INDEX TO CLAUSES

PART 1 - GENERAL

1.1 Work Included

.1 This section specifies the requirements for the installation of traffic and pedestrian crossing signal systems. The Work consists of furnishing all labour, tools, and equipment, and performing all operations necessary to complete the installation of the traffic signal, pedestrian crossing items, UPS - Battery Backup, and any other supplementary systems as shown on the drawings.

1.2 Related Sections

.1	Concrete	Section 03 30 00
.2	Metal Fabrications	Section 05 50 00
.3	Earthwork	Section 31 20 00
.4	Walks, Curbs, and Gutters	Section 32 16 00
.5	Topsoiling and Finish Grading	Section 32 91 19
.6	Reinstatement	Section 32 98 00
.7	Hot Mix Asphalt Concrete	Section S-1
.8	Performance Graded Asphalt Binder	Section S-2

1.3 Reference Standards

.1 CSA C22.1 (latest edition), Canadian Electrical Code Part 1

.2 International Municipal Signal Association (IMSA) Official Wire and Specifications Manual (latest edition)

.3 CSA C22.2 No. 211.2 (latest edition), Rigid PVC (Unplasticized) Conduit.

.4 CSA C22.2 No. 41 (latest edition), Grounding and Bonding.

.5 CSA C22.2 No. 85 (latest edition), Rigid PVC Boxes and Fittings.

.6 CSA S6 (latest edition), Canadian Highway Bridge Design Code.

.7 AASHTO LRFDLTS-1 (latest edition), LRFD Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals.

.8 ASTM C857 (latest edition), Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.

.9 ASTM D412 (latest edition), Standard Test Method for Vulcanized Rubber and Thermoplastic Elastomers – Tension.

.10 ASTM D2240 (latest edition), Standard Test Method for Rubber Property – Durometer Hardness.

.11 NEMA TS-2 (latest edition), Traffic Controller Assemblies with NTCIP Requirements.

.12 NEMA 250- (latest edition), Enclosures for Electrical Equipment (1000 Volts Maximum)

1.4 Shop Drawings

.1 Submit shop drawings in accordance with Section 01 10 00.

.2 Submit shop drawings to HRM for review within 14 calendar days of tender award and order the materials within two (2) working days of receiving HRM's shop drawing review.

1.5 Codes, Bylaws, Ordinances and Regulations

.1 Perform all work covered by this section according to:

- .1 Applicable Halifax Regional Municipality and Nova Scotia Power Incorporated (NSPI) Codes, Bylaws, Ordinances, and Regulations.
- .2 Nova Scotia Department of Transportation and Infrastructure Renewal "Temporary Work Place Traffic Control Manual" (latest revision).
- .3 HRM's Traffic Control Manual Supplement.
- .4 The Canadian Electrical Code

1.6 Certificates

.1 Submit manufacturer's specification and test data that confirms proposed products and materials meet requirements of this Section in accordance with Section 01 10 00.

.2 Provide additional test data for any component specified herein as requested by the Engineer.

.3 Obtain final certificate of approval from NSPI.

1.7 Handling and Storage

.1 Ship poles, mast arms, tenons, signal heads, and other equipment complete with all required hardware.

.2 Handle and store traffic signal system equipment in accordance with the manufacturer's written instructions and in a manner that avoids damage to the equipment. Should any item be damaged as a result of neglect or improper storage or handling, replace at no additional cost to the Contract to the satisfaction of the Engineer.

1.8 Quality Assurance

.1 Have field work on traffic signal systems performed by or directly supervised by a journeyman electrician with a minimum International Municipal Signal Association (IMSA) Traffic Signals Level 1 Certification.

.2 In addition, have Traffic Signals work within the Control Cabinet and involving the Control Cabinet wiring and equipment performed by or directly supervised by a Licensed Journeyman Electrician with IMSA, Traffic Signals Level 2 Certification or an Electrical or Electronics Technician / Technologist with IMSA, Traffic Signals Level 2 Certification.

1.9 Spare Parts

.1 Provide all unused portions of cable spools to the Owner at the conclusion of the Work.

PART 2 - PRODUCTS

2.1 General

.1 All material and equipment supplied must be new unless otherwise stated.

.2 All traffic signal equipment must be compatible with HRM's existing traffic signal systems and must be approved by HRM prior to ordering.

.3 Provide equipment designed to meet or exceed wind loading requirements as set forth in the National Building Code for the HRM region.

.4 Supply all accessories and appurtenances for a fully functional traffic control system.

2.2 Concrete Bases

.1 Cast in place base mix design to Section 03 30 00.

2.3 Conduits

.1 Detector home runs: 38mm diameter rigid PVC: to CSA C22.2 No. 211.2.

.2 Preformed Home-run detector loops: 19mm diameter rigid PVC, to CSA C22.2 No. 211.2.

.3 Signal Cable: Rigid PVC to CSA C22.2 No. 211.2. Sizes shown on drawing.

.4 Pole Risers: to Section 03 30 00, 20mm maximum aggregate size, minimum 35 MPA at 28 days, to sizes and dimensions shown on drawings.

2.4 Pull Pits and Junction Boxes

.1 Pull pit: as per HRM standard drawing HRM 79.

.2 Junction Box: (Above Ground): to CSA C22.2 No. 85, flanged, PVC junction box complete with fibre reinforced cover.

.3 Junction Box: (In Concrete or in Ground): to ASTM C857.

2.5 Transformer Bases

.1 Aluminum transformer base to AASHTO LRFDLTS-1, complete with hinged access door fastened with stainless steel hinges and screws. Bolt circles to match poles and bases.

2.6 Traffic Signal Cables

.1 26-conductor traffic cable complete with PVC jacket. PE insulated and cabled symmetrical in layers with lay as per IMSA 19-1-1984. Tracers to be permanently marked or embedded into insulation not printed. Filler to be PVC or PE. Apply (1) one layer of tape under outside of jacket to lap at least 12.5% of tape width. Cable outside diameter not to exceed (1) one inch. 600 volt ac rating.

- .1 #10 stranded plain copper A.W.G. white.
- .2 #14 stranded plain copper A.W.G as follows:
  - .1 Red: with (1) white tracer, Red with (2) white tracers, Red with (3) white tracers.
  - .2 Orange: with (1) white tracer, orange with (2) white tracers, orange with (3) white tracers.
  - .3 Blue: with (1) white tracer, blue with (2) white tracers, blue with (3) white tracers.
  - .4 Black: with (1) white tracer, black with (2) white tracers, black with (3) white tracers.
  - .5 Yellow: with (1) white tracer, yellow with (2) white tracers, yellow with (3) white tracers.
  - .6 Brown: with (1) white tracer, brown with (2) white tracers, brown with (3) white tracers.

.2 Five (5) conductor traffic cable complete with PVC jacket. PE insulated and cabled symmetrical in layers with lay as per

I.M.S.A. 19-1-1984. Filler to be PVC or PE. Apply (1) one layer of tape under outside of jacket to lap at least 12.5% of tape width. Cable outside diameter not to exceed (1) one inch, 600 volt ac rating. Wire size and color coding is as follows:

.1 #14 stranded plain copper A.W.G as follows: "Red". "Orange", "Blue", "White", "Green".

.3 (4) Four conductor traffic cable, PVC jacket. PE insulated and cabled symmetrical in layers with lay as per IMSA 19-1-84. Filler to be PVC. or PE. Apply one (1) layer of tape under the outside of jacket to lap at least 12.5% of tape width. Cable outside diameter not to exceed ½ inch. 600 volt ac rating. Wire size and color coding is as follows:

.1 #14 stranded plain copper A.W.G as follows: "Green", "White", "Black", "Yellow".

2.7 Detection System

.1 Inductive Detector Loops:

.1 Loop Cable: RWU 90, #14 AWG stranded bare copper conductor complete with cross-linked polyethylene insulation.

.2 Sealant: one-part, moisture curable, polyurethane sealant, self-levelling with the following minimum physical property ranges:

.1 Tensile Strength: 620 psi ± 43 psi to ASTM D412.

.2 Elongation: 290% ± 32% to ASTM D412.

.3 Minimum Hardness (Shore A): greater than 10 to ASTM D2240.

.3 In-ground Lead-in-Cable: 2-conductor, 14 AWG tinned copper, polyethylene insulation outer jacket and aluminum/polyester outer shield.

.4 Overhead Lead-in-Cable: 2 × 2 core with ground and foil shield complete with 5mm support wire.

.2 Preformed Detector Loops:

.1 Four (4) conductor, double-jacketed cable suitable for asphalt or concrete overlay.

.2 Conductors: #18 AWG with 0.5mm thick layer of crosslinked polyethylene (XLPE).

.3 Void between conductors and inner jacket to be spiral wrapped in moisture resistant binder tape and filled with an amorphous water blocking gel.

.4 Inner jacket: 1.0mm crosslinked polyethylene (XLPE).

.5 Outer jacket: 0.9mm thick crosslinked polyethylene (XLPE). For direct buried applications employ an additional 5.0mm thick TPE insulated outer jacket.

.6 Lead-in cable: two (2) conductor, double jacketed cable, #16 AWG with a 0.5mm thick layer of crosslinked

polyethylene (XLPE). Inner jacket and outer jacket to match specification above.

.7 Splices to be soldered, sealed and waterproofed.

.3 Microwave radar detection:

.1 Microwave based radar motion sensor to interface with traffic control cabinet (NEMA 170, 179 and 2070 cabinets). Capable of monitoring up to eight detection zones; motion detection range between 60-600 feet for cars, 160 feet for pedestrians and bicycles; complete with surge protection; powered from TCIB over Ethernet cables; mountable on corner pole or mast arm and capable of tracking up to 64 objects simultaneously.

.4 Radar Detector:

.1 Radar sensor matrix system capable of monitoring real time presence data complete with pre-assembled cabinet backplate and mounting hardware.

.2 Remotely accessible for traffic monitoring and sensor management.

.3 Integral surge protection.

.4 Watertight to NEMA 250.

.5 Accessories:

.1 Rack cards.

.2 Junction box.

.3 6-conductor cable.

.5 Video monitoring equipment:

.1 Camera:

.1 Single bell camera vehicle detection and counting, for highway counting and monitoring application.

.2 5MP CMOS, powered over Ethernet IP68, internally pressurized and leak tested, water tight to NEMA 250 and with an operable temperature range of -34°C to +74°C.

.3 Resolution: 2560 x 1920 pixels

.4 Lens: 180° Fisheye.

.5 Power consumption: 5W nominal, 50W with heaters activated.

.2 Processor:

.1 Vehicle tracking and counting, intersection actuation application, to NEMA TS2.

.2 TCP/IP communication.

.3 Wide Area Network (WAN) port for remote connectivity.

.4 Power: 120/240 VAC 50/60 H

.5 Power consumption: 35Wnominal, 85W with active camera heaters.

.6 Detector I/O: Twenty-four (24) optically isolated I/O, SDLC interface, or ITS interface.

.7 Outputs: 24 optically isolated outputs, SDLC interface conforming to TS2 specs, programmable up to 64 detectors.

.8 Operable temperature range of -34°C to +74°C.

.3 Software: data interface, remotely operable with equipment, storage and retrieval of data. Proprietary software to matches the equipment system, Cloud backup enabled, capable of real time automatic alerts.

2.8 Poles, Mast Arms - Aluminum

.1 Round seamless tubes of aluminum alloy 6063-T6, free from longitudinal welds with No. 120 grit belt surface finish.

.2 Height, diameter, wall thickness, and taper: as indicated.

.3 Poles and arms to meet minimum loading requirements.

.4 Mast arms: aluminum alloy truss style complete with aluminum alloy 6063-T6 brackets, stainless steel nuts, bolts, and washers.

.5 Use anti-seize compound on all threaded hardware.

2.9 Poles, Mast Arms - Steel

.1 Steel poles and mast arms to be round in cross-section and have a constant linear taper of 1.17 cm/m. Shaft to be one piece with no circumferential welded splices.

.2 Tube seam welds for poles and mast arms must be free of cracks and excessive undercut, performed with an automatic process with a smooth finish and have a minimum penetration of 60%. Seams within 100mm of a flange or base plate shall be 100% penetration. Poles to be fabricated to ASTM A572 or ASTMA595 Grade A with a minimum yield strength of 55 ksi.

.3 Pole to include a 100mm x 250mm hand hole with the cover located 26mm to 153mm from pole base and arm base.

.4 All mast arms up to 15.2m in length are to be manufactured and shipped in one piece. Provide each arm with a cast end cap secured in place with set screws.

.5 Poles and arms to be designed in accordance with CSA S6 and must meet minimum loading requirements.

.6 Include anchor bolts with each pole, sized as determined by the fabricator. Use anti-seize compound on all threaded hardware.

.7 Fabricator to be certified to an AISC Fabricator Certified Quality Program.

.8 Treat field cuts and/or drill holes with cold galvanizing compound.

.9 Nuts to be double nutted and tightened to manufacturer's recommended torque.

2.10 Signal Mounting Brackets

.1 Pole Mounted: 38mm diameter aluminum tubing and cast fittings unpainted unless specified on drawings.

.2 Mast Arms: 2-way variable tenon mount, with stainless steel hardware.

.3 Tenons: aluminum alloy complete with 201 stainless steel 19mm banding, buckles, pole plates, one way top bracket assembly, and one way bottom bracket assembly.

.4 Pole Plate: Double Band-it type MH/AL/100 by Pelco or approved equal.

.5 Color: as specified by Engineer.

2.11 Traffic Signal Heads

.1 Housing: Polycarbonate with polycarbonate lenses and black visors unless otherwise specified on the drawings

.2 Color: Yellow housing unless otherwise specified on the drawings.

.3 Lamps: All signals to have 300mm LED modules built to the latest ITE specifications

.4 Complete with snow shield.
.1 Acceptable product: Snow Sentry.

2.12 Pedestrian Signal Heads

.1 Housing: Bi-modal polycarbonate housing.

.2 Color: Yellow housing and black visors unless otherwise specified on the drawings.

.3 Lamps: All pedestrian signals to have Square LED modules built to the latest ITE specifications.

.4 Countdown Pedestrian Signal Heads as shown on the drawings.

.5 Symbols: to the International Municipal Signal Association (IMSA) Official Wire and Specifications Manual (latest edition).

2.13 Pedestrian Push Buttons

.1 Pedestrian push buttons:

.1 Audible signal with accompanying visual one. Wireless Bluetooth communication, 360 degree dual-side speaker output, over-mold board protection, APS connectivity accessibility, and tested to NEMA TS2 for temperature, humidity, mechanical shock vibration and transient surge.

.1 Acceptable Product: Polara i-Navigator APS, Model iN-2 for existing systems, Model iN3 for new systems; or approved equivalent.

.2 Sounds: As per latest recommendation by the Canadian National Institute for the Blind as confirmed by the Engineer.

.3 Colour: Yellow or as specified.

2.14 Pre-Emption Devices

.1 Plug-in, four (4) channel, dual priority, multimode encoded signal device for use with GPS radio/GPS intersection equipment.

.2 Capable of reading three (3) distinct emitter frequencies, high priority, low priority and probe priority.

2.15 Pedestrian (RA-5) Signals

.1 Type: Double-sided illuminated 600mm × 750mm RA-5 Crosswalk sign with walking man symbol inside white border, complete with 300mm flashing amber beacons attached to each side of sign if specified.

.2 Body:

.1 Aluminum, treated to prevent premature peeling and blistering using interprime 5519 etch primer and 519 converter prior to painting. Sign to be painted 514 crosswalk yellow.

.2 All seams to be welded in main body construction.
.3 Bottom of sign to have an opening protected by wire mesh.
.4 No exposed wiring inside sign except for terminal ends in bottom.
.5 Stainless steel hinges with removable pins to hold both door faces of sign to main sign, and stainless latch to close door faces to main sign. Doors to swing upwards freely with no obstructions.
.6 CSA labeled.
.7 Wiring diagram with completed parts list.
.8 RA-5 housing to be a maximum of 660mm W x 790mm L x 320mm D.

.3 Lens:
.1 Lexan 5mm thick, slide in-slide out, replacement.
.2 Facelight source to be LED 120/130 volt 40w lamp, mogul base (lamp to be included). Ballast to be mounted in plate with quick detachable socket for wiring.
.3 Down light source to be LED 120/130 volt 54w lamp, mogul base (lamp to be included). Mount ballast in plate with quick detachable socket for wiring. Down light source to provide illumination of 43 lux on the roadway surface.
.4 Switch inside to provide disconnect to lamp socket.

.4 Mounting:
.1 Mast Arm: top of fixture to be reinforced with minimum 7mm aluminum plate to absorb strain of the hanger. Supply cushion hanger with sign. Supply safety chains and eye bolts on top to prevent signs from rotating in high winds. Doors to swing upwards freely with no obstructions.
.2 Span Wire: top of fixture to be reinforced with minimum 7mm aluminum plate. Provide double span wire suspension hangers with wire entrance port complete with wire clamp and protector. Bottom suspension wire to be clamped with suitable clamping device capable of supporting total weight of signs in the event of primary messenger failure.

.5 Beacons: Each sign to be complete with two (2) 300mm flashing amber LED beacons in yellow polycarbonate housing, one attached to each side of the sign (right side: facing the viewer; left side: facing away from the viewer). Black visors unless otherwise specified on the drawings.

.6 Complete sign assembly to be CSA certified.

.7 Pedestrian controller:
- .1 Controller to be capable of activating the pedestrian signals for a programmable length of time.
- .2 Any press of the push buttons must be capable of starting the crossing countdown over.

2.16 Uninterruptible Power Supply

.1 UPS - Battery Backup Systems (BBS) for Traffic Signals.

.2 Compatibility: BBS to be compatible with the traffic controller cabinet, controller and cabinet components, including the safety monitor, for full time operation. BBS to include all necessary cables to connect Inverter/Controller and battery panel(s).

.3 Run-time: BBS to provide a 2-amp cabinet load a minimum run-time of four (4) hours of full color operation.

.4 Output Capacity: BBS to provide a minimum of 1000W @ +74°C, continuous active output capacity, with a 90% minimum inverter efficiency while running in battery backup mode.

.5 Output Voltage: When under battery power, BBS output voltage to be 120 VAC, pure sine wave output, ±3%, 60 Hz ±0.1%.

.6 Transfer Time: The maximum transfer time allowed, from disruption of utility line voltage to stabilized inverter line voltage from batteries shall be eight (8) milliseconds. The maximum transfer time when switching from inverter line voltage to utility line voltage after the line-qualifying period shall be ten (10) milliseconds. The BBS must be capable of allowing the user to change the transfer time in eight (8) millisecond increments up to 200 milliseconds if needed by the cabinet equipment.

.7 Operating Environment: The operating temperature for the Inverter/Controller, Battery Hub and Power Interface Module (PIM) shall be -35°F to +165°F (-37°C to +74°C).

.8 Surge Protection: BBS transient protection to be able to handle a minimum of 480 joules of energy and 39kA peak current. In addition, input circuit to contain an RF filter, which provides attenuation of line noise of 25 dB at 10 KHz, 65 dB at 100 KHz and 100 dB at 1 MHz.

.9 Power & Control Connections: BBS to have the capability to be replaced with ease utilizing single connectors for AC input, AC output and the battery panel(s).

.1 AC Connection: AC input and output to be separate panel mounted plug/receptacles that allow no possibility of accidental exposure to dangerous voltages. Plug/receptacles to utilize some form of locking mechanism to prevent accidental disconnect.

.2 Battery Connection: battery panel to utilize a single circular barrel type connector for connecting to the Inverter/Controller with ease.

.10 Battery: sealed Nickel-Zinc (NiZn) battery technology. Lead-Acid battery technologies will not be accepted.

.1 Charging/battery monitoring circuitry to be incorporated within the battery panel.

.2 BBS to allow the user to 'Hot Swap' the battery panel(s) while on utility power or battery backup power.

.3 The Inverter/Controller must allow the connection of four (4) battery panels directly to the Inverter/Controller.

.4 The Inverter/Controller must be capable of accepting battery panel(s) of different capacities at once, giving the user the ability to utilize different battery sizes to achieve required run-times.

.5 Inverter/Controller to accept up to sixteen (16) battery panels when utilizing a battery HUB(s).

.11 Charge Time: The BBS must recharge to full charge capacity within four (4) hours of complete discharge when AC utility line voltage is available. The number of battery panels connected to the Inverter/Controller shall have NO effect on the four (4) hour recharge time. Temperatures below 149°F (65°C) shall not have any effect on the ability to recharge or the recharge time. The BBS must not require trickle/float charging.

.12 Unit Failure: The BBS must have a fail-safe utility tie feature that automatically cuts back to the utility line in the event of an Inverter/Controller failure, battery panel(s) failure or complete battery panel(s) discharge.

.13 LCD Display: BBS Inverter/Controller to have a 4 line by 20-character LCD display with an LED back light. From the main screen, LCD display to provide the following information:

.1 Utility line voltage

.2 BBS status

.3 Cabinet current consumption

.4 Battery charge percentage

.5 Available backup time in hours and minutes

.14 Keypad: BBS Inverter/Controller to include a 4-way navigational keypad to allow users the ability to navigate the menu and program user set parameters.

.15 Programmable Relays: BBS Inverter/Controller to include eight (8) programmable relays, which are controlled by power line conditions, and user selected settings of the BBS. These relay contacts shall be rated for 2 amps @ 120 VAC. Each relay shall have the ability to be triggered by multiple conditions simultaneously. The programming options are as follows:

.1 Loss of utility line voltage
.2 Low battery
.3 Time of day
.4 Temperature
.5 Time delay (for red flash)

.16 Event Log: BBS to provide an event log, which will allow the user to view the date, time, and duration of a given event. The event log shall provide the user with an image of the waveform from the given event. Data to be recorded in a FIFO format so the oldest event is purged as the newest is entered.

.17 Manual Bypass Switch: BBS Inverter/Controller to include a manual bypass switch to allow the user to manually bypass the inverter while allowing the utility line voltage through to the cabinet.

.18 Circuit Breakers: Equip the BBS Inverter/Controller with two (2) 20A circuit breakers, one (1) each for the AC input and output.

.19 Force On: Equip the BBS with “Force On” capabilities, which provides the user the ability to turn the BBS on and supply backup power when no utility line voltage is available. This allows the user the ability to install a BBS and provide backup AC power at an intersection that has no utility line voltage available.

.20 Communication:

.1 The BBS must have the capability to provide Ethernet and IP addressing communications with the capability for remote monitoring and programming. This capability must be provided through a desktop application.
.2 Equip BBS with an Ethernet port. Ethernet port to be an RJ45, EIA 568B pin out type connector. Data rate to be 100mbps.

.21 Warranty: provide a warranty for the complete system including battery panel(s) that expressly states the system will be free from defects in material and workmanship for a minimum of five (5) years from the date of original receipt.

.22 Enclosure:

.1 Contain all Batteries, UPS unit and additional equipment in a weather proof aluminum enclosure.

.2 Engineered to accommodate outdoor powering equipment in pole or wall mount configurations. Durable, outdoor design kiosk, CSA approved, NEMA 3R weather resistant UPS enclosure.

.3 All aluminum welded construction and durable powder coat finish provides superior corrosion resistance.

.4 Sliding battery trays with lock-in/lock-out features standard. A variety of configurations available to support specific powering needs. Portable generator cabling access panel.

.5 Single or multiple power supply enclosure to support distributed powering architectures. The power supply is located on the equipment shelf above the batteries for maximum convection cooling.

.6 Includes a removable lockable door and easy opening lid, high magnetic circuit breaker and a duplex AC receptacle.

.7 Dimensions: 762mm W x 1219mm H x 457mm D unless otherwise specified.

PART 3 - EXECUTION

3.1 Excavation and Backfilling

.1 Do excavation and backfilling in accordance with Section 31 20 00 – Earthwork.

3.2 Concrete Bases

.1 Do cast in place concrete in accordance with Section 03 30 00 – Concrete.

.2 Confirm, through survey review, the locates of underground infrastructure and review overhead wire routing prior to excavation to avoid conflicts or obstructions and achieve required offsets.

.3 Protect concrete bases and poles until project completion.

.4 Install a vertical post or pole (metal or wooden) to a height of at least 2 m, within 3 business days of base installation and keep in place until final pole installation.

3.3 Conduit Installation

.1 Location, number, and size of conduit as indicated on drawings or as directed by Engineer.

.2 Do cast in place concrete in accordance with Section 03 30 00 – Concrete.

.3 Obtain permits from NSPI.

.4 Install non-concrete encased conduit in accordance with standard drawing number HRM 78.

.5 Install concrete encased conduit in accordance with detail indicated on the drawings.

.6 Use wood forms for concrete encased conduit rather than place concrete in direct contact with the sides of excavation.

.7 Join conduit in accordance with manufacturer's instructions. Ream the ends of all conduit to ensure smooth interior finish that will not damage the insulation of the wires.

.8 Protect conduit stubs from construction related damage with caps to prevent entrance of foreign materials.

.9 Confirm conduit stubs are located correctly and terminations are suitable for installation of equipment.

.10 Provide complete connections between conduit ends and terminal boxes of electrically operated equipment.

.11 Remove all water and foreign material from conduit and raceways by swabbing out the conduit or by using compressed air.

.12 Draw conductors and/or wire, and pull string through conduit. Use approved lubricants for drawing conductors through conduit. Leave at least one metre of slack in each conductor at panel boards, outlet boxes, and other devices to facilitate the making of joints.

.13 Cover all non-concrete encased conduit along entire length with 38mm × 140mm treated wood plank. Plank to be pressure treated with pentachlorophenol to retention of at least 3.6 kg as per CSA S6 and CSA 080.

.14 Place electrical underground warning tape above the conduit 150mm to 250mm below finished grade. Warning tape shall be 0.9mm thick, 150mm wide, and made of heavy duty polyethylene

material with over-coated graphics. Red with black text that reads: 'CAUTION BURIED ELECTRIC LINE BELOW'.

.15 Install concrete pole riser to cover pipes that run to the surface on all wooden poles as per HRM standard drawing HRM 86. Dowel riser into pole using stainless steel bolts. Use anti-seize compound on all threaded hardware. A metal guard to a height of 2.5m plus expansion joint can be used in place of the concrete pole riser on a wooden pole with single conduit run.

.16 Leave pull wire in each empty duct. Fasten pull string to end of conduit with duct tape.

.17 Have conduit inspected and approved by the Engineer prior to backfilling.

.18 Backfill in accordance with Section 31 20 00 – Earthwork. Carry out surface reinstatement in accordance to Section 32 98 00 – Reinstatement.

3.4 Installation of Detector Loops

.1 Locations and dimensions indicated on drawings are approximate.

.2 Final locations and dimensions to be approved by Engineer prior to saw cutting asphalt.

.3 Unless otherwise directed, saw cut an 10mm wide slot in pavement to a uniform depth between 50mm and 75mm.

.4 Prior to laying the loop wire, ensure that the slots are clean with no sharp corners which could damage the loop wire. Remove chips and moisture using dry air at a pressure of at least 900 kPa. A heat wand may be used to dry the saw cut.

.5 Lay loop wire in one continuous length of wire around the saw cut as per the drawings or as directed by the Engineer. Loop wire to be continuous from junction box at the curb around the loop and back to the curb. No splices are permitted in this section of wiring.

.6 Number of turns as directed by the Engineer.

.7 Tag or label clearly with permanent ink, loop lead in-cable at controller to indicate assigned phase and function, and top and bottom of loop.

.8 Place sealant in saw cut in accordance with detector loop sealant manufacturer's recommendation.

.9 Gain access to curbside junction box by saw cutting curb from street side to back of curb. Saw cuts to be of sufficient depth to provide a minimum depth of 38mm to 50mm cover over loop wires.

.10 Tightly twist loop wires, from the saw cut to the curb side junction box, at a rate of least 15 turns per metre.

.11 Seal curb and saw cuts using detector loop sealant. Confirm no voids are formed between saw cut, loop wire, and sealant when sealant is being applied.

.12 Solder splice between detector loop cable and detector lead-in cable in junction box. Protect splice point with moisture proof seal.

.13 Loop Testing:

.1 Conduct loop insulation test with 500 volt Megger from loop lead-in to earth ground. Obtain a reading of 100 megohm or greater.

.2 Conduct loop continuity test at loop lead-in cable termination ends. Obtain a resistance of 5 ohms or less.

.3 Provide test results to the Engineer.

.14 Loop tails to cabinet termination ends longer than 23 metres require shielded lead-in cable.

.15 Where lead-in cable must be longer than planned, the loop inductance must be equal to or greater than that of the lead-in cable. Loop inductance less than that of the lead-in cable will be considered unacceptable.

3.5 Installation of Transformer Bases Poles and Mast Arms

.1 Secure transformer base to concrete base anchor bolts using galvanized nuts and manufacturer-approved washers 10mm and 13mm thick at top of transformer base. Tighten nuts and torque an equal amount in accordance with the manufacturer's recommendations. Provide a vertical post (metal or wood), minimum 2.0m high, on all bases that do not have a pole.

.2 Confirm poles are installed and secured to a vertical alignment.

.3 Install mast arms and other required fixtures once pole is plumbed and secured.

.4 Install transformer bases flush with the concrete base. Do not install nuts between the transformer base and the concrete base.

.5 Use anti-seize compound on all threaded hardware.

3.6 Installation of Push Button Assemblies

.1 Aluminum and Steel Poles:

.1 Drill and tap pole prior to installation.

.2 Confirm contact points between push button and pole face are silicon sealed.

.3 Ream apertures through pole to provide smooth interior finish, remove all sharp edges and prevent damage to the insulation of the wires.

.4 Drill drain hole in bottom of push button.

.5 Mounting bolts to be stainless steel. Use anti-seize compound on all bolts.

.2 Wood Poles:

.1 Attach push button assembly to pole using a #10 x 50mm Robinson head stainless steel screw.

.2 Install wiring through bottom of push button using liquid tight flex or conduit to prevent condensation or leakage from shorting out the actuator. Drain hole added to the low point of the flex for drainage.

.3 Confirm contact points between push button and pole face are silicon sealed.

3.7 Installation of Traffic Signals and Pedestrian Signals

.1 Install traffic signal heads using mounting specified or as directed by Engineer. Provide aluminum mountings with hub plates, cast nipples, nuts, bolts, and fitting caps.

.2 Seal wire nut connections with professional grade vinyl electrical tape. Bundle off and tie wrap with wire nuts forming a cap and store bundle high up in traffic signal to minimize water damage to the wire nut connections. Do not use terminal strips in signal heads.

.3 Use anti-seize compound on all threaded connections.

.4 For horizontal signal heads, hinges to be on top for doors to swing upward.

3.8 Installation of Pedestrian (RA-5) Signals

.1 Install RA-5 sign as per manufacturer's directions. Test photocell flashing beacon, and fixture light after installation.

3.9 Installation of

.1 Install and test traffic pre-emption equipment and accessories as

Pre-emption Equipment

per manufacturer's directions. Provide all necessary wiring for pre-emption equipment to ensure proper operation of system. No splices are permitted.

.2 Test detectors using tester provided by the Engineer. Provide test results to the Engineer.

3.10 Wiring of Poles, and Mast Arms

.1 Keep wire connections to a minimum, both in junction boxes and transformer bases. The use of pull pits for wire connections will not be permitted. Break out of the cable only those wires that are required, leaving unused wires uncut.

.2 Seal wire nut connections with professional grade vinyl electrical tape. Bundle off and tie wrap with wire nuts forming a cap and store bundle high up in transformer base to minimize water damage to wire nut connections.

.3 Install multi-conductor cable (#14 AWG stranded copper wire) from each signal head location through mast arm and the pole aperture, down through pole to the centre of the access door in the transformer base. Wire to be appropriate number of conductors for each application.

.4 Provide an additional 600mm of cable run for connection.

.5 Continue multi-connector cable run to controller and leave 1200mm additional cable.

.6 Provide drip loop where cable enters the pole from the bracket.

.7 Connect conductors in signal heads to wire nuts. Tape individually and face joints upwards in each head. Leave spare conductors full length, coiled and end terminated by folding back the last 150mm of the conductors with insulating tape.

.8 Ground all metal equipment to ground terminal in base using separate ground wire.

.9 Make final connections. Test the wiring and provide written results to Engineer in duplicate. Obtain approval from Engineer for finished work.

.10 Hot test all signals in the presence of the Engineer.

.11 Label each wire indicating appropriate signal head at pole base.

3.11	Mounting of Traffic Signal Controller Cabinet	.1	Install cabinet on base. If cabinet is to be fastened to a pole, use 19mm stainless steel band-it strapping.
		.2	Seal cabinet to concrete base, using rubber gasket and silicone between cabinet and concrete base. Trim gasket to be flush with cabinet.
		.3	Connect traffic signal field wires to cabinet field terminals. Test to confirm operation as per wiring diagram and as directed by the Engineer.
		.4	Contractor to connect detector loop and pre-emption device wires to cabinet as per wiring diagram and as directed by the Engineer.
3.12	Installation of Pedestrian (RA-5) Signal Controller	.1	Install controller cabinet in accordance with manufacturers directions.
		.2	If cabinet is to be fastened to a pole, use 19mm stainless steel band-it strapping.
3.13	Removal and Disposal of Damaged or Obsolete Equipment	.1	Dispose of hazardous material in accordance with all applicable laws including the Environmental Protection Act.
		.2	If requested by the Engineer, return traffic signal equipment and wires to HRM. Disassemble and handle with care all traffic signal equipment to be returned to HRM.
		.3	When upgrading a traffic signal system, dismantle and remove abandoned traffic signal infrastructure from site.
3.14	Grounding	.1	Ground equipment in accordance with CSA C22.2 No. 41
		.2	Ground each pole and transformer base back to the ground rod or plate and bring the grounding wire back to the ground at the power source and not to the controller.
		.3	Ground the traffic Signal Controller separately from all other equipment to a ground rod at the cabinet location and run back to the service ground.

**** End 34 41 13 ****