METROLINX

Metrolinx Electrification Project

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RESOURCES ROAD MAINTENANCE FACILITY CONCEPTUAL DESIGN

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Submitted by

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1.0 Executive Summary

The Resources Road Maintenance Facility is Metrolinx's first maintenance facility to be built for electrification. This conceptual design presents a facility for inspecting, storing, servicing and maintaining the Union Pearson Express electric multiple unit (EMU) fleet comprised of up to 21 cars. All prior Metrolinx maintenance facilities were built for diesel locomotive-hauled trainsets. Introducing electric train service requires alteration of certain maintenance procedures and practices.

50 Resources Road is a Metrolinx-owned site of approximately 4.94 hectares (12.21 acres) located along the UP Express mainline tracks, between Etobicoke Station and Weston Station. The trapezoidal shaped site is located on the north side of the tracks, east of Islington Avenue and south of Resources Road. Resources Road itself is located adjacent to and immediately south of Highway 401.

The Maintenance Facility will serve four primary maintenance groups –

1. Maintenance and storage of the UP Express electric trainsets
2. Reporting and dispatch base for the on-train engineers and conductors assigned to UP Express.
3. Maintenance base for work crews maintaining the overhead contact system (OCS) and wayside electrification equipment.
4. Building plant maintenance for the facility.

In this conceptual design, the four groups have been assigned space specific to their function, but where possible, they share common facilities, such as locker rooms, washrooms, lunch rooms, training rooms and employee parking. This is both space and cost effective, and offers greater flexibility in responding to staffing and organizational changes.

The Maintenance Facility design consists of the following functional areas –

- The main building which houses the administrative, transportation and building plant maintenance groups, in addition to railcar workshops and parts storeroom
- Bi-directional train washer, enclosed to permit cold-weather train washing
- Two yard storage tracks, collectively storing 4 trainsets, or 12 railcars
- Combined OCS and wayside electrification building.

The Maintenance Facility is designed to provide the most efficient maintenance and train operations possible. It is also designed to reduce potential impacts on surrounding land uses.

2.0 Introduction

2.1 Purpose

This document describes the methodology that guided the development of the conceptual design of the EMU Maintenance Facility.

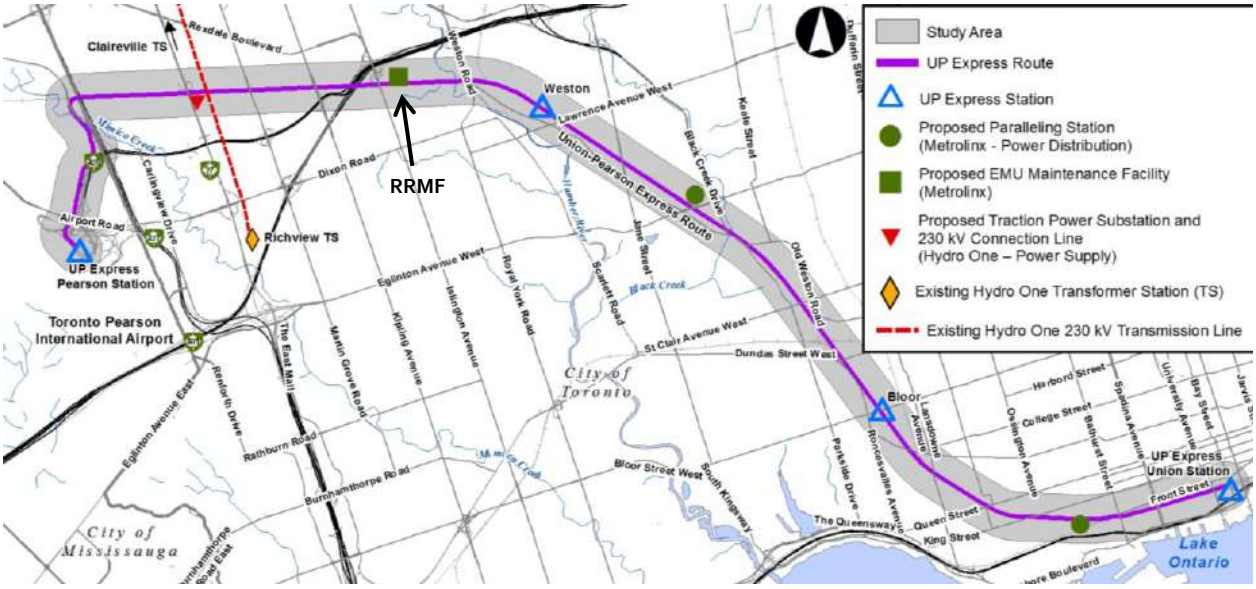
2.2 Scope

This report develops a conceptual-level design for a new, electrified Maintenance Facility for inspecting, servicing, maintaining and storing the UP Express electric multiple unit (EMU) fleet comprised of up to 21 cars. The design also includes the maintenance of way (MOW) equipment associated with maintaining the overhead contact system (OCS) and the wayside electrification equipment.

2.3 Site

The site is situated between Etobicoke Station and Weston Station and Resources Road itself is adjacent to and immediately south of Highway 401. The site is currently used as a staging area for the triple tracking construction and the new Humber River bridge construction. **Figure 2-1** shows the site in relation to the UP Express line.

Figure 2-1 Maintenance Facility Site on Kitchener/UP Express Line



The trapezoidal-shaped site is located on the north side of the tracks, east of Islington Avenue and south of Resources Road, as depicted in **Figures 2-2** and **2-3**. Factors that affect site design include –

- The site is constrained to 4.94 hectares (12.21 acres)
- The Islington Avenue Bridge defines the west boundary of the site, and the signal bungalow at Milepost 10.02 (Humberview Centre) defines the eastern boundary
- UP Express trains must cross the fourth main/freight tracks to enter the yard
- The site is not linear.

Figure 2-2 Maintenance Facility Site

Figure 2-3 Aerial View of Maintenance Facility Site

2.4 Supporting Material

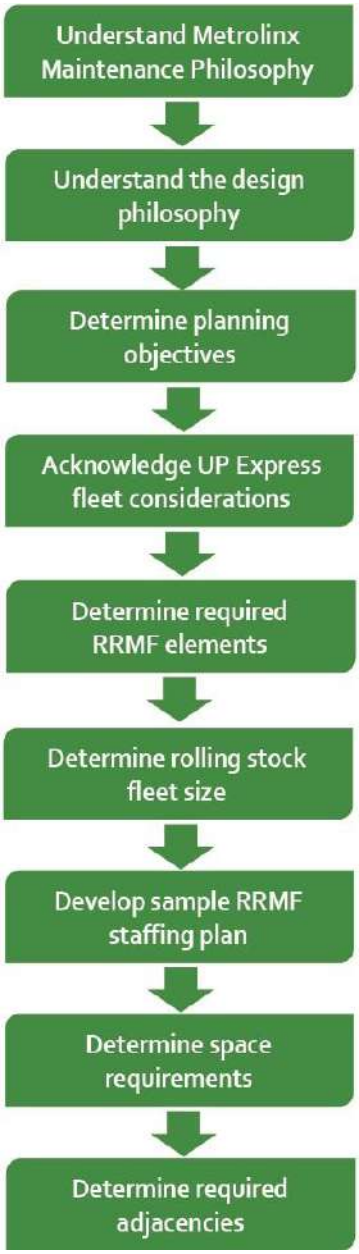
Explanatory information supporting the understanding of this document is provided in –

- Appendix A – Abbreviations & Acronyms
- Appendix B – Definitions
- Appendix C – References & Standards
- Appendix D – Maintenance Philosophy

3.0 Maintenance Facility Planning Inputs

The planning for the Maintenance Facility followed a logical sequence of steps, which are shown in **Figure 3-1**.

Figure 3-1 Maintenance Facility Planning Input Process



Understanding the philosophy ensured that the design responds to the unique needs of the UP Express.

The design must be developed based on an understanding of the Metrolinx maintenance philosophy (presented in **Appendix D** herein).

Efficiency, flexibility and expansion are the fundamental planning objectives.

UP Express is a premium service with a short maintenance window, therefore trainsets must be quickly serviced and maintained to an optimal standard.

These elements are described in *EPS-7000 Maintenance Facilities.*

In consultation with Metrolinx, Parsons Brinckerhoff proposed 'rounding up' the seven trainsets so that each will have three EMU railcars, for a maximum total EMU fleet size of 21 cars.[1]

Absent an existing staffing plan or an organization chart, a sample staffing plan and organization chart was developed.

Using the developed staffing plan and the fleet size, the required amounts of space, in square metres (and feet), for each person and type of maintenance function was determined.

[1] By comparison, the UP Express diesel multiple unit railcar (DMU) fleet will consist of seven trainsets, formed into two and/or three car trainsets.

3.1 Required Maintenance Facility Elements

The shop facilities correspond to Metrolinx/GO Transit's Category A type maintenance shop. Staff accommodated are listed below and described in **Section 4.0** –

- Car maintenance staff
- Transportation staff
- OCS and wayside electric maintenance staff
- MSF building plant staff
- Management and office staff
- Overflow staff.

Shop infrastructure requirements are described in *EPS-7000 Maintenance Facilities Part 2*. In summary, the Maintenance Facility must fulfill the following requirements –

- Provide storage for up to seven trainsets (consisting of three-car trainsets) on a level grade (ideally, 0%)
- Offer a sufficient site footprint to enable UP Express trainsets to be stored, serviced and washed as intact three-car trainsets, eliminating the need to uncouple UP Express trainsets, which is time consuming and operationally inefficient
- Allow UP Express trains to enter the yard from the mainline track from both eastbound and westbound directions
- Within the yard complex, enable UP Express trainsets to move flexibly without affecting other UP Express trains being serviced or stored
- Provide sufficiently wide track centres to accommodate OCS poles/portals, maintenance crew walkways and driveways for pickup trucks/service vehicles
- Offer interior shop space functionality commensurate with Metrolinx's Category A shop repair functions, including interior wheel truing, and railcar truck change-outs
- Provide sufficient yard space for exterior train washing in all weather conditions
- Provide space for maintenance of way (MOW) vehicles (it is currently assumed that road-based hi-rail type maintenance vehicles will be used instead of rail-bound MOW vehicles. Since track related MOW functions are currently based elsewhere, it is assumed that the incremental MOW needs are those associated with OCS and wayside electrification maintenance).
- Provide sufficient space for administrative and crew facilities, parts storage, truck delivery capability and staff parking.

Based on the above requirements, the Maintenance Facility will consist of –

- A full-service main building with maintenance shop facilities, including servicing platforms, a wheel truing machine, administrative offices, transportation and maintenance staff locker and a parts storeroom
- A separate, enclosed train washer for all-weather train washing
- Exterior train storage tracks
- A combined OCS and wayside electrification sub-shop for servicing and maintaining the OCS infrastructure.

3.2 EMU Fleet Size

When planning a new maintenance shop, the size of the railcar fleet is a critical input. The expected fleet size determines the size needed for the shop and yard footprint, and the required maintenance facilities within. Fleet size also helps determine the required employee headcount, which in turn affects space planning.

UP Express will start service using 18 high-floor DMUs operated in fixed formation 'consists' or trainsets. Some consists will be formed with three cars, and others with two cars, to yield seven DMU trainsets. To provide a consistent EMU fleet based on three-car trainsets, Parsons Brinckerhoff proposed a fleet of seven EMU trainsets of three cars each for a total of 21 EMU railcars.
A 21-car fleet will enable all seven UP Express trainsets to operate with a standard consist, which simplifies equipment assignment and maintenance.

3.3 Sample Maintenance Facility Headcounts by Title

Just as the expected railcar fleet size is an important planning input to determine the size of the Maintenance Facility, so too are the number of employees.

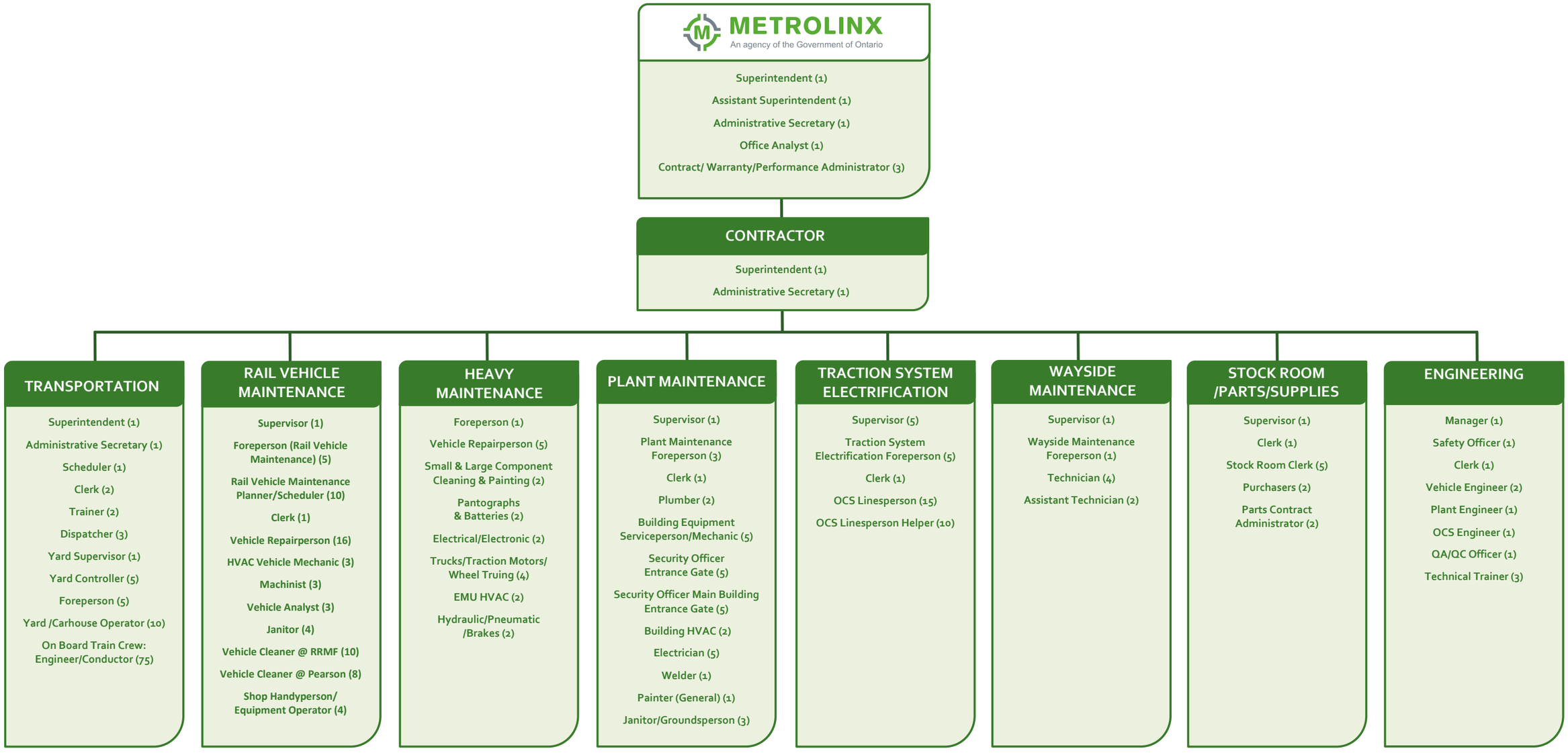
These employees include –

- Car maintenance staff – mechanics and cleaners who maintain the EMUs
- Transportation staff – train engineers and conductors who will report to this location
- OCS and wayside electric maintenance staff – who maintain the electrical components
- MF building plant staff – who clean and maintain the Maintenance Facility
- Management and office staff – supervisors, clerical, engineering and training staff
- Overflow staff – required for special and major events.

Once the expected fleet size was established, the expected number of employees was calculated using a 'bottom-up' approach to match expected staffing to the fleet size. This was developed using professional experience in developing maintenance facilities of a similar size and type as proposed for the Maintenance Facility, and considered typical work assignments and practices.

These expected numbers provide an estimate of staff space, by function/title to determine the space needed for the Maintenance Facility. It is understood that the final staffing plans will be developed by Metrolinx at the time of implementation. A high-level work organization chart is presented in **Figure 3-2**.

Figure 3-2 Proposed Work Organization Chart for Determining Space Requirements



3.4 Maintenance Facility Space Planning Needs & Adjacencies

While the railcar fleet size served as an input into the required size of the shop floor facilities, the staffing plan served as an input into the size of the following areas –

- Office areas – for Metrolinx and private contractor supervisors, clerical/administrative, analysts and engineering staff
- Meeting rooms
- Training rooms and related training offices
- Transportation (primarily on-train crews) – reporting window/train dispatcher's office
- Combined locker rooms, toilets and showers for car maintenance staff, transportation, building plant and administrative staff
- Lunchroom and kitchen
- Employee parking.

Space requirements were assigned a room or area footprint, which were then added together to determine the total required square feet.

Once each space requirement was identified, along with corresponding space requirements, the next step was to determine the layout. For efficiency, certain rooms and functions are clustered together or located in specific areas of the Maintenance Facility. For example, it is beneficial to cluster all the rooms relating to the transportation staff as this promotes collaboration and reduces walking distances between employees in the same functional organization.

Conversely, for safety reasons, certain functions should not be located close together. For instance, the paint booth, which requires special ventilation, should be kept separate from office/administrative areas and from areas where an open flame may be present, such as the welding area. Similarly, it is desirable to separate the hazardous materials storage area from the lunchroom.

4.0 Developed Site Plan

4.1 Site Constraints

The Maintenance Facility is designed for efficiency. As there is limited time for maintenance, the Maintenance Facility is planned to limit extraneous train movements and to enable maintenance to occur in a logical sequence by reducing potential conflicts with other trainsets in the facility. As well, the key buildings within the Maintenance Facility are designed for flexibility so they can be expanded or reconfigured to accommodate future changes in maintenance practice.

The property ends east of Resources Road, which is located east of the Islington Avenue roadway overpass. Milepost 10.02 defines the east end yard limits. Between these two points, the yard tracks have been placed to avoid excessive track curvature. Excessive track curvature can lead to wheel squeal, faster track wear and greater track maintenance requirements. As well, this maintains standard Metrolinx track switches.

Although the site is constrained, it has been designed to support efficient train movements from the yard lead track to the main building, the train washer or the yard storage tracks. Access to all three locations is designed to be direct, depending on the specific maintenance needs of that trainset.

4.1.1 OCS Access

All exterior yard tracks are electrified, except for the track leading to the OCS/wayside electrification building.

As previously mentioned, the Maintenance Facility will service and maintain single-level EMUs . Therefore, the OCS height will be set for single-level EMUs. Although most of the freight track (fourth/northern track) will not have OCS, the fourth track closest to the Maintenance Facility will have OCS to enable UP Express EMU yard access and has been to designed to accommodate double stack freight on the corridor. There will be a height transition between the mainline and the yard for the OCS and this has been captured in the design.

4.2 Site Plan Benefits

The proposed UP Express fleet is small and includes a 'spare factor'. The spare factor is the ratio of railcars held out of service versus the size of the total fleet. This is necessary as there will always be preventative maintenance being performed on part of the fleet. In addition, it is desirable to provide a 'standby' train that can quickly enter service in the event of the breakdown of an in-service trainset. When the train service is marketed as a premium service operation, the need to quickly swap out a defective trainset is even more critical.

4.3 Track Site Access & Yard Plan

4.3.1 Options Analysis

Quick UP Express trainset access into and out of the Maintenance Facility is critical for operational efficiency and to provide maximum maintenance time for trainsets. When planning for efficient train and yard operations, it is highly desirable to avoid situations where the trainset departing or entering must reverse directions on the mainline tracks. Reversing directions, whether on mainline or yard tracks, is operationally inefficient and consumes valuable track capacity. With these considerations in mind, the following three trainset access concepts were analyzed –

- **Double-End Yard Access** – Trainset access from both the east and west ends of the yard site. East end access is at Milepost 10.02 (Humberview Centre Interlocking) and west end access is at Islington Avenue. This allows for a quick service ramp and a flow-through yard and shop design to avoid trapping cars.

- **West End Only Yard Access** – Trainset access from the west end of the yard only, at Islington Avenue. This avoids any potential horizontal clearance impact to the Islington Avenue Overpass and cuts operating costs by quick and direct deadheading to Pearson Airport.

- **East End Only Yard Access** – Trainset access from the east end of the yard only, at Milepost 10.02. This avoids relocating the new signal bungalow and golf course and allows for direct deadhead to Union Station.

The analysis of these access options is presented in **Table 4-1**.

Table 4-1 Maintenance Facility Yard Access Options Analysis

Criteria	Double-End Yard Access	East End Yard Access Only	West End Yard Access Only
Allows trains to enter/leave from east end of yard	**Yes**	**Yes**	**No**
Allows trains to enter/leave from west end of yard	**Yes**	**No**	**Yes**
Provides deadheading trains quick access to Pearson Airport (reducing deadhead costs)	**Yes**	**No (train must reverse on mainline tracks)**	**Yes**
Provides deadheading trains quick access to Union Station (reducing deadhead costs)	**Yes**	**Yes**	**No (train must reverse on mainline tracks)**

Criteria	Double-End Yard Access	East End Yard Access Only	West End Yard Access Only
Yard configuration allows 'flow through' train operation (trains can enter yard and leave yard in one forward movement without reversing)	**Yes**	**No (train must reverse on yard tracks)**	**No (train must reverse on yard tracks)**
Yard has more than one access point for redundancy (in case of yard access track blockage)	**Yes**	**No**	**No**
Yard permits simultaneous arrival and/or departure of trains	**Yes**	**No**	**No**

The double-end concept, which provides both east and west access, fulfills all criteria and was therefore selected.

4.3.2 Double-End Yard Access

The Maintenance Facility has been planned as a double-end yard. This means the yard allows trains to access it from both the east and west. Providing good double-end access is critical for efficiently launching trains into service in the morning at the start of service, and replacing disabled trains at short notice. The ability to launch trains in both directions has several benefits –

- Reducing train deadheading (empty, no passenger train movements) time and mileage
- Reducing train deadhead time increases time allotted in the shop for maintenance
- Reducing train deadhead time and travel miles also reduces unproductive train crew time and costs
- Reducing train deadheads encourages faster response for incidences such as when a disabled train needs to return to the shop or requires rapid replacement and substitution
- Providing redundancy in the event of track or operational disruption affecting one of the yard entrances.

The Islington Avenue overpass on the west end of the site defined the west end yard access point. Placing the yard access point any further west would require relocation of Resources Road and reconstruction of the Islington Avenue overpass, which is a major expense and undertaking. The current design does not have any impact on the Islington Bridge. Milepost 10.02 (Humberview Centre Interlocking) defines the east end yard access point. Placing the east end yard access point any further east would require relocating a soon-to-be installed signal bungalow at Milepost 10.02.

In addition, other yard impacts would possibly emerge during redesign. Instead of redesigning the yard, the simpler solution is to shift the to-be installed Track W2 to W1 crossover further east at Milepost 9.80.

4.3.3 East End Access

To enter the east end yard lead track, a new crossover is required from Track W2 to Track W1 at a point east of Milepost 10.02. The optimal location for this new crossover is between Milepost 9.64 (Humber

River Bridge) and 10.02 at Milepost 9.80. If, however, the east end yard lead was to be moved further west of Milepost 10.02, for example to Milepost 10.20 (to use an existing crossover), this would have major ramifications on the current yard design and would require complete reconfiguration of the yard from a double-end configuration to a single-end configuration. Some of the impacts include, but are not limited to –

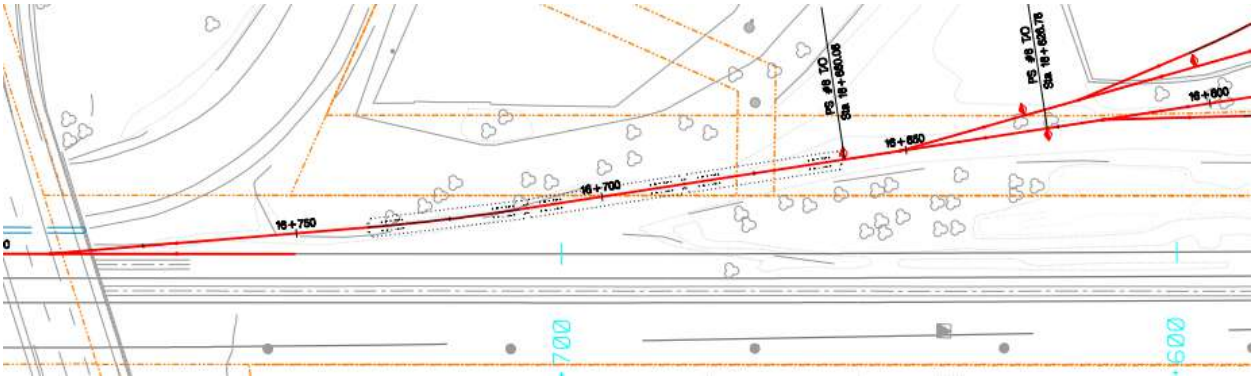
- Requiring all trains entering from the east end to proceed west to a yard rail track, stop, then reverse direction to enter the train storage tracks, main building or car washer. These reverse moves are operationally awkward and may create bottlenecks during peak train maintenance times.

- Shifting the train storage tracks east to become single entry storage tracks. As two trains are stored on each track, there is the potential to trap one train behind another, if the train nearest the storage track exit becomes disabled.

- Shifting the main building east to become a single entry building. This will require all trains to leave the main building using the same tracks, potentially creating bottlenecks during peak train movement times.

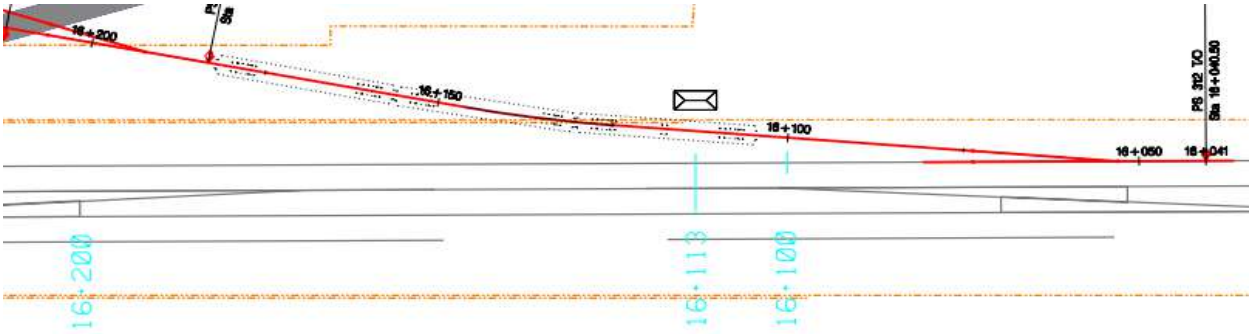
Both the east and west end yard lead tracks are capable of accommodating a three-car trainset between the mainline tracks and the first switch off the yard lead track. This configuration allows trainsets to reverse or shift between the yard tracks freely. As illustrated in **Figure 4-1**, the west end yard lead tracks allow for a three-car trainset to move among different yard tracks without 'fouling' the mainline tracks and disrupting mainline track capacity.

Figure 4-1 West End Yard Lead Tracks



Similarly, the east end yard lead tracks shown in **Figure 5-2** allow for a three-car trainset to move among different yard tracks without 'fouling' the mainline tracks.

Figure 4-2 East End Yard Lead Tracks



Entering from the west entrance, the single yard lead track fans out to serve, from south to north, the –

- Train storage tracks
- Train washer
- Yard bypass track
- Wheel truing track inside the main building
- Heavy maintenance bays inside the main building
- Preventative maintenance bay tracks inside the main building
- Train turntable, which is located at the west end of the yard.

The double-end, flow-through yard plan permits a train from any of the above areas, except for the stub-ended turntable track, to continue in the same direction as it entered, and return to the mainline tracks without reversing direction.

As discussed, the site is constrained, so some site compromises and reverse train movements will be required within the yard. For instance, reverse train movements are needed when a trainset is shifted from the tracks inside the main building to other tracks inside that building, or from the main building to the train washer or to the yard storage tracks.

A train entering from the eastern entrance will encounter the same configuration as from the western entrance. The only difference is that the turntable track is replaced on the east end of the site by a track that serves the OCS/wayside electrification building. The track serving the OCS/wayside electrification maintenance building is needed only if the decision is made to use rail-bound work trains.

The yard track and switch configuration requires some intrusion onto the existing stormwater management pond. This minor intrusion across a corner of the pond can be dealt with in several ways –

- Reconfiguring the stormwater management pond to replace the capacity lost by the tracks cutting across the corner of the pond
- Placing the tracks on a bridge across the pond to maintain pond capacity
- Determining whether the loss of pond capacity can be absorbed without alteration to the pond.

This issue will be reviewed and finalized during the preliminary design stage.

The yard storage tracks are designed to accommodate no more than two trainsets per track. This

limitation was established to prevent trapping one train behind another in case of malfunction or breakdown. With two trainsets per storage track and access to yard exits at both ends, a disabled or immobile train will not prevent a second train from exiting the yard independently.

A yard bypass track is located between the yard storage tracks and the car washer. The purpose of the yard bypass track is to enable railcars or trainsets to move between different portions of the yard without affecting other trains in the yard or trains on the mainline tracks. The placement of the yard tracks considers the installation of the required catenary masts and portal structures.

4.3.4 Fleet Marshalling – Turntable

If an 'A' car in one trainset becomes inoperable, it is sometimes necessary to swap out an 'A' car taken from another trainset to maintain service. If the 'A' car taken from another trainset is facing the wrong direction, a turntable is needed to reposition the 'A' car to face the proper outward direction. As shown in **Figure 4-5**, a turntable to reposition and turn 'A' (cab) cars is proposed at the west end of the site.

An UP Express EMU fleet will be composed of the following cars –

- An 'A' car at the leading end of the train with a sloped front-end cab
- A 'C' car in the middle of the train, with slab ends, enabling passengers and staff to walk through the car to reach other cars in the trainset
- An 'A' car at the end of the train with a sloped back-end cab (ie, a reversed cab car).

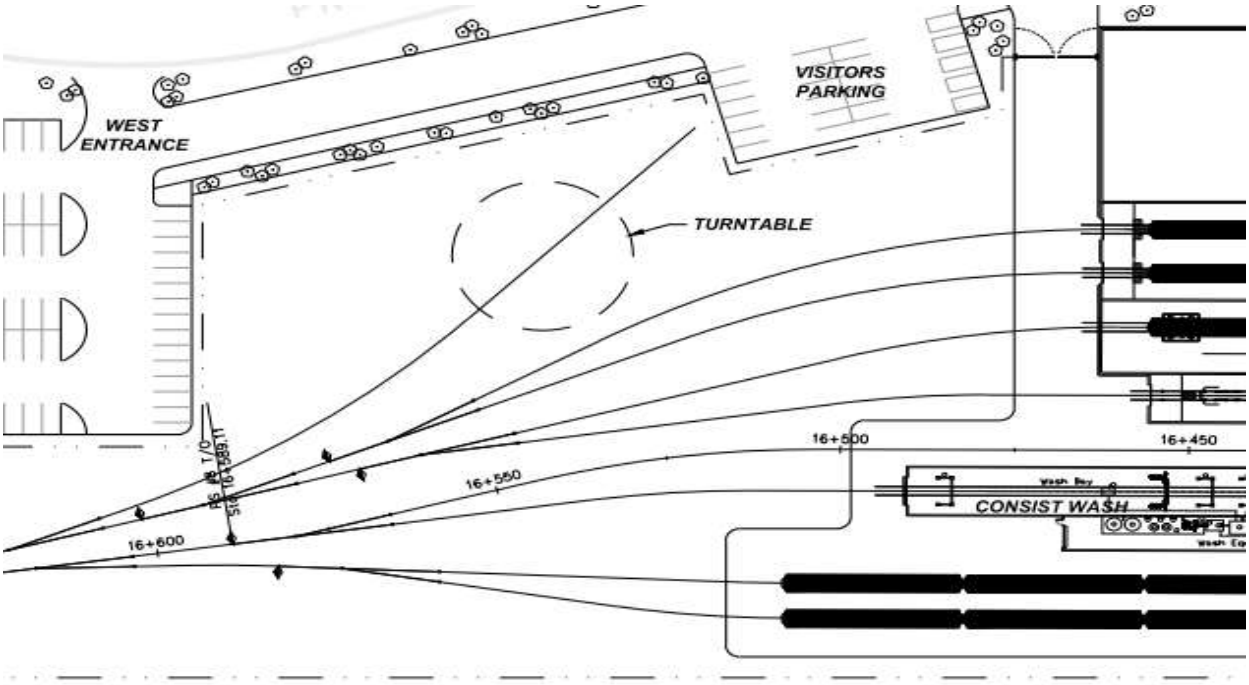
With such a trainset, all sloped front-end 'A' cars are marshalled to face the outer ends of the train. **Figure 4-3** shows the UP Express DMU and is an example of a trainset with an 'A' car.

Figure 4-3 UP Express DMU 'A' Car

An example of an airport express EMU with an 'A' car configuration is the East Japan Railway's Class E259 Narita Express trainsets (**Figure 4-4**) that serve Tokyo's Narita Airport. The engineer's cab in the 'A' car is located atop a retractable inter-car gangway, allowing the train to be driven from both ends.

Figure 4-4 Narita Express Train

Figure 4-5 Turntable



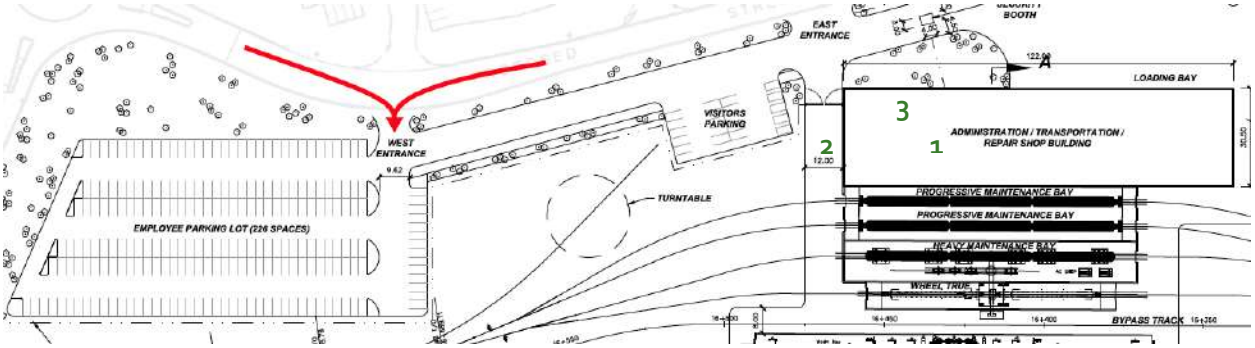
An example of a turntable used to turn railcars around is the unusual X-shaped turntable at BART's Colma Maintenance Facility (**Figure 4-6**). This facility, located south of San Francisco, is used to turn BART's railcars, while also enabling rubber-tired vehicles to drive across it. According to the manufacturer, this turntable can be fitted with a cover to fully enclose the turntable pit.

Figure 4-6 Turntable at BART's Colma Maintenance Facility

4.4 Parking, Entrances & Internal Roadways

Roadway access into the site, as shown in **Figure 4-7**, will be from the unnamed public street that provides customer and delivery truck access to the Lowe's store, located on the street's north side.

Figure 4-7 Maintenance Facility Site Access Map



4.4.1 Parking

Access into the employee and visitor's automobile and bicycle parking lot is uncontrolled, with open access. The size of the employee and visitor parking lot is approximately 245 spaces, which includes accessible parking spaces. This sizing is based on the proposed headcount, with an overlap for shift changes and an additional spare factor for extra staffing, which may be required during special event operations.

4.4.2 Entrances

To proceed beyond the parking lot, access will require passing through one of three entrances, numbered in **Figure 4-7** –

1. **Pedestrian-only entrance** The pedestrian-only entrance is located inside the northwest corner of the main building and is intended to serve employees and visitors. This entrance is supervised by security/reception staff.

2. **Vehicular entrance** A vehicular driveway entrance with a security booth is located on the internal yard driveway leading to the main building shipping and receiving bays and to the OCS/wayside electrification maintenance building. This booth has been set back from the entrance to permit a large truck to queue without impacting other vehicular traffic. This is a gate-controlled entrance and is intended to serve delivery trucks, garbage/recycling, hazmat disposal trucks, and yard service vehicles, such as for the OCS and the wayside installations shop.

3. **Controlled entrance gate** The third entrance is an employee-only gate located on the west side of the main building. This entrance is for service vehicles that need to drive into the yard and is accessible by key card access and monitored by the security centre.

4.4.3 Internal Roadways

The layout of the yard roadway has been planned to separate the private vehicles used by staff and visitors from large trucks and commercial vehicles serving the site.

The yard roadway minimizes the distance that commercial delivery and refuse trucks must travel within the Maintenance Facility. It has been planned to provide as direct as possible a route for large trucks to deliver parts and supplies to the storeroom. The roadway minimizes sharp turns to facilitate these deliveries. A truck turning circle is located east of the main building to allow 18-wheeler trucks to pull out of the shipping and receiving bays in a single, forward movement then turn using the truck turning circle and exit without the need to reverse. Eliminating reverse movements, where possible, improves safety.

By separating delivery trucks from private car traffic, the trucks avoid passing car parking stalls where reversing cars may conflict with truck movement.

The storeroom and garbage/recycling dumpsters are located near the northeast corner of the main building to reduce the distance the associated vehicles must travel. Reducing the distance traveled by non-employee vehicles results in better security.

The internal driveways have been designed to provide clear access to the employee parking lot. This is critical since the train crew must report to work without being delayed by other vehicles, such as delivery trucks maneuvering into a storeroom loading bay.

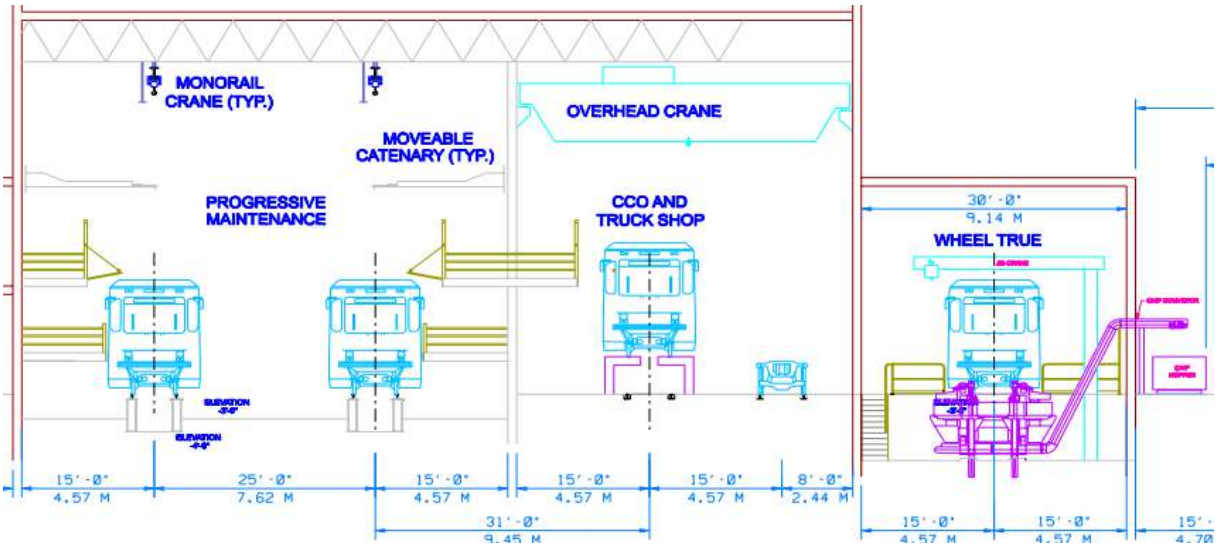
Within the Maintenance Facility, an internal roadway system provides access to the employee parking lot, shop building, train washer, train storage tracks, MOW building, and other areas of the yard.

All yard roadways, driveways, parking lots, and delivery areas will be illuminated with roadway and/or building-mounted lighting.

4.5 Main Building

The 7,100m² (76,400sf) main building (**Figure 4-8**), centrally located on the site, sits south of the unnamed public street and north of the yard bypass tracks.

Figure 4-8 Main Building Cross-Section (Partial View)



The two-storey main building is a multi-purpose, building where most of the activities take place. The ground and second floor plans are shown in **Figure 4-9** and **Figure 4-10**, respectively, and the components are described below.

Figure 4-9 Main Building Ground Floor Plan

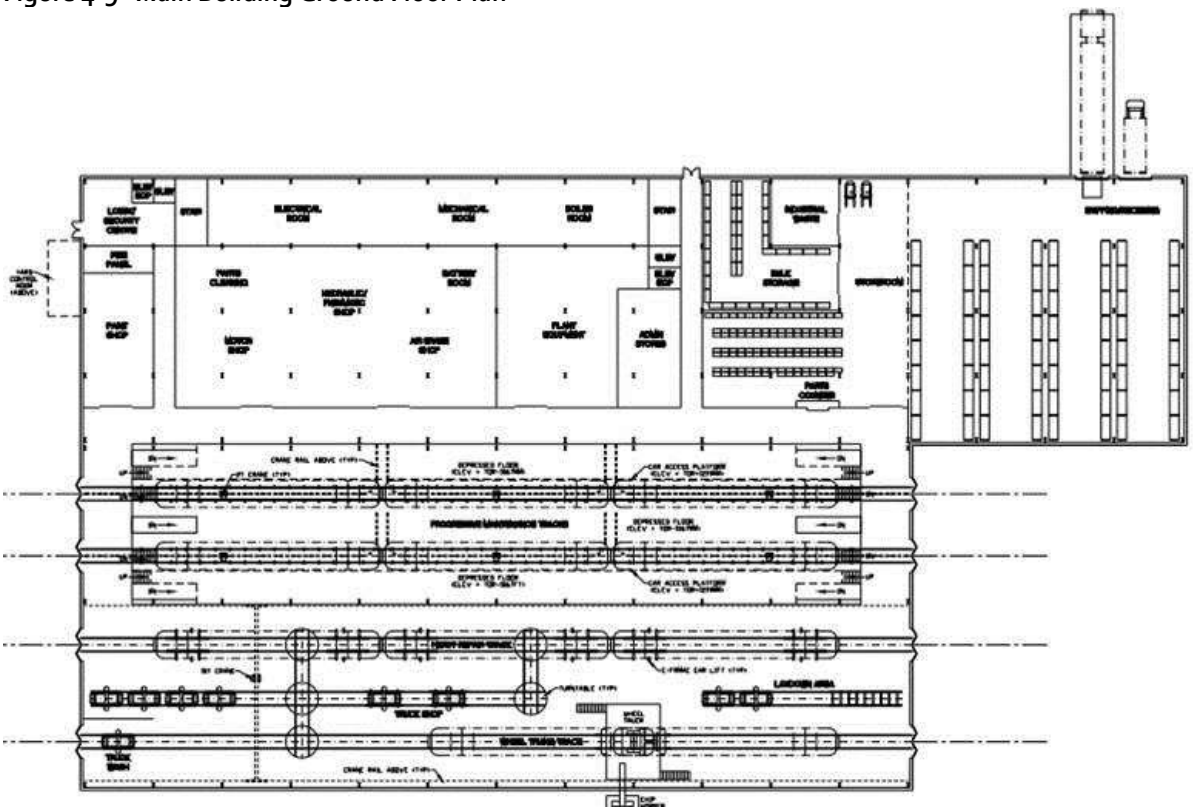
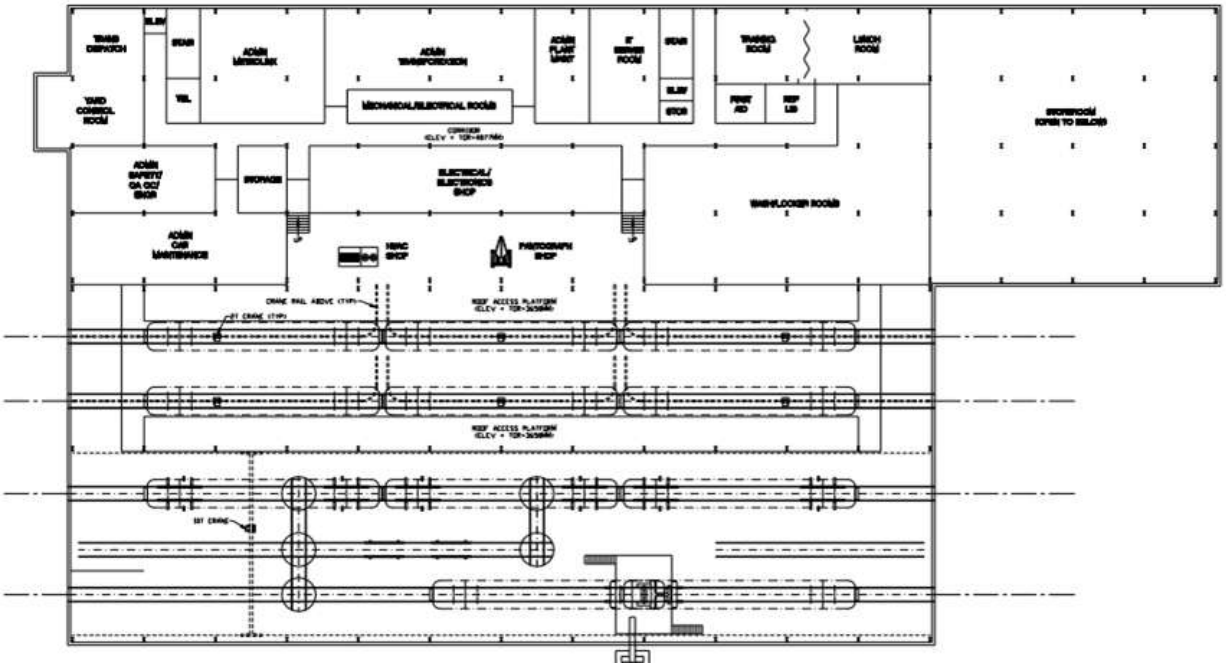


Figure 4-10 Main Building Second Floor Plan



Ground Floor

- Primary location for EMU inspections and maintenance
- Heavy repairs
- Specialized workshops
- Parts storeroom

Second Floor

- Metrolinx and contractor administrative, transportation and mechanical offices
- Transportation crew reporting
- Training facilities
- Employee welfare facilities
- Yard control office
- Additional specialized workshops

As shown above, there are two major functional separations within the building which are described in the sections below –

1. The administration, report shop and storage area (north)
2. The maintenance track area (four tracks).

4.5.1 Administration Offices, Repair Shops & Storage

This two-storey portion of the main building contains offices, training rooms, locker rooms, toilets, lunchroom, yard control room, transportation assembly and dispatch room, storeroom, and various repair shops for HVAC, pantograph, electronics, traction motor, hydraulics, etc.

Heavily-trafficked rooms and rooms with heavy equipment are assigned to the ground floor. This includes the parts storeroom and various repair shops such as traction motor, electronics and hydraulics shops. The storeroom is located at the east end of the main building to reduce the distance that delivery trucks need to travel inside the yard to access the shipping and receiving loading bays.

Various administrative offices, transportation department-related rooms, the yard control room, staff lockers, toilets, training and the lunchroom are located on the second floor. The supervisor's offices face south, enabling supervisors to see into the main building shop floor below. The pantograph and HVAC repair shops, which correspond to the railcar roof-mounted equipment, are located on the second floor to provide easy access from the railcar to the shop.

The entire administrative area is located on the north side of the main building to reduce the distance staff and visitors need to travel from the entrance to the administrative and transportation crew reporting areas, such as the transportation assembly and dispatch room.

4.5.2 Progressive Maintenance Bay

The progressive maintenance (PM) bay portion of the main building is organized around two maintenance tracks. Each track accommodates an intact three-car trainset, which eliminates the need to uncouple (and later recouple) trainsets for cleaning, inspection and light maintenance. This saves time, coupler wear and tear (especially on the electric portion of the coupler), and is more efficient in terms of facilitating maintenance. Only during heavy maintenance is the train uncoupled and broken apart.

All shop tracks are double-ended, which allows trainsets to enter from either the east or west side of

the main building, providing good operational flexibility.

Quick in-and-out shop access is critical since each UP Express trainset is scheduled for progressive maintenance once a week, and such work is typically completed within one work shift.

The two tracks are placed to the north edge of the bay for easy access to storeroom inventory. Each PM bay track is provided with what Parsons Brinckerhoff terms an 'atypical posted rail design with depressed floors'.

This consists of each PM track providing a centre pit with a depth of 1.37m (4'6") below the top-of-rail, accessible by stairs at either end of the pit. In addition, both sides of each PM track feature a depressed floor of approximately 0.91m (3'0") depth, giving a posted rail appearance, which is accessible to forklifts via ramps at both ends of the sunken work area.

A working platform placed approximately 1.28m (4'2½") above top-of-rail (matching the height of the railcar door opening) is provided on one side of each PM bay track. Above this, a railcar rooftop-height platform (with fall protection) is provided to allow maintenance staff to access roof-mounted components, such as the pantograph and modular air conditioning units.

As described in the OCS section herein, both PM bay tracks are fitted with a swing arm catenary. Swing arm catenary allows trainsets to operate under electric power to enter the shop building. Personnel can then shut off OCS power above the train by retracting the swing arm to permit safe access to the railcar rooftop area.

Monorail cranes above both tracks allow heavy items, such as air conditioning units, to be lifted from the cars and moved to off-car work areas.

Toilet servicing (pump out) takes place primarily on the track (a secondary location is the train storage tracks via portable 'honey wagons'). Toilet pumping facilities will be provided at locations matching the locations of the toilet locations on the trainset.

4.5.3 Heavy Maintenance Track

The heavy maintenance track is located just south of the two PM bay tracks.

The heavy maintenance track is fitted with C-frame, in ground hoists that allow railcars to be elevated to a convenient working height above the shop floor. The C-frame design also enables a dismounted truckset to be transported out from under the lifted railcar, which eliminates the need for truck turntables between hoists.

4.5.4 Wheel Truing Track with Truckset Changeout Area

The wheel truing track is designed to allow wheels on a three-car trainset to be trued without the need to remove the truckset or to uncouple the trainset. The wheel truing track is isolated from other tracks by a partition wall. During cold weather, it is necessary for a train to drive through the wheel truing track with the shop doors open at both ends of the wheel truing track. The partition wall will help prevent outside cold air from permeating other portions of the main building shop floor.

The wheel truing track is placed along the south wall of the main building to permit the wheel shavings (chips) from the wheel truing machine to be directly deposited into a scrap metal bin located outside the building at the south wall. The wheel shavings are transported into the scrap metal bin via a conveyor belt penetrating the south wall. The scrap metal bin is placed on a driveway for easy truck pickup.

4.6 OCS/Wayside Electrification Maintenance Building

A 2,230m^2 (24,000sf) OCS/wayside electrification maintenance building (WEM) is located east of the main building (**Figure 4-11**).

Figure 4-11 OCS/WEM Building

Since maintenance of railroad track, structures, signal, and communications are currently performed by a third party based at an off-site location, this document assumes continuation of such maintenance practices.

However, maintenance of the OCS and the wayside electrification equipment (ie, traction power substations, and switching stations) are new elements to be maintained and are assumed to be based at the Maintenance Facility.

Thus, the OCS/WEM building will house the following functions –

- OCS/WEM administrative offices – supervisors and clerical offices
- Specialized OCS and WEM workshops
- OCS and WEM material storage

- OCS/WEM crew reporting
- Employee welfare facilities.

It is assumed that the OCS will be maintained using either hi-rail or rail-bound rolling stock. Exiting the tracks quickly is especially important to relinquish 'work time' track possessions and return the track to service.

Rail-bound work equipment requires either diesel locomotive or self-propelled units, and requires a railroad siding to leave the mainline tracks. If siding track is not immediately available at a work area, rail-bound vehicles have to travel to the next siding to exit the track. As such, the recommendation is to use hi-rail vehicles because they 1) are less expensive, and 2) have more flexibility than rail-bound vehicles in terms of accessing and leaving the railroad right of way.

The OCS/WEM building is flexible and designed to accommodate both methods of maintenance. The building is situated so that it can be served by rail-bound equipment through the east end yard lead track.

If hi-rail catenary maintenance vehicles are used, those tracks can be eliminated for cost savings. Even if tracks are not initially installed, space has been reserved so that, in the future, tracks can be installed if the maintenance method should favour using rail-bound vehicles to maintain the OCS.

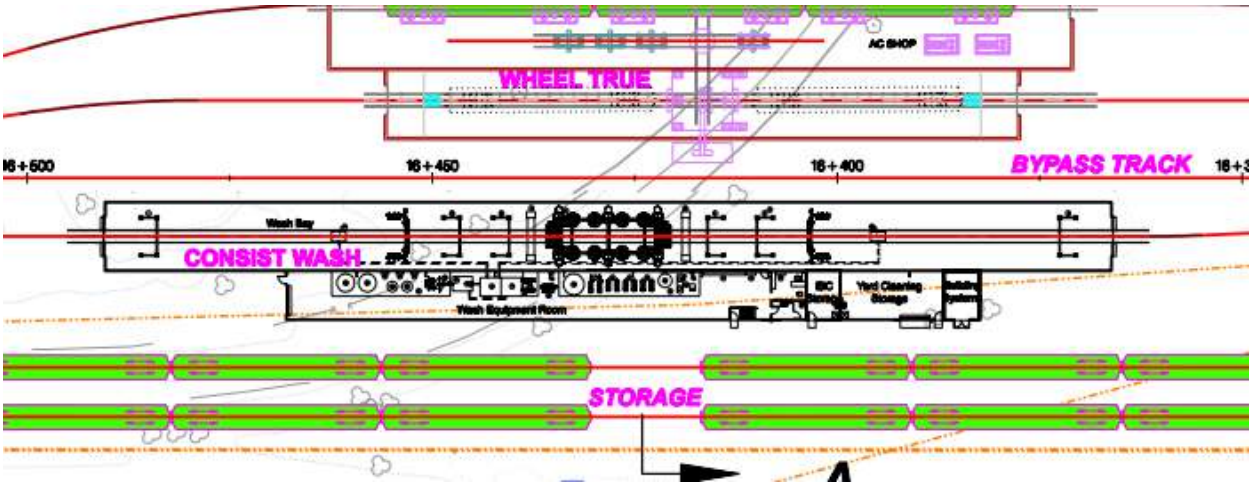
If the contractor decides to house OCS/WEM staff at an off-site location, this building will not be required.

4.7 Train Washer

Marketed as a premium service, it is important to keep the exterior of UP Express trainsets clean.

To enable this, a bidirectional train washer (shown in **Figure 4-12**) is located in an enclosed structure for washing in all types of weather, and allows trains to be washed whether they enter the washer from the east or west end.

Figure 4-12 Bidirectional Train Washer



The location of the train washer and tracks allows easy train access, and avoids conflicts with other yard movements to the extent possible, given site constraints. In addition, the location adjacent to a paved driveway facilitates deliveries of cleaning fluids.

Ideally, if the yard site was large and linear enough, the train washer would be placed in alignment with the main building and storage tracks to allow trains to be washed without the need to reverse directions. However, the site is too small to allow for such optimal placement and, after washing, trains will have to reverse direction to access either the main building or the storage tracks. Reversing direction is more time consuming and operationally less desirable than a simple through movement. The location of the train washer is specifically situated away from any sensitive land uses that may be affected by noise or train wash spray. Additionally, the enclosed train wash building blocks exposure to wind (which can carry spray) and contains train washing noise.

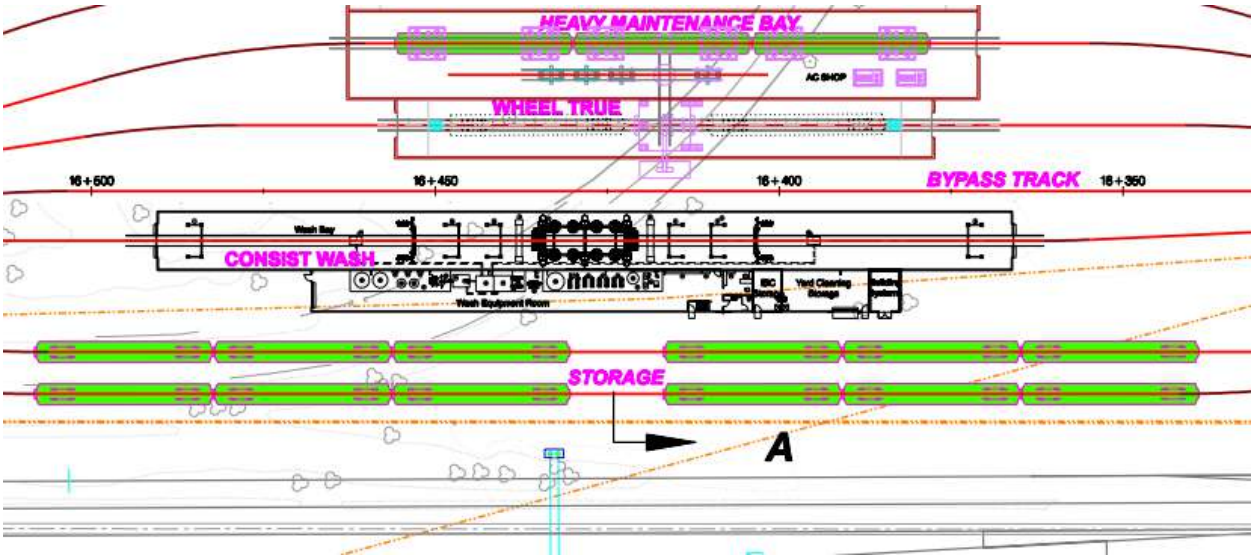
Yard lighting and lighting inside the train washer building will permit train washing during night time hours.

4.8 Train Storage Tracks

Two train storage tracks are located at the southern edge of the site, parallel and adjacent to the mainline tracks. Both train storage tracks are double-ended, allowing trains to enter from the east and west ends of the yard.

Two train storage tracks, each holding two trainsets of three cars, provides overnight storage capacity for 12 EMU railcars. The train storage tracks are located just north of the mainline tracks (**Figure 4-13)** for easy access. These tracks can be reached from both the east and west yard lead tracks**.**

Figure 4-13 Train Storage Tracks



Each train storage track is designed with sufficient space between the parked trainsets to provide access to all sides.

Driveways on both sides of each parked trainset allow service vehicles to access both sides of the train, facilitating light maintenance on these tracks without the need to move these trainsets into the main building. The driveway between the pair of storage tracks is designed to enable a toilet pump vehicle to empty the on-train toilets, although the primary location for this function is on the two PM tracks inside the main building. Because of the need to provide vehicular access along the driveways, this area has been designed to remain clear of catenary poles.

The storage tracks have been designed to store no more than two trainsets per track overnight. This limitation was established to prevent 'trapping' one train behind another in case of malfunction or breakdown. With two trainsets stored per storage track and yard exits at both ends of the yard, even if a train was to breakdown and become immobile, the other train on the same track would be able to exit the yard independently.

Both storage tracks are located on a 0% grade to help prevent trains from rolling away. The four trainset storage spots are designed to enable the three-car trainset to park as an intact trainset and do not require the trainset to be broken apart for storage. Breaking apart the trainset each night would be time consuming for staff, inefficient, and would place stress on the carbodies and the electric pins of the couplers.

4.9 Overhead Contact System (OCS)

All exterior yard tracks are electrified, with the exception of the track leading to the OCS/wayside electrification building. This enables EMU trains to enter and access all required exterior yard tracks under their own power, saving valuable time otherwise needed to hook up and tow the trains within the

yard. This is a critical consideration given the short overnight maintenance window available to service the trains.

The track leading to the OCS/wayside electrification building does not require electrification, as those tracks would be used by self-propelled work cars or locomotive-hauled work cars. Not electrifying this track enables material and equipment to be loaded onto the work cars by cranes without the need to work around the presence of overhead electric wires.

If the contractor maintaining the OCS decides to use hi-rail vehicles instead of rail-bound work cars, then the tracks serving the OCS/wayside electrification building can be eliminated.

All tracks with overhead catenary will have grounding and bonding as required per *EPS-3000 Grounding & Bonding.*

4.9.1 Sectionalization

Yard electrified tracks will be sectionalized to permit specific sections of the OCS to be switched off for OCS maintenance work or to permit safe access to the EMU railcar rooftops for maintenance. A yard sectionalization plan is shown in the drawing set in **Appendix F.**

4.9.2 Main Building Catenary

The two PM bay tracks inside the main building are fitted with swing arm catenary. Swing arm catenary is installed on a pivoting arm that enables the catenary to shift between an extended and retracted position. In the extended position, the catenary wire contacts the train's pantograph. In the retracted position, the catenary wire is de-energized via catenary sectionalization and moved to an offset position to safely allow staff access to the carbody rooftop and to enable overhead crane access. Safety interlock and disconnect switches prevent the swing arm catenary from moving unless the catenary has been de-energized.

A swing arm catenary enables a train to enter the main building under its own power and eliminates the need to tow or push the train in with a locomotive or Unimog. This saves time and is an important consideration since the UP Express fleet will be used intensively. **Figure 4-14** shows a Unimog towing concrete ties for a new mainline construction in the Netherlands and a Unimog towing tank cars within a railroad yard.

Figure 4-14 Unimog Towing 1) Concrete Ties & 2) Tank Cars

Swing arm catenary is not proposed for the heavy maintenance track inside the main building due to longer duration repair activities and the greater use of the overhead crane on that track. For the heavy maintenance track, trainsets or individual railcars will need to be towed or pushed inside using a locomotive or Unimog.

A swing arm catenary on the wheel truing track is optional and reflects shop maintenance preference. If a swing arm catenary is not provided, trainsets or individual railcars will need to be towed or pushed inside using a locomotive or Unimog. If a swing arm catenary is installed over the wheel truing track, safety interlockings and disconnect switches between the wheel truing machine and the OCS will be required.

4.10 SCADA & Communications Systems

The communication systems within the Maintenance Facility includes, but is not limited to, a public address (PA), two closed circuit televisions (CCTV), two-way intercom, voice and data network (phone, Internet, intranet, maintenance management information system (MMIS), site access control and security alarms. The SCADA system (Supervisory Control and Data Acquisition) refers to the traction electrification SCADA components that control the traction power within the Maintenance Facility.

4.10.1 Public Address (PA) System

The public address (PA) system will provide broadcast voice announcements throughout interior of the facilities. The PA system will not broadcast externally into the yard, except for emergencies. Staff working in the yard will communicate using handheld devices such as two-way radios. The PA system will be an Internet Provider (IP)-based network to allow paging through the local telephone system. The design of the PA system will be fully compatible with Metrolinx's existing PA system.

4.10.2 Closed Circuit Television System

The CCTV system provides real-time visual surveillance and event recording of designated areas to enhance the security control. The CCTV system is an IP network which allows both local and remote control options, and monitoring and recording from multiple locations based on Metrolinx requirements. The areas for the CCTV coverage will include, but are not limited to: yard areas, electrical substations, building perimeters, building entrances, yard perimeters, and yard perimeter access/egress points. CCTV coverage is recommended for areas with high value/high criticality assets, which will be determined by Metrolinx during a future design stage.

4.10.3 Two-Way Intercom System

The two-way intercom system provides an internal method of communication other than the telephone system between various locations within the facility. The intercom system has the capability to connect to an external telephone line with access control for different locations and users.

4.10.4 Voice & Data Network

The voice and data network will provide an internet provider (IP)-based communication network throughout the Maintenance Facility, including VOIP telephone server systems and private branch exchange (PBX) equipment, Metrolinx corporate intranet servers and communication equipment, and

other corporate system equipment.

Metrolinx corporate wi-fi access points will be provided at various administrative locations and shop floor locations (eg: PM bays and the heavy maintenance repair areas). The data network is an integral part of the MMIS that will have terminals located at different points within the Maintenance Facility, such as in the administrative and shop floor areas. This permits car maintainers, parts room clerks, OCS maintainers, and other staff to access maintenance logs, parts inventories, online car repair manuals, etc.

4.10.5 Master Clock System

A master clock system will be provided throughout the Maintenance Facility, compatible with the existing Metrolinx/GO Transit network master clock. It will be installed in the working areas including offices, maintenance bays and equipment rooms. The master clock is a network-based GPS clock system.

4.10.6 Access Control & Security System

The access control and security system will be provided for all Maintenance Facility buildings and facilities. This system includes, but is not limited to, the following functions: access control, intrusion detection, general building monitoring, fire monitoring, fire alarm, etc. Proximity card readers and keypads will be provided at building entrances, doors and other areas designated for access control.

4.10.7 SCADA System

A SCADA workstation console is provided in the Maintenance Facility and will be located within the yard dispatcher's office. This workstation is connected to the traction electrification SCADA network via a dedicated single mode fibre optical cable connected to the traction power substation control room located at 175 City View Drive, Toronto. The function of the SCADA workstation is to control the traction power supply system within the Maintenance Facility to support maintenance activities.

This workstation has the capability to energize and de-energize the traction power for different tracks within the Maintenance Facility accordingly based on the sectionalizing plan. This functionality is needed, for instance, after trainsets enter the PM bays and prior to retracting the swing arm catenary over the PM bays to permit railcar rooftop level maintenance work to begin. Examples of rooftop repair work include pantograph servicing and repairs or swap out of modular rooftop air conditioning units.

4.11 Security

4.11.1 Approach

Security consists of a multi-pronged approach –

- Prevention
- Recognition
- Monitoring and detection
- Response.

The Maintenance Facility will operate 24 hours a day, seven days a week, and staffing levels will vary by time of day. Likewise, the number of visitors, vendors and contractors will vary by time of day and day of the week.

Prevention entails reducing the opportunities to trespass or intrude upon the site or into the buildings. Site perimeter control is the first line of defense to prevent intrusion onto the site. Securing access to buildings and sensitive areas such as hazmat storage within the site is another type of prevention. All building entrances will have a form of controlled access.

Recognition allows known employees, authorized vendors or contractors to enter the Maintenance Facility. This is controlled through electronic key card access that is revocable if a specific individual is no longer granted access or employed at the Maintenance Facility.

Monitoring and detection is accomplished through actively-monitored CCTV cameras (as opposed to incident recording CCTV, which is unmonitored), intrusion alarms, motion sensors and other technology to be specified during later stages of design. A network of CCTV cameras will monitor the property and all buildings and provide event recording for future playback.

Staff inside the security booth located adjacent to the entrance gate will be responsible primarily for monitoring and detecting. Monitoring can be delegated to other staff as needed, such as the Operations Control Centre (OCC) staff. Monitoring also consists of roving and performing random security patrols throughout the site.

Response to security incidents or on-site assistance requests will be provided by security staff and, per Metrolinx guidelines, by outside parties such as fire and police personnel.

4.11.2 Perimeter Control

A wall or fence will provide site perimeter control along the west, north and east ends of the site. This is needed to provide site security, prevent people and animals from wandering onto the site and screen portions of the Maintenance Facility from public view.

The wall or fence will define the west end of the site, which abuts a public roadway. On the east end of the site, the wall or fence will abut other commercial uses. The south end of the site will have a safety fence to denote the limits of the site and prevent staff from inadvertently venturing onto the mainline tracks. At the north end of the site, the wall or fence is proposed to serve as a demarcation between the parking lot and the secure areas of the Maintenance Facility. Placing the parking area outside of the secure area is consistent with existing conditions at Willowbrook and with the proposed configuration of the East Rail Maintenance Facility (ERMF). This configuration limits entry for pedestrians, delivery trucks and those in official Metrolinx vehicles. Preventing employee and visitor vehicles from driving into the secure area also helps curtail theft.

To control site access beyond the employee parking lot, all staff, vendors, contractors and visitors must pass through an entrance gate monitored by the adjacent security booth. The security booth is a freestanding structure fitted with CCTV with event recording, alarm monitoring, security radio communications, and the ability to open/close security gates. The entrance gate can be opened by a key card issued to employees if the security booth is unattended.

4.12 Train Control System

4.12.1 Signalling

The signalling system is intended to safely control the movements of trains in a manner that is efficient to railroad and yard operations. Efficient operations are critical due to the limited maintenance windows available for the UP Express fleet.

The overall safety of the train control system within the yard is train collision avoidance and personnel protection. This is achieved by adhering to *Canadian Rail Operating Rules (CROR) 105*, whereby trains operate at reduced speed. At any moment, train engineers must be able to stop the train within half of the distance of their line of sight.

The purpose of the signaling system and yard automation is to remotely control the switches and set routes from the yard control centre located on the second floor of the main building. The aim is to improve operational efficiency and to minimize human intervention as much as possible.

A non-vital signaling system is the recommended choice. It includes a workstation located inside the yard control room. This workstation has graphic/visual representation of the yard track layout and can remotely monitor and control the yard switches and equipment.

As part of normal yard operation, the yardmaster can –

- Throw a powered switch to normal and reverse positions
- Monitor the current status of powered switches
- Block out a powered switch
- Monitor train movement throughout the yard
- Set routes
- Activate the blue flag protection for main building tracks and monitor the status of derails and blue flag indicators
- Monitor and control the switch heaters.

From the yard control room, the yard master can set a route by selecting the entry and exit points into and out of the yard. Once a route is set and executed, the associated switches along the route will be moved to the appropriate position and reserved until the route is 'consumed' by a train occupying and releasing the axle counter block associated with every reserved switch along that route. Another method of releasing a set route is by using the 'route cancelling' option.

'Route queuing' is another feature that contributes to the efficiency of yard operation. The yard master can request a number of conflicting routes, which will be queued and executed once the conflicting conditions are removed (ie: when all switches along a particular route are available to be set in the appropriate position and none of the route segments are blocked by blue flag protection).

In the event of a communication failure between the control centre and site I/O controllers or if the yard master is not present, the powered switches can be hand-thrown locally using push buttons or manual levers.

Every powered switch is equipped with axle counters to detect trains and prevent switch activation when a train is located on top of the switch. There are also bidirectional Switch Position Indicators (SPI), which are driven by switch status. Green corresponds to the switch set in 'normal' position, yellow corresponds to the 'reverse' position, and red represents 'out of correspondence'.

Switches connecting the lead tracks to the mainline (and their associated heaters) are controlled and monitored as part of mainline interlocking locations similar to other GO Transit maintenance facilities and storage yards, including the Willowbrook Maintenance Facility.

The yard signaling system, however, monitors the status of the entry/exit signals to the yard. This is mainly to inform the yardmaster when a 'proceed' signal to the yard is set to route a train into the lead track from the mainline. The yardmaster will also have the train identification and railcar maintenance history through the automatic train location system, ATLS, which requests a route to lead the train to the proper destination to be stored, maintained, etc. A destination display installed at the end of the lead tracks will show the set destination to the train engineer.

4.12.2 Blue Flag System

To provide a high level of worker safety, the blue flag personnel protection procedure will be automated as a part of the signaling system (vs the manually-operated procedure in use at Willowbrook). This system is intended to protect staff working on the storage tracks as well as on the tracks within the main building. This protection is achieved through automatic derails combined with blue flags and lights.

Electronic shop boards are located at both ends of all shop tracks within the main building and on both storage tracks. Blue flag personnel protection can be activated from either the yard control room or via the electronic boards when access to those tracks is required for maintenance purposes. This is achieved by ensuring that no train is approaching and that any existing train on the corresponding track is idle. Maintenance personnel will log on to the system before being provided access to the protected track. As long as someone is logged in to the system, and there is an indication that workers are present, safety protocol will not permit the removal of blue flag protection.

The electronic shop boards will provide some means of logging individuals into the system (by personal electronic keys or equivalent) before they can have access to the track. To remove the protection mode, all workers who are logged in will need to log out. A maintenance supervisor will then be able to remove the protection mode to permit train movement. This will be accomplished by the electronic shop board or by communication with the yard master at the yard control room.

The status of the main building and storage tracks are depicted on the electronic shop board displays in conformance with CROR requirements and are consistent with the blue flag protection procedures at other GO facilities –

- Red, indicating 'train movement is in progress' and trains may be in motion and no employee access is allowed
- Green, indicating 'train is dispatch ready' and a train is in place, ready to move at any time and employee access is allowed
- White, indicating 'blue flag protection' can be applied.

Each track crossing within the main building will also be equipped with a red and blue signal light to continuously display the track status. A flashing blue indicates that blue flag personnel protection is in place, and that track may be crossed. A flashing red indicates a train movement is in progress, and crossing the track is prohibited.

4.12.3 Other Safety Measures

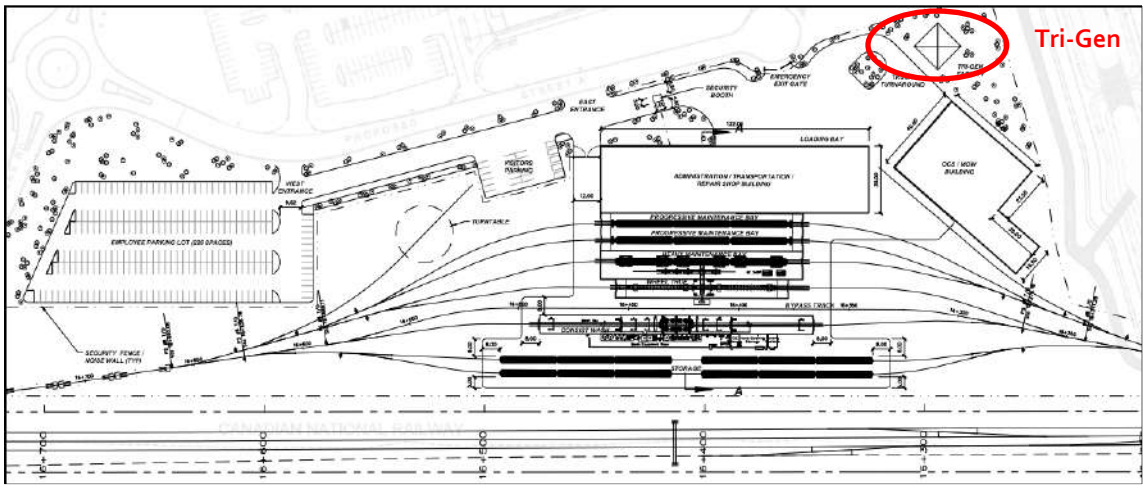
In addition to the blue flag system, safety measures include the following –

- Sectionalization will permit selective shut off of shop and yard OCS for train maintenance purposes
- The swing arm catenary moves the de-energized OCS away to permit safe EMU rooftop working
- There is no catenary over the component change out track
- Safety interlocks and gates prevent access to rooftop platforms when OCS is energized
- Safety shut off switch distributed to allow OCS power to be cut.

4.13 Tri-Generation Facility

The Maintenance Facility will have a tri-generation facility (**Figure 4-15**). This facility will use a natural gas engine to provide enhanced power reliability and to reduce energy consumption. The tri-generation facility is expected to be sized for 100% demand load at the main building, OCS/WEM building, train washer and other ancillary yard buildings, excluding the provision of traction power.

Figure 4-15 Tri-Generation Facility



The tri-gen unit is proposed to run at all times (except during periods of maintenance) as the preferred power source to reduce overall energy cost by using natural gas instead of electricity. During periods of maintenance, or as necessary, the power supply will be drawn from the utility power supply.

The tri-generation facility is located in the northeast corner of the site. This location was selected so as to place the facility as far as possible from the residential areas. The northeast location also places the tri-gen facility outside but nearby the main and OCS/WEM buildings and is accessible to delivery and service trucks that will be needed to service the tri-generation facility.

APPENDIX A – ABBREVIATIONS & ACRONYMS

ac	Alternating Current	mm	millimetres
AODA	Accessibility for Ontarians with Disabilities Act	MMIS	Maintenance Management Information System
AREMA	American Railway Engineering and Maintenance-of-Way Association	MOW	Maintenance of Way
CCO	Component Change Out	mph	miles per hour
CROR	Canadian Railroad Operating Rules	Mx	Metrolinx
CCTV	Closed Circuit Television	OBC	Ontario Building Code
dc	Direct Current	OCC	Operations Control Centre
DMU	Diesel Multiple Unit railcar	OCS	Overhead Contact System
EA	Environmental Assessment	OESC	Ontario Electrical Safety Code
EMC	Electromagnetic Compatibility	OHSA	Occupational Health and Safety Act
EMI	Electromagnetic Interference	O&M	Operations and Maintenance
EMU	Electric Multiple Unit railcar	PA	Public Announcement
EPS	Electrification Performance Specification	PBX	Private Branch Exchange
GO	GO Transit	SCADA	Supervisory Control And Data Acquisition
Hz	Hertz	TES	Traction Electrification System
IP	Internet provider	TPS	Traction Power Substation
km/h	kilometres per hour	SWS	Switching Station
kV	kilovolt	VOIP	Voice over internet protocol
m	metres		

APPENDIX B – DEFINITIONS

Blue Flag Personnel Protection
Both a physical warning device and a specific set of procedures to ensure that trains are not moved while maintenance staff is working under, on, atop or near the train.

Canadian Railroad Operating Rules (CROR)
The set of operating rules used for all Canadian railroads. These rules provide the basis for all railway operations in Canada.

Catenary
An Overhead Contact System (OCS) consisting of two or more conductors, hangers and in-span hardware, including supports.

Component Change Out (CCO)
A form of heavy maintenance work whereby on-railcar components are switched out with other replaceable units, which are then repaired off-railcar.

Consist
Another word used to describe a trainset. Refers to one or more railcars assembled into a train.

Contact Wire
An overhead wire with which the railcar or locomotive pantograph or other current collector is designed to make contact.

Contact Wire Height
Height of the underside of the contact wire above a road or top-of-rail level when not uplifted by the pantograph.

Deadhead
A non-revenue service train movement whereby no passengers are carried. Used to position trains before or after revenue service or in event of train malfunctions.

Electrical Section
The section of the Overhead Contact System (OCS), which, during normal system operation, is powered from a Traction Power Substation (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 switching station (SWS) or line end.

Environmental Assessment
A process to predict the environmental effects of a proposed initiative before it is implemented.

Hi-rail Vehicle
Rubber tired vehicles that are fitted with flanged, steel wheels to permit operation over railroad tracks. Sometimes spelled Hy-Rail.

Maintenance of Way (MOW)
Activities related to maintaining the railroad tracks and structures.

Operations Control Centre (OCC)
A facility for supervision and control of the railroad. The design should be for an integrated multimodal operation, containing dispatch control functions, SCADA, Passenger Information Systems and a communication function.

Spare Ratio
The ratio of railcars in the fleet that is available for revenue service versus those that are not available for revenue service due to planned or unplanned maintenance or other operational reasons.

Supervisory Control and Data Acquisition (SCADA)
The Central Control Centre may contain one or more SCADA Systems. General practice is to use different SCADA systems for different purposes. Most common facilities have one for signals and one for traction power, both normally located in separate rooms or operating theatres, although both could be in the same theatre.

Swing Arm Catenary
Used inside shop buildings, swing arm catenary is installed on a pivoting arm that enables the catenary to shift between an extended and retracted position. In the extended position, the catenary wire allows contact with the pantograph. In the retracted position, the catenary wire is de-engergized, moved to an offset position to safely allow staff access to the carbody rooftop and to allow overhead crane access.

Traction Electrification System (TES)
The system that converts utility power to levels required by the rail vehicles and distributes this power for use by the vehicles.

Traction Power Substation (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 switching station (SWS) or line end. An electrical section may be subdivided into smaller elementary electrical sections.

Truck
A pivotable assembly of two or more axles upon which a railcar rides.

Turntable
A device used to rotate individual railcars, either to access other yard tracks or to reposition the direction of the railcar.

Unimog
A rubber tired, tractor-like vehicle that can operate over rails and is used to tow or push railcars over non-electrified yard tracks.

Work Car (also Rail-bound Work Car)
A steel-wheeled railcar that is used to maintain the MOW or Overhead Contact System (OCS). A work car does not carry passengers.

Yard Lead or Yard Lead Track(s)
The track(s) connecting the yard to the mainline tracks.

APPENDIX C – REFERENCE DOCUMENTS & STANDARDS

Metrolinx documents that relate directly to the subject of maintenance facilities are listed in the Reference Documents table below.

Reference Documents

Document Title	Date of Issue	Issuer
2010 GO Electrification Study – Final Report including Appendices	December 2010	Delcan Arup JV
GO Transit Rail Equipment Maintenance Capacity Strategy	April 2012	Metrolinx
Electronic Performance Specification (EPS)-02000 Traction Power Distribution System	October 2012	Parsons Brinckerhoff
EPS-03000 Grounding and Bonding	October 2012	Parsons Brinckerhoff
EPS-04000 Electromagnetic Compatibility and Interference	October 2012	Parsons Brinckerhoff
EPS-06000 Operation and Maintenance	October 2012	Parsons Brinckerhoff
EPS-08000 Rail System Requirement SCADA System	October 2012	Parsons Brinckerhoff

Standards

Established standards for electrified railways and maintenance facilities are listed below –

- American Railway Engineering and Maintenance-of-Way Association (AREMA)
- Ontario Occupational Health and Safety Requirements
- National Building Code of Canada
- Ontario Building Code (OBC) and Supplementary Standards (SB) as applicable, supplemented by local municipal code amendments
- Ontario Electrical Safety Code (OESC)
- CAN/CSA-C22.3 No.1- 06 Overhead Systems
- Ontario Occupational Health and Safety Act (OHSA) and Regulations Requirements
- Accessibility for Ontarians with Disabilities Act – AODA, 2009
- Accessibility Design Guidelines, City of Toronto, 2004
- Toronto Green Roof Bylaw.

APPENDIX D – MAINTENANCE PHILOSOPHY

When planning a Maintenance Facility, it is important to develop the maintenance philosophy first, and then develop the Maintenance Facility around that philosophy. This helps ensure that the Maintenance Facility will serve Metrolinx, not just for the near term, but well into the future.

The Maintenance Facility will support Metrolinx's rolling stock maintenance philosophy, the key objectives of which are –

- **Safety First** Provide safe and reliable rolling stock and equipment for customers and staff.
- **Safety of the Maintained Assets (Railway Safety)** Sustain a standard of car and fleet safety through quality inspection, preventive maintenance and specified parts and material replacement and repair.
- **Safety of the Maintenance Environment (Occupational Health & Safety)** Provide a sustainable, safe and healthy work environment that promotes a positive and enduring work culture.
- **Availability and Reliability of the Maintained Assets** Deliver a rolling stock fleet on a daily basis that achieves or exceeds specified availability and reliability standards.
- **Quality of Maintenance** Achieve quality workmanship and excellence in maintenance by complying with industry and manufacturer standards.
- **Passenger Satisfaction** Define and achieve quality customer service such that it evokes positive customer satisfaction.
- **Cost Effectiveness** Define and maintain a cost-effective management approach through measurable fleet maintenance methods in purchasing, contracting and scheduling functions.

The concept of preventative maintenance is embodied in the above approach. The goal is to replace components or parts before they fail in service, or at the first repair point after a failure is identified, to reduce UP Express trainset downtime. The Maintenance Facility will support such a preventative maintenance program.

To accomplish this, there are several maintenance levels of corresponding complexity. In general, the more complex the maintenance level, the less frequency of occurrence. These levels are as follows –

- **Daily Inspections** Daily inspections are visual inspections to identify any obvious defect or damage to equipment prior to trainsets entering revenue service. These inspections can be done on a yard storage track and usually take less than an hour per UP Express trainset to complete.
- **Light Repairs** This involves quick, small-scale repairs, such as replacing light bulbs, seat cushions, windows and other small parts. These repairs can be performed when the trainset is parked anywhere at the Maintenance Facility and do not require special facilities, although it is highly

desirable to have paved, trackside driveways on either side of the train to allow maintenance vehicles to pull up alongside the railcar.

- **Progressive Maintenance (PM) Inspections** These are more detailed inspections that can occur on weekly cycles. This type of inspection requires bringing each UP Express trainset to a PM bay inside the maintenance shop.

- **Heavy Scheduled Maintenance Inspections** Heavy inspections can take up to several days inside the repair shop and require special facilities such as overhead cranes, drop tables and pits. These activities involve truck rebuilds, air brake system replacement, and the like.

- **Major Repairs** Major repairs include those resulting from accidents or major equipment failures, such as traction motor repairs.

- **Overhauls/Refurbishment** EMU railcar overhauls/refurbishments are performed off-site and contracted out, per Metrolinx policy applying to the push-pull railcar fleet. These occur at an 18-year interval (mid-life) and involve a complete tear-down and remanufacture of the railcar.

Major repairs and overhauls/refurbishments are intended to return the railcar to a 'like new' condition, and may include renewal of wiring and electrical systems and replacement/upgrade of all interior furnishings and fixtures. This work requires special workshops. Because of the specialized nature of this work, in addition to the relative infrequency of occurrence, this type of work is not within the Maintenance Facility's capability.

UP Express trains will start service each day at approximately 5:00 a.m. and run in service continuously until 1:30 a.m. the next day. The trains will operate every 15 minutes in each direction, requiring five of the seven trainsets to be in revenue service. This leaves two remaining trainsets as spares to be used for either standby service (to substitute for another train in case of train malfunction), or for scheduled maintenance. All seven trainsets will be rotated in the equipment cycle so that all UP Express trainsets can undergo scheduled preventative maintenance.

As the UP Express trainsets will be working very hard and time is tight to conduct daily maintenance, the Maintenance Facility is designed to enable efficient maintenance of the EMU fleet within short maintenance windows