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SECTION 3.0: UTILITIES, STREETLIGHTING, AND TRAFFIC SIGNALS

3.1 GENERAL

The location of all utilities must be established and resolved in conjunction with the Town and the Utility Companies, while generally following the locations shown on the typical road cross-sections.

Compaction of backfill for utility trenches shall be 95% Standard Proctor within boulevards and 100% for driveways and road crossings.

Design Engineer is required to prepare the Composite Utility Plans, secure approvals by all utility companies, including InnPower, and include in the set of Engineering Drawings being part of Subdivision Agreement. Composite Utility Plans must be available for review the latest at the 2nd submission of engineering drawings.

For information of all designers – as required by the Ontario Building Code, all residential properties must be equipped with the Electrical Vehicle Charging outlet. Design Engineer must familiarize himself with the most current charging facilities required by different manufacturers of the electric or hybrid vehicles. The additional load on the electrical system must be included in design of the entire network, including transformers and power cables. Joint consultation with InnPower and Town staff is required at the initial stage of designs**.**

Utility crossings shall be 1.0m minimum horizontally and 0.25m minimum vertically from any service connection (distance is based from the outside edge of utility crossing to the outside edge of the service connection).

3.1 UTILITIES

3.2.1 Telecommunications

Telephone, cable, and fibre optic services shall be underground in locations as shown on the typical road cross-sections and shall be installed by an approved utility Contractor.

3.2.2 Hydro

Hydro service shall be underground in locations as shown on the typical road cross-sections and shall be installed by Innisfil Hydro or an approved Contractor.

3.2.3 Gas

Gas service shall be underground in locations as shown on the typical road cross-sections and shall be installed by the Gas Company or an approved Contractor.

3.3 STREETLIGHTING

3.3.1 General

All roadways are to be lit, unless written approval is received from the Town. Streetlights shall be provided throughout all developments and may be required on roadways bordering developments if deemed necessary by the Town.

All entrances from site plans and private developments are to be lit, unless an exemption is approved by the Town.

All fire routes are to be lit, unless written approval is received from the Town.

A qualified engineering consultant shall prepare the streetlight design, including photometric layouts using an approved computer lighting program such as AGI 32, AutoLux, or equivalent.

All drawings must be sealed by a registered electrical Professional Engineer, licensed to practice in the Province of Ontario. Any attachments to hydro poles must have Hydro Authority approval and comply with Regulation 22/04 (or the latest revision thereof). All roadway lighting design and construction is subject to Electrical Safety Authority (ESA) inspection and approval.

The Transportation Association of Canada (TAC) "Guide for Design of Roadway Lighting", Volumes 1 and 2 provide comprehensive design guidelines and may be used for lighting devices for roadways and associated facilities.

3.3.2 Design Criteria

3.3.2.1 Within Public ROW

Lighting design criteria for roadways, sidewalks, pedestrian walkways, and bikeways on public rights-of-way within the Town of Innisfil shall be based on the "American National Standard Practice for Roadway Lighting", ANSI/IES RP-8-22, or the latest revision thereof.

The lighting system shall provide the average maintained light levels and meet the recommended uniformities and veiling luminance ratios as indicated in the above-noted standard.

"Luminance" criteria may be used for determining light levels on straight and level roads that have a minimum length of ten (10) luminaire mounting heights.

"Illuminance" criteria to be used for intersections, curvilinear road sections, pedestrian walkways, and bikeways.

Refer to ANSI/IES RP-8-22, or latest revision thereof, standard design criteria for luminance, illuminance, and pedestrian conflict area classifications requirements

Intersections shall have an illumination level equal to the sum of the recommended average illumination levels for each of the intersecting roadways. If it is not practical to achieve this level due to geometric constraints, then a minimum level of 50% higher than the recommended level for the main roadway may be acceptable, subject to the Town's approval. Alternatively, Town may request to follow Table 8 in ANSI/IES RP-8-14, or any update of this standard.

For illumination of crosswalks (mid-block or at intersections) refer to Section 5.3 of ANSI/IES RP-8-22, or the latest revision thereof.

Light levels shall be increased by 50% through school areas, libraries, recreation centres, medical centres, railway crossings, bridges and any other location where increased conflict is possible. The street lights shall typically be serviced with underground wiring in ducts between poles. The luminaires shall be alternated between circuits to maintain 50% illumination upon loss of one circuit feeder.
Light fixtures shall be cut-off type to reduce light pollution and shall be dark sky compliant.

Light source for roadway lighting shall be long life (minimum 100,000 hours).

Power supply shall be coordinated and arranged with the Supply Authority from the nearest feasible location. Power supply shall be unmetered and the street lights shall operate at 120 volts 60 Hz AC. Maximum voltage drop at the end of the lighting circuit shall not exceed 5% of the supply voltage.

The design drawings shall show all surface features, all street light pole complete with ID#, all power pedestals complete with ID#, the individual conduits from the power pedestal to the light-emitting diode (LED) lights, the conduit from street light pole to street light pole, all utility road crossings with dimensions from the road crossing to either a side lot line or a street light pole, and dimensions from the street light pole to the lot lines where the street light pole is not opposite a side lot line. The LED street light ID# shall include the type of LED lighting fixture, the circuit number, and the power pedestal number to which it is connected. The Legend shall include duct sizes and an explanation of the street light symbol/ID#'s.

On the single line drawing, there should be an electrical schematic for each power pedestal showing the transformer (complete with InnPower ID#) that supplies power to the power pedestal, the power pedestal cabinet contents (service breakers, service panel, grounding rods, etc.), each circuit and all of the LED street lights (complete with ID#) connected to that circuit with conductor lengths from the pedestal to the first light and from light to light, and all electrical components inside the LED street light fixtures. It should be noted that the maximum conductor length is 100 m.

Lighting calculations shall be prepared for all outdoor site lighting and forwarded to the Municipality for approval.

All luminaires are to be provided with ANSI C136.41 compliant dimming photocontrol allowing at least three different settings for dimming levels and start times.
Refer to Appendix B for a list of materials and specifications.

Streetlight designer should contact Town and confirm full set of criteria before the start of design.

3.3.2.2 Site Plans

Lighting design criteria for roadways, sidewalks, pedestrian walkways, and bikeways for site plans within the Town of Innisfil shall be based on the "American National Standard Practice for Roadway Lighting", ANSI/IES RP-8-22, or the latest revision thereof.

Lighting should be controlled by automatic switching devices such as timers or photocells. The outdoor lighting shall be reduced by 75% after normal hours of operation until dawn.

Parking Lots

Parking lot illumination has to address good visibility for drivers and pedestrians, provide good colour rendition for security identification, and leave sufficient impact for customer attraction.

The recommended light levels for high activity community shopping developments are:

- Average maintained illuminance level 2.0 fc (20 lux) minimum. This could be increased up to 5.0 fc (50 lux), as is common practice for current commercial developments;
- Uniformity, average to minimum 4:1.

The minimum recommended light levels for parking lots are:

- Minimum horizontal illuminance level 0.2 fc (2 lux);
- Uniformity ratio, maximum to minimum 20:1.

Roadways

The recommended light levels for the site roadway zones are:

- Average maintained illuminance level 0.9 fc (9.0 lux);
- Uniformity, average to minimum 6:1.

Pedestrian Walkways

The recommended light levels for pedestrian walkways up to and surrounding any commercial buildings are:

- Average maintained illuminance level for medium activity areas 2.0 fc (20 lux) and high activity areas 4.0 fc (40 lux);

- Uniformity, average to minimum 4:1.

Site Restrictions
The recommended light levels projected onto a residential property (spill light) shall not exceed 0.1 vertical foot candles, measured line-of-site at the property line.

Light pollution, nuisance, and disability glare shall be restricted by use of full cut-off luminaries.

Pylon Signs
Externally illuminated pylon signs shall have the light source aimed downward towards the sign.

3.3.3 Lighting Configurations and Pole Offsets

All streets are to employ a staggered streetlight configuration with pole offsets from EP as per TAC criteria or on shoulder rounding.

In urban areas behind the face of a barrier curb with design speed of 70 km/h or less, pole offsets may be reduced to 1.5 m.

In rural areas where TAC pole offsets outside the clear zone are not possible, frangible breakaway bases may be used. Frangible bases are not permitted at intersections and areas where pedestrians are expected.

Pole offsets that are identified on the Town's Typical Road Cross Sections take precedence.

Lights at signalized intersections should be combined with joint-use traffic signal poles wherever possible.

On curved roadways, the light poles should be positioned on the inside of curves, if possible. Alternatively, light poles may be placed on the outside of curves, but shall be kept out of the vehicle overrun area (the extension of the tangent in the direction of vehicle travel).

Streetlights and power pedestals should be located on the extension side lot lines where possible.

The inclusion of smart functionality in streetlight design may be required. This will be reviewed on a case-by-case basis as directed by the Town.

Refer to Appendix C for minimum offsets for streetlights from other aboveground infrastructure.

3.3.4 Materials

All materials used for street lighting must be CSA approved. Refer to Appendix B for a list of Materials and Specifications.

3.3.5 Installation

The installation of the street lighting system shall be in compliance with ESA, CSA, the Hydro Supply Authority requirements, the Town's standards and specifications, as well as the manufacturer's installation instructions.

Ducts

Ducts shall be solvent welded together in trenches with minimum cover of 750 mm. Ducts shall be surrounded by 80 mm of brick sand and warning tape to cover width of trench.

Road crossings to be carried out by directional bore method using thickwall PVC duct.
Where open-cut road crossings are necessary, ducts shall be concrete encased.
Installation as per OPSD 2100.06 and OPSS 603.

Cables

Cables to be continuous without splices and shall be installed after trenches are back-filled.
Installation Specifications as per OPSS 604.

Fuses

Fuses in pole handholes as per OPSD 2255.020 and OPSS 617.

Grounding

Ground rods to be installed at power service disconnect (minimum 2 rods), at every fifth (5^{th}) lighting pole, and at the last lighting pole in each circuit.
Installation Specifications as per OPSS 609.

Poles

Installation Specifications as per OPSS 615.

Brackets and Luminaires

Installation Specifications as per OPSS 617.

Power Service Disconnect

Installation Specifications as per OPSS 614.

Dimming control

Specifications as per ANSI C136.41. DIM-4 adjustable control.

3.4 TRAFFIC SIGNALS

3.4.1 General

Traffic signal design is to be prepared in accordance with M.T.O. Traffic Manual Book 12 and the appropriate M.T.O. and electrical design codes. All work shall be performed in accordance with the current edition of the Ontario Electrical Code,

including all appending bulletins issued by the Electrical Safety Authority (ESA) which are applicable to the work. All work shall be governed by Federal, Provincial and Local laws and by-laws pertaining to the work, as well as by the latest issue of CSA Standards pertinent to the work. All electrical work is subject to inspection by the Electrical Safety Authority. In the event of a conflict between regulations, the strictest regulation shall apply.

In addition to accommodation of traffic flow, the signalized intersection design shall include pedestrian requirements and accessibility features. All signalized crossings must be designed in accordance with the TAC "Guidelines for the Understanding, Use, and Implementation of Accessible Pedestrian Signals". Accessibility features must include gentle grades for sidewalks, drop curbs (painted yellow), and directional lines in the sidewalk to provide guidance for the visually impaired. Pedestrian crosswalk features shall include single head "walk/don't walk" heads, countdown heads, and audible pedestrian heads with tactile push button.

It is the Contractor's responsibility to ensure possession of the most recent drawings, PHM-125 drawings and Town of Innisfil standard drawings prior to the commencement of construction. Any modifications to the proposed plans must receive pre-approval, be redlined, and documented with the Town of Innisfil.

3.4.2 Materials

Unless otherwise provided for in the contract or contract drawings, all materials shall be new and of a uniform pattern throughout the work. All materials or components or custom equipment shall be CSA approved, where applicable, and comply with the requirements of the ESA with respect to their application. Unless indicated otherwise in the Contract Documents, materials for items covered by MTO specifications shall meet the requirements of the applicable MTO material specifications.

Materials not specified but which are indicated elsewhere in the Contract Documents as being required (including minor accessories such as connectors, fasteners, tape, etc. which are considered incidental to the Work) shall be standard construction grade materials supplied in accordance with CSA Standards to suit the application as required by recognized trade practice or supplied in accordance with the applicable MTO material specification.
The Contractor shall submit Shop Drawings of the following upon request, for the Agency's review and approval:

Concrete Poles	Signal Brackets	Decorative Poles
Luminaires (All Types)	Vehicle Signal Heads	Pre-set Anchors
Luminaire Mast Arm	Pedestrian Signal Heads	Steel Poles
Signal Mast Arm	Tactile Plates	Power Supply
Ground Plate	APS Pushbutton	Electrical Chamber

Shop Drawings may be reviewed by the Agency and Hydro Authority to ensure conformity with the design concept of the project and compliance with the contract documents.

Prior to submission of Shop Drawings to the Agency, the Contractor is required to review Shop Drawings. By this review, the Contractor represents that they have determined and verified field measurements, field construction criteria, catalogue numbers and similar data, and that it has checked and coordinated each Shop Drawing with the requirements of the contract documents. The Contractor shall indicate the review of each Shop Drawing by stamp, date, and signature of an industry competent person.

The Contractor shall take due diligence in reviewing the requirements and specifications before the purchase of any equipment to ensure compatibility and to meet Agency requirements.

3.4.3 Electrical Code, Rules And Regulations

All work shall be executed in strict accordance with ESA and CSA Standards, the Ontario Electrical Safety Code (OESC), and the latest revisions thereto, including all applicable bulletins.

All work shall comply with and be performed in accordance with Federal, Provincial, and Local laws and by-laws relevant to the work, as well as the latest issue of CSA standards pertinent to the work.

Should it become necessary to perform work within close proximity to energized hydro lines, as defined by Section 188 of O. Reg 213/91 (Construction Projects) under the Ontario Occupational Health and Safety Act, the Contractor shall arrange authorization with the appropriate hydro authority. The Contractor must ensure that qualified personnel authorized by the hydro authority perform the work. Any costs associated with these arrangements and the engagement of qualified personnel shall be borne by the Contractor.

3.4.4 Adjustment Of Equipment

All equipment shall be installed in a neat and orderly manner to the satisfaction of the Owner. Minor adjustments to equipment, deemed necessary by the Owner to enhance the appearance of the Site, shall be executed at the Contractor's expense.

The Contractor shall also perform minor adjustments to any equipment that can be optimized for performance, as required. All such adjustments shall be carried out to the satisfaction of the Owner at the Contractor's expense.

Signal heads shall be installed in a manner that does not obstruct the visibility of existing signal heads. The Contractor shall make necessary adjustments to equipment during nighttime conditions to ensure optimal performance, with all such adjustments carried out at the Contractor's expense.

The Contractor shall promptly report any discrepancies or omissions observed by staff to the Agency for resolution.

3.4.5 Traffic Signal Heads

All signal heads supplied under the contract shall be LED. All LED signals shall comply with Standards Drawings, Ontario Traffic Manual Book 12, Ontario Traffic

Manual Book 12A, Highway Traffic Act, Ontario Provincial Standard Specifications, Canadian Standards Association certification, and shall meet or exceed Institute of Transportation Engineers specifications. All LED modules shall have an incandescent appearance, ensuring no individual LED is visible in regular daylight, avoiding a pixelated appearance. All LED modules shall be Electrical Testing Labs (ETL) verified as per Intertek's directory of LED Traffic Signal Modules Certified Products (latest revision). All LED modules shall have a minimum warranty of 5 years from the date of activation.

All vehicle and pedestrian housings shall be constructed of yellow polycarbonate UV-stabilized material with yellow square, cowl, or tunnel visors and matte black interiors, as approved by the Agency and as shown in OTM Book 12 and OPSS 2460. Backboards shall be made of UV-stabilized polycarbonate material or an Agency-approved equivalent, suitable for mounting vehicle signal heads on plumbizers or double arm pipe brackets, as indicated in the drawings. Signal heads shall be supplied with necessary bird stops and neoprene gaskets on the top of the head only.

All signal heads shall include 500mm brackets (as indicated in the signal drawings for center median poles and pedestrian signal heads), T-Type Nipple plumbizers, clamp mount Versa-Brac, cushion hangers, or other mounting hardware, which shall be aluminum with cast aluminum fittings and stainless-steel mounting hardware. All fastening components shall be stainless steel screws, washers, nuts, and bolts.

The Contractor shall use black powder-coated pipe brackets at decorative pole locations at no additional cost. All vehicle signal heads on mast arms shall be mounted with a plumbizer and must have two full-size reinforcing plates mounted at the bottom interior of the red section and top interior of the amber section, at a minimum. Additionally, vehicle signal heads shall include a safety feature of an aircraft cable as per Standard Drawing.

All non-operational signal heads shall be covered with 'Traffic Jackets', complete with mounting hardware. Inactive vehicle signal heads on plumbizers can be tilted facing down with the LED indication not visible to road users. Inactive pedestrian signal heads can be turned to face the pole with the LED indication not visible to road users.

The bird stop shall only be installed on the top head frame, and the washer shall comply with OPSD 2524.01.

3.4.6 Vehicle Signal

Vehicle signal heads may include Highway, Oversized Highway, Type 1, Type 2, Type 9, Type 11.

3.4.7 Programmable Signal

Optically programmable traffic signal heads may be utilized to provide precise lane control for traffic signal displays. The Contractor shall submit a Shop Drawing or detailed specification sheet for the programmable traffic vehicle signal for pre-approval.

Additional types of programmable vehicle signals may be specified.

3.4.8 Pedestrian Signal

The housing equipment shall be constructed of square polycarbonate material. The Contractor shall supply and install the equipment as itemized in the tender items. The “Bi-Modal Walk” and “Don’t Walk” Pedestrian LED signal head sections shall be integrated within a single unit, superimposed in the same housing. All LED pedestrian signals shall comply with TAC, HTA R.R.O. 1990 Regulation 626 Traffic Control Signal Systems, and shall resemble the outline/symbol as specified in OTM Book 12, subject to approval by the Agency. The Pedestrian Countdown Signal (PCS) head section shall feature a transitional countdown display during the “Flashing Don’t Walk” phase only and remain blank at other times. All PCS units shall meet or exceed ITE specifications, resemble the outline/symbol as specified in OTM Book 12 and OTM Book 15, and must be approved by the Agency. The countdown displays shall have an incandescent appearance, ensuring no individual LED is visible in regular daylight.

3.4.9 Bicycle Signal

Bicycle signals shall utilize LED modules and comply with HTA specifications. The LED modules shall exhibit an incandescent appearance, avoiding a pixelated look. All LED modules shall come with a minimum warranty of 5 years from the date of activation. Bicycle signal housings shall be constructed of black UV-stabilized polycarbonate material, equipped with black tunnel visors, and shall not include backboards.

3.4.10 Traffic Signal Mast Arms

The Contractor shall supply and install traffic signal mast arms in accordance with the Contract Standards Drawings, OPSS 2460, OPSD 2501.01, and OPSD 2501.02, as applicable.

Single-member mast arms shall be constructed of spun aluminum or black powder-coated material (as required) and shall comply with the specified drawings. Mast arms shall be equipped with hot-dipped galvanized steel collar pole face plates and adjustable pole back plates. The thickness of these plates shall adhere to the manufacturer’s requirements.

The Agency may also request straight single mast arms for pedestrian crossovers (PXO) or cross rides, which do not have a rise. These arms shall be requested as per contract drawings and provided at no additional cost.

The Contractor is required to install a ¼"-20 set screw between the mast arm and mounting shoe to prevent rotation of the mast arm.

A joint site visit with the Agency representative and Contractor is required to finalize mast arm lengths after the completion of all pole bases.

3.4.11 Traffic Signal Poles

The Contractor shall supply and install traffic signal poles in accordance with the applicable Town of Innisfil Standards and OPSS MUNI 615, and shall be CSA certified as required.

The Contractor shall field drill all apertures on steel or aluminum poles at the appropriate locations for internal wiring and the attachment of mast arms, brackets, and pushbuttons. All apertures shall be treated with zinc-rich or galvanizing paint and fitted with a rubber grommet. All hand hole cover screws shall be treated with anti-seizing lubrication.

Steel Poles

All steel poles shall be hot-dipped galvanized and possess the strength and rigidity to withstand, without failure, the accepted design and pressure standards for Southern Ontario. All traffic signal steel poles shall as per MTOD 2435.020 be as indicated in the signal drawings, or an agency-approved equivalent. Combination traffic signal/streetlight poles shall feature octagonal base mounting as per OPSD 2232.010.

Pushbutton Poles (With Footing)

Pushbutton poles shall be 1.5 meters in height, constructed of aluminum, and installed with a concrete footing. Pushbutton poles shall comply with OPSD 2558.00, and the footing shall adhere to OPSD 2200.041. The Contractor shall supply black powder-coated pushbutton poles at no additional cost unless otherwise specified within the tender items.

3.4.12 Pushbuttons

The Contractor shall supply and install pedestrian pushbuttons on the poles that are part of the traffic signal system as indicated in the signal drawings. The pushbuttons and interface modules shall be installed in accordance with the manufacturers' specifications. Pushbuttons shall be installed using the drill/tap method and fastened with ¼"-20 stainless steel machine screws or as specified by the manufacturer. All openings around the pushbutton and the wiring aperture shall be sealed with outdoor clear silicone. A 1-2/C #12 AWG riser cable shall be installed in the riser conduit from the pushbutton to the splice point.

Town is not responsible of providing sigs. Pushbutton signs supplied by the Contractor shall comply with the OTM Manual unless otherwise instructed. Pushbuttons shall have a minimum warranty of five (5) years. Approved equivalents must be pre-approved by the Agency, and the Contractor must provide detailed specification sheets and drawings or cut sheets.

Pedestrian and Bicycle Pushbutton

Pushbuttons shall be rectangular, yellow in colour, flush mounted onto the pole and have a tactile arrow appropriately aligned with the crossing and a latching LED once activated.

Pushbuttons attached to wood poles shall have a modular cup/housing to allow conduit access.

Pushbuttons attached to round aluminum poles shall include the modular cup/housing to allow conduit access and flush mounted to the pole.

Accessible Pedestrian Signal (APS) Pushbutton
APS pushbuttons shall be yellow in color, capable of operating over a single pair of wires, and equipped with a vibrating tactile arrow with an audible tone. They shall feature a latching indicator, a confirmation tone with vibration upon activation, extended push functions, SDLC capabilities, cuckoo and Canadian melody tones, and shall be AODA compliant. The pushbuttons shall include pedestrian crosswalk signage with instructions for pedestrian operation as per Agency standards.

3.4.13 Traffic Controller Installation / Reconfigure Modifications

The Contractor shall install the traffic cabinet, controller, hardware, and other equipment supplied by the Agency in accordance with the signal drawings and applicable standards to ensure the intersection is fully operational. The Contractor shall connect all field signal circuits and vehicle detector run wires as specified in the cabinet wiring diagram. The Contractor shall perform “Flash-out” and “Conflict Monitor” field checks prior to energizing the signals for operation. The Contractor’s electrician shall sign and date the Conflict Monitor sheet prior to the final energization of the permanent traffic signals.

The Contractor shall ensure that the connection of any existing or new traffic systems communications cables, hardware, and related devices are always fully operational and maintained.

It is the Contractor’s responsibility to ensure functional signal operation compatible with the timing and phasing of the provided controller unit. Any modifications required to a new or existing cabinet to achieve fully functional traffic signals shall be made by the Contractor. If necessary, the Contractor shall arrange for training and support from suppliers or manufacturers at their own expense.

The Contractor shall be capable of completing same-day modifications to an existing cabinet as required. For example, when a new phase such as a left turn phase is implemented, the Contractor shall have a qualified electrician perform tasks such as re-wiring cabinet outputs, adding load bays, deactivating load bays, and making appropriate field/signal wiring outputs. Other tasks may include pole replacements or swaps. In all scenarios, the Contractor shall provide paid duty police officers at their own cost to manage intersection traffic while the signals are off.

The Contractor may be required to install a pole-mounted controller where necessary. The controller shall be installed as indicated in the drawings and in accordance with OPSD 2510.010. The Contractor shall provide all applicable steel strapping, bolts, conduits, and couplers. The Contractor may also be required to supply and install the cabinet skirt as directed by the Agency.

The Contractor shall document all tests and checks completed within the Traffic Signal Maintenance Report (TSMR) on the day of activation.

The Contractor shall document any special cabinet hard wiring modifications on the cabinet drawing with a red pen and notify the Agency of such changes.

3.4.14 Fire Pre-emption Evp/tsp Installation

The Contractor shall supply and install fire pre-emption equipment as directed. The Contractor shall install the manufacturer-recommended cable, terminators, connectors, control unit/card, and connect all equipment to ensure a fully functioning pre-emption system, regardless of the system type.

The Contractor shall prepare the equipment and system for testing by the Agency's maintenance contractor. For new signal installations, testing shall be completed before the signal activation date. The Contractor shall provide appropriate staff as required to support the Agency's maintenance contractor during testing.

All testing shall be conducted by third party independent contractor and the Agency's Maintenance Contractor is responsible for QA testing before sign off/handover.

The Contractor shall supply and install Emergency Vehicle Pre-emption equipment as detailed within the tender items. The Contractor shall supply and install 3/C #20 AWG Global Traffic Technologies (GTT, formerly 3M) SPEC 138 pre-empt cable from each signal pole to the traffic controller, as shown in the drawings. Adequate spare cable shall be left coiled at the detector location and in the signal cabinet for final connection by the Agency's forces.

The Contractor shall also supply and install GTT Opticom 721 Detectors, with mounting brackets, at each location as shown in the drawings. The detectors and detector cards may also be supplied by the Town/Fire Department.

3.4.15 Temporary And Overhead Signal Installation

The Contractor may be requested to provide overhead or temporary signal installations as shown in the contract drawings and in accordance with OPSD 2540.010, 2545.01, 2242.020, and 2245.010, as applicable.

Newly installed overhead traffic signal system spans shall be tightened 30 days after signal activation to ensure proper span and mounting heights are maintained as per contract drawings. These works shall be performed at no additional cost to the Agency.

Overhead Traffic Signal Heads
The Contractor shall supply and install signal heads on span wires or mast arms in an overhead or temporary installation. All vehicle and pedestrian signal heads shall be as per Traffic Signal Heads section.

All signal heads shall be supplied with span wire hangers. Both the upper and lower signal head mount shall be reinforced with a steel plate in each section.

The Contractor, as directed by the Agency, may be required to install signal heads with mast arms directly to wood poles, as per OPSS 2461 and OPSD 2501.020.

All signal heads that are not to be operational during designated construction stages shall be covered with “Traffic Jackets” complete with mounting hardware. Overhead traffic signal heads shall include up to 10m of coiled wire from the junction box to the signal head. The signal head shall be able to move an additional 5m along the span from the location indication of the drawings.

Back Guy Anchors
The Contractor shall supply and install back guys for wood poles and hydro poles, as indicated in the drawings, in accordance with OPSD 2540.010 and OPSD 2235.010. The Contractor shall supply and install back guy anchors as further described in the tender items.

Where it is impractical to install the normal back guy, a sidewalk strut type back guy shall be provided. All back guys shall be installed prior to the installation of suspension spans, cables, signal heads and luminaires.

Where the ground is softer and anchors cannot be placed properly, the Contractor shall pour concrete footing/posts using concrete formwork and set anchor within the concrete footing.

Steel Messenger Cable
The Contractor shall supply and install steel messenger cable and all associated mounting hardware, as indicated on the signal drawings and in accordance with OPSD 2540.010. OPSD 2540.010 is amended to note that all steel messenger cables installed shall be 9mm Grade 160.

The messenger cable is to be spanned between poles using thimble eyebolts that are to be bolted through wood poles or steel-banded spool insulators for steel poles as per the project specifications.

Wherever aerial cable crosses under high voltage hydro lines, the Contractor shall arrange with the appropriate local Hydro Authority for the neutral conductor to be raised to clear the top span by a minimum distance as per local Hydro Authority. If they are unable to achieve this separation, the Contractor shall arrange with the local Hydro Authority to protect the neutral with a flexible line insulator hose. The covers shall extend no less than the minimum distance as per local Hydro Authority on each side of the outmost high voltage conductor. The minimum distance as per local Hydro Authority working clearance from high voltage conductors shall be maintained. Cable spans greater than 60m which require support cable hangers as per OPSD 2540.010 shall be at no additional cost.

The Contractor shall arrange with the appropriate local Hydro Authority for the attachment of overhead traffic signal equipment on their existing hydro poles at the intersection, as required.

Traffic Signal Cable
The Contractor shall supply and install overhead traffic signal cable, as indicated on the drawings and in accordance with OPSD 2540.01. Traffic signal cables shall be sun resistant.

The Contractor shall ensure that no portion of the overhead span installation to be lower than 5.8m over the travelled portion of the roadway. The Contractor shall record the clearance heights measured, and provide documentation to the Agency.

Power Feed Cables and Streetlighting
The Contractor shall supply and install overhead power feed cable for both the traffic controller and streetlights, as shown on the drawings and in accordance with OPSD 2540.010. The power feed cables shall be sun resistant.

Ground Cable
The Contractor shall supply and install overhead ground cable, grounding for the messenger cable and the overhead system, which shall conform to the appropriate local Hydro Authority requirements and in accordance with OPSD 2540.010. The ground wire shall be sun resistant.

Ground Rods/Ground Plate
The requirements for the installation of grounding equipment shall be in accordance with OPSS 609.
At wood poles near a ground rod, the Contractor shall install a ground wire from the upper span to the lower span and then to the ground rod inside a protective moulding stapled to the pole.

Wood Post/ Portable Stand for Pedestrian Pushbutton
The Contractor may be required to provide a wood post or stand, on which to install the pedestrian pushbuttons and signs.

Where indicated on the drawing, a pushbutton with corresponding sign shall be mounted on a 100mm x 100mm x 5m pressure treated direct buried wood post. Wood posts shall be direct buried to a minimum depth of 1.2m and backfilled with limestone screening, compacted as required. Sufficient cable shall be coiled to permit relocation, if required.

Where indicated on the drawing, a pushbutton with corresponding sign shall be mounted on a portable stand and must be constructed to withstand outdoor / inclement conditions in Ontario and weighted down to prevent tipping. Sufficient cable shall be coiled to permit relocation, if required.

A 13mm steel or plastic riser conduit shall be fastened to the wood post or moveable stand from the pushbutton to the top.
Under temporary traffic control conditions, the Contractor is responsible for maintaining the pedestrian posts/stands in their proper location and ensuring full operation during all stages of construction. Moveable pedestrian stands should be placed on level ground and pedestrian accessible location and may require

relocation during construction. All relocation expenses shall be borne by the Contractor.

Overhead Fire Pre-emption Installation
Contractor be required to supply and install GTT 721 detectors on overhead span wires, the Contractor shall supply and install 3/C #20 AWG, GTT SPEC 138 pre-emption cable from each fire pre-emption detector head location to the traffic controller, as shown on the drawings.

The Contractor shall supply and install Emergency Vehicle Pre-emption equipment as detailed within the tender items. The Contractor shall install the manufacturer recommended cable, terminators, connectors, control unit/card and connect all the equipment for a fully functioning pre-emption system regardless of the system type.
The Contractor shall make the equipment ready for the Agency's maintenance contractor for QA test. For new signal installs testing shall be completed before the signal activation date. The Contractor shall provide appropriate staff as required, should the Agency's maintenance contractor require support for testing.

Adequate spare cable will be left coiled at the detector location and in the signal cabinet for final connection. All necessary hardware/brackets to ensure safe and consistent operation shall be supplied by the Contractor.

3.4.16 Uninterruptible Power Supply (UPS)

The Contractor may be required to supply and install UPS, capable of being side-mounted or pad-mounted. The UPS shall house a minimum of four (4) batteries and bypass switches. The UPS enclosure must not interfere with the opening of the traffic cabinet door.

All four (4) batteries must meet their specifications immediately after the initial 24-hour top-off charge. Batteries requiring cycling to meet the AH rating specifications are not acceptable. The UPS shall provide a minimum of four (4) hours of full run-time operation at 500 watts, with an additional nine (9) hours of Red Flash operation at 125 watts.

The UPS shall also feature two (2) independently programmable timers, ranging from zero (0) to eight (8) hours, with two (2) time-of-day restrictions on each timer, providing dry contacts for red flash operation at user-definable times of day. The UPS and batteries shall be easily replaceable with all necessary hardware and shall not require any special tools for installation.

3.4.17 System Communications

The Contractor may be required to include connections to the Public Sector Network (PSN) fiber-optic system. A 50mm conduit shall be supplied and installed by the Contractor, as shown in the drawings, from the nearest PSN access point to the traffic controller location. The PSN facilities shall be installed in the traffic cabinet by other forces, with the Contractor assisting in the completion of any PSN works.

The Contractor may be required to install or relocate wireless radio equipment, such as antennas, cables, and cabinet equipment, to ensure the system is fully operational.

Any existing communications shall be maintained during all stages of construction.
The Contractor may be required to store the equipment for the duration of the project, which shall not incur any additional costs.

3.4.18 Traffic Cabinet Concrete Base

Traffic cabinet bases shall be constructed in accordance with the Standards Drawings, as applicable. Final orientation shall be as per drawings or shall be determined in the field and approved by the Agency's designate as required.

In situations for an MTO specified cabinet concrete base, the Contractor shall be required to supply a cabinet skirt to raise the cabinet and shall provide a detailed drawing of the cabinet skirt from the manufacturer to the Agency.

The Contractor may be required to install a pole mounted controller during temporary stages and at locations where space is limited. The controller shall be installed as indicated on the drawings and in accordance with OPSD 2510.01. Ducts entering the traffic cabinet base shall be sealed with electrical duct seal putty.

3.4.19 Electrical Chambers

Electrical chambers shall be constructed according to OPSD 2112.010, 2112.020, 2112.040, respectively and additionally OPSD 2117.020, 2118.020, and 2123.030. The requirements for the installation of the concrete electrical chambers shall be in accordance with OPSS 602.

If installed within or adjacent to hard surface such as concrete or asphalt the electrical chamber shall be flush to grade as not to create a tripping hazard. Poured concrete shall be placed, vibrated, cured, protected, and finished conforming to OPSS.MUNI.904 and shall be formed as one monolithic structure. All concrete shall be 32 MPa.

All steel junction box/electrical chamber-lids shall be grounded and bonded to the ground wire network.

3.4.20 Concrete Base/footing For Poles Or Power Supply

All pole or power supply concrete bases shall be as per the Contract Drawings. Concrete shall be placed, vibrated, cured, protected, and finished conforming to OPSS.MUNI.904 and shall be formed as one monolithic structure. All concrete shall be 32 MPa.

3.4.21 Traffic Conduits

The Contractor shall supply and install conduits as per OPSS 603.
All rigid and flexible ducts used shall be to:

1. CSA Standard C.22.2 No. C211.2-06 for Rigid conduit; and
2. CSA Standard C.22.2 No. C227.1-06 for Flexible conduit.

At intersections where, underground conduits are to be installed for future traffic signals, as shown on the drawing, the Contractor shall supply and install a continuous #6 AWG (green) insulated ground wire. A minimum of 1.5m of ground cable shall be coiled in each electrical chamber. Where necessary, a split bolt connector shall be used or as per revised ESA standard requirements. The Contractor shall also supply and install No. 10 annealed fish wire or equal strength polyline through each duct going to a pole base/power supply base/electrical chamber/controller cabinet base.

The Contractor is advised that an existing conduit system may be present, as indicated on the drawings. All conduits shall be inspected, and the Contractor shall ensure they are free of obstructions or blockage. Any obstructions shall be cleaned prior to using the conduits. Where a blockage cannot be cleared, the Contractor shall report it to the Agency for authorization to proceed on repairs as directed.

3.4.22 Traffic Cable

Traffic signal cables used shall be #14 AWG colour coded and as per OPSS 2409, IMSA or an approved equal, according to the requirements of the ESA, prior to installing the cable. The cable jacket shall be polyethylene.
It shall be the Contractor's responsibility to provide functional signal operation that is compatible with the timing and phasing of the controller unit provided for each location.

3.4.23 Power Feed And Streetlighting Wires

All power feed cables shall be installed from the source location to the traffic signal controller and/or intersection luminaires, as shown on the drawings.

3.4.24 Ground Wire

The Contractor shall supply and install electrical grounding equipment as per OPSS 609 (where applicable) and the Contract Drawings.
The Contractor shall supply and install 1-1/C #6 AWG solid RWU (Green) insulated copper ground wire in the underground duct system.
All connections shall be bonded to the leads between poles, electrical chambers, neutral of overhead streetlighting and ground rods or ground plates with compression sleeve connectors or as per revised ESA code.

3.4.25 Loop Detector Run Wires/pushbutton Cables

The Contractor shall supply and install 2/C #14 AWG ELV shielded detector cable runs from each vehicle detector splice point to the traffic controller. These cables shall be rated for 600V, have a polyethylene outer jacket, and have a drain wire. All loop detector run cables shall be connected to the appropriate controller cabinet terminals as identified on the cabinet wiring diagram and in accordance with the Contract Drawing.

The Contractor shall also supply the same cables for audible pedestrian pushbuttons and regular pushbutton as directed.

3.4.26 Electrical Power Service Connections

The Contractor shall refer to the Contract Drawings for typical power service supply details. However, the Contractor shall comply with all applicable local Hydro Authority and ESA requirements. The Contractor shall be responsible for arranging all necessary inspections/connections and shall file required applications mandatory for connection to the power source.

The Contractor shall install in-pole breakers as per the municipality requirements. This work shall be carried out in coordination with and, if required, under the supervision of the local Hydro Authority.

The Contractor shall install the complete service facility with ground plates as soon as possible to permit hydro connection prior to the completion of the aboveground signal infrastructure. The Contractor shall arrange for ESA inspections and shall forward a copy to the Agency via email. The local Hydro Authority shall connect the power service facility to the power supply at a specified time once it receives the ESA approval.

For traffic signal intersections, the power supply shall be a 120V/240V split phase 100 amp rated for the main breaker. It shall include a one 30-amp circuit breaker labelled for streetlighting and one 40-amp breaker labelled for the traffic signal system. The power supply shall be a CSA approved weatherproof electrical enclosure.

Installation of the power service shall be completed within the first ten (10) working days of the project to allow Hydro Authority sufficient time to provide power prior to date of signal turn on.

3.4.27 Ground Rod/Plates

The Contractor shall supply and install electrical grounding equipment as per OPSS 609 (as applicable).

The Contractor shall supply and install #6 AWG type RWU (Green) insulated copper ground wire in the underground duct system. All connections shall be bonded to the leads from poles and ground rods or ground plates with compression sleeve connectors.

Ground plates shall be secured by means of exothermic weld connections with a compression connector to allow for #6 AWG (green) ground wire and shall be ESA approved.

Ground plates shall not be less than 6mm thick, 406mm in length and 254mm in width and shall be installed as per CEC Rule 10-700 and CEC Rule 10-702. Each corner boulevard electrical chamber shall have a ground plate and the power supply shall have a minimum of two ground plates.

The Contractor shall test all system and grounding components. The Contractor shall test the resistance to ground between the equipment enclosures and the grounding grid. Readings shall not exceed 25 ohms. These measurements shall

be performed when frost penetration does not exceed 150 mm. In soils of low conductivity, ground plates and ground wires shall be added as required.

3.4.28 Vehicle Detectors

The Contractor may be requested to install alternate means of detections, such as overhead detectors and wireless in-road sensors. It is the Contractor's responsibility to educate themselves on the installation and operation of these technologies to provide a fully operating system as per Agency requirements. In addition, the Contractor shall be familiarized on integrating the detection device to the controller unit. Where the Contractor lacks knowledge or experience about a particular device and requires supplier or manufacturer support, the Contractor shall contact and arrange for training and set up of the device in a timely manner that shall not affect the completion of the project. If necessary, the Contractor shall arrange with all equipment suppliers or manufacturers to provide training and education to ensure proper operation. Any additional expense incurred for such support shall not be considered and shall be borne by the Contractor.

Loops

Vehicle detector loops shall be installed in the road surface in accordance with OPSD 2520.01, OPSD 2520.02 at the locations specified on the drawings or as advised in the field by Town of Innisfil Traffic signal staff. Final placement is to be determined in the field in coordination with Agency staff.
Detector loops shall be in place prior to signal activation unless otherwise directed by the Agency.

A 25mm Electrical Non-Metallic Tubing for each individual loop lead wires shall be installed from the edge of roadway to the electrical chamber, as indicated on the drawings. Loop lead-in wires shall be spliced to run wires in the pole handhole. Where a lead-in splices is made in an electrical chamber, the Contractor shall use waterproof gel connectors.

The Contractor shall coordinate the placement of detector loops in the top course asphalt, such that they are installed prior to the pavement markings being placed. The crosswalk markings are not to be installed until all vehicle detection loops have been completed.

Overhead Detectors

The Agency will continue to test and review new emerging technologies to update the pre-approved overhead detectors. At the discretion of the Agency's traffic signals representative, new units may be installed on a case by case basis as approved by the Agency.

Depending on the type of vehicle detector shown on the drawing the Contractor shall be required to supply and install the proper cable to operate the vehicle detector. There shall be no splices in between cable runs unless specified by the manufacturer. The detector shall be installed in the locations indicated on the drawings unless otherwise directed by the Agency.
Should the Contractor be required to install overhead detector systems on temporary traffic signal installations, the detector unit(s) shall be installed on wood poles. Where installing on wood poles is not possible, the Contractor shall supply

and install all hardware and equipment necessary to install the detector unit on overhead span wire. The requirements for the installation of an overhead vehicle detector shall be in accordance with OPSS 620.

Should the work involve multiple traffic stages, the Contractor is responsible for adjusting and recalibrating the detector units as directed by the Agency or Contract Administrator during staging traffic signal operation. Modification of detection zones may be due to traffic management plan changes and/or to maximize level of service.

The Contractor shall pre-program all detection zones as per design drawings prior to signal turn on unless otherwise directed by the Agency.

Wavetronix Smart Sensor
The unit model to supply and install shall be the Smart Sensor Matrix for the stop bar application. It shall be installed as per the manufacturer recommendations.

New Overhead Technology
New technologies shall include any detection system that has not been identified in this document. The noted technology shall be of similar install to the Wavetronix smart sensor, Iteris Next or Iteris Vantage, in that it shall be one detector appurtenance on a pole or mast arm, with lead-in/runner wires between the controller cabinet to the sensor. The Agency may supply the units, or the Contractor may be asked to purchase the detection unit, hardware, mounting hardware, cables, and control unit for a complete functioning installation.

3.4.29 Energizing Traffic Signals

The Agency or designate must be present when the Contractor energizes the traffic signals for full operations. The Contractor shall provide a minimum of 72 hours advance notice to the Agency when the signals are scheduled to be energized. The Agency reserves the right to cancel any traffic signal activations when the Agency has not been advised of within the 72-hour notice period. If extreme weather conditions present a safety concern, then the Agency and the Contractor can agree to re-schedule energizing the traffic signal.

The Contractor shall have a licensed electrician (experienced with energizing traffic signal installations) present when energizing a temporary or permanent traffic signal. When energizing the signals for acceptance, a Flash-out and a Conflict Monitor check must be completed.

Temporary and/or permanent traffic control signal installations must be energized after all vehicle/pedestrian detection has been installed, all central computer control hardware relocated, and all fire pre-emption hardware installed.

All traffic signal installations must be fully operational, furnished and complete which shall include but not limited to; pushbuttons, audible pedestrian pushbuttons, pre-emption equipment, detection equipment, pavement marking and signage on activation date.

3.4.30 Testing And Acceptance Of Work

Factory finished equipment shall be protected so that the surface will not be damaged during construction. All damaged work shall be removed and replaced at no additional cost to the Owner.

When all electrical work under the Contract has been completely tested and proven satisfactory, the protective covering of factory finished materials shall be removed and the equipment shall be thoroughly cleaned and kept clean so that the work is in good and proper working condition when acceptance is made. Luminaires and lamps shall be cleaned thoroughly prior to final inspection.

Tests on electrical wiring and material shall, unless otherwise specified, conform to the OESC, and shall include insulation value readings and resistance to ground readings. Testing shall only be performed by a certified electrician and shall be done in the presence of the Agency, local Hydro Authority and/or ESA Inspectors, as requested.
The Contractor shall provide all necessary instruments, equipment and personnel required to satisfactorily carry out prescribed tests at their own expense.

The following tests shall be performed as directed by the Agency:

- All conduits and duct systems shall be proven free of stones, dirt, water, or other debris by pulling a test mandrel 6mm smaller in diameter than nominal conduit or duct size through each individual conduit or duct.
- All circuits shall be proven continuous and free of short circuits or ground faults.
- All circuits shall be proven free of unspecified grounds and the resistance to ground for all circuits shall be no less than 50 mega ohms.
- All circuits shall be proven to be operable. Each control or switching device shall be operated no less than 10 times and each circuit no less than eight (8) hours.
- The resistance to ground for the power service facility ground, the controller ground, and the intersection system ground shall be proven not to exceed 25 ohms. The Contractor shall perform the necessary tests and record the values on the form provided by the Agency.
- The Contractor shall measure the incoming voltage at the power service facility and shall record the value on the form provided by the Agency.

In addition to the above tests, the Contractor shall, where directed by the Agency, perform any tests called for where performance of the electrical system indicates a deficiency. The Agency may conduct tests on materials other than electrical materials as described elsewhere in the specifications for the contract.

Where any tests indicate faulty workmanship or unacceptable electrical measurements, the Contractor shall repair or replace the faulty equipment at their own expense and to the satisfaction of the Agency.

The Contractor or its duly appointed representative shall oversee all testing and shall assume full responsibility for any damage which may occur to the equipment installed because of such testing.

Prior to energizing the traffic control signals, the Contractor shall “Flash-out” all field circuits, perform a conflict monitor check as per the Project Conflict Monitor Check Sheet and log accordingly in the TSMR logbook.

3.4.31 Pavement Markings And Traffic Signs

Durable pavement markings in accordance with the Town of Innisfil Standards and OPSS.MUNI 710 shall be installed as per the Contract Drawings.

Where required, the Contractor shall supply and install signs to the pole with steel banding and stand-off brackets, in accordance with the Town of Innisfil Standards.

All signs supplied by the Contractor shall be according to OTM Book 5. The Contractor shall supply and install all signs and sign supports as shown on the contract drawings.

The Contractor shall be required to install an oversized street name sign onto a mast arm, in accordance with the Town of Innisfil Standard Drawings. Where the oversize street name signs are indicated to be installed on overhead span wire, the Contractor shall supply all appropriate hardware.