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**SCHEDULE 15-2
DESIGN AND CONSTRUCTION**

**PART 1
GENERAL REQUIREMENTS**

ARTICLE 1 PHYSICAL LAYOUT

1.1 Project Description

- a) The OLRT Project shall consist of a surface Track and two below-grade Track sections – a Downtown Area underground section and a second underground section that provides the access to the MSF.
- b) The OLRT Project shall include thirteen (13) Stations, with three (3) new Underground Stations located in the Downtown Area of the Project; four (4) Transfer Stations, two (2) of which are also Terminal Stations; four (4) BRT to LRT Station conversions; two (2) new At-Grade Stations, located along the surface Alignment
- c) An MSF shall be provided for servicing and for storing the LRVs. This facility shall be located on Belfast Road, just west of St. Laurent Blvd in the City’s east end. This facility shall contain every requirement for the Maintenance and storage of the Vehicles.
- d) The Lands available for the Project are identified in the PRP drawings. The Lands includes existing City right-of-way, permanent property takings and temporary property takings. See Lands description below for expanded detail.
- e) All Stations, facilities supporting the OLRT and where applicable, associated Bus facilities shall be designed and constructed in accordance with Transport Canada rules and regulations including but not limited to the Canadian Transportation Agency Code of Practice.

1.2 General Alignment Requirements

- a) The Alignment falls within existing City rights-of-ways and the permanent takings as shown on the PRP drawings. Project Co shall Design the Alignment within the envelope as prescribed in the Lands description below.
- b) The Design and Construction of the Project shall be comprised of the conversion of the existing BRT vehicle corridor into the proposed LRT Alignment.
- c) The 12.5 km LRT corridor shall generally follow the established West – East BRT corridor from Tunney’s Pasture Station in the west, which is located near the intersection of Scott Street and Tunney’s Pasture Driveway, to Blair Station in the east, which is located close to the intersection of Regional Road 174 and Blair Road. Included shall be a 2.5 km OLRT Tunnel section through the Downtown Area between Commissioner Street at Wellington Street (west Tunnel portal) and Waller Street at Nicholas Street (east Tunnel portal).

- d) The MSF and access Track shall be constructed east of Belfast Road, west of St. Laurent Boulevard, and south of the existing VIA Rail corridor. The MSF access Track connection shall branch off of the mainline Tracks, westbound and eastbound, near the Belfast Road and Tremblay Road intersection. The two Tracks shall stay on the east side of and within the Belfast Road right of way, avoiding the Belfast Road Bridge and cross under the VIA Rail tracks to connect to the yard Tracks in the MSF.
- e) Four Transfer Stations shall be constructed – one at each end of the Alignment, Terminal Stations – Blair Station and Tunney’s Pasture Station – and two intermediate Stations at Bayview Station and Hurdman Station. Provisions for fare paid bus transfer Platforms, bus layby berths and circulation shall be designed and constructed at these locations with the exception of Bayview Station which requires the construction of a new Platform and fare paid zone to support the transfer of passengers from the City’s O-Train service in lieu of a bus transfer.
- f) The vertical alignment of the Tunnel in the vicinity of the Rideau Canal shall be located below the Rideau Canal Interceptor and the Department of Public Works Sewer Tunnel on the west and east sides of the Rideau Canal. The vertical alignment of the Tunnel under the Rideau Canal shall preclude the `thread the needle` and syphon alignment options.
- g) **Guideway Requirements**
 - (i) Project Co shall be responsible for the complete Design, Construction, testing and commissioning plus Maintenance for the conversion of the existing BRT to the LRT System requirements.
 - (ii) The Guideway shall be completely fenced and segregated from any pedestrian and vehicular traffic. Fencing location, type and height shall be as shown on the Fencing Drawings.
 - (iii) Secure maintenance access gates shall be provided as required to allow access to the Track corridor.

1.3 Tunnel Requirements

- a) Project Co shall be responsible for the complete Design and Construction of the LRT Tunnels, including, but not limited to, cut-and-cover, sequentially mined or bored Tunnels; the access and ventilation shafts; Stations; any required underground facilities; mechanical and electrical facilities; and any other requirements for design, Construction and Maintenance of the Tunnels.

1.4 Systems and Vehicle Requirements

- a) Project Co shall be responsible for the complete design, Construction, testing and commissioning and Maintenance of the complete Systems required for the safe and efficient operation of the LRT.

- (i) Systems includes
 - A. Traction Power
 - B. Revenue Vehicles
 - C. Non-Revenue Vehicles
 - D. Train Control System
 - E. Communications
 - F. Overhead Catenary System and Pantograph
 - G. Electromagnetic Interference and Compatibility
 - H. Corrosion Control
- b) Project Co shall be responsible for the planning, design, manufacturing, procurement and delivery of the LRVs. Included in this responsibility is the required coordination and integration between all System elements and key interfacing disciplines.
- c) Project Co shall supply all non-revenue vehicles required for the continued Maintenance and operation of the LRT System.
- d) Systems and vehicles shall be designed and constructed in accordance with Transport Canada rules and regulations including but not limited to the Canadian Transportation Agency Codes of Practice.

1.5 Facilities Requirements

- a) MSF Requirements
 - (i) Project Co shall be responsible for obtaining all required approvals for the MSF.
 - (ii) Project Co shall be responsible for the complete planning, design, Construction, operation and Maintenance of the MSF, including the supply of all equipment and facilities to maintain the Vehicles to meet the requirements of this Schedule 15 Output Specifications.
 - (iii) The MSF shall be constructed within the Lands.
 - (iv) The administration building and the maintenance building at the MSF shall be “LEED Certified”.
 - (v) The MSF shall be planned and designed to protect for future expansion.
 - (vi) The MSF maintenance yard shall be secured by fencing that is continuous with the fencing protecting the LRT Alignment.

- A. A motor operated gate(s), commercial grade, with all related posts, hardware, electrical and IT to provide controlled access to the MSF shall be integrated into the front entry.

- b) Station Requirements
 - (i) Project Co shall be responsible for the complete design, Construction and Maintenance of the Stations. The Stations shall be designed to meet the functional, accessibility, aesthetics, environmental, safety, operational and technical requirements of the City as contained and described in the Project Agreement.
 - (ii) The Stations shall be designed for a fare control system to be supplied and installed by the City.
 - (iii) All Stations shall be designed to accommodate the Design requirements of the selected LRV.
 - (iv) All Underground and at-grade Stations shall be designed in accordance with any and all applicable standards regarding accessibility and fire/life safety, including but not limited to, emergency egress, lighting and ventilation.
 - (v) The Stations shall be located along the corridor as described below from west to east:
 - A. Tunney's Pasture Station shall be located at the site of the existing BRT station, in the depressed roadway section, at the intersection of Tunney's Pasture Driveway and Scott Street. For the purposes of this design, it shall be considered the western terminus Station and will operate both as a Terminal Station and a Transfer Station that connects with the existing BRT to the west and local surface street bus service;
 - B. The new Bayview Station shall be located west of the existing BRT Station near Albert Street and directly over the O-Train station. The construction of the Transfer Station shall be coordinated with the replacement of the West Transitway CPR Overpass "O-Train" Bridge It shall accommodate vertical connections for the fare paid passenger transfer to the relocated O-Train station platform. The Station Design at the O-Train level shall not preclude a possible future extension of the OLRT to the west or a possible future connection of the O-Train to the OLRT System to and from the east or an interprovincial connection to the north. The new Station design and construction shall include the extension of the existing O-Train spur rail, including buffer stops, to accommodate the relocated O-Train platform and ensure sufficient space and clearance is provided to allow for a future double-tracked electrified light rail line and platform which would replace the existing O-Train spur line;

- C. Lebreton Station shall be located south of the existing BRT roadway at the intersection of the existing BRT and Booth Street. The Station shall be constructed below and integrated with the proposed Booth Street Bridge grade separated Structure with the Platforms east and west of Booth Street. Connections shall be provided to Booth Street and local bus service;
- D. Downtown West Station shall be an Underground Station located in the Queen Street right of way with the westerly end of the Station near Lyon Street;
- E. Downtown East Station shall be an Underground Station located in the Queen Street right of way. The Platform can be located anywhere between sixty-five (65) metres east of the east limits of Bank Street and thirty (30) metres east of the east limits of Metcalfe Street. There shall be a minimum of 300 metres between leading and trailing edges of adjacent Station Platforms;
- F. Rideau Station shall be an Underground Station located within the Tunnel section. Rideau Station shall be located completely within the Alignment Envelope and in accordance with the following:
 - i. The west end of the platform at Rideau Station shall be a minimum of 300m from the east end of the platform at Downtown East; and
 - ii. The west end of the station structure shall be located no further west than the eastern sideline of the intersection of Colonel By/Sussex and Rideau Street.
- G. Campus Station shall be located at the site of the existing BRT station at the University of Ottawa between the intersection of Waller Street with Nicolas Street and Mann Avenue. An existing pedestrian underpass from Colonel By Drive to the University is to remain and shall also provide access to this Station;
- H. Lees Station shall be located at the site of the existing BRT station at Lees Avenue and the BRT;
- I. Hurdman Station shall be located to the north of the existing BRT station east of the Rideau River and west of Riverside Drive. This Station shall be a Transfer Station with fare paid connections to the existing BRT Southeast Transitway and local bus service. The LRT Station shall be elevated and the existing bus transfer station and bus layby shall be reconstructed;
- J. Train Station shall be located west of the existing BRT station that is presently located within the access loop roadway of the VIA Rail station.

The proposed Station shall be located outside of the VIA Rail access loop on the existing BRT roadway east of Riverside Drive;

- K. St. Laurent Station shall be located at the existing dual level BRT station north of Highway 417 and west of St Laurent Boulevard. The upper level shall remain a BRT station and the lower level shall be converted to LRT only. It shall provide connections to local bus service at the surface level of the St. Laurent Shopping Centre;
- L. Cyrville Station shall be located at the site of the existing BRT station near Cyrville Road and Highway 417 with the westerly end of the Platform on the west side of Cyrville Road; and
- M. Blair Station shall be located at the site of the existing BRT station. The LRT portion of this Terminal/Transfer Station shall be located on the existing BRT roadway corridor north of Regional Road 174 and west of Blair Road. The Station shall be designed to allow the passenger transfer to bus platforms within a fare paid zone. The reconstructed BRT station shall be located north of the proposed LRT Station and provide a connection to the BRT roadway to the east and to the local bus service.

1.6 Structure Requirements

a) New Structures

- (i) Project Co shall be responsible for the complete planning, Design and Construction of the new OLRT Structures.
- (ii) The new Structures shall be located along the corridor as described below from west to east.
 - A. The Booth Street Bridge shall be a grade separated Structure to be constructed where the existing BRT crosses Booth Street as an at-grade signalized crossing. The Bridge approaches shall be reconstructed on the existing Booth Street right of way between Albert Street and the Ottawa River Parkway. The Bridge Structure shall provide connections to LeBreton Station located below the Structure on the OLRT Alignment.
 - B. The Booth Street Bridge shall have retaining walls constructed at the north and south approaches. The north approach shall be coordinated with the adjacent future development proposed centerline elevation at the Fleet Street intersection of 56.3. The south approach shall be coordinated with the LeBreton Station Structure and retaining walls. The retaining walls structures shall be constructed within the Lands.

- C. The Commissioner Street/Wellington Street intersection crossing of the OLRT shall be located in the footprint of the existing Commissioner Street/Wellington Street intersection and include the following:
- i. provide continuity of access for pedestrians and cyclists across the OLRT Alignment in the final condition;
 - ii. maintain full access during construction 24/7 to adjacent properties, including but not limited to Fleet Street Pumping Station, Cliff Street Heating Plant, and National Archives parking lot;
 - iii. The OLRT Track Alignment between Lebreton Station and Commissioner Street shall stay within the existing Wellington Street right-of-way, including retaining walls and slopes allowing for minor encroachments on adjacent City property, if necessary, except that no construction or disturbance shall be allowed on the Fleet Street Pumping Station property;
 - iv. The elevation of the roadway over the OLRT Track Alignment shall be approximately the same as the existing roadway elevation;
 - v. The crossing shall be over a Tunnel section of the OLRT alignment;
 - vi. The Tunnel structure profile shall be designed to allow utilities to cross over the roof of the structure. Note the presence of a 1500mm water main in Commissioner Street whose relocation or protection requires coordination with the Tunnel structure design. Project Co shall coordinate with HOL for a proposed high voltage duct bank connecting to the Cliff Street Heating Plant by way of Commissioner Street;
 - vii. The Tunnel box structure shall be designed to the requirements of Schedule 15-2 Part 3; and
 - viii. The excavated area shall be restored to original condition after completion of construction.
- D. The West Portal (Commissioner's Street) Tunnel structure profile shall be designed such that the top of the structure meets the requirements of the Vertical Alignment Envelope and is below 60.5m elevation at the escarpment face;
- i. No work shall be performed above 60.5m elevation at the escarpment face with the exception of the toe of the escarpment within the limits of cut and cover construction;

- E. The East Portal (Waller Street) U-section retaining walls shall be constructed along the Guideway between Nicholas Street to the south and the University of Ottawa Campus to the north.
- F. The Hurdman Station elevated Guideway shall be constructed and shall carry the OLRT Track Guideway from the existing BRT roadway at-grade east of the Rideau River rising to the new elevated Hurdman Station, ending at an embankment Structure at the east end of the Station. West of the Station, the Structure shall be designed to provide a minimum 20m wide right-of-way with a minimum clearance of 5.0m from existing grade to allow for a future two-way local road to access the lands north of the Station as indicated on the Federally Mandated Station Drawings.
- G. A new access Structure shall be provided east of Hurdman Station to provide a minimum 20m wide right-of-way with a minimum clearance of 5.0m from existing grade to allow for a future two-way local road to access the lands north of the Station as indicated on the Federally Mandated Station Drawings.
- H. The Alignment of the OLRT at VIA Rail station shall deviate from the existing BRT and cross under the existing access roadway loop to the north of the existing access roadway Bridge Structure on the east side of the loop. A new Structure shall be constructed where the OLRT Track Guideway crosses under the existing VIA Rail station access roadway.
- I. The Yard Track Connections that branch off of the mainline on the East and West side of Belfast Road at the BRT shall have retaining walls or U-section constructed on the approaches to the Tremblay Road underpass.
- J. The Yard Track Connection shall have retaining walls or U-section constructed at the southeast approach to the MSF Yard tracks after crossing the VIA Rail Line.

b) Existing Structures to be Converted

- (i) Project Co shall perform such Design checks as may be required to ensure that the existing BRT Bridge Structures on the BRT System can be converted to LRT for the chosen LRV. The Design check shall be completed in accordance with all applicable codes and standards.
- (ii) Project Co shall perform Design checks and investigations on all existing Structures to ascertain the BCI number of each Structure. Should the BCI number be below 80, Project Co shall Design and Construct such modifications as are necessary to bring each Structure to a minimum BCI 80 during the construction period.

- (iii) Should such Design checks demonstrate that modification is required to any portion of the Structure or foundation, Project Co shall Design and construct such modifications and to ensure that all applicable codes are met.
- (iv) Existing Structures located along the corridor:
 - A. The Bayview Road Bridge is an existing Structure carrying the BRT over Bayview Road.
 - B. The Mann Avenue Bridge is an existing Structure carrying the BRT over Mann Avenue. It is located east of Campus Station and west of Lees Station.
 - C. The Rideau River Bridge is an existing Structure carrying the BRT over the Rideau River.
 - D. The Riverside Drive Bridge is an existing Structure carrying the BRT over Riverside Drive.
 - E. The Cyrville Road Culvert is an existing Structure that the BRT crosses over.
- c) Existing Structures to be Removed and Replaced
 - (i) Project Co shall be responsible for the complete planning, Demolition, Removal, Design and Construction of the existing BRT Structures and reinstatement of any adjacent re-useable infrastructure such as MSE walls.
 - (ii) Project Co shall be responsible for the complete coordination with OC Transpo, external agencies and stakeholders during demolition staging.
 - (iii) Project Co shall be responsible for the complete coordination with OC Transpo, external agencies and stakeholder during construction staging.
 - (iv) A new replacement Structure shall be located along the corridor as described below:
 - A. The replacement West Transitway Bridge over the O-Train near Albert Street shall be a grade separated Structure to be constructed along the same Transitway alignment. The Bridge approaches shall be reconstructed or redefined as required on the existing Transitway right-of-way between Bayview Road and the existing Bayview Station as required.
 - i. Project Co shall be responsible for the complete planning, Design and Construction of the new OLRT Structures such that it meets the OC Transpo North-South line requirements and allows for functional connections to the Transitway and Bayview Station.

- ii. Project Co shall be responsible for the complete coordination with OC Transpo, external agencies and stakeholder during construction staging.
- iii. Project Co shall be responsible for the maintenance and protection of existing or planned BRT and/or O-Train operations during the demolition and construction period unless such operations are maintained through other means and methods permitted by OC Transpo, the City of Ottawa and external agencies.
- iv. Project Co shall be responsible for the transitions to and interfaces with such removed and replaced structures in concert with the functionality of existing or planned BRT and/or O-Train operations.

1.7 The Lands Requirements

a) Property Request Plans

- (i) Project Co shall utilize the Property Request Plans (PRP) and ensure that the Project remains within the boundaries shown in these plans.
- (ii) Should the approved Final Design require a change to any property boundaries, new PRP's shall be created by the City.
- (iii) Limits of Construction, occupation and all works, except for site access construction of detours and associated works, on existing City/public rights-of-way/property and Cash Allowance Work constructed by Project Co within existing City rights-of-way/property, shall be within the Lands, Temporary Easements and Permanent Easements as shown hatched on the PRP's.
- (iv) For Cash Allowance Work and/or site access, detours and associated works on existing City/public rights-of-way/property that are outside of the Lands, Temporary Easements and Permanent Easements shown on the PRPs, the necessary City/public Authority to construct and implement such detours and Cash Allowance Work (as outlined in PA Schedule 15-2, Part 7), shall be considered by Project Co to be provided upon approval of the TTMP.
- (v) Construction access for vehicles to 300 Queen St (for further clarity the Lands known as the mobilization site and as described in PIN 04114-0364) shall be restricted to entry from Kent St and exit onto Queen St only.

b) Property Identification Package

- (i) The Property Identification Package consists of a binder containing the following sections:
 - A. Master Spreadsheet;

- i. A Master Spreadsheet lists all of the properties anticipated to be affected to any degree at the Preliminary Design stage. Project Co shall utilize the data provided in the Master Spreadsheet when performing the Final Design.
 - B. Property Request Plans (PRP);
 - i. The PRP's depict the property takings and the affected Parent Parcel of land.
 - C. Route Plans with Property Identification Number (PIN); and
 - i. The Route Plans show the relationship between the route of the Project and the PINs.
 - D. OLRT Property PRP Schedule Index Plan showing all PRP's.
 - i. Schedule Plan provides the physical relationship between the route and the layout of the PRP's.
 - (ii) The Property Identification Package shall become a final document when the Final Design is presented to the City and approved.
- c) Alignment Envelope
- (i) The Horizontal Alignment Envelope within which Project Co shall Design the OLRT Alignment between Bank Street and Laurier Avenue is described on a drawing titled "Project Horizontal Alignment Envelope" in the Data Room. The "Project Alignment Envelope" is a reliant document.
 - (ii) The Vertical Alignment Envelope within which Project Co shall Design the OLRT Alignment, between Commissioner Street and Laurier Avenue, is described on a drawing titled "Project Vertical Alignment Envelope" located in the Data Room. The "Project Vertical Alignment Envelope" is a reliant document.
 - (iii) The Alignment Envelope upper vertical limit is defined as the ground surface when under roadways and as shown on the Project Vertical Alignment Drawing when under buildings. However, the roadway surface is considered part of the Alignment Envelope for access and temporary construction uses;
 - (iv) The Alignment Envelope lower vertical limit is defined in the "Project Vertical Alignment Envelope" drawing.
 - (v) The Alignment Envelope shall be within the property takings depicted in the PRP's as permanent takings and shall encompass all elements of the Alignment.
 - (vi) The criteria for locating Structures within the Alignment Envelope are as follows:

- A. The dimensions presented in this section are a guide to establish the final Alignment within the envelope early in the Design and are subject to change by the City as individual site circumstances require. The use of the PRP parcels as Temporary Construction areas to construct the Structures described herein is not restricted by the criteria presented below;

- B. Cut and Cover Tunnels and Stations;
 - i. Laterally the outside limits of the Tunnel Structure shall be at least 1 meter from envelope limit and laterally at stations the outside limits of the station structure shall be determined by Project Co on a case by case basis but not outside of the envelope limits.

 - ii. The Upper Limit of the Tunnel Structure shall be at least 4 meters below the upper envelope limit under roadway (ground surface) to provide space for Utilities in public right-of-ways and for support of excavation. Where the Tunnel is coming to daylight at the surface, the Tunnel structure shall be allowed as near to the surface as is required to construct the Tunnel portal.

 - iii. The Upper Limit of the Station roof Structure shall be at least 4 meters below the upper envelope limit under roadway (ground surface) to provide space for utilities in public ways and for support of excavation.

 - iv. The limits of rock bolts and/or tie-backs shall be within the lateral and upper limits and be within the Lands and permanent or temporary easements described in the Lands Schedule, except that additional Temporary Construction Easements relating to support of excavation elements, rock bolts and tie-backs that are not forming part of the permanent structure of the System and that are outside of the boundaries of the Lands may be acquired by Project Co.

 - v. At Rideau Station the Platform shall be no lower than elevation 37.0m.

 - vi. At Downtown East Station the Platform shall be no lower than elevation 52.0m.

 - vii. At Downtown West Station the Platform shall be no lower than elevation 54.0m.

- C. Sequential Excavation and Bored Tunnels and Stations;
 - i. Laterally the outside limits of the Tunnel Structure shall be at least 2 meters from the envelope limits and laterally at Stations, the

outside limits of the Station Structure shall be determined by Project Co on a case-by-case basis but not outside the Alignment Envelope limits.

- ii. The Upper Limit of the Tunnel Structure shall be at least 4 meters below the upper envelope limit under roadway (ground surface) to provide space for Utilities and support of excavation. Where the Tunnel is coming to daylight at the surface, the Tunnel structure shall be allowed as near to the surface as is required to construct the Tunnel portal.
- iii. The Upper Limit of the Station roof Structure shall be at least 4 meters below the upper envelope limit under roadway (ground surface) to provide space for utilities and support of excavation.
- iv. The limits of rock bolts and/or tie-backs shall be within the lateral and upper limits and within the Lands and Permanent or Temporary easements described in the Lands Schedule, except that additional Temporary Construction Easements relating to support of excavation elements, rock bolts and tie-backs that are not forming part of the permanent structure of the System and that are outside of the boundaries of the Lands may be acquired by Project Co.
- v. At Rideau Station the Platform shall be no lower than elevation 37.0m.
- vi. At Downtown East Station the Platform shall be no lower than elevation 52.0m.
- vii. At Downtown West Station the Platform shall be no lower than elevation 54.0m.

D.

E. Vents and Shafts;

- i. Vent and fan shafts shall be located in right of ways only.

- ii. Vent and fan shafts shall not be permitted to be located within the curb to curb dimension.

1.8 Design and Construction Requirements to Accommodate Future Works

- a) Project Co shall protect for, by not precluding, future works in the Design and Construction of certain elements of the Project.
- b) These future works are described below:
 - (i) Future Western extension of the LRT System either from Tunney's Pasture Station or Bayview Station;
 - (ii) A pocket Track east of Hurdman Station to protect for western extension service patterns.
 - (iii) Future Eastern extension from Blair Station;
 - (iv) Future OLRT Station Platform extensions if necessary to achieve 24,000 pphpd;
 - (v) The future connection of the O-Train Track Alignment at Bayview Station to the OLRT Project Alignment connecting to eastbound and westbound Tracks between Bayview Station and Lebreton Station;
 - (vi) The future northerly interprovincial extension of the O-Train Alignment at Bayview Station to the existing Prince of Wales Bridge over the Ottawa River;
 - (vii) Future expansion of the MSF;
 - (viii) The track elevation in the vicinity of Preston Street shall be no higher than elevation 55.63 between Reference Concept baseline Station 99+980 and Station 100+015 in order to protect for the proposed Preston Street Bridge over the LRT tracks;
 - (ix) The track elevation in the vicinity of LeBreton Station shall be no higher than 56.8m between Reference Concept baseline Station 99+800 and Station 100+400, in order to protect for future development in the Lebreton Flats area that may be constructed over the LRT Guideway. Future development in the Lebreton Flats area will be located 7.0 meters above the Track elevation through this area and no OLRT System Infrastructure shall be located in excess of 7.0 metres above Track elevation ; and
 - (x) The lower vertical envelope limit above the proposed 3000mm CSO tunnel at Kent Street shall be at elevation 50.0 unless Project Co can demonstrate through detailed technical and economic analysis that a lower elevation is technically feasible and will not impact construction, operation or maintenance of the proposed CSO tunnel.

1.9 Maintenance Responsibilities during the Design and Construction Work

Project Co shall submit, as outlined in the Project Agreement, the Works Schedule including but not limited to the phases of construction works, the critical path schedule associated with the respective phase of construction works, the geographical boundaries identifying the phase of construction works, and construction means and methods to perform the phase of construction works.

The phases of construction works outlined in the Works Schedule shall be the basis for determining the commencement of Project Co's Maintenance responsibilities during construction. Notwithstanding Schedule 15-3 Maintenance and Rehabilitation, the City shall be responsible for the existing Infrastructure within the Lands from Financial Close until the identified commencement date for the respective phase of construction works specified by Project Co. For further certainty, the City shall be responsible for the maintenance of including but not limited to the existing BRT, stations, structures, retaining walls, highways, and pathways. Upon the commencement of the phase of construction works and notwithstanding City Specific Responsibilities identified in Schedule 15-3 Maintenance and Rehabilitation, Project Co shall be responsible the Maintenance of the Infrastructure during the respective phase of construction works and until such time as the Infrastructure is either returned and accepted by the Owner of the Infrastructure or termination of the Maintenance Term.

ARTICLE 2 OPERATIONAL PERFORMANCE REQUIREMENTS

2.1 Introduction

- a) Project Co shall provide an integrated LRT System capable of delivering public transit service in a safe, reliable and efficient manner, and in accordance with the following operational performance parameters.

2.2 General

- a) Although operation of rail service will be the responsibility of the City, Project Co shall thoroughly consider the operational needs and the functionality of the System during Design and Construction Work and shall validate the operational capabilities through performance simulation.
- b) Meeting the high capacity operational needs of the City shall require Project Co to design and construct a light rail System that is highly integrated and highly reliable across all major rail Systems including; Vehicle, Train Control and signalling, Traction Power, Stations, Tunnel ventilation, Track and special trackwork.
- c) Project Co shall assist the City in preparing an Operations Service Plan. Project Co will prepare operating procedures, records, training, and related manuals, in consultation with the City, required to operate the System based on the final System Design and results of performance simulations. Project Co shall submit the referenced documents in accordance with Schedule 10 – Review Procedure. Project Co and City shall work cooperatively, each acting reasonably, to achieve an integrated Operations Service Plan.

2.3 Operational Headways

- a) The System shall be designed to reliably support a sustained operational Headway of 2 minutes or less under typical operating conditions.
- b) The System shall be designed to reliably support a sustained operational Headway of 15 minutes during a single Track outage at any location throughout the System to support Maintenance activities and/or continued operation during unplanned outages. Terminal to terminal trip time shall not significantly increase during single tracking operations, other than as a result of speed reductions applied through Maintenance work zones.

2.4 Hours of Operation

- a) System Design and ongoing Maintenance and rehabilitation shall support the following hours of Train operation:
 - (i) Weekday (Monday through Thursday): 05:00-01:00
 - (ii) Friday: 05:00-02:00
 - (iii) Saturday & select Holidays: 06:00-02:00

- (iv) Sunday & select Holidays: 08:00-23:00
 - (v) Operations are anticipated such that a Passenger entering the System at any Station during these hours is able to travel to any other Station on the System such that the actual period that Trains are in operation shall extend outside of the above hours of operation.
- b) Passenger facilities in a Station shall be available for use by Passengers from 15 minutes prior to the departure of the first scheduled Train from that Station until 15 minutes after the departure of the last scheduled Train from that Station.

2.5 Operational Design and Construction Requirements

- a) Based upon the City’s Ridership Forecast as shown in Table 1-2.1 and Table 1-2.2 below, the City has established the following service scenarios:
- (i) Operating Scenario 1: Year 2021 operation with peak period Headways of approximately 3.25 minutes or greater based on peak link load standees not in excess of 3.33 Passengers/m².
 - (ii) Operating Scenario 2: Year 2031 operation with peak period Headways of approximately 2.1 minutes or greater based on peak link load standees not in excess of 3.33 Passengers/m².
- b) Project Co is responsible for designing and constructing the System to support Operating Scenario 1 and Operating Scenario 2 under this Project.
- c) Project Co shall further Design the System such that Passenger carrying capacities can be increased to an ultimate capacity of 24,000 pphpd (Operating Scenario 3) in accordance with the requirements of Section 2.6 (f). Such future expansion shall be by future capital projects without undue modification or loss of investment of the initial System. For further clarity, the Underground Stations shall be designed and constructed for Operating Scenario 3 in accordance with Schedule 15-2 Part 5 2.3.
- d) Notwithstanding the requirements related to the above service scenarios, the proposed System and rolling stock shall further comply with the requirements of Section 2.3 – Operational Headways and Section 2.6 - System Capacity.

Table 1-2.1: 2021 AM Peak Hour Ridership Forecast

LRT Station	Eastbound			Westbound		
	Boardings	Alightings	EB Load	Boardings	Alightings	WB Load
Tunney’s Pasture	9,930	0	9,930	0	2,950	0
Bayview	220	390	9,760	140	570	2,950
LeBreton	130	440	9,450	60	380	3,380
Downtown West	440	2,550	7,340	680	2,860	3,700
Downtown East	480	3,850	3,970	700	4,320	5,880

LRT Station	Eastbound			Westbound		
	Boardings	Alightings	EB Load	Boardings	Alightings	WB Load
Rideau Centre	1,730	2,090	3,610	1,420	2,300	9,500
Campus	330	1,770	2,170	430	1,410	10,380
Lees	210	280	2,100	460	150	11,360
Hurdman	950	1,140	1,910	3,200	540	11,050
Train Station	20	170	1,760	20	80	8,390
St. Laurent	560	580	1,740	910	330	8,450
Cyrville	20	290	1,470	220	100	7,870
Blair	0	1,470	0	7,750	0	7,750
Total	15,020	15,020		15,990	15,990	

Table 1-2.2: 2031 AM Peak Hour Ridership Forecast

LRT Station	Eastbound			Westbound		
	Boardings	Alightings	EB Load	Boardings	Alightings	WB Load
Baseline	5,980	0	5,980	0	2,260	0
Iris	610	40	6,550	20	150	2,260
Queensway	70	200	6,420	310	60	2,390
Lincoln Fields	6,650	840	12,230	190	1,260	2,140
New Orchard	220	40	12,410	70	30	3,210
Cleary	180	110	12,480	30	60	3,170
Dominion	190	30	12,640	40	30	3,200
Westboro	550	100	13,090	90	200	3,190
Tunney's Pasture	1,080	690	13,480	170	1,240	3,300
Bayview	4,870	310	18,040	140	730	4,370
LeBreton	150	940	17,250	230	490	4,960
Downtown West	300	4,380	13,170	1,710	3,680	5,220
Downtown East	380	5,990	7,560	850	5,260	7,190
Rideau Centre	160	3,510	4,210	2,060	3,220	11,600
Campus	400	2,160	2,450	520	1,620	12,760
Lees	260	340	2,370	560	180	13,860
Hurdman	1,830	1,610	2,590	3,900	1,380	13,480
Train Station	50	150	2,490	50	50	10,960
St. Laurent	680	950	2,220	1,200	600	10,960
Cyrville	50	350	1,920	170	50	10,360
Blair		1,920	0	10,240		10,240
Total	24,660	24,660		22,550	22,550	

2.6 System Capacity

- a) The Design and Construction of the System and proposed rolling stock shall support the following peak hour capacities:

- (i) Operating Scenario 1 (Year 2021): minimum of 11,360 PPHPD
- (ii) Operating Scenario 2 (Year 2031): minimum of 18,040 PPHPD
- b) The required System capacity for Operating Scenario 1 and Operating Scenario 2 shall be provided subject to the following passenger comfort load standards, maximum consist lengths, and appropriate operating Headways.
- c) Passenger Comfort Load Standards:
 - (i) The City of Ottawa has adopted the following passenger comfort criteria as it relates to passenger loading densities. Project Co shall use the following passenger comfort criteria for determining fleet size and for service planning purposes over the Project Term.
 - (ii) The average standee density during the peak hour on the peak link load segment shall not exceed 3.33 standees per square meter of available standee space.
 - (iii) At least 40 percent of the required peak hour service capacity must be provided by seats to maintain a high level of comfort and minimize the duration that passengers have to stand. Flip-up seats count toward the 40 percent requirement.
 - (iv) The average standee density during Off-Peak periods on the peak link load segment shall not exceed 0.80 standees per square meter of available standee space.
 - (v) Available standee space shall exclude the area under seats (including flip-up seats), area occupied by feet of seated passengers, any area within 50mm of closed doors, area within 100mm on either side of the moving edge of the articulation pie plate, and any area with dimensions that will not accommodate a standee (e.g. sliver areas between fixed objects), or is otherwise unsuitable or uncomfortable for standees. A minimum floor area of 0.14 square meters shall be allocated for the feet of each seated passenger that protrudes into the standee area.
- d) Train Consist and Platform Lengths:
 - (i) The maximum Train consist length and Platform length shall be determined by Project Co in compliance with all existing codes, regulations and to meet the required service capacities identified in this Article.
 - (ii) The rolling stock shall be configured to maximize Train capacity, and to be generally compatible with long term plans to expand system capacity to 24,000 pphpd in accordance with 2.5(c), which may or may not involve Platform extensions. Project Co shall identify the approach for capacity expansion to 24,000 pphpd and describe how the rolling stock solution supports such expansion.

- (iii) Project Co is responsible to ensure that the first and last door locations of their selected Train consist, Station Platform lengths and Train control system are fully integrated in a manner that provides reliable Train berthing under all operating conditions for safe detraining and entraining of passengers without undue performance degradation.

- e) Operating Headway:
 - (i) The City seeks to minimize operating costs by maximizing Train capacity and peak operating Headway to achieve the required capacity and has identified the Headways stated in Section 2.5 (a). Project Co should establish if required, alternate operating Headways for each Operating Scenario based upon the actual supplied vehicle, provided the other System capacity criteria and Operational Performance Requirements are met.

- f) Operating Scenario 3 - Ultimate Capacity:
 - (i) Compliance with Section 2.5(c), allowing for an ultimate Passenger capacity of 24,000 PPHPD, shall be demonstrated in accordance with the following comfort and operating requirements:
 - A. Standee density shall not exceed 4 standees per square meter of available standee space;
 - B. At least 35 percent of the required peak hour service capacity shall be provided by seats to maintain a high level of comfort and minimize the duration that Passengers have to stand; and
 - C. A minimum operational headway of the greater of 105 seconds or the minimum sustainable headway of the core system. The minimum terminal headways of the initial OLRT system can be disregarded for the purpose of determining the minimum sustainable headway for Operating Scenario 3.

2.7 Maximum Trip Times

- a) To ensure an efficient and effective service, the System and rolling stock shall support a maximum terminal to terminal (start to stop) travel time during the peak period. Terminal to terminal travel times shall be determined using stochastic operations simulation analysis of the proposed System under manual and ATO operations.

- b) The maximum terminal to terminal travel time during the peak period shall be as follows:
 - (i) Manual mode: 24 minutes including Dwell Time and accounting for typical underperformance resulting from Driver-controlled Vehicle movement

 - (ii) ATO mode: 23 minutes including Dwell Time.

- c) Manual Operating Mode
 - (i) Trip times for manual operations shall be determined through simulation with stochastic variations in Driver performance and Dwell Times.
 - (ii) Dwell Time variation shall consider the effect of late Trains based on Project Co or industry experience as documented in the simulation report. In the absence of delay-based Dwell Time simulation a randomized uniform distribution around the nominal calculated Dwell Times of not less than plus and minus 5 seconds shall be applied.
 - (iii) Driver performance variations shall be set such that the average terminal to terminal running time shall be at least 6% greater than the ideal trip time under full performance.
- d) ATO Operating Mode
 - (i) Trip times for ATO operations shall be determined through simulation with stochastic variations of Dwell Times, and appropriate variations in Vehicle performance based on performance tolerances of the Vehicle and ATO equipment as determined by Project Co.
 - (ii) For analysis purposes, Dwell Time variation for ATO shall follow a uniform distribution around the nominal, calculated Dwell Times based on Project Co experience and recommendations, but no less than plus and minus 5 seconds.
- e) Dwell Time
 - (i) Dwell Times shall be included in the calculation of the maximum terminal to terminal travel time.
 - (ii) Passenger loading and unloading time at terminal Stations is considered part of the terminal layover time, and is not included in the calculation of maximum travel time.
 - (iii) Nominal Dwell Times at each Station shall be based on the directional peak hour Passenger boardings and alightings provided in Tables 1-2.1 and 1-2.2 above, industry experience on Passenger flow rates under similar operating conditions, and on the proposed rolling stock solution.
 - (iv) An absolute minimum Dwell Time of 20 seconds shall be assumed at all Stations.
- f) Terminal Time
 - (i) Terminal time shall be defined based on the proposed operating Headway.
 - (ii) A minimum terminal time shall be no less than three minutes or one operating Headway.

- (iii) The absolute minimum terminal time shall not exceed the calculated time required for Passenger loading and unloading at the terminals during the peak hour including an appropriate allowance for variations in Passenger flow.
- (iv) The operational simulation validating compliance with this Article shall report the distribution of terminal time at each terminal and discuss the ability of the System to reliably meet the terminal time requirements.

2.8 Fleet Requirements

- a) Project Co shall provide a sufficient fleet of LRVs to support the needs of the System over the Maintenance Term based on:
 - (i) The planned service capacity as documented in the Operations Service Plan;
 - (ii) To effectively execute the rail fleet Maintenance program proposed by Project Co in accordance with Schedule 15-3 with an appropriate Maintenance spare percentage; and
 - (iii) For further certainty, fleet requirements beyond the initial fleet required for Opening Year operations as documented in the Operations Service Plan shall be procured and provided at the direction of the City in accordance with Schedule 35 – Vehicle Option and Schedule 22 – Variation Procedure.
- b) Project Co shall design and construct the MSF facility to accommodate the LRVs required to meet the Operational Performance Requirements identified in this Article for Operating Scenarios 1 and 2, as well as any non-revenue and specialty vehicles required to fulfill Project Co’s Maintenance Requirements and obligations.

2.9 City Branding Integration

- a) Project Co shall be responsible for the integration of the City branding requirements with their Design solutions for the OLRT project.
- b) Project Co shall provide access and reasonable assistance to City staff (including any firms, organizations or individuals affiliated with the development or implementation of the branding strategy) for the purposes of integrating design and coordinating the Design and implementation of Project Deliverables. Project Co will make available any relevant reference materials for Station environments and vehicles (i.e. engineering drawings, prototype samples, and other design development materials) during the design process.
- c) Project Co shall, through the design and implementation of the Project, consult with the City to ensure the most efficient and cost effective means of incorporating the City’s brand in the design of the OLRT.
- d) Project Co shall ensure that any branding requirements do not conflict with the safety of public or operating staff.

ARTICLE 3 REFERENCE DOCUMENTS

3.1 Application of the Reference Documents, City Standards and Procedures, Ontario Provincial Standards for Roads and Public Works and Other Manuals, Codes and Standards

- a) The Design and Construction Works, shall be carried out in accordance with the applicable Reference Documents, and with the following amendments:
 - (i) Requirements related to design and submission requirements and Quality Assurance in the Reference Documents do not apply; rather, the Design and Construction Specifications and Schedule 11 – Quality Management Plan, respectively shall apply;
 - (ii) Requirements and specifications in the Reference Documents related to equipment for performing the Design and Construction Works do not apply;
 - (iii) Sections within the Reference Documents that are not applicable to this form of agreement, such as payment terms, do not apply;
 - (iv) Any and all references to “approval by the Contract Administrator” or other such reference in the Reference Documents, in terms of acceptance of materials, permission to proceed, work methodology or end product, shall be construed as being the responsibility of Project Co, but each such instance shall be in consultation with the City;
 - (v) Project Co shall consult with the City to determine which Reference Documents submissions are to be submitted under Schedule 10 – Review Procedure;
 - (vi) Any and all references within the Reference Documents related to submission of documentation to the Contract Administrator “for approval”, “for acceptance”, or other qualifying phrase with similar connotation, is to be construed as the City retaining the right to object to the submission as set out in the Review Procedure, if the submission is required to undergo the Review Procedure upon consultation with the City; and
 - (vii) Project Co shall, when required in the Reference Documents to submit for approval by the City samples of any products proposed by Project Co, submit such samples with supporting documentation to the City in accordance with the Review Procedure.

3.2 Reference Documents

- a) Without limiting any other provision in this Project Agreement, the Reference Documents shall apply to the Design and Construction Works as described in this Schedule.

3.3 Order of Precedence

- a) Unless otherwise expressly provided in this Schedule 15-2, if there is any conflict between any of the provisions of this Project Agreement and any of the Reference Documents, the following shall apply in descending order of precedence:
 - (i) the provisions of this Project Agreement;
 - (ii) City Standards and Procedures;
 - (iii) OPS;
 - (iv) AREMA; and
 - (v) any other applicable Reference Documents.

3.4 Reference Concept

- a) Any use by Project Co of any or all aspects of the Reference Concept in performing the Design and Construction Works shall be entirely at Project Co's own risk. Use of the Reference Concept as a basis for Project Co's Design for any part of the Project does not guarantee the City approval of Project Co's Design.

ARTICLE 4 DESIGN AND CONSTRUCTION

4.1 Responsibility for Design and Construction

- a) Project Co shall be responsible for the Design and Construction of the OLRT Project and all other Construction activities, including completion, commissioning and testing of the OLRT, which shall be carried out in strict accordance with the Design and Construction Specifications and in such a manner as to comply with all applicable Project Agreement requirements.

4.2 Control Surveys, Legal Surveys and Digital Mapping

- a) Control Survey
 - (i) A control survey of the Alignment has been completed by the City for this Project. Existing and new monuments were used in establishing the Project control survey.
 - (ii) The Project survey control coordinate system shall be:
 - A. Modified Transverse Mercator, MTM 3 degree, zone 9; and
 - B. The control stations coordinate values shall be delivered in NAD83 original as well as in NAD 83 CSRS format.
 - (iii) Project Co shall evaluate its requirements for a control survey in order to carry out the Design and Construction Work and determine if additional monuments are required. Any such additional monuments shall be installed by Project Co and shall be surveyed to tie into the Project survey control coordinate system. Project Co shall prepare a drawing of each additional survey monument installed and provide a record to the City.
 - (iv) Project Co shall be solely responsible for protecting and maintaining all existing survey control monuments.
- b) Horizontal Control
 - (i) The Project control survey shall be used as the basis for all Design and Construction Works.
 - (ii) The Project control survey shall have a second order standard of accuracy.
 - (iii) All surveys made for the Project shall be tied into monuments in the Project control network and shall be adjusted by holding these monuments fixed. The accuracy of these surveys shall be second order.
- c) Vertical Control

- (i) The vertical control shall be based on the Canadian Geodetic Vertical Datum of 1928 (CGVD 28)
- d) Legal Surveys
 - (i) Legal Surveys intended for fee simple, permanent or temporary easement acquisition to support the Project shall be carried out by the City.
 - (ii) Project Co shall provide requests for Legal Surveys to the City within thirty (30) calendar days from Financial Close, submitted in accordance with Schedule 10 – Review Procedure, to allow sufficient time for preparation of the Legal Surveys by the City, taking into account both the resources necessary to conduct such surveys and whether delay in the delivery of the Survey shall have a material impact on Project Co’s ability to complete the Design and Construction Work.
 - (iii) Project Co shall provide an electronic file, in MicroStation format, of the entire Alignment in Project Coordinate System in 3 dimensions – x, y, z. This shall include integrated Station elements located within existing structures on private property. The 3 dimensional coordinates will be set out in sufficient detail to allow the City to create Reference Plans that accurately depict the extent of ownership of the features and any other requisite property rights, to be included within the Project.
 - (iv) Project Co shall ensure that, in those areas where the proposed Construction is to take place immediately adjacent to a property limit, that an Ontario Land Surveyor is engaged to lay out the property limit in the field.

4.3 Miscellaneous Surveys

- a) Project Co shall be responsible to provide all additional surveys required for the Design and Construction Work including:
 - (i) Preconstruction utility, Structures and Pavement condition surveys and a CCTV survey of sewer systems to be affected by, or which have the potential to be impacted by, the Design and Construction Work; and
 - (ii) Clearance field surveys to check areas of tight clearance in the horizontal and vertical plane.
- b) Right of Access for Surveys
 - (i) Except as otherwise provided in the Project Agreement, Project Co shall prepare all necessary applications, including any necessary attachments, to secure all Permits, access rights, permissions and approvals, to carry out field surveys on the Project.

4.4 Design Components and Their Life Expectancies

- a) Project Co shall Design the components of the Project to reflect the requirements outlined in Table 1-4.1.

Table 1-4.1: Design Components and Their Life Expectancies

	Design Life Required (years)
New Bridge Structures	75
New Retaining Walls	50
Elevated Guideway	75
Stations – Finishes	40
Stations – At-Grade Station Structures	50
Stations – Underground Station Structures	100
Tunnel – Structure	100
Tunnel – Fit Out	20
Track – Ballast	20
Track – Fixed	20
Ties	20
Switches & Cross-overs	20
Maintenance Building	40
Maintenance Building – Shop Equipment	30
Signalling	30
Communications	20
Vehicles	30
Catenary	40
Traction Power Equipment	40

4.5 Climate Data for Design

- a) Project Co shall use the following climate data where required for design, unless otherwise specified:

Extreme Maximum Temperature	38°C
Extreme Minimum Temperature	-38°C
Extreme Daily Rainfall	95mm
Extreme Daily Snowfall	56cm
Extreme Daily Precipitation	80mm
Extreme Snow Depth	135cm
Maximum Hourly Wind Speed	80km/h
Maximum Wind Gust Speed	135km/h

4.6 Conduit Drainage

a) Underground

- (i) All underground conduit, ductbanks, and maintenance holes for electrical, communication, and systems shall be designed and constructed to prevent the accumulation of water and formation of ice in any component within the system

b) Non-Underground

- (i) All conduit and raceways for electrical, communication, and systems shall be designed and constructed to prevent the accumulation of water to prevent moisture from entering any equipment within the system

ARTICLE 5 ROADWAYS, BUS TERMINALS AND LAYBYS

5.1 Order of Precedence

- a) The Design and Construction of the proposed roadways, bus terminals and laybys within the OLRT Project shall comply with the criteria contained within this Article, and all standards, regulations, policies, Applicable Law, guidelines or practices applicable to the Project, including but not limited to the following Reference Documents. In the event of a conflict between the criteria, commitments or requirements contained in this Article and any of the Reference Documents, the more stringent shall apply:
- (i) The criteria in this Article;
 - (ii) Design Manual 1993 (Draft – the Regional Municipality of Ottawa-Carleton Transportation Department TWY-FUN-03(2) – Revision October 1993);
 - (iii) City of Ottawa Road Corridor Planning & Design Guidelines, Urban & Village Collectors / Rural Arterials & Collectors- October 2008;
 - (iv) Region of Ottawa-Carleton Regional Road Corridor Design Guidelines, July 2000, Region of Ottawa-Carleton;
 - (v) City of Ottawa’s Lighting Criteria including the Right of Way Lighting Policy, Draft August 2009;
 - (vi) City of Ottawa’s Pedestrian Plan, Draft January 2009;
 - (vii) Ontario Traffic Manuals (Books 1 through to 12);
 - (viii) The City of Ottawa’s Current Version of Standard Tender Documents and Specifications
 - (ix) City of Ottawa’s speed zoning policy (Ref N°: ACS2009-COS-PWS-0021 – 24 September 2009)
 - (x) Geometric Design Guide for Canadian Roads (TAC-1999);
 - (xi) Ontario Provincial Standard Specifications and Drawings (OPSS);
 - (xii) Ontario Provincial Standard Drawings (OPSD);
 - (xiii) Geometric Design Standard of Ontario Highways-MTO (1985);
 - (xiv) City of Ottawa CADD Standards;
 - (xv) Highway Drainage Design Standards, 2008 (MTO);
 - (xvi) MOE Stormwater Management Planning and Design Guidelines, 2003;

- (xvii) Drainage Act (Ontario);
- (xviii) MTO Gravity Pipe Design Guidelines for Circular Culverts and Storm Sewers, 2007;
- (xix) Ontario Traffic Manual, MTO;
- (xx) Sign Sheeting Memorandum, February 21, 2008, MTO;
- (xxi) King's Highway Guide Signing Policy Manual;
- (xxii) Geometric Design Standards for Ontario Highways Manual;
- (xxiii) Other relevant "City Operation Policy, Procedures and Guidelines; and
- (xxiv) Road Safety Manual, Ministry of Transportation Ontario;

5.2 General Requirements

- a) The overall requirements of typical cross-section and geometric design criteria for the Design and Construction of the Works are predominantly based on the TAC Manual and the City of Ottawa's Design guidelines. The following criteria apply to all sections of the municipal and regional roadway Infrastructure included in this Project.
- b) Design Domain, Road Classifications and Design Speed Considerations
 - (i) The majority of road Infrastructures impacted as the result of the OLRT Project are categorized as low-speed urban collectors or arterial roads/streets that will be subject to retrofit conditions for low-speed urban roads with Design speed of 30 and 60 km/hr. The designation of Design speed has been assumed with reference to the speed limits currently posted on these existing roadways. The existing posted speed limits deemed to be established according to and/or consistent with the requirements of the City of Ottawa's speed zoning policy (Ref N°: ACS2009-COS-PWS-0021 – 24 September 2009).
 - (ii) The selection of the Design criteria parameters shall be based on the road classifications that can be referenced from the TAC Geometric Design Guide, 1999. Each road or street current designation shall be referenced from the City of Ottawa's 2008 Transportation Master Plan.

5.3 Horizontal Alignment

- a) The geometric characteristics of horizontal Alignment shall meet the requirements of the TAC Geometric Design Guide, 1999. In particular, the following requirements apply:
 - (i) Minimum radius and maximum super elevation requirements shall correspond to the characteristics of lower speed urban (Design speed of 30-60 km/hr, Maximum super elevation $e_{\max} = 0.04$ m/m);

- (ii) Minimum length of curve between 30m to 60m is acceptable for urban conditions; and
- (iii) In case of low-speed urban roads and retrofit conditions, application of spiral curves is not a Design requirement.

5.4 Vertical Alignment

- a) Vertical Alignment shall meet the requirements of the TAC Geometric Design Guide, 1999. The following main geometric parameters pertinent to the vertical Alignment apply:
 - (i) Minimum gradient: Minimum grades shall satisfy the requirements of *Minimum Grades: Design Domain Application Heuristics-Urban Areas*.
 - (ii) Equivalent minimum “K” Values: The vertical curve geometry shall be consistent with the requirements of the TAC Geometric Design Guide, 1999:
 - A. “K” value for crest curves shall satisfy the upper limit of the Stopping Site Distance requirements;
 - B. “K” value for sag curves shall satisfy the upper limit of the requirements of Headlight Control and Comfort Control; and
 - C. DSDs, where applicable, shall be calculated and compared to the requirements of TAC Geometric Design Guide, 1999. For Design Speeds less than 60 km/hr calculate the required DSD using Alberta Transportation Highway Geometric Design Guide, January 2004.

5.5 Access and Intersection Layout

- a) Design and implementation of pavement markings, traffic signs, street lighting, traffic control signals and underground traffic plants shall be in accordance with the requirements of the City of Ottawa’s Electrical, Signals, and Lighting Criteria, relevant by-laws and Ontario’s Traffic Manuals and OPSS Standards.
- b) ISD: ISD requirements, including approach, departure, and crossing ISDs, and visibility triangles shall be controlled using the appropriate Design vehicle(s) at all intersections according to the criteria specified in the TAC Geometric Design Guide, 1999.
- c) Intersection layouts and lane configurations shall be designed to address all users’ requirements including pedestrian, cyclist, transit and vehicular traffic. Intersection Design characteristics that preserve and enhance the public safety, minimize the area impacts, and respond to the traffic demand shall be given precedence.

5.6 Cross-Section Elements

- a) The typical cross-sections of a variety of roadways shall be in accordance with the TAC Geometric Design Guide, 1999. The following specific criteria apply:
 - (i) Auxiliary lane width where applicable shall satisfy the requirements of Special Purpose Lanes;
 - (ii) Bicycle lane width shall be 2.0m as noted in Table 1-5.1;
 - (iii) Cross slope shall be set to 2% m/m toward the curbs in order to provide improved surface drainage runoff on paved tangent roadways; and
 - (iv) Superelevations shall satisfy the requirements of lower speed urban roads (Design speed of 30-60 km/hr, maximum superelevation $e_{\max} = 0.04$ m/m).

5.7 Design Vehicles

- a) The controlling Design vehicles shall be used to control the intersection layout geometry, applicable site distances and roadway horizontal and vertical clearance requirements. Considerations to the largest Design vehicle for each roadway, BRT, ramp, etc. shall be based on the following criteria:
 - (i) Truck Route consideration; The City of Ottawa's Urban and Rural Truck Routes (Revision 01-Jan-2011) shall be referenced to identify the "Restricted Load" and "Unrestricted Load" truck routes corridors throughout the road networks of the City;
 - (ii) Commercial Trucks including WB-19 and WB-20 for truck routes, and HSU for non-truck routes;
 - (iii) Bus vehicles including The City's articulated bus, The City's B-12 standard bus, The City's double decker bus, Inter-City bus, Para Transpo vehicles, and school bus;
 - (iv) Emergency vehicles including fire truck and paramedic truck;
 - (v) Maintenance vehicles including snow removal vehicles and garbage trucks; and
 - (vi) Clearance requirements for opposing left-turn design; In Design of intersections with multiple left-turn lanes, especially where simultaneous opposing left turns exist, attention shall be paid to the appropriate selection of Design vehicles.

5.8 BRT Facilities

- a) The primary Design criteria for the geometric requirements of BRT and Stations shall be the Transitway Design Manual 1993 (Draft – the Regional Municipality of Ottawa – Carleton Transportation Department TWY-FUN-03(2) – Revision October 1993).

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- b) The number of berths required at Tunney’s Pasture, Hurdman, and Blair Bus stations shall be in accordance in accordance with Part 5 Article 2 – Architectural Design Criteria.
- c) Horizontal and vertical geometry, auxiliary lanes, intersection geometry, Cross-Section components, drainage requirements, and other roadway and structural details shall be in accordance with the *Regional Municipality of Ottawa-Carleton Transitway Design Manual*, 1993.
- d) The Design speeds for various components of the BRT facilities shall be as following in accordance with the *Regional Municipality of Ottawa-Carleton Transitway Design Manual*, 1993:
 - (i) Transitway main bus: 90 km/hr (minimum radius 340m)
 - (ii) Station areas: 60 km/hr (minimum radius 130m)
 - (iii) Ramps & access routes 40 km/hr (minimum radius 55m)
- e) Minimum radii of turning bus vehicles for at-grade intersections shall be the following in accordance with the *Regional Municipality of Ottawa-Carleton Transitway Design Manual*, 1993:

Turning speed	Minimum inside radii
0-15 km/hr	12.5m
15-25 km/hr	20m
25-35 km/hr	23m
- f) Bus station layouts and turnaround circulation geometry shall:
 - (i) Accommodate the typical bus Design vehicle utilizing a given berth fully independently of the concurrent activity in the adjacent berth (in-line Platform, independent arrivals, normal berth, etc.).
 - (ii) Accommodate passing lanes (width: 4.0 m.) throughout the Station area.
 - (iii) Satisfy the turning paths, sight distance and clearance envelope requirements for all City bus Design vehicles including articulated bus, B-12 standard bus, and double decker buses, as well as the Emergency vehicles.
- g) At the location of bus platforms in order to drain the surface run-off away from the platform curbs cross-falls shall be -2% away from the platform curb side. The basic cross-section components shall conform to the requirements of the *Transitway Design Manual* 1993 (Draft – the Regional Municipality of Ottawa – Carleton Transportation Department TWY-FUN-03(2) – Revision October 1993). Vertical gradients adopted for bus platforms shall address the drainage run-off and satisfy the requirements of

pedestrians accessibility noted in the City of Ottawa's Pedestrian Plan (Draft January 2009). Sidewalks associated with the Platform area shall have a minimum grade of 0.5% and a maximum grade of 5%.

- h) Bus stop pad, shelters with sidewalk and boulevard shall satisfy the requirements of the City's standard drawings (Ref. 2009ISB Standard Tender Documents, Vol.2 – Standard Detail Drawings).
- i) The Design Criteria for the Roadway Improvements in OLRT Project shall meet the requirements of the following Table 1-5.1.

1-5.1 Design Criteria for the Roadway Improvements in OLRT Project

Geometric Design Criteria – Municipal Roadways						
Criteria Description	Booth St. (Between Albert Street and Ottawa River Pkwy)	Albert St. (Between Commissioner Street and Preston Street)	Rideau St. (Between Sussex Street and Nicholas Street) ¹	Belfast Rd. (Between Tremblay Road and Trainyards Dr.)	Preston Street Detour (Between Albert Street and Ottawa River Pkwy)	Bus Ramps at Tunney’s Pasture Station (Including Bus Link from Transitway to Tunney’s Turnaround and the Goldenrod link to Scott St.)
Road Classification	UAD ²	UAD	UAU	UCU	UAU	N/A
Posted Speed (km/hr)	50	50	50	50	50	N/A ³
Design Speed (km/hr)	60	60	60	60	60	40-60
Basic Lanes	6 or 4 ⁴	See Note 5	2EB + 2WB See Note 1	2	6 ¹⁸	2
Minimum Radius (m)	130	130	130	130	130	55-130
Min. K Factor Sag	15-18	15-18	15-18	15-18	15-18	10-20
Min. K Factor Crest	10-13	10-13	10-13	10-13	10-13	5-15
Max. Grade	3%	3%	3%	6%	3%	3.5% – Where possible 6.0% - Absolute
Max. Superelevation	4%	4%	4%	4%	4%	6%
Minimum SSD (m)	85	85	85	85	85	45-85

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Geometric Design Criteria – Municipal Roadways						
Criteria Description	Booth St. (Between Albert Street and Ottawa River Pkwy)	Albert St. (Between Commissioner Street and Preston Street)	Rideau St. (Between Sussex Street and Nicholas Street) ¹	Belfast Rd. (Between Tremblay Road and Trainyards Dr.)	Preston Street Detour (Between Albert Street and Ottawa River Pkwy)	Bus Ramps at Tunney's Pasture Station (Including Bus Link from Transitway to Tunney's Turnaround and the Goldenrod link to Scott St.)
Minimum DSD (m)	205	205	205	205	205	135-205 ⁶
Lane Width (m)	3.5-3.7 ⁷	3.5-3.7	3.5-4.0	4 ⁸	3.5-3.7	3.5 ⁹
Sidewalk Width (m)	3.0	2.0-2.5	Varies 2.5-6.5 See Note 1	2.0-2.5 (SB)	2.0-2.5 (SB)	N/A
Shoulder (m)	N/A	N/A	N/A	2.2m (NB) ¹⁰	1.0m (NB)	N/A
Bike Lane(m)	2.0 ¹¹	2.0 ¹²	N/A	N/A	N/A	N/A
Median Width (m)	1.5-5.0	1.5-5.0	N/A	N/A	N/A	N/A
Design Vehicle(s)	WB20 and A-Bus	WB20 and A-Bus	WB20, A-Bus, and Emergency vehicles	WB20 and Emergency vehicles	WB20 and A-Bus	The City's A-Bus, B-12 standard bus, and double decker bus
Traffic Background Information¹³						
AADT (Average Annual Daily Traffic) (veh./day)	<ul style="list-style-type: none"> North of Transitway (26-Jul-2010): 20,000 South of Transitway (12-Aug-2009): 20,500 	The section between Booth and Preston (13-Aug-07): 15,700	(25-May-2006) 9,700	(06-May-2009) 12,200	As per Booth Street ¹⁶	As per Transitway Manual ¹⁷

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Geometric Design Criteria – Municipal Roadways						
Criteria Description	Booth St. (Between Albert Street and Ottawa River Pkwy)	Albert St. (Between Commissioner Street and Preston Street)	Rideau St. (Between Sussex Street and Nicholas Street)¹	Belfast Rd. (Between Tremblay Road and Trainyards Dr.)	Preston Street Detour (Between Albert Street and Ottawa River Pkwy)	Bus Ramps at Tunney's Pasture Station (Including Bus Link from Transitway to Tunney's Turnaround and the Goldenrod link to Scott St.)
Heavy Vehicle (%) ¹⁴	<ul style="list-style-type: none"> • North of Transitway (26-Jul-2010): 6% • South of Transitway (12-Aug-2009): 5% 	7%	(25-May-2006) 25%	4%	As per Booth Street ¹⁶	As per Transitway Manual ¹⁷
Traffic Growth Rate Assumption ¹⁵	<ul style="list-style-type: none"> • North of Transitway (26-Jul-2010): <1% • South of Transitway (12-Aug-2009): <1% 	<1%	(25-May-2006) <1%	<1%	As per Booth Street ¹⁶	As per Transitway Manual ¹⁷

1. The Design Criteria for Rideau Street between Sussex Ave and Nicholas Street (including road classification, posted speed, lane arrangements, and basic cross-section components such as lane width, sidewalk width, provision for bus lane, bike lane, etc.) shall be developed by Project Co from a detailed traffic and transit study in consultation with the City as a component of the Rideau Station design. The proposed lane configuration, with the Station design, shall include separate bus stops for OC Transpo and STO buses, dedicated bus lanes in each direction and the number of general traffic lanes determined from the analysis. Sidewalk widths shall be adequate for the proposed pedestrian flows. The number of lanes on Rideau Street shall not be reduced by Project Co without a traffic and transit study that demonstrates that general traffic, transit services and local drop offs for deliveries and taxis can be maintained to a level of service acceptable to the City of Ottawa.
2. The City of Ottawa's 2008 Transportation Master Plan (Map-7) identifies Booth Street as a major collector for the portion south of Albert, and as an arterial road north of Albert. Booth Street shall be illuminated along the entire section north of Albert. All Road Classifications to be confirmed by Project Co with the City.

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3. Where applicable, all posted speed limits and advisory speed signs shall be adopted and applied for BRT bus ramps by The City authority.
4. The Pavement width varies in different sections of the proposed Booth Street between Albert Street and the Ottawa River Parkway. The new Booth Street Bridge structure cross-section shall consist of two 3.5m through lanes, one 2.0m dedicated bike lane, that is segregated from the adjacent through and bus lanes by a 0.5m offset, one 3.5m bus lane, and one 3.9m wide bus platform in each NB and SB direction. North of the Booth Bridge Structure, the cross-section shall consist of one 3.5m through lane, one 4.4m through lane, considered as shared bike lane facility, and one 3.0m sidewalk in each NB and SB directions. South of the Booth Street Bridge Structure is the Booth/Albert Intersection.
5. The Reference Concept depicts a Design that provides for a basic 6-lane divided urban cross-section for Albert Street west of Booth. Project Co shall be responsible for completing a traffic analysis to City requirements to confirm the recommended lane configuration of the Booth/Albert Intersection as well as the widening requirements on Albert Street corridor between Commissioner and Preston.
6. Requirements of DSD are referenced from Table B.2.6 of Alberta Transportation Highway Geometric Design Guide, January 2004. The average DSD is calculated for 40 and 60 km/hr Design speeds.
7. General purpose lanes shall be as wide as 3.50 to 3.70 m and north of the Booth Street Bridge Structure where general purpose lanes are shared with bike lane the lane width shall be between 4.0 to 4.5m. in accordance with Section 7.3.1 of the City of Ottawa Road Corridor Planning & Design Guidelines, Urban & Village Collectors / Rural Arterials & Collectors- October 2008).
8. 4.0m. wide shared cycling lane has been considered for Belfast Road north of Trainyards Dr. The shared cycling lanes shall be between 4.0m and 4.5m wide in accordance with section 7.3.1 of the City of Ottawa Road Corridor Planning & Design Guidelines, Urban & Village Collectors / Rural Arterials & Collectors- October 2008.
9. Transitway Design Manual 1993 (Draft – the Regional Municipality of Ottawa – Carleton Transportation Department TWY-FUN-03(2) – Revision October 1993) sections B.2.2.2, B.2.2.3, B.2.2.4, and B.2.2.5 requirement:
 - B.2.2.2- Along rural sections, lane widths are 3.5m, shoulder widths are 2.5m with paved offsets of 0.25m and roundings are 1.0m; Standard side slopes for both cut and fill sections are 3:1 and maximum slopes are 2:1.
 - B.2.2.3- Along urban sections, lane widths are 3.5m plus a curb offset of 0.5m; an asphalt maintenance strip of minimum width of 2.5m is provided adjacent to the curbs for maintenance vehicles, disabled buses and snow storage.
 - B.2.2.4- Along Station sections, Station stopping lane widths are 3.5m; through lanes are 4.0m plus a 1.0 m offset to the face of the median barrier.
 - B.2.2.5- Along ramp sections, single lane ramps are 4.75m wide; multiple lane ramps have 3.75m wide lanes; In the case of an urban section ramp a curb offset of 0.25m shall be added; maintenance vehicle access as well as Transitway access shall be maintained.
10. The 2.2 m. wide paved shoulder shall accommodate the space required for 0.8m pre-cast permanent concrete barrier (OPSD 911.143) and 1.4m shy line offset in the NB direction
11. Where applicable, shared bike and through lanes shall be between 4.0m and 4.5m wide, according to section 7.3.1 of the City of Ottawa Road Corridor Planning & Design Guidelines, Urban & Village Collectors / Rural Arterials & Collectors- October 2008. For Booth Street, between Albert Street and the Ottawa River Parkway with the exception of the bridge, a shared 4.4 m. lane is required.. On the new Booth Street Bridge Structure a 2.0 m. dedicated bike lane segregated from the adjacent through and bus lanes by 0.5 m. offset is required in both northbound and southbound directions.
12. On Albert Street, from Commissioner Street to Preston Street, segregated bike lane requirements will be determined in coordination with the appropriate City departments.
13. The traffic background information has been developed from vehicle turning movement data sheets provided by the City of Ottawa.
14. Heavy vehicles are vehicles having one rear axle with four or more wheels, or having two or more rear axles. These vehicles include OC Transpo, school and inter-city buses. These vehicles types are included in the turning movement count summary provided by the City of Ottawa, and have been referenced in this table under heavy vehicle.
15. Traffic growth rates are based on 'EMME' model outputs (for 2021 and 2031) provided by the City of Ottawa.
16. Traffic information (AADT, Heavy Truck%, and Growth Rate) for Preston Street are based on Booth Street being detoured to the Preston Street corridor during the new Booth Street construction period. The section of Preston Street between Transitway and Albert St may also be utilized to detour BRT traffic (eastbound and westbound) in addition to the Booth Street traffic diversion during the construction.
17. The Design Criteria for BRT and Stations shall be the Transitway Design Manual 1993 (Draft – the Regional Municipality of Ottawa – Carleton Transportation Department TWY-FUN-03(2) – Revision October 1993).
18. The number of lanes may vary in different sections of the proposed Preston Street Detour between the Ottawa River Parkway and Albert Street. The section of Preston Street Detour between Albert Street and south of the (BRT) Transitway requires 2 additional lanes for BRT traffic detoured to/from Albert Street. The section north of and between

the (BRT) Transitway and Ottawa River Parkway does not require additional lanes for BRT detour traffic as the STO buses are not in dedicated lanes on Booth Street presently. Project Co shall be responsible for completing a traffic analysis to City requirements to confirm the recommended lane configuration.

5.9 Pavement

a) Order of Precedence

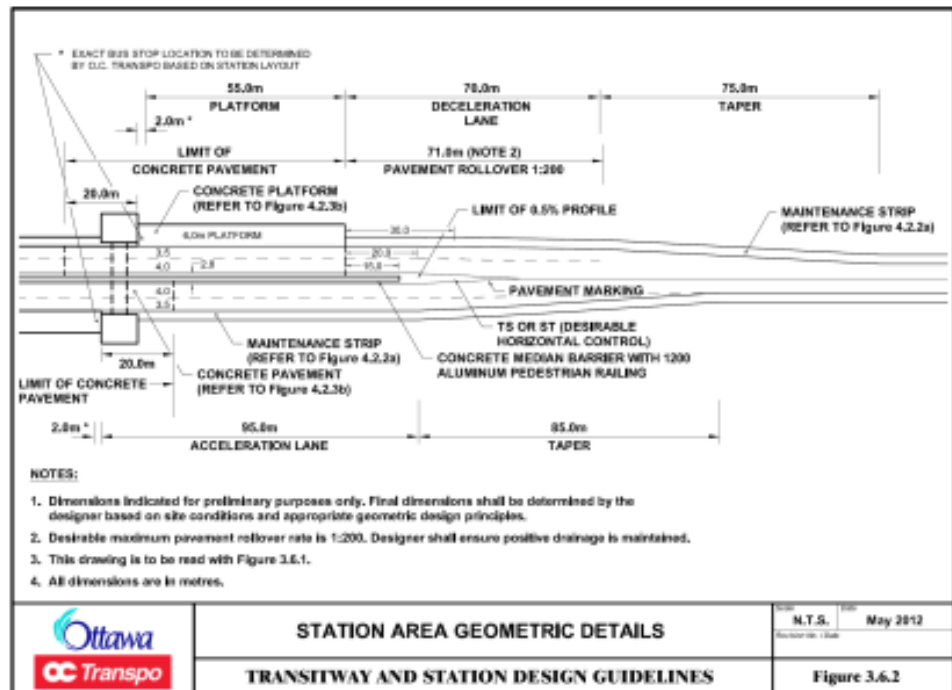
- (i) The Design and Construction of Pavements shall comply with the criteria contained in this Article and all standards, regulations, policies, Applicable Law, guidelines or practices applicable to the Project, including but not limited to each of the following Reference Documents. In the event of a conflict between the criteria, commitments or requirements contained within one document when compared with another, the more stringent shall apply:
 - A. The criteria contained within this Section of this Article;
 - B. The criteria contained within this Article;
 - C. Ontario Pavement and Rehabilitation Manual; 1990;
 - D. Design Manual 1993 (Draft – the Regional Municipality of Ottawa – Carleton Transportation Department TWY-FUN-03(2) – Revision October 1993);
 - E. AASHTO Guide for Design of Pavement Structures, 1993;
 - F. City of Ottawa Technical Information Bulletin – *Superpave Asphalt Mix Selection*, July 2006;
 - G. The City’s Current Version of Standard Tender Documents and Specifications

b) General Requirements

- (i) Project Co shall be responsible for Design of all Pavements. Factors such as traffic volumes, subgrade conditions, environmental effects, Construction traffic, Construction materials and performance of similarly loaded Pavements in the area shall be considered when determining a suitable Pavement Design.
- (ii) Project Co shall identify and acquire any additional geotechnical information that will be required to identify soil conditions/profile of subgrade soils including supplementing and/or confirming existing data.
- (iii) Project Co shall prepare and submit comprehensive Pavement Design Report(s) for the Project as part of the Design Development Submittals according to Schedule 10 – Review Procedure.
- (iv) Design of all new Pavement structures shall be in accordance with the *Ontario Pavement and Rehabilitation Manual* 1993, Design Manual 1993 (Draft – the Regional Municipality of Ottawa – Carleton Transportation Department TWY-FUN-03(2) – Revision October 1993) and AASHTO *Guide for the Design*

of Pavement Structures. For concrete Pavements, both MTO’s Routine Method as described in the SDO-90-01 *Pavement Design and Rehabilitation Manual* and the *Canadian Portland Cement Association’s Simplified Design Procedure* shall be used in addition to the foregoing AASHTO guide.

- (v) If any Roads will be opened to public traffic prior to completing the surface course paving, the Pavement Design shall ensure that the unfinished Pavement is designed to carry public traffic until the surface course is placed.
- (vi) Design of Pavement structures for BRT paved facilities such as lanes, ramps, laybys, and paved storage areas, shall be consistent with the requirements of Section B.5 of the Transitway Design Manual 1993 (Draft – the Regional Municipality of Ottawa – Carleton Transportation Department TWY-FUN-03(2) – Revision October 1993) and the following:
 - A. Outside BRT station platform areas, the Transitway Pavement structure shall be of a flexible (asphalt) Pavement design unless otherwise approved by OC Transpo.
 - B. Within BRT station areas a concrete Pavement structure shall be incorporated within, at a minimum, the limits of the concrete platforms. The following Figure illustrates the approximate limits for concrete Pavement for a typical side loading station. For major stations with center loading platforms, Project Co will review the concrete pavement limits based on the station layout, bus access and operational requirements.



- C. The pavement structure(s) shall be based on Project Co's Pavement Design Report for the Project as part of the Design Development Submittals according to Schedule 10 – Review Procedure. Within access ramps and lay-by locations, which are subject to repeated bus turning movements, Project Co's Pavement Design Report shall provide localized Pavement designs that will mitigate potential Pavement sliding or rutting.
 - D. Factors such as bus volume projections, design vehicles, subgrade conditions, environmental effects, availability of acceptable construction materials, performance of similarly loaded pavements in the area, and economics shall be considered in determining a suitable Pavement design.
 - E. The influence of heavy equipment and delivery vehicles during construction should also be a consideration during the design process, particularly with respect to the thickness of sub-base material and the native subgrade conditions.
- c) Design and Performance Requirements
- (i) The roadway Pavement structure shall conform to the latest standards established by the City.
 - (ii) Design the Pavement structure to have a Pavement life cycle of 25 years.
 - (iii) Project Co shall comply with the following specific OPSS requirements related to the Pavement works, where applicable:
 - A. OPSS 510 for Removals;
 - B. OPSS 206, and 514 for excavation;
 - C. OPSS 212 for Filling;
 - D. OPSS 501 for Granular Material. Thickness shall be suitable for the roadway's intended use;
 - E. OPSS 310, 311, 312 for hot mix asphalt paving. Thicknesses shall be suitable for the roadway's intended use;
 - F. OPSS 350 for concrete Pavement and concrete base. Thickness shall be suitable for its intended use;
 - G. OPSS 353 and 312 for concrete/asphalt, curb and gutter, and medians, where applicable;
 - H. OPSS 405 for Pipe Subdrains; and
 - I. OPSS 355 for Interlocking concrete pavers suitable for its intended use.

5.10 Grading

- a) Project Co shall provide the design, approvals, supply of materials, labour, equipment, inspection and testing associated with the requirements for grading, including earth and rock excavation and embankment Construction, and management of excavated material.
- b) Grading requirements shall conform to the relevant City Standards and Specifications or in absence of such standards to the following:
 - (i) Earth and rock excavation OPSS 206
 - (ii) Borrow, OPSS 212
 - (iii) Compacting OPSS 501
 - (iv) Rip-Rap, Rock Protection and Gravel Sheeting OPSS 511
 - (v) Topsoil, OPSS 570
 - (vi) Seeding and Mulching, OPSS 572
- c) Grading includes excavation of native material and fill of approved materials as required for Construction in accordance with the recommendations resulting from detailed Geotechnical Investigations.

5.11 Drainage

- a) General
 - (i) Drainage Design and Construction shall be in accordance with the criteria contained in this Article and in Part 1 Article 18 – Drainage and Stormwater Management and the applicable Reference Documents.
 - (ii) Project Co shall provide the design, approvals, and supply of materials, labour, equipment, inspection and testing associated with the requirements for drainage as described in these performance specifications.

5.12 Traffic Signals

- a) General
 - (i) Project Co shall be responsible for liaising and coordinating with the City with regard to all modifications that may be required at municipal traffic signals both during and after completion of the Design and Construction. Proposed modifications shall be supported by traffic engineering analysis and meet the City's traffic signal requirements and standards.

- (ii) Where municipal traffic signals are to be included in the traffic signal coordination scheme, Project Co shall define the coordination scheme, and coordinate all work with the City.
- b) Design and Performance Requirements
 - (i) Project Co shall coordinate the design, approvals and Construction requirements for temporary and permanent traffic signals with the City.
 - (ii) The City shall supply and install all above ground traffic signal equipment including controller, poles and signal heads. The City shall also supply and install and make all required terminations for the traffic signal wiring.
 - (iii) Project Co shall be responsible for underground Construction of the permanent traffic infrastructure including supply and Construction of concrete encased ducts, direct buried ducts, pole foundations, maintenance holes, vehicle loop detectors and concrete pads. Project Co shall be responsible for wood poles, double span and anchors, along with any required civil works including conduit, foundations, manholes/hand holes etc., for temporary traffic infrastructure.
 - (iv) Project Co shall provide a minimum of fifteen (15) Business Days advanced notice to the City for the installation of the above ground traffic signal equipment and wiring of the signals to be completed by the City as illustrated on Project Co's Construction Documents.
 - (v) Where Project Co is planning to modify an approach to a signalized intersection beyond OTM Book 7 applications, a three (3) week notification to the City is required. The City will determine if a CAD drawing submission is required by the Project Co.
 - (vi) Traffic Control Plans shall be prepared and submitted as part of the Works Submittal according to Schedule 10 – Review Procedure.
 - (vii) A minimum of ten (10) Business Days prior to Commencement of Construction, Project Co shall arrange a meeting with the City to coordinate the requirements of the electrical work involving the City. Project Co shall provide a schedule of the work to the City and obtain contact names and telephone numbers for the various electrical works to be completed by the City.
 - (viii) Project Co shall provide a minimum of two (2) Business Days advanced notice to the City prior to commencing the following work;
 - A. Permanent Traffic Signals: Underground Construction of the permanent traffic signals including concrete encased ducts, direct buried ducts, pole foundations, maintenance holes, vehicle loop detectors and concrete pads;
 - B. Temporary Traffic Signals: Installation of the temporary traffic signal controller cabinet onto the wood pole; wood poles, double span and

anchors along with any required civil works including conduit, foundations, manholes/hand holes etc., and

- C. Traffic signal activations and deactivations: The City shall be present for all traffic signal activations and deactivations.

5.13 Pavement Marking and Signing

a) General

- (i) Project Co shall provide the design and obtain approvals for all permanent and temporary Pavement marking and roadway signs.
- (ii) Signing and Pavement Marking shall be designed, applied and installed in accordance with the criteria contained in this Article, the requirements of OPS and the applicable Reference Documents.

b) Design and Performance Requirements

- (i) Project Co shall coordinate the design, approvals and Construction requirements for Pavement markings with the City.
- (ii) Project Co shall provide for the supply of materials, labour, equipment, inspection and testing associated with the requirements for all temporary pavement marking.
- (iii) Project Co shall provide for the supply of materials, labour, equipment, inspection and testing associated with the requirements for all temporary and permanent non regulatory signing.
- (iv) The City shall supply all labour, equipment and materials for the supply and installation of all temporary and permanent regulatory signing requirements.
- (v) The City shall supply all labour, equipment and materials for the supply and installation of all permanent Pavement Markings between April 16 and November 14. Project Co shall be responsible for permanent Pavement Markings between November 15 and April 15.
- (vi) Project Co shall be responsible for ensuring the Pavement surface is prepared, clean and free of debris.
- (vii) Project Co shall have completed final grading prior to installation of all permanent and temporary signs. Project Co shall also be responsible for the reinstatement of all areas disturbed during the installation of new or relocated signs.
- (viii) Project Co shall provide a minimum of ten (10) Business Days advanced notice to the City for the installation of the permanent Pavement markings and regulatory

signing to be completed by the City as illustrated on Project Co's Construction Documents.

- (ix) Pavement Marking and Signing CAD drawings shall be prepared and submitted by Project Co at a 1:250 scale.
 - (x) Project Co shall contact the appropriate municipal road authorities to confirm, in writing, the official municipal road names as well as '911' signing requirements. The location, size, and type of each sign shall be indicated on the Traffic Control Plan.
 - (xi) Project Co shall prepare and submit a permanent signing plan and a permanent signing table a minimum of 30 calendar days prior to the implementation of the plan. The permanent signing table shall include, but not be limited to information detailing sign location (station of final location, removal location and on which side of the road to be installed in relation to the direction of travel), height to bottom of sign, lateral offset to post, support type with dimensions, alpha-numeric sign code with dimensions and the message/description, etc.
 - (xii) Project Co shall prepare sign details for the following types of ground-mounted guide Signs: Roadway identification, direction & destination, and location identification. Project Co shall Design and provide all overhead Sign Structures, ground-mounted sign break-away steel supports and associated Sign footings.
- c) Temporary Signing
- (i) Project Co shall be responsible for the design, supply, installation, relocation, Maintenance, and removal of all temporary signage and Pavement Markings, including warning, guide, advisory and directional Signs.
 - (ii) Project Co shall provide signing requirements for all temporary conditions as defined in the Ontario Traffic Manual, throughout the roads. All temporary signing shall be in accordance with the Ontario Traffic Manual, and MTO standards. The location, size and type of each sign shall be indicated on the Traffic Control Plans.
 - (iii) Bilingual signs shall be provided.
 - (iv) There shall be no temporary signing placed between the bullnose of an off-ramp and the bullnose of a downstream on-ramp with the exceptions noted below:
 - A. Wa-33LR Object Marker Sign;
 - B. Wa-132 Ramp Speed KM/H Sign;
 - C. Wa-109 Chevron;
 - D. Post-mounted Delineators;

- E. Wa-175 Truck Overturning Sign & Wa-32t KM/H tab Sign; and
- F. G.f-104 Ground Mounted Exit Sign.
- (v) Project Co shall prepare and submit a temporary signing plan and a temporary signing table a minimum of 30 calendar days prior to the implementation of the plan. The temporary signing table shall include, but, not be limited to information detailing sign location (station of final location, removal location and on which side of the road to be installed in relation to the direction of travel), height to bottom of sign, lateral offset to post #1, support type with dimensions, alpha-numeric sign code with dimensions and the message/description.
- (vi) The temporary signing plan and temporary signing table shall be submitted to the City in accordance with the requirements of the Review Procedure 30 calendar days prior to implementation of the plan.

5.14 Street Lighting

a) General

- (i) Project Co shall provide the design, approvals, and supply of materials, labour, equipment, inspection and testing associated with the City's requirements for Street lighting.

b) Design and Performance Requirements

- (i) Project Co shall coordinate the Design and Construction requirements for permanent street lighting with the City. Street lighting shall meet the requirement of the City of Ottawa Right of Way Lighting Policy, Version 2009
- (ii) Lighting Design for rights-of-way in the City shall be performed or supervised by a Professional Engineer. The lighting Design together with the lighting calculation summary shall be prepared and submitted as part of the Works Submittals according to Schedule 10 – Review Procedure.
- (iii) Bicycle lanes shall be illuminated based on the required roadway lighting levels stipulated in the City of Ottawa Right of Way Lighting Policy, Version 2009. Any illumination requirements shall be governed by the strategy for roadway lighting.
- (iv) Roadway lighting systems shall meet the Conditions of Service set out by the local Electrical Supply Authorities and the ESA.
- (v) Where above ground Utility poles are located within public rights-of-way, these poles shall be utilized, where possible, for the installation of luminaires in order to minimize the number of poles. These joint use Hydro/street light poles shall be coordinated with the local Electrical Supply Authority and shall satisfy the requirements of *Ontario Regulation 22/04 Electrical Distribution Safety (Electricity Act 1998)* for third party equipment mounted on Hydro utility poles.

- (vi) Project Co shall be responsible for the Design coordination of electrical power feeds for all alterations to existing street lighting, temporary lighting and new street lighting. The City shall perform all work impacting existing City owned street lighting within the contract limits, including pole removal (concrete foundations to be removed by the Project Co), wiring, luminaire replacement and aerial cables. Project Co shall coordinate its work with the City.
 - (vii) Project Co shall provide a minimum of fifteen (15) Business Days advanced notice to the City for the installation of temporary roadway illumination and removal of existing roadway illumination.
 - (viii) A minimum of ten (10) Business Days prior to the Commencement of Construction, Project Co shall arrange a meeting with the City to coordinate the requirements of the electrical work involving the City. Project Co shall provide a schedule of its proposed work to the City and obtain contact names and telephone numbers for the various electrical works to be completed by the City.
 - (ix) Lighting shall not contain an upward component. Light Trespass and Disability Glare for drivers shall be minimized.
 - (x) All Roadway luminaries shall be Full Cut-Off.
 - (xi) All permanent roadway lighting levels shall meet the appropriate standard for the roadway classification.
- c) Temporary Lighting During Construction
- (i) All existing lighting in each staging phase shall be maintained in operational order during performance of the Construction on the relevant Construction phase until such time as replacement temporary or permanent lighting is energized.
 - (ii) Temporary illumination shall be provided for the roads to accommodate traffic detours and diversions in accordance with the OPSS 601 and Electrical Engineering Manual (MTO).

5.15 Miscellaneous

- a) Dust Suppressants
 - (i) Project Co shall provide the design, approvals, and supply of materials, labour, equipment, inspection and testing associated with application of dust suppressants in accordance with the City of Ottawa Standards and Specifications and OPSS 506.
- b) Rip Rap Protection and Gravel Sheeting

- (i) Project Co shall provide the design, approvals, and supply of materials, labour, equipment, inspection and testing associated with rip-rap, rock protection in accordance with the City of Ottawa Standards and Specifications and OPSS 511.

- c) Dewatering
 - (i) Project Co shall provide the design, approvals, supply of materials, labour, equipment, inspection and testing associated with the dewatering of pipelines, utility and associated structure excavation to stabilize the ground and keep excavations free of water.

ARTICLE 6 UTILITY DESIGN CRITERIA

6.1 Project Co General Responsibility

- a) Project Co shall be solely responsible for confirming the actual locations of all Utility Infrastructure within the Lands, identifying all Utility Infrastructure relocation requirements, developing and carrying out a Utility Infrastructure Relocation Plan, and performing all required work and coordination with all Utility Companies in connection with the Construction, installation, operation, repair, preservation, relocation, or Maintenance of Utility Infrastructure in, on, under, over, or adjacent to the Lands.
- b) Project Co shall prepare and submit a Utility Relocation Plan in accordance with the requirements of Schedule 10 – Review Procedure.
- c) The City has negotiated memoranda of understanding that set out the general terms for conducting the required work relating to the relocation of Utility Infrastructure with all Utility Companies that have Utility Infrastructure on, in, under, over, and/or adjacent to the Lands at Commercial Close. Project Co shall be responsible for developing and reaching its own agreements with the Utility Companies as required. The City memoranda shall only serve as a basis for these agreements.
- d) Project Co shall not construct, install or permit the Construction or installation of any Utility Infrastructure on, in, under or over the Lands or any part thereof without the prior written consent of the City (which consent may be given or withheld in the discretion of the City).
- e) Without limiting the generality of the foregoing, at no time shall Project Co use or permit the use of the Lands or any other OLRT Infrastructure for Utility Infrastructure (other than Utility Infrastructure, if any, located within the Lands at Commercial Close) without the prior written consent of the City (which consent may be given or withheld in the discretion of the City).
- f) Project Co shall provide access within two (2) hours of request from all Utility Companies to their respective Utilities.
- g) Project Co shall replace all surface and subsurface features disturbed, damaged or removed during the activities related to the Work and reinstate to original or better condition. All such work in accordance with current City or individual standards and specifications.
- h) All detour routes, lane shifts and diversions required to undertake Utility works shall be in accordance with the requirements of Schedule 15-2 Part 7.
- i) All BRT Lane Closures and Lane Closures to undertake Utility works shall be in accordance with the requirements of PA Schedule 37.

6.2 General Provisions for Utility Work

- a) Project Co shall provide, at all times, continuity of Utility service to properties adjoining the Lands. Where utility work affects service to adjacent property owners, Project Co shall coordinate and/or perform such Utility work so as to minimize interference to those affected.
- b) The utilities listed in Part 1 Article 7 – Enabling Works shall not be relocated by Project Co without prior approval of the City.

6.3 Protection of Utilities

- a) All Utility Infrastructure located at Commercial Close or thereafter on, in, under, over, or adjacent to the Lands (including Utility Infrastructure within any excavation) are to remain in service and be protected and preserved by Project Co throughout the Project Term unless otherwise agreed upon by the Utility Company.
- b) Project Co shall be responsible for any damage done by any Project Co Party to Utility Infrastructure throughout the Project Term.
- c) For all Utilities crossing the Lands, utilize the Transport Canada document titled *Standard Respecting Pipeline Crossings Under Railways*. This document shall be utilized for all utilities regardless of the age of the utility.
- d) Project Co shall not damage the Hydro One tower located adjacent to Belfast Road.
- e) Project Co shall maintain the existing OC Transpo optical fibre feed to the BRT stations during OLRT Construction and for the duration of the Maintenance Term. Any temporary communications arrangements to maintain the OC Transpo communications network during Construction shall not disrupt OC Transpo operations or degrade existing OC Transpo network performance.

6.4 Location

- a) Project Co shall be responsible for confirming the actual locations of all Utility Infrastructure, from Financial Close to the Final Completion Date, located on, in, under or over the Lands and ensuring compliance at all times with the provisions of this Schedule 15-2. Project Co shall not rely solely on previous engineering work, location plans, as-built drawings supplied by Utility Companies or other similar documents for confirming locations of Utility Infrastructure.
- b) Project Co shall ensure that a member of its team has a minimum level II (secret) clearance with the Department of Public Works and Government Services in order to access documentation from the Department of Public Works and Government Services throughout the Project.

6.5 Project Co Responsibilities for Utility Work

- a) Project Co shall be responsible for all temporary and permanent Utility Infrastructure required in connection with or as part of the Project, and for all utility work to be carried out in connection with or as part of the Work under the provisions outlined in Project Co's Utility Infrastructure relocation strategy and any Utility Agreements reached with Utility Companies. Subject to the rights of Utility Companies, all utility work shall be carried out by or under the supervision of and at the risk and expense of Project Co and, without limiting the generality of the foregoing, Project Co shall be responsible for:
- (i) obtaining all rights of entry or access to the relevant Utility Infrastructure that are necessary or expedient in connection with the utility work or providing access to the relevant Lands if such work is to be carried out by the Utility Company;
 - (ii) identifying all requirements in respect of the utility work, including determining the most effective strategies for undertaking the utility work;
 - (iii) liaising, arranging, coordinating, and entering into all necessary agreements with relevant Utility Companies in connection with the utility work, including obtaining any necessary consents or approvals in connection therewith, providing access for inspections and providing information and plans during and following completion of the Utility work;
 - (iv) ensuring that all Permits, Licences, and Approvals in connection with the Utility work are obtained, including preparing all required documentation in connection therewith;
 - (v) observing and complying with any instructions or directions relating to the Utility work that may be issued by the City on its own behalf or on behalf of a relevant Utility Company;
 - (vi) securing or causing to be secured the entry into or execution of all relevant construction and maintenance agreements, service contracts, and other agreements in connection with the Utility Work;
 - (vii) when any Utility Work affecting the Utility Infrastructure referred to in a Utility Agreement is to be carried out by or on behalf of Project Co, Project Co shall, prior to commencing such Utility Work, give reasonable written notice to the relevant Utility Company confirming that the Utility Work is being carried out by or on behalf of Project Co pursuant to this Project Agreement;
 - (viii) Project Co shall complete any utility abandonment as per the standards of the relevant Utility Company;
 - (ix) For Bell, Project Co shall install all necessary temporary and/or permanent civil works associated with the relocation of the Utility Infrastructure, which may include duct banks, maintenance holes, handwells, vaults, pads, etc. for the

purpose of the installation of Bell's plant. The civil works shall be installed as per the standards and specifications of Bell.

- (x) For telecommunication utility companies, Project Co shall design and install all necessary temporary and/or permanent civil works associated with the relocation of the Utility Infrastructure, which may include duct banks, maintenance holes, handwells, vaults, pads, etc. for the purpose of the installation of the relevant telecommunication utility company's plant. The civil works shall be installed as per the standards and specifications of the corresponding Utility Company.
 - (xi) For HOL Project Co shall install all necessary temporary and/or permanent civil works associated with the relocation of the utility infrastructure, which may include duct banks, maintenance holes, handwells, vaults, pads, etc. for the purpose of the installation of the HOL's plant. The civil works shall be installed as per the standards and specifications of the corresponding Utility Company.
- b) The Utility Companies shall be individually responsible for the following work which will be covered in the cash allowance (Utilities Work) as noted in Project Agreement Section 20.13:
- (i) Bell shall be responsible for the design of all necessary temporary and/or permanent civil works associated with the relocation of the Utility Infrastructure, which may include duct banks, maintenance holes, handwells, vaults, pads, etc. for the purpose of the installation of the Bell's plant. Bell shall be responsible for the design and installation of all temporary and/or permanent plant works required including wiring, cables, fibres, equipment, etc., installed or placed in, on, over, under or through the civil works including connections to existing Utility Infrastructure for their plant;
 - (ii) Telecommunication Utility Companies shall be responsible for the design and installation of any temporary and/or permanent plant works including wiring, cables, fibres, equipment, etc., installed or placed in, on, over, under or through the civil works including connections to existing Utility Infrastructure;
 - (iii) HOL shall be responsible for the design of all necessary temporary and/or permanent civil works associated with the relocation of the Utility Infrastructure, which may include duct banks, maintenance holes, handwells, vaults, pads, etc. for the purpose of the installation of the HOL's plant. HOL shall be responsible for the design and installation of all temporary and/or permanent plant works required including wiring, cables, equipment, etc., installed or placed in, on, over, under or through the civil works including connections to existing Utility Infrastructure for their plant; and
 - (iv) Enbridge shall be responsible for all design and installation of all temporary and/or permanent works required for their plant.

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- c) Project Co shall attend and update the Ottawa UCC at the first UCC meeting of each year with the following:
 - (i) On-going stray current assessment and mitigation response;
 - (ii) Major maintenance plans for the up-coming year to allow other utilities to coordinate; and
 - (iii) Change of standards, procedures, and methods that would affect other utilities.

6.6 Watermain Requirements

- a) All watermain Design and Construction shall conform to all relevant codes and standards.
- b) The timing of watermain relocations are subject to operational constraints and require hydraulic modelling, by the City, to ensure the adequate supply of water. Project Co shall coordinate the scheduling of all watermain relocation work with the City.
- c) Project Co shall not remove the watermain on Booth Street prior to the completion of a new watermain connecting Albert Street to Fleet Street.
- d) Project Co shall engage a company that can demonstrate a minimum of 10 years of experience in large diameter watermain installation, 3 references where large diameter watermain installation has been provided within the last 5 years, and describe the experience of said company, as well as the individuals who shall be responsible for the management and services delivery and their relevant experience and qualifications, to the City in accordance with the requirements of Schedule 10 – Review Procedure.

6.7 Storm and Sanitary Sewerage System Requirements

- a) Storm and Sanitary Sewer requirements shall conform to all relevant codes and standards.
- b) Relocate sewer maintenance holes out of the OLRT Guideway. By exception-basis only, an offset maintenance hole may be considered at the City’s discretion.
- c) Project Co shall conduct a precondition survey by way of CCTV on all storm and sanitary sewers within the construction limits as per the City of Ottawa Standards.
- d) Relocation of the Merton Street storm sewer shall be completed between November 15th and April 15th of any year.

6.8 Hydro Ottawa Limited

- a) Refer to Appendix H in the “Hydro Ottawa Information to Support the City of Ottawa’s Proposed light Rail System – Phase 1” report, provided in the Data Room for details regarding limits of responsibility for Underground Stations and At-Grade Stations electrical equipment. HOL will operate up to the electrical ownership demarcation point and may operate the customer’s first protective device in from Hydro Ottawa’s

distribution system. HOL clarifies the customer's interface responsibilities with the connection agreement. HOL defines three areas of responsibility between itself and the customer's interface: ownership demarcation ('O'), electrical control authority ('C'), and maintenance authority ('M'). All electrical devices and support structures on HOL's distribution system receive unique identifying nomenclature with the required 'OCM' suffix indicating the defined roles.

- b) Project Co shall ensure that HOL's control authority and staff has 24/7 access to its primary circuits to control the distribution system, ensure public safety, and replace failed components, and a maximum field emergency response time of 60 minutes not withstanding a force majeure. Typical circuit restoration times are outlined in the "Hydro Ottawa Information to Support the City of Ottawa's Proposed light Rail System – Phase 1" report, which is available in the Data Room as Background Information. As well, Project Co shall ensure it has only one control authority over the OLRT electrical system.
- c) Automatic load transfer scheme may be deployed by Project Co where higher than normal reliability is required. Such schemes are subject to HOL approval and any such scheme will be required to be break before make (open transition of greater than 100 milliseconds) configuration. An ongoing monthly stand-by HOL reliability backup capacity charge shall apply where Project Co automatic transfer schemes are implemented and approved and such standby charges shall be the responsibility of Project Co.

ARTICLE 7 ENABLING AND EARLY WORKS

7.1 Hydro Ottawa Limited Enabling Works

- a) The following work is planned to commence by HOL in 2012 in coordination with the City:
 - (i) Temporary Construction Power:
 - A. TWP (Tunnel - West Portal)
 - B. DTW (Downtown West Station)
 - C. RID (Rideau Station)
 - D. TEP (Tunnel – East Portal)
 - E. MSF
 - (ii) HOL forecasts completion of Temporary Power works during Q2 2013 and as detailed in “HOL Temporary Electrical Construction Power” report provided in the Data Room.
- b) Table 1-7.1 summarizes the planned temporary construction power requirements to be provided by HOL recognizing that 1.5 MVA is the maximum capacity 13.2 KV transformer that HOL can provide. Project Co shall be responsible for providing and installing any transformers of greater capacity that may be required to support their construction power needs.

Table 1-7.1: Planned Temporary Construction Power Requirements

Location	Meter #1	Meter #2	Transformer #1	Transformer #2	Equipment Configuration
TWP	7 MVA	5 MVA	Customer Owned	HOL 1.5MVA pad	92006563 E1
DTW	7 MVA	N/A	Customer Owned	N/A	UGS0007
RID	7 MVA	N/A	Customer Owned	N/A	UGS0007
TEP	7 MVA	5 MVA	Customer Owned	HOL 1.5MVA pad	92006563 E1
MSF	Secondary	N/A	HOL 750 kVA pad	N/A	UGS0007

- (i) Temporary Plant Relocation:

- A. TWP (Commissioner)
 - (ii) Permanent Plant Relocation:
 - A. TWP (old Wellington)
 - (iii) System Expansion:
 - A. TWP
 - B. DTW
 - C. RID
 - D. TPS04 (Traction Power Substation 4 - near Campus Station) (King Edward)
 - i. This work is divided over two different time periods (Enabling and Early). The initial underground primary cable, from King Edward HOL substation to King Edward Avenue at Laurier Avenue, is planned to commence in 2012 to supply the temporary supply requirements at TEP. Once construction at TEP is complete, HOL plans to re-use this cable in 2016 for TSP04 permanent supply power by adding on another piece of underground primary cable from King Edward Avenue at Laurier Avenue to King Edward Avenue at Mann Avenue.
- c) Project Co shall provide HOL the required power details for temporary connection assets to support temporary construction power.

7.2 Hydro Ottawa Limited Early Works

- a) Project Co shall be responsible for all coordination of works and timely flow of information, in particular a Level D loading schedule to support permanent power needs, with HOL through own contractual agreements and memorandums.

7.3 Infrastructure Services Department (ISD) Enabling Works

- a) The following work is planned by the City. The City will complete all of the design and construction of the Innes Road Widening, Blair/174 interchange modifications, Blair Road and Gloucester Centre entrance modifications. The work is scheduled for tender in 2013 with construction complete in 2014. Project Co shall be responsible to coordinate their work with respect to these roadway modifications being undertaken by the City.
 - (i) Highway 417/OR 174 eastbound Ramp: Should OR174 and Highway 417 be used as a BRT detour, the 417WB to OR174EB Ramp shall be temporarily closed during the period of time the BRT detour is in operation. This is required to allow

the 417 EB to OR174 EB BRT Detour to operate without the buses mixing with general traffic.

- (ii) OR 174 Road Interchange Modifications: There are modifications to the Blair Road/OR174 interchange westbound ramp required for Transit Priority measures.
- (iii) Blair Road and Gloucester Center Entrance Modifications: A northbound double left-turn lane from Blair Road into Gloucester Centre and associated entrance road receiving lanes will be required to accommodate the BRT detour. In addition, Blair Road northbound lanes will be realigned from three lanes to two lanes to match the downstream northbound right turn lanes and through lanes at Ogilvie Road.

ARTICLE 8 COMMITMENTS AND COMPLIANCE REQUIREMENTS

8.1 General Requirements

- a) In addition to Project Co's obligations under Schedule 17 – Environmental Obligations, Project Co shall ensure that the following commitments, which were made during various public consultations, are addressed:
 - (i) Project Co shall provide for effective pedestrian connections to Bayview Station via Albert Street from the Hintonburg and Dalhousie neighbourhoods.
 - (ii) Project Co, by use of one or all of the following options, and in consultation with The City, shall provide for bicycles to use the LRT:
 - A. Bicycles shall only be permitted on the last car of any Train.
 - B. Bicycles shall only be permitted on Trains during off-peak hours.

8.2 City of Ottawa Council Direction

- a) Per the results of DOTT Planning and EA – Recommended Plan (16-Dec-09 <http://www.ottawa.ca/calendar/ottawa/citycouncil/tc/2009/12-16/disposition40eng.htm> ISCS - RIO), Project Co shall comply with the following:
 - (i) Direction to use Kent and Lyon Streets as detour streets only as a last resort and ensure that those alternative detour corridors are explored for use during and after DOTT construction.
 - (ii) Direction to find, identify and include alternate ways of providing priority to transit vehicles moving from eastbound Albert to northbound Booth.
 - (iii) Direction to explore options to ensure that there is room for the BikeWest project to safely pass the Tunney's Pasture Station on the south side between the station and Scott Street.

8.3 List of External Stakeholders

- a) In addition to the requirements and Stakeholders denoted in Schedule 17 – Environmental Obligations and Schedule 18 – Communications and Consultations of this Project Agreement, Project Co include in its Consultation Plan, the following Stakeholders:
 - (i) CPCS Transcom Ltd.
 - (ii) Steer Davies Gleave
 - (iii) Noxon Associates
 - (iv) Acart Communications

- (v) Economic Development Branch
- (vi) Ottawa Seniors Transportation Committee
- (vii) RCAC
- (viii) Envirocentre
- (ix) University of Ottawa
- (x) School Travel Planning / Green Communities Canada
- (xi) Cycling Vision
- (xii) Citizens for Safe Cycling
- (xiii) OSTC
- (xiv) PTAC

ARTICLE 9 SAFETY MANAGEMENT PLAN

9.1 General Requirements

- a) The SMP shall be in accordance with the criteria contained in this Article and all Applicable Law.
- b) The SMP shall be prepared and submitted as part of the Works Submittals according to Schedule 10 – Review Procedure. Project Co shall coordinate with the City to ensure existing maintenance, and safety plans are not violated.
- c) Project Co, upon request, shall make available a valid Clearance Certificate from the Workplace Safety and Insurance Board.

9.2 Safety Management Plan

- a) The SMP shall demonstrate in detail how Project Co shall meet all of its obligations under the OHSA. The SMP shall also include, but is not limited to, the obligations to: provide a safe workplace; provide information and educate workers on workplace hazards; appoint a designated safety officer; prepare and implement a health and safety policy, mine rescue plan, implement a comprehensive health and safety program to support the policy and take every reasonable precaution to protect the health and safety of Project Co personnel and ensure safe passage for the public.
- b) Project Co’s SMP shall take into account a PHA and TVA, and shall include, but not be limited to the following:
 - (i) Safety Policy Statement
 - A. The SMP shall include a Safety Policy Statement that clearly articulates Project Co’s health and safety objectives and its commitment to continually improve the effectiveness of the implemented SMP. The Safety Policy Statement shall be communicated to all of Project Co personnel and shall be reviewed, as a minimum, annually to ensure it is current.
 - (ii) Safety Management
 - A. The personnel and responsible staff who shall implement, maintain, and enforce the SMP rules and policies shall be identified. As a minimum, Project Co shall provide a full time on-the-job safety manager meeting the qualifications outlined below. In addition, Project Co’s safety management shall also have the minimum additional designated personnel identified below.
 - B. The safety manager’s qualifications, as a minimum, shall include:

- i. 15 years of progressive safety management experience on complex rail infrastructure projects;
 - ii. Training and current certification for CPR and First Aid;
 - iii. Possess verifiable competency in the Construction safety disciplines related to the Works to be performed and/or retain fulltime competent persons required by provincial and federal safety standards;
 - iv. Training in the development and presentation of safety training programs and meetings; and
 - v. Knowledge in safety incentive programs.
- C. As part of Project Co's safety management, all work shifts shall have, as a minimum, an onsite shift safety representative. The shift safety representative shall have the following minimum qualifications:
- i. Three years of progressive safety experience and general competency in the Construction safety disciplines related to the Works; and
 - ii. Training and current certification for CPR and First Aid.
- D. The SMP shall define the role and responsibilities of the safety manager and safety staff, the hierarchical relationship between the safety manager and other managers, supervisors, and employees, and how responsibility and accountability for safety shall be incorporated at all levels.
- E. A clearly stated policy shall be provided that articulates the obligations of all personnel in adhering to the policy.
- F. Clear goals shall be established and communicated, for safety, security, and health, including defined objectives for meeting the goals.
- G. Requirements for evaluating the effectiveness of policies and measuring success in meeting the goals and objectives of the SMP shall be set forth. An environment and means for continuous evaluation and improvement shall be established to achieve the SMP goals and to identify deficiencies so that the goals and objectives can be revised as needed.
- H. A process through which all incidents, emergencies, accidents, and injuries are reported, investigated, and documented shall be established. In addition, provision shall be made that investigation of all accidents be conducted by a trained accident investigator.

(iii) Worksite and Jobsite Analysis

- A. Procedures and requirements shall be established for a comprehensive baseline worksite survey for safety, security, and health issues. In addition, requirements shall be established to involve employees in periodic update surveys, performing routine job hazard analyses, and conducting regular site safety, security, and health inspections so that new or previously missed hazards and hazard control failures, are identified.
 - B. A reliable system shall be provided that allows employees to notify management personnel about conditions that appear hazardous, and to receive timely and appropriate responses, without fear of reprisal.
 - C. Procedures shall be established to investigate accidents and “near miss” incidents so that their causes and means of prevention can be identified. The procedures shall provide a means for analyses of injury and illness trends so that patterns with common causes can be identified and prevented.
- (iv) Hazard Prevention and Personal Safety
- A. Methods and procedures shall be provided to identify and detail all hazards that may be encountered by employees while performing the Works. Practices and procedures shall be developed and implemented to address prevention of identified hazards. A communications protocol shall be established to ensure all employers and employees are aware of hazards in all areas and how to deal with them appropriately. Means shall be provided to evaluate all anticipated and unanticipated activities, and address potential hazards related to these activities.
 - B. Means shall be provided to ensure employees understand and comply with safe work practices and procedures through training, positive reinforcement, correction of unsafe performance, and if necessary, enforcement through a clearly communicated disciplinary system.
 - C. Project Co shall handle hazardous materials in compliance with Schedule 17 – Environmental Obligations, and the applicable requirements of this Article.
- (v) Training
- A. Methods shall be established to identify, develop, and provide relevant training for employees and supervisors designed to ensure that all employees understand and are aware of the hazards to which they may be exposed, and are aware of the proper methods for avoiding the hazards.
 - B. Methods shall be established to identify, develop, and provide supervisory training programs to ensure supervisors understand the key role they play in job site safety and to enable them to carry out their safety and health

responsibilities effectively; to analyze the work under their supervision to anticipate and identify potential hazards; and to maintain physical protection in their work areas, including the establishment of policies that ensure each employee is provided with the equipment necessary to complete assigned tasks safely.

C. Procedures shall be provided to plan and prepare for emergencies, and to conduct training and Emergency drills, as required.

(vi) Incident and Emergency Management

A. Project Co shall provide comprehensive policies and procedures pertaining to incident and Emergency planning, response, mitigation, and recovery. Policies and procedures for safety during incidents and emergencies shall also be addressed. Project Co shall establish procedures to achieve at a minimum, the following:

- i. Maintain communication for the exchange of information between Project Co, the City, and other involved agencies;
- ii. Develop coordinated support through interaction with local, provincial, and federal governmental entities, as well as other entities, for safe and efficient Construction;
- iii. Discuss and coordinate Emergency response, traffic control, security, and operational issues affecting Construction of the Project, and associated system feeders and exits; and
- iv. Update Emergency response agencies regarding status of Construction of the Project, and associated system feeders and exits, to assure safe and timely response to Emergency events. As a minimum, this shall include off-site and on-site traffic routing changes, and changes to job site access, fire suppression system modifications and in-service availability of standpipes or fire suppression water supply, and changes in the Work that may create a greater likelihood of occurrence of a particular type of Emergency.

(vii) Safety Records

A. Project Co shall maintain safety records to provide verification of conformity to Project Co's SMP requirements. Safety records shall be in electronic format and shall be legible, readily identifiable and retrievable and available to the City upon request.

(viii) Accidents and Incidents

- A. The SMP shall include a process to ensure all accidents and incidents are investigated, documented and reported in compliance with all Applicable Law. Accident and incident investigation shall be conducted by qualified personnel, and where corrective and preventive action is required; all such action shall be fully documented and completed.

- B. In addition to the above requirements Project Co shall immediately notify the City of all MOL orders/ charges related to the Work, including documentation of all actions/correspondence undertaken.

ARTICLE 10 SAFETY AND SECURITY CERTIFICATION

10.1 Safety and Security Certification

- a) The Project Design shall be compliant with safety and security criteria, codes, and regulations including Ontario Human Rights Commission Policy and Guidelines on Disability and the Duty to Accommodate requirements, with safety and security of Passengers and employees as the most important requirement of the Project.
- b) Project Co shall be responsible for the preparation of and compliance with the Project's SSCP through strict conformance to contractual obligations. Project Co shall manage its Work and that of its Subcontractors' through final design, Construction and integrated testing in such a way as to support the overall success of the certification process and the ultimate acceptance by the City.
- c) Project Co shall be responsible for performing safety and security certification tasks as specified herein in accordance with IEC 61508. These tasks shall be managed and performed in accordance with the Project SSCP.
- d) Project Co's management responsibilities shall include, but are not limited to, the following:
 - (i) Participation in meetings with the City's SSCRT.
 - (ii) Completion and maintenance of appropriate validation and verification activities and other evidentiary documentation required to monitor the successful completion of safety and security certification. Project Co shall develop a systems assurance process to track PHA, safety and hazard analyses and any subsequent checklist items to final closure and provide status as the Project progresses. The checklists include, but are not limited to, safety and security related conformance for the following:
 - A. Design Criteria;
 - B. Construction Specifications;
 - C. Testing;
 - D. Hazard and vulnerability resolution; and
 - E. Operations and Maintenance manuals.
 - (iii) Cooperation and facilitation of safety and security audits of its work and that of its Subcontractors.
 - (iv) Preparing and submitting Certificates of Conformance to the City according to Schedule 10 – Review Procedure.

- (v) Coordinating, documenting and performing training as specified in the Project Agreement.
 - (vi) Maintaining and updating files and submitting documentation on a timely basis.
 - (vii) Preparing safety and security certification progress reports every other month.
 - (viii) Submitting a record copy of safety and security certification files to the City upon completion of the Work.
- e) Project Co’s responsibilities are defined in the following table. The responsibilities are identified as Primary (P) or Secondary (S). For tasks identified as primary responsibility (P) Project Co shall be responsible for the performance of the activity. For tasks identified as secondary responsibility (S) Project Co shall be responsible to provide support, as required, to accomplish the task. The SSCP describes comprehensive primary and secondary responsibilities for the tasks identified below.

Table 1-10.1

Project Co Safety and Security Responsibilities Matrix		
Safety and Security Certification Tasks	Project Co Responsibility	Comments
Attend SSRCT and FLSSC review meetings and participate in activities as needed.	S	
Perform PHA and hazard analysis	P	
Incorporate resolutions of PHA, hazard analysis mitigations into design, and maintain files and contribute to the hazard tracking system	P	
Perform Train Control Hazard Analysis and supplementary Hazard Analysis, if necessary, and Integrate results into Design.	P	
Perform TVA and supplementary TVA; as necessary	P	
Incorporate TVA results into design, and maintain files and contribute to vulnerability tracking system.	P	
Update Design Criteria Conformance Checklists and Construction Specification Conformance Checklists	P	
Verify Design Criteria Conformance Checklists and Construction Specification Conformance Checklists for completed Work	P	
Prepare and submit Design Criteria Conformance Certificates of Completed Design for acceptance	P	

Project Co Safety and Security Responsibilities Matrix		
Safety and Security Certification Tasks	Project Co Responsibility	Comments
Prepare and submit Construction Specification Conformance Certificates of Completed Work for acceptance	P	
Update Safety Related Testing Conformance Checklists	P	
Perform safety related testing	P	
Verify Safety Related Testing Conformance Checklists	P	
Prepare and submit Safety Related Testing Conformance Certificates of Completed work for acceptance	P	
Cooperate and facilitate safety and security audits of the Project Co's	S	
Develop and implement the System Integration Test Plan	P	
Develop and implement the System Activation Plan and Procedures	P	
Attend Safety and Security Operations Review Committee meetings and participate in activities as needed.	S	
Complete Project Co Provided Training, Project Co Provided Operations and Maintenance Manual Conformance, and Issue Certificates	P	
Coordinate and Participate in Emergency Drills	S	Participate
Follow sensitive security information Procedures	P	
Update and maintenance of System Safety Case	P	

f) Following is additional explanation of some of the safety and security certification activities to be performed by Project Co.:

(i) Design criteria conformance: Project Co shall verify that the safety and security related criteria requirements are incorporated in the Construction Documents prepared as part of Project Co's completed Design. Project Co shall perform the following activities for the safety and security related criteria conformance;

A. An initial Design criteria conformance checklist shall be prepared and verified by Project Co for the design level of the Contract Documents. Project Co shall review and update the Design criteria conformance checklist and verify that Project Co's completed designs comply with the

- safety and security related criteria requirements. All requirements on the checklist shall be verified and submitted according to Schedule 10 – Review Procedure;
- B. Project Co shall verify that the completed designs meet the Ontario Human Rights Commission Policy and Guidelines on Disability and the Duty to Accommodate and other applicable code and regulatory compliance;
 - C. Project Co shall verify that all safety and security related Design review comments have been successfully resolved; and
 - D. After completion of Certification of Compliance with safety and security related Design criteria, Project Co shall prepare and submit Design Criteria Conformance Certificate of completed designs for acceptance by the City;
- (ii) Construction Specification Conformance: Project Co shall verify that the safety and security related requirements imposed by the standards, specifications, hazard analyses and other Contract Documents are met in the as-built System or facility. Project Co shall perform the following activities for the safety and security related Construction specification conformance.
- A. Project Co shall prepare a Construction specification conformance checklist and verify that as-built Systems and documentation meet the safety and security related requirements. All requirements on the checklists shall be verified and submitted to the City for review.
 - B. Project Co shall verify that all changes made after acceptance of Project Co's completed Design meet Design criteria, code and regulatory compliance.
 - C. Project Co shall verify that all identified Fire/Life Safety and Security issues are resolved.
 - D. After completion of inspection of Work performed and certification of compliance, Project Co shall prepare and submit Construction Specification Conformance Certificates according to Schedule 10 – Review Procedure.
- (iii) Witness Point Selection is a City Responsibility. The purpose of defining witness points is to select those locations at which the City wishes to formally witness testing. Project Co shall be responsible for performing the tests covering the City-selected points and for notifying the City at least seven Business Days in advance of the date and time for the test. Selected areas shall include items of high risk, where concerns of compliance have been raised, or those selected by

random sampling. The City shall have the right to attend and witness any and all testing that takes place.

- (iv) **Safety-Related Tests:** Project Co shall verify that subsystems and systems function safely as specified and do not contain or create unforeseen hazards. Safety-related tests cover both intra-discipline and integrated tests. Project Co shall perform the following activities for the safety-related tests:
 - A. An initial safety-related testing conformance checklist shall be prepared for the design level of the Contract Documents. Project Co shall update the safety-related testing conformance checklist and submit it for review. Project Co shall verify that all safety-related tests identified in the specifications and other Contract Documents are successfully performed and the completed tests have been verified within defined test parameters and the systems and subsystems function safely as specified, do not contain or create unforeseen hazards, and contain specified safety features. All requirements on the checklists shall be verified and submitted for review;
 - B. Project Co shall report any noncompliance with applicable code and regulatory requirements noted as a result of safety-related testing. All non-compliances shall be rectified in accordance with applicable codes and regulations; and
 - C. After completion of safety-related testing and certification of compliance with specifications, Project Co shall prepare and submit safety-related testing conformance certificates according to Schedule 10 – Review Procedure.
- (v) **Safety Training and Drills:** This task is a Project Co responsibility. Project Co shall participate and provide support as defined herein. The purpose of the training and drills verification process is to verify that key safety-related training on new equipment is adequate and appropriate for the tasks to be performed in both normal and Emergency response environments. Project Co shall be responsible for providing equipment and setting up locations for test drills to be performed. Where indicated elsewhere herein, Project Co shall also provide instructors to assist in the training.
 - A. Verifying safe System operation through drills is an integral part of a closed-loop, pro-active System safety process. The methodology employed by the training/drill verification process is to obtain written verification from the City that:
 - i. Training and drills are adequate and appropriate for the assigned task, and contain instructions on safety features for normal and Emergency environments;

- ii. Lessons learned from training and drills have been reviewed and all identified hazards or open safety issues have been resolved; and
 - iii. All known comments and issues concerning training and drills, which impact safety, have been satisfactorily resolved.
- (vi) PHA: Project Co shall perform a PHA of the OLRT Project. The methodology for the performance of PHA shall be in accordance with the *APTA Manual for the Development of System Safety Program Plans for Commuter Railroads*. During the progress of the Work, Project Co shall be responsible for identifying hazards that are specific to the OLRT Project which shall be included and analyzed in the PHA. The PHA shall be submitted according to Schedule 10 – Review Procedure prior to proceeding in areas of Work affected by the analyses. The PHA shall contain adequate information to define the conditions being analyzed and discuss the alternatives and mitigations to eliminate the hazard or reduce it to an acceptable level of safety. Project Co shall address and incorporate applicable mitigations from the OLRT PHA.
- A. Mitigations shall include Design considerations, safety devices, warning devices or recommendations for adopting special procedures or training. The resolution process shall verify but not be limited to the following:
 - i. That the resolution of a hazard in one system does not create a new hazard in another system;
 - ii. That hazards involving interfaces between two or more systems have been analyzed and resolved;
 - iii. That all program participants are providing required analyses in a timely manner, and that determination is made where delinquent receipt is delaying hazard resolution; and
 - iv. That proper resolutions are implemented for areas identified with hazard resolutions requiring a change in system Design or development of special procedures.
 - B. The PHA shall also be in accordance with Hazard Analysis Guidelines for transit Projects DOT-FTA_-MA-26-5005-00-01 US Department of Transportation Federal Transit Administration, IEC 61508 and EN 50126 (IEC62278).
- (vii) Project Co shall be responsible for maintaining a HTM to record and track hazards for implementation of resolutions covered in the PHA and hazard analysis. The HTM shall include a description of all identified hazards, a description of the measures taken to resolve each hazard and results of reviews, comments and approvals by the City and outside agencies. All identified hazards shall be tracked through to resolution. Project Co shall submit the most current

copy of HTM to the City for review upon request. After all hazards tracked on HTM have been resolved Project Co shall prepare a hazards resolution certificate of conformance. The HTM shall be submitted according to Schedule 10 – Review Procedure.

- (viii) Preliminary TVA: To be undertaken and provided by the City to Project Co.
- (ix) Fire/Life Safety – Project Co shall be responsible for compliance with fire/life safety requirements included in federal, provincial, local codes and regulations, and the Project Agreement. Project Co shall incorporate these requirements into the Design and Construction of the Project and include all applicable certifiable fire/life safety elements in the appropriate safety and security certification checklists.
- (x) Project Co shall support the approval process by participating in reviews, inspections and technical discussions between the City and local jurisdictional authorities and other Authorities Having Jurisdiction, and incorporating the resulting agreements into the Construction Documents. Project Co shall be responsible for verifying that Project Co’s completed Design complies with the resolutions of fire/life safety issues, and is acceptable to the Authorities Having Jurisdiction.
- (xi) Project Co shall also indicate that all submissions that are safety related and/or are deemed certifiable are in accordance with the SSCP. Submissions shall be in accordance with Schedule 10 – Review Procedure. Those items that are safety related shall be identified as a SCIL element, and shall be classified as a certifiable element. Certifiable safety elements reflected in the contract Submittals and schedules shall be included in Project’s overall safety and security certification checklist. All Submittals identified as a certifiable element shall be clearly marked as such when submitted to the City for review.

10.2 Checklist Format

- a) Checklists for monitoring the completion of certifiable elements shall be maintained by Project Co in electronic “Spreadsheet” format. The files shall consist of the following:
 - (i) Item Number;
 - (ii) Safety Requirement;
 - (iii) Document Reference:
 - A. Document Name; and
 - B. Article Number;
 - (iv) Evidence:

- A. Method of Verification by Project Co;
- B. Method of Validation by Audit Team;
- C. Validated By (Name of Auditor);
- D. Date; and
- E. Remarks.

10.3 RAMS

a) Introduction

- (i) Project Co shall develop and implement a system for the management of RAMS as part of the conceptual detailed design, Construction, installation, commissioning, testing, acceptance and operation phases of the contract. The RAMS program shall provide a statistical foundation for each asset's contribution to overall System performance.
- (ii) Technical Specifications
 - A. The RAMS program shall be undertaken consistent with the following minimum standards:
 - i. RAM studies (IEEE 497)
 - ii. ISO Standard (14224)
 - iii. CAN/CSA-0632-90 – Reliability and Maintainability Management Guidelines
 - iv. CAN/CSA-0396 – Software Quality Assurance Standards
 - v. EN 50126 – Specification and Demonstration of Management of Reliability Availability, Maintainability and Safety
 - (iii) Content of RAMS Analysis
 - A. The RAMS program outlined in this Article is intended to influence the reliability, availability and maintainability of Project elements and the System as a whole as part of an overall quality assurance program and is separate and distinct from the performance targets that may have been established in this Project Agreement to monitor service performance related to revenue operations.
 - (iv) Outline of RAMS Analysis/Modeling

- A. The RAMS program undertaken by Project Co shall include the following:
 - i. Analysis of RAMS component and System performance;
 - ii. The use of Monte Carlo simulation as appropriate; and
 - iii. Sensitivity tests to vary the performance of individual assets, interaction of assets, and the overall System.

- (v) RAMS Analysis/Modeling Report
 - A. Within Article references to the RAMS study are references to the necessity to comply with the requirements including but not limited to the production of reports, calculations, analyses and test data as appropriate to demonstrate compliance with the safety, quality and reliability requirements.

 - B. The RAMS reports shall be organized into the following major categories:
 - i. Data collection;
 - ii. Review and model validation;
 - iii. Modeling and simulation;
 - iv. Validation and documentation of simulation results and sensitivity testing; and
 - v. Report generation/Systems assurance compliance.

 - C. The initial RAMS report shall be submitted according to Schedule 10 – Review Procedure

ARTICLE 11 EMERGENCY RESPONSE PLAN

11.1 General Requirements

- a) The ERP shall be in accordance with the criteria contained in this Article and all Applicable Law.
- b) Project Co shall create and implement an ERP, which ensures that Project Co has considered, trained, addressed, and planned for all potential catastrophic natural and man-made disasters, and has established protocols, procedures, responsibilities and guidelines to mitigate the potential impacts and respond to and recover from the occurrence of a disaster event, in accordance with the ERP.
- c) The ERP shall be completed and submitted as part of the Works Submittals according to Schedule 10 – Review Procedure.
- d) It is understood that the ERP developed by Project Co shall be incorporated into the City of Ottawa Emergency Response Plan, and the Province of Ontario Provincial Emergency Response Plan (PERP). As such, the general outline, organization and structure of the ERP shall generally follow the City of Ottawa Emergency Response Plan and the PERP.
- e) Project Co shall coordinate the development of the ERP with the City and EMO.
- f) This Article is provided as a general outline for the requirements of the ERP, as the ERP shall be modified, revised or changed, as appropriate, to address specific issues, needs, threats, Hazards, vulnerabilities, or concerns, including those identified in the PHA, hazard analysis and FMEA related to the OLRT that develop during the Project Term.

11.2 Emergency Response Plan

- a) Project Co shall implement procedures designed to provide for a safe environment throughout the Project Term. The ERP shall include the required scenario analyses with an incident command hierarchy between Emergency Service Providers and demonstrate in detail how Project Co shall respond to and recover from the occurrence(s) of catastrophic natural and man-made disasters detailed in the PHA and subsequent safety analysis. The ERP shall be consistent and in accordance with all Applicable Law governing Emergency planning, response and recovery. The plan shall be prepared with the involvement of and input from all applicable Emergency Service Providers.
- b) Project Co’s ERP, as a minimum, shall include the following:
 - (i) Emergency Response Policy Statement;
 - A. The ERP shall include an Emergency response policy statement that clearly articulates the purpose of the ERP; scope and applicability of the ERP; and the methodology utilized to develop and implement the ERP. The Emergency response policy statement shall be communicated to all

Project Co Parties and shall be reviewed, as a minimum, and coordinated annually with EMS, Fire, City and others to ensure it is current.

- (ii) Situation Analyses;
 - A. The ERP shall be based upon an analysis of the potential Emergency situations specific to this Project.
 - (iii) Planning Assumptions;
 - A. A section describing and indicating the basic planning assumptions upon which the ERP is based. It shall include lead times, effects of Emergencies, when and how an Emergency is to be declared, what outside assistance is available and the conditions under which an evacuation may be required.
 - (iv) Response Capabilities; and
 - A. A section describing the current response and recovery capabilities of Project Co, which shall summarize the basic capabilities both in-house and from outside sources to deal with response and recovery issues. It shall contain a general description of how resources are currently managed and deployed. It shall also identify shortfalls in response capabilities and strategies to resolve these shortfalls.
 - (v) Critical Facilities.
 - A. Identification of critical facilities of Project Co, providing the system name, address, contact person, property classification, primary Emergency function, the secondary Emergency function, the primary or normal use, the priority for power restoration and the Emergency power requirements. A location map indicating the location of all critical facilities shall be included in this section.
- c) System Management Polices
- (i) This section shall address the current management policies and practices regarding the major factors that can have an impact on the operation of the OLRT. Copies of all written policies and procedures shall be included in an appendix to the plan.
 - (ii) This section is to contain, at a minimum, a discussion of the following factors:
 - A. Surveillance and Incident detection;
 - B. Interdepartmental dependency and communication;
 - C. Information dissemination;

- D. Traffic Incident management procedures;
 - E. Interface with the TSCC, the City, LRT and Bus Operations;
 - F. Public Information and Notifications; and
 - G. Business impact and interruption.
- d) Project Co OLRT Resources
- (i) Project Co shall provide a listing and description of the resources that the City and Project Co have available on a day-to-day basis and a listing of Project Co Parties or outside resources that are available on an on-call or contract basis. Project Co shall also include a listing of all vehicles and equipment owned, leased or available on-call by Project Co.
- e) Day-To-Day Functions and Responsibilities
- (i) Project Co shall provide details on how the various responsibilities and specific parties are organized and managed with respect to Emergencies.
- f) Basic Operations
- (i) Project Co shall provide an overview of the basic operational approach to Emergency situations. Specific details and descriptions of the response organization and assign specific tasks to the agencies and organizations that may be involved in responding to an Emergency. It shall be used by Project Co to guide and direct the development of functional and Emergency specific annexes that provide specific direction and responsibilities for various types and magnitudes of Incidents.
- g) Functional Annexes
- (i) The functional annexes section of the ERP shall provide specific information and direction and shall focus on operations of the OLRT. These annexes shall emphasize responsibilities, tasks and operational actions that pertain to the specific functions. These annexes shall clearly define and describe the policies, processes, roles and responsibilities inherent in the various functions before, during and after any Emergency situation, including how each agency and Project Co shall perform each of the functions. An annex shall include information on the following:
 - A. The purpose of the function;
 - B. A description of the situations that trigger implementation of the function;
 - C. A description of the assumptions that apply to the function;

- D. The concept of operations for the function; and
 - E. Assignment of responsibility for annex Maintenance, review and updating.
- h) Emergency Specific Annexes
- (i) The Emergency specific annex section of the ERP shall describe and offer a means of extending functional annexes to address special and unique response procedures, notifications, protective actions and other needs generated by a specific Incident. Emergency specific annexes shall follow the same structure and similar content as the Basic Operations and Functional Annexes description above.
 - (ii) As per (i) above, at a minimum, the following specific Hazards are to be addressed:
 - A. Major traffic accidents and/or Incidents;
 - B. Hazardous material Incidents;
 - C. Nuclear or radiological Incidents;
 - D. Terrorism Incidents;
 - E. Earthquake;
 - F. Biological Incident;
 - G. Weather related events;
 - H. Railroad Incidents;
 - I. Structural or Tunnel fires;
 - J. Structural failure;
 - K. Electrical power Incidents; and
 - L. Other Utility Incidents.
- i) Recovery Annexes
- (i) The recovery annex section of the ERP shall address the methodology and processes that shall be implemented during the recovery process and shall include, at a minimum the following:
 - A. Identification of the agencies with responsibility for recovery efforts;

- B. Establishment of the documentation and record keeping requirements following the disaster event;
 - C. Establishment of the initial post disaster priorities and responsibilities (0-12 hours);
 - D. Addressing of human needs; and
 - E. Developing and addressing mitigation strategies.
- j) Training and Exercises
- (i) This section of the ERP shall identify and address the specific training program(s) and exercise schedule(s) for Project Co. It shall address, at a minimum, the following:
 - A. Types of training required for each Project Co Party involved in a particular Incident;
 - B. A specific annual training program and schedule for each Project Co Party so identified; and
 - C. Establishment and implementation of the exercise and training program(s) that provides both table-top and full scale training exercises based upon the potential Emergencies to which the OLRT is exposed.

ARTICLE 12 GEOTECHNICAL / FOUNDATION DESIGN CRITERIA

12.1 Order of Precedence

- a) The Design and Construction of all geotechnical and foundation work shall comply with the criteria contained in this Article, and all standards, regulations, policies, Applicable Law, guidelines or practices applicable to the Project, including but not limited to each of the following Reference Documents. In the event of a conflict between the criteria, commitments or requirements contained within one document when compared with another, the more stringent shall apply:
- (i) Criteria contained in this Article;
 - (ii) Schedule 15-2, Part 1 Article 21 – Civil Structural Design Criteria;
 - (iii) Schedule 17 – Environmental Obligations;
 - (iv) City Design Standards and Guidelines;
 - (v) OBC;
 - (vi) NBC;
 - (vii) CHBDC;
 - (viii) OPSS;
 - (ix) CSA Standards;
 - (x) ASTM Standards;
 - (xi) OPSD;
 - (xii) Canadian Foundation Engineering Manual, Third and Fourth Editions;
 - (xiii) Guideline for Professional Engineers Providing Geotechnical Engineering Services, published by Professional Engineers of Ontario; and,
 - (xiv) AREMA Manual for Railway Engineering.

12.2 General Requirements

- a) Geotechnical and foundations Design shall be carried out in accordance with the principles of Limit States Design based on Load and Resistance Factor Design as described in the OBC, CHBDC and Canadian Foundation Engineering Manual, based on the purpose of the Structure. In specific instances, such as slope stability for example, this Article requires use of WSD as a check on other numerical or analytical procedures that may be selected by Project Co.

- b) Project Co shall perform a geotechnical ground conditions assessment based on the available data and develop a complete list of geotechnical design parameters (including a basis for selection) for use in the Design of the Tunnels and underground Structures. In addition, Project Co shall prepare geotechnical profiles for the downtown Tunnel, MSF connection tunnel and shafts greater than 3 meters in diameter. Geotechnical profiles shall include anticipated distribution of the various ground types.

12.3 Foundations

- a) Foundations for Structures shall be designed such that their displacements (Serviceability Limit States, as defined in the relevant Codes and Standards) are compatible with the structural design, function, structure and Performance Requirements, and clearance envelope requirements over their Design Life.
- b) Frost protection for foundation elements shall be provided by either:
 - (i) Earth cover above the underside of foundation elements at least equal to the design frost penetration depth; or
 - (ii) Insulating foundation elements using suitable materials such as high density polystyrene rigid foam. The insulation may be wrapped around the foundation element or may be placed under the foundation element (i.e., such that the foundation bears on the insulation) but shall provide at least the equivalent frost protection as the earth cover specified in (i) above.
 - (iii) The following shall be considered for the use of foundation insulating material:
 - A. The insulation details shall be designed to limit the damage to the insulation due to the placement of backfill or concrete; and
 - B. The insulation details shall ensure that the insulation is continuous and does not provide thermal gaps that could result in localized frost penetration and subsequent freezing induced expansion of the subgrade soils.
 - (iv) Insulation placed under footings shall be designed such that long term creep (compression) of the insulation, and therefore foundation settlement, is limited to less than 5 mm. The loading shall be limited to less than 35% of the insulation manufacturer's quoted compressive strength for high density polystyrene rigid foam.
 - (v) Frost protection details shall be provided to limit differential frost heaving. Typical details to limit the magnitude and extent of differential frost heaving shall include:
 - A. Maintaining a uniform subgrade level or, where the ground surface level changes (such as under a stairway or ramp), maintaining a uniform thickness of frost susceptible soil within the depth of frost penetration;

- B. Where the subgrade level must change, the transition shall be accomplished by sloping the subgrade surface at no steeper than 3 horizontal to 1 vertical;
- C. Providing suitable transition details at the edge of insulated areas to avoid drastic differences in the depth of frost penetration over short distances;
- D. Draining the granular backfill materials to carry away water which would readily feed ice lensing in adjacent frost susceptible soil; and
- E. Maintaining a uniform composition of the subgrade by using excavated backfill materials which, within the zone of frost penetration, match the surrounding soils.

12.4 Cut and Fill Slopes

- a) Permanent cut and fill slopes shall be designed to:
 - (i) Be protected against surficial erosion and shallow surface failures;
 - (ii) Control discharge of surface water and subsurface seepage; and,
 - (iii) Allow for regular Maintenance of the slope surface.
- b) Existing cut and fill slopes shall be modified where necessary to meet all requirements of this Article.
- c) Permanent cut and fill slopes shall be designed with adequate minimum factor of safety no less than 1.5. The minimum factor of safety may be reduced to 1.3 in areas considered a passive land use situation in accordance with the City of Ottawa Slope Stability Guidelines for Development Applications. The Design slope configuration shall also be checked for short-term stability during Construction using appropriate undrained strength parameters. The minimum factor of safety shall be 1.5 for slopes supporting buildings, Bridge abutments or other Structures. The minimum factor of safety during design seismic event shall be no less than 1.1.
- d) Where water bearing deposits, layers, seams or lenses are present at the slope surface, subsurface drainage works shall be incorporated into the slope Design to adequately control seepage and resultant piping at the slope surface, and to control the build-up of pore-water pressures within the slope.
- e) Permanent cut and fill slopes shall exhibit no signs of tension cracks, toe bulging, slumping, or sloughing of embankment or cut slope.

12.5 Embankments

- a) The total and differential post-Construction (i.e., after the Track or road is put in use) settlements of road or Track bed embankments and Pavement surfaces shall be such that

the smoothness and cross-slope requirements are met, ponding and sheeting of water is prevented, Pavement drainage is maintained, and the function of Constructions and ditches is preserved.

- b) No vertical offset at longitudinal joints in Pavement surfaces shall be permitted after Construction.
- c) No vertical offset at longitudinal or transverse joints along Station Platforms, interior walkways or at building connections shall be permitted after Construction.
- d) The post-Construction differential settlement along the Track bed including due to frost heave shall meet the requirements of AREMA.

12.6 Permanent Retaining Structures

- a) The following requirements apply to new and existing Retaining Walls:
 - (i) Reinforced soil slopes equal to or steeper than 40 degrees measured up from horizontal shall also be considered as Retaining Walls;
 - (ii) Proprietary retaining systems shall be designed and constructed in accordance with the manufacturer's guidelines and to meet the requirements of the Project;
 - (iii) Proprietary retaining systems with galvanized steel embedded in the soil shall not be permitted;
 - (iv) Design of all permanent retaining Structures shall allow for full-depth replacement of Track bed or Pavements;
 - (v) When calculating lateral resistances counteracting earth pressures, Project Co shall neglect passive earth pressures above the frost penetration depth.
 - (vi) The stability of the soil mass supporting or contained by the retaining wall shall be checked with respect to all potential surfaces of sliding and shall meet or exceed a minimum global factor of safety of 1.5. The minimum global factor of safety may be reduced to 1.3 in passive land use situations;
 - (vii) Differential rotation displacements, at no time during the Project Term shall be greater than 50% of the as-built wall batter;
 - (viii) Design of all permanent retaining Structures shall address long-term (creep) displacements, as well as the swelling potential of the shale for excavations in rock; and
 - (ix) The global factor of safety against uplift shall be a minimum of 1.1. Side friction shall be neglected for the purpose of computing the factor of safety against uplift.

12.7 Services

- a) The following requirements apply to new water and sewer services installed for this Project:
 - (i) Where fill material is encountered below invert level, the fill material shall be removed from below the pipe and the service shall be founded on engineered fill;
 - (ii) Engineered fill, pipe bedding, cover and trench backfill material shall conform to OPSS and the requirements of this Schedule 15.

12.8 Temporary Slopes and Retaining Structures

- a) The performance of each temporary work shall be sufficient for its expected Service Life. All temporary works shall comply with the OHSA and the construction projects requirements thereunder current at the time of excavation and the additional criteria identified below:
 - (i) Temporary retaining Structures shall be designed and constructed to meet the more stringent requirements of OPSS 902S01, AREMA, and the requirements of this Article. Temporary retaining Structures shall also meet the requirements of limiting surface settlements and ground movements as stipulated under Part 1 Article 20 – Protection of Existing Adjacent Structures. All elements of temporary retaining structures within the upper 1.5 meters of the ground surface shall be removed and properly disposed of upon completion of backfilling;
 - (ii) The Design loads on struts, rakers, or other structural support elements and for flexible wall systems shall not be less than those obtained from the apparent earth pressure diagrams as provided in the Canadian Foundation Engineering Manual, unless detailed numerical models and analyses are performed to demonstrate otherwise;
 - (iii) The global factor of safety against shear failure below the base of the shoring system shall be no less than 1.3. In addition, the Design and Construction of temporary works shall maintain displacements of the soil mass as required to meet the criteria of this Article for protection of Roadways, Buildings, Utilities, and other Adjacent Structures;
 - (iv) Sheet pile walls, contiguous caisson walls and diaphragm walls designed to penetrate granular deposits and partially cut-off the seepage shall be designed with a minimum global factor of safety of 1.5 against piping;
 - (v) The global factor of safety against uplift shall be a minimum of 1.1; and
 - (vi) For excavations in rock, adequate protection shall be provided to address the shale propensity toward swelling upon exposures, and the resulting forces acting on the excavation support system shall be considered.

12.9 Earthwork

- a) Earthwork shall be designed and constructed to meet the applicable requirements of OPSS 501, OPSS 514, and OPSS Construction Specification for Grading, OPSS 212, and OPSS 1010.
- b) Design and preparation of the Track bed subgrade shall be in accordance with AREMA.
- c) All lightweight fills shall be adequately protected from wheel loads, groundwater, road salts, weather, fire, flotation under flood conditions, and fuel spills.
- d) Penetration due to landscaping and sign foundation systems shall be designed such that protective membrane covers required to protect the lightweight fill are not compromised.
- e) Flotation forces corresponding to inundation of the fill to the 100-year flood level shall be considered in the Design of lightweight fills, regardless of any flood protection provided for the area in which the fill is to be constructed.
- f) Expanded polystyrene meeting CAN/ULC-S701 Type 2 (as a minimum) and ASTM material specification requirements shall be used.
- g) Lightweight Fill and Ultra-lightweight Fill shall be defined as materials with angle of internal friction $> 35^\circ$ (ASTM D2850-95), hydraulic conductivity $\leq 8 \times 10^{-3}$ cm/s (ASTM D5856-95, Method A), in situ wet unit weight (ASTM D2922) shall be less than 14.5 kN/m³ for Lightweight Fill and 12.5 kN/m³ for Ultra-lightweight Fill when placed and compacted.
- h) All Granular A, B, M, and Select Subgrade Materials, slag fill, shredded tire fill, ultra-lightweight, lightweight, or other proposed fill materials shall be in accordance with the Leachate Quality Criteria provided in Regulation 347 General—Waste Management under the Environmental Protection Act (Ontario);

12.10 Instrumentation and Monitoring

- a) Instrumentation shall be installed in key/critical areas needing special attention, including fill embankments, deep cut sections, permanent retaining Structures, and existing Building, Bridge or other Structures along the Project Alignment that shall remain in service.
- b) Measurements of differential settlements shall be taken annually during the Project Term following Final Completion. Measurement data shall be provided to the City within 15 Business Days following completion of the measurements.
- c) Project shall decommission existing groundwater observation wells and piezometers installed by the City within the Lands for the purpose of the OLRT Project.

12.11 Groundwater Control – Dewatering/Unwatering

- a) Project Co shall develop and submit plans and procedures in accordance with Schedule 10 – Review Procedures.
- b) Design, Construction, and operation of dewatering/unwatering or groundwater drawdown/depressurization shall not induce detrimental short or long term movements of surrounding Infrastructure. Particular attention shall be given in areas with sensitive clays known to be present in the Ottawa area, and impact of groundwater drawdown or depressurization of the clay settlement.
- c) Specific Water Table and Groundwater Control Requirements
 - (i) A detailed hydrogeological impact assessment and associated risk assessment shall be carried out by Project Co to ensure that any water table drawdown and subsequent effects on the groundwater regime during Construction or during the Design Life of the Project Works, shall have no adverse impact on property, adjacent Infrastructure, the Works and the Environment, over any length of each Tunnel cut-and-cover Structure and shaft, with respect to:
 - A. groundwater draw down effects including contamination migration and impacts on available water for ground water dependent ecosystems and existing groundwater users;
 - B. groundwater draw down effects which may cause settlement of existing Structures or utilities adjacent to the Project Works as required in Part 1 Article 20 – Protection of Existing Adjacent Structures;
 - C. durability requirements and Maintenance consequences from water inflows; and
 - D. treatment and discharge requirements of any water inflows.
 - (ii) Project Co shall ensure that the Work causes no adverse impact on available water for groundwater dependent ecosystems and existing groundwater users, including any impact on the surface water flows of any existing watercourses, the existing use of groundwater resources and deterioration of vegetation within or adjacent to the Lands.
 - (iii) Permanent underground linings shall be designed for groundwater pressures as derived from the above hydrogeological modeling, where required to be undrained, and shall account for the 100 year flood level requirements, whichever governs the Design.
- d) Where groundwater control is essential to successfully completing and maintaining excavations, the necessary piezometric levels to be achieved at each stage of the Work shall be determined. Adequate monitoring of groundwater pressures to verify the adequate performance of the groundwater control system shall be incorporated in the

Design and implemented prior to and during excavation until the permanent Structures or facilities are complete.

- e) Project Co shall provide a water treatment system such that release of gases to the atmosphere shall be controlled to meet OHSA requirements and avoid public nuisance from odours.
- f) All dewatering systems shall be designed and constructed in accordance with the requirements of this Article and OPSS 517 and 518.

12.12 Subsurface Investigations and Testing Prior to Construction

- a) Project Co shall undertake additional subsurface investigations to permit the detailed Design and Construction of the Project as determined to be required by Project Co. Results of investigations shall be provided to the City.
- b) All field and laboratory testing shall be carried out in accordance with applicable CSA or ASTM standards.
- c) The locations and elevations of all boreholes, test pits, cone penetration tests, and other field testing or sounding locations shall be surveyed and referred to fixed reference points and data. Locations shall be identified using the coordinate system identified in Part 1 Article 4 – Design and Construction Provisions. The vertical and horizontal accuracy of survey readings shall be within 0.1m.

12.13 Protection of Potentially Expansive Shale

- a) The shales in the Ottawa area, particularly of the Billings formation, are considered to have a significant swelling potential and this swelling is considered to be caused by the weathering of pyrite which may be present in the shale bedrock and the formation of volumetrically larger gypsum crystals. This swelling occurs when the rock is exposed to moisture and oxygen (i.e., such as when the groundwater level is lowered below the surface of shale bedrock during excavation for Construction works).
- b) Project Co shall undertake all reasonable precautions to prevent short and long term expansion of shale.

12.14 Geotechnical Seismic Design Soil liquefaction, cyclic mobility (or cyclic softening), ground movements associated with soil liquefaction or cyclic mobility, increases in lateral earth pressure, settlement and soil structure interaction effects due to seismic events shall be accounted for in the design.

ARTICLE 13 ARTWORK

13.1 General Requirements

- a) The purpose of this article is to outline the process for the implementation of the OLRT Art Program.
- b) Project Co shall protect existing artwork located within or in the vicinity of the existing BRT west of existing Bayview Station.
- c) The OLRT Art Program includes integrated artwork and non-integrated artwork.
- d) Integrated artwork includes art/art projects that are linked and/or integrated into the architectural and/or landscape Design of Station elements.
- e) Non-integrated artwork includes stand-alone art projects which can be implemented on their own provided the appropriate means of affixing/supporting the artwork is designed and constructed by Project Co.
- f) Objectives of the OLRT Art Program
 - (i) The primary objective of the OLRT Art Program is to enhance the transit riders' experience in utilizing Stations by implementing specific non-integrated and integrated art projects.
 - (ii) The mandate of the OLRT Art Program is driven by and shall comply with the City of Ottawa's Public Art Policy.
 - (iii) To ensure that the OLRT Art Program achieves its overall objectives, the City has developed a specific listing of art projects by Station as outlined in Table 1-13.1.
 - (iv) Project Co shall be responsible for coordinating the implementation of the OLRT Art Program for integrated art and the coordination of the installation of the non-integrated art as outlined in Table 1-13.1 and as outlined in this article.
 - (v) For Federally Mandated Stations, the location, configuration, and setting for specific art projects has been proposed by the City and is reflected in the Federally Mandated Station Drawing Package.
 - (vi) The final location and setting of the art projects are to be resolved between the artist and Project Co.

13.2 Implementation of Art Budget

- a) Project Co shall contract with and pay the artists on the integrated projects with funding provided by the City and allocated according to the Public Art Budget. While the overall art budget is fixed, the budget for individual art projects is subject to change.

- b) Project Co shall be responsible for the base costs to architecturally finish Federally Mandated Stations and other Stations in accordance with Schedule 15-2 Part 5 – Design and Construction Requirements – Stations.
- c) Project Co shall be responsible for the cost of installing non-integrated artwork.
- d) The City is responsible for funding the incremental cost/budget to implement the specified art projects identified in Table 1-13.1 including being responsible for the following incremental costs to implement art over and above standard Station finishes:
 - (i) The incremental cost to implement the specified integrated art projects and the cost of the non-integrated projects excluding installation and support requirements respecting the overall art budget;
 - (ii) The Design fees for artists;
 - (iii) The cost for the artist to develop drawings/specifications in cooperation with Project Co to implement the art projects;
 - (iv) The cost for the artist to produce any artwork as part of the Construction Documents or as part of the fabrication/installation of the artwork;
 - (v) The costs associated with the adjudication for the pre-selection of artists of integrated and non-integrated artwork; and
 - (vi) Except for the cost to affix/support non-integrated art, the City is responsible for the costs associated with non-integrated art.

13.3 Responsibilities for OLRT Art Program

- a) Project Co
 - (i) Project Co shall be responsible for the integration of art into all Stations including the following:
 - A. The hiring of a Public Art Manager
 - i. The Public Art Manager shall have:
 - 1 Minimum of five (5) years’ experience managing public art projects;
 - 2 Successfully completed a minimum of three (3) outdoor public art commissions in urban environments, minimal capital value of each project: \$150,000;
- Or

- 3 Minimum five (5) years experience working on complex urban development projects that included a public art program.
- ii. The Public Art Manager shall:
- 1 Be familiar and ensure compliance with the City's public art program policies and procedures;
 - 2 Coordinate all aspects of Project Co's participation and deliverables of the OLRT Art Program;
 - 3 Liaise with the OLRT art consultant and the City's public art department to ensure successful delivery of the OLRT Art Program;
 - 4 Liaise with the Algonquin art liaison on the art projects for Lebreton Station;
 - 5 Ensure fair and equitable involvement of artists on the Project; and
 - 6 Coordinate the design and review process for the art program as outlined in Schedule 10 – Review Procedure.
- B. In collaboration with the artist, developing integrated art concepts for each Station consistent with the budget available for the incremental cost of each integrated project;
- C. Coordinating with the artist to resolve aesthetic issues between the artist and Project Co on integrated projects;
- D. The procurement of the artists from Table 1-13.2 – Prequalified List of Artists for Integrated Art Projects ;
- E. The execution of agreements between the individual artists and Project Co;
- F. Providing detailed reports on payments to individual artists for work performed for reimbursement from the City;
- G. The substitution of standard architectural finishes in Stations in favour of the specified art projects designed by the artist;
- H. Coordination and integration of the art projects into the overall Station architectural finishes to ensure complete integration from a design, specification, and Construction perspective;

- I. The review of the artist's concepts and providing comments to the artist on:
 - i. Constructability;
 - ii. Suitability of materials;
 - iii. Safety/security issues;
 - iv. Maintainability; and
 - v. Rough order of magnitude design/Construction costs of art concepts and assisting the artist in finding alternative solutions to Design and construct the artwork within the City budget for art projects;
 - J. Submitting artwork to, and responding to comments from, the Design review process;
 - K. Maintenance of the integrated and non-integrated art projects;
 - L. All approvals for concept and final Design of art projects in accordance with Schedule 10 – Review Procedure; and
 - M. The artist shall be responsible for the following components of the art program:
 - i. In collaboration with Project Co, developing integrated art concepts for each Station consistent with the budget available for the incremental cost of each integrated project;
 - ii. Coordinating with Project Co to resolve aesthetic issues between the artist and Project Co on integrated projects; and
 - iii. Assisting Project Co, as required, in the integration of art drawings/specifications into Construction Documents.
- b) The City
- (i) The City will be responsible for the following with respect to the implementation of the art projects.
 - A. The prequalification of artists no later than two months prior to Financial Close;
 - B. The establishment of the art projects to be implemented by Station (consistent with Table 1-13.1);

- C. Ensuring that the overall budget for the incremental cost of the art program is not exceeded. Information related to the budget is provided in Table 1-13.3; and
- D. The manufacture and supply of non-integrated art projects.

13.4 Process for Selection and Assignment of Artists to Individual Art Projects

- a) In a collaborative and consultative process, individual artists shall be selected by Project Co to work on each individual art project outlined in Table 1-13.1.

13.5 Review Process for Art Projects

- a) As part of the review process outlined in Schedule 10 – Review Procedure, Project Co shall be responsible for submitting three-dimensional renderings as integrated into the station design, drawings, specifications and material samples for integrated projects including the following:
 - (i) Overview of art concept;
 - (ii) Location/setting of art project;
 - (iii) Integration details;
 - (iv) Implications for other disciplines/agencies;
 - (v) Itemized pricing for each integrated art project; and
 - (vi) Comments concerning safety, maintainability, cost, suitability of materials, constructability and any other matter that affects the sustainability of the Project over its intended life.

13.6 Maintenance of Artwork (Integrated and Non-Integrated)

- a) Project Co shall:
 - (i) Clean and maintain all artworks in the OLRT art program in accordance with an annual Maintenance schedule as part of the overall Station Maintenance program;
 - (ii) Consult every five (5) years, or as required due to damage, with a professional conservator to provide a condition report on each art project;
 - (iii) Take any necessary action to mitigate any recommendations within these condition reports; and
 - (iv) Provide overstock on art materials at the time of installation and fabrication of artwork, where applicable, in order to assist in the long-term Maintenance of art projects.

13.7 Description of Art Projects

- a) For further clarification of the art projects outlined in Table 1-13.1, the following describes the scope of the individual art projects.
 - (i) Integrated Projects
 - A. Roof and Windscreens Projects
 - i. The roof and windscreens artwork has been conceived to allow artists to participate in the Design of the most visible components of the architecture of the Stations. This artwork allows for a broad range of artistic expression; variations in artworks will allow each Station to be unique from one another while providing a consistent architectural element for artistic expression.
 - ii. Participating Stations
 - 1 Tunney’s Pasture (windscreen combined with benches), Bayview, Lebreton (windscreens only), Campus, Lees, Hurdman, Train (includes covered walkway), Cyrville, Blair.
 - iii. Artwork Locations for Federally Mandated Stations
 - 1 Refer to the Federally Mandated Station Drawing Package.
 - iv. Role of Project Co
 - 1 Project Co shall cooperatively collaborate with the Artist to develop integrated artwork into the roof and windscreens of the Stations.
 - 2 Project Co shall coordinate all components of their work to include the Construction and implementation of the integrated artwork.
 - v. Artist Allocation
 - 1 Each artist shall work on a maximum of one (1) Station. Artworks shall be substantially different between Stations. The Windscreen project for Lebreton Station shall be in collaboration with an artist from the Algonquin community.
 - 2 Artists for the roof and windscreen projects shall be selected from the list of pre-qualified artists for integrated projects.

vi. Technical Specifications

- 1 Artworks shall respect considerations of public safety and shall be constructed of materials that are appropriate to continuous public display, are durable and resistant to vandalism and to repetitive cleaning.
- 2 Artworks shall be structurally sound.
- 3 Artworks shall not have any complex mechanical or electronic devices directly associated with the artwork.

B. Landscape Projects

i. The integrated landscape artworks have been considered for three (3) Stations that lend themselves to this type of project. These site-specific landscape artwork integrations shall address space, object, and pedestrian movement. Maximizing public access and visibility of the artwork integrations are important considerations for the success of these projects.

ii. Participating Stations

- 1 Lebreton, Cyrville, Bayview

iii. Artwork Locations for Federally Mandated Stations

- 1 Refer to Federally Mandated Stations drawing Package.

iv. Role of Project Co

- 1 Project Co shall cooperatively collaborate with the artist and landscape designer to develop integrated landscape artworks.
- 2 Project Co shall coordinate all components of their work to include the Construction and implementation of the integrated landscape artworks.

v. Artist Allocation

- 1 Each artist shall work on one (1) landscape art integration for each of Cyrville and Bayview Stations.
- 2 The integrated landscape artwork for Lebreton Station shall involve collaboration with an artist from the Algonquin community.

- 3 The artists for landscape projects shall be selected from the list of pre-qualified artists for integrated projects.
- vi. Technical Specifications
 - 1 Integrated landscape artworks shall respect considerations of public safety and shall be constructed of hard and soft landscaping materials that are appropriate to continuous public display, are durable, require minimal Maintenance and are resistant to vandalism.

C. Walls and Tunnels

- i. Artworks for walls and Tunnels shall consider space and pedestrian movement, as well as surface, in their Design.
- ii. Participating Stations
 - 1 Walls: Lebreton, Downtown West, Downtown East, St. Laurent, Rideau
 - 2 Tunnel: Downtown West
- iii. Artwork Locations for Federally Mandated Stations
 - 1 Refer to Federally Mandated Station Drawing Package
- iv. Role of Project Co
 - 1 Project Co shall cooperatively collaborate with the Artist to develop integrated artwork(s) into the Platform walls and Tunnels of the participating Stations.
 - 2 Project Co shall coordinate all components of their work to include the Construction and implementation of the integrated artwork(s).
- v. Artist Allocation
 - 1 Each artist shall work on a maximum of one (1) Station.
 - 2 Artists for the wall and Tunnel projects shall be selected from the list of pre-qualified artists for integrated art projects.
 - 3 The integrated wall project at Lebreton Station shall involve collaboration with an artist from the Algonquin community

vi. Technical Specifications

- 1 Artworks shall respect considerations of public safety and shall be constructed of materials that are appropriate to continuous public display, are durable and resistant to vandalism and to repetitive cleaning.
- 2 Artworks shall be structurally sound.
- 3 Artworks shall not have any complex mechanical or electronic devices directly associated with the artwork.

D. Rideau Station Escalator Chambers, non-fare paid underground connector and entry Structures

- i. The walls of the escalator chambers can be considered by the artist recognizing that the Structure that will define the art opportunity is the responsibility of Project Co and not the artist. Perception of the artwork as transit Passengers move vertically shall be considered.
- ii. The non fare paid underground connector crossing Rideau Street can be considered by the artist recognizing that the Structure that will define the art opportunity is the responsibility of Project Co and not the artist.
- iii. In the event that Project Co constructs an entrance within the William Street right of way, the entrance structure and elevator enclosures can be considered by the artist recognizing that the Structure that will define the art opportunity is the responsibility of Project Co and not the artist.
- iv. Role of Project Co
 - 1 Project Co shall cooperatively collaborate with the Artist to develop integrated artwork(s) into the escalator chambers within Rideau Station.
 - 2 Project Co shall cooperatively collaborate with the Artist to develop integrated artwork(s) into the non fare paid underground connector at Rideau Station.
 - 3 Project Co shall cooperatively collaborate with the Artist to develop integrated artwork(s) into the entrance structures to the stair/escalator enclosures and elevator enclosures at Rideau Station.

- 4 Project Co shall coordinate all components of their work to include the Construction and implementation of the integrated artwork(s).
- v. Artist Allocation
 - 1 One artist or artist team shall work on this project.
 - 2 Artists for the Rideau Station escalator chamber, non fare paid underground connector and entry structures shall be selected from the list of pre-qualified artists for integrated projects.
- vi. Technical Specifications
 - 1 Artworks shall respect considerations of public safety and shall be constructed of materials that are appropriate to continuous public display, are durable and resistant to vandalism and to repetitive cleaning.
 - 2 Artworks shall be structurally sound and reflect the architectural space defined by others.
 - 3 Artworks shall not have any complex mechanical or electronic devices directly associated with the artwork, other than illumination.
- (ii) Non-Integrated Projects
 - A. Benches
 - i. There shall be two (2) artist-designed benches installed on the Platform at each Station. Benches shall be of dimensions similar to typical park-style benches but shall vary from bench to bench.
 - ii. Participating Stations
 - 1 All Stations except for those Stations where the installation of the bench would cause the platform to be of insufficient dimension to meet passenger volume requirements or would create a condition that compromises public safety.
 - iii. Project Drawings Artwork Locations for Federally Mandated Stations
 - 1 Refer to Federally Mandated Station Drawing Package.
 - iv. Role of Project Co

- 1 Project Co shall prepare locations for the receipt of the art benches,
 - 2 Project Co shall install art benches, at specific locations on Station Platforms as per consultation with the City.
- v. Artist Allocation
- 1 Artists for benches shall be selected from the list of pre-qualified artists for non-integrated art projects.
 - 2 The bench artwork project for Lebreton Station shall involve collaboration with an artist from the Algonquin community.
- vi. Technical Specifications
- 1 Project Co shall install art benches in a permanent manner, using corrosion-resistant, high strength fasteners.

B. Signbox Program

- i. The signbox program will provide illuminated sign boxes for the display of two-dimensional artworks. Signboxes will be the same as those used in transit shelter advertising programs and shall be integrated into the Station Design. Artworks shall be rotated on a quarterly basis. The City will coordinate the rotation of the artworks.
- ii. Participating Stations
 - 1 Downtown East, Hurdman, Train, Blair, Campus (digital media screen).
- iii. Artwork Locations for Federally Mandated Stations
 - 1 Refer to Federally Mandated Station Drawing Package
- iv. Role of Project Co
 - 1 Signboxes will be supplied by others. There shall be three (3) signboxes installed at Downtown East, Hurdman, Train and Blair Stations. In addition, Campus Station will involve a digital media screen.
 - 2 Project Co shall provide electrical conduits, power supply and electricity to the signboxes and media screen.

- v. Artist Allocation
 - 1 Artists for the signbox project shall be selected from the list of pre-qualified artists for non-integrated projects.

- vi. Technical Specifications
 - 1 Project Co shall install signboxes and media screen in a permanent manner, using corrosion-resistant, high strength fasteners.
 - 2 Electrical specifications for signboxes and media screen to be provided at later date. Signboxes and media screen shall meet appropriate safety standards.

C. Lebreton Station Gate

- i. There shall be one (1) artist-designed gate installed at the Platform level entrance to the Station.

- ii. Participating Stations

- 1 Lebreton

- iii. Artwork Locations for Federally Mandated Stations

- 1 Refer to Federally Mandated Station Drawing Package

- iv. Role of Project Co

- 1 Project Co shall prepare locations for the receipt of the gate.
 - 2 Project Co shall install gate.

- v. Artist Allocation

- 1 Artists for the Lebreton Station Gate project shall be selected from the list of pre-qualified artists for non-integrated projects.
 - 2 This project shall involve collaboration with an artist from the Algonquin community.

- vi. Technical Specifications

- 1 Project Co shall install gate in a permanent manner, using corrosion-resistant, high strength fasteners.

D. Lantern

- i. The Lantern artwork is an opportunity for artists to work on a highly visible artwork that will provide amenity to Lebreton Station patrons.
- ii. Participating Stations
 - 1 Lebreton
- iii. Artwork Locations for Federally Mandated Stations
 - 1 Refer to Federally Mandated Station Drawing Package
- iv. Role of Project Co
 - 1 Project Co shall prepare the lantern for the receipt of the artists' panels.
 - 2 Project Co shall install the artists' panels.
 - 3 Project Co shall provide electrical conduits, power supply and electricity to the Lantern.
- v. Artist Allocation
 - 1 Artists for the Lantern project shall be selected from the list of pre-qualified artists for non-integrated projects.
 - 2 This project shall involve collaboration with an artist from the Algonquin community.
- vi. Technical Specifications
 - 1 Artworks shall respect considerations of public safety and shall be constructed of materials that are appropriate to continuous public display, are durable and resistant to vandalism and to repetitive cleaning.
 - 2 Artworks shall be structurally sound.
 - 3 Artworks shall not have any complex mechanical or electronic devices associated with the artwork other than the required illumination of the Lantern.

Table 1-13.1 – OLRT Artworks by Station

Station	Roof & Screen	Landscape	Wall&/ or Tunnel	Escalator, Non Fare paid Underground Connector and Entry	Benches	Signbox	Gate	Lantern
Tunney's Pasture	•				•			
Bayview	•	•			•	•		
Lebreton	•	•			•		•	•
Hurdman	•				•	•		
Train	•				•	•		
Downtown West			•		•			
Downtown East			•		•	•		
Rideau			•	•	•			
Campus	•				•	•		
Lees	•				•	•		
St. Laurent			•		•			
Cyrville	•	•			•			
Blair	•				•			

Table 1-13.1 Legend

Upper Left Quadrant: Integrated Projects – Federally Mandated Stations

Upper Right Quadrant: Non-Integrated Projects – Federally Mandated Stations

Lower Left Quadrant: Integrated Projects – Non- Federally Mandated Stations

Lower Right Quadrant: Non-Integrated Projects – Non- Federally Mandated Stations

Table 1-13.2 – Pre-qualified List of Artists for Integrated Art Projects

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Table 1-13.3 – Preliminary OLRT Art Budget by Project

Preliminary OLRT Art Budget by Project					
Project	Station	Capital Amount	Design Fees	Production Fees	Notes
Roof & Screen	Tunney's Pasture	400,000	50,000	25,000	Bench and screen combined
Integrated	Bayview	400,000	50,000	25,000	
	Lebreton	400,000	50,000	25,000	Wall & Screens
	Campus	700,000	50,000	25,000	
	Lees	350,000	50,000	25,000	Bike Rail
	Hurdman	350,000	50,000	25,000	
	Train	300,000	50,000	25,000	Roof and Covered Walkway and/or screen
	Cyrville	350,000	50,000	25,000	
	Blair	350,000	50,000	25,000	
	4,275,000	3,600,000	450,000	225,000	
Escalator Chambers, Non Fare Paid Underground Connector and Entry Structures Integrated					
	Rideau	350,000	50,000	50,000	
	450,000	350,000	50,000	50,000	
Tunnel & Platform Walls Integrated					
	Downtown West	250,000	50,000	25,000	
	Downtown East	250,000	50,000	25,000	Platform Walls
	Rideau East	250,000	50,000	25,000	Platform Walls
	St. Laurent	250,000	50,000	25,000	Wall only
	1,300,000	1,000,000	200,000	100,000	
Lantern Non-integrated					
	Lebreton	250,000	50,000	0	
	300,000	250,000	50,000	0	
Ceremonial Gate Non-integrated					
	Lebreton	200,000	50,000	0	

Preliminary OLRT Art Budget by Project					
Project	Station	Capital Amount	Design Fees	Production Fees	Notes
		250,000	200,000	50,000	0
Landscape Integrated	Lebreton	225,000	50,000	0	
	Cyrville	150,000	50,000	0	
	Bayview	225,000	50,000	0	
		750,000	600,000	150,000	0
Benches	Tunney's Pasture	30,000	10,000		Bench and Screen
Non-Integrated (2 per station)	Bayview	20,000	10,000		
	Lebreton	20,000	10,000		
	Downtown West	20,000	10,000		
	Downtown East	20,000	10,000		
	Rideau	20,000	10,000		
	Campus	20,000	10,000		
	Lees	20,000	10,000		
	Hurdman	20,000	10,000		
	Train	20,000	10,000		
	St. Laurent	20,000	10,000		
	Cyrville	20,000	10,000		
	Blair	20,000	10,000		
		400,000	270,000	130,000	
Signbox	Downtown East	15,000			
	Campus	80,000			
Non-integrated (3 per station)	Hurdman	15,000			
	Train	15,000			
	Blair	15,000			
		140,000	140,000		
Future Art Project	To be Determined	150,000	25,000		
Non-Integrated		175,000	150,000	25,000	
ART COST SUBTOTAL		6,560,000	1,105,000	375,000	

ARTICLE 14 CORROSION CONTROL

14.1 General Requirements

- a) The Design and Construction of corrosion control work shall comply with the criteria contained in this Article, and all standards, regulations, policies, Applicable Law, guidelines or practices applicable to the Project, including but not limited to each of the following Reference Documents. In the event of a conflict between criteria, commitments or requirements contained within one document when compared with another, the more stringent shall apply:
- (i) UIC605OR – Protection from Corrosion;
 - (ii) EN 50162:2000 – Railway Applications;
 - (iii) CSA C22.3 No. 4-1974(R1995) Control of Electromechanical Corrosion of Underground Metallic Structures;
 - (iv) ACI Publication SP-77 Sulphate Resistance of Concrete;
 - (v) ACI Publication 201.2R Guide to Durable Concrete;
 - (vi) ACI Publication 222R Protection of Metals in Concrete Against Corrosion;
 - (vii) ACI Publication 506.2 Below Grade Shotcrete Used as Permanent Support;
 - (viii) ASTM G-51, D-516, C 452-75;
 - (ix) AWWA Standard C105;
 - (x) NACE Standards: SP0169 Control of External Corrosion on Underground and Submerged Metallic Piping Systems, SP0187 Design Considerations for Corrosion Control of Reinforcing Steel in Concrete, SP0290 Design Considerations for Corrosion Control of Reinforcing Steel in Atmospherically Exposed Concrete Structures;
 - (xi) TCRP Report No. 57 Track Design Handbook for Light Rail Transit Chapter 8, Corrosion Control;
 - (xii) CSA C22.1-09 Canadian Electrical Code Part I Safety Standard for Electrical Installations;
 - (xiii) CSA C22.2 Canadian Electrical Code Part II General Requirements; and
 - (xiv) Ontario Electrical Code.

14.2 Operational Requirements

- a) Grounding of all Structures and equipment shall meet the requirements for protection of the public as described in IEC 62128-1.
- b) A NACE certified corrosion specialist with a certification in cathodic protection shall serve as the responsible professional and shall approve and coordinate all elements of the corrosion mitigation measures for the OLRT.
- c) Soil Corrosion Control
 - (i) Soil corrosion Control requirements apply to systems or measures installed to mitigate corrosion caused by soil, rock and groundwater.
 - (ii) Project Co shall be responsible to obtain adequate soil/rock samples and ground water samples in areas of anticipated extensive below grade Construction. The soil/rock samples shall be analyzed for resistivity (or conductivity), moisture content, pH, chloride and sulphate ion concentrations and for the presence of sulphides.
 - (iii) Structures shall be protected against environmental conditions by the use of coatings, insulation, cathodic protection, electrical continuity, or a combination of the preceding, as appropriate.
- d) Stray Current Corrosion Control
 - (i) Stray current corrosion control minimum requirements apply to measures installed with the Traction Power system and trackwork to assure that stray earth traction currents do not exceed maximum acceptable levels. These levels are based on system characteristics and the characteristics of underground Structures.
 - (ii) These minimum requirements also apply to measures installed with fixed facilities, and to facilities belonging to others. They are based on anticipated stray earth traction current levels and the characteristics of fixed facilities and other buried Structures.
 - (iii) A baseline survey shall be performed to post-Construction and pre-energization to establish the reference levels of stray current existing prior to energization of the OLRT.
 - (iv) The proponent shall provide continuous track to ground current monitoring to detect any stray current faults.
- e) Atmospheric Corrosion Control
 - (i) Atmospheric corrosion control requirements apply to systems or measures installed to mitigate corrosion caused by local climatological conditions including

condensation, temperature cycling, industrial and vehicle emissions, spray by motor vehicles and snow and air pollutants.

- (ii) The requirements to be applied to all areas where atmospheric corrosion may be anticipated, are selection of materials of proven durability, protective coatings both barrier and sacrificial, sealants to prevent moisture intrusion and prohibiting the use of dissimilar metals.
- (iii) Project Co shall ensure that the electrical insulation design is not affected by the contamination from adjacent road de-icing or dust suppression, which includes but may not be limited to the following compounds:
 - A. Sodium Chloride (NaCl);
 - B. Calcium chloride (CaCl₂);
 - C. Magnesium chloride (MgCl₂);
 - D. Potassium chloride (KCl);
 - E. Brines used in road de-icing/salting; and
 - F. The salt portion of abrasive mixtures and additives commonly used in road salts (ferrocyanides).

f) Coatings

- (i) Coatings specified for corrosion control of buried metallic or concrete facilities shall satisfy the following requirements:
 - A. Minimum thickness as recommended for the specific system, but not less than 380 microns;
 - B. A chemical or mechanical bond to the metal or concrete surface; Pressure-sensitive systems shall not be accepted; non-bonding systems may be used in special instances, after review;
 - C. Minimum 5-year performance record for the intended service;
 - D. Mil application wherever possible, with field application of a compatible system; and
 - E. Mechanical characteristics capable of withstanding installation abuse during handling and earth pressure after installation for the Design Life of the system.

g) Electrical Insulation of Piping

- (i) Devices used for electrical insulators for corrosion control shall include non-metallic inserts, insulating flanges, couplings, unions, and/or concentric support spacers.
 - (ii) Devices shall meet the following requirements:
 - A. A minimum resistance of 10 megohms prior to installation;
 - B. Sufficient electrical resistance after insertion into the operating piping system such that no more than 2 percent of a test current applied across the device flows through the insulator, including flow through conductive fluids if present;
 - C. Mechanical and temperature ratings equivalent to the Structure in which they are installed;
 - D. Internal coating (except complete non-metallic units) with a polyamide epoxy for a distance on each side of the insulator equal to two times the diameter of the pipe in which they are used. Where conductive fluids with a resistivity of less than 2,000 ohm-centimeters are present, internal coating requirements shall be based on separate evaluation;
 - E. Devices (except non-metallic units) buried in soils shall be encased in a protective coating;
 - F. Devices (except non-metallic units) installed in chambers or otherwise exposed to partial immersion or high humidity shall have a protective coating applied over the components;
 - G. Inaccessible insulating devices, such as buried or elevated insulators, shall be equipped with accessible permanent test facilities;
 - H. In the event that construction of the OLRT disturbs or affects an existing grounding system, Project Co shall be responsible for the reinstatement or modification of the system equal to the pre-existing conditions.
 - (iii) A minimum clearance of 300mm shall be provided between new and existing metallic structures. When conditions do not allow a 300mm clearance, the Design shall include special provisions to prevent electrical contact with existing Structure(s).
- h) Electrical Continuity of Piping
- (i) Electrical continuity shall be provided for the non-welded metallic pipe joints and shall meet the following requirements:
 - A. Use of direct burial, insulated, stranded, copper wire with the minimum length necessary to span the joint being bonded; and

- B. Wire size shall be based on the electrical characteristics of the structure and resulting electrical network to minimize attenuation and allow for cathodic protection.
- (ii) A minimum of two wires shall be used per joint for redundancy.
- i) Cathodic Protection
 - (i) Cathodic protection shall be accomplished by sacrificial galvanic anodes to minimize corrosion interaction with other underground Utilities. Impressed current systems shall be used only when the use of sacrificial systems is not technically and/or economically feasible. Cathodic protection schemes that require connection to the transit System negative return system, in lieu of using a separate isolated anode groundbed, shall not be permitted.
 - (ii) Cathodic protection system Design shall be based on theoretical calculations that include the following parameters:
 - A. Estimated percentage of bare surface area (minimum 1 percent);
 - B. Cathodic protection current density;
 - C. Estimated current output per anode;
 - D. Estimated total number of anodes, size, and spacing;
 - E. Minimum anode life of 30 years; and
 - F. Estimated anode groundbed resistance.
 - i. Impressed current rectifier systems shall be capable of operating in constant voltage, constant current or potential control mode. Rectifiers shall be rated at a minimum of 50 percent above calculated operating levels to overcome a higher-than-anticipated anode groundbed resistance, lower-than-anticipated coating resistance, or presence of interference mitigation bonds. Other conditions which may result in increased voltage and current requirements shall be considered.
 - ii. Test facilities consisting of a minimum of two structure connections, one reference electrode connection, conduits and termination boxes shall be designed to permit initial and periodic testing of cathodic protection levels, interference currents, and system components (anodes, insulating devices, and continuity bonds). The designer shall specify the locations and types of test facilities for each cathodic protection system.
- j) Structures and Facilities

- (i) The following paragraphs establish the protective measures to be considered for specific underground Utilities and buried Structures.
 - A. Ferrous Pressure Piping
 - i. All new buried cast iron, ductile iron, and steel pressure piping shall be cathodically protected. System Design shall satisfy the following minimum requirements:
 - B. Application of a protective coating to the external surface of the pipe;
 - C. Electrical insulation of pipe from interconnecting pipe, other Structures and segregation into discrete electrically isolated sections depending upon the total length of piping;
 - D. Electrical continuity through the installation of copper wires across the mechanical pipe joints other than intended insulators; and
 - E. Permanent test/access facilities to allow for verification of electrical continuity, electrical effectiveness of insulators and coating, and evaluation of cathodic protection levels, installed at the insulated connections. Additional test/access facilities shall be installed at intermediate locations, at intervals determined on an individual Structure basis.
 - i. Number and location of anodes and size of rectifier (if required) shall be determined on an individual Structure basis.
 - F. Copper Piping
 - i. Buried copper pipe shall be electrically isolated from non-buried piping, such as that contained in a Station Structure, through use of an accessible insulating union installed where the piping enters through a wall or floor. Pipe penetrations through walls and floors shall be electrically isolated from building structural elements. The insulator shall be located inside the Structure and not buried.
 - G. Gravity Flow Piping
 - i. Corrugated steel piping shall be internally and externally coated with a sacrificial metallic coating and a protective organic coating.
 - ii. Cast or ductile iron piping shall be designed and fabricated to include the following provisions:
 - 1 An internal mortar lining with a bituminous coating on ductile iron pipe only (not required for cast iron soil pipe);

- 2 A bonded protective coating on the external surfaces in contact with soils;
 - 3 An unbounded dielectric encasement shall not be allowed; and
 - 4 A bituminous mastic coating on the external surfaces of pipe 150mm on each side of a concrete/soil interface.
- iii. Reinforced concrete non-pressure piping shall include the following provisions:
- 1 Water/cement ratios meeting the minimum provisions of applicable codes; and
 - 2 Maximum 250 ppm chloride concentration in the total concrete mix.

H. Electrical Conduits

- i. Buried metallic conduits shall include the following provisions:
- 1 Galvanized steel with PVC or other coating acceptable for direct burial, including couplings and fittings. The PVC coating is not required when conduits are installed in concrete.
- ii. Electrical continuity through use of standard threaded joints or bond wires installed across non-threaded joints.

k) Hydraulic Elevator Cylinders

- (i) Steel hydraulic elevator cylinders shall be designed, fabricated and installed to meet the following requirements:
- A. External protective coating resistant to deterioration by petroleum products;
 - B. Outer concentric FRP casing. Casing thickness, diameter and resistivity shall be designed to prevent moisture intrusion (including the bottom) and to maximize electrical insulation between the cylinder and earth;
 - C. Sand fill between the cylinder and FRP casing with a minimum resistivity of 25,000 ohm-centimeters, a pH of between 6 and 8 and a maximum chloride content of 250 ppm;
 - D. Cathodic protection through the use of impressed current with the anodes installed in the sand fill; and

- E. Permanent test facilities installed on the cylinder, anodes and earth reference to permit evaluation, activation, and periodic retesting of the protection system.
 - (ii) Removable moisture-proof sealing lid installed on the top of the casing prior to installation of the cylinder. The top of the casing shall be permanently sealed against moisture intrusion after installation of the cylinder.
- l) Buried Concrete/Reinforced Concrete Structures
- (i) The Design of cast-in-place concrete Structures shall be based on the following provisions:
 - A. Use Type I cement. ASTM C452-75 and ACI Publication SP-77 *Sulfate Resistance of Concrete* shall be used as guidelines for evaluating the sulphate resistance of concrete mixes with non-standard cement types;
 - B. Water/cement ratio and air entrainment admixture in accordance with the structural requirements to establish a dense, low permeability concrete. Refer to applicable sections of ACI 201.2R *Guide to Durable Concrete*;
 - C. Maximum chloride concentration of 250 ppm in the total mix (mixing water, aggregate, cement, and admixtures). The concrete mix shall be such that the water soluble and acid soluble chloride concentrations, at the concrete/ reinforcing steel interface, do not exceed 0.15 and 0.2 percent by weight of cement, respectively, over the life of the Structure. Refer to applicable sections of ACI 222R *Corrosion of Metals in Concrete*;
 - D. Concrete cover over reinforcing steel shall comply with appropriate codes and provide a minimum of 50mm of cover on the soil/rock side of reinforcement when pouring within a form and a minimum of 75mm of cover when pouring directly against soil/rock; and
 - E. The need for additional measures, as a result of localized special conditions, shall be determined on an individual basis.
 - (ii) Precast standardized facilities, such as vaults and maintenance holes, shall be reviewed on an individual basis to determine alternative requirements when they cannot be practically modified to meet some or all of the requirements herein.
 - (iii) Precast segmented concrete ring Construction shall meet the requirements of this Article or be reviewed on an individual basis to determine alternative requirements when they cannot be practically modified to meet some or all of the provisions specified.
- m) Support Pilings

- (i) The following is applicable only to support piling systems which are to provide permanent support. Pilings used for temporary support do not require corrosion control provisions.
 - (ii) Designs based on the use of metallic supports exposed to the environment, such as H or soldier piles, shall include the use of a barrier coating. The need for special measures, such as cathodic protection, shall be determined on an individual basis, based on type of Structure, analysis of soil borings for corrosive characteristics and the degree of anticipated structural deterioration caused by corrosion.
 - (iii) Reinforced concrete piling, including fabrications with prestressed members, shall be designed to meet the following minimum requirements:
 - A. Water/cement ratio and cement types in accordance with applicable codes;
 - B. Chloride restrictions for concrete with non-prestressed members shall be in accordance with applicable codes;
 - C. Chloride restrictions for concrete with prestressed members shall be in accordance with applicable codes, with exception that the concrete mix shall be such that the water soluble and acid soluble chloride concentrations, at the concrete/prestressed steel interface, do not exceed 0.06 and 0.08 percent by weight of cement, respectively, over the life of the Structure; and
 - D. A minimum of 75mm of concrete cover over the outermost reinforcing steel, including prestressing wires, if present.
 - (iv) Concrete-filled steel cylinder columns, where the steel is an integral part of the load bearing characteristics of the support structure, shall be designed considering the need for special measures, such as increased cylinder wall thickness, external coating system, and/or cathodic protection. The Design shall be determined on an individual basis, based on type of Structure, analysis of soil borings for corrosive characteristics and the degree of anticipated structural deterioration caused by corrosion.
- n) **Stray Current Corrosion Control**
- (i) This section provides requirements for designs to minimize the corrosive effect of stray earth traction currents from transit operations on transit Structures and Adjacent Structures.
 - (ii) Stray current control shall reduce or limit the level of stray currents at the source, under normal operating conditions, rather than trying to mitigate the corresponding effects (possibly detrimental) which may otherwise occur on transit facilities and other underground Structures. The basic requirements for stray current control are as follows:

- A. Maximize the isolation of the electrical systems and prevent inadvertent electrical connections between the positive and negative Traction Power distribution circuits and ground; and
 - B. Design the Traction Power System and trackwork to minimize stray earth currents during normal revenue operations.
- o) Traction Power System
- (i) Traction Power supply System shall be designed as a dedicated system, providing power to the LRT System. The Traction Power supply System for the LRT shall be designed electrically isolated.
 - (ii) TPSS shall be spaced at intervals such that maximum track-to-earth potentials do not exceed 50 volts during normal operations and 70 volts during contingency operation as defined in Part 4 Article 2 – Traction Power.
 - (iii) Substations shall be provided with access to the dc negative bus for stray current monitoring. Access shall be provided either inside, through use of dedicated space if available, or outside through the use of a weather tight enclosure with an open conduit between the enclosure and the dc negative bus.
 - (iv) Substations shall be provided with a Utility drainage panel(s) for connection of Utility drain cables if deemed necessary. The drainage panels shall be connected through a raceway system to a drainage pullbox exterior to the substation to facilitate Utility interconnection.
 - (v) Provisions shall be included to monitor track-to-earth potentials on a continuous basis at traction power substations.
- p) Positive Distribution System
- (i) Positive distribution system shall be normally operated as an electrically continuous bus, with no breaks, except during Emergency or fault conditions. Intentional electrical segregation of mainline positive distribution systems is the only type of segregation permitted.
 - (ii) OCS, consisting primarily of support poles, insulators, the contact wire and the messenger wire, shall be designed to meet the following minimum requirements and include the following minimum provisions:
 - A. Discrete grounding of individual at-grade support poles, in lieu of interconnecting poles to each other or to a common ground electrode system. Establish electrical continuity of reinforcing steel in OCS support poles and electrically connect support poles to the foundation reinforcing steel; and

- B. Common grounding of support poles on aerial structures through electrical connection to either bonded (welded) reinforcing steel in the deck or to each other and a common ground electrode system, when present.
- q) Negative Return System
- (i) Running Rails. The mainline, including special trackwork, and grade crossings shall be designed to have a minimum, uniformly distributed, in-service resistance to earth per 300 m of Track (two rails) (based on 115# rail resistance) as determined by the following:
 - A. A computerized simulation shall be used to determine the level of stray current to be permitted and the required Track to earth resistances;
 - B. Soil layer resistivity (ASTM G-57) along the entire Alignment shall be used in the above simulation to determine anticipated earth potential gradients; and
 - (ii) The requirements shall be met through the use of appropriately designed insulating Track fastening devices, such as insulated tie plates, insulated rail clips, direct fixation fasteners, rail boots, or other approved methods.
 - (iii) Ballasted Track Construction shall meet the following minimum provisions:
 - A. Use of a hard rock, non-porous, well drained ballast material;
 - B. A minimum 25mm clearance between the ballast material and the metallic surfaces of the rail and metallic Track components in electrical contact with the rail;
 - C. Mainline Track shall be electrically insulated;
 - D. Mainline Track shall be electrically insulated from foreign railroad connections (sidings) by use of insulating rail joints. Location of the insulating joints shall be chosen to reduce the possibility of a vehicle bridging the insulator(s) for a time period larger than required moving onto or off mainline;
 - E. MSF Track shall be electrically isolated from mainline Track;
 - F. MSF shop Track shall be electrically isolated from yard Track and grounded; and
 - G. Select grade crossing and Track locations shall utilize permanent reference electrode arrays with test stations for monitoring of stray current activity and evaluating the isolation of Track. The requirements for the use of these earth potential gradient test arrays shall be based upon a case by case review of the Track or grade crossing location, type of Track

Construction, adjacent critical utility Structures and others as deemed appropriate.

- (iv) Track-to-earth resistance shall be monitored periodically during Construction to detect variations or decrease in resistance. Investigations shall be initiated as soon as a low resistance reading is obtained and the cause of the low reading repaired.
- (v) Ancillary Systems
 - A. Switch machines, signalling devices, Train to wayside Communication Systems, and other devices or systems attached to the rails shall be electrically isolated from the rails. The requirements shall be met through the use of dielectric materials electrically separating the devices/Systems from the rails.
- (vi) Electrical Continuity
 - A. The running rails shall be constructed as an electrically continuous Traction Power return circuit through use of rail joint bonds, continuously welded rail, or a combination of these, except for the use of insulated rail joints at specific locations. The linear resistance of each individual negative rail shall not exceed 1 ohm per linear 300m of rail at any point along the Tracks.
- r) Aerial Trackway Structures
 - (i) Column and Bearing Assemblies, Tie and Ballast
 - A. This section applies to aerial structures and Bridges that use a column and bearing assembly, but with tie and ballast Track Construction. Welding of reinforcing steel in the deck is not required for this configuration.
 - B. A waterproof, electrically insulating membrane (with protection board on top of the membrane) shall be provided over the entire surface of the deck that will be in contact with the ballast. The membrane system shall have a minimum volume resistivity of 1×10^{12} ohm-cm.
 - C. Electrical isolation of reinforcing steel shall be provided in deck/girders from columns, abutments, and other grounded elements. Isolation can be established through the use of insulating elastomeric bearing pads, dielectric sleeves and washers for anchor bolts and dielectric coatings on selected components. Use of bearings shall take into account the appropriate electrical grounding to ensure that stray current does not pass through the bearing race.
 - (ii) Bents and Girders, Tie and Ballast

- A. This section applies to aerial Structures that use bent type supports with reinforcing steel extending into the deck/girders, but with tie and ballast Track Construction.
 - B. Provide electrical continuity of the column/bent steel by welding appropriate reinforcing to at least two vertical column bars. Make these connections to each of the two vertical bars at the top and bottom of the column/bent.
 - C. Provide electrical continuity of the deck longitudinal bars by welding all lap splices.
 - D. Electrically interconnect column/bent steel to deck/girder steel by welding at least two vertical column bars to collector bars installed at bents.
 - E. Electrically interconnect column/bent steel to footing steel when column/bent steel penetrates the footing. Weld at least two vertical column/bent bars to footing reinforcing steel.
 - F. Electrically interconnect pre or post tensioned cables to continuous longitudinal reinforcing steel by welding a cable between each anchor plate and the longitudinal reinforcing steel.
 - G. Provide test facilities at each hinge and expansion joint and at every other column/bent, starting with the first column/bent from an abutment. Test facilities at hinges and expansion joints shall house bonding cables from adjacent collector bars on each side of the hinge/joint.
 - H. Facilities at columns/bents shall house two wires from vertical column/bent steel and from the collector bar at the top of the bent.
 - I. Provide a waterproof, electrically insulating membrane (with protection board on top of the membrane) over the entire surface of the deck that will be in contact with the ballast. The membrane system shall have a minimum volume resistivity of 1×10^{12} ohm-cm.
- (iii) Concrete Deck/Exposed Steel, Tie and Ballast
- A. This section applies to Bridge Structures that use a reinforced concrete deck with exposed steel superstructure and have insulated trackwork Construction, but with tie and ballast Track Construction. Welding of reinforcing steel in the deck is not required for this configuration.
 - B. Provide a waterproof, electrically insulating membrane (with protection board on top of the membrane) over the entire surface of the deck that will be in contact with the ballast. The membrane system shall have a minimum volume resistivity of 1×10^{12} ohm-cm.

- C. Provide electrical isolation of reinforcing steel in the deck and superstructure steel from columns, abutments and other grounded elements. Isolation can be established through the use of insulating elastomeric bearing pads, dielectric sleeves and washers for anchor bolts and dielectric coatings on selected components.
 - D. If electrical isolation of reinforcing steel in the deck and superstructure steel from columns, abutments, and other grounded elements cannot be obtained, then electrical continuity of metallic components within these latter elements shall be established by appropriate welding and bonding procedures.
- (iv) Retaining Walls
- A. The longitudinal bar overlaps in both faces of the wall, including the top and bottom bars in the footing, shall be tack welded to insure electrical continuity. Longitudinal bars in the footing shall be made electrically continuous to the longitudinal bars of the walls. Collector bars, bonding cables and test facilities shall be installed.
- s) OCS Pole Foundation Grounding
- (i) All metallic components, inclusive of the pole baseplate, that will be partially embedded or come in contact with concrete surfaces shall be coated with a sacrificial/barrier coating. The coating shall be applied to the entire component. The coating shall extend a minimum of 6-inches into the concrete and a minimum of 12.7mm above the surface of the concrete.
 - (ii) At-Grade OCS Support Poles
 - A. Electrical continuity of reinforcing steel within support pole foundations shall be established to provide an adequate means for dissipating any leakage current from the contact wire and, where applicable, the messenger wire. The following minimum provisions shall be included with design:
 - i. The outermost layer of vertical reinforcing steel within the concrete foundation shall be tack welded at the intermediate vertical lap joints and to reinforcing bar collector rings (two) installed at the top and bottom of the reinforcing bar cage;
 - ii. A copper cable shall be connected between the base of the catenary support pole and the foundation reinforcing steel. The cable shall be thermite welded or brazed to the support pole and routed in such a manner that it shall not be susceptible to damage during Construction or after installation is complete. The connection to

the pole shall be coated with a zinc-rich weather resistant coating material; and

- iii. The copper cable shall be sized based upon anticipated fault current and fault clearing time.

(iii) OCS Poles on Aerial Structures

A. OCS poles located on aerial structures shall include either of the following minimum set of provisions, depending on the type of aerial structure.

B. Where the aerial structure includes welded deck reinforcing steel connected to a ground electrode system, electrically interconnect the OCS support poles on the structure and connect these poles to the ground electrode system.

- i. Cabling used to interconnect the poles and the ground electrode system shall be sized based upon anticipated fault current and fault clearing time.

- ii. The cabling shall be routed in conduit and terminated in junction boxes or test cabinets that also house wires from the deck reinforcing steel and the ground electrode system.

- iii. Cabling shall be designed to allow for connection of interconnected OCS poles along the aerial structure to the ground electrode systems installed with a particular aerial structure.

C. Where the aerial structure has welded deck reinforcing steel but does not include a ground electrode system, electrically connect the OCS support poles to the welded deck reinforcing steel.

- i. Provide a copper cable from each OCS support pole to the deck reinforcing steel. The copper cable shall be sized based upon anticipated fault current and fault clearing time.

- ii. Thermite weld or braze the cable to the OCS support pole and to the nearest transverse collector bar installed in the aerial structure deck.

- iii. Where it is not practical to connect an OCS pole directly to a transverse collector bar, because of excessive distance or other factors, connect the pole to a local transverse reinforcing bar using a copper cable and weld the transverse reinforcing bar to at least three upper layer longitudinal reinforcing bars in the deck.

t) Utility Structures

- (i) Piping and conduit shall be non-metallic, unless metallic facilities are required for specific engineering purposes
- u) Metallic Facilities (Systemwide)
 - (i) Pressure or non-pressure piping exposed in crawl spaces or embedded in concrete inverts shall not require special corrosion prevention provisions.
 - (ii) Pressure piping that penetrates foundation, or Station walls shall be electrically insulated from the external piping to which it connects and from watertight wall sleeves. Electrical insulation of interior piping from external piping shall be made on the inside of the foundation or wall.
- v) Facilities Owned by Others
 - (i) Replacement/Relocated Facilities
 - A. Corrosion control facilities provided for protection of buried Utilities and installed by Project Co as part of OLRT shall become the responsibility of the individual Utility owner/operator following acceptance of the corrosion protection system.
 - B. Project Co shall protect the buried Utilities including City watermains so that the maximum anodic potential shift caused by dynamic stray currents on any watermain or buried Utility along the OLRT Alignment shall not exceed 50 mV anodic shift from the average baseline value of the voltage time data logger graphs. Monitoring locations of the dynamic potential shifts and stray currents shall be at the discretion of the Utility operators. Project Co shall obtain copies of the sample baseline monitoring charts and information on some of the possible future monitoring locations from the individual Utilities. Such testing shall be performed by a corrosion/cathodic protection specialist. Where the anodic shift exceeds 50 mV, cathodic protection shall be installed by Project Co at all affected areas to mitigate any adverse impact of corrosive stray currents that are induced by the OLRT System.
 - C. Project Co shall contain City watermains buried under the Guideway to a distance of 3m beyond outside Tracks within a steel casing and install sacrificial anodes and test stations. Watermains requiring relocation by Project Co shall be installed with adequate cathodic protection, coating and test stations.
 - D. Relocated or replaced Utilities installed by Project Co as part of a separate contractual agreement between Project Co and the Utility, shall be installed in accordance with the Utility owner agreed upon specifications and shall include the following minimum provisions. These provisions are

applicable to ferrous and reinforced concrete pressure piping. Other materials and Structures shall require individual review.

- i. Electrical continuity through the installation of insulated copper wires across the mechanical joints for which electrical continuity cannot be assured;
- ii. Electrical access to the Utility Structure via test facilities installed; and
- iii. The need for additional measures, such as electrical isolation, application of a protective coating system, installation of cathodic protection, or any combination of the preceding, shall be based on the characteristics of the specific Structure and to not adversely affect the existing performance within the environment.

(ii) Existing Utility Structures

A. The need for stray current monitoring facilities shall be jointly determined by Project Co and the individual Utility operators. If utilities have no stray current guidelines, Project Co shall provide direction based on the following:

- i. Test facilities at select locations for the purpose of evaluating stray earth current effects during start-up and revenue operations. Guidelines for location of test facilities shall be as follows:
 - 1 At the utility crossings with the system and on Structures parallel to the LRT Tracks; and
 - 2 At locations on specific utility Structures that are near the System TPSS.

(iii) Existing Bridge Structures

A. Stray current corrosion control for existing Bridge Structures shall be addressed by limiting earth current levels at the source (running rails). Meeting the requirements established shall provide the primary stray current control for these facilities.

w) Corrosion control coatings

- (i) Coatings shall have established performance records for the intended service and be compatible with the base metal to which they are applied.
- (ii) Coatings shall be able to demonstrate satisfactory gloss retention, color retention, and resistance to chalking over their minimum life expectancies.

- (iii) Coatings shall have minimum life expectancies, defined as the time prior to major Maintenance or reapplication, as determined by the manufacturer's standard.
- x) Metallic-Sacrificial Coatings
 - (i) Acceptable coatings for carbon and alloy steels for use in crawlspaces, vaults, or above grade shall be as follows:
 - A. Zinc (hot-dip galvanizing or flame sprayed);
 - B. Aluminum (hot-dip galvanizing or flame sprayed);
 - C. Aluminum-zinc;
 - D. Cadmium and electroplated zinc (sheltered areas only); and
 - E. Inorganic zinc (as a primer).
- y) Organic Coatings
 - (i) Organic coating systems shall consist of a wash primer (for galvanized and aluminum substrates only), a primer, intermediate coat(s), and a finish coat. Acceptable organic coatings, for exposure to the atmosphere, are as follows:
 - A. Aliphatic polyurethanes;
 - B. Vinyl copolymers;
 - C. Fusion-bonded epoxy polyesters, polyethylenes, and nylons;
 - D. Acrylics, where not exposed to direct sunlight;
 - E. Alkyds, where not exposed to direct sunlight; and
 - F. Epoxy as a primer where exposed to the atmosphere or as the complete System where sheltered from sunlight.
- z) Conversion Coatings
 - (i) Conversion coatings, such as phosphate and chromate coatings, shall be used as pre-treatments only for further application of organic coatings.
- aa) Ceramic-Metallic Coatings (Cermets)
 - (i) This hybrid-type coating system shall be acceptable for use on metal panels and fastening hardware.
- bb) Sealants

- (i) Crevices shall be sealed with a polysulfide, polyurethane or silicone sealant.
- cc) Barrier Coating System
 - (i) One of the following barrier coating systems shall be used where corrosion protection is required but appearance is not a primary concern:
 - A. Near white blast surface according to NACE NO. 2/SSPC-SP 10;
 - B. Commercial blast surface according to NACE NO. 3/SSPC-SP 6;
 - C. Near white blast surface according to NACE NO. 3/SSPC-SP 10; or
 - D. Apply the coatings according to manufacturer's specifications.
 - (ii) Use one of the following barrier coating systems where corrosion protection and good appearance is needed.
 - A. Near white blast surface according to NACE NO. 2/SSPC-SP 10;
 - B. Near white blast surface according to NACE NO. 2/SSPC-SP 10;
 - C. Commercial blast surface according to NACE NO. 3/SSPC-SP 6;
 - D. Commercial blast surface according to NACE NO. 3/SSPC-SP 6; or
 - E. Apply the coating according to manufacturer's specifications.
- dd) Grounding Coordination
 - (i) Coordination shall be undertaken to ensure that grounding Design and corrosion control measures do not conflict so as to render either the grounding system or the corrosion control system ineffective.
- ee) A stray current test program shall be performed prior to operation of the OLRT. This test program shall be a pre-operation baseline and serve as the basis for decisions regarding mitigation of OLRT caused stray current impacts.

ARTICLE 15 SITE WORK

15.1 General

- a) Project Co shall restore or rehabilitate any disturbed areas extending beyond the limits of the Works, including but not limited to, paving, trackwork, planting or sodding. These areas shall be cleaned of debris and have any temporary paving or structures removed and replaced with planting soil in accordance with the requirements of Part 1 Article 17-Landscaping Design Criteria. A review of the adjacent land uses and site development shall be completed for these locations and the most appropriate groundcover shall be selected.
- b) Existing Conditions
 - (i) Existing conditions shall be verified by Project Co
 - (ii) Underground and surface Utility lines and buried objects are to be identified in the field prior to excavation operations.
- c) Protection
 - (i) Protect and/or transplant existing fencing, trees, landscaping, natural features, bench marks, buildings, Pavement, surface or underground utility lines which are to remain. If damaged, restore to original or better condition unless directed otherwise.
 - (ii) Replace any damaged trees designated to remain, or as directed by the City.
 - (iii) Project Co shall be responsible for installing, maintaining and removing any temporary facilities necessary to access the site, including but not limited to fences, gates, Constructions, granular, silt fences and traffic control devices.

15.2 Order of Precedence

- a) All Project site work shall be designed in accordance with the criteria contained or referenced in this article and all standards, regulations, policies, Applicable Law, guidelines or practices applicable to the Project, including but not limited to each of the following Reference Documents. In the event of a conflict between the criteria, commitments or requirements contained within one document when compared with another, the more stringent shall apply:
 - (i) Specific obligations and criteria identified in the Articles in this Schedule;
 - (ii) City Standards;
 - A. The City of Ottawa's Current Version of Standard Tender Documents and Specifications including:

- B. City of Ottawa Right of way Lighting Policy, Version 2009.
 - C. City of Ottawa's Electrical, Signals, and Lighting Criteria.
 - D. City of Ottawa Road Corridor Planning & Design Guidelines, Urban & Village Collectors / Rural Arterials & Collectors- October 2008.
 - E. City of Ottawa Sewer Design Guidelines.
- (iii) Geometric Design Guide for Canadian Roads (TAC-1999); and
- (iv) Ontario Provincial Standard Specifications and Drawings (OPSS).

ARTICLE 16 DEMOLITION, REMOVALS AND DISPOSAL

16.1 General

- a) Project Co shall demolish any buildings or other Structures on the Real Property interests as required for Construction and obtain all Permits required for demolition. All Demolition refuse and materials shall be the property of Project Co and Project Co shall dispose of all such refuse and materials and leave the Lands in a clean and tidy condition upon completion of the Work.

- b) Performance Criteria
 - (i) Guideway
 - A. Project Co shall remove obstructions encountered in the Construction of the Guideway elements that hinder the installation of said elements. Obstructions may include but are not limited to – pipes, conduits, ductbanks, foundations, debris, poles and any other object.

 - B. Project Co shall remove existing roadway and sidewalk pavements obstructing the Construction of the Guideway elements. Use equipment and methods of removal and hauling which protect underlying Pavement or existing Pavement not designated for removal.

 - C. Project Co shall remove the roads and parking lots associated with the existing Transitway that are no longer being used and are within the Lands but not within the proposed Guideway limits. The Pavement structure and bedding shall be removed and replaced with fill material that shall sustain plant materials as described in Schedule 15.2-Part 1-Article 17 Landscape Design Criteria.

 - (ii) Stations
 - A. The following Stations shall be completely removed or demolished:
 - i. Bayview Station;

 - ii. Lebreton Station;

 - iii. Campus Station;
 - 1 With the exception of the elevators from the pedestrian Tunnel that are to be retained and included in the reconstructed pedestrian Tunnel;

 - iv. Hurdman Station;

 - v. Train Station; and

- vi. Cyrville Station.
 - B. The following Stations shall be selectively demolished and rehabilitated or renovated:
 - i. Tunney's Pasture Station;
 - ii. Lees Station;
 - iii. St. Laurent Station; and
 - iv. Blair Station.
 - C. The demolition, selective demolition and or removals shall be coordinated with City for any salvageable materials that City may want to reuse elsewhere.
 - D. Project Co shall be responsible for the complete removal of the Scotiabank building located at the north east corner of Rideau Street and William Street. For further clarity, any designated substances, if present, within the Scotiabank building shall be the responsibility of Project Co.
- (iii) MSF
- A. Project Co shall inspect the site and perform any pre demolition testing as required to meet all applicable federal, provincial and local regulations. This testing shall be performed in accordance with the City of Ottawa Standards, MOE Standards and OPSS
 - B. Project Co shall remove existing internal roadway, parking lot and sidewalk Pavements obstructing the Construction of the new MSF features.
 - C. Project Co shall remove existing building foundations to a depth sufficient to not interfere with any proposed work necessary to complete the Project.
 - D. The demolition of the existing City facility at 805 Belfast shall be coordinated with the City. Project Co shall provide the City with 30 days' notice of its intention to proceed with the building demolition to allow the City to remove any salvageable materials that the City may want to remove and reuse elsewhere including but not limited to:
 - i. The fuelling equipment.
 - E. The remaining buildings shall be demolished without any restrictions pertaining to previous owner's equipment and material.
- c) Materials

- (i) Project Co shall dispose of all materials removed in accordance with City Standards and OPSS.
- (ii) Project Co shall manage the hazardous materials in accordance with City Standards and OPSS. Project Co shall not store materials on site without precautions to prevent adverse effects of adjacent watercourses, groundwater, the migration of materials offsite, nor allowing the development of a nuisance condition.
- (iii) Project Co shall properly stockpile the materials resulting from removals and/or demolition by using separate stockpiles for waste materials and reusable or recyclable materials.

ARTICLE 17 LANDSCAPE DESIGN CRITERIA

17.1 Introduction

- a) This article presents the Design guidelines for the landscape architecture and urban design that shall be integrated into the Design of the OLRT Project. The work of this section includes the standards for streetscape elements, pedestrian and cycling access to the Stations, planting and tree compensation.

17.2 Reference Documents

- a) The Design and Construction of urban design and landscape works shall comply with the criteria contained in this Article, and all standards, regulations, policies, Applicable Law, guidelines or practices applicable to the Project, including but not limited to each of the following Reference Documents. In the event of a conflict between criteria, commitments or requirements contained within one document when compared with another, the more stringent shall apply:
 - (i) City of Ottawa – Official Plan;
 - (ii) City of Ottawa – Transportation Master Plan;
 - (iii) Ottawa Urban Design, A Reference Guide to Creating Great Places and Great Spaces, Publication #2103;
 - (iv) Downtown Ottawa Urban Design Strategy;
 - (v) City of Ottawa – TOD Guidelines;
 - (vi) City of Ottawa – Green Space Master Plan;
 - (vii) City of Ottawa Cycling Plan;
 - (viii) City of Ottawa – Pedestrian Plan;
 - (ix) City of Ottawa – Integrated Street Furniture Program;
 - (x) Ontario Building Code;
 - (xi) Accessibility for Ontarians with Disabilities Act (AODA);
 - (xii) CTA Terminal Code of Practice, Terminal Accessibility;
 - (xiii) City of Ottawa Construction Specifications and Details;
 - (xiv) Canadian Standards for Nursery Stock, most recent edition; and
 - (xv) The City Transitway Design Manual, most recent edition.

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- b) In addition to the above, the following reference materials shall apply to the applicable Stations:
- (i) Tunney's Pasture Master Plan;
 - (ii) Bayview/Somerset Area Secondary Plan;
 - (iii) Lebreton Flats South Development;
 - (iv) Ottawa Escarpment Area District Plan;
 - (v) An Urban Design Strategy for Sussex Dr., Rideau St. and Colonel By;
 - (vi) University of Ottawa – Main Campus Strategy; and
 - (vii) Federally Mandated Stations Drawing Package for Tunney's Pasture Station, Bayview Station, Lebreton Station, Campus Station, Hurdman Station, Train Station and OLRT corridors.

17.3 Urban Design and Landscape Architectural Design

- a) All areas adjacent to Stations are subject to future land use intensification and Station designs shall support transit-oriented development. Designs shall facilitate barrier free movement of Passengers between surrounding bus waiting areas, sidewalks, entrances and pathways to the Station Platform / OLRT Vehicle area. Safe, efficient and accessible pedestrian circulation shall be given the highest priority in Station Design.
- b) There shall be a consistent use of standard landscape elements including fencing, paving, plant material and other items identified in this article utilized throughout the Alignment.
- c) Urban development and landscape treatments shall compliment the adjacent land use. Pedestrian and cycling links shall be protected and connections to the adjacent communities provided.
- d) Native plant material shall be used.
- e) Weather protection shall be provided along pathways, Station Platforms and waiting areas to ensure customers are protected from inclement weather. The use of plant material as wind screens and shade shall be permitted.
- f) Where appropriate, existing landforms and vegetation shall be preserved and incorporated into urban design. Designs shall be achieved with the intent to minimizing impacts to the surrounding environment.
- g) The landscape Design of each Station shall have standard and common finishes. All Stations shall express the local character and qualities of their communities and planning context and assist in wayfinding/Station identification. Station entrances shall be easily

identifiable and be designed to discourage loitering and to maximize safety/observation through the use of lighting and glazing.

- h) The landscape Design of all Stations, entrances to Underground Stations and surrounding areas shall be subject to CPTED principles. CPTED principles shall be applied in all aspects of Station landscape architecture Design.

17.4 Landscape Plans

- a) Project Co shall submit landscape plans as part of the Works Submittals according to Schedule 10 – Review Procedure.

17.5 Urban Design and Landscape Elements

- a) Sidewalk, Pathways and Plaza Pavement
 - (i) A combination of concrete and unit paving stones shall be used to construct primary sidewalks and plaza spaces. Sidewalks and plazas shall be barrier-free, have a minimum width of 3.0m and shall be a paved surface capable of withstanding heavy duty commercial use including access by Emergency and Maintenance vehicles as per city standards.
 - (ii) Design and materials used at primary sidewalks shall assist in wayfinding.
 - (iii) Contrasting pavers and textures delineating thresholds and pedestrian routes to meet the standards of the AODA shall be provided at all stations. This shall commence at the public sidewalks and be continuous through to the station. The pavers and textures shall be consistent with the materials utilized within the station.
 - (iv) Sidewalks and MUPs to Stations shall be designed in accordance with the applicable existing and recreational networks of the surrounding community and shall adhere to City standards for MUPs. Design and selection of Construction materials and layout alignment shall be consistent with specific site context and associated landscape type.
 - A. These pathways shall be minimum 3.0 m in width unless specified otherwise in this Article or in Schedule 15-2 Part 5 and shall be a paved surface capable of withstanding heavy duty commercial use, including access by Emergency and Maintenance vehicles and shall not be used for calculating the requirements for loading or unloading of the buses.
 - B. A sodded clearance strip of 0.6 m shall be provided on each side of a MUP except in the following conditions;
 - i. Where MUPs are located beneath a Bridge, provide 0.6m of shoulder on each side of MUP;

- ii. Where MUP transverses an open paved plaza, provide pavement markings, change in paving colors or change in hard surface material to identify the route of the MUP; and
 - iii. Where a MUP is adjacent to an existing or a proposed vertical constructed surface or element such as a building, guardrail, retaining wall, fence, etc., a 0.5 m “buffer” space shall be provided from the existing constructed surface in addition to the width of the MUP.
- C. Outside of the Station areas where existing Structures limit the available right of way width and prevent the construction of a MUP in excess of 3.0 m wide, Project Co may reduce the width of the MUP to 3.0 m provided a 0.5m buffer space to vertical obstructions is maintained.
- (v) The MUPs and sidewalks at Stations shall be designed to ensure crossing locations to minimize the potential conflict between cyclists and pedestrians. This may include “T” intersections, small walls, planters or other design elements.
 - (vi) NCC recreational pathways shall remain open to public use to the fullest extent possible during construction. Project Co shall provide temporary signage indicating detours if pathway closures are required.
 - (vii) The primary sidewalks and secondary pathways shall be barrier free, and shall not exceed a grade of 5%. Cross slopes shall not exceed 2%. The primary sidewalks and secondary multi-use pathways shall be designed to maintain proper drainage and eliminate water accumulation in accordance with City guidelines.
 - (viii) Depressed curbs shall be provided at all sidewalk roadway interfaces and shall be in proximity to bicycle parking areas to facilitate safe access from roadway to sidewalk.
 - (ix) Paving Materials shall be as follows:
 - A. Primary Paving Stones: Cambrian Black Buffed, as manufactured by Transpave, or approved equal. Size to meet and match the dimensions of the Platform edge pavers;
 - B. Accent Paving Stones: Beige/Grey, as manufactured by Transpave, or approved equal. Size to meet and match the dimensions of the Platform edge pavers. When utilized as the contrasting colour for the visually impaired, the paver shall have a texture variation to meet the standards of the AODA; and
 - C. Concrete Paving: shall be to 32 MPa, with a magnesium float finish, caulked expansion joints and saw cut control joints. There shall be no tooled edges.

- (x) Where the construction of, including but not limited to, sidewalks, pathways, MUP's and plazas adjoin existing construction, Project Co shall design and construct the new work to provide smooth, safe and seamless transition of materials.

b) Site Furnishing

- (i) Site furniture shall be selected from a family of complementary site furnishings that provide an unobstructed view of the underside of the furniture, coordinated with the interior Station furniture and sustainable in terms of its recycled content and long-term durability. Site furnishings shall be strategically placed along sidewalks, plaza spaces and Platform areas to maximize their use and not encumber pedestrian movement. All furniture shall be fastened to the surface to reduce vandalism and to protect for future replacement requirements.
- (ii) The site furniture shall be located to provide clear access and visibility to any site wayfinding signage, so that it does not obstruct views for CCTV.
- (iii) In addition to the requirements above, the minimum quantities for the site furnishings shall be:

Station	Bicycle Racks**	Additional Bicycle Racks***	Standard Benches*	Waste Receptacles	Pedestrian Lights
Tunney's Pasture	16	16	10	4	38
Bayview	8	8	10	4	10
LeBreton	14	14	10	4	10
Downtown West	4	4	10	2	0
Downtown East	8	8	10	2	0
Rideau	4	4	10	0	0
Campus	16	16	10	3	6
Lees	8	8	10	2	4
Hurdman	16	16	10	5	12
Train Station	8	8	4	2	2
St. Laurent	0	0	10	1	0
Cyrville	16	16	10	4	4
Blair	32	32	10	4	4
MSF	**		1	1	6
Total	150	150	125	38	96

* The above bench quantities do not include custom benches that may be developed under the art program for each Station.

** The minimum number of bicycle racks as required by City regulations or number to satisfy LEED requirements shall be

Station	Bicycle Racks**	Additional Bicycle Racks***	Standard Benches*	Waste Receptacles	Pedestrian Lights
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provided at the Maintenance and Storage Facility.

**** Bicycle racks included in this column are not subject to the minimum sheltered area described in this Article and should be configured and arranged such that they are placed and reside within the Lands.*

- (iv) Waste/Recycle Receptacle units shall be provided and shall be easily accessible for Maintenance and trash pick-up. A clear, transparent type of waste/recycle receptacle design is required. Waste/recycle receptacles shall be open installed outside of all Stations and at the bus platform areas. A minimum of one (1) waste/recycle receptacle unit(s) shall be required per Station entrance and shall be located such that it does not obstruct pedestrian traffic flow. Additional waste receptacles shall be provided as per drawings.
- (v) Benches shall be strategically placed at key gathering and waiting zones, be highly visible (CPTED) and clear of any pedestrian traffic. Both backrest and armrest shall be built into benches to increase its use (AODA). Benches shall not be required where the sitting stone walls are identified.
- (vi) Bicycle Racks shall be provided in accordance with the quantities noted above and configuration as identified in the Federally Mandated Station Drawing Package. A minimum of 80% of bicycle racks shall be sheltered by the Station roof. Clear access from the MUP to the bicycle parking shall be provided and additional area to accommodate dismounting and mounting of the bicycle beyond the width of the MUP.
- (vii) Fencing barriers at all Stations shall be provided to prevent public access to the Tracks and Fare Paid zones. Galvanized steel fencing shall be incorporated with concrete walls and plinths along Platforms and sidewalks. Black vinyl coated chain link fence shall prevent access to the Track. Fences shall also serve as dividers separating pedestrians and cyclists at specific areas.
 - A. Fencing shall be installed in the locations and of the type indicated on the Federally Mandated Station Drawing Package.
 - B. Landscape handrails shall be designed to meet the OBC and the AODA and shall be integrated with the Design of the stairways and ramps to meet the above codes. All handrails shall be stainless steel, exterior grade.
- (viii) Stone walls shall be provided to assist in grade transitions, to provide variation in the landscape and as sitting walls in key locations. Stone materials for retaining walls shall include local limestone to match the regional stone used in Station designs.

- A. Stone walls: as per Federally Mandated Station Drawing Package are designed as dry stone stacked walls, founded on a granular base. All walls shall be designed with a coping stone adhered to the top three (3) layers of the drystone stack wall.
 - B. Limestone: varying thickness from 50 mm to 200 mm, lengths from 300 mm to 1.2m, as supplied from the Cloutier Construction quarry, or approved equal.
- (ix) Bollards shall be provided to control vehicular and cycling activities adjacent to the Stations. Bollards shall be designed to facilitate replacement as required.
- c) Site Lighting
- (i) All Station plazas, sidewalks, OLRT / bus Platforms and other areas external and immediately adjacent to Stations that are accessible to the public shall be lit with an LED light source to provide improved safety and security, and meet the requirements of Part 5 Article 5 – Electrical Design Criteria.
 - (ii) Aesthetic and functional considerations shall include: the lighting for visual impact; the aesthetic character of luminaries and poles; and colour of light. Light poles shall be 5.0 to 6.0 m in height and provide continuous lighting along primary sidewalks. All pedestrian lighting shall be downcast and have full cut-off to minimize light pollution. Additional shielding or cut-off fixture shall be provided adjacent to residential communities.
- A. Exterior Pedestrian Lights shall be Roadstar Series (756 mm), LED lamps, as manufactured by Philips Lumec or approved equal. Colour shall be natural grey.
 - B. Exterior bollard lights shall be Bollard Series BOR80-W as manufactured by Phillips Lumec or approved equal. Colour shall be black.
 - C. Exterior pedestrian lights for Campus Station and pedestrian sidewalks and MUPS adjacent to the University of Ottawa shall meet and match the University standard.
 - D. Exterior Road/Parking Lot Lighting shall be Roadstar Series (1146 mm), LED lamps, as manufactured by Philips Lumec or approved equal. Colour shall be natural grey.
- d) Signage
- (i) The location of the wayfinding signage shall take precedence over the location of street furniture, plant material or other items which may restrict clear access to the view the signage.
- e) Existing Plant Material

- (i) Existing plant material shall be protected where feasible.
 - (ii) Protect plant material during Construction as per City standards.
- f) Any plant material required to be removed for the construction of the OLRT shall be replaced to the City standards for trees, and one to one replacement for shrubs and perennials. Proposed Planting
- (i) Planting outside of Stations shall be used to define spaces, provide shade and reduce wind speed on Platforms to help direct customers safely between public streets and Station entrances and assist in deterring pedestrian crossings through restricted access areas. Plant material shall be designed to be harmonious with the architecture and scale of the Station and coordinated with sight line locations for security cameras and Station lighting, in particular with respect to anticipated vegetation growth.
 - (ii) Street trees shall be integrated into the pedestrian plazas adjacent to the Stations to provide shade and comfort to the pedestrians. To enhance the growing opportunities for these trees, a structural support system or a root control system below the paved surfaces shall be integrated into the overall Design to provide a sufficient root growth to sustain growth.
 - (iii) On Federal Lands, vines shall be planted in front of all chainlink fencing at a consistent spacing, so as to completely cover the wire fabric mesh.
 - (iv) Quality and source shall comply with the CNLA metric guide referring to size, development and rootball of plant material. Measure plants when branches are in their natural position. Use trees and shrubs of No.1 Grade. All plant material shall be hardy to the local urban conditions and native to the Ottawa area where possible. All plant material shall meet the requirements of “Canadian Standards for Nursery Stock.”
 - (v) Plant material shall be hardy to the urban conditions, winter Maintenance requirements and be designed to be low-Maintenance both in the short and long term. Local native species shall be selected wherever feasible. Supplemental watering to assist in establishment of the plant material shall be required. A long term potable water irrigation system shall not be permitted. Supplemental water from the roof drains shall be considered.
 - (vi) The plant material palette shall include a variety of plant material to provide seasonal variety and colour.

Minimum Planting Criteria for Station and Guideway Landscapes

Plant Material	Size	Spacing
Deciduous Trees – large	70 mm cal.	5.0 metres
Deciduous Trees – medium	45 mm cal.	4.0 metres
Coniferous Trees	1.5 m ht	3.0 metres
Coniferous Shrubs	45 cm spread	900 mm
Deciduous Shrubs	45 cm ht	900 mm

A. OLRT planting along the Alignment shall ensure that the accumulation of leaf materials on the Guideway is minimized and that operations and maintenance are not negatively affected by leaves accumulating on the Alignment.

g) Naturalized Landscapes – Bio-swales and Stormwater Management Ponds

- (i) The landscape treatment for the bio-swales and any Stormwater Management ponds shall be designed to provide a naturalized planting scheme for the Stormwater Management facilities and create an aesthetic compliment with the adjacent landscape. The grades for side slopes shall vary from 4:1 to 10:1 to replicate a natural environment.
- (ii) Vegetation shall consist of native or hardy grasses, shrubs, vines and trees established through a mixture of seeding, planting and managed natural succession. Utilize drought and salt tolerant plant species for bio-swales subject to adjoining sidewalk and roadway runoff.
- (iii) Naturalized landscapes shall consist of mass plantings of deciduous tree whips, coniferous trees and shrubs. They shall be a blend of native or naturalized plant material of the Ottawa area and be designed to provide seasonal colour and variety.
- (iv) Hydric soil, harvested soil from an existing wetland, creek or ditch may be utilized to establish the seed source for the native grasses and forbes. All soils shall be from sites that shall not be affected by its removal.
- (v) Specific species shall be determined based on adjacent natural area ecology and size of the Stormwater Management landscape. The following table outlines the minimum requirements for plant size and planting density:

Minimum Planting Criteria for Stormwater Management and Naturalized Landscapes

Plant Material	Size	O.C. Spacing
Deciduous Trees	60 mm cal.	6.0 metres
Deciduous Tree Whips	2.0 m height	2.4 metres
Coniferous Trees	1.5 m B&B	4.0 metres
Coniferous Shrubs	2 gallon	900 mm

Shrubs – whips	450 mm ht.	900 mm
Aquatic plants	Seed/Plugs	300 mm
Native Groundcovers	Seed/Plugs	150 mm
Prairie Seed Mix	Seed	N/A

h) Topsoil

- (i) All in-situ topsoil stripped for Construction requirements shall be removed off-site unless there is sufficient room to stockpile topsoil at no greater height than 1.2 metres. Stockpiled topsoil shall only be used in areas of seeding adjacent to the track corridor.
- (ii) All topsoil shall be fertile, friable, natural sandy loam containing not less than 4% of organic matter for sandy loams, with an acidity value ranging from pH 6.0 to pH 7.5 and capable of sustaining vigorous plant growth. It shall be free of stems or roots, stones and clods more than 50mm diameter or other extraneous matter. Topsoil shall be screened. Topsoil shall not be supplied in a frozen state.

i) Sod

- (i) All turf areas within nine (9) metres of pedestrian pathways, BRT platforms, and plazas within or adjacent to the Stations, shall be sodded.
- (ii) Nursery Sod: quality and source shall comply with standards outlined in ‘Canadian Standards for Nursery Stock’, most recent addition.

j) Seed

- (i) The limits of Construction and staging areas for some Stations and sections of the Track will extend beyond the limits of sodding indicated above. Any disturbed areas extending beyond the limits identified for sod above shall be rehabilitated as per Part 1 Article 15 – Sitework. A review of the adjacent land uses and site development shall be completed for these locations and the most appropriate groundcover shall be selected.
- (ii) Seed: to meet the requirements of the City specifications.

17.6 Tree Compensation

a) Existing Trees

- (i) As per the City by-law, Project Co shall complete a Tree Compensation Plan that shall identify trees to be removed, the value of the tree removals and the mitigation opportunities. To complete the tree mitigation plan, the full extent of the OLRT corridor shall be reviewed.

- (ii) The Tree Mitigation Plan shall be developed in conjunction with the overall planting plan for the OLRT site, including Stations and corridors.
- (iii) The mitigation plan shall be done by a qualified arborist in conjunction with the landscape architect and submitted according to Schedule 10 – Review Procedure.
- (iv) Existing trees (including crown, trunk and root system) in proximity or vulnerable to damage by the Work, shall be protected during all stages of Work. No material, construction equipment or vehicles shall be stored under the drip-line of trees at any time. Trees are to be protected and watered regularly as required by standard horticultural practice during the construction period.
- (v) Work on all Lands subject to FLUA shall be in accordance with the following:
 - A. Snow fencing shall be installed to secure the periphery of zones of tree preservation and is to be kept in good condition at all times. The zones of tree preservation shall be kept free of any circulation, use and storage at all times during construction; and
 - B. Tree removal shall be kept to the minimum required to implement the Project. The area cleared for construction activities shall extend no more than 6 meters from the outside of new building and Structure faces unless otherwise indicated on the Federally Mandated Station Drawings.

17.7 Planting Lists

- a) Project Co shall develop landscape plans that as a minimum identify the species, quantity, size and rootball of plant material for each Station.
- b) Project Co's approach to Landscaping at the Federally Mandated Stations will be assessed as outlined in Schedule 15-2 Part 5 Article 1.
- c) The following plant lists were developed for the Federally Mandated Stations. Species and quantities can be adjusted to suit Project Co's design.

TUNNEY’S PASTURE – PLANT LIST

SYM.	BOTANICAL NAME	COMMON NAME	QTY.	SIZE	REMARKS
TREES –					
UA	ULMUS AMERICANA 'LIBERTY'	LIBERTY ELM	30	80MM. CAL.	WB
AF	ACER X FREEMANII 'JEFFERSRED'	AUTUMN BLAZE MAPLE	7	80MM CAL.	WB
AS	ACER SACCHARUM 'COMMEMORATION'	COMMEMORATION MAPLE	10	70MM. CAL.	WB
AST	ACER SACCHARUM 'TEMPLE'	TEMPLE COLUMNAR MAPLE	84	60MM. CAL.	WB
QC	QUERCUS COCCINEA	SCARLET OAK	9	80MM. CAL.	WB
GT	GLEDITSIA TRIACANTHOS 'SKYLINE'	SKYLINE HONEYLOCUST	33	70MM. CAL.	WB
PP	PICEA PUNGENS	GREEN COLORADO SPRUCE	6	3000MM. HT.	WB
PS	PINUS STROBUS	EASTERN WHITE PINE	8	3000MM. HT.	WB
AG	ACER GINNALA	AMUR MAPLE	84	70MM. CAL.	WB , MULTI-STEM
AM	AMELANCHIER CANADENSIS	NATIVE SERVICEBERRY	12	60MM. CAL.	WB , SINGLE-STEM
SHRUBS					
TC	TAXUS CUSPIDATA SPREADING	SPREADING JAPANESE YEW	110	500mm SPR.	POTTED
JS	JUNIPERUS SABINA	SAVIN JUNIPER	137	500mm SPR.	POTTED
JC	JUNIPERUS CHINENSIS 'OLD GOLD'	OLD GOLD JUNIPER	150	500mm SPR.	POTTED
BT	BERBERIS THUNBERGII 'BAILONE'	RUBY CAROUSEL JAP. BARBERRY	315	500mm, HT.	POTTED
PO	PHYSOCARPUS OPUL. 'DARTS GOLD'	DART'S GOLDEN NINEBARK	75	400mm HT.	POTTED
DL	DIERVILLA LONICERA	BUSH HONEYSUCKLE	75	400mm HT.	POTTED
CS	CORNUS SERICEA FLAVIRAMEA	YELLOW TWIG DOGWOOD	50	500mm HT.	POTTED
GRASSES and VINES					
CK	CALAMAGRO. X ACUT. KARL FOERSTER	KARL FOERSTER FEATHER REED GRASS	345	1 GAL. POTS	
PT	PARTHENOCISSUS TRI. 'VEITCHI'	BOSTON IVY	120	1 GAL. POTS	

BAYVIEW – PLANT LIST

SYM.	BOTANICAL NAME	COMMON NAME	QTY.	SIZE	REMARKS
TREES –					
UA	ULMUS AMERICANA 'LIBERTY'	LIBERTY ELM	2	100MM. CAL.	WB
AF	ACER X FREEMANII 'JEFFERSRED'	AUTUMN BLAZE MAPLE	37	80MM CAL.	WB
AS	ACER SACCHARUM 'COMMEMORATION'	COMMEMORATION MAPLE	20	70MM. CAL.	WB
AST	ACER SACCHARUM 'TEMPLE'	TEMPLE COLUMNAR MAPLE	10	60MM. CAL.	WB
QC	QUERCUS COCCINEA	SCARLET OAK	5	80MM. CAL.	WB
PS	PINUS STROBUS	EASTERN WHITE PINE	7	3000MM. HT.	WB
SHRUBS					
JS	JUNIPERUS SABINA	SAVIN JUNIPER	450	500mm SPR.	POTTED
JC	JUNIPERUS CHINENSIS 'OLD GOLD'	OLD GOLD JUNIPER	250	500mm SPR.	POTTED
BT	BERBERIS THUNBERGII 'BAILONE'	RUBY CAROUSEL JAP. BARBERRY	350	500mm, HT.	POTTED
PO	PHYSOCARPUS OPUL. 'DARTS GOLD'	DART'S GOLDEN NINEBARK	150	400mm HT.	POTTED
DL	DIERVILLA LONICERA	BUSH HONEYSUCKLE	100	400mm HT.	POTTED
CS	CORNUS SERICEA FLAVIRAMEA	YELLOW TWIG DOGWOOD	150	500mm HT.	POTTED
GRASSES					
CK	CALAMAGRO. X ACUT. KARL FOERSTER	KARL FOERSTER FEATHER REED GRASS	300	1 GAL. POTS	
MS	MISCANTHUS SINENSIS 'GRACILLIMUS'	MAIDEN GRASS	250	1 GAL. POTS	

LEBRETON – PLANT LIST

SYM.	BOTANICAL NAME	COMMON NAME	QTY.	SIZE	REMARKS
TREES					
UA	ULMUS AMERICANA 'LIBERTY'	LIBERTY ELM	25	100MM. CAL.	WB
AF	ACER X FREEMANII 'JEFFERSRED'	AUTUMN BLAZE MAPLE	35	70MM CAL.	WB
AS	ACER SACCHARUM 'COMMEMORATION'	COMMEMORATION MAPLE	35	70MM. CAL.	WB
AST	ACER SACCHARUM 'TEMPLE'	TEMPLE COLUMNAR MAPLE	25	60MM. CAL.	WB
QC	QUERCUS COCCINEA	SCARLET OAK	20	50MM. CAL.	WB
PP	PICEA PUNGENS	GREEN COLORADO SPRUCE	25	5000MM. HT.	WB
PS	PINUS STROBUS	EASTERN WHITE PINE	15	3000MM. HT.	WB
POM	PICEA OMORIKA	SERBIAN SPRUCE	10	1800MM. HT.	WB
SHRUBS					
JS	JUNIPERUS SABINA	SAVIN JUNIPER	100	500mm SPR.	POTTED
JC	JUNIPERUS CHINENSIS 'OLD GOLD'	OLD GOLD JUNIPER	100	500mm. SPR.	POTTED
AA	AMELANCHIER ALNIFOLIA	SASKATOON SERVICEBERRY	60	1250mm. HT.	B&B
DL	DIERVILLA LONICERA	BUSH HONEYSUCKLE	150	400mm HT.	POTTED
BT	BERBERIS THUNBERGII 'BAILONE'	RUBY CAROUSEL JAPANESE BARBERRY	100	500mm. HT.	POTTED
CS	CORNUS SERICEA FLAVIRAMEA	YELLOW TWIG DOGWOOD	150	500mm HT.	POTTED
BIOSWALE					
TL	TYPHA LATIFOLIA	COMMON CATTAIL	1800	1 GAL. POTS	
SP	SALIX PURPUREA NANA 'GRACILIS'	BLUE ARCTIC WILLOW	450	600mm. HT.	POTTED
AM	ARONIA MELANOCARPA	NATIVE CHOKEBERRY	400	500mm. HT.	POTTED
SC	CORNUS SERICEA	RED OSIER DOGWOOD	450	500mm HT.	POTTED
CSK	CORNUS SERICEA 'KELSEY'	KELSEY DWARF DOGWOOD	550	300mm HT.	POTTED
HEM	HEMEROCALLIS 'FRANS HALS'	FRANS HALS DAYLILY	700	1 GAL. POTS	
IR	IRIS SIBERICA	SIBERIAN IRIS	500	1 GAL. POTS	
GRASSES					
CK	CALAMAGRO. X ACUT. KARL FOERSTER	KARL FOERSTER FEATHER REED GRASS	125	1 GAL. POTS	
MS	MISCANTHUS SINENSIS 'GRACILLIMUS'	MAIDEN GRASS	150	1 GAL. POTS	

HURDMAN – PLANT LIST

SYM.	BOTANICAL NAME	COMMON NAME	QTY.	SIZE	REMARKS
TREES					
UA	ULMUS AMERICANA 'LIBERTY'	LIBERTY ELM	34	100MM. CAL.	WB
AF	ACER X FREEMANII 'JEFFERSRED'	AUTUMN BLAZE MAPLE	36	70MM CAL.	WB
AS	ACER SACCHARUM 'COMMEMORATION'	COMMEMORATION MAPLE	33	70MM. CAL.	WB
AST	ACER SACCHARUM 'TEMPLE'	TEMPLE COLUMNAR MAPLE	25	60MM. CAL.	WB
QC	QUERCUS COCCINEA	SCARLET OAK	20	50MM. CAL.	WB
PP	PICEA PUNGENS	GREEN COLORADO SPRUCE	50	3000MM. HT.	WB
PS	PINUS STROBUS	EASTERN WHITE PINE	20	3000MM. HT.	WB
POM	PICEA OMORIKA	SERBIAN SPRUCE	20	1800MM. HT.	WB
SHRUBS					
AA	AMELANCHIER ALNIFOLIA	SASKATOON SERVICEBERRY	125	1250mm. HT.	B&B
PO	PHYSOCARPUS OPUL. 'DARTS GOLD'	DART'S GOLDEN NINEBARK	185	400mm HT.	POTTED
DL	DIERVILLA LONICERA	BUSH HONEYSUCKLE	185	400mm HT.	POTTED
CS	CORNUS SERICEA FLAVIRAMEA	YELLOW TWIG DOGWOOD	200	500mm HT.	POTTED
BIOSWALE					
TL	TYPHA LATIFOLIA	COMMON CATTAIL	4000	150mm POTS	
SP	SALIX PURPUREA NANA 'GRACILIS'	BLUE ARCTIC WILLOW	600	600mm. HT.	POTTED
AM	ARONIA MELANOCARPA	NATIVE CHOKEBERRY	400	500mm. HT.	POTTED
SC	CORNUS SERICEA	RED OSIER DOGWOOD	500	500mm HT.	POTTED
CSK	CORNUS SERICEA 'KELSEY'	KELSEY DWARF DOGWOOD	650	300mm HT.	POTTED
HEM	HEMEROCALLIS 'FRANS HALS'	FRANS HALS DAYLILY	1200	1 GAL. POTS	
IR	IRIS SIBERICA	SIBERIAN IRIS	1000	1 GAL. POTS	

REFORESTATION		AREA 1	AREA 2	AREA 3		
ACER SACCHARINUM	SILVER MAPLE	145	170	200	30MM. CAL.	WB
ACER SACCHARUM	SUGAR MAPLE	175	200	275	30MM. CAL.	WB
CELTIS OCCIDENTALIS	COMMON HACKBERRY	135	160	240	30MM. CAL.	WB
TILIA AMERICANA	COMMON BASSWOOD	100	130	150	30MM. CAL.	WB
POPULUS TREMULOIDES	TREMBLING ASPEN	180	220	300	30MM. CAL.	WB
JUGLANS NIGRA	BLACK WALNUT	100	120	180	600MM. HT.	POTTED
JUGLANS CINEREA	EASTERN BUTTERNUT	140	160	200	600MM. HT.	POTTED
AMELANCHIER CANADENSIS	SERVICEBERRY	150	180	230	1000MM. HT.	POTTED
PICEA GLAUCA	WHITE SPRUCE	100	130	200	1800mm HT.	WB

TRAIN STATION – PLANT LIST

SYM.	BOTANICAL NAME	COMMON NAME	QTY.	SIZE	REMARKS
TREES					
UA	ULMUS AMERICANA 'LIBERTY'	LIBERTY ELM	20	100MM. CAL.	WB
AF	ACER X FREEMANII 'JEFFERSRED'	AUTUMN BLAZE MAPLE	15	70MM CAL.	WB
AS	ACER SACCHARUM 'COMMEMORATION'	COMMEMORATION MAPLE	15	70MM. CAL.	WB
AST	ACER SACCHARUM 'TEMPLE'	TEMPLE COLUMNAR MAPLE	30	60MM. CAL.	WB
QC	QUERCUS COCCINEA	SCARLET OAK	10	50MM. CAL.	WB
PP5	PICEA PUNGENS	GREEN COLORADO SPRUCE	10	5000MM. HT.	WB
PP3	PICEA PUNGENS	GREEN COLORADO SPRUCE	5	3000MM. HT.	WB
PP2	PICEA PUNGENS	GREEN COLORADO SPRUCE	5	2000MM. HT.	WB
SHRUBS					
JS	JUNIPERUS SABINA	SAVIN JUNIPER	350	600mm. HT.	POTTED
AA	AMELANCHIER ALNIFOLIA	SASKATOON SERVICEBERRY	100	1250mm. HT.	B&B
PO	PHYSOCARPUS OPUL. 'DARTS GOLD'	DART'S GOLDEN NINEBARK	175	400mm HT.	POTTED
DL	DIERVILLA LONICERA	BUSH HONEYSUCKLE	250	400mm HT.	POTTED
CS	CORNUS SERICEA FLAVIRAMEA	YELLOW TWIG DOGWOOD	150	500mm HT.	POTTED
BIOSWALE					
TL	TYPHA LATIFOLIA	COMMON CATTAIL	1500	150mm POTS	
SP	SALIX PURPUREA NANA 'GRACILIS'	BLUE ARCTIC WILLOW	150	600mm. HT.	POTTED
AM	ARONIA MELANOCARPA	NATIVE CHOKEBERRY	100	500mm. HT.	POTTED
SC	CORNUS SERICEA	RED OSIER DOGWOOD	125	500mm HT.	POTTED
CSK	CORNUS SERICEA 'KELSEY'	KELSEY DWARF DOGWOOD	250	300mm HT.	POTTED
HEM	HEMEROCALLIS 'FRANS HALS'	FRANS HALS DAYLILY	750	1 GAL. POTS	
IR	IRIS SIBERICA	SIBERIAN IRIS	500	1 GAL. POTS	

17.8 Urban Design Criteria for Non-Federally Mandated Stations

- a) In addition to the criteria of this article, the following design criteria and standards shall be incorporated within the following locations:
- b) West Portal: The design of the portal and any improvements shall integrate the naturalized ravine landscape of the tailrace and escarpment. Naturalized woodlot planting shall be of sufficient depth to provide a visual screen upon the initial opening of the OLRT system. A minimum of 200 large deciduous and coniferous trees shall be incorporated within the planting plan with accent shrubs and perennials providing seasonal colour.

All the existing natural features of the aqueduct and escarpment shall be protected. Where there has been previous civil works which altered the adjacent land forms, they shall be reinstated to an integrated grading and landscape plan which minimizes the use of retaining walls. The fence along the right of way shall be planted with vines.

- c) Downtown West Station: The urban design for the station shall maximize the sidewalk widths to accommodate pedestrian access to the station entry points. All sidewalks to be concrete with the precast paving materials and patterns as required to identify the station entry access and extend across the primary sidewalk. Vent shaft grills shall be designed to be offset from the principle sidewalks and be designed to accommodate foot traffic and wheels. The roadway intersections shall be designed to accommodate the projected peak period pedestrian flows from the station.

Bicycle parking shall be provided.

- d) Downtown East Station: The urban design for the station shall maximize the sidewalk widths along the roadway corridor to accommodate pedestrian access to the station entry

points. All sidewalks to be concrete with the precast concrete paving materials and patterns required to identify the station entry access and extend across the primary walkway. Vent shaft grills shall be designed to be offset from the principle sidewalks and be designed to accommodate foot traffic and wheels. The roadway intersections shall be designed to accommodate the projected peak period pedestrian flows from the station.

Four (4) street trees shall be planted in locations where they do not impede the main pedestrian circulation and utilizing the Strata Cell Structural Soil detail for the federal stations or approved equal.

- e) Rideau Station:
 - (i) Rideau Street Right-of-Way
 - A. Utilize pavements, materials, street and pedestrian lamps and site furniture products employed in the Rideau Street phase 1 reconstruction. This includes 100 x 300 x 600 precast unit pavers for all pedestrian pavements, cast-in-place concrete crosswalks, walks, and tree planting in 'strata cell' chambers with custom tree guards and grates and granite block seats. This palette will be set out in the phase I reconstruction tender in the spring of 2012.
 - (ii) William Street Mall
 - A. Surface features shall be integrated into the existing William Street Mall by minimizing visual and physical obstruction in the central open walkway between the existing sidewalk terraces. Match existing pavements, materials and site furniture products.
- f) East Portal: The alignment of the OLRT immediately east of Laurier Avenue will be covered for approximately 155 metres. The lands over the covered section of the OLRT shall be developed as an integral component of the University of Ottawa open space and the works shall extend south to the Campus Station plaza. This shall include a continuous barrier free concrete/unit paving pedestrian pathway, with a minimum width of four (4) metres. Access points to all buildings will be generous, with paving materials consistent with the standards of the University. All pedestrian egress to the buildings shall be designed to be barrier free. Pedestrian lighting shall be integrated throughout the pathway, and will meet the standards for lighting on the campus.
 - (i) Street trees shall be planted along the pedestrian walkway to provide shade and comfort to the users. Additional accent planting shall be incorporated into the design to provide a landscape consistent with the overall campus development.
 - (ii) At the intersection of Laurier Avenue there shall be an open plaza with a minimum of 600 square metres of paving, and include lighting, seating locations, waste receptacles, thirty (30) deciduous street trees, 20 coniferous trees and accent planting. All paving and pedestrian lighting shall be consistent with the

University of Ottawa standards and all turf areas to be sodded. The pedestrian crossing at Laurier Avenue shall be clearly delineated with concrete paving and offset from the access road to the residential buildings to the west of the plaza. Shrub and tree planting shall extend to the east portal and provide a visual screen in front of the fence, walls and guards.

- g) **Campus Station:** The urban design for the Station shall integrate seamlessly into the existing University of Ottawa urban fabric, centred on a broad open pedestrian plaza which leads to all precincts of the campus. Pedestrian flows to and from the Station shall be accommodated across open hard surfaces, punctuated at the edges by large trees. Designated cycling lanes up to and through the transit plaza shall be provided, leading from the south end of the campus and City, beyond to the Nicholas underpass. Pedestrian and cyclist routes shall be separated in the plaza, ramp and through the connecting tunnel to the Rideau Canal. Pavement surfaces in the plaza shall be consistent with the concrete and paver materials used throughout the campus. The threshold at the Station shall be paved with unit pavers consistent with the family of materials used throughout the system. Covered bicycle parking shall be provided, quantity to be as per the table provided. All street furniture within the Station shall be consistent with Station requirements. Street furniture outside the Station shall be consistent with University of Ottawa campus standards. Light standards in the plaza shall be to University of Ottawa campus standards. Planting location, species, and method shall be consistent with current University of Ottawa practices, emphasizing protection of root zones from contamination from winter de-icing agents.
- h) **Lees Avenue Station:** The principle urban design element for the station shall be the main plaza leading to the station entrance that creates an open paved courtyard, extending from the face of the building to the curb edge. Twenty-five (25) street trees will be incorporated at the perimeter of the plaza to define the edges, and lead the users to the entry point. A minimum of six (6) trees shall be planted within the plaza utilizing the Stata Cell Structural Soil detail for the federal stations or approved equal. Connections to the adjacent sidewalks shall be provided as well as additional plaza space to allow for pedestrian queuing at signalized intersections. The street furniture shall be incorporated within the main plaza.
- (i) There shall be a continuous four (4) metre MUP extending from Campus Station to Lees Avenue Station on the east side of the Guideway, and extending through to the bridge over the Rideau River. On the east side of the Guideway, south of Lees Avenue, there shall be a set of stairs, with a bike wheel ramp, to create a direct connection between the MUP and Lees Avenue. On the west side of the OLRT, a three (3) metre wide MUP shall extend from Lees Avenue to the Rideau River. There shall be tree planting along the MUP throughout this section, with a minimum of thirty (30) deciduous trees and 500 tree whips to create shade and shelter.
- (ii) A pedestrian signalized intersection on the west side of the station synchronized with the traffic lights on the east side of the station shall be provided.

- (iii) MUP's shall be provided on both sides of the Rideau River crossing structure. The MUP shall be segregated from the Guideway with protective fencing
- i) Maintenance and Storage Facility: The principle urban design element for the facility will be a generous front entry to the facility. There shall be a main plaza at the building front entrance with concrete paving from the building edge to the internal roadway. Street trees will be planted in the plaza to provide shade and scale to the building. Minimum three (3) metre sidewalks shall be provided from the parking spaces to the front entrance, and delineated by additional tree planting. Tree planting shall also be incorporated in all parking lot islands.
 - (i) There shall be a continuous 1.8 metre chain link fence along the limits of the property. In addition to the fence, where there is sufficient space, there shall be a continuous staggered row of conifers, with a minimum of 91 spruce trees, to buffer the roadway user from the complex. Where there is insufficient space for the staggered row of conifers, a continuous row of thirty (30) deciduous street trees will be utilized to create a streetscape edge.
 - (ii) Any stormwater management ponds shall be designed as constructed wetlands, and incorporate hydric soils and native plant species. There shall be a minimum of 1000 deciduous tree whips integrated around the pond.
 - (iii) Project Co shall provide a 2.0m wide sidewalk adjacent to the westbound lane of Belfast Road extending from the eastern property line to the intersection of Belfast Road and Trainyards Drive.
 - (iv) The MSF site design shall include at a minimum one 3.0m wide pedestrian pathway connection from the sidewalk to the public entrance of the building.
- j) St. Laurent Station: The principle urban design element for the station will be the inclusion of tree planting at the upper platform level. Ten (10) raised planters that provide a seating area as well as sufficient depth for topsoil shall be incorporated within the platform. Bicycling parking shall be provided at the east end of the local platform.
- k) Cyrville Road Station: The principle urban design elements for the station are the paved entrance plaza. This ensures direct pedestrian access from the sidewalk. The plaza shall extend from the building edge to the face of the curb, and integrate the site furniture. Project Co shall provide accessible curb ramps at existing PPUDO locations as identified by the City on each side of Cyrville Road.
 - (i) The planting on the north side of the station shall be a combination of trees and shrubs to provide a buffer between the OLRT and the community and shall reflect the species diversity and spacing from the south side of the corridor, with a minimum of 80 deciduous and coniferous trees and 300 square metres of shrub planting. The plant material shall be designed to provide clear lines of sight from the pathway and the community. Bioswales shall be located in the centre of the tracks and utilize the rainwater from the roof.

- l) Blair Station: The principle urban design element for the station is the integration of the direct pedestrian connections to the community from the station. A three (3) metre concrete sidewalk will be provided from the existing walkway under Blair Road to the north side of the local station with a 2.4 metre concrete sidewalk extending west to the existing sidewalk adjacent to City Park Drive. A six metre walkway shall be provided between the shopping centre and the north station entrance. At the BRT, the width of the platform will extend to the western entrance to the OLRT station.
- (i) A minimum of one hundred (100) deciduous trees shall be located along the sidewalks, roadways and transit corridors to provide shade and delineate the public and transit spaces. One thousand 1 000 square metres of shrub planting shall be completed to reinforce the street trees and assist in control pedestrian movements.
 - (ii) Bicycle parking shall be consolidated on the northeast side of the local bus platform, with the stone walls along the perimeter of the parking area. Use of additional low seating height stone walls, to match the walls at the federal stations, at the entry points and grade transitions shall be used.
- m) OLRT Track: The principle urban design element for the track is the integration with the adjacent landscape. In all locations where the existing BRT roadways and BRT access roads are being modified or removed, all existing road base materials shall be removed, and the landform re-graded to remove the visual appearance of the previous civil engineering works and to reinstate a natural topography. The slopes shall be a maximum of 3:1 to accommodate maintenance activities and shall be reinstated as turf.

ARTICLE 18 DRAINAGE AND STORMWATER MANAGEMENT DESIGN CRITERIA

18.1 Order of Precedence

- a) Drainage Design and Construction shall comply with the criteria contained in this Article, and all standards, regulations, policies, Applicable Law, guidelines or practices applicable to the Project, including but not limited to each of the following Reference Documents. In the event of a conflict between the criteria, commitments or requirements contained within one document when compared with another, the more stringent shall apply:
- (i) The criteria contained in this Article;
 - (ii) Fisheries Act;
 - (iii) Ontario Water Resources Act;
 - (iv) Drainage Act (Ontario);
 - (v) Approval Exemption Regulation (AER) 525;
 - (vi) MOE Stormwater Management Planning and Design Guidelines, (most recent version);
 - (vii) MOE Design Guidelines for Sewage Works (most recent version);
 - (viii) City of Ottawa Sewer Design Guidelines;
 - (ix) City of Ottawa by-laws; and
 - (x) Regional Municipality of Ottawa-Carleton Transitway Design Manual, October 1983.
- b) Other federal, provincial, and municipal acts, policies, and guidelines may apply. A listing of relevant legislation, policy documents, and Design guidelines can be found in Section 1.7 of the “*City of Ottawa Sewer Design Guidelines*” (November 2004).

18.2 General Criteria

- a) The drainage strategy and Stormwater Management Plans shall be developed and submitted as part of the Works Submittals according to Schedule 10 – Review Procedure.

18.3 Drainage Criteria

- a) All Guideway, Tunnel, Stations, MSF, and new roadway/parking lot drainage features shall be designed in accordance with the City of Ottawa Sewer Design Guidelines. Project specific criteria are listed below.

- (i) The minor system associated with the OLRT Infrastructure shall be designed to capture and convey the 10-year storm event.
 - (ii) Major system flows, resulting from storms with a return period of up to 1:100 year, shall be controlled to meet available capacity downstream, and not create flow depths above the top of rail.
 - (iii) OLRT facilities shall meet all requirements of City of Ottawa Drainage By-Law No. 2007-398 and shall not have a negative impact on existing overland flow routes.
 - (iv) Any new outlets to the receiving water shall be approved by the City of Ottawa, RVCA, MNR, and MOE.
 - (v) In Tunnels and other areas without a gravity outlet, groundwater, fireflow discharge, and storm runoff shall be collected and pumped to a municipal sanitary sewer or combined sewer in compliance with Section 4 of City of Ottawa Sewer Use By-Law No, 2003-514.
 - (vi) Any new sewers that cross under the Guideway shall meet the requirements of “Standards Respecting Pipeline Crossings Under Railways” (Transport Canada TC E-10).
- b) Project Co shall provide and maintain all equipment and infrastructure required to ensure adequate drainage during the entire Project. All discharge shall comply with City of Ottawa Sewer Use By-Law No. 2003-514. Any discharge that does not meet the requirements of this by-law shall be treated on-site or Project Co shall obtain an exemption from the City (in the form of a written agreement as stipulated in the by-law).
- (i) Application for an exemption shall be made through the City’s Sewer and Compliance Office. Documentation regarding the quantity of the discharge and its impact on receiving sewers shall be submitted, along with documentation that shows the quality with respect to the limits set out in the by-law.
- c) Agreements shall be obtained for both temporary and permanent discharges.
- d) Project Co shall be responsible for all costs associated with obtaining the required approvals and the construction, operation, and maintenance of the drainage works.

18.4 Stormwater Management Criteria

- a) Project Co shall Design and implement a Stormwater Management Plan and apply practices that are in accordance with the City of Ottawa Sewer Design Guidelines. Project specific criteria are listed below.
 - (i) Any new storm sewer outlets shall meet the MOE “Enhanced” standard for water quality control.

- (ii) Specific Stormwater Management requirements are in place for drainage outlets to the Ottawa River, Rideau River and Greens Creek.
 - (iii) Project site components that ultimately drain to the Ottawa River or Rideau River, and are considered Infill Development, as defined in section 8.3.7.2 of the City of Ottawa Sewer Design Guidelines, shall control peak flows to the minor system as prescribed in section 8.3.7.3 of the Ottawa Sewer Design Guidelines. Water Quality Stormwater Management Practices (SWMPs) for infill development are to provide a net improvement over existing conditions.
 - (iv) Drainage components that drain within the Greens Creek watershed shall meet the stormwater criteria that are currently in effect for the Pinecrest Creek watershed (Pinecrest/Centrepointe Stormwater Management Criteria Study, J F Sabourin & Associates Inc., June 2009) This applies to Guideway areas at the east end of the system, as well as the Cyrville Road and Blair Road Stations.
 - (v) Major flows are to be stored on site to limit the release rate to storm sewers to the minor system capacity or the existing 1:10 year peak flow, whichever is lower.
 - (vi) From a drainage perspective, the MSF and Hurdman Station are considered Greenfield Developments. As such, they require peak flow and volume control and provide treatment to meet the MOE “Enhanced” level.
 - (vii) Drainage/Stormwater Management for the MSF shall include a rainwater harvesting and re-use system.
 - (viii) The maximum instantaneous peak discharge from the MSF to the receiving sewer shall not exceed 90 l/s/ha, as stipulated in the “Ottawa Train Yards Site Servicing Report” (David McManus Engineering Ltd., 2001).
- b) Extended detention or “wet-pond” Stormwater Management facilities shall be designed and constructed to prevent both losses of permanent pool due to infiltration and losses of active storage due to intrusion of groundwater, if required.
 - c) New storm sewers, swales and ditches shall be designed in accordance with the City of Ottawa Sewer Design Guidelines.
 - d) Stormwater extended detention facilities shall be designed in accordance with MOE guidelines, and guidelines currently being applied by the City on other development projects.
 - e) Oil/grit separators shall be designed and specified with a required performance of removal of fine sediment (50-microns), oil, floating and sinking debris, and 80% removal efficiency for TSS.
 - f) Water quality treatment, as required for Greenfield development shall be provided by bioswales, infiltration basins or rain gardens. These facilities shall be designed as

described in Section 18.5 of this Article and in accordance with MOE and City of Ottawa guidelines.

- g) An Erosion and Sediment Control Plan shall be prepared and submitted as part of the Works Submittals according to Schedule 10 – Review Procedure.
- h) Project Co shall obtain PTTWs from the MOE for all Works involving the taking of 50,000 litres or more of water per day, including, but not limited to: watercourse works, Construction dewatering, and any permanent installation of groundwater pumps.

18.5 Bioretention

- a) Bioswales, infiltration trenches and rain gardens shall be designed with an underdrain and a filter bed composed of a mixture of sand, fines and organic material. The selection of mulch ground cover and plants shall be in accordance with the landscaping requirements.
- b) Bioretention facilities shall be located at least 4 metres away from Structure foundations or an impermeable liner shall be applied under the filtration media. Slopes shall be a minimum of 1% and a maximum of 5%. Catchbasins shall be provided to convey runoff directly to the storm sewer when water depth approaches the limit of the available storage.
- c) In situations where the bioretention facility is to capture runoff from parking or road areas, flows may be conveyed by way of opening in the curbs or curb cuts. During winter, snow and ice from road clearing will likely block the inlets. To account for this, alternative drainage, such as catchbasins designed to capture runoff that may accumulate against snow and ice banks, shall be provided.

18.6 Numerical Computational Procedures and Models

- a) All numerical computation procedures shall comply with the principles outlined in Appendix 3 of the City of Ottawa Sewer Design Guidelines. Computer models used shall comply with the computer models listed in Appendix 3 of the City of Ottawa Sewer Design Guidelines. Computer models not listed in Appendix 3 may be used upon written approval from the City. Peak discharges used for Design purposes shall be confirmed using a different method to ensure that conservative estimates are achieved.

18.7 Site Specific Criteria

- a) To meet the Stormwater Management criteria outlined in this article, site-specific SWMPs shall be implemented. Project Co shall design and implement SWMPs as described in this section as follows:
 - (i) Tunney’s Pasture
 - A. Peak flow shall be controlled as prescribed in section 8.3.7.3 of the City of Ottawa Sewer Design Guidelines.

- B. A bioswale, infiltration trench, or a rain garden design shall be applied in the center of the proposed bus loop, the northeast landscaped portion of the site, and the southwest landscaped portion along Scott Street. Runoff from the impervious area draining to the BRT shall be intercepted and treated by an oil/grit separator;
- (ii) Bayview
 - A. Peak flow shall be controlled as prescribed in section 8.3.7.3 of the City of Ottawa Sewer Design Guidelines.
 - B. An oil/grit separator shall be applied to intercept and treat runoff before discharging to the existing storm sewer;
- (iii) Lebreton Flats
 - A. Peak flow shall be controlled as prescribed in section 8.3.7.3 of the City of Ottawa Sewer Design Guidelines.
 - B. Bioswales/infiltration trenches/rain garden Design shall be used in the landscaped areas to the northwest/southwest and northeast/southeast of the Booth St Bridge. Drainage from the Booth Street Bridge shall be directed north to the existing storm sewers and the Stormwater Management facility on the east side of Booth St. along the Ottawa River. A portion of Booth Street shall drain south to Wellington Street, and shall be captured by a proposed storm sewer to be constructed by the City;
- (iv) West Portal
 - A. Peak flow shall be intercepted and discharged to a sanitary or combined sewer. The specific location shall be approved by the City. All flows up to the 1:100 year event shall be attenuated to the 1:10 year peak flow or excess flow may be diverted to other outlets subject to approval by the City;
- (v) Main Tunnel
 - A. The Design peak flow for the main Tunnel shall be the Fire Flow (31.5 l/s for 2 hours), or the 1:100 year flow from the east and west portals combined with groundwater, whichever is greater.
 - B. Flows shall be captured and conveyed to one or more main Tunnel pump stations that shall discharge to suitable municipal sanitary sewers;
- (vi) Rideau West Entrance
 - A. Peak flow shall be controlled as prescribed in section 8.3.7.3 of the City of Ottawa Sewer Design Guidelines;

- (vii) East Portal
 - A. Peak flow shall be controlled as prescribed in section 8.3.7.3 of the City of Ottawa Sewer Design Guidelines.
 - B. Several feasible options exist for the East Portal drainage, including a separate pump station or conveyance of flows to a central pump station. Project Co shall evaluate drainage options and provide a Design that meets the requirements;
- (viii) Campus
 - A. Infill: Peak flow shall be controlled as prescribed in section 8.3.7.3 of the City of Ottawa Sewer Design Guidelines.
 - B. Runoff from the Station roof area and surrounding surfaces shall be collected by proposed catchbasins connected to existing storm sewers. No runoff treatment shall be applied at this Station;
- (ix) Lees
 - A. Infill: Peak flow shall be controlled as prescribed in section 8.3.7.3 of the City of Ottawa Sewer Design Guidelines.
 - B. Treatment for water quality shall not be required for Lees Station. Drainage shall be captured by catchbasins connected to the existing storm sewer;
- (x) Hurdman
 - A. Greenfield Site: Peak flow shall be controlled to the pre-development level. Water quality shall be controlled to meet MOE “Enhanced” standards or 80% total suspended solids (TSS) removal.
 - B. Bioswales/infiltration trenches/rain garden Design shall be applied in the landscaped areas within the proposed bus loop, below the elevated Tracks, and north of the Station to treat stormwater before discharging to the existing storm sewer. An oil/grit separator shall be installed for all roadway and parking areas;
- (xi) Train
 - A. Infill: Peak flow shall be controlled as prescribed in section 8.3.7.3 of the City of Ottawa Sewer Design Guidelines.
 - B. Treatment for water quality shall not be required for Train Station. Drainage shall be captured by catchbasins connecting to an existing storm sewer, which previously served the BRT;

(xii) MSF

- A. Greenfield Stormwater Management criteria apply: Peak flow shall be controlled to a maximum release rate of 90 l/s/ha, unless approved otherwise by the City. Water Quality shall be controlled to meet MOE “Enhanced” standards.
- B. Both minor and major system flows shall be conveyed to an extended detention facility for water quality and quantity control. The collection system shall be composed of drainage swales in the yard and storm sewers/catchbasins within roadways and parking lots. The road surface shall have a continuous slope toward the Stormwater Management facility to safely convey overland flows. The flow depth on any road surface shall not exceed 0.3 m. A rainwater harvesting and re-use system shall be provided to reduce runoff volume from the site;

(xiii) MSF Connecting Tracks

- A. Storm runoff that enters the Tunnels containing the connecting Tracks to and from the MSF facility, combined with flows associated with groundwater infiltration and fire flow, shall be collected by a pump station. Flows shall be pumped to an existing or new (relocated) sanitary sewer on Belfast Road, Tremblay Road, or the sanitary sewer currently servicing the existing BRT.
- B. Project Co shall determine if treatment for water quality and/or quantity is required for the MSF connecting Tracks and shall provide as necessary. The collection system shall be designed for a 1:25 year storm and the Design shall maintain water levels for the 1:100 year below the top of rail level;

(xiv) St. Laurent

- A. Infill: Peak flow shall be controlled as prescribed in section 8.3.7.3 of the City of Ottawa Sewer Design Guidelines
- B. Stormwater treatment for water quality shall not be required for the St. Laurent Station. Drainage shall be collected by new catchbasins connected to the existing storm sewer that currently services the BRT;

(xv) Cyrville

- A. Greenfield: Peak flow and volume shall be controlled to the SWM criteria in effect for the Pinecrest Creek watershed.
- B. Bioswales/infiltration trenches/rain garden Design shall be applied in the landscaped areas between the east and west Tracks and to the northwest of the west Track on both sides of the Cyrville Road overpass with

catchbasins connected to the existing 675mm diameter stormsewer that outlets to Greens Creek;

(xvi) Blair

- A. Greenfield: Peak flow and volume shall be controlled to the Pinecrest Creek SWM Criteria. Stormwater retention, treatment and quantity control shall be provided by underground storage, oil grit separators and/or off-site retention at an existing extended detention facility east of the Station; and

(xvii) Guideway

- A. Infill: Peak flow shall be controlled as prescribed in section 8.3.7.3 of the City of Ottawa Sewer Design Guidelines
- B. Runoff shall be collected by new catchbasins connecting to existing and/or new storm sewers along the Guideway. No treatment for water quality control shall be required for the Guideway. All Guideway drainage shall be captured and conveyed within the Guideway.

18.8 Erosion and Sediment Control Requirements

- a) Project Co shall develop an Erosion and Sediment Control Plan in accordance with City of Ottawa S.P. No: F-1004.

ARTICLE 19 FUTURE ADJACENT CONSTRUCTION REQUIREMENTS

19.1 General Requirements

- a) The City shall prepare a Developers Guide in cooperation with Project Co for the guidance of prospective developers or other entities that may contemplate Construction activities, adjacent to, beneath, on, or over OLRT Lands, facilities, and/or operating Alignment or that will be located within the zone of influence of the OLRT Project. The document shall define the Design criteria and process requirements that prospective developers or other entities must follow for the submittal of documentation about their project to the City and Project Co, and measures that will be required when constructing a project in the vicinity of, or impacting OLRT Lands, facilities and/or operating Alignment, recognizing that the encouragement of development in the vicinity of stations is an objective of the City's Official Plan. The City and Project Co shall review submitted documentation throughout the Project Term. Further, approval of project construction and implementation procedures will be required prior to construction of future adjacent projects to ensure that no adverse impacts will be caused to the OLRT System. These policies are in addition to those other permits required for the construction of the proposed facilities.

- b) Specific items to be addressed in the Developers Guide shall include but are not necessarily limited to the following:
 - (i) Project Co shall assist the City in defining the zone of influence for the OLRT Project with respect to this Article. General procedures and review process that will be required to obtain approval for future adjacent construction within the zone of influence for the OLRT Project, including the process that parties are to follow to obtain as-built OLRT facility information, minimum submittal requirements, review process to be followed by the City and Project Co, and review criteria;
 - (ii) City contact information for development review process, flat rate fees (if any) for development reviews to be paid for by prospective developers, a review classification system based on proximity to OLRT assets/Construction and operational risks and developer submittal requirements for identified risk categories;
 - (iii) Minimum Design criteria for future Adjacent Structures with respect to protection of the OLRT System including, geotechnical criteria, temporary excavation support criteria, specific considerations for future Structures which are above, adjacent to or below, elevated, at-grade and underground OLRT Structures, maximum allowable deflection and vibrations for OLRT Structures, corrosion considerations, electrical and mechanical system considerations, controlled blasting/excavation considerations, dewatering considerations, and, crane swing guideline;

- (iv) Minimum requirements for geotechnical instrumentation and monitoring for OLRT Lands during adjacent construction including but not limited to instrumentation layout, monitoring schedule, reporting schedule, instrumentation response values and contingency plans;
 - (v) Minimum operational guidelines, including restrictions on hours and types of construction activities so as to minimize impacts on the OLRT service and operations;
 - (vi) Procedures to ensure the protection of the OLRT System during construction including potential requirements for site observations of certain activities to minimize damage potential; and
 - (vii) Minimum as-built and final documentation requirements.
- c) Project Co shall review and comment on the draft Developers Guide and assist the City in preparing the final Guide.
- d) Project Co shall coordinate and cooperate with the City with respect to the established development review process recognizing that:
- (i) The City will be responsible for carrying out development reviews in accordance with the process;
 - (ii) The City will retain an independent consultant and/or utilize internal staff resources to undertake the development reviews;
 - (iii) The City will be responsible for screening development applications that require a development review;
 - (iv) Project Co shall be responsible for reviewing and commenting on the draft development review findings; and
 - (v) The development review process developed by Project Co will be formalized in a City by-law to be enacted by the City.

ARTICLE 20 PROTECTION OF EXISTING ADJACENT STRUCTURES

20.1 Scope

- a) This Article provides requirements for; assessment of potential impacts to Existing Adjacent Structures due to OLRT Project Construction activities, development of mitigation measures as necessary, development of a geotechnical instrumentation and monitoring program and pre-and post-Construction surveys.
- b) Reference Documents:
 - (i) City of Ottawa Contract Specification F1011.

20.2 General Requirements

- a) Project Co shall:
 - (i) Assess the effects of Construction related Ground Movements on Existing Adjacent Structures. Prepare a report documenting anticipated impacts. Integrate the pertinent requirements of Part 3 and Part 1 Article 12 – Geotechnical/Foundation Design Criteria into the report.
 - (ii) Based upon report conclusions, Design and implement mitigation measures as necessary to ensure that the structural integrity of Existing Adjacent Structures is maintained and that the appearance, functionality, operability, and durability of Existing Adjacent Structures are unimpaired.
 - (iii) Develop and implement a Geotechnical Instrumentation and Monitoring Program designed to measure Construction impacts to Existing Adjacent Structures and to validate Design assumptions with respect to anticipated behaviour of soil, rock, groundwater, initial support and temporary excavation support systems in response to Project activities. Submit according to Schedule 10 – Review Procedure.
 - (iv) Incorporate where necessary, and as determined by Project Co, existing groundwater observation wells installed for the Project as documented in the Geotechnical Data Report into the geotechnical instrumentation and monitoring program.
 - (v) Prepare reports documenting the basis and development of protection of Existing Adjacent Structures Design.
 - (vi) Perform pre- and post-Construction condition surveys to document the condition of Existing Adjacent Structures. Surveys shall be submitted according to Schedule 10 – Review Procedure.
 - (vii) Remedy all damage caused by Construction or Project activities to pre-existing conditions.

- (viii) Obtain all Permits necessary for performing protection of Existing Adjacent Structures work.
- (ix) Coordinate with the City to facilitate meetings with Existing Adjacent Structures owners as needed to obtain permissions to perform the work needed to ensure the protection of Existing Adjacent Structures.
- (x) Ensure that Utility isolation or relocations do not affect the electrical safety grounding of adjacent properties and if so, provide suitable remedies.

20.3 Qualifications

- a) Design of the geotechnical instrumentation and monitoring program shall be under the direct supervision of a Professional Engineer.
- b) Staff for the Design and implementation of the geotechnical instrumentation and monitoring program shall include personnel who have verifiable design and construction experience with similar programs.
- c) The individual responsible for the surveyors shall be a registered land surveyor in the Province of Ontario with experience in measurements of the types of accuracies that shall be required for geotechnical instrumentation monitoring.

20.4 Design Requirements

- a) Project Co shall:
 - (i) Adjacent Structure Verification Study
 - A. Confirm information related to Existing Adjacent Structure locations, dimensions, elevations, foundations, structural details, materials, and other information necessary to complete a deformation analysis of the Structures. Perform field surveys, utility locates, and foundation test pits as needed.
 - (ii) Deformation Analysis
 - A. Define the Zone of Influence based on anticipated extents of Ground Movements caused by Project activities. The Zone of Influence shall be determined by Project Co using engineering analyses and shall consider all sources of Ground Movements that may be caused by Construction activities, however the minimum Zone of Influence shall be as follows:
 - i. A horizontal distance from the edge of any supported excavation or temporary slope equal to twice the excavation depth as measured from the existing ground surface;

- ii. A horizontal distance from the top of slope for permanent cut slopes equal to the total depth of the cut as measured from the existing ground surface;
 - iii. A horizontal distance from any Tunnel equal to 1.5 times the depth from the ground surface to the Tunnel invert; or
 - iv. A horizontal distance from any dewatering/unwatering, groundwater drawdown, or groundwater depressurization zones equal to the estimated maximum radius of groundwater pressure reduction in any soil or rock layer.
- B. Estimate the magnitude and distribution of Ground Movements caused by Construction Activities. Assess the potential impacts to all Existing Adjacent Structures within the defined Zones of Influence from all forms of Construction related Ground Movements. Assess potential Construction impacts to Existing Adjacent Structures arising from Project Co's means and methods other than excavation and groundwater drawdown related ground movements including impacts from:
- i. Demolition;
 - ii. Scaffolding;
 - iii. Crash decks/protective Structures;
 - iv. Fuel storage;
 - v. Plant and equipment; and
 - vi. Movement and storage of materials, plant and equipment.
- (iii) Impact Mitigation Design
- A. Design Structure-specific mitigation measures needed to prevent a loss in appearance, structural integrity, functionality, operability and durability of potentially impacted Structures. Demonstrate the effectiveness of the proposed mitigation measures by engineering analysis. Confirm and document that the proposed mitigation is acceptable to potentially affected Existing Adjacent Structures owners. Determine instrumentation monitoring requirements for evaluating the effectiveness of the mitigation measure during Construction that is consistent with the means and methods for Construction.
- (iv) Geotechnical Instrumentation & Monitoring
- A. Determine instrumentation requirements for monitoring vibration, displacement and strains, as appropriate for: Existing Adjacent Structures

within the Zone of Influence, temporary excavation support system structures, initial support System structures, soil, and rock adjacent to Project excavations. Determine instrumentation requirements for monitoring groundwater levels in the vicinity of Project excavations and areas that may be affected by Project related groundwater drawdown.

- B. Monitoring of Construction shall be performed to: assess the effects of Construction on the surrounding ground and Existing Adjacent Structures; identify likely causes and distribution of Ground Movements; evaluate Design assumptions and refine estimates of future performance; and check compliance with performance specifications. As needed, the monitoring shall address movements, vibrations, pressures, loads and strains in the ground, on Adjacent Structures, and on temporary and permanent Works. Project Co shall be responsible for designing and implementing the program, augmenting baseline survey data, organizing, evaluating and preserving the data, and undertaking corrective actions if and as needed.
- C. Permanent reference deep surveying benchmarks shall be established as required along the Project Alignment. The number of reference benchmarks established shall be sufficient to provide adequate sight distances to permit monitoring as specified in this Article. Benchmark coordinates and elevations shall thereafter be resurveyed annually.
- D. Measurements of differential settlements of Existing Adjacent Structures shall be taken at least bi-monthly until Final Completion.
 - i. Establish measurable Trigger and Action Levels for monitoring movement, vibrations, and strain of the soil, rock and Existing Adjacent Structures during Construction. Establish measurable Trigger and Action levels for monitoring groundwater levels. Set Action Levels to values that shall ensure that impacts to Existing Adjacent Structures shall not exceed Acceptable levels. Action Levels values shall be confirmed by engineering analysis or by documented case histories appropriate to the Structures and types of Construction being considered. Set Trigger Levels to values less than fifty percent of the Action Level value, but not more than the anticipated value of Ground Movement
 - ii. Establish Trigger Levels and Action Levels for each Existing Adjacent Structure and each instrument. Establish protocols for modifying Construction means and methods, alerting the owners of Existing Adjacent Structures, and implementing contingency measures.
- E. Define the instrument type, location and frequency of readings for each instrument. Assess the need for monitoring interior walls, columns, beam, and slabs.

- F. Provide directions for installing and baselining instruments.
 - G. Establish reading accuracies for each instrument compatible with the Trigger and Action Levels.
 - H. Consider seasonal variations in groundwater levels and ambient ground movements when setting baseline values and interpreting instrumentation readings.
- (v) Pre-and Post-Construction Condition Surveys
- A. Perform pre-Construction condition surveys for the purpose of inspecting and documenting the existing condition of Existing Adjacent Structures prior to Construction. Record information about existing Structure damage or repairs, defects, unusual aspects of Construction, presence of sensitive equipment, and similar pertinent information. Perform this work in accordance with City of Ottawa Contract Specification F1011, except as modified in this Article. Survey information shall be submitted according to Schedule 10 – Review Procedure.
 - B. The surveys shall be performed no more than 60 calendar days prior to performing any work that may result in Ground Movements that may affect the Existing Adjacent Structure to be surveyed, otherwise a second pre-Construction survey shall be required to verify and update the earlier survey findings. At a minimum, where authorized by Existing Adjacent Structure owners, pre-Construction condition surveys shall be performed on all existing above grade Existing Adjacent Structures and major underground Existing Adjacent Structures and within the Zone of Influence. For blasting, perform surveys as required under Schedule 17.
 - C. Develop a standard form to be used in recording observations during the pre-Construction condition survey.
 - D. Prepare pre-Construction condition survey reports for each Existing Adjacent Structure consisting, at a minimum, of the completed standard form, photographs with photo description log sheet, and DVD of digital video and digital photographs. The report shall be stamped by the Professional Engineer responsible for performing the survey.
 - E. Perform a post-Construction condition survey for Existing Adjacent Structures where the limiting levels of Structure movement or deformation have been exceeded, or a damage claim has been received. Collect sufficient data to substantiate whether damage has occurred.
 - F. Perform a post-Construction condition survey for every Existing Adjacent Structure for which a pre-Construction condition survey was performed

after it has been determined that Ground Movements have stabilized and no further movements may reasonably be anticipated.

G. Develop plans for the survey of Utilities.

(vi) Design Reports

A. Prepare and submit Stage 1 Construction Impact Assessment Reports (CIAR-1) and Stage 2 Construction Impact Assessment Reports (CIAR-2) as part of the Works Submittals according to Schedule 10 – Review Procedure.

20.5 Construction Requirements

a) Project Co shall:

(i) General

A. Perform excavations and install temporary excavation support and initial support in a manner consistent with the requirements specified to minimize ground and Structure movement and deformation.

(ii) Geotechnical Instrumentation and Monitoring

A. Furnish and install geotechnical instrumentation intended for the protection of Existing Adjacent Structures as identified in CIAR-2. Document the installation of each instrument and submit to the City, at the City's request.

B. Collect instrumentation readings and store all data in a centralized data management system. Automate the collection and reporting of data to the extent practicable to permit real time remote monitoring of instrumentation. Make all instrumentation data accessible to the City via a secure website. Allow for the display of data in both raw and meaningful engineering units in real time.

C. Provide a demonstration of the features of the instrumentation data reporting website to the City prior to the start of Construction and afterwards as modifications are made to the website.

D. Meet with the City as needed to discuss instrumentation levels and necessary actions to protect Existing Adjacent Structures.

E. Replace damaged or malfunctioning instrumentation. The City may order a temporary work stoppage in areas where there is insufficient working instruments to ensure the protection of Existing Adjacent Structures.

- F. Develop a Construction monitoring program incorporating surface, subsurface, and in-Tunnel instrumentation designed to measure movements and deformations of the ground, Existing Adjacent Structure, Utilities, temporary excavation support and initial support.
 - G. Accommodate the City in inspecting the installation of geotechnical instrumentation, related hardware, and in verifying the proper functioning of the instrumentation monitoring system including, but not limited to the collection, transmission, storage, backup, and reduction of data.
- (iii) Remedy of Damages
- A. When damage to Existing Adjacent Structures is due to Construction, as determined by a Post-Construction Condition Survey, develop and implement a plan to remedy the damage that the Structure owner is amenable to.

20.6 Existing Adjacent Structure Owner Interactions

- a) Project Co shall:
- (i) Follow all communication protocols established by Schedule 18 – Communications Protocol for interactions with Existing Adjacent Structure owners and other impacted or potentially impacted parties.
 - (ii) Work with owners of Existing Adjacent Structures, with the City acting as liaison, to perform Existing Adjacent Structure inspections, develop and implement where required acceptable mitigation measures and geotechnical instrumentation monitoring requirements, and perform pre- and post-Construction condition surveys.
 - (iii) The process of identifying impacts to Existing Adjacent Structures and developing monitoring and mitigation requirements shall generally be as follows once the Stage 1 CIAR is reviewed by the City:
 - A. Step 1. Owners of potentially affected Existing Adjacent Structures, as identified in the CIAR, shall be briefed of the Stage 1 CIAR findings by Project Co. The City will coordinate the interaction. Owners shall be given an opportunity to indicate whether they require a formal review of Design documentation and whether they require any special criteria in connection with developing monitoring and mitigation criteria;
 - B. Step 2. Stage 2 CIAR shall be prepared and provided to the City to provide to potentially affected Existing Adjacent Structures owners. Project Co shall brief potentially affected owners of the proposed mitigation measures and monitoring plans. The City will coordinate the

interaction. Owners will be requested to provide a letter of no objection in response to the proposed mitigation measures and monitoring plans; and

- C. Provide supplemental documentation related to the implementation and performance of monitoring and mitigation works as directed by the City for specific Existing Adjacent Structures.
- (iv) Project Co shall consider each of the above steps as iterative depending on specific requirements of individual Existing Adjacent Structure owners.
- (v) Develop and maintain a schedule of assets to identify the Existing Adjacent Structure owner assets, and other stakeholder assets that rely on Existing Adjacent Structure owner assets. This document shall be updated monthly and shall be used to track the completion of the impact assessments and obtaining acceptances of the monitoring and mitigation plans.
- (vi) Develop and implement a process for obtaining authorization for conducting pre- and post-Construction surveys from Structure owners and review of same by owners, Project Co and the City. At a minimum, this process shall include measures for documenting whether or not owners authorize pre- and post-Construction surveys and requirements for owners, Project Co and the City to review and accept completed pre- and post-Construction surveys.

ARTICLE 21 STRUCTURAL DESIGN CRITERIA AND REQUIREMENTS

21.1 Order of Precedence

- a) All Project Structure work, except as explicitly indicated in other articles, shall comply with the criteria contained in this Article, and all standards, regulations, policies, Applicable Law, guidelines or practices applicable to the Project, including but not limited to each of the following Reference Documents. In the event of conflict between the criteria, commitments or requirements contained within one document when compared with another, the more stringent shall apply:
- (i) Specific obligations and Design Criteria identified in this Schedule;
 - (ii) CAN/CSA S6-06 – including Supplement No. 1, May 2010 and Exceptions to the Canadian Highway Bridge Design Code CAN/CSA S6-00 for Ontario – June 2002
 - (iii) City of Ottawa Standards
 - (iv) OPSS
 - (v) OPSD
 - (vi) CAN/CSA A23.3
 - (vii) CAN/CSA A16
 - (viii) AREMA Manual for Railway Engineering hereinafter referred to as the AREMA Manual
 - (ix) CAN/CSA A23.1
 - (x) CAN/CSA A23.2
 - (xi) CAN/CSA G40.20-04/G40.21-04

21.2 Design Codes and Standards

- a) The following codes, standards, and references shall be utilized for the Design of Structures indicated in this article. If the criteria sources conflict, unless otherwise noted, the most conservative standards shall apply. Where no standard is noted for a particular item of the Works within this Schedule, then Project Co shall develop Project-specific procedures based on industry standards and recognized specifications.
- (i) Codes and Standards

- A. The structural Design shall conform to the most current edition of the following codes and standards. Designs shall be updated, as necessary, to conform to codes revisions through the start of Project Construction.
- i. CAN/CSA S6 and Exceptions to the Canadian Highway Bridge Design Code CAN/CSA S6-00 for Ontario – June 2002
 - ii. CAN/CSA S6.1
 - iii. CAN/CSA A23.3
 - iv. CAN/CSA A16
 - v. AREMA Manual for Railway Engineering hereinafter referred to as the AREMA Manual
 - vi. CAN/CSA A23.1
 - vii. CAN/CSA A23.2
 - viii. AASHTO Manual for Condition Evaluation of Bridges
 - ix. AASHTO Guide Specifications for Strength Evaluation of Existing Steel and Concrete Bridges
 - x. AASHTO Guide Specifications – Thermal Effects in Concrete Bridge Structures
 - xi. TCRP Report 57 Track Design Handbook for Light Rail Transit
 - xii. ACI 358.1
 - xiii. AASHTO Guide Specifications for Design and Construction of Segmental Concrete Bridges.
 - xiv. AASHTO Guide Specifications for Structural Design of Sound Barriers.
 - xv. AASHTO Guide Specifications for Horizontally Curved Highway Bridges
 - xvi. ANSI/ASCE/T&DI 21 – Parts 1 – 4
 - xvii. MTO – Geometric Design Standards for Ontario Highways
 - xviii. NBCC
 - xix. C22.3 No. 7-06 Underground Systems

- xx. CSA S448.1 – Repair of Reinforced Concrete in Buildings
 - xxi. CSA S478 – Guideline on Durability in Buildings
 - xxii. CSA S413 – Parking Structures
- (ii) Design References
- A. PTI Post-Tensioned Box Girder Bridge Manual
 - B. PTI Recommendations for Prestressed Rock and Soil Anchors
 - C. FHWA Post Tensioning Tendon Installation and Grouting Manual
 - D. Canadian Foundation Engineering Manual Third and Fourth Editions
 - E. FHWA-NHI-00-043 Mechanically stabilized earth walls and reinforced soil slopes Design & Construction guidelines
 - F. NCMA Segmental Retaining Wall Design Manual
 - G. SSPC-SP10 – Society for Protective Coatings – Surface Preparations
 - H. MTO – Aesthetic Guidelines for Bridges
 - I. MTO – Bailey Bridge Manual
 - J. MTO – Cathodic Protection Manual for Concrete Bridges
 - K. MTO – Class Environmental Assessment for Provincial Transportation Facilities (2000)
 - L. MTO – Concrete Culvert Design and Detailing Manual
 - M. MTO – Designated Sources for Materials
 - N. MTO – Drainage Management Manual – Volumes 1, 2, 3 and 4
 - O. MTO – Electrical Engineering Manual Volume 1 – Electrical Design
 - P. MTO – Electrical Engineering Manual Volume 2 – Electrical Maintenance
 - Q. MTO – Electrical Engineering Manual Volume 4 – FTMS C.D.E.D.
 - R. MTO – Environmental Guide for Contaminated Property Identification and Management (2006)
 - S. MTO – Environmental Guidelines for Structural Steel Coating (1996)

- T. MTO – Environmental Protection Requirements for Transportation Planning and Highway Design, Construction, Operation and Maintenance (2006)
- U. MTO – Formwork and Falsework Manual
- V. MTO – Integral Abutment Bridges
- W. MTO/DFO/OMNR – Protocol for Protecting Fish and Fish Habitat on Provincial Transportation Undertakings (2006)
- X. MTO/DFO/OMNR – Protocol for Protecting Fish and Fish Habitat on Provincial Transportation Undertakings, User Field Guide (2006)
- Y. MTO/MOE – Memorandum of Understanding on Permits-To-Take-Water (2006)
- Z. MTO/MOE – Protocol for the Management of Excess Materials in Road Construction and Maintenance (1994)
- AA. MTO – Lab Testing Manual
- BB. MTO – Ontario Bikeways: Planning and Design Guidelines
- CC. MTO – Ontario Heritage Bridge Guidelines for Provincially Owned Bridges
- DD. MTO – OSIMS User’s Guide
- EE. MTO – Ontario Structure Inspection Manual
- FF. MTO – OSIM Ontario Structure Inspection Manual
- GG. MTO – Overcoating – Technical Assessment of Existing Coatings of Steel Bridges for Overcoating
- HH. MTO – Performance of Integral Abutment Bridges Report
- II. MTO – Pile Load and Extraction Tests, 1954 – 1992
- JJ. MTO – Chapter 5 of Construction Manual
- KK. MTO – Guide to the Design of Post-Tensioned Decks
- LL. MTO – Pre-stressed Concrete Manual for Quality Assurance of Bridges During Construction
- MM. MTO – RSS Guidelines (2007)

- NN. MTO – Seismic Design Guidelines
- OO. MTO – Semi-Integral Abutment Bridges Manual
- PP. MTO – Structural Manual
- QQ. MTO – Structural Steel Coating Manual
- RR. MTO – Structural Rehabilitation Manual
- SS. MTO – Guidelines for Conducting ½ Cell Survey and Covermeter Survey
- TT. MTO – Guide for Preparing Hydrology Reports for Water Crossings
- UU. City of Ottawa – Transit Technology Choice Report (October 2009)

21.3 General Requirements

a) Design

- (i) Project Co shall include and/or engage a qualified designer to perform and be responsible for execution in the structural Design of the Project. Structural Design shall be performed under the responsible charge and drawings and Design shall be signed and sealed by a Professional Engineer.
- (ii) Unless otherwise noted, all structural Design shall follow the method of Limit States Design and conform to the corresponding code and standard identified in Section 21.2 Design Codes and Standards.
- (iii) The loading criteria to which the Structures are designed shall appear on the structural drawings. When required by design conditions, concrete placing sequence shall be indicated on the drawings or in the supplementary conditions.

b) Durability

- (i) Project Structures shall be designed and detailed to attain durability ensuring the indicated Design Life without replacement of any major components. Time dependent Design calculations, including corrosion, creep and fatigue shall be based on indicated Design Life. Design life calculations shall be per CAN/CSA S6-06 including Supplement No. 1, May 2010.
- (ii) Fatigue cycles for Train Structures shall be a minimum 15,000,000 cycles for peak period Trains of 120m to 150m length.
- (iii) The durability of concrete Structures shall be assured through design and detailing, application of high performance materials, protection of reinforcing steel, and application of concrete sealers.

- A. Foundations in corrosive soils shall be constructed with appropriate cement type and provided with protective coatings or such other mitigations to ensure required Design Live.
- c) Rehabilitation and Maintenance
 - (i) Project Co shall be responsible for the Maintenance of existing Train Structures and shall carry out rehabilitation such as, but not limited to waterproofing, spalled concrete and crack repairs, of any Train Structure it intends to use for operations prior to implementation of the OLRT.
 - (ii) Project Co shall be responsible for the Maintenance of existing and new Structures and Train Structures where System features such as, but not limited to OCS appurtenances and protective barriers, attach to existing structures. This maintenance responsibility shall include any such attachments and further shall extend to the entire Structure for any consequential damage that results directly or indirectly from such attachment as determined by the City.. This responsibility may be further refined based on a baseline stray current survey before and after commencement of Revenue Service and any required mitigation measures. This provision shall not be considered to conflict with the requirements of Schedule 15-2 Part 4 Article 8.14 – Bridge, Overhead and Roof Structure Attachments.

21.4 Material

- a) General
 - (i) All material for the Structures as identified in this article shall conform to OPSS.
- b) Concrete
 - (i) Project concrete shall conform to OPSS 904.
 - (ii) Chloride Permeability
 - A. The 90-day for the superstructure mix shall not exceed 1000 coulombs.
- c) Reinforcing Steel
 - (i) Project Co shall meet the requirements for reinforcement steel as defined in the OPSS 905 and OPSS 1440.
 - (ii) Minimum reinforcement designation shall be 15M.
 - (iii) Welded splices or joints in reinforcing steel shall not be permitted. Welding for purposes of bonding and grounding continuity is permitted.
 - (iv) Couplers shall not be used in plastic hinge zones.

- (v) No splices allowed in plastic hinge zones for substructure components.
- (vi) Reinforcing steel for Train Structures in the top surface of decks, top and bottom of cantilevers and Guideway plinths that may be subject to de-icing salts, such as adjacent to platforms, shall be stainless steel. Further, substructures of Train Structures within the splash zone of roadways treated with de-icing salts shall be stainless steel. Where electrical continuity is required for managing stray currents, weldable reinforcement and suitable welding shall be used.
- (vii) Reinforcement in parapets and sidewalks shall be GFRP or stainless steel and shall match the reinforcing steel in the deck.
- (viii) Reinforcing steel in substructure concrete within the splash zone of adjacent roadways treated with de-icing salts shall be stainless steel. Where electrical continuity is required for managing stray currents, weldable reinforcement and suitable welding procedure shall be used.
- (ix) Corrosion Rates for Steel below Ground
 - A. For the surfaces of structural components exposed to soil, or below the water table, the sacrificial thickness shall be computed at 15 $\mu\text{m}/\text{year}$ for first two (2) years plus 4 $\mu\text{m}/\text{year}$ for subsequent years for galvanization loss and 12 $\mu\text{m}/\text{year}$ after zinc depletion.
- d) GFRP Reinforcement
 - (i) GFRP shall have a minimum modulus of elasticity of 40 GPa.
 - (ii) GFRP shall have a specified minimum tensile strength of 1000 MPa.
- e) Prestressing Tendons
 - (i) Prestressing tendons shall meet the requirements of:
 - A. ASTM A421/421M grade 1665 MPa (240) for stressed relieved steel wire; and,
 - B. ASTM A416/416M grade 1860 MPa (270) low-relaxation seven-wire uncoated steel strand.
 - (ii) Internal unbounded post-tensioning tendons shall not be permitted.
 - (iii) External grouted post-tensioning tendons are permitted for segmental Construction and shall be corrosion protected.
- f) Structural Steel
 - (i) Structural steel shall be designed in accordance with OPSS 906.

- (ii) Steel for superstructure primary members shall comply 350 AT Category 3 for plates, girders; and rolled sections.
- (iii) Primary steel members made from pipe sections shall meet the minimum Charpy Impact energy specified in Table 9 of CSA G40.21-04 for the similar yield strength of steel tested at a Category 3 temperature.
- (iv) Secondary steel shall be grade 350W or 350A.
- (v) Steel fabrication companies shall be CWB certified.
- (vi) Project Co shall detail and protect the structural steel-to-concrete interface in a way that no rust staining of the concrete occurs.
- (vii) Access to steel girders for inspection purposes shall be incorporated into the design, including devices to enable inspectors to walk along all girders and tie-off safely.

21.5 Loads and Forces

- a) Structures or parts of Structures subject to Train and/or highway vehicle loadings shall be designed by Limit States Design method per the CHBDC. Such designs shall consider loads due to System-wide elements such as electrification, signalization and communication equipment.
- b) Bridge Structures not subject to Train loadings shall be designed in conformance to Table 3.1 Load factors and load combinations indicated per the CHBDC.
- c) Bridge Structures subject to Train loadings shall be designed in conformance to Table 3.1 Load factors and load combinations indicated per the CHBDC supplemented and modified as indicated below to recognize Train and rail loadings. Note nomenclature conforms to Legend for Table 3.1.
 - (i) Live Load (L)
 - A. Live load shall consist of any non-permanent loads including the weight of machinery, equipment, sorted materials, persons, Vehicles, work train, or other moving objects, Construction loads, and loads due to Maintenance operations.
 - B. All Bridge Structures, including Train Structures, shall also be designed to accommodate highway vehicular loading CL-625- ONT in accordance to CAN/CSA S6.
 - (ii) Impact (I)
 - A. Impact loads are statically equivalent dynamic loads resulting from vertical acceleration of the live load. Impact acts as part Transitory load L.

B. Impact Considerations

i. Impact considerations for aerial Train Structures and/or work train transit loading shall meet the requirements as follows:

- 1 Impact shall be applied to the superstructure and generally to those members of the Structure that extend down to the top of footings. The portion above the ground line of concrete or steel piles rigidly connected to the superstructure as in rigid frame or continuous design is included. Impact shall not be considered for abutments, retaining walls, wall-type piers, piles, footings and service walks, except for the portion of piles rigidly connected to the superstructure, underground Structures with 900mm or more of cover and base slabs supported by earth (either at-grade or in subways).
- 2 The impact force shall be applied at the top of low rail, distributed the same as outlined for the axle loads.
- 3 In addition to the vertical impact, a horizontal impact (or nosing) force (NF) equal to 10% of railroad train or Train Design load shall be applied. This force shall be equally distributed to the individual axles of the LRV and shall be assumed to act in either direction transverse to the Track at the top of the low rail.

(iii) Centrifugal Force (CF)

A. Centrifugal force shall be determined in accordance with AREMA and CHBDC for Train and highway loadings respectively. Centrifugal force acts as part Transitory load L.

(iv) Rolling (Rocking) Force (RF)

A. A force equal to 10% of the Train loading per Track shall be applied downwards on one rail and upwards on the other, on one or all Tracks. The rolling or rocking force is an impact load in addition to other vertical impact loads and shall be considered when detrimental to the Structure.

(v) Longitudinal Force (LF)

A. Longitudinal force shall be determined in accordance with AREMA and CHBDC for LRT and highway loadings respectively. Longitudinal force acts as part Transitory load L.

i. For Train Loading:

- 1 A longitudinal traction and braking force equal to 25% of the static vertical live load shall be applied on all loaded Tracks at the level of the uppermost rail. The force generated is offset by the resistive clamping force of the rail clip and the number of plinths on the Bridge. Typically, the clamping force per clip is 13.35 KN. The clip clamping force shall be checked and confirmed by the Project Co for each individual case prior to being used in the Design.
 - 2 A longitudinal acceleration/deceleration force equal to 21% of the LRV Design load, without impact, per Track, shall be applied at the center of gravity of the LRV above the top of the rail. Consideration shall be given to combinations of acceleration and deceleration forces where there is more than one Track on the Structure.
- (vi) Horizontal Earth Pressure (E)
- A. Structures which retain earth shall be designed for side pressure due to earth abutting against the Structure and load surcharges resting on abutting earth. Consideration shall be given to multi-layered effects where substantial differences in soil properties occur over the depth of the Structures.
 - B. Train loading may be assumed as a uniform surcharge load equal to an additional 900mm of earth.
 - C. Live and dead loads from adjacent foundations of Structures shall be considered in computing horizontal pressures.
- (vii) Hydrostatic Pressure and Buoyancy (B)
- A. Hydrostatic pressure and buoyancy shall be determined in accordance with CHBDC.
- (viii) Wind Load on Structure (W)
- A. The Bridge Structures shall be designed to withstand wind loads of uniform pressure acting upon the superstructure and substructure as specified in this section.
 - B. Wind loading on catenary shall be considered in the Design of both superstructure and substructure elements. Loads (magnitude and location) shall be determined by Project Co.
 - C. The wind load on the superstructure shall be determined in accordance with CHBDC.

- D. The wind load on the substructure shall be determined in accordance with CHBDC.
- (ix) Wind Load on Live Load (WL)
- A. WL is wind load acting on the LRV and shall be considered part of Transitory load V
 - B. Provision shall be made in the Design of the superstructure for a transverse and longitudinal horizontal wind load as specified in this section. These loads apply to the Design of substructure elements supporting a single Track. For the Design of substructure elements supporting two Tracks, these loads shall be increased by 30% when both Tracks are loaded. This factor accounts fully for shielding effect of Vehicle-on-Vehicle as the two Trains run alongside each other.
 - C. Design shall include a transverse horizontal wind load of 4.4 kN/m and a longitudinal horizontal wind load of 1.1 kN/m for the entire length of Track supported by the element being designed. The transverse load shall be applied to the Train as concentrated loads at the axle locations, in a plane 2.4m above the top of the low rail and normal to the Track. The longitudinal force shall be applied to the rails and superstructure as a uniformly distributed load in a horizontal plane at the top of low rail.
- (x) Thermal Force (T)
- A. Provision shall be made for stresses and deformations resulting from temperature changes described in this section. Indicated thermal forces act as part Transitory load K.
 - B. Expansion Coefficients
 - i. The expansion coefficients of the various Construction materials shall be in accordance with CHBDC.
 - C. Direct-Fixation Temperature Forces
 - i. For direct fixation Track, provision shall be made for transverse and longitudinal forces due to temperature variations in the rail. These forces shall be applied in a horizontal plane at the top of the low rail.
 - ii. Transverse Force
 - 1 For equal adjacent spans, the transverse force in pounds per span of Structure per rail shall be determined by the following formula:

$$T = 2 * E * A * C * T * \sin(1/2) * (L/R) * (180/\pi) \text{ (N)}$$

Where:

E Young's modulus of rail (MPa)

A = rail cross-sectional area (mm²)

C = coefficient of expansion of rail

T = temperature differential (°C)

L = span length along curve (m)

R = curve radius (m)

pi = 3.14159

- 2 For unequal adjacent spans, the transverse force shall be resolved into components parallel and perpendicular to the pier at each rail fastener and then summed.

iii. Longitudinal Force

- 1 The longitudinal force per Structure per rail shall be determined by the following formula, in lieu of more exact coefficient of friction and breakaway load values for specific clips:

$$T = 0.65 * P * L$$

Where:

P = vertical clamping force of rail fastener per linear metre

L = average span length of two adjacent spans (m)

For curved Track, L is measured along curve.

D. Overhead Catenary System Thermal Forces

- i. Thermal forces resulting from the temperature variations in the OCS shall be considered. Loads shall be determined by Project Co.

(xi) Differential Settlement

- A. Load(s) induced on the Structures by tolerable differential settlement shall be considered in the loading combination. Consider this load similar to

shrinkage and thermal forces. The tolerable differential settlement shall be established in accordance with these criteria. This is a Transitory load S in CHBDC Table 3.1.

(xii) Derailment Load (DR)

- A. Potential derailment load effects shall be considered. In the absence of actual crash test data or the results of a detailed dynamic crash/impact analysis the load effect of a derailment event can be accounted for by applying concurrently vertical and horizontal (transverse) forces to the supporting Structure as follows:
- B. DR shall be considered an Exceptional load case. CHBDC Table 3.1 shall be considered expanded with an additional ULS Combination 10 with Permanent loads all with an α coefficient conforming to CHBDC Table 3.2 and with a DR load factor of 1.00.
- C. The vertical derailment load of LRV's shall consist of the LRV's maximum weight multiplied by an impact factor. A vertical impact factor of 100 percent of the LRV weight shall be used to compute the equivalent static derailment load.
- D. Horizontal (transverse) load effect – equal to 20% of the LRV, distributed proportionately along the length of the Train in accordance with the axle load distribution along the length of the Train, acting perpendicular (transverse) to the Track Alignment at the top surface of the rail.
- E. When checking any component of superstructure to substructure that supports two or more Tracks, only one Train on one Track shall be considered to have derailed, with the other Track being loaded with a stationary work train, including work train, cranes, flats, etc., or another Train, ready to receive Passengers from the derailed Train. The Design load used shall be the greatest of these loadings.
- F. For derailment events that would cause LRV wheels to bear directly on the Structure slab, the wheel load distribution on the slab shall be established using a rational method. Location of derailed wheel excursion limited by guard rails or curbs shall be that location that achieves maximum loading condition.
- G. All elements of the Train Structure shall be checked assuming simultaneous application of all derailed wheel loads. The reduction of positive moment in continuous slabs due to derailed wheel loads in adjacent spans shall not be allowed.

(xiii) Earthquake (EQ)

- A. Earthquake load is an Exceptional load EQ in CHBDC Table 3.1. These seismic loads shall be in accordance with CAN/CSA S6-06 Section 4.
- B. New Train Structures and portions of Station structural systems that carry or support Train loads shall be designed to meet Emergency route importance category.
- C. Existing Structures are to be importance category Other.

21.6 Distribution of Loads (for applicable Structure type)

- a) Distribution of Wheel Loads to Slab for Tie and Ballast Track
 - (i) For tie and ballast Track wheel loads are transmitted to the deck slab through the ballast. It can be assumed that the wheel loads are uniformly distributed longitudinally over a length of 900 mm, plus the depth of the Track Structure, plus twice the effective depth of slab, except as limited by wheel spacing. Wheel loads can be assumed to have uniform lateral distribution over a width equal to the length of the tie plus the depth of ballast under the tie, except as limited by the proximity of adjacent Tracks or the extent of the Structure.
- b) Distribution of Wheel Loads to Slab for Direct Fixation Track
 - (i) For direct fixation Track, wheel loads are transmitted to the deck slab through the rail fastening system placed directly on the slab. It can be assumed that the wheel loads are uniformly distributed over a length of 900 mm along the rail. This load can be assumed to be distributed transversely (normal to the rail and centered on the rail) by the width of the rail fastener plus twice the depth of the deck and Track support Structure except as limited by the proximity of adjacent Tracks or the extent of the Structure.

21.7 Design Requirements

- a) Seismic Design
 - (i) Existing overpasses proposed to carry the Train shall not be seismically retrofitted if found to be structurally satisfactory for all other loading combinations. In the exception that an existing overpass Bridge must be rehabilitated to satisfy service load requirements, then it shall be seismically retrofitted in conformance to an Emergency Route importance category.
 - (ii) Seismic retrofit of existing Train Structures shall conform to current standard practice for rail Structures. Retrofit is considered likely to include strengthening of substructures and installation of isolation bearings. Isolation bearing assemblies shall be configured and designed to accommodate service and thermal displacements without permanent deformations. Pendulum bearings with fusible links and/or dampers to restrain service displacements are acceptable. Lead core elastomeric bearings shall not be used for rail Bridges.

b) Collision Protection

- (i) Piers or other Train Structure support elements that are situated less than three meters from the edge of an adjacent street or highway shall be designed to withstand a horizontal static force of 1,000 kN, unless protected with suitable barriers. This force is to be applied on the support element at an angle of 10 degrees from the direction of the road traffic and at a height of 1,200 mm above ground level. This condition occurs with the dead load of the Structure but need not be applied concurrently with other loadings. The provisions of this clause shall apply to existing and proposed Train Structures.
- (ii) To limit damage by the redirection and deflection of equipment, piers supporting Bridges over the LRT and with a clear distance of less than six meters from the centerline of a Track shall be of heavy Construction or shall be protected by a reinforced concrete crash wall.
 - A. Crash wall shall have a minimum height of 1,200 mm above the top of rail. The crash wall shall be at least 600mm thick and at least 3.5 meters long. When two or more columns compose a pier, the crash wall shall connect the columns and extend at least 900mm beyond the outermost columns parallel to the Track. The crash wall shall be anchored to the footings and columns, if applicable, with adequate reinforcing steel and shall extend to at least 1,200mm below the lowest surrounding grade.
 - B. Piers shall be considered of heavy Construction if they have a cross-sectional area equal to or greater than that required for the crash wall and the larger of its dimensions is parallel to the Track.
 - C. Consideration may be given to providing protection for Bridge piers over six meters from the centerline of Track as conditions warrant. In making this determination, account shall be taken of such factors as horizontal and vertical Alignment of the Track, embankment height, and an assessment of the consequences of serious damage in the case of a collision.

c) Vibration and Deflection Control

- (i) Indicated provision for vibration and deflection shall be incorporated into Design of new Project Structures. Vibration and deflection shall be reviewed for existing Structures and reasonable mitigations applied to meet criteria, but variances for vibration and deflection limits shall be allowed for existing Structures.
- (ii) To limit vibration amplification due to the dynamic interaction between the superstructure and the LRV, the first-mode natural frequency of flexural vibration of each Guideway span shall generally be not less than 2.5 cycles per second and no more than one span in a series of three consecutive spans shall have a first-mode natural frequencies less than 2.5 cycles per second provided that due

consideration is given to possible vibration interactions between the Train Structure and the LRV, and their effect on vertical impact loading.

- (iii) The deflection of longitudinal girders under normal live load shall not exceed 1/1000 of the span length. For main cantilever girders, the deflection under normal live load shall not exceed 1/350 of the cantilever span.
 - (iv) A special analysis shall be conducted for any Bridge or superstructures having a first mode of vibration, which is less than 2.5 hertz, or for the condition when more than one span in a series of three consecutive spans has the first mode of vibration, which is less than 3.0 hertz.
 - (v) This analysis shall model the proposed Train Structure and the proposed LRV. The analysis shall contain a sufficient number of degrees of freedom to allow modeling of the Train Structure, LRV truck spacing, LRV primary suspension, LRV secondary suspension, and the car body. It shall make provision for the placement of the LRV on the Train Structure in various locations in order to model the passage of the LRV. When the exact configuration of either the LRV or the Train Structure is not known, the study shall assume a reasonable range of parameters and shall model combinations of those parameters as deemed appropriate.
 - (vi) The analysis shall determine whether impact loads in excess of 30 percent of LRV are required for the Design of the Train Structure. The analysis shall also determine whether certain operational considerations such as speed restriction or other provisions are required in order to ensure the safe operation of the LRV over the Train Structure.
- d) Track Support Transitions
- (i) At all transitions between Track slab or Bridge decks with DFF and tie and ballast Track sections a depressed approach slab shall be provided to permit the Construction of tie and ballast Track up to the end of the DFF section without an abrupt change in rail support condition at that point.

21.8 Design and Construction of New Structures

- a) Environmental, hydrology and channel hydraulic studies shall be performed to address all immediate and long-term impacts and issues for all bridges over water.

21.9 Design of Roadway Structures

- a) Roadway Bridge Structures that do not receive LRV loadings shall be designed in accordance with CAN/CSA S6 per Article 21 Section 21.2.

21.10 Design of “U” Approach and Other Earth Retaining Structures

- a) When Limit States Design methods are used for proportioning wall sections, the lateral earth pressure load factor to be used is 1.5.
- b) Where Structures are design as drained, a drainage layer shall be provided behind the wall including abutments to mitigate the build-up of hydrostatic pressure. Both the water pressure and the lateral soil pressure shall be considered in the Design. Water from drainage layer shall be removed with drainage system acceptable to local Relevant Authority.
- c) MSE walls shall not be utilized as the primary support load paths for Bridge beams and stringers.
- d) Earth retaining Structures whether temporary or permanent greater than five meters in height shall be designed on the basis of specific soils information relating to the backfill material. Such walls shall be analyzed using a recognized numerical design method accounting for the rigidity or flexibility of the soil-structure interaction.

21.11 Description of Project Structures

- a) Project Co shall:
 - (i) Twin-Cell Box Culvert under West Transitway
 - A. Ensure that structural capacity of the top slab not be exceeded with passage of work Trains (speed restriction). All transverse expansion joints shall be replaced.
 - (ii) Holland Avenue Bridge (SN 016240)
 - A. Ensure the passage of LRT Vehicle under this Structure with adequate clearance.
 - B. Construct new pedestrian Bridges adjacent to existing Bridge with similar depth.
 - (iii) Parkdale Avenue Bridge (SN 016230)
 - A. Ensure the passage of LRT Vehicle under this Structure with adequate clearance.
 - (iv) Hinchey Avenue Bridge (SN 016220)
 - A. Ensure the passage of LRT Vehicle under this Structure with adequate clearance.
 - (v) Carruthers Avenue Bridge (SN 016210)

- A. Ensure the passage of LRT Vehicle under this Structure with adequate clearance.
- (vi) Bayview Avenue Bridge (SN 016200)
- A. Rehabilitate and reconstruct as appropriate.
 - B. Address approach slab's bearing on Bridge.
 - C. Identify and remedy the cause of settlement in embankment behind approach MSE retaining walls. Repair any displacements
- (vii) West Transitway CPR Overpass "O-Train" Bridge (SN 015040)
- A. Remove and replace the existing Bridge Structure with a new Train Structure;
 - B. New Train Structure shall be configured so as to allow at least single Track operations during future Train Structure maintenance and rehabilitation, including total replacement of Train Structure. During major rehabilitation or replacement activities, limited weekend double track activities shall be permitted of no more than fifty-four hour durations. Project Co shall submit supporting documents describing compliance with this provision;
 - C. Provide vertical clearances to existing rails that, at a minimum, maintain existing clearances;
 - D. Design pier and abutment locations such that:
 - i. Future O-Train direct connection to OLRT downtown is not prohibited;
 - ii. Horizontal clearance, at a minimum, maintains the existing rail clearances at both existing rail lines;
 - iii. The extension of the existing O-Train spur rail to accommodate the new O-Train is provided for;
 - iv. Sufficient space and clearance is provided to allow for a future double-tracked electrified light rail line and platform which would replace the existing O-Train spur line; and
 - v. The design coordinates with the O-Train platform level LRT Station entry.
 - E. Meet Station Platform edges within required tolerances. Project Co shall note that additional structural provisions may be necessary to moderate

- differential service displacements of Platform and Train Structure to accommodate AODA requirements.
- F. Relative displacements between new Station and Platforms and the Train Structure shall be accommodated to limit damage during service and design seismic event.
- (viii) New Booth Street Bridge
- A. Design for “emergency-route” seismic performance.
 - B. Design to follow Lebreton Station architectural theme.
 - C. North approach design shall consider existing subsurface covered aqueduct crossing under Booth Street.
 - D. Bridge foundation design shall consider all existing subsurface utilities crossing under Booth Street including large brick sanitary sewer.
 - E. Design shall ensure the passage of LRT Vehicle under this Structure with adequate clearance.
- (ix) Mann Avenue Bridge (SN 016950)
- A. Possible use of existing substructure.
- (x) Nicholas Ramp Underpass Structure #401
- A. Ensure the passage of LRT Vehicle under this Structure with adequate clearance.
 - B. Protect existing piers from errant LRT Vehicles.
- (xi) Queensway Underpass Structure (SN 014010)
- A. Ensure the passage of LRT Vehicle under this Structure with adequate clearance.
 - B. Coordinate Work with roadway widening to be carried out by MTO.
- (xii) Lees Avenue Underpass Structure (SN 016050)
- A. Ensure the passage of LRT Vehicle under this Structure with adequate clearance.
- (xiii) Rideau River Crossing (SN 013010)

- A. Possible use of existing Structure. Resonance constraints shall be addressed. Project Co shall investigate and impose restrictions as necessary to limit work Train loading on existing Bridge, if utilized.
 - B. The Structure shall incorporate MUP's on both sides of the Bridge equal in width to the existing.
- (xiv) Hurdman Station West Structure
- A. Design to follow Hurdman Station architectural theme.
 - B. Note landfill area with potential bearing and corrosion issues for substructures.
 - C. Design concept shall incorporate Station concept and shall protect for future roadway configuration.
- (xv) Hurdman Station East Structure
- A. Design to follow Hurdman architectural theme.
- (xvi) Riverside Drive Structure (SN 056650)
- A. Possible use of existing Structure. Should this Structure be utilized for the LRT Project, Design for "other" seismic performance.
- (xvii) West Ring Road Underpass (SN 056660)
- A. Ensure the passage of LRT Vehicle under this Structure with adequate clearance.
 - B. Protect existing piers from errant LRT Vehicles.
- (xviii) New East Ring Road Underpass
- A. Ensure the passage of LRT Vehicle under this Structure with adequate clearance as roadway above to remain. Two-way traffic on one side of D-Loop may be required to maintain existing station ingress and egress. Note close proximity to existing East Ring Road Bridge.
- (xix) Tremblay Road Underpass (SN 056680)
- A. Ensure the passage of LRT Vehicle under this Structure with adequate clearance.
 - B. Protect existing piers from errant LRT Vehicles.
- (xx) Belfast Road Underpass (SN 056690)

- A. Ensure the passage of LRT Vehicle under this Structure with adequate clearance.
 - B. Coordinate Construction with Schedule 40 – Highway Work.
- (xxi) East Transitway Queensway Underpass (SN 056700)
- A. Ensure the passage of LRT Vehicle under this Structure with adequate clearance.
- (xxii) St. Laurent Station Tunnel Structure (SN 056710)
- A. Ensure the passage of LRT Vehicle under this Structure with adequate clearance. Should any trenches be opened up in front of walls to relocate existing large storm sewer directly beneath Transitway, apply stabilization measures to footings as required.
- (xxiii) Combined East Transitway Structure 4 (SN 056720) & Structure 2K
- A. Ensure the passage of LRT Vehicle under this Structure with adequate clearance.
- (xxiv) East Transitway Structure 3 (SN 056730)
- A. Ensure the passage of LRT Vehicle under this Structure with adequate clearance.
- (xxv) East Transitway Structure 8 (SN 056740)
- A. Ensure the passage of LRT Vehicle under this Structure with adequate clearance.
- (xxvi) East Transitway Structure 10 (SN 226720)
- A. Ensure the passage of LRT Vehicle under this Structure with adequate clearance.
- (xxvii) East Transitway Structure 5 (SN 226730)
- A. Ensure the passage of LRT Vehicle under this Structure with adequate clearance.
- (xxviii) Cyrville Road Underpass (SN 226740)
- A. Ensure the passage of LRT Vehicle under this Structure with adequate clearance.
- (xxix) Southbound East Parkway Bridge (SN 226750)

- A. Ensure the passage of LRT Vehicle under this Structure with adequate clearance.
- (xxx) Northbound East Parkway Bridge (SN 226760)
 - A. Ensure the passage of LRT Vehicle under this Structure with adequate clearance.
- (xxxi) Cyrville Drain Culvert (SN 226770)
 - A. Structure current-code deficient, replacing existing structural Construction may be cost effective. Possible replacement with single span Train Structure. Design new Structure for “emergency-route” seismic performance.
- b) New retaining wall drawings exist in the databank for information purposes. A list of retaining wall Structures and the anticipated works is shown below:
 - (i) Booth Street Bridge – North and South approaches
 - A. To protect for future development, the roadway approaches to the Booth Street Bridge, from the north and south, shall be constructed with retaining walls. No sloped embankments shall be permitted greater than 0.3m in height.
 - B. Retaining walls shall be constructed within the Lands.
 - (ii) East Portal to Campus Station Retaining Walls
 - A. Note hydrogeological concerns in this area. Further geotechnical study required including the bedrock. Sensitive subsoil conditions require careful Construction, monitoring and mitigation methods to ensure groundwater changes do not occur. Permanent secant wall socketed into bedrock proposed. Note property constraints.
 - B. Concrete shall be finished in accordance with Schedule 15-2 Part 5 Design and Construction – Stations clause 2.7(a) Architectural cast in place concrete. Exposed surfaces shall have a fenestration pattern of reveals with horizontal spacing 0.8 m (min.), 1.2 m (max.) and vertical spacing of 3.5 m (max.).
 - C. Top of vertical walls shall be detailed to accept the ornamental metal fencing as indicated in the Federally Mandated drawings. Modifications to the detail are permitted as follows:
 - i. Height of wall above adjacent grade may be increased as required to resist traffic loads where the U wall is directly adjacent to a public roadway. Height of concrete at such locations shall be

limited to the minimum required by Code. Temporary excavation support shall be removed to accommodate the minimum height of concrete.

- ii. Width of concrete wall above grade adjacent to pedestrian walkway may be reduced to increase the available sidewalk width.
- (iii) MSF North Portal West and East Retaining Walls
 - A. Proposed U-Boat type wall transitioning to piled L-wall as Tracks merge. Provide for adequate drainage behind wall if designed as a drained Structure.
- (iv) MSF South Portal to Grade Retaining Walls
 - A. Note groundwater and property constraints. U-Boat type concrete section proposed. Provide for adequate drainage behind wall if designed as a drained Structure.

21.12 Construction

- a) Concrete
 - (i) All concrete mixes shall be in accordance with CAN/CSA A23.1-04.
 - (ii) Concrete Constructions shall be in accordance with OPSS 904.
 - (iii) Exposed concrete subjected to salt splashing shall use stainless steel reinforcement.
 - (iv) Concrete under expansion joints such as ballast walls and bearing seat areas shall use stainless steel reinforcement.
- b) Pre-cast Pre-stressed Concrete
 - (i) Pre-cast members shall not be erected until sample cylinders tested per OPSS 1350 achieve a design 28 day compressive strength.
 - (ii) Concrete Constructions shall be in accordance with OPSS 909.
- c) Pre-Cast Segmental Concrete
 - (i) Pre-cast segmental Bridges shall be constructed in accordance with the requirements of AASHTO's Guide Specifications for the Design and Construction of Segmental Bridges (1999 Second Edition and 2003 Interim) except where it conflicts with CAN/CSA S6-06 including supplement No. 1, May 2010.

- d) Structural Steel
 - (i) Structural steel shall be constructed in accordance with OPSS 906.
- e) Drainage
 - (i) Deck Drainage shall be designed in accordance with the Highway Drainage Design Standards. A deck drainage discharge system shall include water collectors in accordance with OPSD 3340.153 with down pipes located at columns. Collectors shall be located to prevent drainage flow across expansion joints. A minimum crossfall of 0.5% shall be provided. Runoff water from the deck surface of the Structure shall be discharged in accordance with the drainage and environmental requirements of the Governmental Authority. Discharge flows shall not cause icing/overland flow in existing roadways.
 - (ii) Expansion joints shall be detailed to allow longitudinal conveyance of runoff without leaking at, or over, the joints.
 - (iii) Drain pipes shall be external to the concrete.
 - (iv) Drainage shall not discharge from the Guideway within the RVCA Regulated Flood Plain.
 - (v) Clean-outs shall be provided at the bases of Guideway drain pipes.
 - (vi) The drain pipes shall be galvanized steel at Stations and Booth Street Bridge.
 - (vii) Deck drains and other local details as per the MTO Structural Manual shall be utilized to prevent/minimize staining to substructure elements.
- f) Deck Slabs shall be designed to the required loading of Section 21.5 above.
- g) Structures supporting highway loads shall be outfitted with approach slabs as per OPSD.
- h) Waterproofing – For all Structures deck waterproofing shall be required. The top of the existing and new concrete Structures shall be waterproofed as per OPSS or AREMA, as appropriate. For Train Structures where Direct Fixation is utilized, another technology such as epoxy base or methyl methacrylate concrete sealer shall be employed. In-situ testing and warranties shall be required.
- i) Soffits shall be uncovered and without coatings.
- j) Bearings shall be uncovered and without coatings.
- k) At abutments access to Bridge bearings shall be electrically bonded with a 1.2m (nominal) standing room space to facilitate regular easy inspection.
- l) Ducts in new Bridges shall only be incorporated within sidewalks.

- m) Bolted connections shall have a minimum diameter of 22mm and A325M designation of weathering steel.
- n) Welded connections – critical welds, such as over supports and midspan, shall be treated as tension splices subjected to more stringent tests (Non-Destructive Testing). Testing schemes shall be submitted by Project Co for review.
- o) Barriers – only PL2 and PL3 shall be acceptable.
- p) Long-term settlements of foundations shall be specified.
- q) Earth Retaining Structures
 - (i) Project Co shall construct earth retaining Structures in accordance with MTO RSS Design Guidelines, September 2008 and CAN/CSA-S6-06 including Supplement No. 1, May 2010.
 - (ii) Long-term settlements of foundations shall be specified.

ARTICLE 22 IMPLEMENTATION CONSTRAINTS

22.1 General Requirements

- a) The Construction planning for this Project shall consider the existing operations of the City, and the impacts to the street network within the City, as well as considering adjacent residences and businesses, with respect to pedestrian and property access and other environmental impacts. The Construction sequencing shall be performed in such a manner that the existing BRT is maintained at a service level similar to existing conditions for the maximum amount of time.
- b) The intent of this Article is not to define or limit Project Co's approach to the Construction or the means and methods that may be chosen but to bring awareness to the Project constraints that are to be considered in the planning processes.
- c) Construction storage on NCC or other Federal Lands shall be limited to the implementation of the OLRT project and shall be contained within the construction boundaries as per Hoarding Plans at all times.
- d) Project Co shall reinstate to their original conditions, unless otherwise indicated in the on the Federally Mandated Station Drawings and at Project Co's expense, all Lands, roadways, pathways and assets affected by the implementation of the OLRT project.
- e) For all Lands and Lands subject to FLUA Project Co shall:
 - (i) Develop hoarding plans in accordance with the NCC hoarding specifications. The boundaries of the construction sites shall be fenced at all times. No use or access to adjacent NCC lands shall be permitted without the express approval by the NCC.
 - (ii) Maintain the construction hoarding in a good condition of repair at all times.
- f) No tree, shrub and brush clearing shall take place during the migratory bird nesting season between April 1st and August 15 of each year.

22.2 Construction Planning and Constraints

- a) Preceding any full closure of any portion of the BRT, Project Co shall complete all temporary Stations and associated facilities for that portion of the BRT in accordance with Project Co's approved BRT Service Management Plan. Refer to Part 7 Article 7 – Traffic Management for Construction Access. In addition, all associated detours for the City bus circulation shall be in service by The City before this portion of the BRT is allowed to be closed.
- b) The City is undertaking improvements to the O-Train at Bayview Station from May-September 2013, Project Co shall not be permitted to work in or around the O-Train platforms at Bayview station during this period unless the Project Co work is coordinated with and approved by the City in advance.

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- c) Project Co shall complete the restoration of the surface streets along the Alignment between and including the west and east portals, including restoration of all work sites including vertical shafts for Station entrances and ventilation structures, completion of all street and sidewalk paving, completion of permanent traffic control signage and street markings, removal of all temporary detours, temporary traffic controls, Construction fences and barricades. This work shall be completed no later than June 1, 2017.
- d) NCC recreational pathways shall remain open to public use to the extent possible during construction. Temporary signage indicating detours shall be provided if pathway closures are required.
- e) The existing BRT layby at Bayview Station shall be protected during construction and kept operational for OC Transpo use. Project Co shall coordinate with OC Transpo for operational implications and duration of use.

22.3 Access to Adjacent Properties

- a) Project Co shall provide access to all adjacent properties, tenants, and residential drives and building entrances, including access points for fire department connections and for waste removal. Should an existing entrance or access have to be closed or reduced, Project Co shall coordinate with the impacted parties to provide an alternative solution to have continuous access.

22.4 Pedestrian Access

- a) Project Co shall accommodate for pedestrian access throughout the Project providing safe passage for pedestrians impacted by the Work. Pedestrian access shall be in conformance with the AODA, CSA accessibility requirements, and the City of Ottawa Accessibility Guidelines, where applicable. Project Co shall prepare and implement a Pedestrian Access Plan detailing pathways, signage and Structures to accommodate pedestrian traffic nearby and through the Project site. The plan shall be submitted according to Schedule 10 – Review Procedure.

22.5 VIA Rail

- a) VIA Rail Crossing: Project Co shall coordinate with CN Railroad and VIA Rail to construct yard leads from the mainline into the MSF. Any proposed work within CN right-of-way including any potential rail interruptions on the CN/VIA Rail tracks shall have been coordinated and final approval granted from CN/VIA Rail.
- b) Rail scheduled service and patron access to all VIA Rail Station Platforms and Station facilities, including passenger pickup and drop-off facilities, shall be maintained throughout any Construction in the area. Any proposed work including any potential interruptions to vehicular and/or pedestrian access to the VIA Station shall have been coordinated and final approval granted from VIA Rail.

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22.6 Coordination with Other Contracts

- a) Project Co shall coordinate with Third Party Contractors who may be performing work which may connect, complement, interfere, or in any manner impact this Project. It is the responsibility of Project Co to work with these Third Party Contractors to fully coordinate interfaces and resolve any disputes or coordination problems that may arise.
- b) A list of planned projects and projects currently underway can be found on the City of Ottawa Website www.ottawa.ca/devapps.
- c)

22.7 Work Hours Limitations

- a) Project Co shall abide by all federal, provincial, and municipal statutes regarding hours of work, except for the City of Ottawa’s Noise By-law No. 2004-253, in which case Project Co shall follow the Noise By-law including the amendment provisions detailed in Table 22.1. Should Project Co need to work hours outside of the statutes or the amendment provisions provided in Table 1-22.1, Project Co shall provide a plan describing the work activities, Construction equipment required, proposed hours of work and mitigation efforts with respect to noise and other environmental considerations potentially impacted with the increased work hours. This plan shall be approved by the governing agency with authority to grant approvals to the specific statute.
- b) Project Co shall be aware of the local community and political public events that may impact the work on the Project.

Table 1-22.1 - City of Ottawa Noise By-law No. 2004-253 Working Hour Restrictions and OLRT Amendments		
By Law Section	By Law Provision	OLRT Amendment for Tunnel Construction
7. Construction		
7. (1)	Between 10 pm of one day and 7 am of the next day , no person shall operate or cause to be operated, any construction vehicle or construction equipment in connection with the construction of any building or structure, highway, motor car, steam boiler or other engine or machine.	Despite sections 7. (1), excavation work shall be permitted after 10 pm and before 7 am for work 3 metres and deeper below the immediate ground surface using tunnelling, sequential excavation or other similar tunnel construction techniques. The construction work at this time of the day shall also not exceed 60 dBA when measured at the point of reception.
7. (2)	Despite subsection (1), no person shall	Despite Subsection 7(2),

Table 1-22.1 - City of Ottawa Noise By-law No. 2004-253 Working Hour Restrictions and OLRT Amendments		
	operate or cause to be operated any construction vehicle or construction equipment before 9 am on any Sunday or statutory or public holiday.	construction vehicles shall be permitted before 9:00 a.m. on any Sunday or Statutory or public holiday for work 3 metres or below the immediate ground surface using tunnelling, sequential excavation, or other similar tunnel construction techniques.
7. (3)	Despite subsections (1) and (2), no person shall operate or cause to be operated any construction vehicle or construction equipment between 10 am and 12 pm of the same day on the 11th day of November in the area within the boundaries described in the by-law (generally areas lead to and are around war memorial)	No amendment recommended.
7. (4)	This is a recommended new Section of the By-law.	Despite the amendment to Section 7. (1), for the National Arts Centre (NAC), the construction work schedule will be coordinated between the NAC and the successful OLRT Proponent such that potential impacts during the performance schedule are managed and mitigated. Construction would be allowed on a 24/7, 365 day a year basis, subject to the NAC/OLRT coordinated work schedule restrictions.
8. Loading & Unloading		
8. (1)	No person shall load or unload any transport truck, moving van or motor vehicle between 11 pm of one day and 7 am of the next day so as to make or cause noises that disturb, or tend to disturb the quiet, peace, rest, enjoyment, comfort or convenience of the neighbourhood or of persons in the vicinity.	Despite Section 8. (1), trucks may be used between 11 pm of one day and 7 am of the next day to remove excavated materials away from OLRT tunnel excavation site(s).
15. Power Equipment		
15. (1)	No person shall operate or cause to be operated any power equipment such as	Despite sections 15. (1), power equipment shall be

Table 1-22.1 - City of Ottawa Noise By-law No. 2004-253 Working Hour Restrictions and OLRT Amendments		
	chain saws, power lawn mowers, leaf blowers, power tools or other similar devices, between 9 pm of one day and 7 am of the next day the noise from which disturbs or tends to disturb the inhabitants of the neighbourhood, or persons in the vicinity.	permitted to be operated between 9 pm of one day and 7 am of the next day to support tunnel excavation work 3 metres and deeper below the immediate ground surface using tunnelling, sequential excavation or other similar tunnel construction techniques.
15. (2)	Despite subsection (1), no person shall operate or cause to be operated any power equipment before 9 am on any Saturday, Sunday, statutory or public holiday.	Despite sections 15. (2), power equipment shall be permitted to be operated before 9 am on any Saturday, Sunday or statutory or public holiday.

22.8 Noise and Vibration Mitigation

- a) Project Co shall abide by all federal, provincial, and municipal statutes regarding noise levels and noise mitigation. Prior to commencement of Construction, Project Co shall prepare and implement a noise control plan in accordance with Schedule 17 prepared by a Professional Engineer describing the predicted Construction noise and mitigation measures required to meet the noise level limitations.

22.9 Construction Staging Areas

- a) Properties that can be utilized as Construction staging areas are shown on the Reference Concept and included on the property matrix referenced in Schedule 1 Appendix 2 – Lands Schedule. Should Project Co require additional properties beyond those shown to be provided, it is the responsibility of Project Co to acquire any additional property.

ARTICLE 23 NEW MUNICIPAL INFRASTRUCTURE

23.1 Responsibility for New Municipal Infrastructure

- a) Project Co is responsible for the Design and Construction, including completion, commissioning and testing, of any new Municipal Infrastructure. Design and Construction shall be carried out in strict accordance with this Project Agreement.
- b) All Design and Construction in connection with the new Municipal Infrastructure to be constructed by Project Co shall incorporate the applicable design standards of the City.

23.2 Handover of New Municipal Infrastructure

- a) From and after twelve (12) months following the Final Completion Date, Project Co shall have no further obligations to perform Maintenance Work in connection with the New Municipal Infrastructure. Handover of any new Municipal Infrastructure shall be done in accordance with the requirements of the City.

ARTICLE 24 EXISTING STRUCTURE SEISMIC UPGRADE

24.1 General

- a) The provisions of this Article relate to RFP Schedule 3 Part 2 – Financial Submission – 3.9 Itemized Price for Seismic Upgrade to augment Article 21.7 (a) – Seismic Design, with additional requirements that apply to certain existing bridges that carry the proposed OLRT Transitway.

24.2 Scope of Work

- a) The provisions of this article apply to the following existing bridge structures:
 - (i) Bayview Avenue Bridge
 - (ii) Mann Avenue Bridge
 - (iii) Rideau River Crossing
 - (iv) Riverside Drive Structure # 665

24.3 Design Requirements

- a) In addition to the provisions of Article 21 Structures, the existing bridges identified by the scope of this Article shall be designed, constructed, and maintained in conformance to the seismic importance category for emergency route bridges as defined by the Canadian Highway Bridge Design Code.

ARTICLE 25 AS BUILT DRAWINGS

25.1 General

- a) For the initial system to be designated/constructed, Project Co shall submit an initial set of As Built Drawings to the City for review in accordance with Schedule 10-Review Procedures
- b) Initial As Built Drawings for all disciplines (architectural, civil, structural, electrical, mechanical, systems, etc.) shall be submitted by Project Co to the City no later than six (6) months prior to Substantial Completion.
- c) The City will provide comments on the initial As Built Drawings within thirty (30) calendar days of receipt.
- d) Project Co shall finalize the As Built Drawings (incorporating the comments from the City) and submit final As Built Drawings to the City no later than three (3) months prior to Substantial Completion.
- e) Changes to the final As Built Drawings after Substantial Completion are to be submitted by Project Co as per Schedule 15-3.

ARTICLE 26 OPERATIONS TRAINING SCHEDULE

26.1 Operations Training Curriculum and Materials

- a) The City shall be given an opportunity to review the curriculum and all training materials associated with any of the Operations Training Programs referenced in this Schedule. Project Co shall be responsible to submit all documentation associated with any of the training referenced in this Article to the City at a minimum three months prior to the specific training program's commencement.
- b) Training programs shall be subject to review by the City, in accordance with Schedule 10. During the three (3) month interval between the submission of the training program and the commencement of training, the City shall review and suggest changes to any of the material that is submitted. Suggested changes to the training programs shall be incorporated prior to the training commencing. In addition, Project Co shall abide by the provisions of Schedule 14, 1.5 (d) Training. The review of the training curriculum and materials apply to programs provided by Project Co Trainers, in addition to those programs provided by OC Transpo Trainers. Project Co shall develop all training programs, including curriculum and materials, referenced in this Article.

26.2 Training Provided to Project Co Drivers

- a) Trained and certified Project Co Drivers shall be responsible for vehicle operation as directed by the City. Project Co Drivers shall be permitted to operate Revenue Service Vehicles during commissioning, Trial Running and after the commencement of Revenue Service. However, Project Co Drivers shall only be allowed to operate Revenue Service Vehicles that are not in service (i.e. not carrying Passengers). Upon the commencement of Trial Running, they shall be responsible for vehicle operation as directed by the City.
- b) Project Co Drivers shall be trained and certified by Project Co Trainers prior to operating Vehicles on the Alignment or within the confines of the MSF.
- c) The Project Co Driver Training program shall utilize a fully developed curriculum, with all training materials, classroom and field training, testing, pass/fail criteria and certification.
- d) The Project Co Driver Training program shall include a provision for verifying that all potential Project Co Driver candidates possess a valid Driver's License that allows for operating an automobile in the Province of Ontario.
- e) Project Co shall be responsible for all costs associated with Project Co Drivers necessary to test and commission the system, as defined in Schedule 14 - Commissioning.

26.3 Training Provided to OC Transpo Trainers

- a) Project Co shall be responsible for training the initial group of OLRT Trainers.

- b) Project Co's Train the Trainer Program (provided by a Project Co Trainer) shall ensure that an OC Transpo Trainer has been trained and certified to instruct and certify employees who are assigned to or have any duties and responsibilities on the OLRT, excluding OLRT Controllers. The program shall utilize a fully developed curriculum, with all training materials, classroom and field training, testing, pass/fail criteria and certification.
- c) Project Co's Train the Trainer Program (provided by a Project Co Trainer) shall ensure that an OC Transpo Trainer has been trained and certified to instruct Emergency Service Providers on all aspects of the System that they may be required to be knowledgeable of in the event of an emergency. The program shall utilize a fully developed curriculum, with all training materials, classroom and field training, testing, pass/fail criteria and credentialing.
- d) Project Co shall be responsible for all costs associated with the Train The Trainer Program. The sole exception will be that the City will bear the cost of providing the employees being trained as OLRT Trainers.
- e) Project Co shall be responsible for at least five(5) OLRT Trainers being fully trained and certified at least three(3) months prior to the anticipated commencement of Trial Running. Trial Running will commence when Project Co has demonstrated to the City that all Testing and Commissioning has been successfully completed.

26.4 OLRT Driver Training

- a) The OLRT Driver Training program shall utilize a fully developed curriculum, with all training materials, classroom and field training, testing, pass/fail criteria and certification. The training curriculum and materials shall be developed by Project Co, and be subject to the review provisions of this Article.
- b) Project Co shall not be responsible for any of the OC Transpo personnel costs associated with the OLRT Driver Training Program.
- c) OLRT Driver Training shall occur commensurate with the Vehicles commencing to operate on the Alignment. It shall continue during commissioning until such time that the requisite number of OLRT Drivers have been trained and certified to support Commissioning and Revenue Service.

26.5 Training Provided to OC Transpo Controllers

- a) Project Co shall be responsible to train the OLRT Controllers.
- b) Project Co's OLRT Controller Training Program (provided by a Project Co Trainer) shall ensure that an OLRT Controller has been trained and certified to safely perform all dispatching functions associated with the System. The program shall utilize a fully developed curriculum, with all training materials, classroom and field training, testing, pass/fail criteria and certification.

- c) Project Co shall be responsible for all costs associated with the OLRT Controller Training Program. The sole exception will be that the City will bear the cost of providing the employees being trained as OLRT Controllers.
- d) Project Co shall be responsible to ensure that the number of Controllers necessary to operate the system are trained and certified prior to the commencement of Trial Running. Project Co shall commence the training of Controllers upon the issuance of the first “track protections” issued to Project Co employees or contractors.

26.6 Training Provided to Emergency Service Providers

- a) The OLRT Training program for Emergency Service Providers shall utilize a fully developed curriculum, with all training materials, classroom and field training, testing, pass/fail criteria and certification. The training curriculum and materials shall be developed by Project Co, and be subject to Schedule 10 – Review Procedure.

ARTICLE 27 ALBERT STREET WORK

27.1 Scope of Work

- a) Project Co will be provided with a complete design from the City of Ottawa for work including but not limited to roadwork, the separation of sewers, water main replacement and other underground utility work in the Albert Street area from approximately Preston Street to Bronson Avenue, including Empress Avenue, Perkins Street, Lorne Avenue and Booth Street from Albert Street to Primrose Avenue.
- b) Project Co shall construct the work shown in the design and reinstate the roadway to the existing ROW configuration upon completion of the underground work.
- c) Project Co shall coordinate the utility and roadway work with the utility and roadway work of the OLRT Project in this area.

27.2 Limits of Allowance Work

- a) The limits of the construction that will be included in the allowance shall be the work shown in the City design within the limits of the existing Albert Street and the other roadways' curb lines and the storm water outfall connection to the Tailrace outfall.
- b) All work associated with the new Booth Street Bridge including intersection improvements at Albert Street and the Booth Street Utility relocations are included in the OLRT project and are not part of this allowance.
- c) All work associated with BRT detours shall be included in the OLRT Project and are not part of this allowance. Should Scott Street (from Smirle Avenue to Bayview Road) and Albert Street (from Bayview Road to Bronson Avenue) be used as a BRT detour, the widening for the detour shall be included in the OLRT Project except that the full width pavement overlay shall be part of this allowance.
- d) The allowance shall be coordinated with the requirements of Project Agreement Section 20.13.

27.3 Mobility Matters Lane Closures

- a) In accordance with the requirements of Schedule 37 Mobility Matters, Part B, the following Lane Closures for Albert Street shall be included in the draft Lane Closure Target Letter:
 - (i) Peak Hour Lane Closures – 1,700 hours.
 - (ii) Off Peak Lane Closures- 4,000 hours.
 - (iii) Night Lane Closures – 500 hours.

ARTICLE 28 QUEEN STREET WORK

28.1 Scope of Work

- a) Project Co shall be provided with a complete design from the City of Ottawa for the separation of sewers and road rehabilitation work along Queen Street from approximately Bronson Avenue to Lyon Street, and water main replacement work along Queen Street from approximately Bronson Avenue to Elgin Street.
- b) Project Co shall construct the work shown in the design and reinstate the roadway to the existing roadway configuration upon completion of the underground work.
- c) Project Co shall coordinate the utility and roadway work with the utility and roadway work of the OLRT Project in this area.

28.2 Limits of Allowance Work

- a) The limits of the construction that will be included in the allowance shall be the work shown in the City design within the limits of the existing Queen Street curb lines.
- b) All work associated with the new Station entrances along Queen Street including utility relocations, are included in the OLRT Project and are not part of this allowance.
- c) The allowance shall be coordinated with the requirements of Project Agreement Section 20.13.

28.3 Mobility Matters Lane Closures

- a) In accordance with the requirements of Schedule 37 Mobility Matters, Part B, the following Lane Closures for Queen Street shall be included in the draft Lane Closure Target Letter:
 - (i) Peak Hour Lane Closures – 600 hours.
 - (ii) Off Peak Lane Closures- 1,400 hours.
 - (iii) Night Lane Closures – 200 hours.

ARTICLE 29 SYSTEMS COORDINATION

29.1 General Description

- a) Notwithstanding the following coordination issues, Project Co shall be responsible for coordinating all aspects of the OLRT Design and the integration of OLRT infrastructure with all other system and subsystems as required. Infrastructure shall be inclusive of the design of the MSF and Tunnels.
- b) This Article provides a listing of the systems elements, the coordination required between these elements and all the OLRT Infrastructure elements.
- c) Revenue Vehicles
 - (i) Typical coordination elements between OLRT infrastructure and OLRT Systems are:
 - A. Vehicle dimensions shall be coordinated with the Guideway Design and selected Vehicle;
 - B. Vehicle weight shall be coordinated with the Guideway Design and selected Vehicle;
 - C. Wheel/rail interface criteria shall be coordinated with the Guideway Design and selected Vehicle;
 - D. Pantograph/contact wire interface criteria shall be coordinated with the Guideway Design, the OCS Design and selected Vehicle;
 - E. Vehicle dynamic and static envelopes for Guideway clearances shall be coordinated with the Guideway Design, Infrastructure Design and selected Vehicle;
 - F. Door height above top of rail for Platform edge shall be coordinated with facilities Design and selected Vehicle;
 - G. Project Co shall work with the Radio System Supplier to ensure that the antenna requirements within the Tunnel and along the Guideway for Vehicle voice /and high speed data radio communication shall be coordinated with Tunnel Design and communications;
 - H. High speed data radio data communication on the vehicle and associated vehicle and trackside antenna requirements within the Tunnel, or along the Guideway, shall be coordinated with Tunnel and Guideway Design and Communications; and

- I. Antenna requirements within Tunnel or Guideway for Train Control communication shall be coordinated with Tunnel and Guideway Design and Communications and Radio Supplier.
- d) Traction Power Supply System
 - (i) Coordination shall be required to route the cables to the Tunnel and Guideway segments, and provide pullboxes, switches and SCADA monitoring as follows:
 - A. Positive cable routing;
 - B. Negative cable routing;
 - C. Communication cable routing; and
 - D. Suitable electromagnetic segregation of cables in the ductlines and conduits.
- e) Overhead Catenary System
 - (i) Coordination shall be required for wire support system hardware, messenger wire, contact wire, feeder wire termination points and appropriate switchboxes as follows:
 - A. OCS typical electrical clearance criteria;
 - B. Messenger wire installation arrangements;
 - C. Contact wire installation arrangements;
 - D. Disconnect/ bypass or isolation switches; and
 - E. Protection devices.
- f) Train Control System
 - (i) Coordination shall be required for the location and mounting of the trackside radio antenna, the location and mounting of termination points, and the routing to the communications room as follows:
 - A. Location of Train Control antenna and interface to communication rooms;
 - B. Location and typical mounting of wayside transponders; and
 - C. Location of ductline and conduit interfaces to wayside transponders.
- g) Communications Systems

- (i) Coordination shall be required for locations and mounting of elements noted below, routing of cabling to each element, termination of cabling to each element, and routing to the communications room:
 - A. Locations of communication ductline and conduit interfaces to communication rooms including the TSCC, YCC and BCC;
 - B. Quantity and sizing of ducts within communications ductlines and conduits;
 - C. Location and quantity of pullboxes;
 - D. Location and arrangements of blue light stations;
 - E. Location and mounting arrangement of CCTV cameras;
 - F. Location and mounting arrangements of PIDS;
 - G. Location and mounting arrangement of telephones, intercoms and communications devices;
 - H. Location and mounting of IAC;
 - I. Location and mounting of Fare collection system; and
 - J. Location and conduit interface for SCADA and BMS.

- h) Corrosion Control System
 - (i) Coordination shall be required with the following:
 - A. Location and typical arrangement for any corrosion control mitigation Equipment;
 - B. Locations of measuring points; and
 - C. Stray current monitoring system.

- i) Non-Revenue Vehicles
 - (i) Coordination shall be required with the following:
 - A. Non-Revenue Vehicle dimensions shall be coordinated with the Guideway Design and selected Non-Revenue Vehicle type;
 - B. Non-Revenue Vehicle weight shall be coordinated with the Guideway Design and selected Non-Revenue Vehicle type;

- C. Where applicable the wheel/rail interface criteria shall be coordinated with the Guideway Design and selected Non-Revenue Vehicle type;
- D. Where applicable the Pantograph/contact wire interface criteria shall be coordinated with the Guideway Design, the OCS Design and selected Non-Revenue Vehicle type;
- E. Non-Revenue Vehicle dynamic and static envelopes for Guideway clearances shall be coordinated with the Guideway Design selected Non-Revenue Vehicle type; and
- F. Project Co shall work with the Radio System Supplier to ensure that the antenna requirements for within the Tunnel and along the Guideway for Non-Revenue Vehicle voice/ and high speed data radio communication and shall be coordinated with the Design of the Tunnel and Communications and the Radio Supplier.

ARTICLE 30 COMBINED SEWAGE STORAGE TUNNEL (CSST) WORK

30.1 Scope of Work

- a) Project Co shall be provided with a complete design from the City of Ottawa for a CSST connection including:
 - (i) Cave Creek Collector pullback sewer consisting of:
 - A. New Chamber at the intersection of Lloyd Street and the Transitway with a connection to the existing Lloyd-Preston Regulator;
 - B. New Chamber at the intersection of Wellington Avenue and the Transitway with a connection to the existing live Interceptor Outfall Sewer; and
 - C. A pipe and duct bank connecting the two chambers noted in A and B above.
 - (ii) Booth Street Collector pullback sewer consisting of:
 - A. New chamber at the intersection of Lloyd Street and Wellington Avenue; and
 - B. A pipe connecting the new chamber at Lloyd/Wellington and the new chamber at Wellington/Transitway.
 - (iii) CSST north branch consisting of:
 - A. New chamber at the intersection of Albert Street and the Transitway; and
 - B. A pipe connection from the new chamber at Wellington/Transitway and the new chamber at Albert/Transitway.
 - (iv) CSST west branch consisting of:
 - A. New chamber at the intersection of Albert Street and Booth Street;
 - B. New chamber at the intersection of Wellington Avenue and Albert Street connecting to the existing live West Nepean Collector;
 - C. A pipe and duct bank connecting the chamber at Albert/Transitway to the chamber at Albert/Booth; and
 - D. A pipe and duct bank connecting the chamber at Albert/Booth to Albert/Wellington.

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- b) The Booth Street Collector pullback sewer, CSST north branch and CSST west branch are subject to the approval of the on-going Environmental Assessment.
- c) Project Co shall construct the work shown in the design and reinstate the surface to the existing ROW configuration upon completion of the underground work.
- d) Project Co shall coordinate the utility work with the utility work of the OLRT Project in this area.

30.2 Limits of Allowance Work

- a) The limits of the construction that will be included in the allowance shall be the work shown in the City design within the limits of the existing Transitway, Wellington Avenue and Albert Street.
- b) All work associated with the new OLRT including utility relocations, are included in the OLRT Project and are not part of this allowance.
- c) The allowance shall be coordinated with the requirements of Project Agreement Section 20.13.

30.3 Mobility Matters Lane Closures

- a) In accordance with the requirements of Schedule 37 Mobility Matters, Parts A and B, the following Lane Closures for CSST Work shall be included in the draft Lane Closure Target Letter:
 - (i) BRT Peak Lane Closures –1,500 hours.
 - (ii) BRT Off Peak Lane Closures-3,000 hours.
 - (iii) BRT Night Lane Closures – 1,500 hours.
 - (iv) Peak Hour Lane Closures –500 hours.
 - (v) Off Peak Lane Closures- 1,000 hours.
 - (vi) Night Lane Closures – 1,000 hours.

ARTICLE 31 ROCK STABILIZATION WORK

31.1 Scope of Work

- a) Project Co shall be provided with a complete design from the City for the Construction of a new retaining wall to reinforce the weathered rock along the BRT in the west Transitway from Bayview to Tunney's Pasture.

31.2 Limits of Allowance Work

- a) The limits of the construction that will be included in the allowance shall be the work shown in the City design.
- (b) All work associated with the new Station and the Guideway are included in the OLRT Project and are not part of this allowance.
- b) The allowance shall be coordinated with the requirements of Project Agreement Section 20.13.

31.3 Mobility Matters Lane Closures

- a) In accordance with the requirements of Schedule 37 Mobility Matters, Part A, the following Lane Closures for rock stabilization work shall be included in the draft Lane Closure Target Letter:
 - (i) BRT Peak Hour Lane Closures – 760 hours.
 - (ii) BRT Off Peak Lane Closures- 1,800 hours.
 - (iii) BRT Night Lane Closures – 0 hours.

ARTICLE 32 COVENTRY BRIDGE WORK

32.1 Scope of Work

- a) Project Co will be provided with a complete design from the City for a multi-use (pedestrian and cyclist) pathway structure from the Ottawa Baseball Stadium parking lot near Coventry Road to the south side of Highway 417 adjacent to Tremblay Road, including ramps, staircases, and multi-use pathway connections. Two of the three required support piers will be constructed in advance of this work by others; one in the Highway 417 median and one in the gore area on the north side of Hwy 417.
- b) Project Co shall construct the remainder of the work shown in the design.
- c) The work shall be completed such that substantial completion is on or before March 3, 2014.

32.2 Limits of Allowance Work

- a) The limits of the construction that will be included in the allowance shall be the work shown in the City design.
- b) Coordination of this work with the Highway Work and the utility and roadway work of the OLRT Project in this area is not part of this allowance.
- c) All work associated with the new Highway Work and the OLRT project are not part of this allowance.
- d) All work associated with BRT detours shall be included in the OLRT Project and are not part of this allowance.
- e) The allowance shall be coordinated with the requirements of PA Section 20.13.

32.3 Mobility Matters Lane Closures

- a) In accordance with the requirements of Schedule 37 Mobility Matters, Part B, the following Lane Closures for Coventry Road Bridge work shall be included in the draft Lane Closure Target Letter:
 - (i) Peak Hour Lane Closures –150 hours.
 - (ii) Off Peak Lane Closures- 400 hours.
 - (iii) Night Lane Closures – 0 hours.