STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

ROY COOPER
GOVERNOR

J.R. "JOEY" HOPKINS
SECRETARY

October 10, 2023

ADDENDUM 1

Division Eleven

Contract No.:	DK00386
WBS:	33879.2.101
County	Surry
Federal Aid No:	Federal Aid
Location:	I-77 Southbound Mile Post 2.65 North of Mount Airy
Type of Work:	Weigh Station Upgrade
Bid Opening:	October 19, 2023

To Whom It May Concern:

Reference is made to the proposal furnished to you on this project.

The following revisions have been made to the ITS Plans.

Sheet Number	Revision
ITS 12 through ITS 14	Revised to reflect quantity change shown below

Please void the above listed Sheets in your plans and staple the revised Sheets thereto.

The following revisions have been made to the proposal.

Page Number	Revision
1-86	Unit Project Special Provisions ITS

Please void the above listed Pages in your proposal and staple the Revised Pages thereto.

On the Bid Form Sheets the following pay item revisions have been made:

ITEM	DESCRIPTION	OLD QUANTITY	NEW QUANTITY
7300000000-E	UNPAVED TRENCHING (1) 2"	3425 LF	4625 LF
7301000000-E	DIRECTIONAL DRILL (2) 2"	410 LF	460 LF
7990000000-E	GENERIC SIGNAL ITEM 3-WIRE COPPER FEEDER CONDUCTORS	50 LF	3135 LF

The Contractor's Bid must include these pay item revisions.

The electronic bidding file has been updated to reflect this revision. Please download the Addendum File and follow the instructions for applying the addendum. Bid Express will not accept your bid unless the addendum has been applied.

Mailing Address:
NC DEPT. OF TRANSPORTATION
DIVISION ELEVEN
P. O. BOX 250
NORTH WILKESBORO, NC 28659

Telephone: (336) 903-9101

Website: www.ncdot.org

Location:
NC DEPT. OF TRANSPORTATION
DIVISION ELEVEN
801 STATESVILLE RD
NORTH WILKESBORO, NC 28659

This revision is reflected on the Proposal and Plans currently on the Division 11 Letting Page.

The contract will be prepared accordingly.

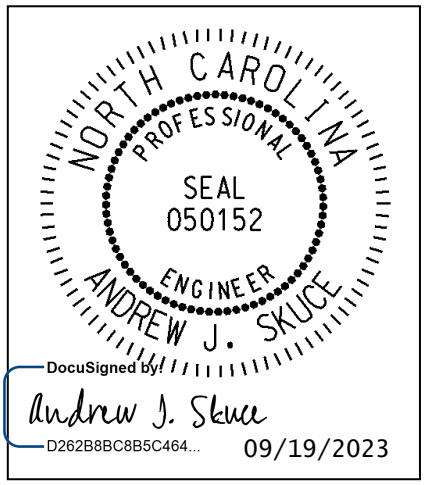
If you have questions about bidding on this project or any other question concerning this project, please contact me at (336) 903-9115 or belmore@ncdot.gov.

Sincerely,

DocuSigned by:
Bethany Elmore
ED2EB0CF5B9342E...

Bethany Elmore, PE
Division Contract Engineer

CC: Michael Poe, PE, Division Engineer
Ivan Dishman, PE, Division Construction Engineer
Brandon Whitaker, PE, Division Maintenance Engineer
Ramie Shaw, PE, Division Project Development Engineer



WBS: 33879.2.101
UPGRADE EXISTING I-74 SOUTHBOUND WEIGH STATIONS WITH AUTOMATED VEHICLE IDENTIFICATION SYSTEM, WEIGH-IN-MOTION, TIRE MONITORING SYSTEM, AUTOMATED LICENSE PLATE READER, AND OTHER DEVICES
PROJECT SPECIAL PROVISIONS

This seal is for sections 1-16 only.

Not Valid Unless Signed

Contents

1. GENERAL REQUIREMENTS

1.1. DESCRIPTION

A. General

Conform to these Project Special Provisions; the Plans; the *2018 Standard Specifications for Roads and Structures* (hereinafter referred to as the "Standard Specifications") including the revisions described below; and the *2018 NCDOT Roadway Standard Drawings* (hereinafter referred to as the "Standard Drawings").

In the event of a conflict between these Project Special Provisions and the Standard Specifications, these Project Special Provisions shall govern.

Conform to the NC Statewide Information Technology Standards and Policies as described at

http://it.nc.gov

B. System Description

This project consists as a minimum of furnishing and installing the following technologies in Surry County at the southbound I-74 approach to the Weigh Station(s) (near Mile Marker #103) to form an Automated Commercial Vehicle Processing System and Credential Screening System to be operated by the Highway Patrol. The overall function and operation of the Automated Commercial Vehicle Processing System and credential screening system is to provide information to the scale house and commercial vehicle driver as to actions required. This project consists of installing equipment at five (5) locations throughout the project limits as listed below:

1) ADVANCE LOCATION

a) Automated Vehicle Identification System -Transponder equipment - (AVI)

b) Weigh-in-Motion (WIM)

c) Overview Camera

d) Automatic License Plate Reader (ALPR)

e) Automated Tire Monitoring System (ATM)

f) Inductive Loops

g) Regulatory Signs

2) NOTIFICATION LOCATION

a) Automated Vehicle Identification System -Transponder equipment - (AVI)

b) Changeable Message Signs (CMS) on support structure

c) Inductive Loops

3) COMPLIANCE LOCATION

a) Inductive Loops (main line)

b) Inductive Loops (ramp)

5) SCALE HOUSE LOCATION

a) Static Scales (Existing)

b) Centralized Equipment

The individual systems as listed above and their supportive components, monitors, electronics, wiring including support structures will form an Automated Commercial Vehicle Processing System and Credential Screening System to be operated by the Highway Patrol.

1.2. Required System Operations

Provide a fully operational Automated Commercial Vehicle Processing System and Credential Screening System. Credential screening will be based on hierarchy requirements as shown below:

a) 1st Tier Priority: Weigh in Motion, Tire Anomaly System

b) 2nd Tier Priority: In Cab-Device/Geo-Fencing system data. Data provided by these systems will be their approved NCSHP screening data and vehicle file ID information. **(Any future reference to an In-Cab device shall imply either a Transponder System and/or Geo-Fencing Type System, where applicable).**

c) 3rd Tier Priority: Automated License Plate Reader

The required operations of this system are based on processing criteria established for the WIM, ATM, AVI systems (Transponder/Geo-Fencing systems with criteria established in their NCSHP approved screening data and vehicle file ID information), ALPR & Overview Camera information, while the vehicles are traveling on the mainline of the Interstate. The CMS will direct the commercial vehicles in compliance based on the Tier Priorities listed above to bypass the weigh station, thus ensuring greater efficiencies for both the commercial vehicles and the weigh station. Vehicles not meeting the established Tier Priority criteria, or selected for a random pull-in, will be notified by the CMS to enter the weigh station for further processing. The Automated Commercial Vehicle Processing System and Credential Screening System will be responsible for making the sort decision.

The system shall ensure that all Commercial Vehicles that are equipped with an In-Cab device receive a Sort Decision and the Vehicles ID record/information from the Credential Screening System. The Sort Decision will also be displayed on the CMS. Additionally, each **Roadside Transponder System and/or Geo-Fencing Type System** is required to send back to the Credential Screening System's "Confirmation Database", a confirmation record consisting of the information received from the Credential Screening System and the sort decision.

Data obtained from the ALPR identification system will be used as a 3rd tier data source in instances where 1) the AVI Systems (Transponder & Geo-Fencing System) does not supply their NCSHP approved screening data and vehicle file ID information and/or 2) for those vehicles not participating in a Transponder/Geo Fencing type system.

A. Processing of Commercial Vehicles

The following scenario describes how commercial vehicles will be processed:

1) All trucks approaching the weigh station will be directed into the right lane of I-74 by means of static signing located prior to the Advance Location.

   As a truck passes the Advance Location, the equipment in the right-most lane will collect vehicle Weight in Motion (WIM) data consisting of axle weight and spacing, gross vehicle weight, vehicle speed, classification, vehicle length and Automatic Tire Monitoring (ATM) data. Vehicles equipped with an In-Cab Transponder or Geo-Fencing type system will push their data (NCSHP approved screening data and vehicle file ID information) for their Vehicles to the Automated Commercial Vehicle Processing System and Credential Screening System.

   Additionally, an Automated License Plate Reader (ALPR) camera/system will take a photo of the vehicles license plate for character recognition for comparison to the database records along with an overview CCTV camera that captures images of each truck as they travel past the location. Images of the vehicles are transmitted to the Scale House Server and become part of the Vehicle ID Record that will be comprised of the WIM data, ATM data, Transponder/Geo-Fencing data and ALPR. All Vehicle ID data/record will be forwarded to the Scale House Server for processing.

2) At the Classification Station embedded loop sensors provide tracking information related to the vehicle with regards to vehicle speed, classification, and vehicle length.

3) At the Notification Location, all commercial vehicles are directed by the CMS as to either Enter or Bypass the Weigh Station based on the Tier Priority data established above. Commercial vehicles not equipped with In-Cab Device will be directed by the CMS to either Enter or Bypass the Weigh Station for further processing based on evaluated results obtained from the WIM, ATM and data received (credential & Safety) from the ALPR. Commercial Vehicles equipped with an In-Cab Device that has been pre-cleared by the sort system (based on weight, tire pressures and other criteria listed above) are allowed to bypass the weigh station. All vehicles are subject to a random pull in requirement.

4) The scale house operator uses the information obtained from the Advance Location to identify why a truck was required to report to the station (i.e. credentials check, weight check, tire anomaly, or random pull-in) and processes the truck accordingly.

1.3. MATERIAL

A. Qualified Products

Furnish new equipment, materials, and hardware unless otherwise required. Inscribe manufacturer's name, model number, serial number, and any additional information needed for proper identification on each piece of equipment housed in a case or housing.

Furnish factory assembled cables without adapters, unless otherwise approved by the Engineer, for all cables required to interconnect any field or central equipment.

Ensure all Contractors-furnished equipment, including pieces and components of equipment, hardware, firmware, software, middleware, internal components, and subroutines which perform any date or time recognition function, calculation, or sequencing will support a four-digit year format for a period of at least 50 years and will support user-definable parameters for setting the start and end dates for daylight savings time.

Certain equipment listed in these Project Special Provisions must be pre-approved on the Department's ITS & Signals Qualified Products List (QPL) by the date of installation. Equipment, material, and hardware not pre-approved when required will not be allowed for use on the project.

The QPL is available on the Department's website at the following address:

https://connect.ncdot.gov/resources/safety/Pages/ITS-and-Signals-Qualified-Products.aspx

B. Warranties

Unless otherwise required herein, provide manufacturer's warranties on Contractors-furnished equipment for material and workmanship that are customarily issued by the equipment manufacturer and that are at least 3 years in length from the successful completion of the 30-day observation period. Include unconditional coverage for all parts and labor necessary or incidental to repair of defective equipment or workmanship and malfunctions that arise during warranty period.

For light emitting diode (LED) signal modules, provide a written warranty against defects in materials and workmanship for a period of 60 months after installation of the modules. During the warranty period, the manufacturer must provide replacement modules within 45 days of receipt of modules that have failed at no cost to the Department.

Upon successful completion of the 30-day observation period, transfer manufacturer's warranties with proper validation by the manufacturer to the Department or its designated maintaining agency.

C. Firmware and Licensing Upgrades

Provide the Department with backups of the System roadside operations software and operating system, application programs, data files and any other element necessary to restore any of the roadside operations controller servers and workstations to normal operation after repair or replacement. Provide this material on compact disk or other approved media. Include instructions for restoring the software and data.

Provide three (3) copies of all software packages on CD-ROM.

Ensure software performance upgrades that occur during the contract period up through final acceptance of the project are available to the Department at no additional cost.

Software upgrades that are developed to correct operating characteristics shall be available to the Department at no additional cost until the warranty period expires.

Provide licensed copies of all software/firmware to the Department for any programmable devices furnished by the Contractor and installed in this project for which licensed software has not already been provided by the Department. The Department shall have the right to install any software/firmware for maintenance and support on all hardware provided under this contract. Provide software/firmware for maintenance and support of the system including support software, utility software, roadside equipment software, and Camera systems, and all other programmable devices provided by the Contractor.

D. Plan of Record Documentation

Comply with all requirements of Article 1098-1(F) of the Standard Specifications for providing plan of record documentation for all work performed under this Project.

1.4. CONSTRUCTION METHODS

A. General

Unless otherwise stated in these Project Special Provisions, perform work that meets the requirements of the *Standard Specifications* and these Project Special Provisions. In the event of a conflict between these Project Special Provisions and the *Standard Specifications*, these Project Special Provisions shall govern.

Locate all underground utilities before beginning drilling, digging, and trenching operations.

Immediately cease work and notify the Engineer and affected owners if damage to existing utilities, cables, or equipment occurs. Make all required repairs and replacements at no additional cost to the Department.

B. Regulations and Codes

Furnish material and workmanship conforming to the *National Electric Code* (NEC), *National Electric Safety Code* (NESC), Underwriters Laboratories (UL), or other listing agencies approved by the North Carolina Department of Insurance, and all local safety codes in effect on the date of advertisement. Comply with Article 4, Chapter 87 of the *North Carolina General Statutes* (Licensing of Electrical Contractors). Comply with the Plans, all previously referenced specifications, and all applicable local ordinances and regulations before and during all stages of the electrical work.

When required by the local ordinances and governmental agencies, upon completion of the work, have all systems inspected and approved in writing by the authorized governmental electrical inspector for the area. Furnish written certification of the authorized inspector’s approval to the Engineer. Inspection by the authorized governmental electrical inspector does not eliminate nor take the place of the inspections by the Engineer. Upon the Engineer’s receipt of written certification and the Contractor’s written request for a final inspection of the installations, the Engineer will perform a final inspection.

Where required, conform to ITE, AASHTO, and ASTM standards in effect on the date of advertisement.

C. Maintenance and Repair of Material

Furnish the Engineer with the name, office telephone number, cellular (mobile) telephone number, and pager number of the supervisory employee who will be responsible for maintenance and repair of equipment during all hours.

Maintain and repair all Contractor-furnished and installed communications related equipment within the project construction limits until completion of the Observation Period and receipt of written notification of final acceptance of the project. This requirement for maintaining and repairing said equipment shall remain in effect in the event of severe weather (see NOAA National Severe Storms Laboratory website http://www.nssl.noaa.gov/primer/) or a natural disaster, including but not limited to floods, winter weather, lightning, damaging winds, hail, tornado, tropical storm or hurricane.

Remove and replace all equipment that fails. The Department will furnish the Contractor replacement equipment for Department-furnished equipment that fails.

D. Wire and Cable

For installation in a conduit system, lubricate cable and wires before installing in conduit. Use lubricant that will not physically or chemically harm cable jacket, wire insulation, and conduit.

Only splice lead-in cables in junction boxes using UL®-approved, underground splice connectors using gel-filled splice connectors in accordance with Standard Drawing 1725.01. Splice all other electrical wire and cable inside equipment cabinets, and cabinet base extenders/adapters at nickel-plated brass, recessed-screw, barrier-type terminal blocks or using gel-filled splice connectors. Unless specifically allowed, connect no more than two conductors to the same terminal screw. Do not splice any electrical wire or cable other than lead-in cables in junction boxes.

Maintain color-coding of wires through splices.

Protect ends of wire and cable from water and moisture.

Place permanent labels on all wires and cables to clearly identify each one. Use an indelible black ink marker or approved labeling devices to write on the permanent labels when required.

Install all wire and cable with necessary hardware including, but not limited to shoulder eyebolts, washers, nuts, thimbleyelets, three-bolt clamps, J-hooks, split bolt connectors, grounding clamps, and lashing material.

E. Inductive Loop Tests and Grounding

Submit a completed Inductive Loop & Grounding Test Form available on the Department's website. The form is located on the Department's website at:

https://connect.ncdot.gov/resources/safety/Pages/ITS-and-Signals.aspx

Provide a length of marker tape 6 to 12 inches below finished grade directly over grounding electrodes and conductors.

F. Electrical Bonding

Using an approved termination means, connect a number 14 AWG minimum 19-strand copper conductor (Type THWN) with green insulation to serve as an equipment grounding conductor to metal poles and other metallic components which are not otherwise bonded, through means approved by the Engineer.

1.5. MEASUREMENT AND PAYMENT

There will be no direct payment for work covered in this section. Payment at the contract unit prices for the various items in the contract will be full compensation for all work covered by this section. Include the incidental costs for furnishing and/or installing materials and equipment expressly required under the contract for successful completion of the contract, but whose measurement and payment is not specifically stated under any of the contract pay items, into the unit cost(s) for the various items in the contract.

2. BASE MOUNTED EQUIPMENT CABINET

2.1. DESCRIPTION

Furnish and install Type 332 base mounted equipment cabinets and all necessary hardware. Conform to CALTRANS Traffic Signal Control Equipment Specifications except as required herein. Furnish CALTRANS Model 332 base mounted equipment cabinet.

Furnish all foundation mounting hardware, one Corbin Number 2 cabinet key, surge protection, lighting fixtures, grounding systems, thermostatically controlled exhaust fan, and all necessary hardware.

The Base Mounted Equipment Cabinet will serve as an equipment cabinet to house various system components located throughout the project limits. Any reference to Roadside Equipment Cabinets will imply the use of a Base Mounted Equipment Cabinet as described herein.

2.2. MATERIAL

Material, equipment, and hardware furnished under this section shall be pre-approved on the Department's QPL.

Provide moisture resistant coating on all circuit boards.

Provide a power line surge protector that is a two-stage device that will allow connection of the radio frequency interference filter between the stages of the device. Ensure that the maximum continuous current is at least l0A at 120V. Ensure that the device can withstand a minimum of 20 peak surge current occurrences at 20,000A for an 8x20 microsecond waveform. Provide a maximum clamp voltage of 280V at 20,000A with a nominal series inductance of 200µh. Ensure that the voltage does not exceed 280V.

A. Type 332 Cabinet Electrical Requirements

Furnish two sets of non-fading cabinet wiring diagrams and schematics in a paper envelope or container and placed in the cabinet drawer.

Provide surge suppression in the cabinet for each type of cabinet device. Provide surge protection for the full capacity of the cabinet.

All AC+ power is subject to radio frequency signal suppression.

Install a UL listed, industrial, heavy-duty type power outlet strip with a maximum rating of 15 A / 125 VAC, 60 Hz. Provide a strip that has a minimum of 3 grounded outlets. Ensure the power outlet strip is mounted securely; provide strain relief if necessary.

Provide a terminal mounted loop surge suppresser device for each set of loop terminals in the cabinet. For a 10x700 microsecond waveform, ensure that the device can withstand a minimum of 25 peak surge current occurrences at 100A, in both differential and common modes. Ensure that the maximum breakover voltage is 170V and the maximum on-state clamping voltage is 30V. Provide a maximum response time of less than 5 nanoseconds. Ensure that off-state leakage current is less than 10 µA. Provide a nominal capacitance less than 220pf for both differential and common modes.

Provide surge suppression on each communications line entering or leaving a cabinet. Ensure that the communications surge suppresser can withstand at least 80 occurrences of an 8x20 microsecond wave form at 2000A and a 10x700 microsecond waveform at 400A. Ensure that the maximum clamping voltage is suited to the protected equipment. Provide a maximum response time less than 1 nanosecond. Provide a nominal capacitance less than 1500pf and a series resistance less than 15 Ω.

Provide conductors for surge protection wiring that are of sufficient size (ampacity) to withstand maximum overcurrent which could occur before protective device thresholds are attained and current flow is interrupted.

Furnish a LED fixture in the rear across the top of the cabinet and another LED fixture in the front across the top of the cabinet at a minimum. Ensure that the fixtures provide sufficient light to illuminate all terminals, labels, switches, and devices in the cabinet. Conveniently locate the fixtures so as not to interfere with a technician's ability to perform work on any devices or terminals in the cabinet. Provide a protective diffuser to cover exposed bulbs. Furnish all bulbs with the cabinet. Provide door switch actuation for the fixtures.

Furnish a quad power outlet (four 15 amp sockets) for use by network equipment.

Furnish power allocations for network equipment. Total power made available to network and telephone company equipment not to exceed 20 amps at l15VAC.

B. Type 332 Cabinet Physical Requirements

Provide a surge protection panel with loop protection devices that allows sufficient free space for wire connection/disconnection and surge protection device replacement.

Provide permanent labels that indicate the slot and the pins connected to each terminal. Label and orient terminals so that each pair of inputs is next to each other. Ensure that a Number 4 AWG green wire connects the surge protection panel assembly ground bus to the main cabinet equipment ground.

Provide a minimum 14 x 16 inch pull out, hinged top shelf located immediately below controller mounting section of the cabinet. The shelf must extend fully to allow the table surface to retract outside the cabinet approximately even with the bottom of the controller. Ensure the shelf has a storage bin interior which is a minimum of 1 inch deep and approximately the same dimensions as the shelf. Provide an access to the storage area by lifting the hinged top of the shelf. Fabricate the shelf and slide from aluminum or stainless steel and ensure the assembly can support the controller plus 15 pounds of additional weight. Ensure shelf has a locking mechanism to secure it in the fully extended position and does not inhibit the removal of the controller when fully extended. Provide a locking mechanism that is easily released when the shelf is to be returned to its non-use position directly under the controller.

2.3. CONSTRUCTION METHODS

Install base mounted equipment cabinets and all necessary hardware as required to provide a fully operational System.

Ensure space in equipment cabinet allows for all system components and network equipment.

2.4. MEASUREMENT AND PAYMENT

Base mounted equipment cabinet will be measured and paid as the actual number of base mounted equipment cabinets furnished, installed and accepted.

No measurement will be made for cabling, connectors, cabinet attachment assemblies, conduit, condulets, grounding equipment, surge protectors, or any other equipment or labor required to install the equipment cabinet and integrate it with the localized system components as these will be considered incidental to furnishing and installing the base mounted equipment cabinet.

Payment will be made under:

Pay Item	**Pay Unit**
Base Mounted Equipment Cabinet	.Each

3. MODIFY ELECTRICAL SERVICE

3.1. Description

Modify existing electrical service equipment as shown in the Plans. Comply with the National Electrical Code (NEC), the National Electrical Safety Code (NESC), the *Standard Specifications*, the Project Special Provisions, and all local ordinances. All work involving electrical service shall be coordinated with the appropriate utility company and the Engineer.

Obtain the maximum available ground fault current from the utility company. Print this information on a durable label and adhere to the dead front of the disconnect.

3.2. Materials

A. Modify Electrical Service

Modify existing meter base/disconnect combination panels at locations shown in the Plans. Provide meter base/disconnect combination panels that have a minimum 125A main service disconnect and a minimum of four (8) additional spaces. Furnish a single pole 15A circuit breaker each with a minimum of 10,000 RMS symmetrical amperes short circuit current rating in a lockable NEMA 3R enclosure. Ensure meter base/disconnect combination panel is listed as meeting UL Standard UL-67 and marked as being suitable for use as service equipment. Ensure circuit breakers are listed as meeting UL-489. Place barriers so that no uninsulated, ungrounded service busbar or service terminal is exposed to inadvertent contact by persons or maintenance equipment while servicing load terminations. Fabricate enclosure from galvanized steel and electrostatically apply dry powder paint finish, light gray in color, to yield a minimum thickness of 2.4 mils. All exterior surfaces must be powder coated steel. Provide ground bus and neutral bus with a minimum of four terminals and a minimum wire capacity range of number 14 through number 2/0 AWG.

Furnish 6” x 6” x 8’ wood pedestals for electrical service equipment as shown in the Plans.

Furnish NEMA Type 3R meter base rated 100A minimum for overhead service and 200A minimum for underground service that meets the requirements of the local utility. Provide meter base with ampere rating of meter sockets based on sockets being wired with insulated wire rated at least 167°F. With each meter base, provide a blank meter socket cover made from UV stabilized polycarbonate or metal and that is either clear or gray in color to prevent access to interior of meter base until meter is installed by the local power company.

Furnish 4 terminal, 600 volt, single phase, 3-wire meter bases that comply with the following:

- Line, Load, and Neutral Terminals accept 2/0 AWG and smaller Copper/Aluminum wire,
- With or without horn bypass,
- Made of galvanized steel,

- Listed as meeting UL Standard US-414,
- Overhead or underground service entrance specified.

Furnish 1.5” watertight hub (i.e., meter socket hub) for threaded rigid conduit with meter base. Furnish and install 1.5” riser assemblies with weatherheads and clamp-on galvanized pole attachment fittings and all necessary hardware for overhead service.

At the main service disconnect, furnish and install UL-approved lightning arrestors that meet the following requirements:

- Type of design ..... Silicon Oxide Varistor
- Voltage ..... 120/240 Single Phase, 3 wire
- Maximum current ..... 100,000 amps
- Maximum energy ..... 3,000 joules per pole
- Maximum number of surges ..... Unlimited
- Response time one milliamp test ..... 5 nanoseconds
- Response time to clamp 10,000 amps ..... 10 nanoseconds
- Response time to clamp 50,000 amps ..... 25 nanoseconds
- Leak current at double the rated voltage ..... None
- Ground wire ..... Separate

B. 1 KVA Single Phase Step-up/Step-Down Transformer

As shown in the Plans, furnish and install a double-wound, dry type general purpose transformer to isolate the line side voltages from the load side voltages to effectively step up a 120V circuit to 480V and step down 480V to provide a 120V circuit to the WIM system. Provide the transformer with the following specifications:

- 1 KVA power rating
- Electrostatic shielding between primary and secondary windings.
- Epoxy-silica encapsulated core and coil.
- Copper windings and copper lead wire terminations.
- Multiple front and bottom knockout for the conduit entry/exit.
- Ground studs for conduit bonding.

Provide the transformers in a NEMA 3R enclosure suitable for mounting to a 6” x 6” wood pedestal.

C. Transformer/Equipment Cabinet Disconnect

Use two 2-pole circuit breakers with an interrupting capacity of at least 14,000 amps that are appropriately rated for the WIM system and CMS sign circuits. Install the disconnect in a NEMA 3R enclosure. The enclosure should be primed and painted with a premium grade exterior paint before installation to increase corrosion resistance. Install an equipment ground bar and provide a lock in accordance with Article 1400-8 of the Standard Specifications.

D. 6” X 6” X 8’ Treated Wood Pedestals

Furnish 6”x6”x8’ treated wood pedestals for mounting electrical service equipment as shown in the Plans. Furnish treated wood poles that comply with the requirements in the Standard Specs.

- Meets ASTM B-3 and B-8 or B-787 standards.

E. 3-Wire Copper Feeder Conductors

Furnish 3-wire stranded #8 AWG copper service feeder conductors with THWN rating for supplying power to the meter base/disconnects. Provide conductors with black, white and green insulation that are intended for power circuits at 600 Volts or less and comply with the following:

- Listed as meeting UL Standard UL-83,
- Meets ASTM B-3 and B-8 or B-787 standards.

F. Grounding System

Furnish 5/8”x10’ copper clad steel grounding electrodes (ground rods), #4 AWG solid bare copper conductors, and irreversible mechanical crimps for grounding system installations. Comply with the NEC, *Standard Specifications*, these Project Special Provisions, and the Plans.

3.3. Construction Methods

All work involving electrical service shall be coordinated with the appropriate electric utility company. Coordinate with the utility company to ascertain the feasibility of installing electrical service at each location before performing any work. Obtain all required local permits before beginning work.

Permanently label cables at all access points using nylon tags labeled with permanent ink. Ensure each cable has a unique identifier. Label cables immediately upon installation. Use component name and labeling scheme approved by the Engineer.

Direct bury pedestals that support combination panel at a minimum embedment depth of 24 inches below grade.

A. Modify Electrical Service

Install meter base/disconnect combination panels with lightning arrestors as called for in the Plans. Route the feeder conductors from the meter base/disconnect to the equipment cabinets in conduit. Provide rigid galvanized conduit for above ground and either PVC or HDPE for below ground depending on the installation method required by the plans. Install wood pedestals in compliance with all requirements of Section1720-3 of the Standard Specifications.

B. 1KVA Single Phase Step-up/Step-down Transformer

As shown in the Plans, furnish and install a single-phase general-purpose step-down transformer in a NEMA 3R enclosure. Route the conductors from the transformer secondary to the equipment cabinet disconnect in new conduit. Bond the equipment cabinet disconnect in accordance with the NEC. Provide all mounting hardware and other parts and labor necessary to successfully install the transformer.

C. Transformer/Equipment Cabinet Disconnect

Install a transformer disconnect as called for in the Plans. Route the conductors from the transformer disconnect to the transformer cabinet in rigid galvanized steel conduit. Bond the transformer disconnect in accordance with the NEC. Ensure that the grounding system complies with the Electrical Service grounding requirements of these Project Special Provisions.

D. 6" X 6" X 8' Treated Wood Pedestals

Install 6" x 6" x 8' treated wood pedestals a minimum of 3 feet below grade.

E. 3-Wire Copper Feeder Conductors

At locations shown in the Plans, install 3-wire THWN stranded copper feeder conductors to supply 120 VAC. Size the conductors in accordance with the NEC. Comply with the *Standard Specifications* and Standard Drawings and all applicable electrical codes.

F. Grounding System

Install ground rods as indicated in the Plans. Connect the #4 AWG grounding conductor to ground rods using an irreversible mechanical crimping process. Test the system to ensure a ground resistance of 20-ohms or less is achieved. Drive additional ground rods as necessary or as directed by the Engineer to achieve the proper ground resistance.

Submit to the Engineer a completed Inductive Loop & Grounding Test Form available on the Department's website at:

https://connect.ncdot.gov/resources/safety/Pages/ITS-and-Signals.aspx

3.4. Measurement and Payment

Modify Electrical Service will be measured and paid as the actual number of complete and functional meter base/disconnect combination panel service locations furnished, installed and accepted. Breakers, lightning arrestors, steel banding and clamps, exposed vertical conduit runs to the cabinet, and any remaining hardware, fittings, and conduit bodies to connect the electrical service to the cabinet will be considered incidental to meter base/disconnect combination panels. All other required feeder conductors will be paid for separately.

1 KVA Single Phase Step-up/Step-down Transformer will be measured and paid as the actual number of complete and functional 1 KVA transformers furnished, installed and accepted. Enclosures, mounting hardware, and any remaining hardware, fittings and conduit bodies to connect the transformer will be considered incidental to the 1 KVA Single Phase Transformer.

Transformer/Equipment Cabinet Disconnect will be measured and paid as the actual number of complete and functional transformer disconnects furnished, installed and accepted. Breakers, exposed vertical conduit runs to the cabinet and any remaining hardware and conduit to connect the equipment cabinet disconnect to the cabinet will be considered incidental to the Transformer Disconnect.

No measurement will be made of 6" x 6" x 8' wood pedestals as these will be incidental to furnishing and installing the Meter base/Disconnect combination panel and 1KVA Transformer/Transformer Disconnect.

3-Wire copper feeder conductors will be measured and paid as the actual linear feet of 3-wire THWN stranded copper feeder conductors furnished, installed and accepted. Payment is for all three conductors. Measurement will be for the actual linear footage of combined conductors after all terminations are complete. No separate payment will be made for each individual conductor. No separate payment will be made for different wire sizes. No payment will be made for excess wire in the cabinets.

5/8" X 10' grounding electrode (ground rod) will be measured and paid as the actual number of 5/8" copper clad steel ground rods furnished, installed and accepted. No separate payment will be made for irreversible mechanical crimps as they will be considered incidental to the installation of the ground rod.

#4 solid bare grounding conductor will be measured and paid as the actual linear feet of #4 AWG solid bare copper grounding conductor furnished, installed and accepted. Measurement will be along the approximate centerline from the base of the electrical service disconnect to the last grounding electrode.

Payment will be made under:

Pay Item	**Pay Unit**
Modify Electrical Service	Each
1 KVA Single Phase Step-up/Step-down Transformer	Each
Transformer/Equipment Cabinet Disconnect	Each
3-Wire Copper Feeder Conductors	Linear Foot
5/8" X 10' Grounding Electrode	Each
#4 Solid Bare Grounding Conductor	Linear Feet

4. WEIGH IN MOTION SYSTEM

4.1. DESCRIPTION

The following is a Performance Based Specification. Furnish and install a Weigh in Motion System (WIM) on the mainline, consisting of in road sensors and roadside electronics. Ensure

the WIMs data is transmitted from the roadside controller to the scale house server to be utilized in the Credential Screening Processes.

As part of the Credential Screening System Requirements the data obtained from the WIM system shall be packaged and made available to all Commercial Vehicle Supplier's which host an In-Cab Device. The weight data will be made part of vehicle record that will include date, time and vehicle speed, and other information typically supplied with a WIM system.

4.2. Materials

Ensure the piezoelectric quartz sensors shall meet or exceed the performance criteria of Type III WIM Systems, ASTM E 1318-09 Standard Specification for Highway WIM Systems with User Requirements and Test Methods.

Furnish piezoelectric quartz sensors that have an uncompensated temperature coefficient of sensitivity of no more than +/-0.02%/ºC.

The piezoelectric quartz sensors shall automatically and accurately weigh, with the tolerances set forth herein, each axle of a multi-axle vehicle and calculate the gross weight of the vehicle by summing the individual axle weights. Each vehicle having a gross weight of 39,000 pounds or more shall be checked for compliance with the Bridge Formula Weights (23 U.S.C. 127, 23 CRF 658) as defined by the Federal Highway Administration. The piezoelectric quartz sensors shall perform these measurements and calculations while the vehicle passes over the piezoelectric quartz sensors but not to exceed 5 seconds.

The gross and individual axle weights of each vehicle shall be accurately established to within the error limits listed in Table 1. These error limits shall be maintained within a confidence level of two standard deviations (95%) for a minimum sample of 100 vehicles. The sample shall consist of a variety of multiple-axle trucks passing over the sensors at speeds ranging from a minimum of 10 mph to a maximum of 100 mph. Tank trucks, livestock, car haulers and those vehicles whose suspension characteristics are determined to affect the scale performance shall not be included in the sample nor shall trucks whose speed varies by 10% or more.

Table 1 - Piezoelectric Quartz Sensors Accuracy

PARAMETER	TOLERANCE
Single Axle Weight	± 15% of actual weight
Axle Group (2 or more) Weight	± 10% of actual weight
Gross Weight	± 6% of actual weight
Axle Spacing	± 6 inches
Vehicle Speed	± 1 mph
Temperature Coefficient of Sensitivity	-.02% per degree C

The actual weight is defined as the vehicle weight established by static weighing on a multi-platform truck scale properly operating within the appropriate tolerance as established for a Class IIIL device as defined by the National Institute of Standards and Technology Handbook 44. The piezoelectric quartz sensors shall operate over an ambient temperature range of -40 to +134 degrees F with 10 to 100% humidity.

Supply a list of at least five installations where piezoelectric quartz sensors have been installed in similar environmental conditions with the same or higher traffic volume and speeds for a minimum of five years. Also, supply clients' contact information for the five installations.

The piezoelectric quartz sensors shall perform the following functions:

- Operate at vehicle speeds between 10 and 100 mph.
- Determine the compliance of each vehicle based on single-axle weight, axle group weight, and GVW.
- For each vehicle in excess of 39,000 pounds GVW, determine the compliance of the on-sensor vehicle with the Bridge Formula.
- Store data (including images) by truck classification broken down by day, month, and calendar year.
- The piezoelectric quartz sensor classifier/controller shall be capable of downloading all data stored on its internal or external storage device.
- The piezoelectric quartz sensor classifier/controller shall be capable of receiving executable control command.
- Suitably demonstrate that the piezoelectric quartz sensors will provide a service life exceeding 7 years. This can be provided by documented customer feedback on operating sites in use and by life cycle cost evaluation.

Attach the piezoelectric quartz sensors to a lead-in cable, which extends from the piezoelectric sensor to the equipment cabinet. The lead-in cable shall be a two-conductor 18 AWG twisted shielded cable.

The necessary hardware and software will be standard with the WIM. The processing components of the system shall generate a data output that is sent to the Scale house along with the ATM, ALPR, Transponder Data, Overview Camera Image, etc..

A. Sensor Sealant

Provide a sand-epoxy resin sealant/grout to secure and seal the sensor and lead-in cable into the pavement. Provide a shrink-free material that adheres to both concrete and asphalt.

Provide a sealant that meets the following requirements:

- Pot Life: 20-40 minutes at 32 degrees F,
- Minimum Curing Temperature: 46 degrees F and
- Density: 1 ounce/cubic inch.

Provide a sealant that meets the following mechanical requirements after seven days:

- Compressive strength: > 8,365 tons/ft.^{2}

- Flexural strength: > 365 tons/ft.^{2}
- Compressive strength: > 8,365 tons/ft.^{2}
- Adhesive strength on steel: > 42 tons/ft.^{2}

Adhesive strength on concrete: > 10 tons/ft.^{2}

4.3. CONSTRUCTION METHODS

A. Installation

Install and space apart from each other the individual piezoelectric quartz sensors as shown in the Plans and as recommended by the manufacturer.

The piezoelectric quartz sensor configurations shall be installed in accordance with the manufacturer's recommendations and shall be designed to monitor a single lane of traffic. Ensure the design and layout of the piezoelectric quartz sensor configurations shall ensure the system independently weighs both sides of the vehicle thus obtaining weight information sufficient to determine any side-to-side balance condition of the vehicle.

The saw slots including tail and lead-in sections for the piezoelectric quartz sensor configurations, must be dry and free of debris prior to their installation. Use compressed air to remove debris and moisture from the saw slot as necessary.

The piezoelectric quartz sensor slot in the pavement shall be no larger than 3.5" wide and extend no deeper than 2.8". Mount piezoelectric quartz sensors precisely flush with the surface of roadway.

Seal the piezoelectric quartz sensors and associated lead-in cable in an epoxy sealant to prevent moisture penetration. Install piezoelectric quartz sensors in such a manner that they will not be damaged by road maintenance such as snow removal. Warranty piezoelectric quartz sensors for a minimum of three (3) years against defects in materials or workmanship.

Furnish on-site engineering consulting by the manufacturer for the installation of the piezoelectric quartz sensors.

Connect the ends of the lead-in cable coaxial cable to the equipment controller's charge amplifier inputs as directed by the manufacturer. Program the equipment controller as instructed by the manufacturer's representative. Establish communications between the equipment controller and downstream equipment controller and the Scale House via the fiber optic cable system and perform calibrations test as required.

B. Calibration and Acceptance

Perform calibration using a single calibration truck within 72 hours of installation. The five (5) axle, test vehicle shall be of a tractor/trailer combination (3S2), complete with air ride suspension and a non-shifting static load. Load the truck to within 90 to 100% of allowable Gross Vehicle Weight for the road under test.

Conduct the calibration procedure as follows:

- Weigh the vehicle using the static weigh scales. Record the weight information on the front (single axle), drive (tandem axle group), and trailer (tandem axle group). Calculate the Gross Vehicle Weight (GVW) of the vehicle by adding the three weights together,
- Measure and record the distance between the five (5) individual axles on the truck,
- Use the test vehicle and make three (3) test passes over the system under test at a selected speed, which is indicative of the truck traffic at the site. Make adjustments on site during this time to fine tune the axle spacing, and weight output of the WIM system, and
- Once all initial adjustments have been made, make two (2) additional test passes with the test vehicle to confirm the accuracy of the adjustments. If all the readings fall within the ASTM ranges for the WIM, continue the tests. If this is not the case, make additional adjustments and make two (2) more confirming passes with the test truck.

Demonstrate through the acceptance tests that the system passes all criteria according to ASTM E1318 Standard, achieving ASTM accuracy Type III. Perform the acceptance test as follows:

- Using the test truck, make an additional ten (10) passes at a selected speed that is indicative of the truck traffic at the test site;
- Place all of the data into a spreadsheet with the approval of the Department;
- Calculate the mean error and standard deviation for all recorded measurements at the end of the ten (10) test passes. Perform the calculations as follows:

For weight measurements, calculate the percent error for each test pass using the following formula,

[(WIM Weight - Static Weight)/Static Weight] x 100 = % error,

Calculate the mean error for each weight type (single, group, GVW) as follows (with each weight type calculated individually):

  - % errors for single, group or GVW/# of samples = Mean error,
  - Calculate the error for individual axle spacings using the following formula (each of the four axle spacings calculated individually), and
  - 10 of [(WIM Axle Spacings - Actual Axle Spacing)]/10 = Mean Axle Spacing Error,

- Enter all of the calculated errors into the spreadsheet;
- Check the calculated result against the acceptable range for the ASTM values. There will be one of two results:
  - If 95% of all recorded test results, (single axles, axle groups, GVW, axle spacing) fall within the ASTM specified tolerance then the system will have passed the requirements, or

- If less than 95% of the calculated differences fall within the ASTM specified tolerance, then readjust the system make and an additional ten (10) test passes to retest the system.

4.4. MEASUREMENT AND PAYMENT

Weigh In Motion System will be measured and paid as the actual number of Weigh In Motion Systems furnished, installed, and accepted. Measurement will be made for the equipment controller and software, cables, amplifiers, epoxy, Piezoelectric quartz sensors, miscellaneous conductors, Ethernet (3 foot or 6 foot) cables, conduit and condulets under ten feet, and conduit fittings located between the sensors and the equipment cabinet, acceptance testing, testing vehicle and set-up, as this will be considered incidental to furnishing and installing the Weigh in Motion System.

Junction boxes, electrical feeder conductors and conduit runs longer than ten feet are accounted for under separate pay items.

Payment will be made under:

Pay Item	**Pay Unit**
Weigh In Motion System	Each

5. AUTOMATED TIRE MONITORING SYSTEM

5.1. DESCRIPTION

The following is a Performance Based Specification. Furnish and install an Automated Tire Monitoring System (ATM) on the mainline, consisting of in road sensors and roadside electronics. Ensure the ATM data is transmitted from the roadside controller to the scale house server to be utilized in the Credential Screening Processes.

As part of the Credential Screening System Requirements the data obtained from the ATM system shall be packaged and made available to all Commercial Vehicle Supplier's which host an In-Cab Device. The Tire Anomaly Data will be made part of vehicle record that will include tire type, underinflated and flat tire flags and other information typically supplied with an ATM System.

5.2. Requirements

Furnish and install an ATM consisting of in road sensors and roadside electronics that will interpolate tire pressures, missing tires and identification of single tires, dual tires and wide based tires (super singles).

The ATM must be able to detect tire anomalies of commercial vehicles at highway speeds (20 to 75 mph) in steady state traffic flows. Ensure, in general, the sensors for the ATM can operate successfully when installed in a mainline or ramp application at WIM locations where

trucks are being weighted and screened for enforcement activities. For this project the ATM will be installed along the mainline.

The ATM shall be able to detect Wide Based Tires, Single Tires, Dual Tires and flat tires. The system shall have a referenceable accuracy exceeding 80%.

The ATM detection sensors must be able to be installed in existing highway pavements without the need for special concrete slabs or site preparation. The sensors shall be of a size that will afford installation in the existing pavement without overly distressing or reducing the life of the existing pavement. Installation of sensors shall be accomplished by installing the sensors in a prepared cut in the existing pavement and secured and encapsulated with a vendor supplied adhesive grout. Sensors shall be replaceable upon failure.

A. Sensor Sealant

Provide an epoxy grout to secure and seal the sensor in the pavement that has minimum flexural strength of 10,000 psi and is approved by the manufacturer of the ATM sensor.

5.3. CONSTRUCTION METHODS

A. Installation

Install the in-road sensor equipment as directed by the manufacturer and as shown in the Plans. The saw slots including tail and lead-in sections for the sensor configurations, must be dry and free of debris prior to their installation. Use compressed air to remove debris and moisture from the saw slot as necessary.

Mount and install the sensors precisely flush with the surface of roadway and/or as directed by the manufacturer.

Seal the sensors and associated lead-in cable in an epoxy sealant to prevent moisture penetration. Install sensors in such a manner that they will not be damaged by road maintenance such as snow removal. Warranty sensors for a minimum of three (3) years against defects in materials or workmanship.

Furnish on-site engineering consulting by the manufacturer for the installation of the sensors.

Connect the ends of the lead-in cable to the roadside electronics equipment as directed by the manufacturer. Program the roadside electronics as instructed by the manufacturer's representative. Establish communications between the ATM and the Scale House via the fiber optic cable system.

B. Acceptance Testing

Perform acceptance test using a five (5) axle, test vehicle/tractor/trailer combination (3S2), complete with air ride suspension and a non-shifting static load. Load the truck to within 50% of allowable Gross Vehicle Weight for the road under test. The State will furnish the test vehicle.

Conduct the acceptance test procedure as recommend by the manufacturer using the calibration vehicle as necessary. As a minimum, using the test vehicle with a missing tire to simulate a tire anomaly.

Demonstrate through the acceptance tests that the system passes all criteria and accuracy reporting.

- Using the test truck, make a minimum of ten (10) passes at a selected speed that is indicative of the truck traffic at the test site;
- Record the number of times the system indicates a tire anomaly to ensure the system meets an 80% or better accuracy rate in reporting a Tire Anomaly.

5.4. MEASUREMENT AND PAYMENT

Automated Tire Monitoring System will be measured and paid as the actual number of Automated Tire Monitoring System furnished, installed, and accepted. Measurement will be made for the equipment controller and software, cables, epoxy, sensors, electrical conductors, Ethernet (3 foot or 6 foot) cables, conduit, condulets and conduit fittings located between the sensors and the equipment cabinet, acceptance testing, testing vehicle and set-up, as this will be considered incidental to furnishing and installing the Automated Tire Monitoring System.

Payment will be made under:

Pay Item	**Pay Unit**
Automated Tire Monitoring System	Each

6. AUTOMATED LICENSE PLATE READER SYSTEM

6.1. Description

Furnish and install an Automated License Plate Rader System (ALPR) equipment with all necessary hardware and software in accordance with the Plans and these Project Special Provisions. Provide an overview image of the vehicle and automatically locate and identify with the corresponding alphanumeric information and jurisdiction/location of issue.

The ALPR system must be capable of producing an ALPR image and an overview image of the passing commercial vehicles.

Ensure the captured still frame image and data captured by the ALPR system is transmitted with the vehicle record from the roadside controller to the scale house server to form an Automated Commercial Vehicle Processing System and credential screening system.

Ensure the ALPR still frame image correspond with the matching Overview Camera images as discussed elsewhere in these Project Special Provisions.

Furnish an ALPR system that produces multiple state and alphanumeric license plate interpretations per vehicle with varying flash, shutter and gain settings to ensure a high quality image regardless of weather or lighting conditions. At a minimum, the ALPR system must read and interpret license plates from the following states:

1) North Carolina

2) South Carolina
3) Virginia
4) Florida
5) Georgia
6) Tennessee
7) Indiana
8) Pennsylvania
9) Illinois
10) Ohio
11) Texas
12) New Jersey

The system must provide effective license plate capture at night using IR illuminators and no other external lighting source.

Furnish an ALPR system with a plate read rate of better than 80% (all characters correctly read for 80% of readable license plates) at speeds up to 75 miles per hour.

Provide a system with an operator interface to include database remote query functionality.

Provide at least one reference from an accredited law enforcement agency currently using the proposed ALPR system in a non-static weigh station application.

ALPR Camera systems meeting the intent of these specifications will be considered as being in “Substantial Conformance”.

6.2. Material

A. Camera

Furnish an ALPR camera that complies with the following:

- Self-illuminating Infrared (IR) illuminators utilizing driver safe non-visible light (greater than 750nm) and only activated when images are being captured.
- IR light-emitting diodes (LEDs) utilized must be “pulsed” to enhance license plate capture.
- IR camera illumination certified to be “eye safe” by an independent testing agency.
- Ultra high resolution with dual color/black white image capture and digital signal processing to reduce color noise.
- Enhanced low light resolution (1.2 million pixels).
- Shutter speed of 1/10,000 sec exposure setting.
- Vibration resistance: 10G (20Hz-200Hz).
- Integrate the camera and ALPR processor into a single, sealed housing enclosure that is impervious to weather and environmental elements and tested to IP68 standards.

- Produces multiple license plate images, with no moving parts in the dual-lens cameras, per vehicle with varying flash, shutter and gain settings to ensure a high quality image regardless of weather or lighting conditions. Lens must capture up to 60 frames per second.
- Integrated ALPR processor with hardware AES encryption to NIST FIPS 197 with optional hardware data encryption.
- ALPRs weighing no more than 16 lbs. (including housing) and operating on less than 25S, 48V DC power with an external trigger mode and a "self trigger mode" to detect the presence of a commercial motor vehicle license plate in the camera's field of view.
- A camera with day/night capabilities is required. Night overview images will be black and white. Daylight images will be in color.
- Operates during typical rain and snow events.
- Triggered by embedded loops in the roadway.

B. ALPR System Software

Furnish ALPR System Software with the following requirements:

- Provide variants of the Optical Character Recognition (OCR) engine that are designed specifically for NC and regional license plates. Provide OCR updates for new plate designs as required.
- Utilizes internal camera controls to facilitate automated setting for optimum flash, gain and shutter configurations.
- Integrates into a wide variety of systems via relay output, RS232, TCP/IP Ethernet with socket and FTP protocols, as well as IP connectivity.
- Offer standard software JPEG compression, with optional hardware JPEG compression.
- Fully web-enabled and IP-addressable.
- Provide a feature to enable or disable, at the user's discretion, "fuzzy logic" plate matching to enable the system to match common number character issues (o/0 and 8/B) or unknown characters.
- Captures a live, corresponding color overview image of the vehicle and simultaneously displaying the captured license plate, along with the date and time stamp of the image and a percentage of confidence rate for each license plate. The confidence level is defined as the percentage of time that an interpretation of that confidence will be correct. For example, an interpretation with a confidence of 95 percent should be correct 95 percent of the time.
- Allow a minimum of 16 GB of optional compact flash storage to allow for buffering of data.
- Provides a permanent record of all interpretations and captured images in a chronological order rate of up to 45 images per minutes as determined by the operator. The operator can directly input whether the interpretation is correct while viewing the image. The system must keep a record of the operator inputs.
- Operator interface that allows reviewing and modifying license plate records associated with each vehicle record.
- Decode license plate numbers into a digital string and associate the captured image and license plate number into a single vehicle record file.

- Provide a still image capture of each commercial motor vehicle for identification purposes; include the original image of the license plate number in the field of view.
- Attaches unique identifying information to each license plate number image capture in order to ensure data integrity and proper vehicle image association with other collection data.
- Provide dynamic exposure control including automated recalibration process to optimize the license plate number decode performance.
- Provide an operator interface to include database remote query functionality.

C. Camera Housing

Furnish the camera housing to meet the following requirements:

- LPR camera enclosure must be rated IP-65 or higher.
- Fabricate from corrosion resistant aluminum, finished in a neutral color of weather resistant enamel or polyester powdercoat.
- Equipped with tempered glass front window.
- Equipped with sunshield.
- Equipped with surge suppressors on all underground conductors.
- Include mounting hardware to match mounting bracket. Provide mounting hardware specifically for vendor's ALPR.

D. Surge Suppression

Protect all equipment at the top of the pole with grounded metal oxide varistors connecting each power conductor to ground.

Protect coaxial cable from each camera with a surge protector at each end of the cable.

6.3. Construction Methods

Comply with the manufacturer's recommendations for installation, conforming to these Project Special Provisions and following the following requirements:

- Install ALPR camera as directed by the Manufacturer to achieve the most accurate and desirable image.
- Install ALPRs with a fixed focal point or target distance.
- Furnish all cabling and camera connectors from the same manufacturer as the ALPR system.
- Use stainless steel banding to attach the ALPRs to the pole.
- Protect all equipment by a surge protector at each end of the cable and connecting each power conductor to ground. Integrate the camera and its output images into the ALPR system including the ALPR software and database search engines to form a part of the Automated Commercial Vehicle Processing System and credential screening system.

6.4. MEASUREMENT AND PAYMENT

Automated License Plate Reader System will be measured and paid as the actual number of ALPR systems furnished, installed, and accepted. No separate measurement will be made for integration, database search engines, software, camera, camera assemblies, IR illuminators, cabling, connectors, Ethernet (3 foot or 6 foot) cables, attachment assemblies, condulets, grounding equipment, surge protectors, testing, training or any other equipment or labor required to install the ALPR system as these will be considered incidental to furnishing and installing the ALPR system.

Payment will be made under:

Pay Item	**Pay Unit**
Automated License Plate Reader System	Each

7. OVERVIEW CAMERA ASSEMBLY

7.1. Description

Furnish and install an overview camera assembly with all necessary hardware, cabling and software in accordance with these Project Special Provisions.

The overview camera located at the Advance Location captures side view images of each commercial motor vehicle as they travel past the location. Ensure the side view images is transmitted with the vehicle record from the roadside controller to the scale house server. Ensure the Overview images correspond with the matching ALPR images as discussed elsewhere in these Project Special Provisions.

Camera systems meeting the intent of these specifications will be considered as being in "Substantial Conformance".

7.2. Material

A. Dual Channel CCTV Camera

Furnish one side fired overview camera that complies with the following:

The overview camera shall meet the following specifications:

- Dual Channel Design:
  - Color – Day
  - Black & White – Night (with a self-illuminating infrared [IR] light source)
- Lens:
  - 40-240mm afl (Day Channel)
  - 40-240 mm afl (Night Channel)
  - Light Sensitivity:

o 2 lux w/digital backlight compensation (Day Channel)
o 0.6 lux (Night Channel)

Faceplate

- Horizontal Resolution:

- 480 Lines (Day Channel)
- 570 Lines (Night Channel)
  - Signal to Noise Ration:
- 50dB (Day Channel)
- 46dB (Night Channel)
  - Geometric Distortion: None
  - Video Output: 1.0 Vp-p NTSC Composite, 75 ohms/BNC
  - Humidity: 100%
  - Operating Temperature Range: -58° F to +140° F w/ sun shield
  - Enclosure – all aluminum weather proof enclosure complete with thermostat, heater, blower, and defrost/defogger
  - Power Input:
- 24 VAC +5%
- 34 Watts (at night w/heater and blower engaged)

B. Camera Housing

Furnish the camera housing to meet the following requirements:

- Fabricate from corrosion resistant aluminum, finished in a neutral color of weather resistant enamel or polyester powder coat.
- Equipped with tempered glass front window.
- Equipped with sunshield.
- Equipped with surge suppressors on all underground conductors. Furnish video surge suppressors specifically for coaxial video transmission lines.
- Include mounting hardware to match mounting bracket.

C. Mounting Bracket

Provide the camera mounting bracket to be a horizontal arm that attaches to a vertical pole, which meets the following requirements:

- Maximum supported weight: 40 lbs.
- Mounted on a vertical pole.
- Attachment to pole: a minimum of two (2) stainless steel bands, approximately five (5) inches apart.
- Pan adjustment: unlimited (360 degrees).
- Tilt adjustment: +/- 75 degrees.
- All aluminum with polyester powder coat finish.

D. Cables

Provide a composite cable carrying power and video between the camera housing and the equipment cabinet. Size the power and video conductors to correspond to the load and the distance. Furnish cable recommended by the manufacturer for underground conduit installation. Furnish crimp-on type connectors. Terminate the video conductors in the equipment cabinet on surge protectors like those in the camera housing.

7.3. Construction Methods

Mount the overview camera to metal poles to capture a side view image of the vehicle in accordance with the manufacturer's recommendations using stainless steel banding.

Ensure that the camera is aimed to provide optimum coverage. Adjust the camera's position as necessary until the Department agrees that the position is optimal from the point of view of the users. Adjust the light threshold for the color/monochrome video switch as necessary until the Department agrees that the threshold is optimal from the point of view of the users.

7.4. MEASUREMENT AND PAYMENT

Overview Camera Assembly will be measured and paid as the actual number of overview camera assemblies furnished, installed, and accepted. No separate measurement will be made for integration, software, IR illuminators, cabling, connectors, attachment assemblies, condulets, grounding equipment, surge protectors, testing, training or any other equipment or labor required to install the overview camera assembly as these will be considered incidental to furnishing and installing the Overview Camera Assembly system.

Poles to support the overview camera assembly will be measured and paid for elsewhere in these Project Special Provisions

Payment will be made under:

Pay Item	**Pay Unit**
Overview Camera Assembly	Each

8. CHANGEABLE MESSAGE SIGNS

8.1. Description

Furnish and install Changeable Message Signs (CMS) at the locations shown on the plans.

Changeable Message Signs meeting the intent of these specifications will be considered as being in "Substantial Conformance" where applicable.

8.2. Material

Furnish CMS that are UL-listed and have a minimum character height of 18 inches. Ensure the CMS meets the following minimum specifications:

- Sign Dimensions: 40" H x 124" L single faced display
- The Sign enclosure shall be watertight, painted matte black, with a matte black finish.
- The Sign shall be double stroke LED. Face
- Two lines of text with 18-inch characters.
- Message visibility: 30-degree cone centered about the optical axis.
- Up to a minimum of 13 characters per line

- The Sign shall have three levels of dimming controlled by photosensors. Dimming levels shall be for day, night, and over bright conditions.
- Operating Temperature of -40°F to 120°F
- Power requirements shall be no more than 120 VAC 2.5 A continuous and shall have a maximum inrush current of 7A.
- Polycarbonate shield with anti-glare coating covering the display face.
- Ensure the sign is accessible from the front and that the polycarbonate shield covering the display face and sign face panel and can be easily hinged up to allow access to the inner workings of the sign to perform maintenance and repair when needed. Ensure that the hinging system securely locks the polycarbonate shield covering display and sign face into a safe position so as not to injure the worker when performing maintenance on the signs.

Use parts made of corrosion-resistant materials, such as plastic, stainless steel, brass, or aluminum. Use construction materials that resist fungus growth and moisture deterioration. Separate dissimilar metals by an inert dielectric material.

8.3. Messages

Ensure each CMS is designed to display the following two (2) messages:

Message 1:

TRUCK *ENTER*
WEIGH STATION

Message 2:

TRUCK *BYPASS*
WEIGH STATION

The appropriate message will be activated for the particular truck being processed. A message shall be displayed for every commercial vehicle.

8.4. Construction Methods

Install the CMS at the locations on the plans with a minimum height of 17 feet from the bottom of the CMS sign face to the highest point of the travel lane. It is the contractor's responsibility to verify the S-dimensions for the CMS to determine the proper post lengths. Install the CMS according to the manufacturer's recommendations using galvanized steel poles and hardware in concrete foundations.

Label and identify all wires and cabling as to their intended function to aid in future servicing of the CMS. Provide a labeling method that is approved by the Engineer.

Install signal cable in continuous lengths between the roadside controller cabinet and the CMS. Route the signal cable to minimize the length of signal cable installed and the number

of cables and conductors in each run. Pull 36 inches of additional signal cable into the roadside controller cabinet and the CMS sign structure for maintenance purposes.

Provide electrical equipment described in this specification that conforms to the standards of NEMA, UL, or Electronic Industries Association (EIA), wherever applicable. Provide connections between controllers and electric utilities that conform to NEC standards. Provide feeder conductors and disconnects to power the CMS that are sized in accordance with the NEC.

Inductive loops installed in the roadway at the CMS locations trigger the CMS system to turn on and off the sign in relation to the commercial vehicles' location in route to the weigh station.

Use the Roadside Equipment Cabinet to house electrical equipment and signal processing equipment necessary to operate the CMS. Install a new 2" conduit between the Roadside Equipment Cabinet and the support structure base entrance using conduit stub-outs.

The CMS message will notify the commercial vehicle to "Bypass" or "Enter" the weigh station based on the screening criteria.

In accordance with the Plan, Loop 5 activates CMS 1. Loop 6 activates CMS 2 and turns off CMS 1. When no vehicles are being processed ensure the CMS goes into blank state

8.5. MEASUREMENT AND PAYMENT

Changeable Message Sign will be measured and paid as the actual number of *Changeable Message Signs* furnished, installed, and accepted.

Each *Changeable Message Sign* consists of a sign enclosure with the pre-identified messages, electrical and signal processing equipment, communications equipment, strapping hardware, conduit, fittings, couplings, sweeps, conduit bodies, condulets, wire, feeder conductors and disconnects, signal cable between the roadside equipment cabinet and the *Changeable Message Sign* enclosure, connectors, photo-electric sensors, tools, materials, all related testing, cost of labor, cost of transportation, incidentals, and all other equipment necessary to furnish and install the CMS system.

Foundation and sign supports are paid for under the Signing Plan.

Payment will be made under:

Pay Item	**Pay Unit**
Changeable Message Sign	Each

9. COMMUNICATIONS HARDWARE

19.1 DESCRIPTION

Furnish and install all equipment described below for a fully functional minimum 100/1000 Mbps Ethernet network for communication to the weigh station.

A. Ethernet Edge Switch

Furnish and install a hardened, field Ethernet edge switch (hereafter "edge switch") for field devices. Ensure that the edge switch provides wire-speed, Ethernet connectivity at each device location to the managed Ethernet switch. Provide adequate number of copper ports for communication with the device at 100/1000 Mbps speed. Provide the switch with adequate number of fiber ports and fiberoptic transceivers to communicate with the existing managed switch in the scale house.

9.2. MATERIALS

A. General

Ensure that the edge switches are fully compatible and interoperable with the Ethernet network interface and that the Ethernet switches support half and full duplex Ethernet communications.

Furnish edge switches that provide 99.999% error-free operation, and that complies with the Electronic Industries Alliance (EIA) Ethernet data communication requirements using single-mode fiber-optic transmission medium and copper transmission medium. Ensure that the edge switches have a minimum mean time between failures (MTBF) of 10 years, or 87,600 hours, as calculated using the Bellcore/Telcordia SR-332 standard for reliability prediction.

Provide all SMFO jumpers required to connect the managed Ethernet switches and proposed edge switches with the connector panels of fiber-optic splice centers. Provide SMFO jumpers that are factory-assembled with Type LC connectors. Provide SMFO jumpers that are a minimum of 3 feet in length for edge switches inside equipment cabinets. Ensure SMFO jumpers meet the operating characteristics of the SMFO cable with which it is to be coupled.

B. Ethernet Edge Switch

(1) Standards

Ensure that the edge switches comply with all applicable IEEE networking standards for Ethernet communications, including but not limited to:

- IEEE 802.1D standard for media access control (MAC) bridges used with the Spanning Tree Protocol (STP),
- IEEE 802.1P standard for Quality of Service (QoS),
- IEEE 802.1Q standard for port-based virtual local area networks (VLANs),
- IEEE 802.1Q-2005 standard for MAC bridges used with the Multiple Spanning Tree Protocol,
- IEEE 802.1w standard for MAC bridges used with the Rapid Spanning Tree Protocol (RSTP),
- IEEE 802.1x standard for port-based network access control, including RADIUS,
- IEEE 802.3 standard for local area network (LAN) and metropolitan area network (MAN) access and physical layer specifications,
- IEEE 802.3u supplement standard regarding 100 Base TX/100 Base FX,
- IEEE 802.3x standard regarding flow control with full duplex operation, and
- RFC 783 – TFTP
- RFC 854 – Telnet Protocol Specification,

- RFC 1112 – IGMP v1,
- RFC 1541 – Dynamic Host Configuration Protocol for IPv4,
- RFC 2030 – SNTP
- RFC 2068 – HTTP
- RFC 2236 – IGMP v2,
- RFC 2865 – RADIUS
- RFC 3414 – SNMPv3-USM
- RFC 3415 – SNMPv3-VACM.

Ensure that the edge switches have a minimum mean time between failures (MTBF) of 10 years, or 87,600 hours, as calculated using the Bellcore/Telcordia SR-332 standard for reliability prediction.

(2) Functional

Ensure that the edge switches support all Layer 2 management features and certain Layer 3 features related to multicast data transmission. These features shall include, but not be limited to:

- An STP healing/convergence rate that meets or exceeds specifications published in the IEEE 802.1D standard,
- An RSTP healing/convergence rate that meets or exceeds specifications published in the IEEE 802.1w standard,
- An Ethernet edge switch that is a port-based VLAN and supports VLAN tagging that meets or exceeds specifications as published in the IEEE 802.1Q standard, and has a minimum 4-kilobit VLAN address table (254 simultaneous),
- A forwarding/filtering rate that is a minimum of 14,880 packets per second for 10 megabits per second and 148,800 packets per second for 100 megabits per second,
- A minimum 4-kilobit MAC address table,
- Support of Traffic Class Expediting and Dynamic Multicast Filtering,
- Support of, at a minimum, snooping of Version 2 of the Internet Group Management Protocol (IGMP),
- Support of remote and local setup and management via telnet or secure Web-based GUI and command line interfaces,
- Support of the Simple Network Management Protocol version 3 (SNMPv3). Verify that the Ethernet edge switch can be accessed using the resident EIA-232 management port, a telecommunication network, or the Trivial File Transfer Protocol (TFTP),
- Port security through controlling access by the users. Ensure that the Ethernet edge switch has the capability to generate an alarm and shut down ports when an unauthorized user accesses the network,
- Support of the TFTP and SNTP. Ensure that the Ethernet edge switch supports port mirroring for troubleshooting purposes when combined with a network analyzer.

(3) Physical Features

Mounting: Provide shelf mount edge switches. Optionally, if cabinet space dictates provide mounting kit to attach the edge switch to a vertical rack rail or a DIN rail in the cabinet. If the Contractor elects to use DIN rail mounting supply the DIN rail with the edge switch.

Ports: Provide 10/100/1000 mbps auto-negotiating ports (RJ-45) copper Ethernet ports for all edge switches. Provide auto-negotiation circuitry that will automatically negotiate the highest possible data rate and duplex operation possible with attached devices supporting the IEEE 802.3 Clause 28 auto-negotiation standard.

Optical Ports: Ensure that all fiber-optic link ports operate at 1310 or 1550 nanometers in single mode. Provide fully functional ports with Type LC connectors and the optics for the optical ports. Do not use mechanical transfer registered jack (MTRJ) or ST type connectors.

Provide 10/100/1000 mbps optical ports that consist of fiber pairs, one fiber will transmit (TX) data and one fiber will receive (RX) data. Provide optical ports that meet the following minimum requirements:

- Optical receiver sensitivity: -32 dBm,
- Optical transmitter power: -15.5 dBm,
- Typical transmission distance: 20 km, and
- Operating wavelength: 1310 nm.

Copper Ports: Provide edge switches that include a minimum of six copper ports. Provide Type RJ-45 copper ports and that auto-negotiate speed (i.e., 10/100/1000 Base) and duplex (i.e., full or half). Ensure that all 10/100/1000 Base TX ports meet the specifications detailed in this section and are compliant with the IEEE 802.3 standard pinouts. Ensure that all Category 5e unshielded twisted pair/shielded twisted pair network cables are compliant with the EIA/TIA-568-B standard.

*Port Security***:** Ensure that the edge switches support/comply with the following (remotely) minimum requirements:

- Ability to configure static MAC addresses,
- Ability to disable automatic address learning per ports, known hereafter as Secure Port. Secure Ports only forward, and
- Trap and alarm upon any unauthorized MAC address and shutdown for programmable duration. Port shutdown requires administrator to reset manually the port before communications are allowed.

*Network Capabilities***:** Provide edge switches that support/comply with the following minimum requirements:

- Provide full implementation of IGMPv2 snooping (RFC 2236),
- Provide full implementation of SNMPv1, SNMPv2c, and/or SNMPv3,
- Capable of mirroring any port to any other port within the switch,
- Meet the IEEE 802.1Q (VLAN) standard per port for up to four VLANs,
- Meet the IEEE 802.3ad (Port Trunking) standard for a minimum of two groups of four ports,
- Telnet/CLI,
- HTTP (Embedded Web Server) with Secure Sockets Layer (SSL), and
- Full implementation of RFC 783 (TFTP) to allow remote firmware upgrades.

*Network Security***:** Provide edge switches that support/comply with the following (remotely) minimum network security requirements:

- Multi-level user passwords,
- RADIUS centralized password management (IEEE 802.1X),
- SNMPv3 encrypted authentication and access security,
- Port security through controlling access by the users: ensure that the Ethernet edge switch has the capability to generate an alarm and shut down ports when an unauthorized user accesses the network,
- Support of remote monitoring (RMON) of the Ethernet agent, and
- Support of the TFTP and SNTP. Ensure that the Ethernet edge switch supports port mirroring for troubleshooting purposes when combined with a network analyzer.

(4) Electrical Specifications

Ensure that the edge switches power on and operate properly with 115 VAC. Ensure that the edge switches have a minimum operating input of 110 VAC and a maximum operating input of 130 VAC. Ensure that if the device requires operating voltages other than 120 VAC, supply the required voltage converter. Ensure that the maximum power consumption does not exceed 50 watts. Ensure that the edge switches have diagnostic light emitting diodes (LEDs), including link, TX, RX, speed (for copper ports/RJ 45 only), and power LEDs.

(5) Environmental Specifications

Provide Ethernet edge switches that adhere to the following environmental constraints as defined in the environmental requirements section of the NEMA TS 2 standard if located within a climate-controlled environment:

- Operating temperature range: -30°F to 165°F,
- Storage temperature range: 14°F to 158°F, and
- Operating relative humidity range: 10% to 90%, non-condensing.

Verify that the edge switch manufacturer certifies their device has successfully completed environmental testing as defined in the environmental requirements section of the NEMA TS 2 standard. Verify that vibration and shock resistance meet the requirements of Sections 2.1.9 and 2.1.10, respectively, of the NEMA TS 2 standard. Ensure that the edge switch is protected from rain, dust, corrosive elements, and typical conditions found in a roadside environment.

The edge switches shall meet or exceed the following environmental standards:

- IEEE 1613 (electric utility substations),
- IEC 6185003 (electric utility substations),
- IEEE 61800-3 (variable speed drive systems), and
- IEC 61000-6-2 (generic industrial).

9.3. CONSTRUCTION METHODS

A. General

Ensure that all communications hardware is UL listed.

Verify that network/field/data patch cords meet all ANSI/EIA/TIA requirements for Category 5e four-pair unshielded twisted pair cabling with stranded conductors and RJ-45 connectors.

Provide a System Design Report identifying or mapping IP address for each device. Submit the System Design Report for approval along with submitting product submittal data prior to installing and configuring the computer and communications hardware.

Ensure that all project IP addresses are assigned as defined in the System Design Report. Ensure the as-built documentation includes the identification of all IP addresses and VLANs, and associated hardware devices and device locations. Configure the Ethernet network so the WIM equipment and CCTV cameras are in separate VLANs.

The Engineer will designate who their network administrator is for the LAN. Upon project completion, ensure that the network administrator will be able to manage remotely the Ethernet switches for switch configuration, performance monitoring, and troubleshooting.

- **Ethernet Edge Switch**

Ensure that all project IP addresses and VLAN IDs are assigned as defined in the System Design Report. Ensure that at a minimum, the switch configuration includes the following features: SNMP, SNTP, Port Security, all required VLANs. Ensure unused switch ports are disabled.

Mount the edge switch inside each field cabinet by securely fastening the edge switch to the vertical rail of the equipment rack or to a shelf using manufacturer-recommended or Engineer-approved attachment methods, attachment hardware, and fasteners. Ensure that the edge switch is mounted securely in the cabinet and is fully accessible by field technicians without blocking access to other equipment. Use fiber-optic jumpers that are factory assembled and connectorized and are certified by the fiber-optic jumpers' manufacturer to meet the relevant performance standards required below. Verify that network/field/data jumper cables meet all ANSI/EIA/TIA requirements for Category 5e 4-pair unshielded twisted pair cabling with stranded conductors and RJ45 connectors.

Connect the Ethernet Edge Switches into the existing managed ethernet network switch in the scale house via the new fiber optic cable.

9.4. MEASUREMENT AND PAYMENT

Ethernet edge switch will be measured and paid as the actual number of Ethernet edge switches furnished, installed, and accepted.

The Ethernet switches include all appropriate ports, cabling, grounding, redundancies, labeling, and any integration between the switches and the communications network as necessary to make a fully working installation. All power supplies, power cords, adapters, mounting hardware, DIN rail mounting brackets, DIN rails, connectors, serial cables, signs, decals, disconnect switches, installation materials, and configuration software necessary to complete this work, will be included and will be incidental.

No separate measurement will be made for SMFO jumpers, communication cables, Ethernet patch cables, electrical cables, mounting hardware, nuts, bolts, brackets, connectors, grounding equipment, or surge suppression, as these will be considered incidental to the pay items listed above.

Payment will be made under:

Pay Item **Pay Unit**

Ethernet Edge Switch..... Each

10. ETHERNET CABLE

10.1. Description

Furnish and install Ethernet cable to serve as interconnect between Ethernet edge switches and co-located devices in the equipment cabinet and to interconnect the Managed Ethernet switch to workstation computers and other peripheral devices in the Scale House. Ensure Ethernet cable is rated for outdoor applications where it will be installed in conduits exposed to outside weather conditions or lashed to messenger cable.

10.2. Materials

Furnish Category 5 Enhanced (5e) Ethernet cable that complies with ANSI/TIA 568-B-5 standards for four-pair shielded twisted copper for Ethernet communications. The cable shall meet all of the mechanical requirements of ANSI/ECEA S-80-576. The Ethernet cable must be rated for medium-power, network-powered broadband communications circuits and must be Type BMU network-powered broadband communications medium-power cable.

Provide a minimum of 4-pair twisted copper Ethernet cable and connectors rated for an ambient operating temperature range of -30º F to 165º F. The cable shall be shielded, outdoor-rated and have a UV-resistant jacket. The void between the insulated copper pairs and the polyethylene outer jacket shall be injected with a water-resistant flooding compound. Furnish Ethernet cable with the following additional requirements:

- 24AWG (minimum) solid bare copper conductor
- High-density polyethylene insulation, PVC jacket
- UL/CSA listed
- Gel Filled
- Supports 10/100/1000 Mbps
- Mean Power Sum for Equal Level Fare End Crosstalk (ELFEXT): 45dB/kft (minimum) at 772kHz
- Worst Pair Power Sum for ELFEXT: 40dB/kft (minimum) at 772kHz
- Mean Power Sum for Near-end Crosstalk (NEXT): 42dB/kft (minimum) at 772 kHz
- Average mutual capacitance: 90nf/mile (maximum)
- Ensure the jacket is printed with foot markings at a minimum of every 3 feet.

Have the manufacturer factory test the Ethernet cable on reels for each pair's mutual capacitance, crosstalk loss, insulation resistance, and conductor resistance. Furnish the Engineer with a certified report for each reel showing compliance with these Project Special Provisions,

the factory test results, and the manufactured date of the cable. The contractor shall not use Ethernet cable manufactured more than one year before the date of installation.

Pre-terminated cables in 3’ to 6’ lengths shall have their ends terminated at the factory. Long haul runs greater than 6’ shall have the ends terminated in a punch down female RJ-45 jack.

No Ethernet patch cable shall exceed 295 feet.

10.3. Construction Methods

A. General

Install Ethernet cable on new or existing messenger cable and in conduits at locations shown in the Plans. Allow a minimum of 10 feet (3 meters) of cable slack.

Ethernet cables shall not be spliced.

All cables shall be labeled with waterproof, smear resistant labels that denote the equipment cabinets or housing they are run from and the device and identifier for that device to which they are connected.

B. Aerial Installation

Double lash the Ethernet cable to the messenger cable where installed aerially.

Wrap the Ethernet cable to the messenger cable using aluminum ribbon wraps where the wire supports other cables.

C. Underground Installation

Install underground Ethernet cable in conduit described in these Special Provisions and as shown in the Plans.

The contractor shall not exceed 80 percent of the manufacturer's maximum pulling tension when installing underground Ethernet cable. Use a clutch device (dynamometer) so as not to exceed the allowable pulling tension if the cable is pulled by mechanical means. Do not use a motorized vehicle to generate cable-pulling forces.

Keep tension on the cable reel and the pulling line at the start of each pull. Do not release the tension in the cable if the pulling operation is halted. Restart the pulling operation by gradually increasing the tension until the cable is in motion.

D. Equipment Cabinet and Scale House Cable Installation

For connections inside equipment cabinets to connect between switches and other co-located devices, provide pre-terminated jumper in 3’ to 6’ lengths.

Long haul cable terminations into RJ-45 jacks can have their ends installed in the field by qualified technician for connections between the Managed Ethernet switch and workstation computers and other peripheral devices.

10.4. Measurement and Payment

Ethernet Cable (Long Haul) will be measured and paid as linear feet of Ethernet Cable (Long Haul) furnished, installed, and accepted. Measurement will be taken by recording and calculating the difference in the foot marking along the cable jacket after the cable is terminated. If the foot marking cannot be recorded, then the cable length after termination will be determined by

measuring the horizontal distances along which the cable lays.

No measurement will be made for terminating and testing of the cable, connectors, cable identification markers, and grounding, as these will be considered incidental to the installation of the Ethernet cable.

Ethernet Cable (3 foot) and Ethernet Cable (6 foot) will be considered incidental as addressed elsewhere in the Project Special Provisions.

Payment will be made under:

Pay Item	**Pay Unit**
Ethernet Cable (Long Haul)	Linear Feet

11. COMPUTER HARDWARE AND PERIPHERALS

11.1. DESCRIPTION

Furnish and Install all materials with the most recently developed and approved product versions that meet or exceed all applicable standards, specifications, and requirements before the system is considered for acceptance. Ensure that all equipment features, functions, and performance measures are met.

Furnish and install one server, one printer, and one computer workstation in the scale house. Ensure that all workstation and server can access the LAN and can be used to monitor, interact, and control all weigh station operations.

A. UPS

Furnish and install rack-mounted uninterruptible power supply (UPS) units as described in this Project Special Provision for the equipment cabinets, managed Ethernet switches, and servers in the scale house. The UPS shall also include any ancillary equipment or incidental items, such as required mounting hardware and cabling. Furnish and install monitoring software to provide email alerts. Furnish all materials with the most recently developed and approved product versions that meet or exceed all applicable standards, specifications, and requirements before the system is considered for acceptance.

B. Equipment Rack

Furnish and install a 19” EIA equipment rack with power cord hook up and outlets to service equipment. Ensure outlets are surge protected. Ensure rack has sufficient space to accommodate all equipment required by this contact and has as minimum of an additional 6 spare rack positions available to house future equipment installs.

11.2. Materials

A. Server

Furnish and install a server in the scale house as described in the Plans and these Project Special Provisions. Connect the servers to the existing managed Ethernet switch. The server shall have the following minimum requirements.

- Rack Mounted Server Grade Machine
- Intel Xeon series 3.5 GHz 4 core 8 thread Processor
- 32GB of 2133 ECC RAM (Multi Channel)
- 4x 600GB 15K RPM 12-Gbps Server Grade HDD
- RAID controller with support for 4 pairs
- Hot Swappable Hard Drive Bays
- 4x USB Ports, minimum 2x USB 3.0 Ports
- Dual Power Supplies
- Dedicated Ethernet Management Port
- 2x 1Gbps onboard network ports
- 64-bit Windows Server 2016 Standard Edition with 5 device Client Access Licenses

The server shall integrate the workstations and allow video and data accessibility and exchange between various system components (i.e. WIM, ATM, AVI, ALPR, Overview Camera, etc.).

B. Computer Workstation

Furnish and install a computer workstation consisting of a CPU, monitor(s), keyboard, and mouse in the scale house scale room. The Computer workstation should meet the following minimum requirements.

- 4 core 3.2GHz Processor
- 8GB of RAM
- 500GB SATA Hard Drive
- 4 USB ports
- HDMI/DP/VGA port
- 24” monitor
- Windows 10 Professional

The computer workstation will operate the central control software over the Ethernet network in the scale house. The computer will be provided with one monitor.

C. Printer

Furnish and install one color laser printer in the scale house scale room.

D. UPS

Furnish UPS units that produce uninterruptible power and power conditioning for the WIM equipment, managed Ethernet switch, and video monitor in the scale house.

For the UPS located in the scale house, size the UPS units to provide at least 20 minutes of UPS power. For the equipment cabinets, size the UPS units to provide at least four hours of UPS power. Provide the UPS a 25% reserve of receptacles. Provide load calculations for each configuration of equipment connecting to a UPS.

a. Standards

Ensure that the UPS units comply with the following standards:

- ANSI
- ASTM
- CSA and
- UL.

b. Functional

Each UPS shall provide adequate capacity to run its respective equipment without commercial power for 20 minutes. Size the UPS units for the proposed loads. Provide load calculations for each configuration of equipment connecting to a UPS assuming a run time of 20 minutes.

Ensure that the UPS and its remote monitoring software perform the following functions:

- Remote environmental monitoring of temperature and humidity,
- Data logging,
- Event logging,
- Fault notification,
- Hibernation,
- Radius authentication,
- Protocols: HTTP, HTTPS, IPv4, IPv6, SMTP (v1-v3), Telnet, SSH v2, SSL,
- Manage all network UPS units,
- Operating system shutdown,
- Load shedding to turn off selected devices or groups of devices,
- Outlet control to turn off, reboot, or shutdown outlets,
- Power event summary,
- Recommended actions,
- Risk assessment summary,
- Run command file, and
- System event log integration.

c. Physical Features

Supply each UPS unit described above with 25 percent spare outlets. Ensure that the UPS meets the following material requirements:

- Rack-mounted and floor mounted as listed below in these Project Special Provisions.
- Sealed AGM type, maintenance free batteries,
- Minimum of nine NEMA 5-15R and two NEMA 5-20R outlets,
- NEMA L5-30P input plug,
- Ethernet network management card using 10/100/1000 Base TX communications,
- USB interface port,
- Remote environmental monitoring of temperature and humidity with telnet management,
- Status lights: power on, power source and overload,
- Alarms: audible and remote notification,
- Manual power on/off switch, and
- Supply UPS unit with multi-pole noise filtering. Supply UPS with a terminal for connecting the UPS to a surge protection device.

a. Environmental Specifications

Verify that the UPS meets all specifications and is capable of performing all of its functions during and after being subjected to:

- Operating temperature: 0° F to 104° F,
- Operating relative humidity: 95%,
- Storage temperature: 5° F to 113° F, and
- Storage relative humidity: 95%.

11.3. CONSTRUCTION REQUIREMENTS

A. General

Integrate all servers, workstations, and printers on the LAN so all applications will be fully functional. Install the operating system, software, and antivirus software to the NCSHP IS standards.

Furnish all tools, equipment, materials, supplies, manufactured hardware, and perform all operations and equipment integration necessary to provide a complete, operational network. All cabling shall be:

- Neatly tagged with permanent labels at both ends of every cable,
- Secured with wire ties and cable management hardware in the communications racks, and
- Grounded to rack grounding hardware.

Ensure that all project IP addresses are assigned as defined in the System Design Report. Ensure the as-built documentation includes the identification of all IP addresses and VLANs, and associated hardware devices and device locations.

B. Server

Install the server in the scale house. Install the software packages described in these Project Special Provisions.

Install all software necessary to support the central control software and to meet all of the data communications requirements described in these Project Special Provisions.

Connect the servers to the existing managed Ethernet switch. Furnish and install Ethernet patch cords between the Ethernet patch panel and the managed Ethernet switch in the scale house. Plug power supplies into outlets on separate circuits.

C. Computer Workstation

Install the computer workstation in the scale house. Connect the workstation to the LAN by furnishing and installing Ethernet patch cords between the Ethernet patch panel and the existing managed Ethernet switch in the scale house. Perform the following operational tests for each computer component in accordance with the test plans. After the equipment has been installed, perform the following:

- Connect all components (monitors, mice, keyboards, existing printers, network cables, power supplies),
- Install all software required in these Project Special Provisions,
- Configure network communications,
- Map network drives and existing printers,
- Run diagnostic utilities on the hardware, and
- Print test pages for each workstation on each existing printer to verify printer configuration.

D. Printer

Install a laser printer in the scale house scale as directed by the Engineer. Connect the printer to the Ethernet network, setup the workstations on the network to use the printer and print a test page from each printer.

E. UPS

Install UPS units with the following equipment connected to them:

- Roadside cabinets housing roadside computers
- Workstations
- Servers
- WIM electronics equipment in scale room

Place the power supply of the managed Ethernet switch on the UPS unit. Allocate the load of the equipment to balance the load while using 120 VAC.

Connect each UPS unit to a power outlet. Connect the UPS monitoring port to the managed Ethernet switch.

Install the UPS monitoring software on the weigh station LAN workstations to remotely monitor the UPS. Run the UPS diagnostics. Configure the remote monitoring to send email alerts.

Plug the power strip mounted on the respective rack frame into the UPS. Plug all communications hardware into the UPS or the power strip.

11.4. MEASUREMENT AND PAYMENT

Server will be measured and paid as the actual number of servers furnished, installed and accepted.

Computer Workstation will be measured and paid as the actual number of computer workstations with monitor(s), keyboard, UPS, mouse, operating system, and software furnished, installed and accepted.

Printer (Install) will be measured and paid as the actual number of printers furnished, installed and accepted.

UPS will be measured and paid as the actual number of UPS furnished, installed and accepted.

No separate measurement will be made for coaxial cables, communication cables, electrical cables, mounting hardware, equipment rack, nuts, bolts, brackets, connectors, risers, grounding equipment, or surge suppression, as these will be considered incidental to the pay items for servers, and workstation computers.

No separate measurement and payments for any additional equipment or components not provided by the Engineer. These items will be considered incidental to the pay items for installing servers and workstation computers.

Ethernet Cable (3 foot) and Ethernet Cable (6 foot) will be considered incidental as addressed elsewhere in the Project Special Provisions.

Payment will be made under:

Pay Item	**Pay Unit**
Server	Each
Computer Workstation	Each
Printer	Each
UPS	Each

12. CENTRAL CONTROL SOFTWARE

12.1. DESCRIPTION

A. General

Furnish and install central control software in accordance with the Plans and these Project Special Provisions. The system will operate automatically and continuously, with limited human intervention, weighing vehicles and interpreting tire anomalies, and screening trucks using their In-Cab devices and their NCSHP approved bypass programs as an integral part of the system to form an Automated Commercial Vehicle Processing System and Credential Screening System.

Operational requirements of the overall system are explained in Section 1 of these Project Special Provisions.

Ensure the Credential Screening System Software can capture WIM data, ATM data and ALPR data, and in-cab device ID data (if equipped) for each commercial vehicle in the right lane of I-74 southbound as they approach the weigh station. Ensure the Credential Screening System Software uses an automatic screening algorithm to receive all captured data to determine the sort decision of pull-in or bypass the Weigh Station. Additionally, ensure the Credential Screening System can push the sort decision along with the captured data back to the AVI Service Providers.

For Commercial Vehicles equipped with In-Cab Devices: Each bypass program will be responsible for providing its NCSHP approved screening data and vehicle ID information to the Credential Screening System to assist the Credential Screening System in making a final sort decision as to either bypass or pull-in the commercial vehicle. The Credential Screening System will in turn be configured to share the captured vehicle ID data and sort decision with the Service Providers sponsoring the in-cab devices. As a minimum the shared information will consist, but not be limited to; the Vehicle ID Data, WIM data, ATM data, AVI date received from the Service Providers, ALPR data, and Final Sort Decision.

Additionally, the AVI Service Providers will provide a return message to the Credential Screening System's Confirmation Database", a confirmation record consisting of the information received from the Credential Screening System and the sort decision. The confirmation records from the In-cab device systems shall report back to the "Confirmation Database".

Furnish and install software that distinguishes potential weight violators from the real-time traffic stream based on automatic weight measurements that exceed the established thresholds. Furnish and install software that identifies potential tire pressure anomaly's violators that exceed the established thresholds.

The specific major functions fulfilled by the baseline roadside operations software as part of the Credential Screening System are:

- Record all vehicle characteristics in a database,
- Produce reports of recorded vehicle characteristics,
- Screen vehicles for credential violations,

- Screen conjunctionally commercial vehicles with in-cab devices and commercial vehicles with out in-cab devices for safety violations,
- Screen conjunctionally commercial vehicles with in-cab devices and commercial vehicles without in-cab devices using operator defined hot lists,
- Allow duly authorized operators to adjust screening criteria and bypass rates based on whether vehicle identification is based on in-cab devices or ALPR sensor data, and to adjust screening criteria, and allow the operator to view vehicle screening results and overview camera shot information.
- Provide a database logging feature to store returned confirmation information from the AVI Service providers.

The software must maintain a configurable number of months, minimum of 3 months, maximum of 12 months, of historical vehicle data for analysis and reporting including the Confirmation Database. Additionally, the system shall be supplied with a user definable Scheduler Program to purge this data from the system on a weekly basis (i.e., once per week the software will examine all of the vehicle records to determine which are older than the specified expiry period and delete them from the database). The day and time at which this purging takes place shall be configurable by a system administrator. Set the purging to occur normally during Saturday or Sunday or during some other time when the weigh station is not busy.

Furnish the Automated Commercial Vehicle Processing System and Credential Screening System (Central Software) to produce printed reports detailing vehicle activity at the weigh station. This function is known as vehicle reporting.

Ensure the Automated Commercial Vehicle Processing System and Credential Screening System can interface to the state CVIEW system to update the local credential and safety database. This function is known as the CVIEW interface.

Ensure the system can maintain or access a vehicle record for each vehicle entered into the system.

Conform to the NC Statewide Information Technology Standards and Policies as described at

http://it.nc.gov

B. Screening Criteria.

1. Operation Overview

Integrate the ALPR, with the existing CVIEW, SAFER, FuelTaCS, PRISM and NCIC programs currently in use by the NCSHP for commercial vehicle data screening and enforcement. Provide the following major features:

- Snapshot screening database containing a local copy of NCIC, FuelTaCS, PRISM, CVIEW and SAFER data.

  Credential processing and screening software algorithms that include automated ALPR screening with PRISM status of the carrier and vehicle to determine if a Federal out-of-service order has been issued against the carrier or if the vehicle has been targeted; automated screening to retrieve the carrier safety information from the screening database, automated screening to check the FuelTaCS database of

carriers who have delinquent fines; and automated screening to check the NCIC database of vehicles which have been reported stolen.

- Automatically alert system users through audible and visual alarms of real-time CMV violators passing the System through user defined thresholds and the screening databases described herein.
- Windows-based graphical user interface (GUI) for accessing the snapshots and credential screening components. Furnish a user-friendly system with one GUI for accessing all screening components.

The specific major functions fulfilled by the Automated Commercial Vehicle Processing System and Credential Screening System (Central Software) software are:

- Record all vehicle characteristics in a database.
- Produce reports of recorded vehicle characteristics.
- Screen vehicles for credential violations.
- Screen vehicles for safety violations.
- Screen vehicles using operator defined hot lists.
- Allow duly authorized operators to adjust screening criteria and bypass rates
- Allow the operator to view vehicle screening results along with the details about the carrier, from the screening database.

Furnish software allowing purging to be configurable by day of week and time of day by a system administrator. Confirm purging schedule with the Engineer.

2. System Characteristics

a. Roadside Operations Requirements

Provide the System with the following functions:

- Vehicle screening.
- Vehicle display.
- Vehicle reporting.
- CVIEW interface.

The System shall use a live/real time connection to a database of the following: CVIEW, SAFER, FuelTaCS, NCIC, PRISM, over a secured connection. Additionally, the system shall be designed with an Operator defined Scheduler to download these databases on a daily basis to use as a backup in case the live feed is disrupted. Upon re-establishing a live/real time connection the system shall be programmed to revert back.

The System must produce printed reports detailing vehicle activity.

The System must maintain a vehicle record for each commercial vehicle passing the system.

Furnish the System vehicle record containing the following information about each commercial vehicle:

- Unique vehicle identifier
- Vehicle number
- Time and date stamp
- ALPR data
- Axle counts
- Vehicle classification
- Overall vehicle weight
- Maximum gross vehicle weight
- Vehicle length
- Error code
- Vehicle speed
- Axle record type
- ESAL or MEPDG value
- Screening decision
- Transponder ID from DSRC transponder
- Vehicle identification number from DSRC transponder
- Carrier ID from DSRC transponder
- Carrier ID (USDOT number) from CVIEW data
- Axle weights and
- Axle spacing
- Tire Pressure Anomaly

Interface the System to the CVIEW and FuelTaCS databases for receiving commercial vehicle data over a secured connection, as described below.

b. Screening Requirements

Automatically screen the PRISM status of the CMV carrier and vehicle to determine if a Federal out-of-service order has been issued against the carrier or if the vehicle has been targeted.

Automatically screen and retrieve the carrier safety information from the screening database and provide an alert when the Gross Vehicle Weight exceeds the registered license weight.

Automatically screen against North Carolina's FuelTaCS database of carriers who have delinquent fines.

Automatically screen the NCIC database of vehicles which have been reported stolen.

Uniquely display each vehicle record including all associated roadside sensor data.

Maintain an operator-defined hot list of carriers regardless of their weight or safety credential status.

Include a carrier hot list with an active date range for each entry defining the period in which the entry is valid.

Include the following information on the carrier hot list:

- Carrier ID.
- License Plate data.

- USDOT numbers.
- Comments – the user can enter what action to take or any other information that would be useful.
- Start date – when the hot list status starts.
- End date – when the hot list status ends.
- Jurisdiction – identifies registering jurisdiction.

Maintain an operator-defined hot list of vehicles regardless of their weight or safety credential status.

Program the System to maintain a local database of carrier snapshot data received from CVIEW, PRISM, and the FuelTaCS systems.

Program the System to permit the operator to override each specific credential/safety screening check on a carrier by carrier basis.

c. Display Requirements

Program the System to provide a Screening Results Display/snapshot screen that permits the operator to do the following:

- View the ALPR system data.
- View the credentials and safety scores that were used in screening a particular vehicle.
- Display which credentials and safety scores failed.
- Display which credentials and safety scores a vehicle is currently failing (if the operator requested updated snapshot data from CVIEW, the screening results may no longer be accurate).
- Search all system components by date, time and vehicle record and allow user-defined alarm notifications to be configured to meet multiple threshold levels.
- Specify which credentials and safety items to use to screen vehicles.
- Enable or disable each individual screening criteria.
- Enter a minimum/maximum allowable value to be used for each safety item while screening vehicles.
- Save a default configuration of screening criteria to be recalled at some point in the future.
- Quickly and easily return all credential and safety score screening criteria to their default values.
- Permit the operator to retrieve current vehicle and carrier snapshot data from the screening database, and store it in the local screening results database.

- View snapshot data retrieved from CVIEW for any requested vehicle or carrier.
- Restrict access to system functions with a user identification and password scheme. The adjustment of screening criteria in particular must be restricted to only personnel with the required privileges.
- Produce reports on vehicle data.
- Permit the operator to view all historical, vehicle data for any vehicle that has passed the System in the last three months.
- Edit each of the hot lists.

d. Reporting Requirements

Program the System to produce the following reports:

- CLASS BY HOUR: showing the count of vehicles in each class for each hour of the day
- CLASS BY DAY: showing the count of vehicles in each class for each day of the week
- SPEED BY CLASS: showing the count of vehicles in each speed range for each class of vehicle
- SPEED BY HOUR: showing the count of vehicles in each speed range for each hour of the day
- FRONT AXLES: showing the count of all front axles recorded within different weight ranges for each vehicle class
- SINGLE AXLES: showing the count of all single axles recorded within different weight ranges for each vehicle class
- TANDEM AXLES: showing the count of all tandem axles recorded within different weight ranges for each vehicle class
- TRIDEM AXLES: showing the count of all tridem axles recorded within different weight ranges for each vehicle class
- QUADREM AXLES: showing the count of all quadrem axles recorded within different weight ranges for each vehicle class
- GROSS VEHICLE WEIGHT: showing the count of vehicles in each Gross Vehicle Weight range for each vehicle class. Display the total GVW in a separate column
- ERRORS: showing the hourly count of vehicle display errors reported by the system
- TOTAL ESAL: showing the hourly summary of Equivalent Single Axle Loads for each vehicle class
- LANE COUNT: showing the count of vehicles in each class for each lane at the weigh station
- WEIGHT VIOLATION BY CLASS: showing for each vehicle class, the total vehicle count, the number of valid vehicles, the number of warning vehicles, the

number of violating vehicles, what percentage of the total was violating, the number of single axle violations, and the number of tandem axle violations

- WEIGHT VIOLATION BY HOUR: showing for each hour of the day, the total vehicle count, the number of valid vehicles, the number of warning vehicles, the number of violating vehicles, what percentage of total was violating, the number of single axle violations, the number of tandem axle violations and the number of GVW violations
- WEIGHT VIOLATION COUNT: showing for each hour of the day and each vehicle's class, the total vehicle count, the number of valid vehicles, the number of warning vehicles, the number of violating vehicles, what percentage of total were violating, the number of single axle violations, the number of tandem axle violations and the number of GVW violations

Program the System to produce specific reports that are based on data stored in the System:

- ALPR system data
- Number of vehicles traveling down each lane
- List of a carrier's vehicles passing the System during a specific time period, include when the vehicle passes the weigh station.
- Report from the "Confirmation Database" to evaluate system Sort Decision against the message provided to the In-Cab device by the AVI Service Providers"

e. Credential Enforcement Screening Requirements

The System must screen data from the CVIEW, SAFER, FuelTaCS, PRISM, and/or the NCIC systems currently in use by the NCSHP for credentials, safety and oversize/overweight enforcements listed below using the field data collected by the System. Ensure that the screening tool allows an operator to enable and disable the screening tools in the setup screen and the vehicle display screen.

At a minimum, include the following Credential Enforcement Screening Requirements:

- UCR Credentials
- HazMat Credentials – As a minimum, Identify the status of the carrier's registration credentials.
- IRP Credentials
- IFTA Credentials
- Safety Enforcement
- Oversize/Overweight Enforcement based on WIM data

3. External Interface Requirements

Provide a secure connection to allow the exchange of carrier and vehicle snapshot data in XML format from the State CVIEW system to the System.

Program the System to continue normal operation while receiving and processing files from the state CVIEW system and to support the processing of data at a rate to be determined, but which may be as often as an update every 15 minutes.

Provide a secure connection to allow the exchange of data in XML format from the PRISM, FuelTaCS, and NCIC to the System.

C. Operator Interface and System Controls

Ensure the system allows operators to view and control system operations through a LAN connection on their laptops or desktop computers. Using laptops or desktop computers, users will view vehicle data collected by each of the detectors and sensors in the system, the ALPR system, view and print reports, identify and respond to system alarms, and view still shot images of violating vehicles. At a minimum, the user display screens will allow the users to view the following information:

a. ALPR Data

Display vehicle records for the lane collecting data in the System. Program the system to show data and images collected.

b. Vehicle Data

Program the system to show data collected by the in-road detectors.

c. Vehicle Data

Program the system to show data collected by the ATM detectors.

d. Individual Vehicle Data

Program the System to display all information on a specific vehicle collected by the System. Program the System to allow operators to view snapshot photographs taken of vehicles via the overview camera.

e. Alarms

Program the system to allow operators to review alarms reported by the System and to allow operators to view snapshot photographs taken by the overview CCTV camera and the ALPR system of violating vehicles.

f. Summary Data

Program the system to allow operators to review summary data for each travel lane in the system. Have the summary data include total vehicle counts, vehicle classifications, vehicle speeds, gross vehicle weights (by category), axle weights and system violations (by type including weight, length, over-height (if applicable), tire pressure anomalies and credentials).

D. System Reports

The software must provide the following reports:

- Targeted as Federal out-of-service

- Carrier safety information
- Delinquent fines
- Reported as stolen
- Violations
- Classification (by hour, by day of the month and by day of the week)
- Vehicle speed (by class and by hour)
- ESALs (Equivalent Single Axle Loads) or MEPDG (Mechanistic-Empirical Pavement Design) by Hour
- Weight violations (by hour and by class)
- Weight violations count
- Truck count (by day of the month and by day of the week)
- Truck count by gross vehicle weight
- Vehicle speeds (by class and by hour)
- System errors (errors reported by system diagnostics
- Vehicle lengths
- ALPR records

E. Historical Search Queries

The software must provide an operator the ability to perform historical data queries. Furnish the ability to view the results of historical database queries on the user's screen and to optionally print the database queries in a format acceptable to the Department.

The software must maintain a configurable number of months, minimum of 3 months, maximum of 12 months, of historical vehicle data for analysis and reporting. Purge this data from the system on a weekly basis (i.e., once per week the software will examine all of the vehicle records to determine which are older than the specified expiry period and delete them from the database). Furnish software allowing purging to be configurable by day of week and time of day by a system administrator. Confirm purging schedule with the Engineer.

The historical search options shall include the ability to set selectable date/time range, search criteria and filter conditions as follows:

- Search criteria includes:
    - Transponder number
    - Carrier name
    - Statuses set
    - Statuses not set
    - License plate & jurisdiction
    - Minimum GVW

- Minimum length
- % of max GVW
- Sort decision
- Sign decision
- USDOT number
- Vehicle class range
- Error set, or no error
- Lanes
- Vehicle record number
- VIN

o Filter conditions include:

- Speed change
- Unequal axle count
- Tailgating
- Wrong lane (i.e. volunteer reporting to station after being told to bypass)
- Running scale
- Not WIM lane (i.e. a commercial vehicle in the AVC lane)
- Overlength
- Over GVW
- Overheight (if applicable)
- Random
- Speed limit
- Credential fail
- Kingpin violation (when applicable)
- Credential hotlist
- Ramp backup

Furnish the ability to view the results of historical search on the user's screen and to optionally print the historical search results list.

12.2. MATERIAL

Provide reproducible and installable copies of all software packages on CD-ROM including third party applications such as database, report generation etc. if applicable. Provide an auto-setup executable file or application that will install all software packages with minimal human interaction. All initial software system configurations shall be handled by the auto-setup application to the extent possible

Furnish perpetual license for all software packages used throughout the system. Furnish all software pre-installed on controller hardware prior to installation.

Controller hardware used to run the software described in this Project Special Provision is accounted for in other specifications in this document.

Provide mockups for all operator screens and system reports prior to generating/developing the screens and reports. Make changes to the report formats and screen views based on the Department's comments.

12.3. MEASUREMENT AND PAYMENT

Central Control Software will be paid for at the contract lump sum price. No measurement will be made for the interface with the individual components of the system, including but not limited to the WIM systems as these will be considered incidental to furnishing and installing the Central Control Software. No measurement will be made for the interface with the individual components of the system, including but not limited to the ALPR, AVI , ATM, inductive loops, and camera systems as these will be considered incidental to furnishing and installing the Central Control Software. No measurement will be made for software licenses and updates required during the System Warranty as these will be considered incidental to furnishing the System Warranty.

Payment will be made under:

Pay Item	**Pay Unit**
Central Control Software	Lump Sum

13. TESTING & ACCEPTANCE

13.1. DESCRIPTION

A. General

Test all equipment, cable and software furnished and installed under this Project. Conduct all testing in the presence of the Department. The Department reserves the right to perform any inspections deemed necessary to assure that the equipment conforms to the requirements required in these Project Special Provisions.

At a minimum, test the following items:

- ALPR
- WIM
- ATM
- CMS
- Camera equipment, including frame grabber
- Infrared Illuminators

Develop detailed test procedures and obtain Department approval before the tests are conducted. Allow 20 days for the review period. Demonstrate through the test procedures that all requirements defined in these Project Special Provisions, including but not limited to, functional/system performance requirements, electrical requirements, data

transmission/communication requirements, safety/password requirements, and interface requirements with other components of the System have been satisfied. During the testing, perform additional tests if the Department's representatives request such to confirm proper operation.

Compare the results of each test with the requirements specified in the Project Special Provisions and with the approved test procedures. Failure to conform to the requirements of any test will be considered as a complete failure and the equipment and software will be rejected. Make any corrections deemed necessary at no additional cost to the Department. Assume total responsibility for documenting the results of such tests and furnishing the documented test results to the Department.

The approval of test procedures and witness of such test will not relieve the Contractors of his responsibility to provide a completely acceptable and operating system that meets all requirements of these Project Special Provisions.

B. Operational Test

Conduct approved tests on all installed equipment and software. Perform these tests in the presence of the Department. The following separate tests are required:

- ALPR System (including the Overview Camera)

Use real vehicles to test the system. Test the system in day and night conditions over a 3 hour period each in full daylight and dusk to night.

- AVI System

Use real vehicles to test the system. Test the system to ensure proper operation with commercial vehicles using the transponder system.

- WIM System

Test the systems performance as described in the WIM System Specifications located in these Project Special Provisions.

- ATM System

Test the systems performance as described in the ATM System Specifications located in these Project Special Provisions.

- CMS System

Ensure during other tests that the CMS displays the correct message and that the diming features of the sign function properly.

C. Observation Period

After all equipment and software comprising the System has been accepted, satisfactory completion of the System acceptance test, and after training is complete, a 30-day observation period begins. The NCSHP will be responsible for operating the system during this period.

The following conditions apply to the observation period:

During the observation period, ensure the system monitors all components of the System and performs all functions described in these Project Special Provisions.

If any hardware item provided under these Project Special Provisions fails, repair the item at the Contractor's expense. If a failure occurs, the observation period would begin for the full 30-day duration.

During the observation period, have personnel responding to the problem within 24 hours after being notified of a problem by the Department. Within two days, have personnel on-site, with replacement equipment, addressing and correcting any issues with the System.

If another problem is discovered, such as erroneous computations, the observation period will be suspended until the Contractors corrects the problem at his expense. Once the problem has been eliminated, the observation period will resume. If the problem was one that affected the entire system rather than just one field device, the observation period will not resume until the system has performed properly for at least 72 hours. During this 72-hour period, demonstrate that any corrections or modifications made are valid, that the problems which restricted system operation have been corrected, and no new problems have resulted from the changes.

Total system "down time" may not exceed 30 hours during the observation period. Down time includes the time of suspension of the observation period as described in the previous paragraph. Down time is a condition caused by failure of the central equipment, system software, field equipment or communications system, which causes the system to cease normal operation. If total system "down time" exceeds 30 hours, a full duration of the observation period will begin again.

Terminate the observation period if 10% or more of the total quantity of any individual hardware item fails. Commence a full observation period for that hardware item upon the repair of a failed hardware item.

Upon successful completion of the observation period, the Department will accept the system, providing that all errors and omissions in Contractors-supplied documentation have been corrected and all other requirements of the Project Special Provisions have been met. Final acceptance will be in writing from the Department.

The 30-day observation period is not considered part of the work to be completed by the project completion date.

13.2. MEASUREMENT AND PAYMENT

There will be no direct payment for the work covered in this section as it will be considered incidental to the work required herein.

14. DOCUMENTS AND SUBMITTALS

14.1. GENERAL

The submittals listed below complement requirements stated throughout these Project Special Provisions and do not replace them.

Submit for approval catalog cuts and/or shop drawings for materials proposed for use on the project. Allow 20 days for review of each submittal. Do not fabricate or order material until receipt of Engineer's approval.

Submit 1 copies of each catalog cut and/or drawing and show for each component the material description, brand name, stock-number, size, rating, manufacturing specification and the intended use (identified by labeling all components with the corresponding contract line item number). Present the submittals neatly arranged in the same order as the contract bid items. Electronic submittals of catalog cuts and drawings may be accepted in lieu of hard copies.

One hard copy and an electronic (PDF) copy of reviewed submittals will be returned to the Engineer.

Supplement each drawing by material cut sheets and parts list. Provide parts list in the following format:

Part ID	Source	Part number	Alternate source	Alternate Part number	Description

14.2. DRAWINGS AND DOCUMENTS' CERTIFICATION

Provide plans for the equipment cabinet, mounting description, and shop drawings with documentation and calculations approved by a Professional Engineer registered in the state of North Carolina that bears his/her signature, seal, and date of acceptance (where applicable).

14.3. MECHANICAL

This set of submittals includes, but is not limited to, material specifications and parts list.

14.4. ELECTRICAL

This set of submittals includes, but is not limited to, material specifications, parts list, and wiring diagrams within the equipment cabinet and any electrical service equipment required.

14.5. ELECTRONICS

This set of submittals includes, but is not limited to, material specifications, parts list, and schematic diagrams for all electronics assemblies and sub-assemblies used in the system.

14.6. BLOCK DIAGRAMS AND USER MANUALS

Provide block diagrams with the material submittals along with user and Instruction Manuals prior to training for approval.

14.7. PROPRIETARY PARTS

Provide a list of all proprietary, non-warranty electronic component parts, along with its associated cost, at which the vendor will supply for a three year period after final project acceptance. Failure to supply this required proprietary part and price information may be grounds for rejection of the submitted item due to incomplete information. A part is considered to be a proprietary part if it is designed and manufactured exclusively for a specific hardware item and is not commercially available for sale to the general public. In addition, any item that is sole source (e.g. available only from the vendor or from a single known manufacturer) is considered to be proprietary and should be identified along with the sole source. Identify and quote a price for parts that are no longer being manufactured and identify the item as one that is no longer manufactured.

14.8. PROTECTION OF MANUFACTURER'S PROPRIETARY INFORMATION

NCDOT will use the above documentation (schematics, drawings, software, firmware, manuals, etc.) exclusively for the following purposes: diagnosing and performing repairs on malfunctioning equipment, equipment circuit boards, and malfunctioning systems; operational test of repaired equipment, circuit boards, systems; and performing authorized upgrades to equipment, circuit boards, and software supplied under this contract. NCDOT will not use or copy devices or software for any purpose other than diagnosis, repair, and testing or to perform authorized firmware or software upgrades.

Upon notification by the manufacturer, the Department agrees not to divulge any proprietary or otherwise confidential information contained in the above required documentation. NCDOT agrees to protect and secure any proprietary documentation identified by the manufacturer as proprietary or confidential. Upon request by the manufacturer, NCDOT agrees to sign a binding non-disclosure agreement with the manufacturer or other business that is providing documentation it considers proprietary or otherwise confidential.

14.9. MEASUREMENT AND PAYMENT

No measurement will be made of this work as these will be considered incidental to the work required herein.

15. TRAINING

15.1. DESCRIPTION

Provide a one day, minimum of 6 hours training covering the operation of the equipment and software being supplied as part of this project for up to 2 sessions, 10 people per session. Enlist

manufacturer's representatives or personnel approved by the Department to conduct the training course.

Include both classroom instruction and practical experience on the System operations. Provide both an introduction to the system and the theory of its operation in the training session. At a minimum, include the components of the system, central software operation, and the configuration of the central and field equipment. Provide each trainee with hands-on experience with the computer and controller system. The course should cover the operation of all software provided in this project. The course should also cover the proper operating techniques. The training shall include:

- System overview supplemented by a detailed block diagram,
- Data-flow diagram,
- Major system's components identification and operation,
- System's theory of operation,
- System administration
- Overview of major system software packages and dependencies,
- Software installation and configuration
- Hardware/software Error codes identification and interpretation
- Troubleshooting tips and procedures
- System startup and reboot
- Software/firmware update procedure
- Warranty claim procedure
- Technical support contact information for regular and after-hour business

At least 40 days prior to commencement of each training course, submit detailed course curriculums, draft manuals and handouts, and resumes of the instructors. The Department will review and request modifications of that material as appropriate.

Conduct all courses on weekdays at times to be specified by the Department. The Department will furnish the training facility.

Provide training material generated for each course including manuals and other handouts for each attendee that serves not only as subject guidance, but as quick reference material for future use. The course must utilize, to the greatest extent possible, the documentation described in these Project Special Provisions. Use the training courses to familiarize the students with all documentation that has been provided as part of this project. Deliver all course material, in reproducible form, to the Department immediately following course completion.

Video record each training session and deliver the DVD to the Department at the conclusion of the training.

15.2. MEASUREMENT AND PAYMENT

Training will be measured and paid for at the contract lump sum price for work detailed in this section. No measurement will be made for instructors, material, and other items required for the training as these will be considered incidental.

Payment will be made under:

Pay Item	**Pay Unit**
Training	Lump Sum

16. SYSTEM WARRANTY

16.1. DESCRIPTION

A. General

Unconditionally warrant the performance of all systems and subsystems for a period of three (3) years from the successful completion of the 30-day observation period.

Provide the necessary labor, parts, materials, tools, test equipment and facilities required to address any warranty issues related to the system after it is installed.

The warranty coverage will be renewable on an annual basis for an additional five (5) years by mutual consent of both parties. Develop the cost for the renewable option through mutual agreement of both parties.

B. Scope of Warranty

Ensure the components of all systems are in good working condition and take appropriate action to remedy performance issues. Good working condition is defined under this project as equipment meeting the system specifications for acceptance, accuracy, and tolerances as defined in these Project Special Provisions.

Provide scheduled diagnosis and repair service and/or respond to repair malfunctioning equipment as outlined below:

- Complete scheduled preventative maintenance, diagnostic testing, and repairs (if needed) at six (6) month intervals. Preventative maintenance shall be completed in accordance with the equipment manufacturer's recommendations and standard practices. Provide routine checks on all major systems, system components and ancillary equipment and take any corrective action to ensure proper long-term operation. The maintenance shall include, but not be limited to the following activities:
- Check installation of grout and sealant for loops and sensors. Repair or replace as required.
- Perform visual inspection of detector housings and repair or replace as required.
- Clean the interior and exterior of the System electronics, power supplies, controllers and communications equipment in the equipment cabinet. Repair or replace as required.
- Check condition of all System cables and connectors, terminal strips, and back-up batteries. Repair or replace as required.

- Perform visual inspection of the equipment cabinet. Repair as required.
- Test and visually inspect equipment cabinet ventilation fan and filter, thermostat, light and fused switch. Repair or replace as required.
- Test and verify control and sequence of operation of interface components.
- Test and verify all components of the System. Adjust, repair or replace as required.
- Provide one (1) session of a System operations course one (1) month prior to the end of the warranty period. The sessions should be a minimum of 5 hours in length. Include in the refresher course a hands-on demonstration of system functionality. The Department will provide facilities for the refresher course.
- Provide emergency repair services, on an as needed basis. The response time for emergency repair service shall be as follows:
    - 24 hours to acknowledge request
    - 48 hours to respond to request
    - 7 business days to repair any roadside equipment located in the equipment cabinet including any auxiliary support equipment located in either the equipment cabinet or in the Scale House and return System functionality. This excludes sensors located in the actual roadway as these items will require scheduling for lane closures and obtaining the proper equipment to replace the failed sensor. The repaired System shall function to the specifications defined in these Project Special Provisions for acceptance, accuracy, and tolerances. Document all activities performed under the warranty agreement, both preventative and emergency maintenance, in an electronic database that facilitates sorting the records by time period and/or device type.
- Submit for approval by the Department a maintenance and repair database proposal that tracks, at a minimum, the following events and information:
    - Date and time of scheduled preventative maintenance
    - All preventative maintenance activities completed.
    - All parts repaired or replaced during preventative maintenance.
    - Technician completing preventative maintenance work.
    - Repair history for all systems and subsystems
    - Date and time of emergency maintenance request
    - Date and time of technician on site to respond to emergency maintenance request.
    - Description of defective equipment or malfunctioning operations during emergency maintenance requests.

- Technician responding to emergency maintenance request.
- Corrective actions taken during emergency maintenance request.
- Date and time that operations restored after emergency maintenance request.
- Model and serial number of any equipment repaired and replaced during emergency maintenance request.

Provide both electronic and hardcopy records of the updated database within ten (10) days of each maintenance activity.

Document all itemized material, equipment, and labor costs incurred to maintain the System during the warranty period. The cost records shall differentiate between preventative and emergency maintenance costs. Provide these records to the Department on a semi-annual basis within fifteen (15) days after the end of the six-month period. These records are for informational purposes only and will not be used as a basis of payments to the Contractors. Ensure that these cost records are complete and accurate. The Department may perform an audit to verify the accuracy of the cost records.

Provide software upgrades for all new software revisions completed during the warranty period at no additional cost to the Department. Identify a cutover procedure for all software upgrades, which ensures that there is no interruption of service or failure of any operation as a result of upgrading the software. Also develop a contingency plan to re-install older versions of software, by the Contractors (at no additional cost to the Department), if any operation fails or any system degradation is encountered as a result of a software upgrade.

C. Warranty Evaluation

Two (2) months prior to the end of the warranty period, the Department will inspect the system thoroughly for potential system defects in presence of the contractor. This inspection will be done by the Department's personnel or representative. Assist the Department's personnel or representative during this inspection. Two (2) weeks prior to the inspection, provide a summary report of all preventative and emergency maintenance records. This report shall document and certify that all components have been maintained fully in accordance with the Project Special Provisions and manufacturer recommendations and that all manufacturer warranties that extend beyond the Contractor's warranty have been in no way compromised.

Following the inspection, the Department will determine if there are any unresolved defects with equipment hardware or software. The Department will provide a punch list to the Contractors for the replacement or repair of defective components or repairs to system software. Replace or repair equipment and software identified in the punch list within thirty days of receipt of the punch list. Also replace any components whose manufacturer warranty has been voided or compromised by any action/inaction on the part of the Contractors. Document all repairs or replacements completed, providing the documentation to the Department within two (2) months of receipt of the punch list.

D. Correction of Work

Re-execute any work that fails to conform to the requirements of the Contract and that appears during the process of the work. Remedy any defects due to faulty materials or workmanship which appear within the warranty period. The provisions of this article apply to work done by subcontractors as well as direct employees of the Contractors.

E. Traffic Control

Traffic control for all maintenance activities requiring lane closures will be provided by NCDOT in accordance with NCDOT standards.

16.2. MATERIALS

All replacement materials and equipment provided under the warranty shall meet or exceed the requirements as defined in the Plans and the Project Special Provisions. If during the warranty period a part or component of a system or subsystem is no longer available to the Contractors, obtain equipment which ensures that the systems and subsystems meet or exceed the specifications and functionality as defined in these Project Special Provisions.

Provide all labor, tools, test equipment and other equipment necessary in the maintenance, repair and replacement of all components furnished under this contract during the warranty period.

16.3. CONSTRUCTION METHODS

In replacing equipment under the maintenance agreement, meet or exceed the construction requirements for each component as defined in the Plans and Project Special Provisions.

16.4. MEASUREMENT AND PAYMENT

System Warranty will be measured and paid for at the contract lump sum price for System Warranty. The System Warranty is not part of the Contract Time.

No measurement will be made for providing labor, parts, materials, shipping, vehicles, tools, test equipment, documentation and facilities as these will be considered incidental to furnishing the System Warranty.

Payment will be made under:

Pay Item	**Pay Unit**
System Warranty	Lump Sum

UPGRADE EXISTING I-74 SOUTHBOUND WEIGH STATIONS WITH AUTOMATED VEHICLE IDENTIFICATION SYSTEM, WEIGH-IN-MOTION, TIRE MONITORING SYSTEM, AUTOMATED LICENSE PLATE READER, AND OTHER DEVICES
PROJECT SPECIAL PROVISIONS

This seal is for sections 17-22 only.

Not Valid Unless Signed

Contents

17. WORK ZONE TRAFFIC CONTROL FOR INTERSTATE/FREEWAY ITS INSTALLATION

17.1. GENERAL REQUIREMENTS

Maintain traffic in accordance with Divisions 10, 11 and 12 of the *2018 Standard Specifications* and the following provisions:

Install Work Zone Advance Warning Signs in accordance with Standard Drawing No. 1101.01 of the *2018 Roadway Standard Drawings* prior to beginning any other work.

When personnel and/or equipment are working within 15 feet of an open travel lane, close the nearest open shoulder using Standard Drawing No. 1101.04 (Shoulder Closure on Divided Facilities) of the *2018 Roadway Standard Drawings* unless the work area is protected by barrier or guardrail or a lane closure is installed.

When personnel and/or equipment are working on the shoulder adjacent to a divided facility and within 10 feet of an open travel lane, close the nearest open travel lane using Standard Drawing No. 1101.02 of the *2018 Roadway Standard Drawings.*

When personnel and/or equipment are working within a lane of travel of a divided facility, close the lane using Standard Drawing No. 1101.02 of the *2018 Roadway Standard Drawings* or as directed by the Engineer. Conduct the work so that all personnel and/or equipment remain within the closed travel lane. Perform work only when weather and visibility conditions allow safe operations as directed by the Engineer.

A. Time Restrictions for Lane Closure and Road Closure Activities

All lane closure and road closure activities shall be performed in compliance with the day and time restrictions listed and defined in this Contract.

Any activities performed outside of these requirements will be subject to the liquidated damages unless approved by the Engineer prior to beginning the activity.

The Contractor may place/pre-stage all required signs and traffic control devices necessary for lane closures prior to the closure time as approved by the Engineer. However, flashing arrow boards and changeable message signs shall not indicate lane closure information until 30 minutes or less prior to the installation of the lane closure. Typical pre-staging times are 1 hour for a single lane closure and 2 hours for double and triple lane closures. The travel lane(s) are to be closed at the prescribed times defined in this Contract. When available, law enforcement should be onsite to shadow workers during pre-staging activities.

For removal, the lane(s) must be reopened in compliance with the times defined in this Contract. It is acceptable to remove the signs and traffic control devices from the shoulder/staging area after the lane(s) are reopened to traffic. All electronic lane closure messages and flashing arrow displays shall be off once lanes are opened. When available, law enforcement should remain on the project while workers remove and secure their signs and devices.

B. Work Zone Speed Limits and Digital Speed Limit Signs (DSLS)

All speed limits are the sole authority of the NCDOT. An ordinance by the State Traffic Engineer is required for all speed limits in order to have a lawfully enforceable speed limit. No speed limit messages/signs shall be installed prior to receiving a signed ordinance.

The Regional Traffic Engineering Office and the Division Construction Engineer in coordination with the Work Zone Traffic Control Section will provide all work zone speed limit recommendations based on activities and conditions.

When lane closures are in effect, implement a Work Zone Variable Speed Limit Reduction as stated in the ordinance and in accordance with the attached provision and drawing.

Use Digital Speed Limit Signs (DSLS) to display the work zone speed limit as shown in the attached special provision and drawing. The speed limit shall be continuously displayed on the digital speed limit signs.

The Contractor will be responsible for coordinating with the Engineer when the work zone speed limits are to be changed and will have to seek approval by the Engineer before the speed limit is changed.

When the variable speed limit reductions are in effect, cover or remove any existing speed limit signs located within the active work area that conflict with the variable speed limit reduction.

The speed limit shall be returned to the existing speed limit when the lane closure is removed and traffic is returned to the existing pattern.

C. Connected Lane Closure Devices

Furnish and install Connected Lane Closure Devices that transmit the location of the lane closure to navigational companies and the Statewide Transportation Operations Center (STOC).

D. Work Zone Presence Lighting and Sequential Flashing Warning Lights

Provide the following for nighttime work activities in accordance with attached drawing and special provisions:

1. Furnish and install Work Zone Presence Lighting to supplement the Contractor's portable construction and equipment lighting for the purpose of alerting motorist to the existence of an active work zone and to encourage compliance with the reduced work zone speed limit. See attached special provision.

2. Furnish and install Sequential Flashing Warning Lights on drums used for merging tapers to assist motorists in determining which direction to merge and to decrease late lane merging. See attached special provision.

E. Law Enforcement

Use two (2) off duty, uniformed law enforcement officers and official law enforcement vehicles, equipped with blue lights during lane closure operations and two (2) additional law enforcement officers for ramp/loop closures when both operations occur simultaneously.

Use law enforcement officers to assist in the shadowing of workers during the installation and during the removal of lane closures.

Law enforcement vehicles shall not be parked within the buffer space. When possible, position one law enforcement officer downstream of the other to conduct enforcement operations. When space is confined, conduct enforcement outside of the lane closure area.

17.2. TEMPORARY TRAFFIC CONTROL (TTC)

Refer to Standard Drawing No. 1101.02, 1101.11, 1110.01, 1110.02, 1115.01, 1130.01, 1135.01, 1165.01, and 1180.01 of the *2018 Roadway Standard Drawings* when closing a lane of travel in a stationary work zone.

Drums are recommended for all lane closure operations occurring at night. However, if skinny drums are used at night, they shall be placed every 20’ in the tangent sections of lane closure operations. Skinny drums shall not be used for upstream tapers.

When covering work zone signs, use an opaque material that prevents reading of the sign at night by a driver using high beam headlights. Use material which does not damage the sign sheeting.

17.3. TRAFFIC OPERATIONS

F. Project Requirements:

Failure to comply with the following requirements will result in a suspension of all other operations:

1. Prior to the commencement of construction activity, the Contractor shall submit a written construction sequence for traffic control and construction lighting to the Engineer at the first pre-construction meeting and the sequence must be approved before closing a lane of traffic. The Contractor and Engineer will coordinate with the State Work Zone Engineer at 919-814-5037 for additional traffic control guidance, as necessary.

2. The maximum length of lane closure is 1 mile unless permitted otherwise by the Engineer.

3. Perform work only when weather and visibility conditions allow safe operations as directed by the Engineer.

4. Obtain written approval of the Engineer before working in more than one location or setting up additional lane closures.

5. The Contractor on this and any adjacent projects, or subcontractors working within this project shall coordinate lane closure location, type, and direction with the Engineer to best maintain lane continuity through the limits of this and adjacent projects.

6. Operate equipment and conduct operations in the same direction as the flow of traffic. Maintain vehicular access in accordance with Article 1101-05 of the *2018 Standard Specifications.*

7. Provide appropriate construction lighting in accordance with Section 1413 of the *2018 Standard Specifications.*

8. Do not install proposed structures or equipment that are within 30 feet of an open travel lane prior to the installation of proposed guardrail.

G. Work Zone Signing:

1. Description

Install Work Zone Advance Warning Signs in accordance with Standard Drawing No. 1101.01 of the *2018 Roadway Standard Drawings* prior to beginning any other work.

Install and maintain signing in accordance with Divisions 11 and 12 of the *2018 Standard Specifications.*

2. Installation

All stationary Advance/General warning work zone signs require notification to existing Utility owners per Article 105-8 of the 2018 Standard Specifications and Special Provision SP1 G115 within 3 to 12 full working days prior to installation.

Install all Advance/General warning work zone signs before beginning work. If signs are installed more than seven (7) calendar days prior to the beginning of work, cover the signs until the work begins. Install each work zone Advance/General warning sign separately and not on the same post or stand with any other sign except where an advisory speed plate or directional arrow is used.

All sign locations to be verified by the Engineer prior to installation. Once the signs have been installed and accepted, any sign relocations requested by the Department will be compensated in accordance with Article 104-7. Any additional signs other than the ones required in this provision or attached drawings will be compensated in accordance with Article 104-7.

If there is a period of construction inactivity longer than 14 calendar days, remove or cover advance/general warning work zone signs. Uncover advance/general warning work zone signs no more than 7 calendar days before work resumes.

All other operations may be suspended upon failure to comply with the above requirements. Such suspended operations would not be resumed until the above requirements are fulfilled.

3. Sign Removal

Once the project is substantially complete, as determined by the Engineer, it is acceptable to remove the Stationary Work Zone Signs. Any remaining punch list items requiring traffic control are to be completed with portable work zone signing.

Stationary Work Zone Sign removal is a condition of final project acceptance.

4. Lane Closure Work Zone Signs

Install any required lane closure signing needed during the life of the project in accordance with the Standard Drawing No. 1101.02, 1101.11 and 1110.02 of the *2018 Roadway Standard Drawings.*

18. LUMP SUM PAYMENT FOR TRAFFIC CONTROL:

18.1. General

The Contractor shall provide, install and maintain all traffic control devices and maintain traffic on I-74 in accordance with the Work Zone Traffic Control for Interstate/Freeway ITS Installation Special Provision during construction or as directed by the Engineer.

The lump sum price bid for traffic control shall include labor, tools, equipment, and incidentals to furnish, install, maintain, and remove the following:

Work Zone Signs (Stationary)
Work Zone Signs (Portable)
Flashing Arrow Board
Portable Changeable Message Signs
Drums
Skinny Drums
Truck Mounted Impact Attenuator
Law Enforcement

18.2. Basis of Payment

Refer to the respective Sections of Division 11 and 12 of the 2018 Standard Specifications for the satisfactory installation and removal of temporary traffic control devices.

Partial payments will be made on each payment estimate based on the following: Fifty percent of the contract lump sum price bid will be paid on the first monthly estimate and the

remaining 50% of the contract lump sum price bid will be paid on each subsequent estimate based on the percent of the project completed.

Digital Speed Limit Signs, Connected Lane Closures, Sequential Flashing Warning Lights, and Work Zone Presence Lighting are paid separately in accordance with their respective special provisions.

Pay Item	**Pay Unit**
Traffic Control	Lump Sum

19. CONNECTED LANE CLOSURE DEVICES:

19.1. Description

Furnish, install, operate, maintain, relocate, and remove connected lane closure devices for use on Interstate and Freeway lane closures. The purpose of a Connected Lane Closure System (CLCS) is to transmit real-time information of active lane closures on Interstate and Freeways for use by the State Transportation Operations Center (STOC), Regional Transportation Management Centers (TMCs), and 511 systems; and for third party vendors (Mapping, Navigation, Connected Vehicles, etc.) to identify and provide advanced notification of active lane closures to approaching motorists.

19.2. Materials

The connected lane closure devices shall be designed and built to transmit the location of the real-time lane closure from the START to the END such that the full length of the lane closure is known. . The information transmitted shall be approved by each entity, conform to the current version of the USDOT's Work Zone Data Exchange (WZDx) specification and be publicly available to NCDOT approved consumers of this data. More information about the WZDx specification can be found at (https://www.transportation.gov/av/data/wzdx)

The connected lane closure devices shall be capable of wireless communication.

The initial connected device representing the START location shall be designed and attached to the flashing arrow board in such a manner that it is only activated when either the left or right arrows are displayed, not when the flashing arrow board is operated in caution mode. When the lane closure is removed, and the flashing arrow board turned off or changed to caution mode, the connected device shall automatically turn off simultaneously and its location shall no longer be transmitted. The device shall also have a visual indicator (e.g. an illuminated light either steady burn or flash) to allow clear, visual proof the device is powered on, has established

communication and is transmitting. The visual indicator shall not be located such that it potentially creates confusion to the motorists.

The second connected device representing the END location shall be installed on a crashworthy (e.g. NCHRP 350 or MASH-16) traffic control device. It shall have an easily accessible power switch and a small status indicator light mounted such that it is visible when passing by in a vehicle at operating speed. When switched to the ON position, the light shall indicate that device has established communication and is transmitting. The light may be either steady burn or flashing and shall not exceed one (1) inch in diameter. The second connected device representing the END location may be created virtually by a connected flashing arrow board.

The devices shall have battery life sufficient to maintain operation for the duration of the lane closure or have the ability to be recharged without deactivating the device or impacting the location of the lane closure information transmitted to the external parties. All costs associated with charging are incidental and shall be included in the cost of the system.

19.3. Construction Methods

Connected lane closure devices shall be used on all lane closures on freeways and interstates throughout the project.

A START and END location shall be established per grouping of lane closures (single, double, or triple); one attached and wired into the flashing arrow board at the beginning of the first taper, and the other at the last traffic control device at the end of the lane closure(s) if the END location cannot be created virtually. Supplemental flashing arrow boards in advance of the first lane closure taper or flashing arrow boards in subsequent lane closures (for double and triple lane closures) shall not be transmitting if equipped with connected devices. Subsequent lane closures occurring downstream of where all lanes have been reopened and lane closures in the opposite direction of travel will require additional connected devices.

The second connected lane closure device shall be manually turned ON and OFF by crews installing and removing the lane closure unless the device can be controlled or virtually created by the initial connected device. The unit shall be turned on immediately upon installation of the lane closure and turned off immediately upon removal of the lane closure.

Once installed, the Contractor shall verify that the connected lane closure devices are transmitting information prior to leaving the device unattended and re-verify transmission every 72 hours for long-term installations.

19.4. Technical Requirements

The connected devices shall be run continuously during any active lane closures for the length of the contract.

The GPS within the connected devices shall have a horizontal accuracy of 10 feet, 95% of the time.

The connected device information, including the location, transmission status, and battery status shall be transmitted within five (5) minutes of initiation and updated every thirty (30) minutes to the central server.

The contractor shall provide multiple logins to a secured server (e.g. vendor dashboard) that provides real-time and historic status. The status must be exportable, within 24 hours, in .csv or .xls format and include data for date, display direction, time on, time off, and GPS coordinates. The historic logged information shall be available to CLCS users 24/7/365 during the length of the entire construction phase. All logged information from the project shall be retained by the Contractor and be available to the NCDOT for at least one (1) year after the contract ends. Information shall include timestamps, device name, flashing arrow mode, communication status, battery voltage and GPS location.

The battery voltage shall be collected at least once an hour. The information shall be stored and available for troubleshooting. The system shall transmit an alert if the battery voltage of a device is under a specified threshold.

The CLCS shall provide an immediate electronic alert (e.g. via E-mail or SMS) to the Traffic Control Supervisor or other designated individual if a device is not transmitting its position for a period of 30 minutes or more.

The outputs from the connected device on the arrow board and the downstream connected (or virtual) device at the end of the lane closure shall be easily identifiable as a single system, either by sequential device IDs, identical project names, or other method as approved by the Engineer. Additional pairs on the project shall have unique identifiable information such that it is not confused with another project pair.

19.5. Measurement and Payment

Connected Lane Closure Devices will be measured and paid as the maximum number of connected devices acceptably placed and in use at any one time during the life of the project. Each lane closure system may be satisfied by one of the following:

- Two (2) connected lane closure devices; one connected to the flashing arrow board and the other on a crashworthy device at the downstream end of the lane closure.

- One (1) connected lane closure device connected to the flashing arrow board that can generate a virtual END location with 50’ accuracy.

All devices for each system must be functioning properly to receive payment for the system. No payment will be made for a system until all devices are satisfactorily installed and operational at

the device and on the vendors dashboard. A copy of the device status reporting should be provided by the contractor every 2 weeks.

The price for each connected lane closure system will cover all material, labor, maintenance, relocation, removal, and communication costs required for the duration of the project.

Flashing Arrow Boards will be measured and paid in accordance with Section 1115.

Crashworthy devices (such as drums) used to mount the downstream connected lane closure device shall be considered incidental.

Pay Item	**Pay Unit**
Connected Lane Closure System	Each

20. WORK ZONE DIGITAL SPEED LIMIT SIGNS

20.1. Description

Furnish and install Work Zone Digital Speed Limit Signs on interstates and freeways with speed limits of 55 mph or greater. These signs are regulatory speed limit signs with LED displays for the speed limit numbers.

20.2. Materials

Digital Speed Limit Signs shall be a minimum 36” wide x 48” high. The speed limit sign (R2-1) shall be black on white with high intensity white prismatic sheeting.

The Digital Speed Limit Sign shall be mounted such that the bottom of the sign is 7’ above roadway.

The LED panel shall be a minimum of 28” wide x 18” high. The display on the LED panel shall be amber or white.

The LED numbers shall have a minimum 5 wide by 7 high pixel array with a minimum height of 18”.

The LED panel shall have auto brightness/dimming capability.

The black on orange “WORK ZONE” sign shall be mounted above the speed limit sign. It shall be 36” wide x 24” high with high intensity prismatic orange sheeting.

The black on white “$250 FINE” sign shall be mounted below the speed limit sign. It shall be 36” wide x 24” high with high intensity prismatic white sheeting.

All digital speed limit systems shall have operational software and wireless communications that allows for remote operation and data monitoring. It shall be configured to allow access by the Engineer or their designee to change each sign independently or change the speed limit on all signs at once from a PC, tablet or cellular phone application.

Radar equipment to detect approaching speeds on the digital speed limit systems is optional. However, if the systems have radar, they will be equipped to store the detected speed data, this information should be available in a spreadsheet format and accessed remotely from a secure cloud location.

The Work Zone Digital Speed Limit systems shall have flashing beacons. The beacons are to be a minimum of 8” diameter LED circular yellow. They shall be mounted above and below the sign assemblies and are to be centered. The beacons shall alternately flash at rates not less than 50 or more than 60 times per minute.

In addition, the flashing beacons shall be mounted in such a manner that the $250 FINE sign is not obscured when in operation.

Digital Speed Limit Signs may be trailer mounted or stationary mounted. The unit shall be solar powered and have the ability to operate continuously. It shall be supplemented with a battery backup system which includes a 110/120 VAC powered on-board charging system.

The batteries, when fully charged, shall be capable of powering the display for 20 continuous days with no solar power. The unit shall be capable of being powered by standard 110/120 VAC power source.

Store the battery bank and charging system in a lockable, weather and vandal resistant box.

All Work Zone Digital Speed Limit Sign equipment shall be on the NCDOT Approved Products List.

20.3. Digital Speed Limit Displays

The speed limit shall be continuously displayed on the signs. All other stationary speed limit signs shall be covered when Digital Speed Limit systems are in operation.

A. Reduced Speed Limit Displays

The Digital Speed Limit systems shall have beacons activated when the work zone speed limit is reduced. Otherwise, the beacons are to remain off.

IF THE DIGITAL SPEED LIMIT SYSTEM IS EQUIPPED WITH RADAR: The Digital Speed Limit Signs shall display the reduced work zone speed limit without flashing the LED speed limit number unless approaching speeds are detected to be 6 MPH or higher than the displayed speed limit. If speeds are detected 6 MPH or above the displayed Speed Limit, then the LED shall flash the speed limit until the speeds are within the 6 MPH tolerance.

B. Existing Speed Limit Displays

When the existing speed limit is displayed on the Digital Speed Limit Signs, the beacons are to remain off.

IF THE DIGITAL SPEED LIMIT SYSTEM IS EQUIPPED WITH RADAR: The speed limit number is not to flash unless the approaching speeds are detected to be 6 MPH or higher than the displayed speed limit.

20.4. Other Construction Methods

The speed limits are the sole authority of the NCDOT. An ordinance by the State Traffic Engineer is required for all speed limits in order to have a lawfully enforceable speed limit.

The Regional Traffic Engineering Office and the Division Construction Engineer in coordination with the Work Zone Traffic Control Section will provide all work zone speed limit recommendations based on activities and conditions.

The Contractor will be responsible for coordinating with the Engineer when the work zone speed limits are to be changed and will have to seek approval by the Engineer or their designee before the speed limit is changed.

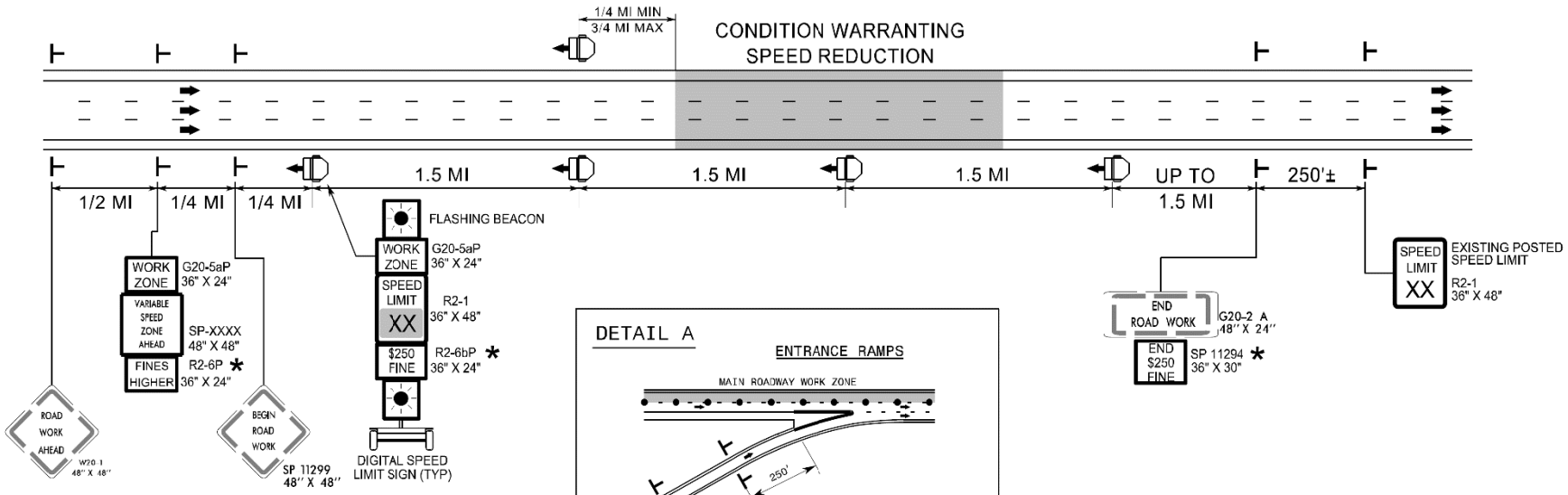
Whenever possible, each trailer mounted unit shall be placed on the paved shoulder and shall have the capability of being leveled.

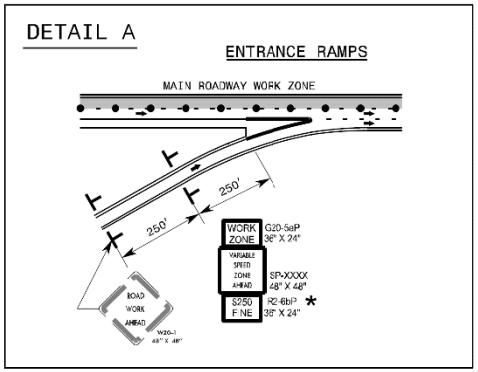
20.5. Measurement and Payment

Work Zone Digital Speed Limit Signs will be measured and paid as the maximum number of Work Zone Digital Speed Limit Signs satisfactorily installed according to the attached detail and properly functioning at any one time during the life of the project.

This includes all materials and labor to install, maintain and remove all the Work Zone Digital Speed Limit Signs.

Pay Item	**Pay Unit**
Work Zone Digital Speed Limit Signs	Each





* USE ONLY IF ORDINANCED. SEE NOTE 5 BELOW.

NOTES

1. THE DIGITAL SPEED LIMITS SIGNS WILL BE INSTALLED (TRAILER MOUNTED OR STATIONARY MOUNTED) IN ADVANCE OF AND SPACED APPROXIMATELY 1.5 MILES THROUGHOUT THE THE PROJECT LIMITS, UNLESS DIRECTED OTHERWISE.
2. WITHIN ¼ TO ¾ MILE UPSTREAM OF CONDITION WARRANTING A SPEED REDUCTION, PLACE A DIGITAL SPEED LIMIT SIGN ON BOTH THE INSIDE AND OUTSIDE SHOULDERS, UNLESS DIRECTED OTHERWISE BY THE ENGINEER. AT ALL OTHER LOCATIONS DOWNSTREAM, PLACE A SINGLE DIGITAL SPEED LIMIT SIGN ON THE OUTSIDE SHOULDER.

   IF SIGNS ARE NOT HIGHLY VISIBLE TO ALL MOTORISTS, SUPPLEMENTAL DIGITAL SPEED LIMIT SIGNS ARE PERMITTED ON THE MEDIAN SHOULDER.
3. THE DIGITAL SPEED LIMIT SIGNS TAKE PRECEDENCE OVER EXISTING SPEED LIMIT SIGNS AND SHOULD REMAIN UPRIGHT AND VISIBLE AT ALL TIMES. ALL EXISTING SPEED LIMIT SIGNS SHALL BE COVERED OR REMOVED FOR DURATION OF THE PROJECT.
4. NCDOT HAS SOLE AUTHORITY OF THE SPEED LIMITS DISPLAYED ON THE DIGITAL SPEED LIMIT SIGNS.
5. THE WORK ZONE VARIABLE SPEED LIMIT AND THE $250 SPEEDING PENALTY ARE SEPARATE ORDINANCES THAT MUST BE SIGNED BY THE STATE TRAFFIC ENGINEER TO BE VALID AND ENFORCEABLE. WITHOUT SIGNED ORDINANCES, THE SPEED LIMIT ON A FACILITY SHALL REMAIN UNCHANGED AND/OR HIGHER FINES SIGNS SHALL NOT BE USED.
6. THE REDUCED SPEED SHALL BE DISPLAYED A MINIMUM OF ¼ MILE AND A MAXIMUM OF ¾ MILE IN ADVANCE OF AND THROUGHOUT THE AREA MEETING CONDITIONS LISTED IN THE CHART. THE EXISTING SPEED LIMIT SHALL BE DISPLAYED ON ALL OTHER DIGITAL SPEED LIMIT SIGNS.
7. THE SPEED DISPLAYED SHALL BE THE LOWER OF THE EXISTING SPEED LIMIT OR THE SPEED IN THE WORK ZONE CONDITION CHART.
8. THE BEACONS ON THE DIGITAL SPEED LIMIT SIGNS SHALL ONLY FLASH DURING TIMES THE SPEED IS REDUCED, AND REMAIN OFF AT ALL OTHER TIMES.

	WORK ZONE CONDITIONS	SPEED TO DISPLAY (SEE NOTE 6 & 7)
LANE CLOSURES	2 LANES REDUCED TO 1 LANE	55
	3 LANES REDUCED TO 1 LANE	55
	3 LANES REDUCED TO 2 LANES	60
	4 LANES REDUCED TO 1 LANE	55
	4 LANES REDUCED TO 2 LANES	60
	4 LANES REDUCED TO 3 LANES	65
CONTINUOUS BARRIER (LENGTH OF BARRIER GREATER THAN 1 MILE)	1 OPEN LANE WITH CONTINUOUS BARRIER ON BOTH SHOULDERS	55
	1 OPEN LANE WITH CONTINUOUS BARRIER ON 1 SHOULDER	60
	3 OR 2 OPEN LANES WITH CONTINUOUS BARRIER ON BOTH SHOULDERS	60
	3 OR 2 OPEN LANES WITH CONTINUOUS BARRIER ON 1 SHOULDER	65
	4 OPEN LANES WITH BARRIER CONTINUOUS ON BOTH SHOULDERS	65
	4 OPEN LANES WITH BARRIER CONTINUOUS ON 1 SHOULDER	EXISTING
	UNEVEN LANES	60

SIGN NUMBER: WZTC
TYPE: STATIONARY
QUANTITY: SEE PLANS

SIGN WIDTH: 4′-0″
HEIGHT: 4′-0″
TOTAL AREA: 16.0 Sq.Ft.

BORDER TYPE: INSET
RECESS: 0.47″
WIDTH: 0.63″
RADII: 1.5″

NO. Z BARS: 2
LENGTH: 40.0

BACKG COLOR: Fluorescent Orange
COPY COLOR: Black

SYMBOL	X	Y	WID	HT

MAT′L: 0.080″ (2.0 mm) ALUMINUM

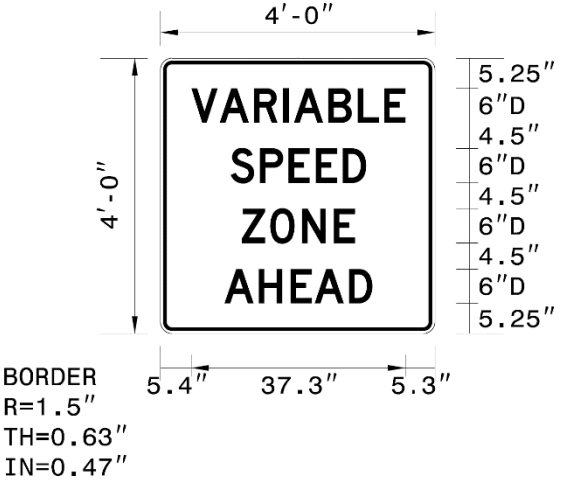
DESIGN BY: J.Navarrete
PROJECT ID:

CHECKED BY:
LOCATION:

May 13, 2019
DIV: DIV

USE NOTES: 1,2

1. Legend and border shall be direct applied black non-reflective sheeting.
2. Background shall be NC GRADE B fluorescent orange retroreflective sheeting.



Spacing Factor is 1 unless specified otherwise

LETTER POSITIONS

Letter spacings are to start of next letter

																									Series/Size Text Length
	V	A	R	I	A	B	L	E																	D 2000
5.4	4.9	6	5.1	1.9	6	5.1	4.6	3.7	5.3																37.3
	S	P	E	E	D																				D 2000
12.2	5.1	5	4.7	4.7	4.1	12.1																			23.6
	Z	O	N	E																					D 2000
14.2	5	5.6	5.5	3.7	14																				19.8
	A	H	E	A	D																				D 2000
11.2	6	5.5	4.2	6	4.1	11																			25.8

FILENAME: Special Signs 7

NORTH CAROLINA D.O.T. SIGN DETAIL

21. WORK ZONE PRESENCE LIGHTING

21.1. Description

Furnish and install Work Zone Presence Lighting during nightly lane closures on multilane roadways with speed limits of 55 mph or greater.

21.2. Materials

Anti-glare lighting systems are required. Work Zone Presence Lighting shall be installed in accordance with the attached detail and the Manufacturer's recommendations.

Supply a power source for each light to provide the light output as described in the chart below.

Each light unit shall be capable of providing a minimum of 14,000 lumens illuminating a minimum area of approximately 3,000 square feet. The light shall be capable of being elevated to a height of 14 feet above the pavement.

Each light unit support base or mounting stand shall have the capability of being leveled such that the light mast is plumb.

Provide Work Zone Presence Lighting listed on the NCDOT Approved Products List.

21.3. Construction Methods

Work Zone Presence Lighting is permitted to be pre-staged (up to 1 hour prior for single lane closures and up to 2 hours prior for double or triple lane closures) along with other traffic control devices or installed within 1 hour after the necessary traffic control has been installed for the lane closure(s). At the end of the work night, the Work Zone Presence Lighting shall be removed within 1 hour before or after the lane closure(s) is removed.

Whenever possible, each light unit shall be placed on the outside paved shoulder, a minimum of 4 feet from the travel lane and spaced according to the chart below based on the amount of light output for each unit.

Work Zone Presence Lighting is permitted to supplement the Portable Construction Lighting inside the lane closure. At no time shall Work Zone Presence Lighting be used in lieu of Portable Construction Lighting when required.

If there is sufficient existing overhead lighting, Work Zone Presence Lighting may be eliminated as directed by the Engineer.

21.4. Lighting Unit Installation Requirements

The lighting units shall be installed in advance of the lane closure as shown on the attached detail and spaced according to the chart below:

		AREA 1		AREA 2	
Light Output (Lumens)	**Illuminated Fixture Area (Sq. Ft.)**	**# of Lights**	**Spacing***	**# of Lights**	**Spacing***
14,000 - 35,000	4	6	640’ (16 skips)	8	480’ (12 skips)
35,001 - 59,999	5	5	800’ (20 skips)	6	640’ (16 skips)
60,000+	6+	4	1,000’ (25 skips)	5	800’ (20 skips)

*Skips refer to traditional 10’ pavement marking lines with 30’ gaps.

Area 1: Begins 2,640’ downstream from CMS; Extends to just past 1st Lane Closure Sign

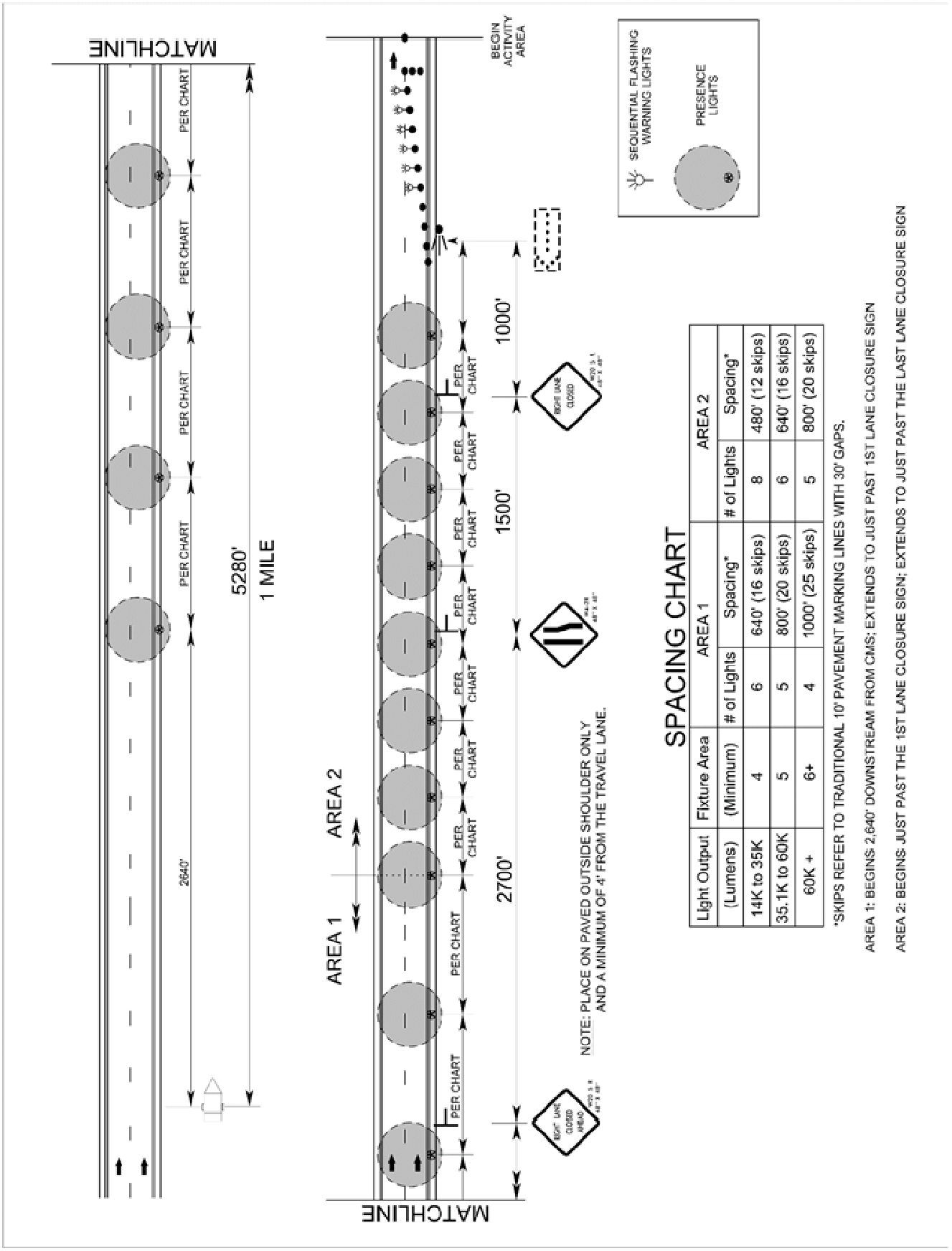
Area 2: Begins just past the 1st Lane Closure Sign; Extends to just past the last Lane Closure Sign

21.5. MEASUREMENT AND PAYMENT

Work Zone Presence Lighting will be measured and paid as the maximum number of lighting units satisfactorily placed, accepted by the Engineer, and in use at any one time during the life of the project.

Relocation, replacement, repair, removal, and maintenance of Work Zone Presence Lighting units will be incidental to the work of this section. No measurement or separate payment will be made for power generators, batteries, or other power supply devices.

Pay Item	**Pay Unit**
Work Zone Presence Lighting	Each



SPACING CHART

Light Output	Fixture Area	AREA 1		AREA 2	
(Lumens)	(Minimum)	# of Lights	Spacing*	# of Lights	Spacing*
14K to 35K	4	6	640' (16 skips)	8	480' (12 skips)
35.1K to 60K	5	5	800' (20 skips)	6	640' (16 skips)
60K +	6+	4	1000' (25 skips)	5	800' (20 skips)

*SKIPS REFER TO TRADITIONAL 10' PAVEMENT MARKING LINES WITH 30' GAPS.

AREA 1: BEGINS 2,640' DOWNSTREAM FROM CMS; EXTENDS TO JUST PAST 1ST LANE CLOSURE SIGN

AREA 2: BEGINS JUST PAST THE 1ST LANE CLOSURE SIGN; EXTENDS TO JUST PAST THE LAST LANE CLOSURE SIGN

22. SEQUENTIAL FLASHING WARNING LIGHTS

22.1. Description

Furnish, install, relocate, maintain, and remove sequential flashing warning lights on drums used for the merging tapers of nighttime lane closures.

Materials

Provide sequential flashing warning lights that meet all of the requirements for Type A warning lights in accordance with the Manual of Uniform Traffic Control Devices (MUTCD).

Each light unit shall be capable of operating fully and continuously for a minimum of 200 hours when equipped with a standard battery set.

Each light in the sequence shall be flashed at a rate of not less than 55 times per minute and not more than 75 times per minute. The flash rate and flash duration shall be consistent throughout the sequence.

The lights shall be weather independent and visual obstructions shall not interfere with the operation of the lights.

Use sequential flashing warning lights listed on the NCDOT Approved Products List.

22.2. Construction Methods

Use sequential flashing warning lights on all multilane roadways with speed limits of 55 mph or greater.

These lights shall flash sequentially beginning with the first light and continuing until the final light.

The sequential flashing warning lights shall automatically flash in sequence when placed on the drums that form the merging taper.

The number of lights used in the drum taper shall equal the number of drums used in the taper.

Drums are the only channelizing device allowed to mount sequential flashing warning lights.

The sequential flashing warning lights shall automatically sequence when placed in line in an open area with a distance between lights of 10 to 100 feet.

If one light fails, the flashing sequence shall continue. If more than 1 light fails, all of the lights are to be automatically turned to the “off” mode. Non-sequential flashing is prohibited.

When lane closures are not in effect, the sequential flashing warning lights shall be deactivated.

22.3. Maintenance

Periodically inspect sequential flashing warning lights. Replace any sequential flashing warning lights as needed.

22.4. Measurement and Payment

Sequential Flashing Warning Lights will be measured and paid as the maximum number of sequential flashing warning lights satisfactorily installed and properly functioning at any one time during the life of the project.

This includes all materials and labor to install, maintain and remove all the Sequential Flashing Warning Lights.

Pay Item	**Pay Unit**
Sequential Flashing Warning Lights	Each

County: SURRY

Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
			ROADWAY ITEMS			
0001	0000100000-N	800	MOBILIZATION	Lump Sum	L.S.	
0002	4054000000-E	902	PLAIN CONCRETE SIGN FOUNDATIONS	1 CY		
0003	4060000000-E	903	SUPPORTS, BREAKAWAY STEEL BEAM	314 LB		
0004	4066000000-E	903	SUPPORTS, SIMPLE STEEL BEAM	930 LB		
0005	4110000000-N	904	SIGN ERECTION, TYPE *** (GROUND MOUNTED) A	2 EA		
0006	4110000000-N	904	SIGN ERECTION, TYPE *** (GROUND MOUNTED) B	4 EA		
0007	4138000000-N	907	DISPOSAL OF SUPPORT, STEEL BEAM	1 EA		
0008	4141000000-N	907	DISPOSAL OF SUPPORT, WOOD	2 EA		
0009	4236000000-N	907	DISPOSAL OF SIGN, A & B (GROUND MOUNTED)	1 EA		
0010	4423000000-N	SP	WORK ZONE DIGITAL SPEED LIMIT SIGNS	2 EA		
0011	4424000000-N	SP	WORK ZONE PRESENCE LIGHTING	14 EA		
0012	4434000000-N	SP	SEQUENTIAL FLASHING WARNING LIGHTS	12 EA		
0013	4589000000-N	SP	GENERIC TRAFFIC CONTROL ITEM TRAFFIC CONTROL	Lump Sum	L.S.	
0014	4600000000-N	SP	GENERIC TRAFFIC CONTROL ITEM CONNECTED LANE CLOSURE SYSTEM	1 EA		
0015	7279000000-E	1715	TRACER WIRE	5,410 LF		
0016	7300000000-E	1715	UNPAVED TRENCHING (**********) (1) 2"	4,625 LF		

County: SURRY

Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0017	7300000000-E	1715	UNPAVED TRENCHING (**********) (2) 2"	1,540 LF		
0018	7300000000-E	1715	UNPAVED TRENCHING (**********) (3) 2"	690 LF		
0019	7301000000-E	1715	DIRECTIONAL DRILL (**********) (2) 2"	460 LF		
0020	7324000000-N	1716	JUNCTION BOX (STANDARD SIZE)	10 EA		
0021	7348000000-N	1716	JUNCTION BOX (OVER-SIZED, HEAVY DUTY)	25 EA		
0022	7360000000-N	1720	WOOD POLE	1 EA		
0023	7444000000-E	1725	INDUCTIVE LOOP SAWCUT	400 LF		
0024	7456000000-E	1726	LEAD-IN CABLE (**********) 18-2	2,500 LF		
0025	7516000000-E	1730	COMMUNICATIONS CABLE (** FIBER) 12-FIBER	1,400 LF		
0026	7540000000-N	1731	SPLICE ENCLOSURE	1 EA		
0027	7552000000-N	1731	INTERCONNECT CENTER	4 EA		
0028	7566000000-N	1733	DELINEATOR MARKER	10 EA		
0029	7684000000-N	1750	SIGNAL CABINET FOUNDATION	2 EA		
0030	7901000000-N	1753	CABINET BASE EXTENDER	2 EA		
0031	7980000000-N	SP	GENERIC SIGNAL ITEM 1KVA SINGLE PHASE STEP-UP/STEP-DOWN TRANSFORMER	2 EA		
0032	7980000000-N	SP	GENERIC SIGNAL ITEM 5/8" X 10' GROUNDING ELECTRODE	2 EA		
0033	7980000000-N	SP	GENERIC SIGNAL ITEM AUTOMATED LICENSE PLATE READER SYSTEM	1 EA		

County: SURRY

Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0034	7980000000-N	SP	GENERIC SIGNAL ITEM AUTOMATED TIRE MONITORING SYSTEM	1 EA		
0035	7980000000-N	SP	GENERIC SIGNAL ITEM BASE MOUNTED EQUIPMENT CABINET	2 EA		
0036	7980000000-N	SP	GENERIC SIGNAL ITEM CHANGEABLE MESSAGE SIGN	2 EA		
0037	7980000000-N	SP	GENERIC SIGNAL ITEM COMPUTER WORKSTATION	1 EA		
0038	7980000000-N	SP	GENERIC SIGNAL ITEM ETHERNET EDGE SWITCH	2 EA		
0039	7980000000-N	SP	GENERIC SIGNAL ITEM MODIFY ELECTRICAL SERVICE	1 EA		
0040	7980000000-N	SP	GENERIC SIGNAL ITEM OVERVIEW CAMERA ASSEMBLY	1 EA		
0041	7980000000-N	SP	GENERIC SIGNAL ITEM PRINTER	1 EA		
0042	7980000000-N	SP	GENERIC SIGNAL ITEM SERVER	1 EA		
0043	7980000000-N	SP	GENERIC SIGNAL ITEM TRANSFORMER/EQUIPMENT CABINET DISCONNECT	2 EA		
0044	7980000000-N	SP	GENERIC SIGNAL ITEM UPS	3 EA		
0045	7980000000-N	SP	GENERIC SIGNAL ITEM WEIGH IN MOTION SYSTEM	1 EA		
0046	7985000000-N	SP	GENERIC SIGNAL ITEM CENTRAL CONTROL SOFTWARE	Lump Sum	L.S.	
0047	7985000000-N	SP	GENERIC SIGNAL ITEM SYSTEM WARRANTY	Lump Sum	L.S.	
0048	7985000000-N	SP	GENERIC SIGNAL ITEM TRAINING	Lump Sum	L.S.	
0049	7990000000-E	SP	GENERIC SIGNAL ITEM #4 SOLID BARE GROUNDING CONDUCTOR	90 LF		

County: SURRY

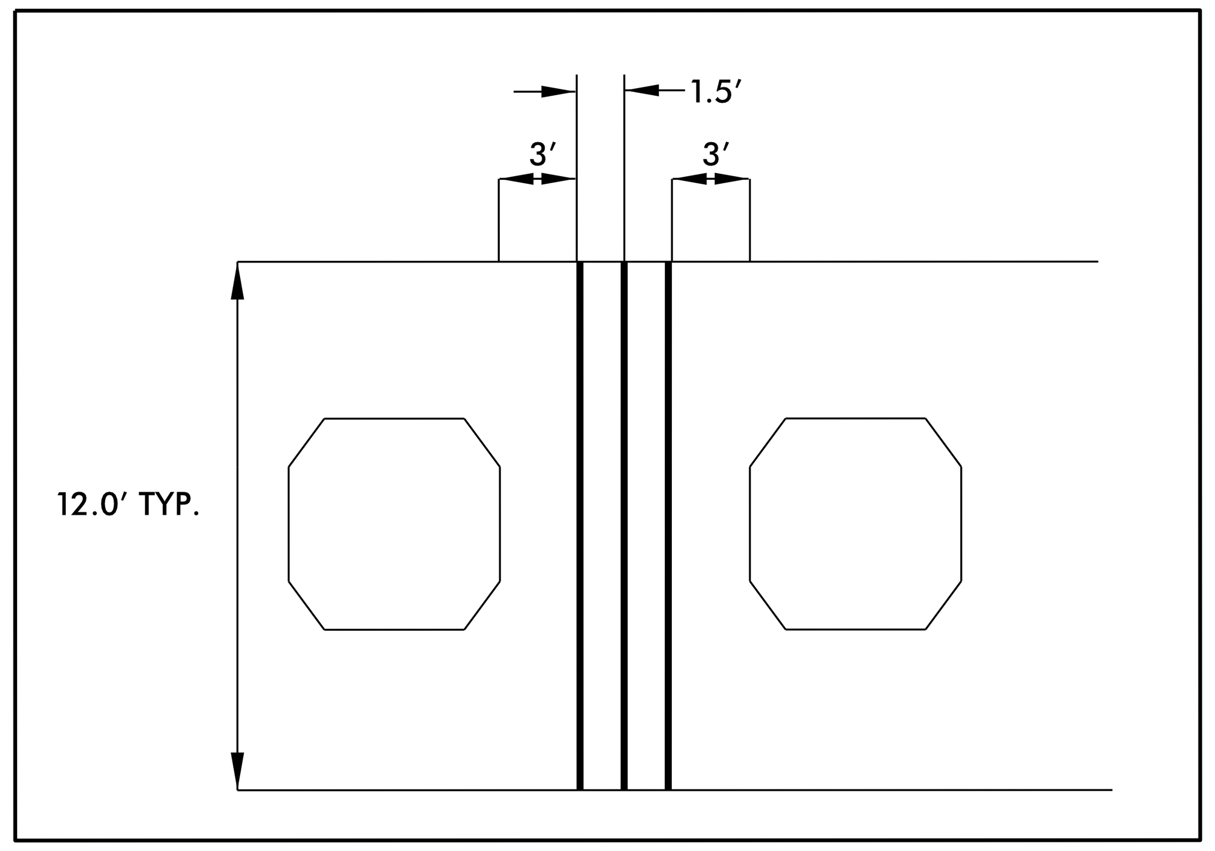
Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0050	7990000000-E	SP	GENERIC SIGNAL ITEM 3-WIRE COPPER FEEDER CONDUCTORS	3,135 LF		
0051	7990000000-E	SP	GENERIC SIGNAL ITEM ETHERNET CABLE (LONG HAUL)	150 LF		

0946/Oct10/Q21767/D342181100000/E51

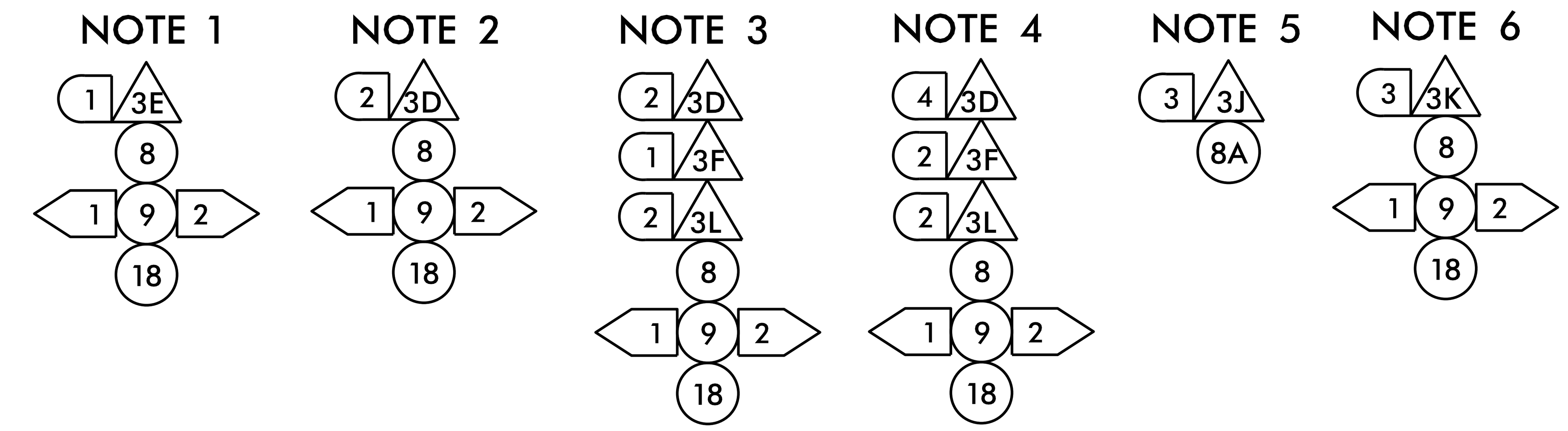
Total Amount Of Bid For Entire Project :

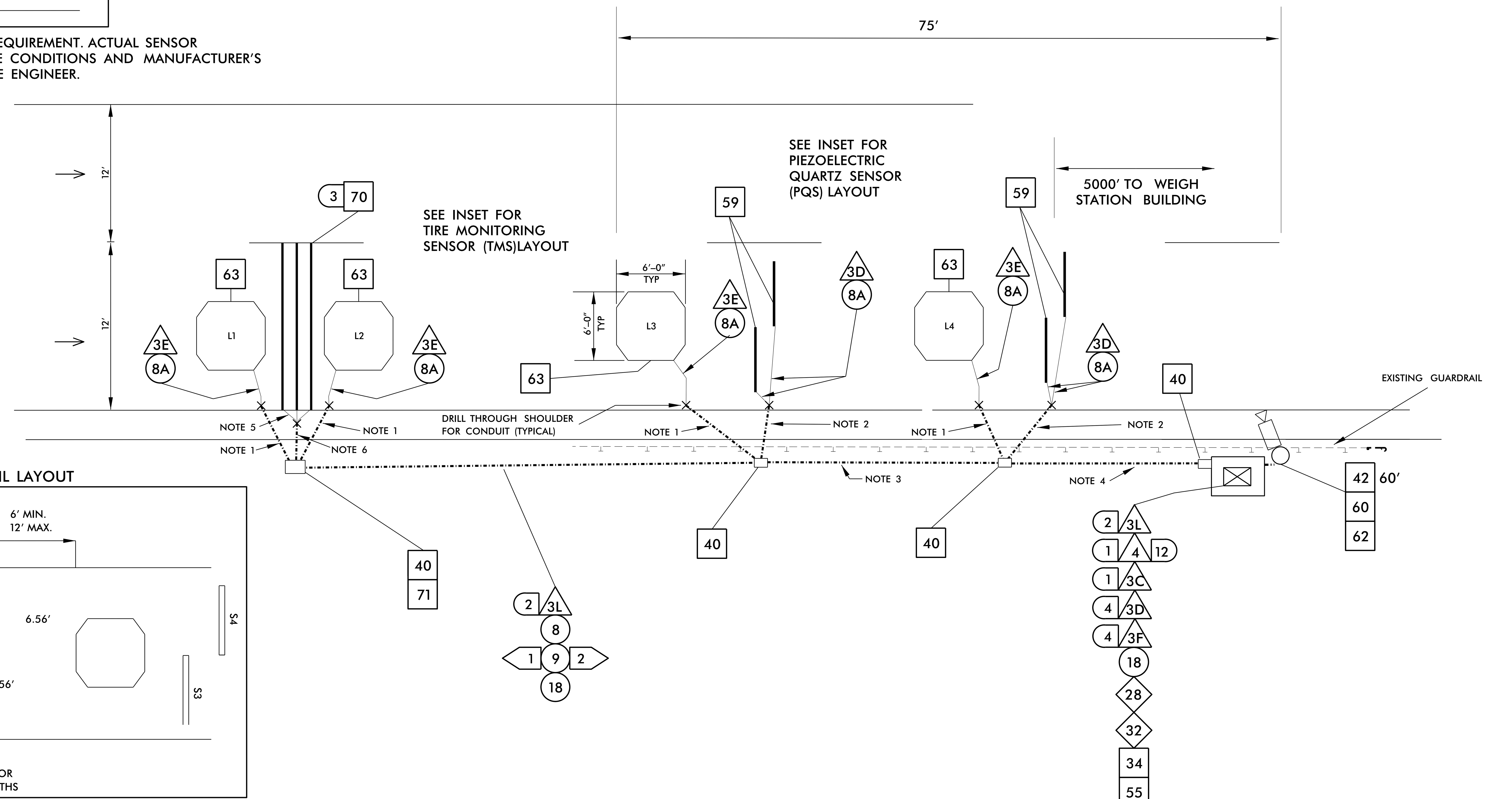
PROJECT REFERENCE NO.	SHEET NO.
33879.2.101	ITS-12

TMS DETAIL LAYOUT

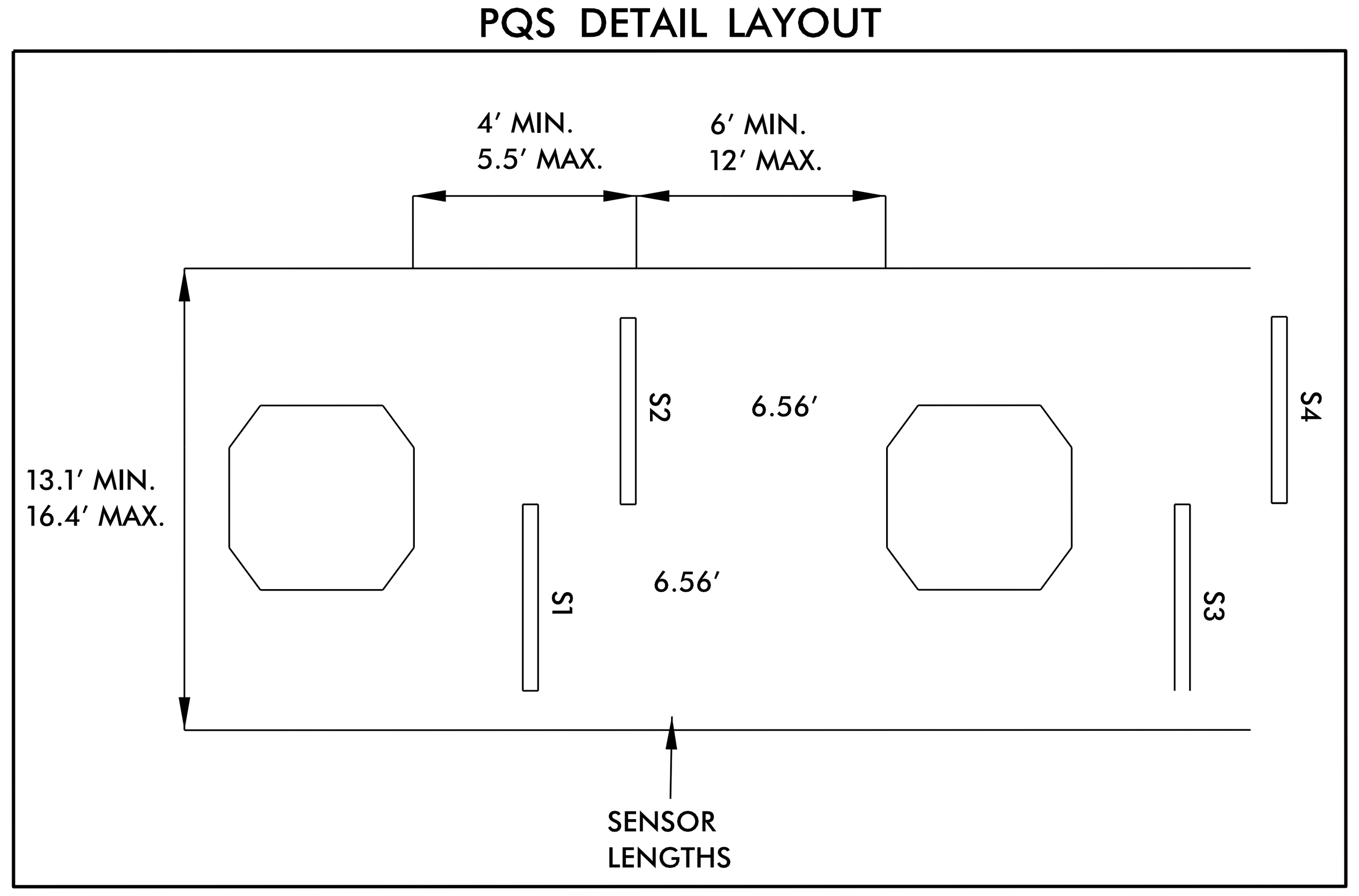


SENSOR SPACING SHOWN IS TYPICAL REQUIREMENT. ACTUAL SENSOR SPACING MAY BE ALTERED TO SUIT SITE CONDITIONS AND MANUFACTURER'S SPECIFICATIONS UPON APPROVAL BY THE ENGINEER.





PQS DETAIL LAYOUT



SENSOR SPACING SHOWN IS TYPICAL REQUIREMENT. ACTUAL SENSOR SPACING MAY BE ALTERED TO SUIT SITE CONDITIONS AND MANUFACTURER'S SPECIFICATIONS UPON APPROVAL BY THE ENGINEER.

NOTES:

A. EXISTING FIBER OPTIC CABLE AND CONDUIT SYSTEM RUNS FROM THE WEIGH STATION BUILDING TO THE EXISTING "OPEN/CLOSED" SIGN. IN ADDITION, THERE IS AN EXISTING QUEUE DETECTION SYSTEM AND OVERHEAD LIGHTING CIRCUITS ON THE RAMP. BEFORE BEGINNING ANY UNDERGROUND WORK CONTACT THE DIVISION TRAFFIC ENGINEER TO LOCATE THE EXISTING UNDERGROUND COMPONENTS.

B. PIEZOELECTRIC QUARTZ SENSOR AND INDUCTIVE LOOP SAW SLOTS, INCLUDING TAIL AND LEAD-IN SECTIONS, MUST BE DRY CUT.

Prepared in the Offices of:
750 N. Greenfield Pkwy., Garner, NC 27529

ADVANCE LOCATION AND WIM DETAIL

DIVISION 11 SURRY COUNTY MT. AIRY

PLAN DATE: SEPTEMBER 2023 REVIEWED BY:

PREPARED BY: A. J. SKUCE

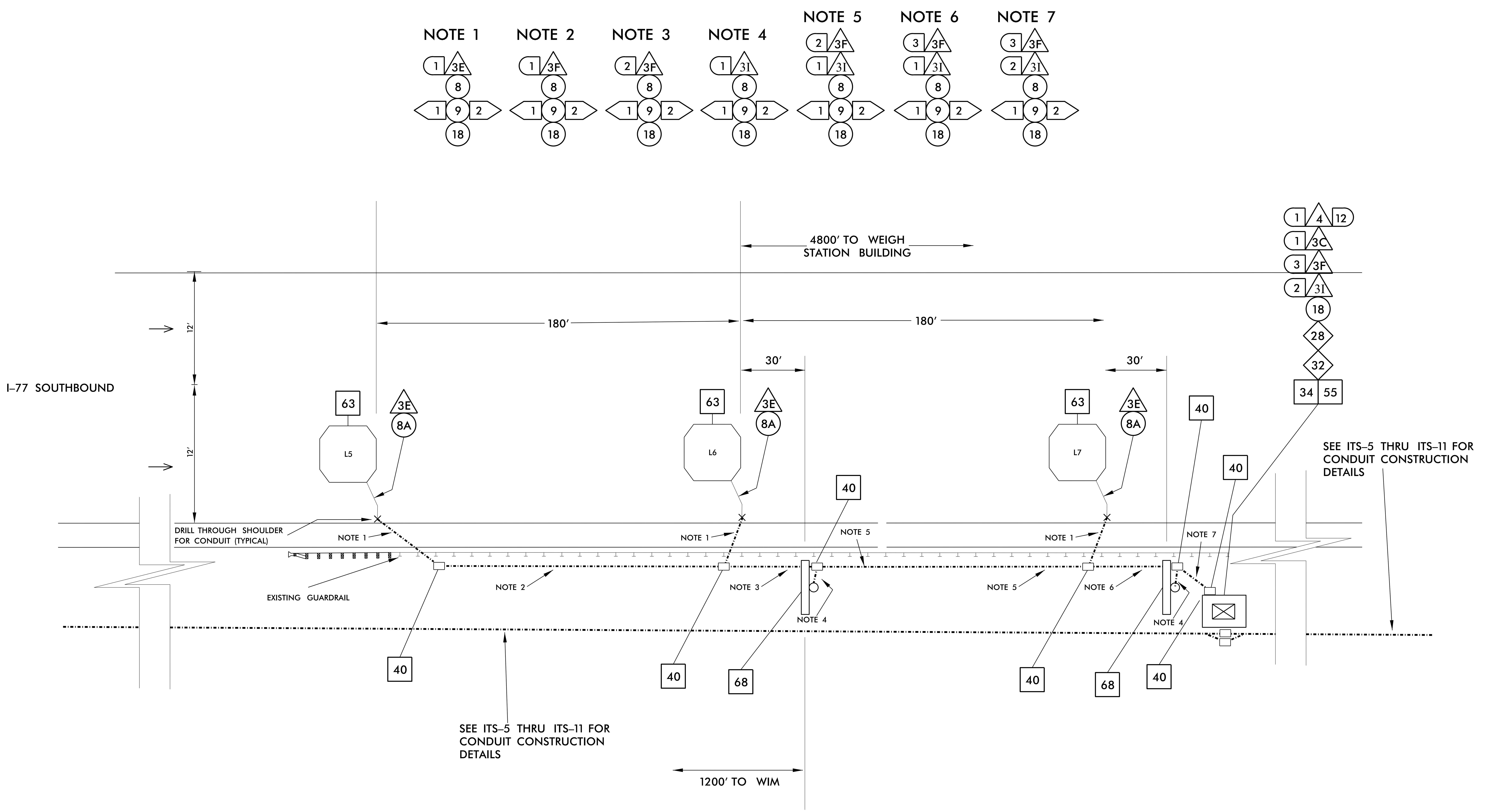
SCALE: NOT TO SCALE

REVISIONS	INIT.	DATE

SEAL
NORTH CAROLINA PROFESSIONAL ENGINEER
SEAL 050152
ANDREW J. SKUCE

DocuSigned by: Andrew J. Skuce

09/19/2023
DATE



DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

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B. INDUCTIVE LOOP SAW SLOTS, INCLUDING TAIL AND LEAD-IN SECTIONS, CAN BE WET CUT AT THIS LOCATION.

Prepared in the Offices of: Transportation Mobility and Safety Division, Intelligent Transportation Systems Section
750 N. Greenfield Pkwy., Garner, NC 27529

NOTIFICATION LOCATION, AVI READER, & CHANGEABLE MESSAGE SIGNS

DIVISION 11	SURRY COUNTY	MT. AIRY
PLAN DATE: JULY 2023	REVIEWED BY:	
PREPARED BY: A. J. SKUCE		

SCALE: NOT TO SCALE

REVISIONS	INIT.	DATE

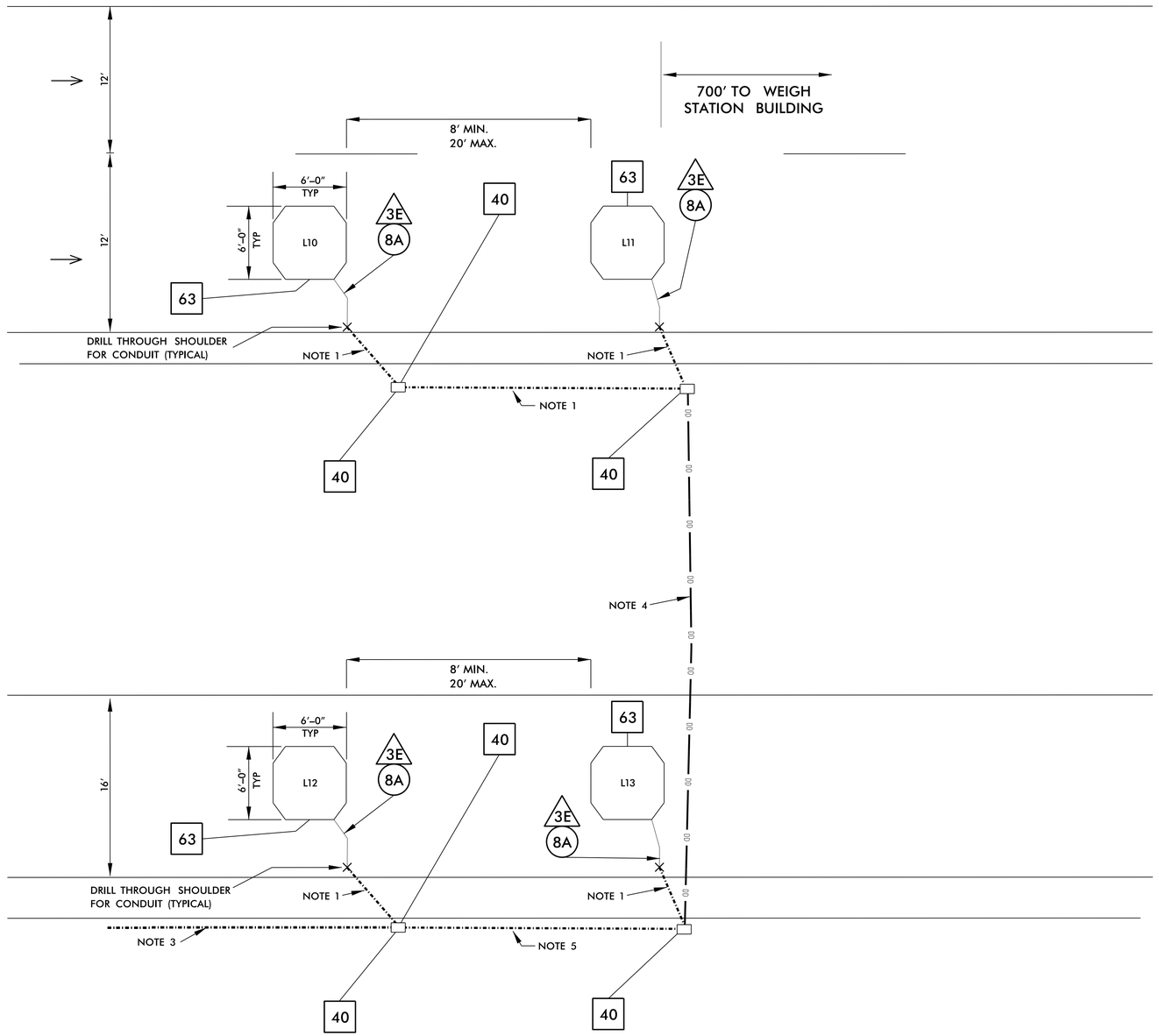
SEAL NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 050152 ANDREW J. SKUCE

DocuSigned by: Andrew J. Skuce D262B8BC8B5C484...

09/19/2023
DATE

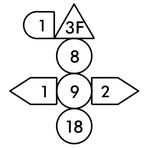
PROJECT REFERENCE NO.	SHEET NO.
33879.2.101	ITS-14

I–77 SOUTHBOUND
MAIN LINE



WEIGH STATION
RAMP LANE

NOTE 1



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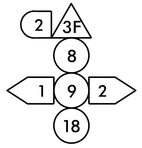

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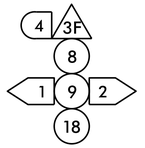

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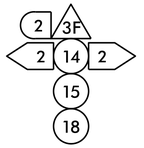
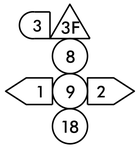


NOTE 5



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DOCUMENT NOT CONSIDERED FINAL
UNLESS ALL SIGNATURES COMPLETED

Prepared in the Offices of:
Transportation Mobility and Safety Division
STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
Integrated Transportation Solutions
750 N. Greenfield Pkwy., Garner, NC 27529

COMPLIANCE LOCATION

DIVISION 11 SURRY COUNTY MT. AIRY

PLAN DATE: JULY 2023 REVIEWED BY:

PREPARED BY: A.J. SKUCE

SCALE: NOT TO SCALE

REVISIONS	INIT.	DATE

SEAL
NORTH CAROLINA PROFESSIONAL
SEAL 050152
ENGINEER
ANDREW J. SKUCE

DocuSigned by:
Andrew J. Skuce
D262B8BC8B5C464...

09/19/2023
DATE