

GO Design Requirements Manual

GO-DRM-STD-2017-Rev5

September 2023

Superseded

METROLINX

GO Design Requirements Manual

GO-DRM-STD-2017-Rev5

Publication Date: April 2016

Revision Dates: February 2017, March 2019, February 2020, September 2021, September 2023

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Preface

This is the 35th edition of the GO Design Requirements Manual (also referred to as the DRM) and supersedes all previous editions.

This edition has been updated to include approved Bulletins FEA-010 Generator Fuel Storage Requirements, Bulletin FEA-011 Propane Tank Design and Sizing, Bulletin FEA-012 Major Mechanical Updates to GO DRM, Bulletin FEA-013 Minor Communications Updates to GO DRM, Bulletin FEA-014 Major Electrical Updates, Bulletin FEA-015 Mechanical Updates, and recently approved Bulletin FEA-016 DRM Civil/Site Updates. This edition also incorporates the Site/Civil, Electrical, and Mechanical components from STS-001.

The DRM is a set of standard technical requirements for engineering and design consultants and internal Metrolinx staff. The DRM consists of requirements and technical details for the infrastructure requirements to design and build GO stations, terminals, and facilities. The requirements may exceed industry regulations and codes. The DRM is part of a suite of publications that inform the design and construction of Metrolinx capital assets. It is applicable to new construction and retrofit capital infrastructure programs. The DRM is available for external users to download via the Metrolinx public download site at http://www.gosite.ca/engineering_public/.

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1 Scope

1.1 Overview

1.1.1 GO Transit is an inter-regional public transit system in Southern Ontario who primarily serves the GTHA, with operations extending to several communities in the Greater Golden Horseshoe. GO Transit operates commuter rail and coach bus services that connect with other regional transit providers such as VIA Rail Canada, the Toronto Transit Commission (TTC), and local municipal bus services.

1.1.2 This GO Design Requirements Manual (DRM) is a document that, along with Metrolinx Design Standards, outlines the standard requirements and technical details to design and build GO stations, terminals, and facilities.

1.1.3 This Manual balances and harmonizes corporate objectives, stakeholder requirements, and industry best practice by defining a performance-based set of standard technical requirements used as detailed instructions for designers and users.

1.2 Ownership

1.2.1 GO Transit owns this Manual, in both printed and/or digital form, and will keep a record of issuance, and forward amendments to all consultants, designers, and contractors registered with us as Manual Holders.

1.2.2 Manual Holders may reproduce the contents of this DRM for use as required during a project assignment from GO Transit, and is responsible to ensure that the most recent version, and all its requirements, is used at the time the assigned project.

2 Abbreviations, codes, and regulations

2.1 Abbreviations

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2.1.1 The abbreviations used in this standard shall have the meaning prescribed in Table 1.

Table 1. List of Abbreviations

Abbreviation	Definition
AC	Alternating Current
AED	Automated External Defibrillators
AFF	Above Finished Floor
ANSI	American National Standards Institute
AODA	Accessibility for Ontarians with Disabilities Act
APTA	American Public Transportation Association
AREMA	American Railway Engineering and Maintenance of Way Association
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ATR	Above top of rail
ATS	Automatic Transfer Switch
AVL	Automatic Vehicle Location
AVM	Add Value Machine
AWG	American wire gauge
BAS	Building Automation System
CC	Concentrator Complex
CCTV	Closed-circuit television
CEC	Canadian Electrical Code
CGSB	Canadian General Standards Board
CGVD	Canadian Geodetic Vertical Datum
CISPR	International Special Committee on Radio Interference
CL	Centre Line

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CN	Canadian National
CNIB	Canadian National Institute for the Blind
CP	Canadian Pacific
CPTED	Crime Prevention Through Environmental Design
CPU	Central processor unit
CRI	Colour Rendering Index
CSA	Canadian Standard Association
CSRS	Canadian Spatial Reference System
CT	Current Transformers
UL/cUL	Canadian Underwriters Laboratories
DC	Direct Current
DGZ	Dedicated Ground Zone
DHW	Domestic Hot Water
DRM	Design Requirements Manual
DTMF	Dual tone multi-frequency
DWA	Designated Waiting Area
EEMAC	Electrical Equipment Manufacturers Association of Canada
EIA	Electronic Industries Alliance
EMT	Electrical Metallic Tubing
EPA	Environmental Protection Agency
ERV	Energy recovery ventilators
ESA	Electrical Safety Authority
EV	Electrical Vehicle
FCC	Federal Communications Commission

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FLC	Fuzzy Logic Control
FTA	Federal Transit Administration
GFI	Ground Fault Circuit Interrupters
GTHA	Greater Toronto Hamilton Area
HCR	Handheld Card Reader
HM	Hollow Metal
HOV	High occupancy vehicle
HP	Horse Power
HVAC	Heating, ventilation and air conditioning
IAQ	Indoor Air Quality
IEC	International Electrotechnical Commission
IEEE	The Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IESNA	Illuminating Engineering Society of North America
IGBT	Insulated Gate Bipolar Transistors
IR	Infrared Radiation
IT	Information Technology
LED	Light-emitting diode
LEED	Leadership in Energy and Environmental Design
LRT	Light Rail Transit
LV	Low voltage
MCC	Motor Control Centres
MIL STD	Military Standard
MOE	Ministry of the Environment

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MRL	Machine-Room-Less
MTM	Modified Transverse Mercator
MTO	Ministry of Transportation
MUP	Multi-Use Path
NAD	North American Datum
NEMA	National Electrical Manufacturer Association
NFPA	National Fire Protection Association
NPT	National Pipe Thread
NRC	National Research Council
OBC	Ontario Building Code
OESC	Ontario Electrical Safety Code
OHSA	Occupational Health and Safety Act
OPSD	Ontario Provincial Standard Drawing
PA	Public Address
PA	Public Address System
PCB Card	Printed circuit board card
PDF	Photometric Digital File
PIR	Passive Infrared Radiation
PLC	Programmable Logic Controller
PoE	Power over Ethernet
Project Co.	Project Consortium (a company/ entity that enters into a Project Agreement with Metrolinx)
PUDO	Passenger Pick up and Drop off
PSR	Pre-Start Health and Safety Reviews
PT	Potential Transformers

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PTZ	Pan Tilt Zoom
PUC	Public Utilities Commission
PVC	Permanent Virtual Circuit
PWM	Pulse width modulation
RGS	Rigid galvanized steel
ROW	Right of way
RSA	Railway Safety Act
RFI	Radio Frequency Interference
SCADA	Supervisory control and data acquisition
SCC	Station Control Computer
SCR	Silicon Control Rectifiers
SFTP	Station Fare Transaction Processor
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SOV	Single occupant vehicle
SPD	Surge Protective Devices
SPOS	Station Point of Sale
STC	Sound Transmission Class
TC	Tangent-Curve
TCP/IP	Transmission Control Protocol/Internet Protocol
T/O	Top of
TOD	Transit Oriented Development
TSSA	Technical Standards and Safety Authority
TTC	Toronto Transit Commission
TVM	Ticket Vending Machine

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TVSS	Transient Voltage Surge Suppression
TWSI	Tactile Walking Surface Indicator
ULC	Underwriters Laboratories of Canada
UPE	Union Pearson Express
UPS	Uninterruptible Power Systems
U/S	Underside
USB	Universal Serial Bus
VCP	Visual Comfort Probability
VOC	Volatile Organic Compound
VT	Voltage Transformer
WAP	Wireless Access Points
WC	Water Closet
WMA	Wheeled Mobility Aids

2.2 How to use the DRM

2.2.1 The DRM is the starting point of infrastructure technical requirements for GO Stations, Terminals, and Facilities.

2.2.2 It has requirements that are performance based and may exceed industry regulations and codes.

2.2.3 The DRM does not absolve the designer of record from current regulations and codes or professional duty of care.

2.2.4 Information is in the order of design development, starting with identification of program elements, site planning, and then to technical details such as electrical, mechanical, communications, etc.

2.2.5 Technical requirements are performance-based and expected to be used as the starting point for design development. The DRM is part of a suite of products that shall be used to inform the design. The suite of products also includes:

a) GO Standard Drawings and Specifications;
b) All applicable Metrolinx standards.

2.3 Codes and Regulations

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2.3.1 It is required that consultants design in accordance with current version of all applicable standards, regulations, and codes to the approval of all authorities having jurisdiction.

2.3.2 Where design alternatives will provide substantially equivalent or where conflicts exist between the requirements of this Manual and standards or legislation enacted by the federal or provincial governments, the most stringent requirements shall apply.

2.3.3 Consultants for specific projects shall define codes as applicable and list them in the contract tender documents.

2.3.4 Other codes and regulations, imperative to the business that must be adhered to include but not limited to:

a) Ontario Building Code (OBC);
b) Accessibility for Ontarians with Disabilities Act (AODA;
c) Railway Safety Act (RSA);
d) Transport Canada Grade Crossing Regulations;
e) Canadian Road/Railway Grade Crossing Detailed Safety Assessment Field Guide;
f) Transport Canada RTD-10 Technical Standards Manual; RTD-10 will govern requirements for active warning system;
g) AREMA (American Railway Engineering and Maintenance of Way Association) Communications and Signals Manual;
h) Existing Railway Corridors Standard and Specifications for Crossing Warning Systems;
i) Manual of Uniform Traffic Control Devices for Canada;
j) Ontario Provincial Standards

2.4 Drawing Standards

2.4.1 For Drawing Standards, refer to the CADD/ BIM Standards Manual located on MyLinx and the Metrolinx external website in the GO Standard Drawings and Specifications tab: http://www.gosite.ca/engineering_public/ .

2.4.2 All project specifications to be developed in the current edition of National Master Specification (NMS)'s MasterFormat™.

2.5 Document Amendment Record

2.5.1 The Amendment Record identifies revisions, by subject category and date. Consultants, designers, and contractors shall use the Amendment Record to ensure they are working from the latest version. An e-mail notification is issued whenever a revision/addition has been made to the Design Requirements Manual. The revision/addition is noted on the Amendment Record and immediately posted on our intranet and external website by the Standards team https://assets.metrolinx.com/image/upload/Documents/Engineering/Amendment_Record-_Stations_and_Facilities.pdf.

2.6 Corporate Policies

2.6.1 Implement corporate policies that support green operations throughout the life of the facility, such as Green Cleaning, Solid Waste Management, and Green Education, and select LEED

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credits for certification.

2.6.2 As the industry evolves and new certifications become relevant to GO, they too can be explored, upon approval from Metrolinx.

2.6.3 All buildings, terminals, and facilities are to achieve LEED certification, refer to appendix A. Specifically, select credits have been identified to ensure that only LEED credits that bring value to GO Transit's goals of energy efficiency and reduced operating and maintenance costs are targeted.

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3 Site Program

3.1 Site Planning and Organization

3.1.1 In developing a site layout, safety of the users or passengers shall be the prime consideration followed by convenience.

3.1.2 The overall layout shall respect any existing natural assets of the site, and complement the form of adjacent community. It should allow for emergency, service, parking and maintenance access.

3.1.3 Projects with multiple phases require the submission of phasing plans that identify all current and future site layout developments.

3.1.4 Station site planning consists of a system of components that support the GO transit service. Key principles in planning and organizing GO sites include:

a) Separate modes of travel;
b) Connectivity to community pathways, walkways and transit;
c) Plan for future/flexibility;
d) Intuitive wayfinding to major elements;
e) Maximization of barrier free routes;
f) Use of sustainable materials and technologies;
g) Integration with local communities and municipalities;
h) Complete separation between vehicular and pedestrian traffic.

3.1.5 Site Components consist of:

a) Site access;
b) Station building(s) and Ancillary building(s);
c) Platform(s) access (including pedestrian tunnels, bridges, stairs, ramps, and elevators);
d) Rail Platform(s) including mini-platforms;
e) Bus Loop(s) and Platform(s);
f) Passenger Pick-up and Drop-Off (PUDO);
g) Surface Parking (Accessible, Vehicular, Bicycle) and Parking Structures;
h) Pedestrians Walkways;
i) Bicycle Access and/or Multi-Use Paths; and
j) Landscaping.

3.1.6 Requirements for specific elements of each component within GO facilities in Site Program section are found in both the DRM and the Metrolinx Design Standards.

3.1.7 Where a requirement contained in Site Program section conflicts with a requirement in another Metrolinx design standard, the more conservative requirement shall apply.

3.1.8 Drawings within the Site Program section in the DRM are Not to Scale

3.1.9 Sites shall be designed to promote convenient and efficient transfer of users and passengers between various modes of transportation by prioritizing site access as follows:

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a) Pedestrians and cyclists;
b) Public Transit;
c) Passenger Drop off and Pick-up Area; and
d) Parked private vehicles.

3.1.10 Multiple access points should be implemented to facilitate access and egress, in particular pedestrian/cyclist only entry ways to connect from adjacent communities or trails.

3.1.11 Site Vehicular Access

3.1.11.1 Provide a complete system of vehicular roads and access points that promotes efficient circulation and maintains fluid access and egress to and from local streets.

3.1.11.2 Maximize the number of vehicular access points, in particular egress lanes, to mitigate traffic congestion. Design of vehicular access roads shall passively encourage speed reduction.

3.1.11.3 Provisions shall be made for access by emergency vehicles, particularly to the station building. Layout and widths of main access roadways shall allow for emergency vehicles, including buses to pass in the event of a stalled vehicle. Designated fire access route shall meet OBC and local fire department requirements.

3.1.11.4 Vehicular connection between the bus loop and the surface parking lot or Parking garage shall not be provided.

3.1.12 Pedestrian Connections

3.1.12.1 Pedestrian circulation must be designed to allow pedestrians to intuitively move from place to place within the property without confusion. Pedestrian routings shall not be made through internal bus loops.

3.1.12.2 Dedicated and continuous pedestrians routes shall be separated from vehicular traffic.

3.1.12.3 GO site components shall be connected to adjacent site properties as required (For example: Pedestrians connections within the GO site and public sidewalk).

3.1.12.4 The pedestrian circulation patterns shall minimize walking distance but not compromise safety.

3.1.12.5 The pedestrian route shall not be located where it would require people to pass behind vehicles that may be backing out.

3.1.12.6 Provisions shall be made to prevent potential conflicts between pedestrians & bikeways and where walkways intersect with bikeways, the design of the intersection shall prioritize pedestrians. Refer to Metrolinx Design Standards for further details.

3.1.12.7 Walkways requirements are as follows:

a) Walkways shall meet the Ontario provincial standards and specification. OPSD/OPSS shall be referenced in drawings;
b) Make walkways a minimum 1800 mm wide, or as per the Metrolinx Universal Design Standard;
c) When a pedestrian entrance is provided from a recreational trail, provide a clear opening of at least 1200 mm to allow the passage of wheeled mobility aids (as per the Metrolinx Universal Design Standard), whether the entrance includes a gate, bollard, or other

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barrier;

d) Walkways shall be raised from adjacent vehicular surfaces and constructed of hard materials that are slip resistant and visually distinct from surrounding areas;

e) Walkways shall be designed to accommodate for the snow removal machine weight;

f) Walkways shall be designed to facilitate drainage. Refer to Table 3: Pavement Slopes.

3.1.12.8 Delineated Crosswalks requirements are as follows:

a) Crosswalks shall be installed in conjunction with signs and provide guidance for pedestrians and alert road users of a designated pedestrian crossing point by defining and delineating paths with crosswalk markings;

b) Crosswalks shall be equipped with curb ramps;

c) Crosswalks shall line up with proposed or existing curb ramps and sidewalks;

d) Tactile attention indicators and curb ramp width shall match that of the crosswalk;

e) Crosswalks shall not cross over the centre median where the median is not equipped with curb ramps or at-grade depressions;

f) Crosswalks shall be as short as possible without compromising other design factors;

g) Crosswalks shall be laid out such that pedestrians (specifically a person with a mobility device) are not forced outside of the lines of the crosswalk due to the angle of the curb ramps;

h) Stop Controlled (Non-signalized) crosswalk width shall be 2100mm (or 2500mm if cyclists are also expected to use the crossing);

i) Signalized crosswalk width shall be 3000mm (or 4000mm if cyclists are also expected to use the crossing);

j) At high potential incident areas and crossings, raised crosswalk shall be used to provide emphasis on pedestrian crossing and to reduce vehicles speed;

k) If the minimum width stated in the DRM does not satisfy pedestrian flow modeling, then a larger width shall be provided as recommended by the report.

l) Stop Controlled (Non-signalized) crossings shall be installed where pedestrians are required to cross vehicular roadways. Crossing specifications shall adhere to OTM Book 15 standards. Please refer to DRM Section 3.2 Bus Infrastructure for details related to bus-only roadways.

3.1.13 Curbs

a) Curb and gutter shall meet the Ontario provincial standards and specification. OPSD/OPSS shall be referenced in drawings;

b) Curbs shall have chamfered edges to reduce risk of damage;

c) Curb ramps shall be provided for pedestrian crossings, the curb ramps must align with the direction of travel and shall have a minimum clear width of 1600 mm, exclusive of any flared sides.

d) Raised non-mountable curbs shall be restricted to the perimeter of parking, site access/egress routes, bus loop platforms, and pedestrian walk areas to facilitate traffic flow.

3.1.14 Islands

3.1.14.1 The use of curbed islands shall be minimized, with line-marked islands preferred.

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3.1.14.2 Incorporate raised islands and soft landscaped buffers within large parking lots to define major vehicle and pedestrian routes and to break up large paved areas.

3.1.14.3 Raised islands between access roads and parking or the PUDO shall be a:

a) Minimum 2600 mm wide between curb faces;
b) Include a 1000 mm section for vehicle overhang;
c) Remaining width shall be used for either pedestrian circulation or landscaping.

3.1.14.4 Islands connecting to a pedestrian crosswalk shall have all components (e.g., curb ramps, blended transitions, crosswalk segments) in a single continuous lateral alignment.

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3.2 Bus Infrastructure

3.2.1 General

3.2.1.1 The bus infrastructure standards apply to the following GO Transit bus facilities:

a) Bus Terminals;
b) Bus Loops;
c) Park & Ride and Carpool Lots.

3.2.1.2 The following two types of buses shall be used for bus infrastructure design:

a) ENVIRO 500 Super Low;
b) MCI D4500.

3.2.1.3 Bus infrastructure shall be designed to prioritize passenger safety and shall ensure separation between pedestrian and vehicular traffic.

3.2.1.4 Bus infrastructure shall be designed to support forward bus movements.

3.2.1.5 Municipalities may request that GO Transit provide relevant transit facilities within the municipal right-of-way. The design of such facilities shall adhere to all Metrolinx requirements. Design requirements can adhere to MTO and municipal requirements, but shall not supersede Metrolinx standards unless explicitly permitted.

3.2.2 Bus Loop Configuration

To best ensure safe operations, bus loop layout shall consider key elements such as site constraints, traffic flow and trip patterns. Refer to Drawings 3.1 and 3.2 for the respective layouts.

3.2.2.1 Linear bus loop configuration:

a) The linear bus loop configuration has a linear alignment across the bus loop area.
b) In a linear bus loop, buses circulate through the site in a linear direction.
c) Linear bus loop shall be designed where pedestrians are not required to cross the bus loop area.
d) The linear bus loop layout is preferred at sites:
    1) With high pedestrian activity and
    2) Separate bus egress can be provided.

3.2.2.2 Teardrop bus loop configuration:

a) The teardrop bus loop configuration has platforms on the perimeter of the bus loop where customers access the bus. The bus follows a counterclockwise route to circulate the loop.
b) The teardrop bus loop configuration shall be provided at a site with a high volume of bus service.
c) The teardrop bus loop configuration shall be designed so that it does not create a safety hazard related to pedestrians crossing the bus loop area.

3.2.2.3 Within the bus loop area, layovers are to occur only in dedicated bus bays. Any layovers occurring outside of the bus loop area shall be in close proximity to the bus loop area. Buses

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are required to circulate to the designated bus platform for passenger boarding and alighting purposes.

3.2.2.4 Layover locations shall support forward movement only and shall not require reverse movements. Consideration shall be given to the movement of buses from the layover location to the platform i.e., tight turns within the bus loop.

3.2.3 Bus Loop Area

3.2.3.1 The bus loop area is considered as the dedicated transit right-of-way within a GO Transit site.

3.2.3.2 Bus Access

a) Bus loop access and egress areas shall be segregated from general vehicle, bicycle and pedestrian modes of travel. Where segregation is not possible, enhanced features such as dedicated bus lanes and transit signal priority (TSP) shall be considered. A risk assessment shall be conducted by the designer if bus operations are compromised.

b) The section measuring 6,000 mm closest to the bus platform area entrance shall be painted solid red and include appropriate 'Do Not Enter (Buses Excepted)' signs to alert and deter non-bus vehicles from entering the area. The red pavement markings should begin downstream of the crosswalk, at the greater distance of the end of the curb radius or 500 mm from the crosswalk.

c) Dedicated bus lanes and transit signal priority shall be available at external site accesses to provide priority to bus services.

d) Bus ingress and egress shall meet all horizontal and vertical clearances necessary to accommodate the bus fleet required for the site.

e) The bus platform layout shall be designed to support layovers as required by Metrolinx.

3.2.3.3 Pedestrian Access

a) The bus platform layout shall be designed and located to allow for pedestrian flow that prohibits passengers from crossing the bus loop.

b) Bus terminal pedestrian entrances and exits shall direct pedestrians to appropriate sidewalks and crossings and discourage the crossing of the bus loop.

c) Where required, fencing shall be installed to prevent pedestrians from entering the bus driving area. The fencing should direct pedestrians to appropriate pathways, crossings and bus platforms. Fencing shall not restrict pedestrian access and pedestrian flow to required areas.

d) Where there is the potential for undesirable pedestrian crossings, 'Pedestrian Do Not Enter' stencils, 'Pedestrian Do Not Cross' signage and/or 'Danger: DO NOT CROSS' shall be installed within the bus loop and/or bus platform area to discourage unsafe pedestrian crossings. Stencils and/or signage installation is subject to specific site conditions. Refer to Metrolinx Design Standards for stencil and signage specifications.

e) Non-traversable bio-retention areas (e.g. ponds, swales, ditches) shall be incorporated in the centre of bus loops where feasible to deter pedestrian crossings and to improve drainage. Fencing shall encompass the bioswale to prevent pedestrians from entering the area and discourage crossing of the bus loop.

f) When provision of a crosswalk is deemed to be safer and practical for pedestrian traffic to cross the bus-only driveway, a request shall be submitted following the Procedure for Requesting Deviations to Metrolinx Standard Requirement (refer to CKH-ENG-PRC-001

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for more details) for consideration by Metrolinx. Refer to DRM Section 3.1.12.8 Delineated Crosswalks for additional details.

3.2.4 Bus Platform Layout

3.2.4.1 Bus platforms shall be located and designed to minimize the distance of customer path of travel, and to route pedestrians to cross at controlled crossings, discouraging uncontrolled crossings within the bus loop configuration.

3.2.4.2 The location and design of bus platforms shall be prioritized in conjunction with accessible parking and pick-up and drop-off areas.

3.2.4.3 Platform layout is subject to the number of bus bays required.

3.2.4.4 Platforms shall be able to be clear of snow by required snow clearing equipment so they are operable during winter months. Space for snow storage shall be identified.

3.2.4.5 Platforms shall be located outside of areas subject to falling debris, including but not limited to, overhead ice accumulation from hydro cables and supporting structures.

3.2.4.6 Bus platform curb height shall be 150 mm. Refer to OPSD 600 for minimum curb design specifications. Final design shall consider the two buses indicated in DRM Clause 3.2.1.2 and 3.2.5.1

3.2.4.7 All platforms shall have a straight platform edge unless bus driveway length is a limiting and critical consideration. Where the bus driveway length is the limiting and critical consideration, the sawtooth platform edge shall be considered to maximize space.

3.2.4.8 The linear bus loop configuration requires a minimum driveway width of 10,000 mm for the straight platform layout and 9,000 mm for the sawtooth platform layout.

3.2.4.9 The teardrop bus loop configuration requires a minimum driveway width of 12,000 mm for the straight platform layout. For the sawtooth platform layout, the driveway width ranges between 12,000 mm and 12,900 mm.

3.2.4.10 The sawtooth layout bus platform dimension details are provided in Drawings 3.1 and 3.2.

3.2.5 Vehicle Design Criteria

3.2.5.1 GO Transit operates two types of highway coaches (buses), each of which can accommodate a front mounted bike rack. The specifications of these buses must be obtained and reviewed prior to finalizing the design:

a) Single Deck Coach Model MCI D4500:
   1) Width: 2,591 mm;
   2) Length: 13,870 mm and
   3) Height: 3,439 – 3,480 mm. This bus has the ability to vary height. Refer to bus specification data obtainable from Metrolinx.

b) Double Deck Coach Enviro 500 Super Low Model ADL:

Superseded

1) Width: 2,520 – 2,580 mm;
2) Length: 13,037 – 13,817 mm
3) Height: 3,910 – 4,149 mm. This bus has the ability to vary height. Refer to bus specification data obtainable from Metrolinx.

c) Bicycle rack to accommodate two (2) bicycles.

3.2.5.2 When designing Metrolinx facilities, the most stringent dimensions of GO Transit bus vehicles should govern the design. The buses identified in Clauses 3.2.1.2 and 3.2.5.1 shall be used for critical bus lengths, widths and turning radii and height clearances. Height clearances must account for the ability for the buses to vary in height. Calculations of heights must also consider ramps and slopes in addition to flat surface travel. Consideration must be given to wherever the Bus travels and every structure, sign and obstruction through its travels has impact on the bus's ability to clear in all directions. It is the designer's responsibility to account for all movements of a bus, both in motion, stationary and under distress conditions. Examples of consideration that a designer must account for, but not limited to are: horizontal and vertical clearances, ramp grades and acceptable slope, pavement finishes, requirement for snow melt system, transition requirements, curb sweep clearances, speed limits and traction control, allowable turning radius, allowable widths, runaway bus considerations, towing and rescue clearance, emissions in facilities to name a few.

3.2.5.3 The GO Transit bus fleet is fully accessible and will seat two (2) wheeled mobility devices. The buses require a minimum platform side clearance for the clear accessible area. Refer to DRM Section 3.2.8 Clear Accessible Area for details.

3.2.5.4 Both bus types listed under DRM Clause 3.2.1.2 and 3.2.5.1 can kneel, lowering the front end to support accessible boarding and alighting when needed.

3.2.5.5 Lifts for wheeled mobility devices are located as follows:

a) Single Deck Coach Model MCI D4500 – Off center towards the front of the bus.
b) Double Deck Coach Enviro 500 Super Low Model ADL – At the front door.

3.2.6 Bus Circulation Design Criteria

3.2.6.1 The bus route, movement and turning radii shall be designed to meet performance requirements and ensure safe and smooth vehicle movements with minimum restrictions.

3.2.6.2 The following criteria shall be considered for site circulation reviews:

a) Design Vehicle: Single Deck Coach Model MCI D4500;
b) Bus design speed: 15 kilometers per hour;
c) A distance of 1,000 mm shall be added to the bus length at its front to account for a deployed bicycle rack; and
d) Turning steering wheel fully to the right; and
e) Lateral clearance of 250 mm from each side of the bus for mirrors width.
f) A horizontal clearance of 1,500 mm shall be provided between the design vehicle turning radius and any fixed object or curb, excluding the immediate bus loading area, as the buses are required to be adjacent to the curb.
g) Additional horizontal clearance of 450 mm shall be added from rear corner of the bus parallel to the bus platform curb.

Superseded

3.2.6.3 Bus circulation shall consider the need for customer comfort by avoiding unnecessary short turns where possible.

3.2.6.4 The bus loop areas are designed to not require any bus overhang.

3.2.6.5 A 3,000 mm continuous horizontal clearance is required from face of the curb to edge of the structure (e.g. building structure, bus shelters etc) at all bus platforms. Small fixed objects such as light poles and stop sign poles must avoid conflicting with the accessible area path and shall be setback 1,000 mm horizontal clearance from the face of the curb.

3.2.6.6 Vertical clearance requirements are as follows:

a) Where overhead structure (bridge, screen, overhead sign, indoor bus terminal etc) is above the bus-only driveway, the minimum vertical clearance shall be 5,300 mm.

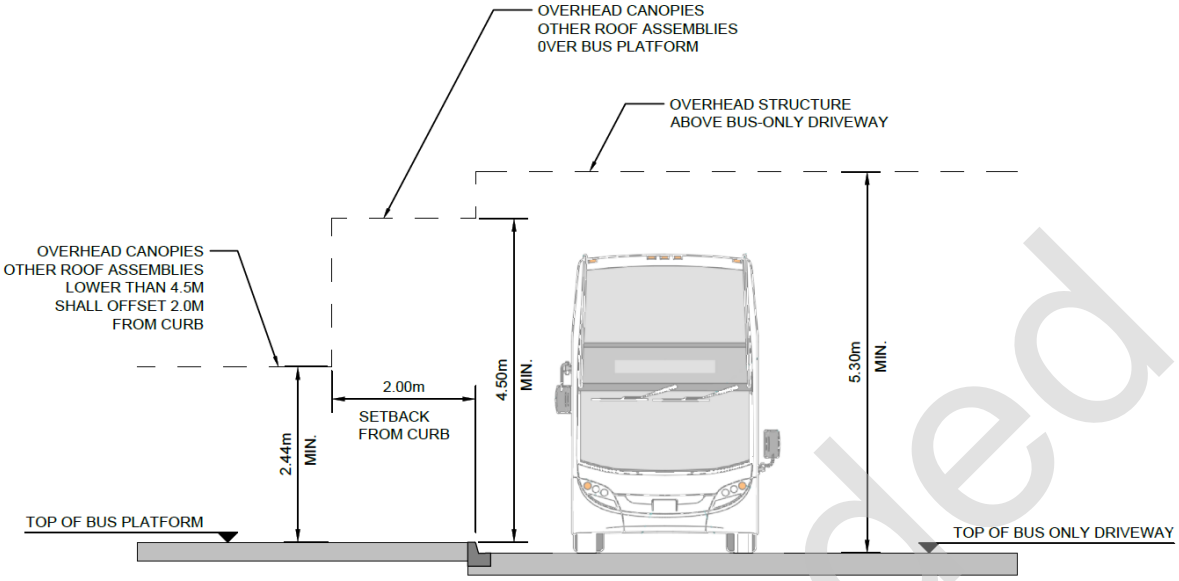
b) Where overhead structure (bridge, screen, overhead sign, indoor bus terminal etc) is offset from the bus-only driveway within 2,000 mm of the top of the curb, the minimum vertical clearance shall be 4,500 mm.

c) Where overhead structure (bridge, screen, overhead sign, indoor bus terminal etc) is offset from the bus-only driveway more than 2,000 mm of the top of the curb, the minimum vertical clearance shall be 2,440 mm.

d) Please refer to DRM Clause 3.2.5.2 and Sketch 1 for further details.

Superseded

Sketch 1 : Vertical Clearance requirements



3.2.6.7 Vehicle swept path analysis shall be conducted for all Bus Facility designs.

3.2.6.8 Vehicle swept path analysis shall illustrate all the obstructions (including but not limited to poles, fences, signposts, canopies) on the bus platform to prove the feasibility of horizontal clearances of the Bus Facility design

3.2.7 Materials

3.2.7.1 The bus loop area, including bus platforms, bus bays and bus access roads shall be concrete. Final texturing as per OPSS 350 is required to achieve friction standards. Further pavement design shall be subject to site specific needs and design.

3.2.7.2 Curbs shall be painted yellow (top and side) along their entire length for the entire extent of the bus platform area. The minimum depth of the paint should be 610 mm from the face of curb. GO Transit bus platform area shall not have Tactile Attention Indicators (TAI). Additional elements, which might be difficult for bus drivers and customers to see in the bus platform area, shall be painted yellow at the discretion of GO Transit.

3.2.7.3 Pavement marking paint details shall follow applicable contract specifications and Metrolinx standards. Aspects such as site illumination, maintenance schedules, durable and temporary applications, existing pavement marking contracts, seasonal variations, and OTM and TAC standards shall be considered.

3.2.7.4 Grading at Clear Accessible Area to be flat and allow space for bus barrier free lift deployment.

3.2.8 Clear Accessible Area

3.2.8.1 A clear accessible area is required along the frontage of all bus platform area to provide all customers, including those with mobility aids, appropriate space to board and alight buses. Frontage is considered the platform space adjacent to the dedicated bus dwelling space. This area includes space for ramp deployment and wheeled mobility device maneuvering.

Superseded

3.2.8.2 The clear accessible area shall:

a) Be clear and free of any obstructions.
b) Be a minimum of 3135 mm wide from the face of curb and 6415 mm long.
c) Where required along the length of the bus platform layout to accommodate the site-specific bus types or bus positions.
d) Have a clear height for its entire area so as to not be infringed by elements such as bus shelter overhangs, lighting fixtures, and sign blades.
e) Be adjacent and connected to the accessible route to and from the bus platform.

3.2.8.3 The clear accessible area shall accommodate the two types of buses GO Transit uses on their accessible bus routes, with one having a front door folding ramp (Enviro 500) and the other a mid-bus door lift (MCI D4500). See DRM Clause 3.2.5.5.

3.2.8.4 Bus shelters shall be installed and positioned to provide an accessible exterior route from the shelter to adjacent sidewalks, streets, pedestrian paths and customer zones. Bus shelters shall not reduce the required clear accessible area. Bus shelters shall be oriented with opening oriented towards the platform curb. Refer to Metrolinx Design Standards for additional accessibility requirements.

3.2.8.5 Final position of the clear accessible area shall be reviewed with GO Transit Bus Services Staff representatives.

3.2.9 Stop Identification Post and Signage

3.2.9.1 The purpose of the stop identification post and signage are to identify a bus stop.

3.2.9.2 The stop identification post (also referred to as “standard design pole”) shall be located at a standard or uniform position at all stops, as they serve as a point of reference for those with disabilities, particularly the visually impaired to determine the approximate location of the front entrance of the bus.

3.2.9.3 The stop identification post shall be located immediately downstream of the platform clear accessible area. The post shall be located 1000 mm away from the edge vehicle path (i.e. curb face) so it can be identified by approaching buses. The sign shall be perpendicular to the vehicle path of travel, facing on-coming buses.

3.2.10 Drainage in bus path travel

3.2.10.1 Site drainage in areas of bus travel – Refer to DRM Section 3.7 Civil Works.

3.2.10.2 Pavement design – Refer to DRM Section 3.5 Pavement and Line Markings.

Superseded

3.3 Passenger Pick-Up and Drop-Off (PUDO)

3.3.1 General Requirements

3.3.1.1 General requirements shall be applied for all PUDO configurations in addition to the specific configuration requirements.

3.3.1.2 Short-term parking facilities for passenger pick-up and drop-off (PUDO) shall be provided at GO Stations and Park-&-Ride (Carpool Lots). A PUDO Facility refers to the area and infrastructure in a site dedicated to supporting passenger pick-up and drop-off functions.

3.3.1.3 A PUDO Facility shall be one direction, free flowing and give easy access to station entrance and exit. It shall face the main station building or at a secondary entrance to the platform (if applicable).

3.3.1.4 A PUDO Facility consists of the following main components:

a) Vehicle Waiting Area: Designated area where vehicles can wait if they arrive before their passenger. In some cases, a vehicle waiting area may not be provided if there are significant space constraints on the station site;

b) Passenger Designated Waiting Area (DWA): Designated area where passengers can wait if they arrive before their vehicle. Typically, this area is part of the station building or pavilion. Please refer to Metrolinx Design Standards. Where it is not possible for the station building to be adjacent to the PUDO facility with clear sightlines, DWA features shall be provided at the PUDO Passenger Waiting Area for customer convenience and safety.

c) Vehicle Loading Area: Curbside area where vehicles can stop to load or unload passengers;

d) Passenger Loading Area: Curbside area where passengers can board or alight from vehicles.

e) Barrier-Free Drop-off Zone: Zone that is protected from vehicular traffic with related accessible elements and located on the shortest possible accessible route to station building or tunnel entrance.

3.3.1.5 Adjacencies requirements are as follows:

a) The Passenger Loading Area and Vehicle Loading Area shall be adjacent;

b) At GO stations where bus loops are present, the Passenger Loading Area and DWA shall be located so that the two Areas jointly serve passenger movements to and from both rail and bus transit services.

3.3.1.6 Location requirements are as follows:

a) The location of the PUDO Facility shall respect the modal hierarchy established in the latest version of the GO Rail Station Access Plan;

b) The PUDO Facility shall be designed in a manner that discourages long term parking;

c) Passenger Loading Areas shall be located to facilitate safe and convenient access to the Station Building, DWA and access to rail and bus platforms;

d) The PUDO Facility shall be visible from the Passenger Waiting Area; and

e) A barrier-free, accessible route with curb ramps designed to the requirements of the Universal Design Standard shall be provided between the Passenger Loading Area and

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the DWA, Station Building and continue throughout station facilities.

3.3.1.7 Access and Circulation

3.3.1.7.1 The PUDO Facility shall have priority access from and egress to the local road network over drive-and-park traffic. This can be achieved by:

a) Providing dedicated lanes, where possible.;
b) Ensuring access to and egress from the PUDO Facility is not routed through the drive-and-park where possible;
c) Minimizing the number of stop or yield signs between the PUDO Facility and the local road network; and
d) Providing priority access to and from the PUDO Facility with the use of stop and yield signs for drive-and-park traffic when merging with PUDO traffic.

3.3.1.7.2 Pavement markings shall be provided to guide customer/vehicle movements. For Signage and Wayfinding please refer to Metrolinx Design Standards.

3.3.1.7.3 The PUDO Facility shall not be utilized for the purpose of situating retail operations.

3.3.1.7.4 The PUDO Facility shall be arranged to facilitate one-way traffic flow and discourage vehicle reversing movements.

3.3.1.7.5 Shall include a 3000 mm wide barrier-free drop-off hatched area for rear lift equipped vehicles as well as side mounted lifts.

3.3.1.7.6 Ensure a barrier-free drop-off zone complete with curb ramps and dedicated passengers loading/unloading area to be located on the right to discharge passengers at the curb or walkway and shall not intersect with the bikeways, Multi-Use Path (MUP) or the accessible path of travel.

3.3.1.8 Pedestrian Thoroughfare requirements are as follows:

a) The PUDO Facility shall be located on the most direct and shortest pedestrian route to the accessible station building entrance and designated accessible boarding areas of the platforms (mini-platforms) and avoid conflicts with other multi-modal circulation modes, including primary pedestrian walkways and bikeways.

3.3.1.9 Vehicle Loading Area and Passenger Loading Area requirements are as follows:

a) Passenger Loading Areas shall be 3000 mm wide and separate from, station walkway and bikeway facilities;
b) The open doors of vehicles in the Vehicle Loading Area shall not obstruct walkways and bikeways.
c) If the Passenger Loading Areas are parallel to walkways or bikeways, consideration shall be given to preventing pedestrian or cyclist encroachment into the Passenger Loading Area. This can be achieved by providing a wide buffer, or a significant visual and tactile contrast between the Passenger Loading Areas and the walkway or bikeway;
d) Vehicle Loading Area and Passenger Loading Area shall be clearly marked with signage and pavement markings indicating a maximum stopping time to prevent their use as a Vehicle Waiting Area. Curbs at station buildings are to be “no stopping” areas. They are reserved for emergency vehicles;
e) A curb ramp at each end of the barrier-free drop-off zone is required to ensure

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customers safely transition between the vehicles and onto the accessible path of travel.

3.3.1.10 Required Analysis by Designer or Engineer of Record

3.3.1.10.1 Vehicle swept path analysis shall be conducted for all PUDO Facility designs.

3.3.1.10.2 The PUDO Facility shall be designed to accommodate:

a) Customer cars circulation during peak periods; and
b) Access by emergency vehicles, snowplows, and delivery trucks when empty. Designated fire routes shall meet OBC and local fire department requirements.

3.3.1.10.3 Where a design is deemed by Metrolinx to deviate from standard PUDO design or does not provide the recommended number of waiting spaces (per the GO Rail Station Access Plan, latest version), designers shall provide modeling such as, but not limited to, micro-simulation which demonstrates that PUDO design shall meet expected traffic level.

3.3.2 Specific PUDO Configuration Requirements

The configuration for a PUDO shall be selected based on site constraints and optimal traffic flow patterns (vehicle, cyclists, local services, and connections). The following configurations provide standard requirements and details for each of these options.

3.3.2.1 Ferry Style Configuration

3.3.2.1.1 The Ferry Style Configuration has Vehicle Waiting Area, dedicated ingress and egress for vehicles to safely maneuver in and out of the PUDO and Accessible Passenger drop-off and pick-up area, and THROUGH lane for efficient passenger pick-ups and drop-offs.

3.3.2.1.2 Criteria for Application of Ferry Style Configuration:

a) The Station Categorization, reported in the GO Rail Station Access Plan should meet the “Base” “Medium”, or “Interchange” (“Base” to “Medium”) threshold categories;

3.3.2.1.3 Capacity

The PUDO capacity shall be sized as per the current version of the GO Rail Station Access Plan.

3.3.2.1.4 Access and Circulation requirements are as follows:

a) The design shall be lineal, parallel layout, sized on the basis of passenger loading and vehicle projections, allowing a space 3000 mm wide by 6000 mm long for each vehicle. Where possible, provide more lanes of shorter length to allow for easier vehicles access and exit;
b) Physical separation shall be achieved through a minimum 2500 mm wide, raised curb or landscaped buffer between PUDO facility and general vehicle traffic flow;
c) Orient vehicle circulation in a counter-clockwise direction to eliminate vehicle cross over;

3.3.2.1.5 Pedestrian Thoroughfare requirements are as follows:

a) Pedestrian movements at the PUDO Vehicle Waiting Area shall be aligned parallel to the traffic in order to limit the pedestrian and vehicle conflict points.

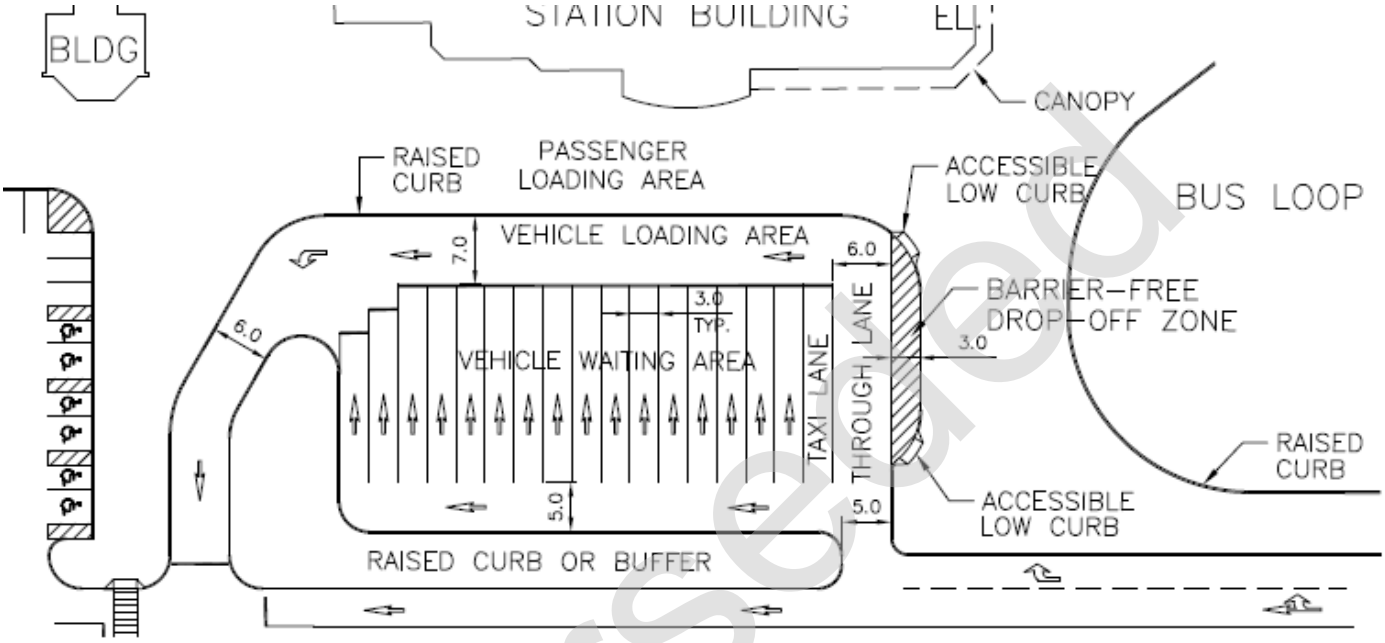
3.3.2.1.6 Vehicle Waiting Area

a) Taxi Lane shall be part of the PUDO which shall accommodate taxis, ride-sourcing, and

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micro-transit vehicles.

Figure 1: Ferry Style Configuration (Guidelines only)



3.3.2.2 High Ridership Configuration

3.3.2.2.1 The High Ridership Configuration has modular Vehicle Waiting Areas, channelized lanes for vehicles to safely maneuver in and out of the PUDO, and a pedestrian walkway that contains painted/tactile markings to facilitate snow clearing with maintenance vehicles through the PUDO.

3.3.2.2.2 Criteria for Application of High Ridership Configuration:

a) The Station Categorization, reported in the GO Rail Station Access Plan should meet the “Medium”, “High”, or “Interchange” (“Medium” or “High”) threshold categories;

b) Station shall have Two-Way, All-Day service frequency, or be planned for service expansion.

3.3.2.2.3 Capacity

The overall capacity of the Vehicle Waiting Area and Vehicle Loading Area shall not be less than the station specific numbers identified in the latest version of the GO Rail Station Access Plan, or as per project-specific contractual documents.

3.3.2.2.4 Location:

The PUDO Facility shall be located adjacent to surface parking, which can be removed to accommodate future modular or incremental expansion of the PUDO Facility should demand

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be forecast to increase.

3.3.2.2.5 Pedestrian Thoroughfare requirements are as follows:

a) A pedestrian walkway shall be provided with direct crossing locations that begin at the Passenger Waiting Area. Pedestrian crossing locations shall be well-marked and highly visible to drivers;

b) Additional traffic calming measures to reduce vehicle speed should be provided if required.

3.3.2.2.6 Vehicle Waiting Area requirements are as follows:

a) The PUDO shall provide space to accommodate taxis, ride-sourcing, and micro-transit vehicles;

b) Each space in the Vehicle Waiting Area shall have an additional 1000 mm continuous hatched area across the front of each space.

3.3.2.3 Strip Configuration

3.3.2.3.1 The Strip Configuration is designed to allow for a PUDO Facility on constrained station sites when land availability is a significant concern. It shall contain a raised but mountable island to allow for emergency vehicle access.

3.3.2.3.2 Criteria for Application of Strip Configuration:

a) Land availability at the station area shall be demonstrated to be significantly restricted:
   1) Surface parking is constrained or not available on the station site;
   2) Station facility parking is constrained or cannot be co-located with adjacent development;
   3) Expansion or acquisition opportunities for parking are constrained or not available.

b) Demonstration that application of the “Ferry Style” and “High Ridership” configurations are either not feasible or have negative impact on the functioning of the station area.

3.3.2.3.3 Capacity

The capacity of the Vehicle Loading Area may be less than the station specific numbers identified in the latest version of the GO Rail Station Access Plan.

3.3.2.3.4 Access and Circulation

The radius of the turnaround shall be the minimum required to accommodate service vehicles and allow for safe emergency vehicle access.

3.3.2.3.5 Pedestrian Thoroughfare requirements are as follows:

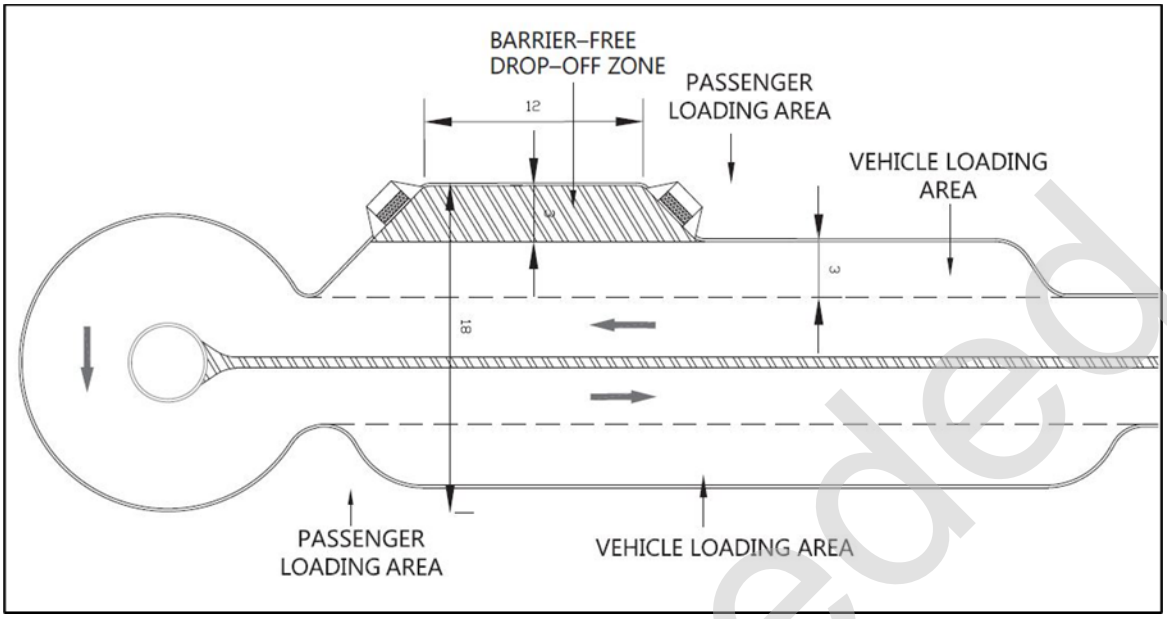
a) Where pedestrian crossings of perpendicular traffic flows are required, pedestrian movements shall be directed to pedestrian crossing locations. Pedestrian crossing locations shall be well-marked and highly visible to drivers;

b) Should crossings not be feasible given the configuration of this design and the required mountable island, traffic calming measures shall be used to limit vehicle speed.

c) A pedestrian traffic flow study shall be conducted to demonstrate where pedestrian crosswalk locations shall be provided. Mitigation measures shall be installed to guide pedestrians and alert road users of a designated pedestrian crossing points.

Superseded

Figure 2: Strip Configuration (Guidelines only)



3.3.2.4 Urban Configuration

3.3.2.4.1 The Urban Configuration is designed for station sites where there are minimal, or no station lands available.

3.3.2.4.2 Criteria for Application of Urban Configuration:

a) Where there are significant space constraints on a station site, Vehicle Waiting Areas shall not be provided and the PUDO Facility may be located on a public or private road, subject to coordination with the relevant and appropriate municipality and/or agency, as follows:
   1) Surface parking is constrained or not available on the station site.
   2) Station facility parking is constrained or cannot be co-located with adjacent development.
   3) Expansion or acquisition opportunities for parking are constrained or not available.
b) Demonstration that application of the “Ferry Style”, “High Ridership”, and “Strip” configurations are either not feasible or have negative impact on the functioning of the station area.

3.3.2.4.3 Adjacencies - No Vehicle Waiting Area shall be provided.

3.3.2.4.4 Capacity requirements are as follows:

a) The capacity of the Vehicle Loading Area may be less than the demand as forecasted in the GO Rail Station Access Plan, latest version;
b) If the site is size constrained, the PUDO Facility shall accommodate, at a minimum, the requirements of the Universal Design Standard.

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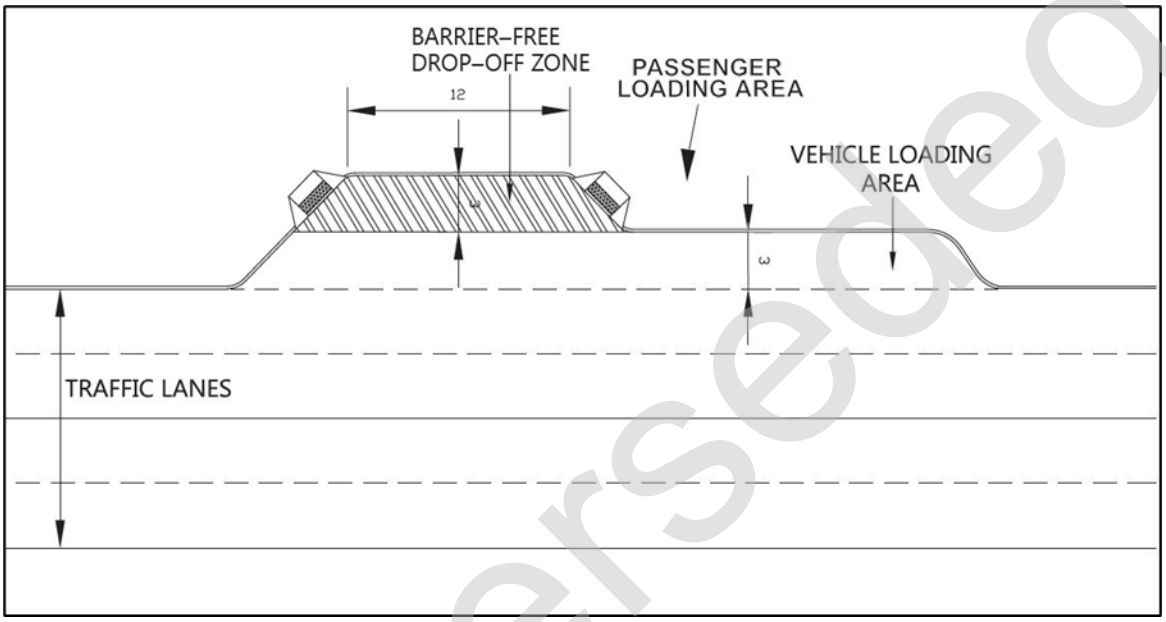
3.3.2.4.5 Access and Circulation requirements are as follows:

a) The PUDO Facility shall be arranged to facilitate one-way traffic flow and discourage vehicle reversing movements and U-turns if located on a local road;

b) The PUDO Facility shall be designed to avoid conflict with other road users.

3.3.2.4.6 Vehicle Loading Area - Where appropriate the PUDO Facility should contrast visually or tactilely from the adjacent local road to designate the Vehicle Loading Area.

Figure 3: Urban Configuration (Guidelines only)



3.3.3 PUDO Dimension Requirements

3.3.3.1 The table below provides a summary of the required dimensions of the PUDO Facility.

Table 2: PUDO Facility Dimensions Requirements

No.	Facility Type	Required Dimension
1	Vehicle Loading Area (General vehicle space)	Length: 7000 mm Width: 3000 mm
2	Vehicle Waiting Area (Ferry Style Configuration)	Length: 6000 mm Width: 3000 mm

Superseded

3	Vehicle Waiting Area (High Ridership Configuration)	Length: 6000 mm with additional 1000 mm hatched area at front of space Width: 3000 mm
4	Passenger Loading Area	Width: 3000 mm
5	Through Lanes	Width: 3000 mm
6	Pedestrian Walkway (only in scenario where pedestrian walkway is adjacent to Passenger Loading Area)	Width: minimum 1600 mm The width shall not overlap with 3000 mm wide Passenger Loading Area.
7	Barrier-Free Drop-Off Zone	Length: 12000 mm Width: 3000 mm

Superseded

3.4 Parking Infrastructure

3.4.1 Organize large surface parking areas into smaller lots to manage traffic flow, facilitate better site navigation.

3.4.2 Locate parking structures to balance desired direct access to the rail platform.

3.4.3 Parking layouts shall respond to property size and site geometry. Parking layout configurations shall maximize number of parking stalls while maintaining a safe environment, taking into consideration typical customer travel patterns.

3.4.4 Provide a safe, interconnected pedestrian network within and adjacent to parking lots to connect station building entrances, parking spaces, public sidewalks, transit stops and other pedestrian destinations.

3.4.5 Vehicle swept path analysis shall be provided as deemed necessary by Metrolinx.

3.4.6 Provide vehicle queuing space. A queuing study may be required as deemed necessary by Metrolinx;

3.4.7 Site elements (i.e. light poles, signage, bollards, etc.) located within the parking area shall not interfere with the parking stalls sizes and aisles width.

3.4.8 Entrances and exits to/from parking shall be designed to accommodate all vehicle types including delivery, service vehicles, and emergency vehicles as required for the specific operational needs of the site.

3.4.9 Staff Parking: Every facility requires a minimum of two (2) maintenance parking spaces strategically located to main service buildings. If a facility is staffed with Customer Service employees, a minimum of two (2) additional parking spaces shall be provided in close proximity to main station facility. Staff may be required to work in off hours (late or early) and CPTED solutions for employee safety shall be considered when laying out a site.

3.4.10 Access road requirements are as follows:

a) The required number of entrance / egress points is one for 300 parking spaces minimum;
b) Single lane (one-way traffic) access roads shall be 4500 mm wide minimum;
c) Two-lane (two-way traffic) access roads shall be 7000 mm wide minimum;
d) Three lane access road (where a left turn lane is required) shall be 10500 mm wide minimum;

3.4.11 Parking Infrastructure Design Requirements are provided in Table 2.

Table 3: Parking Infrastructure Requirements

Criteria	Specifications
Standard parking stalls	2500 mm wide and 5500 mm long
Stalls abutting curbs	4500 mm long with a 1000 mm allowance for vehicle overhang

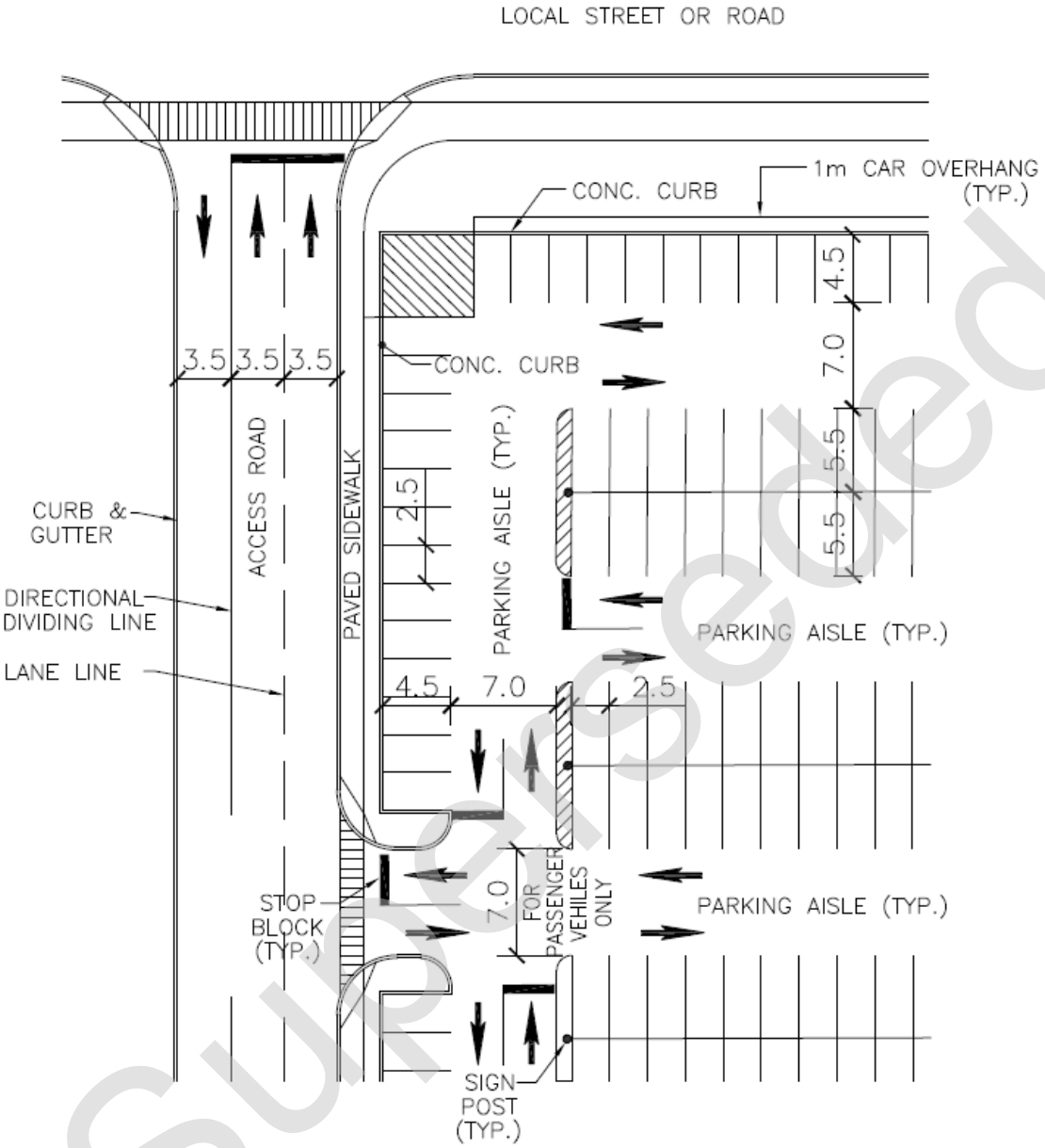
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	(Sodding shall not be located under car overhangs)
Parallel parking stalls	3000 mm wide x 7000 mm long
Vehicular overhang	1000 mm
Parking drive aisles	7000 mm wide
Sign posts	Shall be provided at parking row locations to indicate tow away zones (refer to the Metrolinx Design Standards for details)
Accessible Parking	Refer to Metrolinx Design Standards

3.4.12 Carpool to GO parking shall be up to 2% of total parking spaces in proximity to barrier free parking. Signage shall be provided at each carpool parking space location.

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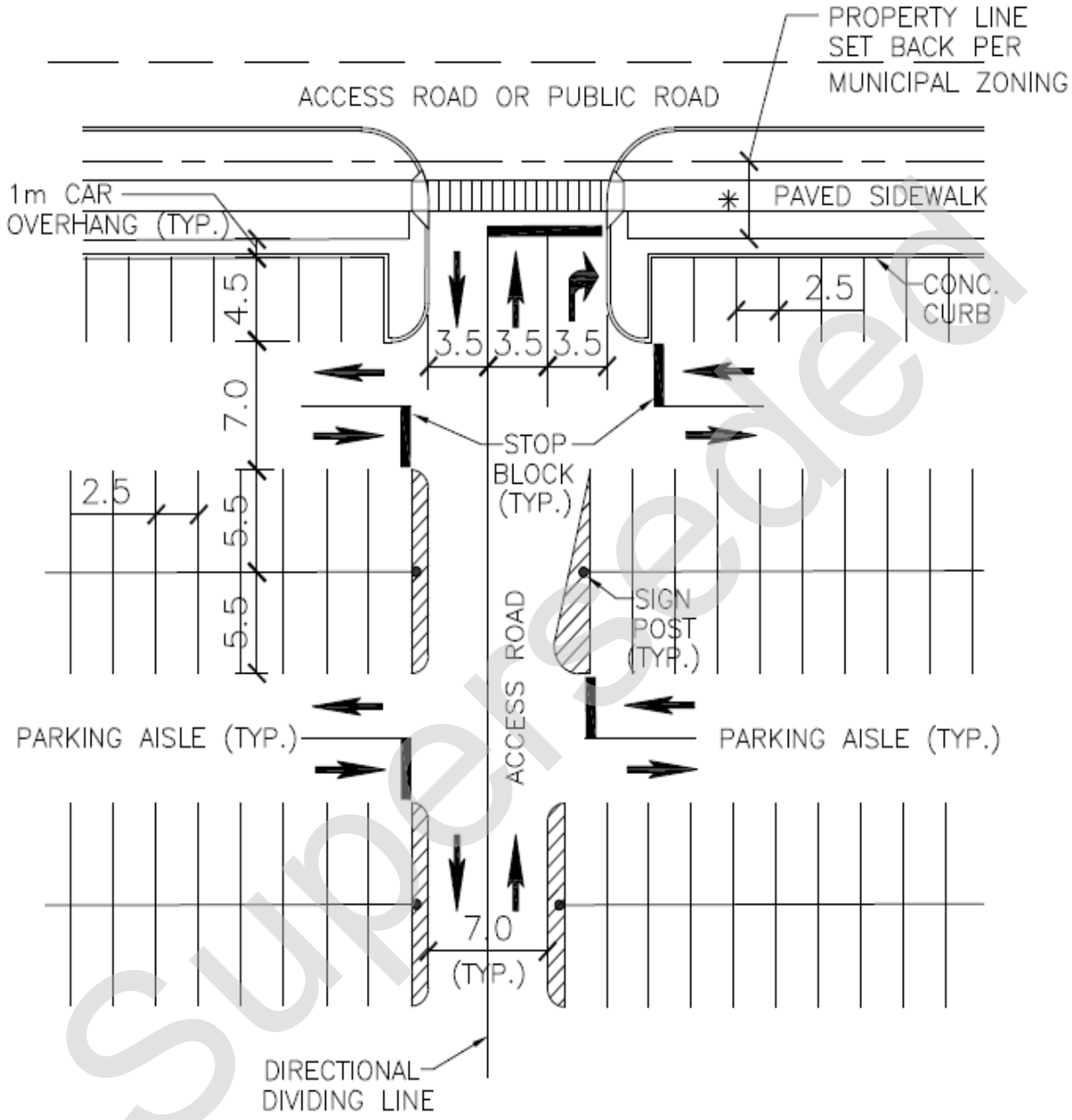
Figure 4: Vehicular Parking Diagram 1



NOTE: ISLANDS & CURBS TO BE RESTRICTED TO ACCESS ROADS & PERIMETER PARKING TO FACILITATE SNOW REMOVAL

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Figure 5: Vehicular Parking Diagram 2



NOTE: ISLANDS & CURBS TO BE RESTRICTED TO ACCESS ROADS & PERIMETER PARKING TO FACILITATE SNOW REMOVAL

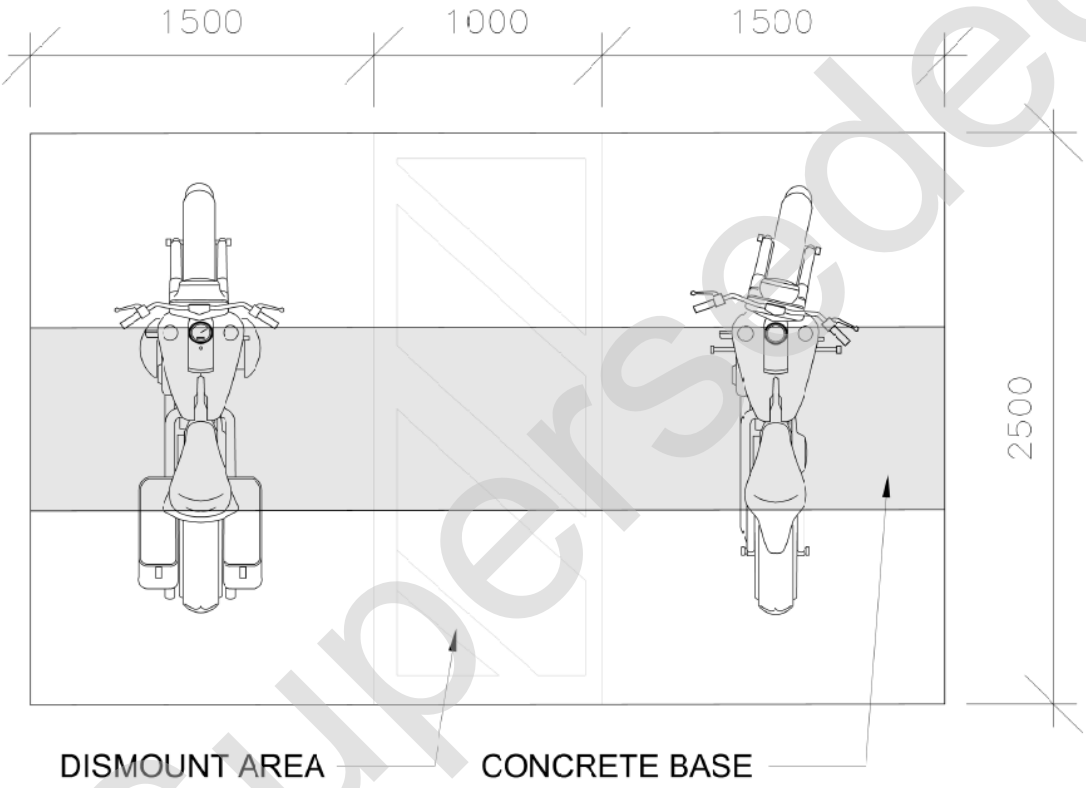
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3.4.13 Motorcycle/Scooter Parking

Motorcycle/Scooter parking is located in parking areas that would otherwise not be useable for standard vehicular parking. The following are Motorcycle/Scooter Parking requirements:

a) Each parking space shall be a minimum of 1500 mm wide by 2500 mm long;
b) The parking area shall have a concrete base at grade for the mounted ring as per consultant design;
c) A designated dismount area shall be provided adjacent to motorcycle and scooter parking by pavement markings.

Figure 6: Motorcycle Configuration



3.4.14 Multi-Level Parking Garages

3.4.14.1 The following are general requirements for a Multi-Level Parking Garage:

a) Efficient traffic flow patterns for access and egress based on GO passenger patterns;
b) Functional Parking geometries with consideration for size, height, and turning radius of automobiles;
c) Efficient internal pedestrian & vehicular flow with redundant access / egress points;
d) Consideration for pedestrian and bicycle access;
e) Incorporate CPTED (Crime Prevention Through Environmental Design) principles;
f) Incorporate Emergency response and access;
g) Appropriate Wayfinding Measures; Signage; Building Identification and Corporate

Superseded

Branding;

h) Incorporation of Sustainable Design Principles, energy efficient lighting and other proven ‘green’ initiatives and/or technologies to mitigate potential environmental impacts;

i) Incorporation of anti-bird surfaces, especially in light fixtures;

j) Provide accommodation for salt protection and safe service maintenance activities; Include space counting system with a UPS for car counting system;

k) Building elements (i.e. bollards, pipes, etc.) located within the parking area shall not interfere with the parking stalls sizes and aisles width;

l) Satisfy building code requirements of fall arrest;

m) Ensure the overall building envelope meets the open air requirements.

3.4.14.2 Access-Entry and Exit requirements are:

a) Provide vehicle queuing space. A queuing study may be required deemed necessary by Metrolinx;

b) Internal circulation patterns shall minimize vehicular and pedestrian conflict, minimize travel distances and, conflicting movements;

c) All vehicular ramps shall be provided with transition zones at the top and bottom of the ramp at a minimum;

d) The vertical clearance of the parking garage shall accommodate all vehicle types having to enter the garage, including service vehicles as required by Metrolinx.

3.4.14.3 Snow Management requirements are:

a) Allow easy snow removal and minimize any damage from its operations and chemical treatment applications;

b) Architectural elements such as spandrel or enclosure panels shall minimize snow drifting and wind;

c) Exterior ramps and stairway areas to be provided with hydronic or electric resistance snow melting embedded below the traffic surface;

d) In all areas, floor drains and floors shall be configured to prevent ponding and allow for quick and easy drainage.

3.4.14.4 Exterior Elevation requirements are:

a) Exhibit a high level of architecture detail such as decorative screens that shall be corrosion resistant, and shall have no sharp edges;

b) Provide overhead canopies over pedestrian walkways;

c) Lighting shall be considered in the exterior finishes and configuration.

3.4.14.5 Finishes requirements are:

a) Traffic surfaces shall accommodate pavement markings;

b) As a minimum, structural steel members shall be corrosion resistant both to the expected environment as well as the adjacent material it comes into contact with;

c) All exposed Mechanical systems to be painted, refer to Metrolinx Standard specification 20 05 10 Basic Mechanical Materials and Methods for detailed requirements;

d) Increase surface friction at entrance locations using a variety of techniques such as (but not limited to) grooves, heated ramps, additional drainage;

e) Ramps exposed to exterior environmental elements will require increased surface

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friction, provisions for snow melting systems, and a chevron pattern spaced maximum 30 mm apart and 5 mm deep to help with drainage;

f) Apply waterproofing system to parking decks and ramps with appropriate wear coarse and aggregate for the expected vehicular traffic.

3.4.14.6 Electrical requirements are:

a) Electrical and communications rooms are not to be below grade;
b) Main Electrical and communication rooms shall be located next to each other;
c) Emergency Backup Power Systems shall be provided;
d) Service entrance distribution panel board, transformers, transfer switches, contactors and controls, UPS and branch circuit panel boards shall be located in the electrical room;
e) Provide access controls i.e. fob access and keypad to the Electrical, Communications and Hub rooms;
f) Energy Management System/ Smart Panels (smart panels have a main breaker which is capable of providing a network IP address giving current readings at each circuit in the panel) shall provide the most flexible control system available: multi-level lighting, occupancy lighting changes, light harvesting, programmable circuit control, IP addressable, open architecture (backnet/ modbus compliant);
g) For all receptacles and plugs refer to the Metrolinx Standard Receptacles and Plugs Specification 26 27 26;
h) All electrical components, panels, ducts are to be mounted on standoffs;
i) No direct connections to the wall or ceilings are permitted;
j) LED lighting and control to be used in all areas. Refer to Electrical section of DRM and Metrolinx Lighting and Control Specification 26 50 00;
k) For further information, refer to Electrical and Communication Technical Requirements and the GO Standard Drawings and Specifications.

3.4.14.7 Mechanical Systems requirements are:

a) Mechanical systems to be designed without confined spaces;
b) Connect sanitary sewer to building sanitary drainage outlet by gravity drainage where elevation inverts allow;
c) If not possible, refer to Metrolinx mechanical specification 22 30 00 Plumbing Equipment for detailed requirements of the sump pumps and sump pit accessories and provide duplex epoxy coated sanitary sump pump with:
    1) 2 independent seal assemblies;
    2) Guide bars;
    3) Four float level control system;
    4) Lifting equipment including lifting davit;
    5) Chain hoist and hook;
    6) Lifting device;
    7) Gas tight access frame.
d) Self-opening cover complete with piston kit and safety grid cover shall be traffic bearing where needed and completely assembled stainless steel;
e) There shall be no need for personnel to enter the wet well to service the pumps. Utility

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water meter to municipal standards shall be provided with 3 valve by-pass arrangement;

f) Accommodate water service on every level;

g) Provide exterior non-freeze water hydrants evenly spaced along the perimeter. Refer to Mechanical section of DRM for the specific requirements where hose bibbs are to be provided;

h) Incorporate heat tracing. Refer to Mechanical section of DRM for the specific requirements where heat tracing is to be provided on piping;

i) Provide heavy duty parking area drains with accessible cleanout, duty grate and sediment buckets.

j) Important: All pipes and mechanical fixtures shall be designed to be corrosion free (no Copper type M is permitted).

3.4.14.8 Service and Maintenance Area requirements are:

a) A designated storage area in the parking structure shall be provided to accommodate service equipment, sweeper storage, and tools in a secure location;

b) The room(s) shall be accessed by a double leaf Hollow Metal (HM) door and the doors shall not open onto vehicular traffic; a concrete apron shall be provided with bollards;

c) For service rooms details refer to Technical Requirements section of DRM.

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3.5 Pavement and Line Markings

3.5.1 Asphaltic and concrete pavement shall be in accordance with Ontario Provincial Standards.

3.5.2 Pavement Design shall be based on the Geotechnical Consultant's recommendations. However, the minimum asphalt thickness shall be:

a) Car and emergency vehicle access routes: 40 mm HL3 on 80 mm HL8;
b) Parking: 40 mm HL3 on 40 mm HL8;
c) Bus Platforms: Concrete;
d) Sealed Rail Platforms: 50 mm HL3A; and
e) Other miscellaneous items: 40 mm HL3 on granular.

3.5.3 Concrete Paving requirements are:

a) Concrete walkways: Ontario Provincial Standards criteria to govern;
b) Concrete bus access routes: per Geotechnical and Structural Engineers' design.

3.5.4 The Pavement Slopes requirements are provided in Table 3.

Table 4: Pavement Slopes

Slopes				
Location	***Longitudinal***		***Cross Slopes***	
	Preference	***Max***	***Preference***	***Max***
Walks	0%	5%	2%	OPSD
Platforms (Rail & Bus)	0%	1% Note 1	1%	2%
Parking Lots	1%	3%	1%	3%
Fire Access Routes	Slopes to suit OBC fire access route criteria.			

Note 1: Design and layout are to be in accordance with details shown on Figures. Material Standards: OPSS 710. For pavement areas interfacing with public thoroughfares, design shall be in accordance with the current MTO Manual of Uniform Traffic Control Devices and the Manual of Uniform Traffic Control Devices of Canada.

3.5.5 Line markings requirements are provided in Table 5 and Table 6.

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Table 5: Line Markings

Line Marking	
Location	***Colour***
Parking stalls, parking restricted areas and islands	Yellow
Directional dividing lines	Yellow
Rail Platform safety line	Yellow (TWSI)
Lane lines, arrows	Yellow
Stop Block	White
Pedestrian crosswalk lines	White
Stop lines	White

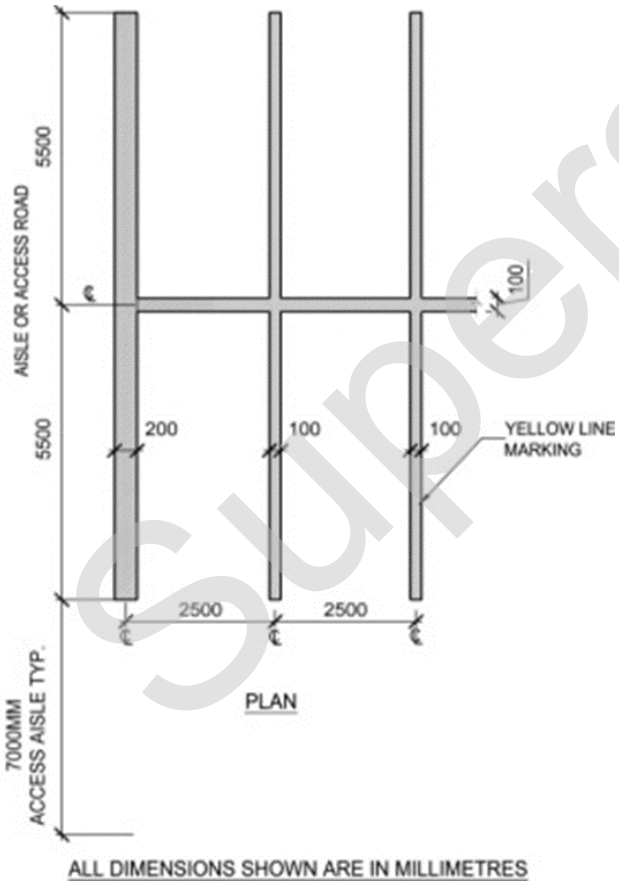
Note – All line painting shall be completed as per OPSS 710. Durable paint application shall be used unless otherwise approved by Metrolinx Station Operations.

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Table 6: Line Markings (Parking Structures only)

Line Marking (Parking Structures Only)	
Location	***Colour***
Parking stalls, parking restricted areas and islands	Yellow
Directional dividing lines	White with reflectorizing glass beads
Lane lines, stop lines and arrows	White with reflectorizing glass beads
Stop Block	White with reflectorizing glass beads
Pedestrian crosswalk lines	White with reflectorizing glass beads

Figure 7: Vehicular Parking Diagram - Detail



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Figure 8: Line Marking – Row Parking Stalls

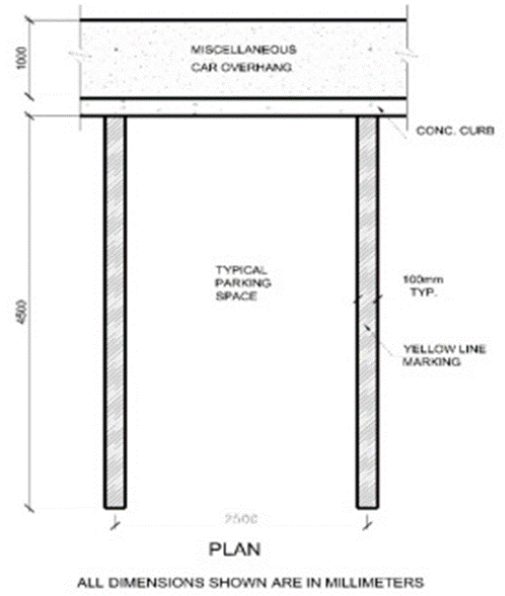
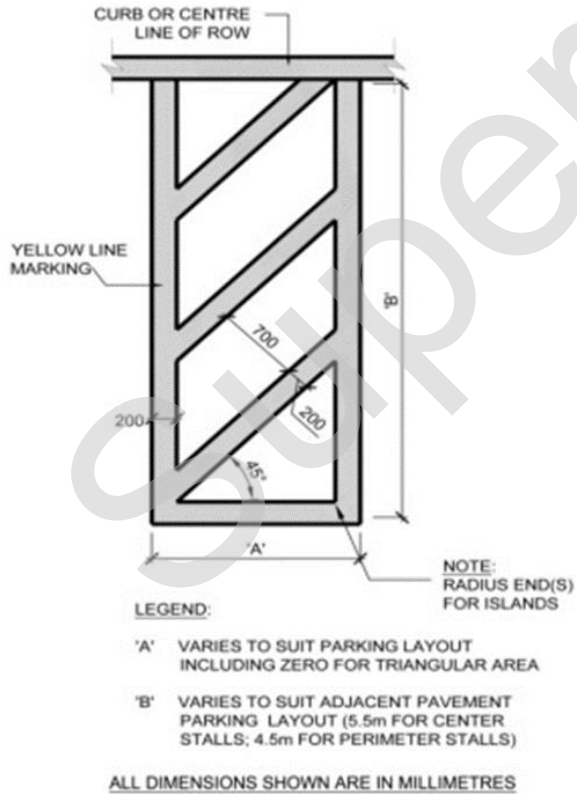
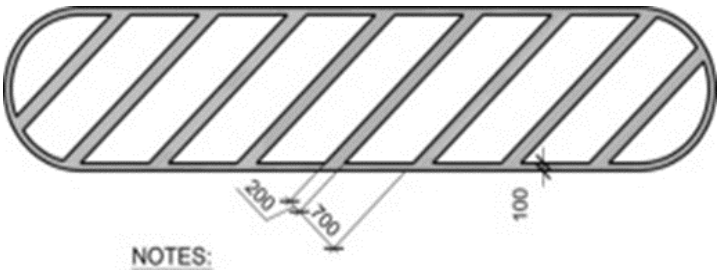


Figure 9: Hatched Parking Area Configuration



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Figure 10: Line Marking for Islands



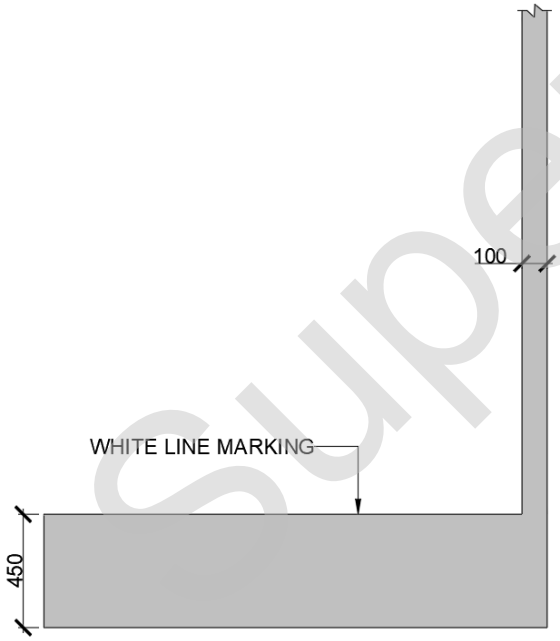
NOTES:

SAME AS PARKING RESTRICTED AREA, WITH RADIUS ENDS TO SUIT LAYOUT, BUT PERIMETER LINE 100mm.

LINE MARKING COLOR: YELLOW.

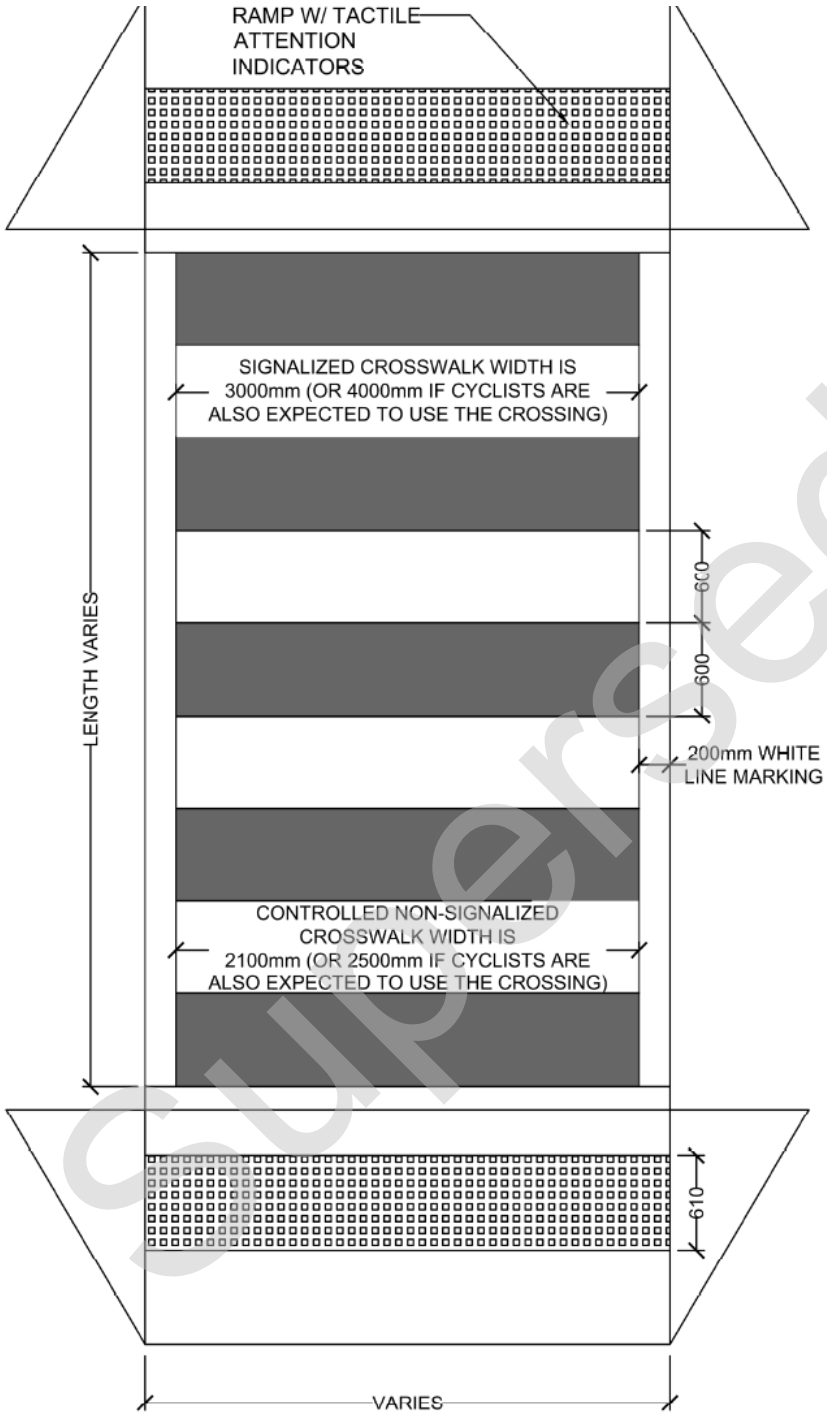
ALL DIMENSIONS SHOWN ARE IN MILLIMETRES

Figure 11: Stop Block



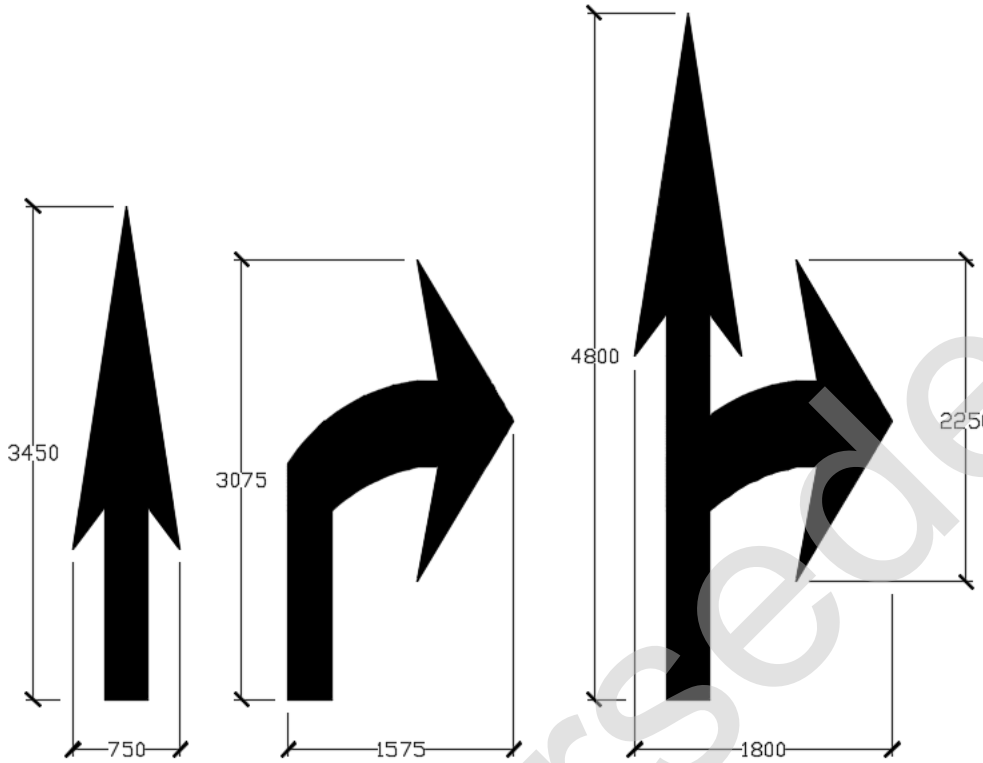
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Figure 12: Crosswalks Line Marking



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Figure 13: Line Marking – Pavement Arrows



3.5.6 Pavers

3.5.6.1 Pavers shall be locally available, and it is preferred that they be a stock item to ensure ease of repair and replacement. Custom colors are not an acceptable solution.

3.5.6.2 Areas of pavers shall not be laid within door swings when doors swing to the exterior. There shall be concrete surface surrounding the facility to ensure weather suitability and to eliminate heave affecting doors.

3.5.6.3 Pavers may be used as accent surface treatment and not used in any area that is expected to sustain traffic, both vehicular and pedestrian. Drainage shall be designed to be passive, to ensure year round clean surfaces.

3.5.6.4 It is encouraged to use pavers around outside edge of parking lots for vehicle overhang. For locations to be operated under GO Transit, permeable paving shall not be permitted in areas of public vehicular parking and movement.

3.5.6.5 Careful consideration shall be given to allow for space to pile snow and allow a clear, barrier free access.

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3.6 Site Elements

3.6.1 Fencing

3.6.1.1 A fencing system is a component of safety and access control systems. Installation of fencing systems shall be conducive to operations and not become a maintenance burden.

3.6.1.2 All fencing shall include the following characteristics and features, regardless of the intended performance of the fence at a given location (varying only in height).Each fence shall be:

a) Secure;
b) Anti-climb;
c) Anti-cut;
d) Vandal-resistant;
e) Transparent;

3.6.1.3 Fences are required at, but not limited to, the following categories of GO facilities:

a) For fencing along and within Railway Corridors–refer to Fencing and Anti-trespassing Requirements;
b) High Risk Facilities–2,400-mm-high security fencing at the following facilities:
    1) Layover yards and sites;
    2) Electrical sub-stations;
    3) Fuel yards and tanks;
    4) Maintenance facilities.
c) Medium Risk Facilities: Minimum 1800-mm-high security fencing shall be provided at the following facilities:
    1) Storage and warehouse facilities;
    2) Signal bungalows.
d) Low Risk Facilities and Site Components: Knuckles down fencing, no higher than 1,200 mm and with no vertical protrusions (especially around facilities serving public and transit passengers), shall be provided at the following facilities:
    1) Fencing dividing multiple tracks;
    2) Rail side platforms;
    3) Significant grade and elevation change;
    4) Boundary definition as directed by Metrolinx;
    5) Bus loops and platforms;
    6) Access control flow;
    7) Ponds, ditches, swales, and high embankments.

3.6.1.4 Fencing must also consider the land use of adjacent properties and in some cases fencing height needs to be increased to prevent movement from GO property to adjacent properties. Minimum of 1,800 mm height of the fence is required if adjacent property is CN/CP rail corridor.

3.6.1.5 Note that condensers and generators adjacent to a station or terminal building shall have decorative fencing and lockable gates per manufacturer's clearance requirements.

3.6.1.6 Careful consideration shall be given to design of fencing to ensure that it is easily

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maintained. Complicated filigree and similar finishes shall be avoided. Fences adjacent to roadways and drive aisles are susceptible to increased accumulation of dirt and debris from seasonal conditions. Where possible, place buffers at these locations and ensure fences are installed at least 1 meter (approximately 3 feet) from the facility of maintenance building.

3.6.2 Gates

3.6.2.1 Railway Corridors–refer to Fencing and Anti-trespassing Requirements;

3.6.2.2 Maintenance access gates shall be a minimum of 2700-mm-wide, hinged single or double gates.

3.6.2.3 Sliding gates between tracks shall be a minimum of 2700 mm wide, single, or bi-parting gates.

3.6.2.4 All gates shall be lockable, single, or double locks if required by the Railway, Hydro, or other users.

3.6.2.5 Grounding and bonding is required for metal gates.

3.6.2.6 All gates that require electrical operation shall have local and remote capabilities (addressing access control, CCTV, intercom, data and power requirements).

3.6.2.7 Facilities that require a security gate to gain entry shall include an access control system, two-way communication to Metrolinx Security Office and CCTV monitoring of the gate.

3.6.3 Garbage and Recycling Storage Areas

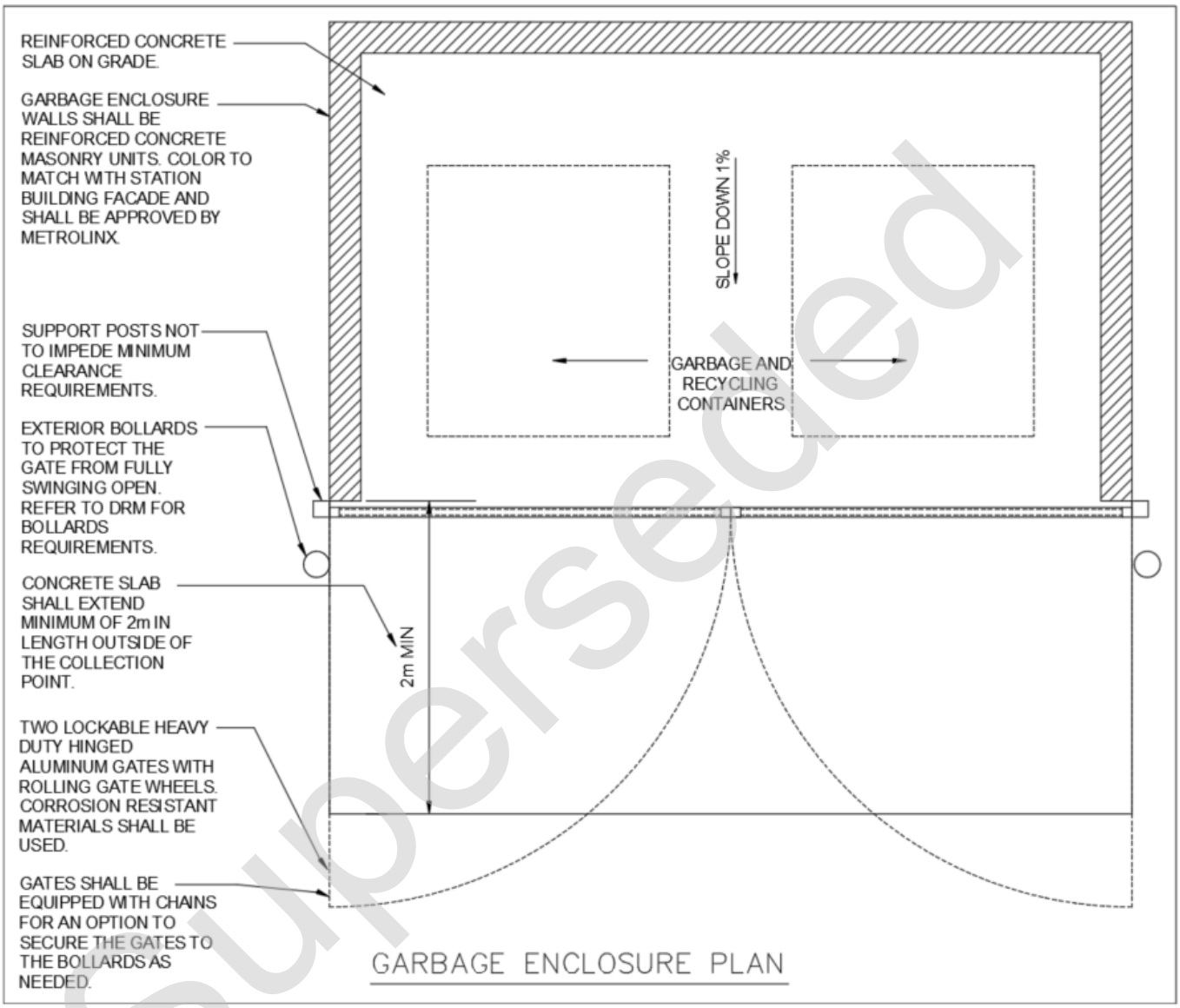
3.6.3.1 The Consultant shall verify garbage and recycling bin sizing with Metrolinx station services, local municipality and/or service provider to validate garbage enclosure dimensions prior to design. At a minimum, garbage enclosures must be large enough to conceal two 8-yard bins. Garbage enclosure spacing shall enable operational activities with space to allow garbage truck to lift bins from the enclosure.

3.6.3.2 The following criteria shall be met when deciding on a location for a garbage enclosure:

a) Safe and direct garbage truck access;
b) Roadway width to accommodate for the garbage truck turning radius;
c) Safe and direct Staff access / proximity to station;
d) Place on surplus land (land which cannot be used for anything else);
e) Keep away from pedestrian paths and waiting areas;
f) Keep out of direct view when entering the site;
g) Gates shall be equipped with “No Parking” signage to ensure accessibility is always maintained.
h) Figure 14 contains garbage enclosure design requirements.

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Figure 14: Garbage Enclosure



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3.6.4 Waste Receptacles

3.6.4.1 Placement of waste receptacles shall be provided in a way that does not interfere with customer access to station facilities and customer amenities. Turning circles shall easily accommodate commercial vehicles.

3.6.4.2 Provisions for waste receptacles shall be strategically determined based on site design, pedestrian flow and customer touch points throughout the facility.

3.6.5 Exterior Bollards requirements are:

a) Shall be integrated with station and bus terminal area design;
b) Bollards shall be approximately 200 mm in diameter and fabricated from 304 grade stainless steel with a satin finish;
c) The bollards shall project 1000-1200 mm above grade and set minimum 1200 mm into concrete pier. Bollards shall have a 50 mm contrasting reflective band (or approved equivalent) around the circumference of the bollard at a designated recessed space (to ensure durability), 80 mm below top surface;
d) Areas requiring additional safety, such as bus plazas with roll over curbs, shall have 200 mm diameter galvanized steel pipe, concrete filled, and protected with a 304 grade stainless steel cover of minimum 3 mm thickness and two 50 mm contrasting reflective bands around the circumference of the bollard;
e) At bus fuel storage areas, rail and bus maintenance facilities etc., provide bollards to protect electrical equipment locations and impact protection to hydrants and any other structures or equipment installed within 2000 mm of vehicle traffic areas; and
f) These bollards shall be 250 mm diameter concrete filled bollards. See Section 4 - Building Program, Maintenance Facilities requirements for details.

3.6.6 Interior Bollards requirements are:

a) When located in maintenance facilities shall be 150 mm diameter galvanized steel pipe;
b) Concrete filled;
c) Protected with 3 mm minimum thick high density polyethylene ‘safety yellow’ (or other colour as specified by GO) coloured cover;
d) The bollards shall project 1000-1200 mm. above finished floor with a minimum of 300mm below grade;
e) Cast with welded plate and 4 anchors into concrete slab;
f) The bollards shall be equipped with pole sleeve covers;
g) Interior bollards when located in stations and bus terminals shall be 200 mm in diameter and fabricated from 304 grade stainless steel with a satin finish.
h) Where bollards are to be installed at customer facing spaces, bollards shall have a 50 mm contrasting reflective band (or approved equivalent) around the circumference of the bollard at a designated recessed space (to ensure durability), 80 mm below top surface.

3.6.7 Removable Bollards

a) Permanently installed receiver below grade, with a top that is flush with the pavement and a cap to prevent dirt accumulation while the post is removed;
b) Removable post that can be manually lifted out of the receiver to allow access;
c) Exposed locking mechanism, with a padlock keyed to the line master;
d) Dimensions, covers and color schemes shall meet Exterior and Interior Bollard's requirements above.

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3.7 Civil Works

3.7.1 Storm Drainage

3.7.1.1 The design flood criteria for all sites shall comply with the Ministry of the Environment, Conservation and Parks Storm Water Management Practices, Planning and Design Manual, the Ontario Provincial Standards and Ontario Ministry of Transportation, as well as Regional and/or Municipal Storm Water Management requirements.

3.7.1.2 Storm drainage management systems shall be designed with consideration of future developments where applicable.

3.7.1.3 Drainage areas shall be directed to a storm water practice that incorporates an (OGS) Oil/Grit separators pre-treatment, where space permits, to mitigate the impacts of oil spills. OGS shall be placed within bus loops and diesel generator fueling areas and as directed by Metrolinx requirements. The location proposed for OGS shall eliminate any possible bus loop closure due to vacuum and service vehicles.

3.7.1.4 Generally surface water flow shall not be directed from parking lot to landscape areas. The exceptions include where parking lots drain to landscaped bioretention.

3.7.1.5 Manage rainwater and snowmelt on-site with design that encourages infiltration, evapotranspiration and water re-use.

3.7.1.6 Plant trees above grade from ponding areas and clear of stormwater flow; where applicable.

3.7.1.7 Platform slopes (longitudinal slope and cross slope) shall be designed such that it prevents water from ponding on the platform. Grading around structures shall promote positive drainage away from platform structure to avoid ponding against the structure or entering enclosed areas.

3.7.2 Storm Sewers

3.7.2.1 Catch basins shall be located upstream of pedestrian crossing areas, and 1500 mm clear of any driveway curb depressions.

3.7.2.2 Inlets and maintenance holes shall be located out of bus wheel path.

3.7.2.3 Side inlets shall be used within bus travel path.

3.7.2.4 Passenger platform curbs shall not be indented around catch basins.

3.7.2.5 Inlets and maintenance holes shall not be located on pedestrian access routes and/or in front of building doors.

3.7.2.6 Inlets and maintenance holes shall not be located in the wheel path of vehicular tires.

3.7.2.7 Catch basins in landscape areas shall be avoided.

3.7.2.8 Storm inlets systems shall have adequate capacity to accommodate storm runoff. Inlets shall mitigate flooding areas of pedestrian movement during storm events.

3.7.2.9 Grates shall be designed to handle expected load when subject to traffic and grates shall be designed for bicycle and wheelchair traffic.

3.7.2.10 Grates shall be diagonal type.

Superseded

3.7.3 Ditch Drainage and Ditch Culverts

3.7.3.1 Where a storm sewer system is not available, ditches and culverts shall be used.

3.7.3.2 Ditches shall be fenced, for safety, or filled with rip-rap, and topped with geotextile fabric and granular topsoil and sod as directed by Metrolinx.

3.7.3.3 Ditch Culverts shall have safety grates at ends.

3.7.4 Grading

3.7.4.1 Grading shall be designed to avoid excessive slopes and shall be integrated with surrounding landforms to provide slope stabilization and positive flows to the drainage system. Grade to eliminate rough spots and low areas and ensure positive drainage.

3.7.4.2 Grading and drainage shall be directed away from buildings and tracks to inlets of the stormwater management system in all areas, including paved surfaces.

3.7.4.3 Where existing landforms, or vegetation, are to be preserved, appropriate erosion and sediment control measure shall be implemented.

3.7.4.4 Where natural slopes cannot be accommodated due to space constraints, provide retaining walls as per the following requirements:

a) The Consultant shall select the optimum permanent retaining method (wood shall not be used for retaining walls).
b) Where concrete retaining walls are in proximity to the public, they shall be sandblasted.
c) Low retaining walls shall be precast concrete units.
d) Gabion walls may be used in non-public areas.
e) Where retaining walls are adjacent to buildings, the material shall be compatible with the architecture.

3.7.5 Waterproofing

3.7.5.1 All constructed below-grade reinforced concrete structures shall be designed to be watertight via an adhered impermeable waterproofing system where possible. At locations where the waterproofing system needs to be installed prior to casting the concrete structure, a waterproofing system with at least one impermeable non-expansive layer shall be selected. The waterproofing system shall be installed on the exterior (positive) side of the structure in conjunction with waterstops to be installed at all construction joint locations within the structure. All movement joint seals shall be designed to accommodate the expected movements and shall be compatible with the waterproofing system to achieve an integrated watertight system.

3.7.5.2 If portions of a below-grade reinforced concrete structure extrudes above-grade level and is exposed to chlorides, such as staircase knee walls then the above-grade portion of the structure shall also be designed to be waterproofed via an adhered impermeable waterproofing system. The waterproofing system shall be installed on the exterior (positive) side of the structure in conjunction with waterstops to be installed at all construction joint locations within the structure. If separate waterproofing systems are used for the above-grade and below-grade portions of the structure, then an overlapping detail shall be designed and included in the design package with selected product manufacturer for Metrolinx review, comments and edits. Separate overlapping systems shall only be selected from one (1) product manufacturer to ensure a continuous uniform warranty.

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3.7.5.3 All on-grade concrete structures such as slabs-on-grade shall be coated with a breathable penetrating sealer, such as silane-based sealer. Design documents shall include a statement ensuring that prior to the application of the sealer, the concrete has achieved its designed/specified compressive strength. The application of an impermeable coating is not permitted on the topside of such structures as moisture can freeze below the coating and cause de-bonding of the coating and/or surface delamination under the impermeable coating.

3.7.5.4 All suspended above-grade reinforced concrete structures that experience vehicular and pedestrian traffic such as, but not limited to, suspended slabs at rail platforms and parking structures, shall be coated with an impermeable traffic coating system to protect the reinforced concrete from traffic wear, water and chloride penetration. The selected traffic coating system shall be finished with a wear course that is manufactured to tolerate the expected level and type of traffic. At locations where the traffic topping is exposed to sunlight, an Ultraviolet (UV) stable product shall be selected.

3.7.5.5 All waterproofing systems shall be designed by a building science specialist. The design submittals and design specification indicate the specific product list to be submitted to Metrolinx for review, comments, and edits prior to submitting the 90% design package. Design documents shall include a statement ensuring that prior to the application of the waterproofing system, that the concrete has achieved its designed/specified compressive strength and the moisture content in the concrete meets the waterproofing manufacturer's requirements.

3.7.6 Snow Control

3.7.6.1 Provision for snow control to reduce snow deposits in unwanted areas shall be employed.

3.7.6.2 Snow storage areas shall be identified on the Landscape Plan.

3.7.6.3 Provide snow storage areas away from public streets, motorist/pedestrian sight distance and where continuous landscape screening is essential.

3.7.6.4 Snow storage is not permitted on permeable paving or bioretention features; pre-treatment, such as a grass filter strip, shall be implemented between snow storage and the receiving low impact development (LID) practice.

3.7.6.5 Snow storage shall be considered from the early design stage, coordinate location with Metrolinx operation team.

3.7.6.6 Storm inlets shall be designed to capture snow melt from snow storage areas.

3.7.6.7 Snow storage shall not block inlets intended for draining surrounding area.

3.7.6.8 Landscaped areas with salt tolerant plants may be identified for snow storage.

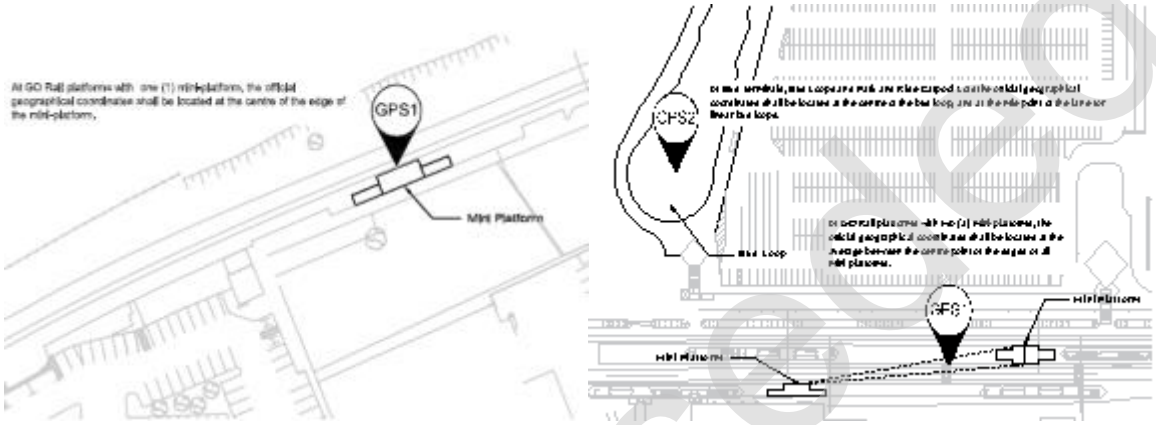
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3.8 Geodetic Reference

3.8.1 Station Geographical Coordinates

3.8.1.1 For GO Stations, the official geographical coordinates are to be located at the centre of the edge of the mini platform as outlined in figure–Geographical Coordinate Placement at Mini-Platforms.

Figure 15: Geographical Coordinates Placement



3.8.2 Projection System

3.8.2.1 The following Reference Datums and Grid System shall be used, in accordance with the MTO's Engineering Survey Manual dated October 2006:

a) Map Projection→ 3-degree Modified Transverse Mercator (MTM) Zone 10;
b) Horizontal Reference Datum→ North American Datum (NAD) 1983, using the NAD83 Canadian Spatial Reference System (CSRS) adjustment Horizontal Datum / Ellipsoid: NAD83 CSRS v.6 (epoch 2010.0) / GRS80;
c) Vertical Reference Datum→ Canadian Geodetic Vertical Datum (CGVD) 1928 Orthometric Elevation: CGVD1928:78 Adjustment.

3.8.3 Three-Dimensional Geodetic Control Points

3.8.3.1 All GO Stations, Bus Terminals and Park and Ride Car Pool lots shall have three-dimensional geodetic control points installed with both Vertical and Horizontal known measurements.

3.8.3.2 Along the rail corridors, three-dimensional geodetic control points shall be installed and the monuments placed on fixed and stable structures including: bridges, abutments, retaining walls and grade separations.

3.8.3.3 Control points shall be placed on a fixed and stable structure, including, station buildings, parking structures, tunnels, bridges or abutments.

3.8.3.4 At locations with existing geodetic control points, benchmarks shall be removed and replaced during construction.

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3.8.3.5 Accuracy requirements are:

a) Horizontal Control Points:
   1) Network Accuracy of 4 cm (95% Confidence Interval) for Northing, Easting, and Ellipsoid Elevation relative to the Active Control Stations;
   2) Local Accuracy of 2 cm (95% Confidence Interval) for Northing, Easting, Ellipsoid Elevation relative to the adjoining station baselines at each location.

b) Vertical Control Points:
   1) Elevation values of all installed monuments to be established by precise leveling. Methodology, equipment, and procedures shall comply with “Vertical;
   2) Control Survey Specifications,” MTO, May 2011;
   3) Vertical accuracy shall be first order;
   4) Level loops to begin and end on an existing first order vertical benchmark;
   5) For each existing benchmark used, a stability check shall be done prior to commencement of leveling;
   6) All existing 1st Order geodetic benchmarks adjacent to a GO station must be measured.

3.8.3.5.1 In cases where stable 1st Order benchmarks do not exist in areas adjacent to a GO station, other benchmarks may be used subject to authorization and instructions from the GO lead surveyor.

3.8.3.5.2 For additional Geodetic reference information refer to Asset Data and Information Standards, Metrolinx Survey Control in Transit Corridor Supplement, and CADD/ BIM Standards Manual.

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4 Building Program

4.1 Bus Terminals

4.1.1 GO Transit has three basic types of bus terminals: stand-alone, station-shared and joint-development. The exterior architectural form will vary as follows:

a) Stand-alone terminal buildings shall be designed to suit the architectural context of the site. Refer to GO Station Architecture Design Standards for detailed requirements;

b) For stations and terminals that share space with other agencies, functional program and building size shall be determined in consultation with partner agencies; and

c) Joint-development terminals shall conform to the architecture of the development that encompasses them or shall be designed as stand-alone terminals, where external visual identity is warranted within the development. Refer to GO Station Architecture Design Standards for detailed requirements.

4.1.2 Building Program for Terminals follows the Station Building requirements with the exception of areas outlined below.

4.1.2.1 Refer to GO Station Architecture Design Standard for detailed requirements.

4.1.2.2 Refer to Technical Requirements and Operational Facilities for building service details.

4.1.3 Dispatcher Room

4.1.3.1 The bus dispatcher room, where required, shall be elevated to permit the dispatcher in a seated position to have sight lines of all buses. It shall be located strategically for visibility of bus bays, particularly of arriving buses. The usual location is on an external wall, but it may also be located within the waiting room. Generally, it shall be adjacent to the driver room and shall have access from the driver room.

4.1.3.2 Both rooms may also be adjacent to the station attendant room, in which case a staff room may be provided in common for the dispatcher, drivers, and station attendants, with shared washroom and kitchenette facilities. Depending on the size of the facility, separate male and female staff/driver washrooms may be required.

4.1.3.3 The floor shall be elevated a minimum of 570 mm above the waiting room floor level and platform level, equivalent to a minimum 3-riser stair requirement. The seated dispatcher's eye level will then be approximately 1.69 m above platform level, over the heads of most passengers. Other design requirements include:

a) Desk-height counter with insulated glazing above, knee-space below;

b) Side and/or back counters to be typical counter height with task lighting from wall-hung cabinets;

c) Wall hung cabinets with adjustable shelves and lockable doors;

d) Non-glare recessed LED luminaries with lenses;

e) If the room is on an exterior wall, insulating glass shall be fully tempered tinted low-E glass;

f) Interior locations to have fully tempered 10 mm clear glazing;

g) Where a dispatcher room is adjacent to a driver room, but has a separate entrance, a pass-through sliding-glass window shall be provided between them, operable by the

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dispatcher, for receiving driver reports and direct communications;

h) Where a dispatcher room is in a waiting room, the pass-through window may be required into the waiting room;

i) A coat storage closet, or coat space behind entrance door;

j) A Driver Manual storage cabinet with shelves and doors;

k) A window transom/bulkhead designed for blinds;

l) A magnetic bulletin/white-board, wall mounted or on cabinet doors above counter-height, built-in if required;

m) Access to a staff washroom (see above); and

n) Water cooler.

4.2 Operational Facilities

4.2.1 Rail Operational Facilities - Refer to standalone GO specifications for Rail Operational Facilities.

4.2.2 Bus Operational Facility

4.2.2.1 GO owns a number of Bus Operational Facilities for the purpose of storage, repair, maintenance, cleaning, and fueling, with ancillary administrative offices. Bus Operational Facilities are classified as Type A, B, or C based on land sizing, parking, facilities provided and fleet requirements. Refer to the Table for Bus Operational Facility Typology and associated amenities.

4.2.2.2 Detailed design criteria will be provided by GO at the commencement of new projects. This Section is not intended to be a specification; the intent is to ensure uniformity in the Bus Operational Facility designs.

4.2.2.3 The standard Bus Operational Facility program is based on the following:

a) Maintenance Facility;

b) Storage Facility;

c) Office Facility.

4.2.3 Bus Operational Facility Typology provided in Table 8

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Table 7: Bus Operational Facility Typology

Bus Operational Facility Typology					
Land Requirements			***Type A Full Service***	***Type B***	***Type C***
			15+ acres	***5-14 acres***	***3-4 acres***
Parking	Buses	Indoor	40-105	21-42	12
		Outdoor	12	0-5	0-4
	Cars	Employee	140-200	33-56	14-20
		Corporate	10-12	2-6	1-2
Facility Requirements		Rooms	Yes	Yes	Yes
		Showers	Yes	Yes	Yes
		Lockers	Yes	Yes	Yes
		Lunchroom	Yes	Yes	Yes
		Kitchenette	Yes	Yes	Yes
		Lounge	Yes	Yes	-
		Office	Yes	Yes	Yes
Bus Fleet Maintenance	Fueling	Indoor	Yes	Yes	-
		Outdoor	-	Yes	Some
		Offsite	-	Some	Yes
	Repair Area	# Hoist Repair Bays	0-2	0-2	-
		Hoist	Yes	0	-
		Pit	2-3	0-1	-
		Bus Wash	2	1	-

Superseded

4.2.4 Type “A” Bus Operational Facility

4.2.4.1 This program describes the general spatial provisions at a Type “A” bus operational facility.

Superseded

Table 8: Exterior Circulation

Exterior Circulation	
Feature	***Design Requirements***
Roadway Tie-Ins	Interface with existing and future road and walkway networks One way traffic is preferred with minimum reverse operations.
Paving	Paving shall support vehicle types without cracking or settlement from standing or moving traffic. Concrete surfaces shall be provided for high bus traffic areas especially corners and outdoor fueling areas.
Curbs	Shall be designed and located per site conditions and industry standards.
Exterior Stairs/Ramps	Provide for barrier free and pedestrian access
Fencing	Fencing shall be a 2.44m high wrought iron fence along the front façade. The remaining perimeter will be 2.4m high black vinyl coated chain link fence.
Gates	Require high-speed by-fold automatic gates to be operated remotely from area(s) designated by the owner or through the FOB, two-way communication system if available. Gates must be activated by underground loop detectors, proximity cards, and existing bus transponders. Electrical controls shall be provided as part of the gate system and gate height is to match site fencing. All security gates shall have CCTV monitoring. Refer to Gates under Fencing in technical requirements. for further information.
Stormwater Management	Stormwater Management shall be designed by grading the site to direct run-off water to catch basins and subsequently to storm sewer system. In areas where drainage to grade would run to paved areas, direct to storm sewer. Ensure grades are provided to slope away from the building. No surface storage/ponding of water will be accepted in parking areas during storm events.
Impact Protection	Provide impact protection to hydrants and any other structures or equipment installed within 2.0m of vehicle traffic areas. Refer to technical requirements., Site Furnishings, and Exterior Bollards for installation details.

Superseded

Table 9: Landscaping

Landscaping	
Feature	***Design Requirements***
Design	Landscape design shall ensure ease of maintenance. Materials shall be durable (e.g., salt resistant) and resistant to vandalism. Snow storage shall be taken into consideration. Landscape design shall respect the form, scale, and materials of both the surrounding area and proposed development. Circulation, comfort and safety, environment and crime protection (CPTED) shall also be considered in the choice of landscaping elements
Native Plant Material	Native plant material as appropriate is encouraged. Patio areas with coloured concrete are preferable
Lawn Sprinkler Systems	Lawn Sprinkler systems, if required, shall be provided with timer (plus manual override)
Future Expansion	Landscape shall be able to accommodate future expansion with minimal disruption or disturbance.

Table 10: Signage

Signage	
Feature	***Design Requirements***
Signage	Refer to Metrolinx Sign Implementation Manual GO Transit Edition

Table 11: Clearance and Circulation

Clearance and Circulation	
Feature	***Design Requirements***
Heights	Coordinate clear building heights with actual heights of buses, equipment, and the like. Maintain minimums provided and as required for full and complete operation of the facility.
Features	Design the facility to accommodate ample clearance requirements in plan and elevation of all current GO buses and equipment and GO standard vehicle turning radius' and sweep paths with allowable safety factors.

Table 12: Structural Elements

Superseded

Structural Elements	
Feature	***Design Requirements***
Structural System	The design shall be based on the most cost effective structural system when considered in the context of both the capital cost of construction and the projected life-cycle cost of the maintenance facility garage assuming a 50-year service life.
Building	The building shall be reinforced concrete, pre-stressed concrete, structural steel, or a combination of these.
Loading and Deformation Requirements	The design shall consider the loading and deformation requirements of the structure in relation to the requirements of other disciplines. These disciplines shall identify the loading and deflection requirements and the anticipated structural deformations and movements of their work for incorporation in the structural design and construction.

Table 13: Architectural Elements

Superseded

Architectural Elements	
Feature	***Design Requirements***
Architectural Pre-Cast Panels	Panels must comply with OBC requirements and have R-values as required by current industry standards. Rainscreens, if proposed, are to be installed with proper joint treatment using low VOC sealant. Interior of the precast panels shall be finished smooth suitable for paint application. Architectural elements carrying branding features need prior approval from GO
Insulated Metal Siding	Shall be designed to withstand windload from inside and outside as required by current industry standards
Explosion Relief Panels	Design pressure relief panel system and shop calibrate to release at a static pressure differential between interior and exterior. Design panels and structural supports to withstand wind loads as required by current industry standards
Pre-Finished Aluminum Panels	Oil canning and deflection are unacceptable. Standard materials, components, fasteners and cap flashing per industry standards are preferred
Canopy	Soffit and flashing shall be prefinished aluminum panels.
Roofing	Easily maintained, roofing system technologies to meet specific LEED criteria.
Aluminum Curtain Walls And Windows	Fenestration shall comply with CAN/CSA standards regarding air and water leakage for aluminum windows. Exterior doors shall meet air-leakage rate requirements. The system shall be designed to accommodate expansion and contraction with a service temperature range of -35° C to +35° C
Roof Items	Above ground, roof serviceable items shall be designed to avoid fall hazards.
Skylights	Tinted, sealed, double-glazed units in clear anodized aluminum framing with positive drainage, and complete with integral curbs, is recommended. Sealed glass requirements shall be the same as specified for curtain walls but with heat strengthened exterior light and laminated heat strengthened interior light
Exterior Bollards	Refer to Section D.7, Site Furnishings, Exterior Bollards.

Superseded

Sound Transmission Class (STC)	Private offices, meeting rooms, training rooms, drivers' quiet areas, and all office washrooms shall be designed to achieve a minimum STC rating of 55. Stores and Simulator rooms shall have a STC rating of 63, unless otherwise specified
Masonry Partitions	Block size; fire rating, etc. shall be standard concrete block, reinforced to Code Requirements.
Exterior Industrial Doors Overhead Doors	Exterior Industrial Doors/Overhead Doors are Foam-in-place, insulated, sectional overhead, torsion spring counterbalanced and electrically operated. Controls and equipment and shall be of minimum lift 30' per sec speed with multiple safety systems to prevent damage or injury. Doors shall have a min. R-value of 12.5. Edge protection for operators (Machine Safeguarding) shall be provided. Door height shall accommodate overhead clearances per bus type at designated facilities
Interior Hollow Metal Doors	To have the maximum glass lights as allowed by Code. All exterior hollow metal doors shall have clear insulating vision lights (150 x 600 typical).
Oversized Doors	At electrical rooms, storage rooms, mechanical rooms, compressor rooms, etc. shall allow for equipment delivery and removal
Wood Doors	Hardwood veneer in species in all administration areas with side and door lights
Overhead Coiling Fire Doors	Shall be face-of-wall mounted galvanized steel, manually operated complete with locking mechanism, fabricated in accordance with NFPA 80 standards
Counter Shutter	Coiling steel in the administration area shall have similar requirements as above and electrical powered.
High-Speed Fabric Doors	High-speed fabric doors shall be fabric curtain with breakaway and electric reversing bottom bar, view windows, frames, counterbalance mechanism, controls, operators, and dual electric safety eyes. Curtain shall be selected to suit door opening width.
Office Doors	Office doors shall have frosted glass for glazing and adjoining windows to have roller shades.

Superseded

Traffic Lights	Shall be provided for all non-pedestrian doors: Green and red signals to indicate safe or unsafe conditions for vehicle “IN” movement. Lights shall be traffic style, complete with signs.
Motion Sensors	Shall be provided to increase monitoring distance to stop and reverse doors when in downward motion.
Sliding Automatic Entrance Doors (Exterior and Interior)	Sliding automatic entrance doors shall include operator, header and track, jambs, sliding door panels, and sidelights. Units can be mounted within rough opening with sliding panels sliding along sidelight. Units will be bi-part and slide-swing panels shall slide along interior side with Microprocessor Master Control.
Internal Handrails and Guardrails	Internal handrails and guardrails shall be stainless steel. All external and wet location handrails and guardrails shall be Hot Dip Galvanized.
Interior Bollards	Shall be 150mm diameter steel pipe concrete filled, galvanized and protected with a yellow 1/8” thick high density polyethylene ‘safety yellow’ coloured cover, projecting 1.2 m. above floor and cast with welded plate and 4 anchors into concrete slab, they shall be equipped with pole sleeve covers
Lockable Gates	Shall be minimum (600 mm x 1200 mm wide) with heavy-duty hinges and cylinder locks. Barrier free gates where located, shall be sliding and motorized with security features. Refer to Gates under Fencing in Section D & Table E-18 & E-19 for further information.
Wash Splash Guards	Wash splash guards shall be provided on each side of service lanes between bus wash equipment and building wall. Splash guards shall be corrosion-proof, minimum height 1.2 m above top of wash equipment
Hallway Windows	Shall allow natural light infiltration, UV protection film is recommended for sunlight diffusion.
Bike Lockers	Bike lockers shall be provided with power outlets for electrical bikes as determined by GO staff.
Concrete Curbs	Underneath the electrical panels shall be provided to protect conduits from the maintenance equipment (floor sweepers, etc.).

Table 14: Architectural Finishes

Superseded

Architectural Finishes	
Feature	Design Requirements
Ceramic Tiles	Ceramic tiles shall be installed on high traffic area walls (4' high tile cladding for corridors) and wall dado installation for washrooms.
Porcelain/Resilient Tile Flooring	Tile flooring shall be provided in maintenance offices, hallways, vestibules, and high occupancy areas.
Carpet Tile	Shall be provided in offices, meeting rooms, etc.
Rubber Sports Floor	Rubber sports flooring shall be provided in the Wellness Room.
Stair Treads and Landings	Stair treads and landings shall be rubber treads with non-slip nosings to meet current industry accessibility standards.
Service Lanes and Degrease Bay Floors	3-part troweled system consisting of a two-part epoxy sand aggregate and topcoat in manufacturer's standard colour range.
Shop and Garage Area Floors	Minimum 4.88 kg/m2 trap rock, water cure, and liquid densifying sealer. Floor sealant shall provide necessary traction to avoid bus skidding at storage/service area/garage area.
Interior Painted Lines	Interior painted lines shall be provided along Safety Area around electrical panels and fire hoses and at hoist bays, pits and all shops. Epoxy based line painting shall be provided in all bus storage and maintenance areas.
Stock Room Counter	Shall be stainless steel with wood backing
Touch Zone	Up to 3m of the maintenance and storage facilities shall be epoxy coated to allow for pressure washing.

Table 15: Fixtures

Superseded

Fixtures	
Feature	***Design Requirements***
Toilet Partitions and Urinal Screens	Toilet partitions and urinal screens shall be stainless steel, ceiling, or wall mounted.
Aqueous Ozone Cleaning System (AOCS)	High stability (24 hour) Aqueous Ozone Cleaning System (AOCS) to meet Green Seal standards GS-37 and GS-53.
Sloped Top Lockers	Top lockers shall be pre-finished, sloped top, located on concrete base.
Coat and Hat Racks	Coat and hat racks shall be provided in administration areas.
Foot Grilles	Foot grilles shall be vinyl surfaced, recessed type, in extruded 6063-T52 aluminum alloy framing.
Roller Shades	Rollers shades shall be provided for all windows in the Administration Building.
Meeting Room Fixtures	Meeting rooms shall be equipped with ceiling mounted motorized projection screen, projectors, and speakers.
Kitchen Equipment/Fixtures	Kitchens shall be commercial quality, energy star compliant. Kitchens shall include refrigerators, ovens with a range ventilation hood to the outside, built-in or counter top microwaves, and dishwashers.
Dual Burner Coffee Makers	Coffee makers shall have an in-line water filter and be provided in the Training Centre and Administration Lunch Room
TVs	TV's shall be provided to suit the Lunch Room size.
Countertops	Countertops in all kitchens, washrooms, and dispatch areas shall be solid surfacing 12 or 13 mm thick with a backsplash–6 mm thick.
Pop and Snack Dispenser	One (1) pop and snack dispenser each shall be located in the lunch area.

Table 16: Specialties

Superseded

Specialties **(the facility design shall incorporate these specialty features)**	
Feature	***Design Requirements***
Hybrid Bus Wash System	Hybrid bus wash systems shall be environmentally friendly, with front and rear high-pressure wash and side brush systems.
Fueling Monitoring	Indoor or outdoor bus fueling service bays per facility type with full TSSA compliance for operation and maintenance
Inspection Pit Bays	Shall comprise of inspection pits, pit jacks, central pit catch basins, fluids distribution, waste fluid drains and compressed air distribution and explosion proof low voltage lighting / ventilation (bottom pit air vents).
Fluid Dispensing and Tank Storage	Fluid dispensing and tank storage shall be designed for spill containment.
Compressed Air	Compressed air distribution
Tracking Systems	Radio/Antennae/Vehicle tracking systems/Satellite TV provision
High Speed Doors	With machine safeguarding
Traffic Signals	Traffic Signals/detector loops
Environmental Controls	Separators/sand pits and Sand and oil interceptors.
Control	Geodetic control survey movements
Arrest System	Roof Fall Arrest System Travel Arrest as Required
Elevators	Electric Traction MRL Elevator(s)
Snow Melting	Snow melting at desired locations.
Floor Heating	Radiant floor heating.
Equipment	Equipment shall include Loading Dock, Door, Seal, Trailer Restraint, and Leveler Equipment.
Architectural Specialties	Include toilet partitions and screens, washroom accessories, lockers, coat and hat racks, foot grilles, coat hooks and shelf unit, ceiling mounted projection screen, pass-thru window.

Table 17: Life Safety

Superseded

Life Safety	
Feature	***Design Requirements***
Fire Safety Plan	Fire Safety Plan to be developed specifically to the category / facility type it is design for, and consistent with local Fire Department requirements. The facility design shall incorporate the following features: • Alarm systems–interface/monitoring including vehicle emission alarms with CO2 and NO sensors. • Automated energy and environmental monitoring/management systems • First Aid/Emergency routing • Monitoring systems • Sprinklers • AED

Table 18: Safety and Security

Superseded

Safety and Security	
Feature	***Design Requirements***
Design Optimal Safe Solutions	Design Consultant to demonstrate their design's optimal safe solutions based on comprehensive Risk Assessment and sound Safety Engineering Principles. Some elements may include Cost Benefit Analysis, Alternatives Comparison, Threat Vulnerability Assessment, Safety Factors, and Residual Risks. Office of System Safety shall be consulted for solution assessment.
Site Assessment	Each site shall be assessed to determine the extent to which perimeter security and controlled access points are provided. In general, perimeter fencing and controlled gated vehicular access shall be required to protect the Bus Maintenance Facility from unauthorized entry, vandalism, theft, and terrorism.
Points of Entry	All points of entry must be furnished with street lighting, controlled access systems monitored with closed circuit video system camera which is to be fed to a central location named by GO.
Fencing	• Fencing shall be designed as one of the physical delineation measures around the facility to control and monitor authorized access into the area. • Designs shall consider first passive security measures i.e., CPTED (Crime Prevention Through Environmental Design) before active ones.
Design Features	The design shall incorporate the following features: • High speed gates • Surveillance • Access control–Proximity cards • Local intercom controlling gates onto property • Design facilities to follow basic Safety Engineering principles: • Eliminate hazards by engineering design • Follow FTA / APTA recommendations, guidelines for Bus Facilities • Exceed relevant safety legislations (i.e., OHSA, TSSA, CSA, OESC, CEC etc.) as required to minimize risk(s) • Consider potential future expansion, modifications, retrofits • The design of the facility shall be safe and easily serviceable, maintainable and user friendly.

Superseded

Design Concerns	• Some of the typical, but not limited concerns include: • Fall Hazards (adequate roof perimeter protection–parapet, guardrails if necessary, adequately load rated skylights, location and position of serviceable equipment above ground level / at height, roof access, adequate clearance from the roof edge (min. 3.0 m), etc. • Aligning of lighting fixtures, gas lines, power lines (and other serviceable components) with flat landing section and avoid interference with structural components for easy access. • Avoid Confined Spaces (adequate ventilation, atmospheric condition, access, egress, rescue, etc.). • Avoid pinch points / spots / corners (adequate walkways, clearances, visibility, access, egress, reach, etc.). • Any sources of energy to be lockable–(CSA Z 460) • All qualified equipment / machine to be properly safeguarded–(CSA Z 432) • Electrical, for information on Arc Flash Hazards and labeling" after reference to Arc Flash • PSR's (Pre-Start H&S Reviews–Industrial Establishments, O. Reg. 851 / 06 section 7) to be conducted as required. • Ergonomics, cognitive concepts to be utilized (signage, information effectiveness etc.) • Human Factors, Ergonomics, cognitive concepts to be utilized (signage, information presentation, effectiveness etc.); MIL STD 1472 is suggested as a minimum, may be supplemented by other respected references. • Traffic flow to separate / reduce crossovers (cars, buses, pedestrians)
Securing and Monitoring of Facilities	• Design Facilities to be adequately secured and monitored • Some of the typical, but not limited, concerns include: • Follow proper Safety & Security Planning (i.e., TVA, study crime rate within the specified area etc.) • Entire facility's perimeter to be adequately delineated / fenced (physical security, CPTED principles to be utilized). • Gates / Access control plan. • Fire Separation Zones (vulnerable areas) • CCTV cameras / system • Other Security measures ('cash in / out' activities, secure transactions) where applicable.

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Environmental Concerns	• Design Facilities to be environmentally friendly • Some of the typical, but not limited concerns: • Isolate and protect vulnerable areas, enhance detection systems, hardened protective materials i.e., storage tanks. • Spill containment to be within the room, few levels of redundancies anticipated. • Septic tank, if required, to be isolated from oil collecting system (potential overflow concern). • Bulk fluids tank to be strategically placed and protected (accidental damages.
Bus Traffic Flow	• Bus Traffic flow: • To eliminate 180 degree bus turns. • To separate / reduce traffic crossovers (passenger cars, buses, pedestrians) • Skylights shall be designed with consideration for material, location, position, fall protection, etc.). • Guardrails on the roof shall be provided if required as a fall arrest system.

Table 19: Communications

Superseded

Communications	
Feature	***Design Requirements***
Key Components	• The key components of communications in bus maintenance facilities are as follows: • CCTV • Security and Telephone (interconnected with GO regional offices) • Network synchronized clock and coax cable distribution. • PRESTO
System Interface	• The following systems shall interface with existing GO related services: • Radios Trunking system • Telephones • IT/LAN • Public address system • Intercom system • Cable TV distribution system • Access Control and Intrusion Detection System • Building Automation System (BAS) • Refer To Metrolinx Standard Building Automation Systems Performance Specification 25 05 10 for details. • Tank and Fuel Card Lock System • CCTV system • Signal lights

Table 20: Mechanical

Superseded

Mechanical	
Feature	***Design Requirements***

Superseded

Guidelines	Requirements for the design, specification, and installation of mechanical equipment are to be used in conjunction with this Manual. The Consultant shall ensure that all applicable codes and standards are included in the construction documents. Fire suppression systems shall be provided in all applicable areas. Domestic hot water will be supplied by natural-gas fire instantaneous hot water heaters. Floor drains shall be used in the office and general area and trench drains or precast concrete catch basins and degrease bays are to be provided in repair garages, bus bays and storage areas. Control Flow of roof drainage with heat tracing shall be provided. Standpipe system for type “A” facilities shall be provided. Use CSA approved plumbing fixtures in all washrooms, showers, lunchrooms and kitchenettes and wherever else applicable. Provide gravity drainage systems wherever possible. Comply with code requirements for indoor air quality. Ensure proper maintenance of repair garages, inspection pits, service lanes, and storage garages. High-level ducted exhaust shall be provided. Unit heaters or radiant heating system shall be provided at every external door location. Central hot water generating and distribution system shall be provided. Bus engine exhaust and bus auxiliary heater exhaust system, battery charging areas, lube room and hazardous materials storage, shall be provided. Insulate ductwork and piping shall be provided as specified. Piping materials, which are compatible with environmental conditions, shall be used. Valves, thermometers, pressure gauges shall be installed as detailed. Complete building automation system shall be provided. Refer to Metrolinx Standard Building Automation Systems Performance Specification 25 05 10 for details. Where applicable, provide fuel storage and dispensing system, which shall be designed and certified by a licensed engineer. Provide gas fired, heated, multi-station pressure washer systems. Provide vehicle wash systems as specified by GO standards. Provide in-ground bus hoists, mobile lifting columns, inspection pit axle hoists, service fluids, central vacuum systems, compressed air systems, and gas detection systems as specified by GO standards.

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	Mechanical systems and services must be designed to permit future expansions with minimum disruption in operations
Mechanical Requirements	The following shall also be provided as part of the mechanical requirements of the facility: • Commissioning • Energy efficiency • Construction IAQ managing • Electric heat tracing and snow melting
Process Equipment and Systems	Process equipment and systems to include: • Fuel storage and dispensing • Pressure-washer systems • Vehicle wash systems • Bus hoists • Fueling card lock system • Tank monitoring system • Service fluids dispensing system • Central vacuum systems • Compressed air system • Hose reels • Gas Detection Systems

Table 21: Electrical

Electrical	
Feature	***Design Requirements***
Electrical	Refer to Section 5

Table 22: Future Expansion

Superseded

Future Expansion	
Feature	***Design Requirements***
Mechanical and Electrical Systems and Services	Mechanical and electrical systems and services must be designed to permit future expansion with minimum disruption to operations.
Radiant Floor Heating Systems	Radiant floor heating systems must be expandable without cutting the slab previously installed.
Fire Suppression Systems	Must be designed so that zones installed may be expanded without modification of existing piping, or spare piping must be run from the header or pre-action control unit, for connection extension in the future. Headers and/or pre-action control equipment must be sized to accommodate the future expansion
Compressed Air Piping	Must include valves and capped connection to permit extension of the system installed in this phase without disruption to operations.
Sanitary Drainage Systems and Storm Drainage Systems	Sanitary and storm drainage systems must be installed with invert elevations and configuration to permit expansion without removal of more than 2 m2 of slab on grade at each connection within 1.2 m of building exterior wall.
Control Systems	Control systems shall include provision for future expansion without replacement or duplication of operator's workstation.

Table 23: CCTV

CCTV	
Feature	***Design Requirements***
Location	Exterior to the main facility may have storage for buses and other maintenance equipment
Bus Movement	Bus movement is restricted to authorized and appropriately licensed personnel with directional control in and around the facility.

Table 24: Automated or Monitored Gates

Superseded

Automated or Monitored Gates	
Feature	***Design Requirements***
Features	• Dedicated cameras • Individual cameras for each gate • Identify individual and vehicle movement • Read license plate and or any vehicle identifiers • PTZ type set to maximize control point area • May be mounted on building or dedicated 6m pole, depending on location • Refer to Gates under Fencing in Section D & Table E-18 & E-19 for further information

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Table 25: Main Gate

Man Gates	
Feature	***Design Requirements***
Features	• Individual cameras for each man gate • Identify individual and movement • PTZ type set to maximize control point area • May be mounted on building or dedicated 6m pole, depending on location • Refer to Gates under Fencing in Section D & Table E-18 & E-19 for further information

Table 26: General Office

Superseded

General Office	
Space	***Design Requirements***
Main Entrance Vestibule and Lobby	Main entrance vestibule and lobby shall have reception counter and separate workstation.
Unisex Visitors Washroom	Unisex visitors' washroom shall be barrier free.
Managers' Offices	Fleet Transit Safety and Facilities Managers, rooms shall be sized as per GO Standard Office Module Furniture.
Radio System Specialist Office	GO Standard Workstation Modules.
Senior Fleet Supervisor Office	GO Standard Workstation Modules.
Bus Facilities Supervisor Office	GO Standard Workstation Modules.
Administrative Staff Workstations	GO Standard Workstation Modules.
Customer Care Coordinator	GO Standard Workstation Modules.
Performance Advisor	GO Standard Workstation Modules.
Spare 'hoteling' Workstation	Spare hoteling workstation shall be common to all functions.
Storage Room	Storage room shall secure File Storage, Printer, Fax, and Vault.
Meeting Rooms	Capacity: (8/12/20 persons), as advised by GO.
Lunchroom / Kitchen	Lunchroom / kitchen shall accommodate 12 people at any given time.
Printer / Fax / Photocopier Room	Printer / fax / photocopier shall be centrally located room with supply storage, work surfaces, and office mail slot.
Men's Washroom	Men's washroom shall be barrier Free, WC's and urinals as per program requirement.
Women's Washroom	Women's washroom shall be barrier Free, 3 WC's.
File Area	File area shall be a central file and office supply and MTO Records Storage.

Table 27: Safety and Training Programs

Superseded

Safety and Training Programs (as Advised by GO)	
Space	***Design Requirements***
Transit Safety Group Supervisors (Min. 2)	GO Standard Workstation Modules.
Transit Safety Staff Coordinators Workstations	GO Standard Workstation Modules.
Video Viewing Room	Video viewing room Shall contain Video Storage Shelves.
Transit Safety File Storage Room	Secure file Storage Printer and Fax.
Driver's Safety & Training Centre	To be used by Transit Safety for presentations to 30 people.
Simulator room	To be used by Transit Safety for presentations to 30 people.
Training Centre Supply Room	The Training Centre Supply Room shall be provided with shelving.
Kitchenette–Training Centre	-
Safety & Training Supervisor	File storage area required.

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Table 28: Administration and Services - Operations

Superseded

Administration and Services: Operations	
Space	***Design Requirements***
Manager of Operations and Bus Facilities	Room sized per GO Standard Office Module Furniture.
Superintendent of Operations	GO Standard Workstation Module.
Bus Operations Supervisor	GO Standard Workstation Module. File storage area required.
Bus Driver's Quiet Room	Bus drivers quiet room to accommodate recliners per program requirement.
Bus Driver's Reporting Room	Bus drivers reporting room shall have no more than 20% attendance at any time.
Dispatch Area	Adjacent to Reporting Area, with pass thru window, Radio system, Bus AVL, Train AVL, White Board, TV. Monitors faced away from general viewing. These include workstations per program requirement.
Main Communications Equipment	-
Cash In Room	Cash in room shall be located with a view to Dispatch and shall be provided with built-in workstation and pass-through window.
Driver's Mail & Forms Room	Driver's mail and forms room shall be equipped with shelving for storage and mail slots.
Men's Washroom & Showers	WCs, urinals, showers, lockers for the Wellness Centre and full lockers for Transit Safety and Station Services per program requirement.
Women's Washroom & Showers	Close to Wellness Centre, with ½ size lockers as required, placed on a 100mm concrete curb.
Bus Drivers Lockers	-
Meeting Room	-
Records Storage Room	-
Wellness Centre (With External View)	Separate Wellness Centre lockers are required. Lockers shall accommodate half size lockers per facility type requirements.

Superseded

Bus Drivers' Lunchroom	Bus drivers' lunchrooms shall be sized to suit program requirement, outdoor patio with natural gas connection, and be provided with a BBQ with provision for outdoor furniture.
Bus Drivers' Kitchen	The bus drivers' kitchen shall be adjacent to Lunchroom.
Bike Storage Room	The Bike Storage Room capacity shall meet LEED requirements with electrical receptacles.
Uniforms Room	Operations and Maintenance.
First Aid Room	-

Table 29: Maintenance Facilities - Service Lanes

Maintenance Facilities: Service Lanes	
Space	***Design Requirements***
Service Lanes	Service lanes are drive through bays, bus wash lanes, and bypass lanes as per program requirements. They shall include: • Rapid doors when required • Additional 3m at the end of a bus The layout shall incorporate smooth functional-flow forward movement with minimized reverse movements, one-way traffic, and the ability to circulate buses within the property while designed to eliminate potential for sharp and abrupt turning (more than 90?).
Unisex Washroom	Unisex washrooms shall be barrier free.
Wash Equipment Room	• Within Service Lanes • Pressure Wash in separate room

Table 30: Maintenance Facilities - Plant Maintenance

Superseded

Maintenance Facilities: Plant Maintenance	
Space	***Design Requirements***
Internal Driveway	In-floor heating system shall be embedded in the concrete apron and snowmelt system for all exterior door areas. Heat tracing systems shall be installed, if required.
Special Clean (Double Bay)	There shall be a minimum of one bus per bay. Industrial vacuum with six outlets and commercial grade hoses, hangers and tools, pressure washer, hose bibs, sink and trench drains. Hot & cool water source required. Vehicle exhausts system and wet area to be provided. Bus wash equipment shall be placed on elevated concrete pads. Harvested rainwater could also be used for bus wash.
Mechanical Room	Between Special Clean and Degrease. Houses pressure washer, vacuum cleaner, air compressor and related equipment and supplies. Provide foot operated wash basin(s).
Shop Electrical Room	Between Special Clean and Degrease.
Degrease Bay	In-ground hoist with sediment pits, trench drains and pressure washer with reels and hoses (wet area). Complete fluid distribution system. Vehicle exhausts system. Floor mounted equipment shall be placed on elevated concrete pads.
Body Repair Bay	The body repair bay shall contain a portable hoist to assist in transporting bus windows, windshields during removal and installation, and a vehicle exhausts system.
Fabrication Rebuild Shop	The Fabrication Rebuild Shop shall include a drill press, band saw, welding materials supplies, sink / parts washer, portable hoists, exhaust hoods and additional ventilation. Design foundation (concrete base) with adequate capacity to accept mobile hoists.
Inspection Pit Bays	The inspection pit bays shall include waste oil removal and pit jacks. Complete fluid distribution system. Vehicle exhausts system.

Superseded

In Ground Hoists	Complete fluid distribution system with side drains and central drains. Vehicle exhausts system.
Above Ground Hoists	Portable bus hoists. Vehicle exhausts system and fluid distribution.
Waste Fluids Disposal Area	-
Pump Room	Oil/grease interceptors. Dedicated catchbasin as floor drains shall be provided.
Fleet Equipment Storage	Fleet equipment storage shall include mobile repair equipment.
Parts Degrease Room	Wash/spray equipment (area).
Bus Wash Area	Hybrid water recycling & wash, all structural steel to be galvanized, walls, no copper or schedule 40 pipe PVC or stainless only
Fuel Area	Anti-Slip floor, one dispenser per lane, monitoring system
Shop Equipment Storage	-
Small Comp. Rebuild / Storage	Shelving
Transit Enforcement Storage Room	Caged parts storage area
Radio Storage Room	Shelving
Radio Repair	Shelving with HVAC

Table 31: Maintenance Facilities - Training Area

Superseded

Maintenance Facilities: Supervisory Training Area	
Space	***Design Requirements***
Fleet Maintenance Supervisors	The workstations shall be located in one room at the centre of the shop with a good view of shop.
File Storage, Fax/Photocopy	File storage, fax, and photocopiers shall be in the Maintenance Supervisor space.
Kitchenette	The kitchenette shall be attached to the Maintenance Supervisor's office.
Meeting Room	Seating capacity per program requirement, kitchenette, smart board, projector and power screen.
Mechanic's Training Room	The mechanic's training room shall be located on the exterior wall, soundproofed with a small kitchenette.
Classroom with Kitchenette	Seating capacity per program requirement, kitchenette, smart board, projector and power screen.
Classroom Storage	Accessible from classroom, storage for wheel chair, scooter.
Training Supervisor's Office	The training supervisor's office shall be located on the exterior wall and soundproofed.
Men's & Women's Washroom	The men and women's washroom shall be adjacent Fleet Maintenance Supervisors.

Table 32: Maintenance Facilities - Shop Employee Service Rooms

Superseded

Maintenance Facilities: Shop Employee Service Rooms	
Space	***Design Requirements***
Men's Washroom & Showers	The men's washroom and showers shall be barrier Free with urinals, WCs, and showers.
Women's Washroom & Showers	The women's washroom and showers shall be barrier Free with WCs and showers.
Men's Lockers	Men shall have two lockers per person & Half-Bradley's adjacent to the washroom.
Women's Lockers	Women shall have two lockers per person.
Lunchroom	Seating capacity as advised, outdoor patio.
Laundry Room	-
First Aid Room	-
Eyewash Station and Drinking Fountains	The eyewash station shall be tucked or 'niched' in, located on the shop floor, and provided with bottle fill spouts and filers.

Table 33: Storage Facilities - Bus Storage Garage

Storage Facilities: Bus Storage Garage	
Space	***Design Requirements***
Garage	Capacity based on a Type "A" facility. Based on a (±) 14.5m long (±) 2.75m wide bus. Double Decker buses need a minimum height clearance of 5.2m in the storage garage and minimum 7m height clearance at the repair shops (includes the portable hoists clearances). Provide for future expansion (as advised by GO).

Superseded

Table 34: Storage Facilities - Stores

Storage Facilities: Stores	
Space	***Design Requirements***
Part's Counter	• Workstations with PC`s, rugged stainless counter • Under counter storage for computers and office supplies
Large Parts Storage	Adjacent to Shipping / Receiving Dock, Shelving requirements
Small Parts Storage	Racking requirement
Tool Storage Room	Shelving requirement
Bulk Drum Storage & Dispensing	Area included in Parts Storage
Empty Drum Storage	Area included in Parts Storage
Store's Office	Office staff in on enclosed space with HVAC
Station Services Area	Includes one (1) office and storage room with shelving and HVAC
Tire Storage & Repair Area	Used/rebuild tires, maximum of 125 with appropriate storage and racking
Battery Storage &Charging	Shelving and chargers, special ventilation and forklift access
Bulk Fluid Storage (Oils/Lube/etc.)	Special Ventilation adjacent flammables room
Flammable Dispensing Room	• Blast wall, grounding, containment, special ventilation and fire safeguards • Threshold (concrete) to contain spills and dedicated catchbasin as floor drain
Mezzanine	Over Small Shop Areas with clear fork lift access.
Receiving Loading Dock	There shall be two loading docks (one at grade, one below grade with dock leveler) and one workstation shielded when doors are open.
Men's & Women's Washroom	The men and women's washroom shall be located close to the Parts Counter.

Superseded

Table 35: Other – Interior Spaces

Other–Interior Spaces	
Space	***Design Requirements***
Sprinkler Room	• Refer to Metrolinx Standard Fire Protection Sprinkler System Specification 21 13 00 • Connect Sprinkler System to Fire Alarm and BAS systems
Mechanical Room	Adjacent to Shipping / Receiving Dock, shelving requirements
Electrical Room	Refer to technical requirements, Service Room Requirements
Hub Rooms	Placed as needed, easily accessible, located to support Metrolinx Network Power over Ethernet (PoE) Architecture
Janitor's Room	In Administration Office Area • Floor mounted slop sink with easy access clean out for slop sink P- trap • Faucets and floor drains • High stability (24 hour) Aqueous Ozone Cleaning System (AOCS) • Domestic cold water complete with shut-off valve, dedicated for AOCS, water pressure shall be minimum 30 PSI (207 kPa) and maximum 65 PSI (488 kPa).
Garbage Recycling Room	-
Other	Catwalk by the clerestory windows provides access to bay fluid lines on/off valves. Sound Isolation shall be provided for all noise generating equipment. High Pressure hot water equipment shall not be located in wet areas.
PRESTO Room	Placed as needed, easily accessible
Electrical Closet	Placed as needed
Generator	Refer to Technical Requirements, Backup Power Systems

Superseded

Table 36: Other – Exterior Spaces

Superseded

Other–Exterior Spaces	
Space	***Design Requirements***
Transformer	Exterior Location
Generator	Refer to Technical Requirements, Backup Power Systems
Patio	Exterior Ground Level Location
Gatehouse	Exterior Location
Brake Test Area	Exterior Location (included in circulation driveways)
Compressed Gas Storage Area	1 for propane, 1 for oxygen–gated, fenced with roof. (also refer to 5.4.5.13.9, 5.4.5.13.10 and 5.4.5.13.11 for additional design requirements for propane storage)
Compressor Room	Scroll Compressor with dryer
Garbage/Recycling Storage Area	Exterior Location, visually hidden
Bulk Fuel Storage	• Exterior, In ground Location for 2 X 50,000 liters • Card lock system with remote access shall be provided. • SS Fittings • Double fuel pump hoses: • (1) ¾" nozzle for light trucks • (1) 1" nozzle for buses shall be provided
Service Fluids tanks	Service fluid tanks shall be guarded with additional containment near shop. Automatic Tank gauges monitoring system shall be provided with remote access.
Powered Gas Tools Storage Shed	-
Service Vehicles Parking	For Operations, Fleet and Transit Safety
Bus Storage Parking	• Exterior, 12 buses in a single area near fleet shop • 115V 15Amp circuits for block heaters and battery chargers

Superseded

Staff Parking	• Exterior, parking spots with gated personnel entrance to the secure facilities compound +16 parking spots for GO Transit support • Motorcycle Pad • EV plug in locations as advised
Bus Storage Parking Expansion space	As advised
Co-generation / Tri-generation	If provided, minimum area needed = 15m X 8m

5 Technical Requirements

5.1 General Technical Requirements

5.1.1 Apart from compliance with good Engineering practice, the design shall meet the requirement as per the relative regulations, codes and standards, and address energy use to reduce consumption.

5.1.2 All equipment shall be provided from a recognized manufacturer with proven product testing. Any alterations or changes to equipment shall be approved for use prior to installation.

5.1.3 All systems and equipment provided shall be easily accessible for maintenance & operation purposes. Equipment shall not be located and installed in such a manner that the maintenance, removal, and replacement of the equipment is not physically possible or requires removal of other equipment and/or obstructions in the way or the use of specialized equipment.

5.1.4 The maintenance, removal or replacement of equipment shall not hinder the flow of pedestrian movement and the operation of vertical circulation elements. Avoid locating equipment that requires maintenance higher than 10ft in elevation where possible. Where it is not possible, fixed ladders and or catwalks shall be provided for access and shall be reviewed with Metrolinx Station Operations for approval.

5.1.5 For additional information, refer to GO Standard Specifications and Drawings.

5.1.6 For existing facilities projects, existing electrical and communication systems are to be upgraded to meet the latest DRM, Electrical Specifications, Electrical Safety Code and other CSA requirements.

5.2 Electrical

5.2.1 Electrical systems for GO Transit facilities shall comprise the following, including all relevant supply, protection, distribution, and control of alternating and direct current systems:

a) Primary and secondary power services;

b) Illumination;

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c) Grounding;
d) Equipment labeling and identification.

5.2.2 Supply of Primary and Secondary Power Sources.

5.2.2.1 Incoming Utility Services

5.2.2.1.1 The local Supply Authority (PUC) will supply utility services to a site or building.

5.2.2.1.2 Services to an electrical room or kiosk shall be underground.

5.2.2.2 Service Requirements:

a) The service shall be sized to accommodate current and future known loads plus 50%, 400 amp min, 347/600 Volt or 120/208 Volt service. Maintenance, Repair, Shop and Garage facilities and facilities with elevators: 347/600 Volt service. Refer to Table 38 for Utilization Voltages.
b) Incoming services, utility metering, dedicated Metrolinx metering complete with remote monitoring, disconnected switches, distribution breakers shall be in one switchboard/distribution panel;
c) Where GO Transit has tenants, check meters shall be required. One for each tenant;
d) Service size shall be based on the application of conservative engineering design principles consistent with cost effective provisions for future station/terminal or other facility expansion;
e) Temporary facilities shall have underground services;
f) Disconnect switches shall come equipped with visual means to ensure power disconnection such as an LED indicator or viewing window. For additional information, see Disconnect Switches Specification 26 28 23.

Superseded

Table 37: Utilization Voltages

Superseded

System	Utilization	Voltage
Lighting	LED	347V or 120 V 1 phase interior, 347 V or 120 V 1 phase for all exterior application
Life Safety Egress Lighting	LED	347V or 120 V 1 phase interior, + Life safety emergency power
Heating	Greater than 5 kW	600/347 V 3 phase
	5 kw or less	120/208 V 1 phase
Life Safety Fire Pumps		600/347V or 208/120 V 3 phase interior, + Life safety emergency power
Motors (fans and sump pumps shall be off of emergency power)	Greater than ½ HP	600/347V, 3 phase
	½ HP or less	120/208V, 1 phase
Elevators	Motors and Controls	120/208V, or 600/347V 3 phase + emergency power
PA (70V)		Feed to the PA is 120V 1 phase + emergency power
Telephone System		120V 1 phase + emergency power
CCTV		CCTV cameras are PoE + emergency power
Security/Alarm		120V 1 phase + emergency power
Passenger Information		120V 1 phase + emergency power

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Fire Alarm		120V 1 phase + Life safety emergency power
Proof-of-Payment Fare Collection System		120V 1 phase + emergency power
Electronic Payment Systems		120V 1 phase + emergency power
Intercom		120V 1 phase + Life safety emergency power
Video Transmission		120V 1 phase + emergency power
Digital Clock System (network)		120V 1 phase + emergency power
Signage and Display System		120V 1 phase + emergency power
Wayside Power System:		600V 3 phase
Building Automation System		120V 1 phase + emergency power
Computers		120V 1 phase + emergency power
Fuel Management Systems		120/208V, or 600/347V 3 phase + emergency power
Sand Distribution Systems		120/208V, or 600/347V 3 phase + emergency power
Electric Vehicle Charging Systems		120V/208 1 phase + emergency power for operations purposes
Car counting Systems		120V1 phase + emergency power
Aqueous Ozone Cleaning System (AOCS)		120V1 phase 20A GFCI, dedicated circuit + emergency power

Superseded

5.2.2.3 Balancing of Phases

5.2.2.3.1 Where single-phase power is taken from a 3-phase source, the loads shall be balanced among the three distribution phases.

5.2.2.3.2 Sites that have a single-phase source are to maintain a balanced load within the distribution panels.

5.2.2.4 Voltage Drop

5.2.2.4.1 The maximum allowable voltage drop is 2%.

5.2.2.5 Power Factor

5.2.2.5.1 The overall system power factor shall be greater than 90% or .9 PF.

5.2.2.5.2 Power factor design calculations shall be done using an 80% or .8 PF.

5.2.2.6 Backup Power Systems

5.2.2.6.1 This subject describes the functional requirements for Metrolinx facilities backup power system.

5.2.2.6.2 The power generated by the backup system shall be either true sinusoidal 60 Hz or DC, depending on the requirements. The backup power system shall be sized to accommodate current and future emergency/critical/life safety loads plus 50% additional capacity.

5.2.2.6.3 The intent of the backup power system is to ensure the continuing operation of essential equipment and services, and to effectively move passengers from station buildings and train platforms to outside parking areas in the event of a sustained power failure.

5.2.2.6.4 The final design of the backup power system must include an as-built schematic drawing of the system distribution. It shall also include a checklist for commissioning, operation, and maintenance, respectively.

5.2.2.6.5 Back-up power generators shall be installed in accordance with the Electrical Safety Authority (ESA), Technical Standards and Safety Authority (TSSA) and the regulations of the electrical inspection agency having jurisdiction. The back-up power generator shall be protected from surface deterioration caused by exposure to conditions (i.e: condensation, weather, winter maintenance and de-icing chemicals) producing corrosion. Flat surfaces which may retain water are not permitted. Provide safe access (min 1m).

5.2.2.7 Backup Required Time

5.2.2.7.1 Back-up power generators are a mandatory requirement, for providing the majority of our operational elements/ systems for system operational duration as per Table 38:

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Table 38: Backup Generator Run Time Requirement

Facility	Total Backup Time Requirement at Generator Full Load (hours)
Priority 1	48
Priority 2	24
Priority 3	8
Priority 4	0

Note: Consult with Metrolinx Project Delivery Team to determine the facility priority level as per Metrolinx Station Services Requirements

5.2.2.7.2 Backup Power System's design can include components such as Generator, UPS, Inverter, Rectifier, etc. As a minimum, the backup Power System shall include diesel or natural gas generator complete with UPS systems having a minimum of 30-minute duration or UPS systems with 90-minute minimum duration if there is no diesel/natural gas generator set.

5.2.2.7.3 In each case, the UPS shall be double conversion continuous duty type to provide the electronic communications systems with clean sine wave power. The UPS/Inverter shall be rated for life safety applications and be provided with signals for indication of general alarms and with dial in remote monitoring control, plus a remote alarm to the station alarm system and Network/ BAS.

5.2.2.7.4 There shall be one UPS for the site for operations critical equipment and one UPS/ Inverter dedicated to Life Safety equipment support as per the OESC. For further information on UPS inverters, rectifiers etc., refer to Metrolinx Standard Inverter Rectifier and Charger Specification 26 33 33.

5.2.2.7.5 Diesel is the preferred fuel for backup generators. Where site and operational conditions do not allow for the use of diesel fuel, natural gas fuel powered generators are acceptable with Metrolinx approval.

5.2.2.7.6 Rectifiers shall be used for backup DC power in maintenance and layover facilities where required.

5.2.2.8 Design Requirements

5.2.2.8.1 The following Table 39 shows a list of items that are considered essential. The table shows both backup power system conditions (i.e. Generator + UPS or UPS only).

5.2.2.8.2 The actual power draws shall be provided in the detail design. Third party systems shall not be connected to UPS power supplied by Metrolinx.

Superseded

Table 39: Backup Power Systems - Design Requirements

Superseded

Backup Power Systems–Design Requirements					
Essential and Life Safety Load	**With Generator**			**Without Generator (Existing Facility Only)**	
	Generator Backed Panel	**Generator Backed UPS Panel**	**Generator Backed Life Safety Inverter/ UPS Panel**	**UPS Panel**	**Life Safety Inverter/ UPS Panel**
Exit signs–buildings, tunnels and similar structures (LED type)			x		x
Public Address System		x		x	
CCTV System		x		x	
Any additional rack in the Comms. Room		x		x	
GO Transit telephone system		x		x	
All Passenger Elevators and shafts	x			x	
Elevator controls	x			x	
Alarm Monitoring Systems		x		x	
Fire Alarm System, if required			x		x
Lighting					
Tunnels, bridges and stairwell illumination (at least 1 fixture on normal power)	x				

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Electrical Room Illumination (at least 1 fixture on normal power)	x	x		x	
Communications Room Illumination (at least 1 fixture on normal power)	x	x		x	
Service Area Illumination	x	x		x	
Waiting Area Illumination–minimal	x			x	
Platform Lighting (Train and Bus)	x				
Main Parking Lots (Surface Parking)	x				
Parking Structures	x				
Pick-Up and Drop-Off (PUDO) (Passenger Pick up and Drop off)	x				
Bus Loop Lighting	x				
Life Safety or Egress Lighting (Station, Service Rooms, Tunnel, Bridge, Stairs, etc.)			x		x
Systems					
Ticket Sales Equipment		x		x	
Communications Equipment (White board, Pins etc.)		x		x	
Presto		x			

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Door Operators (Building, Vestibules, Shelters)	x			x	
Mechanical					
Sump/Sanitary Pump	x			x	
HVAC for electrical & communication room	x				
HVAC for Service Counter and Waiting Area	x				
Water Heater Equipment	x				
HVAC and Exhaust of Elevator Shafts	x				

5.2.3 Generators

5.2.3.1 Generators shall be placed within an enclosed area (a space with closed walls and ceiling) to ensure a long term operation. Open generator rooms (not enclosed) will not be permitted within a building.

5.2.3.2 Generators shall be built with load banks and shall be tested on an ongoing schedule to ensure operation when required. Access shall be provided without interfering with customers at stations. Stations without load banks shall have easily accessible connection points and sufficient space to bring in a trailer.

5.2.3.3 For generators, provide catwalks/platforms to completely encircle the unit(s) for safety and ease of maintenance.

5.2.3.4 Due to operational noise, the location of the generator shall consider neighboring communities. Efforts including careful location placement, screening, installing a sound attenuating enclosure consisting of 4 walls and a roof, landscaping, etc. shall be employed to minimize effects of noise.

5.2.3.5 Fuel filling shall be located within easy access of a drive aisle to facilitate delivery vehicle. Ramp approaches will not be acceptable. Access shall be provided on ground level (adjacent to delivery route) of storage areas.

5.2.3.6 Oil separator shall be placed within diesel generator fueling area and as directed by other Metrolinx requirements.

5.2.3.7 The prime rated generator shall be provided as a factory tested single unit and rated kW, 120/208 or 347/600 Volts, 3-phase, 4-wire, 60Hz, 1800 rpm. The generator shall be certified to CSA C22.2 No. 100, EEMAC MG1-22.40, NEMA MG1, and meet the requirements of Ontario Electrical Safety Code, ESA, EPA, MOE, TSSA, along with all applicable local codes and regulations. Generator load summary shall be provided with an itemized breakdown. The load summary at minimum should provide connected load, demand factor and demand

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load for each item. The generator is not to be loaded more than 80% of its overall capacity. For additional information on generators refer to Metrolinx Standard Backup Power Supply Generator Specification 26 32 00. Refer to Table 40 for generators noise levels.

Table 40: Generators Noise Levels

kW	dB(A)	Meters
≤ 150	65	7.0
≥150 to ≤500	75	7.0
>500	80	7.0

5.2.3.8 Diesel Engine

5.2.3.8.1 The engine shall comply with E.P.A. Tier 4 final standards for emissions.

5.2.3.8.2 ULC/CSA labelled double wall construction sub-base mounted steel fuel tank with an enough storage capacity to run the generator set at full load for 48 hours without refueling. The tanks and fueling system shall be accepted by TSSA and equipped with fuel paddling system.

5.2.3.9 Natural or Propane Gas Engine

5.2.3.9.1 (For Prime Generators ≤ 150 kVA). Include liquid cooled, spark ignition engine.

5.2.3.10 Minimum Required Accessories

5.2.3.10.1 The minimum required accessories are the following:

a) Line circuit breakers;
b) Dedicated load bank of 110% capacity for each generator (On Site).

5.2.3.10.2 There shall be a load bank for testing available on site rather than bringing a load bank onto site and connecting and disconnecting it.

5.2.3.10.3 This load bank shall be able to be added in steps for testing up to 110% of the generators capacity.

5.2.3.10.4 Load bank shall be located on a concrete pad with a clearance to vegetation/combustibles on intake and discharge side as per manufacturers recommendation.

5.2.3.10.5 The controller shall have provisions for disconnecting a load bank (during exercise) if there is a loss of normal power by an Electrical and Mechanical interlock through ATS.

5.2.3.11 Generator Enclosures

5.2.3.11.1 Prime Generator Room Criteria are as follows:

a) A Prime Generator room is a separate dedicated room for a Prime Generator that can be a standalone building or an integrated room in a Metrolinx Facilities Building. The Prime Generator Room shall be a self-contained room, complete with roof. If there are instances where a facility cannot accommodate a self-contained room, a request shall

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be submitted following the Procedure for Requesting Deviations to Metrolinx Standard Requirements (refer to CKH-ENG-PRC-001 for more details) for consideration by Metrolinx;

b) A Prime Generator room shall house the fuel storage unit and all generator accessories including the Generator Electrical Switchboard and Automatic Transfer Switch. Generator room design criteria shall be in accordance with Generator's Manufacturer's operating requirements and good engineering experience;

c) The room shall be separated from the rest of the building by construction with a 2-hour fire resistance rating;

d) The room must meet all of the Generator's Manufacturer's operating requirements for ambient outdoor temperatures between -40°C to +40°C;

e) The room shall be sound attenuating, limiting the overall noise to the to the average dB level in Table 40. The exterior of room housing the Generator shall be painted as per site specific requirements. Refer to Figure 18 for Emergency Power Distribution with Generator.

5.2.3.11.2 Exterior Generator Housing Enclosure Criteria are as follows:

a) An exterior Generator housing enclosure is an alternative option for Generator Enclosures for existing facilities with no construction taking place. In instances where a facility cannot accommodate a self-contained Prime Generator Room, a request for an Exterior Generator Housing Enclosure shall be submitted following the Procedure for Requesting Deviations to Metrolinx Standard Requirements (refer to CKH-ENG-PRC-001 for more details) for consideration by Metrolinx. An exterior Generator housing enclosure shall be sound attenuating, limiting the overall noise to the average dB level in Table 40. The housing shall be aluminum or stainless steel (304L or greater) for a weather proof and sound attenuation enclosure;

b) Interior walls and ceilings shall be insulated with sound attenuating foam, black stainless steel pad- lockable latches, doorkeepers on all doors and zinc die-cast hinges/grab handles;

c) The Generator housing enclosure must meet all of the Generator's Manufacturer's operating requirements for ambient outdoor temperatures between -40°C to +40°C; and

d) Locate Generator housing enclosure in an inconspicuous location and above any threat of flooding. The Generator shall not be located below grade or adjacent to potential water hazards (restrooms, tunnels, areas that may be affected by firefighting operations, sewer water backups and other disasters). Refer to Table 41 for Exterior Enclosure. Exterior Generator housing enclosure with subbase fuel tanks shall be provided with industrial steel grating platform, stairs and railing on all sides of the generator that require maintenance access.

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Table 41: Exterior Enclosures

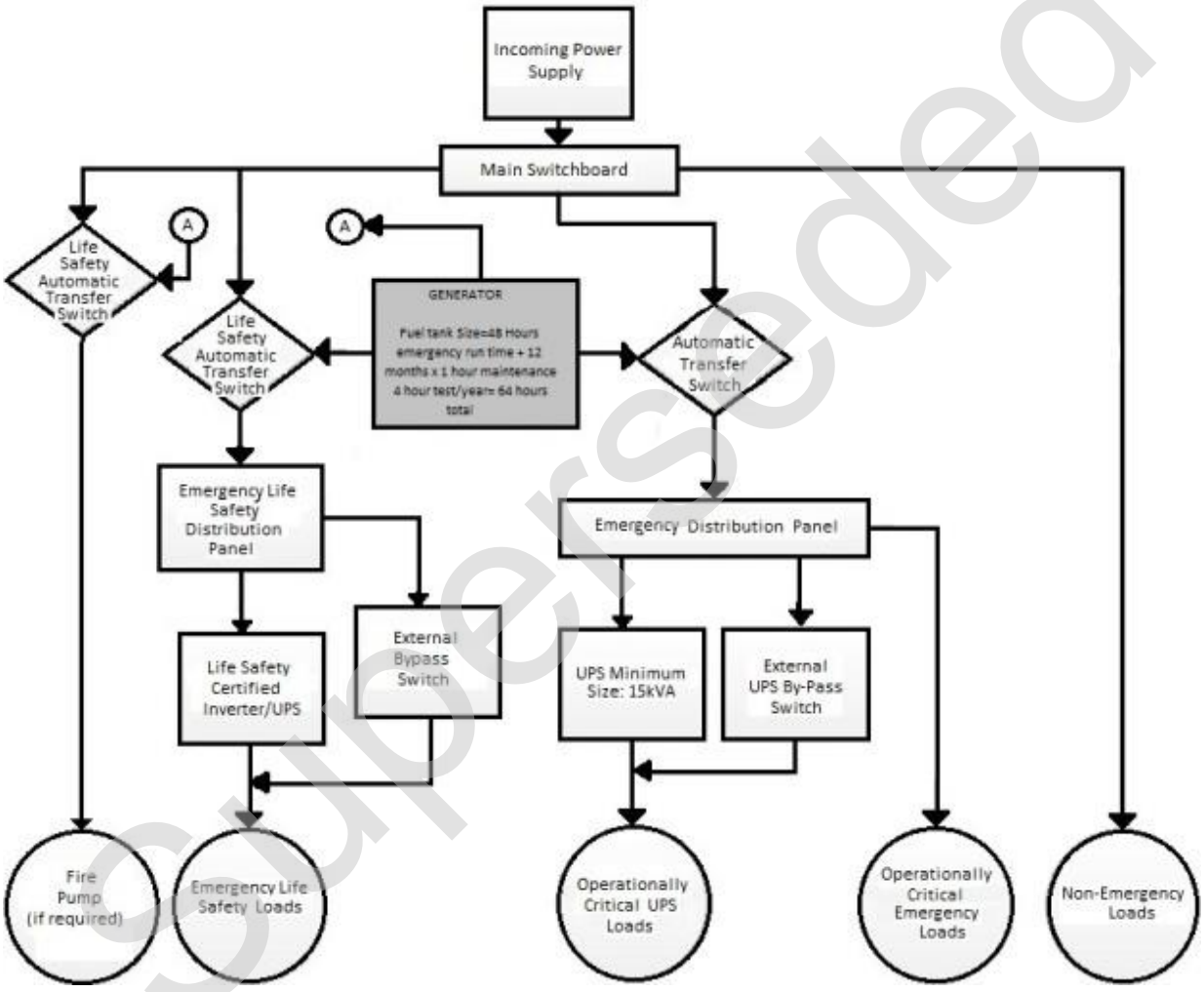
Superseded

Exterior Enclosure	
Exterior Weatherproof Enclosure:	• Owner's Common keyed. • Compliant with CSA Standard. • Sound Attenuated. • Capable of withstanding 150mph sustained winds. • Designed to resist rainfall angles of up to 45 degrees without interior flooding. • Enclosure shall be wildlife proof.
Construction:	• Stainless steel (304L or greater) for a weather proof and sound attenuation enclosure. • Aluminum panel construction for a weather proof and sound attenuation enclosure. • Powder coated paint
Roof:	• One piece pitched roof designed to prevent water accumulation.
Exhaust System:	• Internally mounted muffler and sound insulating Panels. • Catalytic Converter: Include catalytic converter when defined by local codes.
Doors:	• Door Hardware: Stainless steel. • Doors shall be lockable by padlock. • Hardware locks shall be keyed the same. • Door drip caps designed to keep moisture accumulation off the top of doors. • Doors hinged to allow 180 degree opening.
Sound Attenuation:	• Generator shall be sound attenuated, both interior walls and ceilings shall be insulated with sound attenuating foam. • Average dB level, enclosure limits overall noise see Table 40 (above).
Block Heater:	• 1500 watt minimum.
Space Heater:	• Include inside enclosure, thermostatically controlled to maintain a minimum10 ˚C, except when engine is running, in accord with CSA C282, 208v.
Motorized Louvers:	• Include on air intake to meet CSA C282, level 2 sound attenuated.

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Emergency Lighting:	• Include inside enclosure, 50 lumens, DC battery powered, two hour operation, in accord with CSA C282.
Engine Fluid Containment Pan:	• Sized to 110 percent of available fluid in accord with CSA-C282.

Figure 16: Emergency Power Distribution with Generator



Superseded

5.2.4 Uninterruptible Power Supply (UPS)

5.2.4.1 Uninterruptible Power Supplies (UPS) are used to support Life Safety systems and protects computers and other sensitive electronic loads from power outages and other power anomalies. This Section includes 3 phase ≥ 3 kVA and Single phase < 3 kVA, on-line, static-type, UPS system, comprising the following:

a) Complete rectifier/charger-battery-inverter system with automatic static switch and maintenance by-pass circuit;

b) Central Monitoring System for all UPS units, along with proper interfacing with Metrolinx software, Metrolinx I&IT communication, and station operations shall be provided in order to display and control all required parameters;

c) All intercommunication shall be through the Mod bus, BAC Net, etc;

d) Input isolation transformer for UPS units, where technically required;

e) Connection of normal AC power from assigned terminals/switch/circuit breaker;

f) The UPS shall be of commercial type and shall comply with relevant IEC, EIA, NEMA, NFPA 70, IEEE, ISO 9001, ISO 14001, UL-1778, CSA, FCC Class A, and Life Safety certified standards;

g) UPS and its components shall be sized for current and future known loads plus 50% future spare capacity. UPS load summary shall be provided with an itemized breakdown. The load summary at minimum shall provide connected load, demand factor and demand load for each item. The UPS shall not to be loaded more than 80% of its overall capacity.

h) Radio frequency interference (RFI) suppression shall be in accordance with CISPR and IEC 50091-2 recommendations;

i) UPS shall be certified for use to support Life Safety Systems;

j) UPS assembly shall include a mimic diagram with digital and LED displays, indicating instruments and control devices, in true relative positions;

k) System overall efficiency shall be not less than 92% at full load and 91% at half load;

l) Noise level of complete assembly is not to exceed 55 dB (A) at 1.0 m distance anywhere within the room that the UPS is located;

m) The system shall have an external maintenance bypass that will allow the removal and replacement of the UPS without rewiring;

n) The Voltage supplied to the UPS shall be the voltages on the output of the UPS;

o) The UPS shall be located inside the main Electrical Room.

5.2.4.2 Rectifier/Charger

5.2.4.2.1 For further information refer to Metrolinx Standard Inverter Rectifier Charger Specification 26 33 33.

5.2.4.3 Battery Criteria are as follows:

a) High rate discharge, heavy duty, industrial, high impact resistant, clear plastic encased, sealed (gas recombination) type cells with automatically re-closing explosion proof safety vents;

b) Ampere-hour rating shall be sufficient for UPS + Generator period specified with all inverters operating at full rated output, to a discharge limit of not less than 1.65 V per cell.

5.2.5 Inverters

5.2.5.1 For further information refer to Metrolinx Standard Inverter Rectifier Charger Specification 26 33 33.

5.2.6 Transfer Switch (Automatic and Manual Bypass Switch)

5.2.6.1 The transfer switch shall be 120/208 or 347/600 V, 4 wire, 3 phase, 100% rated in Amperes for total system transfer including control of motors, electric-discharge lamps, electric

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heating, and electronic lamp load. Switches rated 400 A and below shall be suitable for 100% Amp loads. Switches rated above 400 A shall be suitable for 80% Amp loads.

5.2.6.2 Automatic transfer switch shall be rated for continuous duty or repetitive load transfer switching. The bypass- selector switch shall provide operating positions: Bypass Normal, Bypass UPS + Generator, and Bypass Open.

5.2.6.3 A two-way bypass isolation switch shall provide manual bypass of the load to either source, permit isolation of the automatic transfer switch from all source, and load power conductors. All main contacts shall be manually driven. Electrical and Mechanical interlock arrangements utilizing electrically driven contacts are prohibited.

5.2.6.4 The manual bypass handle will provide two operating modes: Bypass Open and Bypass Closed. Bypass to the load-carrying source shall be affected without any interruption of power to the load (make-before-break contacts). Load break-type bypass for ATS test and isolation shall not be acceptable. In the bypass open mode, bypass contacts shall be open so they will not be subjected to fault currents. For additional information on transfer systems refer to Metrolinx Standard Transfer Switch Specification 26 36 23.

5.2.7 Distribution of Primary and Secondary Sources

5.2.7.1 In general, loads shall be locally fed from power panels, distribution panels, motor control centers, etc. The electrical rooms, other than the main electrical room, shall service the area around it. (i.e. electrical rooms in station building should supply power to the station building only, or panels in communication rooms shall service only the communication equipment.

5.2.7.2 General lighting and system circuits shall be alternately circuited to maintain partial service and illumination in the area in the event of circuit failure. The same principle shall be used in communications that have a failure or maintenance on one component and will not remove coverage of the area. This item shall be verified upon commissioning.

5.2.8 Stations & Facilities

5.2.8.1 Refer to Table 42 for Electrical Requirements at Stations and Facilities.

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Table 42: Electrical Requirements at Stations and Facilities

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Electrical Requirements at Stations and Facilities	
Feature	***Design Requirements***
Studies	The following studies shall be completed for design: • Short circuit • Load Flow • Protective coordination • Device evaluation and arc flash hazard with coordinated ground fault protection • Grounding, to determine Ground Potential Rise as well as touch and step voltages • Electrical, for information on Arc Flash Hazards and labeling • Feeder plus main brace feeders on the main switchboard
System Voltages	Ensure that system voltages are adequately selected. Provide appropriate main incoming service and transformer.
Power Factor Correction System	Provide a power factor correction system with the following characteristics: Capacitors in banks, automatic switching of banks, maintain power factor between 0.9 and 1.0. Ensure that power is supplied by the nearest available utility freestanding enclosure, located near the main switchboard.
Utility Power Failure	In the event of a utility power failure, provide emergency power by means of an emergency/back-up generator set or a group of generator sets connected to a common synchronized bus. Provide an uninterruptible power system for critical components.
Electrical Handholes	Electrical handholes shall be precast concrete or fiberglass reinforced and designed for heavy traffic areas. Cast iron covers shall be bolted down. All metal components shall be grounded, except the cover.
Surface Mounted or Suspended Equipment	Provide galvanized steel mounting channel for all surface mounted or suspended electrical and communications infrastructure. No electrical and communications infrastructure shall be mounted directly to any wall or structural element.

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<table>
<tr><td>Enclosures</td><td>Provide enclosures with the following characteristics:
Sprinkler proof, NEMA type 1 (indoor, dry and damp)
NEMA Type 4X (outdoor and damp/wet spaces)
NEMA Type 4 (indoor and damp/wet spaces)
100mm concrete housekeeping pads for floor mounted equipment, disconnect switch at each motor</td></tr>
<tr><td>Disconnect Switches</td><td>Provide dedicated disconnect switches at electrical equipment.</td></tr>
<tr><td>Grounding System</td><td>Provide a grounding system consisting of 19mm copper clad steel ground rods and bare copper conductors around the perimeter of the building.</td></tr>
<tr><td>Electrical Equipment Connections</td><td>Major electrical equipment connected to systems at 600V and higher shall be connected to ground system through a minimum of two (2) paths</td></tr>
<tr><td>Lighting System</td><td>Provide a lighting system that shall be designed to IESNA recommendations for industrial facilities with the following characteristics:
<table>
<tr><th>Area</th><th>Specification</th></tr>
<tr><td>Exterior circulation areas</td><td>30 lux</td></tr>
<tr><td>Exterior parking areas</td><td>30 lux</td></tr>
<tr><td>Pedestrian gates</td><td>100 lux</td></tr>
<tr><td>Building entrances and exits</td><td>100 lux</td></tr>
<tr><td>Interior repair garage, general</td><td>500 lux</td></tr>
<tr><td>Interior repair garage, workbenches</td><td>750 lux</td></tr>
<tr><td>Bus garage areas</td><td>300 lux</td></tr>
<tr><td>Utility areas</td><td>200 lux</td></tr>
<tr><td>Office areas</td><td>400 lux</td></tr>
<tr><td>Emergency and night time lighting</td><td>20 lux</td></tr>
</table></td></tr>
</table>

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Lighting Control	Control interior lighting by local switches, occupancy sensors and lighting control system. Control exterior lighting by means of a photocells, occupancy sensors, central over-ride switches and/or contactors with a manual override; provide a computer based lighting control system to switch various lighting circuits through the building.
Receptacles	All receptacles are shall be duplex type spec grade to code use. Receptacles shall be located in the following places: • Offices • Control and Electrical Room • On a dedicated circuit, at each workbench • On the roof adjacent to each HVAC unit • GFCI in wet and outdoor locations • Distributed equally along the building perimeter • Pendant cord mounter single receptacles in the repair garage and the front and rear of each hose location
Welding Outlets	Welding outlets shall be installed at appropriate location for supplying power to portable welders.
Traffic Signals	Provide traffic signals as required near the entrances of the facility.
Fire Alarm Systems	Multiplex fire alarm system shall be provided.
Storage Garage	Lighting not to interfere with structural components, gas lines, power lines (easily accessible for maintenance).
Stair Shaft	Lighting shall be easily accessible for maintenance

5.2.9 Service Duct Banks

5.2.9.1 Service duct banks shall conform to OESC (Ontario Electrical Safety Code) latest edition inside property line, or rail corridor per AREMA, CSA Standard C22.3 No. 7 Underground Systems, and OESC, coordinate with local Hydro and Bell for area having jurisdiction and for utility requirements.

5.2.9.2 Provide concrete encased duct banks in heavy vehicular areas and fire routes. Minimum 30% spare conduits with no cables or wires except for the ground wire and pull-cords shall be provided in duct banks for future use, coordinate with Metrolinx. Duct bank shall be filled out from bottom to top. Empty conduits shall be sealed at the ends. Conduit locations to ensure easy access for filled and spare conduits.

5.2.10 Wiring Methods

5.2.10.1 Raceways and conductors

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5.2.10.1.1 Raceways and branch circuitry shall be implemented to minimize failure of a complete system due to failure or malfunctioning of any single electrical component.

5.2.10.1.2 Distribution minimizing conductors of different circuits sharing common raceways and pull-boxes, etc., shall be implemented. No free air cabling is allowed. All wiring shall be in conduit of the proper type, size and material as identified in the DRM and GO Specifications

5.2.10.1.3 Raceways shall not exceed a maximum of 40% capacity.

5.2.10.1.4 Communication backbone raceways sized 53mm shall not exceed a maximum of 30% capacity for communication cabling.

5.2.10.1.5 Raceways selected shall suitably resist mechanical damage and environmental deterioration effects. In particular, special attention shall be applied to corrosion inhibitors and protective coatings or treatments on surface mounted conduit in underground areas (e.g., tunnels, below grade electrical rooms, Bridges and parking structures etc.). Minimum 30% spare conduits with ground wire and pull-cords shall be provided for future use, coordinate with Metrolinx. Bundling of cables with different operating voltages is not permitted. Empty conduits shall be sealed at the ends.

5.2.10.1.6 A minimum 12 AWG stranded copper wire green insulated RWU90 below grade and RW90 above grade shall be placed inside each raceway. This wire shall be used as a tracer wire inside a buried raceway for the purpose of locates after installation.

5.2.10.1.7 Slack wire shall be provided. In all runs, the amount of slack shall be no less than 1.0m at each termination point and 600mm in each pull point. Access wire shall be neatly coiled and be available for future use.

5.2.10.1.8 When installing wires in an existing raceway, it shall be the responsibility of the installer to ensure that new wires are neatly installed and tied together with all existing wiring.

5.2.10.1.9 Drip loops shall be provided on all outside hanging raceways or conductors.

5.2.10.1.10 Backbone spare raceways for electrical and communications shall be provided across the length of the platform with separate hand holes. The spare raceways shall consist of nine (9) 53mm power conduits and nine (9) 53mm communication conduits with ground wire and pull-cords for future use. Empty conduits shall be sealed at the ends.

5.2.10.1.11 Refer to Metrolinx Standard Specifications: Rail Corridor Raceway Requirements, Raceway for Electrical Systems 36 05 34 and Electrical Conductors and Cables 26 05 21 Refer to Metrolinx electrification standards for electromagnetic interference (EMI) protection of devices and cables.

5.2.10.2 Conduits

5.2.10.2.1 All conduits that is located in damp (outdoor/indoor) and wet (outdoor/indoor) spaces shall be RGSEC (Rigid Galvanized Steel Epoxy Coated).

5.2.10.2.2 Conduit that is expose and in dry, indoor, HVAC controlled spaces shall be RGS (Rigid

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Galvanized Steel).

5.2.10.2.3 PVC Conduit shall be used in concrete encased or direct buried applications.

5.2.10.2.4 Conduits in finished areas shall be concealed and not visible to the public.

5.2.10.2.5 Concrete encasements shall be provided for bus loops, road crossings, and railway right-of-ways.

5.2.10.2.6 Rigid non-metallic conduit shall be used below ground, either direct buried or concrete encased.

5.2.10.2.7 Epoxy coated rigid galvanized steel conduit shall be used in areas that are exposed to condensation, exposed to moisture, exposed to wet conditions or areas with corrosion problems. Metrolinx approval is required for any variations.

5.2.10.2.8 PVC conduit shall not be installed above ground, or in exposed locations. Conduit, having a minimum of 53mm shall be used in parking lots.

5.2.10.2.9 Concrete encasements shall be provided for bus loops, road crossings, and railway Right-of-Ways.

5.2.10.2.10 In finished areas, all conduits shall be concealed and not visible to the public.

5.2.10.2.11 Refer to GO Standard Specifications 26 05 34 Raceway for Electrical Systems for detailed requirements

5.2.10.3 Cable Trays

5.2.10.3.1 Where required, cable trays shall be ladder type; hot dip galvanized steel or aluminum or non-metallic as required for the application, complete with vertical barriers to separate systems or cables as required.

5.2.10.3.2 Class shall be selected based on conductor weight plus 50% spare capacity as a minimum.

5.2.10.3.3 Cable trays shall be cantilever-supported for ease in installation of cables.

5.2.10.3.4 Fire barriers of multi-transit type shall be provided at firewalls and fire separations, and shall be in accordance with the O.B.C. and CAN4-S115-M.

5.2.10.3.5 Types of Cable trays shall be used:

a) Wire Cable Trays: Used in Data Center raised floor configuration and GO Transit Radio rooms only;
b) Ladder Cable Trays: Used in Electrical/Communication Rooms;
c) Enclosed Cable Trays-Cable bus from transformers to main substation switch gear, outdoors.

5.2.10.4 Wire and Cable

5.2.10.4.1 All conductors shall be stranded copper.

5.2.10.4.2 Conductors smaller than No. 12 AWG shall not be permitted for lighting or motor branch circuit wiring, except that No. 14 AWG multi-strand type conductors may be used for control

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circuits only. Provide appropriate connection for terminating and standard wire.

5.2.10.4.3 Conductors shall have a minimum insulation temperature rating of 90°C, but design shall be for 75°C. All conductor insulation shall be colour coded.

5.2.10.4.4 A manufacturer and code compliant transition method shall be established when different gauges of wire are to be terminated together.

5.2.10.4.5 Refer to Metrolinx Standard Electrical Conductors and Cables Specification 26 05 21 for more information on Wire and Cable.

5.2.10.5 Responsibility

5.2.10.5.1 The Consultant shall specify responsibility for wiring and equipment connections. Examples: For voice-activated intercoms, the type of wiring shall be as recommended by the equipment supplier, and shall be installed by the electrical contractor, but connected by the equipment supplier.

5.2.10.5.2 For the PA, CCTV, Access Control and Intrusion Detection System, the electrical contractor shall provide conduit with pull-strings, and the equipment supplier shall install wiring and the equipment, making all connections, testing and commissioning. Any equipment customization shall have appropriate seals from approved standards authority.

5.2.10.6 Enclosures

5.2.10.6.1 Enclosures shall be selected for the environment in which they are intended to be installed. In general, enclosures for indoor, dry application shall be EEMAC sprinkler proof type 1 or type 12 where applicable. Enclosure for outdoor and damp/wet areas shall be EEMAC type 4X or NEMA type 4X equivalent. The enclosures requirements are as follows:

a) Where installed in public areas, all enclosures, cover-plates, outlets plates, access panels, and handwells shall be provided with method of securing doors and covers. All enclosures and panels shall have a common key and in an enclosed, protected area where possible.

5.2.10.7 Manholes, Handholes and Pullboxes

a) Manholes shall be located remotely from doors, main road and pedestrian traffic areas;
b) Handholes shall be located remotely from doors, shelters and main road and pedestrian traffic areas;
c) Electrical and communication pull points such as manholes or boxes shall have a maximum 45m distance between manholes;
d) No splices are permitted, with the only exception being PA speakers spliced above grade and in approved enclosures;
e) Underground conduits entering Mechanical, Electrical and Communications Rooms from the exterior shall be sloped to ensure positive drainage away from room;
f) Underground raceways entering any Mechanical, Electrical or Communications Room shall be interrupted by a drained manhole or handhole within 3000 mm of the room;
g) The minimum opening in the top of the handhole shall be no smaller than 460 mm;
h) The lip of the handhole and manholes shall be identified as to the type of service within by means of grooves cut into the collar of the handhole or manhole;
i) These markings are on the collar shall be 2 grooves; 3 mm deep for communications in the direction of conduit in and out and 1 groove; 3 mm deep in the direction of conduit in

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and out for electrical;

j) All electrical or communications handholes placed in the path of vehicular traffic or snow removal equipment shall be OPSD-2112.040 with OPSD-401.030 covers. If OPSD-2112.02 handholes are used, the covers shall be reinforced.

5.2.11 Relay Protection and Metering

5.2.11.1 Relays shall have RS485 communication port and connectivity to monitoring system using Modbus RTU protocol as a minimum. Communication ports of relays and meters on the bus shall be daisy chained from breaker cell to breaker cell and connected to a separate terminal block for connection to a SCADA or BAS.

5.2.11.2 Phase overcurrent and ground fault devices shall be coordinated such that ground faults, short circuits, or overloads will trip only the immediate upstream protective device from the point where the fault or overload occurs.

5.2.11.3 The Preliminary Arc Flash hazard study analysis shall be submitted along with the design drawings prior to the co-ordination study. The preliminary arc flash study shall be used to modify the design in order to minimize the hazard. The study shall also be used for the floor boundary marking. The Preliminary Short Circuit, Load Flow, and Coordination study analysis shall be submitted with design. The final studies shall be provided after purchasing of equipment.

5.2.11.4 Dedicated incoming power quality digital metering shall be provided, beside Hydro metering, and shall measure true RMS current, voltage and display and provide 3 years history capabilities per phase.; Volts, Amps, kW, KVA KVAR, pf, Hz, kW demand and peak. Communication port shall be provided; Meters shall be mounted at eye level (approximately at 5’-6” A.F.F) Metering devices shall be housed in a separate compartment enclosure, have no exposure to 600 Volt bus or terminators. Contractor to obtain validation certificate from Hydro Utility for the meter installed on behalf of the owner. The meter shall be part of the BAS.

5.2.11.5 Surge Protective Devices (SPD, formerly known as TVSS), Lightning, Phase Over & Under Current and Ground Fault Protection shall be provided as required for protection and safety of building, equipment and personnel. SPD shall be distributed through the distribution system.

5.2.11.6 Dedicated incoming digital metering, shall be provided for all panelboards, and shall measure true RMS current, voltage, and display, minimum 3 years history capabilities. Units to be measured: per phase Volts, Amps, also kW, KVA KVAR, Pf, Hz, kW demand, and peak. The meters shall be part of the BAS.

5.2.12 Receptacles

5.2.12.1 Receptacles shall be specification grade suitable for back and side wiring and complete with wire ground terminal. Receptacles shall be 20 amp 120 volt duplex non-locking grounding type (CSA configuration 5-20R) in service and public areas. Stainless steel face plates shall be used throughout. Twist lock receptacles and special coloured ground receptacles shall be used in communications.

5.2.12.2 Receptacles shall not be on lighting circuits, and there shall be no more than six (6) receptacles per circuit in public areas, and no more than four (4) receptacles per circuit in service areas.

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5.2.12.3 In general, building areas–janitorial outlets are required for cleaning and maintenance. In public open areas, receptacles shall be spaced at 5 m centres maximum, and at ceiling level for Christmas Lights as directed by GO transit. Tunnel and exterior building receptacles shall be GFCI type outdoors, located at spacing to suit 15 m extension cords or as required by GO user groups during detail design review.

5.2.12.4 If switched receptacles are required, or receptacles on UPS, these shall have a unique standard colour identifying the type of receptacle and the use at the site. The colour or marking shall differentiate regular, regular backed up, UPS, and switched or controlled receptacles.

5.2.12.5 Other receptacle requirements are as following:

a) Electrical/mechanical rooms–minimum 2 receptacles per room;
b) Station attendant room;
c) Elevator and escalator machine room, as required by Code;
d) Maintenance facility, shop and garage receptacles shall suit equipment requirements;
e) Maintenance/Janitorial – dedicated receptacle located above the AOCS unit to the right side. Confirm cable length of selected system prior to installation and ensure stress-free connection of the provided power cord. Identify circuit number and source Electrical Panel on receptacle plate;
f) Charging of Equipment – Dedicated power receptacles shall be provided.
g) Receptacles shall also be provided for tenants and vending machines as required;
h) Communications room–minimum of 4 receptacles with 2 on emergency power.

5.2.12.6 Refer to Metrolinx Standard Electrical Receptacles and Plugs Specification 26 27 26.

5.2.13 Switchboards

5.2.13.1 The switchboards requirements are as follows:

a) Factory assembled, dead front, metal enclosed and self-supporting switchboard. Complete with; line and load side terminations;
b) Bus material shall be copper, silver-plated;
c) Bus bracing minimum 65 ka rms;
d) Enclosure: CSA type 2, indoor use equipped with arc flash reduction protection;
e) Control compartments shall be installed on front of the board away from buses;
f) Future Provisions: fully equipped spaces for future devices with bussing and bus connections suitably braced for short circuit current;
g) Allow for 25% spare breakers and 25% spaces on new installations.

5.2.13.2 Refer to Metrolinx Standard Switchboards and Panelboards Specification 26 24 13 and Low Voltage Switchgears Specification 26 23 00

5.2.13.3 Service Entrance Circuit Breakers

5.2.13.3.1 Provide Sensor and trip plug, solid-state trip circuit breakers, 100% continuous duty rating, factory mounted. Coordination study shall be provided.

5.2.13.3.2 All service entrances, solidly grounded, 1000 amps at 600V or 2000A at 120/208V and above shall have ground fault protection downstream to the loads. The main incoming

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breaker shall not be provided with ground fault protection for better protection coordination.

5.2.13.4 Monitoring and Metering

5.2.13.4.1 Provide dedicated digital monitoring meters system and sub-meters c/w remote communication capability and capable of storing data for minimum 3 years.

5.2.13.4.2 All metering shall be part of the BAS system.

5.2.14 Panelboards

5.2.14.1 Shall be flush or surface mounted as required, complete with hinged locking door and flush catch, and finished with corrosion-resistant primer, equipment gray. Surface mounted panelboards shall be installed on unistrut galvanized steel framing channels with 75 mm clear between back of panelboard and wall. Where practical, panelboards shall be grouped in proximity. Swing-door-style inner door trim panelboard shall not be used.

5.2.14.2 Panelboard shall be copper bus type, with full capacity solid neutral design and sequence style bussing, composed of an assembly of bolt-in-place moulded case circuit breakers with thermal and magnetic trip and trip- free position separate from either the “ON” or “OFF” positions. Multi-pole circuit breakers shall have common simultaneous trip.

5.2.14.3 Provide dedicated relay panel, smart panels, powerlink panels, multi circuit monitoring panel or equivalent, for circuit control, energy saving and monitoring capability. Requirements shall be established on site-by-site basis together with Metrolinx. Allow for 25% spare breakers and 25% spaces on new installations.

5.2.14.4 Refer to Metrolinx Standard Switchboards and Panelboards Specification 26 24 13 and Low Voltage Switchgears Specification 26 23 00.

5.2.15 Switches and Disconnects

5.2.15.1 Refer to Metrolinx Standard Disconnect Switches Specification 26 28 23 for detailed requirements.

5.2.16 Switchgear

5.2.16.1 All components at the completed assembly shall be CSA approved and bear a CSA label. Dimensional Coordination: Verify that dimensions of switchgear do not exceed spaces provided.

5.2.16.2 Digital Metering and Relaying: Provide dedicated power monitoring meters system and sub-meters c/w remote communication capability and capable of storing data for minimum 3 years.

5.2.16.3 Refer to Metrolinx Standard Low Voltage Switchgears Specification 26 23 00 for detailed requirements.

5.2.17 Building Automation System (BAS)

5.2.17.1 The site BAS system Head end shall be Located in the main Communication room. Access to the BAS shall be through access network portal.

5.2.17.2 Refer to Metrolinx Standard BAS Performance Specification 25 05 10 for detailed requirements.

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5.2.18 Circuit Breakers and Fuses

5.2.18.1 In order to use existing spare breaker on site, Metrolinx approval is required. The existing spare breaker shall be replaced with a new spare breaker to match the existing breaker ratings. Refer to Metrolinx Standard Circuit Breakers and Fuses Specification 26 28 00 for detailed requirements.

5.2.19 Transformers

5.2.19.1 The following are the transformer types:

a) Current Transformers (CT);
b) Voltage Transformers (VT) or Potential Transformers (PT);
c) Low Voltage Transformers.

5.2.19.2 Refer to Metrolinx Standard Liquid Filled Transformer Specification 26 12 13 and Dry Type Transformer Specification 26 12 16 for detailed requirements.

5.2.19.3 Refer to Metrolinx Standard Circuit Breakers and Fuses Specification 26 28 00 for circuit overload protection and other details.

5.2.20 Motors and Controls

5.2.20.1 Motor Starters - Provide auto mode for all life safety motor loads.

5.2.20.2 Motor Control Centers (MCC)

5.2.20.2.1 In general, circuit breaker type combination starters in Motor Control Centres shall be used for 600-volt motors. However, individually mounted circuit breaker type combination starters may be used where practicable. All starters shall be magnetic, full voltage start, single speed, non-reversing type (except when the driven equipment characteristics or power company limitations require other types), and shall be equipped with an additional one open and one normally closed contact for possible remote status indication at the Motor Control Centre.

5.2.20.2.2 Each starter shall be equipped with 120-volt transformer and three thermal overload relays. Shall be able to be monitored, solid state overload relays shall be equipped with controller capable of remote communication. Each motor starter shall have stop and start button and/or hand/off/auto switch with indicator lights. A local heavy-duty unfused isolating disconnect shall be provided within sight of the motor to safely disconnect equipment for servicing.

5.2.20.2.3 Refer to Metrolinx Standard Specifications: Motor Starters and Contactors 26 29 10 and Motor Control Centres 26 24 19 for detailed requirements

5.2.21 Monitoring and Controls

5.2.21.1 Installation of supervision monitoring and control systems at selected locations, will monitor status of equipment, power quality and demand, control and will provide capacity for automated reporting. Metrolinx Main Computer Centre will monitor the selected sites via the Metrolinx Network. Meter additions are considered in designated locations. Other requirements are as following:

a) Digital Metering devices shall be housed in a separate compartment having no exposure to the 600 Volt bus or terminations. Metering compartments shall be installed such the

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metering unit is viewable at approx. 5’ –6”;

b) Metering shall be as specified on specification sheet. In addition, each MCC shall have an incoming Power Measurement meter. The meter shall be complete with Modbus RTU communications module, and 2 PT’s and 3 CT’s. Provide fuse blocks for PT’s and shorting blocks for CT’s. Only dead front fuse holders shall be utilized in metering circuits. One (1) or a maximum of two (2) Internet Static (IP) addresses 10Mb will be required per selected Central Office. For each new installation, inform Metrolinx IT representative that a new IP address is required;

c) The Main Meter/Controller is set up with BACnet network Card;

d) Communication is established through Metrolinx Corporate Network utilizing TCP / IP;

e) Design and As-built Drawings shall be done in AutoCAD at a minimum;

f) Send CAD design to Metrolinx representative to allow for commenting and acceptance.

5.2.21.2 Power Measurement Controller

5.2.21.2.1 At selected offices and sites, install Power Measurement Controller, providing per-phase power monitoring, analysis and control capabilities, at each low voltage incoming main distribution point.

5.2.21.2.2 The following option shall be included depending on the applications. Limit the required Digital Inputs and the Return Input in consideration of the following:

a) Connection with other Counters such as Gas Meter, Water Meter, etc;

b) Counters taking in consideration that they can use the same return Input;

c) Synchronization with Hydro Meter.

5.2.21.3 Electric Power Monitors–Installation

5.2.21.3.1 Coordination with Metrolinx Technical Support Representative.

5.2.21.3.2 The installation of power monitoring units in a Metrolinx Main Computer Centre office (number and models of units to install, location of units,) must be coordinated with a representative of the Metrolinx Technical Support group.

5.2.21.4 Physical location, Communication (i.e. BACnet network)

5.2.21.4.1 Supply a minimum 6"x6" box on a wall as close as possible from the Main Power Measurement Controller master unit in electrical room.

5.2.21.4.2 Supply a minimum 19mm conduit and a communication cable.

5.2.21.4.3 Between the box and the Main Power Measurement Controller master unit, install a 19mm conduit and cable inside. The length of the cable must be 25' at the maximum.

5.2.21.5 RS-485

5.2.21.5.1 Starting from the Main Power Measurement Controller master unit, install a minimum 19mm conduit between all powers monitoring unit in order to create a daisy chain. The sequence used to link all those units has no importance.

5.2.21.5.2 Use #12AWG, 2 conductors cable with metal shield, type FT-4 to link all the power-

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monitoring units.

5.2.21.5.3 The metal shield in the daisy chain sequence must be continuous.

5.2.21.5.4 When connecting the cable to the RS-485 port, the shield of the incoming cable must be linked to the shield of the outgoing cable.

5.2.21.5.5 The metal shield in the daisy chain sequence must be connected to the terminal of only one (1) power-monitoring unit. This is to avoid a ground loop.

5.2.21.6 120V Power Feed

5.2.21.6.1 The 120V power feed of the power monitoring devices must continuous, i.e. come from a UPS or an inverter.

5.2.21.6.2 Install a minimum 19mm conduit between the UPS or inverter and the Main Power Measurement Controller master unit.

5.2.21.6.3 Starting from the Main Power Measurement Controller master unit, install a minimum 19mm conduit between all powers monitoring unit in order to create a daisy chain. The sequence used to link all those units has no importance.

5.2.21.6.4 Connect the 120V power feed of all power monitoring units to one UPS or inverter circuit of 15A.

5.2.21.6.5 Use a #12AWG cable, type multi-strand, for the 120V power feed.

5.2.21.7 Commissioning

5.2.21.7.1 When the installation activity performed by the electrician is done and that all monitoring units are functional, commissioning of these units must be performed.

5.2.21.7.2 An agreement with GO/ Metrolinx shall be signed for commissioning activities.

5.2.21.7.3 Commissioning agent shall be present on site and verify the quality of installation, program and calibrate the monitoring units, verify the communication between the units and between the Power Measurement controller master unit and the server.

5.2.21.8 Power Monitors–Monitoring Program

5.2.21.8.1 Install Monitoring Program to locally monitor all Power Meters at selected sites.

5.2.22 Wayside Power

5.2.22.1 Wayside power and control requirements are for the storage of trains. Wayside power may be 600 V ac or 480 V ac depending on the consist being stored at the site. Refer to Metrolinx Standard Drawings.

5.2.23 EV Charging

5.2.23.1 EV charging shall be provided for operations fleet of vehicles.

5.2.23.2 Provide empty conduit, complete with #12 AWG green insulated grounding conductor RWU90 for easy tracing terminated in a handwell, sized as per OESC (Ontario Electrical Safety Code) but, not smaller than 2” (50mm).

5.2.24 Service Rooms Requirements (General)

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5.2.24.1 Design Considerations

5.2.24.1.1 Electrical Closet:

a) An electrical closet is a space in the building dedicated to accommodating electrical services and be constructed in accordance with The Ontario Building Code. The electrical closet shall be built to electrical room requirements and standards as indicated in this document and Metrolinx Specifications. The electrical closet shall be provided with a locked door and clearances as per OESC, CSA and other applicable codes. The electrical closet can only consist of maximum one electrical panel, one lighting relay panel, light switches, junction boxes and electrical conduits. No communication or IT devices shall be installed in the electrical closet unless otherwise required for the electrical equipment in the closet. The electrical closet shall not be used for storage and shall be kept clear of obstruction and arranged to give authorized persons ready access to all parts requiring attention.

b) Maximum height of Electrical Room, Closet Hub, and Communications Room shall be 15 feet. Height exceeding 15 feet will need prior approval from Metrolinx.

5.2.24.1.2 Incoming utility services at Metrolinx facilities shall be located in the primary Substation and/or Electrical Room, closet, kiosk, bunker, Hub and Communications Room.

5.2.24.1.3 All Electrical Rooms and Communications Rooms shall be dedicated and not be shared with other functions, including, but not limited to: custodial, access services, communications, electrical, mechanical and storage.

5.2.24.1.4 Access to Electrical Rooms and Communications Rooms via pass through is not allowed.

5.2.24.1.5 The main Electrical Room and the main Communications Room shall be located next to each other with exterior access.

5.2.24.1.6 Electrical Room, Closet, Hub Room, Mini-Hub Room, and Communications Room walls shall not have windows, skylights, roof access hatches/doors, etc.

5.2.24.1.7 All electrical and communication rooms shall be designed to accommodate a 47” x 95” x 80” scissor lift (with access for an employee to operate it) in all facilities with an interior/exterior height of >3500mm.

5.2.24.1.8 The Service rooms’ floor plan shall always be rectangular or square in shape. Electrical Room, Closet, Hub Room, Mini-Hub Room and Communications Room shall always be a one level room and these rooms shall be above grade (grade is considered platform level). The room shall be sized for the known (current and future) equipment with a provision for a minimum of 25% extra wall space to accommodate future additional equipment.

5.2.24.1.9 Drawings shall indicate to scale the arrangement of allocated equipment inside Electrical Rooms, Closets, Hub, and Communications Rooms, including spaces and clearances. Elevation drawings shall show to scale all related wall mounted equipment for each wall.

5.2.24.1.10 A minimum 1 m clear working space shall be provided in front of access points, which may occur behind equipment. Provide a minimum of 1.5 m clearance in front of the racks and minimum 1m clearance at the sides and rear of the rack.

5.2.24.1.11 A wall mounted, flip down work surface will be provided in each communication room. The work surface will be 25.4 mm thick, 762 mm wide by 610 mm deep, solid wood, plastic laminate on both main surfaces with a vinyl self-edge. The work surface will be mounted at a

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height of 915 mm above the finished floor. The work surface shall be located near the entry door and maintain all regulatory clearances from exit and equipment as required by code when in the open position. One (1) duplex receptacle and one (1) RJ-45 data connection will be provided at the workstation and mounted above the tabletop in the open position. Provide heavy duty stainless steel mortise hinges, mechanism to hold the table open and blocking in the wall as required.

5.2.24.1.12 No liquid piping, steam piping, drainage piping, and/or dry liquid piping shall pass through or within walls of any Electrical Room, Hub Room, Mini-Hub Room, or Communications Room, except for refrigerant and condensate piping for the A/C unit dedicated for that room. Sprinkler systems shall only be installed where mandated by applicable codes. For sprinkler system requirements refer to Table 58 – Fire Protection System.

5.2.24.1.13 All Electrical Rooms, Hub, and Communications Rooms shall have a break in all ducts within 3000 mm of the building by a junction box, handhole, or manhole. All manholes or handholes shall be designed so that water is drained away. All ducting shall have the piping slope away from the room.

5.2.24.1.14 Ducting in the Electrical Room, Hub, Mini-Hub and Communications Room shall be tray and rigid galvanized steel conduit above floor. Electrical Metallic Tubing (EMT) requires Metrolinx approval before being used on site.

5.2.24.1.15 Third party equipment shall not be installed in Metrolinx service rooms. It shall be designed as per project specific requirements as a separate secured room and shall be approved by Metrolinx. Third party systems shall be a standalone system and not require Metrolinx network or infrastructure support.

5.2.24.1.16 Refer to section 5.2.10.6 – Enclosures, for additional design requirements regarding Service Rooms.

5.2.24.2 Walls Design Requirements

5.2.24.2.1 The building envelope shall be insulated to meet or exceed ASHRAE 90.1 requirements. Walls shall extend from finished floor to the structural ceiling and shall be structurally sound for wall-mounted equipment. Concrete cinder blocks shall be used on all walls where poured concrete structural walls are not present. Studded walls are not permitted. Walls shall be fire-rated as required by the applicable codes and regulations and shall be painted with a minimum of two coats of non-dust producing white or light gray paint. All Electrical Rooms, Sub-Electrical Rooms, Communication Rooms, Hub Rooms, Mini-Hub Rooms, Mechanical Rooms and other service rooms shall have fire-rated plywood on all four walls.

5.2.24.2.2 A 1200 mm wide x 2440 mm x 21 mm class C or better fire rated sheet of plywood, void free, shall be installed for wall mounted equipment. The bottom of plywood shall be mounted 150 mm above finished floor. Paint plywood with a minimum of two coats of fire-retardant white or light gray paint. The fire-rating designation shall be displayed in an area that is easily visible and shall not be painted over. One visible designation per sheet of plywood is required

5.2.24.3 Floors Design Requirements

5.2.24.3.1 Poured concrete sealed floor shall be provided in Electrical Room, Hub Room, Mini-Hub Room and Communications Room. Floor finish shall be antistatic dissipative light gray epoxy sealer, applied per manufacturer's published specifications. A 100 mm rubber wall base shall be provided. No floor drain is allowed. The floor shall have a slope to provide a

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way for water to exit the room in a manner that does not create any slipping hazards.

5.2.24.4 Doors Design Requirements:

a) The doors shall be at least 915 mm wide x 2135 mm high and shall be hollow metal slab type (no windows) with hollow metal frames;
b) Double or oversized doors shall be provided for rooms that have large equipment shall be installed and maintained;
c) If the door to the Room is in a fire separation, then the door shall have an appropriate fire resistance rating per O.B.C.;
d) When feasible, the rooms shall have exterior access, but doors shall not open onto a public space;
e) The Electrical Room and Communication Room within a parking structure may be exempt from having an exterior door access, providing access to the Room door is unrestricted;
f) Doors shall not open in to the path of vehicle traffic;
g) Access shall be provided through GO Transit uniform master key system and a centrally controlled alarm keypad and proximity access device system, with an access override feature;
h) The door shall be lockable from outside only.

5.2.24.5 Ceiling Design Requirements:

a) No suspended ceiling shall be installed;
b) Finished ceiling minimum height shall be 3050 mm (10'- 0");
c) Prime and paint the ceiling with a minimum of two coats of non-dust producing paint. White paint is required;
d) Where OWSJ are present, prime and paint all exposed structures to meet flame spread and smoke developed ratings designated by local Code requirements.

5.2.24.6 Flood Prevention Design Requirements

5.2.24.6.1 Locate all Electrical Rooms/Closets and Communications/Hub Rooms and Mini-Hub Rooms at or above grade away from any threat of flooding. Avoid locations that are below grade or adjacent to potential water hazards. Roof drains and pipe penetrations into the room shall be avoided.

5.2.24.7 Fire Protection Design Requirements:

a) Fire-stop all room penetrations (cables, pipes, pathways, trays, conduit slots). Ensure that the fire-resistance rating of installed fire-stopping assembly shall be not less than the fire-resistance rating of surrounding floor and wall assembly to match the corresponding fire rating of fire separation.
b) For fire suppression, install a hand held 10lbs CO2 (10 B:C rated) fire extinguisher, with current certification, meeting NFPA 10 requirements. The extinguisher shall be wall mounted on the latch side of the entry door and installed in accordance with manufacturer's recommendations. All panels, boxes, and conduit shall be sprinkler proof if required.

5.2.24.8 HVAC Design Requirements:

5.2.24.8.1 Heating, ventilation, and air conditioning of Electrical Room/Closet, Hub Room, Mini-Hub

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Room, Elevator Control Room, and Communications Room shall be provided by a dedicated heat pump AC unit with the following features:

a) Low ambient cooling;
b) Heating at -25°C;
c) R 410A refrigerant;
d) Variable compressor speed.

5.2.24.8.2 A fan-forced heater shall be provided as a redundancy in case the heat pump does not provide enough heating during the extreme cold days. Because Hub Rooms and Mini-Hub Rooms are smaller than a typical Communications Room and a bunker or kiosk is smaller than an Electrical Room, a heat pump with hyper-heating may not be available on the market. If this is the case, a split A/C unit with ambient cooling would provide cooling and the fan-forced heater will provide heating. Control of both systems shall be central in order to avoid both systems fighting each other. The heat pump and heater shall be fed from the generator backed up power panel located in the Room where available. Temperature and humidity requirements are on a 24 hours, 7 days a week basis, regardless of the heat generated by normally operating electrical and communications equipment.

5.2.24.8.3 The required capacity shall be calculated based on the following:

a) For sensible heat gain from electrical equipment use a minimum 5000 Watts per rack (in the Communications Room);
b) Sensible heat gain from lighting;
c) Include the future growth of systems by 25%;
d) Determine heat gain/loss to the room from the outside (heat transfer through building structures, including solar load) g the following design criteria;
e) Outdoor temperatures.

5.2.24.8.4 Use 1% winter & 2½% summer design temperatures per Ontario Building Code for the geographical location. Indoor temperatures:

a) Winter design: 15°C;
b) Summer design: 22°C D B with a maximum of 50% relative humidity;
c) An infiltration rate from outside of 0.5 air changes per hour;
d) A recirculation rate of 100% for the air conditioning system;
e) A safety factor of 5%.

5.2.24.8.5 The air conditioning system shall be selected to suit the specific capacity by taking into consideration the room's very high sensible load factor. Heat loss calculation shall not include credit for equipment and lighting heat gain.

5.2.24.9 Emergency Cooling

5.2.24.9.1 Provisions for emergency cooling in Hub Room, Mini-Hub Room, Elevator Control Room, Communications Room and Electrical Room:

a) Provide a 150mm diameter vent opening provision, secured from inside, for portable A/C unit in both electrical and communication rooms, venting to the outside;
b) Provide dedicated 120V, 20A, 5-20R and 120V, 30A, 5-30R power receptacles (generator backed-up) from dedicated circuit breakers for portable A/C unit, in Electrical and Communication rooms;

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c) Receptacles shall be mounted at 300mm height above finished floor;
d) Contractor to provide Labels above receptacles stating: the respective Amps, panel and circuit numbers and “DEDICATED FOR PORTABLE A/C UNIT”;
e) Provide an exhaust fan controlled by a reverse acting thermostat and an override switch;
f) High/low temperature alarm;
g) All alarm inputs shall be placed in Metrolinx Vendor System and BAS.

5.2.24.9.2 The sequence of operations shall be as follows:

a) When A/C unit fails and temperature starts rising, the high temperature sensor sends an alarm to the current corporate supplier of monitoring services;
b) Station Operations will be notified to send a portable A/C unit and the HVAC service contractor is notified to repair the broken A/C unit;
c) The ventilation system will then kick-in to help reduce the temperature until a portable A/C unit is installed;
d) Station Ops will install the portable A/C unit and switch off the ventilation system.

5.2.25 Electrical Rooms

5.2.25.1 Design Considerations

5.2.25.1.1 Electrical service Substations are typical at GO/ Metrolinx Rail Service Centres but can occur at a large station, maintenance facilities or where ever else Metrolinx requires them.. For an example of a substation, see Standard Layover drawings. Install a dedicated HVAC in all electrical rooms w/auto changeover.

5.2.25.1.2 Whenever possible there shall be one main Electrical Room that feeds the entire site, as it is a requirement to have only one utility power source. Sub Room(s) shall be strategically placed around the main Electrical Room to facilitate an efficient distribution of power to loads to boilers, tunnels, bridges, main and sub- structures (e.g. parking structures, stations, service and storage buildings and maintenance facilities), as required. Electrical closets shall be provided to minimize the number of home runs from distribution panels to their respective sub-panels or equipment loads, and to reduce the number of conductors and minimize voltage drop or in preparation for future requirements.

5.2.25.1.3 The typical Electrical Room at Metrolinx facilities shall include space for locating:

a) Distribution panels, switches and boards;
b) Metering Cabinets;
c) Transformers;
d) Uninterruptible power supply (UPS);
e) Transfer Switches;
f) Battery Pack backup emergency lighting above and beyond the generator backed up lighting and UPS lighting of the space;
g) Automatic Transfer Switch (ATS);
h) Data and telephone outlets;
i) A service-working station by the door with power and data connections;
j) The station shall be a cabinet-lectern combination sized to hold ANSI B drawings, to serve as a working surface and storage for drawings, manuals and onsite component and parts;

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k) A minimum continuous 17 m of wall space is required for equipment installation.

5.2.25.1.4 All wall installed panels and conduits or ducts shall be installed on strut channel mounting system. All floor mounted panels and equipment shall be installed on housekeeping concrete pads. The housekeeping pad shall be a minimum of 100 mm above the floor and shall extend beyond the equipment footprint as per manufacturer's requirements.

5.2.25.1.5 A non-fade single line diagram of the electrical system related to the room shall be framed and posted under a polycarbonate cover adjacent to the entrance of the Electrical Room and Communication Room. The diagram shall be legible from a distance of 1 m.

5.2.25.1.6 Provide markings on the floor showing the arc flash boundaries in around equipment and panels.

5.2.26 Communications, Hub, and Mini-Hub Rooms Design Considerations

5.2.26.1 All Communications Rooms shall be designed in accordance with ANSI/TIA/EIA-569-A-Commercial Building Standard for Telecommunications Pathways and Spaces.

5.2.26.2 The Communications, Hub, and Mini-Hub Rooms shall accommodate the following equipment (refer to Metrolinx I&IT Telecommunications and Systems Standards for a list of IT equipment):

a) Network System Rack;
b) CCTV System Rack;
c) PA System Rack;
d) Passenger Notification System (PINS, Whiteboard, etc.);
e) Telephone Infrastructure;
f) Two-way Communication Infrastructure (elevator cab intercom and information intercom);
g) Fare Collection Equipment: Presto and legacy;
h) Alarm and Security Monitoring Equipment;
i) Fire Safety System;
j) Space Counting System (in parking structures);
k) Building Automation System Server (all support systems shall be located appropriately with the equipment).

5.2.26.3 Communications Room shall be located next to the Electrical Room with exterior access , within parking garages these rooms shall open onto the interior of the garage and be protected from vehicular traffic by a delineated marking on the ground and bollards bordering the area of delineated marking.

5.2.26.4 At facilities where the distance of cable runs exceeds 90 m (300 ft.) between the end device and accumulation point as deemed necessary by Metrolinx, Communications Hub Room(s) shall be implemented. Hub Rooms are satellite Communications Rooms, designed to accommodate a minimum of two floor-mounted racks. Hub Room's purposes are to minimize the number of home runs from remote devices to their respective head end equipment; reduce usage of optical fiber and associated equipment; concentrate the distribution of collocated devices; facilitate future implementation of Communications systems.

5.2.26.5 Mini Hub Rooms

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5.2.26.5.1 Mini-Hub Rooms are strategically located on or beside the rail platform to service rail platforms and all PoE devices within the limitation of the Metrolinx I&IT standard (PoE extenders, multipliers, etc. are not allowed). Mini-Hub rooms shall be provided at rail platforms to span beyond the 90 m limitations of Power over Ethernet (PoE) Architecture and in areas where devices are deployed in numbers that require consequential infrastructure. Standalone cabinets, wall mounted or otherwise, shall not be used on rail platforms or where devices are deployed in numbers. Grounding shall be provided from a single point within the Mini-Hub room utilizing the "HALO" distribution method. Refer to section 5.2.32.6 Grounding of Electrical and Communication Rooms, and Fixed Machinery for further details.

5.2.26.5.2 Consequential infrastructure is defined as the use of multiples of support enclosures and devices, additional/costly components and resource and infrastructure intensive to install and maintain.

5.2.26.6 Interior

5.2.26.6.1 Mini-Hub Rooms shall, at a minimum, be of sufficient size to house one full size floor mounted network rack that is capable of pivoting to allow technicians to access the rear of devices which are mounted on the rack thus minimizing the room's footprint. Mini-Hub room interiors, finishes, and materials shall follow the DRM requirements for Communication/Hub Room, System Room finishes. Refer to Metrolinx I&IT Standards for rack type and size.

5.2.26.6.2 An HVAC system shall be provided by a heat pump type A/C unit, a fan-forced heater shall be provided as a redundancy. A multi-split unit may be provided for elevator area and Mini Hub Room, where feasible. A dedicated heater and condensing unit shall be located within the Mini Hub Room.

5.2.26.7 Power

5.2.26.7.1 Grounding shall be provided from a single point within the main Electrical Room utilizing the "HALO" distribution method. The size of the ground bus shall be 50 mm x 6 mm or sized to provide grounding to all systems, racking and supporting infrastructure within the room including doors and door frames. Refer to section 5.2.32.6 Grounding of Electrical and Communications Rooms, and Fixed Machinery for further details.

5.2.26.7.2 Power panels shall be provided, minimum one UPS and one regular power.

5.2.26.7.3 Provide a cable tray and cable ladders to facilitate wiring infrastructure within the Mini Hub Room.

5.2.26.7.4 Two receptacles shall be provided on the cable tray above the network rack with each having a distinct and separate UPS circuit to provide power for systems within the rack.

5.2.26.7.5 Provide two wall mounted GFI receptacles on generator power for maintenance.

5.2.26.7.6 Illumination shall be provided in front of the racks and be tied to a hinge switch.

5.2.26.7.7 High/Low temperature sensors and access control utilizing Keypad/FOB for entry shall be implemented.

5.2.26.7.8 Power bars shall not be used within the Mini-Hub Room.

5.2.26.7.9 All wall mounted equipment shall be mounted at level boarding height. All stub up conduit

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shall be cut to above level boarding height to allow for the raised platform height.

5.2.26.8 Utilization

5.2.26.8.1 Rail platforms used by GO Transit are minimum 315 m long. To provide infrastructure for the number of current and future systems, it will be necessary to provide more than one Mini Hub Room for each rail platform.

5.2.26.8.2 Mini-Hub rooms provide infrastructure and connectivity for Metrolinx network devices on Metrolinx platforms, tunnels, and bridges. Metrolinx networking architecture utilized PoE architecture. To implement 100% PoE support, consideration and location planning is essential.

5.2.26.8.3 The Mini-Hub Room shall be located at platform grade in a manner that will minimize passenger flow disruptions and in compliance with CPTED practices. Mini-Hub Rooms shall not be located beyond the ends of the platforms extending into the rail corridor.

5.2.26.8.4 Mini-Hub Rooms shall meet or exceed rail corridor regulations and all regulatory items that apply.

5.2.26.9 Exterior

5.2.26.9.1 Exterior cladding shall match adjoining structural material palette to give a consistent, cohesive, uniform appearance. This includes the wall shared by the Mini Hub Room and an enclosure.

5.2.26.9.2 Where a Mini Hub is located under a platform canopy, extend the exterior enclosure of the Mini Hub Room shall be continuous to the underside of the platform canopy. Where the location does not have a canopy, extend the exterior finish of the Mini Hub Room to the height of the adjacent structure (elevator or stairwell).

5.2.26.9.3 Where possible, the Mini Hub Room shall be installed outside of the OCLZ.

5.2.26.9.4 At multi-level parking structures, Communications Hub Room(s) shall be strategically placed directly above the main Communications Room and centrally located to meet the 90 m (300 ft.) cable run distance limitation. One Hub Room can serve more than one floor. In Parking Structures, careful planning is required when locating the Communications and Hub Rooms. Attention must be paid to equipment placement within these rooms in relation to the structural ceiling elements. The required vertical clearance above the racks must also be taken into account. Ideally, cable trays shall be kept level, precast openings in structural “T’s” as determined by the structural engineer, to get to the sidewalls of the room.

5.2.26.9.5 Communications Hub Rooms and Mini Hub Rooms shall be dedicated and not be shared with other functions, including, but not limited to: custodial, access services, electrical, mechanical and storage. Access to Communications Hub Rooms and Mini Hub Rooms via (pass through) Electrical, Mechanical, Maintenance/Janitor Rooms, etc., shall not be permitted. The Hub Rooms may share space with an electrical-sub room e.g. at stairways for bridges, tunnels and elevator machine rooms, provided that the following requirements are met:

a) There is sufficient clearance between the electrical equipment and the communication racks;

b) The electrical equipment is limited to 100 A at 120/208 V, 3 phase or 100 A at 120/240 V, single phase; and

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c) There is no electrical equipment rated 600 V, or 600 V-120/208 V stepdown transformers.

5.2.26.9.6 For further information regarding Mini Hub Rooms refer to the Service Rooms Requirements (General) section of this document and the Electrical Communications Infrastructure Mini Hub Rooms drawing in the GO Standard Drawings and Specifications.

5.2.26.10 System Controller

5.2.26.10.1 The System Controller shall provide the following primary functions:

a) Switches of audio channels to the required zone drivers;
b) The switching function shall be performed by the zone switching card;
c) Allows programming and testing through a RS 232 /RS 485 port;
d) Supplies power to the system processor, display and interface cards;
e) Four audio input channels that can each provide an audio output on any pre-configured group combination or manually selected zone;
f) Provision shall be made for an ALL Call broadcast to all zones simultaneously;
g) Appropriate Zone Driver and Zone Relay Cards for the requisite number of drivers/zones within the system;
h) The audio channels are interfaced to the driver input/output circuits by zone driver and relay cards;

5.2.26.11 Communications and Hub Rooms Construction

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5.2.26.11.1 For Room dimensions (minimum wall to wall) Refer to Table 43.

Table 43: Minimum Room Dimensions

Location	Size
Communications Hub Room	Space for 2 racks. Refer to Metrolinx I&IT requirements for rack sizes
Communications Mini-Hub Room	Site specific. Follow Mini-Hub Room design requirements
Communications Rooms at stations and small to medium sized facilities	Space for 5 racks. Refer to Metrolinx I&IT requirements for rack sizes
Communications Rooms at Large Facilities and/or Parking Structures Note: Small, medium, and large size facilities are determined by the number of racks that are needed to house all equipment systems and varies per facility.	Space for 6 racks. Refer to Metrolinx I&IT requirements for rack sizes
For Type A Bus and Rail Facilities	Space for 6 Racks. Refer to Metrolinx I&IT requirements for rack sizes
Type B Bus Facilities	Space for 5 Racks. Refer to Metrolinx I&IT requirements for rack sizes
Type C Bus Facilities	Space for 4 Racks. Refer to Metrolinx I&IT requirements for rack sizes

5.2.26.12 Communications and Hub Rooms Communications Connectivity

5.2.26.12.1 A minimum of nine 53 mm dedicated conduits shall provide connectivity from the Main Communications Room to each Hub Room and Mini-Hub Room. Note that the required number of power conduits are not part of these nine dedicated communication conduits. If more than one Hub Room is required, then each Room must have its own direct dedicated set of conduits linking it to the Main Communications Room, which may be designed as a pass-through layout. Spare communication conduits (excluding tracks and signals) shall be 53 mm.

5.2.26.12.2 If more than one Communications Room on site, provide eight 53mm conduits for communications power to each Hub Room and Mini-Hub Room from the Main Communications Room. A minimum of nine 53 mm dedicated conduits shall provide connectivity from one Communications Room to the other. Refer to I&IT Telecommunication and Systems Standards for list of equipment. Spare communication conduits (excluding

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tracks and signals shall be 53mm.

5.2.26.13 Conduit Infrastructure

5.2.26.13.1 Communications conduit shall be included in all rail platforms, power, communication and mechanical systems.

5.2.26.13.2 Power shall be run in a dedicated duct bank. Communications shall be run in a dedicated duct bank.

5.2.26.13.3 Power and Communications shall run the entire length of the platform and be fed from the Systems designated Main Electrical Room and Main Communications Room respectively.

5.2.26.13.4 For platform communications provide nine 53mm conduits and eight 53mm conduits for communication power for the entire length of the platform.

5.2.26.13.5 Provide routing of all conduits with the capability of connecting the Mini-Hub rooms and terminating at each end of the platforms in hand-wells that can provide future connectivity to rail corridor systems.

5.2.26.14 Communications and Hub Rooms Electrical Requirements

5.2.26.14.1 All communications equipment in the Communications Room shall be serviced minimum by a dedicated 120/208 V 3 phase 4W 225 A panel located inside the Room, and fed from an UPS placed inside the Main Electrical Room. If 208 V service is not available, 120/240 V 1 phase 3W 225 A panels shall be used.

5.2.26.14.2 All communications equipment in the Hub Room shall be powered from a sub-panel fed from the dedicated back-up UPS electrical panel located in the Communications Room.

5.2.26.14.3 All communications equipment shall be powered from the UPS panels located in the Communications Room, Hub Rooms, or Mini-Hub rooms.

5.2.26.14.4 A dedicated electrical panel shall be provided for regular power inside each Communications Room. This panel grounding shall be connected to the Electrical Room grounding system.

5.2.26.14.5 All panels shall be sized to meet DRM requirements. All panels shall have remote monitoring and control of all circuits' capabilities.

5.2.26.14.6 All panels and boxes shall have NEMA ratings designations.

5.2.26.14.7 Half of the light fixtures inside Communications, Hub and Mini-Hub Rooms shall be powered from the UPS backed-up panel.

5.2.26.14.8 Heating and air conditioning of the Communications and Hub Room shall be generator backed-up only (no UPS back-up).

5.2.26.14.9 All panels, boxes, and conduit shall be sprinkler proof.

5.2.26.15 Communications and Hub Rooms Power Outlets

5.2.26.15.1 Each communications equipment rack shall be fed from two independent tray mounted twist lock L-20R single specification grade receptacles. Each such receptacle shall be fed from a dedicated circuit. Refer to the I&IT Telecommunications and Systems Standards for detailed

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specifications.

5.2.26.15.2 Metrolinx communications racks shall be powered by two individual dedicated circuits fed from the UPS panel located in the Communications Room.

5.2.26.15.3 Provide a minimum of three normal power 5-20R 120 V duplex receptacles, powered from three dedicated circuits, for maintenance and identified as such. These receptacles shall be wall mounted and not located on cable tray or cable ladders, as not to be confused with communication-dedicated receptacles. Power bars are not allowed.

5.2.26.15.4 All power receptacles shall be mounted on Class C or better fire-rated plywood with nameplates to provide power tracing ease. All equipment connecting to the receptacles shall have nameplates indicating model, capacity, and electrical data. Refer to Metrolinx specification 26 05 53 – Electrical Identification and Nomenclature for more details.

5.2.27 Illumination

5.2.27.1 Lighting Design

5.2.27.1.1 This section addresses interior and exterior illumination and lighting design strategy for GO site and building facilities. The intent is to provide good uniform quality lighting design strategy that meets the locations application. The Lighting design strategy shall be applied as a sequential overlay of Guiding Principles; followed by lighting design considerations, lighting typology applications and selection criteria and individual lighting design requirements.

5.2.27.1.2 Lighting Design Guiding Principles → Design Considerations → Typologies → Design Requirements

5.2.27.1.3 Refer to Metrolinx Lighting and Controls Specification 26 50 00 for detailed requirements.

5.2.27.2 Lighting Design Guiding Principles as follows:

a) A cohesive and adaptable hierarchy of lighting;
b) Provide a consistent and flexible lighting approach across all sites will promote intuitive wayfinding;
c) Utilize built site elements with internal lighting as beacons to support wayfinding;
d) Associate lighting types with the same conditions/activities at each element, to provide a recognizable visual language;
e) The hierarchy of lighting is identified as:

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1) Areas of transition and boarding of Metrolinx services that are highlighted to enhance the experience;
2) Illuminated built structures that serve as lanterns and aid wayfinding throughout the site. The lighting shall provide comfort, feel and uniformity with accent lighting for points of interest and art;
3) Pedestrian scaled illumination for areas of rest and waiting that promote activity specific design, comfort and feel of the space;
4) In areas of vehicular movement and parking, the lighting shall meet the BUG rating system, be uniform and have no glare;
5) Durable and adaptable design with sustainable maintenance and operational efficiencies;
6) Use LED technology;
7) Integrate control systems and sensors to meet energy management goals and sustainable practices. Equipment shall be non-proprietary and shall not be a custom design;
8) Shall guide customers through the sequence of unique customer journey touchpoints at a site;
9) Use lighting to articulate each site element's sense of place;
10) Highlight areas of transition to heighten the experience of movement;
11) Reinforce site order and hierarchy by emphasizing important zones with light that will match the activity of the space and the lighting levels needed for all users;
12) Deliver an engaging, comfortable, and safe experience for the customer;
13) Use a variety of lighting types and methods to create ambiance and provide comfort;
14) Highlight significant edges of site elements–thresholds–to create a dynamic and engaging experience;
15) Provide lighting levels that ensure visual and physical comfort of customers. In noncustomer areas, the lighting levels shall ensure visual and physical comfort to perform required tasks;
16) Use light sources with good colour rendering and colour temperature to support comfort, well-being and health;
17) Highlight edges of train platforms and curbs to provide a high level of safety and legibility.

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5.2.27.3 Lighting Design Considerations as follows:

a) The levels and quality of lighting for the various types of areas shall be as outlined to meet the latest edition of the Illuminating Engineering Society of North America (IES) Lighting Library, Ontario Building Code and Ontario Electrical Safety Code. They shall take into consideration the aging population and the needs for accessibility of all groups (e.g. CNIB recommendations). The lighting design shall be done by a qualified lighting designer;

b) Illumination systems design shall incorporate requirements of: minimal maintenance, shall be energy efficient and readily accessible, designed for passenger safety and security;

c) Illumination shall be designed to provide visual comfort and minimum glare for GO staff and passengers;

d) The illumination systems lighting levels shall be compatible with CCTV systems requirements;

e) Building luminaries in public areas shall be integrated with the architecture;

f) Luminaries shall be in locations dictated by the architect in conjunction with the lighting designer, complementing daylight sources;

g) All luminaries must be accessible for maintenance and lamp replacement without having to construct special means of approaching the fixture;

h) The illumination systems component maintenance requirement shall be easy to access, tool-less maintenance, easily removed and replaced;

i) Public area lighting such as tunnels, bridges, and station buildings, shall have LED Fixtures with quick connects / support system and safety chains. The fixtures shall come complete with pigtail plugs that connect to a twist lock receptacle or by a manufacturer designed plug and play wiring system;

j) Illumination sources whenever possible should not be visible to the public;

k) Urban light fixtures for each station site shall be selected from one fixture family and matched to the uses and lighting types called for at each site element;

l) Wayfinding through each station site shall be supported by using fixtures that are common to the scale of the user wherever possible. For example, for lighting fixtures on 6 meter poles shall look the same or very similar to the fixtures on the 12 m poles in look and shape. This is to provide a uniform look and feel throughout the site;

m) Light fixture design shall be simple, elegant and contemporary;

n) Site lighting controls, including sensors and timers, shall be provided for all site element lighting where appropriate, and shall be integrated into the station building automation system;

o) Lighting controls shall support daylight harvesting where applicable;

p) Lighting controls shall support reduction when not occupied;

q) Lighting controls shall support dimming to Metrolinx levels;

r) Photosensors shall be located so that there is a direct view of the sun and that no shadows or obstructions will interfere with readings;

s) Occupancy sensors shall be provided in the following areas: Parking garage, tunnels, bridges, service rooms, outdoor lighting, offices and other areas as required;

t) Non-proprietary controls and occupancy sensors shall be used;

u) Photosensors shall be provided for site lighting in the following areas:

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1) Bus platforms, including shelters;
2) Surface parking lots;
3) Station plaza;
4) Rail platforms;
5) Open bridges, including stairways;
6) Closed bridges.

5.2.27.3.1 Refer to GO Standard specifications for detailed requirements.

5.2.27.3.2 Lighting in enclosed stairways and parking garages shall remain on at all times, unless otherwise noted.

5.2.27.3.3 Lighting fixtures and ballasts/drivers shall be selected and installed to ensure ease of access for servicing and ease of maintenance.

5.2.27.3.4 All light fixtures shall be LED with the following criteria:

a) CRI (Colour Rendering Index) shall be a minimum of 80 unless otherwise noted;
b) Colour temperature shall be 4000K unless otherwise noted;
c) Exterior luminaires to have CSA or CUL Wet Location labels;
d) Use light fixtures equipped with industry standard LED light engines that are equal or better in; performance and build quality to Bridgelux or Xecato or equivalent
e) Specify light fixtures that limit glare and uplight, and support dark sky policy with the exception of color temperature;
f) The light fixtures shall come with a lens over the LEDs to allow for easy cleaning;
g) Specify light fixtures that are locally distributed and serviced;
h) Lighting fixtures to have a minimum 5-year warranty;
i) Negotiate longer warranties where option is offered by the manufacturer;
j) Where accessible by the public, light fixtures are to have vandal resistant features;
k) The underside of ceiling mounted fixtures is shall be a minimum of 2750mm above the finished floor;
l) Glare: Adjacent properties shall be shielded from glare or light trespass. There shall be no interference with railroad signal or operations systems due to glare. The discomfort Glare Rating shall have a Visual Comfort Probability (VCP) of 65% or greater for interior lighting. Station attendants and passengers at service counters shall be able to see each other 100% when the sliding glass panel is in the closed position. Luminaries in this location shall have parabolic egg crate lenses, with all illumination directed vertically down to the task. Passengers and station attendants shall be capable of seeing out to the exterior at night. All glass shall be clear and not tinted, for maximum visibility of the interior. Luminaries' placement shall take into account viewing angles and fields of view of close circuit television cameras. Luminaries shall not present a source of glare to surveillance cameras;
m) Exit lights shall be of the fully self-contained and low energy LED type. LED replacement bulb-style is permitted;
n) Emergency lighting shall be in accordance with the OBC, the Ontario Electrical Safety Code, and the latest CSA standards;
o) Daylight–Particular attention shall be directed to parking structure, rail station and bus terminal entrance/ exit areas, especially on large projects. Illumination shall provide for a

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visually comfortable transition from outdoors to facility entry areas during all hours of system operation. Illumination levels will likely have to be graduated during the daylight hours to minimize otherwise abrupt changes from outdoors to indoors, and vice versa. Photoelectric cells for the automatic operation of additional lighting fixtures may be utilized;

p) Sundry: All rail platform poles shall be hinged. Hinged poles shall be installed in such a manner to avoid obstructions when lowered. Hinging shall be always parallel to the track. CCTV camera(s) shall have dedicated split pole(s). PA speakers can be installed on existing lighting poles only if they are split. High mast poles are not allowed for CCTV use.

q) Standard Light Pole Drawings: are available for 3 and 6 meter hinged pole, 6 meter, 12 meter and 30 meter (high mast) pole on the public GO site under Standard Drawings and Specifications;

r) The following are the Uniformity Ratio:
   1) Maximum to minimum: 4:1 or better;
   2) Average to minimum: 3:1 or better;

s) Where lighting is of a complex or unique nature or if required by GO, the Consultant shall engage the services of a qualified Illumination Designer;

t) Design photometric digital file in PDF or DWG format, complete with printouts using recognized computer lighting design software, shall be provided for GO review of design illumination levels. These photometric files shall be included in the As-built drawings.

5.2.28 Lighting Design Requirements

5.2.28.1 Pole design shall adhere to the Metrolinx standard lighting drawing for poles (3, 6, 12 and 30 meter) unless instructed otherwise by Metrolinx.

5.2.28.2 Placement of light fixtures shall not provide glare to fare device screens, staff workspaces or provide discomfort to customers.

5.2.28.3 Access to light fixtures for re-lamping shall be facilitated without the use of specialized equipment (except parking lot fixtures which require a scissor lift). Consideration shall be given to allow re-lamping to be done without impacting primary or critical customer access points.

5.2.28.4 Selection of lighting fixtures shall be assessed against insect or animal related matters such as nesting for birds.

5.2.28.5 All light fixtures shall have long lasting drivers to maximize reliability, be non-proprietary and have a 5 year warranty.

5.2.28.6 Light fixtures and luminaires shall be readily available, off the shelf versions. Custom lights are not desirable due to cost, maintenance, and reliability issues and are only permissible if luminaires are easily accessed and readily available to replace locally,

5.2.28.7 Parking lot fixtures on high mast lighting shall be lowered for maintenance.

5.2.28.8 Heat sinks are required to ensure consistent use throughout various weather conditions.

5.2.28.9 Fixtures shall be modular in design with easily replaceable boards, drivers, lenses, etc.

5.2.28.10 Fixtures shall not be placed in inaccessible environments such as over stairs or above

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fixtures or equipment. Luminaires shall be easily accessed for removal and replacement without the need for specialized tools (excluding tamper resistant screws or scissor lifts).

5.2.28.11 Suspended light fixtures shall be strategically placed to provide even light distribution and not interfere with access to any services. Lighting shall not be an obstacle to ongoing maintenance.

5.2.28.12 Luminaires shall be operable/maintainable/replaceable by Metrolinx technicians and provide toolless entry (when applicable) and not require a certified electrician for fixture maintenance.

5.2.28.13 Light covers shall be durable, easily removable and replaceable without tools (when above height level due to safety concerns).

5.2.28.14 Bus Loops lighting requirements:

a) General illumination for bus platform shall be provided by a line of full cut-off single-headed downlights on lampposts aligned with the back of bus shelters;

b) Lamppost height shall be kept to a minimum, based on site layout and context. Refer to Figure 19;

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Figure 17: Lighting Design Requirements - Bus Loop



c) Lighting of the bus shelter, while not within the scope of site lighting, shall be taken into consideration in calculations and overall balance of lighting design;

d) Supplementary lighting can be integrated with the digital information signage at the front of the bus bay;

e) Minimum average maintained illumination levels shall be:

1) Bus Platform Boarding Area: 100 lux horizontal and 50 lux vertical;

2) Bus Platform: 50 lux horizontal, 25 lux vertical;

3) Colour temperature shall be 4000K and shall be confirmed through testing with site materials.

5.2.28.15 Parking Garage lighting requirements:

a) The lighting in the parking area of the garage shall be provided by direct/indirect fixtures positioned above the bottom edge of structural beams, Refer to Figure 20;

b) The lighting in the elevator lobby shall be provided by graphic direct LED fixtures positioned parallel to the elevator doors;

c) In cases where the design and layout of the garage permit, use graphic direct LED fixtures to highlight key pedestrian areas and promote wayfinding within the garage;

d) Minimum average maintained illumination levels shall be:

1) General Parking and Pedestrian Areas: 55 lux horizontal;

2) Ramps and Corners: 110 lux horizontal;

3) Elevator Lobbies: 200 lux horizontal;

4) Parking Garage Entrance Areas–Nighttime: 110 lux horizontal, 55 lux vertical;

5) Parking Garage Entrance Areas–Daytime: 550 lux horizontal, 275 lux vertical;

6) Colour temperature–4000K minimum;

7) CRI–80 minimum.

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Figure 18: Lighting Design Requirements - Parking Garage



5.2.28.16 Surface Parking lighting requirements:

a) The lighting in the parking and drive aisle areas shall be provided by full cut-off single and double-headed downlights on lampposts, Refer to Figure 21;
b) Lamppost height shall be kept to a minimum, based on site layout and context;
c) Maximum height of pole for luminaire shall be 30m;
d) Minimum average maintained illumination levels shall be:
    1) Parking Lot: Refer to Table 46 ;
    2) Pedestrian Walkways: 20 lux horizontal;
    3) Colour temperature–4000K CRI–80 minimum.

Figure 19: Lighting Design Requirements - Surface Parking

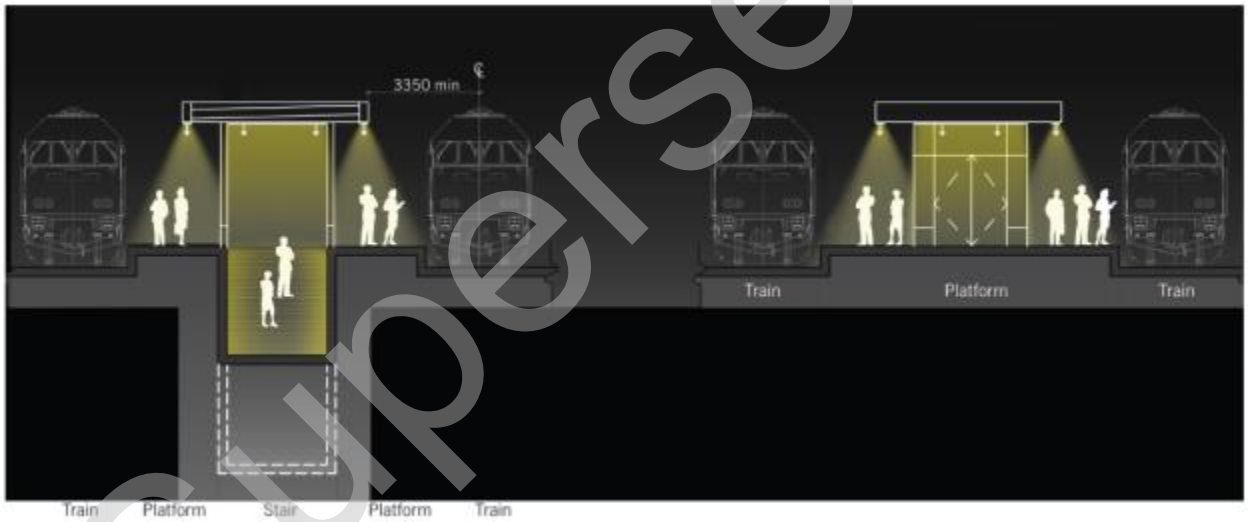


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5.2.28.18 Rail Platforms lighting requirements:

a) The lighting of the platform area and its stair and elevator access points shall be provided by direct/indirect lighting fixtures that produce a graphic effect, aligned parallel to the platform edge, Refer to Figure 22;
b) At platforms without roof soffits, lighting shall be provided by direct full cut-off lighting. The platform shall be uniformly illuminated;
c) Lamp post height shall be 6m pole, based on site layout and on a raised base above grade;
d) Stairwells shall have lighting which is easily accessible for maintenance;
e) There shall be step lighting as well as general overhead lighting provided;
f) Avoid placing lights in the ceiling above stairs;
g) Minimum average maintained illumination levels shall be:
    1) Platform Boarding Area: 100 lux horizontal, 50 lux vertical;
    2) Platform: 50 lux horizontal, 25 lux vertical;
    3) Stairwells: 200 lux horizontal;
    4) Colour temperature shall be 4000K.

Figure 20: Lighting Design Requirements - Rail Platform



5.2.28.19 Station Plaza lighting requirements:

a) Lighting along the Plaza Edge/Drop Off and Pick-up Area shall be provided by full cut-off double-headed downlights on lampposts aligned parallel to edge of plaza;
b) One head will provide roadway lighting, the other head will provide pedestrian scale lighting on the plaza;
c) Lamppost height shall be kept to a minimum, based on site layout and context;
d) Lighting of the station building shall be taken into consideration in calculations and overall balance of lighting design;
e) Minimum average maintained illumination levels shall be:

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1) Plaza Edge/Drop Off and Pick-up Area: 50 lux horizontal, 25 lux vertical;
2) Lighting within the plaza shall be provided by indirect light lampposts aligned parallel to the station building and integrated with the planting zone if one exists;
3) Plaza: 50 lux horizontal;
4) Colour temperature shall be;
5) Plaza Edge/Drop Off and Pick-up Area: 4000K.

5.2.28.20 Bridges lighting requirements:

a) Enclosed bridges shall have ceiling integrated direct/indirect lighting that produces a graphic effect;
b) Open bridges shall have lighting integrated on the interior, into side elements such as structure, handrails and guards;
c) Light sources shall not to be visible from the point of view of train conductors;
d) Enclosed stairs to bridges shall have lighting integrated into side walls above head height, and lighting integrated into handrails;
e) Open stairs to bridges shall have lighting integrated into walls or handrails;
f) railing lights shall not be integral with handrail requiring replacement of handrail on light failure;
g) Minimum average maintained illumination levels shall be:
   1) Enclosed and Open Bridges: 150 lux horizontal, 75 lux horizontal;
   2) Enclosed and Open Stairs: 200 lux horizontal;
   3) Colour temperature shall be 4000K.

5.2.29 Lighting Control Design Criteria

5.2.29.1 For additional information on lighting control, refer to Metrolinx Standard Lighting and Controls Specification 26 50 00.

5.2.29.2 Early Morning Period Interior Controls

5.2.29.2.1 One half (1/2) hour before the first AM train and/or bus:

a) Station Building and/or Bus Terminal lighting shall be 100% ON excluding ancillary area;
b) Tunnel and Bridge lighting shall be 100% ON;
c) Parking structure lights shall be 100% ON.

5.2.29.2.2 Switches and ceiling mounted occupancy sensors shall be provided in driver washrooms, maintenance rooms, mechanical, electrical, and communications rooms, staff service and back-of-house area.

5.2.29.2.3 All areas with more than two fixtures shall have multiple circuits and switches. The area cannot go dark if there is maintenance or failure of a circuit.

5.2.29.2.4 Tunnel lighting shall be on occupancy sensors. When no motion is detected, the lights shall dim to maximum 50% output (not less). Once motion is detected, lighting shall turn on to 100%.

5.2.29.2.5 Bridges shall be connected to daylight harvesting photocells to save on energy when there is

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sufficient daylight entering the bridge.

5.2.29.2.6 Parking structure lights to turn OFF with the aid of photocells where light levels are high enough from daylight harvesting.

5.2.29.3 Early Morning Period Exterior Controls

5.2.29.3.1 One half (1/2) hour before the first AM train and/or bus:

a) Platform, platform canopy, platform shelter, information signs and shelters, and building canopy lighting shall be 100% ON;
b) Bus loop and bus loop shelter lighting shall be 100% ON;
c) Parking lot lighting shall be 100% ON.

5.2.29.4 Evening Period Interior Controls

5.2.29.4.1 One (1) hour after the last PM train and/or bus:

a) Station Building and/or Bus Terminal lighting to drop to 30% illumination;
b) Tunnel lighting to drop to 50% illumination;
c) Parking structure lighting to drop to security lighting (i.e. 30% or better);
d) Occupancy sensors shall be provided on Station Building and/or Bus Terminal lighting controls;
e) Tunnel lighting shall be on occupancy sensors. When no motion is detected, the lights shall drop 50% output, as noted above. Once motion is detected, lighting shall turn on to 100%;
f) Occupancy sensors shall be provided on Parking Structure lighting controls.

5.2.29.5 Evening Period Exterior Controls

5.2.29.5.1 One (1) hour after the last PM train and/or Bus:

a) Platform, platform canopy, platform shelter, information signs and shelters, and building canopy lighting shall be 100% OFF;
b) Building canopy security lighting (i.e. 30% or better, as determined by Station Services) to remain on;
c) Parking lot lighting to drop to security lighting (i.e. 30% or better, as determined by Station Services);
d) Illuminated Station ID sign to turn OFF;
e) Bus loop and bus loop shelter lighting shall be 100% OFF.

5.2.29.5.2 Lighting control shall be incorporated into a BAS.

5.2.29.6 Exterior Lighting On/Off Controls

5.2.29.6.1 The lighting controls shall be designed to provide the following functions:

a) The lighting controller (i.e. timer) shall be programmable controlled, PLC, complete with automatic daylight savings adjustment;
b) Provide a photocell control on all control designs where the default is “dusk to dawn”;
c) Sites that are being rehabilitated shall have their lighting controls modified to meet these requirements;

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d) Wireless lighting control shall be permitted;
e) Exterior override lighting control shall be added as well for wireless systems.

5.2.29.7 Dimmable Illumination requirements:

a) Photocells, motion and occupancy sensors shall be used within multi-level parking structures, tunnels and pedestrian bridges;
b) Occupancy sensors shall be placed to allow no blind spots;
c) Refer to Illumination Levels section for minimum lighting levels within multi-level parking structures, tunnels and pedestrian bridges as recommended by IESNA;
d) The lighting control shall be flexible i.e. programmable controlled per circuit complete with IP addressable and remote access and control;
e) Methods of reducing energy usage and maintenance shall be considered in design. LED Lighting shall be continuous dimmable (0 to 10 V DC). The design shall consider occupied and a 50 % reduction in light levels when unoccupied. Light harvesting systems shall also be considered.

5.2.29.8 Override Switches

5.2.29.8.1 Station lighting shall be wired into separate zones listed in the table and controlled independently by one of three master override switches. Switches shall be strategically located at the following 3 locations within:

a) Service Counter area;
b) Electrical Room;
c) Exterior of the station.

5.2.29.8.2 Switches shall be labeled and housed in a weather tight, PVC lockable box accessible to GO staff, and GO approved contractors/agents.

5.2.29.8.3 Remote parking shall have its own override switches following the same requirements as above.

5.2.29.8.4 The locations shall be inside the local power cabinet and outside the cabinet housed in a weather tight, PVC lockable box.

5.2.29.8.5 Overall Master Shut Off overrides programmed lighting controls for a prescribed timeframe. When prescribed time frame elapses, programmed lighting resumes.

5.2.29.8.6 Zones for Override Switches as follows:

a) Station building;
b) Surface parking;
c) Multi-level parking;
d) Bus loop;
e) Rail Platform;
f) PUDO;
g) Access Road;
h) Overall Master turn on or shut off.

5.2.30 Illumination Levels requirements:

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a) The lighting control shall be flexible i.e. programmable controlled per circuit complete with IP addressable and remote access and control;
b) The design shall consider methods of reducing energy usage and maintenance. LED Lighting shall be continuous dimmable (0 to 10 V DC);
c) The design shall consider occupied and a 50% reduction in light levels when unoccupied. Light harvesting systems shall also be considered;
d) The system shall be controlled by a Programmable Logic Controller which can handle multiple lighting levels and areas complete with unique on and off, a remote override, and a changeable daylight savings time;
e) The changes to the on and off configurations shall be done either remote or local computer connections;
f) Service areas like electrical rooms are to have ceiling mounted occupancy sensors on all light switches;
g) Exterior decorative, illuminated signage and perimeter lighting shall be all part of the design;
h) Pole lighting shall be to GO Standards for referenced in the DRM;
i) Reduction of light pollution of flood lights and wall washers (spill off into surrounding canopies) shall be considered;
j) Station locations with a high probability of vandalism shall have extra bright illumination, if required and viable in terms of adjacent neighborhoods;
k) Photocells and occupancy sensors shall be used.
l) The lighting levels for inside a covered parking facility shall be to a minimum recommended by IESNA and Table 47;
m) Illumination levels to further meet the requirements of Table 44, Table 45, Table 46 and Table 47.

Table 44: Illumination Levels

Location	**Working Plane Height**
Circulation Areas ***both public and non-public including exterior traffic areas***	***Floor level***
Public Seating (waiting areas)	850 mm
Workshops	850 mm
Vertical illumination (task lighting)	At the task

Superseded

Table 45: Interior Lighting Illumination Levels

Location	Illumination Level
Waiting Room	20 Fc (200 LUX)
Station Attendant Room	20 Fc (200 LUX)
Service Counter task lighting	40 Fc (400 LUX)
Staff Washroom	20 Fc (200 LUX)
Public Washroom	20 Fc (200 LUX)
Electrical Room	75 Fc (750 LUX)
Communications Room	75 Fc (750 LUX)
Maintenance/Storage Room	20 Fc (200 LUX)
Elevator/Escalator (incl. elevator vestibules)	20 Fc (200 LUX) (Note 1)
Shelter	5 Fc (50 LUX) (Note 2)
BRT Building (Bus Rapid Transit)	15 Fc (150 LUX)
Shop/Workbenches	30 Fc (300 LUX)
Electronic Shop Workbenches (task lights)	As per IES
Garage	30 Fc (300 LUX)
Mechanical Room	75 Fc (750 LUX)
Dispatch Room	15 Fc (150 LUX)
Hallway/Corridor/Tunnel/Stairwell	20 Fc (200 LUX)
Office	As per IES or CNIB
Other	As per IES or as directed by GO or CNIB

Minimum average maintained illumination levels as per IES / CNIB or as directed by GO:

Note 1: Elevator Code to govern.

Note 2: Low illumination level to equalize visibility of the platform.

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Table 46: Exterior Lighting Illumination Levels

Superseded

Location	Illumination Level
Parking Lot	3 Fc (30 LUX)
Parking Structures	
General Parking and Pedestrian Areas Occupied	5 Fc (55 LUX)
Unoccupied Areas	2.5 Fc (28 LUX)
Ramps and Corners	10 Fc (110 LUX)
Entrance Areas	50 Fc (540 LUX)
Passenger Drop-off & Pick-up Areas	5 Fc (50 LUX)
Train Platform	5 Fc (50 LUX)
Mini-Platform/Designated Waiting Area	15 Fc (150 LUX)
Access Road	2 Fc (20 LUX)
Bus Platform	5 Fc (50 LUX)
Platform Boarding Area (bus and train)	10 Fc (100 LUX)
Canopy Separate from Buildings	20 Fc (200 LUX)
Canopy Walkways at Buildings	10 Fc (100 LUX)
Canopy at Platform	5 Fc (50 LUX)
Canopy at Mini Platform	15 Fc (150 LUX)
Canopy at Station	10 Fc (100 LUX)
Platform Union Station and UP Express	20 Fc (200 LUX)
Canopy at Boarding Edge	10 Fc (100 LUX)
Bridges, Tunnel or Overpass & Open Stairwell at a Building	20 Fc (200 LUX)
Exterior Stairs & Walkways Separate from Buildings	20 Fc (200 LUX)
Pedestrian Paths and Bike Ways	2 Fc (20 LUX)
Layover General Lighting	2 Fc (20 LUX)

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Wayside cabinet and Switch Area	5 Fc (50 LUX)
Pedestrian Bridges	20 Fc (200 LUX)

Note: Minimum average maintained illumination levels as per IES / CNIB or as directed by GO.

Table 47: Lighting Levels for Inside a Covered Parking Facility

Area	Specification	Colour Temperature
General Parking and Pedestrian Areas	5 Fc (50 LUX)	4000 K
Ramps and Corners	10 Fc (110 LUX)	4000 K
Entrance Areas	50 Fc (540 LUX)	4000 K
Service Rooms	50 Fc (540 LUX)	4000 K
Stairways and Elevator Lobbies	20 Fc (200 LUX)	4000 K

5.2.31 Light Sources and Controls

5.2.31.1 Lighting sources and controls are as follows in Table 48, and Table 49.

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Table 48: Interior Lighting Sources and Controls

Superseded

Location	Light Source	Control and Backup
Platform Access (Tunnels and Bridges)	LE-1, LE-2	Time of day controller, 100% station open hours, 50% minimum station closed with occupancy sensors. Daylight harvesting where possible. Occupancy sensor overrides all.
Waiting	LE-3, LE-4, LE-5	Time-of-day controller, 100% station open hours, 10% minimum station closed, 10% on Generator. Day light harvesting were possible.
Station Attendant	LE-3, LE-4, LE-6, LE-7, LE-8, LE-10	Local switches. One fixture UPS + Generator backed-up over service counter, one over cash area and safe, or 10% minimum station closed
Staff Washroom	LE-11	Occupancy sensor switch. One luminaire on UPS + Generator
Public Washroom	LE-12, LE-13	On/Off switch with occupancy sensor, one fixture on UPS + Generator
Electrical, Comms, Mechanical, Maintenance/Janitor, and Storage Rooms.	LE-15	On/Off switch with occupancy sensor, 50% on UPS + Generator in Mechanical, Electrical and Comms. Rooms only
Shop	Linear LED 2438 mm long, suspended. Task lights over equipment and work-benches to suit functions	Local switching or to suit particular application, 10% on UPS + Generator
Garage Maintenance Shop	LED for shops. LED Task lights where required	Panel or central switching to suit particular application. 10% on UPS + Generator or to Code requirements
Dispatch	LED, and supplementary illumination for maintenance with task lights to suit	Local switches, dimmers, 10% on UPS + Generator.

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Vestibule and Other Miscellaneous Areas	LE-14	Time-of-day controller, 100% station open hours, 10% minimum station closed, 10% on Generator. Day light harvesting where possible
Office	Per IES	10% on UPS + Generator

Table 49: Exterior Lighting Sources and Controls

Superseded

Location	Light Source	Control and Backup
Parking Lot Passenger Drop-off and Pick-up Areas Bus Loop Bus Platforms	LED area lights or down lights on 6 or 12 m high galvanized steel poles or 30m high masts (use of LED on 30m high masts approved by GO Transit on a case-by-case basis).	Circuited and dimmed for 30% in operation during station closed hours (photo-control only) and to have manual override of the photo control and time-clock (the manual override shall not be digital) on generator
Access Roads	LED area lights or down lights on 6 or 12 m high galvanized steel poles or 30m high masts (use of LED on 30m high masts approved by GO Transit on a case-by-case basis).	Circuited for 30% in operation during station closed hours (photo-control only) and to have manual override of the photo control and time-clock (the manual override shall not be digital)
Parking Structure	LED	Day light harvesting and occupancy sensor control of two light levels and timer on generator
Rail Platform	LED on 6 m hinged poles on 300 mm high concrete bases or in canopy.	Both timer and photocell controlled, on Generator. During station closed hours 100% off. Override switch (snow removal use): 100% on
Mini-Platform	Same as Rail Platform	Controlled as part of Rail Platform
Tunnel, Enclosed Bridges and Canopies	LED, 1219 mm long, c/w vandal resistant lenses, lights shall be dimmable, when space not occupied. Allow for at least 2 circuits, alternate circuits every other pole	Lighting control, 50% on UPS + Generator
Internal Stairwell (tunnel, parking structure)	LED luminaries, semi-recessed in walls, below handrails	Lighting control, 30% on UPS + Generator
Exterior Stair and Walkway	Same as parking lot, Pole location to suit	Same as parking lot

5.2.31.2 All lighting controls shall be fully documented and turned over at the commissioning phase. Consultant shall examine the different alternatives of parking lot illumination design: high mast, flood lighting, and area lighting. Generally, stations near residential areas shall have

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area lighting. (Flood lighting shall be avoided were ever possible). Where floodlighting is used, upward glare shall be addressed and minimized. High mast lighting shall be considered for parking lots in non-residential areas.

5.2.31.3 For ease of lighting maintenance, large areas (tunnel, bride, waiting area, boardrooms, lunchrooms, maintenance facilities, etc.) lighting shall have at least two lighting circuits.

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5.2.32 LED Lighting Requirements:

a) LED light fixtures shall be warranted for a minimum of five years;
b) LED light fixtures shall work with the available power supply on site;
c) LED light fixtures shall be provided with quick connect or receptacle connection. Direct connection to light fixtures are not permitted.
d) Every fixture shall have surge suppression;
e) Fixtures shall be provided with a lighting facts label;
f) Outdoor fixtures must have an IP65 general use rating. For locations subject to high pressure washing (tunnels, platforms, or parking structures) the fixtures shall have an iP66 rating;
g) The lighting design shall be such that the specified minimum lighting levels shall be maintained for a minimum of 15 years;
h) Fixtures' lighting efficiency shall equal the most current industry accepted standard;
i) The lighting efficiency shall not be achieved by overdriving the LEDs;
j) The LEDs in the fixture must be of the same colour temperature;
k) LEDs with CRI below 75 are not acceptable for indoor lighting;
l) Colour temperature of LED light fixtures shall be uniform throughout the area (3500 K for indoors, 4000 K for outdoors);
m) The fixture shall meet LM 79 rating and the chips shall meet LM 80 rating. LED B50 and L70 lifetime graph shall be provided;
n) The fixture must be vandal resistant and shall be modular in design for easy upgrade of the LED light engine, simple maintenance (straightforward part replacement) and installation;
o) The component connections shall be of plug-in type, tool-less removal and replacement;
p) The fixture shall be dark sky compliant, with the exception of colour temperature, with good light control and minimum to no glare;
q) Lens, if required, shall be flat tempered glass, unless otherwise noted;
r) The fixtures shall have network connectivity option and be remotely dimmable.

5.2.33 Lightning Protection, Grounding and Bonding

5.2.33.1 Grounding and Bonding

5.2.33.1.1 This Section outlines protective grounding and equipotential bonding requirements, based on the TN-S system arrangement, including:

a) Transformer neutral grounding;
b) Electrical and Communications Rooms;
c) Exposed conductive parts of electrical equipment;
d) Extraneous conductive parts;
e) Building main ring electrode.

5.2.33.1.2 The design of the ground system shall be based on:

a) Ground resistivity data;
b) Ground resistance of the whole system and its components;
c) Ground potential rise;

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d) High ground resistance;
e) Systems fault currents and their duration;
f) Conductor ratings.
g) Electrified Territory (For grounding requirements in electrified territories, refer to Electrification Standards and Specifications).

5.2.33.1.3 The design calculations shall show that the fault currents and DC stray currents will not damage the grounding system.

5.2.33.2 Soil and Survey Calculations

5.2.33.2.1 A ground resistivity survey shall be carried out at each site. The weather conditions prior to and at the time of the surveys shall be recorded in the report and an assessment made of the seasonal variations in resistivity based on meteorological data for the area.

5.2.33.3 System Requirements

5.2.33.3.1 Grounding system components include:

a) Ground electrode;
b) Main grounding terminals or bars;
c) Grounding conductors;
d) Protective conductors;
e) Equipotential bonding conductors;
f) Electrically independent ground electrodes for special systems (clean ground).
g) Grounding test pits.

5.2.33.3.2 Shared neutral is not allowed. Ground electrode total combined resistance value shall no exceed 5.0 ohm, during any season of the year and before interconnection to other grounded systems or grounding means.

5.2.33.3.3 Protective conductors shall not to be formed by conduit, trunking or ducting. Ground Fault Loop Impedance for complete circuits shall be recorded. Supplementary Equipotential Bonding: Connect all extraneous conductive parts of the buildings such as metallic conduit and raceways, cable trays and cable armour to nearest grounding terminals by equipotential bonding conductors.

5.2.33.3.4 A Ground Inspection Chamber shall be provided for each ground rod where connected to a grounding conductor and shall extend 150 mm below top of ground rod.

5.2.33.4 Transformer Grounding

5.2.33.4.1 Transformer body grounding terminal shall be connected to MV main grounding bar by insulated copper grounding conductor not less than 3 AWG per 100 kVA of transformer rating, with a minimum of 2 AWG.

5.2.33.4.2 Transformer neutral (star point) for solidly grounded system shall be connected by insulated grounding conductor (colour White) directly to independent grounding electrode. Neutral grounding conductor shall be sized for maximum ground fault cur- rent for 5 seconds.

5.2.33.4.3 Transformer neutral (star point) for resistance grounded system shall be connected by insulated ground conductor (colour white) directly to the resistance grounding resistor. Neutral grounding conductor shall be sized one size larger than the minimum requirement

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indicated in Ontario Electrical Safety Code.

5.2.33.5 Grounding of Distribution Boards, Lighting Installations and Wiring Accessories

5.2.33.5.1 Distribution, lighting and power panel boards shall be connected by separate insulated protective conductors run together with incoming feeder cable, connecting ground terminals in panel boards with respective main distribution board grounding bar.

5.2.33.5.2 Final Ring Sub-circuits: Protective conductor of every final ring sub-circuit shall be in the form of a ring having both ends connected to ground terminal at origin of circuit in panel board.

5.2.33.5.3 Lighting fixtures and other exposed conductive parts of electrical installations, such as switches, heaters, air conditioning units, etc. shall be connected by protective ground conductors to grounding terminals of their respective panel boards.

5.2.33.6 Grounding of Electrical and Communications Rooms, and Fixed Machinery

5.2.33.6.1 A common 50 mm wide x 6 mm thick grounding copper bus shall be connected to the door frame and encircle the Electrical Room and Communications Room.

5.2.33.6.2 Motor and other equipment ground terminals shall be connected also by protective ground conductors of each branch circuit to ground terminal/bar at motor control centre, panel, or distribution unit.

5.2.33.6.3 Conductors shall be securely fixed, recessed in floor grooves or niches, or fixed to walls by appropriate staples. Ground bar or loop shall be securely fixed to building wall with copper or brass saddles.

5.2.33.7 Grounding of Road/Parking Lot Lighting Poles requirements:

a) All circuits require dedicated ground wires;
b) Every other pole shall have a dedicated grounding rod;
c) Any metal surfaces associated with handwells and manholes, including non-conductive metal surfaces, must be grounded;
d) Every second pole shall be grounded with a minimum of one ground rod complete with inspection chamber.

5.2.33.8 Grounding of Signal and Communication Systems

5.2.33.8.1 For telephone, alarm, voice and data, and other communication systems, provide a clean system to each service location, terminal cabinet, wiring closet, and central equipment location. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

5.2.33.9 Clean Ground

5.2.33.9.1 In general, clean ground grounding system shall be provided for data system, telephony and other communication systems, and:

a) Shall be single point ground to main electrical system ground;
b) Grounding cables shall not be run parallel with other grounding cables or power cab.

5.2.33.10 Grounding of Fences

5.2.33.10.1 Metallic fences within 1.8 m of any equipment or structure above the surface of the ground,

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which is connected to the main grounding system, shall be bonded to the grounding system.

5.2.33.10.2 Ground rods shall be driven adjacent to the posts inside the fence line to a depth of not less than 3.0 m. Where no metallic posts are provided, the ground rods shall be connected directly to the metal wires, mesh, or other components of the fence.

5.2.33.11 High Resistance Grounding Systems

5.2.33.11.1 The high resistance grounding system shall limit the ground fault through the transformer neutral. The equipment will be located indoors in a climate-controlled building. The resistor shall be stainless steel edge wound type. The resistor shall be provided with taps for the adjustment of ground current magnitude in several steps.

5.2.33.11.2 Meter relay with auxiliary contacts shall sense voltage across the grounding resistor and initiate remote annunciation of a ground fault condition. The high resistance grounding system shall be provided with self-monitoring capabilities with Modbus or BACnet protocol. The monitoring system shall be connected to the SCADA or BAS system for alarms and monitoring. The resistor to include appropriate taps to limits the ground current flow between 0.9 to 5.0 Amperes for 600V.

5.2.33.12 Service, Communications and Hub Room Grounding

5.2.33.12.1 The Communications rooms and Hub rooms shall form a Dedicated Ground Zone (DGZ).

5.2.33.12.2 All communications equipment in the Communications and Hub Room shall be electrically insulated from the building structure.

5.2.33.12.3 A single point grounding method shall be employed in grounding the communications equipment.

5.2.33.12.4 The access doorframe and door to the communication room shall be grounded using the same grounding method and loop as the Communications and Hub Room.

5.2.33.12.5 Refer to section 5.2.32.6 Power, Grounding of Electrical and Communications Rooms, and Fixed Machinery for additional grounding requirements.

5.2.34 Lightning Protection

5.2.34.1 Lightning protection system is designed to protect structures from damage due to lightning strikes by intercepting such strikes and safely passing their extremely high voltage and current to “ground.” Such system shall be installed were there are no surrounding structures that would provide a cone of protection.

5.2.34.2 Lightning protection systems shall include a network of lightning rods, metal conductor, and ground electrodes, designed to provide a low resistant path to ground for potential strikes.

5.2.35 Identification

5.2.35.1 Label and identify all wiring, equipment, instruments, control and electrical devices etc. to indicate duty, nomenclature identification number, service/function, to the satisfaction of GO. Identifications shall be in English. Alternative methods of labelling may be submitted for approval.

5.2.35.2 For information on Identification and nomenclature shall be used refer to Metrolinx Electrical Identification and Nomenclature Specification.

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5.3 Communications

5.3.1 The Communications Infrastructure design shall provide a method and means to deliver forward facing infrastructure that prioritizes security, redundancy and scalability. Physical and networked strategies are used to increase security. Redundancy is accomplished through digital and analogue connectivity architecture with the ability to facilitate ease of growth for the next generation of Metrolinx communication systems.

5.3.2 The level of design and installation at each station, facility, or wayside layover will depend upon the unique conditions of each site and in accordance with GO Metrolinx corporate policy. Monitoring and recording requirements will be determined by the stakeholders.

5.3.3 This Section outlines the design requirements for Communications of GO Transit fixed facilities in terms of the following subjects:

a) Close Circuit Television (CCTV);
b) Public Address System (PA);
c) Innovation and Information Technology (I&IT);
d) Telephone Network;
e) Access Control and Intrusion Detection System;
f) Fare Handling Systems;
g) Service Counter Talk Thru Systems;
h) Building Automation Systems;
i) Radio.

5.3.4 Closed Circuit Television (CCTV)

5.3.4.1 Closed Circuit Television (CCTV) systems provide a method to remotely monitor and assess areas identified either as secure, public, or controlled access. GO utilizes Closed Circuit Television systems at stations, terminals, and other locations to monitor train, bus arrivals, and departures, observe customer flow, and to conduct surveillance related to the protection of its corporate assets.

5.3.4.2 The level of CCTV system design and installation at each station or facility depends upon the unique conditions of each site and in accordance with GO corporate needs. Monitoring and recording requirements are determined by the stakeholders.

5.3.4.3 All the CCTV cameras at various GO locations can be viewed by the following user groups:

a) Rail Operations and Bus Operations;
b) Station Services;
c) Customer Protection Services;
d) Metrolinx Security Personnel.

5.3.4.4 The CCTV systems are divided into two significant groups, Operational systems, and Access Control and Intrusion Detection Systems. Coordination with Lighting and Signage System installation:

a) For new facilities, Lighting and Video Systems shall be designed concurrently;
b) For existing facility that already have lighting, the Video System must be designed to work with the existing lighting or upgrades may be needed for the existing lighting,

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privacy concerns of viewing and recording video images, work rule concerns of viewing and recording video images, and/or legal implications of video surveillance.

5.3.4.5 The corporate standard system for archiving recorded video must be used. This includes, but it is not limited to, the following factors:

a) Legal requirements;
b) Secure and controlled storage area.

5.3.4.6 Design Plans shall comprise of:

a) CCTV Block Diagram, line and riser diagrams;
b) CCTV coverage zones and locations;
c) Power support for systems, including Emergency and UPS power;
d) Communication support for systems;
e) Temperature control for systems.

5.3.4.7 Operational System

5.3.4.7.1 This system supplies operational assistance to various GO Transit departments by providing and recording real time images.

5.3.4.8 Access Control and Intrusion Detection System Function

5.3.4.8.1 The CCTV system provides real time video feed and records images, used to deter unauthorized entry, assist in ongoing or live incident responses and provide a record of events for Metrolinx Security Personnel investigations.

5.3.4.8.2 The video information derived from the cameras of the Operational, Access Control and Intrusion Detection Systems are recorded on local servers.

5.3.4.8.3 The CCTV system shall have a minimum 72 hour recoding cycle.

5.3.4.8.4 Metrolinx Security Personnel will evaluate and direct retention cycles at each station or facility. Metrolinx standards is to provide 100% CCTV coverage by fixed cameras.

5.3.4.8.5 PTZ cameras are to be located to assist in ongoing or live investigational concerns and must be located in areas giving general overview of all GO properties.

5.3.4.8.6 All other areas that require CCTV coverage are to be designed with the Metrolinx project groups.

5.3.4.9 Local Monitoring

5.3.4.9.1 All cameras, including pan/tilt/zoom (PTZ) at each site are viewed locally on a dedicated video monitor and manipulated by means of a keyboard, mouse, and/or joystick.

5.3.4.10 Remote Monitoring

5.3.4.10.1 The systems are connected via GO Transit network, which allows remote and local access to all cameras on all systems. The current method of transmission of video images is operating on MPLS circuits and Metrolinx IT WAN Infrastructure. Various CCTV system viewing, and monitoring rights are granted through administrative privileges as set out by GO System

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Safety.

5.3.4.11 CCTV Head End System

5.3.4.11.1 The CCTV Head End System is located in the Main Communications Room of each Metrolinx facility. Refer the I&IT Station Telecommunication and Systems Standards for detailed specifications.

5.3.4.12 Components

5.3.4.12.1 The equipment required for either the Operational or the Security CCTV system generally includes, but is not limited to the following:

a) Colour Monitors–24” or 32” display monitor inside station service area, 32” or 50” at Transit Safety Dispatch, wall or ceiling mounted each site is dependent on local requirements and conditions;
b) This will include all hardware required for the installation;
c) Outdoor grade platform monitors to assist CSA to ensure doorways are clear of passengers;
d) CSA screens are typically used on curved platforms with obscured vision and installed on mini-platform on dedicated 3.0 m pole;
e) Cameras–Fixed or Pan/Tilt/Zoom, refer to Metrolinx I&IT Telecommunication and System Standards for details on approved camera specifications and models;
f) Camera Housings–weatherproof (outdoor), moisture and dust-proof, maintain the ambient temperature within the housing in the camera operating temperature range of 40°C to +50°C. All cameras in damp, wet, and outdoor spaces shall have heaters and ventilation capabilities to reduce moisture and condensation and mitigate excessive heating;
g) A sunscreen is fitted to protect the camera from direct sunlight;
h) Indoor housings are either high impact polycarbonate or epoxy coated steel, dust-proof, with top mount assembly, suitable for cameras with fixed focal length and shall include a smoked dome cover;
i) Lenses–Fixed with auto-Iris. Aspherical lenses are used on platforms to suit lighting conditions.

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5.3.4.13 Design/Installation Criteria

5.3.4.13.1 CCTV system implementation is part of the overall facility design. The level of design and installation at each station, facility, or wayside layover will depend upon the unique conditions of each site and in accordance with GO corporate needs. Monitoring and recording requirements will be determined by the user groups.

5.3.4.14 Data and Power Transmission

5.3.4.14.1 Must be included in the overall system wiring and power design, and includes the following:

a) Cable Systems (wire and fiber optic);
   1) CAT6A F/FTP;
   2) Coaxial Cable (for existing analog cameras only);
   3) Fiber Optic (Single Mode Fiber).
b) Transmission Architecture;
   1) Metrolinx Network.

5.3.4.15 Installation: CCTV Cabling Requirements:

a) All cables shall be run in a neat and orderly fashion in a conduit system;
b) CCTV cables shall be designated at both ends as per design requirements provided in Metrolinx Specification 26 05 21 Electrical Conductors and Cables;
c) All cables that run from cameras to terminating equipment shall be single length (splices in these cables are not allowed);
d) Sufficient slack (minimum 1.0 m) shall be left in case it is necessary to re-terminate the cable, and cables shall be coiled and concealed from view;
e) Emergency power–all systems and components shall be powered via a single source from the emergency power panel within the communication room;
f) PoE extenders are not permitted.

5.3.4.16 CCTV Conduit Requirements:

a) Conduits shall be designated with “CCTV” at terminating ends. And CCTV conduits shall not be shared with any other system;
b) Wiring shall be run in conduit. Cables located in damp, wet, and outdoor spaces shall be run in epoxy coated rigid galvanized steel (RGSEC); Cables located in dry, indoor, HVAC controlled spaces shall be installed in RGS. The use of flex conduit greater than 1 m is not allowed. The use of EMT is not allowed.;
c) All underground conduits shall be rigid PVC;
d) Conduit breaks prior to entry in to a building shall be incorporated in the design. For detailed design requirements refer to Metrolinx Standard Specification 26 05 34 Raceway for Electrical Systems;

5.3.4.17 Connections Requirements:

a) All copper connections shall be copper-to-copper compression type with insulating covers.
b) Poles with cameras shall have one-meter slack cable in raceway.
c) Fish cord in all CCTV raceways shall be installed for future use.
d) Splices involving CCTV connections are not allowed.

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5.3.4.18 Hand Wells Requirements:

a) Dedicated hand wells, located away from doors and main traffic areas, shall be provided for CCTV, separate from power.
b) Where installed in public areas, all enclosures, cover-plates, outlet plates, access panels, and hand wells shall be provided with keyed temper-proof hardware.
c) Drainage shall be considered for all hand wells.

5.3.4.19 CCTV Camera Placement

5.3.4.19.1 Placement shall include the following considerations:

a) Mount cameras at 6 m height to prevent damage and provide good field of view;
b) 6 m dedicated poles are to be used for normal mounting;
c) Firm mounting masts shall be used to prevent motion;
d) Utilize and include existing physical characteristics and infrastructure using CPTED principles;
e) Civil structures–roads, building, windows, important rooms, etc. existing barriers and fencing, terrain and ground contours;
f) Use of lens, zoom, and terrain conditions when setting and selecting camera locations;
g) Be aware of rising and setting sun when setting camera alignment to avoid the flare and blinding effects on the camera;
h) Fish eye lenses for 180° or 360° views are not allowed. Multiple cameras shall be used.
i) Mount cameras inside secure areas and provide tamper protection assume all cameras are subject to tamper;
j) Outdoor, cold, hazardous conditions, etc. Provide appropriate camera housings for worst-case environmental conditions. Heating and ventilation shall be provided for all damp, wet, and outdoor spaces;
k) Existing lighting; existing power; existing data and communication networks;
l) Existing environmental controls;
m) Impact considerations on neighboring properties;
n) At a minimum, an illumination of 2 foot-candles throughout assessment area shall be maintained.

5.3.4.19.2 Table CCTV Coverage Type (Image Quality) provides image resolution for CCTV Camera Placement Tables below 50 thru 55.

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Table 50: CCTV Coverage Type (Image Quality)

Requirement	Pixels / Meter
Identification	250
Recognition	125
Monitor	75

Table 51: CCTV Camera Placement - Parking

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Parking Lots – At GO Stations				
Area	***Fixed***	***PTZ***	***Coverage Type (Image Quality)***	***Comment***
Entrances to Specific Lots	X		Identify	Identify driver and plate
Exits from Specific Lots	X		Identify	Read plate, monitor traffic flow
General Area Coverage	X		Monitor	Provide coverage, aid in investigation, customer security, deter crime. General coverage shall be provided through the use of multiple strategically placed cameras on dedicated poles for each lot area. The goal is to achieve 100% coverage if possible.
Main Entry drive Feeding to Multiple Lots	X		Identify	Capture plate number, driver identification, monitor traffic flow.
Main Exit Leaving	X		Identify	Read plate, monitor traffic flow, aid in investigations
Immediate Area		X	Monitor	Pan Tilt Zoom (PTZ) cameras within or adjacent to lot in order to facilitate operational needs / safety inquiries / security investigations / incident response / etc. Positioning shall be in a manner that a PTZ camera is able to zoom in and view any immediate area. Multiple strategically located PTZ cameras through the parking lot perimeter areas shall be coordinated to allow viewing of all parking lots for the entire station during investigation only. PTZ cameras shall not be considered as part of the typical coverage areas under surveillance.
Parking Lots - At GO Facilities - Park and Ride				
Entrances to Specific Lots	X		Identify	Identify driver and plate
Exits from Specific Lots	X		Identify	Read plate, monitor traffic flow

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General Area Coverage	X	X	Monitor	Provide coverage, aid in investigation, customer security, deter crime. PTZ cameras on as-needed basis. Higher crime rates will dictate the usage of additional cameras.
Bike Shelters	X		Recognize	Monitor and recognize all who enter the shelter providing investigational information, customer reassurance
Parking Structures				
Area	***Fixed***	***PTZ***	***Coverage Type (Image Quality)***	***Comment***
Entrances to Structure	X		Identify	Identify driver and plate dedicated to entry lane.
Exits from structure	X		Identify	Read plate, monitor traffic flow. Dedicated to exit lane
General Area Coverage	X		Monitor	Provide coverage, aid in investigation, customer security, deter crime. Each drive and parking lane shall have at least one dedicated camera at each end looking in to provide a more complete coverage area.
Pedestrian Entry	X		Identify	Identify all who enter through a controlled entry point.
Pedestrian Exit	X		Identify	Identify everyone who exits through a controlled entry point.
Stairs	X		Monitor	From top looking down maximum view, use 2 cameras with U-shaped stairs to view the entire length of the stairs. The intent is to aid in customer claims of slip and fall, decrease likelihood of vagrancy, vandalism and violence.
Stair Vestibules	X		Monitor	Coverage of the entire vestibule to promote safety and for investigational purposes.
Elevator Interior	X		Recognize	Passenger security, investigation purposes, emergency situations, confined space monitoring. Dedicated inside elevator viewing maximum area with emphasis on the emergency call button.

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Elevator Door	X		Monitor	Dedicated to view vestibule outside elevator and ability to view maximum area inside the elevator. When multiple elevators exist side by side it may be necessary to share coverage with 2 cameras
Elevator Lobby/Waiting Area	X		Monitor	Dedicated to view vestibule outside elevator, viewing 2-way call for assistance button and ability to view entire waiting area. If required, more than 1 camera shall be used to achieve as close to 100% coverage as possible.
Service Rooms	X		Monitor	Monitor door - can share camera with other service rooms if sharing a common entry area.
Perimeter	X	X	Monitor	Strategically place fixed cameras on each side monitoring entire exterior perimeter walls. One PTZ to monitor and investigate on each side of perimeter.
2 Way Call devices	X		Recognize	Each 2 way call device shall have a dedicated fixed camera monitoring the device.
General NOTE: 1		X	Monitor	Each parking level drive lane shall have PTZ camera capable of viewing immediate floor level for investigation, monitoring. More than one PTZ is required to facilitate coverage of structures with multiple drive lanes. PTZ camera shall not be used in place of fixed monitoring
General NOTE: 2		X	Monitor	One on each exterior side of structure to monitor general area, provide live monitoring, and aid in investigation. If obstructions such as stairs are hindering view then a second camera shall be dedicated to facilitate complete coverage.

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Table 52: CCTV Camera Placement – Stations Exterior and Interior

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Station Exterior				
Area	***Fixed***	***PTZ***	***Coverage Type (Image Quality)***	***Comment***
Entry Points - Doors	X		Identify	Facial recognition at all entry points. Where vestibules exist, cameras shall be dedicated to identify passengers. Separate dedicated cameras shall be used to provide vestibule coverage with no hiding spots.
Waiting Areas Include DWA	X		Monitor	Waiting areas shall have dedicated coverage of entire area. If area is large multiple cameras may need to be utilized to ensure 100% coverage.
PUDO Pickup	X		Monitor	Cover entire area with fixed cameras ensuring the Bell telephone and any 2-way communication device locations are covered by fixed monitoring. Provide PTZ for investigation in area. Ability to view vehicle plates and passenger pick up and drop off points.
Pedestrian Walkways	X		Monitor	Provide coverage of entire walkway on Metrolinx property.
Bike Shelters	X		Recognize	Monitor and recognize all who enter the shelter providing investigational information, customer reassurance. Larger bike shelters may require 2 fixed cameras for best viewing.
Bike Lanes	X		Monitor	Bike lanes within Metrolinx property, end to end.
Property Perimeter	X	X	Monitor	Strategically place fixed cameras to monitor entire station and lot perimeter. One PTZ to monitor and investigate on each side of perimeter.
Laneways / driveways	X		Monitor	Coverage of all laneways allowing for continuous monitoring of vehicle movement throughout the property; this must provide ability to track vehicles from when they enter the property to final parking location in lot or parking structure. Entry points not covered by the parking lot cameras shall have the capability to capture license plates if specific location placement allows.

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Station Interior				
Stairs / Escalator	X		Monitor	From top looking down - maximum view if long stairs use 2 cameras.
Stair Vestibules	X		Monitor	Dedicated camera to cover vestibules not covered by stair cameras
Elevators Cab Interior	X		Recognize	Passenger security, investigation purposes, emergency situation, confined space monitoring. Dedicated inside elevator viewing - maximum area with emphasis on the emergency call button.
Elevator Door	X		Monitor	Dedicated to view vestibule outside elevator and ability to view maximum area inside the elevator. When multiple elevators exist side by side it may be necessary to share coverage with 2 cameras.
Elevator Lobby/Waiting Area	X		Monitor	Dedicated to view vestibule outside elevator, viewing 2-way call for assistance button and ability to view entire waiting area. Possibly more than one camera shall be used to achieve as close to 100% as possible.
Station Lobby	X	X	Monitor	Coverage of entire lobby with fixed camera, 1 PTZ for live monitoring and investigation centrally located.
Station Entry Points (pedestrian)	X		Identify	Identify any person who enters through any controlled entry point (pedestrian entry points).
Station Exit Points	X		Identify	Identify everyone who exits through a controlled entry point.
Customer Service Desk Interior	X		Identify	Fixed dedicated camera for each service counter attendant, camera placed to view customer face over the shoulder of service attendant. Provide fixed camera dedicated to view door entry to customer service area (from inside area)
Customer Service Desk Exterior	X		Monitor	Camera shall view the side of the service counter, providing a profile view of anyone at service counter.

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Station Vestibules	X		Monitor	Coverage of entire vestibule area. Separate from entry and exit cameras at doorways and entry points
Service Rooms	X		Monitor	Monitor door - can share camera with other service rooms if on same side of building

Table 53: CCTV Camera Placement - Rail Platforms, Tunnels, Bridges, Bus Platforms

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Rail Platforms				
Area	***Fixed***	***PTZ***	***Coverage Type (Image Quality)***	***Comment***
Service Rooms	X		Monitor	Monitor door - can share camera with other service rooms if on same side of building
Stairs / Escalator	X		Monitor	From top looking down maximum view, if long stairs use 2 cameras to view the entire length.
Stair Vestibules	X		Monitor	Dedicated camera to cover vestibules not covered by stair cameras
Elevators	X		Recognize	Dedicated to view elevator cab interior, viewing 2-way emergency call for assistance button.
Elevator Vestibules	X		Monitor	Dedicated to view vestibule outside elevator, viewing 2-way call for assistance button and ability to view maximum area inside the elevator.
Elevator Lobby/Waiting Area	X		Monitor	Dedicated to view vestibule outside elevator, viewing 2-way call for assistance button and ability to view entire waiting area. Possibly more than one camera shall be used to achieve as close to 100% as possible.
Platform Ends Both -Rail operations		X		Looking down track to monitor rail traffic and switches (Operational)
Platform Ends Both - Platform Monitoring	X		Monitor	Monitoring platform, looking in towards customer waiting areas on platform.
Mini Platform	X		Identify	Coverage from both sides, capture 2-way call button.
General Platform Area	X		Monitor	Coverage with fixed cameras 100%.
Platform Shelters	X		Recognize	Interior. Dedicated fixed cameras.

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Central Location		X		At opposite end of Mini Platform from 2-way call button, monitor mini platform / safety & security investigations / incident response / etc.
Customer Service Attendant (CSA) - Cameras	X		Monitor	Cameras to be deployed at all stations that have a curve on platform. The CSA while standing on the Mini Platform shall be able to view the coverage provided on the dedicated screen/s. Coverage shall also be provided for any and all pedestrian crossings on the rail corridor. These are operational cameras and shall not be considered part of the typical platform coverage provided. These are in addition to the platform coverage monitoring.
Note: 100% coverage of platforms is required.				
Tunnels				
Area	***Fixed***	***PTZ***	***Coverage Type (Image Quality)***	***Comment***
Stairs / Escalator	X		Monitor	From top looking down maximum view, use 2 cameras if U-shaped stairs. Intent is to aid in customer claims of slip and fall, decrease likelihood of vagrancy, vandalism and violence.
Stair Vestibules	X		Monitor	Dedicated camera to cover vestibules not covered by stair cameras. Intent/purpose: passenger security, investigation purposes, emergency situation, confined space monitoring.
Elevators	X		Monitor	Dedicated to view interior of elevator, viewing 2-way emergency call for assistance button and ability to view maximum area inside the elevator.
Elevator Vestibules	X		Monitor	Dedicated to view vestibule outside elevator, viewing 2-way call for assistance button and ability to view maximum area inside the elevator.

Superseded

Elevator Lobby/Waiting Area	X		Monitor	Dedicated to view vestibule outside elevator, ability to view entire waiting area. Possibly more than one camera shall be used to achieve as close to 100% as possible.
Centrally Placed Elevators	X		Monitor	When an elevator is located in the middle of the tunnel and walkways exist on all sides, cover all walkways where possible. Note: strategic placement of tunnel cameras may assist.
Service Rooms	X		Monitor	Monitor door - can share camera with other service rooms if on same side of building
Entry / Exit points	X		Identify	Identify everyone who enters or exits through a controlled entry point.
Tunnel areas	X		Monitor	Dedicated to view entire tunnel area, overlapping cameras strategically placed to eliminate blind spots. If doors exist, fixed cameras to view any potential hiding areas.
Bus Platforms				
Area	***Fixed***	***PTZ***	***Coverage Type (Image Quality)***	***Comment***
Bus Shelters	X		Recognize	Inside bus shelters cover maximum area possible.
Bus Platform, Individual Bus Boarding area	X		Recognize	One camera for each bus platform, covering bus entry point.
Bus Bays	X		Recognize	One dedicated fixed per bay
Immediate area - away from obstructions		X		PTZ in vicinity of bus loop for operational use / security investigations / incident response / etc. This camera shall not be considered as coverage in any bus bay
Bridges, Connector Walkways				
Bridge main walkway	X		Monitor	Entire length multiple cameras cross coverage overlapping of cameras, no hiding spots or blind corners

Superseded

Elevators	X		Recognize	Dedicated to view inside elevator, viewing 2-way emergency call for assistance button.
Elevator Vestibules	X		Monitor	Dedicated to view vestibule outside elevator, viewing 2-way call for assistance button and ability to view maximum area around the elevator.
Elevator Lobby/Waiting Area	X		Monitor	Dedicated to view lobby, ability to view entire waiting area. Possibly more than one camera shall be used to achieve 100% coverage.
Stairs / Escalator	X		Monitor	Dedicated camera to cover vestibules not covered by stair cameras
Service Rooms	X		Monitor	Monitor door - may share camera with other service rooms if on same side of building
Entry and Exit points	X		Identify	Identify everyone who enters or exits through entry and exits doors.
Two Way Communication Devices	X		Recognize	On longer bridges it may be necessary to have 2-way call devices, at those locations a dedicated fixed camera shall be installed to view call device.

Table 54: CCTV Camera Placement - Service Rooms, Service Buildings, Bunkers, Devices

Superseded

Service Rooms/ Other				
Area	***Fixed***	***PTZ***	***Coverage Type (Image Quality)***	***Comment***
Treasury Rooms	X		Recognize	100% coverage, no blind spots
Operations Security	X		Monitor	General area coverage
Holding Rooms	X		Recognize	100% coverage, no blind spots
Security Office	X		Monitor	100% coverage, no blind spots
Secure Corridors	X		Monitor	100% coverage, no blind spots for entire path: Secure corridors to secure areas leading to secure areas. From building entry point to inside secure area 100% coverage, includes loading ramp.
Bus Cash in Rooms	X		Recognize	100% coverage, no blind spots
Service Buildings, Bunkers, Substations				
Perimeter	X	X	Monitor	Strategically place fixed cameras monitoring entire perimeter. One PTZ to monitor and investigate on each side of perimeter.
Communications Room	X		Monitor	Monitor door - can share camera with other service rooms if on same side of building
Electrical Room	X		Monitor	Monitor door - can share camera with other service rooms if on same side of building
Exterior Generator Housing Enclosure	X		Identify	Identify everyone who enters or exits through entry and exit doors
Mechanical Room	X		Monitor	Monitor door - can share camera with other service rooms if on same side of building
Service Room (Storage, High value area)	X		Recognize	Monitor door - can share camera with other service rooms if on same side of building
Prime Generator Room	X		Monitor	Monitor door - can share camera with other service rooms if on same side of building
Substations	X		Recognize	100% General area coverage using fixed cameras around perimeter of substation.

Superseded

Devices				
TVM, ATM	X		Recognize	Dedicated coverage, shall not be able to read input of pin code
2 Way Call device	X		Recognize	Dedicated coverage of each device.
Gates	X	X	Recognize	Dedicated coverage of each device. PTZ to monitor gate area in addition to fixed
Emergency Call Buttons	X		Recognize	Dedicated fixed camera. (typically, only in elevator)
Bell Phone	X		Recognize	Dedicated coverage of each device.

Table 55: CCTV Camera Placement - Facilities – Storage/Garage (Bus), Storage/Layover (Rail)

Superseded

Bus Garage Storage Facility				
Area	***Fixed***	***PTZ***	***Coverage Type (Image Quality)***	***Comment***
Vehicle Gate (“main gate”)	X	X	Recognize	Dedicated camera for vehicles, facial and plate recognition. 1 PTZ for investigation, live monitoring.
Pedestrian Gate (“man gate”)	X	X	Recognize	Dedicated camera for pedestrian gate, facial recognition at control point. 1 PTZ for investigation, live monitoring. Note: If vehicular gate and pedestrian gate have sufficient proximity, 1 PTZ may be used for both.
Car Parking, Employees	X		Monitor	100% General coverage. Supplementary PTZ as required in the general area for live investigation.
Car Parking, Guests	X		Monitor	100% General coverage. Supplementary PTZ as required in the general area for live investigation.
Building Exterior	X		Monitor	View of entire sides, no hiding spots, bind spots. If obstruction exists add camera.
Building Entry Points - Vehicles	X		Recognize	Identify driver and plate
Building Entry Points - Pedestrian	X		Recognize	All pedestrian entrances shall have dedicated cameras
Property Perimeter	X	X	Monitor	Strategically place fixed cameras monitoring entire perimeter. One PTZ to monitor and investigate on each side of perimeter.
Cash Rooms	X		Recognize	100% coverage, no blind spots
Main Entrance	X		Identify	Dedicated camera for entry doors, facial recognition Head on view, not as side shot.
Elevators	X		Recognize	Dedicated inside elevator viewing maximum area with emphasis on the emergency call button. Passenger Security, Investigation purposes, confined space monitoring.

Superseded

Elevator Vestibules	X		Monitor	Dedicated to view inside the elevator as much as possible and view the vestibule outside elevator, viewing 2-way call for assistance button and ability to view entire waiting area. Possibly more than one camera shall be used to achieve as close to 100% as possible.
Service Rooms	X		Monitor	Monitor door - can share camera with other service rooms if on same side of building
Loading Docks	X	X	Monitor	Coverage of entire loading dock, monitor any access control, point from loading dock to building
Loading Dock Man Door	X			Coverage of 2-way call device for access to building.
Bus Routes Internal	X		Monitor	General coverage
Bus Routes External	X		Monitor	General coverage
Bus Parking, Internal and External	X		Monitor	General coverage
Fueling/Fuel Storage	X	X	Monitor and Recognize	Dedicated 100% coverage by Fixed type camera, one additional PTZ camera for area overview and live incident monitoring.
Service Roads To/From Fueling and Fuel Storage Areas	X		Monitor	Dedicated 100% coverage by Fixed type cameras.
Supplementary Coverage		X		PTZ camera(s) installed at locations which will provide direct line of sight to areas such as parking lot, gates, building entrances / exits, property perimeter.
Rail – Maintenance and Storage Facility/Layover				
Area	***Fixed***	***PTZ***	***Coverage Type (Image Quality)***	***Comment***
Vehicle Gate (“main gate”)	X	X	Recognize	Dedicated camera for vehicles, facial and plate recognition. 1 PTZ for investigation, live monitoring.

Superseded

Pedestrian Gate (“man gate”)	X	X	Recognize	Dedicated camera for pedestrian gate, facial recognition at control point. 1 PTZ for investigation, live monitoring. Note: If vehicular gate and pedestrian gate have sufficient proximity, 1 PTZ may be used for both.
Car Parking, Employees	X		Monitor	100% General coverage including coverage for Metrolinx support/service vehicles. Supplementary PTZ as required in the general area for live investigation.
Car Parking, Guests	X		Monitor	100% General coverage. Supplementary PTZ as required in the general area for live investigation.
Building Exterior	X		Monitor	View of entire sides, No hiding spots, bind spots. If obstruction exists add camera.
Building Entry Points - Vehicles	X		Recognize	Identify driver and plate
Building Entry Points - Pedestrian	X		Recognize	All pedestrian entrances shall have dedicated cameras
Area	***Fixed***	***PTZ***	***Coverage Type (Image Quality)***	***Comment***
Property Perimeter	X	X	Monitor	Strategically place Fixed cameras monitoring entire perimeter 100%. One PTZ to monitor and investigate on each side of perimeter. 100% coverage using fixed cameras at each train entrance into a rail maintenance or layover yard, leading to its rest position. PTZ cameras shall be strategically located for ongoing investigations.
Service Rooms	X		Monitor	Monitor door - can share camera with other service rooms if on same side of building
Lost & Found	X		Recognize	Entry to Lost and Found room and/or closet

Superseded

Loading Docks	X	X	Monitor	Coverage of entire loading dock inside and out; monitor any access control point from loading dock to building. Camera(s) installed at locations which will provide monitoring of offloading areas (Sand, Fuel, DEF, Toilet servicing chemicals, holding tanks, etc..)
Loading Areas & Doors	X		Recognize	Coverage of 2-way call device for access to building. Note: All 2-way call devices at doors shall have coverage.
Fueling/Fuel Storage Areas	X	X	Monitor	Dedicated fixed coverage of the entire area with 1 PTZ camera for general overview and incident monitoring. The views must be completely unobstructed at the point of fueling/refueling and fuel storage area(s).
Roads Leading to Fueling/Fuel Storage Areas	X		Monitor	If not already covered by other dedicated site CCTV cameras, provide dedicated, unobstructed, fixed camera coverage of the entire area
Rail Equipment	X	X	Recognize	Monitor length of parked train at each end looking in. One PTZ central location to monitor Rail movement between tracks Fixed camera to monitor wayside power cabinets as well as the connection point to the trains.
Equipment	X		Recognize	Fixed cameras to monitor the entire area around major pieces of shop equipment including but not limited to: - drop tables, - car & body hoist systems, - wheel truing machines Note: Additional critical shop equipment to be identified by the applicable business unit during the planning stages of a project

Superseded

Area	*Fixed*	*PTZ*	*Coverage Type (Image Quality)*	*Comment*
Supplementary Coverage		X	Monitor	PTZ camera(s) installed at locations which will provide direct line of sight to areas such as parking lot, gates, building entrances / exits, property perimeter. PTZ to be used to supplement 100% fixed camera coverage for investigative purposes. Locations to be coordinated with Metrolinx Security Personnel and operational business unit. Note: pole placement shall not interfere w/ operations.
Wash Equipment Rooms	X		Recognize	Provide 100% coverage using fixed cameras
Warehouse / Forklift areas	X		Monitor	Fixed cameras to monitor forklift activities throughout stores and along travel paths.
Wash bays	X		Recognize	Provide 100% coverage dedicated to the wash process, using fixed cameras
Maintenance Bays	X		Monitor	Fixed cameras to monitor all rolling stock movements into or exiting the maintenance bays. 100% coverage via fixed cameras. Interior and exterior as required.
Progressive Maintenance Bays	X	X	Monitor	Fixed cameras to monitor: Derails & blue flags outside of the maintenance bays, Fixed cameras to monitor train consist, entry into the building, Fixed camera coverage (100%) to monitor activities for the full length of the PM facility. PTZ placed in a supplemental fashion for investigation purposes.
Rail Maintenance Facilities	X	X	TBD	Additional coverage shall be provided according to requirements identified by Metrolinx during asset/infrastructure design
Note: Site specific CCTV requirements will be identified and incorporated for each project during the design stage.				

5.3.5 Public Address System

5.3.5.1 Public Address Systems (PA) are provided at bus terminals and rail stations for direct communication to passengers. These systems are used by Station Operations and Rail Operations and predominantly include rail and bus platforms, bus loops, passenger waiting areas, tunnels/stairways, and shelters.

Superseded

5.3.5.2 Coverage–Local

5.3.5.2.1 A system of speakers divided into zones enable announcements from the service counter throughout the station or to specific areas, e.g., tunnels or platforms. Under normal working conditions, pages are made using the all call feature to all areas.

5.3.5.3 Remote

5.3.5.3.1 Rail Station PA Systems can be accessed through existing VOIP interface to enable announcements to be made by Rail Operations at Union Station. This allows GO Operations personnel to access rail stations PA systems to make announcements.

5.3.5.4 Paging

5.3.5.4.1 Paging is presently conducted manually throughout the Rail System PA Network. The PA system is designed to utilize a IP-based infrastructure for both live and pre-recorded announcements at all bus and rail locations from a central control location.

5.3.5.5 References

5.3.5.5.1 The design and installation of the PA System will comply with the following:

a) Innovation & Information Technology Telecommunication & Systems Standards;
b) Universal Design Standard.

5.3.5.6 Controller

5.3.5.6.1 The controller provides, through a system processor, audio input to the various groups of speakers, referred to as zones.

5.3.5.7 Dual Tone Multi Frequency (DTMF) Existing Systems

5.3.5.7.1 If required by GO Transit to phase out, disconnect, and remove an existing system, the Consultant shall specify that the Contractor turn over all removed and unused equipment to GO Transit. The process of phasing in the new system shall not cause any undue disruption to the services of the existing system.

5.3.5.8 System Requirements

5.3.5.8.1 The PA System generally consists of zone-grouped speakers strategically located in or at GO Transit facilities, buildings, tunnels, stairwell entrances, elevator vestibules, rail platforms, PUDO Areas, and Bus Loops, and a System Controller located in the Communications Room of the facility.

5.3.5.8.2 For Station and Terminal Facilities - The System shall accept local inputs from local phones and DTMF paging phone in the Service Area and a remote input from GO

5.3.5.9 Emergency Power

5.3.5.9.1 PA System equipment and auxiliary equipment shall be supplied from the emergency power panel located inside the station communication room.

5.3.5.10 Prioritized Paging

5.3.5.10.1 The PA system shall be user configurable to provide prioritized paging announcements when announcements are generated simultaneously from different inputs. Initial configuration

Superseded

shall establish to the following priority level:

a) Highest Priority - GO Operations;
b) Lowest Priority Requirements:
    1) Other Paging telephones including Service Area;
c) Group zone
    1) Selection codes shall be configurable through the system configuration menu;
    2) The operation of VOIP phone shall automatically select independent user- defined 'group' zones.

5.3.5.11 Audio Power, Coverage and Quality

5.3.5.11.1 The amplifier capacity of the system shall be determined by the number of speakers required to achieve the design criteria: three amplifiers minimum, as follows.

5.3.5.11.2 A minimum of two amplifiers shall be provided for the Platform area in order to maintain continuous system functionality. The amplifiers shall operate independently of each other. The first amplifier shall not be used to feed an audio signal to the second amplifier.

5.3.5.11.3 A third amplifier shall be provided to cover the PUDO area, Station building, tunnels, stairwell entrances, elevator vestibules, and if required, a third platform or bus platform.

5.3.5.11.4 The method of cable installation and speaker mounting on the rail platforms shall be arranged such that, not more than a 6dB drop shall be experienced whenever one amplifier fails.

5.3.5.11.5 Platform speakers shall be arranged in such a way as to maintain 50% coverage on each platform upon failure of a single amplifier.

5.3.5.11.6 For all areas, which require coverage, the PA system shall maintain a uniformly distributed sound pressure level measured at 1.5 m above floor level. The minimum sound pressure level at station platforms shall be 10dB above the measured ambient noise level to a maximum of 82dBA at day

5.3.5.11.7 Time hours and a maximum of 76 dBA at night time hours. The speech quality of the system shall be high and messages shall be clean and intelligible. There shall be no unwanted noise or spurious audio signals (20dB or less) emanating from the system.

5.3.5.11.8 A real time clock shall be used to provide the timing signals for volume adjustment. The real time clock shall run continuously even when power is removed and it shall maintain full date and time with automatic spring and fall Canadian daylight-saving time adjustments.

5.3.5.11.9 The PA system shall be designed to minimize unwanted noise at nearby residences in compliance with applicable noise control bylaws, shall these be less than the maximum values specified above, without however, reducing the effectiveness as an emergency voice communication system.

5.3.5.12 Components

5.3.5.12.1 PA System Controller Rack

Refer to Metrolinx I&IT Telecommunication and Systems Standards for rack type

Superseded

5.3.5.12.2 Quick Disconnect Terminal Requirements:

a) All speaker cabling entering the communication enclosure shall be individually connected to a “quick” disconnect terminal
b) The quick disconnect facility shall allow individual outgoing zone cables to be quickly disconnected from the controller without the use of a screwdriver
c) The rail shall be marked to identify each respective zone/cable and incoming cables shall be tie-wrapped to rigid internal cable bars to prevent undue movement
d) The termination rail also provides individual earth (ground) terminals to allow the screen of each zone cable to be grounded
e) A laminated termination rail diagram, in addition to a control riser and/or single line block diagram shall be mounted on the inside of the rear door and a copy of such drawings shall also be included in the system manual.

5.3.5.13 Surge Protection

5.3.5.13.1 An independent transient voltage suppression and surge protection device shall be provided meeting UL 1449 TVSS rating power source located at the bottom of the enclosure. All required control system power supplies shall be installed on a “quick disconnect” DIN rail. All public address components shall be fed from a UPS panel. Provide redundant UPS power circuit to racks.

5.3.5.14 Limiter Circuits

5.3.5.14.1 The enclosure shall incorporate all the required driver assemblies suitably wired to their respective control circuits and terminal rail connections.

5.3.5.15 Voltage Adjustment

5.3.5.15.1 The System Controller shall provide for automatic volume adjustment for configurable Day/Night time periods using an integrated real time clock in addition to automatic daylight saving time adjustment. The automatic volume adjustment shall be available for all input channels via the system controller.

5.3.5.16 PCB Cards (Printed Circuit Board Cards)

5.3.5.16.1 The System Controller shall include a 483mm (19”) card frame shelf, with suitable backplate assembly to receive the following plug-in PCB cards:

a) Amplifier;
b) Processor Control card c/w Real Time Clock Chip;
c) Zone Switch Card;
d) Zone Switch;
e) Paging Phone Interface;
f) Zone Driver Cards (quantity as required);
g) Zone Relay Cards (quantity as required);
h) Power Supply;
i) Back Plate.

5.3.5.16.2 Audio Coverage Requirement

The number of speakers required to achieve the required audio coverage will depend on the

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location, the location's acoustic properties, background noise levels, the mounting height and the ability to meet the output levels as defined in the DRM.

5.3.5.16.3 Temperature Requirement:

The operating temperature shall be between -40 ºC to 70 ºC

5.3.5.17 Speakers–Shelter and Tunnel

5.3.5.17.1 Housing

Speakers shall have a vandal resistant diecast housing complete with stainless steel tamper-resistant "TORX" screws to prevent unauthorized access (Phillips or Robertson screws are not acceptable).

5.3.5.17.2 Output and Power

Speakers shall be designed for maximum output at a minimum power loss and shall be installed in accordance with manufacturer's recommendations.

5.3.5.17.3 Format Requirements:

a) Speakers shall be sealed dual cone construction and manufactured of phenolic impregnated resin;
b) Speakers shall incorporate a sealed back for extra protection and audibility. They shall be white in colour or finished as required by GO Transit.

5.3.5.17.4 Brackets

When used in exposed areas or inside tunnels, a stainless steel speaker-mounting bracket must be used.

5.3.5.17.5 Features Requirements:

a) Line voltage 70V and maximum wattage 8W RMS continuous;
b) Operating temperature range of -30°C to +50°C.

5.3.5.18 Installation

5.3.5.18.1 PA Cabling Requirements:

a) All cables shall be run in a neat and orderly fashion in a conduit system;
b) PA cables shall be designated at both ends as per information supplied on tender;
c) All cables that run from speakers to terminating equipment shall be single length (splices in these cables are not allowed–that is: no splices in conduits);
d) Sufficient slack (1 meter) shall be left in case it is necessary to re-terminate the cable;
e) Emergency power–all systems and components shall be powered via a single source from the emergency power panel.

5.3.5.18.2 PA Cabling Specifications Requirements:

a) AWG: 14;
b) Stranding: 41 x 30;
c) Conductor: TC, 2 conductors;
d) Insulation: 0.02" Polyolefin;

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e) Capacitance: 30 pF/ft. (conductor to conductor);
f) 58 pf/ft. (1 cond. and other cond. connected to shield);
g) Shield: Delfoil Aluminum/Polyester;
h) Jacket: Blue or White Polyvinylchloride (depending on application);
i) Nom. Cable OD: 0.302";
j) Voltage: 600;
k) Temp: 80°C;
l) Weight: 56 lbs/mft;
m) CSA: AWM, CMG;
n) UL: CM;
o) Flame Test: FT4;
p) Application: 70V PA Speaker Applications.

5.3.5.18.3 PA Conduit Requirements:

a) Conduits shall be designated with “PA” at terminating ends;
b) Wiring shall be run in conduit;
c) Refer to Sections: 5.2.10.2 Conduits and 5.3.4.16 Conduits;
d) All underground conduits shall be Rigid PVC.

5.3.5.18.4 Connections Requirements:

a) All speakers connected in a single zone shall be run in a single line configuration;
b) All splices or connections shall be copper-to-copper compression type with insulating covers;
c) Poles with speakers shall have one meter slack cable in raceway;
d) Fish cord in all PA raceways shall be installed for future use.

5.3.6 Telephone Network

5.3.6.1 The main telephone switch shall consist of trunk lines to allow for local and/or long distance calling. The network is to be capable of interfacing with 4-digit dialing as well as integrating with the voice mail system. In addition, analog lines are provided at all locations for redundancy and for emergency systems.

5.3.6.2 Telephone switches at remote sites such as Middlefield or Wolfdale shall be linked to the main switch at Head Office to permit 4-digit dialing between all sites.

5.3.6.3 All systems are to be provided with backup power supplies from Uninterruptible Power Sources at each location by generator power.

5.3.6.4 The network shall be capable of permitting paging to be performed through the local telephone system at all stations.

5.3.6.5 Provision shall be made for local caller I.D., call hold, call waiting, transfer, and conferencing.

5.3.6.6 Individual telephones shall be speaker type, capable of accepting multiple lines and speed dialing.

5.3.6.7 Conduits and power for the telephone network shall be provided at each trunk switch location.

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5.3.7 Talk-Thru System

5.3.7.1 The talk-thru system provides instant two-way voice communication between the public and station attendants through the glass divider at the station service counter.

5.3.7.2 The talk-thru unit provides hands free and effective duplex communication between the station operator and the passengers. The voice switching function is automatically biased in the direction from the passenger to the operator. Noise cancelling and omnidirectional microphones will be mounted on the passenger and service attendant sides respectively, of the booth glass divider. Two rotary encoded controllers will be provided to adjust the volume of each microphone. The operator's boom microphone will automatically override the passenger microphone when activated. Provision will be made for inter speech pause time. Refer to I&IT Telecommunication and Systems Standards – Service counter point to point two way talk system requirements for further details. Components:

a) Microphone Override Pushbutton;
b) Power On/Off L.E.D. Switch;
c) Noise Cancelling Microphone;
d) Seller's Mike-Off Switch;
e) Wiring–Conduits and 120 volt A/C source power outlets for each voice link assembly. Refer to Metrolinx I&IT Telecommunication and Systems Standards – Service counter point to point two-way talk system requirements for details.

5.3.7.3 Access Control and Intrusion Detection Systems

5.3.7.3.1 Security at GO Transit Rail and Bus Stations is managed by integrated access control and alarm systems. These systems are supplied and installed, as well as monitored by Metrolinx Vendor of Access Control and Intrusion Detection Systems on a 24-hour basis.

5.3.7.4 Access Control

5.3.7.4.1 Entry into the station sets off the time-delay actuated intrusion alarm, which is disarmed by entering an accepted.

5.3.7.4.2 I.D. code in the system keypad- The alarm control panel will continue to monitor all connected functions except the intrusion alarm sensors. When the premises are exited, re-entering the accepted I.D. code will reactivate the intrusion alarm. Designated employees are provided with individual I.D. codes to permit access into the premises. Time and date are recorded at central monitoring stations at the East and West Region facilities.

5.3.7.5 Building Alarms

5.3.7.5.1 Actuation of any equipment failure or fire alarm devices will cause a digital signal to be transmitted to the Metrolinx Vendor of Access Control and Intruder Detection central alarm monitoring location, as well as the local keypad. Activation of a hold up pushbutton will cause a silent signal to be transmitted to the Metrolinx Vendor central monitoring location, indicating where the alarm originated.

5.3.7.5.2 Stations and facilities operations personnel shall be consulted prior to final design.

5.3.7.6 Alarm Systems

5.3.7.6.1 Devices are strategically located throughout the buildings to detect and alarm the following

Superseded

conditions:

a) Intrusion;
b) Smoke;
c) Low Temperature;
d) High Temperature;
e) Hold Up (manually operated by the Station Attendant);
f) Sump Pump Failure;
g) Inverter and UPS Failure;
h) Low Voltage (station main power supply).

5.3.7.7 General Features

5.3.7.7.1 The complete station alarm system shall include, but not be limited to, the following components:

a) Metrolinx Vendor Control Panel;
b) User Interface;
c) Access control devices shall be open architecture;
d) Signal Transmitter and Receivers;
e) Audible Signal Device;
f) Hold-Up Alarm Buttons;
g) Intrusion Detectors, IR, PIR and ultrasonic;
h) Smoke Detection Devices;
i) Low and High Temperature Sensors;
j) Inverter System–Trouble and AC Output Sensors;
k) Smoke Detector By-Pass Switch;
l) Central Commercial Monitoring Services.

5.3.7.8 Alarm Monitoring Equipment

5.3.7.8.1 Metrolinx Vendor Alarm Control Panel - The system controls are housed in a surface wall-mounted EEMAC cabinet either with a hinged lockable door and gasket or a secured by screws for tamper protection. A tamper switch is included to provide an alarm in the case of tamper for the latter protection.

5.3.7.8.2 The alarm control panel is microprocessor controlled for monitoring 8 to 128 zones including the following:

a) Fire alarm detection with smoke detectors;
b) Intrusion alarm with dual microwave and infrared motion detectors;
c) Hold up alarm from high collar pushbuttons;
d) AC power failure, voltage sensor relays;
e) Low station temperature alarm;
f) Inverter system–trouble and AC failure output sensors;
g) Alarm system trouble/low battery condition;
h) Annunciation time delay devices for voltage sensors and thermostats.

Superseded

5.3.7.8.3 System Test momentary contact push-buttons are provided to test the alarm control functions including alarm output and telephone transmission. A manual “System Reset” push-button is provided to reset each alarm function at the keypad after the initiation devices have been set. An “Alarm Signal Silence” push-button in the alarm control panel is provided at the keypad to silence the audible alarm signals. An 8,192 event memory is either retrievable on site or from a remote PC located at a central facility. The system shall be subdivided from 2 to 16 areas that can carry up to 4,000 programmable codes, with 50 levels of authority. The system shall have false alarm prevention zones. All zones to be displayed on a liquid crystal display.

5.3.7.9 Power Supply

5.3.7.9.1 A 12 volt DC power supply for all system supervision, control and alarm functions shall be provided in the alarm control panel as an integral part of the system, complete with sealed gel type batteries and solid state charging equipment through 120 volt, 1 phase, 60 Hz normal power supply and step down transformer.

5.3.7.9.2 The battery capacity will be sufficient to operate supervisory conditions for a minimum of 12 hours, including audible alarm signals and auto-dialer and at the end of this period to energize all alarm devices simultaneously for a period of 5 minutes continuously.

5.3.7.9.3 The automatic charger shall be capable of restoring 90% of dead battery capacity within 12 hours. Discharge protection shall be provided to disconnect the charger when the voltage drops below 60%. The system shall report locally on the display loss of power and battery failure.

5.3.7.10 Audible Signal Device

5.3.7.10.1 The audible signal device shall be a vibrating horn with 110dB rating for intrusion and fire, operating at 12 volt DC.

5.3.7.11 User Interface

5.3.7.11.1 The user interface shall be surface mounted with tamperproof alarm. This unit will be used for entering application–oriented commands such as BA day-set/night-set, silencing audible annunciation and programming of access codes, etc. It contains a sounder and a liquid crystal display, which annunciates zones and system status. Shall more than one alarm be registered at the same time, the liquid crystal display will scroll through all alarms.

5.3.7.12 Intrusion Detector

5.3.7.12.1 Dual technology (microwave and infrared) motion detectors shall have Fresnel lenses, multi-segment mirrors, and automatic temperature compensation.

5.3.7.13 Smoke Detector

5.3.7.13.1 A single zone, single state detection system shall be installed. The photoelectric combustion detector is of solid-state design, surface or flush mounted. At stations with an existing Fire Alarm Panel, the output contacts will be wired to The Alarm Control Panel.

5.3.7.14 Hold-Up Button

5.3.7.14.1 The hold-up push-buttons shall be of the high collar momentary type.

5.3.7.15 Low Temperature Sensor

Superseded

5.3.7.15.1 The temperature sensor shall have an adjustable setting with a scale from 10C to 30C. The thermostat shall be housed in a vandal-resistant enclosure with maximum air circulation over the sensing element.

5.3.7.16 AC Voltage Sensor

5.3.7.16.1 The AC voltage sensor shall be of solid-state type with adjustable pick up and drop out settings and sensing relays with dry rated switching contacts.

5.3.7.17 Inverter System

5.3.7.17.1 The inverter unit shall have trouble and AC output failure alarm settings as provided by the manufacturer. Dry output contacts from the Inverter shall be wired to the security control panel.

5.3.7.18 Trouble Alarm Set

5.3.7.18.1 AC Failure: Shall indicate failure of AC supply to the unit.

5.3.7.18.2 One General alarm and one AC output fail alarm shall be supplied.

5.3.7.18.3 Low Battery Voltage: Shall indicate the battery voltage has fallen below a pre-set limit during the discharge process.

5.3.7.18.4 High Battery Voltage: Shall indicate that the battery voltage has risen above a pre-set limit during the charging process.

5.3.7.18.5 Charger Failure: Shall indicate the charger is not providing any output to the batteries.

5.3.7.18.6 The occurrence of any of the above conditions will provide a common alarm.

5.3.7.19 AC Failure Output Alarm Set

5.3.7.19.1 No AC Output: This alarm shall trigger upon the absence of AC output for any reason.

5.3.7.20 Smoke Detector Bypass Switch

5.3.7.20.1 A smoke detector bypass pushbutton switch, a double contact shunt switch, shall be provided to indicate to central monitoring that the detector is in the by-pass mode when not connected to the main fire alarm control panel. The smoke detector bypass push button switch is not required when the detector is connected to the main fire alarm control panel.

5.3.7.21 System Functional Performance

5.3.7.21.1 Actuation of any intrusion alarm-initiating device will cause the system local alarm panel to operate as follows:

a) To transmit a signal, depending on the location and type of alarm, to a central alarm monitoring location and to annunciate on the local keypad;

b) An audible alarm signal in the station will sound continuously for 5 minutes and then be automatically silenced.

5.3.7.21.2 Actuation of any fire alarm initiating devices will cause the system local panel to operate as follows:

a) To transmit a digital signal, depending on the location and type of alarm, to a central alarm monitoring location and to annunciate on the local keypad;

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b) Actuation of a hold-up push-button will cause the alarm control panel to transmit a silent alarm to a central alarm monitoring location, identifying to the operator the station where the alarm originated and the type of alarm.

5.3.7.21.3 Actuation of a thermostat for low temperature, AC power failure, inverter system trouble, or Access Control and Intrusion Detection System trouble, will cause the alarm panel to:

a) Transmit a digital signal, depending on the location and type of alarm, to a central monitoring location and to annunciate on the local keypad after the pre-set time delay has expired;

b) An audible signal in the keypad will sound continuously for 5 minutes and be automatically silenced.

5.3.7.22 Sequence of Operation

5.3.7.22.1 The following is a typical procedure for entry into and exit from a station:

a) Entry – The designated door is unlocked and the time delay intrusion alarm is immediately activated;

b) The alarm is disarmed by key-in at the keypad located in the station before expiry of the time delay;

c) If the code is accepted, the intrusion alarm is disarmed and the alarm control panel will continue to monitor all the connected functions except the intrusion alarm sensors;

d) Exit – The exit code is entered in the keypad and the system will respond by initiating the time delayed intrusion alarm;

e) The station must be exited and the door locked before the end of the time delay;

f) The system will respond at the end of the time delay by arming all of the intrusion sensors.

5.4 Mechanical

5.4.1 Overview

5.4.1.1 This section applies to the mechanical engineering design related to:

a) Heating, Ventilation and Air-Conditioning (HVAC) systems;

b) Building Automation System (BAS);

c) Radiant Floor Heating and Snow Melting Systems;

d) Plumbing and Drainage systems;

e) Fire Protection systems;

f) Identification, Appearance and Noise Vibration;

g) Basic and user-friendly computerized and automated equipment controls and energy-management programs shall be utilized. Remote monitoring of equipment shall be provided if required by Metrolinx.

5.4.1.2 Refer to GO Standard specifications and drawings for detailed requirements.

5.4.2 Heating, Ventilation, and Air Conditioning (HVAC) Systems

5.4.2.1 Design Requirements

5.4.2.1.1 Heating, Ventilation and Air-Conditioning System shall be by means of the most cost-

Superseded

effective energy source available at the site. Daytime design temperatures (Daytime: with

Superseded

Nighttime setbacks) for rooms shall be as tabulated below.

Table 56: Heating, Ventilation, and Air Conditioning (HVAC)

Superseded

Room	Winter Min. (°C)	Summer Max. (°C)	Summer RH (%)	Energy Source
Passenger Waiting Room (including vending/ concessions)	18	25	50%	HVAC
Station Attendant	22	22	50%	HVAC
Staff Room	22	22	50%	HVAC
Dispatcher Room	22	22	50%	HVAC
Office Room	22	22	50%	HVAC
Communications room	15	22	50%	HVAC (Note 1)
Hub room	15	22	50%	HVAC (Note 1)
Mini-hub room	15	22	50%	HVAC (Note 1)
Third Party Room	15	22	50%	HVAC (Note 1)
Electronics Workshop	22	22	50%	HVAC
Washroom	22	N/A	N/A	Ventilation & Heating
Janitor Room	18	N/A	N/A	Ventilation & Heating
Battery Room	18	N/A	N/A	Ventilation, Heating & Gas Monitoring
Electrical Room	15	25	50%	HVAC (Note 1)
Elevator control room	15	25	50%	HVAC (Note 1)
Mechanical Room	18	N/A	N/A	Ventilation & Heating
Sump pump room	18	N/A	N/A	Ventilation & Heating
Maintenance Room	18	25	50%	HVAC
Boiler Room	18	N/A	N/A	Ventilation, Heating & Gas Monitoring
Generator Room	15	N/A	N/A	Ventilation & Heating

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Fuel Room	15	N/A	N/A	Ventilation & Heating
Elevator Hoistway	15	25	50%	HVAC (Note 2)
Workshop	22	22	50%	HVAC
Storage Room	20	22	50%	HVAC
Station secondary entrance, and pedestrian bridge	N/A	N/A	N/A	Ventilation
Tunnel	N/A	N/A	N/A	Mechanical ventilation: min. 3 ACH
Hydro Vault	N/A	N/A	N/A	
Shelter	N/A	N/A	N/A	Note 3

Notes:

1. For HVAC system detail requirement refer to service rooms requirements in section 5.2.23.
2. For HVAC system detail requirement refer to Elevators in section 5.5.5.
3. For HVAC system detail requirement refer to GO-Shelter standard drawing and specification.

5.4.2.1.2 Configurations that minimize drafts and cold air infiltration directly into staff areas shall be employed.

Thermal comfort: it is important that the air temperature within Staff Office / back of house / waiting areas / climate controlled areas will be maintained at a comfortable level year round for comfort.

a) Summer Conditions: acceptable range – reference to table 56
b) Winter Conditions: acceptable range – reference to table 56
c) Maintain 50% relative humidity and average air speed of <0.15 m/s in public areas. Refer to MOL, CSA Z412-17 Office Ergonomics for further information.

5.4.2.2 Stations

5.4.2.2.1 Heating and Air Conditioning of the waiting area and the service area shall be achieved by energy efficient, premium quality air handling unit c/w outdoor condensing unit, or roof top unit depending on different projects, Equipment shall be accessible for operations and maintenance.

5.4.2.2.2 The service area will have a VAV box controlled by a thermostat, while the main thermostat shall be located in the maintenance room and interlocked with the waiting area temperature sensor.

5.4.2.2.3 Communication room and Electrical room shall have a dedicated split Heat Pump A/C unit, fan-forced heater as redundancy, and emergency cooling for each room, for detail refer to service room requirements in section 5.2.23.

5.4.2.2.4 Depending on area, washrooms shall be ventilated by Energy Recovery Ventilators or

Superseded

exhaust fans, and shall be heated by radiant heating (if available in the building) or by electric baseboard heating.

5.4.2.2.5 HVAC system shall be provided for Elevator hoistway. For detail, refer to Elevators in section 5.5.5.

5.4.2.3 Facilities

5.4.2.3.1 Radiant floor heating shall be the main heating system in the entire facility.

5.4.2.3.2 Office area shall be heated and air conditioned by energy efficient, premium quality rooftop packaged gas heating/electric cooling units.

5.4.2.3.3 Storage area and repair area shall be ventilated by heavy-duty industrial Air Handling Unit c/w heat recovery unit.

5.4.2.3.4 This system shall be controlled by thermostats and gas monitoring system.

5.4.2.3.5 To minimize infiltration through open overhead doors in rail facilities, heavy-duty industrial air curtains shall be installed above overhead doors.

5.4.2.3.6 Communication room and electrical room shall have a dedicated split Heat Pump A/C unit, fan-forced heater as redundancy, and emergency cooling for each room. For detail refer to service room requirements in section 5.2.23. .

5.4.2.3.7 Large Communication room and/or Computer room shall have an independent dedicated HVAC system including precision air conditioning equipment and under floor plenum supply. The complete HVAC system shall comply with ASHRAE Thermal Guidelines for Data Processing Environments.

5.4.2.4 Air Curtain

5.4.2.4.1 For high-traffic door locations, or where drafts are a problem with station attendants, linear diffuser air-curtains shall be provided at the doors.

5.4.2.4.2 Refer to Metrolinx Standard Air Curtains Specification 23 33 45 for detailed requirements.

5.4.2.5 Split Heat Pump Unit

5.4.2.5.1 Refer to Metrolinx Standard Split Type Air to Air Heat Pumps Specification 23 81 26 for detailed requirements.

5.4.2.6 HVAC Air Distribution

5.4.2.6.1 Refer to Metrolinx Standard HVAC Air Distribution Specification 23 30 00 for detailed requirements.

5.4.2.7 Air Terminal Unit

5.4.2.7.1 Refer to Metrolinx Standard Air Terminal Units Specification 23 36 00 for detailed requirements.

5.4.2.8 Custom Made Air Handling Unit

5.4.2.8.1 Refer to Metrolinx Standard Custom Made Air Handling Units Specification 23 75 00 for

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detailed requirements.

5.4.2.9 Piping and Pumps

5.4.2.9.1 Refer to Metrolinx Standard HVAC Piping and Pumps Specification 23 20 00 for detailed requirements.

5.4.2.10 Fan

5.4.2.10.1 Airfoil or backward inclined design is preferred.

5.4.2.10.2 Forward curved wheels may be used for low pressure applications.

5.4.2.10.3 Variable pitch axial fans shall be considered for fan wheel diameters greater than 610mm and where system air volumes vary, due to control characteristics of summer/ winter operation.

5.4.2.10.4 Propeller fans may be used where they serve non-public or unoccupied areas.

5.4.2.10.5 Additional ventilation with emergency power backup may be required in large facilities.

5.4.2.10.6 Refer to Metrolinx Standard HVAC Fans Specification 23 34 00 for detailed requirements.

5.4.2.11 Energy Recovery Ventilator

5.4.2.11.1 Energy Recovery Ventilator (ERV) shall be specified for energy conservation in all Metrolinx facilities and stations, where practical and cost effective.

5.4.2.11.2 In station building they shall be above the public washrooms or the maintenance room, in the ceiling space, where applicable.

5.4.2.11.3 Access by ceiling hatch sized accordingly. Provide engineered tie off points if access is higher than 3m after finished floor.

5.4.2.11.4 Refer to Metrolinx Standard Energy Recovery Ventilators Specification 23 33 65 for detailed requirements.

5.4.2.12 Air Filter and Accessory

5.4.2.12.1 Filters used in supply air systems shall be 50 mm (2”) thick throwaway type minimum efficiency of 30%.

5.4.2.12.2 Refer to Metrolinx Standard Air Filters and Accessories Specification 23 41 00 for detailed requirements.

5.4.2.13 System Control

5.4.2.13.1 HVAC systems shall be controlled using programmable thermostats to achieve night setbacks and BAS compatible.

5.4.2.13.2 Interlocks for fire protection to be as per OBC and NFPA.

5.4.2.13.3 If a room has two HVAC systems, both systems shall be controlled by a single programmable automatic heating/cooling changeover controller.

5.4.2.14 Heater

Superseded

5.4.2.14.1 Electric fan forced heaters shall be considered in the waiting area and entrances. Heaters can be wall or ceiling mounted. Heaters shall be controlled by wall mounted space sensors. No built-in thermostats shall be allowed.

5.4.2.14.2 Supplemental electric fan forced heater shall be considered in the service area.

5.4.2.14.3 Electric resistance duct heaters shall have Silicon Control Rectifiers (SCR), minimum airflow switch, and two high-temperature limit sensors.

5.4.2.14.4 Gas fired unit heaters and infrared heaters shall be considered in large facilities.

5.4.2.14.5 Electric infrared radiant heater shall be considered, refer to Metrolinx standard shelters.

5.4.2.14.6 Refer to Metrolinx Standard Heaters Specification 23 83 00 for detailed requirements.

5.4.2.15 Diffuser

5.4.2.15.1 Diffusers shall be aluminum.

5.4.2.15.2 For perforated metal ceilings diffusers to be perforated type to match the ceiling profile and colour.

5.4.2.15.3 Refer to Metrolinx Standard HVAC Air Distribution Specification 23 30 00 for detailed requirements.

5.4.2.16 Duct

5.4.2.16.1 Air ducts shall be galvanized sheet metal confirming to ASHRAE, SMACNA Duct Construction Standards, and NFPA 90A.

5.4.2.16.2 Diffuser branch-ducts and air terminal ducts may be circular metal flex-ducts where concealed.

5.4.2.16.3 Exposed ducts in public areas shall be aluminum spiral ducts. Hangers and fasteners shall also be protected from the detergents and moisture or be fabricated of materials that are not subject to corrosion.

5.4.2.16.4 Refer to Metrolinx Standard HVAC Air Distribution Specification 23 30 00 for detailed requirements.

5.4.2.17 Fire Damper

5.4.2.17.1 Fire dampers shall be fusible link type conforming to ULC-S505.

5.4.2.17.2 An access door shall be installed for inspection and resetting.

5.4.2.17.3 Refer to Metrolinx Standard HVAC Air Distribution Specification 23 30 00 for detailed requirements.

5.4.2.18 Connector

5.4.2.18.1 Flexible connectors shall be provided between vibrating equipment and connecting ducts.

5.4.2.18.2 Refer to Metrolinx Standard Basic Mechanical Materials and Methods Specification 20 05 10 for detailed requirements.

5.4.2.19 Insulation

Superseded

5.4.2.19.1 Acoustical and thermal duct insulation shall be in accordance with the OBC. and ASHRAE 90.1.

5.4.2.19.2 Acoustical insulation shall be provided to maintain a maximum room sound rating of 40dBA.

5.4.2.19.3 Piping insulation shall be in accordance with ASHRAE 90.1, with PVC jackets.

5.4.2.19.4 Refer to Metrolinx Standard Mechanical Insulation Specification 20 05 25 for detailed requirements.

5.4.2.20 Rooftop Air Handling Unit

5.4.2.20.1 High efficiency, meeting ASHRAE 90.1 requirements, UL listed and labelled.

5.4.2.20.2 Units supplying high occupancy rooms, such as meeting rooms, shall be controlled by a carbon dioxide sensor, in order to modulate the outside air damper.

5.4.2.20.3 Factory installed downflow economizer c/w barometric relied damper, solid state enthalpy, and differential enthalpy control.

5.4.2.20.4 Refer to Metrolinx Standard Rooftop Air Conditioning Unit Specification 23 74 17 for detailed requirements.

5.4.2.21 Fuel Oil System

5.4.2.21.1 Refer to Metrolinx Standard Fuel Oil System Specification 23 11 13 for detailed requirements.

5.4.2.22 Natural Gas Piping System

5.4.2.22.1 Refer to Metrolinx Standard Natural Gas Piping System Specification 23 11 23 for detailed requirements.

5.4.2.23 Refrigerant Piping System

5.4.2.23.1 Refer to Metrolinx Standard Refrigerant Piping, Valves and Accessories Specification 23 23 00 for detailed requirements.

Superseded

5.4.3 Building Automation System (BAS)

5.4.3.1 All facilities, stations, and terminal buildings shall have a central computer-based, Building Automation System installed that will control and / or monitor the following building systems at a minimum:

Table 57: Building Automation System (BAS)

Mechanical	Electrical	Communications
• HVAC system • Plumbing and drainage system • Compressed air system • Vehicular and Pedestrian Gates and Doors • Fuel System • Gas Detection Systems • Well water systems, if applicable • Alarms system • Compressed air dryers • Fire protection system • Snow melting system • In Floor heating system • Natural gas system • All third party (retail, users) water and gas • Layover Systems including Sand, Fuel, Air and Track Load	• Power Systems • Lighting Systems • Controllers • Shelter Heater System • Panel Loads per circuit • SCADA Remote Monitoring • All third party (retail, users) power • Environmental readings • Radio Systems (power consumption) • Monitoring of signaling system capability • Hydro • Generator, UPS and Emergency Power Systems (loss of power, monitoring of damper status, batteries status and alarms) • Layover Systems	• Telecommunications Systems (excluding CCTV) • PA and Intercom Systems • Security and Access Management Systems • All Systems on site including car counting system. • Car Counting System,

5.4.3.2 Provide sub-metering for panels and sub-panels with remote communication capability from IT Central Gathering Centre. The system shall be able to store data for a minimum of three (3) years.

5.4.3.3 The local BAS shall be able to communicate and send information to an IT Central Gathering Centre.

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5.4.3.4 The location of the BAS control panel and location of the outlets is to be included on the electrical drawings.

5.4.3.5 BAS shall be part of the commissioning process. Two full years are necessary before final commissioning of the BAS system.

5.4.4 Radiant Floor Heating and Snow Melting Systems

5.4.4.1 Design Requirements

5.4.4.1.1 Radiant Floor Heating and Snow melting Systems shall refer Metrolinx Standard specifications and Standard drawings for detailed requirements, typical applications include:

a) Stations;
   1) Full width hydronic snow melting system shall be installed on all rail platforms, and exterior ramps and stairs leading to platform area;
   2) Radiant floor heating shall be installed in Station building except areas identified as unconditioned in DS-04 GO Station Architectural Design Standard, mechanical room, communication room and electrical room.
b) Bus Operation Facilities;
   1) Radiant Heating system shall be installed in all Bus Facilities;
   2) Partial snow melting system shall be provided at bus facility ramped entrances.
c) Rail Operation Facilities - Radiant Heating system and snow melting system shall be installed as directed by Metrolinx.

5.4.5 Plumbing and Drainage Systems

5.4.5.1 Basis of Criteria

5.4.5.1.1 This Section deals with plumbing systems, building storm and sanitary drainage systems, compressed air systems and special applications within the immediate vicinity of any building.

5.4.5.1.2 Refer to GO Standard specifications and drawings for detailed requirements.

5.4.5.1.3 Typical Applications include:

a) Distribution;
b) Elements;
c) Fixtures;
d) Storm and Sanitary Drainage;
e) Special Applications;
f) Staff washrooms;
g) Public washrooms;
h) Tenant and vending premises;
i) Bus and rail maintenance facilities;
j) Hose bibs at buildings, tunnels and on platforms;
k) Sump pits for tunnels, elevators and buildings (if applicable).

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5.4.5.1.4 Specialized installations include:

a) Vehicle wash equipment;
b) Progressive maintenance bays (PMBs) for locomotive and coach water supply and sewage disposal;
c) Wells and septic systems or holding tanks at rural sites.

5.4.5.1.5 Any plumbing planned for non-conditioned spaces shall be heat traced, with access to system valves, drains, cleanouts and other serviceable elements within areas that will not impede customer flow while servicing.

5.4.5.2 Water Piping Requirements

5.4.5.2.1 Domestic water piping shall be copper, type “L” above ground, type “K” for buried services. Copper type “M” and galvanized pipe shall not be used;

5.4.5.2.2 Hangers and fasteners shall be protected from the detergents and moisture or be fabricated of materials that are not subject to corrosion;

5.4.5.2.3 Waterlines in unheated areas shall be protected from freezing with electric tracing, thermostatically controlled. These sections of piping shall be valved to enable isolation and drainage;

5.4.5.2.4 Insulation shall be in accordance with ASHRAE 90.1 standard;

5.4.5.2.5 Piping shall be concealed in public areas. Exposed chrome piping shall have chrome- plated anchors and hangers;

5.4.5.2.6 Pipes shall not be routed through electrical rooms, control rooms or communication rooms;

5.4.5.2.7 Cathodic protection for buried pipes shall be provided if required.

5.4.5.3 Hot Water System Requirements

5.4.5.3.1 Where gas is available, gas type DHW tank shall be provide;

5.4.5.3.2 Service hot water shall be provided tempered 40°C at station and bus terminal washbasins and in washrooms. Shops, maintenance and garage facilities may have higher temperatures if required;

5.4.5.3.3 A re-circulation system normally is not required in a typical Metrolinx/GO Station building;

5.4.5.3.4 Hot water heaters in stations/bus terminals shall be located in maintenance rooms, ceiling-hung to suit space requirements. Relief valves shall be piped to floor drains with air break;

5.4.5.3.5 A gas fired tankless type hot water system may be used where approved by Metrolinx/GO, to minimize piping.

5.4.5.4 Landscape Water System Requirements:

5.4.5.4.1 Buried water supply piping systems shall be provided for the manual watering of landscaping only if specifically requested by Metrolinx/GO. If requested, they shall consist of PVC piping and quick coupling hose attachments spaced so that every point in the landscaped area can

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be reached by a 30 m hose extended from the hose attachment;

5.4.5.4.2 The system shall be capable of being completely drained or air-blown dry in the autumn.

5.4.5.5 Storm Drainage System Requirements:

5.4.5.5.1 Drainage shall be designed to meet the requirements of local authorities, and the relevant stormwater management study;

5.4.5.5.2 Drainage: oil and grit interceptors and inlet control devices may be required;

5.4.5.5.3 The location of scupper drains and splash pads shall be coordinated with the prime consultant;

5.4.5.5.4 Rail platform shelter roof drains where required, may be directed to Railway R.O.W. ditches, where approved by the Railway, or to a sump pit in the tunnel and then pumped to the storm system.

5.4.5.6 Sanitary Drainage System Requirements:

5.4.5.6.1 Drainage shall be designed to meet the requirements of local authorities;

5.4.5.6.2 All washrooms, maintenance/janitor rooms, mechanical rooms, vending and concession areas and certain maintenance areas as directed by Metrolinx, shall be provided with floor drains and strainers;

5.4.5.6.3 Strainer and sediment buckets shall be provided for heavy-duty floor drains, trench drains, and tunnel floors. Tunnels shall have open shallow trench drains at the wall perimeters;

5.4.5.6.4 Food preparation areas require grease interceptors. This applies particularly to tenant premises;

5.4.5.6.5 Service stations, repair shops, and garages require oil interceptors. Parking lots and elevator pits do not require oil interceptors as per O.B.C.

5.4.5.7 Hydrants and Hose Bibs Requirements:

5.4.5.7.1 Wall hydrants and hose bibs shall be minimum 20 mm anti-siphon, non-freeze type in flush mounted box with locking cover;

5.4.5.7.2 Non-freeze wall mounted hose bibbs shall be provided at station buildings spaced no further than 30m apart along the perimeter of the station building. The location of the hose bibbs shall be placed such that the surrounding landscape around the station building (i.e. planters, pedestrian walkways etc.) can be serviced by a 18.3m hose. Where there are obstructions preventing a single hose bibb from meeting this criteria, additional hose bibbs shall be provided as required;

5.4.5.7.3 Station buildings shall not be provided with less than two non-freeze hose-bibs. For station buildings where two hose bibbs are sufficient to meet the above criteria, they shall be located on different exterior facing walls;

5.4.5.7.4 Non-freeze wall mounted hose bibbs shall be provided at platforms and in pedestrian tunnels spaced no further than 30m apart along the length of the platform and pedestrian tunnel. The location of the hose bibbs shall be placed such that the entire platform and tunnel can be serviced by a 18.3m hose. Where there are obstructions preventing a single hose bibb from

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meeting this criteria, additional hose bibbs shall be provided as required;

5.4.5.7.5 Interior wall mounted hose bibbs shall be provided in any room which contains a sump pit;

5.4.5.7.6 Tunnel/platform hose-bib pipe systems shall have gravity drain capability for water shut-off;

5.4.5.7.7 Hose-bibs shall also be located in shops, maintenance facilities, loading docks, bus platforms, etc. as directed by Metrolinx, sized to suit;

5.4.5.7.8 Interior hose bibbs shall be located at Platform Access Buildings, Station Buildings, all Tunnels, and rail/bus platforms. Bibbs should only be installed in areas where it is heated as they do not have non-freeze mechanism. Areas such as tunnel entrances and rail/bus platforms are susceptible to freezing and should have exterior hose bibbs installed.

5.4.5.7.9 Exterior hose bibbs shall be heat traced and self-draining (non-freeze) and shall be provided at all landscaping areas and within 30m spacing throughout the site for cleaning and maintenance requirements.

5.4.5.7.10 Hose bibbs shall be integrated into structural elements instead of stand-alone units. Winterizing: Water lines shall have positive flow drainage to assist with winterizing activities and there shall be drains in lines to ensure all systems are protected against potentials ice damage.

5.4.5.7.11 Refer to Metrolinx Standard Domestic Water Piping and Specialties Specification 22 11 00 for detailed requirements.

5.4.5.8 Pipe Sleeves Requirements:

5.4.5.8.1 Galvanized steel pipe sleeves shall be provided in concrete structures to accommodate future piping installations, if required;

5.4.5.8.2 Hangers and fasteners shall also be protected from the detergents and moisture or be fabricated of materials that are not subject to corrosion;

5.4.5.8.3 Refer to Metrolinx Standard Basic Mechanical Materials and Methods Specification 20 05 10 for detailed requirements.

5.4.5.9 Water Meters Requirements:

5.4.5.9.1 Water supply lines shall be sized for the specific requirements of the facility;

5.4.5.9.2 The incoming service shall be metered inside with an exterior readout acceptable to the local utility;

5.4.5.9.3 Major tenants shall have check-meters;

5.4.5.9.4 Valves: Each fixture shall have a key operated service valve or shut-off valve. All valves shall be labelled with a metal tag;

5.4.5.9.5 Back flow preventers shall be provided;

5.4.5.9.6 Additional shut-off valves shall be provided for each group of fixtures, e.g., a washroom. At least one shut-off valve shall be provided for each room with one or more fixtures;

5.4.5.9.7 Refer to Metrolinx Standard Domestic Water Piping and Specialties Specification 22 11 00

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for detailed requirements.

5.4.5.10 Sump Pumps Requirements

5.4.5.10.1 Where storm or sanitary drains cannot be discharged to the sewer by gravity flow, flow shall be discharged into a tightly covered and vented sump pit, from which the liquid is lifted and discharged to the sewer by an automatic duplex pump system with automatic changeover and guide bars. Each pump shall be sized for 100% flow. Pumps shall be epoxy coated with two independent seal assemblies;

5.4.5.10.2 A 4-float control system shall be provided (OFF–LEAD ON–LAGG ON–ALARM). Provision shall be made for dry 'C' contacts for connection to a remote alarm. Pumps shall be easily removable for maintenance without the need to enter the wet well. Control system shall be enabled without the use of any proprietary programming involved;

5.4.5.10.3 Pit cover shall be gas tight, self-opening with piston kit and safety grid. Sump pump pit shall be with an access ladder installed where are no means of utilizing a portable ladder (primarily required in small, tight areas);

5.4.5.10.4 System shall be complete with lifting equipment including lifting davit, chain hoist, lifting device, and chain hook;

5.4.5.10.5 Sump pits are used for shelter, roof, and tunnel drainage, and in elevator or escalator pits;

5.4.5.10.6 Special sump pumps may be required for maintenance facilities or rural stations (TBD);

5.4.5.10.7 Refer to Metrolinx Standard Plumbing Equipment Specification 22 30 00 for detailed requirements.

5.4.5.11 Plumbing Fixtures Requirements:

5.4.5.11.1 All fixtures except janitor sink shall be vandal resistant vitreous china Certified to CAN/ CSA-B45.0, "General Requirements for Plumbing Fixtures";

5.4.5.11.2 All trims to be touchless, electronic, hard-wired barrier free where applicable;

5.4.5.11.3 Refer to Metrolinx Standard Plumbing Fixtures and Trim Specification 22 42 00 for detailed requirements.

5.4.5.12 Compressed air system Requirements:

5.4.5.12.1 Refer to Metrolinx Standard General Service Compressed Air System Specification 22 15 00 for detailed requirements.

5.4.5.13 Special Requirements

5.4.5.13.1 Septic systems and/or holding tanks for rural facilities;

5.4.5.13.2 Filling stations for locomotive and coach washroom water supply;

5.4.5.13.3 Coach washroom sewage removal facilities at PMBs in train maintenance facilities;

5.4.5.13.4 Train and bus wash facilities including recycling of wash water;

5.4.5.13.5 Wells or water reservoirs at rural facilities to approval of authorities having jurisdiction,

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including filtration and purification systems;

5.4.5.13.6 A minimum Metrolinx requirement is ultraviolet purification for coliforms and E.coli bacteria with pre-filters;

5.4.5.13.7 Thermostat controlled electric pipe heating cables shall be used on all pipes above frost line in unheated areas, where the temperature may fall below freezing;

5.4.5.13.8 Minimum burial depth of piping shall be 1650 mm or to municipal requirement.

5.4.5.13.9 The propane storage tank design shall consider storage volume limits noted within the current Federal Environmental Emergencies Regulation and its Technical Guidance under the Canadian Environmental Protection Act (CEPA) requirements to ensure systems are designed in such as way as to avoid Environmental Emergencies (E2) Plan development and implementation requirements, wherever possible.

5.4.5.13.10 Where the propane storage tank exceeds the specified threshold volume, as stated within the regulation, and designs to avoid E2 Plan requirements cannot be attained, the designers shall provide the rationale for why the design cannot meet the isolation requirement. Where the propane storage tank volume or system design exceeds the specified threshold volume and an E2 plan is required, the designers shall develop the E2 Plan in consultation with the owners and provide a finalized E2 Plan report at project handover. The designers shall also provide a training session regarding the E2 Plan requirements, as well as facilitate and document the initial on-site emergency exercise with the owners, as required by the regulations.

5.4.5.13.11 Propane Storage Tank location shall consider the extent of Hazardous Area Classification and propane spill distances. Hazardous Area Classification shall be done according to Ontario Electrical Safety Code, API RP 500 (American Petroleum Institute, Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2) and a dedicated drawing, stamped by a Professional Engineer with Area Classification, shall be part of design submittals.

5.4.6 Fire Protection Systems Design Requirements

5.4.6.1 Fire Protection System shall be provided as per Ontario Building Code, NFPA, Ontario Fire Code and Regulators, and refer Metrolinx Standard specifications for detailed requirements.

Superseded

Table 58: Fire Protection System

Item	Features
Sprinkler System	• Sprinkler heads in public areas shall be concealed flush type. • Drum drips shall be insulated and electrically heat traced, with dedicated circuits • Pre-action sprinkler system shall be provided for service rooms (eg. electrical and communication rooms) when the building/space is required to be sprinklered per code. • Dry zone sprinkler system shall be provided in unheated areas and areas where sprinkler system piping maybe susceptible to freezing when the building/space is required to be sprinkled per code.
Standpipe and hose system	• In unheated area, dry standpipe system shall be provided. • Drain pipe shall be drained to sanitary system instead of dumping on the floor.
Fire Hydrant System	• Hydrant shall be provided as per code and include a trace line. • Fire hydrants located in a landscaped area or snowdrift area shall be raised or marked with raised identification “flag” devices. • Minimum burial depth of piping and pipe-marking/protection shall be to municipal requirements.
Dry Fire Suppression System	• Dry Fire Suppression System or clean agent system for main communication, electrical and computer and telephone equipment room shall be provided where required by Metrolinx.
Portable Fire Extinguisher	• Fire extinguisher shall be available during construction and be provided as per Metrolinx for occupancy of premises.

5.4.7 Identification, Appearance, and Noise/ Vibration

5.4.7.1 Identification Requirements

5.4.7.1.1 Equipment, piping, and systems shall be clearly identified according to industry standards. Equipment shall include manufacturer’s nameplate, CSA, and/or CUL registration plates where applicable. Piping and ducting systems shall be identified using a standard identification system, ASHRAE, CGSB or similar;

5.4.7.1.2 All labels, tags, nameplates, etc., shall be stainless steel, brass, or thick laminated plastic, as appropriate to suit application;

5.4.7.1.3 Any alteration to equipment shall be approved for use by recognized certification and/or field evaluation markings;

5.4.7.1.4 Refer to Metrolinx Standard 20 05 10 Basic Mechanical Materials and Methods Specification for detailed requirements.

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5.4.7.2 Appearance Requirements

5.4.7.2.1 All equipment, vent, access door, door grille, diffuser, return air grille, and exposed duct locations etc. shall be coordinated by the architect/prime consultant;

5.4.7.2.2 Roof-mounted equipment shall be screened. Where permitted, multiple exhaust ducts shall be combined to minimize building penetration. On sloping station roofs, exhaust ducts shall be directed to vertical gable vents, if applicable;

5.4.7.2.3 Exterior grade-level equipment (condensing units, etc.) shall be elevated 300 mm minimum above grade, and screened by fencing;

5.4.7.2.4 Grilles, vents and diffusers shall be recessed or flush with adjoining base-building materials, as detailed by the architect/prime consultant, and shall not be surface-mounted over base-building materials.

5.4.7.3 Noise and Vibration Requirements

5.4.7.3.1 Isolators and vibration control devices shall be specified as required to ensure that equipment-noise and vibration do not interfere with Metrolinx Transit operations, as well as to protect adjacent properties from noise and vibration, where necessary;

5.4.7.3.2 Equipment noise control: all efforts shall be given to ensure all systems are quiet and do not impede staff's ability to communicate with customers at or within the facility. Acceptable ambient noise from all public facing areas shall be below 55 dB. Service rooms hosing generators / pumps / boilers shall maintain levels as per the related code requirement.

5.4.7.3.3 Refer to Metrolinx Standard 20 05 10 Basic Mechanical Materials and Methods Specification for detailed requirements.

5.4.8 Operation and Maintenance requirement:

5.4.8.1 Replacement parts: as part of the overall 'Availability' principal, Metrolinx is also committed to ensure that assets which are out of service are quickly repaired. Common replacement parts shall be locally available and sourced to allow for less than 10% operational downtime.

5.4.8.2 Equipment Repairs: Keep building systems serviceable and well laid out to facilitate any repairs required within the space. An area where staff can access, use and lay out tools and equipment shall be provided. Any building systems shall be installed in such a way as to ensure full access to all consumable parts such as filers, belts, fittings, etc.

5.4.8.3 There shall be no exposed risers, or plumbing accessible within customer exposed areas.

5.4.8.4 HVAC Systems: All regularly accessed portions of HVAC equipment (i.e. air filters) in dedicated service rooms (electric, mechanical, communications) shall be reachable without the need for specialized equipment. Spaces which house HVAC equipment shall not have any interference that prohibit or intrude on access to maintainable features of the equipment.

5.4.8.5 Ensure on adequate path of travel is provided at all service spaces (min, 915 mm wide by 2100 mm high) or greater as required by authorities having jurisdiction. At areas that require access servicing (i.e. filter changes) a space 1.5 times larger than the space allocation recommendation identified by the equipment manufacture, shall be provided.

5.4.8.6 Installation of equipment within mechanical rooms, services spaces or on facility roofs or yard to provide proper access (1.5 times the clearances recommended by the

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manufacturer's) for servicing and for removal and re-installation of individual items (coils, filters, fans, valves, operators, etc.) or equipment such as, boilers, generators, air handling units, etc.

5.4.8.7 Wall-mounted adjustable devices such as thermostats and sensors located in public areas shall be enclosed in a clear lockable box with ventilation slots for proper environment measurement.

5.4.8.8 In-floor heating manifolds or any wall recessed manifolds located in public areas shall be enclosed in vandal resistant lockable cabinet enclosures.

5.4.8.9 Sump pumps pit and/or manifolds chamber shall not be installed in the customer path of travel to ensure operational integrity during any sort of maintenance; specifically, no sumps or manifolds shall be placed within tunnels.

5.4.8.10 Snow Melt Systems: Snow melt systems shall be provided within all rail platforms to ensure efficient and effective snow and ice control at high risk areas.

5.4.8.10.1 There shall be no splices used within glycol tubing or power wires for snowmelt sensors as outlined in Specification 23 21 18: Glycol Solution Snow Melting System. Snowmelt platform sensors are to be embedded within concrete to minimize movement and reduce water ponding.

5.4.8.10.2 Controls and systems shall be maintainable by operational staff and shall not be of a proprietary nature, OEM parts list shall be locally available.

5.4.8.10.3 Snowmelt manifolds and other equipment that requires ongoing maintenance shall be designed to allow for access without interrupting the flow of customers to platforms and trains.

5.4.8.10.4 All manifold covers to have lift assist and 'hold open' arms. Safe operation by a single staff member may be required, air shocks should be utilized when available.

5.4.8.11 Boiler rooms shall not be placed below grade and shall conform to Metrolinx Standards and be designed to comply with all electrical and plumbing codes. Large ancillary service rooms (i.e. boiler room(s), main electrical room(s), main communication room(s), mechanical room(s)) located along side platforms shall be setback from the tracks such that flagging would not be required when maintenance and servicing work is occurring in these rooms (i.e. equipment removals and replacements). It is the responsibility of the designer/consultant to understand the flagging requirements per project basis and coordinate the location of the service rooms.

5.5 Fixtures and Furnishings

5.5.1 Digital Signs at Line Stations, Terminals and Carpool Lots

5.5.1.1 Suite of sign types:

a) Digital Departure Signs (Train and/or Bus);
b) Digital Platform Specific Signs (Train or Bus);
c) Digital Parking Counter;
d) Digital Wayfinding Interactive Kiosks (TBD);
e) Infotainment.

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5.5.1.2 Digital Departure Signs (Train and/or Bus)

5.5.1.2.1 Location Criteria – Digital Departure Sign (Train and/or Bus) shall be located at:

a) Inside Station/Terminal buildings, adjacent to waiting area; mounted at barrier free height as per OBC and AODA regulations;

b) At Rail Platform Access Points (platform access area, entrances to tunnels, bridges, parking structures, side platforms – via ramp and/or walk-on);

c) At Primary Bus Loop Access Point(s);

d) At Car Pool Lots shall be located at remote parking lot locations (at GO's discretion).

5.5.1.2.2 Placement & Appearance Criteria

a) Information and Service Modules to be used for interior and exterior applications, with modules adjusted as required, based on site conditions (in consultation with GO);

b) For exterior applications, integrate within building envelope where possible and provide weather protection i.e. building canopy;

c) Provide independent weather protection if integration with building canopy is not possible (in consultation with GO);

d) Where an Information or Service Module cannot be established due to site conditions, consider suspending the screen from underside of canopy. At remote locations consider implementing the concept of the suite of shelters;

e) At car pool lots, integrate into car pool shelter;

f) Where possible recess eye-level digital signs into walls to prevent potential injuries. Install such that face of screen is flush with adjacent surfaces. Ensure entire screen is visible from all angles. Conceal all conduits, connections and infrastructure.

5.5.1.2.3 Monitor Size - Use current I&IT standard

5.5.1.2.4 Number of Monitors

a) Minimum one Digital Departure Sign for Train, plus one for Bus, or one combination Train and Bus Digital Sign (confirm with GO)

b) For larger sites with significant service, confirm number of monitors for each of the above with GO.

5.5.1.3 Digital Platform Specific Signs (Train or Bus)

5.5.1.3.1 Location Criteria - Rail

a) Island Platforms: three sets of back to back Digital Platform Specific Signs (Train) at each track used by GO;

b) Side Platforms: three sets of back to back Digital Platform Specific Signs (Train) at each track used by GO;

c) Avoid clustering of digital signs in close proximity; Digital Departure Sign locations take precedence over Digital Platform Specific Signs;

d) Always locate one set of Digital Platform Specific Signs at mini platform and the other two equally spaced;

e) Digital Platform Specific Signs should be mounted to underside of rail platform canopy;

f) Ensure digital screens are outside of train envelopes.

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5.5.1.3.2 Location Criteria - Bus

a) At each bus platform at Line Stations, Bus Terminals and Car Pool Lots: one set of back to back Digital Platform Specific Signs (Bus);
b) Locate digital signs consistently at driver end of each platform, outside of road envelope;
c) Mount Digital Platform Specific Signs from underside of canopy, where possible. If not possible, use standard GO pole. Ensure poles are away from the barrier-free path of travel.

5.5.1.3.3 Placement & Appearance Criteria

a) Follow GO standard drawings for poles and canopy mounts;
b) At rail platforms, place static platform number on track side;
c) At bus platforms, place static platform number on road side.

5.5.1.3.4 Monitor Type/Size

LED type (Use current I&IT standard)

5.5.1.3.5 Number of Monitors

Set of two screens, back-to-back, at each location.

5.5.1.4 Digital Parking Counter

5.5.1.4.1 Location Criteria - At vehicular entrance(s) to parking structures, visible when approaching by road

5.5.1.4.2 Appearance - The look and feel to be integrated with GO Station ID Totem suite.

5.5.1.5 Technical Requirements

5.5.1.5.1 Process Requirements:

a) The digital signs will be supplied, commissioned and maintained by Information and Information Technology (I&IT), except for the Digital Parking Counter. I&IT will install the PCs, routers, and switches in the communications room;
b) Capital Project Delivery will perform the physical installation of the monitor, power cabling, and data cabling to the monitors from the communications rooms;
c) Screens and digital media players (DMP's), CPU's to be provided by IT and installed by the Contractor. Pick up from storage to be by Contractor;
d) Transceivers, cabling terminations, communication room racks, and all civil work (conduits, pulling of wiring, pole footings, pole structure, mountings, NEMA boxes, etc.) to be by the Contractor;
e) Fully installed and tested solution by the Contractor;
f) Commissioning by the Contractor in coordination with IT and Station Operations.

5.5.1.5.2 Technical Design Requirements:

a) Each Digital Sign location must be shown on the electrical drawings and must include data and electrical outlet locations as well as any enclosures or other infrastructure associated with these signs:

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1) Monitors: (Use current IT standard);
2) Digital Media Player (DMP):(Use current IT standard).

b) Contractor to provide transceivers/receivers, associated with cabling type and the balance of digital sign components. Provide receivers with minimal profile; by Extron or approved equivalent – reference products:
1) Extron DTP HDMI 4K 330 Transmitter/ Receiver for shielded cable;
2) Extron HFX 100 Transmitter/Receiver for fiber.

c) Poles and mounting standards – refer to digital signage location criteria and requirements; GO pole conceptual design drawings under development. Shop drawings to be developed by the Contractor in coordination with digital signage equipment.

5.5.1.5.3 Connectivity Requirements:

a) Each of these devices requires a minimum of one CAT6 network outlet. These network outlets are to be cabled back to the nearest telecommunications room network rack and terminated as per the copper horizontal cabling standard;
b) CAT6 shielded cable for devices placed within 90m from the Communications (Hub) Room;
c) Multimode 6 strand fiber for installation beyond the 90m mark.

5.5.1.5.4 NEMA Enclosure Requirements:

a) NEMA enclosures shall be provided for receivers and fiber terminations at digital screens;
b) NEMA/EEMAC Type 4X IP-65 with solid door capable to accept box lock requested by IT Field Services, and physically separated into two compartments to isolate power from communications devices;
c) BEL R SS Series EEMAC/NEMA 4-4x-12 / IP-65 or Hoffman CONCEPTTM Type 4x or any other box meeting NEMA Type 4X IP-65, physical separation capabilities and box lock requirements;
d) The enclosure size selection shall be based on the electrical and electronic equipment to be housed inside the box;
e) All NEMA enclosures to be concealed within poles or finishes adjacent to screens. Visible NEMA boxes shall not be accepted. Provide access to concealed NEMA boxes. Do not drill or perforate the integrity of the NEMA box in any manner.

5.5.1.5.5 Conduit Requirements:

a) One 53mm conduit for power and separate 53mm conduit for data from the communications (hub) room all the way to the last pull point before the device; from the last pull use 25mm conduit to the device;
b) Follow DRM in terms of conduit selection (PVC for buried conduit, RGSEC (Rigid Galvanized Steel Epoxy Coated at the factory) for all exposed locations such as tunnels, etc); 53mm liquid-tight conduits from the NEMA enclosure to the monitor mounting bracket. Provided with drip loops and easy release on the NEMA enclosure side;
c) All conduits and connections to be concealed within poles or adjacent finishes.

5.5.1.5.6 Power Requirements:

a) Dedicated single 5-20R duplex receptacles shall be used;
b) Outdoor locations require sizing based on external enclosure and screen power draws.

Superseded

All receptacles must be GFI Type which may be reset at the NEMA enclosure. This is to be coordinated at time of design and must adhere to DRM. All field assembled equipment installed in any NEMA box shall have final accredited certification as approved for use from the appropriate authority;

c) All devices shall be UPS backed-up. If the existing UPS does not provide enough capacity or if there is no UPS whatsoever, provide a Surge Protection Device in the local panel where the monitor and DMP is fed from. This device shall be appropriate for the specific panel at each location.

5.5.1.5.7 Data Requirements:

a) DMP's to be placed in Communication (Hub) Rooms;
b) Assume one DMP per digital display. (confirm with IT);
c) For design assumptions, use Cisco Interactive Experience Client 4650.

5.5.2 Fare Systems

5.5.2.1 Fare handling machines are proprietary equipment and will be provided and installed by the appropriate supplier. Consultants shall meet with GO Transit staff to ensure the required facilities needed to operate these machines, e.g., power, are provided.

5.5.2.2 The following equipment identified below are typical fare handling devices:

a) "Interac", etc. (including data polling, Station Control Computer (SCC), Debit and Credit equipment;
b) Smart Card equipment PRESTO;
c) Ticket Vending Machines (TVMs).

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5.5.3 PRESTO Overview

5.5.3.1 Presto Fare Handling System is a smartcard-based fare payment system designed to support the use of one common fare card for fare payment on various participating public transit systems.

5.5.3.2 PRESTO equipment is proprietary, provided, and installed by the appropriate supplier, and comprises:

a) SPOS (Station Point of Sale)–located on the Service Counters;
b) SFTP (Station Fare Transaction Processor);
c) CQD (Card Query Device);
d) HCR (Handheld Card Reader) and the HCR Cradles–located in Safety Systems Offices;
e) WAP (Wireless Access Points)–located at bus facilities;
f) CC (Concentrator Complex)–installed in main racks;
g) AVM's (Add Value Machines).

5.5.3.3 Location

5.5.3.3.1 Devices may be located either in the station building, on the platforms, at access points to platforms (tunnels, pedestrian bridges, walkways, stairs, ramps, etc)

5.5.3.4 General Placement Criteria:

a) Placement of devices and way-finding signage is site specific;
b) Devices shall be placed to avoid work within the Structure Clearance Envelope on/or beside Railway Track;
c) Bus Terminal locations require CQDs and SPOSs and TVM's; all fare collecting equipment is located on the bus;
d) Minimum clearance of 500 mm between two adjacent devices shall be maintained;
e) Devices shall not impede accessible clearances and accessible routes.

5.5.3.5 SFTP Placement Criteria:

a) Devices shall be placed at all rail platform access points. Devices shall be placed maximum 75 m apart at locations with direct parking lot to rail platform access;
b) Devices shall be placed along passenger natural flow, at clear and visible locations, and shall be readily accessible by Cardholders for fare payment;
c) Remote locations shall be provided with two (2) devices on different circuits, to provide redundancy in case of power failure.

5.5.3.6 CQD Placement Criteria:

a) Shall be located outside the passenger flow, near TVM and/or Information Board/Digital Station Information Signs;
b) Refer to Standard Drawings for Presto System Architecture and installation details.

5.5.3.7 Ticket Vending Machines (TVM) at Line Stations, Terminals and Carpool Lots

5.5.3.7.1 Placement Philosophy - Each Rail Line Station and GO Bus Terminal shall provide, when possible a minimum of 2 TVM at the following mandatory locations:

a) 1 TVM located within the vicinity of the station building. If no station building is provided,

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1 TVM will be placed at main entrance to platform (as per site conditions) along the Barrier free path of travel in such a way that the path remains barrier free;

b) 1 TVM to be located at an additional platform access point.

5.5.3.7.2 Additional TVM's locations to be considered at the following pedestrian access points for the following areas within Rail Line and Bus Station sites:

a) Main Bus Loop/Platform;
b) Parking Structure;
c) Pedestrian bridge, mid span, as site conditions allow;
d) Satellite surface parking lot;
e) Any additional areas as determined by GO Design Standards staff;
f) Park and Ride Facilities may be provided 1 TVM located on passenger platform adjacent to the shelter where power and communication infrastructure is available.

5.5.3.7.3 TVM Configuration Criteria:

a) When site configuration allows, it is encouraged to locate TVM's that satisfy both mandatory and preferred locations. The intention is to maximize TVM accessibility and convenience to customers with the use of a single TVM. The TVM must be visible from main entrance and located where there is a high volume of passengers. Ensure that placement does not block major egress locations;
b) Location of TVM to be coordinated with the location of CDQ tower, S4 Digital Information Sign, and the SFTP tower where possible;
c) When a cluster of all 4 devices is possible, the TVM and CQD shall be placed adjacent to each other;
d) A minimum 500 mm horizontal clearance is required between the CQD and the TVM;
e) TVM to be weather sheltered where possible;
f) Preference is for a shelter over the TVM;
g) TVM's are to utilize sunshade top (both large and smaller sized sunshades) as site conditions warrant where a full shelter is not possible;
h) A minimum queuing space in front of TVM shall be three customers;
i) Queuing space shall be increased based on historical peak station demand information provided by GO staff;
j) Placement and orientation of TVM's and queuing areas shall not adversely impact the main flow of customers;
k) TVM concrete base installation details as per GO Standard Drawings TVM-001, TVM-002 and TVM-003;
l) TVM Electrical and Communication details as per Electrical and Communications sections.

5.5.4 Two Way Intercom

5.5.4.1 Design Requirements – General

5.5.4.1.1 The Two Way communication device is a customer service amenity, which assists customers with inquiries at rail station site to provide an enhanced customer service amenity at our platforms, elevators, parking structures, universal washrooms and maintenance facilities.

5.5.4.1.2 Two Way Communication Devices shall be placed at the following locations at a typical GO

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Rail station site:

a) At each elevator lobby on site including tunnels, pedestrian bridges and parking structures (new device technology to address current technical and operational issues);
b) In the vicinity of the Mini platform (to replace existing Bell telephones);
c) In all universal washrooms;
d) Secure entrance points for GO Operational Facilities;
e) In each elevator cab;
f) At each Carpool/Park and Ride site;

5.5.4.1.3 The Call flow shall be made to service attendant with call backup available 24/7 by Transit Safety.

5.5.4.1.4 Refer GO Standard Specifications for detailed two way communication device requirements.

5.5.5 Elevators

5.5.5.1 The requirements do not constitute a project specification. Each project shall have its own specification based upon the GO Master Elevator Performance Specification.

5.5.5.2 Variance requests shall be supported by an explanation of the reason for the deviation and detailed information on the proposed alternative.

5.5.5.3 Important: Refer to Metrolinx Standard Elevator Performance Specification 14 20 06 for details.

5.5.5.4 Configuration requirements are:

a) GO Transit elevators shall be Machine-Room-Less (MRL) elevator type;
b) Generator standby power shall be provided to permit continued operation of the elevator(s);
c) All electric elevators shall be provided with their own back-up battery power system;
d) All elevators shall be provided with battery powered emergency lighting;
e) All serviceable equipment, not directly connected to elevator operation, shall be serviceable from the exterior of the shaft.

5.5.5.5 Communications requirements are:

a) All elevators shall have CCTV camera mounted inside elevator cab;
b) Camera mounted in vestibules and lobbies shall view inside and outside of each elevator at each level;
c) All elevators shall have a two-way emergency call system.
d) All elevators banks shall have a two-way call device located beside each elevator bank on all floors serviced by the elevators.
e) All elevators shall have an internally located Emergency Call system. The Emergency Call shall meet all Metrolinx Elevator Performance Specifications providing Emergency Call system 8-hour window of operation.

5.5.5.6 Heating requirements are:

a) Fan forced heater with built-in thermostat;
b) Heat Pump with hyper heating capability down to -25°C, ducted type and located outside

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the hoistway.

5.5.5.7 Air Conditioning requirements are:

a) Air conditioning via Heat Pump type A/C unit with low ambient cooling;
b) All elevators shafts shall be provided with heating and air conditioning systems.

5.5.5.8 Floor Grille

5.5.5.8.1 Constructed from stainless steel and shall be designed for cleanout by one person, unaided.

5.5.5.9 Elevator Numbering Convention

a) Elevators north of the tracks shall be assigned numbers first (if not applicable, east side of track shall be first);
b) Elevators serving platforms shall be numbered in a sequence following platform numbers being served (i.e. platform one first, followed by subsequent platforms);
c) Elevator groups serving a parking structure to be numbered in one sequence.

6 Heavy Rail

For Heavy Rail, the reference should be made to the GO Transit Track Standards and GO Transit Track Standard Plans.

7 Information Technology; Telecommunication & Systems

For all IT Telecommunication and Systems requirements refer to the I&IT Telecommunication and Systems Standards.

8 Appendix A – LEED Mandatory Credits

8.1 How to Use the GO LEED Mandatory Credit Checklist

8.1.1 Mandatory credits have been established for each building type to ensure that credits that are important to GO Transit's goals of energy efficiency and reduced operating and maintenance costs are targeted, integrated into the design early and achieved.

8.1.2 Designers shall incorporate LEED certification and the GO Transit Mandatory credits into each project's scope of work. For projects pursuing certification under LEED v.4, Gold certification is preferred, Silver certification is the minimum requirement and shall follow LEED v.4 mandatory credit tables. Projects that qualify for LEED 2009 shall attain LEED Gold certification and follow LEED 2009 mandatory credit tables. LEED has five key areas under which credits are obtained. These are:

a) Sustainable Sites;

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b) Water Efficiency;
c) Energy & Atmosphere;
d) Materials & Resources; and
e) Indoor Environmental Quality;
f) The operation of VOIP phone shall automatically select independent user- defined ‘group’ zones.

8.1.3 Each area has Prerequisites that the project must achieve in order to consider going for LEED certification, these are non-negotiable. There is also an Innovation & Design section where innovative systems not accounted for elsewhere, exemplary performance and operational procedures can be considered for a credit. Each credit is worth anywhere from one to nineteen points, the number of points obtained determines the LEED rating achieved.

8.1.4 In order to achieve LEED Gold certification, anywhere between sixty (60) and seventy nine (79) points must be granted by the Canadian Green Building Council (CaGBC). It is recommended that sixty five points are targeted on each project pursuing Gold certification since the CaGBC is the final arbiter on which points are granted, so some points may be lost.

8.1.5 The GO LEED credit checklists that follow indicate the Prerequisites and GO Transit Mandatory credits which must be targeted and achieved. There are additional columns indicating optional points for consideration from which the shortfall can be made, credits that are not to be pursued are also identified in the checklist.

8.2 LEED v.4 Mandatory Credits

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Table 59: Appendix A – LEED v.4 Mandatory Credits for GO Stations

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Mandatory	Optional	Not to be Pursued	Project Totals (pre-certification estimates): 110 Points Certified: 40-49 points Silver: 50-59 points Gold: 60-79 points Platinum: 80 points and above	Available Points
37	53	20		110
0	1	0	INTEGRATIVE PROCESS (IP)	1
0	1	0	Integrative Process	1

0	14	2	LOCATION AND TRANSPORTATION (LT)	16
0	0	16	LEED for Neighborhood Development Location	16
0	1	0	Sensitive Land Protection	1
0	2	0	High-Priority Site	2
0	5	0	Surrounding Density and Diverse Uses	5
0	5	0	Access to Quality Transit	5
0	0	1	Bicycle Facilities	1
0	0	1	Reduced Parking Footprint	1
0	1	0	Green Vehicles	1

1	9	0	SUSTAINABLE SITES (SS)	10
PREREQUISITE			Construction Activity Pollution Prevention	
0	1	0	Site Assessment	1
0	2	0	Site Development - Protect or Restore Habitat	2
0	1	0	Open Space	1
0	3	0	Rainwater Management	3
0	2	0	Heat Island Reduction	2
1*	0	0	Light Pollution Reduction	1

Superseded

6	3	2	WATER EFFICIENCY (WE)	11
PREREQUISITE			Outdoor Water Use Reduction	
PREREQUISITE			Indoor Water Use Reduction	
PREREQUISITE			Building-Level Water Metering	
2	0	0	Outdoor Water Use Reduction	2
3	3	0	Indoor Water Use Reduction	6
0	0	2	Cooling Tower Water Use	2
1	0	0	Water Metering	1

* Recognition that in some situations this is not applicable. If credit not targeted, consultant to demonstrate why it cannot be achieved.

15	8	10	ENERGY & ATMOSPHERE (EA)	33
PREREQUISITE			Fundamental Commissioning and Verification	
PREREQUISITE			Minimum Energy Performance	
PREREQUISITE			Building Level Metering	
PREREQUISITE			Fundamental Refrigerant Management	
6	0	0	Enhanced Commissioning	6
7	3	8	Optimize Energy Performance	18
1	0	0	Advanced Energy Metering	1
0	0	2	Demand Response	2
0	3	0	Renewable Energy Production	3
1	0	0	Enhanced Refrigerant Management	1
0	2	0	Green Power and Carbon Offsets	2

5	3	5	MATERIALS & RESOURCES (MR)	13

Superseded

PREREQUISITE			Storage & Collection of Recyclables	
PREREQUISITE			Construction and Demolition Waste Management Planning	
0	3	2	Building Life-Cycle Impact Reduction	5
1	0	1	Building Product Disclosure and Optimization - Environmental Product Declarations	2
1	0	1	Building Product Disclosure and Optimization - Sourcing of Raw Materials	2
1	0	1	Building Product Disclosure and Optimization - Material Ingredients	2
2	0	0	Construction and Demolition Waste Management	2

6	9	1	INDOOR ENVIRONMENTAL QUALITY (EQ)	16
PREREQUISITE			Minimum Indoor Air Quality Performance	
PREREQUISITE			Environmental Tobacco Smoke (ETS) Control	
0	2	0	Enhanced Indoor Air Quality Strategies	2
2	1	0	Low-Emitting Materials	3
1	0	0	Construction IAQ Management Plan	1
0	2	0	Indoor Air Quality Assessment	2
1	0	0	Thermal Comfort	1
2	0	0	Interior Lighting	2
0	2	1	Daylight	3
0	1	0	Quality Views	1
0	1	0	Acoustic Performance	1

4	2	0	INNOVATION (IN)	6
3	2	0	Innovation	5
1	0	0	LEED Accredited Professional	1

Superseded

0	4	0	REGIONAL PRIORITY (RP)	4
0	4	0	Regional Priority Credit	4

Table 60: Appendix A – LEED v.4 Mandatory Credits for GO Maintenance Facilities

Superseded

Mandatory	Optional	Not to be Pursued	Project Totals (pre-certification estimates): 110 Points Certified: 40-49 points Silver: 50-59 points Gold: 60-79 points Platinum: 80 points and above	Available Points
38	61	11		110
0	1	0	INTEGRATIVE PROCESS (IP)	1
0	1	0	Integrative Process	1
1	15	0	LOCATION AND TRANSPORTATION (LT)	16
0	0	16	LEED for Neighborhood Development Location	16
0	1	0	Sensitive Land Protection	1
0	2	0	High-Priority Site	2
0	5	0	Surrounding Density and Diverse Uses	5
0	5	0	Access to Quality Transit	5
0	1	0	Bicycle Facilities	1
0	1	0	Reduced Parking Footprint	1
1	0	0	Green Vehicles	1
2	8	0	SUSTAINABLE SITES (SS)	10
PREREQUISITE			Construction Activity Pollution Prevention	
0	1	0	Site Assessment	1
0	2	0	Site Development - Protect or Restore Habitat	2
1	0	0	Open Space	1
0	3	0	Rainwater Management	3
0	2	0	Heat Island Reduction	2
1	0	0	Light Pollution Reduction	1

Superseded

5	6	0	WATER EFFICIENCY (WE)	11
PREREQUISITE			Outdoor Water Use Reduction	
PREREQUISITE			Indoor Water Use Reduction	
PREREQUISITE			Building-Level Water Metering	
2	0	0	Outdoor Water Use Reduction	2
2	4	0	Indoor Water Use Reduction	6
0	2	0	Cooling Tower Water Use	2
1	0	0	Water Metering	1

15	15	3	ENERGY & ATMOSPHERE (EA)	33
PREREQUISITE			Fundamental Commissioning and Verification	
PREREQUISITE			Minimum Energy Performance	
PREREQUISITE			Building Level Metering	
PREREQUISITE			Fundamental Refrigerant Management	
6	0	0	Enhanced Commissioning	6
7	8	3	Optimize Energy Performance	18
1	0	0	Advanced Energy Metering	1
0	2	0	Demand Response	2
0	3	0	Renewable Energy Production	3
1	0	0	Enhanced Refrigerant Management	1
0	2	0	Green Power and Carbon Offsets	2

5	3	5	MATERIALS & RESOURCES (MR)	13

Superseded

PREREQUISITE			Storage & Collection of Recyclables	
PREREQUISITE			Construction and Demolition Waste Management Planning	
0	3	2	Building Life-Cycle Impact Reduction	5
1	0	1	Building Product Disclosure and Optimization - Environmental Product Declarations	2
1	0	1	Building Product Disclosure and Optimization - Sourcing of Raw Materials	2
1	0	1	Building Product Disclosure and Optimization - Material Ingredients	2
2	0	0	Construction and Demolition Waste Management	2

6	7	3	INDOOR ENVIRONMENTAL QUALITY (EQ)	16
PREREQUISITE			Minimum Indoor Air Quality Performance	
PREREQUISITE			Environmental Tobacco Smoke (ETS) Control	
0	2	0	Enhanced Indoor Air Quality Strategies	2
2	1	0	Low-Emitting Materials	3
1	0	0	Construction IAQ Management Plan	1
0	2	0	Indoor Air Quality Assessment	2
1	0	0	Thermal Comfort	1
1	1	0	Interior Lighting	2
1	0	2	Daylight	3
0	0	1	Quality Views	1
0	1	0	Acoustic Performance	1

4	2	0	INNOVATION (IN)	6
3	2	0	Innovation	5

Superseded

1	0	0	LEED Accredited Professional	1

0	4	0	REGIONAL PRIORITY (RP)	4
0	4	0	Regional Priority Credit	4

8.3 LEED 2009 Mandatory Credits

Superseded

Table 61: Appendix A – LEED 2009 Mandatory Credits for GO Stations

Superseded

Mandatory	Optional	Not to be Pursued	Project Totals (pre-certification estimates): 110 Points Certified: 40-49 points Silver: 50-59 points Gold: 60-79 points Platinum: 80 points and above		Available Points
47	57	8			110
7	**17**	**2**	**SS**	**SUSTAINABLE SITES**	**26**
PREREQUISITE			SSp1	Construction Activity Pollution Prevention	
	1		SSc1	Site Selection	1
	5		SSc2	Development Density & Community Connectivity	5
	1		SSc3	Brownfield Redevelopment	1
6			SSc4.1	Alternative Transportation, Public Transportation Access	6
		1	SSc4.2	Alternative Transportation, Bicycle Storage & Changing Rooms	1
	3		SSc4.3	Alternative Transportation, Low-Emitting & Fuel Efficient Vehicles	3
	2		SSc4.4	Alternative Transportation Parking Capacity	2
	1		SSc5.1	Site Development, Protect or Restore Habitat	1
		1	SSc5.2	Site Development, Maximize Open Space	1
	1		SSc6.1	Stormwater Design, Quantity Control	1
	1		SSc6.2	Stormwater Design, Quality Control	1
	1		SSc7.1	Heat Island Effect, Non-Roof	1
1			SSc7.2	Heat Island Effect, Roof	1
	1		SSc8	Light Pollution Reduction	1

7	**3**	**0**	**WE**	**WATER EFFICIENCY**	**10**
PREREQUISITE			WEp1	Water Use Reduction	

Superseded

4			WEc1	Water Efficient Landscaping	4
	2		WEc2	Innovative Wastewater Technologies	2
3	1		WEc3	Water Use Reduction	4

14	**17**	**4**	**EA**	**ENERGY & ATMOSPHERE**	**35**
PREREQUISITE			EAp1	Fundamental Commissioning of Building Energy Systems	
PREREQUISITE			EAp2	Minimum Energy Performance	
PREREQUISITE			EAp3	Fundamental Refrigerant Management	
7	12		EAc1	Optimized Energy Performance	19
	3	4	EAc2	On-Site Renewable Energy	7
2			EAc3	Enhanced Commissioning	2
2			EAc4	Enhanced Refrigerant Management	2
3			EAc5	Measurement & Verification	3
	2		EAc6	Green Power	2

7	**6**	**1**	**MR**	**MATERIALS & RESOURCES**	**14**
PREREQUISITE			MRp1	Storage & Collection of Recyclables	
	3		MRc1.1	Building Reuse: Maintain Existing Walls, Floors, Roof	3
	1		MRc1.2	Building Reuse: Maintain Interior Non-Structural Elements	1
2			MRc2	Construction Waste Management	2
	2		MRc3	Materials Reuse	2
2			MRc4	Recycled Content	2
2			MRc5	Regional Materials	2

Superseded

		1	MRc6	Rapidly Renewable Materials	1
1			MRc7	Certified Wood	1

8	**6**	**1**	**EQ**	**INDOOR ENVIRONMENTAL QUALITY**	**15**
PREREQUISITE			EQp1	Minimum Indoor Air Quality Performance	
PREREQUISITE			EQp2	Environmental Tobacco Smoke Control	
	1		EQc1	Outdoor Air Delivery Monitoring	1
		1	EQc2	Increased Ventilation	1
1			EQc3.1	Construction IAQ Management Plan, During Construction	1
	1		EQc3.2	Construction IAQ Management Plan, Before Occupancy	1
1			EQc4.1	Low Emitting Materials, Adhesives & Sealants	1
1			EQc4.2	Low Emitting Materials, Paints and Coatings	1
1			EQc4.3	Low Emitting Materials, Flooring Systems	1
1			EQc4.4	Low Emitting Materials, Composite Wood & Laminate Adhesives	1
	1		EQc5	Indoor Chemical & Pollutant Source Control	1
1			EQc6.1	Controllability of System: Lighting	1
	1		EQc6.2	Controllability of System: Thermal Comfort	1
1			EQc7.1	Thermal Comfort, Design	1
	1		EQc7.2	Thermal Comfort, Verification	1
1			EQc8.1	Daylight & Views, Daylight	1
	1		EQc8.2	Daylight & Views, Views	1

4	**4**	**0**	**ID**	**INNOVATION & DESIGN PROCESS**	**6**
1			IDc1.1	Innovation in Design: Green Housekeeping	1

Superseded

1			IDc1.2	Innovation in Design: Solid Waste Management Policy	1
1			IDc1.3	Innovation in Design: Green Education	1
	1		IDc1.4	Innovation in Design: Low Mercury Lamps	1
	1		IDc1.5	Innovation in Design: Exemplary Performance SSc4.1 or other	1
	1			Innovation in Design: Process Water Reuse, vehicle wash (if applicable)	
	1			Innovation in Design: TBD	
1			IDc2	LEED AP	1

0	**4**	**0**	**RP**	**REGIONAL PRIORITY**	**4**
	1		RP1	Durable Building	1
	1		RP2.1	Regional Priority Credit 1	1
	1		RP2.2	Regional Priority Credit 2	1
	1		RP2.3	Regional Priority Credit 3	1

Table 62: Appendix A - LEED 2009 Mandatory Credits for GO Maintenance Facilities

Superseded

Mandatory	Optional	Not to be Pursued	Project Totals (pre-certification estimates): 110 Points Certified: 40-49 points Silver: 50-59 points Gold: 60-79 points Platinum: 80 points and above		Available Points
47	57	8			110
8	**17**	**1**	**SS**	**SUSTAINABLE SITES**	**26**
PREREQUISITE			SSp1	Construction Activity Pollution Prevention	
	1		SSc1	Site Selection	1
	5		SSc2	Development Density & Community Connectivity	5
	1		SSc3	Brownfield Redevelopment	1
3	3		SSc4.1	Alternative Transportation, Public Transportation Access	6
1			SSc4.2	Alternative Transportation, Bicycle Storage & Changing Rooms	1
3			SSc4.3	Alternative Transportation, Low-Emitting & Fuel Efficient Vehicles	3
	2		SSc4.4	Alternative Transportation Parking Capacity	2
	1		SSc5.1	Site Development, Protect or Restore Habitat	1
		1	SSc5.2	Site Development, Maximize Open Space	1
	1		SSc6.1	Stormwater Design, Quantity Control	1
	1		SSc6.2	Stormwater Design, Quality Control	1
	1		SSc7.1	Heat Island Effect, Non-Roof	1
1			SSc7.2	Heat Island Effect, Roof	1
	1		SSc8	Light Pollution Reduction	1

7	**3**	**0**	**WE**	**WATER EFFICIENCY**	**10**
PREREQUISITE			WEp1	Water Use Reduction	
4			WEc1	Water Efficient Landscaping	4

Superseded

	2		WEc2	Innovative Wastewater Technologies	2
3	1		WEc3	Water Use Reduction	4

14	**17**	**4**	**EA**	**ENERGY & ATMOSPHERE**	**35**
PREREQUISITE			EAp1	Fundamental Commissioning of Building Energy Systems	
PREREQUISITE			EAp2	Minimum Energy Performance	
PREREQUISITE			EAp3	Fundamental Refrigerant Management	
7	12		EAc1	Optimized Energy Performance	19
	3	4	EAc2	On-Site Renewable Energy	7
2			EAc3	Enhanced Commissioning	2
2			EAc4	Enhanced Refrigerant Management	2
3			EAc5	Measurement & Verification	3
	2		EAc6	Green Power	2
7	**6**	**1**	**MR**	**MATERIALS & RESOURCES**	**14**
PREREQUISITE			MRp1	Storage & Collection of Recyclables	
	3		MRc1.1	Building Reuse: Maintain Existing Walls, Floors, Roof	3
	1		MRc1.2	Building Reuse: Maintain Interior Non-Structural Elements	1
2			MRc2	Construction Waste Management	2
	2		MRc3	Materials Reuse	2
2			MRc4	Recycled Content	2
2			MRc5	Regional Materials	2
		1	MRc6	Rapidly Renewable Materials	1

Superseded

1			MRc7	Certified Wood	1

7	**6**	**2**	**EQ**	**INDOOR ENVIRONMENTAL QUALITY**	**15**
PREREQUISITE			EQp1	Minimum Indoor Air Quality Performance	
PREREQUISITE			EQp2	Environmental Tobacco Smoke Control	
		1	EQc1	Outdoor Air Delivery Monitoring	1
		1	EQc2	Increased Ventilation	1
1			EQc3.1	Construction IAQ Management Plan, During Construction	1
	1		EQc3.2	Construction IAQ Management Plan, Before Occupancy	1
1			EQc4.1	Low Emitting Materials, Adhesives & Sealants	1
1			EQc4.2	Low Emitting Materials, Paints and Coatings	1
1			EQc4.3	Low Emitting Materials, Flooring Systems	1
1			EQc4.4	Low Emitting Materials, Composite Wood & Laminate Adhesives	1
	1		EQc5	Indoor Chemical & Pollutant Source Control	1
1			EQc6.1	Controllability of System: Lighting	1
	1		EQc6.2	Controllability of System: Thermal Comfort	1
	1		EQc7.1	Thermal Comfort, Design	1
	1		EQc7.2	Thermal Comfort, Verification	1
1			EQc8.1	Daylight & Views, Daylight	1
	1		EQc8.2	Daylight & Views, Views	1
4	**4**	**0**	**ID**	**INNOVATION & DESIGN PROCESS**	**6**
1			IDc1.1	Innovation in Design: Green Housekeeping	1

Superseded

1			IDc1.2	Innovation in Design: Solid Waste Management Policy	1
1			IDc1.3	Innovation in Design: Green Education	1
	1		IDc1.4	Innovation in Design: Low Mercury Lamps	1
	1		IDc1.5	Innovation in Design: Exemplary Performance SSc4.1 or other	1
	1			Innovation in Design: Process Water Reuse, vehicle wash (if applicable)	
	1			Innovation in Design: TBD	
1			IDc2	LEED AP	1

0	**4**	**0**	**RP**	**REGIONAL PRIORITY**	**4**
	1		RP1	Durable Building	1
	1		RP2.1	Regional Priority Credit 1	1
	1		RP2.2	Regional Priority Credit 2	1
	1		RP2.3	Regional Priority Credit 3	1

Superseded

9 Appendix B

9.1 Site Components and Typical Schematic Layout

9.1.1 Accessible Route

The accessible route is defined as a continuous unobstructed external and internal path connecting all accessible elements and spaces to enable personal barrier free mobility.

At GO facilities, the accessible route is identified as the travel path to/from/between the barrier free parking or drop off area, to the rail mini platform / bus platform.

9.1.2 Redundant Access

Provide a secondary barrier-free means of access/egress from the rail platform to the station building or pick-up area.

All island platforms shall be equipped with two elevators connecting to an underground pedestrian tunnel or an overhead pedestrian bridge.

Side platforms shall have various direct access points where covered ramps are the preferred means of egress.

9.1.3 Mini-Platform

Barrier-free access to the trains is provided by an accessible elevated “mini-platform” which is aligned with the designated accessible rail car. Refer to Standard Drawings for mini-platform details.

9.1.4 Designated Waiting Area (DWA)

The Designated Waiting Area (DWA) at GO stations is to be located on the rail mini-platform.

It is intended to be a convenience feature, whereby a customer can expect to avail assistance and have a reasonable sense of safety.

The DWA has augmented functionality and visibility at the station mini-platform. Key features include:

- Enhanced lighting
- Dedicated CCTV coverage
- Signage
- Two-way communications device
- PA system
- Overhead cover (canopy)
- Bench seating on rail platform in the proximity of the DWA
- Enhanced accessibility features in the mini-platform design
- Wayfinding signs on the accessible route
- Station ID sign
- Minimum horizontal and vertical clearances as mandated by functionality; and advanced warning identifiers.

Superseded

9.2 Rail Platform and Platform Access

Refer to respective GO Transit Track Standards for track standards.

Rail platforms are a foundational item to GO rail stations. Their orientation, design, alignment, geometry, and site conditions are the framework around which all other site components are configured.

- The use of side platforms is preferred
- Island platforms to allow for multiple points of access and egress
- Locate the platforms to minimize travel distances to adjacent transit modes and barrier-free path of travel.
- Where there are reduced width locations, include warning pavement markings and signage

When locating and orienting the mini-platform the steps outlined below shall be followed:

Step 1–Orient mini-platform, with an understanding of train consist orientation and operation

Step 2–Locate mini-platform and rail platform dimension, dependent on island vs. side platform configuration in accordance with criteria and specifications and subsequent tables.

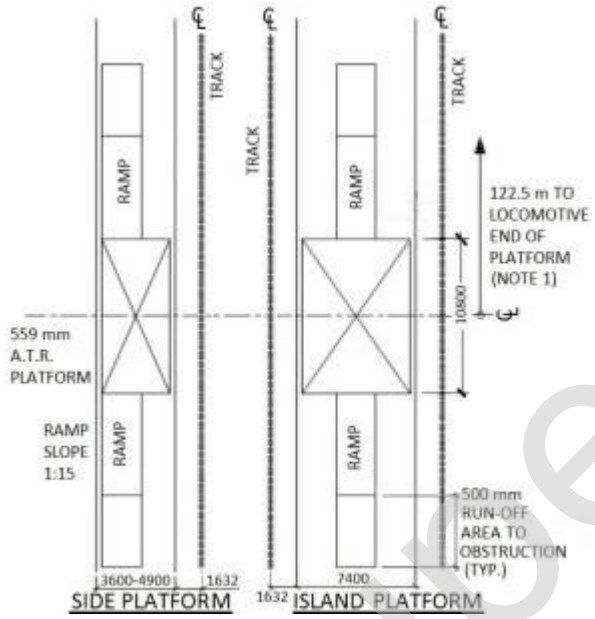


Figure 1: Typical Configuration of Mini Platforms

Note 1: The Locomotives are at the east end in Union Station. Refer to Locomotive Orientation Figure 2

Superseded

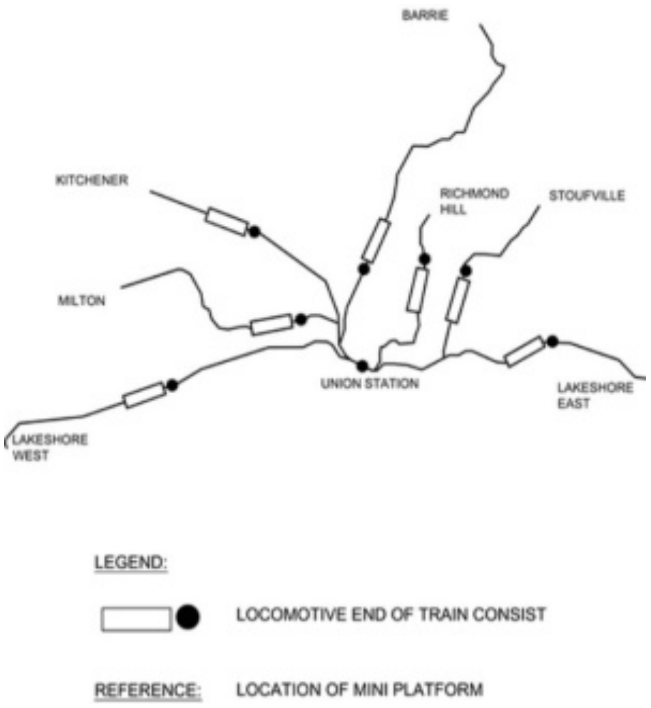


Figure 2: Typical Orientation of Locomotive End to Locate Mini Platforms

9.2.1 Rail Platform

These criteria are based on CN Rail data, applicable also to CP Rail, for preliminary design. Detail design shall be reviewed by the appropriate railway authority and GO Transit, at which time, some dimensions may be defined more precisely.

Table 1: Rail Platform Design Criteria

Rail Platform Design Criteria	Specifications
Width of island platform	7.4 m (min.)
Width of side platform	3.6 m (min. clear width) 4.9 m (min. including shelter)
Length of platform	315 m (min.)
Center line of mini-platform to locomotive end of main platform (Refer to Figure D-4 for location of locomotive for each corridor)	122.5 m
Centre line to centre line of tracks serving island platform	10.67 m (min.)
Track centers, center line to center line, new station facilities only	Refer to GO Transit Track Standards

Superseded

Usable platform area	Exclude the width of the Tactile Walking Surface Indicator (TWSI) tiles when calculating usable platform space; and Consider specific points of congestion (e.g., no standing zones) when determining the extent of platform crowding
Yellow Tactile attention indicators Tile at Platform Edge	0.61 m
Maximum height of mini-platform ATR	Refer to GO Transit Track Standards
SLOPES	
Island platform, Side platforms	2% (cross slope), drain away from the tracks
Where platforms slope longitudinally: • Tracks, elevator floor, stair enclosure and shelter buildings shall be raised • Transitionally adjusted at door locations to prevent water entry	1% maximum
CLEARANCES	
Minimum horizontal (from track CL)	Refer to GO Transit Track Standards
Minimum vertical clearance (ATR)	Refer to GO Transit Track Standards
Clearance from edge of platform to platform structures (shelters/stair enclosures, etc.)	2.44 m (min.)
Lateral clearance from centre line of track to mini-platforms	1.99 m
Lateral clearance to major and elevated platform structures, centre line of track to canopies, roof overhangs, etc.	3.35 m
Note: Refer to Metrolinx Design Standards for additional pavement markings and signage required for reduced platform clearances.	

Superseded

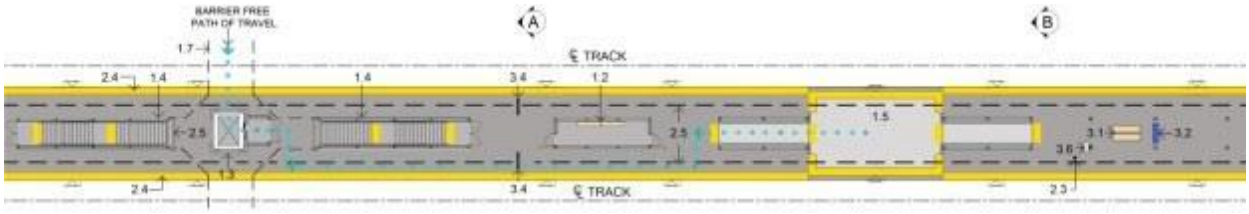


Figure 3: Typical Rail Platform Configuration

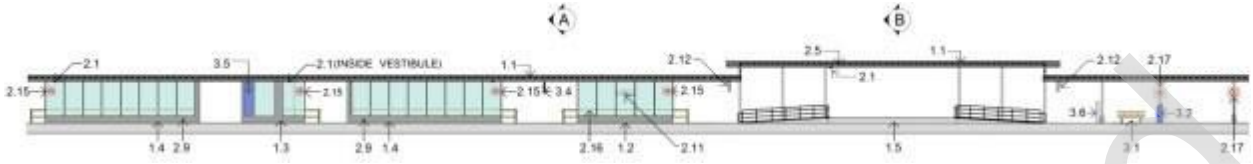


Figure 4: Typical Rail Platform Elevation

LEGEND		
1.1 Continuous Platform Canopy 1.2 Integrated Platform Shelter 1.3 Elevator and Vestibule 1.4 Stair Access and Vestibule 1.5 Mini Platform 1.6 Platform Lighting (not shown) 1.7 Tunnels 1.8 At Grade Pedestrian Crossings (not shown) 1.9 Pedestrian Bridges (not shown) 1.10 Poles (PA and CCTV-not shown) 1.11 Ramps (not shown) 2.1 CCTV 2.2 PA (not shown)	2.3 Snowmelt System w/ Platform Sensors 2.4 Detectible Platform Edge Tile 2.5 Platform/Canopy/Raceway 2.6 Corridor Raceways (TBD) 2.7 Drainage (not shown) 2.8 IT Node/Cluster Infrastructure (not shown) 2.9 Hose Bib 2.10 Fencing (Not Shown) 2.11 Platform Sign ID 2.12 Directional / Way finding Signs 2.16 Safety Signage 2.17 Warning Signage 2.18 Operational Signs	2.13 Accessibility Signage 2.14 Amenity Signage 2.15 Regulatory Signage 3.1Platform Bench / Seating 3.2 Waste Containers 3.3 Information Board 3.4 Platform Digital Monitors 3.5 Advertising (TBD) 3.6Two Way Communication Devices 3.7 Wi-Fi (not shown) 3.8 Ladder Tie-off points 3.9 Fall restraint

Superseded

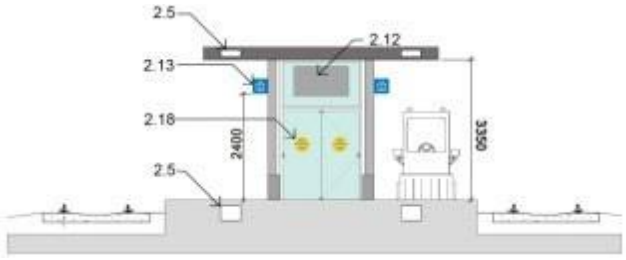


Figure 5: Typical Rail Platform Elevation - Section A



Figure 6: Typical Rail Platform Elevation - Section B

9.2.2 Rail Platform Canopies

Canopies on all rail platforms with integrated shelters and accesses such as elevator and stair enclosures and related amenities shall be provided.

The canopy shall be continuous and should extend to provide maximum coverage (at least 85% of platform length) over the rail platforms.

Canopies shall contain two (2) separate raceways along the full length - one for data, the other for power.

Vertical clearance from top of platform / mini platform to underside of lowest point of canopy shall be 3350mm.The underside of canopy height shall be determined such as to accommodate digital screens suspended from the underside of canopy; ensuring adequate weather protection below canopy and maintaining all horizontal and vertical clearances including a minimum vertical clearance of 2440 mm below all obstructions (including digital signage) for snow clearing and other equipment.

Min. 400mm high concrete pier shall be provided at each support column.

Integrate canopy lighting and other fixtures and amenities such as CCTV, digital signage etc in the canopy ceiling structure.

9.2.3 Rail Platform Access–Tunnels/Ramps/Stairs

Provide a network of barrier-free pedestrian pathways that connects all of the station components to facilitate easy intermodal transit connections.

Connect the station site with adjacent communities via sidewalks, local pathways, or bridges to maximize the pedestrian access to the site and minimize walking distances.

Provide direct pedestrian paths, continuous from the closest local road to at least two of the barrier-free platform access points.

When side platforms are used, provide direct walk on platform paths to maximize access to each platform.

At least one barrier-free rail platform access must be as close as possible to the mini-platform.

Superseded

Connect one of the rail access tunnels with the station building to provide additional convenience and customer service.

Consider whether the tunnels or bridges connecting to the platforms can also act as barrier-free community connection points on either side of the tracks. If so, ensure each community connection point can remain open when the station needs to be closed.

Platform access shall be visually discernible from site access points to encourage intuitive site navigation to the rail platform.

Provide redundant means of barrier-free access to island platforms by means of two elevators.

This section covers platform access structures including but not limited to:

- Pedestrian Tunnels
- Stairs and Stair enclosures
- Ramps
- Elevators
- Bridges and Pedestrian Overpasses
- At Grade Pedestrian Crossings

9.2.4 Elevators

The requirements do not constitute a project specification. Each project shall have its own specification based upon the GO Master Elevator Performance Specification.

Variance requests shall be supported by an explanation of the reason for the deviation and detailed information on the proposed alternative.

Key design objectives for vertical transportation include:

- Highest degree of safety and security
- Functionality for universal accessibility
- Service reliability
- Convenient operations and maintenance
- Non-proprietary tools, equipment, and knowledge

Important: Refer to Metrolinx Standard Elevator Performance Specification 14 20 06 for details.

9.2.4.1 Configuration

- GO Transit Elevators shall be Machine-Room-Less (MRL) Elevator type
- Generator standby power shall be provided to permit continued operation of the elevator(s)
- All electric elevators shall be provided with their own back-up battery power system
- All elevators shall be provided with battery powered emergency lighting
- Barrier-free, “flow through” configuration
- Elevator shaft, car enclosure and entrance doors shall be constructed with the maximum amount of glazing
- All serviceable equipment, not directly connected to elevator operation, to be serviceable from the exterior of the shaft.

Superseded

9.2.5 Bridges and Overpasses

9.2.5.1 Open Overpasses

Open overpasses shall not have solid guards.

9.2.5.2 Enclosed Overpasses

- Enclosed overpasses and stairs shall have windows/skylights, including at the ends
- Overpasses connecting platforms shall have unobstructed interior barrier-free routes and turn-around spaces
- Corridors shall be free of overhead and protrusion hazards
- Stair center handrails shall terminate at landings to permit crossover
- Maintenance access is to be provided around the bridge in the form of a catwalk or similar structure

9.2.5.3 Pedestrian Bridges

Pedestrian bridges over tracks shall be single-span structures with supports beyond the operating right-of-way, to the approval of the Railway. Intermediate supports are not allowed. Pedestrian bridges connecting platforms shall have unobstructed interior barrier-free routes and turn-around spaces. Corridors shall be free from protruding hazards.

9.2.5.4 Bridges at Public Thoroughfares

Bridges at public thoroughfares may have intermediate supports, subject to the approval of the authority having jurisdiction.

Superseded

9.3 Fixtures and Furnishings

9.3.1 Shelters

Refer to GO Station Architecture Design Standards, GO Transit Standard Drawings and Specifications and Metrolinx Universal Design Standard for detailed shelter requirements.

Important: Sheltered areas for customer comfort integrated within the canopy on the rail or bus platform are the preference for application of the sheltered areas.

Sheltered areas shall typically provide the following amenities:

- **a)** Heaters
- **b)** Digital Information Walls
- **c)** GO Standard Benches
- **d)** Wi-Fi reception
- **e)** Charging Receptacles

Fare Systems (only in certain applications at car pool lots and or remote station access locations or where there is no station building)

Where the integrated sheltered option is not applicable, standalone shelters shall be provided within the GO Standard suite of shelters, comprising of:

- **a)** Passenger Shelters
- **b)** Car Pool Shelters (sizing shall be determined by the Capital Projects Bus Rapid Transit Program)

The number of sheltered areas on a bus platform is determined such that each bus passenger shelter would accommodate approximately a bus-load of passengers. Where bus bays are remote from the terminal building, passenger shelters shall be provided where required by GO.

The number of sheltered areas on a rail platform is determined such that each rail passenger shelter would accommodate approximately two coach-loads of passengers. Shelter rain water leaders shall discharge into subgrade where available to avoid slippery conditions on platforms.

Superseded