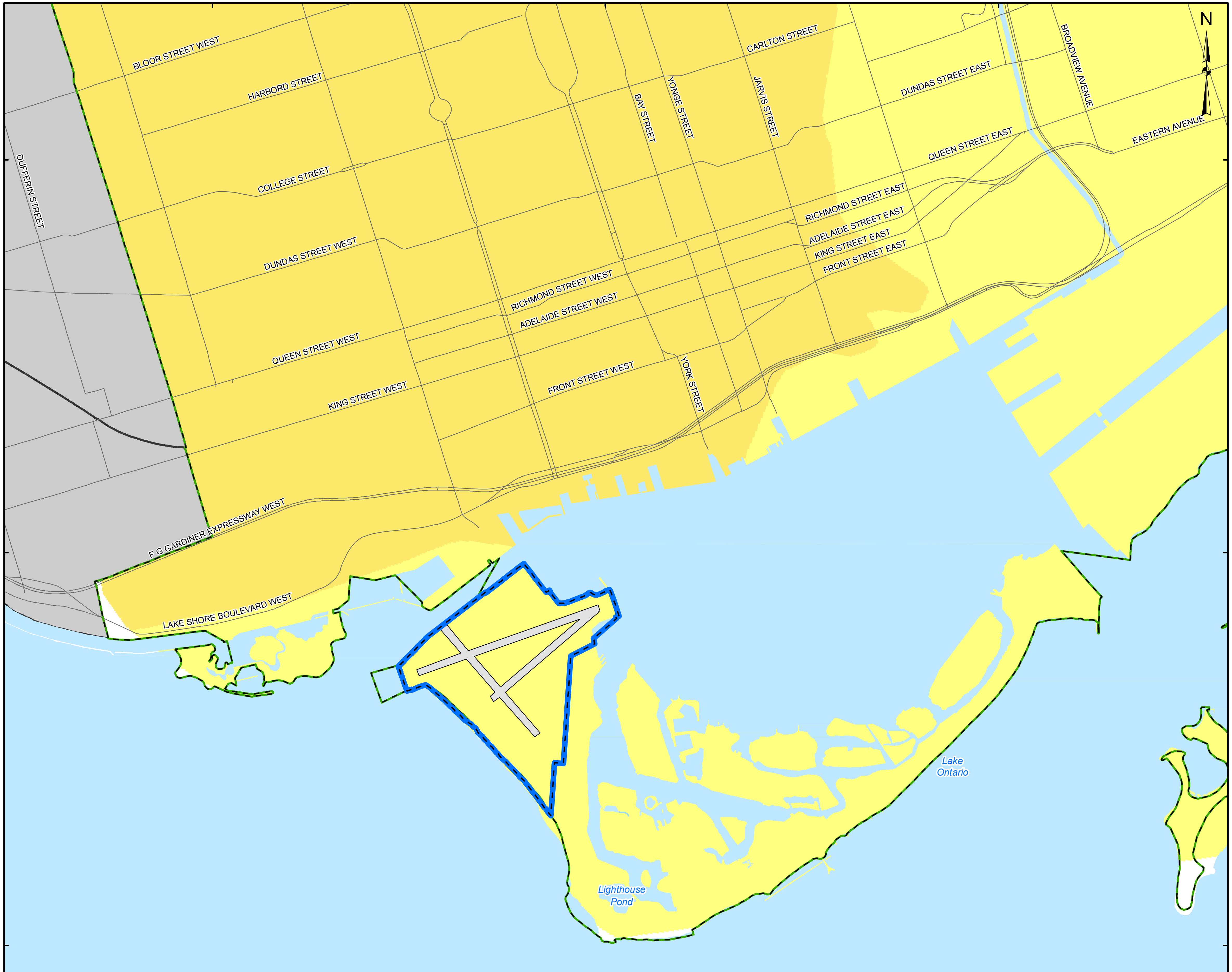
TITLE
Chromium - Maximum Annual Concentrations - Future Scenario (CS100ss and Q400s)

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008		
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

FIGURE: 36

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 36 Chromium - Maximum Annual Concentrations - Future Scenario (CS100ss and Q400s).mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

Chromium (µg/m³)

- 0.0084 - 0.0091
- 0.0077 - 0.0084
- 0.007 - 0.0077
- 0.0063 - 0.007
- 0.0056 - 0.0063
- 0.0049 - 0.0056
- 0.0042 - 0.0049
- 0.0035 - 0.0042
- 0.0028 - 0.0035

REFERENCE

Base Data - MNR LIO, obtained 2009
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Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 17

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

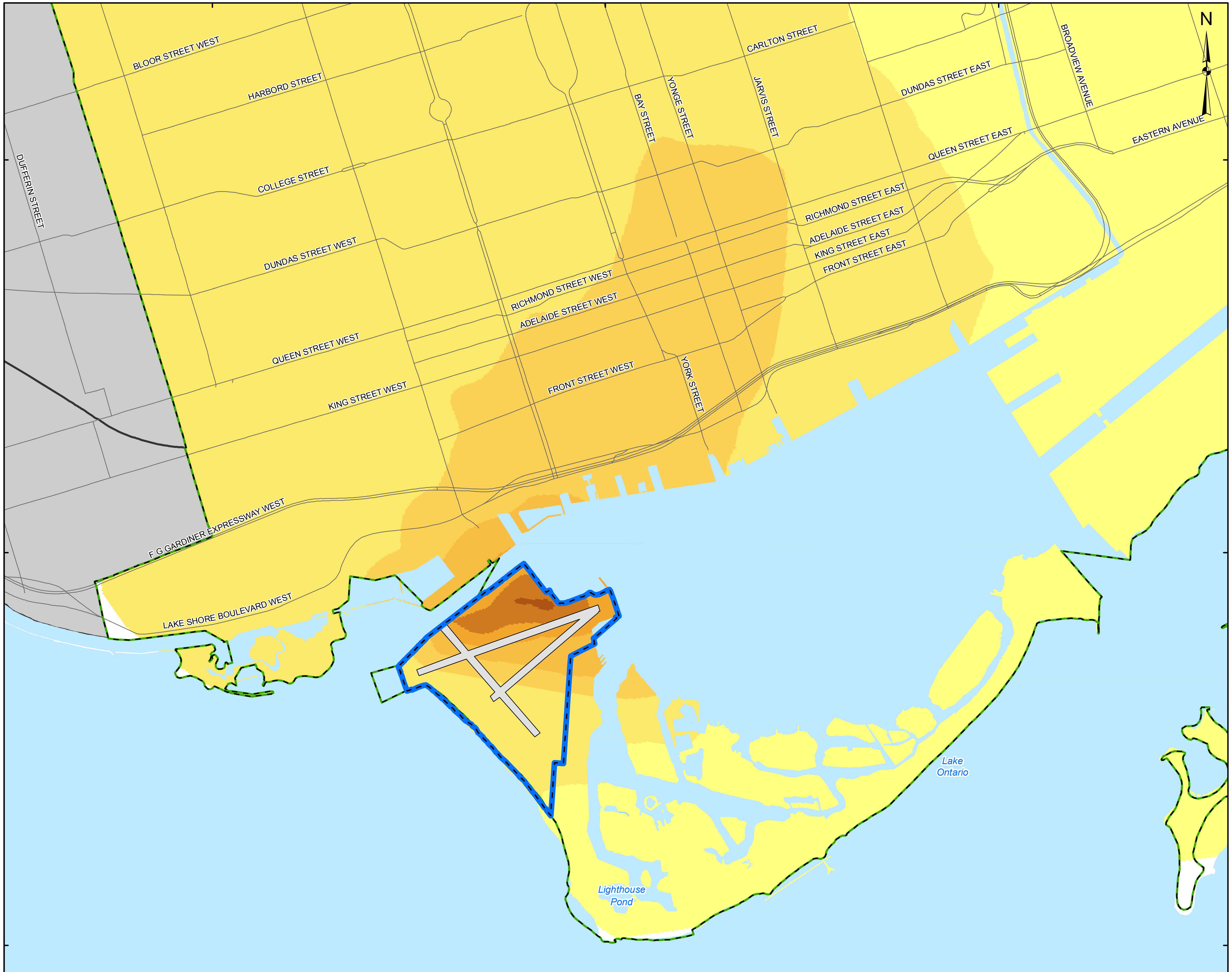
TITLE
Chromium - 95%ile 24 hour Averaged Concentrations - Baseline

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008		
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

FIGURE: 37

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 37 Chromium - 95ile 24 hour Averaged Concentrations - Baseline.mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

Chromium (µg/m³)

- 0.0084 - 0.0091
- 0.0077 - 0.0084
- 0.007 - 0.0077
- 0.0063 - 0.007
- 0.0056 - 0.0063
- 0.0049 - 0.0056
- 0.0042 - 0.0049
- 0.0035 - 0.0042
- 0.0028 - 0.0035

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

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

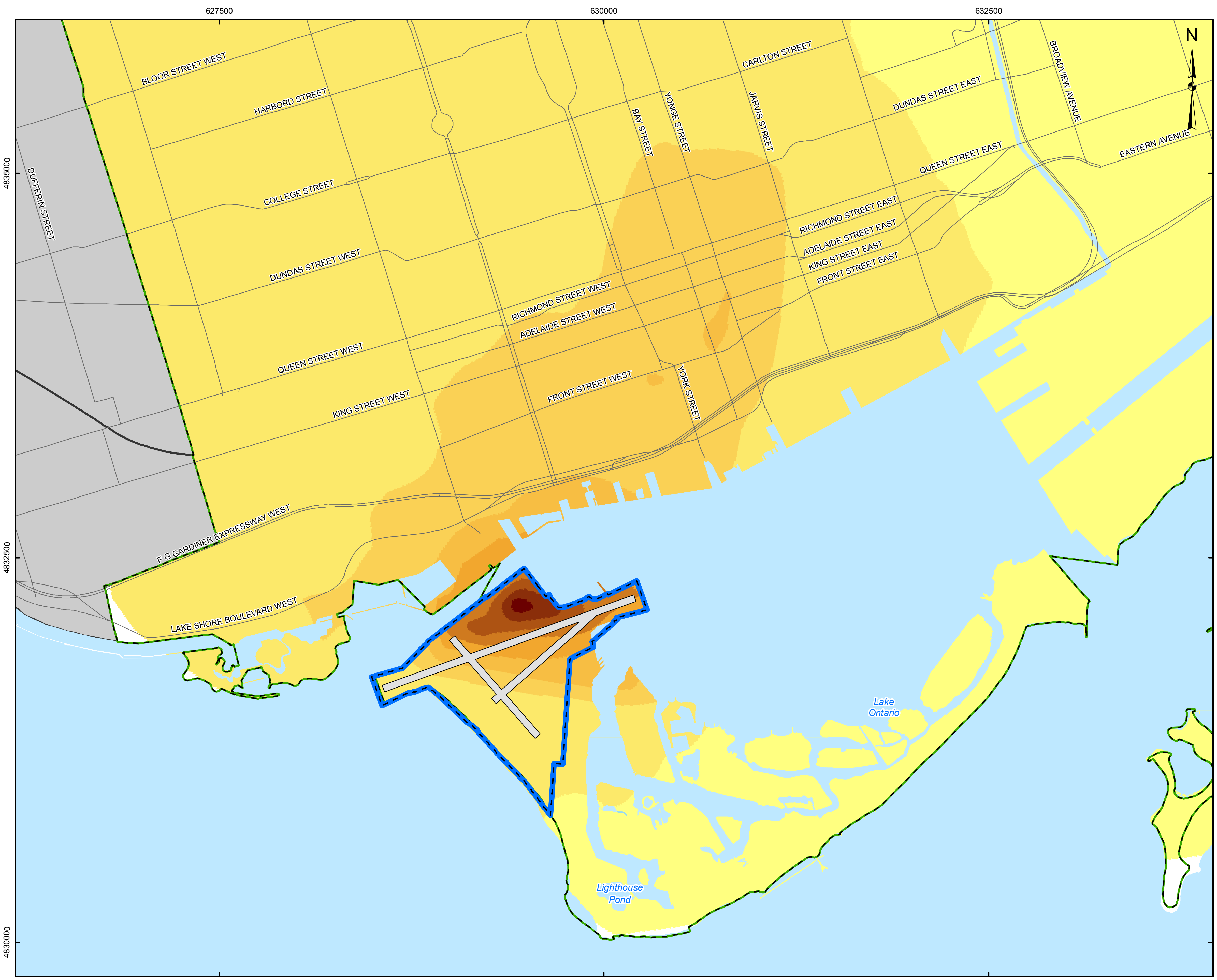
PROJECT	CITY OF TORONTO HUMAN HEALTH IMPACT ASSESSMENT BILLY BISHOP AIRPORT
TITLE	**Chromium - 95%ile 24 hour Averaged Concentrations - Current Airport Operations (Q400s only)**

PROJECT NO. 13-1151-0215	SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008
GIS	JO	16 Nov. 2013
CHECK	KSA	16 Nov. 2013
REVIEW	AC	16 Nov. 2013

Golder Associates
Mississauga, Ontario

FIGURE: 38

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 38 Chromium - 95%ile 24 hour Averaged Concentrations - Current Airport Operations (Q400s only).mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

Chromium (µg/m³)

- 0.0084 - 0.0091
- 0.0077 - 0.0084
- 0.007 - 0.0077
- 0.0063 - 0.007
- 0.0056 - 0.0063
- 0.0049 - 0.0056
- 0.0042 - 0.0049
- 0.0035 - 0.0042
- 0.0028 - 0.0035

REFERENCE

Base Data - MNR LIO, obtained 2009
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Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 17

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

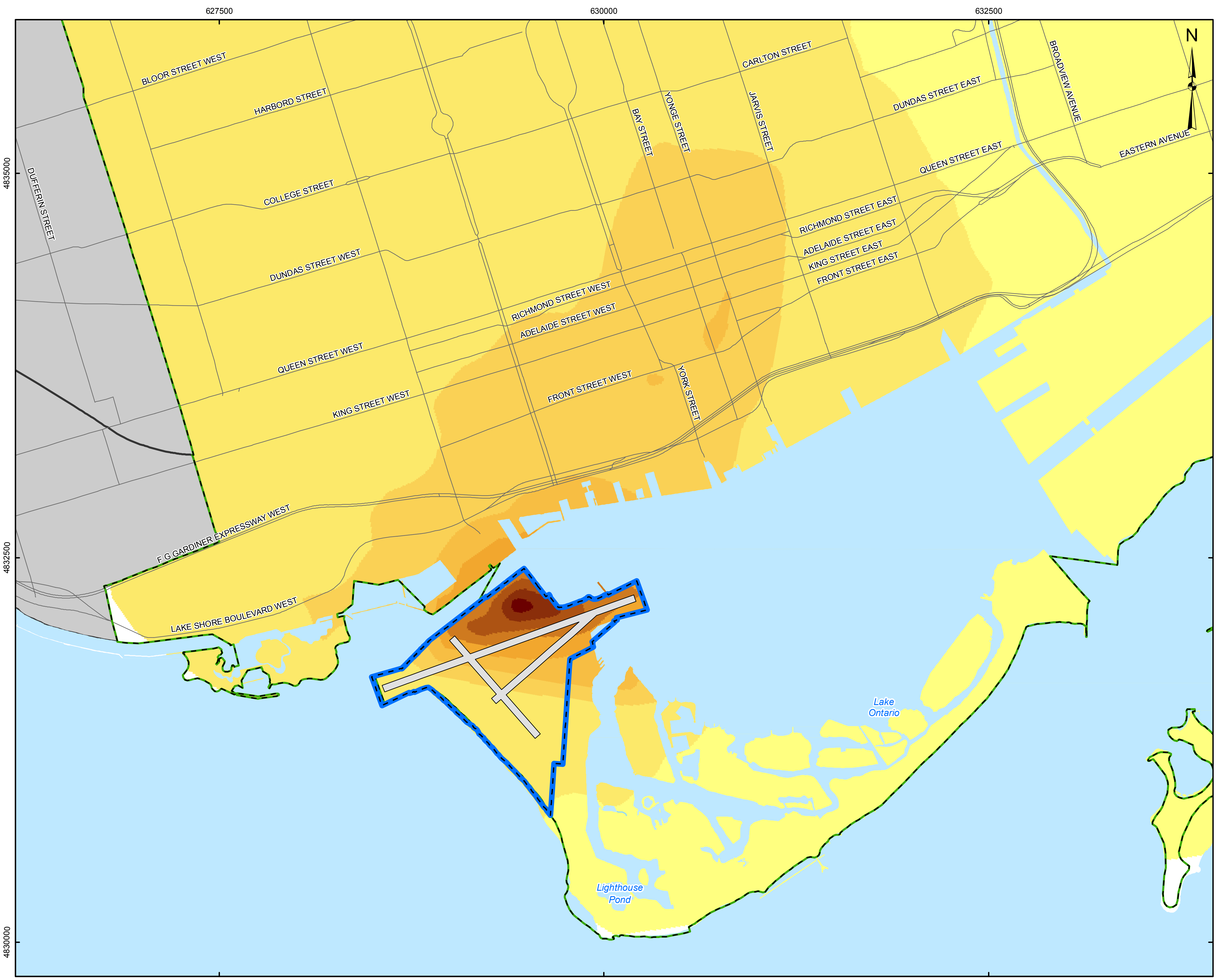
TITLE
Chromium -
95%ile 24 hour Averaged Concentrations -
Future Scenario (737s and Q400s)

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008		
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

Golder Associates
Mississauga, Ontario

FIGURE: 39

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 39 Chromium - 95%ile 24 hour Averaged Concentrations - Future Scenario (737s and Q400s).mxd



LEGEND

- Major Roads
- Waterbody
- Billy Bishop Toronto City Airport
- Air Quality Assessment Study Area

Chromium (µg/m³)

- 0.0084 - 0.0091
- 0.0077 - 0.0084
- 0.007 - 0.0077
- 0.0063 - 0.007
- 0.0056 - 0.0063
- 0.0049 - 0.0056
- 0.0042 - 0.0049
- 0.0035 - 0.0042
- 0.0028 - 0.0035

REFERENCE

Base Data - MNR LIO, obtained 2009
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Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 17

250 125 0 250 500 750 1,000 1,250
SCALE 1:25,000 METRES

PROJECT
CITY OF TORONTO
HUMAN HEALTH IMPACT ASSESSMENT
BILLY BISHOP AIRPORT

TITLE
Chromium - 95%ile 24 hour Averaged Concentrations - Future Scenario (CS100ss and Q400s)

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1151-0215			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	14 Nov. 2008		
GIS	JO	16 Nov. 2013		
CHECK	KSA	16 Nov. 2013		
REVIEW	AC	16 Nov. 2013		

FIGURE: 40

G:\CLIENTS\CITY_OF_TORONTO\BBTCA\99_PROJ\13-1151-0215\05_PRODUCTION\AIR\FINAL\Figure 40 Chromium - 95%ile 24 hour Averaged Concentrations - Future Scenario (CS100ss and Q400s).mxd

As a global, employee-owned organisation with over 50 years of experience, Golder Associates is driven by our purpose to engineer earth's development while preserving earth's integrity. We deliver solutions that help our clients achieve their sustainable development goals by providing a wide range of independent consulting, design and construction services in our specialist areas of earth, environment and energy.

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