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SCHEDULE 15-2
DESIGN AND CONSTRUCTION

PART 2 DESIGN AND CONSTRUCTION REQUIREMENTS – CIVIL AND GUIDEWAY

ARTICLE 1 INTRODUCTION

1.1 General

(a) The Expanded Trillium Line intends to improve intermediate recovery time between stopping points, supporting achievable headway service. Key improvements include lengthening existing sidings and improving Track geometry.

(b) The Existing Trillium Line shall be extended south from Greenboro Station to Limebank Station with new Stations also located at South Keys, adjacent to the existing BRT Station, at Leitrim, about 275m south of Leitrim Road, and at Bowesville Road.

(c) The entire Expanded Trillium Line, which falls within the existing rail corridor, is subject to be designed to accommodate freight. Project Co shall provide a continuous single-Track freight route, with the following exceptions:

(i) The **[REDACTED]** Grade Separation at Ellwood Diamond is not required to carry freight. Refer to clause 2.9(d)(ii) of Schedule 15-2, Part 1.

(ii) A Leitrim Road over Rail grade separation shall not be subject to freight clearance under the Structure. Refer to Schedule 15-2 Part 2 Appendix C.

(iii) The alignment of the Trillium Line Extension deviates from the existing rail corridor south of Earl Armstrong Road. The extension which falls outside the existing rail corridor is not required to be designed to accommodate freight.

(iv) An Earl Armstrong rail over road grade separation shall not be subject to freight gradients as outlined in Article 2.9 (b) (iii) of this Part 2, however shall be subject to freight loading requirements outlined in Article 4.5 (c) (i) of this Part 2.

(d) The Existing Trillium Line currently provides access for freight deliveries to and from the NRC Facility ten to twelve times per year from the Walkley Interchange to the NRC Facility about 500m south of Lester Road. The Trillium Line Extension shall include an NRC Spur Line to provide for freight deliveries to the NRC Facility.

(e) The Trillium Line Extension shall include a branch line to the OMCIA referred to as the Airport Link. The Airport Link shall operate the Expanded Trillium Line Trains exclusively (no freight traffic) from 300m south of Hunt Club road where the alignment extends outside the existing established rail corridor.

1.2 General Description of the Guideway and Guideway Requirements

(a) Project Co shall design and construct the Guideway in the following Track configuration:

(i) one Mainline Track for operation from Limebank Station in the south end to Bayview Station in the north end for a length of approximately 19.5km;

(ii) with single Track passing sidings off the mainline at:

A. Leitrim: of a length of 6.64 km originating at Limebank Station and terminating at 23+511.334 (Reference Concept stationing) with a powered turnout;

B. South Keys: of a length of 0.933km from station 27+077 with a powered turnout at station 28+00 (Reference Concept stationing);

C. Brookfield: of a length of 0.86km shifting the southerly existing powered turnout to station 29+820 and shifting the northerly powered turnout to station 30+680 (Reference Concept stationing);

D. Carleton: of a length of 0.641km with powered turnouts at station 32+314 and station 32+955 (Reference Concept stationing). The existing powered turnouts have recently been replaced with new turnouts. These existing turnouts shall be relocated and used in the design;

E. Gladstone: of a length of 1.307km from powered turnout at station 34+847 (Reference Concept stationing) to Bayview Station;

(iii) with a single-Track branch line, Airport Link, for operation from the OMCIA in the west to north of South Keys Station, for a length of approximately 4.5km with a single Track passing siding at Uplands Station for a length of 1.15km with powered turnouts at station 11+420 and station 12+577 (Reference Concept stationing);

(iv) with two Tracks for non-revenue connections, one going north and one going south, to the Mainline Tracks to/from New Walkley Yard.

(v) Project Co shall provide the Track layout so that all Trains can move into and out of service to/from both directions of the Mainline Tracks to/from New Walkley Yard.

(b) Project Co shall design and construct the Guideway with Guideway alignment characteristics as follows:

(i) Existing Trillium Line

A. Maintain the existing Mainline Track and embankment from about 360m north of South Keys to 250m north of Gladstone Station with short segments of Track shift to improve geometry and to accommodate proposed siding extensions at Brookfield, Carleton, and Gladstone;

B. Replacement of existing Track from 250m north of Gladstone Station to Bayview Station including extending Gladstone siding to Bayview Station with new CWR Track for approximately 1.12km and by revising the Track profile, meeting design criteria as required, to provide a TOR to Platform height at Bayview Station as outlined in Schedule 15-2, Part 4, Clause 2.7 (a)(vii)D;

C. Maintain the existing Walkley line Connecting Tracks from the mainline 280m south of the Walkley Diamond to New Walkley Yard and from the mainline 400m north of the Walkley Diamond to New Walkley Yard;

D. Replacement of existing Track within the limits of Dows Lake Tunnel, including the replacement of all Track ballast and all existing Timber ties with NFPA 130 compliant ties;

E. Replacement of existing jointed Track of the North Prescott Spur from the existing NRC freight connection 500m south of Lester Road to Greenboro Station with new CWR Track for approximately 3.5km including a mainline elevated structure crossing over Lester Road; and,

F. Construction of a new Spur Track for the NRC freight connection, from the existing NRC internal connection located 500m south of Lester Road to the mainline. Construction of the new spur track shall include but not be limited to, the following:

i All new Track shall be constructed with new CWR Track.

ii NRC Spur Track shall include a powered turnout at the mainline and a turnout at the NRC internal connection (No. 9 or equal to the existing turnout) and located such that minimal Track rework is required to the internal NRC Tracks.

iii NRC Spur Track shall include a gate in the perimeter fence at the NRC connection. Security of this gate shall be the responsibility of Project Co.

iv An at-grade crossing at Lester Road is acceptable for the NRC freight connection subject to the requirements outlined in Schedule 15-2, Part 3, Clause 10.2 (s).

v 200m of runout Track south of the NRC internal connection turnout shall be constructed for storage and marshalling.

(ii) Proposed Trillium Line Extension

A. Construction of a section of mainline double Track from Bowesville Station to the existing established rail corridor through greenfield with new CWR Track for approximately 0.7km;

B. Construction of a section of mainline double Track from Limebank Station to Bowesville Station through greenfield with new CWR Track for approximately 3.5km;

C. Construction of a passing siding from Limebank Station to 400m north of Leitrim Road with new CWR Track for approximately 6.64km; and,

D. Rehabilitation of the abandoned rail corridor ROW, for the Mainline Track, formerly the North Prescott Spur, from 100m south of Earl Armstrong Road to the existing NRC Freight Connection 500m south of Lester Road with new CWR Track for approximately 3.92km, including a mainline at-grade crossing at the Private Airport Access Road;

(iii) Airport Link

A. Construction of a section of Spur Track (Airport Link) on elevated structure operating Expanded Trillium Line Trains exclusively (no freight traffic) from Airport Station to 525m west of Uplands Drive through greenfield with new CWR Track for approximately 0.75km such that;

i The elevated Guideway Structure shall not protrude into the future terminal expansion area as defined by a 1.0m offset from column line "M" as shown on the Ottawa Macdonald-Cartier International Airport Expansion Program Terminal Building drawings in the data room.

B. Construction of a section of Spur Track (Airport Link) on embankment operating Expanded Trillium Line Trains exclusively (no freight traffic) from approximately 525m west of Upland Drive to approximately 480m east of Airport Parkway, through greenfield with new CWR Track for a length of approximately 1.7km includes Upland Station and elevated structures over Uplands Drive and Airport Parkway;

C. Construction of a passing siding on embankment operating Expanded Trillium Line Trains exclusively (no freight traffic) from approximately 40m east of Upland Drive to approximately 480m east of Airport Parkway through greenfield with new CWR Track for approximately 1.15km includes an elevated structure over Airport Parkway;

D. Construction of an at-grade section of Spur Track (Airport Link) operating Expanded Trillium Line Trains exclusively (no freight traffic) from approximately 480m east of Airport Parkway to approximately 300m south of Hunt Club Road, through greenfield and in the existing rail corridor with new CWR Track for a length of approximately 0.88km; and,

E. Construction of an at-grade section of Spur Track (Airport Link) from approximately 300m south of Hunt Club Road, to the turnout approximately 750m north of Hunt Club Road in the existing rail corridor with new CWR Track for a length of approximately 1.1km, includes South Keys Station and a pocket Track north of South Keys Station.

(c) Project Co shall design and construct the Guideway with components for safe and efficient operation of the System, including but not limited to:

(i) Trackwork;

(ii) Communications and low voltage power duct banks;

(iii) Signalling and Train Control System;

(iv) Drainage systems and SWM;

(v) Other appurtenances as required by Project Co's design for the safe and efficient Operation of the System;

(vi) Track turnout power or dual-control switch machines and heaters;

(vii) Track turnout hand throw switch stands; and,

(viii) Wayside rail lubrication systems.

(d) Project Co shall design and construct lighting to the required safety walkway area as per the requirements of NFPA 130.

1.3 Access of Emergency Services Vehicles to the Guideway

(a) Project Co shall design and construct all sections of the Guideway with a means of Emergency egress in compliance with the requirements of NFPA 130 via an unobstructed clear width.

(b) Project Co shall provide Emergency egress points that will allow ESP access as per the requirements of NFPA 130. These locations shall be in addition to end of Platform egress points. These points shall be provided with a gated entry through the security fencing of the Guideway where they are located between Stations. A unique identification system shall be developed for the gates in consultation with the City and signage shall be fixed to both sides of each gate for identification purposes.

(c) Project Co shall design and construct the Guideway so that Emergency vehicles are able to travel by a paved route to within 15m of the gated entry point. The route may be from an existing Transitway, nearby public Roadway allowance, nearby commercial parking lot or public MUP. If existing routes are not within 15m Project Co shall construct an access route.

(d) Project Co shall design and construct access for Emergency egress routes to a minimum paved width of 6.0m and shall be designed to the requirements of Clause 6.10 of this Part 2. The paved route shall be maintained for winter travel by Project Co. If the route is more than 90m in length then a turnaround for the Emergency vehicle shall be provided at the gated entry point or, in the case of multiple entry points being accessed from one route, at the end of the route at a minimum. The turnaround shall be designed for a minimum center line radius of 12m. The turnaround shall be either circular cul-de-sac or a hammer head with minimum dimensions of 14m x 14m.

ARTICLE 2 GEOMETRIC DESIGN CRITERIA FOR TRACK ALIGNMENT

2.1 Reference Documents

(a) The design and construction of the alignment work shall comply with the criteria contained within this Article and the 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 within one document when compared with another, the more stringent shall apply. The order of precedence for this portion of the Project Agreement shall be as follows:

(i) The criteria in this Article 2;

(ii) Transit Cooperative Research Program TCRP Report 155 – Track Design Handbook for Light Rail Transit, 2nd Edition;

(iii) The American Railway Engineering and Maintenance-of-Way Association Manual for Railway Engineering (2014);

(iv) European Standard (EN) For Railway Applications;

(v) Union International Des Chemin de Fer (UIC) Standards;

(vi) OHSA; and,

(vii) Standard Respecting Railway Clearance - Transport Canada - TC E-05 (1992).

2.2 Use of Minimum or Maximum Criterion

(a) Where specific numbers are given for limitations on alignment elements, such limitations are not targets to be achieved by Project Co, but limits to be avoided if at all practical. Project Co shall in all cases strive to exceed the minimum requirements.

(i) Design for maximum Passenger comfort where no physical restrictions or significant construction cost differences are encountered.

(ii) Design to meet the operating objectives without compromising ride quality or taxing the mechanical limits of the vehicle and maintain the operational performance requirements to the maximum extent possible at reasonable cost where physical restrictions or significant cost differences are encountered.

(iii) Minimum and maximum values are determined primarily by the vehicle design limitations and/or safety considerations, with maximum operating speeds and passenger comfort as secondary considerations. Minimum and maximum values have potential impacts in terms of Maintenance costs, noise, wheel life and Track

life. Minimum and maximum values should be used as a last resort where physical restrictions prevent the use of Passenger comfort values, as extensive use of minimum and maximum values can result in service problems and unacceptable Maintenance costs. The use of minimum and maximum values shall be used when it can be demonstrated that no other value will work and shall be justified and documented in a Basis of Design Report, and shall only be used by Project Co when approved by the City.

2.3 General

(a) Project Co shall provide the Mainline Track, non-revenue Track, including Connecting Track, Storage Track and Yard Track, for maximum operating speed to satisfy the criteria identified in Schedule 15-2, Part 1, Article 3 - Operational Performance Requirements, as dictated by existing topography, permanent physical features, property, and alignment constraints.

(b) Project Co shall ensure that the design and construction for the Trillium Line Extension systems are integrated with all systems of the Existing Trillium line.

(c) Project Co shall design the Spur Track to Mainline Track Design Criteria.

2.4 Horizontal Alignment

(a) Project Co shall design the horizontal Track alignment in accordance with the requirements of Clause 2.2 of this Part 2, and shall be such that all the SI is contained within the Lands as defined in Schedule 33 – Lands.

(b) Project Co shall design the mainline and Airport Link Track for the maximum operating speed to satisfy the criteria identified in Schedule 15-2, Part 1, Article 3 – Operational Performance Requirements; 100km/h wherever possible unless Physical Constraints do not allow, in which case Project Co shall design the mainline and Airport Link Track so as to maximize the operating speed. Where the existing Mainline Track is to remain horizontally and vertically unaltered, no design modifications are required.

(c) Project Co shall provide a tangent horizontal alignment through Station Platform limits and for a minimum of 15m beyond the end of Platforms, with a distance of 25m provided where there are no physical constraints. The spiral transition curve may begin closer to the Platform, with the City's approval, if Site conditions do not provide sufficient length, provided sufficient running clearance between the Vehicle and Platform is achieved and the relationship of the Revenue Vehicle and Platform are achieved as per Schedule 15-2, Part 4, Clause 2.7(a)(vii).

(d) All non-Track related construction layout shall be related to or dimensioned from the centreline of the Mainline Track, unless otherwise noted.

(e) Project Co shall design the connections to the New Walkley Yard for a speed of no less than 30 km/hr and shall also consider the safety of the geometrics. Project Co shall design the Connecting Track to maximize the operating speed.

2.5 Track Centres

(a) Ballasted Track center spacing shall be 4.5m or greater.

(b) Where Site constraints are physically restricted, ballasted Track centre spacing of 4.0m on tangent Track and increased on curves for superelevation and carbody overhang may be constructed with City approval of the design exception.

2.6 Horizontal Curves

(a) Project Co shall define circular curves by the arc definition of curvature and specified by their radius in metres to three decimal places.

(b) For Mainline Tracks, the minimum radii of curves shall be designed to maintain the maximum possible operating speed as dictated by existing topography, permanent physical features, property, and the alignment constraints per this Part 2. The minimum radius shall be 125m.

(c) Project Co shall provide the New Walkley Yard Track with curves of the following radii:

(i) New Walkley Yard Lead Track radii shall be designed to operate with maximum design speed of 30km/hr. The minimum radius of curve shall be 100m; and,

(ii) New Walkley Yard Track radii shall be designed to operate with maximum speed of 15km/hr. The minimum radius of curve shall be 100m.

(d) Project Co shall provide a tangent distance between horizontal curve and reverse curves for the Mainline Track, Connecting Track and Yard Track, as per the following formula where V is speed in km/hr and LT is the length of the tangent:

(i) LT=0.57V; and,

(ii) the minimum tangent length between curves shall be 51.4m unless physical constraints do not allow this then the minimum length shall be 35m.

(e) Reverse Curves

(i) The minimum tangent length between reverse curves in New Walkley Yard shall be per TCRP Report 155 Chapter 3.2.1 or 10m, whichever is higher.

(ii) The minimum tangent length between reverse curves in a crossover shall be per TCRP Report 155 Chapter 3.2.1 or 10m, whichever is higher.

(iii) The minimum tangent length between reverse curves in a Track other than mainline shall be per TCRP Report 155 Chapter 3.2.1 or 10m, whichever is higher.

(iv) There shall be no tangent between curves in the same direction in New Walkley Yard for curves with a ratio of radii less than 1.5:1.

(v) The minimum distance shall be 17m for back-to-back turnouts with same hand throw.

(vi) The minimum distance shall be 5m for back-to-back turnouts with a different hand throw.

(f) Compound Curves

(i) Compound curves shall not be permitted on the mainline or Yard Track design, except for the existing mainline curves from Station 29+094 to 29+378.

2.7 Spirals

(a) Spiral transition curves shall be used on all mainline and New Walkley Yard lead Tracks to connect circular curves to tangents, with the exception that spirals are not required where both actual superelevation and unbalanced superelevation is zero.

(b) Project Co shall determine the minimum length of a spiral transition curve (Ls) by the rate of change from zero superelevation to full superelevation being achieved within the length of the spiral at a rate of 25mm Ea per 19m of spiral.

2.8 Superelevation

(a) Superelevation shall be linearly attained throughout the full length of the spiral curve by raising the rail farthest from the curve centre, while maintaining the top of the inside rail at profile grade.

(b) Project Co shall determine Superelevation by applying the following equations:

(i) $Ee = 12.0\ V2/R$

(ii) $Ea = 6.57(V2/R)-5.58$

(iii) Ea = 100mm maximum. If physical constraints do not allow maximum speeds of 100km/hr, then maximum of 150mm may be applied.

(iv) Eu=Ee-Ea

where Ee = equilibrium superelevation in mm

Ea = actual or applied superelevation in mm

Eu = unbalanced superelevation in mm

V = design speed in km/hr

R = horizontal curve radius in meters

(c) Project Co shall use zero actual superelevation for special Trackwork, with a maximum unbalanced superelevation of 50mm at turnouts.

(d) Project Co shall design the Track superelevation for new Track to meet or exceed the following criteria:

(i) maximum unbalanced superelevation, Eu of 50mm.

(ii) maximum actual superelevation, Ea of 100mm unless physical constraints do not allow maximum speeds of 100km/hr then maximum of 150mm may be applied.

(iii) Round actual superelevation to the nearest 5mm.

(iv) Superelevation, Ea and Eu shall be applied equally or proportionally up to maximum Eu with no Ea until Eu = 13mm.

(v) Existing Trackwork that is to be maintained unaltered shall be exempt from these criteria for new Track.

2.9 Vertical Alignment

(a) General

(i) All references to profile in the vertical alignment shall represent the top of the low rail for a given Track.

(ii) Project Co shall provide vertical curves separated by a minimum tangent length of 35m.

(iii) Vertical alignment shall conform to the existing freight envelope in the vicinity of the future Golf Course Runway (07C-25C), per Schedule 32 - City Permits, Licences, Approvals and Authorizations.

(iv) Where the existing Mainline Track is to remain horizontally and vertically unaltered, no design modifications are required.

(b) Grades

(i) Project Co shall not apply changes in grade or vertical curves within the limits of Station Platforms and future Platforms.

(ii) Project Co shall provide grades through Stations of a minimum grade of 0.5% and a maximum grade of 1.5%. A minimum grade of 0.0% shall be permitted when additional measures to accommodate positive drainage are provided.

(iii) Project Co shall provide the mainline between Bayview Station and Earl Armstrong Road for freight service Track with a minimum grade of 0.30% and maximum of 2%with the exception of the **[REDACTED]** Grade Separation and the Earl Armstrong Grade Separation as outlined in Clauses 1.1(c)(i) and (iv) of this Part 2.

(iv) Project Co shall provide the mainline where it is Passenger service only Track with a maximum grade of 4.0%, compensated.

A. The maximum grades are after compensating for any horizontal curvature.

i Grade compensation for horizontal curvature:

1. $Gc = G + 0.04\% \times (5729.6/R \times 3.28)$

Where:

Gc = compensated gradient to account for horizontal curvature, in percent;

G = grade before adjustment in percent; and,

R = horizontal curve radius in metres.

(v) Project Co shall not overlap horizontal and vertical curvature unless physical constraints do not allow it.

(vi) Project Co shall provide the alignment such that the maximum grade for mainline turnouts is 2.0%. Where existing turnouts are unaltered no design modifications are required.

(vii) All special Trackwork shall be located on constant grades with no vertical curves within the limits of the special Trackwork.

(viii) Project Co shall provide Mainline Storage Track and Tail Tracks with a maximum grade of 0.3% with Tail Tracks sloped away from the mainline, or provide means

of mitigating potential Vehicle rollaway onto Mainline Track in case of brake failure.

(c) Vertical Curves

(i) Project Co shall provide parabolic vertical curves for all grade changes.

(ii) Project Co shall provide a minimum distance of 15m between Platform limits and any point of vertical curvature.

(iii) The length of a vertical curve shall be as long as practicable, but no less than shown below.

A. The minimum length of vertical curve (L_{VC}, m) for mainline and connection Tracks shall be determined by the following equations where A = Algebraic difference in grades:

i Lvc=60A

ii Minimum, where V=100km/hr unless physical constraints do not allow:

1. Greater of either Lvc= $0.005AV^2$ or 30m, for crest curves;

2. Greater of either Lvc= $0.003AV^2$ or 30m, for sag curves;

2.10 Special Trackwork

(a) Project Co shall provide Special Trackwork that conforms to AREMA requirements and AREMA Specification for Special Trackwork for rails 115lb and heavier.

(b) Project Co shall provide the Special Trackwork on tangent Track and on a constant vertical grade.

(c) Project Co shall provide the alignment such that the minimum horizontal tangent length beyond Special Trackwork located on Mainline Track and Connecting Track is 51.4m unless physical constraints do not allow it in which case the minimum length shall be 35m.

(d) Project Co shall provide the Special Trackwork at a minimum horizontal tangent distance of 15m from the end of Station Platforms.

(e) Project Co shall determine minimum horizontal and vertical tangent lengths beyond New Walkley Yard Special Trackwork based on Vehicle requirements as defined in Schedule 15-2, Part 8 - Vehicles.

(f) Project Co shall use No. 20 turnouts on Mainline Tracks of the Trillium Line Extension Project including diamond cross-overs with the following exceptions: at end of the line where No. 8 turnouts shall be used; at pocket Tracks where No. 8 and No. 4 equilateral turnouts shall be used; at the NRC turnout where No. 8 shall be used; and, at the Bowesville and Bayview diamond cross-overs where No. 8 shall be used. All Existing Trillium Line turnouts shall be reused or relocated. No. 7 turnouts shall be used for yard and Storage Tracks. Special Trackwork with lead curve radii greater than a Standard AREMA No. 7 turnout may also be used for Yard Tracks and Storage Tracks. No. 4 Equilateral turnouts may be used for Storage Tracks (e.g. pocket Tracks).

2.11 Other Alignment Requirements

(a) Combined horizontal and vertical curvature shall not be used. Where this situation is unavoidable, Project Co shall include justification in its Trackwork Design Report with reference to alignment safety at the design speed.

2.12 Clearances

(a) Vehicle Clearances

(i) Project Co shall measure horizontal clearance dimensions perpendicular to the Track centreline accounting for any superelevation in the Track.

(ii) Project Co shall account for structure chord lengths, tilt from superelevation, Track type, and outswing and inswing of a Vehicle that occurs along horizontal curves in their horizontal clearance calculations.

(iii) Project Co shall design a single continuous Track for the Freight Vehicle clearances for the alignment which falls within the existing rail corridor including Platform extenders at all Stations. Project Co shall design for the Revenue Vehicle clearance only (not including Freight Vehicle) where the alignment falls outside the existing rail corridor.

(iv) Project Co shall define the Revenue Vehicle clearance envelope as the space occupied by the dynamic envelope, or maximum movement, of the Vehicle as it travels along the Track plus an additional running clearance of 150mm, or any other dimension in excess of 150mm deemed pertinent by Project Co's own analysis for the Passenger service route. Project Co shall provide a clearance envelope such that the Revenue Vehicle clearance envelope provides sufficient running clearances and tolerances under all operating conditions.

(v) Project Co shall define the Freight Vehicle clearance envelope from freight train clearances Diagram 1 and Diagram 2 found in TC E-05. This document is available on the Transport Canada website.

(vi) Project Co shall design the alignment based on the information of the Vehicle dynamic envelope.

(vii) Project Co shall determine the horizontal clearance dimensions from the centreline of Track to the finished edge of Station Platform based on the criteria identified in Schedule 15-2, Part 8 - Vehicles, Revenue Vehicle pass-through speed criteria, and compliance with applicable accessibility standards. Platforms will require retractable extenders to meet Freight Vehicle clearance requirements where the alignment is within the existing rail corridor.

(viii) Vertical clearance dimensions shall always be measured in a vertical plane irrespective of any superelevation or profile grade. When superelevation is present, the top of low rail shall be used as the reference elevation when calculating vertical clearance.

(b) Other Clearance Requirements

(i) Temporary clearance requirements for construction shall be assessed on an individual basis.

(ii) Project Co shall account for additional clearance requirements for Train overhang and mid-ordinate overhang for all horizontal curves.

(iii) Project Co shall allow for the future electrification of the Expanded Trillium Line by providing clearance for a future OCS pole to be installed without impacting Revenue Service or cutting off access to the live Track.

(iv) Project Co shall allow for the future electrification of the Expanded Trillium Line by providing a 4.5m clearance for a future OCS under all overhead Structures.

(v) Project Co shall not preclude for the future double tracking of the Expanded Trillium Line including all future clearance requirements.

(vi) Signal, Trackwork, wayside, and Track-mounted equipment shall be kept clear of the under car clearance envelope of the Revenue Vehicle.

(vii) Refer to Schedule 15-2, Part 2, Article 8 – Utility Infrastructure Design Criteria for watermain clearance requirements.

ARTICLE 3 TRACKWORK

3.1 Reference Documents

(a) Project Co shall provide Trackwork in accordance 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:

(i) APTA Manual of Standards and Recommended Practices for Rail Transit Systems;

(ii) AREMA Manual for Railway Engineering;

(iii) European Standard (EN) for Railway Applications;

(iv) UIC Standards;

(v) ASTM Standards;

(vi) ISO 2631 Mechanical Vibration and Shock;

(vii) NFPA 130 Standard for Fixed Guideway Transit and Passenger Rail Systems;

(viii) TCRP Report 155 Design Handbook for Light Rail Transit, latest edition;

(ix) TCRP Report 71 Track-Related Research; and,

(x) Transport Canada Track Safety Rules.

3.2 Scope of Work

(a) Project Co shall provide all Works related to the construction of a complete System for Trackwork, including Track, Track materials, Special Trackwork, and Spur Track as required in this Part 2.

(b) Project Co shall provide Special Trackwork as described in this Part 2, including all turnouts, crossovers, diamond crossings, adjoining Trackwork, Track materials, switch machines, switch clearing devices, expansion joints, end-of-Track devices, wheel/rail friction control devices, and all other Track materials.

(c) Project Co. Co shall be responsible for control and any mitigation which may be a result of wheel-rail noise throughout the System in accordance with Schedule 17 - Environmental Obligations.

3.3 Track Classification

(a) Project Co shall classify Track as follows:

(i) Mainline Track: used for the operation of Revenue Vehicles carrying Passengers and railbound Maintenance Vehicles;

(ii) Tail Track: located at Terminal Stations to provide overrun protection and potential Vehicle storage;

(iii) Mainline Storage Track: used to store Revenue Vehicles adjacent to Mainline Track and for potential crossover functionality;

(iv) Yard Track: includes shop Track located in Maintenance shops, Storage Track, Spur Track, and other Track required beyond Connecting Track within the New Walkley Yard;

(v) Connecting Track: links Yard Track to Mainline Track; and

(vi) Spur Track: Track that branches off the Trillium Line Extension Mainline Track as a secondary Track either for the Airport Link or for allowing for the delivery of freight service to the NRC connection.

3.4 General Requirements

(a) Project Co shall provide Trackwork that is compatible with the Revenue Vehicle wheel profile and back-to-back gauge identified in Schedule 15-2, Part 8 - Vehicles and that can accommodate Freight traffic.

(b) Project Co shall provide Trackwork that permits diverging route speeds consistent with Schedule 15-2, Part 1, Article 3 - Operational Performance Requirements.

(c) Project Co shall provide Trackwork that is durable for more than or equal to the Design Life identified in Schedule 15-2, Part 1, Article 4 – Design and Construction.

(d) Project Co shall provide Trackwork to meet the requirements identified in Schedule 15-3 - Maintenance and Rehabilitation Requirements.

(e) Project Co shall provide Trackwork that is safe, efficient and allows continuous Operation under all operating conditions.

(f) Project Co shall provide Trackwork that performs safely and efficiently under all local, Site-specific climatic and environmental conditions.

(g) Project Co shall provide for the coordination of Trackwork with conduits, cabling, duct banks, raceways, wayside equipment, and Track-mounted equipment for associated S&TCS, communications, electrical, and other systems.

(h) A Trackwork Design and Construction Test Plan shall be submitted by Project Co in accordance with Schedule 10 – Review Procedure.

(i) Track Gauge and Cant

(i) Project Co shall provide 1435mm Track gauge on tangent Track.

(ii) Project Co shall provide rail cant for Special Trackwork that is compatible with Mainline Track and/or includes appropriate transitions.

(j) Project Co shall set the criteria for total and differential post-construction settlements along the Track bed to satisfy the requirements of Clauses 3.10, 3.11 and 3.12 of this Part 2.

(k) Track Loading

(i) Project Co shall provide Trackwork to accommodate the vertical, horizontal and longitudinal loading from the Freight Vehicles, Revenue Vehicles and Maintenance Vehicles, without exceeding permissible stress limits of the elements comprising the Track system or Track subgrade.

(ii) Project Co shall incorporate loading arising from thermal stress within the rail, based on the rail temperature range for local climatic and environmental conditions, into the Track system design, including allowance for heating due to direct sunlight exposure and extreme cold.

(l) Corrosion Control

(i) Project Co shall protect all Track components from corrosion in accordance with the requirements outlined in Schedule 15-2, Part 3, Article 11 - Corrosion Control.

(ii) Project Co shall provide reinforcing steel compliant with structural grounding requirements identified in Schedule 15-2, Part 3, Article 11 - Corrosion Control, and compliant with ACI 318M and AREMA Chapter 8 requirements.

(iii) Project Co shall provide Trackwork that ensures the rail and fasteners are electrically insulated from ground.

(iv) Electrical Continuity of Rail

A. Project Co shall ensure rail electrical continuity and rail bonding are in accordance with the requirements identified in this Article.

B. Project Co shall ensure that the rails shall be electrically bonded at locations requiring bolted rail joints. Otherwise all rail shall be CWR meeting AREMA requirements.

C. Project Co shall provide rail bonding compliant with the standards identified in AREMA Chapter 33 Part 7 and Chapter 4 Section 3.7.

3.5 Track Structure Types

(a) General

(i) Project Co shall provide Track to support and hold the rails in place to the correct alignment, profile, cross level, and Track gauge.

(ii) Project Co shall provide Track compliant with NFPA 130 requirements for trainways.

(iii) Project Co shall coordinate the placement of Track fastener assemblies and ties with the location of deck or slab steel reinforcement, rail joints, Track-mounted equipment, and wayside equipment.

(iv) Project Co shall provide any of the following permitted Track types for at-grade locations or elevated Guideways, subject to additional conditions in this Clause 3.5:

A. direct fixation; or,

B. ballasted.

(b) Direct Fixation Track

(i) Project Co shall provide DF Track as an open Track form consisting of a resilient, elastic DFF system anchored into a concrete foundation slab or elevated Structure deck.

(c) Ballasted Track

(i) Project Co shall provide ballasted Track as an open Track form consisting of a resilient, elastic fastening system and concrete, composite, or timber ties.

(ii) Ballasted Track shall be permitted for use provided that:

A. At Roadway crossings only fully planked, timber, asphalt concrete or solid rubber planking will be accepted. Gravel or filled crossing surfaces shall not be permitted;

B. Vehicle clearance envelope for ballasted Track is applied;

C. Guideway fits within prescribed property limits; and,

D. NFPA 130 requirements are satisfied.

(iii) Material Requirements

A. Crushed stone or other material shall conform to AREMA ballast specifications, with evidence of previous approval on a similar or heavier rail type system within the last 5 years provided to the City.

B. The particle size requirements shall conform to AREMA requirements in relation to the crushed stone ballast, class number 4A.

C. Project Co shall provide ballast gradation with sufficient voids to permit water to migrate freely.

D. Project Co shall provide sub-ballast compliant with the requirements found AREMA Chapter 1 Part 2.

E. Project Co shall provide for ballast resistivity of not less than 3000 ohm-metres.

3.6 Rail Configurations

(a) Project Co shall, as necessary, coordinate the following rail configurations with Track structure types. Project Co may consider the principles identified in TCRP Report 155.

(b) Rail/ 115 lb RE Rail

(i) Supply rail that meets:

A. AREMA Volume 1, Chapter 4, Part 2; and

B. ASTM A1.

(c) Restraining Guard Rail

(i) All running rail and guard rail for Track shall be new and shall conform to the associated AREMA specifications.

(ii) Application:

A. Project Co shall install restraining rails along the gauge side of the low rail based on Revenue Vehicle requirements related to negotiating short radius mainline horizontal curves.

B. Restraining rail shall be electrically isolated from running rail in order to maintain broken rail protection as per Schedule 15-2, Part 3 - Systems.

C. Restraining rail may use bolted joints to avoid difference in thermal stress level between the restraining rail and adjacent CWR running rail.

(d) Emergency (Steel Inner) Guard Rail

(i) Emergency Guard Rail shall be provided at location where it is important to prevent a derailed Train from traveling more than a few inches from the running rails. Emergency Guard Rails shall be installed at retained embankments, on approached to Tunnel portals, near Overhead Structure abutments and at location where a derailed Train would likely impact critical non-transit facilities such as high tension power line poles.

(ii) Project Co shall provide Emergency Guard Rail at the following DF and ballasted Track locations where structural lateral restraints capable of containing a derailed Train within the Guideway are not present:

A. Adjacent (within Train car length) to pier of column;

B. Track is on embankment near the top of retaining walls where the top of rail is a minimum of 600mm above the surrounding grade, or other value agreed upon by Project Co and the City;

C. Track is located on a Bridge or an aerial Structure;

D. At approaches to obstructions or other adjacent Structure.

(iii) Project Co shall provide Emergency Guard Rail that:

A. On Mainline Tracks extends 30m ahead of the beginning of the Bridge Structure or area being protected on the approach end, and 15m beyond the end of the protected Structure on the departure end.

(iv) Emergency guard rail shall not be required on Tracks where structural lateral restraints occur and are strong enough to contain a derailed Vehicle.

(v) Project Co shall provide lateral structural restraints capable of containing a derailed Train within the Guideway.

3.7 Track Materials

(a) General

(i) Project Co shall provide Rail/ 115 lb RE Rail that meets:

A. AREMA Volume 1, Chapter 4, Part 2; and

B. ASTM A1.

(ii) Head- Hardened Rail (High-Strength) :

A. Shall comply with the requirements of AREMA, Chapter 4.

B. Shall be used on 500m radius or lower.

C. Shall be used on vertical gradients steeper than 4.0%.

D. Shall be used in Special Trackwork sections.

(b) Rail

(i) General

A. Project Co shall provide running rail as CWR in accordance with AREMA Chapter 4 Section 3.11, and Chapter 5 Part 4 and Part 5 standards.

B. Project Co shall provide all new rail that has undergone mill scale removal.

C. Project Co shall provide new rail that has a profile as per the Existing Trillium Line current implemented rail.

(ii) Restraining Guard Rail

A. Project Co shall provide restraining rail based on vehicle integration.

(iii) Emergency (Steel Inner) Guard Rail

A. Worn/used rail may be used for Emergency Guard Rails, provided it is free from strength-impairing defects. All Emergency Guard Rail used on the Project shall be the same section and rail drilling. Project Co shall

consider undercar clearances and rail wear limits when determining the vertical position of Emergency Guard Rail.

B. Emergency guard rail shall be electrically isolated from the running rail.

(c) Track Fasteners

(i) General

A. All new Track fasteners shall have Design Life as identified in Schedule 15-2, Part 1, Article 4 – Design and Construction.

B. Project Co shall provide the new Track fasteners as a Track fastening system(s) that:

i provides vertical and lateral stability to the rail;

ii distributes loadings to the Track substructure;

iii resists longitudinal CWR forces due to thermal, acceleration and braking forces;

iv prevents rail buckling under all climatic and environmental conditions;

v resists corrosion and electrically insulates the rail from ground;

vi absorbs vibration energy in order to attenuate noise and vibration and reduce Track substructure loading;

vii are of a standardized elastic, resilient, self-tensioning type that applies a constant toe load to the rail under all service conditions;

viii permits the removal and re-installation of the rail vertically without loss of Track fastener function;

ix are easily installed and removed by one person with standard hand tools;

x are capable of being removed and reinstalled without loss in toe load, stiffness, or other performance properties;

xi are compatible with the Revenue Vehicle dynamic envelope and clearances; and,

xii complies with the criteria identified in Article 4 - Structural Design Criteria and Requirements, of this Part 2.

(d) Timber ties

(i) Project Co shall provide timber ties made from hardwood that shall conform to the requirements of Chapter 30, Part 3 of the AREMA Manual for Railway Engineering.

(e) Composite ties

(i) Project Co shall provide composite ties that conform to the requirements of Chapter 30, Part 5 of the AREMA Manual for Railway Engineering.

(f) Concrete ties

(i) Project Co shall provide concrete ties that shall conform to the requirements of Chapter 30, Part 4 of the AREMA Manual for Railway Engineering.

(g) Direct fixation plates

(i) Project Co shall provide DF plates that:

A. are typically used in ballastless Track designs that include concrete base slabs and/or concrete plinths;

B. shall incorporate elastomeric elements that permit a controlled amount of vertical deflection under dynamic loads; and,

C. shall be secured with anchor bolts and inserts that provide adequate resistance to lateral and vertical forces from Train movements.

(h) Track Type Transitions

(i) Project Co shall design and construct transition sections to facilitate a gradual change in Track stiffness, where Track structure type changes occur. Transition section lengths shall be a minimum of 30m unless otherwise directed by the City.

(i) Rail Joints

(i) Insulated Joints

A. Project Co shall provide insulated rail joints wherever it is necessary to electrically isolate contiguous rails from each other in order to comply with Track signalling criteria.

B. Project Co shall determine the need for and the positioning of insulated rail joints based on coordination with the S&TCS requirements and in compliance with applicable AREMA standards and good industry practice.

C. Project Co shall provide bonded insulated joints compliant with the requirements of AREMA Chapter 4 Section 3.8 or equivalent, where insulated rail joints are required.

(ii) Welded Joints

A. General

i Project Co shall provide no holes in the rail located within a minimum of 150mm of the weld location, including for temporary bolted locations.

B. Flash-Butt Welds

i All CWR shall be welded by means of electric flash-butt method compliant with the requirements of AREMA Chapter 4 Section 3.10. Electrical flash-butt welds shall be used for all running rail connections consistent with CWR practice. Rail shall be welded into the longest strings practical during Construction.

C. Thermite Welds

i Project Co shall perform the thermite welding method compliant with the requirements of AREMA Chapter 4 Section 3.13 or CEN EN 14730, where impossible to weld rail joints by means of flash-butt welding.

(iii) Bolted Joints

A. Standard bolted joints shall not be installed in Mainline Track. Bolted Joints are acceptable as a temporary condition only.

B. Project Co shall provide bolted joints with standard diameter holes and standard hole-spacing for the rail type.

C. Project Co shall provide bolted rail joint components compliant with the requirements identified in AREMA Chapter 4 or equivalent standard for 115lb RE rail.

(iv) Rail Expansion Joints

A. Project Co shall determine the need for rail expansion joints at elevated Structures due to thermal and longitudinal rail stresses based on rail-to-structure interface analysis.

3.8 Special Trackwork

(a) Special Trackwork refers to all rail installations where Tracks converge, diverge or cross. Standard Trackwork is made simply from rolled rails of a constant cross-section, while rails in several Special Trackwork components are cast or machined and have cross-sections that vary along their length.

(b) General

(i) Turnout materials shall be in general accordance with AREMA or approved equals;

(ii) Special Trackwork shall include running surfaces of castings machined to conform to the cross-section of 115lb RE rail;

(iii) Special Trackwork shall include running surfaces, flangeways and guarded dimensions that are compatible with the Revenue Vehicle wheels and back-to-back gauge dimensions;

(iv) Special Trackwork that is installed at locations with sensitive receptors as indicated in Schedule 17 - Environmental Obligations shall include appropriate "service-proven" mitigation measures;

(v) Project Co shall provide the following minimum required operational Track facilities:

A. crossovers, turnouts, Storage Tracks and Special Trackwork at locations necessary to comply with the operational requirements identified in Schedule 15-2, Part 1, Article 3 - Operational Performance Requirements while providing maximum redundancy and minimizing single points of failure;

B. Tail Tracks and crossovers at Terminal Stations sufficient to facilitate the reversing of trains, accommodate safe braking distance as defined in Schedule 15-2, Part 3, Article 10 – Signalling and Train Control System, and maximize approach speeds;

C. inline failure management crossovers comprising single crossovers, double crossovers, and three-Track storage crossovers;

D. scissors crossovers or universal crossovers at the following Stations:

i South Keys; and,

ii Bayview.

E. storage crossovers at the following Stations:

i South Keys.

(vi) Project Co shall provide turnouts located on Mainline Track that:

A. employ standard lateral turnout geometries and straight frogs;

B. route mainline traffic through the tangent side of the turnout at inline locations. Routing mainline traffic through the diverging side of turnouts shall be permitted at Terminal Station locations only; and,

C. comply with the operational requirements identified in Schedule 15-2, Part 1, Article 3 - Operational Performance Requirements and maximize approach speeds.

(vii) Project Co shall provide Special Trackwork layouts:

A. comprised of a constant Track structure type located entirely within a constant Guideway structure type;

B. located clear of road vehicle and pedestrian intersections and crossings;

C. located clear of elevated Structures unless structural lateral restraints are present that are capable of containing a derailed Train; and,

D. adjacent to a safe walkway compliant with NFPA 130 requirements in order to accommodate an Operator Driver walking the full length of a 3-Revenue Vehicle Train at Storage Track locations and at turnback locations if not located at a Platform. The safe walkway shall be located clear of the Vehicle dynamic envelope if the Operator is exposed to an adjacent live Track.

(c) Special Trackwork Components

(i) Project Co shall design and construct all mainline turnouts to include flangeways that can accommodate both freight and the Revenue Vehicles.

(ii) Project Co shall design and construct all mainline Special Trackwork to be boltless welded manganese frogs (conformal frogs).

(iii) Project Co shall design and construct all new yard Special Trackwork to utilize RBM frogs as well as conformal frogs.

(iv) Project Co shall design and construct all mainline and yard Special Trackwork to be equipped with either plate rollers or point rollers installed on concrete ties with heaters.

(d) End-of-Track Protection Devices

(i) Project Co shall provide end-of-Track shock-absorbing devices for use at Terminal Station Tracks. These devices shall be mounted near the end of the Track at Bayview Station, Airport Station and Limebank Station. These devices shall be located to prevent the Train from running over any pedestrian path located adjacent to the end of Track or running off of the elevated Guideway;

(ii) End-of-Track shock-absorbing devices shall meet the following criteria:

A. suitable for permanent exterior exposure;

B. be capable of stopping an unoccupied Train travelling at 10km/hr;

C. engage the vehicle symmetrically about the coupler at bumper height;

D. have a cushioned face and not produce any damage to a Vehicle at Vehicle speeds less than 5km/hr. Project Co shall coordinate the design of the stopping device to ensure engagement to the car is adequate to prevent damage; and,

E. meet requirements as outlined in Schedule 15-2, Part 3, Clause 10.2 (p).

(e) Wheel/Rail Friction Control

(i) Project Co shall provide wheel/rail friction control measures in locations consistent with the practices identified in AREMA Chapter 5 Section 5.9, Chapter 4 Section 4.11, CEN EN 15427, and TCRP Report 71 Volumes 1 and 4.

(ii) Project Co shall provide lubricant selection and application aimed at minimizing loss of traction.

(iii) Project Co shall provide lubricators capable of adjusting lubricant application based on Site-specific conditions.

(iv) Project Co shall provide space within the Guideway for lubricator cabinets, tubing, ancillary equipment, and Maintenance access. Project Co shall protect tubing from impact damage.

3.9 Track Commissioning Tests

(a) Project Co shall complete and submit the following minimum verification tests of Track installation to the City, in accordance with Schedule 10 – Review Procedure prior to Revenue Service:

(i) Track geometry assessment by automated self-propelled measuring equipment;

(ii) Track clearances measurement;

(iii) Revenue Vehicle Platform clearances (horizontal and vertical) measurements;

(iv) Track rail profile assessment measurement;

(v) Ultrasonic Rail Flaw Detection assessment; and,

(vi) Revenue Vehicle ride quality measurement for end-to-end Vehicle operation of the New Vehicle Fleet and Existing Vehicle Fleet across the entire alignment. Project Co shall provide a custom test procedure to demonstrate that interior Vehicle vertical and lateral accelerations across the alignment meet appropriate Passenger comfort criteria and Operator comfort criteria for both Vehicle types.

3.10 Track Measurement and Assessment Standards

(a) Project Co shall implement the following Track measurement and assessment standards:

(i) Track parameters based on vehicle integration as follows:

A. Track gauge limits measured against construction tolerances of ±3mm;

B. cross level and superelevation measured against construction tolerances of ±3mm from design values;

C. horizontal curve and spiral alignments compliance with design for radii and lengths;

D. relative horizontal alignment measured against construction tolerances of ±3mm in a 20m chord from design values; and,

E. relative vertical alignment measured against construction tolerances of ±3mm in a 20m chord from design values.

(ii) Track clearances compliant with the criteria in this Part 2;

(iii) Revenue Vehicle clearance to Platforms compliant with the criteria defined in Schedule 15-2, Part 4, Article 2 - Architectural Design Criteria;

(iv) Revenue Vehicle ride quality compliant with the criteria defined in Schedule 15-3, Appendix B, Article 4.0, Table 4.1 b, with resulting noise and vibration not to exceed the limits imposed by City Bylaws or Schedule 17 – Environmental Obligations. Ride quality shall be measured across the complete alignment; and,

(v) rail defect criteria, prioritization, and remedial action compliant with EN 13146 or APTA Standard for Rail Transit Track Inspection and Maintenance.

3.11 Track Measurement and Assessment Methodology

(a) Project Co shall complete verification of Track geometry by means of a Track geometry measuring vehicle in accordance with AREMA Chapter 2 Part 1 practices.

(b) Project Co shall complete verification of Track clearances by means of a Track clearance measuring system in accordance with AREMA Chapter 2 practices.

(c) Project Co shall complete verification of rail profile measurements by means of a rail measuring system in accordance with AREMA Chapter 2 Part 2 practices.

(d) Project Co shall complete verification of rail defects by means of an ultrasonic rail flaw detection system in accordance with practices identified in AREMA Chapter 4, Part 4 and Part 5.

(e) The scheduled frequency of Track measurement and assessment activities shall comply with the following criteria:

(i) Schedule 15-3 - Maintenance and Rehabilitation Requirements, applicable to visual Trackwork and CWR inspections; and,

(ii) automated Track geometry inspections by self-propelled equipment compliant with AREMA or EN standards four times per year as evenly distributed as possible to make allowances for inclement weather.

ARTICLE 4 STRUCTURAL DESIGN CRITERIA AND REQUIREMENTS

4.1 Scope

(a) This Article governs the design and construction for Bridges, Elevated Guideways, at-grade Guideways, portal walls, Culverts, retaining walls, pole bases and other Structures not included elsewhere.

(b) Stations and Ancillary Facilities shall be in accordance with Schedule 15-2, Part 4 - Stations.

4.2 Reference Documents

(a) The codes, standards and references indicated in this clause shall be utilized for the design and construction of the Structures indicated in this Article, except as explicitly indicated in other articles. The structural design shall conform to the most current edition of the following codes and standards. If the criteria sources conflict, unless otherwise noted, the following shall apply in descending order of precedence:

(i) Applicable laws and regulations;

(ii) Specific obligations and Design Criteria identified in this Part 2;

(iii) Pedestrian and Roadway Structures:

A. CAN/CSA-S6 Canadian Highway Bridge Design Code; and Exceptions to the Canadian Highway Bridge Design Code CAN/CSA-S6 for Ontario;

B. City of Ottawa Standard Tender Documents for Unit Price Contracts;

C. MTO Structural Manual;

D. OPSS; and,

E. OPSD.

(iv) Vehicle Guideway Structures:

A. AREMA Manual for Railway Engineering, hereinafter referred to as AREMA;

B. CAN/CSA-S6 Canadian Highway Bridge Design Code; and Exceptions to the Canadian Highway Bridge Design Code CAN/CSA-S6 for Ontario;

C. City of Ottawa Standard Tender Documents for Unit Price Contracts;

D. MTO Structural Manual;

E. OPSS; and,

F. OPSD.

(v) Freight Guideway Structures:

A. AREMA;

B. Transport Canada Standards Respecting Railway Clearances (TC E-05);

C. CAN/CSA-S6 Canadian Highway Bridge Design Code; and Exceptions to the Canadian Highway Bridge Design Code CAN/CSA-S6 for Ontario;

D. City of Ottawa Standard Tender Documents for Unit Price Contracts;

E. MTO Structural Manual;

F. OPSS; and,

G. OPSD.

(vi) MTO Design Supplement for TAC Geometric Design Guide for Canadian Roads;

(vii) MTO Roadside Safety Manual;

(viii) CAN/CSA A23.3 Design of Concrete Structures;

(ix) CAN/CSA A23.1 Concrete Materials and Methods Construction;

(x) CAN/CSA A23.2 Test Methods and Standard Practices for Concrete;

(xi) CAN/CSA S16 Design of Steel Structures;

(xii) CAN/CSA G40.20-04/G40.21-04 General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel;

(xiii) MTO Reports and Guidelines; and,

(xiv) TAC Geometric Design Guide for Canadian Roads.

4.3 General Requirements

(a) Roadway and pedestrian Structures shall be designed by the limit states design method in accordance CAN/CSA S6.

(b) Guideway Structures shall be designed in accordance with AREMA. Live loads shall be as specified in Clause 4.5 of this Part 2. The design of all Guideway Structures shall also consider loads and space requirements due to system-wide elements such as signalization, communication equipment and electrification, for the future Expanded Trillium Line LRV.

(c) 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.

(d) Minimum clearance requirements

(i) New Overhead Structures and existing Bridge Structures being modified to Overhead Structures shall span:

A. The Guideway;

B. Emergency access walkways; and,

C. The minimum Vehicle clearance in accordance with Clause 2.12 of this Part 2.

(ii) New Guideway Structures and existing Bridge Structures being modified to Guideway Structures shall have a Structure width to allow for:

A. The Guideway;

B. Emergency access walkways; and,

C. The minimum Vehicle clearance in accordance with Clause 2.12 of this Part 2.

(iii) The minimum vertical clearance for Overhead Structures shall be in accordance with Clause 2.12 of this Part 2.

(iv) The minimum vertical clearance for new Guideway Structures over Roadways shall be in accordance with the MTO Design Supplement for TAC Geometric Design Guide for Canadian Roads.

4.4 Design Requirements

(a) Pedestrian and Roadway Structures

(i) Seismic Design

A. New Bridge Structure shall be designed to meet importance category "Other".

B. PBD approach in accordance with CAN/CSA S6 shall be used for all new Bridge Structures.

C. New Bridge Structures shall be analyzed for design earthquake loads for all three return periods and damage states in accordance with CAN/CSA S6.

D. Seismic design for buried Structures and retaining walls shall be as per CAN/CSA S6.

E. Table 2-4.1 summarizes the design approach, return period and performance requirements.

Table 2-4.1: Design Approach, Return Period and Performance Requirements

Seismic Design Summary	
Design Approach	PBD
Seismic ground motion probability of exceedance in 50 years (return period)	2%, 5% and 10% (2475yrs, 975yrs, and 475yrs)
Performance Level and Criteria	As per CAN/CSA S6

(ii) Collision Protection for Overhead Structures which provide freight clearance under the Structure shall meet the collision requirements as specified in AREMA.

(iii) Collision Protection for Overhead Structures which do not provide freight clearance under the Structure shall meet the following requirements:

A. Piers supporting new and existing Bridges over the alignment and with a clear distance of less than 6m from the centerline of a Track shall be of heavy construction or shall be protected by a reinforced concrete crash wall.

i Crash walls shall have a minimum height of 1200mm above the TOR. The crash wall shall be at least 600mm thick and at least 3.5m 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 1200mm below the lowest surrounding grade.

ii 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.

(iv) Vibration and deflection control for pedestrian Structures shall be in accordance with CAN/CSA S6 and the MTO Structural Manual.

(b) Guideway Structures

(i) Seismic Design

A. Seismic design of new Guideway Structures shall be in accordance with AREMA.

B. The seismic evaluation of existing Guideway Structures shall be in accordance with AREMA and shall use the return periods specified in Table 2-4.2. The seismic evaluation of existing buried structures is not required.

Table 2-4.2: Return Period (in Years) for Existing Guideway Structures

	SN055350 Hunt Club Bridge	**SN055900** Walkley Yard Lead	**SN055910** Rail Bridge over Transitway			**SN015290** Rideau River
Serviceability Limit States Return Period	92.5	90.6	90.6			92
Ultimate Limit States Return Period	312.5	260	267.5			312
Survivability Limit States Return Period	1910	1577.5	1857.5			1910

C. When background information required to undertake a seismic analysis of a Structure is incomplete, Project Co Shall obtain additional information via field measurement, exploratory removals, sampling and material testing.

(ii) Structure support elements shall withstand the collision load in accordance with Clause 4.5 of this Part 2.

(iii) Vibration and Deflection Control shall be in accordance with AREMA.

(c) New or existing Guideway Bridges shall be designed or modified such that rehabilitation work can be performed while maintaining a minimum of one Track. New or existing Roadway Bridges shall be designed or modified such that rehabilitation work can be performed while maintaining a minimum of two traffic lanes, bicycle lanes and one sidewalk, as applicable.

(d) The structural capacity and the condition of existing Structures being modified to carry future electrified Vehicle, Vehicle and freight loading or subject to Project Co Construction Activities shall be assessed and confirmed in coordination with the Governmental Authorities. Project Co shall perform any repairs or strengthening required to accommodate the applicable vehicle loading or Construction Activities.

(e) Project Co shall note all Design Criteria, including geotechnical and condition survey information, to which the Structures are designed on submissions and/or the structural drawings.

(f) Design of new Structures which are interfacing with existing Structures shall be coordinated with the owners and shall comply with the design and construction requirements of the Governmental Authorities. Environmental, hydrology and hydraulic studies shall be performed to address all immediate and long-term impacts and issues for Culverts and all Bridges, including Elevated Guideways, over water in coordination with the Governmental Authorities, and the design shall comply with the requirements of the Governmental Authorities.

(g) Access to steel girders for inspection purposes shall be incorporated into the design, including devices/system to enable inspectors to walk along all girders and tie-off safely.

(h) All new Bridges, Elevated Guideways and at-grade Guideways shall meet NFPA 130 requirements. Emergency walkways on Guideway Structures and under Overhead Structures shall meet the requirements of Clause 1.3 of this Part 2.

(i) Noise and vibration measures and control shall comply with the requirements of Schedule 17 – Environmental Obligations.

(j) Aesthetic Design

(i) All new Structures shall meet the requirements of the MTO Aesthetic Guidelines for Bridges, supplemented by the additional requirements of this Article. All references in the MTO Aesthetics Guideline to Ministry Bridge Aesthetics Evaluation Group or MBAEG shall be replaced with the City. The aesthetic design review process and approval procedures as detailed in Chapter 11 of the MTO Aesthetic Guidelines for Bridges are not applicable to this project. Chapter 11 of the MTO Aesthetic Guidelines for Bridges shall be considered deleted in its entirety.

(ii) The Bridge Aesthetic Level and Classification for new Structures shall be as specified in Appendix C of this Part 2.

(iii) The aesthetic design of Level One Bridges (High Aesthetic Classification) shall be subject to City review and approval. Project Co shall prepare and submit an Aesthetic Design Report in accordance with Schedule 10 – Review Procedure for all Level One Structures. The Aesthetic Design Report shall:

A. Be signed by the Design Architect.

B. Document the Architect's consideration of the following aesthetic design principals, as defined in the MTO Aesthetic Guidelines for Bridges, and how each of the aesthetic design principals were successfully addressed in the preliminary bridge design:

i Functional clarity – The size and shape of each primary element shall be appropriate for its respective structural task and the form of the Structure should truthfully and clearly express the loads that are being carried and transferred to the ground.

ii Economy and simplicity – The number of materials, textures, colours and architectural features should be kept at a minimum without becoming visually monotonous and should be applied consistently to provide a continuity of appearance.

iii Scale and proportion – The Structure shall be designed to minimize the overall dimensions of elements and shall appear in scale with its surroundings.

iv Harmony and visual balance – The Structure exhibits visual balance amongst its component part as well as with its surroundings.

v Contrast and complexity – The design of the Structure shall introduce complexity as a means of relieving visual monotony without the use of excessive eye-catching elements, colours or superfluous decoration.

vi Enduring visual quality, with a focus on surface finishes – The Structure shall be designed and constructed to ensure the quality and durability of base materials in order to achieve a lasting positive visual effect.

vii Integration with context – The Structure shall be designed to make a positive aesthetic contribution to its physical setting.

C. Include drawings of Bridge alternatives, details of specific aesthetic enhancements and 3D computer renderings of the proposed Structure viewed at perspective angles. Renderings shall be inclusive of the surrounding context.

(iv) Level Three Bridges (Low Aesthetic Classification) shall not be subject to aesthetic design approval by the City. Submission of Aesthetic Design Report shall not be required for Level Three Bridges (Low Aesthetic Classification).

(v) There are no Level Two Bridges (Medium Aesthetic Classification) on this Project.

(vi) Chain link fencing shall not be used on pedestrian Structures.

(i) Project Co shall detail and protect the structural steel-to-concrete interface in a way that no rust staining of the concrete occurs.

(k) Durability

(i) New Structures shall be designed to attain the indicated Design Life as detailed in Schedule 15-2, Part 1, Article 4 – Design and Construction. Time dependent design calculations, including corrosion, creep and fatigue shall be based on indicated Design Life.

(ii) Time dependent design calculations for modified existing Structures, shall take into account the age and condition of the Structure.

(iii) Fatigue cycles for Guideway Structures shall be a minimum 15,000,000 cycles for peak period Trains of 120m to 150m length.

(iv) Structures shall be designed to protect against atmospheric corrosion, soil corrosion and stray current corrosion in accordance with Schedule 15-2, Part 3, Article 11 – Corrosion Control.

A. New steel girder Structures over and adjacent to highways or exposed to salt spray shall be steel box girders.

B. Waterproofing shall be required for all Structure decks. The top of the existing and new concrete Structures shall be waterproofed as per applicable standards. Where DF is utilized, a waterproofing technology compatible with DF shall be applied. In-situ testing and warranties shall be required.

C. Steel piles shall not be used in corrosive ground water. Precast concrete piles may be used under these conditions, if specified with sulphate resisting cement.

(v) Where technically feasible, new Bridges shall be designed with integral or semi-integral abutments.

(l) A depressed approach slab shall be provided at all transitions between Track slab or Bridge decks with DFF and tie and ballast Track. Approach slabs shall be waterproofed.

(m) Approach slabs shall be designed and constructed for all new Structures supporting highway loads. Approach slabs shall be waterproofed.

(n) Drainage

(i) All Structures shall include provision for drainage in accordance with Article 5 – Drainage and Stormwater Management Design Criteria, of this Part 2.

(ii) Joints shall be detailed to allow longitudinal conveyance of runoff without leaking at the joints.

(iii) Drain pipes shall be external to the concrete.

(iv) Drainage from Structures within RVCA or SNCA Regulated Flood Plains shall be in accordance with Article 5 – Drainage and Stormwater Management Design Criteria, of this Part 2 and requirements of Governmental Authorities within whose jurisdiction the Structures are located.

(v) Drainage pipes shall not reduce the vertical and horizontal clearance of existing Structures.

(vi) Catch basins shall not be located within the approach slab area.

(o) Ductbanks

(i) Ductbanks shall be provided as necessary for systems and Operation conduits, including pull boxes and access to connecting devices.

(ii) The design of ductbanks at existing Structures shall with the requirements of the Governmental Authorities.

(iii) Services carried through or under Bridges shall be located as per the requirements of the MTO Structural Manual.

(p) Design of Retaining Structures

(i) A drainage layer shall be provided behind the wall to mitigate the build-up of hydrostatic pressure, where Structures are designed as drained. Both the water pressure and the lateral soil pressure shall be considered in the design.

(ii) MSE walls and MSE true abutments shall not be utilized as the primary support paths for Bridge beams and girders.

(iii) Earth retaining Structures whether temporary or permanent greater than 3m 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.

(q) Demolition and Restoration

(i) Demolition and restoration shall be as per Schedule 15-2, Part 1, Article 13 – Demolition, Removals and Disposal in addition to the provision contained in this Clause.

(ii) The condition of the existing Structures within the Project ZOI of the demolition shall be surveyed and recorded with the cooperation of the owners of the Structures affected and the Governmental Authorities. The condition of Structures to be demolished shall not be required to be surveyed and recorded.

(r) Project Co shall provide pedestrian, bicycle or combination barrier in accordance with CAN/CSA S6 on all new and existing Roadway and pedestrian Structures, where applicable.

(s) Any structural work or upgrades undertaken by Project Co shall not obstruct existing MUP, sidewalk, Roadway or waterway connections on or under the Structure.

4.5 Loads and Forces

(a) Pedestrian and Roadway Structures

(i) All loads, load factors and load combination shall be determined in accordance with CAN/CSA S6, supplemented and/or modified to meet the requirements of this Clause.

(ii) Loads due to horizontal earth pressure and hydrostatic pressure (E) shall be determined in accordance with CAN/CSA S6. Lateral earth pressure shall have a maximum load factor of 1.5 when used for proportioning wall sections of earth retaining Structures.

(iii) Earthquake (EQ) load shall be in accordance with CAN/CSA S6 and as modified by Clause 4.4 of this Part 2.

(b) Vehicle Guideway Structures

(i) Vehicle Guideway Structures shall be designed to support the following Live Load (L) conditions:

A. The Alstom CORADIA LINT 41 is the Existing Trillium Line Revenue Vehicle, a low-floor DMU vehicle with maximum axle loads of 196kN, as shown in Figure 2-4.1.

Figure 2-4.1: Alstom CORADIA LINT 41 Vehicle Loading

[REDACTED]

B. Expanded Trillium Line Revenue Vehicle provided by Project Co based on the selected Vehicle. The Revenue Vehicle shall be selected in accordance with Schedule 15-2, Part 8 – Vehicles.

C. The Alstom CITADIS SPIRIT shall be considered as the future Expanded Trillium Line LRV. The maximum axle load for this vehicle is 14.9 tonnes (126kN), axel loading and spacing shall be as shown in Figure 2-4.2.

Figure 2-4.2: Alstom CITADIS SPIRIT Vehicle Loading

[REDACTED]

D. Maintenance vehicle live load to be determined and provided by Project Co.

(c) Freight Guideway Structures

(i) Freight Guideway Structures shall be designed to support the following Live Load (L) conditions:

A. Cooper E80 loading as specified by AREMA.

B. The Alstom CORADIA LINT 41 is the Existing Trillium Line Vehicle, a low-floor DMU vehicle with maximum axle loads of 196kN, as shown in Figure 2-4.1.

C. Future Expanded Trillium Line Revenue Vehicle provided by Project Co based on the selected Vehicle. The future Revenue Vehicle shall be selected in accordance with Schedule 15-2, Part 8 – Vehicles.

D. The Alstom CITADIS SPIRIT electrical vehicle shall be considered as the future Expanded Trillium Line LRV. The maximum axle load for this vehicle is 14.9 tonnes (146kN), axel loading and spacing shall be as shown in Figure 2-4.2.

E. Maintenance vehicle live load to be determined and provided by Project Co.

(d) The following load conditions for the future OCS shall be taken into consideration for all Guideway Structures:

(i) Wind loading on the OCS shall be considered in the design of both superstructure and substructure elements.

(ii) Thermal forces resulting from the temperature variations in the OCS shall be considered. Loads shall be determined in accordance with AREMA unless otherwise determined by Project Co using other established codes of practice.

4.6 Material

(a) Material used for the modification, repair and rehabilitation of existing Structures shall be compatible with the existing in-situ material.

(b) Material selection and/or coating of attached elements shall be used to minimize staining to concrete elements.

(c) All material for the Structures as identified in this article shall conform to OPSS.

(d) Earth Retaining Structures

(i) Permanent RSS systems located beyond the salt spray zone shall meet, as a minimum, medium performance and low appearance requirements in accordance with MTO RSS Design Guidelines. RSS systems within 10m of a salt spray zone or associated with the Bridge Structure shall meet high performance and high appearance requirements in accordance with MTO RSS Design Guidelines.

(ii) Where accessible to Passengers within the Fare Paid Zone, including bus Platform areas and adjacent to public areas at Station entrances, gabion stones at the face of gabion walls shall be sized to prevent removal.

(e) Concrete

(i) Concrete shall conform to OPSS 1350 and City Special Provisions F-9045 and F-9043.

(ii) All concrete mixes shall be in accordance with CAN/CSA A23.1.

(iii) Concrete strength for Roadway and pedestrian Structures shall be as per the MTO Structural Manual, except for Bridge decks and sidewalks which shall be 35 MPa.

(f) Reinforcing Steel

(i) Reinforcing steel shall meet the material requirements as defined in 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 permitted in plastic hinge zones.

(v) No splices shall be permitted in plastic hinge zones for substructure components.

(vi) Premium reinforcing for Roadway and pedestrian Structures shall be used where required in accordance with the MTO Structural Manual.

(vii) Premium reinforcing for Guideway Structures shall be used in:

A. Guideway plinths that may be subject to de-icing salts, such as adjacent to Platforms; and,

B. Substructure elements that are located within the splash zone of Roadways treated with de-icing salts. Parking lots will not be considered a splash zone.

(viii) Where electrical continuity is required for managing stray currents, weldable reinforcement and suitable welding shall be used.

(ix) Epoxy coated reinforcing shall be used in accordance with Schedule 15-2, Part 3, Article 11 – Corrosion Control.

(g) GFRP Reinforcing bars:

(i) GFRP reinforcing bar shall only be permitted in barrier and parapet wall applications.

(ii) The GFRP reinforcing bars shall conform to the following standards:

A. CAN/CSA S806: Design & Construction of Building Structures with Fibre Reinforced Polymer

B. CSA S807: Specifications for Fibre Reinforced Polymer

(iii) GFRP shall have a minimum modulus of elasticity of 40 GPa.

(iv) GFRP shall have a specified minimum tensile strength of 1000 MPa.

(v) GFRP shall be type 2 or type 3.

(h) Prestressing Tendons

(i) Internal unbonded post-tensioning tendons shall not be permitted.

(ii) External grouted post-tensioning tendons are permitted for segmental Construction and shall be corrosion protected.

(i) Structural Steel

(i) Structural Steel for Roadway and pedestrian Structures shall conform to the material requirements in the MTO Structural Manual.

(ii) Structural steel for Guideway Structures

A. Superstructure primary members shall be grade 350AT Category 3 for primary plates, girders and rolled section members.

B. Primary members made from pipe sections shall meet the minimum Charpy impact energy specified in Table 9 of CSA G40.21 for the similar yield strength of steel tested at a Category 3 temperature.

C. Secondary steel members shall be grade 350W or 350A.

D. ASTM A 588 may be substituted for grade 350A or grade 350AT. ASTM A 588 shall only be substituted for grade 350AT steel when the Charpy impact energy requirements are verified by the submission of test documentation.

(iii) Steel fabrication companies shall be CWB certified.

(iv) The use of uncoated weathering steel shall be in accordance with CAN/CSA S6, based on applicable environmental exposure conditions.

(j) Deck joint assemblies shall comply with City of Ottawa Special Provision F-9201, including the 5 year warranty period for all New Municipal Infrastructure Structures.

(k) Bearings shall comply with City of Ottawa Special Provision F-9221, including the 5 year warranty period for all New Municipal Infrastructure Structures.

(l) Corrugated Steel Pipe, regardless of thickness or type, shall not be used for Bridge or Culvert construction.

4.7 Construction

(a) Concrete construction shall be in accordance with OPSS 904 and City of Ottawa Special Provision F-9040.

(b) Precast Prestressed Concrete

(i) Construction shall be in accordance with OPSS 909.

(ii) Precast members shall not be erected until sample cylinders tested per OPSS 1350 achieve a design 28 day compressive strength.

(iii) Precast segmental Bridges shall be constructed in accordance with the requirements of AASHTO's Guide Specifications for the Design and Construction of Segmental Bridges except where it conflicts with CAN/CSA S6.

(c) Structural steel shall be constructed in accordance with OPSS 906.

(d) Soffits shall be uncovered and without coatings.

(e) Bearings shall be uncovered.

(f) Bolted connections shall have a minimum diameter of 22mm and A325M designation of weathering steel.

(g) 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 Schedule 10 – Review Procedure.

(h) Project Co shall not store and/or leave exposed to the environment, prefabricated Bridge decks or partially constructed prefabricated Bridge decks in the Construction staging area during the calendar dates from December 1 to March 30. Prefabricated Bridge decks and partially Constructed prefabricated Bridge decks include Structural steel, reinforcing steel bars and concrete.

(i) Prefabricated Bridge decks shall be constructed in the designated construction staging area, transported to Site and erected into place in the same construction season.

4.8 Description of Project Structures

(a) Structures shall meet the requirements in Schedule 15-2, Part 1, Article 2 – Physical Layout, Clause 2.8 as well as the requirements contained in this Clause.

(b) Provisions contained in this Clause shall be read in conjunction with Appendix C of this Part 2.

(c) Project Co shall design and construct the following Works for the Expanded Trillium Line Mainline:

(i) Limebank Road Bridge (SN225710)

A. Design and construct a new grade separation at Limebank Road to either accommodate the alignment over the Roadway or the Roadway over the alignment. The new Structure shall accommodate:

i The Limebank Road cross section in accordance with Clause 6.18 of this Part 2 on the Structure;

ii The northbound and southbound Track alignment, including Emergency walkway; and,

iii The future Roadway cross section for a collector Roadway and a MUP in accordance with Clause 6.18 of this Part 2.

B. Design and construction of a new grade separation that accommodates Limebank Road over the alignment shall:

i Include the installation of Bridge Structure fencing in accordance with the requirements in Schedule 15-2, Part 6, Clause 2.7; and,

ii Accommodate a collector Roadway on the north side of the Track in accordance with Clause 6.18 of this Part 2.

iii Accommodate a future MUP on the south side of the Track corridor in accordance with Clause 6.18 of this Part 2.

C. Design and Construction of a new grade separation that accommodates the alignment over Limebank Road shall:

i Include the installation of a pedestrian barrier/railing system on each side of the Structure.

ii Center piers shall not be permitted.

iii Accommodate a collector Roadway on the north side of the track corridor in accordance with Clause 6.18 of this Part 2.

iv Accommodate a future MUP connection between the north and south sides of the Track corridor, on the east side of Limebank Road, in accordance with clause 6.18 of this Part 2.

(ii) Mosquito Creek Rail Bridge (SN225050)

A. Design and construct a new Guideway Structure to carry the alignment over Mosquito Creek. The new Structure shall accommodate:

i The northbound and southbound Track alignment, including Emergency walkway on the Structure;

ii Mosquito Creek and wildlife path under the Structure; and,

iii The wildlife path shall provide a minimum clearance envelope of 3m wide by 4m high. The wildlife clearance envelope shall be outside of and unobstructed by the channel that contains the average flow.

(iii) Bowesville Road Bridge (SN225690)

A. Design and construct a new grade separation at Bowesville Road to either accommodate the alignment over the Roadway or the Roadway over the alignment. The new Structure shall accommodate:

i The Bowesville Road cross section in accordance with Clause 6.18 of this Part 2;

ii The northbound and southbound Track alignment, including Emergency walkway; and,

iii MUP.

B. Design and construction of a new grade separation that accommodates Bowesville Road over the alignment shall:

i Include the installation of Bridge Structure fencing in accordance with the requirements in Schedule 15-2 Part 6 Clause 2.7; and,

ii Accommodate the MUP under the Structure on the south side of the alignment.

C. Design and Construction of a new grade separation that accommodates the alignment over Bowesville Road shall:

i Include the installation of a pedestrian barrier/railing system on each side of the Structure;

ii Allow for an at-grade MUP crossing with Bowesville Road to the south of the Structure; and,

iii Center piers shall not be permitted.

(iv) Earl Armstrong Bridge (SN225680)

A. Design and construct a new grade separation at Earl Armstrong Road to either accommodate the alignment over the Roadway or the Roadway over the alignment. The new Structure shall accommodate:

i The Earl Armstrong Road cross section in accordance with Clause 6.18 of this Part 2;

ii The northbound and southbound Track alignment, including Emergency walkway under the Structure; and,

iii A MUP.

B. Design and construction of a new grade separation that accommodates Earl Armstrong Road over the alignment shall:

i Include the installation of Bridge Structure fencing in accordance with the requirements in Schedule 15-2, Part 6, Clause 2.7; and,

ii Accommodate the MUP under the Structure on the east side of the alignment.

C. Design and Construction of a new grade separation that accommodates the alignment over Earl Armstrong Road shall:

i Include the installation of a pedestrian barrier/railing system on each side of the Structure; and,

ii Allow for an at-grade MUP crossing with Earl Armstrong Road to the east of the Structure.

(v) High Road Bridge (SN225670)

A. Design and construct a new Overhead Structure to carry a MUP and ecological corridor over the alignment. The new Structure shall accommodate:

i A MUP and ecological corridor on the Structure; and,

ii The northbound and southbound Track alignment, including Emergency walkway under the Structure.

B. Configuration of the MUP and ecological corridor on the Structure shall be in accordance with Schedule 15-2, Part 6, Clause 4.4.

C. Install Bridge Structure fencing in accordance with the requirements in Schedule 15-2, Part 6, Clause 2.7.

(vi) Leitrim Road Bridge (SN225610)

A. Design and construct a new grade separation at Leitrim Road to either accommodate the alignment over the Structure or the Roadway over the alignment. The Structure shall accommodate:

i The Leitrim Road cross section in accordance with Clause 6.18 of this Part 2;

ii The northbound and southbound Track alignment, including Emergency walkway; and,

iii A MUP.

B. The new Structure shall abide by the Airport Zoning Regulations Exemption to be secured by the City as outlined in Schedule 32 – City Permits, Licenses, Approvals and Authorizations.

C. The two existing watermains adjacent to the alignment shall be protected in accordance with the requirements of Article 8 of this Part 2.

D. Design and construction of a new grade separation that accommodates Leitrim Road over the alignment shall:

i Include the installation of Bridge Structure fencing in accordance with the requirements in Schedule 15-2, Part 6, Clause 2.7; and,

ii The Design Life for the new Overhead Structure shall be 40 years and.

E. Design and construction of a new grade separation that accommodates the alignment over Leitrim Road shall:

i Include the installation of a pedestrian barrier/railing system on each side of the Structure; and,

iii. Center piers shall not be permitted.

(vii) Rail Bridge over Lester Road (SN225620)

A. Design and construct a new elevated Guideway Structure to carry the alignment over the Lester Road. The new Structure shall accommodate:

i The single Track alignment, including an Emergency walkway on the Structure; and,

ii The Lester Road cross section in accordance with Clause 6.18 of this Part 2 under the Structure.

B. Install a pedestrian barrier/railing system on each side of the Structure.

C. Center piers shall not be permitted.

D. Structure shall be designed and constructed to allow for future widening of the Bridge to accommodate a second Track. Overbuilding of the substructure is not required.

E. Use of the new rail Bridge over Lester Road for the NRC access to the current NRC yard in lieu of a separate NRC spur line shall be permitted, provided that:

i The new Bridge is designed and constructed to allow for the passage of the Vehicle and freight Trains; and,

ii Modifications to the existing NRC internal Track and yard are not required.

(viii) Hunt Club Road Bridge (SN055350)

A. Complete a seismic evaluation to determine if seismic upgrades are required to AREMA requirements. Project Co shall perform all required repairs and/or seismic upgrades or replacement.

B. Replace the existing railing system on the Structure with a new pedestrian barrier/railing system.

(ix) Rail Bridge over Hunt Club Road (SN055440)

A. Design and construct a new Elevated Guideway to carry the alignment over Hunt Club Road. The new Structure shall accommodate:

i The single Track alignment on the Structure; and,

ii The existing Hunt Club Road cross section under the Structure.

B. Install a pedestrian barrier/railing system on each side of the Structure.

(x) Hunt Club Road MUP Bridge (SN058620)

A. Design and construct a new pedestrian Structure to carry a MUP over Hunt Club Road. The new Structure shall accommodate:

i A MUP with a minimum width of 4.2m on the Structure; and,

ii The existing Hunt Club Road cross section under the Structure.

iii Install a bicycle barrier/railing system on each side of the Structure. Barrier/railing system on the Structure shall be a minimum of 1.37m in height.

(xi) Rail Bridge over MUP north of Hunt Club Road (SN055740)

A. Design and construct a new Guideway Structure to carry the alignment over a MUP. The new Structure shall accommodate:

i The northbound and southbound alignment, including Emergency walkway on the Structure; and,

ii A MUP under the Structure.

B. The minimum opening under the Structure shall be 6m wide and 3m high. The haunches of a concrete box section shall be permitted to intrude into this opening provided the haunch dimensions do not exceed 600mm x 600mm.

C. Install a pedestrian barrier/railing system on each side of the Structure.

(xii) Rail Bridge at South Keys Station (SN058490)

A. Project Co shall complete a structural evaluation to ensure the structural capacity of the Structure is not exceeded with the application of all loads as defined in Clause 4.5 of this Part 2.

B. Project Co shall ensure that the Structure has adequate width to accommodate a second railway Track and Train platform for the South Keys Station. Project Co shall perform all required Structure modifications and/or repairs needed to accommodate a second Track and Train Platform. Structure modifications shall be completed in conjunction with the South Keys Station.

C. Project Co shall perform all required repairs, strengthening or replacement to ensure the structural capacity of the Structure is not exceeded.

(xiii) Pedestrian Overpass north of South Keys Station (SN055750)

A. Design and construct a new Guideway Structure to carry the alignment over a future MUP. The new Structure shall accommodate:

i The northbound and southbound alignment, including Emergency walkway, on the Structure; and,

ii A future MUP under the Structure.

B. The minimum opening under the Structure shall be 6m wide and 3m high. The haunches of a concrete box section shall be permitted to intrude into this opening provided the haunch dimensions do not exceed 600mm x 600mm.

C. The Structure shall be designed and constructed in conjunction with the South Keys Station. Refer to Schedule 15-2, Part 4, Clause 3.9 (e).

D. Install a pedestrian barrier and/or handrail on each side of the Structure.

(xiv) Walkley Yard Lead over Transitway (SN055900)

A. Project Co shall complete a seismic evaluation to determine if seismic upgrades are required to meet AREMA requirements. Project Co shall perform all required repairs, seismic upgrades or replacement.

(xv) Rail Bridge over Transitway at Walkley Yard Connecting Track (SN055910)

A. Project Co shall complete a seismic evaluation to determine if seismic upgrades are required to meet AREMA requirements. Project Co shall perform all required repairs, seismic upgrades or replacement.

(xvi) Sawmill Creek Culvert (SN055470)

A. Project Co shall complete a structural evaluation to ensure the structural capacity of the Structure is not exceeded with the application of all loads as defined in Clause 4.5 of this Part 2. Project Co shall perform all required repairs, strengthening or replacement to ensure the structural capacity of the Structure is not exceeded.

(xvii) Sawmill Creek Bridge (SN055200)

A. Project Co shall decommission and remove the Structure in accordance with Schedule 15-2, Part 1, Article 13 – Demolition, Removals and Disposal.

(xviii) Rail Bridge over Southeast Transitway (SN055930)

A. Project Co shall decommission and remove the Structure in accordance with Schedule 15-2, Part 1, Article 13 – Demolition, Removals and Disposal.

(xix) **[REDACTED]** Grade Separation at Ellwood Diamond (SN055940)

A. Design and construct a new Guideway Structure to separate the alignment from the **[REDACTED]** tracks at the Elwood Diamond. The new Structure shall accommodate:

i The alignment, including Emergency walkway, on the Structure; and,

ii The existing **[REDACTED]**, the existing Transitway, Sawmill Creek and the existing Brookfield MUP under the Structure.

B. Project Co shall ensure that neither **[REDACTED]** nor **[REDACTED]** operations are impacted by the construction of the grade-separation.

C. The existing Brookfield MUP connection adjacent to Sawmill Creek shall be maintained and meet the requirements of Schedule 15-2, Part 6 – Landscape Architecture and Connectivity Requirements.

D. Project Co shall ensure the design of the Guideway Structure will not obstruct the construction of a future second Track, to be supported on either a widened Structure or an independent twin Structure.

(xx) Rideau River Bridge (SN015290)

A. Project Co shall complete a seismic evaluation to determine if seismic upgrades are required to meet AREMA requirements.

B. Project Co shall complete a structural evaluation to ensure the structural capacity of the Structure is not exceeded with the application of all loads as defined in Clause 4.5 of this Part 2. Project Co shall perform all required repairs, strengthening, seismic upgrades or replacement to ensure the structural capacity of the Structure is not exceeded. At a minimum, Project Co shall peform the following upgrades;

i Replacement of span 2 and span 4 bearings to ensure the safe transfer of loads from superstructure to substructure

ii Repoint all stone masonry joints in the south abutment and wingwalls

iii Repair deteriorated masonry stones in the south abutment and wingwalls

iv Remove the existing deteriorated parging, reface the north abutment and wingwalls and install wall drains through the wingwalls to prevent build-up of water behind the abutment

v Remove existing concrete refacing and reface pier #1

vi Repoint deteriorated stone masonry joints in pier #2 and pier #3 shafts

vii Remove and replace the concrete collars at the base of pier #2 and pier #3 shafts and

viii Repair spalled and delaminated areas of concrete at the top of the South Abutment

C. Install a pedestrian barrier/railing system on each side of the Structure.

(xxi) University Road Pedestrian Bridge over Rideau River (SN018750)

A. Design and construct a new single span pedestrian Structure to carry a MUP over the Rideau River. The new Structure shall accommodate:

i A MUP with a minimum clear width of 5.0m on the Structure;

ii A minimum clear span length of 63.5m; and,

iii A design service life of 75 years.

B. Bridge superstructure shall be a painted steel Structure with a concrete deck. Concrete deck shall include curbs and a drainage system to prevent runoff onto the supporting superstructure.

C. Project Co shall provide bridge with a fabrication camber that counters the effects of full dead load deflection in order to obtain a final vertical camber that matches approach grade slopes.

D. Bridge substructure shall be constructed of reinforced concrete. Foundations shall be spread footings bearing on rock. Bottom of footings shall be cast a minimum of 250mm into sound bedrock and sides of footings shall be cast against undisturbed rock.

E. Intermediate piers shall be prohibited.

F. Outer faces of abutment walls shall accommodate:

i A natural stone architectural finish consisting of a 75mm minimum depth as defined in Schedule 15-2, Part 6 – Urban Design, Landscape Architecture and Connectivity Requirements. Relief pattern shall appear natural and non-repeating; and,

ii An anti-graffiti coating shall be applied to the full height of the natural stone finish. Coating shall be clear and shall not alter the color of the stone finish.

G. Install a pedestrian barrier/railing system on each side of the Structure and along retaining walls and wingwalls, as required, a minimum of 1.37m in height consisting of a painted steel guardrail and an IPE wood handrail.

H. Project Co shall demonstrate that the barrier/railing system is designed to prevent the attachment of pad-locks to longitudinal elements along the Bridge.

I. Centreline of the Structure shall be offset by a minimum of 23m from the centreline of the adjacent Rideau River Bridge.

J. Project Co shall design the Structure bottom chord to be above the greater of the following:

i A minimum opening under the Structure based on a 3.0m navigational clearance above the normal water elevation of the Rideau River, to be confirmed by Transport Canada's Navigational Protection Act requirements as per Schedule 32 - City Permits, Licences, Approvals and Authorizations; or.

ii A 0.3m clearance above the 1:100 year flood elevation which will result from the placement of fill as defined in Clause 5.7 of this Part 2.

K. The coating system for the steel truss and railing shall conform to the following requirements, at a minimum:

i Low VOC Paint Coating System 2 as specified in the MTO Structural Steel Coating Manual; and,

ii The colour of the topcoat shall be 17038 black – according to Federal Standard 595B colours.

L. An anti-slip coating shall be applied to all expansion joint cover plates.

M. Removable bollards shall be installed at both bridge approaches to prevent vehicular access.

N. All stone retaining walls along the Bridge approaches required to construct the pedestrian Bridge shall be designed and checked by a Professional Engineer.

(xxii) South Rail Bridge over MUP at Carleton University (SN018510)

A. Project Co shall complete a structural evaluation to ensure the structural capacity of the Structure is not exceeded with the application of all loads as defined in Clause 4.5 of this Part 2. Project Co shall perform all required repairs, strengthening or replacement to ensure the structural capacity of the Structure is not exceeded.

B. Project Co shall ensure the Structure has adequate width to accommodate siding Track. Project Co. shall carry out all required Structure modifications and/or repairs needed to accommodate the siding Track.

C. Install a pedestrian barrier/railing system on each side of the Structure.

(xxiii) Carleton University Tunnel at Carleton Station (SN015440)

A. Design and construct a new pedestrian Tunnel segment. The new Structure shall accommodate:

i The southbound and northbound Track alignment over the Structure; and,

ii Future pedestrian traffic in the Tunnel.

B. The Tunnel shall be designed and constructed within the Lands and in accordance with the requirements of Schedule 15-2, Part 4, Clause 3.5.

(xxiv) Existing Carleton University Tunnel System (SN015430)

A. Project Co shall complete a structural evaluation to ensure the structural capacity of the Structure is not exceeded with the application of all loads as defined in Clause 4.5 of this Part 2. Project Co shall perform all required repairs, strengthening or replacement to ensure the structural capacity of the Structure is not exceeded.

(xxv) North Rail Bridge over MUP at Carleton University (SN018490)

A. Project Co shall design and construct a new elevated Guideway Structure to carry the alignment over a MUP. The new Structure shall accommodate:

i The single Track and siding Track alignment, including an Emergency walkway on the Structure; and,

ii A MUP under the Structure

B. The Structure shall have a minimum opening size of 9m wide by 3m high. The haunches of a concrete box section shall be permitted to intrude into this opening provided the haunch dimensions do not exceed 600mm x 600mm.

C. Install a pedestrian barrier/railing system on each side of the Structure.

(xxvi) Existing Tunnel under Dow's Lake (SN019020)

A. Project Co shall design and construct Tunnel upgrades and rehabilitation work for the following components of the Tunnel. Design and construction documents are to be submitted per the requirements of Schedule 10 – Review Procedure.

i Concrete structural repairs for spalled surfaces greater than 50mm deep with exposed rebar, crack repairs for crack widths between 0.15mm to 1mm and ballast curb concrete and rebar replacement sections.

ii Existing Tunnel Track tie removal and replacement with ties meeting NFPA 130 requirements and having an elastic fastening system per the material requirements of Clause 3.7 of this Part 2.

iii Track ballast removal and replacement with material meeting the requirement of Clause 3.5 (c)(iii), of this Part 2.

iv Assess the condition of the concrete Tunnel Track slab and curbs after Track and ballast removal. Project Co shall make repairs to the Track slab and curbs as necessary to properly support the Track and to ensure the water infiltration criteria at the expansion joint locations of Clause 4.8 (c)(xxvi)(B) of this Part 2 are met and that the surface and slope of the Track slab allows for positive drainage to the ballast curb weep holes for collection in the Tunnel drainage gutters as originally designed. Track slab repair design and construction shall be in accordance with the applicable criteria for Guideway Structures as specified in this Article 4 and the Track requirements of Article 3 – Trackwork, of this Part 2.

v Dry standpipe system upgrades meeting NFPA 130 standards, and the design criteria in Schedule 15-2, Part 4 – Stations, work to include but not be limited to:

1. Removal of all existing standpipe hose connections, shut off valves, drop piping and installation of new components meeting NFPA standards;

2. Provide/relocate fire department connections at locations as required per NFPA standards and modify piping accordingly;

3. Demolish existing standpipe isolation valves and provide new isolation valves at a height that can be operated at floor level;

4. Provide automatic air relief-vacuum valves at all standpipe high points;

5. Provide drains at all fire standpipe system low points;

6. Provide pipe supports to meet requirements for new installations;

7. Replace all existing mechanical couplings for the standpipe main where any existing coupling connection failed the initial pressure test; replace the existing standpipe main in its entirety where any two or more existing connections or pipe failed the initial pressure test; and,

8. The standpipe system upgrades shall not involve any structural modifications and structural lining removals of the Tunnel Structure. If the existing Tunnel Structure and Vehicle clearance envelope prevent compliance with NFPA requirements Project Co shall propose an alternative design that is acceptable with the AHJ and will be documented in the NFPA 130 Compliance Report described herein.

vi The Tunnel Drainage System, including all facilities which remove or are intended to remove water which would otherwise collect within the Tunnel, including but not limited to all ditches, gutters, catch basins and other inlets, grates, catch basin leads, maintenance holes, sewers and other drainage piping, weep holes, screens, pumping stations, force mains and outlets including the outlet pipe and outfall to Dow's Lake. Work shall include but not be limited to:

1. Evaluate the existing Tunnel Drainage system and implement remedial measures as necessary to bring the Tunnel drainage system into compliance with the

requirements as specified in Article 5 – Drainage and Stormwater Management Design Criteria of this Part 2;

2. Remedial measures may include: improvement of connections between Tunnel Drainage gutters and the external storm sewer; improvement of cross connections between existing east and west drainage gutters; interception of flows within drainage ditches upstream of one or both Tunnel portals and diversion either by gravity or pumping to alternative outlet(s); improvement of the alternative outlet to include upsizing or installation of downstream sewers; the replacement of existing pumps and/or installation of additional pumps; and, installation of storm water quality and quantity controls for outlets; and,

3. The evaluation of the Dow's Lake Tunnel Drainage System shall make allowance for fire-fighting flows and infiltration.

vii Tunnel ventilation system meeting the requirements of NFPA 130 for Emergency Tunnel ventilation and the Canada Occupational Health and Safety Regulations for normal operation and ventilation of Revenue Vehicles meeting the requirements of Schedule 15-2, Part 8 - Vehicles. Design Criteria for the ventilation system is outlined in the Emergency Ventilation System and Egress Evaluation Report requirements of this Article.

viii Expansion joint water infiltration mitigation measures meeting the design requirements of the Water Infiltration Management Plan of this Article.

ix Upgrades to the Tunnel to comply with NFPA 130 standards. The upgrades are to include but not be limited to, the following:

1. Improvements to the existing Emergency walkway where the walkway does not meet the egress standards of NFPA 130;

2. Replacement of existing non-fire rated wiring in the Tunnel with wiring meeting NFPA 130 standards;

3. Provide a battery back-up system for Tunnel lighting;

4. Provide directional signs in Tunnel and illuminated exit signs at the portals; and,

5. Install FTELs in the Tunnel and upgrade the communications systems in the Tunnel and BAS with the TOCC and ESP. Refer to Schedule 15-2, Part 3, Article 3 – Telephone and Intercom System and Article 5 – Voice and Data Radio System, for radio communications requirements. The FTELs shall provide the same function as the blue light stations of NFPA 130 but shall be modified such that a fluorescent or reflective sign describing the function of the FTEL is located at the top of the station instead of the standard blue light. Signage shall be provided adjacent to each FTEL station providing information that identifies the location of the Tunnel exits and the distance to the exits in both directions. Refer to Schedule 15-2, Part 4, Article 7 – Wayfinding and Signage for applicable signage design criteria. The FTELs shall be located in the Tunnel at both portal exits and any Emergency egress (two safety bays) locations within the Tunnel. The FTEL stations shall be spaced throughout the Tunnel 100m apart along the Emergency walkway. Based on a 600m tunnel, roughly eight FTELs shall be installed in the Dows Lake Tunnel.

B. Project Co shall prepare and submit a Water Infiltration Management Plan for the 22 existing expansion joints in the Tunnel per the requirements of Schedule 10 – Review Procedure. The plan shall include design drawings showing the means and methods of managing water infiltration at the expansion joints. The plan shall incorporate the following criteria and minimum requirements:

i Water from the expansion joint shall not be allowed to leak onto the Track, ballast, ballast curbs and Emergency walkway;

ii Water from the expansion joints shall not drip onto Tunnel equipment, conduits, piping, lighting and any other system components in the Tunnel:

iii Water shall not be allowed to freeze in the joint and the joint shall be kept free of debris;

iv Determine a maximum infiltration rate per expansion joint as well as a total Tunnel expansion joint infiltration volume on a total L/day measurement that can be accommodated by the upgraded Tunnel drainage system. The infiltration rate and total infiltration volumes shall incorporate the Drainage and Stormwater

Management Design Criteria of Article 5 – Drainage and Stormwater Management Design Criteria of this Part 2, and any design improvements required to the existing drainage system as defined in this Article. The maximum infiltration rate at any one expansion joint shall not exceed 500L/day;

v Schedule for periodic inspections of the expansion joints and the concrete either side of the expansion joint a minimum of once a year for the duration of the Project Term to ensure the water infiltration management plan is performing as designed;

vi Schedule for expansion joint water infiltration volume measurements taken during periods when the Tunnel is experiencing the highest rate of water infiltration through the joints for the duration of the Project Term to verify the design maximum infiltration rates are not exceeded; and,

vii Designs shall account for the vertical clearances of Clause 2.12 of this Part 2.

C. Project Co shall prepare and submit in accordance with Schedule 10 – Review Procedure, an Emergency Ventilation System and Egress Evaluation Report for the Tunnel ventilation system per the requirements of NFPA 130. Evaluation shall include at a minimum SES and if required CFD analyses for fire cases in the Tunnels to demonstrate that the existing exhaust fans meet the design criteria of NFPA 130. Modifications to the existing Emergency ventilation system necessary to meet the design criteria based on the SES and CFD study results shall be included in the analyses. The report shall include modelling assumptions, methodology and criteria including reference to applicable Codes and standards, tenability criteria and time of tenability calculations for the Tunnel, fire scenario development, fire detection time and ventilation system start up time, modelling input data and assumptions, acceptable limits and other constraints. The Tunnel ventilation fans shall satisfy the following design criteria:

i Design Fire Data: Project Co shall determine the fire heat release rate using the Revenue Vehicle properties and fuel capacities based on a probable fire scenario in the Tunnel.

ii Maximum Emergency operation air velocity of 11.0 m/s.

iii Ventilation equipment noise shall not exceed a speech interference level, measured at 1.5 m above walking surface along the path of

evacuation in the Tunnel, of 78 dBZ Leq 'slow' over any period of 1 minute, using the arithmetic average of unweighted sound pressure level in the 500, 1000, 2000 and 4000 Hz octave bands.

iv Refer to Schedule 17 – Environmental Obligations for external noise level restrictions.

v Normal fan operation shall ensure carbon monoxide limits in the Tunnel from Revenue Vehicles and the Vehicle requirements of Schedule 15-2, Part 8 - Vehicles do not exceed safe concentrations for exposure to passengers, operators and persons working in the Tunnel. The report shall include limits for carbon monoxide concentrations as well as particulate matter visibility levels in the Tunnel as determined through Code requirements and environmental regulations. At a minimum, the ventilation system shall be designed to operate when carbon monoxide limits are above 100 ppm and the fans shall only turn off when the carbon monoxide level is brought below 30 ppm. For visibility, an extinction coefficient above 0.007 per meter shall activate the ventilation system until visibility falls below 0.005 per meter. Carbon monoxide and visibility monitoring equipment shall be included in the design and connected to the BAS.

vi Modification or replacement of the existing ventilation system shall be designed and constructed based on the available space and physical constraints of the Tunnel clearance envelope and the ventilation air shaft. Structural modifications to the Tunnel and ventilation shaft shall not be permitted to accommodate a modified or replacement Tunnel ventilation system. Refer to Clause 2.12 of this Part 2 for vertical clearance requirements in the Tunnel.

vii The existing pump house building may be modified to accommodate an upgraded Tunnel ventilation system as determined by Project Co's Co's Emergency Ventilation System and Egress Evaluation Report and the ventilation system maintenance responsibilities of Schedule 15-3 – Maintenance and Rehabilitation Requirements. Pump house modifications shall be subject to the requirements of Schedule 15-2, Part 4 - Stations and all applicable codes and standards referenced therein. Architectural and structural modifications shall also be required to match the existing building materials and structural systems and shall be subject to the City's and the NCC's approval.

viii Any upgrades to the existing Tunnel ventilation system or replacement Tunnel ventilation system shall be classified as a new Tunnel ventilation system. Project Co shall design a new stand-alone head end located in the TOCC and BCC for the new Tunnel ventilation system, which shall not be integrated with the Existing Confederation Line SCADA. The Trillium Line's new S&TCS and fire detection and alarm systems shall be integrated with the Dow's Lake Tunnel Tunnel ventilation system head end to communicate with Vehicle Operators and prevent their entry into Dow's Lake Tunnel during an Emergency. Project Co shall design, procure and install all of the hardware and software necessary to operate and monitor the Tunnel ventilation system including two new operator workstations in the TOCC operational theatre and one new operator workstation in the BCC operational theater. Operator workstation functions shall vary based upon the responsibility and access rights of the person who is logged on at that workstation at any given time. The workstations shall include visual displays, keyboards, telephones, head-set connection and head-set, microphone and printer. Project Co shall connect the new Tunnel ventilation system to the new head end in the TOCC and BCC via the CTS. Refer to Schedule 15-2 Part 3 – Systems for S&TCS and CTS design requirements.

D. Project Co shall develop an NFPA 130 Compliance Report for the Tunnel components demonstrating design modifications and upgrades to satisfy the requirements for trainways, Emergency ventilation, Emergency procedures, communications, controls, wire, and cable requirements. Refer to Schedule 15-2, Part 4 Stations, clause 5.8 - Building Automation System for BAS design requirements and compatibility with other BAS systems of the Existing Trillium Line to be incorporated along with the NFPA 130 requirements. The CTS requirements of Schedule 15-2 Part 3 – Systems, shall be implemented for all modifications and replacements to the systems and equipment in the Tunnel and pump house building necessary to satisfy compliance. The report shall include a compliance checklist identifying each applicable requirement of NFPA 130 with design narratives and supporting documentation demonstrating how the design addresses these requirements. The report and compliance checklist shall be submitted per the requirements of Schedule 10 – Review Procedure.

E. Project Co shall design and install an automatic fire detection system in the Tunnel that shall be integrated with the new Dows Lake Tunnel ventilation system head end. The fire detection system shall communicate with the Dows Lake Tunnel ventilation system head end workstations and

an annunciator panel in the pump house via the CTS or otherwise acceptable methods satisfying NFPA 130 and the City and the AHJ. Project Co shall perform a reliability analysis per the requirements of NFPA 130 to satisfy operational continuity of the systems in the Tunnel for a specified time during a fire with acceptance from the City and AHJ. Refer to Schedule 15-2, Part 4 – Stations for electrical requirements for the fire detection system.

F. Project Co shal perform a smoke dispersion/recirculation study for the existing and modified Emergency ventilation system to demonstrate smoke discharged from Emergency ventilation exhaust points is not drawn into the Tunnel or the pump house;

G. Project Co shall be permitted to drill into and connect to the existing Tunnel structural lining for supporting the upgrades to the Tunnel drainage, ventilation and FLS, required by the design, subject to the design calculations demonstrating the loads imposed do not overstress the Structure. The connection design and construction shall not reduce the existing structural capacity or water tightness of the Tunnel lining.

(xxvii) Walkley Road Overpass O-Train Line (SN055330)

A. Install Bridge Structure fencing in accordance with the requirements in Schedule 15-2, Part 6, Clause 2.7.

(xxviii)Heron Road Overpass O-Train Line (SN055260)

A. Install Bridge Structure fencing in accordance with the requirements in Schedule 15-2, Part 6, Clause 2.7.

(xxix) Riverside Drive Overpass O-Train Line (SN055280)

A. Install Bridge Structure fencing in accordance with the requirements in Schedule 15-2, Part 6, Clause 2.7.

(xxx) Campus Avenue Overpass O-Train Line (SN015850)

A. Install Bridge Structure fencing in accordance with the requirements in Schedule 15-2, Part 6, Clause 2.7.

(xxxi) Somerset Street Overpass O-Train Line (SN015340)

A. Install Bridge Structure fencing in accordance with the requirements in Schedule 15-2, Part 6, Clause 2.7.

(xxxii) Trinity Pedestrian Bridge (SN018430)

A. Design and construct a new pedestrian Structure to carry pedestrian traffic from the development at 900 Albert to the west Bayview Station Platform area. The new Structure shall accommodate:

i A pedestrian connection on the Structure; and,

ii The northbound and southbound Track alignment, including Emergency walkway and MUP under the Structure.

B. The Structure shall be designed and constructed in accordance with the requirements of Schedule 15-2, Part 4, Clause 3.2.

(xxxiii)Albert Street Overpass O-Train Line (SN015380)

A. Install Bridge Structure fencing in accordance with the requirements in Schedule 15-2, Part 6, Clause 2.7.

(d) Project Co shall complete the following work as part of the Airport Link:

(i) Elevated Guideway to OMCIA Terminal (SN225110)

A. Design and construct a new elevated Guideway Structure to carry the alignment over various Roadway and parking areas. The new Structure shall accommodate:

i The single Track alignment, including Emergency walkway on the Structure; and,

ii The existing Paul Benoit Driveway, Tracker Private, Silver-Star Private and Convair Private cross sections and existing airport parking lots under the Structure.

B. Structure shall be designed and constructed to be visually compatible and have similar layout as the existing adjacent airport Bridge Structure while also meeting the aesthetic requirements of a Level 1 Bridge.

C. The Structure shall be designed and constructed in conjunction with the new elevated Airport Terminal Station. Design shall be coordinated with OMCIAA representatives.

D. Install a pedestrian barrier/railing system on each side of the Structure.

E. The substructure and deep foundations shall be designed and constructed to protect for the cantilevered Airport Station concourse, as shown in the STA-AP-A RCD dated April 3, 2017 or as otherwise agreed to by the City and the OMCIAA.

F. The Structure and Station Platform shall be designed and constructed in conjunction with the requirements of Schedule 15-2, Part 4, Clause 3.13.

G. The Structure shall be designed and constructed to allow for future widening of the Bridge to accommodate a second Track. Overbuilding of the substructure is not required.

H. The Structure shall be detailed to discourage bird nesting.

I. The Station Platform shall be designed and constructed in a manner which will allow the OMCIAA contractor to safely remove the top 25mm of concrete from the surface of the Station Platform over a 3000mm length measured from the juncture between the Station Platform and the airport facility.

J. Graffiti-resistant coating shall be applied to all porous opaque surfaces, including but not limited to, concrete, masonry and stone up to a minimum of 2.5m above the adjacent ground or where surfaces are reachable to tag.

(ii) Railway Bridge over Uplands Drive (SN 225640)

A. Design and construct a new single span elevated Guideway Structure to carry the alignment over Uplands Drive. The new single span Structure shall accommodate:

i The single Track alignment, including Emergency walkway on the Structure; and,

ii The future Uplands Drive cross section in accordance with Clause 6.18 of this Part 2, and MUP in accordance with Schedule 15-2, Part 6, Clause 4.4, under the Structure.

B. Install a pedestrian barrier/railing system on each side of the Structure.

C. The Structure shall be designed and constructed to allow for future widening of the Bridge to accommodate a second Track. Overbuilding of the substructure is not required.

D. Graffiti-resistant coating shall be applied to all porous opaque surfaces, including but not limited to, concrete, masonry and stone up to a minimum of 2.5m above the adjacent ground or where surfaces are reachable to tag.

(iii) Railway Bridge over Airport Parkway (SN 225630)

A. Design and construct a new elevated Guideway Structure to carry the alignment over Airport Parkway. The new Structure shall accommodate:

i The northbound and southbound Track alignment, including Emergency walkway on the Structure; and,

ii The future Airport Parkway cross section in accordance with Clause 6.18 of this Part 2 under the Structure.

B. Install a pedestrian barrier/railing system on each side of the Structure.

C. Graffiti-resistant coating shall be applied to all porous opaque surfaces, including but not limited to, concrete, masonry and stone up to a minimum of 2.5m above the adjacent ground or where surfaces are reachable to tag.

ARTICLE 5 DRAINAGE AND STORMWATER MANAGEMENT DESIGN CRITERIA

5.1 Reference Documents

(a) Project Co shall complete the Works in accordance with the criteria contained in this Article, the Project Agreement, and the Applicable Law, including but not limited to the latest edition of the following Reference Documents:

(i) City Publications:

A. City of Ottawa Sewer Design Guidelines, including Technical bulletins;

B. Stormwater Management Facility Design Guidelines;

C. City of Ottawa By-Laws; and,

D. Riverside South Community Master Drainage Plan, Stantec.

(ii) Federal and Provincial Codes, Acts and Regulations:

A. Fisheries Act (Canada);

B. Ontario Water Resources Act;

C. Drainage Act (Ontario);

D. Ontario Regulation 525/98 - Approval Exemption; and,

E. Ontario Building Code.

(iii) Conservation Authority Publications:

A. RVCA: Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses (Ontario Regulation 174/06);

B. SNCA: Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses (Ontario Regulation 170/06), Conservation Authorities Act, R.S.O. 1990, c. C.27;

C. RVCA: Solutions for Shoreline Erosion;

D. TRCA/CVC: Low Impact Development Stormwater Management Planning and Design Guideline; and,

E. CVC: Low Impact Development Construction Guide.

(iv) MOECC Publications:

A. Stormwater Management Planning and Design Manual;

B. Design Guidelines for Sewage Works;

C. Guideline B-6 – Guidelines for Evaluating Construction Activities Impacting on Water Resources;

D. Environmental Activity and Sector Registry information https://www.ontario.ca/page/environmental-activity-and-sector-registry; and,

E. Permit To Take Water Manual.

(v) Ontario MNR Publications:

A. Technical Guide – River & Stream Systems: Flooding Hazard Limit.

(vi) MTO Publications:

A. Drainage Management Manual;

B. Highway Drainage Design Standards;

C. Gravity Pipe Design Manual; and,

D. Environmental Guide for Erosion and Sediment Control during Construction of Highway Projects.

(vii) CHBDC**;**

(viii) AREMA Manual for Railway Engineering;

(ix) NFPA 130; and,

(x) Other applicable policies, acts and guidelines by the City, Regulators, and Governmental Authorities.

5.2 General Criteria

(a) Project Co shall design and construct a drainage and SWM system such that Revenue Service operations can safely continue, and such that surface ponding remains below the TOR, during the 100-Year Storm event.

(b) Project Co shall evaluate the performance of the drainage and SWM system under historical storms and 100-Year Storm Plus 20% (stress test condition) and modify the design as needed in accordance with the City of Ottawa Sewer Design Guidelines and Technical Bulletins.

(c) Runoff from at-grade and below grade segments shall be collected by trackside ditches, perforated underdrain pipes, or storm sewers. All Guideway drainage shall be captured and managed within the Guideway ROW/Lands with SWMPs that provide attenuation up to the 100-Year Storm and water quality protection that meets MOECC's 'Enhanced' standard before discharging to outlet locations. Discharge shall be to outlet locations identified in Clause 5.7 – Site Specific Criteria, of this Part 2. Storm water from the Guideway shall not be allowed to sheet flow onto adjacent properties at greater peak rates than existing.

(d) Runoff from raised Guideway, where Guideway is an embankment, may be discharged along the embankment provided runoff is evenly distributed to prevent erosion, before being collected by SWMPs that provide attenuation up to the 100-Year Storm and water quality protection that meets MOECC's 'Enhanced' standard.

(e) Runoff from raised Guideway, where the raised Guideway is a Structure, shall be conveyed by gutter systems to inlets. Inlets shall discharge to SWMPs that provide attenuation up to the 100-Year Storm and water quality protection that meets MOECC's 'Enhanced' standard.

(f) Project Co shall secure all permits and approvals where necessary for the implementation of the Drainage and SWM systems for the Project, and shall be responsible for preparing and submitting all necessary drawings and supporting documentation associated with obtaining those permits and approvals in accordance with Schedule 10 – Review Procedure.

(g) Project Co shall be responsible for all costs associated with obtaining the required permits and approvals, and those associated with providing the Drainage and SWM systems for SI.

(h) Project Co shall obtain sewer discharge permits and approvals in accordance with the City, MOECC, RVCA, and SNCA requirements.

(i) Project Co shall obtain all PTTWs and/or Environmental Activity and Sector Registry registrations, in accordance with current MOECC requirements, for the Works.

(j) Project Co shall obtain municipal approval for additions and modifications to existing sewers and related appurtenances and shall ensure that these additions and modifications conform to the requirements of the City or other Governmental Authorities.

(k) Project Co shall ensure services to adjoining properties are supported in place and maintained in operation during additions to or modifications of the existing sewers.

(l) Without limiting any other obligations of Project Co, Project Co shall be in compliance with Ontario Regulation 166/06 (Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses) for Works within RVCA and SNCA regulated areas.

(m) No sanitary sewer discharge shall be permitted to enter the Drainage and SWM systems supporting SI.

(n) Project Co shall design and construct Drainage and SWM systems such that any impact to existing Drainage systems and overland flow is mitigated and such that new Hazards are not introduced.

(o) Project Co shall provide complete design packages for all Drainage and SWM components, submitted in accordance with Schedule 10 – Review Procedure. Design packages shall include all Drainage and SWM works including detailed drawings, calculations, reports, and related ECA applications.

5.3 Drainage Criteria

(a) The Drainage Design Criteria provided herein are considered a minimum standard. The design of drainage facilities belonging to the City and other Governmental Authorities which are to be relocated or modified to accommodate SI shall conform to the Design Criteria and standards of the City and other Governmental Authorities.

(b) Required relocation of existing drainage facilities shall be Replacement-In-Kind unless specified otherwise.

(c) Project Co shall design and construct drainage measures for the Project including the Guideways, Tunnels, Stations, the New Walkley Yard, Roadways, parking lots, and other SI, in accordance with City and provincial standards.

(d) Project Co shall not increase flow rates to existing combined sewers or separated sewers unless the increase is approved by the City. Flow rates shall be limited in accordance with Section 3.2 of the Ottawa Sewer Design Guidelines.

(e) Project Co shall design and construct new storm sewers to convey minor system flows such that they capture and convey a design storm event in accordance with Section 5.10 of the City of Ottawa Sewer Design Guidelines.

(f) Project Co shall design and construct on-Site controls and overland flow routes for storage and conveyance of SI runoff in excess of the design capacity of the receiving minor system, in accordance with Section 5 of the City of Ottawa Sewer Design

Guidelines and Technical Bulletins, for all storms up to the 100-Year Storm. The combination of a minor system and an overland flow system shall not create flow depths above the TOR.

(g) Project Co shall demonstrate to the City through hydrologic/hydraulic analysis that the flow rates and the hydraulic grade line of receiving storm sewers does not adversely affect the existing level of service, in terms of flood protection and minor system performance, as a result of the Works.

(h) In the below-grade sections of the Guideway and Stations, Project Co shall keep Tunnel portals, Tunnels, and Stations free from flooding due to all storms up to and including the 100-Year Storm event. Refer to Clause 4.8 of this Part 2 for additional Drainage design requirements for the Dow's Lake Tunnel.

(i) Project Co shall design and construct pedestrian underpasses such that ponding does not occur for all storms up to the 5-year storm event.

(j) All Drainage for Tunnels and other areas without a local gravity outlet shall be collected and discharged to a storm sewer approved by the City. The Tunnel drainage system shall meet the requirements of Article 4 – Structural Design Criteria and Requirements, of this Part 2.

(k) Project Co shall design and construct all Drainage and SWM systems required to ensure adequate drainage during Construction of the Works. Discharges shall comply with Applicable Law and City requirements, including the Sewer Use by-law.

(l) Project Co shall comply with the following requirements for Guideway drainage:

(i) The Guideway drainage system shall be designed and constructed such that ponding levels do no exceed TOR elevation and such that ponding does not contribute to subgrade instability for all storms up to and including the 100-Year Storm;

(ii) All Drainage discharges from the Guideway shall be in accordance with Applicable Law and the requirements of the City and other Governmental Authorities; and,

(iii) Project Co shall provide maintenance holes (access points) outside of the Guideway on all new service connections, between the City's ROW and the Guideway, in accordance with City requirements. The maintenance holes and sewers shall be turned over to the City to enable the City to carry out its maintenance responsibility for storm drain/sewer service connections located beyond the limits of the Guideway.

(m) Groundwater, fireflow discharge, and storm runoff at all underground structures and other areas without a gravity outlet shall be collected and pumped to a municipal storm sewer in compliance with the City of Ottawa Sewer Use By-Law unless otherwise noted.

(n) Project Co shall design and construct a drainage system for new MUPs in accordance with the City's MUP standards and such that existing flow direction is maintained. MUP drainage shall not be combined with SI ditch drainage system. Where SI drainage goes to a closed (piped) system, and where MUPs undergo winter maintenance with de-icing salts, MUP drainage shall be managed separately from SI drainage.

(o) All new Culverts under the Guideway, regardless of size, shall be of reinforced concrete construction.

5.4 Stormwater Management Criteria

(a) SWM for the Project shall be designed and constructed in accordance with the City's "Sewer Design Guidelines" and MOECC's "Stormwater Management Planning and Design Manual".

(b) Project Co shall prepare complete SWM plans and design packages in accordance with the City and Provincial requirements for all drainage and SWM aspects of the Works to address at a minimum:

(i) Water balance, quantity and quality control requirements imposed by local, provincial and federal government regulations along with the Project environmental impacts and mitigations;

(ii) Impact on existing municipal drainage and SWM systems, and natural drainage systems;

(iii) Existing ditches, watercourses, Culvert crossings, and storm sewers that will be affected or are relevant to the Project;

(iv) Potential impacts of the Project on the existing drainage system and on any environmentally sensitive areas, in consultation with Governmental Authorities;

(v) Existing drainage patterns and how the proposed Drainage system design will extend the existing minor and major drainage systems;

(vi) Directions by Governmental Authorities in respect to changes in drainage patterns, upgrades to Drainage infrastructure or modifications, and any agreements reached with the City or Governmental Authorities;

(vii) Proposed SWMPs to mitigate potential impacts of the Works, including appropriate plans and drawings to illustrate the same; and,

(viii) All pertinent background information, calculations and model output to support the proposed designs and Works.

(c) Project Co shall submit the above SWM Plans and design packages to the City as part of the Works Submittals in accordance with Schedule 10 – Review Procedure.

(d) Drainage and SWM designs of Facilities that require review and approval from Governmental Authorities shall be submitted in accordance with the procedures established by the respective Governmental Authority and in accordance with Schedule 10 – Review Procedure. Project Co shall comply with the Governmental Authority permit requirements and conditions.

(e) The design of stormwater detention facilities and control measures proposed as part of the Works shall be submitted to the City and other Governmental Authorities for approval.

(f) Where LID measures are required, they shall be designed in accordance with the "Low Impact Development Stormwater Management Planning and Design Guidelines". Refer to Schedule 15-2, Part 6, Article 2 – Design Criteria for landscaping requirements of LID measures.

(g) Roof Drainage (above-grade structures) shall be managed in accordance with a Site-specific SWMP. Roof drainage shall not be routed to the underground Track Drainage system.

(h) Unless otherwise noted, all SWM facilities shall be designed to meet the MOECC's "Enhanced" standard.

(i) 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 3.2.2 and 8.3.7 of the City of Ottawa Sewer Design Guidelines. Water quality SWMPs for Infill development are to provide a net improvement over existing conditions.

(j) Extended detention or "wet-pond" SWM 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.

(k) OGS structures shall be designed with a required performance of removal of fine sediment, oil, floating and sinking debris, and 80% removal efficiency for TSS.

(l) OGS structures located outside of the Guideway shall be accessible by rubber tire vehicle.

5.5 Numerical Computational Procedures and Models

(a) All numerical computation procedures shall comply with the requirements of the City of Ottawa Sewer Design Guidelines. Computer models used shall comply with the guidelines for model selection provided in the MTO's "Drainage Management Manual."

(b) Project Co shall confirm the suitability and acceptance of any computer model nominated for use in the design and analysis of drainage or SWM system for the Project with the City and other Governmental Authorities.

(c) Peak flows to be used for design purposes for drainage areas greater than 40 hectares shall be verified using a method approved by the City and other Governmental Authorities.

5.6 Erosion and Sediment Control Requirements

(a) Project Co shall implement stormwater control, mitigation, ESC measures appropriate for the urban context of the Project to ensure deleterious substances and other pollutants do not leave the Site and enter watercourses or the municipal Drainage infrastructure.

(b) Project Co shall prepare an Erosion and Sediment Control Plan for the Project, as a component plan of the Environmental Management Plan described in Schedule 17 – Environmental Obligations, to comply with environmental approvals and commitments and with any and all Applicable Codes. In addition, Site-specific ESC Plans shall be developed to address local potential environmentally sensitive Site conditions, including watercourse crossings. The ESC Plan for the Project and the Site specific ESC Plans shall be submitted to the City in accordance with Schedule 10 – Review Procedure.

(c) In addition to City and Governmental Authority requirements, Erosion and Sediment Control Plans shall be prepared in accordance with the following documents:

(i) MNR, et al., 1987, Guidelines on Erosion and Sediment Control for Urban Construction Sites.

(ii) MTO's Environmental Guide for Erosion and Sediment Control during Construction of Highway Projects.

(d) Project Co shall obtain all permits and approvals for all in-water works in accordance with all Governmental Authorities' requirements.

(e) Project Co shall adhere to all fisheries (timing) window restrictions imposed by the RVCA, SNCA, or other Governmental Authorities on activities on or adjacent to watercourses associated with the Works.

5.7 Site-Specific Criteria

(a) New Walkley Yard

(i) Project Co shall implement methods, such as OGS units, to control runoff that contains sand (due to braking) or oil and grease (Track lubricant) from operations in compliance with the City of Ottawa Sewer Use By-Law. Runoff shall not be directed to any storm sewer permanently or temporarily unless the runoff is treated to meet Sewer Use By-Law criteria and MOECC's 'Enhanced' standard.

(ii) Treated runoff from the New Walkley Yard shall drain to the tributary to Sawmill Creek north of the Facility.

(iii) Any SWM facility for the New Walkley Yard shall be constructed in accordance with City requirements and MOECC 'Enhanced' Standards.

(iv) Project Co shall assess the condition of the existing Culvert under Albion Road North at the entrance to the New Walkley Yard and shall design and construct modifications and/or replacement of the Culvert as required.

(b) Gladstone

(i) The Gladstone Station is considered infill development. As such, design and construction of this Station shall comply with Section 3.2.2 and 8.3.7 of the Ottawa Sewer design Guidelines.

(ii) A storm sewer shall be constructed to convey runoff from the trackside ditches to the south of the Station and outlet to the existing 900mm diameter storm sewer that is located approximately 200m north of the Gladstone Avenue overpass.

(iii) Project Co shall include on-site SWM measures to control runoff to the 2-year pre-development level.

(c) Carling, Carleton, and Confederation

(i) The Stations are considered infill development. As such, the design and construction of these Stations shall comply with Section 3.2.2 and 8.3.7 of the Ottawa Sewer design Guidelines.

(d) Walkley

(i) The Walkley Station is considered infill development. As such, design and construction of this Station shall comply with Section 3.2.2 and 8.3.7 of the Ottawa Sewer design Guidelines.

(ii) The existing 750mm diameter Culvert shall be removed. A new RCP Culvert (minimum 750mm diameter) shall be constructed to the south of the Station Platform and convey runoff from the Station and from the adjacent catchment area east of the alignment, bordered to the north by Bank street, to the west by Walkley road, to the south by the LCBO warehouse property northern boundary, and to the east by the Guideway on the Expanded Trillium Line. This Culvert shall discharge to the west trackside ditch.

(e) Greenboro

(i) Runoff from the Greenboro Station shall drain to the existing "Sawmill Creek Constructed Wetland" SWM Facility.

(ii) No specific quantity or quality SWMPs are required.

(f) South Keys

(i) Runoff from the South Keys Station shall drain to the existing "Sawmill Creek Constructed Wetland" SWM Facility.

(ii) No specific quantity or quality SWMPs are required.

(g) Leitrim

(i) The SWM system for the Leitrim Station and adjacent Park and Ride shall drain to the existing ditch on the east side of Gilligan Road.

(ii) SWM design for the Station and Park and Ride shall be based on LID standards.

(iii) SWM and drainage for the Leitrim Station and adjacent Park and Ride shall be designed and constructed to accommodate initial and ultimate Site configuration. Refer to Schedule 15-2, Part 4 – Stations for initial and ultimate Site configuration requirements of the Leitrim Park and Ride.

(h) Bowesville

(i) The Bowesville Park and Ride Station is within the tributary area to Mosquito Creek. Project Co shall confirm the SWM discharge criteria with the City and RVCA. Project Co shall include drainage from areas upstream of the Site and accommodate them in the Bowesville Park and Ride Station design. Project Co

shall design and construct SWM measures within the Bowesville Park and Ride Station site to meet the SWM criteria for Mosquito Creek.

(ii) SWM design for the Station and Park and Ride shall be based on 80% TSS removal and specific quantity control SWM criteria for Mosquito Creek, consistent with the draft 2015 Master Drainage Plan update for Riverside South, and any required adjustments made necessary by the development of this Site.

(iii) SWM and drainage for the Bowesville Station Park and Ride shall be designed and constructed to accommodate the initial Site configuration, and expandable to accommodate the ultimate Site configuration with no interruption of service and no major changes to the initial SWM and drainage layout and location. Refer to Schedule 15-2, Part 4 – Stations for initial and ultimate Site configuration requirements of the Bowesville Station Park and Ride.

(iv) Project Co shall design and construct drainage infrastructure downstream of the site necessary to accommodate drainage from the site.

(i) Limebank

(i) The City is updating the Master Drainage Plan and a Master Servicing Study for the Riverside South community, which also discharges to Mosquito Creek. SWM design for the Station shall meet 80% TSS removal and the specific quantity and erosion control SWM criteria for Mosquito Creek that are required as part of the Master Drainage Plan update for Riverside South.

(j) Uplands

(i) The Uplands Station is considered Greenfield development. Station drainage shall have SWMPs in accordance with this Article.

(ii) Runoff from Uplands Station shall drain to an existing ditch along the northern edge of the EY Centre property line. Project Co shall design and construct improvements to the existing ditch as required to manage runoff in accordance with this Article.

(k) Airport Station

(i) The Airport Station is considered part of the existing airport development. Station drainage shall be conveyed by the existing Drainage infrastructure. SWM requirements shall be compatible with the existing airport drainage and SWM system to the satisfaction of the OMCIAA.

(l) At-Grade Guideway – Existing Trillium Line

(i) The existing Drainage system shall be modified as required to accommodate the additional sidings and/or other modifications associated with the Expanded Trillium Line.

(m) At-Grade Guideway –Trillium Line Extension, South Keys to Bowesville

(i) Project Co shall replace or remove the following Culverts identified in Table 2-5.1.

Table 2-5.1 – Culvert Replacements and Removals

ID	Existing Structure	Northing *	Easting*	Replacement/ Removal
	Size/Material			
A	2050 x 1700 Cast-in-Place Concrete	5023567.1	371184.7	Replacement
B	2700 x 1900 Cast-in-Place Frame	5023370.1	371262.8	Removal
C	2000 x 1900 Cast-in-Place Frame	5022602.7	371596.7	Replacement
D	600 diam. CSP	5022367.4	371699.1	Replacement
E	Unknown**	5022167.5	371784.7	Replacement
F	2500 x 1300 Cast-in-Place Frame	5021855.1	371925.1	Replacement
G	350 diam. CSP	5021494.0	372103.2	Replacement
H	450 diam. CSP	5020668.0	372448.1	Replacement
I	600 diam. CSP	5019955.9	372753.4	Replacement
J	500 diam. CSP	5019939.6	372745.0	Replacement
K	600 diam. CSP	5019607.3	372894.8	Replacement
L	750 diam. CSP	5025765.1	370136.8	Removal
M	Unknown	5025707.1	370190.0	Replacement
N	Unknown	5018223.4	373162.4	Replacement

* Coordinates are NAD83 MTM Zone 9 Locations are approximate
** Culvert is part of the Alexander Municipal Drain

(ii) Project Co shall regrade and enlarge the west trackside ditch, also known as the Cahill Drain, between Culverts A and B identified in Table 2-5.1, a distance of approximately 200m. Project Co shall design and construct the enlarged ditch to convey flows from the Cahill Drain to the south in a northerly direction to the

Sawmill Creek Constructed Wetland SWM Facility. Project Co shall design and construct modified and new channel sections using natural channel design principles and shall obtain input and review of the design by a fluvial geo-morphologist.

(iii) Project Co shall relocate an approximate 125m length of a tributary to Alexander Drain that is currently located on the east side of the Guideway, north of Lester Road, between the rail embankment and a gravel access road. This reach has been confirmed as a Coolwater Fishery. Culverts D and E identified in Table 2-5.1 convey flow to this tributary. The design and construction of the realignment shall be completed in accordance with environmental, geomorphological requirements, and meet the conditions of applicable regulatory approvals.

(iv) The replacement of Culvert F, as identified in Table 2-5.1, located on the Alexander Drain immediately south of Lester Road shall include the replacement of a beaver control device to prevent the crossing being affected by the formation of a beaver dam.

(n) At-Grade and Below Grade Guideway – Trillium Line Extension, Bowesville to Limebank

(i) Project Co shall design and construct Track drainage for the Guideway from Bowesville Station to Limebank Station in accordance with the requirements of this Article.

(ii) SWM design for the Guideway shall meet 80% TSS removal and the specific quantity and erosion control criteria for Mosquito Creek that are required as part of the Master Drainage Plan update for Riverside South.

(iii) Project Co shall design and construct a Culvert to convey external drainage area flows from south to north of the alignment. The exact location of the culvert will be subject to review by the City to confirm compatibility with the Master Drainage Plan for Riverside South.

(iv) Project Co shall relocate a tributary to Mosquito Creek over an approximate channel length of 70m. Project Co shall comply with the following:

A. The tributary in question crosses the Track alignment approximately 1.5km west of Bowesville Road, east of Mosquito Creek. Project Co shall relocate the tributary at this crossing with the Track alignment such that existing meanders in the channel are preserved or reinstated and that the overall channel length is equal to or greater than the existing channel length.

B. The tributary shall be relocated within a 60m wide corridor adjacent to the Guideway. The relocated channel shall be designed and constructed in accordance with natural channel design principles.

C. The design and construction of the realignment shall be completed in accordance with environmental, geomorphological requirements, and meet the conditions of applicable regulatory approvals.

D. The channel realignment shall be designed by a fluvial geomorphologist who can demonstrate a Master's degree in fluvial processes (or equivalent), and who has at least 10 years' experience designing channels in urban environments.

(o) At-Grade, Below Grade, and Raised Guideway – Trillium Line Extension to Ottawa MacDonald Cartier International Airport

(i) Guideway drainage shall discharge to the existing airport drainage system. Project Co shall design and construct SWM controls as required to be compatible with the SWM requirements of the existing airport drainage and SWM system to the satisfaction of the OMCIAA.

(ii) Runoff from the raised Guideway between Uplands Drive and the Airport Terminal shall be discharged to underground SWM controls and existing airport storm sewer system. Project Co shall not construct above-ground SWM controls in the segment of raised Guideway between Uplands Drive and the Airport Terminal.

(iii) Project Co shall install new Culverts as required to maintain existing drainage patterns.

(p) University Rd Ped Bridge over Rideau River

(i) SWM design for the Bridge shall be based on MOECC's 'Enhanced' standard for TSS removal and specific quantity control SWM criteria designed to LID standards. Refer to Schedule 15-2, Part 6, Article 4 – Site Specific Desired Outcomes, for landscaping requirements.

(ii) Project Co shall demonstrate to the City through hydrologic/hydraulic modeling that the cumulative impacts of the Works will not increase peak flow rates or the peak hydraulic grade line of the Rideau River for all rain events up to the 100-Year Storm. This analysis shall be submitted in accordance with Schedule 10 – Review Procedure.

(iii) Project Co shall design for the loss of floodplain storage volume within the 1:100 year floodplain which will result from the placement of fill. Project Co shall fully

compensate for this loss of floodplain storage volume through a balanced cut (or excavation) to be performed in close proximity to and concurrent with the placement of the fill.

(iv) Two sites on the north side of the Rideau River have been identified for floodplain compensation: 1) to the west of the proposed Structure, adjacent to **[REDACTED]**, and 2) land adjacent to the existing pond, located within Brewer Park. This work shall be performed in accordance with the following requirements:

A. The volume of available floodplain storage capacity within the affected river or stream reach shall not be reduced;

B. The minimum proposed ground elevation in the compensating excavation area shall not be lower than the minimum existing ground elevation in the proposed fill area. Excavation below the normal high water mark shall not be considered for calculation purposes and filling below the normal high water mark shall not be permitted;

C. The proposed site grading shall be designed to result in no increase in upstream water surface elevations in the affected channel cross-sections under a full range of potential flood discharge conditions (1:2 year to 1:100 year return periods). Compliance with this requirement shall be demonstrated by means of hydraulic computations completed to the satisfaction of the RVCA.

D. Any work located adjacent to existing sports fields shall satisfy the following requirements, at a minimum:

i The compensating excavation area shall be located a minimum of 25m from the perimeter of the existing 90m x 54m sports field #3 at Brewer Park;

ii Project Co shall plant coniferous and deciduous trees between sports field #3 and the compensating excavation area, to the satisfaction of the City. The tree planting shall be located a minimum of 10m from the field perimeter, and shall be designed to aid in intercepting soccer balls that are struck from the field towards the compensating excavation area.

iii The compensating excavation area shall be designed and constructed to maintain a pedestrian trail around the perimeter of Brewer Pond and to accommodate the potential development of a minimum 2m wide accessible pathway around the pond in the future;

iv Project Co shall submit the following by December 31 of the year prior to commencing construction within Brewer Park, to the satisfaction of the City:

1. Construction schedule;

2. Grading plan;

3. Landscape plan;

4. Tree conservation report; and,

5. Construction staging, hoarding and access plan.

v Project Co shall not commence construction within Brewer Park prior to obtaining written authorization from the City.

vi Construction shall not be permitted in Brewer Park between May 15 and August 30, of any given year.

vii Construction access and staging shall not be permitted on the existing sports field #3 or within a 10m buffer around the field perimeter unless approved in writing by the City.

(v) All work proposed within Brewer Park shall be performed in accordance with the following requirements:

A. A pre-consultation meeting to discuss ecological values that should be incorporated into the design shall be held with the following agencies at a minimum:

i RVCA;

ii MNRF; and,

iii City.

B. No construction work shall take place between May 1 and August 31, of any given year. No in-water works shall take place between March 15 and June 30, of any given year.

C. In-water work shall not be conducted at times when flows are elevated due to local rain events, storms or seasonal floods.

D. A silt curtain shall be installed along the extent of shoreline that will be disturbed to prevent a potential sediment release into the Rideau River.

This shall remain in place until sediment settles and then shall be removed. The majority of the embayment feature shall be constructed/shaped prior to work along the shoreline.

E. An aquatic species stranding mitigation program shall be implemented by a qualified biologist, familiar with the aquatic species in the area, immediately following isolation to ensure that they are removed from the work site and released immediately downstream of the work area. A report of the results of the species relocation including species and quantities relocated shall be submitted to the MNRF and the RVCA.

F. Any excess excavated material, as a result of the work, shall be disposed of in a suitable location outside any regulatory floodplain and fill regulated area.

G. A temporary construction sign shall be installed outside the construction area between sports field #3 and the compensating excavation area adjacent to the floodplain conpensation wetland feature to provide the public with information about the project and its purpose during construction.

H. The floodplain conpensation wetland feature and adjacent buffer area will be planted with a native shoreline seed mix and tree/shrub species. A landscape plan shall be submitted in accordance with Schedule 10 – Review Procedure.

I. A post effectiveness monitoring plan for the wetland embayment creation project shall be prepared in consultation with the RVCA and shall be approved prior to commencement of the constructed wetland embayment. The plan shall include three years of monitoring for effectiveness of the new wetland feature (year 1, 3, 5) and shall identify plans to address deficiencies.

ARTICLE 6 ROADWAYS, BUS TERMINALS, AND LAY-BYS

6.1 Reference Documents

(a) Project Co shall complete the Works in accordance with the criteria contained within this Article, the Applicable Law, all the City of Ottawa's by-laws, regulations, policies, standards, guidelines and practices applicable to the Project, including but not limited to the following Reference Documents:

(i) The criteria in this Article 6 – Roadways, Bus Terminals and Lay-Bys, including Appendices;

(ii) AASHTO, Guide for Design of Pavement Structures;

(iii) City of Ottawa, Standard Tender Documents;

(iv) City of Ottawa, Transportation Master Plan;

(v) City of Ottawa, Official Plan;

(vi) City of Ottawa, OC Transpo - Transitway and Station Design Guidelines (June 2013);

(vii) City of Ottawa, Municipal Road Activity (By-law No. 2003-445) and Guidelines for Completing the Application for Road Cut Permit;

(viii) City of Ottawa, Municipal Traffic and Parking (By-law No. 2003-530) - City of Ottawa Regulating Traffic and Parking on Highways;

(ix) City of Ottawa, Municipal Zoning (By-law No. 2008-250) Consolidation;

(x) City of Ottawa, Transit-Oriented Development Guidelines;

(xi) City of Ottawa, CADD Standards;

(xii) City of Ottawa, Urban and Rural Truck Routes Map;

(xiii) City of Ottawa, Road Corridor Planning & Design Guidelines - Urban and Village Collectors / Rural Arterials and Collectors;

(xiv) City of Ottawa, Right-of-Way Lighting Policy;

(xv) City Of Ottawa, Accessibility Design Standards;

(xvi) City of Ottawa, Transportation Impact Assessment Guidelines;

(xvii) Region of Ottawa-Carleton, Regional Road Corridor Design Guidelines;

(xviii) MTO, Ontario Pavement and Rehabilitation Manual;

(xix) MTO, Ontario Provincial Standard Drawings;

(xx) MTO, Ontario Provincial Standard Specifications;

(xxi) MTO Materials Information Report MI-183 "Adaptation and Verification of AASHTO Pavement Design Parameters for Ontario Conditions";

(xxii) MTO, Ontario Traffic Manual Books 1 through 18;

(xxiii) MTO, Roadside Safety Manual;

(xxiv) TAC, Geometric Design Guide for Canadian Roads;

(xxv) TAC, The Canadian Road Safety Audit Guide;

(xxvi) TAC, Guide to Bridge Traffic and Combination Barriers;

(xxvii) OC Transpo, Interaction Zone Design Guidelines for Bus Stops and Bike Lanes

(xxviii) Other relevant City of Ottawa Operation Policy, Procedures and Guidelines.

(b) Project Co shall design and construct all Roadways under the scope of Works in accordance with the geometric Design Criteria contained in this Article 6 and applicable appendices, and standards and manuals included in Clause 6.1(a) of this Part 2, and if there is any conflict between the criteria contained in this Part 2 and standards and manuals included in Reference Documents, the following shall apply in descending order of precedence:

(i) The criteria contained in Appendices A and B of this Part 2;

(ii) The criteria contained in this Article 6;

(iii) The applicable City of Ottawa Standard Tender Documents and applicable standards and guidelines;

(iv) TAC, Geometric Design Guide for Canadian Roads;

(v) TAC, The Canadian Road Safety Audit Guide;

(vi) MTO, Roadside Safety Manual.

6.2 General Requirements

(a) Project Co shall provide the design, including obtaining all necessary approvals, and supply the materials, labour, equipment, inspection and testing in order to fulfill the requirements for the execution and Commissioning of the Works.

(b) The overall engineering design and construction requirements of the Works, including typical cross-sections and geometric Design Criteria, are primarily based on the contents of this Part 2, and the Reference Documents from the City of Ottawa and TAC.

(i) Project Co shall design the proposed improvements on all Works according to the Design Criteria included in Appendix A of this Part 2. In all cases where a specific Design Criteria is not provided for a Roadway and/or interchange in Appendix A of this Part 2, Project Co shall undertake a detailed survey and review of the existing conditions, confirm the Roadway and/or interchange ramps geometric Design Criteria by referencing the existing, appropriate standard and proposed design parameters, in order to address the necessary improvements.

A. Under the circumstances whereby an existing Roadway, impacted by the Works, does not meet current TAC standards, Project Co shall design and construct the necessary Roadway improvements so that either the existing conditions of the Roadway will be maintained or upgraded to meet current standards within the available Lands.

B. Project Co shall also undertake a detailed intersection operations and level of service analysis associated with the necessary improvements on all impacted signalized intersections. Project Co shall demonstrate that the traffic operations and levels of service are acceptable and feasible using projected traffic volumes, expected transit operations for 2031 horizon year per the requirements of the City of Ottawa Transportation Impact Assessment guideline, including pedestrian and cyclist movements.

C. Project Co shall submit to the City the results of above-noted investigations by submitting an existing conditions report, a preliminary design report including the proposed Design Criteria and design synopsis, and a separate traffic analyses report and seek approval from the City at least 20 calendar days prior to initiating the development of geometric design.

(ii) Project Co shall undertake all necessary traffic and transit assessments, modelling and analysis including vehicular and non-vehicular road user needs, using projected traffic volumes as specified in Appendix A of this Part 2 for a horizon year of 2031 to determine the necessary Roadways and traffic improvements and provide the requisite design and construction of such works, as per the

requirements of the City of Ottawa's TIA guidelines and other applicable standards.

A. All traffic data used for analysis for traffic management purposes shall be based on the most current data and shall be no older than two years. The information to be collected shall include, but not be limited to all of the hourly traffic volumes and AADTs for all modes of travel on all Roadways, bus Facilities, bike facilities and pedestrian facilities which will be affected by the Project and as a part of the permanent Works. Project Co shall be responsible for obtaining or collecting all traffic data necessary for its traffic analysis, if traffic data less than two years old is not relevant to the traffic analysis due to temporary conditions that existed at the time the data was collected, then the data shall not be used for analysis for traffic management purposes. Project Co shall confirm with the City that the data is appropriate prior to conducting an analysis using said data.

B. Project Co shall undertake a traffic management study to determine the traffic impacts on other intersections and local road networks that are impacted as the result of the Project permanent Works and to determine appropriate mitigation measures, if road capacity and level of service is reduced. The traffic management study shall involve area wide traffic modeling to determine impacts to all modes of transportation including adjacent corridors impacted by the permanent Works. The study shall include Project Co's forecast for, but not limited to, changed traffic volumes, speeds, and travel times for all modes of travel on all routes subject to the study. The traffic management study shall be submitted as a part of the Project Co's traffic report document in accordance with Schedule 10 – Review Procedure.

C. All vehicle, transit customer, pedestrian, and cycling data used for analysis for traffic management purposes shall be based on the most current data, and no older than two years with growth factors acceptable to the City. Project Co shall be responsible for obtaining any vehicle, pedestrian, and cycling data necessary for its traffic management analysis.

(iii) Appendix B of this Part 2 demonstrates only the minimum lane requirements and lane configurations at certain intersections that Project Co is responsible for in their design and construction. Shall Project Co's traffic and transit assessment, modelling and analysis determine that additional traffic lanes and improvements are required in addition to the information shown in Appendix B of this Part 2, Project Co shall be responsible for the design and construction of all such improvements.

(c) Basic ROW widths and protection requirements shall reference the City of Ottawa's Transportation Master Plan and Official Plan (Annex 1).

(d) Design Criteria, Road Classifications and Design Speed Considerations.

(i) Design Criteria parameters, based on the Roadway classifications, shall reference:

A. City of Ottawa Transportation Master Plan – Annex B Maps;

B. City of Ottawa Official Plan – Schedule B and Annex 1;

C. City of Ottawa Road Design Guidelines:

i Region of Ottawa-Carleton, Regional Road Corridor Design Guidelines; and

ii City of Ottawa Road Corridor Planning & Design Guidelines - Urban and Village Collectors / Rural Arterials and Collectors.

D. Appendix B of this Part 2.

(ii) In general, the designation of design speeds shall be based on the speed limits currently posted for the respective Roadways, unless specified otherwise in this Article 6. Project Co shall design the modifications intended on the existing urban collectors or arterials that have design speed of 60 km/hr or lower as per the TAC GDGCR guidelines applicable to low-speed roads subject to retrofit conditions. The design of new or existing arterial roads and highways with design speeds greater than 60 km/hr shall meet the requirements of high-speed roads as per TAC GDGCR requirements accordingly.

(iii) In the absence of City of Ottawa adopted standards, Design Criteria parameters shall reference the TAC GDGCR.

(e) Project Co shall obtain approval from the City for all Works, including construction Works that involves the modification of existing City infrastructure, contained within the scope of Works.

(f) Project Co shall determine the road cross slope based on the road classification using the City standards and TAC GDGCR requirements and to match the existing cross slope of the undisturbed section.

(g) Superelevations shall satisfy the pertinent requirements as per the road classification, and City of Ottawa's design guidelines and standards, TAC GDGCR requirements.

(h) Project Co shall refer to Article 4 – Structural Design Criteria and Requirements, of this Part 2, for any structural requirements associated with the Roadway improvements specified in this Article 6.

(i) Project Co shall design and construct all necessary requirements for landscape, road furniture and streetscape elements required in all Works as per the requirements of Schedule 15-2, Part 6 – Urban Design, Landscape Architecture and Connectivity Requirements.

(j) Project Co shall design and construct the necessary Utilities and associated underground and above ground infrastructures for the Works per the requirements of Article 8 – Utility Infrastructure Design Criteria, of this Part 2.

(k) Project Co shall design and construct all necessary temporary improvements, traffic staging detours, and all associated improvements necessary to support the construction of permanent Works as per the requirements of Schedule 15-2, Part 7 – Traffic and Transit Management and Construction Access.

(l) Project Co shall design and construct all Roadway improvements to meet the applicable accessibility requirements, including but not limited to COADS or AODA.

(m) Project Co shall set the criteria for total and differential post-construction settlements of the Pavement to satisfy the requirements of Clauses 6.10, 6.11, and 6.12 of this Part 2, including Embankment Settlement Criteria for Design, July 2010, MTO.

6.3 Horizontal Alignment

(a) The geometric characteristics of the horizontal alignment shall meet the requirements of the TAC GDGCR, unless otherwise specified in Article 6. In particular, the following requirements shall apply:

(i) Minimum radius and maximum superelevation rate requirements shall correspond to the existing road characteristics as per the road classifications in Clause 6.2 – General Requirements of this Part 2. For urban collectors, the maximum superelevation rate (e_{max}) shall be limited to 2%. For local Roadways, no superelevation is required. For new construction road improvements, the maximum superelevation rate (emax) shall be 4% for low-speed urban arterial roads with design speed of 60km/hr or lower. For new rural roads and new high speed urban arterial applications (i.e. urban roads with design speeds greater than 60km/hr) the maximum superelevation rate shall be 6%. Project Co shall follow the criteria specified in TAC GDGCR (Clause 2.1.2.2 – Circular Curves, Maximum Superelevation: Design Domain) for all other retrofit conditions.

(ii) For urban conditions, the minimum length of curve shall be between 30m to 60m.

(iii) For high-speed urban roads (i.e. Urban roads with design speeds greater than 60 km/hr) and all rural roads, Project Co shall apply spiral curves to the design of the horizontal alignment.

(iv) Project Co shall provide a shy line offset from edge of road lane to Station walls, portal walls, bridge railings, barriers, stop structures, retaining walls and any other obstruction located within the road clear zone for the safe operation of vehicular traffic in the road ROW. The shy line offset values shall be to TAC standards and treatment within the shy line distance and shall be to the guidelines specified in TAC Guide to Bridge Traffic and Combination Barriers and MTO Road Side Safety Manual.

6.4 Vertical Alignment

(a) Vertical alignment shall meet the requirements of the TAC GDGCR, unless specified otherwise in this Article 6. The following main geometric parameters pertinent to the vertical alignment shall apply:

(i) Minimum gradient: Minimum grades shall satisfy the requirements of TAC GDGCR Section 2.1.3 under Minimum Grades: Design Domain Application Heuristics - Urban Areas.

(ii) Equivalent minimum "K" Values: The vertical curve geometry shall reference the requirements of the TAC GDGCR Section 2.1.3.3 – Item 2:

A. "K" value for crest curves shall satisfy the upper limits of the SSD requirements. In all cases, Project Co shall confirm appropriate SSDs by calculating the distance travelled during deceleration and perception and reaction time, considering the effect of grades on deceleration and verified against available sight lines according to TAC GDGCR; and,

B. "K" value for sag curves shall satisfy the upper limit of the requirements of headlight control and comfort control.

6.5 Sight Distance Requirements

(a) Project Co shall satisfy the upper limit of the required sight distances beyond the minimum sight distance requirements at all intersections and in particular in situations where there are increased interactions between vehicular traffic and non-vehicular modes of traffic, such as areas within 150m of Stations entrances.

(i) Project Co shall determine visibility sight triangles and SSD for road horizontal and vertical geometry. Project Co shall ensure that the sight distances provided in the design meet or exceed the minimum sight distance requirements of the TAC

GDGCR based on calculations considering the corresponding Design Criteria parameters.

(ii) Project Co shall design DSD in accordance with requirements of the TAC GDGCR.

(b) Project Co shall determine all ISD requirements, including approach, departure, and crossing ISDs, and visibility triangles using the appropriate design vehicle(s) at all intersections according to the criteria specified in the TAC GDGCR.

6.6 Access and Intersection Layout

(a) Project Co shall design and construct Pavement markings, traffic signs, traffic control signals and underground traffic plants in accordance with the requirements of the applicable Reference Documents.

(b) Project Co shall design all intersection layouts and lane configurations to address all system users' requirements including pedestrian, cyclist, transit and vehicular traffic. Project Co shall give precedence to intersection design characteristics which preserve and enhance the public Safety, minimize the area impacts, and respond to the traffic demand.

(c) Project Co shall design and construct street lighting in accordance with Clause 6.15 – Street Lighting of this Part 2.

(d) Project Co shall design and construct all intersection layouts, lane widths, ramp throats, and Pavement widths using the appropriate design vehicle as defined in Clause 6.8 – Design Vehicles, Clause 6.9 – Facilities Operated by OC Transpo, and Appendix A of this Part 2.

(i) Project Co shall design intersection geometry such that the turning radius of the selected design vehicles is applied from traffic lane to traffic lane.

(ii) Project Co shall design intersection layouts so that turning movements will not encroach on cycling lanes.

(e) All pedestrian and cycling crossing facilities shall meet the City requirements and reference OTM Book 15 and OTM Book 18.

6.7 Cross-Section Elements

(a) Project Co's design of typical cross-sections for Roadways shall be in accordance with the requirements of City of Ottawa Design standards, TAC GDGCR and MTO GDSOH, unless specified otherwise in the Roadways corresponding Design Criteria (Refer to Clause 6.18 – Municipal Roads of this Part 2).

(i) Auxiliary lane width, where applicable, shall satisfy the requirements of Special Purpose Lanes as specified under Clause 2.2.3 of the TAC GDGCR; and,

(ii) Project Co shall provide a cross-slope of 2% towards the curbs or shoulders in order to provide improved surface drainage runoff on paved tangent Roadways, unless specifically noted otherwise in the specific municipal Roadway improvements in Clause 6.18 – Municipal Roads of this Part 2.

6.8 Design Vehicles

(a) Project Co shall use the appropriate design vehicles to design the intersection layout geometry, and to accommodate the applicable sight distances and horizontal and vertical Roadway clearance requirements. For additional requirements pertinent to horizontal and vertical clearances under Overhead Structures, refer to Article 4 – Structural Design Criteria and Requirements of this Part 2. Selection of the largest design vehicle for each Roadway, bus facility, ramp, etc. shall follow the subsequent criteria:

(i) Commercial Trucks, including WB-20 shall govern the design for all intersections, roads, and streets that are designated as a truck route in the City of Ottawa's Urban and Rural Truck Route Maps.

(ii) Commercial Heavy Single Unit Trucks, and the largest Emergency vehicles, including fire and paramedic vehicles shall govern the design for all other intersections, roads, and streets that are listed as non-truck routes.

(iii) All roads and streets that are a designated bus routes shall accommodate the turning movement requirements of the City's B-12 standard bus, articulated bus, double decker bus, and Para-Transpo vehicles.

(iv) Where applicable, inter-City bus and school bus shall govern the design of roads, streets, and intersections.

(v) Where applicable, maintenance vehicles including snow removal vehicles and garbage trucks shall govern the design of roads, streets, and intersections.

(vi) Clearance requirements for opposing left-turn design: in design of intersections with multiple left-turn lanes, especially where simultaneous opposing left turns exist, Project Co shall ensure that design vehicle is appropriately selected. In the design of intersection layouts with double turn left lanes, the design shall accommodate the simultaneously turning manoeuvers of the largest design vehicle with a second Light Single Unit truck. Under extremely constrained conditions, as a minimum, a simultaneous double left-turn design shall accommodate the largest design vehicle turn with a passenger car.

(vii) Project Co shall design and construct all improvements on intersection layouts, and Roadways geometry using turning simulation software (Transoft AutoTURN) with the appropriate design vehicle turning templates to allow for simple turning movements using the generate corner path method.

A. Minimum turning speed of a design vehicle shall not be assumed less than 15 km/hr. Only in extremely constrained conditions, where Project Co can demonstrate that no feasible design solution can be developed considering a 15 km/hr turning speed, a minimum 10 km/hr turning speed may be acceptable.

B. The design of OC Transpo bus turning paths shall satisfy the requirements of the OC Transpo - Transitway and Station Design Guidelines. Bus design turning speeds at intersection corners and curb returns shall not be less than 15 km/hr. Also refer to Clause 6.9 – Facilities Operated by OC Transpo of this Part 2.

(b) Project Co shall have regard to the Official Plan and Policy designations for the affected areas and Roadways, including the City of Ottawa Multi-Modal Level of Service targets which are affected by curb radii. Pedestrian and cycling LOS targets are especially high in the central area, near schools and rapid transit stations and every effort shall be made to achieve these targets within the context of the City of Ottawa Complete Streets Implementation Framework.

6.9 Facilities Operated by OC Transpo

(a) Project Co shall design and construct all OC Transpo Roadways and Facilities to meet the interim and ultimate operational requirements of the City during all Construction stages and following Revenue Service. Project Co shall obtain the City's approval prior to advancing the design of all Roadways and facilities operated by OC Transpo.

(b) Project Co's design and construction of all temporary or permanent bus stop Facilities, Station amenities, infrastructure and shelters shall meet the requirements of Schedule 15-2, Part 4 - Stations, including Appendix A and B, and shall comply with City accessibility design standards and features, including but not limited to COADS requirements.

(c) Unless specified otherwise, Project Co shall accommodate the following requirements:

(i) The primary reference for the design, construction and operational requirements of all roads, accesses, bus Platforms, PPUDO and Park and Ride facilities operated by OC Transpo is OC Transpo's Transitway and Station Design Guidelines.

(ii) The primary reference for the design of all Roadways and bus transit Facilities operated by OC Transpo including but not limited to the design speeds, geometric Design Criteria, horizontal and vertical alignments, auxiliary lanes, intersection geometry, cross-section components, drainage requirements, ramp design, pedestrian and cyclists connectivity, safety and security, accessibility, bus station Platform layouts and turnaround circulation geometry and other Roadways, facilities, and structural details shall meet the requirements of OC Transpo's Transitway and Station Design Guidelines. For specific Station Site design layout requirements with respect to pedestrian and cyclists' connectivity refer to Schedule 15-2, Part 4 – Stations and Schedule 15-2, Part 6 - Urban Design, Landscape Architecture and Connectivity Requirements.

(iii) For the design and construction of Park and Ride facilities, in the event of a conflict between the criteria contained in this Article and any other City or OC Transpo's reference document(s), the following shall apply in descending order of precedence:

A. All criteria and requirements specified in this Article 6 and in other pertinent parts and clauses of this Part 2;

B. City of Ottawa, OC Transpo - Transitway and Station Design Guidelines (June 2013);

C. COADS;

D. City of Ottawa, Municipal Traffic and Parking (By-law No. 2003-530) - City of Ottawa Regulating Traffic and Parking on Highways;

E. City of Ottawa, Municipal Zoning (By-law No. 2008-250) Consolidation; and,

F. City of Ottawa, Transit-Oriented Development Guidelines.

(iv) Sidewalks associated with bus stops and Station Platform areas shall accommodate positive drainage and have a minimum grade of 0.5% towards the curb.

(v) Bus shelters, bus stop pad, shelters with sidewalk and boulevard shall satisfy the requirements of both the City's Standard Tender Documents and the OC Transpo's Transitway and Station Design Guidelines, unless specifically noted otherwise in Schedule 15-2, Part 4 – Stations and/or in Schedule 15-2, Part 6 - Urban Design, Landscape Architecture and Connectivity Requirements. In particular, for additional landscape Site design provisions such as bus shelters, lighting, and shade tree requirements refer to Schedule 15-2, Part 4 – Stations and

Schedule 15-2, Part 6 - Urban Design, Landscape Architecture and Connectivity Requirements.

(vi) Design of bus loops, bus driveway accesses, bus stops, bus Platforms and bus lay-bys in bus Station Facilities shall meet the following requirements:

A. Project Co shall design and construct the bus Facilities, Station amenities and infrastructure that will be used for the operation of buses as per the standard established in this Part 2. Project Co shall submit the design of all bus Station Facilities for review in accordance with Schedule 10 - Review Procedure. The bus Station Facility submission shall include sufficient detail to allow the City to understand the full operation of the bus Facility, including interface with any other activities on the Site, all Station amenities, and infrastructure.

B. Project Co shall run AutoTURN analysis to confirm the suitability of the design. Project Co shall obtain the dimensions and characteristics of a typical OC Transpo bus vehicle prior to performing the AutoTURN analysis for the appropriate bus design vehicles. Project Co shall submit the turning movement results for review and approval in accordance with Schedule 10 – Review Procedure and shall consider the following requirements:

i Buses shall line up parallel to the bus Platforms with a distance of no more than 150mm (preferred)/ 300mm (absolute maximum) from Platform curbs.

ii All bus maneuvers in the swept path analysis shall ensure a smooth, continuous movement without instantaneous steering movements. The swept path analysis shall not include 0m radius turns, with the exception of the first turn away from a parking spot under constrained conditions.

iii Project Co shall perform field tests for compliance and functionality of bus movement clearance through the means of a bus test on mock-up facilities (demarcating curbs and other features using traffic cones and or paint lines) with dimensions identical to the proposed bus Facilities.

iv Project Co shall design bus loops and driveways for one way circulation at bus terminals. Exceptions to the above requirement may be acceptable where a two-way circulation offers better transit operations, for which Project Co shall consult with and seek

approval from the City prior to proceeding with such alternative design.

v All bus loops and driveway accesses shall allow buses to safely pass stalled or parked buses.

vi Project Co shall ensure a bus can maneuver parallel to the Platform curbs and depart independently of parked busses with the assistance of vehicle turning movement simulation software or the appropriate turning movement templates. Project Co shall submit the turn analysis to the City for review and approval in accordance with Schedule 10 – Review Procedure.

vii Project Co shall provide a clearance of 0.5m between bus movements and all obstructions, including the worst case stopping positions of buses in bus bays and lay-by areas.

viii Project Co shall simulate the appropriate bus turning movements considering the minimum outside turning radius (wall to wall radius) to allow for simple turning movements using the "Generate Corner Path" function (Transoft AutoTURN) at the appropriate turning speeds referenced in Clause 6.8 of this Article 6 for operating efficiency.

C. Project Co shall design and construct bus Platforms, Station amenities, and associated infrastructure located on the Platforms so that these elements are unobstructed and appropriately sized to accommodate the volume of Passengers boarding and exiting the buses. Project Co's design shall provide for additional area to accommodate peak load volumes, not less than the minimum stated as per the OC Transpo's Transitway and Station Design Guidelines.

D. Project Co shall design and orient bus stops to allow Passengers to load and unload from the right side of a bus, providing Passengers with direct access to pedestrian pathways and / or into the bus terminals or Station entrance, without having to cross the front or rear of a bus. Project Co shall not provide pedestrian crossings within bus facilities without written consent and approval from the City. The design shall preclude such behaviour in addition to placing appropriate and accessible TCDs. Under exceptional circumstances, where the above requirements cannot be met due to constrained conditions and a crossing facility is required, Project Co shall confirm the appropriate traffic control requirements and demonstrate that the pedestrian crossing facility is safe and meets bus operational requirements. Project Co shall present a risk analysis

developed by a certified traffic Safety auditor prior to design and implementation and seek approval from the City.

E. Project Co shall locate bus stops, designated as drop-off Platforms, as close as possible to the driveway entrance and Station entries.

F. Project Co shall consult with and seek approval from the City and OC Transpo with respect to the dimensions, layout, and location of all bus stops and bus lay-by areas and the preferred bus stop grouping and arrangements at Platform locations (i.e. single, double, or triple stops).

G. Bus Platforms shall not be located on curved laneways.

H. Project Co shall design and construct all permanent and temporary bus stops during staged Construction to include safe and secure pedestrian access from / to bus stops and all bus stop shelters as per the requirements specified in COADS and Schedule 15-2, Part 7 – Traffic and Transit Management and Construction Access. Project Co shall reference Schedule 15-2, Part 4, Appendix B for any applicable permanent bus terminal requirements.

6.10 Pavement

(a) Order of Precedence

(i) Project Co shall provide the Pavements in compliance with the criteria contained in this Article, the Applicable Law, standards, guidelines or practices applicable to the Project and including but not limited to each of the following Reference Documents.

(ii) In the event of a conflict between the criteria contained in this Article and any Reference Document(s), the following shall apply in descending order of precedence for design and construction of Pavements:

A. The criteria contained within this Article;

B. OPSS;

C. OPSD;

D. The City's Current Version of Design Guidelines, Standard Tender Documents and Specifications;

E. Ontario Provincial Standards for MTO Designated Source of Materials (DSM);

F. Procedures for Estimating Traffic Loads for Pavement Design, 1995, MTO;

G. MTO Materials Information Report MI-183 "Adaptation and Verification of AASHTO Pavement Design Parameters for Ontario Conditions";

H. MTO Ontario's Default Parameters for AASHTOW are Pavement ME Design Interim Report, 2014;

I. 1993 AASHTO Guide for the Design of Pavement Structures;

J. Canadian Portland Cement Association – Thickness Design for Streets and Highways;

K. MTO Directive PHM-C-001 The Use of Surface Course Types on Provincial Highways;

L. MTO Pavement Design and Rehabilitation Manual (Second Edition);

M. The criteria contained within Article 7 – Geotechnical Design Criteria and Requirements, of this Part 2;

N. Embankment Settlement Criteria for Design, July 2010, MTO;

O. ASTM Standards; and,

P. MTO Laboratory Standards.

(iii) For the design of rigid concrete Pavements, Project Co shall use both MTO's Routine Method as described in the *Pavement Design and Rehabilitation Manual* and the *Canadian Portland Cement Association's Simplified Design Procedure* in addition to the foregoing AASHTO guide for Design of Pavement Structures.

(b) General Requirements

(i) In general, the design of Pavement structure(s) shall be the responsibility of Project Co and be based on the City's current Pavement design practices.

A. Project Co shall follow the requirements of the OC Transpo's Transitway and Station Design Guidelines for Pavement design of paved areas subject to bus traffic, Park and Ride lots, and Facilities operated by OC Transpo vehicles.

B. Pavement structure shall be of a flexible (asphalt) Pavement design outside bus Station Platform areas, where paved areas are subject to bus traffic, unless otherwise approved by the City.

C. Project Co shall incorporate a rigid (concrete) Pavement structure within, at a minimum, the limits of the concrete Platforms. OC Transpo's Transitway and Station Design Guidelines shall be utilized for the approximate limits for concrete Pavement for a typical side loading Station. Project Co shall review the concrete Pavement limits for Stations with center loading Platforms, based on the Station layout, bus access and operational requirements, recommend an appropriate Pavement design and seek approval from the City prior to advancing the design. Project Co shall provide an extension of concrete Pavement 30m exceeding the Platform. A proper transition treatment shall be provided from one Pavement type to another.

(ii) Project Co shall be responsible for design of all new Pavements and all existing paved areas that are subject to upgrade or reinstatement as a part or result of the Work both during temporary staged construction and in post construction. Project Co shall reinstate the Pavement to match the standards of either the existing adjacent Pavement structure or the current City and OC Transpo's standards and requirements specified in this Article, whichever is more stringent. In all cases, the Pavement reconstruction shall be in accordance with the following requirements:

A. Where the existing Pavement structure adjacent to a localized widening is greater than current City standards and requirements specified in this Article, the new Pavement structure shall match the existing Pavement structure; and,

B. Where the existing Pavement structure adjacent to a localized widening is the same or less than the current City Standards, the new Pavement structure shall match the current City standards and requirements specified in this Article.

(iii) Project Co shall design and build all Pavement structures in compliance with City standards in areas where Pavement structures will be built as New Municipal Infrastructure, in City ROW. Project Co shall be responsible to obtain the acceptance from the City of all works within the City ROW prior to construction. In areas where the Pavement structures will be built as New Municipal Infrastructure, on Federal Lands, Project Co shall complete Pavement designs following City standards for review and approval from Governmental Authorities in accordance with the procedures established by the respective Governmental

Authority. Project Co shall comply with the Governmental Authority permits requirements and conditions.

(iv) Project Co shall ensure that any roads or sections of roads with unfinished Pavement, including but not limited to milled Pavement or Pavement without a surface course opened to traffic, including but not limited to public or construction traffic, are designed to carry the expected traffic and to prevent water penetration. Project Co shall maintain and ensure all unfinished pavement opened to traffic are in compliance with the City standards prior to final paving. For milled pavement surfaces, Project Co shall follow the requirement of Schedule 15-2, Part 7 – Traffic and Transit Management and Construction Access.

(v) Project Co shall ensure that design and construction of flexible and rigid Pavement structures for all paved Roadways and paved bus Facilities such as lanes, ramps, lay-bys, and Park and Ride Facilities, and paved storage areas, as per the following:

A. For the bus terminals and loops, Project Co shall design and construct the Pavement of the bus facilities for uninterrupted operation of the OC Transpo's buses in light of the expected bus volumes. Project Co shall submit a Pavement Design Report in accordance with Schedule 10 – Review Procedure for all paved facilities stating their consideration of the bus volumes and assumptions of private vehicles. Project Co's report shall also include a Site-specific recommendation for the periodical Maintenance and rehabilitation of the paved facility considering the facilities Design Life.

B. Project Co shall consider factors such as traffic volumes, subgrade conditions, environmental effects, construction traffic, availability and suitability of Construction materials and performance of similarly loaded Pavements in the area, and economics when determining a suitable Pavement design.

C. Project Co shall provide Site-specific Pavement design reports for the Project in accordance with Schedule 10 – Review Procedure.

D. Project Co shall consider the influence of heavy equipment and delivery vehicles during construction during the design process, particularly with respect to the thickness of sub-base material and the native subgrade conditions.

E. Project Co's Pavement design report shall provide localized Pavement designs that shall mitigate potential Pavement sliding or rutting in areas

along bus Platforms, within access ramps, bus stops, and bus lay-by locations, which are subject to repeated bus turning movements.

(c) Design and Performance Requirements

(i) Project Co shall ensure that the Roadway Pavement structure conforms to the latest standards of the Governmental Authorities.

(ii) Project Co shall ensure that designed Pavement structure has a Pavement life cycle as specified in Schedule 15-2, Part 1, Article 4 – Design and Construction. In the absence of City standards, 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, 1010 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.

(iii) Project Co shall ensure that all the Pavement surfaces in areas drivable by vehicles shall have paved surfaces and comply with all expected performance characteristics for safe use by the public.

(iv) Project Co shall design and construct appropriate drainage systems that meet the City's standard when Pavement type is transitioned from interlocking pavers to flexible Pavement.

(v) Project Co shall ensure that the grading conforms to the requirements of OPSS 206 (Construction Specification for Grading) for work within municipal

jurisdictions. The Compaction shall conform to the requirements of OPSS 501 (Construction Specification for Compacting) for work within municipal jurisdictions. Granular Base and Sub-base shall be according to OPSS 314.

(d) Smoothness and Other Ride Quality

(i) Following Substantial Completion, the completed Pavements shall meet the smoothness criteria provided in SP 103F31 for hot mix asphalt Pavements.

6.11 Grading

(a) Project Co shall design and construct all earthworks and grading requirements so that all such work conforms to the relevant City Standards and Specifications or in absence of such standards to the following:

(i) OPSS 206 - Earth and Rock Excavation;

(ii) OPSS 212 – Borrow;

(iii) OPSS 501 – Compacting;

(iv) OPSS 511 - Rip-Rap, Rock Protection and Gravel Sheeting;

(v) OPSS 570 – Topsoil;

(vi) OPSS 572 - Seeding and Mulching; and,

(vii) OPSS 803 – Sodding.

(b) Project Co shall meet the requirements of Schedule 15-2, Part 1, Article 5 – Implementation Constraints, in the design and construction of all earthworks and rock excavations.

(c) Grading includes excavation of native material and fill of approved materials as required for Construction in accordance with the recommendations resulting from Pavement design reports.

(d) Project Co shall manage all excess and imported material per the requirements described in Schedule 17, Part 4 – Contaminated and Excavated Material Management.

(e) Project Co shall maintain positive drainage during construction on all areas subject to grading at all times. Project Co shall treat any cut or fill slopes, left unattended for 30 calendar days or more, with temporary hydraulic mulch, erosion control blankets or vegetative cover.

(f) Project Co shall minimize and control the amount of dust generated by construction operations at all times within and outside the construction zone. Project Co shall remove any mud, debris or dust deposited outside of the construction zone, on Roadways and in boulevards, resulting from the Works.

(g) 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.

(h) 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 and rock protection in accordance with the City Standards and Specifications and OPSS 511.

(i) Dewatering

(i) Project Co shall provide the design, approvals (permits to take water, where required), supply of materials, labour, equipment, inspection and testing associated with all the dewatering Works.

(j) Temporary Measures

(i) Project Co shall adjust all Roadway infrastructure, including but not limited to catch basins, maintenance holes, valve chambers, and any other structures in the Roadway, flush with the base asphalt lift in order to provide snowplough protection in areas where the final lift of asphalt is not paved in advance of winter shutdown. Project Co shall design and construct temporary asphalt curbs to contain Roadway drainage at the proposed curbline of catch basins and maintenance holes. Project Co shall remove and make final adjustments immediately prior to placement of the surface course asphalt.

(ii) Project Co shall restore all trenches to match the existing original conditions or to the new construction cross section 24 hours of the completion of the trench. In situations where the trench is Constructed in consecutive stages with a delay in between, Project Co shall restore the trench in stages within 24 hours after the completion of each stage.

(iii) Project Co shall provide temporary conditions design drawings to specify all temporary measures and are responsible for all costs associated with the above noted work.

6.12 Drainage

(a) Project Co shall provide the drainage in accordance with the criteria contained in this Article 6 and in Article 5 – Drainage and Stormwater Management Design Criteria of this Part 2 and the applicable Reference Documents.

6.13 Traffic and Transit Signals

(a) General

(i) Project Co shall liaise and coordinate with the City and the City's designated traffic control signal contact person, with regards to all modifications that may be required at municipal traffic signals during the design and construction period. Project Co shall support all proposed modifications with traffic engineering analysis to meet the City's traffic signal requirements and standards.

(ii) Project Co shall define the coordination scheme, and coordinate all work with the City for municipal traffic signals that are included in the traffic signal coordination scheme.

(iii) Project Co shall reference the information provided in Schedule 15-2, Part 7, Clause 1.11, and coordinate with the City to identify and confirm the location of all existing and new traffic cameras, ITS devices, and all associated infrastructure 60 calendar days in advance of the design stage. Project Co shall require the approval of the City for all relocations, design and construction requirements, and types and specifications of such facilities that are impacted or required as a result of the Works.

(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) For permanent new traffic and transit signal facilities, or new permanent configurations at existing signalized intersections, with the exception of PXOs, the City shall supply and install all above ground traffic signal equipment as required by the governing road authority, including but not limited to controller, poles, pedestrian and traffic signal heads with push buttons, audible displays, etc. The City shall supply, install and make all required terminations for the traffic signal wiring. The City shall provide all equipment and labour associated with the installation of permanent above-ground traffic signal infrastructure. Project Co shall coordinate with the City the design of electrical power feeds for all alterations to existing traffic signals, and new traffic signals; the cost of obtaining new electrical power feeds shall be a City responsibility.

A. Project Co shall construct all permanent underground traffic infrastructure, including the supply and construction of concrete encased ducts, direct buried ducts, pole foundations, maintenance holes, maintenance hole frames and covers, vehicle loop detection and concrete pads.

B. For all permanent signalized intersections, the City shall design the vehicle detection system and specify the type of detection equipment to be used. Project Co shall only be responsible for the cost and coordination of the installation of inductive loop detectors; any other detection equipment specified by the City's design shall be supplied and installed by the City.

C. Where the location selected for a traffic signal pole is not suitable for a standard pole foundation, as per City of Ottawa Standard Detail Drawings (e.g., where the pole is designed to go on top of pre-existing utilities), Project Co shall be responsible for the design of the non-standard foundation, in addition to the construction requirement in A. above.

(iii) For all temporary traffic and transit signals, or temporary modifications to existing signalized intersections, the City shall supply and install all above ground traffic signal equipment as required by the governing road authority including but not limited to controller, poles (with the exception of wood poles), pedestrian and traffic signal heads with push buttons, audible signals, etc. The City shall also supply and install and make all required terminations for the traffic signal wiring. The City shall provide all equipment and labour associated with the installation of temporary above-ground traffic signal infrastructure. Project Co shall coordinate with the City the design of electrical power feeds for all temporary traffic signals or temporary modifications to existing signalized intersections; the cost of obtaining new electrical power feeds shall be a City responsibility.

A. For all temporary signalized intersections, the City shall design the vehicle detection system and specify the type of detection equipment to be used. Project Co shall only be responsible for the cost and coordination of the installation of inductive loop detectors; any other detection equipment specified by the City's design shall be supplied and installed by the City.

B. Where temporary signal infrastructure requires the use of wood poles and/or span wire, the City shall be responsible for the design of signal head placement only. Project Co shall design the location of the wood poles, guy wires, and span wires based on the City’s signal head placement.

C. Project Co shall construct all temporary underground traffic infrastructure, including the supply and construction of concrete encased ducts, direct buried ducts, pole foundations, maintenance holes, maintenance hole

frames and covers, vehicle loop detection and concrete pads. Project Co shall Construct all above ground infrastructure Works, including but not limited to installation, removals and reinstatement of wood poles, all aerial strand support and suspension cables, guys, anchors, ground rods, and plates, along with any required underground Civil Works including conduit, foundations, manholes/hand holes, frames and covers, as required to accommodate the staged construction of Work, with the exception of traffic signal equipment as described above, which shall remain the responsibility of the City.

(iv) For all PXOs, Project Co shall supply and install all above ground equipment, including but not limited to poles, hardware, arms, RRFBs, etc. Project Co shall provide the labour associated with the installation of the PXOs.

A. The design and installation of PXOs shall be in accordance with OTM Book 15, City of Ottawa Pedestrian Crossover Program and Examples Documents 1 and 2, and Appendix F – Pedestrian Crossover Infrastructure Requirements of this Part 2.

(v) For all temporary and permanent traffic signals, Project Co shall provide interconnection ensuring that all signals can communicate with the City's Traffic Operations Center. Interconnection duct shall be designed by the City and installed by Project Co. The City will consider City-owned system-connectivity infrastructure prior to private-owned infrastructure to establish this connectivity.

(c) Notification Requirements and Timelines

Table 6.1: Permanent/temporary new traffic signals or permanent/temporary modifications to existing traffic signals

Item	Description	Notification (Calendar Days)	Prior to	Information to be supplied to City	Information to be supplied to Project Co
1	Design	30	Desired receipt of signal design	1:250 CADD for the intersection, including pavement markings on all approaches	City provides traffic signal design, including traffic signal displays, traffic signal plant design, detection system

					design, etc., within 30 calendar days
2	Commencement of civil works (prerequisite – signal design completed)	30	Construction of civil works	Date when works are to begin, schedule of work	None
3	Electrical work involving the City (prerequisite – signal design completed)	30	Construction of civil works	Meeting date regarding electrical works, schedule of work	Contact names and telephone numbers of relevant staff
4	Scheduling of installation date by City forces (prerequisite – signal design completed)	30	Desired signal installation date	Desired installation date by City forces	Scheduled date for installation to be provided to Project Co within eight calendar days of the notification. Scheduled date shall be within 10 calendar days of Project Co's request
5	City Inspection of civil work completed by Project Co (pre-requisite – signal installation date	14	Scheduled signal installation date	Confirmation of work being completed	Confirmation that the work was completed to City satisfaction, within seven calendar days of Project

	scheduled)				Co's notification that work was completed

(i) Project Co shall provide 30 calendar days' notice to the City where modification of an approach to a signalized intersection beyond OTM Book 7 applications is being proposed. Project Co shall submit 1:250 scale CADD drawings for all such modifications, as required.

(ii) Project Co shall prepare and submit TCPs, which show the signal design for the installation of, or modification of a traffic control signal, in accordance with Schedule 10 – Review Procedure. Project Co shall submit these particular TCPs at least 45 calendar days before the start of any Construction Activities related to the installation or modification. Note however, that in the case of multiple simultaneous traffic control signal installations or modifications, the City may require more than 45 calendar days for submission review. Project Co shall meet with the City at least 60 calendar days in advance of these types of scheduled Works in order to discuss the submission schedule, and Project Co shall adjust the submission lead time to a timeframe acceptable to the City.

(iii) Project Co shall address the City's comments and changes on signs and Pavement marking plans developed as a part of Project Co's TCPs and incorporate the revised plans as applicable. Project Co shall submit the revised drawings to the City at least 30 calendar days prior to the scheduled placement of said signs and Pavement markings, all in accordance with Clause 6.14 – Pavement Marking and Signing of this Part 2 and Schedule 10 – Review Procedure.

(iv) Per Item 2 from Table 6-1, Project Co shall provide a minimum of 30 calendar days advanced notice to the City prior to commencing the following works:

A. Permanent Traffic Signals: Underground Construction of the permanent traffic signals including concrete encased ducts, direct buried ducts, pole foundations, maintenance holes, vehicle loop detection 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.,

(v) Per Item 3 from Table 6-1, a minimum of 30 calendar days prior to 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.

(vi) In accordance with the schedule specified in Item 4 from Table 6-1, City forces shall perform all traffic signal activations and deactivations.

(vii) Per Item 5 from Table 6-1, at least 14 calendar days prior to the date scheduled for the City to install the traffic signal equipment, Project Co shall have completed their portion of the Work for permanent and/or temporary traffic signals modification/installation, and provided the City with notice that the Works are complete.

6.14 Pavement Marking and Signing

(a) General

(i) Project Co shall provide the design drawings and obtain approvals from the City for all permanent and temporary Pavement marking and Roadway signs.

(ii) Project Co shall provide the design drawings and obtain approvals from the City for all permanent and temporary Pavement marking and signage at the locations of bus Transitway and Facilities operated by OC Transpo.

(iii) Unless specified otherwise in this Article 6, Project Co shall provide all signing and Pavement markings in accordance with the criteria contained in this Article 6, the requirements of OPSS, and the applicable Reference Documents.

(b) Design and Performance Requirements

(i) Project Co shall design, obtain approvals, and comply with construction requirements for permanent Pavement markings as per the City of Ottawa's standards and specifications and applicable OPSS.

(ii) Project Co shall provide for the supply of materials, labour, equipment, inspection and testing associated with the requirements for all temporary Pavement markings during construction.

(iii) 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 supply all labour, equipment and materials for the supply and installation of permanent Pavement markings between November 15 and April 15.

(iv) Project Co shall supply all labour, equipment, materials, inspection and testing associated with the requirements for all temporary and permanent non-regulatory signing.

(v) The City shall supply all labour, equipment and materials for the supply and installation of all temporary and permanent regulatory signing requirements.

(vi) Project Co shall ensure the Pavement surface is prepared, clean and free of debris.

(vii) Project Co shall complete 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 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) Project Co shall make all submissions in relation to the requirements of this section in accordance with Schedule 10 – Review Procedure.

A. Project Co shall submit Pavement marking and signage CADD drawings formatted in Microstation V.8i at a scale of 1:500.

(x) Project Co shall obtain the library of symbols from the City prior to commencing any work.

(xi) Project Co shall contact the appropriate municipal and / or provincial road authorities to confirm, in writing, the official municipal road names as well as Civic Address Signs (911 Identification Numbers and signing) requirements and incorporate such signs in the permanent and temporary Pavement and signing design drawings. Project Co shall indicate the location, size, and type of each sign on the TCPs. Project Co shall ensure that the above noted signs are in place and visible at all times. If the placement of the signs conflict with Project Co's construction, Project Co may temporarily relocate the signs, provided the signs remain unobstructed and with the affected property limits for the duration of the Project. Project Co shall replace any damaged signs immediately.

(xii) 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.

(xiii) 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.

6.15 Street Lighting

(a) General

(i) For all the temporary and permanent street lighting, Project Co shall design, obtain approvals, and supply of materials, labour, equipment, build, provide inspection and testing associated with the City's requirements for Street lighting standards and best practices.

(b) Design and Performance Requirements

(i) Project Co shall design and construct all permanent and temporary street lighting including power feeds. Street lighting shall meet the requirements of the City of Ottawa Right of Way Lighting Policy. Project Co shall prepare and submit the lighting design together with the lighting calculation summary in accordance with Schedule 10 – Review Procedure.

(ii) Project Co shall illuminate cycle facilities based on the required Roadway lighting levels stipulated in the City of Ottawa Right of Way Lighting Policy.

(iii) All activities related to Roadway lighting systems (i.e. design, construction, etc.) shall meet the Conditions of Service set out by the local Electrical Supply Authorities, the ESA, and any other entity having jurisdiction.

(iv) The installation of luminaires shall utilize existing above ground Utility poles located within public ROW to minimize the number of poles. Project Co shall coordinate the use of these joint use **[REDACTED]**/street light poles 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 **[REDACTED]** Utility poles.

(v) Project Co shall coordinate with the City the design of electrical power feeds for all alterations to existing street lighting, temporary lighting and new street lighting; the cost of obtaining new electrical power feeds shall be a City responsibility.

(vi) 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 15 Business Days advanced notice to the City for the installation of temporary Roadway illumination and removal of existing Roadway illumination.

(viii) Project Co shall arrange a meeting with the City, a minimum of 10 Business Days prior to Construction, to coordinate the requirements of the electrical work involving the City. Project Co shall provide a schedule of its proposed work to the City in this meeting.

(ix) Lighting shall not contain an upward component, minimize light trespass and disability glare for drivers.

(x) Project Co shall design and construct all Roadway luminaries to be LED and meet the full cut-off type and specifications.

(xi) All permanent Roadway lighting levels shall meet the appropriate standard for the Roadway classification.

6.16 Passenger Pick-Up and Drop Off Facilities

(a) Project Co shall design and construct PPUDO facilities for the location and number of PPUDO spaces specified in Schedule 15-2, Part 4 - Stations, Appendix A – Trillium Line Station Functional Requirements. Project Co shall obtain approval from the City for the location of all PPUDO locations prior to advancing any Roadway designs.

(b) Project Co shall satisfy the requirements of OC Transpo's Transitway and Station Design Guidelines, including City of Ottawa By-laws and reference material included in Clause 6.1 of this Part 2.

(c) The following general requirements shall apply to all PPUDO facilities:

(i) Project Co shall limit the location of curbside PPUDO facilities to tangent Roadway segments offset from adjacent intersections and accesses as per the City of Ottawa By-law 2003-530.

(ii) Project Co shall satisfy the upper limit of all geometric dimensions for the design of PPUDO facilities including, but not limited to, parking space dimensions and aisle widths as per the City of Ottawa By-law 2008-250.

(iii) Project Co shall ensure the locations and design of PPUDO facilities will avoid conflicts with cycling facilities, bike racks, bus access and egress and operations, and Station operations.

(iv) PPUDO facilities shall include a fully accessible, direct, and barrier-free pedestrian access from / to all bus stops and Station access and egress. Each

PPUDO facility shall include provisions for boarding and alighting from an accessible parking space as per the accessibility requirements and best practices specified under sections 3.1 and 3.2 of COADS.

(v) Project Co shall design and construct PPUDO facilities physically separated from fare paid zones.

(vi) Project Co shall ensure all curbside recessed PPUDO stalls can accommodate the safe entry and exit manoeuvres with the use of curb transitions as per the City of Ottawa Standard Detail Drawing R8 – Typical Intersection Narrowing (Single) and/or R9 – Typical Mid-Block Narrowing.

6.17 Road Safety Audits and Road Safety Design Reviews

(a) Order of Precedence

(i) Project Co shall have independent Road Safety Audits and Road Safety Design Reviews completed in accordance with the criteria set out in this Article 6 and the following reference documents. If there is any conflict between the criteria contained in this Article 6 and any of the reference documents, the following shall apply, in descending order of precedence:

A. The criteria contained in this Article 6;

B. TAC, Geometric Design Guide for Canadian Roads;

C. TAC, The Canadian Road Safety Audit Guide;

D. MTO, Roadside Safety Manual;

E. MTO, Ontario Traffic Manual Books 1 through 18; and,,

F. AASHTO, Roadside Design Guide.

(ii) Project Co shall perform the necessary Road Safety Audits and Road Safety Design Reviews in the context of the traditional Road Safety Audit processes but shall expand the process in order to include human factors, the review of drawings and plans (Reviews).

(b) General Requirements

(i) Road Safety Audits shall include the Road Safety Audit processes as identified in The Canadian Road Safety Audit Guide, and shall for clarity include human factor considerations.

(ii) Project Co shall provide the City of Ottawa with the Road Safety Review and Audit team's individuals' qualifications, experience, and knowledge, and letters of reference from the relevant Governmental Authorities where prior audits were performed, 60 calendar days in advance of any safety review or audit work. Project Co shall receive the City's approval for the proposed Road Safety Audit Team in accordance with the requirements of the Review Procedure specified in clause 6.17 - Road Safety Audits and Road Safety Design Reviews of this Part 2 and prior to any safety review or audit work being initiated.

(iii) The Road Safety Audits and Road Safety Design Reviews team's individuals shall not be an employee of any of the companies on Project Co's design and construction team, other than being paid for services rendered to Project Co in their capacity as Road Safety Auditor. The auditing team shall be fully independent and at arm's length from any company participating on Project Co's team.

(iv) All Project Co's Road Safety Audits and Road Safety Design Reviews shall include a human factors expert experienced in road and highway design and construction, who shall provide input and review of the safety and operation of the work from a human factors perspective.

(v) Project Co shall immediately correct any "as constructed" element that does not conform to the design, does not meet the required safety standards, or deemed not to meet a reasonable level of safety by the Road Safety Auditor. Project Co shall prepare the corrective measures and rectification recommendations noted above and shall ensure a Professional Engineer stamps and seals the appropriate recommendations for the review and acceptance by the Road Safety Audits and Road Safety Design Reviews team and to the City of Ottawa.

(vi) Project Co shall assume responsibility for any existing or proposed Site conditions found not to meet a reasonable level of safety, and shall rectify the condition immediately, or otherwise construct temporary works to address the safety concern until repairs are made.

(c) Road Safety Audits and Road Safety Design Reviews Team

(i) The Road Safety Audits and Road Safety Design Reviews individual and supporting team is more generally referred in this context as the Road Safety Auditor.

(ii) Project Co's Road Safety Audits and Road Safety Design Reviews team shall consist of a team of auditors, with a minimum of three qualified personnel, who are independent of the Project Co's design and construction team, and shall meet the following minimum criteria:

A. Be Professional Engineers trained in the area of road and public safety, with over 20 years of engineering experience and demonstrated experience or resume working in the area of public safety and undertaking formal Road Safety Audits and Road Safety Design Reviews, with references from government agency;

B. Demonstrated experience in undertaking formal safety reviews and experience with The Canadian Road Safety Audit Guide, and Canadian and Ontario roadside safety standards;

C. Demonstrated experience in road safety analysis, traffic engineering, geometric design, and demonstrated expertise with human factors in design and safety reviews and audits;

D. Participated in at least two recent formal road safety audits with criteria similar to the Road Safety Audits and Road Safety Design Reviews in this Work, where such previous participation was on projects delivered using design build or public private partnership project delivery methods; and,

E. Demonstrated professional independence in undertaking Road Safety Audits and Road Safety Design Reviews in this Work.

(d) Project Co's Responsibility:

(i) Project Co shall undertake Road Safety Audit and Road Safety Design Review as per the requirements of this Clause 6.17 of this Part 2 on all temporary and permanent Roadway improvements listed below:

A. All facilities operated by OC Transpo including, but not limited to, all bus loops and associated accesses, lay-bys, bus stops, PPUDOs, Park and Ride Facilities, as specified in Clause 6.9 of this Part 2;

B. All Roadway improvements listed under Clause 6.18 of this Part 2; and,

C. All staging detour routes, Lane Shifts, lane closures and temporary conditions designed and constructed by Project Co as part of the Works per the requirements specified in the Schedule 15-2, Part 7 - Traffic and Transit Management and Construction Access.

(ii) Project Co shall assume responsibility for the following items:

A. Scheduling, initiating, allowing access to the applicable Site and managing the Road Safety Audits and Road Safety Design Reviews process at the appropriate times during the course of the Works;

B. Providing all necessary design drawings and supporting documentation for the Road Safety Audit Team to conduct the Road Safety Audit and Road Safety Design Reviews;

C. Ensuring that the Road Safety Design Reviews and Road Safety Audit is conducted in accordance with good industry practice;

D. Receiving and reviewing the Road Safety Audit Team's report with the City of Ottawa representative;

E. Responding to the Road Safety Audit Team's report, including presenting rectification alternatives to address deficiencies;

F. Implementing required re-design as a result of the corrective suggestions as described in the sub clause noted above in an expeditious and timely manner;

G. Updating changes on the required design drawings; and,

H. Providing all draft and final documentation related to the Road Safety Audits and Road Safety Design Reviews to the City of Ottawa's representative.

(iii) Project Co shall accept responsibility for and account for all costs associated with Road Safety Audits and Road Safety Design Reviews, including any re-design and increased costs to the Works that result from the Road Safety Audits and Road Safety Design Reviews.

(iv) After each Road Safety Audit and Road Safety Design Review, except as otherwise expressly agreed in writing by the City of Ottawa's representative, Project Co shall address all recommendations made by the Road Safety Audit Team.

(e) Road Safety Design Review

(i) Project Co shall undertake an initial Road Safety Design Review at the outset of the Works and no later than 60 calendar days after Commercial Close of the Works in order to assess Project Co's proposed design elements including both temporary and permanent improvements that may have any bearing on public, Maintenance or operational safety from the point of view of any user within the Lands.

(ii) In each Road Safety Design Review, Project Co shall review, identify and resolve any safety concerns prior to advancing the design of both temporary and permanent improvements such that the design can be modified in a timely fashion

to address the safety concerns within the Works. Project Co shall plan, schedule and execute the review, together with providing a report that addresses any safety concerns and the recommendation or resolution of the initial Road Safety Design Review. The initial Road Safety Design Review shall precede the design activity and the subsequent design stages shall accommodate any required recommendation or resolution of this initial Road Safety Design Review.

(iii) Project Co shall undertake Road Safety Design Reviews on an ongoing basis through the different stages and duration of all designs and all to be constructed elements, both temporary and permanent improvements that may have any bearing on public, Maintenance or operational safety from the point of view of any users within the Lands.

(f) Road Safety Audit Process

(i) Project Co shall complete the Road Safety Audit process in accordance with The Canadian Road Safety Audit Guide. References to "review" or "response" from the owner agency, or other qualifying phrase with similar connotation in the process, shall be construed as the responsibility of Project Co in accordance with the requirements in this Clause 6.17 of this Part 2.

(ii) Project Co's Road Safety Audit Team shall prepare a report to document the audit findings and submit the Road Safety Audit reports to the Design Team for the stages identified in the clause that follows. The Road Safety Audit reports shall clearly identify safety hazards that need to be addressed by Project Co along with recommendations for remediation. Project Co shall respond to the identified hazards and recommendations with remediation counter-measures or provide appropriate reasons why the safety issue may not be addressed as recommended in the reports. Under any circumstances, Project Co's response and remediation countermeasures shall address the safety issue to the satisfaction of the Road Safety Audit Team.

(iii) For all temporary conditions and temporary Roadway improvements to accommodate staged construction under long duration Works as specified under Clause 2.5.4 Long Duration (LD) in the MTO's OTM Book 7, Project Co shall perform Stage 3a and Stage 3b audits for all temporary Roadway improvements according to the requirements outlined in Clause 6.17(f)(v) of this Part 2.

(iv) Project Co shall perform Stage 3b audits for all Station construction Sites according to the requirements outlined in Clause 6.17(f)(v) of this Part 2.

(v) Project Co shall submit the Road Safety Audit reports to the City of Ottawa's representative in accordance with the review procedures specified in Schedule 10 – Review Procedure for review at all the stages identified below:

A. Stage 1: Pre-Final Design Road Safety Audit

i Project Co shall conduct a Stage 1 Road Safety Audit immediately before submission of the Pre-final Design Development submittals in accordance with the requirements of Schedule 10 – Review Procedure of the Project Agreement. Project Co shall undertake a detailed review of the Pre-final Design Development submittals to identify any potential safety-related enhancements that might have an impact on the design and construction of Works. Issues considered shall include, but not be limited to, the following:

1. Design consistency;
2. Site conditions and visibility;
3. Drivers' work load and perceived road information;
4. Vehicular traffic speed management and associated safety risk factors;
5. Traffic control devices;
6. Human factors;
7. Horizontal and vertical alignment;
8. Cross section design;
9. Intersection design and configuration;
10. Access location;
11. Sight distance including, but not limited, to stopping sight distance and turning sight distance, sight distances to traffic control devices, bullnoses, etc.;
12. Operation of public transit;
13. Operational and Maintenance safety;
14. Traffic operations;
15. Environmental factors;
16. Clearances to roadside objects;

17. Safety barriers; and,

18. Provision for vulnerable road and all multi-modal road ROW users.

B. Stage 2: Final Design Road Safety Audit

i Project Co shall conduct a Stage 2 Road Safety Audit immediately before submission of the Final Design Development Submittals in accordance with Schedule 10 – Review Procedure of the Project Agreement. The audit shall undertake a detailed review of the completed Final Design Development submittals to identify any potential safety-related enhancements that might have an impact on the operational safety of the Works. Project Co shall consider in the audit and address issues such as the items included, but not be limited to the following items:

1. Signing and Pavement markings;

2. All interface with adjacent design disciplines (including rail Track corridors and LRT facilities; Tunnel, civil, facilities including Stations and landscaping, Utilities and Bridges, etc.);

3. Traffic signal configuration;

4. Intersection details;

5. Municipal services;

6. Drainage and SWM elements;

7. Lighting;

8. Fencing;

9. Clearances to roadside objects;

10. Safety barriers;

11. Surface standards including treatments and structures;

12. Traffic control devices;

13. Streetscape and road furniture;

14. Provision for vulnerable road and all multi-modal road ROW users;

15. Accommodation of design vehicles;

16. Emergency responses requirements;

17. Road maintenance;

18. Traffic staging plan; and,

19. Any other Stage 1 Road Safety Audit results affected by the final design.

C. Stage 3a: Temporary Traffic Control On-Site Road Safety Audit

i Project Co shall conduct Stage 3a Road Safety Audits on the applicable Sites within Lands before implementation of temporary traffic and transit control set-ups that meet one or more of the following criteria:

1. Two or more individual temporary work zones in close proximity to each other such that one would influence the traffic and transit operation of the other. The spacing between the termination area of one work zone and the advance warning area of the next work zone for which one temporary traffic control set-up influences the traffic operations of the next temporary traffic control set-up is 2.0 km or less.

2. Temporary staging are required within the existing Roadways and the duration of temporary traffic control set-ups is five calendar days or more. The set-up does not necessarily have to be in place for the entire time but can be one of a number of repeating set-ups that are active at different times.

3. The duration of temporary traffic control set-ups is ten calendar days or more on roads other than those identified (2) above. The set-up does not necessarily have to be in place for the entire time but can be one of a number of repeating set-ups that are active at different times.

D. Stage 3b: Construction Road Safety Audit

i Project Co shall conduct Stage 3b Road Safety Audits on the applicable Sites within Lands during construction of Works. These audits shall examine the field conditions of the Work under construction and assess any circumstances that may have a bearing on public safety from the point of view of any user and public areas that are within the Lands, or are modified and constructed as a part of the Works. The audits shall meet the following criteria:

1. Project Co shall undertake two of the Stage 3b Road Safety Audits annually within the high construction season, between June and September (i.e. two audits to be performed annually between June and September) and one in the winter season, annually between December and February. Project Co shall preplan for only one of the audits, while Project Co shall perform the other audits unannounced.

E. Stage 4: Post-Construction Road Safety Audit

i Project Co shall carry out a Stage 4 Road Safety Audit prior to opening any portions of the Roadway Works for traffic operation. Project Co's audit shall investigate and identify potential safety enhancements that may reduce the frequency and/or the severity of collisions. The Road Safety Auditor shall also check for safety deficiencies that result from using particular combinations of design elements not previously detected or any synergistic effects of using minimum Design Criteria for multiple design elements that may compromise users' safety.

ii Project Co shall plan for and conduct Stage 4 Road Safety Audits prior to and as a condition of the issuance of the substantial completion certificate.

iii Pursuant to the requirements of the two clause (i) and (ii) of the intended Stage 4 Road Safety Audit noted-above, the Road Safety Audit Team shall fully examine the Works by:

1. Meeting with Project Co to review any issues relating to the Works, in particular design changes that may affect the safety of Roadway Works included in this Article 6;

2. Checking to ensure that safety issues identified in the Stage 2 Road Safety Audit are addressed and the resulting design changes do not create further safety issues;

3. Reviewing any design changes that occurred during the relevant Works to ensure they do not create safety issues; and,

4. Conducting field reviews of such Works, under both daytime and night time conditions.

(g) City-requested Safety Audit

(i) The City of Ottawa reserves the right to request Site-specific Road Safety Audits at any time in addition to the audits required in all other Road Safety Design Reviews and Road Safety Audits specified in Clause 6.17 of this Part 2. Such request may be for any Site conditions, design element, design concern or Constructed element of Works that is of concern to the City of Ottawa. The City's written request will outline the safety concern and the issues required to be investigated and addressed by Project Co.

(ii) Project Co shall demonstrate that the design and proposed Constructed Works meet a reasonable level of safety for all affected users. Project Co shall provide supporting research or engineering rationale and analyses for the design decisions, and for the support of the proposed design and constructed Works that are subject to investigation.

(iii) Project Co shall address the concerns and/or modify the proposed design and constructed Works accordingly and provide all available technical information to the Road Safety Audit Team for consideration.

(iv) The Road Safety Audit Team will render an opinion with the safety issue, and Project Co shall address the safety issue to the satisfaction of the Road Safety Audit Team and the City of Ottawa. The disposition and rectification of the safety concern is Project Co's full responsibility and obligation based on full and due consideration of input from the City of Ottawa and the Road Safety Audit team.

(h) Road Safety Audit Certificates

(i) Project Co shall submit to the City of Ottawa's representative a Road Safety Audit Certificate called in the form attached as Appendix D - Form of Road Safety Audit Certificates to Schedule 15-2 – Design and Construction Requirements in respect of the Stage 1, Stage 2 and Stage 4 Road Safety Audits respectively. Each Road Safety Audit Certificate shall be signed by Project Co's

Design Manager, Project Co's Construction Contractor representative, Project Co's Project Co Representative, and the Road Safety Audit Team.

(ii) Project Co shall provide the Independent Certifier with the Stage 4 Road Safety Audit Certificate. The Substantial Completion Certificate shall not be issued unless a Stage 4 Road Safety Audit Certificate has been submitted and signed by the Project Co's Design Manager, Project Co's Construction Contractor representative, Project Co's Project Co Representative, and the Road Safety Audit Team.

(i) Random Audits

(i) The City of Ottawa retains the right to perform additional independent audits on any part of design and construction Works at any time.

6.18 Municipal Roads Improvements

(a) Leitrim Road

(i) Project Co shall design and construct a new Bridge Structure including its approach embankments in order to grade separate Leitrim Road with the proposed Trillium Line Track corridor at a location approximately 260m west of the existing Leitrim Road / Gilligan Road intersection, where the new Track corridor shall cross the existing Leitrim Road corridor.

A. Project Co shall ensure the horizontal and vertical clearances for the proposed Bridge Structure meet the requirements of the applicable bridge codes as per Article 4 – Structural Design Criteria and Requirements of this Part 2.

B. Under a scenario in which Project Co's proposed grade separation facility may involve a road-over-rail grade separation configuration, Project Co shall design and construct the proposed Bridge Structure and associated approach embankments on a realignment of the Leitrim Road corridor that will be located to the north of existing Leitrim Road, such that the existing section of Leitrim Road between the Track and Gilligan Road can be used as a paved municipal service road, herein referred to as Leitrim Service Road.

i Project Co shall design and construct all the necessary improvements on the Leitrim Service Road so that it can provide unobstructed access to / from the following properties located on the south side of the existing Leitrim Service Road at all times during the staged construction and ultimately upon the completion of Works:

1. **[REDACTED]**

2. **[REDACTED]**

3. **[REDACTED]**

4. **[REDACTED]**

5. **[REDACTED]**

ii Project Co shall design and construct all the necessary improvements on Leitrim Service Road to provide a suitable vehicle turnaround facility for the Design Vehicle specified for this Roadway in Appendix A of this Part 2, as well as for the controlling municipal emergency and maintenance vehicles to service all existing private approach accesses on Leitrim Road per the requirements of Clause 6.8 – Design Vehicles of this Part 2.

iii Project Co shall ensure the condition of the pavement structure for the intended service road meets the general service life requirements specified in Clause 6.10 – Pavement of this Part 2.

C. Under a scenario in which Project Co's proposed grade separation facility may involve a rail-over-road grade separation configuration, Project Co shall satisfy the following requirements for Leitrim Road:

i Project Co shall design and construct the proposed grade separation facility and associated improvements to accommodate all horizontal and vertical clearances, Roadway geometry, and appropriate cross sectional elements, including roadside barriers, grading, drainage, and pathway connection requirements for Leitrim Road and shall satisfy all associated Roadway design safety requirements as per the Design Criteria in Appendix A of this Part 2.

ii Project Co's design and construction shall provide for full access with appropriate sight lines for all properties affected by Works in both temporary and permanent improvement conditions.

iii Project Co shall undertake a traffic analysis study and determine the appropriate type of traffic control for a proposed MUP crossing that will be crossing Leitrim Road at a location on the east side of the rail-over-road grade separation facility under this scenario. Project Co shall prepare a traffic report, including the assumptions and results of the traffic analysis, concluding the design and

construction requirements of the intended MUP crossing facility and seek the City's approval 30 days prior to the PFDD submission.

(ii) Project Co shall design and construct all the necessary Roadway improvements on Leitrim Road, Gilligan Road, and Leitrim Service Road, as applicable, per the Design Criteria requirements specified in Appendix A of this Part 2. Project Co shall design and construct a signalized intersection at the intersection of Leitrim Road and Gilligan Road, corresponding to the lane configuration requirements shown in Appendix B of this Part 2.

(iii) Project Co shall undertake a detailed traffic analysis including an intersection level of service analysis as per the City of Ottawa's TIA Guidelines, and confirm the control type, storage lengths and geometry and general layout of all intersections on Leitrim Road and Gilligan Road, and Leitrim Service Road, as applicable, using projected traffic and transit volumes for a 2031 horizon year. Project Co shall submit a comprehensive traffic report and include the results and recommendations of the above-noted traffic analysis and seek approval from the City at the early stages of the preliminary design, and a minimum of 20 Business Days prior to initiating the detailed design per the requirements of Schedule 10 – Review Procedure.

(iv) Project Co shall design and construct the proposed Roadway improvements for Leitrim Road, Gilligan Road, and Leitrim Service Road, as applicable, to include all necessary traffic staging detours and temporary access requirements such that all temporary and permanent Works are contained within the Lands as defined in Schedule 33 – Lands.

(v) Project Co shall provide the appropriate lighting requirements, including but not limited to, adequate and uniform light levels, appropriate light standards and all associated underground infrastructure along Leitrim Road, Gilligan Road, and Leitrim Service Road, as applicable, within the limits of the Works, per the requirements specified in Clause 6.15 - Street Lighting of this Part 2.

(vi) Project Co shall reference the information provided in Schedule 15-2, Part 7 - Traffic and Transit Management and Construction Access for the specific traffic staging and access management requirements for all private approaches from the existing Leitrim Road and Gilligan Road during staged construction and temporary conditions.

(vii) Project Co's design and construction of the Roadway improvements for Leitrim Road shall meet the requirements of Clause 6.17 – Road Safety Audits and Road Safety Design Reviews of this Part 2.

(b) Lester Road

(i) Project Co's design and construction of the Track and Guideway Structure over Lester Road shall accommodate and protect for the future widening of Lester Road without a need to undertake any modification or addition to the Guideway Structure facility when Lester Road corridor is widened in the future. Project Co shall design and construct the Guideway Structure to accommodate all horizontal and vertical clearances, Roadway geometry, and all future cross sectional elements, including grading, drainage, and pathway connection requirements, for the future widening of Lester Road. For additional design and construction requirements of the Track and Lester Road Guideway Structure, refer to Article 4 – Structural Design Criteria and Requirements of this Part 2.

A. Project Co's design of the Guideway Structure shall account for all the following specific cross-sectional elements for Lester Road:

i The ultimate cross section for future Lester Road widening will have a typical 4-lane rural arterial undivided cross section with side ditches.

1. General-purpose lanes shall be 3.75m for inside lanes and 3.5m for outside lanes (i.e. the lanes beside shoulder) in both eastbound and westbound directions of traffic.

2. Paved shoulders shall be 3.0m under the Guideway Structure and transition to typical 2.5m paved shoulders in the sections away from the Guideway Structure.

3. A 3.0m MUP is planned to run along the north side of Lester Road under the Guideway Structure. The MUP will be located 1.5m offset from the outside edge of the (westbound) shoulder. Away from the Structure, the offset between the MUP and the outside edge of the westbound shoulder shall transition to 4.5m.

4. All future improvements for Lester Road shall accommodate a design speed of 90 km/hr, with a posted speed of 80km/hr.

ii The horizontal and vertical clearances under the proposed Guideway Structure shall meet the requirements of the applicable bridge codes as per Article 4 – Structural Design Criteria, and the requirements of this Part 2.

(ii) Project Co shall design and construct all necessary Roadway improvements to accommodate the System requirements for the proposed HGCWD equipment specified in Schedule 15-2, Part 3, Clause 10.2 – Scope of Work and the proposed Systems Maintenance Service requirements specified in Schedule 15-3, Appendix A – Attachment 3 – Clause 2 – Service Requirements.

(c) Airport Parkway

(i) Project Co's design and construction of the Track and Guideway Structure over Airport Parkway shall accommodate and protect for the future realignment and widening of Airport Parkway without a need to undertake any modification or addition to the Guideway Structure facility when the Airport Parkway is widened in the future. Project Co shall design and construct the Guideway Structure to accommodate all horizontal and vertical clearances, Roadway geometry, and all future cross sectional elements, including grading, drainage and pathway connection requirements, for the requirements of the future widening of Airport Parkway. For additional design and construction requirements of the Track and Airport Parkway Guideway Structure refer to Article 4 - Structural Design Criteria, and the requirements of this Part 2.

A. Project Co's design of the Guideway Structure shall account for all the following specific cross sectional elements for the Airport Parkway:

i The ultimate cross section for the Airport Parkway will have a typical 4-lane rural arterial divided cross section with side ditches:

1. The ultimate cross section of the future Airport Parkway realignment and widening will have a minimum 6m wide concrete median at the location under the proposed Guideway Structure.

2. The horizontal and vertical clearances under the proposed Guideway Structure shall meet the requirements of the applicable bridge codes as per Article 4 – Structural Design Criteria, and the requirements of this Part 2.

ii The Airport Parkway alignment will be subject to a minimum grade raise of minimum 1.2m above the existing pavement elevations in order to account for the environmental geotechnical conditions associated with the nearby wetland areas in this section. Project Co's design shall account for this grade raise requirement in addition to the vertical clearance requirements under the LRT Guideway Structure.

iii Future Airport Parkway improvements shall accommodate a design speed of 90 km/hr with posted speed limit of 80 km/hr.

iv General-purpose lanes shall be 3.75m for inside lanes (beside the raised median) and 3.5m outside lanes (i.e. the lanes beside the shoulder) in both southbound and northbound directions of traffic.

v Paved shoulders shall be 3.0m under the bridge structure and transition to typical 2.5m paved shoulders in the sections away from the structure.

(d) Uplands Drive

(i) Project Co's design and construction of the LRT Guideway Structure over Uplands Drive shall accommodate and protect for the future widening of Uplands Drive without a need to undertake any modification or addition to the Guideway Structure facility when Uplands Drive is widened in the future. Project Co shall design and construct the Guideway Structure to accommodate all horizontal and vertical clearances, Roadway geometry, and all future cross sectional elements, including grading, drainage and pathway connection requirements, for the requirements of the future widening of Upland Drive. For additional design and construction requirements of the Track and Uplands Drive Guideway Structure refer to Article 4 - Structural Design Criteria, and the requirements of this Part 2.

A. Project Co's design of the Guideway Structure shall account for all the following specific cross-section elements for Uplands Drive:

i The ultimate cross section for Uplands Drive will have a typical 4-lane rural arterial undivided cross section with side ditches.

1. A 3m MUP is planned to run along the east side (i.e. along the northbound shoulder) of future Uplands Drive widened corridor under the bridge. The MUP will be located 1.5m offset from the outside edge of the (northbound) shoulder.

ii The horizontal and vertical clearances under the proposed Guideway Structure shall meet the requirements of the applicable bridge codes as per Article 4 – Structural Design Criteria, and the requirements of this Part 2.

iii Future Uplands Drive improvements shall accommodate a design speed of 90 km/hr with posted speed limit of 80 km/hr.

iv General-purpose lanes shall be 3.75m for inside lanes and 3.5m outside lanes (i.e. the lanes beside the shoulder) in both eastbound and westbound directions of traffic.

v Paved shoulders shall be 3.0m under the bridge structure and transition to typical 2.5m paved shoulders in the sections away from the structure.

(e) Earl Armstrong Road

(i) Project Co shall design and construct a Bridge Structure, including its approach embankments, in order to grade separate the proposed Earl Armstrong Road with the Track corridor at a location approximately 760m east of the existing Earl Armstrong Road / Bowesville Road intersection, where the new Track corridor shall cross the Earl Armstrong Road corridor.

A. Project Co's design and construction of the Bridge Structure shall accommodate and protect for the future widening of Earl Armstrong Road as per the Design Criteria requirements specified in Appendix A of this Part 2 without a need to undertake any modification or addition to the Bridge Structure built by Project Co when Earl Armstrong Road is widened in the future to the north side.

i Under a scenario in which Project Co's proposed grade separation facility may involve a road-over-rail grade separation configuration, Project Co shall construct an Overhead Structure for a 2-lane Roadway. The future widening of Earl Armstrong Road will be accomplished through the construction of a separate Overhead Structure to accommodate future lanes.

ii Under a scenario in which Project Co's proposed grade separation facility may involve a rail-over-road grade separation configuration, Project Co shall construct a Guideway Structure that spans over a 4-lane Roadway cross-section as per the information provided for the future Earl Armstrong Road widening in Appendix A of this Part 2.

B. Project Co shall ensure the horizontal and vertical clearances for the proposed grade separation Structure meet the requirements of the applicable bridge codes as per Article 4 – Structural Design Criteria, and the requirements of this Part 2.

(ii) Project Co shall design and construct the Roadway improvements on Earl Armstrong Road per the Design Criteria requirements specified in Appendix A and lane configuration specified in Appendix B of this Part 2.

A. Project Co's design and construction of the proposed Earl Armstrong Road shall accommodate and protect for the future widening, realignment, and associated improvements of Earl Armstrong Road as per the requirements of the City:

i Under a scenario in which Project Co's proposed grade separation facility may involve a road-over-rail grade separation configuration, Project Co shall demonstrate early in the design process and design and construct the proposed Earl Armstrong Road improvements and realignment, including the Overpass Structure, to be located as far to the south as necessary within the Lands such that the Roadway and Bridge Works constructed by Project Co will not be impacted by the future construction of a separate Overhead Structure to carry two future westbound lanes. The Roadway and Bridge Works that will be constructed by others under the future Earl Armstrong Road widening and realignment improvements will provide for the two westbound lanes and associated cross section elements in the future. The cross section for the westbound lanes on the future 4-lane Earl Armstrong Road shall be a reflection of the eastbound lanes about the outside edge of the 2.5m north shoulder or the proposed Earl Armstrong Road cross section as described in Appendix A of this Part 2.

ii Under a scenario in which Project Co's proposed grade separation facility may involve a rail-over-road grade separation configuration, Project Co shall demonstrate early in the design process and design and construct the proposed Earl Armstrong Road improvements and realignment, including the Guideway Structure and associated embankment approaches, within the Lands such that the Roadway and Bridge Works constructed by Project Co will not be impacted by the future construction of Earl Armstrong Road realignment and widening. The Roadway Works that will be constructed by others under the future Earl Armstrong Road widening and realignment improvements will provide for the two westbound lanes and associated cross section elements in the future. The cross section for the westbound lanes on the future 4-lane Earl Armstrong Road shall be a reflection of the eastbound lanes about the outside edge of the 2.5m north shoulder or the proposed Earl Armstrong Road cross section as described in Appendix A of this Part 2.

vi Project Co shall demonstrate in an early stage of the preliminary design process and seek approval from the City a minimum of 60 calendar days in advance of the PFDD submission that a feasible

and economical design can be achieved for such a future widening and realignment improvements of Earl Armstrong Road that would meet the City's planning and design requirements.

B. Project Co shall design and construct a signalized intersection at the intersection of Earl Armstrong Road and Bowesville Road and associated access requirements to the Bowesville Park and Ride Facility as per the requirements of this Part 2 and associated Appendices.

C. Project Co shall undertake a detailed traffic analysis including an intersection level of service analysis as per the City of Ottawa's TIA Guidelines, and confirm the control type, transit priority measures as per City requirements, storage lengths, and geometry and general layout of all Park and Ride accesses on Earl Armstrong Road as required using projected traffic and transit volumes for a 2023 horizon year per the requirements of Schedule 15-2, Part 4 - Stations. Project Co shall submit a comprehensive traffic report and include the results and recommendations of the above-noted traffic analysis and seek approval from the City at the early stages of the preliminary design, and a minimum of 20 Business Days prior to initiating the detailed design per the requirements of Schedule 10 – Review Procedure.

D. Project Co shall design and construct the proposed Roadway improvements for Earl Armstrong Road to include all necessary traffic staging detours and temporary access requirements such that all temporary and permanent Works are contained within the Lands as defined in Schedule 33 – Lands.

E. Project Co shall reference the information provided in Schedule 15-2, Part 7 - Traffic and Transit Management and Construction Access, for the specific traffic staging and access management requirements for all private approaches from Earl Armstrong Road during staged construction and temporary conditions.

F. Project Co's design and construction of the Roadway improvements for Earl Armstrong Road shall meet the requirements of Clause 6.17 – Road Safety Audits and Road Safety Design Reviews, of this Part 2.

(f) Bowesville Road

(i) Project Co shall design and construct a Bridge Structure, including its approach embankments, to accommodate for the grade separation of Bowesville Road with the Track corridor at a location approximately 180m south of the existing Earl

Armstrong Road/ Bowesville Road intersection, where the new Track corridor shall cross the Bowesville Road corridor.

A. Project Co shall ensure the horizontal and vertical clearances for the proposed Bridge Structure meet the requirements of the applicable Bridge codes as per Article 4 – Structural Design Criteria and Requirements of this Part 2.

(ii) Project Co shall design and construct the Roadway improvements on Bowesville Road per the Design Criteria requirements specified in Appendix A and Appendix B of this Part 2.

A. Project Co's design and construction of the proposed Bowesville Road shall accommodate and protect for future improvements of Bowesville Road as per the requirements of the City.

i In addition to the requirements for the design and construction of the intersection of Earl Armstrong Road and Bowesville Road as described in Article 6.18 of this Part 2, Project Co shall undertake a detailed traffic analysis, including an intersection level of service analysis as per the City's TIA Guidelines, to determine future improvements for the southern leg at the intersection of Earl Armstrong Road and Bowesville Road, using projected traffic and transit volumes for a 2031 horizon year, for the purpose of accommodating the future Roadway cross section on the Bridge Structure so that any future improvements on Bowesville can be accommodated without the need to reconstruct or modify the proposed grade separated Structure and retaining walls/ embankments

(iii) Project Co shall design and construct all the improvements on Bowesville Road necessary to accommodate the requirements of the Bowesville Park and Ride facility including all the associated Roadway, intersections, and access improvements as specified under Clause 6.18(h) – Bowesville Park and Ride Facility of this Article 6, Schedule 15-2, Part 4 – Stations, and as a part of the scope of Works.

(iv) Project Co shall design and construct a signalized intersection at the intersection of Earl Armstrong Road and Bowesville Road, including the associated access requirements to the Bowesville Park and Ride Facility, as per the requirements specified in Clause 6.18(e) and (h).

(v) Project Co shall design and construct the proposed Roadway improvements for Bowesville Road to include all necessary traffic staging detours and temporary

access requirements such that all temporary and permanent Works are contained within the Lands as defined in Schedule 33 – Lands.

(vi) Project Co shall reference the information provided in Schedule 15-2, Part 7 - Traffic and Transit Management and Construction Access, for the specific traffic staging and access management requirements for all private approaches from Bowesville Road during staged construction and temporary conditions.

(vii) Project Co's design and construction of the Roadway improvements for Bowesville Road shall meet the requirements of Clause 6.17 – Road Safety Audits and Road Safety Design Reviews of this Part 2.

(g) Leitrim Park And Ride Facility

(i) Project Co shall design and construct the Leitrim Park and Ride Facility to include a bus station Facility with dedicated space for public parking. The bus station Facility shall include a bus loop, bus bays, bus lay-bys and bus station Platforms, ensuring all necessary bus turning movements are accommodated per OC Transpo's Transitway and Station Design Guidelines.

A. The proposed improvements, and the specific functional and performance requirements, such as number of parking spaces, bus Platforms, bus lay-bys and bus bays required for the Leitrim Park and Ride Facility shall meet the requirements of Schedule 15-2, Part 4, Article 3 – Station Specific Architectural Design Criteria and Schedule 15-2, Part 4, Appendix A – Trillium Line Station Functional Requirements.

(ii) Project Co shall design and construct all the proposed improvements at the Leitrim Park and Ride as per the standards and requirements specified in Clause 6.9 – Facilities Operated by OC Transpo of this Part 2, unless specified otherwise in Clause 6.18 – Municipal Roads Improvements of this Part 2.

(iii) Project Co's design and construction of the Roadway improvements for Leitrim Park and Ride shall meet the requirements of Clause 6.17 – Road Safety Audits and Road Safety Design Reviews of this Part 2.

(iv) Refer to Schedule 15-2, Part 6, Article 2 – Design Criteria for the connectivity, landscape and streetscape requirements for the Leitrim Park and Ride Facility.

(v) Project Co shall design and construct all temporary bus detours, temporary transit operations, traffic staging and access management strategies to ensure access and current functionality of the existing Park and Ride Facility is maintained during staged Construction and temporary conditions. Refer to Schedule 15-2, Part 7 - Traffic and Transit Management and Construction Access for the specific improvements noted above.

(vi) Project Co shall undertake a traffic analysis according to the City of Ottawa's TIA guidelines in order to determine the layout geometry, lane configuration, intersection improvements, and traffic control types for the Park and Ride Facility accesses and all impacted Roadways within the limits of construction of Works including but not limited to Leitrim Road and Gilligan Road.

A. The analysis shall include, but not be limited to, a network analysis and an intersection operation and capacity analysis including traffic operations at the new Park and Ride Facility. In the analysis, Project Co shall also consider the projected traffic and transit volumes for a 2031 horizon year, existing and potential developments in the area, and connectivity for pedestrians and cyclists.

i The results of the analysis shall include, but not be limited to intersection layout configuration, traffic control types, and auxiliary storage lane requirements.

B. Project Co shall summarize and submit the findings from the analysis in a detailed report to the City of Ottawa for approval, a minimum of 20 Business Days prior to initiating the detailed design.

(vii) Project Co shall design and construct all internal access road layouts to accommodate all mixed traffic access from Gilligan Road. The layout of the Park and Ride Facility shall accommodate the turning movements of the appropriate design vehicle according to Clause 6.8 – Design Vehicles of this Part 2 and Clause 6.9 – Facilities Operated by OC Transpo of this Part 2.

(viii) Project Co shall design and construct the Leitrim Park and Ride Facility to include an exclusive bus access into the bus terminal area in such a way that delays to buses resulting from operating in mixed traffic (including pedestrian and cyclist traffic) are minimized.

(ix) Project Co shall evaluate the existing conditions and provide any widening or Pavement improvements requirement of the existing roads to accommodate safe bi-directional operation of transit buses. Project Co shall design and construct the widening within the existing ROW and within Lands Schedule 33 – Lands.

(x) Project Co shall design and construct all intersections to accommodate transit bus access and operations between the local road networks and the proposed Leitrim Park and Ride Facility.

A. Project Co shall confirm the appropriate traffic control type and necessary intersection improvements required at all existing and proposed intersections and where warranted, shall install transit priority measures to provide precedence to transit operations.

B. Project Co shall develop and confirm the type of transit priority measures appropriate for each intersection, and shall seek approval from the City and OC Transpo prior to proceeding with the implementation of the proposed transit priority measures.

(xi) Project Co's design and construction of the Leitrim Park and Ride Facility shall not reuse the existing Pavement structure either partially or totally in the new improvements unless Project Co can satisfy the following conditions:

A. Project Co shall undertake a traffic assessment, detailed field survey, geotechnical investigation to evaluate the existing ground conditions, Pavement structure, and associated drainage conditions of the existing parking Site.

i Project Co shall identify any risks associated with the substandard drainage and underlying ground conditions, evaluate the existing Pavement failure patterns using pertinent pavement condition assessment guidelines and standards and report on the adequacy of the existing subgrade and Pavement structure. Project Co shall calculate the remaining service life of the existing Pavement structure using appropriate lab and field tests and design methods. Project Co shall develop Site specific improvements and Pavement rehabilitation strategies in the proposed design and construction of Leitrim Park and Ride Facility to demonstrate that an acceptable design service life of the Pavement can be achieved that can meet or exceed the requirements of Schedule 15-2, Part 2, Clauses 6.10 – Pavement, 6.11 - Grading, and 6.12 - Drainage of this Part 2 and Schedule 15-1, Part 1, Clause 4.3 – Design Requirements, Table 1-4.1.

B. Project Co shall demonstrate in the proposed design and receive approval from the City of Ottawa that use of the existing Pavement in the proposed design and construction will not compromise the future expansion of the Leitrim Park and Ride Facility as specified in Schedule 15-2, Part 4, Article 3 – Station Specific Architectural Design Criteria.

C. Project Co shall submit the findings, results, and recommendations of the above-noted investigations in the form of a comprehensive report and receive approval from the City of Ottawa prior to advancing the design that would make use of the existing Pavement in the proposed design and construction of the Leitrim Park and Ride Facility.

(h) Bowesville Park and Ride Facility

(i) Project Co shall design and construct the Bowesville Park and Ride Facility in the southeast quadrant of the Earl Armstrong Road and Bowesville Road intersection within the Lands. The proposed Bowesville Park and Ride Facility shall include a bus station Facility with dedicated space for public parking. The bus station Facility shall include a bus loop, bus bays, bus lay-bys, and bus station Platforms, ensuring all necessary bus turning movements are accommodated per OC Transpo's Transitway and Station Design Guidelines.

A. The proposed improvements, and the specific functional and performance requirements, such as number of parking spaces, bus Platforms, bus lay-bys and bus bays required for the Bowesville Park and Ride Facility shall meet the requirements of Schedule 15-2, Part 4, Article 3 – Station Specific Architectural Design Criteria and Schedule 15-2, Part 4, Appendix A – Trillium Line Station Functional Requirements.

(ii) Project Co shall design and construct all the proposed improvements at the Bowesville Park and Ride as per the standards and requirements specified in Clause 6.9 – Facilities Operated by OC Transpo of this Part 2, unless specified otherwise in Clause 6.18 – Municipal Roads Improvements of this Part 2.

(iii) Project Co's design and construction of the Roadway improvements for Bowesville Park and Ride shall meet the requirements of Clause 6.17 – Road Safety Audits and Road Safety Design Reviews of this Part 2.

(iv) Refer to Schedule 15-2, Part 6, Article 2 – Design Criteria for the connectivity, landscape and streetscape requirements for the Bowesville Park and Ride Facility.

(v) Project Co shall design and construct all temporary traffic staging and access management strategies to ensure property accesses and current access to and from the entire existing local road network is maintained during staged construction and temporary conditions. Refer to Schedule 15-2, Part 7 - Traffic and Transit Management and Construction Access for the specific improvements noted above.

(vi) Project Co shall undertake a traffic analysis according to the City of Ottawa's TIA guidelines in order to determine the layout geometry, lane configuration, intersection improvements, and traffic control types for any accesses to the Park and Ride Facility, and all impacted Roadways within the limits of construction of Works, including but not limited to Bowesville Road and Earl Armstrong Road.

A. The analysis shall include, but not be limited to, a network analysis and an intersection operation and capacity analysis, including traffic operations at the new Park and Ride Facility. In the analysis, Project Co shall also consider the projected traffic and transit volumes for a 2023 horizon year,

existing and potential developments in the area, and connectivity for pedestrians and cyclists.

i The results of the analysis shall include, but not be limited to determining the intersection layout configuration, traffic control types, and auxiliary storage lane requirements.

ii Project Co shall ensure that the proposed design of intersections and local road improvements meet the requirements of the City's future development planned in the area. Project Co shall engage the City early in the preliminary design process in order to incorporate in the design, the necessary information from the future planned developments that may impact the design within the limits of Construction.

B. Project Co shall summarize and submit the findings from the analysis in a detailed report to the City of Ottawa and receive approval, a minimum of 20 Business Days prior to initiating the detailed design.

(vii) Project Co shall design and construct all access roads required to accommodate all mixed traffic access from Bowesville Road and / or Earl Armstrong Road per the requirements of this Part 2 and Schedule 15-2, Part 4 – Stations. The layout of the Park and Ride Facility shall accommodate the turning movements of the appropriate design vehicle according to Clause 6.8 – Design Vehicles of this Part 2 and Clause 6.9 – Facilities Operated by OC Transpo of this Part 2.

(viii) Project Co shall design and construct the Bowesville Park and Ride Facility to include an appropriate access, or accesses, for buses and general traffic into the intended Bowesville Park and Ride Facility in such a way that delays to buses, pedestrian and cyclist traffic are all minimized.

(ix) Project Co shall evaluate the existing conditions and provide any widening or Pavement improvements requirement of the existing roads to accommodate safe bi-directional operation of transit buses. Project Co shall design and construct the widening within the existing ROW and within Lands as per the requirements of Schedule 33 – Lands.

(x) Project Co shall design and construct all intersections to accommodate transit bus access and operations between the local road networks and the proposed Bowesville Park and Ride Facility.

A. Project Co shall confirm the appropriate traffic control type and necessary intersection improvements required at all existing and proposed intersections and where warranted, shall install transit priority measures to provide precedence to transit operations.

B. Where warranted, Project Co shall develop and confirm the type of transit priority measures appropriate for each intersection, and shall seek approval from the City and OC Transpo prior to proceeding with the implementation of the proposed transit priority measures.

(i) Limebank Road

(i) Project Co shall design and construct the Roadway improvements on Limebank Road per the Design Criteria requirements specified in Appendix A of this Part 2.

(ii) Project Co shall design and construct a grade separation Bridge Structure, including its approach embankments, at a location approximately 300m south of the existing Earl Armstrong Road/ Limebank Road intersection, where the new Track corridor shall cross the Limebank Road corridor.

A. Under a scenario in which Project Co's proposed grade separation facility may involve a road-over-rail grade separation configuration, Project Co shall construct an Overhead Structure, including its associated approach embankments, to carry the proposed Limebank Road over the Track corridor.

i Project Co shall design and construct the Overhead Structure to accommodate for a future widening of Limebank Road further south without the need to reconstruct the southern approach embankments for the Overhead Structure.

ii The entire raised length of Limebank Road over the Track corridor shall meet the 4-lane divided cross section requirements as specified in Appendix A of this Part 2. Project Co shall design and construct an appropriate transition for the improved Limebank Road to change its cross-section from the 4-lane divided urban cross section to the existing 2-lane undivided rural cross section beyond the southerly limits of the proposed grade raise.

iii The overall length of the Limebank Road Overhead Structure shall provide the span required to:

1. Carry Limebank Road over the Track corridor, and,

2. Accommodate a collector Roadway on the north side of the Track corridor, and a MUP on the south side of the Track corridor, as prescribed in Clause 6.18(i)(iii)(C) of this Part 2.

B. Under a scenario in which Project Co's proposed grade separation facility may involve a rail-over-road grade separation configuration, Project Co shall construct a Guideway Structure, including its associated approach embankments, which spans over the Roadway cross-section as described in Appendix A of this Part 2.

i Project Co shall design and construct the single span Guideway Structure to accommodate for a future widening of Limebank Road without a need to reconstruct any part of the Guideway Structure.

1. The design of the Guideway Structure shall also accommodate and protect for a collector Roadway cross section, on the north side of the Track corridor, and a MUP on the south side of the Track corridor, as prescribed in Clause 6.18(i)(iii)(C) of this Part 2.

2. The design of the Guideway Structure shall also protect for a future MUP connection between the north and south sides of the Track corridor on the east side of Limebank Road (minimum 7.0m between the east abutment and the east edge of the Limebank Road ROW).

ii Project Co shall design and construct an at-grade signalized intersection at the intersection of Limebank Road and Connector Road.

1. Project Co shall undertake a detailed traffic analysis, including an intersection LOS analysis considering vehicular and non-vehicular road user needs as per the City of Ottawa's TIA Guidelines, and confirm the intersection control type, storage lengths and geometry and general layout, using projected traffic and transit volumes for a 2031 horizon year, including cyclists and pedestrians.

2. Project Co shall submit a comprehensive traffic report and include the results and approval from the City at the early stages of the preliminary design, and recommendations of the above-noted traffic analysis and seek a minimum of 20 Business Days prior to initiating the detailed design per the requirements of Schedule 10 – Review Procedure.

(iii) Project Co shall accommodate a collector Roadway cross section, on the north side of the Track corridor and a MUP on the south side of the Track corridor, as described below.

A. Project Co shall design and construct the collector Roadway north of the Track corridor, herein referred to as Connector Road. Project Co shall refer to Clause 6.18(j) for the scope of the design and construction requirements of Connector Road.

B. Project Co shall design and construct an appropriate transition required for Connector Road as per the requirements of Clause 6.18 (j)(i)(D) of this Part 2.

C. Project Co shall protect for a future MUP south of the Track corridor. The future MUP shall have a minimum clear width of 7.0m and a minimum overhead clearance of 3.0m.

(iv) Project Co shall ensure the horizontal and vertical clearances for the proposed grade separation facility meet the requirements of the applicable Bridge codes as per Article 4 – Structural Design Criteria and requirements of this Part 2.

(v) Project Co shall undertake a detailed traffic analysis, including an intersection level of service analysis, as per the City's TIA Guidelines, to confirm the traffic control types and storage lengths and geometry and general layout for the limit of the Works on the southern leg of the Limebank Road / Earl Armstrong intersection, as required, using a projected traffic and transit volumes for a 2031 horizon year and taking into consideration all associated pedestrian and cycling requirements. Project Co shall submit a comprehensive traffic report and include the results and recommendations of the above-noted traffic analysis and seek approval from the City at the early stages of the preliminary design, and a minimum of 20 Business Days prior to initiating the detailed design per the requirements of Schedule 10 – Review Procedure. Project Co shall provide for all additional intersection improvements as required on the southern leg of the intersection according to the results of the above-noted traffic analysis.

(vi) Project Co shall design and construct the proposed Roadway improvements for Limebank Road to include all necessary traffic staging detours and temporary access requirements such that all temporary and permanent Works are contained within the Lands as defined in Schedule 33 – Lands.

(vii) Project Co shall reference the information provided in Schedule 15-2, Part 7 – Traffic and Transit Management and Construction Access, for the specific traffic staging and access management requirements for all private approaches from Limebank Road during staged construction and temporary conditions.

(viii) Project Co shall refer to Schedule 15-2, Part 6 - Urban Design, Landscape Architecture and Connectivity Requirements, for the pedestrian and cycling

connectivity, landscape and streetscape requirements for Limebank Road and associated intersecting Roadways.

(ix) Project Co's design and construction of the Roadway improvements for Limebank Road shall meet the requirements of Clause 6.17 of this Part 2.

(x) Project Co shall protect for future access to/ from Limebank Road as per the requirements of the most current Riverside South community design plans and guidelines.

(j) Connector Road

(i) Project Co shall design and construct the entire length of the proposed Connector Road between Main Street and Collector D.

A. The basic cross-section elements for Connector Road between the Limebank Road grade separation facility and Collector D shall include an 8.0m wide 2-lane urban collector undivided Roadway with a 2.1m uni-directional cycle track, located between the collector road and Track corridor, and a 5.1m wide segregated pedestrian and cycling facility on the opposite side.

B. Project Co shall design and construct an appropriate connection/transition to the southern limit of the Collector D to accommodate the required turning movements of the appropriate design vehicle according to Clause 6.8 and 6.9 of this Part 2.

C. Project Co shall design and construct an urban collector undivided cross-section for Connector Road in the section between Main Street and the Limebank Road grade separation facility. The proposed cross-section of this section of Connector Road shall consist of the following elements:

i 4-lanes urban undivided cross-section consisting of one 4.0m wide shared traffic lane and one 3.5m wide curbside bus stop lane to accommodate bus operations at Platforms in each direction of traffic;

ii Design and dimensions of the proposed Station Platforms required in the eastbound and westbound directions of traffic and design and construction specifications shall be as per the City of Ottawa Transitway and Station Design Guidelines;

1. Project Co shall design and construct the Terminal Station Platforms for Limebank Station per the requirements of Schedule 15-2, Part 4 – Stations.

iii Cycling and pedestrian facilities shall include:

1. 2.1m wide cycle track shall be located behind the proposed bus Platform and between the eastbound Station Platform and the Track corridor;

2. A 2.0m wide boulevard shall be provided between the back of each Platform and cycle track, noted above, along the entire length of the bus Platforms; and,

3. 3.0m wide sidewalk on Connector Road shall extend further west along the north side of the above-noted cycle track.

D. Project Co shall design and construct appropriate tapers on Connector Road corridor to transition from the 2-lane cross-section on the east end of the Connector Road to the 4-lane cross-section on the west end of the Connector Road.

E. Project Co shall refer to Schedule 15-2, Part 6 - Urban Design, Landscape Architecture and Connectivity Requirements, for the connectivity, landscape and streetscape requirements along Connector Road.

(k) Main Street

(i) Project Co shall design and construct a 7.0m wide 2-lane urban collector undivided Roadway to connect the west limit of Connector Road to Earl Armstrong Road as per the following cross section:

A. One travel lane in each direction (northbound and southbound) with the centerline matching the centerline of the ROW;

B. 1.8m wide sidewalk, adjacent to the curbline, on the east and west side between Connector Road and the proposed PPUDO locations;

C. 3.0m MUP, adjacent to the sidewalk, on the east side between Connector Road and Earl Armstrong Road; and,

D. For additional information regarding the cycling and pedestrian facilities for Main Street, Project Co shall refer to Schedule 15-2, Part 6 - Urban Design, Landscape Architecture and Connectivity Requirements.

(ii) Project Co shall provide a PPUDO on both sides of Main Street in the vicinity of the intersection with Connector Road per the requirements of Schedule 15-2, Part 6 – Urban Design, Landscape Architecture and Connectivity Requirements.

(iii) Project Co shall design and construct Main Street with consideration for a future southerly extension of the Main Street to the west of Limebank Station.

(iv) Project Co shall design and construct two controlled intersections on Main Street. One intersection shall be located at the southern limit of Main Street where it connects to the west end of Connector Road, which shall provide for two controlled pedestrian crossings across both Main Street and across Connector Road. Project Co shall design and construct another controlled intersection at Main Street / Earl Armstrong Road intersection.

A. Project Co shall undertake a detailed traffic analysis to determine the requirements of both intersections noted above, including an intersection level of service analysis, as per the City's TIA Guidelines, to confirm the traffic control types and storage lengths and geometry and general layout for the limit of the Works, as required, using a projected traffic and transit volumes for a 2031 horizon year and taking into consideration all associated pedestrian and cycling requirements. Project Co shall submit a comprehensive traffic report and include the results and recommendations of the above-noted traffic analysis and seek approval from the City at the early stages of the preliminary design, and a minimum of 20 Business Days prior to initiating the detailed design per the requirements of Schedule 10 – Review Procedure. Project Co shall provide for all additional intersection improvements as required on the southern leg of the intersection according to the results of the above-noted traffic analysis.

B. The intersection of Main Street, Connector Road and Earl Armstrong Road shall accommodate the required turning movements of the appropriate design vehicle according to Article 6.8 and 6.9 of this Part 2.

(l) Collector D

(i) Project Co shall coordinate with the City of Ottawa early in the design process and evaluate the existing conditions of Collector D and provide any widening or Pavement improvements required for the existing Roadway to accommodate the an appropriate transition and connection from Connector Road to Collector D. Project Co shall design and construct any improvements on Collector D within the existing ROW and within the Lands identified in Schedule 33 - Lands.

ARTICLE 7 GEOTECHNICAL DESIGN CRITERIA AND REQUIREMENTS

7.1 Reference Documents

(a) Design and construction of all geotechnical and foundation Work shall comply with the criteria contained in this Article, and the 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 within one document when compared with another, the more stringent shall apply:

(i) Criteria contained in this Article;

(ii) Schedule 15-2, Part 2, Article 9 – Protection of Existing Adjacent Structures;

(iii) Schedule 15-2, Part 2, Article 4 – Structural Design Criteria and Requirements;

(iv) Schedule 17 – Environmental Obligations;

(v) Municipal Standards according to Master Agreement including Schedule B, Appendix 2, Standard and Guidelines;

(vi) OBC;

(vii) NBCC;

(viii) CHBDC;

(ix) OPSS/OPSD;

(x) CSA;

(xi) ASTM;

(xii) CFEM;

(xiii) MOECC;

(xiv) PEO, Guideline for Professional Engineers Providing Geotechnical Engineering Services;

(xv) AREMA; and,

(xvi) OHSA and Applicable Law.

(b) Project Co shall comply with the Applicable Law, design manuals or practices applicable to the Project, issued by all relevant third parties including MTO and the City. Project Co shall submit design and construction plan for all geotechnical and foundation works including excavation, backfilling, underpinning, modifications, monitoring and mitigation plans for review and acceptance by all relevant third parties including City, MTO, Utility Companies, other third party owners. Project Co shall comply with the following documents and requirements:

(i) Schedule 10 – Review Procedure.

(ii) To prevent impact to third parties' structures in the alignment, all Construction Activities such as groundwater control, excavation, underpinning, modification, and support of excavation systems shall meet third party stakeholders' requirements. In particular:

A. For construction within or in the vicinity of the NCC land, specific design approaches shall be considered to avoid adverse impacts of construction dewatering operations on NCC land and other existing Structures; and,

B. For construction near or under the Highway 417 Bridge, specific design approaches shall be considered to prevent settlement of or other damage to the Bridge.

7.2 General Requirements

(a) Geotechnical and foundations design shall be carried out in accordance with design concepts used in the reference documents listed in Clause 7.1 of this Part 2 such as the principles of LSD based on Load-and-Resistance Factor Design and WSD based on AREMA. The factors of safety and allowable stress for the Track supports should be based on the functional requirements of the structure.

(b) Project Co shall perform a geotechnical subsurface soil and groundwater conditions assessment using available data for the entire Guideway and shall provide a detailed and complete set of geo-engineering design reports including geo-engineering Design Criteria with a tabulated list of geotechnical and hydrogeological design parameters. The basis for selection of the Design Criteria should be provided for all components of any underground structures, all components of any retaining and support of excavation structures, and at grade and elevated structures. In addition, Project Co shall prepare stratigraphic profiles along the Guideway with proper cross-sections particularly for the underground sections along the alignment that are to be constructed by Project Co. The stratigraphic profiles shall include anticipated distribution of the various ground types and hydrogeological regimes and conditions, and Reports shall be submitted in accordance with Schedule 10 – Review Procedure.

(c) Project Co shall review all existing geo-environmental data and information and develop an Excess Materials Management Plan. Further details on environmental compliance and management requirements are provided in Schedule 17 – Environmental Obligations.

(d) Project Co shall retain the services of qualified consultants who hold a Professional Engineers of Ontario Certificate of Authorization and practice as a geotechnical consultant. Geotechnical laboratories shall be certified by CCIL and shall have participated and met the MTO correlation program for soil testing. Environmental laboratories shall be accredited by the CALA for analytical tests.

(e) Project Co shall retain the services of qualified consultants who hold an Association of Professional Geoscientists of Ontario Certificate of Authorization and practice as a hydrogeological consultant.

(f) Project Co shall submit details of any proprietary geo-engineering systems, for review by the City in accordance with Schedule 10 – Review Procedure. Project Co shall demonstrate a minimum 10 years of successful performance on at a minimum of three projects of such geo-engineering systems. These three projects must be of a similar scale to the proposed use on this Project.

(g) The frost penetration depth for Ottawa is 1.8m. Project Co shall consider this and ensure sufficient frost protection is provided for all Structures.

(h) Project Co shall demonstrate project experience designing and building structures founded on the sensitive marine clays in the Ottawa area, locally known as Leda Clays, and shall retain personnel who have verifiable local design and construction experience with Leda Clay.

7.3 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 and performance requirements, and clearance envelope requirements over their Design Life. When a WSD is used, the allowable stress shall be checked under the various loading combinations defined in the relevant Codes and Standards.

7.4 Permanent Cut and Fill Slopes

(a) Permanent cut and fill slopes and geo-structures shall be designed according to applicable Standards and with adequate safety margin (such as factor of safety), as described in the relevant Codes and Standards.

(b) Total and differential post-construction settlements along the Track bed or Pavement including those due to frost heave shall meet the requirements of Article 3 – Trackwork and Article 6 – Roadways, Bus Terminals and Lay-bys, of this Part 2. Project Co shall ensure 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.

(c) No vertical offset at longitudinal joints in Pavement surfaces shall be permitted after construction.

(d) No vertical offset at longitudinal or transverse joints along Station Platforms, interior walkways or at building connections shall be permitted after construction.

7.5 Permanent Retaining Structures and Cut & Cover Structures

(a) The following requirements apply to new cut & cover structures, new retaining systems, and existing retaining walls and cut & cover structures:

(i) Permanent water-tight underground structures on the alignment shall be designed to resist groundwater pressures and shall account for the Project flood level requirements provided in Article 5 – Drainage and Stormwater Management Design Criteria, of this Part 2.

(ii) The lateral earth pressure coefficient corresponding to the characteristic at-rest conditions (Ko) and appropriate to the adjacent native ground or backfill soils shall be applied to determine the magnitude of the characteristic earth pressure distribution. The Ko conditions must be determined and then reduced according to the proposed structure's characteristics (stiffness, deformability, etc.). Project Co shall estimate, or measure Ko by conducting testing using the appropriate standard methods in the field and in the laboratory;

(iii) Consideration of friction piles, micropiles and anchored systems for resisting uplift forces shall be incorporated into the cut & cover foundations design, provided redundancy is built in the design. For micropiles, the required redundancy shall be achieved by using adequate resistance factor provided that a testing program as indicated in OPSS 903 is followed. For frictional piles, adequate resistance factors with or without a load test shall be used in accordance with relevant design Codes and Standards. For anchored systems, the requirements as indicated in OPSS 942 shall be followed. The design reduction factor to be applied to the uplift resistance capacity of the friction piles and micropiles shall be based on the type of structure, loading, allowable displacements, and soil and groundwater conditions.

(iv) Project Co shall not utilize side friction between the soil and Underground Structure walls to resist uplift, unless Project Co can clearly demonstrate that side

friction can be relied upon and will not induce detrimental effects to the Underground Structure. Project Co shall not utilize side friction between the soil and structure walls that have an exterior waterproofing system to resist uplift.

(v) All temporary excavation support systems for permanent cut and cover structures shall be carried out in accordance with Clause 7.7 of this Article.

(vi) The upper 1.8m as measured from lowest adjacent grade shall be discounted in any axial and lateral load analyses to account for possible future excavations around the pile group.

7.6 Services

(a) All services including installation and reconstruction of water and sewer lines, engineering fill application, pipe bedding, cover and trench backfill material shall conform to the City requirements, including but not limited to requirements of Article 8 – Utility Infrastructure Design Criteria, of this Part 2.

7.7 Temporary Slopes and Retaining Structures

(a) The performance of each temporary Works shall be sufficient for its service life. All temporary Work shall comply with the OHSA, relevant design Codes and Standards and the Project requirements applicable at the time of excavation and the additional criteria:

(i) Temporary retaining structures shall meet the requirements of limiting ground movements, such as surface settlement, as stipulated under this Article;

(ii) Protection of Existing Adjacent Structures in accordance with Article 9 - Protection of Existing Adjacent Structures, of this Part 2;

(iii) Design, installation, and testing of tie backs shall follow OPSS 942;

(iv) Project Co shall comply with third party requirements for tie-back de-stressing as stated in this Article. Removal of temporary support system shall follow OPSS 539;

(v) Temporary unsupported excavation side slopes shall meet OHSA requirements; and,

(vi) All elements of temporary retaining structures within the upper 2m of the ground surface shall be removed and properly disposed of upon completion of backfilling.

7.8 Earthwork and Geo Environmental

(a) Backfilling and reuse of excavated material on City property and ROW shall follow City Standards, Schedule 17 – Environmental Obligations and third party standards.

(b) Buoyancy corresponding to inundation of the fill to the flood level shall be considered in the design of using lightweight fills. Permanent flood protection shall be provided for the area in which the fill is to be used. Fuel spills, salt, wheel loading, penetration from landscaping, and penetration from sign foundation shall also be considered.

(c) Geo-Environmental requirements are specified in Schedule 17, Part 4 - Contamination and Excavated Material Management.

7.9 Geotechnical Instrumentation

(a) Project Co shall determine and install geotechnical instrumentation in the key and critical areas described as follows where special attention or continued monitoring is required. As a minimum, Project Co shall determine instrumentation requirements, frequency and duration of monitoring for construction-induced noise and vibration, displacement and strains for fill embankments, groundwater elevation and pressure, ground movements adjacent to deep excavations, temporary retaining structures (including piles, struts and tiebacks), Tunnel and Tunnel portals, permanent retaining structures, Utility Infrastructure, hydro towers, existing rail Tracks, highways, Roadways, pathways, existing buildings, bridges or other Structures along the alignment that shall remain in service.

(b) Design of the geotechnical instrumentation and monitoring program shall be under the direct supervision of a Professional Engineer.

(c) 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.

(d) In accordance with all applicable laws, regulations, and by-laws (as amended), Project Co shall decommission and dispose of all geotechnical, hydrogeological, and/or geo-environmental instrumentation installed by Project Co or the City for the purposes of this Project, at the end of construction or after the instrumentation is no longer required for Project activities. Project Co shall decommission and dispose of any existing geotechnical, hydrogeological, and/or geo-environmental instrumentation, that is documented in the Background Information or that may not be documented and otherwise encountered by Project Co during construction, used for monitoring/not used for monitoring on, in, or under the Lands. Project Co shall obtain acceptance from the City prior to decommissioning and disposal of any existing geotechnical, hydrogeological, and/or geo-environmental instrumentation, that is documented in the Background Information or that may not be documented and otherwise encountered by

Project Co during construction, used for monitoring/not used for monitoring, on, in, or under the temporary Lands as defined in Schedule 33 - Lands. Project Co shall provide decommissioning records to the City.

(e) GIMP: Project Co shall prepare a comprehensive GIMP and submit to the City for review in accordance with Schedule 10 - Review Procedure. The GIMP shall span the Project Operations for the duration of construction, testing, and Commissioning. As a minimum, the GIMP shall include the following:

(i) A DMP which shall be a GIS-based system using a secure internet connection capable of receiving and visualizing near real time monitoring data. The DMP shall be used to create and send alarm reports/notifications and create monitoring reports including batch reports if Response Levels defined by Project Co and indicated in Article 9 – Protection of Existing Adjacent Structures, of this Part 2 are exceeded. Project Co shall provide access credentials to the City for simultaneous users for the DMP. Project Co shall set up the DMP such that the City is immediately notified of exceedances.

(ii) Appropriate geotechnical instrumentation for Stations, Structures and Tracks. The instruments shall be capable of collecting and transmitting continuous real time monitoring data to be incorporated and visualized in the DMP. Collecting and transmitting real time monitoring data shall not be required when monitoring Structures that will not experience adverse impacts due to dewatering induced settlement as a result of construction excavation, such as Structures founded directly on intact bedrock or deep foundations extending to bedrock.

(iii) All instruments including existing instruments turned over to Project Co by the City and instruments to be installed by Project Co.

(iv) Typical installation details and location of additional instruments.

(v) Schedule for installation, taking baseline readings, frequency and duration of monitoring for each phase of Construction.

(vi) Construction-induced noise and vibration control and monitoring plan.

(vii) The plan and schedule for decommissioning and disposing of all additional instruments installed by Project Co as well as all existing instruments turned over to Project Co. Project Co shall notify the City of the intention to decommission instruments.

(viii) All Response Levels (refer to Article 9 – Protection of Existing Adjacent Structures, of this Part 2), as specified and defined by Project Co.

(ix) A Response Action Plan, which shall consist of methods and means to respond to various Review and Alert Level scenarios Article 9 – Protection of Existing Adjacent Structures, of this Part 2 based on types of geotechnical instruments that indicate Review Levels. Project Co shall inform the City of subsequent response actions in accordance with the Response Action Plan. At a minimum, Response Action Plan should include the following:

A. Names, telephone numbers, and locations of persons responsible for implementation of contingency plans;

B. Materials and equipment required to implement contingency plans;

C. Location on Site of all required materials and equipment to implement contingency plans;

D. Step-by-step procedure for performing works involved in implementation of the contingency plans;

E. Specific actions related to the Alert Level values for all instruments, including means of reducing or eliminating movements and rates of movements;

F. Inspection of affected facilities, structures and Utilities and performance of acceptable corrective and restorative measures; and,

G. Clear identification of objectives of contingency plans and methods to measure plan success.

(x) All measures and specific instrumentation and monitoring requirements to protect Existing Adjacent Structures in accordance with Article 9 – Protection of Existing Adjacent Structures, of this Part 2.

(xi) All measures and specific instrumentation and monitoring requirements for protecting heritage buildings identified in the Project Assessment Study Environmental Project Report and relevant updated revisions which are within the Project ZOI as defined in Article 9 – Protection of Existing Adjacent Structures, of this Part 2.

(xii) For all Underground Structures, Project Co shall provide, install, maintain, and monitor for the duration of construction, testing, and commissioning a system of instruments that will indicate the pressures and deformations imparted to the permanent structures. The instrumentation shall include:

A. Two arrays of pressure cells with one array on each long side of the Station. Each array shall consist of three cells installed at three different

elevations (top, middle and bottom levels along the vertical side walls and away from end walls). Pressure cells shall be installed behind the water proofing system on the overburden side, including soil and rock, prior to start of concrete pouring for the walls.

B. An instrument on both sides of the longest side of the Station to measure the deformations. This instrument shall consist of an array of either MEMS gravity sensors separated by special joints to measure tilt along three axes, or in-place-inclinometers, or equivalent.

C. Install a minimum of 3 equally spaced surface settlement monitoring points on both sides of the excavation along a line perpendicular to the excavation, with the first monitoring point located at the edge of the excavation, the second monitoring point located at the farthest point no further away than the limits of the Project ZOI outlined in Article 9 – Protection of Existing Adjacent Structures, of this Part 2, and the third monitoring point located equally between the first and second monitoring points. These lines of monitoring points shall be spaced a maximum of every 30 m running parallel to the excavation.

D. Install in-place-inclinometers on both sides of the excavation spaced a maximum of 50m running parallel to the alignment. Inclinometers shall be placed a maximum allowable distance of 1m from the edge of excavation.

E. Install piezometers on both sides of the excavation spaced a maximum of every 50m. Project Co shall locate and monitor piezometers to ensure the groundwater drawdown restrictions of Clause 7.11, of this Part 2, are followed.

F. All the above instruments shall be connected directly or indirectly to permanent data loggers. Connecting instruments to permanent data loggers shall not be required when monitoring Structures that will not experience adverse impacts due to dewatering induced settlement as a result of construction excavation, such as Structures founded directly on intact bedrock or deep foundations extending to bedrock.

G. All of the above instruments shall have a minimum daily reading frequency, when located less than or equal to 30m from the edge of excavation, and a weekly reading frequency when located greater than 30m from the edge of excavation.

H. Project Co shall submit an updated monitoring report in electronic format, in accordance with Schedule 10 – Review Procedure every week.

(f) Project Co shall establish permanent reference monuments and deep surveying benchmarks as required along the alignment in accordance with the requirements of this Article 7.

(g) Provide a demonstration of the features of the instrumentation DMP GIS based system to the City prior to the start of construction and afterwards as modifications are made to the website.

(h) Meet with the City as needed to discuss instrumentation levels and necessary actions to protect EAS.

(i) 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 EAS.

(j) 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.

7.10 Monitoring Requirements

(a) Project Co shall integrate the following monitoring requirements in addition to other monitoring requirements outlined in Clause 7.9 of this Part 2.

(b) Project Co shall incorporate into the monitoring program, data from existing condition surveys, including data provided by the City.

(c) The monitoring reports prepared and submitted by Project Co shall be in accordance with the requirements of Schedule 10 – Review Procedure.

(d) Monitoring shall include logs and survey notes which contain the following information:

(i) Record of measurements of in-Tunnel or other deformations;

(ii) Construction staging, loading or other construction activities associated with the Works in the vicinity of instruments; and,

(iii) Record of any cracks in, or damage to any Structures.

(e) Project Co shall indicate locations where, due to contractual interfaces or changes in the extent of the Project ZOI Article 9 – Protection of Existing Adjacent Structures, of this Part 2, re-baselining of instrumentation readings shall be conducted.

7.11 Groundwater Control – Dewatering/Unwatering and Depressurization

(a) For the purposes of Clause 7.11 of this Part 2, Unwatering is defined as the removal of water that has accumulated in a project excavation or Tunnel and is an element of groundwater control. Groundwater control is defined as dewatering/unwatering and/or aquifer depressurization.

(b) Project Co shall develop and submit plans and procedures for groundwater control (including effluent discharge) in accordance with Schedule 10 – Review Procedure. The plans and procedure shall include, but not limited to the following items:

(i) Detailed shop drawings of the entire dewatering system(s) that bear the seal and signature of a professional engineer licensed in Ontario, and include, but not be limited to, details, and calculations of proposed type of dewatering system(s), showing arrangement, location, and depths of components of system including details of screens and filter media, complete description of equipment and materials to be used, procedure to be followed, standby equipment, standby power supply, and proposed location(s) of points of discharge of water and abandonment of dewatering system(s), a description of any permits and approvals that pertain to the groundwater control activities;

(ii) A discharge plan that includes: Discharge location(s) including methods; procedures and equipment to convey water to Discharge locations; location and dimensions of treatment equipment; procedures for water testing; water quality laboratory analyses procedures, test results or analyses, and water treatment methods; location and construction details of monitoring observation wells, a description of any permits and approvals that pertain to the discharge activities;

(c) Project Co shall apply for Permits, Licenses, Approvals and Authorizations, including PTTW and/or Environmental Activity and Sector Registry, and discharge permits (e.g., Municipal, Conservation Authority and/or Environmental Compliance Approval).

(d) Design, construction, and operation of groundwater control measures shall not induce detrimental short- and/or long-term movements of surrounding Structures, infrastructure, and ground surface. Evaluation of detrimental movements shall follow provisions included in Article 9 – Protection of Existing Adjacent Structures, of this Part 2.

(i) Project Co shall develop plans and procedures for groundwater control (including effluent discharge), establish monitoring requirements, and carry out a hydrogeological impact assessment and associated risk assessment and submit to the City in accordance with Schedule 10 – Review Procedure. This process shall consider all required project Permits, Licenses, Approvals and Authorizations. Project Co shall ensure that any groundwater control, effluent discharge, and subsequent effects during construction or during the Design Life shall have no

adverse impact on the following features within the Project ZOI: properties, adjacent Structures, infrastructure, active groundwater supply wells, and environmental features. Specifically, the following potential impacts shall be managed/mitigated such that they are not/do not become adverse:

A. Groundwater drawdown effects including impacts on the quantity and quality of groundwater available for groundwater dependent ecosystems and existing groundwater users;

B. Groundwater drawdown effects which may cause settlement of existing Structures or Utilities within the Project ZOI as required in Article 9 – Protection of Existing Adjacent Structures, of this Part 2; and,

C. Appropriate quantity and quality of dewatering effluent with respect to the receiver (e.g., Municipal sewer, natural environment, off-site receiver, etc.), in accordance with all applicable project permits and approvals.

(e) Project Co shall obtain RVCA review and approval for any activity within RVCA or SNCA Regulated Areas and all Works shall be carried out in agreement with the applicable requirements and regulations of RVCA or SNCA.

(f) Project Co shall design, install, operate, monitor, maintain, and decommission (as required) the project-specific groundwater control systems, as necessary to meet Project requirements and shall continue proper discharging of effluent according to the relevant City's Sewers Use By-law, as well as any other applicable regulatory (e.g., Conservation Authority and MOECC) approvals without any interruption or negative impact on existing Structures. It will be the sole responsibility of Project Co to verify the condition of the groundwater control systems and operate them as required.

(g) Project Co shall submit, on a quarterly basis, the data obtained from all instrumentation utilized for monitoring including hydrogeological and geotechnical instrumentation to the City for review in accordance with Schedule 10 – Review Procedure.

(h) Project Co shall conduct all monitoring required by the obtained permits and approvals (including daily pumping volumes).

(i) Project Co shall submit the monitoring results to the applicable agencies as stated in the obtained permits and approvals in accordance with Schedule 10 – Review Procedure.

(j) Project Co shall respond to/address any complaints received that are potentially related to groundwater control activities.

7.12 Seismic Design

(a) Seismic Site classification

(i) Project Co shall complete a Site classification and seismic response study and provide a report to the City in accordance with Schedule 10 – Review Procedure. Site classification and seismic response shall follow NBCC and OBC as applicable.

(b) Seismic Load

(i) The design of the Underground Structures shall use a dual-level seismic design criterion with an upper level design earthquake to provide a life safety performance objective and a lower level design earthquake for operational performance objective. The design shall conform to Article 4 – Structural Design Criteria and Requirements, of this Part 2, and the following:

A. The upper level design earthquake is an MDE where the probability of exceedance is approximately 4% in the 100-year Design Life, which corresponds to the 2% probability of exceedance in 50 years that is specified in the NBCC. The Underground Structures shall be designed with adequate strength and ductility to resist loads and deformations imposed on the structures during the MDE, thereby preventing Structure collapse and maintaining life safety; and,

B. The lower level design earthquake shall be the ODE where the probability of exceedance is approximately 20% in the 100-year Design Life, which corresponds to the 10% probability of exceedance in 50 years that is defined by the GSC using the NBCC seismic hazard maps. When subjected to ODE, the Underground Structures shall be designed to respond essentially in elastic manner. There shall be no collapse, and no damage to primary structural elements. The Structure shall remain fully operational immediately after the earthquake, at a full operational status.

(ii) The design shall use ground deformation analysis methods that account for soil-structure interaction in assessing the seismic effect on Underground Structures. Project Co shall perform in-depth numerical modelling, such as dynamic finite element and/or finite difference methods (as required).

(iii) For partially buried structures (structures partially above ground and partially below ground surface), the design shall account for the effect of the above-ground portion.

(iv) Interior structure not rigidly connected to the exterior Tunnel Structure shall be analysed using the response spectra method. Restrained structures that oscillate in phase with or are rigidly attached to the Tunnel shall be analysed using ground deformation methods.

7.13 Subsurface Investigations and Testing Prior to Construction

(a) Project Co shall review all provided geo-engineering data and be responsible to undertake additional subsurface investigations to enable the detailed design and construction of the Project. Results of investigations shall be provided to the City in accordance with Schedule 10 – Review Procedure. The actual design basis shall conform to the available and additional geo-engineering data. Copies of any reports and interpretations provided by Project Co for design should be submitted to the City to review for design consistency purposes in accordance with Schedule 10 – Review Procedure.

(b) All field and laboratory testing shall be carried out in accordance with Applicable Law including but not limited to CSA, MTO or ASTM standards. The locations and elevations of all boreholes, test pits, cone penetration tests, and other field testing or sounding locations shall be surveyed in accordance with the requirements of Schedule 15-2, Part 1, Article 4 – Design and Construction.

ARTICLE 8 UTILITY INFRASTRUCTURE DESIGN CRITERIA

8.1 Project Co General Responsibility

(a) The timing of Utility Work including relocations shall be subject to operational constraints. Project Co shall coordinate the scheduling of all Utility Work including relocation work with the relevant Utility Companies.

(b) Project Co shall be solely responsible for identifying the actual locations and condition of all existing Utility Infrastructure to complete the Utility Work, identifying all Utility Infrastructure relocation requirements, developing and preparing a Utility Infrastructure Relocation Plan, in accordance with Schedule 10 – Review Procedure and performing all required work to protect, safeguard, remove, and relocate Utility Infrastructure as required and obtaining requisite consents from and with all Utility Companies with respect to the design, construction, installation, servicing, operation, repair, preservation, relocation, and or Commissioning of Utility Infrastructure in, on, under, over, or adjacent to the Lands. The Utility Infrastructure Relocation Plan shall include:

(i) identification of existing Utilities;

(ii) recommended Utilities Work;

(iii) assumptions and considerations;

(iv) approach to, and documentation of, communication and coordination with Utility Companies including articulating an understanding of Utility Companies' operational constraints;

(v) approach to communication and coordination with other Stakeholders including businesses and property owners;

(vi) approach to managing service interruption to Utilities customers including property owners;

(vii) providing early identification and approach to mitigation of impacts to critical Utility Work;

(viii) identification of, and applications for, Permits, Licenses, Approvals and Authorizations required for Utility Work;

(ix) evidence of coordination with all other Utility Infrastructure relocations in the same area; and,

(x) approach to supplying Utility services to the Project.

(c) Project Co shall prepare and submit a Utility Infrastructure Relocation Plan to each Utility Company and a fully coordinated overall Utility Infrastructure Relocation Plan to the City, in accordance with Schedule 10 – Review Procedure.

(i) Project Co shall submit the following Utility Relocation Plans, without limitation:

A. Utilities on Airport Lands;

B. Water infrastructure along the alignment from the South Ottawa Pumping Station to Leitrim Road;

C. South Keys Station; and,

D. Fibre Optics parallel to the alignment.

(d) Project Co shall provide to the City, copies of transmittals only, for all submittals provided to and from Utilities Companies within two Business Days of the date of each transmittal. For clarity, transmittals shall be provided to the City for information purposes only.

(e) Project Co shall provide within two Business Days all documentation to and from Utilities Companies upon the City's request.

(f) Project Co shall prepare and submit a written workplan, in accordance with Schedule 10 – Review Procedure, separate from the Utility Infrastructure Relocation Plan which shall include:

(i) durations and timelines for each Utility relocation and or other strategies, by location; and,

(ii) identifying dependencies and conflicts with overall Works Schedule.

(g) Project Co shall be solely responsible for identifying the requirements for and obtaining all consents and approvals, including without limitation, crossing and other agreements in favour of the City from Utility Companies and others having rights over and an interest in the Lands, whether below, at, or above grade.

(h) All Utility Work shall be in compliance with all relevant codes and standards of each Utility Company and with the requirements of all Governmental Authorities, and with the requirements of this Project Agreement.

(i) The Utility Work shall preserve the existing Utility Company network performance and existing capacity subject to relevant codes and standards of each Utility Company and with the requirements of all Governmental Authorities, where Project Co has identified that Utility Infrastructure shall be relocated or removed and replaced.

(j) Project Co shall provide access within two hours of request from all Utility Companies to their respective Utilities. Project Co shall provide the City uninterrupted access to all watermain valves.

(k) Project Co shall coordinate Utility Work with the overall System design such that any Operations, Maintenance, repair and/or replacement activities undertaken by the Utility Company shall not interrupt the Operation of the System.

(l) 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 Utility Companies, the City, and any other entity whose consent is required and without obtaining all required permits and approvals.

(m) Project Co shall replace all surface and subsurface features and Utility Infrastructure disturbed, damaged or temporarily removed during the activities related to Utility Work and reinstate in accordance with the requirements of this Project Agreement.

(n) All Lane Closures, detour routes, lane shifts and diversions required to undertake Utility Work shall be in accordance with the requirements of this Project Agreement.

8.2 General Provisions for Utility Work

(a) Project Co shall coordinate and perform Utility Work so as to minimize impact to continuity of service and disruption to property owners and customers of the Utility Companies to the satisfaction of the Utility Companies, private Utility owners and the City.

(b) Utility Infrastructure shall be relocated such as to provide access, acceptable to the Utility Company, for Maintenance and repairs. Sufficient width shall be provided to accommodate all required Utilities and provide the necessary clearances as determined by the Utility Companies and any applicable City Standards;

(c) The demarcation point between any Utility service and the System shall be defined as the point where the responsibility of ownership transitions from the Utility Company to the owner. The location and configuration of demarcation points between any Utility service and the System shall comply with relevant Utility Company standards and industry practices between the Utility Company and its customers. Where no such appropriate Utility Company standards and industry practices exists, the location and configuration of demarcation points shall be mutually agreed upon between the Utility Company and Project Co.

(i) For **[REDACTED]**, the civil demarcation point shall be defined as the point where the ownership of the civil infrastructure associated with electrical services transitions from **[REDACTED]** to the City. The location and configuration of the

civil demarcation shall comply with **[REDACTED]**. The electrical ownership demarcation point may not be the same as the civil demarcation.

(ii) For **[REDACTED]**, the electrical demarcation point shall be defined as the point where the ownership of electrical infrastructure transitions from **[REDACTED]** to the City. The location and configuration of the electrical demarcation shall comply with **[REDACTED]**.

(d) Project Co shall provide or maintain access to maintenance holes and watermain valves located outside the Guideway by rubber tire vehicle.

(e) Project Co shall not construct, relocate or reinstate Utilities to new, reconstructed, or existing MTO-owned Bridge Structures.

(f) Project Co shall not be permitted to attach, construct, or relocate any fluid carrying Utilities to new, reconstructed, or existing City owned Bridge Structures.

(g) Project Co shall be permitted to reinstate non-fluid carrying Utilities into existing conduit on existing City owned Bridge Structures that are otherwise not reconstructed.

(h) Project Co shall be permitted to attach new non-fluid carrying Utilities to new, existing, or reconstructed City owned Bridge Structures. Utilities shall not be permitted under sidewalks, in parapet walls or directly suspended from thin deck slabs.

(i) Project Co shall encase all inter city fibre optic carriers (**[REDACTED]**) conduit or cable crossings of MUPs, Roadways, and Tracks, in split steel. Project Co shall encase all inter city fibre optic carriers' conduit or cable located beneath Platforms and Foundations in split steel.

8.3 Protection of Utilities

(a) Project Co shall be responsible for protection and all repairs as a result of any damages caused by any actions, or neglect of any actions, by Project Co or any Project Co Party to Utility Infrastructure. Project Co shall further be responsible for ancillary costs related to maintaining normal levels of service or incurred by the Utility Company as a result of these damages. Refer to Article 9 – Protection of Existing Adjacent Structures of this Part 2 for the minimum CIAR requirements for existing Utility Infrastructure within the ZOI and the baseline performance criteria for Utility Infrastructure impact mitigation to be used in the development of the GIMP Response Action Plan.

(b) All Utility Infrastructure located at Commercial Close, or thereafter, on, in, under, over, or adjacent to the Lands (including Utility Infrastructure within any excavation) shall remain in service and be protected and preserved by Project Co throughout the Construction Period unless otherwise agreed upon by the Utility Company.

(c) Project Co shall be responsible for any damage done by Project Co or any Project Co Party to Utility Infrastructure throughout the Construction Period.

(d) For all existing and new Utilities crossing the Lands, Project Co shall utilize and adhere to all requirements of the Transport Canada document titled "Standard Respecting Pipeline Crossings Under Railways TC E10". Requirements for TC E10 shall apply for all Track segments irrespective as to whether they are subject to the jurisdiction of the Minister of Transport pursuant to the Railway Safety Act.

(i) For all existing gravity sewer pipeline crossings, where no record drawing information is available, Project Co may assume requirements for TC E10 are already satisfied or may be waived for pipe segments located beneath the existing track alignment. Where new sidings are constructed or changes to Track alignments relative to existing pipeline crossings are made, Project Co shall adequately uncover pipe segments and verify that TC E10 requirements are satisfied, and/or reconstruct, modify, or provide suitable protection to satisfy requirements of TC E10 as necessary.

(ii) For all existing watermain crossings under existing Tracks, where record drawing information is available, there are no requirements to further modify or provide additional protection to satisfy requirements of TC-E10, providing the Track alignment is unchanged from existing and no new sidings are added over the pipeline.

(iii) For all existing watermain crossings where no record drawing information is available, Project Co shall adequately uncover the pipeline crossing, assess the pipeline for adherence to TC E10, and reconstruct or provide suitable protection to satisfy requirements of TC E10 as necessary.

(iv) For all existing **[REDACTED]** pipeline crossings where no record information is available, Project Co shall include time for **[REDACTED]** to assess the pipeline for adherence to TC E10 with reference to the final Trackwork design, and where necessary, coordinate for **[REDACTED]** to reconstruct or protect the pipeline to satisfy requirements of TC E10.

(e) Project Co shall maintain the existing OC Transpo optical fibre feed to the Transitway Stations during the Construction Period and for the duration of the Maintenance Period. 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.

8.4 Project Utilities Services

(a) Project Co shall be responsible for all Utility Work for all temporary and permanent Utilities services for the Project necessary to comply with the requirements of relevant standards, codes and approvals, as described in this Project Agreement.

8.5 Location and Condition of Utility Infrastructure

(a) Project Co shall be responsible for identifying and ascertaining the locations and conditions of all Utility Infrastructure, located on, in, under, over or adjacent to the Lands and ensuring compliance at all times with the provisions of this Project Agreement. 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.

8.6 Project Co Responsibilities for Utility Work

(a) All Utility Work shall be performed by, or under the supervision of, and at the risk and expense of Project Co subject to the rights of Utility Companies to specify who will perform the Utility Work. 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 in connection with the Utility Work and providing access to the relevant Lands if such Utility Work is to be performed 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) obtaining all Permits, Licenses, Approvals and Authorizations for the Utility Work;

(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 design, construction, crossing, and maintenance agreements, service contracts, and other agreements in connection with the Utility Work;

(vii) Project Co shall complete any Utility Infrastructure abandonment as per the standards of relevant Utility Company and City standards, guidelines and specifications. Abandoned underground Utility Infrastructure which results from the relocation of Utility plant, shall be removed up to the first Utility structural chamber beyond the abandoned sections;

(viii) 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;

(ix) For **[REDACTED]** 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, grounding grids, etc. for the purpose of the installation of the **[REDACTED]**'s plant;

(x) For **[REDACTED]**, Civil Works design for specialty structures inclusive of Bridges, vaults, viaducts, buildings, vent shafts and other **[REDACTED]** structures shall be Project Co's responsibility and shall be coordinated with other **[REDACTED]** Civil Works design. The Civil Works shall be installed as per the standards and specifications of **[REDACTED]**;

(xi) The new installation, modification, relocation, and/or upgrade all Utility services and related assets for existing and new Stations and other systems as necessary to meet Project requirements; and,

(xii) The installation of any heating equipment required for Track switches from the proposed connection with the Utility Company that is supplying the Utility to such heating equipment.

A. Refer to Appendix G of this Part 2 for connection details related to the supply of electricity from **[REDACTED]** and natural gas from **[REDACTED]**. Project Co shall at their discretion, request and utilize any of the proposed Utility supply points. Proposed Utility supply points are provided at no cost to Project Co, as related to **[REDACTED]** and **[REDACTED]**. Project Co shall coordinate their requirements with the City. Supply coordinates listed in Appendix G of this Part 2 are approximate, and exact final supply point locations shall be designated by the Utility Company.

B. Any propane supply storage tanks shall be provided by the City. Project Co shall co-ordinate with the City to confirm the number and location of such propane storage tanks. Project Co shall be responsible for all costs to install such supply tanks, and corresponding supply lines.

C. All works related to heating equipment required for Track switches shall form part of the Project Co Utility Works.

(xiii) The provision of new or alteration of low voltage electrical services for streetlighting and traffic signals as coordinated by City signals and streetlighting departments.

(b) The Utility Companies shall be individually responsible for the following work which will be covered in the Utility Company Works Cash Allowance as noted in Project Agreement Section 20.13. For clarity, only Utility Work explicitly described here shall be subject to cash allowance. Work by the Utilities beyond the Utility ownership demarcation point shall not attributable to the Utility Company Works Cash Allowance. **[REDACTED]** work beyond the **[REDACTED]** civil demarcation point including wiring, transformers and other connection assets shall not be subject to the Utility Company Works Cash Allowance. As exceptions, any **[REDACTED]** work associated with a change in supply point where there is an existing supply, or where a change in a proposed supply point is requested, additional supply points are requested, or an upgrade to exiting connection assets is required, shall not be subject to cash allowance:

(i) 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 that is associated with Utility relocation. Utility Works performed associated with new telecommunication services shall not be attributable to the Utility Company Works Cash Allowance;

(ii) Inter city fibre optic carriers (**[REDACTED]**) maintain duct structure and direct burial cable fibres adjacent to existing Trackwork along the Expanded Trillium Line alignment. The respective carriers shall be responsible for design and construction for relocation of fibre optic cables and related duct structures where in conflict with SI. Project Co shall coordinate with fibre optic carriers and City to arrive at a final design.

(iii) **[REDACTED]** shall be responsible for the design of all necessary temporary and/or permanent Civil Works, excluding specialty structures as per Clause 8.6 of this Part 2, associated with the relocation of the Utility Infrastructure, which may include duct banks, maintenance holes, handwells, pads, etc. for the purpose of the installation of the **[REDACTED]**'s plant.

(iv) **[REDACTED]** shall be responsible for the design and construction 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 associated with the relocation of Utility Infrastructure.

(v) **[REDACTED]** shall be responsible for design and construction of all necessary temporary and/or permanent Utility poles, line cover-ups, and associated wiring with the relocation of Utility Infrastructure.

(vi) **[REDACTED]** shall be responsible for the design and construction 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 associated with the relocation of Utility Infrastructure, that is operated and maintained by **[REDACTED]** on OMCIA lands. Refer to "**[REDACTED]**" in the background information for clarity on underground electrical that is operated and maintained by **[REDACTED]**.

(vii) **[REDACTED]** shall be responsible for the design and construction 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 **[REDACTED]**'s plant.

(viii) **[REDACTED]** shall be responsible for the design and construction 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 associated with the relocation of the Utility Infrastructure.

(ix) **[REDACTED]** shall be responsible for design and construction of all necessary temporary and/or permanent Utility poles, line cover-ups, and associated wiring with the relocation of Utility Infrastructure.

(x) **[REDACTED]** shall be responsible for all design and construction of all temporary and/or permanent works associated with required relocation for their plant. Works associated with new natural gas services shall not be included in the Utility Company Works Cash Allowance.

(xi) The City shall be responsible for final connections for watermains equal or less than 406 mm in diameter. The City shall also be responsible for installation of new water services and water meters, and disinfection of new water infrastructure where required.

(xii) **[REDACTED]** shall be responsible for all design and construction of all temporary and/or permanent works associated with required relocation, modification and/or inspection for their plant.

(c) Project Co shall be responsible for the cost of any temporary electrical services and associated energy accounts.

(d) Inter city fibre optic carriers (**[REDACTED]**) located in the rail ROW south of station 27+100 (Reference Concept stationing) shall be relocated by others as enabling works in 2018. Project Co shall be responsible for costs that are not attributable to Utility Company Works Cash Allowance, for additional relocations of fiber optic carriers south of station 27+100 (Reference Concept stationing).

(e) Project Co shall be responsible for the cost of modifications or relocations of **[REDACTED]** transmission towers between Earl Armstrong Road and Bowesville Road and any such requirements shall not be attributable to cash allowance.

8.7 Watermain Requirements

(a) All watermain design and construction shall conform to all relevant codes, standards and City of Ottawa Design Guidelines – Water Distribution 2010 and Technical Bulletins.

(b) Project Co shall coordinate the scheduling of all watermain relocation work with the City.

(c) Project Co shall be responsible for City of Ottawa drinking water permits related costs for final connections, testing, chlorination and Commissioning of all water related works.

(d) All watermain designs shall be subject to review and final approval by the City in accordance with Schedule 10 – Review Procedure.

(e) Timing for the temporary removal of watermains from service for relocation, protection, or facilitating other Construction shall be subject to operational constraints. The City will review requests for isolations on a case by case basis with consideration to:

(i) Hydraulic modelling performed by the City to verify that adequate supply of water can be maintained;

(ii) Seasonal demand variations, where typically Maximum Day Demands are realized May 15th to Oct 15th of any calendar year, and Basic Day Demands are realized elsewhere. Exact dates are dependent on recent climatic conditions and vary from year to year;

(iii) Other capital works or Maintenance activities which may impact the water distribution network;

(iv) Available redundancy in water distribution system to ensure acceptable levels of risk to normal service delivery are maintained;

(v) Unforeseeable conditions due to system failures or Maintenance which may impact water service delivery;

(vi) Winter potable water treatment and production operation capacities which may be reduced with colder water temperatures;

(vii) For large diameter watermains (greater than 406mm) , isolation requests shall be made a minimum of 60 calendar days in advance of the date required, specifying the extents and duration of the isolation in accordance with Schedule 10 – Review Procedure; and,

(viii) Known constraints on watermain isolations and the removal of watermains from service. Refer to the "Trillium Line Extension Project Drinking Water Operational Constraints Matrix" for specific references in this Article and other background information.

(f) Construction of, or near large diameter watermains (greater than 406mm), in a pressurized or non-pressurized state shall be subject to requirements of CIAR submittals in accordance with Article 9 – Protection of Existing Adjacent Structures, of this Part 2. The City retains the right to reject construction means and methods where in the City's opinion there is unacceptable potential for impacting feedermain integrity and or threatening normal service levels in ongoing water service delivery. Requirements for Construction monitoring including but not limited to settlement and vibration monitoring may be imposed by the City as deemed necessary and shall be accommodated by Project Co.

(g) Project Co shall provide full time qualified inspection services where constructing or altering large diameter watermains (greater than 406mm) and related infrastructure (valves, chambers. etc.) to witness and ensure quality control activities are completed at prescribed intervals, materials, material handling and construction are as per design specifications and is completed in accordance with industry standards, manufacturer and City standard specifications, report and take corrective action to remedy deficiencies where required.

(h) Project Co shall engage a company that can demonstrate a minimum of 10 years of experience in large diameter watermain installation, three references where large diameter watermain installation has been provided within the last five 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 Schedule 10 – Review Procedure.

(i) For pre-stressed concrete pressure pipe watermains with diameter greater than or equal to 610mm, the following coating, lining and mortar special provisions shall apply:

(i) The concrete mortar exterior coating mix shall have properties that limit the potential for chloride-induced corrosion by reducing the permeability of the concrete coating. The exterior pipe mortar shall be type 10HSF cement with high quality 9% silica fume additive in accordance with AWWA C205. The high quality silica fume shall comply with C.S.A A23.5-M98. The exterior mortar shall have a thickness of 25mm measured from the outer edge of the prestressed wires. The cement coating shall be able to withstand occasional freezing/thawing cycles during the lifetime of the pipe.

(ii) The pipe exterior surface shall be completely coated in the factory with a polyurethane coating 40 mils DFT Corrotec, as manufactured by SICO Inc. or an equivalent approved by the City. The coating shall pass an A.C. Holiday Detector Test set at a voltage of 4000 Volts. The adhesion of the Corrotec onto the concrete shall exceed 700 psi (4830 kPA).

(iii) All piping with coatings and linings delivered to the Site shall be inspected for defects and cracks. Any repairs to coatings and linings shall comply with the applicable AWWA and ASTM standards. Any damages to the pipe exterior surface shall be repaired by cleaning the area affected and completely coating with a polyurethane coating 40 mils DFT Corrotec, as manufactured by SICO Inc. or an equivalent approved by the City. A pipe shall be deemed as extensively damaged and the pipe will be rejected if defects or damages in any section of a pipe are numerous or severe enough that, in the City's judgement, it would be unsatisfactory to make separate repairs to the coating or linings.

(iv) The exterior pipe joints shall be made using a pre-packaged grout consisting of one part type 10HSF cement with high quality 9% silica fume additive, in accordance with AWWA C205, to two parts of chloride free sand. The high quality silica fume shall comply with C.S.A A23.5-M98. The installation of the field grout shall follow the manufacturer's recommendations. The joint shall be poured using a "Stretch Coat" bituminous diaper that will remain in place after pouring the grout. The addition of excessive water to the grout mix will reduce strength and shall not be tolerated. In order to seal the joints, the diaper shall overlap the pre-stressed concrete pressure pipe Corrotec coating by a minimum of 50mm. The exterior polyurethane coating shall be cut back (not applied) 60mm from both pipe ends to ensure that the poured diaper grout be in contact with the pipe exterior mortar cover for optimal adhesion.

(v) Pipe interior joints shall be mortar lined to completely fill the gap with an NSF 61 compliant mortar. All interior exposed steel shall also be similarly mortar lined with an NSF 61 compliant mix. An NSF 61 compliant epoxy coating shall be factory applied to the exposed steel of the bell interior and spigot exterior at the pipe joint (around the gasket area), where interior joints cannot be mortar lined due to size restrictions. The epoxy shall have a minimum thickness of 20 mils.

(vi) At the tie-in connection closure piece, the welded slip sleeve and any exposed steel shall be grouted. The joint shall be mortar covered with grout using a "Stretch Coat" bituminous diaper or shall be concrete encased with the encasement covered with a Bituthene 3000 waterproof membrane which shall be formed in place.

(j) Project Co shall not construct Foundations above or within 3m horizontally of watermains or valve chambers.

(k) Project Co shall not construct or relocate watermains or valve chambers beneath or within 3m of any Platform or Foundation. Project Co shall not construct valve chambers within 3m of Bridges.

(l) Project Co shall relocate all water valves and valve chambers out of the Guideway.

(m) Project Co shall not construct Bridges within 3m horizontally of valve chambers.

(n) Project Co shall not construct Platforms over or within 3m horizontally of watermains or valve chambers other than where specified below:

(i) Station 31+245, 406mm private sleeved watermain crossing the existing Confederation Station Platform; and

(ii) Station 28+340, 406mm sleeved watermain crossing the proposed extended Greenboro Station Platform.

8.8 Storm and Sanitary Sewerage System Requirements

(a) All storm and sanitary sewer design and construction shall conform to all relevant codes, standards and City of Ottawa Sewer Design Guidelines 2012 and Technical Bulletins.

(i) Project Co shall conduct a precondition survey by way of CCTV on all storm and sanitary sewers within the ZOI as per the City of Ottawa Standard Tender Documents for Unit Price Contracts, Volume 1 and 2.

(ii) Project Co shall conduct post construction condition survey by way of CCTV within 90 days on all storm and sanitary sewers within the ZOI as per the City of Ottawa Standard Tender Documents for Unit Price Contracts, Volume 1 and 2.

(iii) Project Co shall conduct post construction condition survey by way of CCTV at a minimum of one year following completion of Construction on all storm and sanitary sewers within the ZOI as per the City of Ottawa Standard Tender Documents for Unit Price Contracts, Volume 1 and 2.

(iv) Project Co shall conduct post construction condition survey by way of CCTV within 90 days for all newly constructed or modified storm and sanitary sewers as per the City of Ottawa Standard Tender Documents for Unit Price Contracts, Volume 1 and 2.

(v) For sanitary or combined sewers greater than 1500mm diameter, all CCTV condition surveys shall include sonar sensing technology.

(vi) Project Co, at the City's request, shall conduct additional CCTV surveys or other condition assessments where in the City's opinion may be impacted by Construction Activities.

(vii) Where CCTV reports are received and, in the opinion of the City, pipe sections are not of satisfactory cleanliness to adequately assess the condition of the pipe, Project Co, at the City's request, shall be required to clean the respective pipe sections and re-inspect.

(viii) Project Co shall not construct Foundations over or within 3m horizontally of sewers.

(ix) Project Co shall not construct Bridges within 3m horizontally of sewer maintenance holes.

(x) Project Co shall not construct Platforms over or within 3m horizontally of sewers other than where specified below:

A. Station 31+250, 300mm sanitary sewer crossing the existing Confederation Station Platform. Adjacent maintenance hole access shall remain;

B. Station 27+660 to 27+640, 1050mm storm sewer crossing the proposed South Keys Station Platform;

C. Station 27+645, 900mm storm sewer crossing the proposed South Keys Station Platform;

D. Station 27+640, two 1200mm storm sewers crossing the proposed South Keys Station Platform;

E. Station 27+635, 1200mm storm sewers crossing the proposed South Keys Station Platform; and,

F. Station 36+075, 1650mm West Nepean Collector crossing the proposed Bayview pedestrian Platform connecting Bayview Station to the

pedestrian Bridge overpass. Adjacent maintenance hole access shall remain.

(xi) Project shall not construct sewer maintenance holes within 3m horizontally of Bridges.

(xii) Project Co shall relocate all sanitary sewer maintenance holes out of the Guideway.

(xiii) Project Co shall relocate all storm sewer maintenance holes out of the Guideway unless the maintenance hole is part of a storm sewer system dedicated to Guideway drainage.

(xiv) Project Co shall not construct or relocate sewers beneath or within 3m horizontally of any Platform or Foundation.

(b) The employment of inverted siphons shall be prohibited.

(c) All sewer designs shall be subject to review and final approval by the City.

(d) Construction of, or near large diameter sanitary or combined sewers (greater than 750mm), shall be subject to the requirements of CIAR submittals in accordance with Article 9 – Protection of Existing Adjacent Structures, of this Part 2. The City retains the right to reject means and methods where in the City's opinion there is unacceptable potential for impacting sewer integrity and or threatening normal service levels. Requirements for construction monitoring including but not limited to settlement and vibration monitoring may be imposed by the City as deemed necessary.

8.9 [REDACTED]

(a) Refer to "**[REDACTED]**" for specific references in this Article and other background information.

(b) **[REDACTED]** shall designate the Supply Point locations for the project's electrical connections and the ownership, control, and Maintenance demarcation points between **[REDACTED]** distribution system and the Expanded Trillium Line. The proposed Supply Points and available capacities are listed in Tables 1-1, 1-2, and 1-3 of Appendix E of this Part 2. **[REDACTED]** will designate the final Supply Point.

(c) **[REDACTED]** will operate up to the electrical ownership demarcation point and may operate the customer's first protective device in from **[REDACTED]** distribution system. **[REDACTED]** clarifies the customer's interface responsibilities with the connection agreement. **[REDACTED]** 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 **[REDACTED]**'s distribution system receive unique identifying nomenclature with the required 'OCM' suffix indicating the defined roles.

(d) In the **[REDACTED]**'s Offer to Connect, Installation & Service agreement and Operation & Maintenance agreement associated with each project electrical connection, the on-going roles, responsibilities, and ownership shall be defined between the Utility Company, the City, and Project Co. These agreements shall be executed between the three parties within 30 Business Days after the electrical detail design is approved for each Project electrical connection and before construction starts for each Project electrical connection.

(e) Project Co shall utilize existing **[REDACTED]** supply points and connection assets where possible. Refer to Table 1-3, Appendix E for **[REDACTED]** existing supply point locations, existing feeder capacity and capacity ratings of existing Station transformers and service connection assets. Where existing capacity is not sufficient, or where an alternate Supply Point location is required, Project Co shall be responsible for any required **[REDACTED]** system expansion, removal, or abandonments and upgrade of connection assets, including primary switchgear, Station transformers, metering and related construction. Refer to Table 1-2 Appendix E for alternate **[REDACTED]** Supply Points locations and available capacity where existing capacity is insufficient and Project Co elects to change or upgrade the capacity of supply point.

(f) **[REDACTED]** shall purchase, install and own Supply Point connection assets including primary switchgear, Station transformers and metering equipment.

(g) Project Co shall be responsible for the costs associated with any temporary electrical services and associated energy accounts.

(h) Project Co shall file detailed maximum Supply Point loading schedule and its assumptions with **[REDACTED]** at least two years before energization of the Station/Facility is required.

(i) Project Co shall ensure that **[REDACTED]**'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 "**[REDACTED]** Information to Support the City of Ottawa's Proposed light Rail System – Stage 2" report. Project Co shall ensure it has only one control authority over the Project's electrical system.

(j) Other than the Utility Works identified to be paid by the City, Project Co shall pay for the Utility Works that may occur due to a requested change by Project Co in the Utility Owner's Supply Point location and / or any additional Supply Points required.

(k) Other than the Utility Works identified in this Project Agreement to be paid by the City, Project Co shall pay for the Utility Works with the "connection assets" (the portion of the distribution system used to connect a customer to the existing main distribution system, and consists of the assets between the designated **[REDACTED]**'s Supply Point on a distributor's main distribution system and the electrical ownership demarcation point with that customer) that will be owned by the Utility Owner.

(l) Automatic load transfer schemes may be deployed by Project Co where redundant electrical servicing is required. Such schemes are subject to **[REDACTED]** approval and any such scheme will be required to be break before make (open transition of greater than 100 milliseconds) configuration. Automatic transfer schemes shall have provisions for remote monitoring and blocking to the **[REDACTED]** control centre. Procedures related **[REDACTED]** ATS blocking shall be developed with consultation to **[REDACTED]** and included in the **[REDACTED]**.

8.10 Utility Works Special Provisions

(a) Leitrim Watermain Reconfiguration and OMCIAA servicing modifications

(i) Project Co shall undertake Utility Work to relocate the 610mm watermain servicing the Uplands area from the Ottawa South Pumping Station to OMCIAA lands.

A. General requirements shall be as follows:

i Construction on OMCIAA lands shall only occur between October 2019 and March 2020. The golf course may still be operational.

ii Project Co shall maintain water service supply and existing zone pressure to all services affected during Construction. Project Co shall maintain uninterrupted minimum fire flow pressure to OMCIA during construction. The OMCIA is serviced from the Ottawa South Pumping Station's 610mm watermain and operates at 152m HGL. The 2W2C pressure zone servicing Hunt Club and surrounding Ottawa South Pumping Station operates at 130m HGL. See background graphic "TRI_OMCIA Airport Water Pressure Zones_RA.pdf" for the pressure zones' boundary limits.

iii All inspection port flanges required for inspection of watermains shall follow City Standard Design Drawings W-10, modified as follows:

1. The minimum clearance between the top of the flange to the valve chamber top slab shall be 750mm.

2. The minimum diameter of inspection port gate valves shall be 150mm.

3. Project Co shall provide access to ground level centered above the flange complete with frame and cover.

iv All new valve chambers and valves shall be accessible within the City ROW or **[REDACTED]**. All new valve chambers shall have access provided outside the fence line of the Expanded Trillium Line Guideway.

v All new or reconstructed watermain crossings to the Expanded Trillium Line alignment shall cross the Track perpendicularly.

vi Isolation valves shall be provided such that all watermain segments may be isolated independently.

B. Specific Construction requirements shall be as follows:

i Modify existing VC00956 and construct a new valve chamber on the west side of the Expanded Trillium Line alignment, outside the ROW limits on OMCIA lands. Construct a new 610 mm watermain connecting VC00956 to the new valve chamber.

ii Provide a 610mm connection between the new 610mm crossing of the Expanded Trillium Line and VC01472, to allow interconnect between the 610mm watermain and 914mm watermain.

iii Construct a new 610mm watermain with 610mm isolation valve servicing OMCIA lands from the new valve chamber to the airport watermain WAT30463. The watermain shall be located on OMCIA lands with a minimum separation of 25m from Expanded Trillium Line Track alignment.

iv Abandon the existing 610mm service from VC90056 to watermain WAT30463.

v The existing 610mm watermain from VC90056 to Leitrim Road shall be exempt from requirements for protection or relocation as related to TC-E10. The City will remove the watermain from service when no longer required for service.

vi Abandon the existing 610mm connection between VC01471 and VC01472.

vii Where valve chambers and/or mains are relocated/reconstructed to respect requirements of TC-E10 or facilitate other construction, Project Co shall:

1. Maintain all existing watermain connections, valves, and connectivity between valve chambers VC01473, VC01474, VC01324, and provide VC01707.

2. Maintain a minimum 6m clearance between the 406mm and 610mm parallel watermains on Leitrim Road.

3. Provide one top mount inspection port flange in a valve chamber between valve 372020F019 and valve 372020F015 for future inspection of the 914mm watermain between VC01472 and VC01543.

4. Provide one top mount inspection port flange in a valve chamber between valve 372019F046 and valve 372020F015 for future inspection of the 914mm watermain between VC01474 and VC01543.

5. Provide one top mount inspection port flange in a valve chamber between valve 372019F044 and valve 372019F040 for future inspection of the 914mm watermain between VC01474 and VC01475.

6. For any constructed 914mm watermain, provide one top mount inspection port flange in a valve chamber between isolation valves for future inspection of the 914mm watermain.

viii Project Co shall remove/fill/abandon all valve chambers, valves, and watermains no longer required for service.

(b) Electrical service construction restrictions for the NRC Uplands Road campus on OMCIAA lands.

(i) Project Co shall undertake Utility Work on the NRC-owned electrical service lines and pole(s) supplying the NRC Uplands Road campus located on OMCIAA lands with the following restrictions:

A. Permissible electrical service shut-downs to the NRC Uplands Road campus shall be limited to:

i 2-day weekends;

ii A maximum of 4 weekends total; and,

iii All submitted shut-down dates shall be subject to approval by the NRC.

B. Project Co shall provide the NRC with a minimum of eight weeks written notice of an electrical service shut-down.

(ii) The NRC-owned electrical service lines and pole(s) up to the **[REDACTED]** demarcation point are privately owned and shall not be attributable to cash allowance.

(c) **[REDACTED]** Crossing

(i) For the **[REDACTED]** crossing at approximately Station 18+840, general requirements shall be as follows:

A. Project Co shall apply for and obtain a crossing agreement with **[REDACTED]** for the Guideway crossing of the pipeline.

B. Preliminary design shall be submitted to **[REDACTED]** for assessment to determine if preparatory works are required. Preparatory works may include pipe replacement, casing, change in cover, exposing of pipeline for coatings and or inspections.

C. The design of any modification and/or protections of the pipeline shall be managed directly by **[REDACTED]** or through a company retained by **[REDACTED]**. Relocation of the pipeline requires NEB approval.

8.11 Enabling Utility Works

(a) The Sponsor, in conjunction with **[REDACTED]** and **[REDACTED]**, is proceeding with design for the relocation any of ducts, fibers, pedestals and handholes as far as practical from the proposed Track alignment, to minimize conflicts, protection requirements and further relocations to be coordinated with Project Co from Greenboro Station southwards. It is the intent to complete these relocations in 2018.

(b) The Sponsor, in conjunction with **[REDACTED]** will relocate and protect the 200 mm gas main crossing the Trillium alignment at Young Street. Protection and relocation will be provided to satisfy TC E10 requirements and rock wall excavation in accordance with the Reference Concept Track alignment, and be completed by May 31, 2020.

8.12 Traffic Fiber Conduit Requirements

(a) Project Co shall complete the works in accordance with the criteria contained in this Article, the Project Agreement and the Applicable Law, including but not limited to the latest edition of the City of Ottawa Standard Specifications and Drawings.

(b) Project Co shall undertake Utility Work to provide an empty duct for City Traffic Operations Fiber Optic at six designated locations.

(i) General requirements as follows:

A. Project Co shall construct the empty duct within the Guideway Lands from the communications closets at the designated Stations to a breakout point for City Traffic Operations staff to connect to the existing fiber optic system. A handhole conforming to City of Ottawa Standard Drawing T-1 shall be provided at the breakout point for the connection. Hand holes or pull boxes shall be provided approximately at 80m intervals along the constructed duct.

B. The duct shall be 100mm PVC pipe which shall include a pull rope for the City to install the cables after construction, inspection, and acceptance of the installed ducts.

C. Project Co shall coordinate with City Traffic Operations staff such that Traffic Operations staff is able to pull cable and perform maintenance along the cable run, including along the light rail ROW, before the Expanded Trillium Line enters service.

D. The duct shall be installed underground in the Guideway and Roadway and shall be surface mounted on abutments and Bridge Structures.

(ii) Designated Locations Breakout Point Coordinates

A. Gladstone Avenue – Gladstone Station

i X – 366322.33
ii Y – 5029636.22
iii Z - 62.8 +/-

B. Heron Road – Confederation Station
i X – 368620.48
ii Y – 5026679.29
iii Z - 81.4 +/-

C. Walkley Road – Walkley Station

i X – 370103.59
ii Y – 5025793.38
iii Z - 90.8 +/-

D. Hunt Club Road – South Keys Station
i X – 371103.87
ii Y – 5023772.10
iii Z – 97.7 +/-

E. Leitrim Road – Leitrim Station
i X – 372758.97
ii Y – 5019960.83
iii Z - 103.2 +/-

F. Uplands Road – Uplands Station
i X – 370778.17
ii Y – 5021672.12
iii Z – 102.0 +/-

ARTICLE 9 PROTECTION OF EXISTING ADJACENT STRUCTURES

9.1 Scope

(a) This Article provides requirements for the following:

(i) Determination of the Project ZOI, as defined below, to assess the potential impacts to EAS due to the Construction Activities associated with the Works;

(ii) Criteria for evaluating impacts on EAS;

(iii) Development of mitigation measures as necessary to ensure safety and continued operation of the EAS; and,

(iv) Pre- and post-construction condition surveys.

(b) Project ZOI shall refer to the area within and adjacent to the Works, including EAS, that potentially may be impacted by Construction Activities associated with the Works including dewatering.

9.2 General Requirements

(a) Project Co shall:

(i) Determine the limits of the Project ZOI and identify all existing structures and Utilities both above and below ground that are within the ZOI. Assess the effects of construction related ground movements including dewatering on these structures and identify the structures and Utilities that meet the definition of EAS. Prepare and submit for the City review a report in accordance with Schedule 10 – Review Procedure documenting anticipated impacts. Integrate the pertinent requirements of this Article into the report.

(ii) Based upon the report conclusions, design and implement mitigation measures as necessary to ensure that the structural integrity of EAS is maintained and that the appearance, functionality, operability, and durability of EAS are unimpaired.

(iii) Perform pre and post-construction condition surveys to document the condition of the EAS. Surveys shall be submitted in accordance with Schedule 10 - Review Procedure.

(iv) Mitigate and remedy all damage caused by Construction Activities associated with the Works, including demolition, to pre-existing conditions. A complete report, that includes all temporary and permanent corrective measures, shall be submitted after completion of construction confirming all damages had been remedied.

(v) Project Co shall obtain necessary Permits, Licenses, Approvals and Authorizations from third party owners of the EAS to perform necessary Works. For communication protocols, Project Co shall follow Schedule 18 - Communications and Stakeholder Engagement Obligations. Project Co shall not use any existing permits to enter to the EAS that had been granted for other projects or other purposes.

(vi) Ensure that Utility isolation or relocations do not affect the electrical safety grounding of EAS.

9.3 Qualifications

(a) Determination of the ZOI, evaluation of impacts on EAS and the design and implementation of mitigation measures shall be undertaken by staff that have verifiable design and construction experience with similar programs and be directly supervised by a Professional Engineer.

(b) 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.

9.4 Design Requirements

(a) Project Co shall:

(i) Obtain pertinent information of EAS and Utilities.

(ii) Obtain all specific design, protection and monitoring requirements from owners of Third Party Facilities including but not limited to City requirements for excavations adjacent to structures including bridge components and other structures and Utility Companies

(iii) More specifically, prior to undertaking any excavations, Project Co shall provide the predicted movements (vertical, horizontal, rotational, tilt, relative movement) for review by the City. For such excavations, a detailed real time (24/7) monitoring plan to monitor settlements, ground movements and tilting/movement of adjacent bridge components shall be implemented in the GIMP and made available on DMP. City structures staff shall be notified, according to the communication protocols stipulated in Schedule 18 - Communications and Stakeholder Engagement Obligations, if any Alert Levels are exceeded. Project Co shall provide modelling and assessment of the anticipated settlement in a CIAR-2 level report as well as a sensitivity analysis of the impact of varying settlement levels on the City bridges to be undertaken in 5mm increments.

(iv) Complete EAS verification study to include confirming information related to EAS 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.

(v) Deformation Analysis

A. Project Co shall consider the available Site specific geotechnical reports and reference documents to identify the Project ZOI. The Project ZOI shall be determined by Project Co using engineering analyses and shall include all sources of ground movements that may be caused by Construction Activities associated with the Works including dewatering, for temporary and permanent structures. At a minimum the Project ZOI 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.

B. Design Reports:

i Prepare and submit CIAR-1 and CIAR-2 in accordance with the requirements of Schedule 10 – Review Procedure. CIAR-1 and CIAR-2 shall include magnitude and distribution of ground movements as well as potential impacts on EAS. CIAR-1 is applicable to:

1. First level of assessment and screening for all EAS.

2. EAS such as low rise commercial buildings and single family residences that are assumed to be flexible small frame buildings.

3. EAS which are absent of any large rigid grade beam elements, which may have the potential to attenuate ground settlements.

4. Small, low-rise non-critical EAS where the predicted impact poses no risk to public safety or loss of functionality.

5. Utilities within the Project ZOI.

ii To assess the magnitude of impact to EAS and facilities, CIAR-1 analysis shall include the following tasks as a minimum:

1. Review of literature on impact assessment methodologies.
2. Conduct building and Utility inventory by identifying buildings and Utilities within the settlement trough using building type and use survey.
3. Overall evaluation of EAS and facilities potentially at risk.
4. Detailed definition of damage levels.
5. Determine strain, settlement, and angular distortion limits for each building.
6. Determine joint rotation, joint pull-apart, and tensile strain limits for each Utility.
7. Determine EAS or locations requiring a further CIAR-2 analysis.

iii CIAR-2 analysis is generally appropriate for EAS that meet any of the following criteria:

1. EAS recommended by the findings of CIAR-1.
2. Exterior cladding systems that generally consist of non-load bearing masonry, precast concrete or glass.
3. EAS that generally include deep, multi-storey basements which could possibly alter the slope of the ground settlement profile
4. Mid-rise and high-rise EAS.
5. Critical EAS that are considered to be of historical or cultural significance, heritage buildings or essential services buildings and Utilities that exceed a CIAR-1 predicted impact levels.

iv The representative EAS for CIAR-2 analysis, as a minimum, shall be selected based on the following criteria:

1. Results of CIAR-1.

2. Proximity to the cut-and-cover excavation zone or dewatering zone.

3. Potential to sustain cut-and-cover excavation or dewatering induced settlement impacts.

4. Type and sensitivity of superstructure and cladding.

v As a result of this selection process, the CIAR-2 analyses are expected to provide an estimate of the potential structural impacts due to Construction Activities. The results of these CIAR-2 analyses shall be used to predict excavation induced settlement impact to other similar EAS within the Project limits.

vi Project Co shall use established numerical simulation methods such as finite element method or finite difference method. Simplified numerical methods and empirical methods may be used only for CIAR-1 for screening purposes.

(b) Impact Mitigation Design

(i) Design Structure-specific mitigation measures needed to prevent a loss in appearance, structural integrity, functionality, operability and durability of potentially impacted EAS and ensure safety and continued operation of the EAS. Demonstrate the effectiveness of the proposed mitigation measures by engineering analysis. Confirm and document that the proposed mitigation is acceptable to all potentially affected EAS owners which shall also include but will not be limited to City structures and Utility Companies. Determine instrumentation monitoring requirements; include Review and Alert Levels in the GIMP; refer to Schedule 15-2, Part 2, Article 7 – Geotechnical Design Criteria and Requirements for evaluating the effectiveness of the mitigation measures during construction that is consistent with the means and methods for construction. The DMP, as stated in this Article, shall be used to create and send alarm reports/notifications if Alert Levels are exceeded. Project Co shall inform the City of subsequent response actions taken by Project Co.

(ii) Project Co shall prepare a response action plan, as stated in Article 2 – Geometric Design Criteria for Track Alignment, of this Part 2, which shall consist of preliminary methods and means to respond to various Review and Alert Level scenarios based on types of geotechnical instruments that indicate Review and Alert Levels.

A. The Review Level is a geotechnical instrument reading that triggers a set of review and mitigation actions to ensure that the Alert Level is not exceeded. Review Level is set at 10 mm movement.

B. The Alert Levels is maximum permissible geotechnical instrument reading that triggers consideration of temporary work stoppage to prevent damage to EAS. Alert Levels is set at 25 mm movement.

C. Project Co shall adhere to the allowable joint pull-apart, joint rotation and tensile strain in table below for Utilities within the Project ZOI.

Material	Joint Pull-Apart (mm)	Joint Rotation (rad)	Tensile Strain (με)
Cast Iron	15 (1)	0.0075 (2)	150 (1)
Steel	25 (2)	0.0075 (2)	550 (2)
Ductile Iron	25 (2)	0.0075 (2)	500 (1)
RCP	25 (2)	12.5mm/diam. (2)	300 (3)
Brick & Concrete	NA	NA	150 (3)
Precast Concrete	25 (2)	12.5mm/diam. (2)	300 (3)

1. Bracegirdle et al. (1996)
2. CIRIA No. 30 (1992)
3. North American Tunneling Proceedings (2014)

D. Project Co shall develop limits for concrete pressure pipe joint pull-apart, joint rotation and tensile strain in accordance with the pipe manufacturer's recommendations and industry standards, whichever is the more stringent.

(iii) Project Co shall include in the GIMP all measures and specific instrumentation and monitoring requirements for protecting EAS within the Project ZOI as defined by Project Co.

(c) Pre, during- and post-construction condition surveys

(i) Project Co shall be solely responsible to perform required condition surveys for the purpose of inspecting and documenting the existing condition of EAS prior to, during and after construction. Record information about EAS damage or repairs, defects, unusual aspects of construction, presence of sensitive equipment, and similar pertinent information. Perform this work in accordance with Applicable Law, relevant standards, regulations and by-laws including but not limited to the City municipal code. Survey information shall be submitted in accordance with Schedule 10 – Review Procedure.

(ii) Where pre-construction condition surveys for EAS are performed by Project Co, survey reports shall be prepared and submitted for review in accordance with

Schedule 10 – Review Procedure. The survey reports shall consist, 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.

(iii) Perform during- or post-construction condition surveys for EAS where the Response Levels of structure movements or deformation have been exceeded, or a damage claim has been received.

9.5 Existing Adjacent Structures Owner Interactions

(a) Project Co shall:

(i) Follow communication protocols established in Schedule 18 - Communications and Stakeholder Engagement Obligations, for interactions with EAS owners and other impacted or potentially impacted parties.

(ii) Work with owners of EAS to perform required 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 EAS and developing monitoring and mitigation requirements shall generally be as follows:

A. Step 1: Owners of potentially affected EAS, as identified in the CIAR-1, shall be briefed of the CIAR-1 findings by Project Co.

B. Step 2: CIAR-2 shall be prepared and provided to potentially affected EAS owners and the City.

(b) Project Co shall consider each of the above steps as iterative depending on specific requirements of individual EAS owners including but not limited to the City, Utility Companies and other owners of Third Party Facilities. Project Co shall be proactive and thorough in their approach.

(c) Develop and maintain a schedule of the EAS and other stakeholders that rely on EAS. This document shall be updated as required and shall be used to track the completion of the impact assessments and obtaining acceptances of the monitoring and mitigation plans including review and approval by all relevant third parties including but not limited to the City, Utility Companies and other third party owners. Submit the updated document to the City on a quarterly basis in accordance with Schedule 10 – Review Procedure requirements.

9.6 Future Adjacent Construction Requirements and Protection of Expanded Trillium Line Infrastructure

(a) Assist the City with the review of submitted documentation for proposed development throughout the Project Term. Project Co review comments will be used by the City for approval of Project Construction and implementation procedures required prior to construction of future adjacent projects to ensure that no adverse impacts will be caused to the System. 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 performing 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; and

(iv) Project Co shall be responsible for reviewing and commenting on the draft development review findings at the request of the City.