UP Express Electrification EA
Air Quality Assessment Report

FINAL

Project No. 1124019.00 March, 2014

Executive Summary

Report Structure

The purpose of this report is to: 1) establish baseline air quality conditions and 2) to assess air quality impacts of the proposed electrification of the Union Pearson Express (UP Express) as part of the UP Express Electrification EA. This Air Quality Assessment Report contains **Parts A** and **B**. **Part A** includes the **Air Quality Baseline Conditions Report,** and **Part B** includes the **Air Quality Impact Assessment Report.**

With respect to baseline air quality conditions along the UP Express route (from the future UP Express Union Station to UP Express Pearson station, along the existing Union Station and Kitchener Rail Corridors), baseline conditions include the existing pollutant burden within the study area and include the operation of Tier 4 Diesel Multiple Units (DMUs) for the UP Express service. Therefore, for the purposes of the UP Express Electrification EA, baseline air quality conditions within the UP Express route (rail corridor) are considered to be the modelled air quality impacts from the July 2009 Georgetown South Service Expansion and Union-Pearson Rail Link Environmental Assessment, which are based on the operation of Tier 4 DMUs plus background monitoring data from representative MOE monitoring stations.

Baseline air quality conditions associated with the location for an Electrical Multiple Unit (EMU) Maintenance Facility are based on average 90th percentile contaminant concentrations from the five (5) most recent years of monitoring data from the MOE Toronto West monitoring station.

The UP Express service will commence operation with train sets comprised of Diesel Multiple Units (DMUs). The UP Express Electrification EA is investigating air quality impacts associated with replacing these DMUs with Electric Multiple Units (EMUs), as well as impacts associated with the implementation of facilities necessary to support the electrified service.

The assessment of operations resulted in a conclusion that there will be no predicted net effects within the UP Express corridor due to the change in technology (i.e., replacing DMUs with EMUs). Air quality within the UP Express corridor will improve based on the displacement of emissions from the operation of DMUs to emissions from the generation of electricity in Ontario to power the operation of EMUs. A loading assessment also indicates reductions in the emission of contaminants based on generating electricity to power EMUs versus emissions from the operation of DMUs.

The assessment also concluded that there are no significant sources of atmospheric emissions at two (2) proposed electrical power distribution Paralleling Stations; therefore, there are no anticipated net air quality effects from these facilities.

The Maintenance Facility does include sources of atmospheric emissions including a cooling tower, a diesel-fired emergency generator, a natural gas-fired trigeneration unit and natural gas-fired unit heaters. A modelling assessment based on worst case maximum operating conditions of all equipment at the

Maintenance Facility indicates that maximum ground level contaminant concentrations are within applicable Ontario Ambient Air Quality Criteria (AAQC).

TABLE OF CONTENTS

Glossary of Terms i
Part A – Baseline Conditions Report A-1
1. Background A-1
1.1 Environmental Assessment Process A-1
1.2 Description of the Project A-2
1.2.1 Traction Power Distribution System A-3
1.2.1.1 Overhead Contact System A-3
1.2.1.2 Paralleling Stations A-5
1.2.2 Maintenance Facility A-8
1.3 Study Area A-10
1.4 Purpose A-10
2. Methodology A-11
2.1 UP Express Route/Corridor A-11
2.2 EMU Maintenance Facility A-12
2.3 Power Distribution Facilities A-12
3. Baseline Conditions A-13
3.1 Background Pollutant Concentrations A-14
3.2 Summary of Baseline Air Quality Conditions A-15
3.2.1 Section 1 – UP Express Union Station to Bloor Station A-15
3.2.2 Section 2 - Bloor Station to Weston Station A-15
3.2.3 Section 3 - Weston Station to Highway 427 ..... A-15
3.2.4 Section 4 - Highway 427 to UP Express Pearson Station A-15
Part B – Air Quality Impact Assessment Report B-1
1. Purpose B-1
1.1 Methodology B-1
2. UP Express Electrification Preliminary Design B-2
3. Air Quality Assessment Approach B-3
3.1 UP Express Route/Corridor B-3
3.2 Power Distribution - Paralleling Stations B-3
3.3 EMU Maintenance Facility B-3

3.4 Construction Activities B-4
3.4.1 Power Distribution Components B-4
4. Air Quality Impact Assessment B-5
4.1 Operation of EMUs within UP Express Corridor B-6
4.1.1 Operations and Maintenance Impacts B-6
4.1.2 Construction Impacts B-7
4.2 Paralleling Stations B-9
4.2.1 Operations and Maintenance Impacts B-9
4.2.2 Construction Impacts B-9
4.3 EMU Maintenance Facility B-10
4.3.1 Operations and Maintenance Impacts B-11
4.3.1.1 Sources of Emissions B-11
4.3.1.2 Sensitive Points of Reception B-11
4.3.1.3 Applicable Criteria B-11
4.3.1.4 Assessment Methodology B-12
4.3.1.5 Assessment Results B-12
4.3.2 Construction Impacts B-13
4.4 Mitigation Measures B-14

List of Figures

Figure 1-1. UP Express Electrification EA Study Area A-2
Figure 1-2. Example of OCS Support Structures (Portals) A-4
Figure 1-3. Typical Paralleling Station A-5
Figure 1-4. Paralleling Station – Ordnance St. A-6
Figure 1-5. Paralleling Station – 3500 Eglinton Ave. W. A-7
Figure 1-6. Electrified Maintenance Facility – 50 Resources Rd. A-9
Figure 3-1. Study Area Sections A-13
Figure 4-1. Study Area Sections B-5

List of Tables

Table 3-1. 90th Percentile Background Values Used for EMU Maintenance Facility B-14
Table 4-1. Estimated UP Express System Wide EMU Regional 24-hr Contaminant Emission Rates B-7
Table 4-2. Estimated UP Express System Wide DMU Local 24-hr Contaminant Emission Rates B-7
Table 4-3. Applicable Criteria B-11
Table 4-4. Summary of Model Results B-12
Table 4-5. Summary of Recommended Mitigation Measures during Construction B-14

Appendices

Appendix A - Georgetown South Service Expansion & Union Pearson Rail Link (GSSE-UPRL) Environmental Project Report (2009)

Appendix B - Air Quality Assessment Georgetown South Service Expansion & Union Pearson Rail Link Toronto, Ontario (July 2009)

Appendix C - Georgetown South & Airport Rail Link Final Report Air Quality Impact Assessment – Enhanced Analysis (May 11, 2011)

Appendix D – Detailed Maintenance Facility Emission Calculations

Glossary of Terms

ADMGO	The acronym for Air Dispersion Modelling Guideline for Ontario
AREMA	The acronym for American Railway Engineering and Maintenance of-Way Association. AREMA is the organization that represents the engineering function of the North American railroads.
Autotransformer	Apparatus which helps boost the overhead contact system (OCS) voltage and reduce the running rail return current in the 2 X 25kV autotransformer feed configuration. It is a single winding transformer having three terminals. The intermediate terminal located at the midpoint of the winding is connected to the rail and the static wires, and the other two terminals are connected to the catenary and the negative feeder wires, respectively.
Bonding	A low impedance path obtained by permanently joining all normally-non-current-carrying conductive parts to ensure electrical continuity and having the capacity to conduct safely any current likely to be imposed on it.
Cantilever	A cantilever is a beam that is supported by a pole at only one end and carries the load of the electrification equipment on top of tracks. At multiple track locations where cantilever frames are not practical, portal structures should be utilized.
Catenary System	An assembly of overhead wires consisting of, as a minimum, a messenger wire, carrying vertical hangers that support a solid contact wire which is the contact interface with operating electric train pantographs, and which supplies power from a central power source to an electrically-powered vehicle, such as a train.
CEAA	The acronym for Canadian Environmental Assessment Act.
Cess	The area on either side of the railway immediately off the ballast shoulder, within the rail right of way. This area is considered a safe area for workers to stand when a train approaches.
Class EA	Under the Ontario Environmental Assessment Act (EA Act), Class Environmental Assessments are those projects that are approved subject to compliance with an approved class environmental assessment process (e.g., Class EA for Minor Transmission Facilities, GO Transit Class EA, etc.) with respect to a class of undertakings.
Contact Wire	A solid grooved, bare aerial, overhead electrical conductor of an OCS that is suspended above the rail vehicles and which supplies the electrically powered vehicles with electrical energy through roof-mounted current collection equipment - pantographs - and with which the current collectors make direct electrical contact.
Control Centre	The building or room location that is used to dispatch trains and control the train and maintenance operations over a designated section of track.
Cross Bonds	The method of tying tracks together electrically to equalize traction return currents between tracks. This is done to minimize touch potential.
Cross Feeding System	Overhead feeder lines are provided between the main gantry and strain gantry across the electrified track to feed power to the OCS wires.
Deadhead Movements	In the case of UP Express, deadhead movements are considered to be empty train movements required to reposition a train before or after revenue service. (Revenue service entails train movements that carry fare paying passengers). Deadhead movements are also referred to as "unproductive moves" as they incur the costs of train operations, but are not offset by any revenue from passengers

Detailed Design	The detailed design phase of a project is defined as the last design stage before system implementation phase including Software and Hardware development starts.
DMU	Diesel Multiple Unit; a train comprising single self -propelled diesel units.
Double Stacked Freight (DSF)	Freight trains carrying double stack containers.
Duct Bank	A duct bank is an assembly of electrical conduits that are either directly buried or encased in concrete. The purpose of the duct bank and associated conduit is to protect and provide defined routing of electrical cables and wiring. It also provides a physical separation and isolation for the various types of cables.
Electrical Potential	A measurement of the voltage (or potential difference) between two points in a system. For UP Express electrification, eelectrical potential is the electrical charge difference between the electrified UP Express railway and the ground. The unit for electrical potential is expressed in volts.
Electrical Section	This is the entire section of the OCS which, during normal system operation, is powered from a TPS circuit breaker. The TPS feed section is demarcated by the phase breaks of the supplying TPS and by the phase breaks at the nearest SWS or line end. An electrical section may be subdivided into smaller elementary electrical sections.
Electric Traction Facility	A traction substation, paralleling station, or switching station.
EMC	The acronym for Electromagnetic Compatibility. Electromagnetic compatibility is the ability of a device, equipment, or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment.
EMF	The acronym for Electric and Magnetic Field. Electric and magnetic fields arise from natural forces and permeate our environment. In addition to natural background EMF, anthropogenic sources include electric fields which arise anywhere electricity or electrical components are used and magnetic fields which arise wherever there is a flow of electric current. Common manmade sources of EMF include: electronics, power stations, transmission lines, telecommunication infrastructure, electric motors, etc. The strength of man-made EMF depends on the characteristics of the source including amongst others, voltage, current strength and frequency.
EMI	The acronym for Electromagnetic Interference. Electromagnetic interference is a disturbance that affects an electrical circuit due to either electromagnetic induction or radiation from an external source.
EMU	Electric Multiple Unit; a train comprising single self-propelled electric units.
Elementary Electrical Section	The smallest section of the OCS power distribution system that can be isolated from other sections or feeders of the system by means of disconnect switches and/or circuit breakers.
EPR	The acronym for Environmental Project Report. The proponent is required to prepare an Environmental Project Report to document the Transit Project Assessment Process followed, including but not limited to: a description of the preferred transit project, a map of the project, a description of existing environmental conditions, an assessment of potential impacts, description of proposed mitigation measures, etc. The EPR is made available for public review and comment for a period of 30 calendar days. This is followed by a 35-day Minister's Decision Period.

ESR	The acronym for Environmental Study Report. Proponents are required to prepare an Environmental Study Report to document the planning process followed under the Class Environmental Assessment for Minor Transmission Facilities.
Gantry	Supporting structures parallel to the tracks, and on both sides of the tracks, at TSS, SWS, and PS used to connect the traction power feeders to the catenary.
g/kWh	It stands for grams (of contaminant) per kilowatt-hour of energy generated.
Grounding	Connecting to earth through a ground connection or connections of sufficiently low impedance and having sufficient current-carrying capacity to limit the build-up of voltages to levels below that which may result in undue hazard to persons or to connected equipment.
Grounding Grid	A system of horizontal ground electrodes that consists of a number of interconnected, bare conductors buried in the earth, providing a common ground for electrical devices or metallic structures, usually in one specific location.
Heavy Maintenance	Heavy maintenance includes: replacement of engine traction motors, replacement of diesel engines on DMU's, replacement of transformers and ac propulsion systems on EMUs and replacement of wheel sets on engines. On railcars, heavy maintenance includes the replacement of wheel sets, repairs to windows and brake lines, and body repairs.
HV	Acronym for high voltages and refers to electrical energy at voltages high enough to cause injury and harm to human beings and living species. According to IEC voltages above 1000 V for alternating current, and 1500 V for direct current is considered high voltage.
Hydro One	Hydro One Incorporated delivers electricity across the province of Ontario. Hydro One has four subsidiaries, the largest being Hydro One Networks. They operate 97% of the high voltage transmission grid throughout Ontario.
Impedance Bonds	An electrical device located between the rails consisting of a coil with a centre tap used to bridge insulated rail joints in order to prevent track circuit energy from bridging the insulated joint while allowing the traction return current to bypass the insulated joint. The centre tap can also be used to provide a connection from the rails to the static wire and/or traction power facilities for the traction return current.
kV	Abbreviation for kilovolt and equal to 1000 volts.
kVAh	Abbreviation for kiloVoltAmphours. It is the standard power measurement used by electricity service utility companies.
LV	Acronym for low voltage and according to IEC voltages between 50-1000 V for alternating current, and between 120-1500 V for direct current is considered low voltage.
Main Gantry	These 25 kV feeders from the TPF will be connected to the OCS with the help of main and strain gantries and a cross feeder arrangement. The main gantry also referred to as the catenary feeding gantry is the one parallel to and toward the TPF side of the track.
Maintenance Facility	A mechanical facility for the maintenance, repair, and inspection of engines and railcars.
Messenger Wire	In catenary construction, the OCS Messenger Wire is a longitudinal bare stranded conductor that physically supports the contact wire or wires either directly or indirectly by means of hangers or hanger clips and is electrically common with the contact wire(s).
Mid-span	Area between two OCS registration points

Minister	Ontario Minister of the Environment.
Mitigation Measure	Actions that remove or alleviate, to some degree, the negative effects associated with the implementation of an alternative.
MOE	The acronym for Ontario Ministry of the Environment.
MVA	The abbreviation for Megavolt-Ampere. This is a unit for measuring the apparent power in an electrical circuit equivalent of one million watt.
Negative Feeder	Negative feeder is an overhead conductor supported on the same structure as the catenary conductors, which is at a voltage of 25 kV with respect to ground but 1800 out-of-phase with respect to the voltage on the catenary. Therefore, the voltage between the catenary conductors and the negative feeder is 50 kV nominal. The negative feeder connects successive feeding points, and is connected to one terminal of an autotransformer in the traction power facilities via a circuit breaker or disconnect switch. At these facilities, the other terminal of the autotransformer is connected to a catenary section or sections via circuit breakers or disconnects.
Net Effect	The effect (positive or negative) associated with an alternative after the application of avoidance/mitigation/compensation/enhancement measures.
Notice of Commencement	The Proponent is required to prepare and distribute a Notice of Commencement, which “starts the clock ticking” for the 120-day portion of the transit project assessment process. Proponents must prepare and distribute a Notice of Commencement to indicate that the assessment of a transit project is proceeding under the transit project assessment process. Proponents must complete their documentation (the Environmental Project Report) of the transit project assessment process within 120 days of distributing the Notice of Commencement.
Notice of Completion	The Notice of Completion must be given within 120 days of the distribution of the Notice of Commencement (not including any “time outs” that might have been taken). The Notice of Completion of Environmental Project Report signals that the Environmental Project Report has been prepared in accordance with section 9 of the regulation and indicates that the Environmental Project Report is available for final review and comment (for 30 calendar days). Following the 30 day public review period, there is a 35 day Minister’s decision period.
NOx	Nitrogen Oxides
Open Route	The term used to describe an area of tracks where there is no vertical conflicts to OCS.
Overhead Contact System (OCS)	OCS is comprised of: 1. The aerial supply system that delivers 2x25 kV traction power from traction power substations to the pantographs of Metrolinx electric trains, comprising the catenary system messenger and contact wires, hangers, associated supports and structures including poles, portals, head spans and their foundations), manual and/or motor operated disconnect switches, insulators, phase breaks, section insulators, conductor termination and tensioning devices, downguys, and other overhead line hardware and fittings. 2. Portions of the traction power return system consisting of the negative feeders and aerial static wires, and their associated connections and cabling.
Overhead Structure	A structure that allows a road to cross over a railway underneath.
Overpass	A structure that allows a railway to cross over a road or watercourse underneath.

Pantograph	Device on the top of a train that slides along the contact wire to transmit electric power from the catenary to the train.
Paralleling Station (PS)	An installation which helps boost the OCS voltage and reduce the running rail return current by means of the autotransformer feed configuration. The negative feeders and the catenary conductors are connected to the two outer terminals of the autotransformer winding at this location with the center terminal connected to the traction return system. The OCS sections can be connected in parallel at PS locations.
Performance Standards	General specifications and criteria that define the parameters and requirements of a particular system.
Phase Break	An arrangement of insulators and grounded or non-energized wires or insulated overlaps, forming a neutral section, which is located between two sections of OCS that are fed from different phases or at different frequencies or voltages, under which a pantograph may pass without shorting or bridging the phases, frequencies, or voltages.
$PM_{2.5}$	Fine Particulate Matter. Particles with diameter less than 2.5 μm
Portal	Portal is an OCS structure that spans over the tracks between two OCS support poles located on the sides of the tracks in order to support the electrification equipment. The portal structure is used at multiple track locations where cantilever frames are not practical.
Portal Boom	Top steel section or truss / lattice at the top of the portal structure, supported by two columns placed either side of the railway. The "portal boom" provides support points for the OCS conductors.
Positive Train Control	A signalling system using on board and wayside equipment to automatically reduce the speed, or stop a train depending on the conditions on the track ahead.
Potential Effect	A possible or probable effect of implementing a particular alternative.
Preliminary Design	The design of a proposed project (including a detailed cost estimate) to a level that demonstrates that the project is buildable within the given parameters of the design scope.
Preventive Maintenance	Preventive maintenance includes items such as: replacing brake pads, measuring wheels, inspection of running gear, inspection and repair of central air conditioning, check radios and repair/replace, repair broken windows and doors, etc.
Proponent	A person who carries out or proposes to carry out an undertaking or is the owner or person having charge, management or control of an undertaking.
Rail Potential	Rail Potential is defined as the voltage between running rails and ground occurring under operating conditions when the running rails are utilized for carrying the traction return current or under fault conditions.
Resilient Arm	A combined registration and support assembly with vertical resilience, used for support of catenary conductors in situations with restricted clearance such as tunnels and overhead bridges.
Running Rails	Rails that act as a running surface for the flanged wheels of a car or locomotive.
SCADA	The acronym for System Control And Data Acquisition. SCADA is a control system that controls and monitors the status of the industrial processes and devices for the electrification system. These devices may include motor operated disconnect switch, relay, meter and circuit break, of the Electrification System.

Screening	The process of applying criteria to a set of alternatives in order to eliminate those that do not meet minimum conditions or requirements.
Service Maintenance	Service maintenance is the light maintenance of engines (i.e., window cleaning, check oil levels and sand levels, clean engine cab, refill potable water, and empty washroom holding tanks).
Signal System	The rail signal system is a combination of wayside and on board equipment and/or software to provide for the routing and safe spacing of trains or rail vehicles.
SO_2	Sulphur Dioxide
Spur	A railroad track that diverges from the main track to service a specific location or industry.
Static Wire (Aerial Ground Wire)	A wire, usually installed aerially adjacent to or above the catenary conductors and negative feeders, that connects OCS supports collectively to ground or to the grounded running rails to protect people and installations in case of an electrical fault. In an AC electrification system, the static wire forms a part of the traction power return circuit and is connected to the running rails at periodic intervals and to the traction power facility ground grids. If mounted aerially, the static wire may also be used to protect the OCS against lightning strikes. It is sometimes termed “aerial ground wire”.
Strain Gantry	These 25 kV feeders from the TPF will be connected to the OCS with the help of main and strain gantries and a cross feeder arrangement. The strain gantry is located within the railroad right-of-way (ROW) parallel to and on the opposite side of the track from the TPF, with footprints exactly equal to that of the main gantry.
Traction Power Substation	Electric Traction Facility that transforms the utility supply voltage of 230 kV to 50 kV and 25 kV for distribution to the trains via catenary and negative feeders.
Switching Station (SWS)	SWS is an installation where the supplies from two adjacent traction power substations are electrically separated and where electrical energy can be supplied to an adjacent but normally separated electrical section during contingency power supply conditions. It also acts as a paralleling station (PS).
Touch/Step Potential	Touch potential is defined as the voltage between the energized object and the feet of a person in contact with the object. Step potential is defined as the voltage between the feet of a person standing near an energized grounded object.
Top of Rail	Top of Rail is defined as the highest point in a running rail profile.
Traction Electrification System (TES)	TES is the combination of the traction power supply system (TPSS), the overhead contact system (OCS), and the traction power return system, together with appropriate interfaces to the TES related supervisory control and data acquisition (SCADA) system. It forms a fully functional 2x25 kV ac traction power supply and distribution system and provides the traction power to the electrically powered vehicles on the Metrolinx electrified railway line.
Traction Power Facilities (TPF)	TPFs include: traction power substations (TPS), switching stations (SWS), and paralleling stations (PS).
Traction Power Return System	The traction power return system includes all conductors (including the grounding system) for the electrified railway tracks, which form the intended path of the traction return current from the electrified rolling stock to the traction power substations. Conductors may include:

	• Running rails • Impedance bonds • Static wires, and buried ground or return conductors • Rail and track bonds, • Return cables, including all return circuit bonding and grounding interconnections • Ground • Negative feeders due to the configuration of autotransformer connections
Traction Power Supply System (TPSS)	TPSS is the railway traction distribution network used to provide energy to Metrolinx electric trains, which comprises incoming high voltage supplies, traction power substations (TPS) at which power is converted from high voltage to nominal 2x25 kV railway traction voltage to the overhead contact system (OCS), other traction switching facilities including switching stations (SWS) and paralleling stations (PS), and connections to the OCS and the traction return and grounding system.
TPAP	The acronym for Transit Project Assessment Process. The transit project assessment process is defined in sections 6 – 17 in Ontario Regulation 231/08: Transit projects and Metrolinx Undertakings. Proponents must complete the prescribed steps of the transit project assessment process within specified time frames. The process allows for a six month assessment process whereby potential environmental effects of the transit project are identified, assessed and documented. The proponent must issue a Notice of Completion within 120 days of issuing the Notice of Commencement.
Traction Power Substation (TPS)	TPS is an electrical installation where power is received at high voltage and transformed to the voltage and characteristics required at the OCS for the nominal 2x25 kV system, containing equipment such as transformers, circuit breakers and sectionalizing switches. It also includes the incoming high voltage lines from the power supply utility.
TS	Acronym for Transformer Station.
Transit Project	A transit project is defined as an undertaking consisting of: (a) An enterprise or activity that is the planning, designing, establishing, constructing, operating, changing or retiring of a facility or service that, aside from any incidental use for walking, bicycling or other means of transporting people by human power, is used exclusively for the transportation of passengers by bus or rail, or anything that is ancillary to a facility or service that is used to support or facilitate the transportation of passengers by bus or rail; or, (b) A proposal, plan, or program in respect of an enterprise or activity described in clause (a) above.
Transmission Line	Transmission lines electrically interconnect generating power plants and electrical substations located near demand centers for bulk transfer of electrical energy over long distances, at a high voltage generally 115 kV or higher. Transmission of power at high voltage is distinct from the local wiring between high-voltage substations and customers, which is typically referred to as electric power distribution. Transmission lines, when interconnected with each other, are called transmission network or electric grid.

Tunnel Arm	A combined registration and support assembly used for support of catenary conductors within a tunnel where there is not enough clearance for OCS portal and cantilever structures.

Part A – Baseline Conditions

1. Background

In July 2009, Metrolinx completed an environmental assessment (EA) for the Georgetown South Service Expansion and Union-Pearson Rail Link (GSSE-UPRL). This project included a number of infrastructure improvements along the GO Transit (GO) Kitchener (previously known as Georgetown) corridor, including construction of a new three kilometre spur line (from Highway 427 to Terminal 1 at Pearson Airport), and construction of new tracks along the GO Kitchener corridor. In addition, new stations will be constructed at both Union Station and at Terminal 1 (Pearson International Airport), while the existing Bloor and Weston stations will be upgraded. Portions of this project are currently under construction, and the UP Express service is anticipated to be in operation by 2015.

The UP Express will initially operate using Diesel Multiple Units (DMUs) and will run from downtown Toronto at UP Express Union Station) with stops at Bloor GO Station and Weston GO Station, then terminate at the future UP Express Pearson Station at Pearson International Airport.

Following the 2009 GSSE-UPRL EA, Metrolinx completed the GO Electrification Study in December 2010, which examined electrification of the entire GO Transit rail system as a future alternative to diesel trains currently in service. Subsequently, Metrolinx initiated Phase 1 which includes the EA study for electrification of the UP Express service, development of performance standards for electrification, as well as preparation of the electrification design.

1.1 Environmental Assessment Process

With regard to EA process, the proposed conversion of the UP Express service from diesel to electric power falls under *Schedule 1, Subsection 2 (1) 7 of O. Reg. 231/08 - Transit Projects and Metrolinx Undertakings* which applies to transit projects including: "*Electrification of rail equipment propulsion on existing commuter rail corridor and associated power distribution system."* Therefore, the environmental impact of the traction power distribution system components and new electrified maintenance facility is being assessed by Metrolinx under the **Transit Project Assessment Process (TPAP),** in accordance with **Ontario Regulation 231/08 – Transit Projects and Metrolinx Undertakings.**

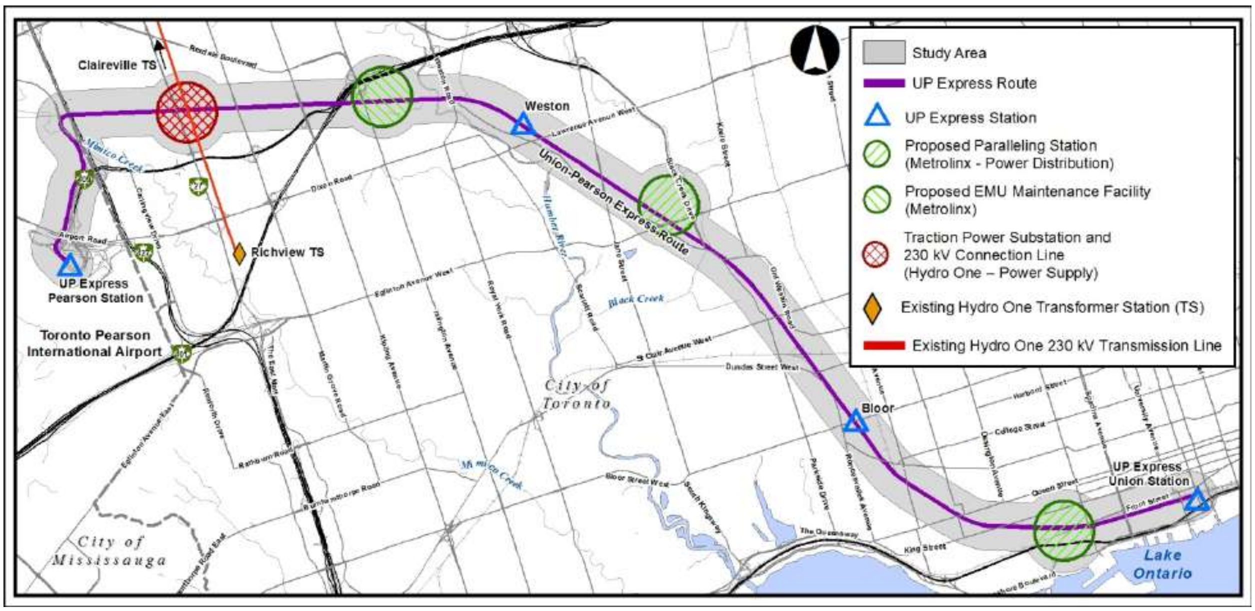
In addition, electrification of the UP Express requires a connection to Ontario's electrical system. It is proposed that the power be supplied from the existing 230 kV transmission line that runs between Hydro One's Claireville Transformer Station (located near Highway 407 and Highway 27 in the City of Vaughan) and Richview Transformer Station (located near Highway 401 and Highway 27 in the City of Toronto). Two new cables will deliver power to a new 230 kV Traction Power Substation (TPS). The TPS will convert the voltage from 230 kV to 25 kV so that it can be used to power the electric trains. The power supply portion of the project is being carried out by Hydro One under the ***Class EA for Minor Transmission Facilities (Class EA)***.

1.2 Description of the Project

The scope of the proposed UP Express Electrification undertaking includes the construction, operation and maintenance of an electrified rail service along the UP Express route. The route includes approximately 25 km of track beginning at the future UP Express Station (west of the Union Station train shed) in the City of Toronto, along the existing Union Station GO rail corridor and Kitchener GO rail corridor to Highway 427, where the route then follows the new UP Express spur link (currently under construction) into the future UP Express Pearson Station (Terminal 1, Toronto Pearson International Airport) in the City of Mississauga (see **Figure 1-1**). More specifically, the UP Express Electrification project involves converting the UP Express service from diesel power to electric. Therefore, the base case scenario is defined as the UP Express operating with Diesel Multiple Unit (DMU) trains.

Electrification of the UP Express service will be achieved through a Traction Electrification System which will provide electrical power to the trains by means of a traction power distribution system (by Metrolinx) and traction power supply system (by Hydro One). The traction power distribution system components (which are being assessed under the TPAP) are further described below.

Figure 1-1. UP Express Electrification EA Study Area



1.2.1 Traction Power Distribution System

The proposed traction power distribution system is an Overhead Contact System (OCS) comprised of a wiring system providing power to the trains. The wiring system will be suspended from a number of OCS structures (i.e., portals, cantilevers) placed along and over the track. The traction power distribution system also includes two paralleling stations (PS) to boost the voltage along the UP Express route, as well as 25 kv feeders and gantries (which provide power to the OCS) located in the vicinity of each PS. In addition, a new electrified maintenance facility will need to be built to carry out maintenance on the new electric trains.

The following sections provide an overview of the electrification infrastructure requirements associated with the traction power distribution system as the basis for collecting baseline conditions information within the study area. In addition, the Environmental Project Report provides additional background information on the process followed for identifying the preferred siting locations for each facility. As a result, the preferred locations for siting each facility have been included in this report for the purpose of describing baseline conditions associated with the respective sites.

1.2.1.1 Overhead Contact System

The preferred traction power distribution system for UP Express electrification is an Overhead Contact System (OCS) that is comprised of a wiring system which will provide power to the electric trains. The wiring system will be suspended from a number of new OCS support structures (i.e., portals, cantilevers) placed along and over the track, including on bridges/overpasses where required. It should be noted that the majority of OCS support structures will be situated within the existing Metrolinx owned rail Right-of-Way (ROW) along the UP Express route/corridor, except for a small number of locations where the structures cannot be accommodated within the existing rail ROW.

Specifically, the overhead wires will be supported from galvanized steel structures positioned along the track at a spacing of up to 65 metres. The most common OCS support structures will be portals which span multiple tracks (see **Figure 1-2**).

Figure 1-2. Example of OCS Support Structures (Portals)

1.2.1.2 Paralleling Stations

A paralleling station helps boost the OCS voltage and reduce running rail current. As the train moves away from the source of power, the OCS voltage drops (see example shown in **Figure 1-3)**. Electric trains can only operate if the OCS voltage remains within acceptable limits. Paralleling stations help raise the OCS voltage and hence, facilitate operation of trains further away from the source of power. Paralleling stations also help reduce flow of return current in rails and thereby, contribute towards safety of passengers and other persons boarding or detraining at train stations.

Figure 1-3. Typical Paralleling Station

In order to ensure reliability of the electrified UP Express system, paralleling stations need to be located approximately every 8-12 kms along the electrified route. There are two PSs required as part of the electrified UP Express system: one at Ordnance St, and one at 3500 Eglinton Ave. W. as shown in **Figures 1-4** and **1-5** respectively. The approximate footprint area required for constructing a paralleling station is anticipated to be 900 sq. m. (45 m X 20 m).

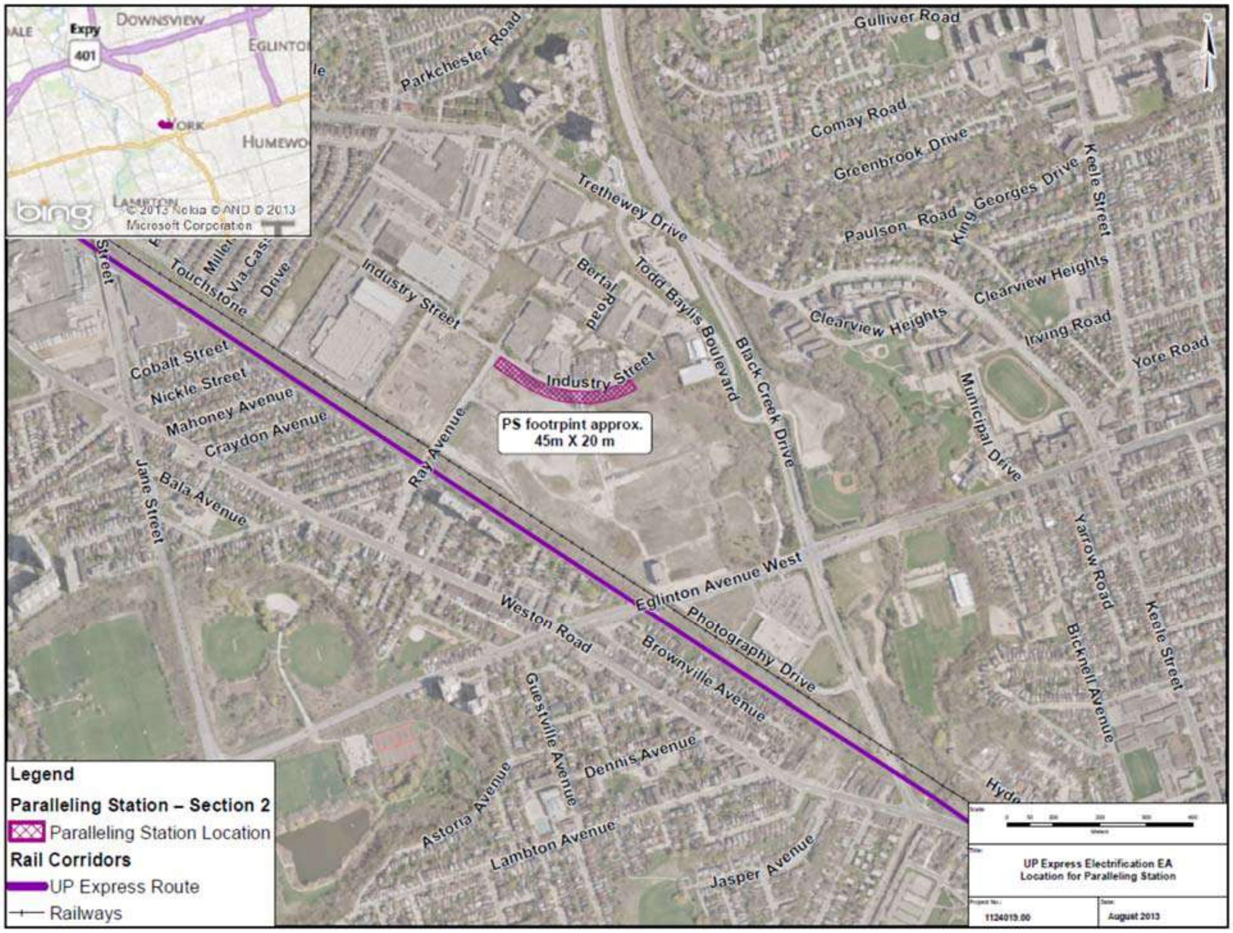
Gantries and Ductbanks

A set of two gantries (main and strain gantry), as well as 25 kV power supply feeders (routed underground via duct banks) will be located in the vicinity of each PS location. The locations of the gantries and duct banks will be identified as part of the preliminary design phase. Therefore, the potential environmental impacts associated with these components will be assessed and documented within the Natural Environmental Impact Assessment Report.

Figure 1-4. Paralleling Station – Ordnance St.

(350453-002 FINAL
Airquality_Impactassessrpt_18Mar2014.Docx)

Figure 1-5. Paralleling Station – 3500 Eglinton Ave. W.

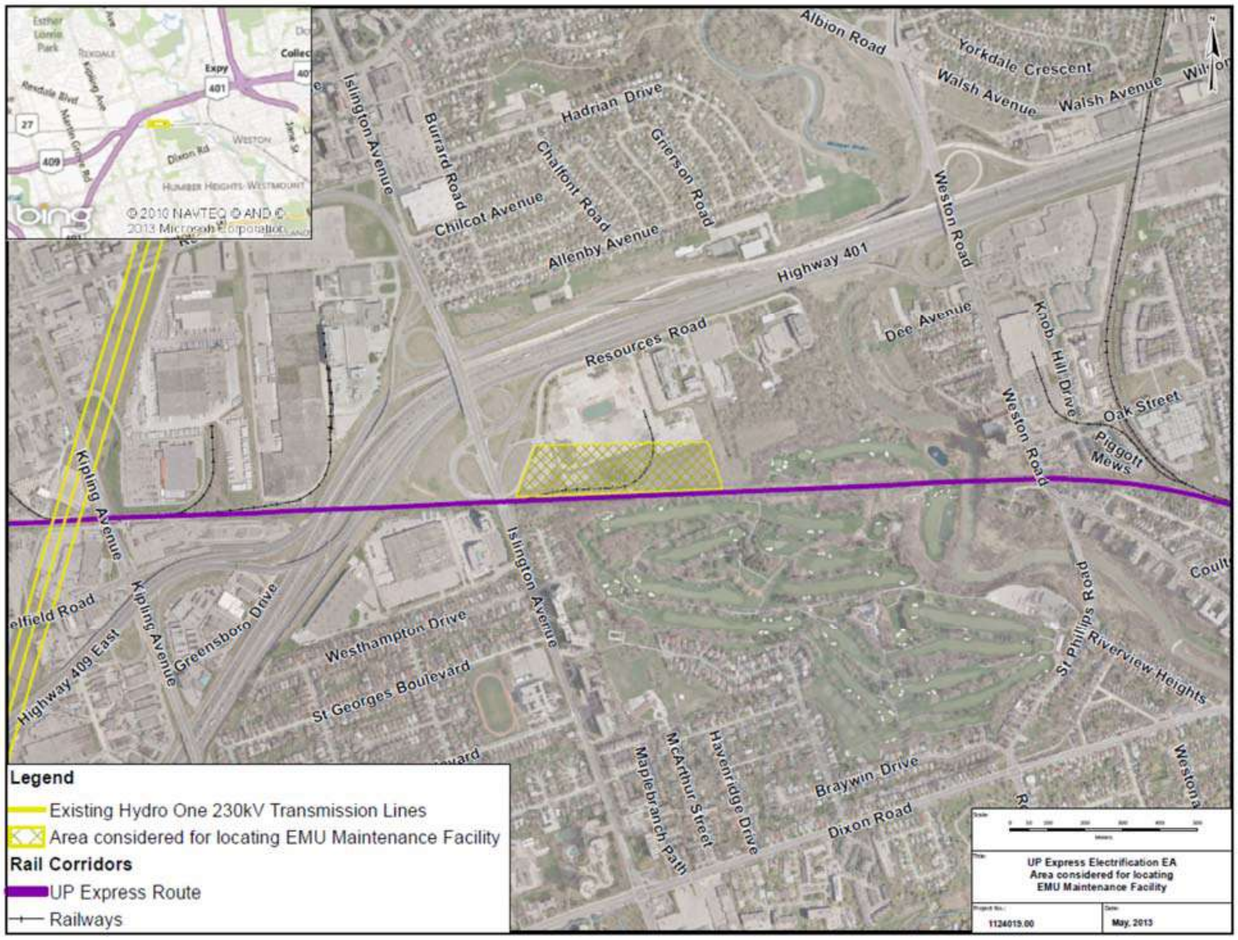


1.2.2 Maintenance Facility

As part of implementing an electrified UP Express service, the new electric trains will need to be regularly maintained and serviced. As a result, the scope of the UP Express Electrification EA includes consideration of the infrastructure requirements related to a new electrified maintenance facility.

Supporting Document #1: Assessment of Alternative Facility Locations summarizes the process followed for identifying the preferred location for the electrified Maintenance Facility, i.e., 50 Resources Rd. (see **Figure 1-6).** The approximate footprint size required for constructing the new MF is anticipated to be 5 hectares.

Figure 1-6. Electrified Maintenance Facility – 50 Resources Rd.



1.3 Study Area

Based on the description of the UP Express Electrification project components provided above, the project Study Area (as illustrated in Figure 1-1) is described as follows:

- UP Express route/rail corridor beginning at the future UP Express Union Station in the City of Toronto, along the existing GO Kitchener and GO Union Station Rail Corridors, and terminating at the future UP Express Pearson Station (Terminal 1, Toronto Pearson International Airport) in the City of Mississauga; and
- Preferred locations for associated electrification infrastructure/facilities including: one electrified Maintenance Facility, and two Paralleling Stations.

As the EA progresses and potential impacts are identified, the Study Area will be expanded (if required) to capture the full range of potential environmental effects.

1.4 Purpose

The purpose of this report is to document baseline conditions within the UP Express Electrification Study Area related to the natural environment. This Baseline Conditions Report will form '*Part A'* of the Natural Environment Assessment Report which will become a supporting document to the final Environmental Project Report (EPR). The baseline conditions information collected will establish the basis from which potential impacts of the proposed UP Express Electrification project will be assessed and documented in the Natural Environment Impact Assessment report.

2. Methodology

The following section outlines the methodology that was carried out to establish baseline air quality conditions related to the proposed UP Express Electrification project, and is based on the Air Quality Work Plan submitted to the Ministry of the Environment (MOE) Central Region in July 2013.

2.1 UP Express Route/Corridor

With respect to baseline air quality conditions along the UP Express route (from the future UP Express Union Station to UP Express Pearson station, along the existing Union Station and Kitchener Rail Corridors), baseline conditions include the existing pollutant burden within the study area and include the operation of Tier 4 Diesel Multiple Units (DMUs) for the UP Express service. Therefore, for the purposes of the UP Express Electrification EA, baseline air quality conditions within the UP Express route (rail corridor) are considered to be the modelled air quality impacts from the July 2009 Georgetown South Service Expansion and Union-Pearson Rail Link Environmental Assessment, which are based on the operation of Tier 4 DMUs plus background monitoring data from representative MOE monitoring stations.

The 2009 EA for the GSSE-UPRL included an air quality assessment titled: *Air Quality Assessment Georgetown South Service Expansion & Union Pearson Rail Link, Toronto, Ontario – July 2009* (2009 Air Quality Assessment GSSE)- and a report titled: *Georgetown South & Airport Rail Link Final Report Air Quality Impact Assessment – Enhanced Analysis May 11, 2011* (Enhanced Air Quality Analysis Report). These reports considered air quality impacts associated with the operation of DMUs added to a background within the study area based on available monitoring data. The Enhanced Air Quality Analysis Report (2011) is an update to the original 2009 GSSE-UPRL EA Air Quality Assessment based on MOE comments on the original report.

For the purposes of the UP Express Electrification EA, baseline conditions are considered to be the modelled air quality impacts based on the most recent 2011 Enhanced Air Quality Analysis Report (associated with the operation of Tier 4 DMUs) plus background monitoring data from representative MOE monitoring stations.

An outline of the Tier 4 Future Build modelling methodology within the 2011 Enhanced Air Quality Analysis Report is as follows:

- Study area was the UP Express (Kitchener) rail corridor from Bathurst Street extending northwesterly to the airport spur and into Terminal 1 at Pearson International Airport;
- Contaminants of concern were: $PM_{2.5}$, NO_2 and SO_2;
- Ozone Limiting Method (OLM) was used to estimate the maximum short-term NO_2 concentrations resulting from emissions of NO_x;
- UP Express, GO Transit, Via and CN/CP railway emissions within the study area were modelled with CAL3QHCR for the full build;
- Hourly background contaminant concentrations from MOE Toronto West monitoring station (Station ID 35125 located at 125 Resources Rd.) for the year 2007 were added to model results;

- Modelling was completed with 2007 meteorological data from Pearson Airport (surface data) and Buffalo (upper air data); and
- Model predicted concentrations were assessed at the 10 representative worst case receptor locations as identified within the 2009 Air Quality Assessment GSSE Report.

Greenhouse Gas Emissions

Baseline conditions for greenhouse gas emissions resulting from Tier 4 DMUs operating within the UP Express Corridor are based on results presented within the 2009 Air Quality Assessment GSSE Report.

2.2 EMU Maintenance Facility

Baseline conditions for the proposed EMU Maintenance Facility location (see Figure 1-6) are based on historical ambient monitoring. The MOE maintains a network of ambient monitoring stations and the Toronto West monitoring station (Station ID 35125 located at 125 Resources Rd.) is located approximately 400 m from the proposed EMU Maintenance Facility location. Therefore, baseline conditions associated with the proposed EMU Maintenance Facility are based on average 90th percentile contaminant concentrations from the five (5) most recent years of monitoring data from the MOE Toronto West monitoring station.

The expected contaminant emissions from the proposed Maintenance Facility are products of combustion from natural gas-fired equipment and an emergency diesel generator. Contaminant emissions from the UP Express Corridor are also products of combustion from locomotive and DMU diesel engines; therefore, for consistency purposes, the same contaminants of concern (i.e., $PM_{2.5}$, NO_2 and SO_2) that are documented for the UP Express Route/Corridor are also used to establish baseline conditions associated with the proposed Maintenance Facility location.

2.3 Power Distribution Facilities

Baseline conditions associated with the proposed locations for two (2) new paralleling stations (power distribution) have not been established as these facilities do not contain equipment that emit air contaminants. Paralleling station equipment will include switchyard components, a switchgear room, a control room and power transformers.

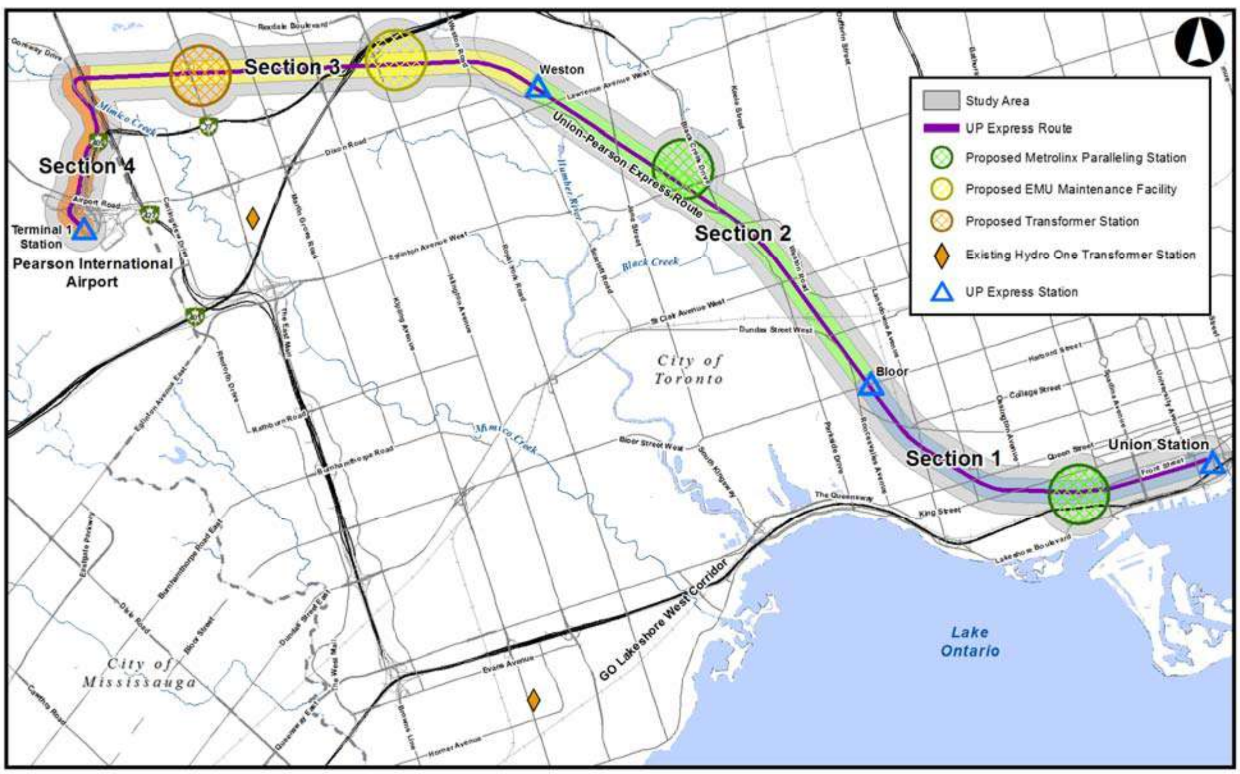
3. Baseline Conditions

The following provides a summary of baseline conditions related to air quality. For the purposes of describing the various features within the UP Express Electrification Study Area, this section has been separated into four segments as follows (see Figure 3-1):

- UP Express Union Station (future) to Bloor Station
- Bloor Station to Weston Station
- Weston Station to Highway 427
- Highway 427 to UP Express Pearson Station (future)

The project area is an urban setting with point sources (light industrial); mobile sources (roadways, railways, and air transport) as well as a spectrum of miscellaneous area sources (residential and commercial space heating, etc.). In addition to local sources, there is also an influx of pollutants via long range transport from other regions upwind of the UP Express Corridor.

Figure 3-1. Study Area Sections



SENES
MORRISON HERSHFIELD

3.1 Background Pollutant Concentrations

Ambient background concentrations used in air quality assessments represent the contribution from sources such as upwind industrial facilities, other roadways, transboundary pollution, etc. that are not included in the modelling. It is important to add background pollutant concentrations to modelled concentrations in order to assess the combined effect of all sources at a specific receptor location for comparison against relevant objectives and standards.

The Enhanced Air Quality Analysis Report identified the Ministry of the Environment Toronto West monitoring station (125 Resources Road) as representative of background contaminant concentrations within the study area. For the 2011 Enhanced Air Quality Analysis assessment, hourly data from this monitoring station for the year 2007 were added to hourly model results based on 2007 meteorological data. This approach considered a variable background rather than a constant 90th percentile concentration, and by combining background contaminant concentrations with model results from the same hour of meteorological data, this approach represented a more accurate depiction of expected contaminant concentrations.

For the proposed EMU Maintenance Facility, a conservative 90th percentile value from monitoring data was used. Typically, annual average pollutant levels tend to vary from year to year due to changes in emissions sources, changes in activity levels and variations in meteorological conditions. Therefore, to establish baseline air quality conditions for the new EMU Maintenance Facility, background concentrations from the five most recent years of available monitoring data from the MOE Toronto West monitoring station were used. A summary of 90th percentile background pollutant values established for the new EMU Maintenance Facility are provided in Table 3-1 below.

Table 3-1. 90th Percentile Background Values Used for EMU Maintenance Facility

Pollutant	Averaging Period	90th Percentile Background Value	Ontario AAQC
$PM_{2.5}$	24 hour	12.8 µg/m^3	30 µg/m^3 (CWS[2])
	Annual	6.8 µg/m^3	10.0 µg/m^3 (CAAQS[3])
NO_2[1]	1 hour	67.3 µg/m^3	400 µg/m^3
	24 hour	56.3 µg/m^3	200 µg/m^3
SO_2[1]	1 hour	7.7 µg/m^3	690 µg/m^3
	24 hour	6.9 µg/m^3	275 µg/m^3
	Annual	3.3 µg/m^3	55 µg/m^3

Note: [1] Background levels were converted from ppb to µg/m^3 assuming 10°C
[2] Canada Wide Standard based on the 24 hour 98th percentile ambient measurement annually, averaged over three consecutive years. To be reduced to 28 µg/m3 in 2015 and 27 µg/m3 in 2020
[3] Canadian Ambient Air Quality Standard. Standard comes into effect in 2015, to be reduced to 8.8 µg/m^3 in 2020.

3.2 Summary of Baseline Air Quality Conditions

The sections below summarize results from the 2011 Enhanced Air Quality Analysis Report for CAL3QHCR model predicted impacts associated with the operation of DMUs within the UP Express Corridor, which represent baseline air quality conditions within the UP Express Corridor. For the new EMU Maintenance Facility within the Section 3 study area outlined below, baseline air quality conditions are considered to be 90th percentile background values as summarized in Section 3.1.

3.2.1 Section 1 – UP Express Union Station to Bloor Station

The existing GO rail corridor extends west from the Union Station Train Shed, and curves to the north-west north of King Street. The land uses along this segment of the corridor include a mixture of residential (including detached and semi-detached dwellings, townhouses, as well as high-rise and low-rise multi-unit buildings), commercial buildings, park space and institutional lands (i.e., school/daycare/place of worship).

3.2.2 Section 2 - Bloor Station to Weston Station

This segment of the GO Kitchener corridor extends north-west from Bloor Station to Weston Station. The land uses along this segment of the corridor include a mixture of residential (including detached and semi-detached dwellings, townhouses, as well as high-rise and low-rise multi-unit buildings), commercial buildings, and institutional lands (i.e., school/daycare/place of worship).

3.2.3 Section 3 - Weston Station to Highway 427

This segment of the GO Kitchener corridor extends north-west from Weston Station, and curves to the west at St. Phillips Road. The land uses along this segment of the corridor include a mixture of residential (including detached and semi-detached dwellings, townhouses, as well as high-rise and low-rise multi-unit buildings), commercial / industrial lands, recreational areas (golf course), and institutional lands (i.e., school/daycare/place of worship).

<u>EMU Maintenance Facility – 50 Resources Rd.</u>

As mentioned above, an EMU Maintenance Facility is required as part of UP Express Electrification within Section 3 at 50 Resources Rd. Baseline air quality conditions are considered to be 90th percentile background values as summarized in Section 3.1.

3.2.4 Section 4 - Highway 427 to UP Express Pearson Station

At Highway 427, a spur line will be installed extending from Highway 427 into Terminal 1 at Pearson International Airport. The spur line will carry only rail traffic associated with the UP Express. This spur line parallels the Highway 427 southbound off-ramps to Highway 409 and Highway 409 off-ramps to Viscount Road/Airport Road on the west side. The land use in this area is primarily commercial / industrial.

The Enhanced Air Quality Analysis Report did not identify any sensitive or critical receptors along this section of the UP Express Corridor.

Part B – Impact Assessment

1. Purpose

The purpose of this section of the report (Part B) is to document the air quality impact assessment that was carried out as part of the UP Express Electrification EA. This Impact Assessment Report forms *Part B* of the Air Quality Impact Assessment Report which will become a supporting document to the final Environmental Project Report (EPR).

1.1 Methodology

The baseline conditions information contained in *Part A* of the Air Quality Assessment Report was used as the basis from which the potential impacts of constructing and operating/maintaining the electrified UP Express service were identified based on the engineering design provided in the UP Express Electrification Preliminary Design Report. The impact assessment process was based on the following steps:

- Identify potential effects (positive and negative);
- Establish avoidance/mitigation/compensation measures to eliminate or minimize potential negative effects (as required); and
- Identify net effects (i.e., residual effects after applying avoidance/mitigation/compensation measures).

For purposes of differentiating the various types of potential environmental impacts related to the UP Express Electrification undertaking, they were characterized and grouped as follows:

Operations and Maintenance Impacts	Potential (long term) effects on existing air quality features (including receptors) due to operations and maintenance activities associated with the electrified UP Express service (e.g., operation of the traction power distribution system, operation of EMU Maintenance Facility, etc.).
Construction Impacts	Potential disruption/disturbance (short term) effects on existing air quality features (including receptors) due to construction activities associated with the UP Express Electrification project (e.g., construction of OCS components, construction of paralleling stations, etc.).

Following identification of potential impacts, mitigation measures were identified based on a combination of best management practices and development of more specific mitigation measures, as appropriate, to address project-specific impacts.

2. UP Express Electrification Preliminary Design

As mentioned, the assessment of potential air quality impacts was based on the UP Express electrification preliminary design, which includes the following key components:

- Traction Power Distribution System
  - Overhead Contact System (OCS)
  - Two Paralleling Stations
    - Proposed site configuration
    - Gantry design/locations
    - Underground 25 kv feeder (duct bank) design/locations
- EMU Maintenance Facility
  - Proposed site configuration
  - Description of maintenance activities/operations
- Bridge / Rail Overpass Structure Modifications
  - Protection barriers
  - Grounding and bonding
- GO Station Modifications
- Grounding and Bonding Requirements

A detailed project description has been included in the UP Express Electrification Environmental Project Report, Chapter 5.

3. Air Quality Assessment Approach

3.1 UP Express Route/Corridor

Air quality effects along the UP Express route/corridor were assessed through a qualitative approach based on the change from DMUs to EMUs. Contaminant emissions will effectively be reduced to zero due to conversion to EMUs; therefore, it is intuitive that potential effects will be positive as overall air quality will improve based on a net reduction in contaminant emissions within the UP Express route/corridor.

The qualitative approach employed is as follows:

- Consistent with the most recent air quality impact assessment within the corridor, i.e., Georgetown South & Airport Rail Link Final Report Air Quality Impact Assessment – Enhanced Analysis (May 11, 2011), contaminants of concern are considered to be NO_2, $PM_{2.5}$ and SO_2;
- DMU specifications and emission factors for the contaminants of concern (and other available data for other contaminants) are presented; and
- An emissions loading assessment for DMUs and EMUs is presented, which includes average emissions for contaminants of concern associated with the generation of electricity in Ontario. The UP Express service with EMUs is anticipated to commence operation as early as 2017; therefore, contaminant emissions from the projected electrical supply mix for Ontario in 2017 are considered.

Greenhouse Gas Emissions

Greenhouse gas emissions resulting from the generation of electricity to be used by EMUs operating within the Kitchener/ UP Express Corridor are quantified. The UP Express service with EMUs is anticipated to commence operation in 2017; therefore, greenhouse gas emissions from the projected electrical supply mix for Ontario in 2017 are considered.

3.2 Power Distribution - Paralleling Stations

A qualitative assessment is presented for the proposed paralleling stations (PS) that includes a technical description of the proposed facilities, followed by a supporting rationale that demonstrates why emissions to the atmosphere are not expected.

3.3 EMU Maintenance Facility

The proposed EMU Maintenance Facility will have emissions to the atmosphere; therefore, a quantitative assessment of potential air quality effects is presented.

Expected contaminant emissions from the proposed Maintenance Facility are products of combustion from natural gas-fired equipment and an emergency diesel generator; therefore, for consistency the same contaminants of concern assessed for the Kitchener/UP Express Corridor are also assessed for the Maintenance Facility (i.e., $PM_{2.5}$, NO_2 and SO_2).

The U.S. EPA AERMOD pollutant air dispersion model was used for assessing air quality effects from the proposed Maintenance Facility. For consistency with the assessment within the Kitchener/ UP Express Corridor, compliance is assessed against Ambient Air Quality Criteria (AAQC) at the property line and at the nearest receptor location. Dispersion modeling includes modeling emissions from the proposed EMU Maintenance Facility, with model results added to 90th percentile values from the five most recent years of available monitoring data. Default MOE meteorological data from Pearson Airport was used.

3.4 Construction Activities

3.4.1 Power Distribution Components

Construction activities related to the UP Express Electrification project including installation of catenary foundations and structures (portals and/or cantilevers), site preparation, installation of 25 kV feeders, paralleling station, and EMU Maintenance Facility, etc. are expected to be of short duration and will result in mainly nuisance effects that are common to construction activities of this nature. As a result, potential air quality impacts related to construction activities were addressed qualitatively.

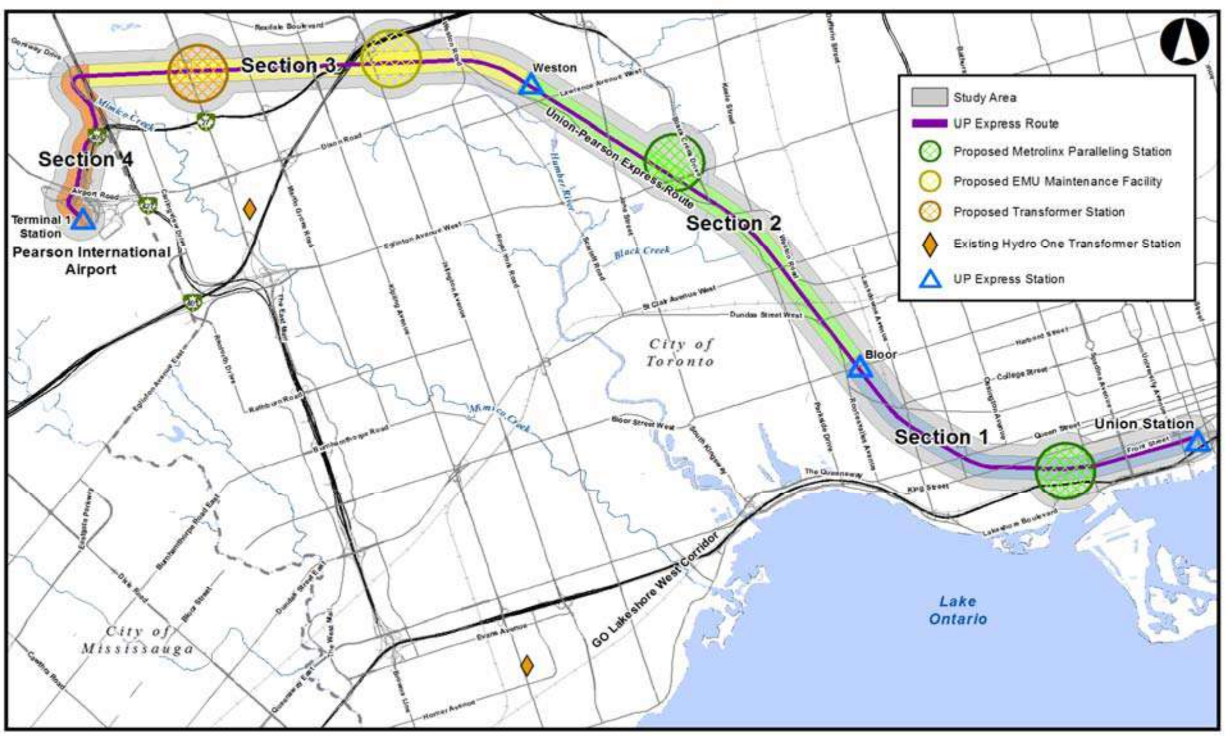
4. Air Quality Impact Assessment

The following report sections document the potential air quality impacts associated with the various features within the UP Express Electrification Study Area, including a description of the proposed avoidance/ mitigation/ compensation measures to eliminate or minimize the potential impacts, followed by identification of net effects (positive or negative). In general, mitigation measures were identified based on a combination of best management practices and development of more specific mitigation measures as appropriate to address project-specific impacts.

Each feature considered is listed in Figure 4-1 below, which also divides the study area into four segments as follows:

- Section 1 - UP Express Union Station (future) to UP Express Bloor Station
- Section 2 - UP Express Bloor Station to UP Express Weston Station
- Section 3 - UP Express Weston Station to Highway 427
- Section 4 - Highway 427 to UP Express Pearson Station (future)

Figure 4-1. Study Area Sections



4.1 Operation of EMUs within UP Express Corridor

To provide context, below is a brief overview of the four (4) identified sections of the UP Express Corridor:

Section 1 - UP Express Union Station (future) to UP Express Bloor Station

The existing GO rail corridor extends west from the Union Station Train Shed, and curves to the north-west north of King Street. The land uses along this segment of the corridor include a mixture of residential (including detached and semi-detached dwellings, townhouses, as well as high-rise and low-rise multi-unit buildings), commercial buildings, park space and institutional lands (i.e., school/daycare/place of worship).

Section 2 - UP Express Bloor Station to UP Express Weston Station

This segment of the GO Kitchener corridor extends north-west from Bloor Station to Weston Station. The land uses along this segment of the corridor include a mixture of residential (including detached and semi-detached dwellings, townhouses, as well as high-rise and low-rise multi-unit buildings), commercial buildings, and institutional lands (i.e., school/daycare/place of worship).

Section 3 - UP Express Weston Station to Highway 427

This segment of the GO Kitchener corridor extends north-west from Weston Station, and curves to the west at St. Phillips Road. The land uses along this segment of the corridor include a mixture of residential (including detached and semi-detached dwellings, townhouses, as well as high-rise and low-rise multi-unit buildings), commercial / industrial lands, recreational areas (golf course), and institutional lands (i.e., school/daycare/place of worship).

Section 4 - Highway 427 to UP Express Pearson Station (future)

At Highway 427, a spur line is currently under construction extending from Highway 427 into Terminal 1 at Pearson International Airport. The spur line will carry only rail traffic associated with the UP Express. This spur line parallels the Highway 427 southbound off-ramps to Highway 409 and Highway 409 off-ramps to Viscount Road/Airport Road on the west side. The land use in this area is primarily commercial / industrial.

4.1.1 Operations and Maintenance Impacts

EMUs are electrically powered and there are no anticipated local contaminant emissions from within the UP Express corridor associated with the operation of EMUs. However, there will be indirect regional contaminant and greenhouse gas (GhG) emissions associated with the generation of electricity within the Province of Ontario.

The Traction Power System Simulations Report (2012) estimated that system wide, UP Express EMUs will consume energy at a rate of 49,911.8 kVAh during a 24-hour period. To estimate regional 24-hour emissions from the operation of the UP Express, average emission rates from the projected Ontario electrical supply mix were multiplied by this estimated electrical energy consumption rate (see Table 4-1 below).

Table 4-1. Estimated UP Express System Wide EMU Regional 24-hr Contaminant Emission Rates

Contaminant	Ontario Wide Average Emission Rate* (g/kWh)	UP Express System Wide EMU 24-hour Contaminant Emission Rate (kg/24-hrs)
$PM_{2.5}$	0.002	0.11
NO_2	0.030	1.52
SO_2	0.004	0.22
GhG (CO_2e)	32.4	1,618

* Calculated year 2020 values from 2005 Integrated Power Service Plan (IPSP) data and Ontario Power Authority (OPA) Supply Mix Summary for Electricity Production

To identify net effects, local contaminant emissions from baseline DMU operations during a 24-hour period were also estimated. The operation of EMUs is expected to require 8.9% less energy to operate versus DMUs due to energy savings from regenerative braking. DMUs are also expected to consume 51.5 L diesel per DMU per round trip, with three car consists and 70 round trips per day. Based on these parameters and U.S. EPA Tier 4 non-road diesel emission factors, baseline UP Express system wide local 24-hour contaminant emission rates with DMUs were estimated (see Table 4-2 below).

Table 4-2. Estimated UP Express System Wide DMU Local 24-hr Contaminant Emission Rates

Contaminant	UP Express System Wide DMU 24-hour Contaminant Emission Rate (kg/24-hrs)
$PM_{2.5}$	2.20
NO_2	190.9
SO_2	2.27
GhG (CO_2e)	32,509

Emission rates based on data from:
Traction Power System Simulations Report, 2012

A comparison of estimated EMU (Table 4-1) and DMU (Table 4-2) 24-hour contaminant emission rates indicates reductions based on the electrification of the UP Express.

4.1.2 Construction Impacts

Changing from DMUs to EMUs will not include any construction impacts; however, construction of the OCS associated with EMUs does have the potential to affect air quality in the vicinity of the UP Express corridor.

For Sections 1, 2, 3 (UP Express Union Station to Highway 427), the OCS infrastructure will primarily be installed within the existing Union Station and Kitchener rail corridors, except in specific locations where OCS support structures are located slightly outside the corridor due to insufficient horizontal space. With this in mind, there are three main construction activities associated with OCS construction described as follows:

OCS Foundation Installation

The foundation sizes are dependent on the type of OCS structure to be installed (i.e., portal, cantilever), however typical sizes are estimated to be as follows be: 600 mm diameter (single track cantilever), 800 mm diameter (two track cantilever), 1200 mm diameter (portal structure<24 meters wide), 1500 x 2500 (portal structure>24 meters wide). Excavation will be required to install OCS foundations at an approximate depth of 5 metres, however dewatering is not anticipated to be required.

Install OCS Support Structures

Once foundations have been established, OCS support structures will be installed. For portal structures, this is done via road or rail crane. The structures will be transported to the site via truck or by railcar.

For cantilever structures, this is done with road or rail crane. The structures will be transported to the site via truck or railcar.

Installation of OCS supports will take place within Metrolinx's rail ROW.

Install OCS Wiring

The installation of OCS wiring involves running the contact and messenger wires together under tension. This is typically completed using a four vehicle wiring unit, where the base vehicle dispenses wire, the second vehicle with working platform is equipped to allow messenger to be installed onto cantilever, the third vehicle with working platform is equipped to allow contact wire to be installed, and a fourth vehicle installs hangers.

Grounding and Bonding

Grounding and Bonding (G&B) within the rail ROW is required for the OCS structure locations. The construction of the G&B will occur concurrently with OCS structure foundation construction, since each OCS structure will be individually grounded and interconnected through the static wire. The running rail is the return path for the current, thus it is grounded through the impedance bonds located maximum 1 km apart along the tracks.

Emissions that are associated with the above construction activities include dust (including $PM_{2.5}$) and typical combustion emissions, which include $PM_{2.5}$, NO_2 and SO_2, from construction equipment. As with any construction site, these emissions will be of relatively short duration and are unlikely to have any long-lasting effect on the surrounding area. As well, dust impacts can be successfully mitigated through the use of proper controls, such as:

- periodic watering of unpaved (non-vegetated) areas;
- seed/re-vegetate all exposed soil as soon as possible;
- limiting the speed of construction vehicular travel;

- cover all trucks hauling excess material;
- sweeping and/or water flushing of the entrances to the construction zones; and
- install silt fences around site perimeter to prevent dust migration.

Net effects associated with the construction of the OCS are anticipated to be temporary and minor.

4.2 Paralleling Stations

As outlined in Figure 3-1 there are two proposed Paralleling Stations to be located on a property adjacent to Ordnance Street and Strachan Avenue within Section 1 and at 3500 Eglinton Avenue West within Section 2.

4.2.1 Operations and Maintenance Impacts

Each Paralleling Station is comprised of one power transformer (10 MVA), two autotransformers (25 kV each) and a control/switchgear room located within an approximate 40m by 25m footprint. There are no sources of atmospheric emissions associated with Paralleling Station equipment; therefore, there are no anticipated contaminant emissions from the Paralleling Stations and no net effects during operation.

4.2.2 Construction Impacts

The construction of Paralleling Stations does have the potential to affect air quality in the vicinity of Ordnance St. and 3500 Eglinton Avenue West during the construction phase.

Switchyard components, switchgear room, control room and power transformers will be prepackaged off site. Heavy truck and machinery will be required to carry and install the prepackaged equipment to each respective PS site.

Site Preparation and Construction

- Clear site
- Remove contaminated soil (if required)
- Install concrete pads
- Install prepackaged equipment
- Install security fence
- Access to the PS sites will be via existing local roads (no new access roads are proposed)
- No additional construction staging areas will be required adjacent to the PS sites, as the staging areas will be contained within the boundaries of each PS site.

Installation of Ductbanks/25 kV Feeders

- Excavate soil (approximately 4 m wide and 1 m depth) via open cut method at CityView Dr. TPS site and Ordnance PS site

- Excavation under Industry Rd. and Ray Ave will be required at 3500 Eglinton Ave. W. PS site
- Install cables (25 kV feeders) within duct banks
- Pull the feeder cables through the ductbanks and connect the cables to the main gantry
- Backfill as per design

Grounding and Bonding

The grounding and bonding material for the paralleling stations will be delivered to the site by heavy truck. To install the G&B material at each PS, the following activities are required:

- Excavate the soil to the required depth (approximately 1 m)
- Install grounding mats, conductors and rods as per design
- Connect the grounding system internally and with adjacent existing grounding system, where required
- Backfill the grounding system as per design
- Install the junction boxes and connect grounding conductors, where required

Construction activities related to the two PS facilities is anticipated to occur during day time hours.

Emissions that are associated with the above construction activities include dust (including $PM_{2.5}$) and typical combustion emissions, which include $PM_{2.5}$, NO_2 and SO_2, from construction equipment. As with any construction site, these emissions will be of relatively short duration and are unlikely to have any long-lasting effect on the surrounding area. As well, dust impacts can be successfully mitigated through the use of proper controls, such as:

- periodic watering of unpaved (non-vegetated) areas;
- seed/re-vegetate all exposed soil as soon as possible;
- periodic watering of any stockpiles;
- limiting the speed of construction vehicular travel;
- cover all trucks hauling excess material;
- use of water sprays during the loading, unloading of any aggregate materials;
- sweeping and/or water flushing of the entrances to the construction zones; and
- Install silt fences around site perimeter to prevent dust migration.

Net effects associated with the construction of the Paralleling Station are anticipated to be temporary and minor.

4.3 EMU Maintenance Facility

As outlined in Figure 3-1 there is a proposed Maintenance Facility to be located at 50 Resources Road in Section 3 of the UP Express corridor.

4.3.1 Operations and Maintenance Impacts

4.3.1.1 Sources of Emissions

The proposed EMU Maintenance Facility will operate 24-hours per day and will include the following equipment with emissions to atmosphere:

- Cooling Tower
- Diesel Fired Emergency Generator
- Natural Gas-Fired Trigeneration System
- Natural Gas-Fired Unit Heaters

$PM_{2.5}$, NO_2 and SO_2 emission rates for the above sources were derived from a combination of manufacturer specifications, U.S. Environmental Protection Agency emission factors and engineering calculations. Calculations and assumptions for emission rate calculations are provided in Appendix D.

4.3.1.2 Sensitive Points of Reception

The closest receptors to the Maintenance Facility are residences on Adriatic Road located south of the rail corridor, approximately 80 m away. However, the location of maximum impacts is immediately adjacent to the site property line; therefore, compliance was assessed at the location of maximum impacts and at the nearest receptor location.

4.3.1.3 Applicable Criteria

Applicable criteria are outlined in Table 4-3 below.

Table 4-3. Applicable Criteria

Pollutant	Averaging Period	Ontario AAQC
$PM_{2.5}$	24 hour	30 µg/m^3 (CWS[1])
	Annual	10.0 µg/m^3 (CAAQS[2])
NO_2	1 hour	400 µg/m^3
	24 hour	200 µg/m^3
SO_2	1 hour	690 µg/m^3
	24 hour	275 µg/m^3
	Annual	55 µg/m^3

Note: [1] Canada Wide Standard based on the 24 hour 98th percentile ambient measurement annually, averaged over three consecutive years. To be reduced to 28 µg/m3 in 2015 and 27 µg/m3 in 2020
[2] Canadian Ambient Air Quality Standard. Standard comes into effect in 2015, to be reduced to 8.8 µg/m³ in 2020.

It should be noted that criteria for emissions from testing of the emergency diesel generator are limited to NO_x (as NO_2) emissions at 1,880 µg/m^3 over a half-hour period.

4.3.1.4 Assessment Methodology

The U.S. EPA AERMOD pollutant air dispersion model was used for assessing air quality effects from the proposed Maintenance Facility, with impacts assessed at the property boundary and the nearest receptor location. Dispersion modeling includes modeling emissions from the proposed EMU Maintenance Facility, with model results added to 90th percentile values from the five most recent years of available monitoring data. Default MOE meteorological data from Pearson Airport was used. Dispersion modelling followed Ministry of Environment Guideline A-11 Air Dispersion Modelling Guideline for Ontario.

4.3.1.5 Assessment Results

Table 4-4 presents the maximum predicted contaminant concentrations at the property line and at the closest receptor location. As indicated in Table 4-4, the maximum predicted concentrations for all contaminants are below applicable AAQC criteria.

Table 4-4. Summary of Model Results

Contaminant	Total Facility Emission Rate (g/s)	Averaging Period	Background Concentration ($\mu g/m^3$)	Maximum Off-Property Concentration (Includes Background) ($\mu g/m^3$)	Maximum Concentration at Nearest Receptor (Includes Background) ($\mu g/m^3$)	AAQC Limit ($\mu g/m^3$)
Nitrogen Oxides (as NO_2)	0.232[1]	½-hour	80.8	225[2]	94[2]	1,880
	0.170	1 hour	67.3	140	78	400
		24 hour	56.3	78	59	200
Sulphur Dioxide (SO_2)	0.001	1 hour	7.7	8.1	7.8	690
		24 hour	6.9	7.0	6.9	275
		annual	3.3	3.3	3.3	55
$PM_{2.5}$	0.014	24 hour	12.8	22.8	13.7	27[3]
		annual	6.8	7.8	6.8	8.8[3]

Notes:
[1] Site wide emissions including emergency generator (per MOE 4131e - Emergency Generator Checklist)
[2] 1-hr AERMOD output was multiplied by 1.2 to estimate half-hour averaging period emissions per ADMGO, March 2009
[3] Canadian Ambient Air Quality Standard (CAAQS) that comes into effect in 2020

It should be noted that the emission inventory and dispersion modelling was conducted on a "maximum effects" basis where all equipment was assumed to be operating simultaneously at their maximum rated capacities under worst case meteorological conditions.

4.3.2 Construction Impacts

The construction of the Maintenance Facility does have the potential to affect air quality in the vicinity of 50 Resources Road during the construction phase.

Construction activities related to the new maintenance facility will include the following:

Site Preparation and Construction:

- Clear site
- Site grading
- Remove contaminated soil, if required
- Install building foundations
- Construct the buildings and shops
- Rail and track construction
- Install security fence
- Grounding and bonding of MF buildings and electrified tracks
- OCS installation at MF (refer to description of OCS installation above)

Access to the Resources Rd. site will be via a new road being constructed between the Lowes retail store and the MF site (via the east end of the new Lowe's Place road. Construction for the MF will generally occur during daytime hours.

Emissions that are associated with the above construction activities include dust (including $PM_{2.5}$) and typical combustion emissions, which include $PM_{2.5}$, NO_2 and SO_2, from construction equipment. As with any construction site, these emissions will be of relatively short duration and are unlikely to have any long-lasting effect on the surrounding area. As well, dust impacts can be successfully mitigated through the use of proper controls, such as:

- periodic watering of unpaved (non-vegetated) areas;
- seed/re-vegetate all exposed soil as soon as possible;
- periodic watering of any stockpiles;
- limiting the speed of construction vehicular travel;
- cover all trucks hauling excess material;
- use of water sprays during the loading, unloading of any aggregate materials;
- sweeping and/or water flushing of the entrances to the construction zones; and
- Install silt fences around site perimeter to prevent dust migration.

Therefore, adverse net effects associated with the construction of the Maintenance Facility are anticipated to be temporary and relatively minor.

4.4 Mitigation Measures

Based on the results of this Air Quality Impact Assessment there are no proposed mitigation measures for the operation of EMUs in the UP Express corridor. However, Table 4-5 provides a summary of the proposed air quality mitigation measures during the construction of supporting infrastructure for the electrification of the UP Express corridor.

There are no proposed monitoring requirements. However, an Environmental Compliance Approval (ECA) from MOE for the EMU maintenance facility will be required prior to its implementation.

Table 4-5. Summary of Recommended Mitigation Measures during Construction

Potential Effect	Recommended Mitigation Measure
• Dust emissions during construction.	• Periodic watering of unpaved (non-vegetated) areas; • Seed/re-vegetate all exposed soil as soon as possible; • Periodic watering of any stockpiles; • Limiting the speed of construction vehicular travel; • Cover all trucks hauling excess material; • Use of water sprays during the loading, unloading of any aggregate materials; • Sweeping and/or water flushing of the entrances to the construction zones; and • Install silt fences around site perimeter to prevent dust migration.

References

LTK Engineering Services, *Traction Power System Simulations Report*, 2012

Metrolinx, *Georgetown South Service Expansion & Union Pearson Rail Link (GSSE-UPRL) Environmental Project Report*, 2009

Ontario Ministry of Environment, *Air Dispersion Modelling Guideline for Ontario, Version 2.0,* March 2009

Ontario Power Authority, Supply Mix Summary (December 2005) http://www.powerauthority.on.ca/integrated-power-system-plan/supply-mix-summary-december-2005

Railway Association of Canada, *Locomotive Emissions Monitoring Program 2010*

RWDI Inc., *Air Quality Assessment Georgetown South Service Expansion & Union Pearson Rail Link Toronto, Ontario*, July 2009

RWDI Inc., *Georgetown South & Airport Rail Link Final Report Air Quality Impact Assessment – Enhanced Analysis*, May 11, 2011

SENES Consultants Limited, Supplementary Environmental Impacts Report for the Integrated Power System Plan, June 2007 http://www.powerauthority.on.ca/sites/default/files/page/4503_G-3-1_Att_1.pdf

Appendix A

Georgetown South Service Expansion & Union Pearson Rail Link (GSSE-UPRL) Environmental Project Report (2009)

http://www.gotransit.com/gts/en/docs/finalEPR/Final_EPR_text_only.pdf

Appendix B

Air Quality Assessment Georgetown South Service Expansion & Union Pearson Rail Link Toronto, Ontario (July 2009)

http://goweb02.gotransit.com/gts/fr/docs/finalEPR/Report-Air_Quality_Assessment.pdf

Appendix C

Georgetown South & Airport Rail Link Final Report Air Quality Impact Assessment – Enhanced Analysis (May 11, 2011)

http://www.gotransit.com/gts/en/docs/GTS_Enhanced_AQ_Analysis.pdf

Appendix D

Detailed Maintenance Facility Emission Calculations

SOURCE SUMMARY TABLE

Contaminant	Source Data						Emissions Data		
	Source Identifier	Stack Volumetric Flow Rate (m^3/s)	Stack Temperature (K)	Stack Inner Diameter (m)	Stack Height Above Grade (m)	Stack Height Above Roof (m)	Maximum Emission Rate (g/s)	Averaging Period	Percentage of Overall Emission
Nitrogen Oxides (as NO_2)	DG	1.6	773	0.2	2.8	0.3	6.15E-02	½-hour	100% of DG NOx
Nitrogen Oxides (as NO_2)	TRI-GEN	11.8	393	1.0	2.7	0.5	1.33E-01	1-hr & 24-hr	78.2%
	UNIT-1	0.1	523	0.1	8.2	0.3	3.71E-03		2.2%
	UNIT-2	0.1	523	0.1	8.2	0.3	3.71E-03		2.2%
	UNIT-3	0.1	523	0.1	8.2	0.3	3.71E-03		2.2%
	UNIT-4	0.1	523	0.1	8.2	0.3	3.71E-03		2.2%
	UNIT-5	0.1	523	0.1	15.0	0.3	3.71E-03		2.2%
	UNIT-6	0.1	523	0.1	15.0	0.3	3.71E-03		2.2%
	UNIT-7	0.1	523	0.1	15.0	0.3	3.71E-03		2.2%
	UNIT-8	0.1	523	0.1	15.0	0.3	3.71E-03		2.2%
	UNIT-9	0.1	523	0.1	15.0	0.3	3.71E-03		2.2%
	UNIT-10	0.1	523	0.1	15.0	0.3	3.71E-03		2.2%
Sulphur Dioxide (SO_2)	TRI-GEN	11.8	393	1.0	2.7	0.5	7.59E-04	1-hr & 24-hr	77.3%
	UNIT-1	0.1	523	0.1	8.2	0.3	2.23E-05		2.3%
	UNIT-2	0.1	523	0.1	8.2	0.3	2.23E-05		2.3%
	UNIT-3	0.1	523	0.1	8.2	0.3	2.23E-05		2.3%
	UNIT-4	0.1	523	0.1	8.2	0.3	2.23E-05		2.3%
	UNIT-5	0.1	523	0.1	15.0	0.3	2.23E-05		2.3%
	UNIT-6	0.1	523	0.1	15.0	0.3	2.23E-05		2.3%
	UNIT-7	0.1	523	0.1	15.0	0.3	2.23E-05		2.3%
	UNIT-8	0.1	523	0.1	15.0	0.3	2.23E-05		2.3%
	UNIT-9	0.1	523	0.1	15.0	0.3	2.23E-05		2.3%
	UNIT-10	0.1	523	0.1	15.0	0.3	2.23E-05		2.3%
$PM_{2.5}$	TRI-GEN	11.8	393	1.0	2.7	0.5	6.67E-03	24-hr	47.5%
	UNIT-1	0.1	523	0.1	8.2	0.3	2.82E-04		2.0%
	UNIT-2	0.1	523	0.1	8.2	0.3	2.82E-04		2.0%
	UNIT-3	0.1	523	0.1	8.2	0.3	2.82E-04		2.0%
	UNIT-4	0.1	523	0.1	8.2	0.3	2.82E-04		2.0%
	UNIT-5	0.1	523	0.1	15.0	0.3	2.82E-04		2.0%
	UNIT-6	0.1	523	0.1	15.0	0.3	2.82E-04		2.0%
	UNIT-7	0.1	523	0.1	15.0	0.3	2.82E-04		2.0%
	UNIT-8	0.1	523	0.1	15.0	0.3	2.82E-04		2.0%
	UNIT-9	0.1	523	0.1	15.0	0.3	2.82E-04		2.0%
	UNIT-10	0.1	523	0.1	15.0	0.3	2.82E-04		2.0%
	COOL-1	28	ambient	1.5	3.4	0.02	4.54E-03		32.4%

Source ID TRI-GEN
Methodology: Emission Factor (EF)

A 1200 kW tri-generation system will provide electricity, heating and cooling for all site buildings.

NO_x and $PM_{2.5}$ contaminant emission rates are based on limits as presented in the Ministry of Environment Policy Decision "Emission Limits for Internal Combustion Engines used for Non-Emergency Power Generation".

SO_2 emission rates are based on U.S. EPA AP-42 Table 3.2-1 emission factors and an assumed worst case engine efficiency of 40%.

Sample Calculations:

$$NOx\ g/s = 1{,}200\,kW \times \frac{0.40\,kg}{MW-hr} \times \frac{1\,MW}{1{,}000\,kW} \times \frac{1\,hr}{3{,}600\sec} \times \frac{1{,}000\,g}{1\,kg}$$
$$= 0.133\,gNOx/\sec$$

$$SO_2\ g/s = 1{,}200\,kW \times \frac{5.88E-04\,lb}{MMBtu} \times \frac{454\,g}{lb} \times \frac{1\,MMBtu}{1.055E+9\,J} \times \frac{1{,}000\,J}{1\,kW-\sec} \times \frac{1}{40\%}$$
$$= 0.0008\,gSO_2/\sec$$

Description	Generator Rating	Emission Factor	Emission Rate (g/s)
NOx	1,200 kW	0.4 kg/MWh[1]	0.133
SO_2		5.88E-04 lb/MMBtu[2]	0.0008
$PM_{2.5}$		0.02 kg/MWh[1]	0.007

[1] Emission factor based on output power
[2] Emission factor based on input power

Source ID UNIT-1 to UNIT-10
Methodology: Emission Factor (EF)

Comfort heating will be provided by the tri-generation unit; however, it is also assumed that 300,000 Btu/hr natural gas fired unit heaters will be located adjacent to each bay door opening - 10 total.

Emission rates from natural gas-fired unit heaters were calculated with AP-42 Table 1.4-1 emission factors, assuming worst case uncontrolled emission factors for small boilers.

Sample Calculations:

$$NOx\ g/s = \frac{300{,}000\,Btu}{hr} \times \frac{100\,lbNOx}{1{,}000{,}000\ ft3} \times \frac{ft3}{1020\,Btu} \times \frac{1\,hr}{3{,}600\sec} \times \frac{454\,g}{1\,lb}$$
$$= 0.0037\ gNOx/\sec$$

Description	Input Btu/hr	Emission Factor	Emission Rate (g/s)
NOx	300,000	100 lb/10^6scf	0.0037
SO_2		0.6 lb/10^6scf	0.00002
$PM_{2.5}$		7.6 lb/10^6scf	0.0003

Source ID COOL TWR: Cooling Tower
Methodology: Engineering Calculation (EC)

The contaminant of concern emitted from the Cooling Tower is $PM_{2.5}$

$PM_{2.5}$ emissions are calculated based on the Environment Canada NPRI Toolbox spreadsheet: Induced Draft Cooling Tower PM Emissions and conservative assumptions. A print out of the NPRI Toolbox spreadsheet summary page is provided on the following page.

Sample Calculations:

Cooling tower water flow rate as provided by manufacturer = 600 USGPM
SPM Emission Rate = 16.356 g/hr
= 0.005 g/s

Description	Water Flow Rate (USGPM)	Emission Rate (g/hr)	Emission Rate (g/s)
COOL-1	600	16.36	0.0045

Induced Draft Cooling Tower PM Emissions

The purpose of this spreadsheet is to determine the annual TPM emissions, as well as the PM10 and PM2.5 fractions of TPM from the pertinent drift data tables (see Tables 1, 2, and 3 below).

Instructions: Enter in the yellow cells the appropriate number. Results are shown in blue cells in the three drift data tables below for the PM10 and PM2.5 fractions, and in red cells in row 16 for the TPM emissions.

Use one of the tables below that is the most representative of your cooling tower drift rate for the resulted percentage values of PM10 and PM2.5 in TPM. Multiply these percentages by the TPM value in row 16 for the respective calculations of PM10 and PM2.5 emissions (see the calculation example in the guide).

Substance	Circulating Water (m^3/h	Emission Ra (g/hr)	Annual Ope Period (hr)	Emission Quantity	Unit
TPM	136.3	16.36	24	0.00	tonnes

Drift, % of water flow	0.0010	0.02%	AP-42, > 20 year old towers
		0.001%	standard new tower (source: www.ctdepotinc.com)
		0.0005%	new tower, best demister (source:www.ctdepotinc.com)
TDS, ppmw:	12,000	33,000	sea water
		12,000	AP-42, high dissolved solids
		3,000	Great Lakes water * concentration factor ~10
DS Sp. Gr. :	2.2		Specific gravity of NaCl

Source ID DG: Back-Up Diesel Generator Combustion Emissions
Methodology: Emission Factor (EF)

As stated in the "Emergency Generator Checklist" - MOE Document 4131e, the significant contaminants emitted to atmosphere from an emergency generator are nitrogen oxides.

The emergency generator is to be located outside within an acoustic enclosure.

NOx emissions from the back-up diesel generator are estimated based on equipment manufacture after 2011, which must be U.S. EPA Tier III compliant.

NOx 0.3 g NOx/hp-hr	Assumes the emergency generator is manufactured after 2011 and will be U.S. EPA Tier 3 compliant

Sample Calculations:

Power Rating = 550 ekW = 738 hp

$$738\,hp \times \frac{0.3\,g\;NOx}{hp-hr} \times \left(\frac{1\,hr}{3{,}600\,\sec}\right) = \frac{0.062\,gNOx}{\sec}$$

Description	Power Rating (hp)	Emission Factor (g/hp-hr)	Emission Rate (g/s)
NOx	738	0.3 g/hp-hr	0.062