STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH, N.C.

PROPOSAL

Revised 3-11-14

DATE AND TIME OF BID OPENING: **MARCH 18, 2014 AT 2:00 PM**

CONTRACT ID	C203357
WBS	41188.3.FS1
FEDERAL-AID NO.	IMS-085-1(106)3
COUNTY	GASTON
T.I.P. NO.	I-4928
MILES	2.244
ROUTE NO.	I 85
LOCATION	I-85 NBL WEIGH STATION FROM SR-1302 (CROWDERS MOUNTAIN RD) TO SR-1307 (EDGEWOOD RD).
TYPE OF WORK	WEIGH STATION, GRADING, DRAINAGE, PAVING, LIGHTING & CULVERT

NOTICE:

ALL BIDDERS SHALL COMPLY WITH ALL APPLICABLE LAWS REGULATING THE PRACTICE OF GENERAL CONTRACTING AS CONTAINED IN CHAPTER 87 OF THE GENERAL STATUTES OF NORTH CAROLINA WHICH REQUIRES THE BIDDER TO BE LICENSED BY THE N.C. LICENSING BOARD FOR CONTRACTORS WHEN BIDDING ON ANY NON-FEDERAL AID PROJECT WHERE THE BID IS $30,000 OR MORE, EXCEPT FOR CERTAIN SPECIALTY WORK AS DETERMINED BY THE LICENSING BOARD. BIDDERS SHALL ALSO COMPLY WITH ALL OTHER APPLICABLE LAWS REGULATING THE PRACTICES OF ELECTRICAL, PLUMBING, HEATING AND AIR CONDITIONING AND REFRIGERATION CONTRACTING AS CONTAINED IN CHAPTER 87 OF THE GENERAL STATUTES OF NORTH CAROLINA. NOTWITHSTANDING THESE LIMITATIONS ON BIDDING, THE BIDDER WHO IS AWARDED ANY FEDERAL - AID FUNDED PROJECT SHALL COMPLY WITH CHAPTER 87 OF THE GENERAL STATUTES OF NORTH CAROLINA FOR LICENSING REQUIREMENTS WITHIN 60 CALENDAR DAYS OF BID OPENING.

BIDS WILL BE RECEIVED AS SHOWN BELOW:

THIS IS A <u>SCALES</u> PROPOSAL

5% BID BOND OR BID DEPOSIT REQUIRED

PROPOSAL FOR THE CONSTRUCTION OF

CONTRACT No. C203357 IN GASTON COUNTY, NORTH CAROLINA

Date_____ 20____

DEPARTMENT OF TRANSPORTATION,

RALEIGH, NORTH CAROLINA

The Bidder has carefully examined the location of the proposed work to be known as Contract No. **C203357**; has carefully examined the plans and specifications, which are acknowledged to be part of the proposal, the special provisions, the proposal, the form of contract, and the forms of contract payment bond and contract performance bond; and thoroughly understands the stipulations, requirements and provisions. The undersigned bidder agrees to bound upon his execution of the bid and subsequent award to him by the Board of Transportation in accordance with this proposal to provide the necessary contract payment bond and contract performance bond within fourteen days after the written notice of award is received by him. The undersigned Bidder further agrees to provide all necessary machinery, tools, labor, and other means of construction; and to do all the work and to furnish all materials, except as otherwise noted, necessary to perform and complete the said contract in accordance with *the 2012 Standard Specifications for Roads and Structures* by the dates(s) specified in the Project Special Provisions and in accordance with the requirements of the Engineer, and at the unit or lump sum prices, as the case may be, for the various items given on the sheets contained herein.

The Bidder shall provide and furnish all the materials, machinery, implements, appliances and tools, and perform the work and required labor to construct and complete State Highway Contract No. **C203357** in **Gaston County**, for the unit or lump sum prices, as the case may be, bid by the Bidder in his bid and according to the proposal, plans, and specifications prepared by said Department, which proposal, plans, and specifications show the details covering this project, and hereby become a part of this contract.

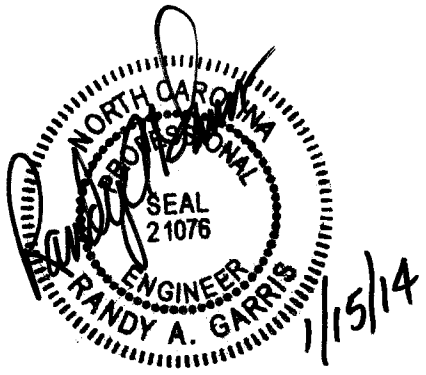
The published volume entitled *North Carolina Department of Transportation, Raleigh, Standard Specifications for Roads and Structures, January 2012* with all amendments and supplements thereto, is by reference incorporated into and made a part of this contract; that, except as herein modified, all the construction and work included in this contract is to be done in accordance with the specifications contained in said volume, and amendments and supplements thereto, under the direction of the Engineer.

If the proposal is accepted and the award is made, the contract is valid only when signed either by the Contract Officer or such other person as may be designated by the Secretary to sign for the Department of Transportation. The conditions and provisions herein cannot be changed except over the signature of the said Contract Officer.

The quantities shown in the itemized proposal for the project are considered to be approximate only and are given as the basis for comparison of bids. The Department of Transportation may increase or decrease the quantity of any item or portion of the work as may be deemed necessary or expedient.

An increase or decrease in the quantity of an item will not be regarded as sufficient ground for an increase or decrease in the unit prices, nor in the time allowed for the completion of the work, except as provided for the contract.

Accompanying this bid is a bid bond secured by a corporate surety, or certified check payable to the order of the Department of Transportation, for five percent of the total bid price, which deposit is to be forfeited as liquidated damages in case this bid is accepted and the Bidder shall fail to provide the required payment and performance bonds with the Department of Transportation, under the condition of this proposal, within 14 calendar days after the written notice of award is received by him, as provided in the *Standard Specifications*; otherwise said deposit will be returned to the Bidder.



State Contract Officer

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GENERAL

CONTRACT TIME AND LIQUIDATED DAMAGES:
(8-15-00) (Rev. 12-18-07) 108 SP1 G07 A

The date of availability for this contract is **April 28, 2014**, except that work in jurisdictional waters and wetlands shall not begin until a meeting between the DOT, Regulatory Agencies, and the Contractor is held as stipulated in the permits contained elsewhere in this proposal. This delay in availability has been considered in determining the contract time for this project.

The completion date for this contract is **November 15, 2017**.

Except where otherwise provided by the contract, observation periods required by the contract will not be a part of the work to be completed by the completion date and/or intermediate contract times stated in the contract. The acceptable completion of the observation periods that extend beyond the final completion date shall be a part of the work covered by the performance and payment bonds.

The liquidated damages for this contract are **Two Hundred Dollars ($200.00)** per calendar day. These liquidated damages will not be cumulative with any liquidated damages which may become chargeable under Intermediate Contract Time Number 1.

INTERMEDIATE CONTRACT TIME NUMBER 1 AND LIQUIDATED DAMAGES:
(7-1-95) (Rev. 2-21-12) 108 SP1 G13 A

Except for that work required under the Project Special Provisions entitled *Planting, Reforestation* and/or *Permanent Vegetation Establishment* and NCDOT ITS and Signal Project Special Provisions Systems Warranty, included elsewhere in this proposal, the Contractor will be required to complete all work included in this contract and shall place and maintain traffic on same.

The date of availability for this intermediate contract time is **April 28, 2014**.

The completion date for this intermediate contract time is **November 15, 2016**.

The liquidated damages for this intermediate contract time are **Two Thousand Dollars ($2,000)** per calendar day.

Upon apparent completion of all the work required to be completed by this intermediate date, a final inspection will be held in accordance with Article 105-17 and upon acceptance, the Department will assume responsibility for the maintenance of all work except *Planting, Reforestation* and/or *Permanent Vegetation Establishment System Warranty*. The Contractor will be responsible for and shall make corrections of all damages to the completed roadway caused by his planting operations, whether occurring prior to or after placing traffic through the project.

INTERMEDIATE CONTRACT TIME NUMBER 2 AND LIQUIDATED DAMAGES:
(2-20-07) 108 SP1 G14 A

The Contractor shall complete the required work of installing, maintaining, and removing the traffic control devices for lane closures and restoring traffic to the existing traffic pattern. The Contractor shall not close or narrow a lane of traffic on **I-85 NB** during the following time restrictions:

DAY AND TIME RESTRICTIONS

One Lane on I-85 NB
Monday thru Sunday 6:00 a.m. to 8:00 p.m.

In addition, the Contractor shall not close or narrow a lane of traffic on **I-85 NB**, detain and/or alter the traffic flow on or during holidays, holiday weekends, special events, or any other time when traffic is unusually heavy, including the following schedules:

HOLIDAY AND HOLIDAY WEEKEND LANE CLOSURE RESTRICTIONS

1. For **unexpected occurrence** that creates unusually high traffic volumes, as directed by the Engineer.

2. For **New Year's Day**, between the hours of **6:00 a.m.** December 31st and **8:00 p.m.** January 2nd. If New Year's Day is on a Friday, Saturday, Sunday or Monday, then until **8:00 p.m.** the following Tuesday.

3. For **Easter**, between the hours of **6:00 a.m.** Thursday and **8:00 p.m.** Monday.

4. For **Memorial Day**, between the hours of **6:00 a.m.** Friday and **8:00 p.m.** Tuesday.

5. For **Independence Day**, between the hours of **6:00 a.m.** the day before Independence Day and **8:00 p.m.** the day after Independence Day.

   If **Independence Day** is on a Friday, Saturday, Sunday or Monday, then between the hours of **6:00 a.m.** the Thursday before Independence Day and **8:00 p.m.** the Tuesday after Independence Day.

6. For **Labor Day**, between the hours of **6:00 a.m.** Friday and **8:00 p.m.** Tuesday.

7. For **Thanksgiving Day**, between the hours of **6:00 a.m.** Tuesday and **8:00 p.m.** Monday.

8. For **Christmas**, between the hours of **6:00 a.m.** the Friday before the week of Christmas Day and **8:00 p.m.** the following Tuesday after the week of Christmas Day.

9. For **any NASCAR Car Racing event at the Charlotte Motor Speedway**, between the hours of **6:00 a.m.** the **Wednesday before the first race** and **8:00 p.m.** the **Monday after the last race**.

Holidays and holiday weekends shall include New Year's, Easter, Memorial Day, Independence Day, Labor Day, Thanksgiving, and Christmas. The Contractor shall schedule his work so that lane closures will not be required during these periods, unless otherwise directed by the Engineer.

The time of availability for this intermediate contract work shall be the time the Contractor begins to install all traffic control devices for lane closures according to the time restrictions listed herein.

The completion time for this intermediate contract work shall be the time the Contractor is required to complete the removal of all traffic control devices for lane closures according to the time restrictions stated above and place traffic in the existing traffic pattern.

The liquidated damages are **Five Hundred Dollars** (**$500.00**) per **fifteen (15) minute time period**.

INTERMEDIATE CONTRACT TIME NUMBER 3 AND LIQUIDATED DAMAGES:
(2-20-07) 108 SP1 G14 A

The Contractor shall complete the required work of installing, maintaining, and removing the traffic control devices for lane closures and restoring traffic to the existing traffic pattern. The Contractor shall not close or narrow a lane of traffic on **I-85 NB** during the following time restrictions:

DAY AND TIME RESTRICTIONS

Two Lanes on I-85 NB
Monday thru Sunday 6:00 a.m. to 10:00 p.m.

In addition, the Contractor shall not close or narrow a lane of traffic on **I-85 NB**, detain and/or alter the traffic flow on or during holidays, holiday weekends, special events, or any other time when traffic is unusually heavy, including the following schedules:

HOLIDAY AND HOLIDAY WEEKEND LANE CLOSURE RESTRICTIONS

1. For **unexpected occurrence** that creates unusually high traffic volumes, as directed by the Engineer.

2. For **New Year's Day**, between the hours of **6:00 a.m.** December 31st and **8:00 p.m.** January 2nd. If New Year's Day is on a Friday, Saturday, Sunday or Monday, then until **8:00 p.m.** the following Tuesday.

3. For **Easter**, between the hours of **6:00 a.m.** Thursday and **8:00 p.m.** Monday.

4. For **Memorial Day**, between the hours of **6:00 a.m.** Friday and **8:00 p.m.** Tuesday.

5. For **Independence Day**, between the hours of **6:00 a.m.** the day before Independence Day and **8:00 p.m.** the day after Independence Day.

   If **Independence Day** is on a Friday, Saturday, Sunday or Monday, then between the hours of **6:00 a.m.** the Thursday before Independence Day and **8:00 p.m.** the Tuesday after Independence Day.

6. For **Labor Day**, between the hours of **6:00 a.m.** Friday and **8:00 p.m.** Tuesday.

7. For **Thanksgiving Day**, between the hours of **6:00 a.m.** Tuesday and **8:00 p.m.** Monday.

8. For **Christmas**, between the hours of **6:00 a.m.** the Friday before the week of Christmas Day and **8:00 p.m.** the following Tuesday after the week of Christmas Day.

9. For **any NASCAR Car Racing event at the Charlotte Motor Speedway**, between the hours of **6:00 a.m.** the **Wednesday before the first race** and **8:00 p.m.** the **Monday after the last race**.

Holidays and holiday weekends shall include New Year's, Easter, Memorial Day, Independence Day, Labor Day, Thanksgiving, and Christmas. The Contractor shall schedule his work so that lane closures will not be required during these periods, unless otherwise directed by the Engineer.

The time of availability for this intermediate contract work shall be the time the Contractor begins to install all traffic control devices for lane closures according to the time restrictions listed herein.

The completion time for this intermediate contract work shall be the time the Contractor is required to complete the removal of all traffic control devices for lane closures according to the time restrictions stated above and place traffic in the existing traffic pattern.

The liquidated damages are **Two Thousand Five Hundred Dollars ($2,500.00)** per **fifteen (15) minute time period**.

INTERMEDIATE CONTRACT TIME NUMBER 4 AND LIQUIDATED DAMAGES:
(2-20-07) (Rev. 10-15-13) 108 SP1 G14 E

The Contractor shall complete the required work of installing, maintaining and removing the traffic control devices for road closures and restoring traffic to the existing traffic pattern. The Contractor shall not close **I-85 and all Ramps & Loops** during the following time restrictions:

DAY AND TIME RESTRICTIONS

Monday thru Sunday, 5:00 a.m. to 12:00 Midnight

The maximum allowable time for **overhead sign and structure installation** is **fifteen (15)** minutes for **I-85 and all Ramps & Loops**. The Contractor shall reopen the travel lanes to traffic until any resulting traffic queue is depleted.

The time of availability for this intermediate contract time will be the time the Contractor begins to install traffic control devices required for the road closures according to the time restrictions stated herein.

The completion time for this intermediate contract time will be the time the Contractor is required to complete the removal of traffic control devices required for the road closures according to the time restrictions stated herein and restore traffic to the existing traffic pattern.

The liquidated damages are **Two Thousand Five Hundred Dollars ($2,500.00)** per **fifteen (15)**-minute time period.

PERMANENT VEGETATION ESTABLISHMENT:

(2-16-12) (Rev. 10-15-13) 104 SP1 G16

Establish a permanent stand of the vegetation mixture shown in the contract. During the period between initial vegetation planting and final project acceptance, perform all work necessary to establish permanent vegetation on all erodible areas within the project limits, as well as, in borrow and waste pits. This work shall include erosion control device maintenance and installation, repair seeding and mulching, supplemental seeding and mulching, mowing, and fertilizer topdressing, as directed. All work shall be performed in accordance with the applicable section of the *2012 Standard Specifications*. All work required for initial vegetation planting shall be performed as a part of the work necessary for the completion and acceptance of the Intermediate Contract Time (ICT). Between the time of ICT and Final Project acceptance, or otherwise referred to as the vegetation establishment period, the Department will be responsible for preparing the required National Pollutant Discharge Elimination System (NPDES) inspection records.

Once the Engineer has determined that the permanent vegetation establishment requirement has been achieved at an 80% vegetation density (the amount of established vegetation per given area to stabilize the soil) and no erodible areas exist within the project limits, the Contractor will be notified to remove the remaining erosion control devices that are no longer needed. The Contractor will be responsible for, and shall correct any areas disturbed by operations performed in permanent vegetation establishment and the removal of temporary erosion control measures, whether occurring prior to or after placing traffic on the project.

Payment for *Response for Erosion Control*, *Seeding and Mulching*, *Repair Seeding*, *Supplemental Seeding*, *Mowing*, *Fertilizer Topdressing*, *Silt Excavation*, and *Stone for Erosion Control* will be made at contract unit prices for the affected items. Work required that is not represented by contract line items will be paid in accordance with Articles 104-7 or 104-3 of the *2012 Standard Specifications*. No additional compensation will be made for maintenance and removal of temporary erosion control items.

MAJOR CONTRACT ITEMS:
(2-19-02) 104 SP1 G28

The following listed items are the major contract items for this contract (see Article 104-5 of the *2012 Standard Specifications*):

Line #	Description
7	Unclassified Excavation
9	Borrow Excavation
57	11 ½" PCC Pavement Ramps (With Dowels)

SPECIALTY ITEMS:
(7-1-95)(Rev. 1-17-12) 108-6 SP1 G37

Items listed below will be the specialty items for this contract (see Article 108-6 of the *2012 Standard Specifications*).

Line #	Description
3 thru 4	Building Items
97 thru 106	Guardrail
107 thru 109	Fencing
113 thru 140	Signing
154 thru 160	Long-Life Pavement Markings
167	Permanent Pavement Markers
168 thru 196	Lighting
197 thru 203	Utility Construction
204 thru 231	Erosion Control
232 thru 304	Signals/ITS System

FUEL PRICE ADJUSTMENT:
(11-15-05) (Rev. 2-18-14) 109-8 SP1 G43

Revise the *2012 Standard Specifications* as follows:

Page 1-83, Article 109-8, Fuel Price Adjustments, add the following:

The base index price for DIESEL #2 FUEL is **$3.1476** per gallon. Where any of the following are included as pay items in the contract, they will be eligible for fuel price adjustment.

The pay items and the fuel factor used in calculating adjustments to be made will be as follows:

Description	Units	Fuel Usage Factor Diesel
Unclassified Excavation	Gal/CY	0.29
Borrow Excavation	Gal/CY	0.29
Class IV Subgrade Stabilization	Gal/Ton	0.55
Aggregate Base Course	Gal/Ton	0.55
Sub-Ballast	Gal/Ton	0.55

Asphalt Concrete Base Course, Type ____	Gal/Ton	2.90
Asphalt Concrete Intermediate Course, Type ____	Gal/Ton	2.90
Asphalt Concrete Surface Course, Type ____	Gal/Ton	2.90
Open-Graded Asphalt Friction Course	Gal/Ton	2.90
Permeable Asphalt Drainage Course, Type ____	Gal/Ton	2.90
Sand Asphalt Surface Course, Type ____	Gal/Ton	2.90
Aggregate for Cement Treated Base Course	Gal/Ton	0.55
Portland Cement for Cement Treated Base Course	Gal/Ton	0.55
__" Portland Cement Concrete Pavement	Gal/SY	0.245
Concrete Shoulders Adjacent to __" Pavement	Gal/SY	0.245

SCHEDULE OF ESTIMATED COMPLETION PROGRESS:

(7-15-08) (Rev. 5-21-13) 108-2 SP1 G58

The Contractor's attention is directed to the Standard Special Provision entitled *Availability of Funds Termination of Contracts* included elsewhere in this proposal. The Department of Transportation's schedule of estimated completion progress for this project as required by that Standard Special Provision is as follows:

	Fiscal Year	Progress (% of Dollar Value)
2014	(7/01/13 - 6/30/14)	8% of Total Amount Bid
2015	(7/01/14 - 6/30/15)	51% of Total Amount Bid
2016	(7/01/15- 6/30/16)	33% of Total Amount Bid
2017	(7/01/16 - 6/30/17)	8% of Total Amount Bid

The Contractor shall also furnish his own progress schedule in accordance with Article 108-2 of the *2012 Standard Specifications*. Any acceleration of the progress as shown by the Contractor's progress schedule over the progress as shown above shall be subject to the approval of the Engineer.

DISADVANTAGED BUSINESS ENTERPRISE:

(10-16-07)(Rev. 12-17-13) 102-15(J) SP1 G61

Description

The purpose of this Special Provision is to carry out the U.S. Department of Transportation's policy of ensuring nondiscrimination in the award and administration of contracts financed in whole or in part with Federal funds. This provision is guided by 49 CFR Part 26.

Definitions

Additional DBE Subcontractors - Any DBE submitted at the time of bid that will not be used to meet the DBE goal. No submittal of a Letter of Intent is required.

Committed DBE Subcontractor - Any DBE submitted at the time of bid that is being used to meet the DBE goal by submission of a Letter of Intent. Or any DBE used as a replacement for a previously committed DBE firm.

Contract Goal Requirement - The approved DBE participation at time of award, but not greater than the advertised contract goal.

DBE Goal - A portion of the total contract, expressed as a percentage, that is to be performed by committed DBE subcontractor(s).

Disadvantaged Business Enterprise (DBE) - A firm certified as a Disadvantaged Business Enterprise through the North Carolina Unified Certification Program.

Goal Confirmation Letter - Written documentation from the Department to the bidder confirming the Contractor's approved, committed DBE participation along with a listing of the committed DBE firms.

Manufacturer - A firm that operates or maintains a factory or establishment that produces on the premises, the materials or supplies obtained by the Contractor.

Regular Dealer - A firm that owns, operates, or maintains a store, warehouse, or other establishment in which the materials or supplies required for the performance of the contract are bought, kept in stock, and regularly sold to the public in the usual course of business. A regular dealer engages in, as its principal business and in its own name, the purchase and sale or lease of the products in question. A regular dealer in such bulk items as steel, cement, gravel, stone, and petroleum products need not keep such products in stock, if it owns and operates distribution equipment for the products. Brokers and packagers are not regarded as manufacturers or regular dealers within the meaning of this section.

North Carolina Unified Certification Program (NCUCP) - A program that provides comprehensive services and information to applicants for DBE certification, such that an applicant is required to apply only once for a DBE certification that will be honored by all recipients of USDOT funds in the state and not limited to the Department of Transportation only. The Certification Program is in accordance with 49 CFR Part 26.

United States Department of Transportation (USDOT) - Federal agency responsible for issuing regulations (49 CFR Part 26) and official guidance for the DBE program.

Forms and Websites Referenced in this Provision

DBE Payment Tracking System - On-line system in which the Contractor enters the payments made to DBE subcontractors who have performed work on the project. https://apps.dot.state.nc.us/Vendor/PaymentTracking/

DBE-IS *Subcontractor Payment Information* - Form for reporting the payments made to all DBE firms working on the project. This form is for paper bid projects only. http://www.ncdot.org/doh/forms/files/DBE-IS.xls

RF-1 *DBE Replacement Request Form* - Form for replacing a committed DBE. http://connect.ncdot.gov/projects/construction/Construction%20Forms/DBE%20MBE%20WBE%20Replacement%20Request%20Form.pdf

SAF *Subcontract Approval Form* - Form required for approval to sublet the contract. http://connect.ncdot.gov/projects/construction/Construction%20Forms/Subcontract%20Approval%20Form%20Rev.%202012.zip

JC-1 *Joint Check Notification Form* - Form and procedures for joint check notification. The form acts as a written joint check agreement among the parties providing full and prompt disclosure of the expected use of joint checks.
http://connect.ncdot.gov/projects/construction/Construction%20Forms/Joint%20Check%20Notification%20Form.pdf

Letter of Intent - Form signed by the Contractor and the DBE subcontractor, manufacturer or regular dealer that affirms that a portion of said contract is going to be performed by the signed DBE for the amount listed at the time of bid.
http://connect.ncdot.gov/letting/LetCentral/Letter%20of%20Intent%20to%20Perform%20as%20a%20Subcontractor.pdf

Listing of DBE Subcontractors Form - Form for entering DBE subcontractors on a project that will meet this DBE goal. This form is for paper bids only.
http://connect.ncdot.gov/municipalities/Bid%20Proposals%20for%20LGA%20Content/08%20DBE%20Subcontractors%20(Federal).doc

Subcontractor Quote Comparison Sheet - Spreadsheet for showing all subcontractor quotes in the work areas where DBEs quoted on the project. This sheet is submitted with good faith effort packages.
http://connect.ncdot.gov/business/SmallBusiness/Documents/DBE%20Subcontractor%20Quote%20Comparison%20Example.xls

DBE Goal

The following DBE goal for participation by Disadvantaged Business Enterprises is established for this contract:

Disadvantaged Business Enterprises **12.0%**

(A) *If the DBE goal is more than zero*, the Contractor shall exercise all necessary and reasonable steps to ensure that DBEs participate in at least the percent of the contract as set forth above as the DBE goal.

(B) *If the DBE goal is zero*, the Contractor shall make an effort to recruit and use DBEs during the performance of the contract. Any DBE participation obtained shall be reported to the Department.

Directory of Transportation Firms (Directory)

Real-time information is available about firms doing business with the Department and firms that are certified through NCUCP in the Directory of Transportation Firms. Only firms identified in the Directory as DBE certified shall be used to meet the DBE goal. The Directory can be found at the following link. https://partner.ncdot.gov/VendorDirectory/default.html

The listing of an individual firm in the directory shall not be construed as an endorsement of the firm's capability to perform certain work.

Listing of DBE Subcontractors

At the time of bid, bidders shall submit all DBE participation that they anticipate to use during the life of the contract. Only those identified to meet the DBE goal will be considered committed, even though the listing shall include both committed DBE subcontractors and additional DBE subcontractors. Additional DBE subcontractor participation submitted at the time of bid will be used toward the Department's overall race-neutral goal. Only those firms with current DBE certification at the time of bid opening will be acceptable for listing in the bidder's submittal of DBE participation. The Contractor shall indicate the following required information:

(A) Electronic Bids

Bidders shall submit a listing of DBE participation in the appropriate section of Expedite, the bidding software of Bid Express®.

(1) Submit the names and addresses of DBE firms identified to participate in the contract. If the bidder uses the updated listing of DBE firms shown in Expedite, the bidder may use the dropdown menu to access the name and address of the DBE firm.

(2) Submit the contract line numbers of work to be performed by each DBE firm. When no figures or firms are entered, the bidder will be considered to have no DBE participation.

(3) The bidder shall be responsible for ensuring that the DBE is certified at the time of bid by checking the Directory of Transportation Firms. If the firm is not certified at the time of the bid-letting, that DBE's participation will not count towards achieving the DBE goal.

(B) Paper Bids

(1) *If the DBE goal is more than zero,*

(a) Bidders, at the time the bid proposal is submitted, shall submit a listing of *DBE* participation, including the names and addresses on *Listing of DBE Subcontractors* contained elsewhere in the contract documents in order for the bid to be considered responsive. Bidders shall indicate the total dollar value of the DBE participation for the contract.

(b) If bidders have no DBE participation, they shall indicate this on the *Listing of DBE Subcontractors* by entering the word "None" or the number "0." This form shall be completed in its entirety. **Blank forms will not be deemed to represent zero participation**. Bids submitted that do not have DBE participation indicated on the appropriate form will not be read publicly during the opening of bids. The Department will not consider these bids for award and the proposal will be rejected.

(c) The bidder shall be responsible for ensuring that the DBE is certified at the time of bid by checking the Directory of Transportation Firms. If the firm is not certified at the time of the bid-letting, that DBE's participation will not count towards achieving the corresponding goal.

(2) *If the DBE goal is zero,* entries on the *Listing of DBE Subcontractors* are not required for the zero goal, however any DBE participation that is achieved during the project shall be reported in accordance with requirements contained elsewhere in the special provision.

DBE Prime Contractor

When a certified DBE firm bids on a contract that contains a DBE goal, the DBE firm is responsible for meeting the goal or making good faith efforts to meet the goal, just like any other bidder. In most cases, a DBE bidder on a contract will meet the DBE goal by virtue of the work it performs on the contract with its own forces. However, all the work that is performed by the DBE bidder and any other DBE subcontractors will count toward the DBE goal. The DBE bidder shall list itself along with any DBE subcontractors, if any, in order to receive credit toward the DBE goal.

For example, if the DBE goal is 45% and the DBE bidder will only perform 40% of the contract work, the prime will list itself at 40%, and the additional 5% shall be obtained through additional DBE participation with DBE subcontractors or documented through a good faith effort.

DBE prime contractors shall also follow Sections A and B listed under *Listing of DBE Subcontractor* just as a non-DBE bidder would.

Written Documentation – Letter of Intent

The bidder shall submit written documentation for each DBE that will be used to meet the DBE goal of the contract, indicating the bidder's commitment to use the DBE in the contract. This documentation shall be submitted on the Department's form titled *Letter of Intent.*

The documentation shall be received in the office of the State Contractor Utilization Engineer or at DBE@ncdot.gov no later than 12:00 noon of the sixth calendar day following opening of bids, unless the sixth day falls on an official state holiday. In that situation, it is due in the office of the State Contractor Utilization Engineer no later than 12:00 noon on the next official state business day.

If the bidder fails to submit the Letter of Intent from each committed DBE to be used toward the DBE goal, or if the form is incomplete (i.e. both signatures are not present), the DBE participation will not count toward meeting the DBE goal. If the lack of this participation drops the commitment below the DBE goal, the Contractor shall submit evidence of good faith efforts, completed in its entirety, to the State Contractor Utilization Engineer or DBE@ncdot.gov no later than 12:00 noon on the eighth calendar day following opening of bids, unless the eighth day falls on an official state holiday. In that situation, it is due in the office of the State Contractor Utilization Engineer no later than 12:00 noon on the next official state business day.

Submission of Good Faith Effort

If the bidder fails to meet or exceed the DBE goal, the apparent lowest responsive bidder shall submit to the Department documentation of adequate good faith efforts made to reach the DBE goal.

A hard copy and an electronic copy of this information shall be received in the office of the State Contractor Utilization Engineer or at DBE@ncdot.gov no later than 12:00 noon of the sixth calendar day following opening of bids unless the sixth day falls on an official state holiday. In that situation, it is due in the office of the State Contractor Utilization Engineer the next official state business day. If the contractor cannot send the information electronically, then one complete set and 9 copies of this information shall be received under the same time constraints above.

Note: Where the information submitted includes repetitious solicitation letters, it will be acceptable to submit a representative letter along with a distribution list of the firms that were solicited. Documentation of DBE quotations shall be a part of the good faith effort submittal. This documentation may include written subcontractor quotations, telephone log notations of verbal quotations, or other types of quotation documentation.

Consideration of Good Faith Effort for Projects with DBE Goals More Than Zero

Adequate good faith efforts mean that the bidder took all necessary and reasonable steps to achieve the goal which, by their scope, intensity, and appropriateness, could reasonably be expected to obtain sufficient DBE participation. Adequate good faith efforts also mean that the bidder actively and aggressively sought DBE participation. Mere *pro forma* efforts are not considered good faith efforts.

The Department will consider the quality, quantity, and intensity of the different kinds of efforts a bidder has made. Listed below are examples of the types of actions a bidder will take in making a good faith effort to meet the goal and are not intended to be exclusive or exhaustive, nor is it intended to be a mandatory checklist.

(A) Soliciting through all reasonable and available means (e.g. attendance at pre-bid meetings, advertising, written notices, use of verifiable electronic means through the use of the NCDOT Directory of Transportation Firms) the interest of all certified DBEs who have the capability to perform the work of the contract. The bidder must solicit this interest within at least 10 days prior to bid opening to allow the DBEs to respond to the solicitation. Solicitation shall provide the opportunity to DBEs within the Division and surrounding Divisions where the project is located. The bidder must determine with certainty if the DBEs are interested by taking appropriate steps to follow up initial solicitations.

(B) Selecting portions of the work to be performed by DBEs in order to increase the likelihood that the DBE goals will be achieved.

(1) Where appropriate, break out contract work items into economically feasible units to facilitate DBE participation, even when the prime contractor might otherwise prefer to perform these work items with its own forces.

(2) Negotiate with subcontractors to assume part of the responsibility to meet the contract DBE goal when the work to be sublet includes potential for DBE participation (2nd and 3rd tier subcontractors).

(C) Providing interested DBEs with adequate information about the plans, specifications, and requirements of the contract in a timely manner to assist them in responding to a solicitation.

(D) (1) Negotiating in good faith with interested DBEs. It is the bidder's responsibility to make a portion of the work available to DBE subcontractors and suppliers and to select those portions of the work or material needs consistent with the available DBE subcontractors and suppliers, so as to facilitate DBE participation. Evidence of such negotiation includes the names, addresses, and telephone numbers of DBEs that were considered; a description of the information provided regarding the plans and specifications for the work selected for subcontracting; and evidence as to why additional agreements could not be reached for DBEs to perform the work.

(2) A bidder using good business judgment would consider a number of factors in negotiating with subcontractors, including DBE subcontractors, and would take a firm's price and capabilities as well as contract goals into consideration. However, the fact that there may be some additional costs involved in finding and using DBEs is not in itself sufficient reason for a bidder's failure to meet the contract DBE goal, as long as such costs are reasonable. Also, the ability or desire of a prime contractor to perform the work of a contract with its own organization does not relieve the bidder of the responsibility to make good faith efforts. Bidding contractors are not, however, required to accept higher quotes from DBEs if the price difference is excessive or unreasonable.

(E) Not rejecting DBEs as being unqualified without sound reasons based on a thorough investigation of their capabilities. The bidder's standing within its industry, membership in specific groups, organizations, or associates and political or social affiliations (for example, union vs. non-union employee status) are not legitimate causes for the rejection or non-solicitation of bids in the bidder's efforts to meet the project goal.

(F) Making efforts to assist interested DBEs in obtaining bonding, lines of credit, or insurance as required by the recipient or bidder.

(G) Making efforts to assist interested DBEs in obtaining necessary equipment, supplies, materials, or related assistance or services.

(H) Effectively using the services of available minority/women community organizations; minority/women contractors' groups; Federal, State, and local minority/women business assistance offices; and other organizations as allowed on a case-by-case basis to provide assistance in the recruitment and placement of DBEs. Contact within 7 days from the bid opening the Business Development Manager in the Business Opportunity and Work Force Development Unit to give notification of the bidder's inability to get DBE quotes.

(I) Any other evidence that the bidder submits which shows that the bidder has made reasonable good faith efforts to meet the DBE goal.

In addition, the Department may take into account the following:

(1) Whether the bidder's documentation reflects a clear and realistic plan for achieving the DBE goal.

(2) The bidders' past performance in meeting the DBE goals.

(3) The performance of other bidders in meeting the DBE goal. For example, when the apparent successful bidder fails to meet the DBE goal, but others meet it, you may reasonably raise the question of whether, with additional reasonable efforts the apparent successful bidder could have met the goal. If the apparent successful bidder fails to meet the DBE goal, but meets or exceeds the average DBE participation obtained by other bidders, the Department may view this, in conjunction with other factors, as evidence of the apparent successful bidder having made a good faith effort.

If the Department does not award the contract to the apparent lowest responsive bidder, the Department reserves the right to award the contract to the next lowest responsive bidder that can satisfy to the Department that the DBE goal can be met or that an adequate good faith effort has been made to meet the DBE goal.

Non-Good Faith Appeal

The State Contractor Utilization Engineer will notify the contractor verbally and in writing of non-good faith. A contractor may appeal a determination of non-good faith made by the Goal Compliance Committee. If a contractor wishes to appeal the determination made by the Committee, they shall provide written notification to the State Contractual Services Engineer or at DBE@ncdot.gov. The appeal shall be made within 2 business days of notification of the determination of non-good faith.

Counting DBE Participation Toward Meeting DBE Goal

(A) Participation

The total dollar value of the participation by a committed DBE will be counted toward the contract goal requirement. The total dollar value of participation by a committed DBE will be based upon the value of work actually performed by the DBE and the actual payments to DBE firms by the Contractor.

(B) Joint Checks

Prior notification of joint check use shall be required when counting DBE participation for services or purchases that involves the use of a joint check. Notification shall be through submission of Form JC-1 *(Joint Check Notification Form)* and the use of joint checks shall be in accordance with the Department's Joint Check Procedures.

(C) Subcontracts (Non-Trucking)

A DBE may enter into subcontracts. Work that a DBE subcontracts to another DBE firm may be counted toward the contract goal requirement. Work that a DBE subcontracts to a non-DBE firm does not count toward the contract goal requirement. If a DBE contractor or subcontractor subcontracts a significantly greater portion of the work of the contract than would be expected on the basis of standard industry practices, it shall be presumed that the DBE is not performing a commercially useful function. The DBE may present evidence to rebut this presumption to the Department. The Department's decision on the rebuttal of this presumption is subject to review by the Federal Highway Administration but is not administratively appealable to USDOT.

(D) Joint Venture

When a DBE performs as a participant in a joint venture, the Contractor may count toward its contract goal requirement a portion of the total value of participation with the DBE in the joint venture, that portion of the total dollar value being a distinct clearly defined portion of work that the DBE performs with its forces.

(E) Suppliers

A contractor may count toward its DBE requirement 60 percent of its expenditures for materials and supplies required to complete the contract and obtained from a DBE regular dealer and 100 percent of such expenditures from a DBE manufacturer.

(F) Manufacturers and Regular Dealers

A contractor may count toward its DBE requirement the following expenditures to DBE firms that are not manufacturers or regular dealers:

(1) The fees or commissions charged by a DBE firm for providing a *bona fide* service, such as professional, technical, consultant, or managerial services, or for providing bonds or insurance specifically required for the performance of a DOT-assisted contract, provided the fees or commissions are determined to be reasonable and not excessive as compared with fees and commissions customarily allowed for similar services.

(2) With respect to materials or supplies purchased from a DBE, which is neither a manufacturer nor a regular dealer, count the entire amount of fees or commissions charged for assistance in the procurement of the materials and supplies, or fees or transportation charges for the delivery of materials or supplies required on a job site (but not the cost of the materials and supplies themselves), provided the fees are determined to be reasonable and not excessive as compared with fees customarily allowed for similar services.

Commercially Useful Function

(A) DBE Utilization

The Contractor may count toward its contract goal requirement only expenditures to DBEs that perform a commercially useful function in the work of a contract. A DBE performs a commercially useful function when it is responsible for execution of the work of the contract and is carrying out its responsibilities by actually performing, managing, and supervising the work involved. To perform a commercially useful function, the DBE shall also be responsible with respect to materials and supplies used on the contract, for negotiating price, determining quality and quantity, ordering the material and installing (where applicable) and paying for the material itself. To determine whether a DBE is performing a commercially useful function, the Department will evaluate the amount of work subcontracted, industry practices, whether the amount the firm is to be paid under the contract is commensurate with the work it is actually performing and the DBE credit claimed for its performance of the work, and any other relevant factors.

(B) DBE Utilization in Trucking

The following factors will be used to determine if a DBE trucking firm is performing a commercially useful function:

(1) The DBE shall be responsible for the management and supervision of the entire trucking operation for which it is responsible on a particular contract, and there shall not be a contrived arrangement for the purpose of meeting DBE goals.

(2) The DBE shall itself own and operate at least one fully licensed, insured, and operational truck used on the contract.

(3) The DBE receives credit for the total value of the transportation services it provides on the contract using trucks it owns, insures, and operates using drivers it employs.

(4) The DBE may subcontract the work to another DBE firm, including an owner-operator who is certified as a DBE. The DBE who subcontracts work to another DBE receives credit for the total value of the transportation services the subcontracted DBE provides on the contract.

(5) The DBE may also subcontract the work to a non-DBE firm, including from an owner-operator. The DBE who subcontracts the work to a non-DBE is entitled to credit for the total value of transportation services provided by the non-DBE subcontractor not to exceed the value of transportation services provided by DBE-owned trucks on the contract. Additional participation by non-DBE subcontractors receives credit only for the fee or commission it receives as a result of the subcontract arrangement. The value of services performed under subcontract agreements between the DBE and the Contractor will not count towards the DBE contract requirement.

(6) A DBE may lease truck(s) from an established equipment leasing business open to the general public. The lease must indicate that the DBE has exclusive use of and control over the truck. This requirement does not preclude the leased truck from working for others during the term of the lease with the consent of the DBE, so long as the lease gives the DBE absolute priority for use of the leased truck. This type of lease may count toward the DBE's credit as long as the driver is under the DBE's payroll.

(7) Subcontracted/leased trucks shall display clearly on the dashboard the name of the DBE that they are subcontracted/leased to and their own company name if it is not identified on the truck itself. Magnetic door signs are not permitted.

DBE Replacement

When a Contractor has relied on a commitment to a DBE firm (or an approved substitute DBE firm) to meet all or part of a contract goal requirement, the contractor shall not terminate the DBE for convenience. This includes, but is not limited to, instances in which the Contractor seeks to perform the work of the terminated subcontractor with another DBE subcontractor, a non-DBE subcontractor, or with the Contractor's own forces or those of an affiliate. A DBE may only be terminated after receiving the Engineer's written approval based upon a finding of good cause for the termination.

All requests for replacement of a committed DBE firm shall be submitted to the Engineer for approval on Form RF-1 *(DBE Replacement Request).* If the Contractor fails to follow this procedure, the Contractor may be disqualified from further bidding for a period of up to 6 months.

The Contractor shall comply with the following for replacement of a committed DBE:

(A) Performance Related Replacement

When a committed DBE is terminated for good cause as stated above, an additional DBE that was submitted at the time of bid may be used to fulfill the DBE commitment. A good faith effort will only be required for removing a committed DBE if there were no additional DBEs submitted at the time of bid to cover the same amount of work as the DBE that was terminated.

If a replacement DBE is not found that can perform at least the same amount of work as the terminated DBE, the Contractor shall submit a good faith effort documenting the steps taken. Such documentation shall include, but not be limited to, the following:

(1) Copies of written notification to DBEs that their interest is solicited in contracting the work defaulted by the previous DBE or in subcontracting other items of work in the contract.

(2) Efforts to negotiate with DBEs for specific subbids including, at a minimum:

(a) The names, addresses, and telephone numbers of DBEs who were contacted.

(b) A description of the information provided to DBEs regarding the plans and specifications for portions of the work to be performed.

(3) A list of reasons why DBE quotes were not accepted.

(4) Efforts made to assist the DBEs contacted, if needed, in obtaining bonding or insurance required by the Contractor.

(B) Decertification Replacement

(1) When a committed DBE is decertified by the Department after the SAF (*Subcontract Approval Form*) has been received by the Department, the Department will not require the Contractor to solicit replacement DBE participation equal to the remaining work to be performed by the decertified firm. The participation equal to the remaining work performed by the decertified firm will count toward the contract goal requirement.

(2) When a committed DBE is decertified prior to the Department receiving the SAF (*Subcontract Approval Form*) for the named DBE firm, the Contractor shall take all necessary and reasonable steps to replace the DBE subcontractor with another DBE subcontractor to perform at least the same amount of work to meet the DBE goal requirement. If a DBE firm is not found to do the same amount of work, a good faith effort must be submitted to NCDOT (see A herein for required documentation).

Changes in the Work

When the Engineer makes changes that result in the reduction or elimination of work to be performed by a committed DBE, the Contractor will not be required to seek additional participation. When the Engineer makes changes that result in additional work to be performed by a DBE based upon the Contractor's commitment, the DBE shall participate in additional work to the same extent as the DBE participated in the original contract work.

When the Engineer makes changes that result in extra work, which has more than a minimal impact on the contract amount, the Contractor shall seek additional participation by DBEs unless otherwise approved by the Engineer.

When the Engineer makes changes that result in an alteration of plans or details of construction, and a portion or all of the work had been expected to be performed by a committed DBE, the Contractor shall seek participation by DBEs unless otherwise approved by the Engineer.

When the Contractor requests changes in the work that result in the reduction or elimination of work that the Contractor committed to be performed by a DBE, the Contractor shall seek additional participation by DBEs equal to the reduced DBE participation caused by the changes.

Reports and Documentation

A SAF (*Subcontract Approval Form*) shall be submitted for all work which is to be performed by a DBE subcontractor. The Department reserves the right to require copies of actual subcontract agreements involving DBE subcontractors.

When using transportation services to meet the contract commitment, the Contractor shall submit a proposed trucking plan in addition to the SAF. The plan shall be submitted prior to beginning construction on the project. The plan shall include the names of all trucking firms proposed for use, their certification type(s), the number of trucks owned by the firm, as well as the individual truck identification numbers, and the line item(s) being performed.

Within 30 calendar days of entering into an agreement with a DBE for materials, supplies or services, not otherwise documented by the SAF as specified above, the Contractor shall furnish the Engineer a copy of the agreement. The documentation shall also indicate the percentage (60% or 100%) of expenditures claimed for DBE credit.

Reporting Disadvantaged Business Enterprise Participation

The Contractor shall provide the Engineer with an accounting of payments made to all DBE firms, including material suppliers and contractors at all levels (prime, subcontractor, or second tier subcontractor). This accounting shall be furnished to the Engineer for any given month by the end of the following month. Failure to submit this information accordingly may result in the following action:

(A) Withholding of money due in the next partial pay estimate; or

(B) Removal of an approved contractor from the prequalified bidders' list or the removal of other entities from the approved subcontractors list.

While each contractor (prime, subcontractor, 2nd tier subcontractor) is responsible for accurate accounting of payments to DBEs, it shall be the prime contractor's responsibility to report all monthly and final payment information in the correct reporting manner.

Failure on the part of the Contractor to submit the required information in the time frame specified may result in the disqualification of that contractor and any affiliate companies from further bidding until the required information is submitted.

Failure on the part of any subcontractor to submit the required information in the time frame specified may result in the disqualification of that contractor and any affiliate companies from being approved for work on future DOT projects until the required information is submitted.

Contractors reporting transportation services provided by non-DBE lessees shall evaluate the value of services provided during the month of the reporting period only.

At any time, the Engineer can request written verification of subcontractor payments.

(A) Electronic Bids Reporting

The Contractor shall report the accounting of payments through the Department's DBE Payment Tracking System.

(B) Paper Bids Reporting

The Contractor shall report the accounting of payments on the Department's DBE-IS *(Subcontractor Payment Information)* with each invoice. Invoices will not be processed for payment until the DBE-IS is received.

Failure to Meet Contract Requirements

Failure to meet contract requirements in accordance with Subarticle 102-15(J) of the *2012 Standard Specifications* may be cause to disqualify the Contractor.

CERTIFICATION FOR FEDERAL-AID CONTRACTS:
(3-21-90) SP1 G85

The prospective participant certifies, by signing and submitting this bid or proposal, to the best of his or her knowledge and belief, that:

(A) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(B) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, *Disclosure Form to Report Lobbying*, in accordance with its instructions.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by *Section 1352, Title 31, U.S. Code*. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

The prospective participant also agrees by submitting his or her bid or proposal that he or she shall require that the language of this certification be included in all lower tier subcontracts, which exceed $100,000 and that all such subrecipients shall certify and disclose accordingly.

CONTRACTOR'S LICENSE REQUIREMENTS:
(7-1-95) 102-14 SP1 G88

If the successful bidder does not hold the proper license to perform any plumbing, heating, air conditioning, or electrical work in this contract, he will be required to sublet such work to a contractor properly licensed in accordance with *Article 2 of Chapter 87 of the General Statutes* (licensing of heating, plumbing, and air conditioning contractors) and *Article 4 of Chapter 87* of the *General Statutes* (licensing of electrical contractors).

U.S. DEPARTMENT OF TRANSPORTATION HOTLINE:
(11-22-94) 108-5 SP1 G100

To report bid rigging activities call: **1-800-424-9071**

The U.S. Department of Transportation (DOT) operates the above toll-free hotline Monday through Friday, 8:00 a.m. to 5:00 p.m. eastern time. Anyone with knowledge of possible bid rigging, bidder collusion, or other fraudulent activities should use the hotline to report such activities.

The hotline is part of the DOT's continuing effort to identify and investigate highway construction contract fraud and abuse is operated under the direction of the DOT Inspector General. All information will be treated confidentially and caller anonymity will be respected.

SUBSURFACE INFORMATION:
(7-1-95) 450 SP1 G112 D

Subsurface information is available on the roadway and structure portions of this project.

LOCATING EXISTING UNDERGROUND UTILITIES:
(3-20-12) 105 SP1 G115

Revise the *2012 Standard Specifications* as follows:

Page 1-43, Article 105-8, line 28, after the first sentence, add the following:

Identify excavation locations by means of pre-marking with white paint, flags, or stakes or provide a specific written description of the location in the locate request.

RESOURCE CONSERVATION:
(5-21-13) 104-13 SP1 G118

In accordance with North Carolina Executive Order 156, NCGS 130A-309.14(2), and NCGS 136-28.8, it is the policy of the Department to aid in the reduction of materials that become a part of our solid waste stream, to divert materials from landfills, and to find ways to recycle and reuse materials for the benefit of the Citizens of North Carolina.

Initiate, develop and use products and construction methods that incorporate the use of recycled or solid waste products in accordance with Article 104-13 of the *2012 Standard Specifications*. Report the quantities of reused or recycled materials either incorporated in the project or diverted from landfills on the Project Construction Reuse and Recycling Reporting Form.

A location-based tool for finding local recycling facilities and the Project Construction Reuse and Recycling Reporting Form are available at:

http://connect.ncdot.gov/resources/Environmental/Pages/North-Carolina-Recycling-Locations.aspx

DOMESTIC STEEL:
(4-16-13) 106 SP1 G120

Revise the *2012 Standard Specifications* as follows:

Page 1-49, Subarticle 106-1(B) Domestic Steel, lines 2-7, replace the first paragraph with the following:

All steel and iron products that are permanently incorporated into this project shall be produced in the United States except minimal amounts of foreign steel and iron products may be used provided the combined material cost of the items involved does not exceed 0.1% of the total amount bid for the entire project or $2,500, whichever is greater. If invoices showing the cost of the material are not provided, the amount of the bid item involving the foreign material will be used for calculations. This minimal amount of foreign produced steel and iron products permitted for use is not applicable to high strength fasteners. Domestically produced high strength fasteners are required.

PORTABLE CONCRETE BARRIER - (Partial Payments for Materials):
(7-1-95) (Rev. 8-16-11) 1170-4 SP1 G121

When so authorized by the Engineer, partial materials payments will be made up to 95 percent of the delivered cost of portable concrete barrier, provided that these materials have been delivered on the project and stored in an acceptable manner, and further provided the documents listed in Subarticle 109-5(C) of the *2012 Standard Specifications* have been furnished to the Engineer.

The provisions of Subarticle 109-5(B) of the *2012 Standard Specifications* will apply to the portable concrete barrier.

MAINTENANCE OF THE PROJECT:
(11-20-07) (Rev. 1-17-12) 104-10 SP1 G125

Revise the *2012 Standard Specifications* as follows:

Page 1-35, Article 104-10 Maintenance of the Project, line 25, add the following after the first sentence of the first paragraph:

All guardrail/guiderail within the project limits shall be included in this maintenance.

Page 1-35, Article 104-10 Maintenance of the Project, line 30, add the following as the last sentence of the first paragraph:

The Contractor shall perform weekly inspections of guardrail and guiderail and shall report damages to the Engineer on the same day of the weekly inspection. *Where damaged guardrail or guiderail is repaired or replaced as a result of maintaining the project in* accordance with this article, such repair or replacement shall be performed within 7 consecutive calendar days of such inspection report.

Page 1-35, Article 104-10 Maintenance of the Project, lines 42-44, replace the last sentence of the last paragraph with the following:

The Contractor will not be directly compensated for any maintenance operations necessary, except for maintenance of guardrail/guiderail, as this work will be considered incidental to the work covered by the various contract items. The provisions of Article 104-7, Extra Work, and Article 104-8, Compensation and Record Keeping will apply to authorized maintenance of guardrail/guiderail. Performance of weekly inspections of guardrail/guiderail, and the damage reports required as described above, will be considered to be an incidental part of the work being paid for by the various contract items.

TWELVE MONTH GUARANTEE:

(7-15-03) 108 SP1 G145

(A) The Contractor shall guarantee materials and workmanship against latent and patent defects arising from faulty materials, faulty workmanship or negligence for a period of twelve months following the date of final acceptance of the work for maintenance and shall replace such defective materials and workmanship without cost to the Department. The Contractor will not be responsible for damage due to faulty design, normal wear and tear, for negligence on the part of the Department, and/or for use in excess of the design.

(B) Where items of equipment or material carry a manufacturer's guarantee for any period in excess of twelve months, then the manufacturer's guarantee shall apply for that particular piece of equipment or material. The Department's first remedy shall be through the manufacturer although the Contractor is responsible for invoking the warranted repair work with the manufacturer. The Contractor's responsibility shall be limited to the term of the manufacturer's guarantee. NCDOT would be afforded the same warranty as provided by the Manufacturer.

This guarantee provision shall be invoked only for major components of work in which the Contractor would be wholly responsible for under the terms of the contract. Examples would include pavement structures, bridge components, and sign structures. This provision will not be used as a mechanism to force the Contractor to return to the project to make repairs or perform additional work that the Department would normally compensate the Contractor for. In addition, routine maintenance activities (i.e. mowing grass, debris removal, ruts in earth shoulders,) are not parts of this guarantee.

Appropriate provisions of the payment and/or performance bonds shall cover this guarantee for the project.

To ensure uniform application statewide the Division Engineer will forward details regarding the circumstances surrounding any proposed guarantee repairs to the Chief Engineer for review and approval prior to the work being performed.

GIFTS FROM VENDORS AND CONTRACTORS:

(12-15-09) 107-1 SP1 G152

By Executive Order 24, issued by Governor Perdue, and *N.C.G.S.§ 133-32,* it is unlawful for any vendor or contractor (i.e. architect, bidder, contractor, construction manager, design professional, engineer, landlord, offeror, seller, subcontractor, supplier, or vendor), to make gifts or to give favors to any State employee of the Governor's Cabinet Agencies (i.e. Administration, Commerce, Correction, Crime Control and Public Safety, Cultural Resources, Environment and Natural Resources, Health and Human Services, Juvenile Justice and Delinquency Prevention, Revenue, Transportation, and the Office of the Governor). This prohibition covers those vendors and contractors who:

(A) Have a contract with a governmental agency; or
(B) Have performed under such a contract within the past year; or
(C) Anticipate bidding on such a contract in the future.

For additional information regarding the specific requirements and exemptions, vendors and contractors are encouraged to review Executive Order 24 and *N.C.G.S. § 133-32.*

Executive Order 24 also encouraged and invited other State Agencies to implement the requirements and prohibitions of the Executive Order to their agencies. Vendors and contractors should contact other State Agencies to determine if those agencies have adopted Executive Order 24.

EROSION AND SEDIMENT CONTROL/STORMWATER CERTIFICATION:

(1-16-07) (Rev 9-18-12) 105-16, 225-2, 16 SP1 G180

General

Schedule and conduct construction activities in a manner that will minimize soil erosion and the resulting sedimentation and turbidity of surface waters. Comply with the requirements herein regardless of whether or not a National Pollution discharge Elimination System (NPDES) permit for the work is required.

Establish a chain of responsibility for operations and subcontractors' operations to ensure that the *Erosion and Sediment Control/Stormwater Pollution Prevention Plan* is implemented and maintained over the life of the contract.

(A) *Certified Supervisor* - Provide a certified Erosion and Sediment Control/Stormwater Supervisor to manage the Contractor and subcontractor operations, insure compliance with Federal, State and Local ordinances and regulations, and manage the Quality Control Program.

(B) *Certified Foreman* - Provide a certified, trained foreman for each construction operation that increases the potential for soil erosion or the possible sedimentation and turbidity of surface waters.

(C) *Certified Installer* - Provide a certified installer to install or direct the installation for erosion or sediment/stormwater control practices.

(D) *Certified Designer* - Provide a certified designer for the design of the erosion and sediment control/stormwater component of reclamation plans and, if applicable, for the design of the project erosion and sediment control/stormwater plan.

Roles and Responsibilities

(A) *Certified Erosion and Sediment Control/Stormwater Supervisor* - The Certified Supervisor shall be Level II and responsible for ensuring the erosion and sediment control/stormwater plan is adequately implemented and maintained on the project and for conducting the quality control program. The Certified Supervisor shall be on the project within 24 hours notice from initial exposure of an erodible surface to the project's final acceptance. Perform the following duties:

(1) Manage Operations - Coordinate and schedule the work of subcontractors so that erosion and sediment control/stormwater measures are fully executed for each operation and in a timely manner over the duration of the contract.

(a) Oversee the work of subcontractors so that appropriate erosion and sediment control/stormwater preventive measures are conformed to at each stage of the work.
(b) Prepare the required National Pollutant Discharge Elimination System (NPDES) Inspection Record and submit to the Engineer.
(c) Attend all weekly or monthly construction meetings to discuss the findings of the NPDES inspection and other related issues.
(d) Implement the erosion and sediment control/stormwater site plans requested.
(e) Provide any needed erosion and sediment control/stormwater practices for the Contractor's temporary work not shown on the plans, such as, but not limited to work platforms, temporary construction, pumping operations, plant and storage yards, and cofferdams.
(f) Acquire applicable permits and comply with requirements for borrow pits, dewatering, and any temporary work conducted by the Contractor in jurisdictional areas.
(g) Conduct all erosion and sediment control/stormwater work in a timely and workmanlike manner.
(h) Fully perform and install erosion and sediment control/stormwater work prior to any suspension of the work.
(i) Coordinate with Department, Federal, State and Local Regulatory agencies on resolution of erosion and sediment control/stormwater issues due to the Contractor's operations.

(j) Ensure that proper cleanup occurs from vehicle tracking on paved surfaces or any location where sediment leaves the Right-of-Way.

(k) Have available a set of erosion and sediment control/stormwater plans that are initialed and include the installation date of Best Management Practices. These practices shall include temporary and permanent groundcover and be properly updated to reflect necessary plan and field changes for use and review by Department personnel as well as regulatory agencies.

(2) Requirements set forth under the NPDES Permit - The Department's NPDES Stormwater permit (NCS000250) outlines certain objectives and management measures pertaining to construction activities. The permit references *NCG010000, General Permit to Discharge Stormwater* under the NPDES, and states that the Department shall incorporate the applicable requirements into its delegated Erosion and Sediment Control Program for construction activities disturbing one or more acres of land. The Department further incorporates these requirements on all contracted bridge and culvert work at jurisdictional waters, regardless of size. Some of the requirements are, but are not limited to:

(a) Control project site waste to prevent contamination of surface or ground waters of the state, i.e. from equipment operation/maintenance, construction materials, concrete washout, chemicals, litter, fuels, lubricants, coolants, hydraulic fluids, any other petroleum products, and sanitary waste.

(b) Inspect erosion and sediment control/stormwater devices and stormwater discharge outfalls at least once every 7 calendar days, twice weekly for construction related *Federal Clean Water Act, Section 303(d)* impaired streams with turbidity violations, and within 24 hours after a significant rainfall event of 0.5 inch that occurs within a 24 hour period.

(c) Maintain an onsite rain gauge or use the Department's Multi-Sensor Precipitation Estimate website to maintain a daily record of rainfall amounts and dates.

(d) Maintain erosion and sediment control/stormwater inspection records for review by Department and Regulatory personnel upon request.

(e) Implement approved reclamation plans on all borrow pits, waste sites and staging areas.

(f) Maintain a log of turbidity test results as outlined in the Department's Procedure for Monitoring Borrow Pit Discharge.

(g) Provide secondary containment for bulk storage of liquid materials.

(h) Provide training for employees concerning general erosion and sediment control/stormwater awareness, the Department's NPDES Stormwater Permit NCS000250 requirements, and the applicable requirements of the *General Permit, NCG010000.*

(i) Report violations of the NPDES permit to the Engineer immediately who will notify the Division of Water Quality Regional Office within 24 hours of becoming aware of the violation.

(3) Quality Control Program - Maintain a quality control program to control erosion, prevent sedimentation and follow provisions/conditions of permits. The quality control program shall:

(a) Follow permit requirements related to the Contractor and subcontractors' construction activities.
(b) Ensure that all operators and subcontractors on site have the proper erosion and sediment control/stormwater certification.
(c) Notify the Engineer when the required certified erosion and sediment control/stormwater personnel are not available on the job site when needed.
(d) Conduct the inspections required by the NPDES permit.
(e) Take corrective actions in the proper timeframe as required by the NPDES permit for problem areas identified during the NPDES inspections.
(f) Incorporate erosion control into the work in a timely manner and stabilize disturbed areas with mulch/seed or vegetative cover on a section-by-section basis.
(g) Use flocculants approved by state regulatory authorities where appropriate and where required for turbidity and sedimentation reduction.
(h) Ensure proper installation and maintenance of temporary erosion and sediment control devices.
(i) Remove temporary erosion or sediment control devices when they are no longer necessary as agreed upon by the Engineer.
(j) The Contractor's quality control and inspection procedures shall be subject to review by the Engineer. Maintain NPDES inspection records and make records available at all times for verification by the Engineer.

(B) *Certified Foreman* - At least one Certified Foreman shall be onsite for each type of work listed herein during the respective construction activities to control erosion, prevent sedimentation and follow permit provisions:

(1) Foreman in charge of grading activities
(2) Foreman in charge of bridge or culvert construction over jurisdictional areas
(3) Foreman in charge of utility activities

The Contractor may request to use the same person as the Level II Supervisor and Level II Foreman. This person shall be onsite whenever construction activities as described above are taking place. This request shall be approved by the Engineer prior to work beginning.

The Contractor may request to name a single Level II Foreman to oversee multiple construction activities on small bridge or culvert replacement projects. This request shall be approved by the Engineer prior to work beginning.

(C) *Certified Installers* - Provide at least one onsite, Level I Certified Installer for each of the following erosion and sediment control/stormwater crew:

(1) Seeding and Mulching
(2) Temporary Seeding
(3) Temporary Mulching
(4) Sodding
(5) Silt fence or other perimeter erosion/sediment control device installations
(6) Erosion control blanket installation
(7) Hydraulic tackifier installation
(8) Turbidity curtain installation
(9) Rock ditch check/sediment dam installation
(10) Ditch liner/matting installation
(11) Inlet protection
(12) Riprap placement
(13) Stormwater BMP installations (such as but not limited to level spreaders, retention/detention devices)
(14) Pipe installations within jurisdictional areas

If a Level I *Certified Installer* is not onsite, the Contractor may substitute a Level II Foreman for a Level I Installer, provided the Level II Foreman is not tasked to another crew requiring Level II Foreman oversight.

(D) *Certified Designer* - Include the certification number of the Level III-B Certified Designer on the erosion and sediment control/stormwater component of all reclamation plans and if applicable, the certification number of the Level III-A Certified Designer on the design of the project erosion and sediment control/stormwater plan.

Preconstruction Meeting

Furnish the names of the *Certified Erosion and Sediment Control/Stormwater Supervisor, Certified Foremen, Certified Installers* and *Certified Designer* and notify the Engineer of changes in certified personnel over the life of the contract within 2 days of change.

Ethical Responsibility

Any company performing work for the North Carolina Department of Transportation has the ethical responsibility to fully disclose any reprimand or dismissal of an employee resulting from improper testing or falsification of records.

Revocation or Suspension of Certification

Upon recommendation of the Chief Engineer to the certification entity, certification for *Supervisor, Certified Foremen, Certified Installers* and *Certified Designer* may be revoked or suspended with the issuance of an *Immediate Corrective Action (ICA), Notice of Violation (NOV),* or C*ease and Desist Order* for erosion and sediment control/stormwater related issues.

The Chief Engineer may recommend suspension or permanent revocation of certification due to the following:

(A) Failure to adequately perform the duties as defined within this certification provision.
(B) Issuance of an ICA, NOV, or Cease and Desist Order.
(C) Failure to fully perform environmental commitments as detailed within the permit conditions and specifications.
(D) Demonstration of erroneous documentation or reporting techniques.
(E) Cheating or copying another candidate's work on an examination.
(F) Intentional falsification of records.
(G) Directing a subordinate under direct or indirect supervision to perform any of the above actions.
(H) Dismissal from a company for any of the above reasons.
(I) Suspension or revocation of one's certification by another entity.

Suspension or revocation of a certification will be sent by certified mail to the certificant and the Corporate Head of the company that employs the certificant.

A certificant has the right to appeal any adverse action which results in suspension or permanent revocation of certification by responding, in writing, to the Chief Engineer within 10 calendar days after receiving notice of the proposed adverse action.

Chief Engineer
1536 Mail Service Center
Raleigh, NC 27699-1536

Failure to appeal within 10 calendar days will result in the proposed adverse action becoming effective on the date specified on the certified notice. Failure to appeal within the time specified will result in a waiver of all future appeal rights regarding the adverse action taken. The certificant will not be allowed to perform duties associated with the certification during the appeal process.

The Chief Engineer will hear the appeal and make a decision within 7 days of hearing the appeal. Decision of the Chief Engineer will be final and will be made in writing to the certificant.

If a certification is temporarily suspended, the certificant shall pass any applicable written examination and any proficiency examination, at the conclusion of the specified suspension period, prior to having the certification reinstated.

Measurement and Payment

Certified Erosion and Sediment Control/Stormwater Supervisor, Certified Foremen, Certified Installers and *Certified Designer* will be incidental to the project for which no direct compensation will be made.

PROCEDURE FOR MONITORING BORROW PIT DISCHARGE:

(2-20-07) (Rev. 3-19-13) 105-16, 230, 801 SP1 G181

Water discharge from borrow pit sites shall not cause surface waters to exceed 50 NTUs (nephelometric turbidity unit) in streams not designated as trout waters and 10 NTUs in streams, lakes or reservoirs designated as trout waters. For lakes and reservoirs not designated as trout waters, the turbidity shall not exceed 25 NTUs. If the turbidity exceeds these levels due to natural background conditions, the existing turbidity level shall not be increased.

If during any operating day, the downstream water quality exceeds the standard, the Contractor shall do all of the following:

(A) Either cease discharge or modify the discharge volume or turbidity levels to bring the downstream turbidity levels into compliance, or

(B) Evaluate the upstream conditions to determine if the exceedance of the standard is due to natural background conditions. If the background turbidity measurements exceed the standard, operation of the pit and discharge can continue as long as the stream turbidity levels are not increased due to the discharge.

(C) Measure and record the turbidity test results (time, date and sampler) at all defined sampling locations 30 minutes after startup and at a minimum, one additional sampling of all sampling locations during that 24-hour period in which the borrow pit is discharging.

(D) Notify DWQ within 24 hours of any stream turbidity standard exceedances that are not brought into compliance.

During the Environmental Assessment required by Article 230-4 of the *2012 Standard Specifications*, the Contractor shall define the point at which the discharge enters into the State's surface waters and the appropriate sampling locations. Sampling locations shall include points upstream and downstream from the point at which the discharge enters these waters. Upstream sampling location shall be located so that it is not influenced by backwater conditions and represents natural background conditions. Downstream sampling location shall be located at the point where complete mixing of the discharge and receiving water has occurred.

The discharge shall be closely monitored when water from the dewatering activities is introduced into jurisdictional wetlands. Any time visible sedimentation (deposition of sediment) on the wetland surface is observed, the dewatering activity will be suspended until turbidity levels in the stilling basin can be reduced to a level where sediment deposition does not occur. Staining of wetland surfaces from suspended clay particles, occurring after evaporation or infiltration, does not constitute sedimentation. No activities shall occur in wetlands that adversely affect the functioning of a wetland. Visible sedimentation will be considered an indication of possible adverse impacts on wetland use.

The Engineer will perform independent turbidity tests on a random basis. These results will be maintained in a log within the project records. Records will include, at a minimum, turbidity test results, time, date and name of sampler. Should the Department's test results exceed those of the

Contractor's test results, an immediate test shall be performed jointly with the results superseding the previous test results of both the Department and the Contractor.

The Contractor shall use the *NCDOT Turbidity Reduction Options for Borrow Pits Matrix,* available at http://www.ncdot.gov/doh/operations/dp_chief_eng/roadside/fieldops/downloads/Files/TurbidityReductionOptionSheet.pdf to plan, design, construct, and maintain BMPs to address water quality standards. Tier I Methods include stilling basins which are standard compensatory BMPs. Other Tier I methods are noncompensatory and shall be used when needed to meet the stream turbidity standards. Tier II Methods are also noncompensatory and are options that may be needed for protection of rare or unique resources or where special environmental conditions exist at the site which have led to additional requirements being placed in the DWQ's 401 Certifications and approval letters, Isolated Wetland Permits, Riparian Buffer Authorization or a DOT Reclamation Plan's Environmental Assessment for the specific site. Should the Contractor exhaust all Tier I Methods on a site exclusive of rare or unique resources or special environmental conditions, Tier II Methods may be required by regulators on a case by case basis per supplemental agreement.

The Contractor may use cation exchange capacity (CEC) values from proposed site borings to plan and develop the bid for the project. CEC values exceeding 15 milliequivalents per 100 grams of soil may indicate a high potential for turbidity and should be avoided when dewatering into surface water is proposed.

No additional compensation for monitoring borrow pit discharge will be paid.

EMPLOYMENT:
(11-15-11) (Rev. 1-17-12) 108, 102 SP1 G184

Revise the *2012 Standard Specifications* as follows:

Page 1-20, Subarticle 102-15(O), delete and replace with the following:

(O) Failure to restrict a former Department employee as prohibited by Article 108-5.

Page 1-65, Article 108-5 Character of Workmen, Methods, and Equipment, line 32, delete all of line 32, the first sentence of the second paragraph and the first word of the second sentence of the second paragraph.

STATE HIGHWAY ADMINISTRATOR TITLE CHANGE:
(9-18-12) SP1 G185

Revise the *2012 Standard Specifications* as follows:

Replace all references to "State Highway Administrator" with "Chief Engineer".

PROJECT SPECIAL PROVISIONS

ROADWAY

CLEARING AND GRUBBING - METHOD III:

(4-6-06) (Rev. 1-17-12) 200 SP2 R02B

Perform clearing on this project to the limits established by Method "III" shown on Standard Drawing No. 200.03 of the *2012 Roadway Standard Drawings*.

BURNING RESTRICTIONS:

(7-1-95) 200, 210, 215 SP2 R05

Open burning is not permitted on any portion of the right-of-way limits established for this project. Do not burn the clearing, grubbing or demolition debris designated for disposal and generated from the project at locations within the project limits, off the project limits or at any waste or borrow sites in this county. Dispose of the clearing, grubbing and demolition debris by means other than burning, according to state or local rules and regulations.

SHOULDER AND FILL SLOPE MATERIAL:

(5-21-02) 235, 560 SP2 R45 B

Description

Perform the required shoulder and slope construction for this project in accordance with the applicable requirements of Section 560 and Section 235 of the *2012 Standard Specifications*.

Measurement and Payment

When the Contractor elects to obtain material from an area located beneath a proposed fill sections which does not require excavation for any reason other than to generate acceptable shoulder and fill slope material, the work of performing the excavation will be considered incidental to the item of *Borrow Excavation* or *Shoulder Borrow*. If there is no pay item for *Borrow* or *Shoulder Borrow* in the contract, this work will be considered incidental to *Unclassified Excavation*. Stockpile the excavated material in a manner to facilitate measurement by the Engineer. Fill the void created by the excavation of the shoulder and fill slope material with suitable material. Payment for material used from the stockpile will be made at the contract unit price for *Borrow Excavation* or *Shoulder Borrow*. If there is no pay item for *Borrow Excavation* or *Shoulder Borrow*, then the material will be paid for at the contract unit price for *Unclassified Excavation*. The material used to fill the void created by the excavation of the shoulder and fill slope material will be made at the contract unit price for *Unclassified Excavation*, *Borrow Excavation*, or *Shoulder Borrow*, depending on the source of the material.

Material generated from undercut excavation, unclassified excavation or clearing and grubbing operations that is placed directly on shoulders or slope areas, will not be measured separately for payment, as payment for the work requiring the excavation will be considered adequate compensation for depositing and grading the material on the shoulders or slopes.

When undercut excavation is performed at the direction of the Engineer and the material excavated is found to be suitable for use as shoulder and fill slope material, and there is no area on the project currently prepared to receive the material generated by the undercut operation, the Contractor may construct a stockpile for use as borrow at a later date. Payment for the material used from the stockpile will be made at the contract unit price for *Borrow Excavation* or *Shoulder Borrow*.

When shoulder material is obtained from borrow sources or from stockpiled material, payment for the work of shoulder construction will be made at the contract unit price per cubic yard for *Borrow Excavation* or *Shoulder Borrow* in accordance with the applicable provisions of Section 230 or Section 560 of the *2012 Standard Specifications*.

PIPE INSTALLATION:

(11-20-12) 300 SP3 R01

Revise the *2012 Standard Specifications* as follows:

Page 3-1, Article 300-2, Materials, line 23-24, replace sentence with:

Provide foundation conditioning geotextile in accordance with Section 1056 for Type 4 geotextile.

NCDOT APPROVED PIPE LINER:

Furnish and install pipe liner as shown at recommended locations on the plans. Pipe liner should be from NCDOT Approved Product Listing for drainage pipe liners at the following link or an approved equal:

https://connect.ncdot.gov/resources/Products/Pages/default.aspx

Pipe liner is subject to approval by the Engineer.

NCDOT Approved Pipe Liner will be measured and paid as the actual number of linear feet of pipe liner that has been incorporated into the completed and accepted work.

Pay Item	**Pay Unit**
NCDOT Approved Pipe Liner	Linear Foot

ASPHALT PAVEMENTS - SUPERPAVE:

(6-19-12) (Rev. 2-18-14) 605, 609, 610, 650, 660 SP6 R01

Revise the *2012 Standard Specifications* as follows:

Page 6-3, Article 605-7 APPLICATION RATES AND TEMPERATURES, replace this article, including Table 601-1, with the following:

Apply tack coat uniformly across the existing surface at target application rates shown in Table 605-1.

TABLE 605-1
APPLICATION RATES FOR TACK COAT

Existing Surface	Target Rate (gal/sy)
	Emulsified Asphalt
New Asphalt	0.04 ± 0.01
Oxidized or Milled Asphalt	0.06 ± 0.01
Concrete	0.08 ± 0.01

Apply tack coat at a temperature within the ranges shown in Table 605-2. Tack coat shall not be overheated during storage, transport or at application.

TABLE 605-2
APPLICATION TEMPERATURE FOR TACK COAT

Asphalt Material	Temperature Range
Asphalt Binder, Grade PG 64-22	350 - 400°F
Emulsified Asphalt, Grade RS-1H	130 - 160°F
Emulsified Asphalt, Grade CRS-1	130 - 160°F
Emulsified Asphalt, Grade CRS-1H	130 - 160°F
Emulsified Asphalt, Grade HFMS-1	130 - 160°F
Emulsified Asphalt, Grade CRS-2	130 - 160°F

Page 6-7, Article 609-3 FIELD VERIFICATION OF MIXTURE AND JOB MIX FORMULA ADJUSTMENTS, lines 35-37, delete the second sentence of the second paragraph.

Page 6-18, Article 610-1 DESCRIPTION, lines 40-41, delete the last sentence of the last paragraph.

Page 6-19, Subarticle 610-3(A) Mix Design-General, line 5, add the following as the first paragraph:

Warm mix asphalt (WMA) is allowed for use at the Contractor's option in accordance with the NCDOT Approved Products List for WMA Technologies available at:

https://connect.ncdot.gov/resources/Materials/MaterialsResources/Warm%20Mix%20Asphalt%20Approved%20List.pdf

Page 6-21, Subarticle 610-3(C) Job Mix Formula (JMF), replace Table 610-1 with the following:

TABLE 610-1
DESIGN MIXING TEMPERATURE AT THE ASPHALT PLANT[A]

Binder Grade	HMA JMF Temperature	WMA JMF Temperature Range
PG 64-22	300°F	225 - 275°F
PG 70-22	315°F	240 - 290°F
PG 76-22	335°F	260 - 310°F

A. The mix temperature, when checked in the truck at the roadway, shall be within plus 15° and minus 25° of the temperature specified on the JMF.

Page 6-21, Subarticle 610-3(C) Job Mix Formula (JMF), lines 4-6, delete first sentence of the second paragraph. Line 7, in the second sentence of the second paragraph, replace "275°F" with "275°F or greater."

Page 6-22, Article 610-4 WEATHER, TEMPERATURE AND SEASONAL LIMITATIONS FOR PRODUCING AND PLACING ASPHALT MIXTURES, lines 15-17, replace the second sentence of the first paragraph with the following:

Do not place asphalt material when the air or surface temperatures, measured at the location of the paving operation away from artificial heat, do not meet Table 610-5.

Page 6-23, Article 610-4 WEATHER, TEMPERATURE AND SEASONAL LIMITATIONS FOR PRODUCING AND PLACING ASPHALT MIXTURES, replace Table 610-5 with the following:

TABLE 610-5
PLACEMENT TEMPERATURES FOR ASPHALT

Asphalt Concrete Mix Type	Minimum Surface and Air Temperature
B25.0B, C	35°F
I19.0B, C, D	35°F
SF9.5A, S9.5B	40°F
S9.5C, S12.5C	45°F
S9.5D, S12.5D	50°F

Page 6-26, Article 610-7 HAULING OF ASPHALT MIXTURE, lines 22-23, in the fourth sentence of the first paragraph replace "so as to overlap the top of the truck bed and" with "to".

Page 6-41, Subarticle 650-3(B) Mix Design Criteria, replace Table 650-1 with the following:

TABLE 650-1
OGAFC GRADATION CRITERIA

Grading Requirements	**Total Percent Passing**		
Sieve Size (mm)	*Type FC-1*	*Type FC-1 Modified*	*Type FC-2 Modified*
19.0	-	-	100
12.5	100	100	**80** - 100
9.50	75 - 100	75 - 100	55 - **80**
4.75	25 - 45	25 - 45	15 - **30**
2.36	5 - 15	5 - 15	5 - **15**
0.075	1.0 - 3.0	1.0 - 3.0	2.0 - 4.0

Page 6-50, Table 660-1 MATERIAL APPLICATION RATES AND TEMPERATURES, lines 1-2, replace Note A in Table 660-1 with the following:

A. Use No. 6M, No. 67, No. 5 and No. 78M aggregate for retreatment before an asphalt overlay on existing pavement based on the width of the cracks in the existing pavement. Choose No. 78M for sections of roadway where the average width of existing cracks is 1/4" or less in width, No. 67 for sections of roadway where the average width of existing cracks are 1/4" to 5/8" in width and choose No. 5 for sections of roadway where the existing crack widths are greater than 5/8".

ASPHALT BINDER CONTENT OF ASPHALT PLANT MIXES:
(11-21-00) (Rev. 7-17-12) 609 SP6 R15

The approximate asphalt binder content of the asphalt concrete plant mixtures used on this project will be as follows:

Asphalt Concrete Base Course	Type B 25.0__	4.4%
Asphalt Concrete Intermediate Course	Type I 19.0__	4.8%
Asphalt Concrete Surface Course	Type S 4.75A	6.8%
Asphalt Concrete Surface Course	Type SA-1	6.8%
Asphalt Concrete Surface Course	Type SF 9.5A	6.7%
Asphalt Concrete Surface Course	Type S 9.5__	6.0%
Asphalt Concrete Surface Course	Type S 12.5__	5.6%

The actual asphalt binder content will be established during construction by the Engineer within the limits established in the *2012 Standard Specifications.*

ASPHALT PLANT MIXTURES:
(7-1-95) 609 SP6 R20

Place asphalt concrete base course material in trench sections with asphalt pavement spreaders made for the purpose or with other equipment approved by the Engineer.

PRICE ADJUSTMENT - ASPHALT BINDER FOR PLANT MIX:
(11-21-00) 620 SP6 R25

Price adjustments for asphalt binder for plant mix will be made in accordance with Section 620 of the *2012 Standard Specifications.*

The base price index for asphalt binder for plant mix is **$559.29** per ton.

This base price index represents an average of F.O.B. selling prices of asphalt binder at supplier's terminals on **February 1, 2014**.

FINAL SURFACE TESTING NOT REQUIRED:
(5-18-04) (Rev. 5-15-12) 610 SP6 R45

Final surface testing is not required on this project.

OIL/WATER SEPARATOR:

Description

This work consists of constructing an oil/water separator in adjacent to the weigh station in accordance with the plans and as directed by the Engineer.

Construction Methods

Construct oil/water separator to accommodate draining from the adjacent weigh station static scales. Oil/water separator shall be designed by the Cntractor in accordance with the International Plumbing Code (IPC) Chapter 10, Section 1003 and Subsection 1003.4. This work does not include the oil/water separator located inside the Weigh Station Inspection Building which is covered under the inspection building plans and provisions.

Measurement and Payment

Oil/Water Separator will be measured and paid in units of each. Such price includes, but is not limited to, all material, labor, design of the separator, and other work required to construct the separator as shown in the plans and as directed by the Engineer.

Payment will be made under:

Pay Item	**Pay Unit**
Oil/Water Separator	Each

SLUICE GATE:
(7-1-95) (Rev. 3-17-09) 838 SP8 R20

Description

This work consists of the construction of a sluice gate on an endwall in accordance with the details in the plans, the applicable requirements of Section 838 of the *2012 Standard*

Specifications, in accordance with the manufacturer's recommendations and as directed by the Engineer.

Materials

Sluice gates shall meet the manufacturer's recommendations for the corresponding pipe size. Due to variations in individual manufacturer's products, a slight variation from the size specified may be allowed. Submit the proposed catalog cut to the Engineer for approval prior to use.

Construction Methods

Provide a gate that forms a watertight seal when closed.

Measurement and Payment

____" *Sluice Gate* will be measured and paid as each for the actual number of sluice gates incorporated into the completed and accepted work. Such prices and payment will be full compensation for all materials, labor, tools, equipment and incidentals necessary to complete the work.

The endwall will be measured and paid in accordance with Article 838-4 of the *2012 Standard Specifications*.

Payment will be made under:

Pay Item	Pay Unit
____" Sluice Gate	Each

CONVERT EXISTING TRAFFIC BEARING DROP INLET TO TRAFFIC BEARING JUNCTION BOX:

(1-1-02) (Rev. 7-18-06) 840, 859 SP8 R50

At the proper phase of construction, convert the existing Traffic Bearing Drop Inlet at locations indicated in the plans or where directed, to Traffic Bearing Junction Box in accordance with the details in the plans and the applicable requirements of Sections 840 and 859 of the *2012 Standard Specifications*.

Convert Existing Traffic Bearing Drop Inlet to Traffic Bearing Junction Box will be measured and paid as each, completed and accepted. Such price and payment is considered full compensation for all equipment, materials, labor, tools, and incidentals necessary to complete each conversion satisfactorily.

Payment will be made under:

Pay Item	Pay Unit
Convert Existing Traffic Bearing Drop Inlet To Traffic Bearing Junction Box	Each

GUARDRAIL ANCHOR UNITS, TYPE M-350:

(4-20-04) (Rev. 1-17-12) 862 SP8 R60

Description

Furnish and install guardrail anchor units in accordance with the details in the plans, the applicable requirements of Section 862 of the *2012 Standard Specifications*, and at locations shown in the plans.

Materials

The Contractor may, at his option, furnish any one of the following guardrail anchor units or approved equal.

The guardrail anchor unit (SRT-350) as manufactured by:

Trinity Industries, Inc.
2525 N. Stemmons Freeway
Dallas, Texas 75207
Telephone: 800-644-7976

The guardrail anchor unit (FLEAT) as manufactured by:

Road Systems, Inc.
3616 Old Howard County Airport
Big Springs, Texas 79720
Telephone: 915-263-2435

The guardrail anchor unit (REGENT) as manufactured by:

Energy Absorption Systems, Inc.
One East Wacker Drive
Chicago, Illinois 60601-2076
Telephone: 888-32-ENERGY

Prior to installation the Contractor shall submit to the Engineer:

(A) FHWA acceptance letter for each guardrail anchor unit certifying it meets the requirements of NCHRP Report 350, Test Level 3, in accordance with Article 106-2 of the *2012 Standard Specifications*.

(B) Certified working drawings and assembling instructions from the manufacturer for each guardrail anchor unit in accordance with Article 105-2 of the *2012 Standard Specifications*.

No modifications shall be made to the guardrail anchor unit without the express written permission from the manufacturer. Perform installation in accordance with the details in the plans, and details and assembling instructions furnished by the manufacturer.

Construction Methods

Guardrail end delineation shall be required on all approach and trailing end sections for both temporary and permanent installations. Guardrail end delineation consists of yellow reflective sheeting applied to the entire end section of the guardrail in accordance with Article 1088-3 of the *2012 Standard Specifications* and is incidental to the cost of the guardrail anchor unit.

Measurement and Payment

Measurement and payment will be made in accordance with Article 862-6 of the *2012 Standard Specifications*.

Payment will be made under:

Pay Item	Pay Unit
Guardrail Anchor Units, Type M-350	Each

GUARDRAIL ANCHOR UNITS, TYPE 350 TL-2:

(10-21-08) (Rev. 8-16-11) 862 SP8 R64

Description

Furnish and install guardrail anchor units in accordance with the details in the plans, the applicable requirements of Section 862 of the *2012 Standard Specifications*, and at locations shown in the plans.

Materials

The Contractor may at his option, furnish any one of the guardrail anchor units or approved equal.

Guardrail anchor unit (ET-Plus) manufactured by:

Trinity Industries, Inc.
2525 N. Stemmons Freeway
Dallas, Texas 75207
Telephone: 800-644-7976

The guardrail anchor unit (SKT 350) as manufactured by:

Road Systems, Inc.
3616 Old Howard County Airport
Big Spring, Texas 79720
Telephone: 915-263-2435

Prior to installation the Contractor shall submit to the Engineer:

(A) FHWA acceptance letter for each guardrail anchor unit certifying it meets the requirements of NCHRP Report 350, Test Level 2 in accordance with Article 106-2 of the *2012 Standard Specifications*.

(B) Certified working drawings and assembling instructions from the manufacturer for each guardrail anchor unit in accordance with Article 105-2 of the *2012 Standard Specifications*.

No modifications shall be made to the guardrail anchor unit without the express written permission from the manufacturer. Perform installation in accordance with the details in the plans, and details and assembling instructions furnished by the manufacturer.

Construction Methods

Guardrail end delineation is required on all approach and trailing end sections for both temporary and permanent installations. Guardrail end delineation consists of yellow reflective sheeting applied to the entire end section of the guardrail in accordance with Article 1088-3 of the *2012 Standard Specifications* and is incidental to the cost of the guardrail anchor unit.

Measurement and Payment

Measurement and payment will be made in accordance with Article 862-6 of the *2012 Standard Specifications*.

Payment will be made under:

Pay Item	Pay Unit
Guardrail Anchor Units, Type 350 TL-2	Each

GUARDRAIL ANCHOR UNITS, TYPE 350:

(4-20-04) (Rev. 8-16-11) 862 SP8 R65

Description

Furnish and install guardrail anchor units in accordance with the details in the plans, the applicable requirements of Section 862 of the *2012 Standard Specifications*, and at locations shown in the plans.

Materials

The Contractor may at his option, furnish any one of the guardrail anchor units or approved equal.

Guardrail anchor unit (ET-Plus) as manufactured by:

Trinity Industries, Inc.
2525 N. Stemmons Freeway
Dallas, Texas 75207
Telephone: 800-644-7976

The guardrail anchor unit (SKT 350) as manufactured by:

Road Systems, Inc.
3616 Old Howard County Airport
Big Spring, Texas 79720
Telephone: 915-263-2435

Prior to installation the Contractor shall submit to the Engineer:

(A) FHWA acceptance letter for each guardrail anchor unit certifying it meets the requirements of NCHRP Report 350, Test Level 3, in accordance with Article 106-2 of the *2012 Standard Specifications*.

(B) Certified working drawings and assembling instructions from the manufacturer for each guardrail anchor unit in accordance with Article 105-2 of the *2012 Standard Specifications*.

No modifications shall be made to the guardrail anchor unit without the express written permission from the manufacturer. Perform installation in accordance with the details in the plans, and details and assembling instructions furnished by the manufacturer.

Construction Methods

Guardrail end delineation is required on all approach and trailing end sections for both temporary and permanent installations. Guardrail end delineation consists of yellow reflective sheeting applied to the entire end section of the guardrail in accordance with Article 1088-3 of the *2012 Standard Specifications* and is incidental to the cost of the guardrail anchor unit.

Measurement and Payment

Measurement and payment will be made in accordance with Article 862-6 of the *2012 Standard Specifications*.

Payment will be made under:

Pay Item	**Pay Unit**
Guardrail Anchor Units, Type 350	Each

IMPACT ATTENUATOR UNITS, TYPE 350:
(4-20-04) (Rev. 1-17-12) SP8 R75

Description

Furnish and install impact attenuator units and any components necessary to connect the impact attenuator units in accordance with the manufacturer's requirement, the details in the plans and at locations shown in the plans.

Materials

The Contractor may at his option, furnish any one of the **NON-GATING** impact attenuator units or approved equal:

The impact attenuator unit (QUADGUARD) as manufactured by:

Energy Absorption Systems, Inc.
One East Wacker Drive
Chicago, Illinois 60601-2076
Telephone: 312-467-6750

The impact attenuator unit (TRACC) as manufactured by:

Trinity Industries, Inc.
2525 N. Stemmons Freeway
Dallas, Texas 75207
Telephone: 800-644-7976

The Contractor may at his option, furnish any one of the **GATING** impact attenuator units or approved equal:

The impact attenuator unit (BRAKEMASTER) as manufactured by:

Energy Absorption Systems, Inc.
One East Wacker Drive
Chicago, Illinois 60601-2076
Telephone: 312-467-6750

The impact attenuator unit (CAT) as manufactured by:

Trinity Industries, Inc.
2525 N. Stemmons Freeway
Dallas, Texas 75207
Telephone: 800-644-7976

Prior to installation the Contractor shall submit to the Engineer:

(A) FHWA acceptance letter for each impact attenuator unit certifying it meets the requirements of NCHRP Report 350, Test Level 3, in accordance with Article 106-2 of the *2012 Standard Specifications*.

(B) Certified working drawings and assembling instructions from the manufacturer for each impact attenuator unit in accordance with Article 105-2 of the *2012 Standard Specifications*.

No modifications shall be made to the impact attenuator unit without the express written permission from the manufacturer. Perform installation in accordance with the details in the plans, and details and assembling instructions furnished by the manufacturer.

Construction Methods

If the median width is 40 feet or less, the Contractor shall supply one of the NON-GATING Impact Attenuator Units listed in the Materials Section herein.

If the median width is greater than 40 feet, the Contractor may use any of the GATING or NON-GATING Impact Attenuator Units listed in the Materials Section herein.

Measurement and Payment

Impact Attenuator Unit, Type 350 will be measured and paid at the contract unit price per each. Such prices and payment will be full compensation for all work covered by this provision including, but not limited to, furnishing, installing and all incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Impact Attenuator Units, Type 350	Each

PREFORMED SCOUR HOLE WITH LEVEL SPREADER APRON:

(10-15-02) (Rev. 10-20-09) 410 SP8 R105

Description

Construct and maintain preformed scour holes with spreader aprons at the locations shown on the plans and in accordance with the details in the plans. Work includes excavation, shaping and maintaining the hole and apron, furnishing and placing filter fabric, rip rap (class as specified in the plans) and permanent soil reinforcement matting.

Materials

Item	Section
Plain Rip Rap	1042
Filter Fabric	1056

The permanent soil reinforcement matting shall be permanent erosion control reinforcement mat and shall be constructed of synthetic or a combination of coconut and synthetic fibers evenly distributed throughout the mat between a bottom UV stabilized netting and a heavy duty UV stabilized top net. The matting shall be stitched together with UV stabilized polypropylene thread to form a permanent three dimensional structure. The mat shall have the following minimum physical properties:

Property	Test Method	Value Unit
Light Penetration	ASTM D6567	9 %
Thickness	ASTM D6525	0.40 in
Mass Per Unit Area	ASTM D6566	0.55 lb/sy
Tensile Strength	ASTM D6818	385 lb/ft
Elongation (Maximum)	ASTM D6818	49 %
Resiliency	ASTM D1777	>70 %
UV Stability *	ASTM 4355	≥80 %
Porosity (Permanent Net)	ECTC Guidelines	≥85 %
Maximum Permissible Shear Stress (Vegetated)	Performance Bench Test	≥8.0 lb/ft^2
Maximum Allowable Velocity (Vegetated)	Performance Bench Test	≥16.0 ft/s

*ASTM D1682 Tensile Strength and % strength retention of material after 1,000 hours of exposure.

Submit a certification (Type 1, 2, or 3) from the manufacturer showing:

(A) The chemical and physical properties of the mat used, and
(B) Conformance of the mat with this specification.

Construction Methods

All areas to be protected with the mat shall be brought to final grade and seeded in accordance with Section 1660 of the *2012 Standard Specifications*. The surface of the soil shall be smooth, firm, stable and free of rocks, clods, roots or other obstructions that would prevent the mat from lying in direct contact with the soil surface. Areas where the mat is to be placed will not need to be mulched.

Measurement and Payment

Preformed Scour Holes with Level Spreader Aprons will be measured and paid as the actual number incorporated into the completed and accepted work. Such price and payment will be full compensation for all work covered by this provision.

Payment will be made under:

Pay Item	Pay Unit
Preformed Scour Hole with Level Spreader Aprons	Each

FOUNDATIONS AND ANCHOR ROD ASSEMBLIES FOR METAL POLES:

(1-17-12) (Rev. 5-21-13) 9, 14, 17 SP9 R05

Description

Foundations for metal poles include foundations for signals, cameras, overhead and dynamic message signs (DMS) and high mount and low level light standards supported by metal poles or upright trusses. Foundations consist of footings with pedestals and drilled piers with or without grade beams or wings. Anchor rod assemblies consist of anchor rods (also called anchor bolts) with nuts and washers on the exposed ends of rods and nuts and a plate or washers on the other ends of rods embedded in the foundation.

Construct concrete foundations with the required resistances and dimensions and install anchor rod assemblies in accordance with the contract and accepted submittals. Construct drilled piers consisting of cast-in-place reinforced concrete cylindrical sections in excavated holes. Provide temporary casings or polymer slurry as needed to stabilize drilled pier excavations. Use a prequalified Drilled Pier Contractor to construct drilled piers for metal poles. Define "excavation" and "hole" as a drilled pier excavation and "pier" as a drilled pier.

This provision does not apply to materials and anchor rod assemblies for standard foundations for low level light standards. See Section 1405 of the *2012 Standard Specifications* and Standard Drawing No. 1405.01 of the *2012 Roadway Standard Drawings* for materials and anchor rod assemblies for standard foundations. For construction of standard foundations for low level light standards, standard foundations are considered footings in this provision.

This provision does not apply to foundations for signal pedestals; see Section 1743 of the *2012 Standard Specifications* and Standard Drawing No. 1743.01 of the *2012 Roadway Standard Drawings*.

Materials

Refer to the *2012 Standard Specifications*.

Item	Section
Conduit	1091-3
Grout, Nonshrink	1003
Polymer Slurry	411-2(B)
Portland Cement Concrete	1000
Reinforcing Steel	1070
Rollers and Chairs	411-2(C)
Temporary Casings	411-2(A)

Provide Type 3 material certifications in accordance with Article 106-3 of the *2012 Standard Specifications* for conduit, rollers, chairs and anchor rod assemblies. Store steel materials on blocking at least 12" above the ground and protect it at all times from damage; and when placing in the work make sure it is free from dirt, dust, loose mill scale, loose rust, paint, oil or other foreign materials. Load, transport, unload and store foundation and anchor rod assembly

materials so materials are kept clean and free of damage. Bent, damaged or defective materials will be rejected.

Use conduit type in accordance with the contract. Use Class A concrete for footings and pedestals, Class Drilled Pier concrete for drilled piers and Class AA concrete for grade beams and wings including portions of drilled piers above bottom of wings elevations. Corrugated temporary casings may be accepted at the discretion of the Engineer. A list of approved polymer slurry products is available from:
connect.ncdot.gov/resources/Geological/Pages/Products.aspx

Provide anchor rod assemblies in accordance with the contract consisting of the following:

(A) Straight anchor rods,

(B) Heavy hex top and leveling nuts and flat washers on exposed ends of rods, and

(C) Nuts and either flat plates or washers on the other ends of anchor rods embedded in foundations.

Do not use lock washers. Use steel anchor rods, nuts and washers that meet ASTM F1554 for Grade 55 rods and Grade A nuts. Use steel plates and washers embedded in concrete with a thickness of at least 1/4". Galvanize anchor rods and exposed nuts and washers in accordance with Article 1076-4 of the *2012 Standard Specifications*. It is not necessary to galvanize nuts, plates and washers embedded in concrete.

Construction Methods

Install the required size and number of conduits in foundations in accordance with the plans and accepted submittals. Construct top of piers, footings, pedestals, grade beams and wings flat, level and within 1" of elevations shown in the plans or approved by the Engineer. Provide an Ordinary Surface finish in accordance with Subarticle 825-6(B) of the *2012 Standard Specifications* for portions of foundations exposed above finished grade. Do not remove anchor bolt templates or pedestal or grade beam forms or erect metal poles or upright trusses onto foundations until concrete attains a compressive strength of at least 3,000 psi.

(A) Drilled Piers

Before starting drilled pier construction, hold a predrill meeting to discuss the installation, monitoring and inspection of the drilled piers. Schedule this meeting after the Drilled Pier Contractor has mobilized to the site. The Resident or Division Traffic Engineer, Contractor and Drilled Pier Contractor Superintendent will attend this predrill meeting.

Do not excavate holes, install piles or allow equipment wheel loads or vibrations within 20 ft of completed piers until 16 hours after Drilled Pier concrete reaches initial set.

Check for correct drilled pier alignment and location before beginning drilling. Check plumbness of holes frequently during drilling.

Construct drilled piers with the minimum required diameters shown in the plans. Install piers with tip elevations no higher than shown in the plans or approved by the Engineer.

Excavate holes with equipment of the sizes required to construct drilled piers. Depending on the subsurface conditions encountered, drilling through rock and boulders may be required. Do not use blasting for drilled pier excavations.

Contain and dispose of drilling spoils and waste concrete as directed and in accordance with Section 802 of the *2012 Standard Specifications*. Drilling spoils consist of all materials and fluids removed from excavations.

If unstable, caving or sloughing materials are anticipated or encountered, stabilize holes with temporary casings and/or polymer slurry. Do not use telescoping temporary casings. If it becomes necessary to replace a temporary casing during drilling, backfill the excavation, insert a larger casing around the casing to be replaced or stabilize the excavation with polymer slurry before removing the temporary casing.

If temporary casings become stuck or the Contractor proposes leaving casings in place, temporary casings should be installed against undisturbed material. Unless otherwise approved, do not leave temporary casings in place for mast arm poles and cantilever signs. The Engineer will determine if casings may remain in place. If the Contractor proposes leaving temporary casings in place, do not begin drilling until a casing installation method is approved.

Use polymer slurry and additives to stabilize holes in accordance with the slurry manufacturer's recommendations. Provide mixing water and equipment suitable for polymer slurry. Maintain polymer slurry at all times so slurry meets Table 411-3 of the *2012 Standard Specifications* except for sand content.

Define a "sample set" as slurry samples collected from mid-height and within 2 ft of the bottom of holes. Take sample sets from excavations to test polymer slurry immediately after filling holes with slurry, at least every 4 hours thereafter and immediately before placing concrete. Do not place Drilled Pier concrete until both slurry samples from an excavation meet the required polymer slurry properties. If any slurry test results do not meet the requirements, the Engineer may suspend drilling until both samples from a sample set meet the required slurry properties.

Remove soft and loose material from bottom of holes using augers to the satisfaction of the Engineer. Assemble rebar cages and place cages and Drilled Pier concrete in accordance with Subarticle 411-4(E) of the *2012 Standard Specifications* except for the following:

(1) Inspections for tip resistance and bottom cleanliness are not required,
(2) Temporary casings may remain in place if approved, and
(3) Concrete placement may be paused near the top of pier elevations for anchor rod assembly installation and conduit placement or
(4) If applicable, concrete placement may be stopped at bottom of grade beam or wings elevations for grade beam or wing construction.

If wet placement of concrete is anticipated or encountered, do not place Drilled Pier concrete until a concrete placement procedure is approved. If applicable, temporary

casings and fluids may be removed when concrete placement is paused or stopped in accordance with the exceptions above provided holes are stable. Remove contaminated concrete from exposed Drilled Pier concrete after removing casings and fluids. If holes are unstable, do not remove temporary casings until a procedure for placing anchor rod assemblies and conduit or constructing grade beams or wings is approved.

Use collars to extend drilled piers above finished grade. Remove collars after Drilled Pier concrete sets and round top edges of piers.

If drilled piers are questionable, pile integrity testing (PIT) and further investigation may be required in accordance with Article 411-5 of the *2012 Standard Specifications*. A drilled pier will be considered defective in accordance with Subarticle 411-5(D) of the *2012 Standard Specifications* and drilled pier acceptance is based in part on the criteria in Article 411-6 of the *2012 Standard Specifications* except for the top of pier tolerances in Subarticle 411-6(C) of the *2012 Standard Specifications*.

If a drilled pier is under further investigation, do not grout core holes, backfill around the pier or perform any work on the drilled pier until the Engineer accepts the pier. If the drilled pier is accepted, dewater and grout core holes and backfill around the pier with approved material to finished grade. If the Engineer determines a pier is unacceptable, remediation is required in accordance with Article 411-6 of the *2012 Standard Specifications*. No extension of completion date or time will be allowed for remediation of unacceptable drilled piers or post repair testing.

Permanently embed a plate in or mark top of piers with the pier diameter and depth, size and number of vertical reinforcing bars and the minimum compressive strength of the concrete mix at 28 days.

(B) Footings, Pedestals, Grade Beams and Wings

Excavate as necessary for footings, grade beams and wings in accordance with the plans, accepted submittals and Section 410 of the *2012 Standard Specifications*. If unstable, caving or sloughing materials are anticipated or encountered, shore foundation excavations as needed with an approved method. Notify the Engineer when foundation excavation is complete. Do not place concrete or reinforcing steel until excavation dimensions and foundation material are approved.

Construct cast-in-place reinforced concrete footings, pedestals, grade beams and wings with the dimensions shown in the plans and in accordance with Section 825 of the *2012 Standard Specifications*. Use forms to construct portions of pedestals and grade beams protruding above finished grade. Provide a chamfer with a 3/4" horizontal width for pedestal and grade beam edges exposed above finished grade. Backfill and fill in accordance with Article 410-8 of the *2012 Standard Specifications*. Proper compaction around footings and wings is critical for foundations to resist uplift and torsion forces. Place concrete against undisturbed soil and do not use forms for standard foundations for low level light standards.

(C) Anchor Rod Assemblies

Size anchor rods for design and the required projection above top of foundations. Determine required anchor rod projections from nut, washer and base plate thicknesses,

the protrusion of 3 to 5 anchor rod threads above top nuts after tightening and the distance of one nut thickness between top of foundations and bottom of leveling nuts.

Protect anchor rod threads from damage during storage and installation of anchor rod assemblies. Before placing anchor rods in foundations, turn nuts onto and off rods past leveling nut locations. Turn nuts with the effort of one workman using an ordinary wrench without a cheater bar. Report any thread damage to the Engineer that requires extra effort to turn nuts.

Arrange anchor rods symmetrically about center of base plate locations as shown in the plans. Set anchor rod elevations based on required projections above top of foundations. Securely brace and hold rods in the correct position, orientation and alignment with a steel template. Do not weld to reinforcing steel, temporary casings or anchor rods.

Install top and leveling (bottom) nuts, washers and the base plate for each anchor rod assembly in accordance with the following procedure:

(1) Turn leveling nuts onto anchor rods to a distance of one nut thickness between the top of foundation and bottom of leveling nuts. Place washers over anchor rods on top of leveling nuts.

(2) Determine if nuts are level using a flat rigid template on top of washers. If necessary, lower leveling nuts to level the template in all directions or if applicable, lower nuts to tilt the template so the metal pole or upright truss will lean as shown in the plans. If leveling nuts and washers are not in full contact with the template, replace washers with galvanized beveled washers.

(3) Verify the distance between the foundation and leveling nuts is no more than one nut thickness.

(4) Place base plate with metal pole or upright truss over anchor rods on top of washers. High mount luminaires may be attached before erecting metal poles but do not attach cables, mast arms or trusses to metal poles or upright trusses at this time.

(5) Place washers over anchor rods on top of base plate. Lubricate top nut bearing surfaces and exposed anchor rod threads above washers with beeswax, paraffin or other approved lubricant.

(6) Turn top nuts onto anchor rods. If nuts are not in full contact with washers or washers are not in full contact with the base plate, replace washers with galvanized beveled washers.

(7) Tighten top nuts to snug-tight with the full effort of one workman using a 12" wrench. Do not tighten any nut all at once. Turn top nuts in increments. Follow a star pattern cycling through each nut at least twice.

(8) Repeat (7) for leveling nuts.

(9) Replace washers above and below the base plate with galvanized beveled washers if the slope of any base plate face exceeds 1:20 (5%), any washer is not in firm contact with the base plate or any nut is not in firm contact with a washer. If any washers are replaced, repeat (7) and (8).

(10) With top and leveling nuts snug-tight, mark each top nut on a corner at the intersection of 2 flats and a corresponding reference mark on the base plate. Mark top nuts and base plate with ink or paint that is not water-soluble. Use the

turn-of-nut method for pretensioning. Do not pretension any nut all at once. Turn top nuts in increments for a total turn that meets the following nut rotation requirements:

NUT ROTATION REQUIREMENTS (Turn-of-Nut Pretensioning Method)	
Anchor Rod Diameter, inch	**Requirement**
≤ 1 1/2	1/3 turn (2 flats)
> 1 1/2	1/6 turn (1 flat)

Follow a star pattern cycling through each top nut at least twice.

(11) Ensure nuts, washers and base plate are in firm contact with each other for each anchor rod. Cables, mast arms and trusses may now be attached to metal poles and upright trusses.

(12) Between 4 and 14 days after pretensioning top nuts, use a torque wrench calibrated within the last 12 months to check nuts in the presence of the Engineer. Completely erect mast arm poles and cantilever signs and attach any hardware before che cking top nuts for these structures. Check that top nuts meet the following torque requirements:

TORQUE REQUIREMENTS	
Anchor Rod Diameter, inch	**Requirement, ft-lb**
7/8	180
1	270
1 1/8	380
1 1/4	420
≥ 1 1/2	600

If necessary, retighten top nuts in the presence of the Engineer with a calibrated torque wrench to within ± 10 ft-lb of the required torque. Do not overtighten top nuts.

(13) Do not grout under base plate.

Measurement and Payment

Foundations and anchor rod assemblies for metal poles and upright trusses will be measured and paid for elsewhere in the contract.

No payment will be made for temporary casings that remain in drilled pier excavations. No payment will be made for PIT. No payment will be made for further investigation of defective piers. Further investigation of piers that are not defective will be paid as extra work in accordance with Article 104-7 of the *2012 Standard Specifications*. No payment will be made for remediation of unacceptable drilled piers or post repair testing.

MATERIALS:

(2-21-12) (Rev. 1-21-14) 1000, 1005, 1024, 1050, 1056, 1074, 1078, 1080, 1081, 1086, 1084, 1087, 1092 SP10 R01

Revise the *2012 Standard Specifications* as follows:

Page 10-1, Article 1000-1, DESCRIPTION, lines 9-10, replace the last sentence of the first paragraph with the following:

Type IL, IP, IS or IT blended cement may be used instead of Portland cement.

Page 10-1, Article 1000-1, DESCRIPTION, line 14, add the following:

Use materials which do not produce a mottled appearance through rusting or other staining of the finished concrete surface.

Page 10-1, Article 1000-2, MATERIALS, line 16, add the following to the table of item references:

Item	**Section**
Type IL Blended Cement	1024-1

Page 10-5, Table 1000-1, REQUIREMENTS FOR CONCRETE, replace with the following:

TABLE 1000-1
REQUIREMENTS FOR CONCRETE

Class of Concrete	Min. Comp. Strength at 28 days	Maximum Water-Cement Ratio				Consistency Max. Slump		Cement Content			
		Air-Entrained Concrete		Non Air-Entrained Concrete		Vibrated	Non-Vibrated	Vibrated		Non- Vibrated	
		Rounded Aggregate	Angular Aggregate	Rounded Aggregate	Angular Aggregate			Min.	Max.	Min.	Max.
Units	*psi*					*inch*	*inch*	*lb/cy*	*lb/cy*	*lb/cy*	*lb/cy*
AA	4,500	0.381	0.426	-	-	3.5	-	639	715	-	-
AA Slip Form	4,500	0.381	0.426	-	-	1.5	-	639	715	-	-
Drilled Pier	4,500	-	-	0.450	0.450	-	5-7 dry 7-9 wet	-	-	640	800
A	3,000	0.488	0.532	0.550	0.594	3.5	4	564	-	602	-
B	2,500	0.488	0.567	0.559	0.630	2.5	4	508	-	545	-
B Slip Formed	2,500	0.488	0.567	-	-	1.5	-	508	-	-	-
Sand Light-weight	4,500	-	0.420	-	-	4	-	715	-	-	-
Latex Modified	3,000 7 day	0.400	0.400	-	-	6	-	658	-	-	-
Flowable Fill excavatable	150 max. at 56 days	as needed	as needed	as needed	as needed	-	Flow-able	-	-	40	100
Flowable Fill non-excavatable	125	as needed	as needed	as needed	as needed	-	Flow-able	-	-	100	as needed
Pavement	4,500 design, field 650 flexural, design only	0.559	0.559	-	-	1.5 slip form 3.0 hand place	-	526	-	-	-
Precast	See Table 1077-1	as needed	as needed	-	-	6	as needed	as needed	as needed	as needed	as needed
Prestress	per contract	See Table 1078-1	See Table 1078-1	-	-	8	-	564	as needed	-	-

Page 10-23, Table 1005-1, AGGREGATE GRADATION-COARSE AGGREGATE, replace with the following:

TABLE 1005-1
AGGREGATE GRADATION - COARSE AGGREGATE

Std. Size #	Percentage of Total by Weight Passing											Remarks
	2"	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#10	#16	#40	#200	
4	100	90-100	20-55	0-15	-	0-5	-	-	-	-	-	A	Asphalt Plant Mix
467M	100	95-100	-	35-70	-	0-30	0-5	-	-	-	-	A	Asphalt Plant Mix
5	-	100	90-100	20-55	0-10	0-5	-	-	-	-	-	A	AST, Sediment Control Stone
57	-	100	95-100	-	25-60	-	0-10	0-5	-	-	-	A	AST, Str. Concrete, Shoulder Drain, Sediment Control Stone
57M	-	100	95-100	-	25-45	-	0-10	0-5	-	-	-	A	AST, Concrete Pavement
6M	-	-	100	90-100	20-55	0-20	0-8	-	-	-	-	A	AST
67	-	-	100	90-100	-	20-55	0-10	0-5	-	-	-	A	AST, Str. Concrete, Asphalt Plant Mix
78M	-	-	-	100	98-100	75-100	20-45	0-15	-	-	-	A	Asphalt Plant Mix, AST, Str. Conc, Weep Hole Drains
14M	-	-	-	-	-	100	35-70	5-20	-	0-8	-	A	Asphalt Plant Mix, AST, Weep Hole Drains, Str. Concrete
9	-	-	-	-	-	100	85-100	10-40	-	0-10	-	A	AST
ABC	-	100	75-97	-	55-80	-	35-55	-	25-45	-	14-30	4-12[B]	Aggregate Base Course, Aggregate Stabilization
ABC (M)	-	100	75-100	-	45-79	-	20-40	-	0-25	-	-	0-12[B]	Maintenance Stabilization
Light-weight[C]	-	-	-	-	100	80-100	5-40	0-20	-	0-10	-	0-2.5	AST

A. See Subarticle 1005-4(A).
B. See Subarticle 1005-4(B).
C. For Lightweight Aggregate used in Structural Concrete, see Subarticle 1014-2(E)(6).

Page 10-46, Article 1024-1, PORTLAND CEMENT, line 33, add the following as the ninth paragraph:

Use Type IL blended cement that meets AASHTO M 240, except that the limestone content is limited to between 5 and 12% by weight and the constituents shall be interground. Class F fly ash can replace a portion of Type IL blended cement and shall be replaced as outlined in Subarticle 1000-4(I) for Portland cement. For mixes that contain cement with alkali content

between 0.6% and 1.0% and for mixes that contain a reactive aggregate documented by the Department, use a pozzolan in the amount shown in Table 1024-1.

Page 10-65, Article 1050-1, GENERAL, line 41, replace the first sentence with the following:

All fencing material and accessories shall meet Section 106.

Page 10-73, Article 1056-1 DESCRIPTION, lines 7-8, delete the first sentence of the second paragraph and replace with the following:

Use geotextile fabrics that are on the NCDOT Approved Products List.

Page 10-73, Article 1056-2 HANDLING AND STORING, line 17, replace "mechanically stabilized earth (MSE) wall faces" with "temporary wall faces".

Page 10-74, TABLE 1056-1 GEOTEXTILE REQUIREMENTS, replace table with the following:

TABLE 1056-1
GEOTEXTILE REQUIREMENTS

Property	**Requirement (MARV[A])**					**Test Method**
	Type 1	**Type 2**	**Type 3[B]**	**Type 4**	**Type 5[C]**	
Typical Application	*Shoulder Drains*	*Under Rip Rap*	*Temporary Silt Fence*	*Soil Stabilization*	*Temporary Walls*	
Elongation (MD & CD)	≥ 50%	≥ 50%	≤ 25%	< 50%	< 50%	ASTM D4632
Grab Strength (MD & CD)	Table 1[D], Class 3	Table 1[D], Class 1	100 lb	Table 1[D], Class 3	-	ASTM D4632
Tear Strength (MD & CD)			-		-	ASTM D4533
Puncture Strength			-		-	ASTM D6241
Ultimate Tensile Strength (MD & CD)	-	-	-	-	2,400 lb/ft (unless required otherwise in the contract)	ASTM D4595
Permittivity	Table 2[D], 15% to 50% *in Situ* Soil Passing No. 200[E]		Table 7[D]	Table 5[D]	0.20 sec^{-1}	ASTM D4491
Apparent Opening Size					No. 30[E]	ASTM D4751
UV Stability (Retained Strength)					70%	ASTM D4355

A. MARV does not apply to elongation
B. Minimum roll width of 36" required
C. Minimum roll width of 13 ft required
D. AASHTO M 288
E. US Sieve No. per AASHTO M 92

Page 10-115, Subarticle 1074-7(B), Gray Iron Castings, lines 10-11, replace with the first two sentences with the following:

Supply gray iron castings meeting all facets of AASHTO M 306 excluding proof load. Proof load testing will only be required for new casting designs during the design process, and conformance to M306 loading (40,000 lbs.) will be required only when noted on the design documents.

Page 10-126, Table 1078-1, REQUIREMENTS FOR CONCRETE, replace with the following:

TABLE 1078-1
REQUIREMENTS FOR CONCRETE

Property	28 Day Design Compressive Strength 6,000 psi or less	28 Day Design Compressive Strength greater than 6,000 psi
Maximum Water/Cementitious Material Ratio	0.45	0.40
Maximum Slump without HRWR	3.5"	3.5"
Maximum Slump with HRWR	8"	8"
Air Content (upon discharge into forms)	5 + 2%	5 + 2%

Page 10-151, Article 1080-4 Inspection and Sampling, lines 18-22, replace (B), (C) and (D) with the following:

(B) At least 3 panels prepared as specified in 5.5.10 of AASHTO M 300, Bullet Hole Immersion Test.

(C) At least 3 panels of 4"x6"x1/4" for the Elcometer Adhesion Pull Off Test, ASTM D4541.

(D) A certified test report from an approved independent testing laboratory for the Salt Fog Resistance Test, Cyclic Weathering Resistance Test, and Bullet Hole Immersion Test as specified in AASHTO M 300.

(E) A certified test report from an approved independent testing laboratory that the product has been tested for slip coefficient and meets AASHTO M253, Class B.

Page 10-161, Subarticle 1081-1(A) Classifications, lines 29-33, delete first 3 sentences of the description for Type 2 and replace with the following:

Type 2 - A low-modulus, general-purpose adhesive used in epoxy mortar repairs. It may be used to patch spalled, cracked or broken concrete where vibration, shock or expansion and contraction are expected.

Page 10-162, Subarticle 1081-1(A) Classifications, lines 4-7, delete the second and third sentences of the description for Type 3A. **Lines 16-22,** delete Types 6A, 6B and 6C.

Page 10-162, Subarticle 1081-1(B) Requirements, lines 26-30, replace the second paragraph with the following:

For epoxy resin systems used for embedding dowel bars, threaded rods, rebar, anchor bolts and other fixtures in hardened concrete, the manufacturer shall submit test results showing that the bonding system will obtain 125% of the specified required yield strength of the fixture. Furnish certification that, for the particular bolt grade, diameter and embedment depth required, the

anchor system will not fail by adhesive failure and that there is no movement of the anchor bolt. For certification and anchorage, use 3,000 psi as the minimum Portland cement concrete compressive strength used in this test. Use adhesives that meet Section 1081.

List the properties of the adhesive on the container and include density, minimum and maximum temperature application, setting time, shelf life, pot life, shear strength and compressive strength.

Page 10-163, Table 1081-1 Properties of Mixed Epoxy Resin Systems, replace table with the following:

Table 1081-1
Properties of Mixed Epoxy Resin Systems

Property	Type 1	Type 2	Type 3	Type 3A	Type 4A	Type 4B	Type 5
Viscosity-Poises at 77°F ± 2°F	Gel	10-30	25-75	Gel	40-150	40-150	1-6
Spindle No.	-	3	4	--	4	4	2
Speed (RPM)	-	20	20	--	10	10	50
Pot Life (Minutes)	20-50	30-60	20-50	5-50	40-80	40-80	20-60
Minimum Tensile Strength at 7 days (psi)	1,500	2,000	4,000	4,000	1,500	1,500	4,000
Tensile Elongation at 7 days (%)	30 min.	30 min.	2-5	2-5	5-15	5-15	2-5
Min. Compressive Strength of 2". mortar cubes at 24 hours	3,000 (Neat)	4,000-	6,000-	6,000 (Neat)	3,000	3,000	6,000
Min. Compressive Strength of 2" mortar cubes at 7 days	5,000 (Neat)	-	-	-	-	5,000	-
Maximum Water Absorption (%)	1.5	1.0	1.0	1.5	1.0	1.0	1.0
Min. Bond Strength Slant Shear Test at 14 days (psi)	1,500	1,500	2,000	2,000	1,500	1,500	1,500

Page 10-164, Subarticle 1081-1(E) Prequalification, lines 31-33, replace the second sentence of the first paragraph with the following:

Manufacturers choosing to supply material for Department jobs must submit an application through the Value Management Unit with the following information for each type and brand name:

Page 10-164, Subarticle 1081-1(E)(3), line 37, replace this subarticle with the following:

(3) Type of the material in accordance with Articles 1081-1 and 1081-4,

Page 10-165, Subarticle 1081-1(E)(6), line 1, in the first sentence of the first paragraph replace "AASHTO M 237" with "the specifications".

Page 10-165, Subarticle 1081-1(E) Prequalification, line 9-10, delete the second sentence of the last paragraph.

Page 10-165, Subarticle 1081-1(F) Acceptance, line 14, in the first sentence of the first paragraph replace "Type 1" with "Type 3".

Page 10-169, Subarticle 1081-3(G) Anchor Bolt Adhesives, delete this subarticle.

Page 10-170, Article 1081-3 Hot Bitumen, line 9, add the following at the end of Section 1081:

1081-4 EPOXY RESIN ADHESIVE FOR BONDING TRAFFIC MARKINGS

(A) General

This section covers epoxy resin adhesive for bonding traffic markers to pavement surfaces.

(B) Classification

The types of epoxies and their uses are as shown below:

Type I – Rapid Setting, High Viscosity, Epoxy Adhesive. This type of adhesive provides rapid adherence to traffic markers to the surface of pavement.

Type II – Standard Setting, High Viscosity, Epoxy Adhesive. This type of adhesive is recommended for adherence of traffic markers to pavement surfaces when rapid set is not required.

Type III – Rapid Setting, Low Viscosity, Water Resistant, Epoxy Adhesive. This type of rapid setting adhesive, due to its low viscosity, is appropriate only for use with embedded traffic markers.

Type IV – Standard Set Epoxy for Blade Deflecting-Type Plowable Markers.

(C) Requirements

Epoxies shall conform to the requirements set forth in AASHTO M 237.

(D) Prequalification

Refer to Subarticle 1081-1(E).

(E) Acceptance

Refer to Subarticle 1081-1(F).

Page 10-173, Article 1084-2 STEEL SHEET PILES, lines 37-38, replace first paragraph with the following:

Steel sheet piles detailed for permanent applications shall be hot rolled and meet ASTM A572 or ASTM A690 unless otherwise required by the plans. Steel sheet piles shall be coated as required by the plans. Galvanized sheet piles shall be coated in accordance with Section 1076. Metallized sheet piles shall be metallized in accordance to the Project Special Provision "Thermal Sprayed Coatings (Metallization)" with an 8 mil, 99.9% aluminum alloy coating and a 0.5 mil seal coating. Any portion of the metallized sheet piling encased in concrete shall receive a barrier coat. The barrier coat shall be an approved waterborne coating with a low-viscosity which readily absorbs into the pores of the aluminum thermal sprayed coating. The waterborne coating shall be applied at a spreading rate that results in a theoretical 1.5 mil dry film thickness. The manufacturer shall issue a letter of certification that the resin chemistry of the waterborne coating is compatible with the 99.9% aluminum thermal sprayed alloy and suitable for tidal water applications.

Page 10-174, Subarticle 1086-1(B)(1) Epoxy, lines 18-24, replace this subarticle with the following:

The epoxy shall meet Article 1081-4.

The 2 types of epoxy adhesive which may be used are Type I, Rapid Setting, and Type II, Standard Setting. Use Type II when the pavement temperature is above 60°F or per the manufacturer's recommendations whichever is more stringent. Use Type I when the pavement temperature is between 50°F and 60°F or per the manufacturer's recommendations whichever is more stringent. Epoxy adhesive Type I, Cold Set, may be used to attach temporary pavement markers to the pavement surface when the pavement temperature is between 32°F and 50°F or per the manufacturer's recommendations whichever is more stringent.

Page 10-175, Subarticle 1086-2(E) Epoxy Adhesives, line 27, replace "Section 1081" with "Article 1081-4".

Page 10-177, Subarticle 1086-3(E) Epoxy Adhesives, line 22, replace "Section 1081" with "Article 1081-4".

Page 10-179, Subarticle 1087-4(A) Composition, lines 39-41, replace the third paragraph with the following:

All intermixed and drop-on glass beads shall not contain more than 75 ppm arsenic or 200 ppm lead.

Page 10-180, Subarticle 1087-4(B) Physical Characteristics, line 8, replace the second paragraph with the following:

All intermixed and drop-on glass beads shall comply with NCGS § 136-30.2 and 23 USC § 109(r).

Page 10-181, Subarticle 1087-7(A) Intermixed and Drop-on Glass Beads, line 24, add the following after the first paragraph:

Use X-ray Fluorescence for the normal sampling procedure for intermixed and drop-on beads, without crushing, to check for any levels of arsenic and lead. If any arsenic or lead is detected, the sample shall be crushed and repeat the test using X-ray Fluorescence. If the X-ray Fluorescence test shows more than a LOD of 5 ppm, test the beads using United States Environmental Protection Agency Method 6010B, 6010C or 3052 for no more than 75 ppm arsenic or 200 ppm lead.

Page 10-204, Subarticle 1092-2(A) Performance and Test Requirements, replace **Table 1092-3 Minimum Coefficient of Retroreflection for NC Grade A** with the following:

TABLE 1092-3
MINIMUM COEFFICIENT OF RETROREFLECTION FOR NC GRADE A
(Candelas Per Lux Per Square Meter)

Observation Angle, degrees	Entrance Angle, degrees	White	Yellow	Green	Red	Blue	Fluorescent Yellow Green	Fluorescent Yellow
0.2	-4.0	525	395	52	95	30	420	315
0.2	30.0	215	162	22	43	10	170	130
0.5	-4.0	310	230	31	56	18	245	185
0.5	30.0	135	100	14	27	6	110	81
1.0	-4.0	**120**	60	8	16	3.6	64	48
1.0	30.0	45	34	4.5	9	2	36	27

SELECT MATERIAL, CLASS III, TYPE 3:
(1-17-12) 1016, 1044 SP10 R05

Revise the *2012 Standard Specifications* as follows:

Page 10-39, Article 1016-3, CLASS III, add the following after line 14:

Type 3 Select Material

Type 3 select material is a natural or manufactured fine aggregate material meeting the following gradation requirements and as described in Sections 1005 and 1006:

Percentage of Total by Weight Passing							
3/8"	#4	#8	#16	#30	#50	#100	#200
100	95-100	65-100	35-95	15-75	5-35	0-25	0-8

Page 10-39, Article 1016-3, CLASS III, line 15, replace "either type" with "Type 1, Type 2 or Type 3".

Page 10-62, Article 1044-1, line 36, delete the sentence and replace with the following:

Subdrain fine aggregate shall meet Class III select material, Type 1 or Type 3.

Page 10-63, Article 1044-2, line 2, delete the sentence and replace with the following:

Subdrain coarse aggregate shall meet Class V select material.

SHOULDER AND SLOPE BORROW:
(3-19-13) 1019 SP10 R10

Use soil in accordance with Section 1019 of the *2012 Standard Specifications*. Use soil consisting of loose, friable, sandy material with a PI greater than 6 and less than 25 and a pH ranging from 5.5 to 7.0.

Soil with a pH ranging from 4.0 to 5.5 will be accepted without further testing if additional limestone is provided in accordance with the application rates shown in Table 1019-1A. Soil type is identified during the soil analysis. Soils with a pH above 7.0 require acidic amendments to be added. Submit proposed acidic amendments to the Engineer for review and approval. Soils with a pH below 4.0 or that do not meet the PI requirements shall not be used.

TABLE 1019-1A
ADDITIONAL LIMESTONE APPLICATION RATE TO RAISE pH

pH TEST RESULT	Sandy Soils Additional Rate (lbs. / Acre)	Silt Loam Soils Additional Rate (lbs. / Acre)	Clay Loam Soils Additional Rate (lbs. / Acre)
4.0 - 4.4	1,000	4,000	6,000
4.5 - 4.9	500	3,000	5,000
5.0 - 5.4	NA	2,000	4,000

Note: Limestone application rates shown in this table are in addition to the standard rate of 4000 lbs. / acre required for seeding and mulching.

No direct payment will be made for providing additional lime or acidic amendments for Ph adjustment.

TRUCK MOUNTED CHANGEABLE MESSAGE SIGNS:
(8-21-12) 1101.02 SP11 R10

Revise the *2012 Roadway Standard Drawings* as follows:

Drawing No. 1101.02, Sheet 12, TEMPORARY LANE CLOSURES, replace General Note #11 with the following:

11- TRUCK MOUNTED CHANGEABLE MESSAGE SIGNS (TMCMS) USED ON SHADOW VEHICLES FOR "IN LANE" ACTIVITIES SHALL BE A MINIMUM OF 43" X 73". THE DISPLAY PANEL SHALL HAVE FULL MATRIX CAPABILITY WITH THE CAPABILITY TO PROVIDE 2 MESSAGE LINES WITH 7 CHARACTERS PER LINE WITH A MINIMUM CHARACTER HEIGHT OF 18". FOR ADDITIONAL MESSAGING, CONTACT THE WORK ZONE TRAFFIC CONTROL SECTION.

12- TMCMS USED FOR ADVANCED WARNING ON VEHICLES LOCATED ON THE SHOULDER MAY BE SMALLER THAN 43" X 73". THE DISPLAY PANEL SHALL HAVE THE CAPABILITY TO PROVIDE 2 MESSAGE LINES WITH 7 CHARACTERS PER LINE WITH A MINIMUM CHARACTER HEIGHT OF 18". FOR ADDITIONAL MESSAGING, CONTACT THE WORK ZONE TRAFFIC CONTROL SECTION.

Drawing No. 1101.02, Sheet 13, TEMPORARY LANE CLOSURES, replace General Note #12 with the following:

12- TRUCK MOUNTED CHANGEABLE MESSAGE SIGNS (TMCMS) USED ON SHADOW VEHICLES FOR "IN LANE" ACTIVITIES SHALL BE A MINIMUM OF 43" X 73". THE DISPLAY PANEL SHALL HAVE FULL MATRIX CAPABILITY WITH THE CAPABILITY TO PROVIDE 2 MESSAGE LINES WITH 7 CHARACTERS PER LINE WITH A MINIMUM CHARACTER HEIGHT OF 18". FOR ADDITIONAL MESSAGING, CONTACT THE WORK ZONE TRAFFIC CONTROL SECTION.

13- TMCMS USED FOR ADVANCED WARNING ON VEHICLES LOCATED ON THE SHOULDER MAY BE SMALLER THAN 43" X 73". THE DISPLAY PANEL SHALL HAVE THE CAPABILITY TO PROVIDE 2 MESSAGE LINES WITH 7 CHARACTERS PER LINE WITH A MINIMUM CHARACTER HEIGHT OF 18". FOR ADDITIONAL MESSAGING, CONTACT THE WORK ZONE TRAFFIC CONTROL SECTION.

PERMANENT SEEDING AND MULCHING:

(7-1-95) 1660 SP16 R02

The Department desires that permanent seeding and mulching be established on this project as soon as practical after slopes or portions of slopes have been graded. As an incentive to obtain an early stand of vegetation on this project, the Contractor's attention is called to the following:

For all permanent seeding and mulching that is satisfactorily completed in accordance with the requirements of Section 1660 in the *2012 Standard Specifications* and within the following percentages of elapsed contract times, an additional payment will be made to the Contractor as an incentive additive. The incentive additive will be determined by multiplying the number of acres of seeding and mulching satisfactorily completed times the contract unit bid price per acre for Seeding and Mulching times the appropriate percentage additive.

Percentage of Elapsed Contract Time	Percentage Additive
0% - 30%	30%
30.01% - 50%	15%

Percentage of elapsed contract time is defined as the number of calendar days from the date of availability of the contract to the date the permanent seeding and mulching is acceptably completed divided by the total original contract time.

PROJECT SPECIAL PROVISIONS

GEOTECHNICAL

GEOTEXTILE FOR PAVEMENT STABILIZATION: **(1-21-14)**

Description

Furnish and place geotextile for pavement stabilization in accordance with the contract. Geotextile for pavement stabilization may be required to prevent pavement cracking and provide separation between the subgrade and pavement section at locations shown in the plans and as directed.

Materials

Refer to Division 10 of the *Standard Specifications*.

Item	Section
Geotextiles	1056

Provide Type 5 geotextile for geotextile for pavement stabilization that meets the following requirements:

GEOTEXTILE FOR PAVEMENT STABILIZATION REQUIREMENTS		
Property	**Requirement (MARV[A])**	**Test Method**
Tensile Strength @ 5% Strain (MD & CD[A])	1,900 lb/ft	ASTM D4595
Ultimate Tensile Strength (MD & CD[A])	4,800 lb/ft	ASTM D4595
Melting Point	300° F	ASTM D276

A. Define "minimum average roll value" (MARV), "machine direction" (MD) and "cross-machine direction" (CD) in accordance with ASTM D4439.

Construction Methods

Notify the Engineer when the roadbed is completed within 2" of subgrade elevation. The Engineer will sample and test subgrade soils for quality to determine if geotextile for pavement stabilization is required at locations shown in the plans and other locations as directed. For subgrades without stabilization, allow 24 days to determine if geotextile for pavement stabilization is required. For stabilized subgrades with geotextile for pavement stabilization, stabilize subgrade soils to 12" beyond the base course as shown in the plans.

Place geotextile for pavement stabilization on subgrades immediately below pavement sections as shown in the plans and in slight tension free of kinks, folds, wrinkles or creases. Install geotextiles with the MD perpendicular to the roadway centerline. The MD is the direction of the length or long dimension of the geotextile roll. Do not splice or overlap geotextiles in the MD so splices or overlaps are parallel to the roadway centerline. Extend geotextile for pavement stabilization 12" beyond the base course as shown in the plans.

Completely cover subgrades with geotextile for pavement stabilization so geotextiles are adjacent to each other in the CD, i.e., perpendicular to the MD. The CD is the direction of the width or short dimension of the geotextile roll. Overlapping geotextiles in the CD is permitted but not required. Overlap geotextiles in the direction that base course will be placed to prevent

lifting the edge of the top geotextile.

For asphalt base courses, asphalt mixture temperatures in the truck may not exceed 315° F at the time of placement. Do not damage geotextile for pavement stabilization when constructing base courses. Place and compact base courses in accordance with the *Standard Specifications*. Do not operate heavy equipment on geotextiles any more than necessary to construct pavement sections. Replace any damaged geotextiles to the satisfaction of the Engineer.

Measurement and Payment

Geotextile for Pavement Stabilization will be measured and paid in square yards. Geotextiles will be measured along subgrades as the square yards of exposed geotextiles before placing base courses. No measurement will be made for overlapping geotextiles. The contract unit price for *Geotextile for Pavement Stabilization* will be full compensation for providing, transporting and placing geotextiles.

Payment will be made under:

Pay Item	Pay Unit
Geotextile for Pavement Stabilization	Square Yard

POLYURETHANE GROUT INJECTION (SPECIAL)

DESCRIPTION

The work specified in this Special Provision consists of filling the voids and improving the subsurface conditions by means of polyurethane grout injection. The subgrade improvement shall be conducted by injecting high density polyurethane grout into the subsurface. The polyurethane should be capable of filling the present voids and improving the very loose to loose granular substrata beneath the existing and new culverts.

All installation procedures and equipment shall be in accordance with this Special Provision and manufacturer's recommendations. Polyurethane material injection (filling voids and densifying soils) shall be performed at the locations specified in the plans.

The term "polyurethane material" used in this Special Provision refers to high density water blown formulation exhibiting the physical characteristics and properties as described herein. The purpose of the polyurethane grout injection is specifically used to provide the following:

1. To fill the voids underneath the culvert structure.
2. To densify the soil while limiting additional soil movement. The polyurethane grout injection product should mix with the soil to become a homogenous unit in order to prevent future migration of fines.
3. To provide adequate compressible strength/bearing strength to support the embankment fill and highway traffic.

Procedures shall include a construction site survey, preparing the site, injection of the polyurethane material, corresponding material testing, and the finalized project report.

Personnel: Provide the services of the Polyurethane Grout Injection (PGI) Supervisor for the work under this Special Provision meeting the following requirements:

1. Certification by the manufacturer of the high density polyurethane material as having the necessary competence to accomplish the work.
2. A minimum of 3 years of experience of supervising similar work.

Provide the experience record and certification of the PGI Supervisor to the Resident Engineer and the NCDOT Geotechnical Operations Engineer, a minimum of 2 weeks prior to beginning work.

QUALITY CONTROL

Include the following under this Special Provision in the Quality Control Plan:

1. List and size of proposed equipment including methods to provide the minimum diameter injection holes, pumping units, and types of heave monitoring leveling equipment.
2. A list of construction methods used for the preparation of the site including methods for measurements concerning culvert lifting requirements and clearing of debris.
3. A construction site survey that includes the elevations of the ground surface and related structures, existing distress, photographs of the existing distress, and locations of the underground utilities potentially affected by this work.
4. A list of construction methods used to perform the injection of the polyurethane grout with a detailed sequence of injection operations
5. Manufacturer information pertaining to the approved polyurethane materials with the current specifications.

MATERIALS

Grout Description: The polyurethane material used for the subgrade improvement shall be dual-component high density polyurethane. The material shall be a closed cell, hydro-insensitive, high density polyurethane system that upon injection results in rapid expansion and curing in both dry and wet environments without dilution.

Grout Properties: The material shall exhibit the following physical characteristics and properties:

Property	Value	ASTM Test Method
Material Density, pcf	4.0 Minimum	D1622 with conditioning
Compressive Strength, psi	60 Minimum	D1621 with conditioning

Cure Time: The material shall reach a minimum compressive strength of 45 psi within 30 minutes after the last injection of material.

Certification: The material characteristics must be certified by the manufacturer. Submit appropriate documentation to the Engineer. The certified report shall specify that the material meets all the requirements in this Special Provision.

EQUIPMENT REQUIREMENTS

Include a pumping unit capable of injecting material to depths of 15 feet with electric generating capabilities necessary to support the grouting operations under a surrounding pressure of 70 feet of overburden materials. Provide equipment capable of precisely controlling the rate of flow of material as required to achieve the desired results while minimizing blowback and blowouts. Provide equipment with a certified flow meter or volumetric measurement device having a visual readout to measure the amount of material injected at each location.

Provide equipment with pressure and temperature control devices capable of maintaining proper temperature and proportionate mixing of the polyurethane component materials.

Provide pneumatic or electric drilling equipment capable of efficiently drilling 5/8-3/4 inch diameter injection holes through the culvert floor slab structure without damaging the integrity of the existing structure. Provide injection holes on a typical 3-5 ft pattern or as based on the accepted grouting plan, with spacing not to exceed 5 ft. unless approved by the Engineer.

Provided grout injection tubing that is to be installed with a pneumatic hammer to insure immediate contact with the surrounding soils to minimize travel along the annulus.

Provide laser levels, target readers, zip levels and other measuring devices capable of monitoring movement at the surface of the culvert floor slab to verify that the injected subsoils have been properly densified and stabilized without adversely affecting the existing grade.

Provide all necessary equipment such as electric generators, compressors, heaters, hoses, containers, valves, and gauges to efficiently conduct and control the work.

CONSTUCTION METHODS

Preparation: Measurements of the culvert floor slab surface shall be made, in cooperation with the Engineer, to ensure no movement of the surface occurs during the injection operations. A proper leveling unit(s) shall be set in place and properly adjusted prior to beginning injection. The required grout injection holes shall be drilled at the locations and spacing shown on the Polyurethane Grout Injection Plan sheets, or as directed by the Engineer.

Quality Control: If a two-component polyurethane is used, perform a quality check, in the presence of the Engineer, using flow meters and/or measurement devices, on the ratio of the polyurethane components provided by the injection system. Perform a test shot of material from one gun at a time with a minimum of 1 gallon of each material, comparing the output in gallons of resin to the gallons of activator to determine the injection ratio. If the ratio is less than 0.95 or greater than 1.05, the system is to be checked for problems, adjusted, and the ratio rechecked

until a proper ratio is obtained. Repeat the quality check for all injection guns. Following these checks and adjustments, and prior to performing the work each day, reset the measurement devices on the pumping units to zero.

Injection Placement: The polyurethane grout shall be injected through a steel pipe beginning at the specified depth, as shown on the Polyurethane Grout Injection Point Plan, under the existing and new culvert floor slab structures. After the injection pipe has been installed, grout should be injected until a significant pressure increase is observed on the back pressure gauge. The injection pipe shall be withdrawn 1-foot and the process repeated.

The pumping unit rate of injection shall be controlled at all times to prevent culvert floor slab heave. Excessive polyurethane material extruding from cracks or the drilled holes shall be removed from the area and the drilled holes sealed properly to the full depth of the culvert floor slab section. The approved leveling unit(s) shall be used to monitor the elevation of the culvert floor slab to ensure that no heave has taken place.

A level control system shall be installed and operated by the Contractor during the injection operation. The monitoring shall be carried out to detect movement within a 10 foot radius from the point of injection whenever injection is occurring, or as approved by the Engineer. Continuously monitor using either a laser level or dial indicator micrometer during injection to determine if culvert floor slab movement of the adjoining culvert structure has occurred. Inject grout gradually to avoid excessive force build up. If culvert floor slab movement exceeds the previously measured settlement, take corrective actions necessary to stop the movement and perform repairs. Immediately notify the Engineer if signs of movement such as new culvert floor slab cracks, increased size of existing cracks, or separation of joints between the two sections are observed. Repair any damage to the structures caused during the work to the satisfaction of the Engineer, at no cost to the Department.

Remove excessive polyurethane material extruding from cracks or the drilled holes. Seal the drilled holes to the full depth of the culvert floor slab section with cement grout. Allow the polyurethane material to cure before allowing traffic on to the improved area.

FINAL INJECTION REPORT

Submit to the Engineer a report documenting the polyurethane material injection and instrumentation. The report shall contain injection volumes per port of injection, duration of injection at each port, problems encountered during construction, and resolutions made, as well as all the associated testing results. In addition, provide as-built injection drawings and grade readings. Submit these items prior to final acceptance.

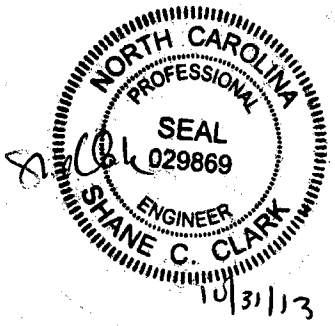
MEASUREMENT AND PAYMENT

Polyurethane Grout Injection will be measured and paid in pounds as recorded by a calibrated and certified metering device. The contract unit price for *Polyurethane Grout Injection* will be full compensation for providing designs, submittals, labor, tools, equipment, excavating, backfilling, hauling and removing excavated materials and any incidentals necessary to construct install *Polyurethane Grout Injection*. No additional payment will be made and no extension of completion date or time will be allowed for repairing damage caused by *Polyurethane Grout Injection*.

Price and payment will be full compensation for all work specified in this Special Provision.

Payment will be made under:

Polyurethane Grout Injection	Pounds



Asphaltic Concrete Grinding Specification

Perform grinding with abrasive grinding equipment, designed specifically for grinding pavement surfaces to close tolerances, utilizing diamond-cutting blades with a minimum cutting width of 36" in accordance with ASTM 1318-02. Such equipment shall accurately establish slope elevations and profile grade controls. The finished pavement surface 200' before and 100' after the WIM sensor array shall meet the following smoothness requirement.

Grind the entire lanes where the WIM sensors are installed. Ground surfaces shall not be smooth or polished. Provide a surface texture consisting of parallel groves between 0.09 inches and 0.13 inches wide with a land area between the groves of 0.060 inches to 0.110 inches and the differences between the peaks and ridges and the bottom of the grooves of approximately 1/16 inch.

Grind the pavement so the cross slope does not exceed 3%. The surface shall be ground to achieve a surface smoothness from 200 feet in advance and 100 beyond the WIM sensors. Check using a 6-in. (150-mm) diameter circular plate 0.125-in. (3 mm) thick that cannot be passed beneath a 20-ft (6-m) long straightedge when the straightedge is positioned and maneuvered in the following manner.

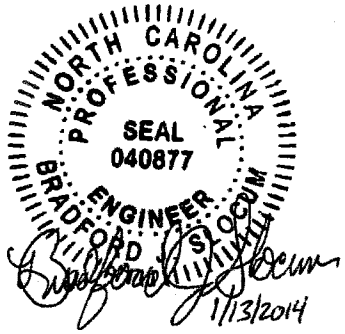
Pick up residue from grinding operations by means of a vacuum attachment to the grinding machine and do not allow the residue to flow across the pavement nor be left on the surface of the pavement. Dispose of the residue from grinding concrete pavement.

Beginning at the longitudinal center of the WIM system sensors, or sensor array, place the straightedge along each respective lane edge with the end furthest from the sensors at the distances from the longitudinal center of the sensors as indicated below. Then pivot the straightedge about its end, and sweep the end nearest the sensors between the lane edges while checking clearance beneath the straightedge with the circular plate.

Lane Edge	Longitudinal Distance From Center of Sensors (Ft.)												
Right	20	30	44	60	76	92	108	124	140	156	172	188	204
Left	20	36	52	68	84	100	116	132	148	164	180	196	212

When the straightedge is laid on finished pavement in a direction longitudinal with centerline or transverse to centerline, the surface shall not vary more than 0.125 inches (1/8") from the lower edge. If there are areas still outside of specification, the pavement should have a total regrind, spot bump grinding shall not be allowed.

This work is incidental to the other pay items in the contract.



NONWOVEN GEOTEXTILE INTERLAYER:

(01-13-14) SPI 10-07

Description

Furnish and install a nonwoven geotextile interlayer at locations shown on the plans.

General

Schedule a Pre-Pave Meeting at least 3 weeks prior to paving to discuss installation and construction procedures for the nonwoven geotextile interlayer with representatives from the Contractor including Paving Superintendent, Subcontractor, Geotextile Manufacturer, Engineer, Roadway Inspector, Area Roadway Construction Engineer, Division Construction Engineer, and the State Pavement Construction Engineer.

Materials

The geotextile interlayer shall be constructed of a non-woven needle-punched geotextile, with no thermal treatment (calendaring or IR). The material shall be resistant to chemicals, mildew, and rot and shall not have any tears or holes that will adversely affect the in-situ performance and physical properties of the installed material.

Furnish with each shipment a Type 3 Certification in accordance with Article 106-3 of the *Standard Specifications* certifying that the paving mat is a non-woven needle-punched geotextile with no thermal treatment (calendaring or IR) meeting the requirements shown:

Physical Properties of Non-Woven Geotextile Interlayer			
Property	**Test Method**	**Units**	**Value**
Minimum Mass per unit area	ASTM D 5261	oz/yd^2	15.0
Minimum thickness under load (a) at 2 kPa (0.29 psi) (b) at 20 kPa (2.9 psi) (c) at 200 kPa (29 psi)	ASTM D 5199	in	(a) 0.12 (b) 0.10 (c) 0.04
Minimum wide-width tensile strength	ASTM D 4595	lb/ft	685
Maximum wide-width elongation	ASTM D 4595	%	130
Minimum water permeability in normal direction under load (pressure) at 20 kPa (2.9 psi)	Mod. ASTM D 5493 or ASTM D 4491	ft/s	$3.3x10^{-4}$
Minimum in-plane water permeability (transmissivity) under load (pressure) (a) at 20kPa (2.9 psi) (b) at 200kPa (29 psi)	Mod. ASTM D 6574 or ASTM D 4716	ft/s	(a) $1.6x10^{-3}$ (b) $6.6x10^{-4}$
Minimum weather resistance retained strength	ASTM D 4355 at 500 hrs. exposure	%	60
Alkali resistance, minimum polypropylene/polyethylene	Manufacturer certification of polymer	%	96

Note: Requirements must be met for 95 percent of samples.

General Requirements

A trained and experienced installer, certified by the Geotextile Manufacturer, shall be present on-site during the installation of the geotextile and until the crew has a comfort level working with this material.

Ensure that any potential for keying of the two cementitious layers is minimized through proper repair techniques. Clean the underlying surface to remove loose debris before applying the interlayer. Roll the geotextile out on the underlying layer. The geotextile shall be tight and without excess wrinkles and folds. No more than 650 feet of geotextile shall be installed in advance of the paving operation at a given time. The interlayer shall be placed no more than 3 days before concrete placement.

Keep driving on the interlayer to a minimum. Tight radius turns and excessive acceleration and braking shall be avoided.

The geotextile shall be secured to the underlying layer with pins or nails punched through 2 to 2.75 inch galvanized washers or disks every 6 feet or less. Additional fasteners shall be used as needed to ensure that the geotextile does not shift or fold before or during concrete placement. Edges of the geotextile shall overlap by 8 +/- 2 inches. No more than three layers of geotextile shall overlap at any location. Transverse seams of adjacent rolls shall be staggered to prevent four layers from coinciding at any location. The free edge of the geotextile shall extend beyond the edge of the new concrete into a location that facilitates drainage.

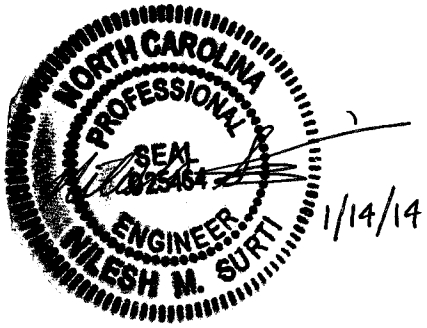
Measurement and Payment

Nonwoven Geotextile Interlayer will be measured and paid at the contract unit price per square yard. In measuring this quantity, the length will be the actual length installed, measured along the surface. The width will be the width measured along the underlying layer that has been acceptably placed. No separate measurement will be made for overlapping fabric.

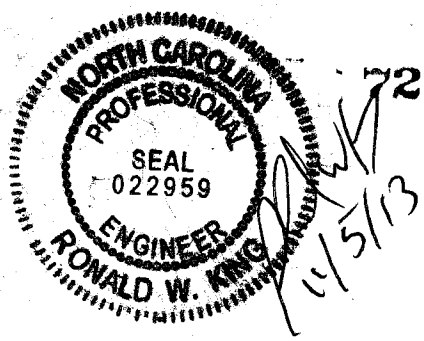
The contract prices for this section shall include but not be limited to furnishing all labor, materials, tools, equipment and other incidentals necessary to perform the required work.

Payment will be made under:

Pay Item	**Pay Unit**
Nonwoven Geotextile Interlayer	Square Yard



TIP # I-4928 Gaston County



OVERHEAD AND DYNAMIC MESSAGE SIGN FOUNDATIONS:

Description

Sign foundations include foundations for overhead and dynamic message signs (DMS) supported by metal poles or upright trusses. Sign foundations consist of footings with pedestals or drilled piers with or without grade beams or wings, conduit and anchor rod assemblies. Construct sign foundations in accordance with the contract and accepted submittals. Define "cantilever sign" as an overhead cantilever sign support in accordance with Figure 1-1 of the *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.*

Materials

Use sign foundation materials that meet the *Foundations and Anchor Rod Assemblies for Metal Poles* provision.

Assumed Subsurface Conditions

Assume the following soil parameters and groundwater elevation for sign foundations unless these subsurface conditions are not applicable to sign locations:

(A) Unit weight (γ) = 120 lb/cf,

(B) Friction angle (ϕ) = 30°,

(C) Cohesion (c) = 0 lb/sf and

(D) Groundwater 7 ft below finished grade.

A subsurface investigation is required if the Engineer determines these assumed subsurface conditions do not apply to a sign location and the sign cannot be moved. Subsurface conditions requiring a subsurface investigation include but are not limited to weathered or hard rock, boulders, very soft or loose soil, muck or shallow groundwater. No extension of completion date or time will be allowed for subsurface investigations.

Subsurface Investigations

Use a prequalified geotechnical consultant to perform one standard penetration test (SPT) boring in accordance with ASTM D1586 at each sign location requiring a subsurface investigation. Rough grade sign locations to within 2 ft of finished grade before beginning drilling. Drill borings to 2 drilled pier diameters below anticipated pier tip elevations or refusal, whichever is higher.

Use the computer software gINT version V8i or later manufactured by Bentley Systems, Inc. with the current NCDOT gINT library and data template to produce SPT boring logs. Provide boring logs sealed by a geologist or engineer licensed in the state of North Carolina.

Sign Foundation Designs

Design sign foundations for the wind zone and clearances shown in the plans and the slope of finished grade at each sign location. Use the assumed soil parameters and groundwater elevation

above for sign foundation designs unless a subsurface investigation is required. For sign locations requiring a subsurface investigation, design sign foundations for the subsurface conditions at each sign location. Design footings, pedestals, drilled piers, grade beams and wings in accordance with the 6th Edition of the *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*. In some instances, conflicts with drainage structures may dictate sign foundation types.

Design footings in accordance with Section 4.4 of the *AASHTO Standard Specifications for Highway Bridges*. Do not use an allowable bearing pressure of more than 3,000 lb/sf for footings.

Design drilled piers for side resistance only in accordance with Section 4.6 of the *AASHTO Standard Specifications for Highway Bridges* except reduce ultimate side resistance by 25% for uplift. Use the computer software LPILE version 6.0 or later manufactured by Ensoft, Inc. to analyze drilled piers. Provide drilled pier designs with a horizontal deflection of less than 1" at top of piers. For cantilever signs with single drilled pier foundations supporting metal poles, use wings to resist torsion forces. Provide drilled pier designs with a factor of safety of at least 2.0 for torsion.

For drilled pier sign foundations supporting upright trusses, use dual drilled piers connected with a grade beam having a moment of inertia approximately equal to that of either pier. The Broms' method is acceptable to analyze drilled piers with grade beams instead of LPILE. Use a safety factor of at least 3.5 for the Broms' design method in accordance with C13.6.1.1 of the *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*.

Submit boring logs, if any, working drawings and design calculations for acceptance in accordance with Article 105-2 of the *2012 Standard Specifications*. Submit working drawings showing plan views, required foundation dimensions and elevations and typical sections with reinforcement, conduit and anchor rod assembly details. Include all boring logs, design calculations and LPILE output for sign foundation design submittals. Have sign foundations designed, detailed and sealed by an engineer licensed in the state of North Carolina.

Construction Methods

Construct footings, pedestals, drilled piers, grade beams and wings and install anchor rod assemblies for sign foundations in accordance with the *Foundations and Anchor Rod Assemblies for Metal Poles* provision.

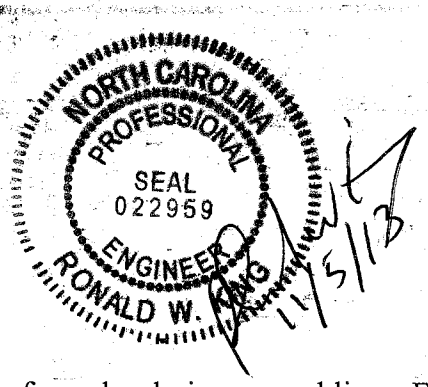
Measurement and Payment

Overhead Footings will be measured and paid in cubic yards. Sign foundations will be measured as the cubic yards of foundation concrete for footings, pedestals, drilled piers, grade beams and wings shown on the accepted submittals. The contract unit price for *Overhead Footings* will be full compensation for providing labor, tools, equipment and foundation materials, stabilizing or shoring excavations and supplying concrete, reinforcing steel, conduit, anchor rod assemblies and any incidentals necessary to construct sign foundations. Subsurface investigations required by the Engineer will be paid as extra work in accordance with Article 104-7 of the *2012 Standard Specifications*.

TIP # I-4928 **Gaston** **County**

Payment will be made under:

Pay Item	**Pay Unit**
Overhead Footings	Cubic Yard



OVERHEAD SIGN SUPPORTS:

Description

Design, fabricate, furnish and erect various types of overhead sign assemblies. Fabricate supporting structures using tubular members of either aluminum or steel. The types of overhead sign assemblies included in this specification are span structures, cantilever structures and sign structures attached to bridges.

Materials

Structural Steel	Section 1072
Overhead Sign Structures	Section 1096
Signing Materials	Section 1092
Organic Zinc Repair Paint	Article 1080-9
Reinforcing Steel	Section 1070
Direct Tension Indicators	Sections 440 and 1072

Construction Methods

A. General

Fabricate overhead sign assemblies in accordance with the details shown in the approved working drawings and the requirements of these specifications.

No welding, cutting or drilling will be permitted in the field, unless approved by the Engineer.

Drill bolt holes and slots to finished size. Holes may also be punched to finished size, provided the diameter of the punched holes is at least twice the thickness of the metal being punched. Flame cutting of bolt holes and slots is not permitted.

Erect sign panels in accordance with the requirements for Type A or B signs as indicated in the plans or Roadway Standard Drawings. Field drill two holes per connection in the Z bars for attaching signs to overhead structures. Provide two U-bolts at each U-bolt connection such as each truss chord to sign hanger and each truss chord to walkway support or light support. Provide two U-bolts at each U-bolt connection where ends of truss chords are supported. The minimum diameter of all U-bolts is ½ inch.

For all U-bolt connections of hanger beams to overhead assembly truss chords, provide all U-bolts with a flat washer and double nuts at each end of the U-bolts. All double nuts that are on any U-bolt shall be the same thickness and weight. When

assembled, the double nuts shall be brought tight against each other by the use of two wrenches.

Use two coats of a zinc-rich paint to touch up minor scars on all galvanized materials.

For high strength bolted connections, use direct tension indicators. Galvanize bolts, nuts and washers in accordance with the Standard Specifications.

B. Shop Drawings

Design the overhead sign supports, including foundations, prior to fabrication. Submit design calculations and working drawings of the designs to the Engineer for review and acceptance.

Have a professional engineer registered in the State of North Carolina perform the computations and render a set of sealed, signed and dated drawings detailing the construction of each structure.

Submit to the Engineer for review and acceptance complete design and fabrication details for each overhead sign assembly, including foundations and brackets for supporting the signs and maintenance walkways, if applicable, electrical control boxes, and lighting luminaires. Base design upon the revised structure line drawings, wind load area and the wind speed shown in the plans, and in accordance with the *Standard Specifications for Structural Structures for Highway Signs, Luminaires and Traffic Signals.*

Submit thirteen (13) copies of completely detailed working drawings and one copy of the design calculations including all design assumptions for each overhead sign assembly to the Engineer for approval prior to fabrication. Working drawings shall include complete design and fabrication details (including foundations); provisions for attaching signs, maintenance walkways (when applicable), lighting luminaires to supporting structures, applicable material specifications, and any other information necessary for procuring and replacing any part of the complete overhead sign assembly.

Allow 40 days for initial working drawing review after the Engineer receives them. If revisions to working drawings are required, an additional 40 days shall be required for review and approval of the final working drawings.

Approval of working drawings by the Engineer shall not relieve the Contractor of responsibility for the correctness of the drawings, or for the fit of all shop and field connections and anchors.

C. Design and Fabrication

The following criteria govern the design of overhead sign assemblies:

Design shall be in accordance with the *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 5th Edition, 2009* and the 2010 and 2011 Interim Revisions.

Within this Specification, there are several design criteria that are owner specified. They include:

- Overhead cantilever sign structures shall include galloping loads (exclude four-chord horizontal trusses).
- The natural wind gust speed in North Carolina shall be assumed to be 11.6 mph.
- The fatigue importance category used in the design, for each type of structure, shall be for:
- Cantilever structures with span greater than 50 feet – Fatigue Category I.
-
- Cantilever structures with span less than or equal to 50 feet – Fatigue Category II.
- Non-cantilever structures – Fatigue Category II

The following Specification interpretations or criteria shall be used in the design of overhead sign assemblies:

- For design of supporting upright posts or columns, the effective length factor for columns "K", as provided for in Appendix B, Section B.5, shall be taken as the following, unless otherwise approved by the Engineer:

  Case 1 For a single upright post of cantilever or span type overhead sign structure, the effective column length factor, "K", shall be taken as 2.0.

  Case 2 For twin post truss-type upright post with the post connected to one chord of a horizontal truss, the effective column length factor for that column shall be taken as 2.0.

  Case 3 For twin post truss-type upright post with the post connected to two truss chords of a horizontal tri-chord or box truss, the effective column length factor for that column shall be taken as 1.65

- For twin post truss-type uprights, the unbraced length of the post shall be from the chord to post connection to the top of base plate

- For twin post truss-type uprights when the post is subject to axial compression, bending moment, shear, and torsion, the post shall satisfy *Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals* Equations 5-17, 5-18 and 5-19. To reduce the effects of secondary bending, in lieu of Equation 5-18, the following equation may be used:

$$\frac{f_a}{F_a} + \frac{f_b}{\left(1 - \frac{0.6 f_a}{F_é}\right) F_b} + \left(\frac{f_v}{F_v}\right)^2 \leq 1.0$$

Where fa = Computed axial compression stress at base of post

- The base plate thickness for all uprights and poles shall be a minimum of 2" but not less than that determined by the following criteria and design.

Case 1 Circular or rectangular solid base plates with the upright pole welded to the top surface of base plate with full penetration butt weld, and where no stiffeners are provided. A base plate with a small center hole, which is less than 1/5 of the upright diameter, and located concentrically with the upright pole, may be considered as a solid base plate.

The magnitude of bending moment in the base plate, induced by the anchoring force of each anchor bolt shall be calculated as $M = (P \times D_1) / 2$.

Case 2 Circular or rectangular base plate with the upright pole socketed into and attached to the base plate with two lines of fillet weld, and where no stiffeners are provided, or any base plate with a center hole that is larger in diameter than 1/5 of the upright diameter
The magnitude of bending moment induced by the anchoring force of each anchor bolt shall be calculated as $M = P \times D_2$.

- M - bending moment at the critical section of the base plate induced by one anchor bolt
- P - anchoring force of each anchor bolt
- D_1 - horizontal distance between the center of the anchor bolt and the outer face of the upright, or the difference between the radius of the bolt circle and the outside radius of the upright
- D_2 - horizontal distance between the face of the upright and the face of the anchor bolt nut

- The critical section shall be located at the face of the anchor bolt and perpendicular to the radius of the bolt circle. The overlapped part of two adjacent critical sections shall be considered ineffective.

- The thickness of Case 1 base plate shall not be less than that calculated based on formula for Case 2.

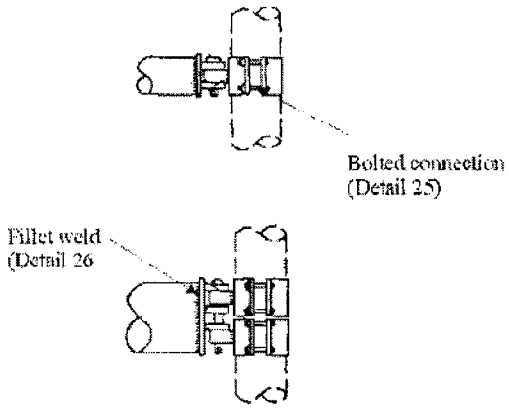
- Uprights, foundations, and trusses that support overhead signs shall be designed in accordance with the Overhead and Dynamic Message Sign Foundations Project Special Provision for the effects of torsion. Torsion shall be considered from dead load eccentricity of these attachments, as well as for attachments such as walkways, supporting brackets, lights, etc., that add to the torsion in the assembly. Truss vertical and horizontal truss diagonals in particular and any other assembly members shall be appropriately sized for these loads.

- Uprights, foundations, and trusses that support overhead mounted signs shall be designed for the proposed sign wind area and future wind areas. The design shall consider the effect of torsion induced by the eccentric force location of the center of wind force above (or below) the center of the supporting truss. Truss vertical and horizontal truss diagonals in particular and any other assembly members shall be appropriately sized for these loads.

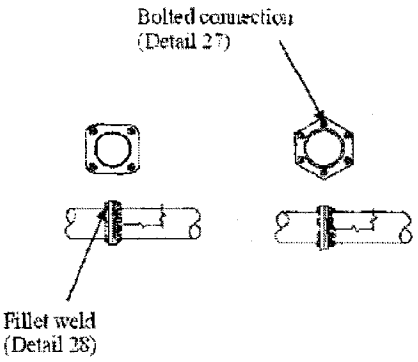
For non-cantilevered monotube sign support structures, the following table and figures are considered as a required addition to the Standard Specifications for Structural Support for Highway Signs, Luminaires and Traffic Signals, 5th Edition, 2009:

Construction	Detail	Stress Category	Application	Example
Mechanically Fastened Connections	25. Bolts in Tension	D	Beam column connection for monotube structures	16
Fillet Weld Connections	26. Fillet welded with one side normal to applied stress	E'	Beam column connection for monotube structures	17
Mechanically Fastened Connections	27. High strength bolts in tension	D	Monotube or truss-chord splice	17
Fillet Weld Connections	28. Fillet welded with one side normal to applied stress	E'	Monotube or truss-chord splice	17
Mechanically Fastened Connections	29. U-bolts tied to transverse truss column to keep chords in place	D	Horizontal truss connection with vertical truss	18
Mechanically Fastened Connections	30. Net section of full-tightened, high tension bolts in shear	B	Truss bolted joint	18

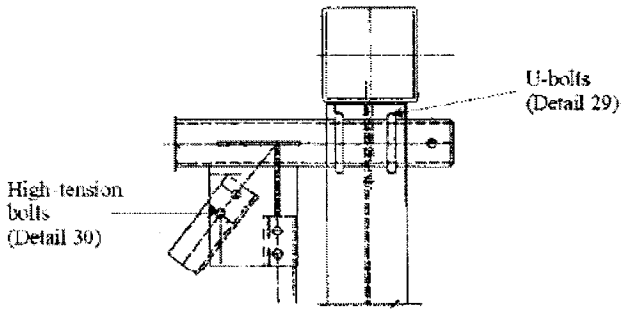
Add to the Specifications. Figure 11-1:



Beam-Column Connection for monotube structure
Example 16



Monotube beam splice
Example 17



Beam-Column Connection for Truss Structure
Example 18

Fabricate all overhead sign assemblies, including but not limited to foundations, in accordance with the details shown on the approved shop drawings and with the requirements of these Specifications.

Fabricate the span and cantilever supporting structures using tubular members of either aluminum or steel, using only one type of material throughout the project. Sign support structures that are to be attached to bridges shall be fabricated using other structural shapes.

Horizontal components of the supporting structures for overhead signs may be of a truss design or a design using singular (monotube) horizontal members to support the sign panels.

Truss or singular member centerline must coincide with the centerline of sign design area shown on the structure line drawing.

Provide permanent camber in addition to dead load camber in accordance with the *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.* Indicate on the shop drawings the amount of camber provided and the method employed in the fabrication of the support to obtain the camber.

Use cantilever sign structures that meet the following design criteria:

a. Do not exceed an L / 150 vertical dead load deflection at the end of the arm due to distortions in the arm and vertical support, where L is the length of the arm from the center of the vertical support to the outer edge of the sign.

b. Do not exceed an L / 40 horizontal deflection at the end of the arm due to distortions in the arm and vertical support, as a result of design wind load.

Fabricate attachment assemblies for mounting signs in a manner that allows easy removal of sign panels for repair.

Compensation

The work covered by this section will be paid for at the contract lump sum for each *Supports, Overhead Sign Structure @ Sta* _____. Such price will be full compensation for all work covered by this specification includes all design, fabrication, construction, transportation, and erection of the complete overhead sign structure, supporting structure, hardware, lighting support brackets, preparing and furnishing shop drawings, and attaching the signs to the overhead assembly.

Payment will be made under:

Supports, Overhead Sign Structure @ Sta _____	Lump Sum

WORK ZONE TRAFFIC CONTROL
Project Special Provisions

Law Enforcement:
(05/14/2013)

Description

Furnish Law Enforcement Officers and marked Law Enforcement vehicles to control traffic in lane closures and direct traffic through intersections in accordance with the contract.

Construction Methods

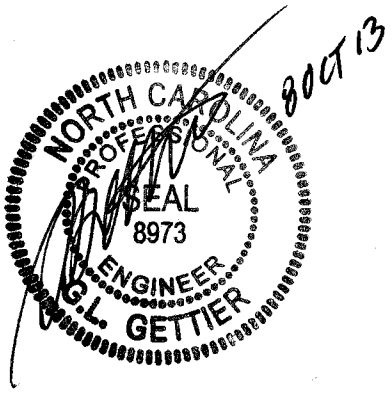
Use uniformed Law Enforcement Officers and marked Law Enforcement vehicles equipped with blue lights mounted on top of the vehicle, and Law Enforcement vehicle emblems to direct or control traffic as required by the plans or by the Engineer.

Measurement and Payment

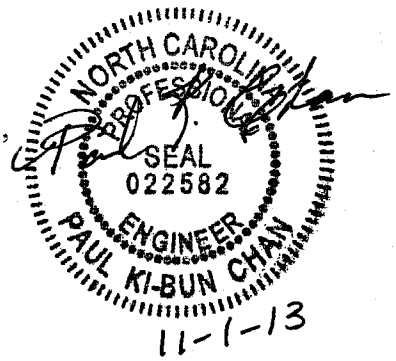
Law Enforcement will be measured and paid for in the actual number of hours that each Law Enforcement Officer is provided during the life of the project as approved by the Engineer. There will be no direct payment for marked Law Enforcement vehicles as they are considered incidental to the pay item.

Payment will be made under:

Pay Item	Pay Unit
Law Enforcement	Hour



PROJECT SPECIAL PROVISIONS
HYDROSTATIC WEIGHING SYSTEMS,
AREA LIGHTING AND ITS POWER



1.00 DESCRIPTION

The work described by the following special provisions consists of the complete manufacturing, furnishing, installation, testing, training, and servicing for an operating hydrostatic scale system. It also includes the furnishing, installing, connecting, and placing into satisfactory operating condition of area and roadway lighting and equipment disconnects at locations shown on the plans.

Perform all work in accordance with these Special Provisions, the Plans, the National Electrical Code, and North Carolina Department of Transportation "Standard Specifications for Roads and Structures" (Standard Specifications). The Contractor shall provide all materials necessary to complete the work.

The Contractor or his designated subcontractor(s) shall have valid licenses to accomplish the work including but not limited to the following.

- North Carolina Electrical Contractors License as prescribed in Chapter 87 of the General Statutes.

- Scale Technician License from the NC Department of Agriculture and Consumer Services Standards Division.

The Static Scale manufacturer shall have a minimum of five years experience in weighing systems of the type and size described in these special provisions. A list of at least three customer references, which have purchased and installed weighing systems similar to those specified herein shall be provided. The list shall include the contact name, organization, phone number, address, date of installation, and description of systems purchased for each reference.

Evaluation and final acceptance of all submittals shall be the responsibility of the Engineer.

1.10 REFERENCES USED

References used in these special provisions include but are not limited to the following:

- North Carolina Department of Transportation (NCDOT) Standard Specifications
- National Electrical Code 2011
- Underwriters Laboratories Standards

- NIST Handbook 44, "Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices"

1.20 SCOPE OF WORK

The Contractor shall furnish a complete and operating hydrostatic scale weighing system for legal enforcement of the State of North Carolina laws pertaining to the weighing of trucks consisting of, but not limited to, the following:

- Static Scale Pits
- Static Scale Decks
- Static Scale Weigh Bridges
- Static Scale Load Cells
- Controllers, Cabinets, and Accessories with Interconnect and Power Cabling and Conduit
- Central Command Computers:
- Certified Tests
- Training of Personnel
- Service during Observation Period

The weighing system described in these Special Provisions consists of essentially identical design and installation for each side of the scale building. The hydrostatic scale system will consist of two (2) sets of scales consisting of three decks each.

Each hydrostatic weighing system shall be operated from inside the scale room where it shall be possible to monitor and control the weighing of trucks.

The weighing system operation shall allow the direction of weigh station operations as indicated on overall roadway plan sheets, and in particular the weighing system sheet showing the vehicle flow chart (E15 , Figures 1). These operations include manual selection and direction of vehicles for inspection or other purposes as well as automatic random selection and automatic direction associated with the weigh station operation.

1.30 STANDARD OF PRACTICE

The weighing system by its nature utilizes state of the art concepts and equipment. The Department reserves the right to reject any equipment or system which does not comply with the current standard of practice in all aspects including field reliability, serviceability, accuracy, and function. The burden of proof for standard of practice conformance will be that of the Contractor.

1.40 OPERATIONAL FUNCTIONAL FACILITY

The Contractor shall assure that the completed hydrostatic weighing system meets all operational requirements and needs of the NC DMV Enforcement Section for this weigh station facility. A thirty (30) day test period is required prior to project acceptance.

1.50 TRAINING OF PERSONNEL

The Contractor shall provide training to employees of the Department of Public Safety. The training shall address all aspects of the static scale system operation and minor maintenance.

Each training class shall be composed of a classroom period and a workshop period. Concepts and particular details shall be addressed during the classroom period in a traditional classroom setting manner. During the workshop period each employee shall be taught the operation of the equipment through actual hands on training with installed operating equipment.

The Contractor shall train through classes and shall provide operation manuals for up to thirty (30) employees of the Department of Public Safety.

Additionally, the Contractor shall provide thirty (30) classroom training manuals to allow Department personnel familiar with the weigh station operation to train additional personnel not familiar with weigh station operations.

The Contractor shall provide an outline of the training classes and the training manual for the Engineer's review and comments. The Engineer's comments shall be incorporated into the final training manual and training course outline. The final training manual and course outline shall be approved by the Engineer before beginning the training. The Contractor shall allow thirty (30) days each for the Engineer's review of the outlines and final review and approval.

The training classes shall be held at a site(s) selected by the Engineer, no more than one month before the weigh station is placed in operation.

There will not be any direct payment for the training classes and manuals because they will be considered incidental and included in the overall contract bid items.

1.60 MEASUREMENT AND PAYMENT

All requirements necessary to satisfy the contract and the scope of CONTRACTOR responsibilities described above will not be paid for directly. The cost of such work shall be included in the unit price bid for the various contract items. All necessary documentation shall also be included in the contract bid prices.

1.70 FINAL SYSTEM ACCEPTANCE

The final acceptance of the system shall be based on the satisfactory completion of a system performance test which will be followed by a 180 day system observation period.

A. System Performance Test

Following completion of the stand-alone tests of all equipment and the subsystem tests, the entire complement of subsystems and equipment shall be integrated into one system.

Following this integration, a system performance test shall be conducted by the Contractor.

The system performance test shall, as a minimum, exercise all functional operations of each unit of equipment in the field and in the control center as an integrated system. The test shall also include a thirty (30) day period of normal operations without any failure. Normal operations will be operation of the weigh station by Department personnel in the intended function of weighing trucks.

In the event of a failure of any CONTRACTOR supplied equipment, that portion of the system affected by the failure shall be subjected to an additional 30 day test period. For example, a failed load cell would be repaired and only that cell be tested for 30 more days. However, a failed central computer would require the entire system to be tested for 30 additional days.

B. Observation Period

The Contractor shall be required to maintain the system for 180 days following satisfactory completion of the 30 day system performance test. During this time period the system will be operated in its intended normal truck weighing operational mode.

In the event of a failure, all equipment shall be returned to its operational state not later than seventy-two (72) hours after the Contractor has been provided with notification of the failure. Failures which affect the proper operation of the system(s) shall suspend the timing of the observation period. After the cause of such failures has been determined and corrected, the observation period shall resume.

The Contractor shall have on hand spare parts to make repairs for the satisfactorily completion of the observation period.

The Contractor shall designate a supervisor who will have complete charge of the repair responsibilities. This supervisor shall be given full authority by the Contractor to take such action as may be necessary to insure that maintenance and service is provided in accordance with the requirements of the contract. The supervisor shall work with the Engineer or his designated representative so that the Engineer is informed of all details concerning the Contractor's maintenance and service work. The Contractor's

maintenance and service supervisor or his designated representative shall be on call at all times to receive notification that maintenance and service work is needed.

The Contractor shall keep a detailed maintenance record throughout the observation period. The record shall indicate the date and scope of each maintenance activity. As a minimum, each entry shall include a description of the type of work performed; the cause of the malfunction; the necessary labor, materials and special equipment used; and the time required in completing the activity. The record shall be made available to the Engineer during the observation period, and one copy of the maintenance record shall be submitted to the Engineer within two weeks from the date of the end of the 180-day system observation period.

The observation period is not a part of the work to be completed by the completion date of this project. The observation period shall be warranted by the payment and performance bond.

2.00 STATIC SCALE SYSTEM

2.10 DESCRIPTION

The work described by this division includes the furnishing, constructing and placing into operation, full electronic weighing systems in accordance with the plans and specifications included herein.

The Contractor shall furnish and install complete weighing systems on each side of the weigh station scale building at locations shown in the plans.

The complete systems shall meet the requirements for commercial scales as specified in the National Institute of Standards and Technology (NIST) Handbook No. 44 with current changes.

Each scale system shall include full electronic instrumentation utilizing load cells and solid state devices to provide individual, accumulated and total weights for three (3) scale platforms in pounds. Weights shall be displayed in the building scale room. The consoles shall each contain controls to activate a printer to record individual and total weights.

2.20 SUBMITTALS

A. Catalog Cuts and Shop Drawings

The Contractor shall submit for the Engineer's approval eight (8) sets of complete information on the scale equipment and pit construction. The submittals shall show sufficient information to verify that the proposed equipment and installation meet the requirements of the specifications. The information shall include catalog cuts with specifications and/or drawings for electrical and mechanical components proposed.

Information for approval shall include but is not limited to the following areas:

- basic capacity and rating of weighing system
- scale deck, weigh bridge and anchorage
- scale deck checks
- load cells
- load cell mounting
- load cell junction box
- load cell signal cable
- instrumentation
- pit construction drawing

Within 40 days, the Engineer will return three (3) sets of approved submittals or reasons for rejection to the Contractor. The Contractor shall not deliver materials to the project prior to the approval of catalog cuts or shop drawings.

B. Schematics

Complete electrical schematics "certified for construction" showing all components and interconnections for each part of the weighing system shall be submitted. The schematics shall show wire and terminal numbers, and all devices properly identified with ratings or part numbers according to the best practice of preparing electrical schematics for field use of qualified technicians to install, start up, and maintain the system.

C. Manuals

Operating and Maintenance Manual(s) which completely describe the normal operating and maintenance procedures shall be submitted. The operating procedures shall include all the necessary information for an operator to turn on, operate, check and turn off the system. The maintenance procedures shall include all the necessary information for a qualified technician to trouble shoot, adjust and repair the system, except components requiring such sophisticated test equipment or expertise as is normally reserved for the manufacturer.

D. Parts and Price List

A complete list of parts, with the numbers and description cross-referenced with the schematics and operating and maintenance manuals, so that any part may be readily identified and a replacement ordered shall be submitted. Prices shall be included with parts which are recommended for stock. The "recommended for stock" parts list shall include; load cells, fuses, surge protection components, power supplies, printed circuit boards, readout components, and ink or toner cartridges for printer.

2.30 GUARANTEES AND WARRANTIES

The Contractor shall present to the Department a written guarantee clearly stating the guarantee provisions stipulated below, and executed in a legal manner acceptable to the Engineer.

2.31 Guarantees

The scale equipment, including the instrumentation and load cells shall be guaranteed against malfunction for a minimum of five (5) years.

2.32 Maintenance and Service

For a period of 180 days (6 months) after the Department accepts the scale equipment, the Contractor shall provide a periodic inspection, maintenance, test and calibration of each scale. This shall include emergency servicing of the equipment when the system fails to operate properly. The Department shall be furnished a written report each time periodic and emergency work is performed on the scale system.

Within 3 days (72 hours) after notification the Contractor shall perform tests and inspections to determine the accurate operation of the weighing systems and shall make necessary repairs and/or replacements.

The Contractor shall provide an adequate inventory of replacement parts, manufactured to the scale equipment manufacturer's specifications, to insure that all repairs will be made in a prompt and timely manner.

The Contractor shall provide qualified technicians and proper equipment to perform the maintenance and service work and to conduct tests as follows.

2.40 TESTING

Each scale shall be tested at any time maintenance or service is rendered if such service or maintenance in any way affects the calibration and accuracy of the scale.

Tests shall include a strain test, increasing load test, zero repeatability test and such other tests as required by the NC Department of Agriculture and Consumer Services Standards Division.

2.50 REPORTS AND CERTIFICATIONS

The Contractor shall submit a report, showing work done, parts used, and test results of each inspection or visit. The original copy shall be submitted to the Engineer with copy to the North Carolina Department of Agriculture and Consumer Services, Standards Division, 2109 Blue Ridge Road, Raleigh, NC 27607. In addition, the "service certificate" specified

in General Statute 81A-73 and approved by the Department of Agriculture shall be submitted to the Engineer for any service rendered on any scale or weighing device.

All costs to provide the maintenance and service work as described above shall be included in the contract bid items.

2.51 Calibration

After the entire installation has been completed, the scales shall be tested, calibrated and certified by the manufacturer to be accurate within the accepted tolerance required by the National Institute of Standards and Technology (NIST) Handbook No. 44 with current changes.

The Contractor shall also arrange with the N. C. Department of Agriculture and Consumer Services, Standards Division, to have the scales certified. A NCDA&CS, Standards Division seal of approval shall be on each scale prior to acceptance of the work.

2.60 LOAD CELLS

2.61 Hydrostatic Load Cells

The load cells shall be rigidly attached and shall be mounted in such a manner that any possible motion of the weighbridge will not be detrimental to their operation. The design of this mounting shall include protection from shock loads and contraction and expansion of the weighbridge.

Load cell lines from the cells to the 3" conduit to the scale room building shall be neatly arranged and protected from physical damage during normal cleaning and inspection of the pit. Load cell lines shall be made of grade 316 stainless steel, neatly cut to the required length and shall be continuous, without splice, from the summing totalizer to the load cell.

The load cells shall have a minimum of 100% safe overload rating and an ultimate overload rating of 200% minimum. This shall apply to the linkage of the load cell as well as the load cell itself.

2.62 Grounding

All necessary provisions shall be made to insure a completely grounded scale system in its entirety so as to protect the components from natural occurrences of the environment in which the installation exists, including normal power outages and surges which may be expected to occur. Grounding as shown in the details will be the minimum acceptable and any additional grounding as recommended by the scale equipment manufacturer shall be installed.

All decks shall be bonded together with #4AWG minimum copper conductor. All connections shall be with approved terminal devices and shall be to clean metal surfaces.

In addition to the bonding and grounding of the decks, special circuitry and devices shall be provided to protect the solid state components of the instrumentation. This shall be in the form of isolation transformers, metal oxide semiconductors, resistor/capacitor circuits, shielding and other means as provided by the scale equipment manufacturer for premium electrical protection.

2.7 INSTRUMENTATION

2.71 Specifications

The scale instrumentation shall be solid state microprocessor based units for individual scale and total weight readouts, printer and control and data handling functions. It shall be housed in enclosures as indicated in the plans or these specifications. The weights and total on the readouts and printer shall be one over the other with the top digits indicating the weight on the forward 12' x 12' deck, the next lower set of digits indicating the weight on the center 12' x 14' deck, the next lower set of digits indicating the weight on the 12' x 54' deck, and the lowest readout indicating the total weight on all three decks.

The instrumentation shall be in conformance with NIST Handbook 44, "Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices".

The digital readouts shall show weight in 20 pound increments and shall indicate accurately to the following full load capacities.

12' x 12' scale	60,000 lbs.
12' x 14' scale	60,000 lbs.
12' x 54' scale	150,000 lbs.
Total	150,000 lbs.

Overload of the scale shall not be detrimental to the electronics up to the ultimate overload rating of the load cells.

The instrumentation and load cells shall have operating temperature ratings which exceed the extremes anticipated at each location.

The system shall be operable in either an automatic or manual mode.

Manual operation shall be similar to the automatic operation, except individual scale weights shall be accumulated as they are selected by individual push-buttons for scale 1, 2 and 3. Multiple individual weighments shall be possible for each scale

and the accumulated weighments shall be displayed with the total and shall be printed when the PRINT key is pressed, after which the system shall revert to the automatic mode.

2.72 Power

All power for all components of the instrumentation including remote display, printers and console shall be supplied through dedicated electrical outlets near the console. It shall be 120 VAC, 60 HZ 20 Amp, 2 wire with equipment grounding conductor.

2.80 MEASUREMENT AND PAYMENT

There will not be any actual measurement for the static scale systems because they will be paid for on a lump sum basis.

Payment for the static scale systems shall be at the lump sum price bid for "_____ Static Scale System" at the appropriate location. Such price and payment will be full compensation for materials, tools, equipment, labor and incidentals necessary to accomplish the work. Included in the work shall be instrumentation.

Payment will be made under:

_____ Static Scale System.....Lump Sum

3.00 ELECTRICAL WORK IN STATIC SCALE PITS

3.10 DESCRIPTION

The work described in this section consists of furnishing and installing (a) lights, switches, receptacles and conductor, (b) conduit for the weighing system load cell lines, and (c) grounding of the scale decks.

3.20 MATERIALS

Unless otherwise noted on the plans, all embedded conduit shall be polyvinyl chloride (PVC) and all exposed conduit shall be rigid galvanized steel (RGS) with threaded connections and hot dipped galvanized fittings.

Light fixtures shall be incandescent, vapor tight, cast iron type with screw on gasketed glass globe, metal guard, with medium base socket rated for 150 watt lamps.

Switches shall be installed with waterproof covers. Receptacles shall be ground fault indicator (GFI) type, labeled as weather resistant and shall have waterproof covers installed over the receptacle.

Ground Rods shall be 5/8" x 8' copper clad steel. The clamp shall be one piece silicone bronze with a socket or hex head screw. All grounding and bonding equipment shall conform to UL Standard 467, "Electrical Grounding and Bonding Equipment".

All electrical conductor used in the static scale pit shall be THHN/THWN and sized as shown on the plans.

3.30 CONSTRUCTION METHODS

Conduit shall be encased in the concrete walls, floor, and pedestals of the pit except where clearly shown otherwise. Fixtures, switches, and receptacles shall not be located on the pit walls where they may be exposed to water from the decks.

All RGS conduit shall be made up wrench tight and have a water proof coating at joints.

Permanent non-harding duct sealer shall be placed around all conduits and ground rods to prevent the entrance of water.

Protection shall be provided at all times against the entrance of water or other foreign matter into the conduit. Conduit shall be plugged or capped when work is temporarily suspended, including nightly stoppage of work.

All conduit shall be clean before installation, and upon completion of the system an approved cleaner with a diameter not less than 85% of the nominal diameter of the conduit shall be snaked through each conduit prior to installing the conductor.

The conduit shall be installed in such a manner that temperature changes will not cause elongation or contraction which might damage the system. Expansion fittings shall be provided where conduit crosses structure expansion joints.

Grounding and bonding jumpers shall be attached to the deck steel with approved lugs, bolts, and washers. The bolts shall be through drilled holes and the area around the holes shall be cleaned of all paint and corrosion which might prevent a good electrical connection. After inspection by the Engineer the exposed raw metal shall be coated with an approved paint.

Conduits between the pit and scale room shall enter the pit through the pit wall at the areas shown on the plans.

Install ¾" PVC conduit from junction box in pit to the mechanical room. Conduit shall be installed prior to scale building floor being poured and prior to final grading.

Wire and cable shall conform to IPCEA specifications and shall have marks for identification (manufacturer's name, type insulation, and gauge of conductor) and the U.L. label. All wire insulation shall be rated at 600 VAC or greater.

No wire shall be pulled through a conduit system until the system is complete and has been cleaned. Approved wire pulling lubricants shall be used. Wires shall be pulled into conduit at a slow steady pace and careful attention given to assure that no wire is damaged.

Joints, taps, and splices will only be permitted at locations indicated on the plans and by the following methods.

3.40 MEASUREMENT AND PAYMENT

The electrical work required by this section when completed and accepted will be paid for at the contract lump sum price for "_____ Pit Electrical Work" at the appropriate location. Such price and payment will be full compensation for all materials, labor, and equipment to provide all the receptacles, lights, switches, ground rods, bonding jumpers and load cell line conduit.

Payment will be made under:

" _____ Pit Electrical Work".....Lump Sum

4.00 LIGHT EMITTING DIODE (LED) LUMINAIRES

4.10 DESCRIPTION

Furnish, install and place into satisfactory operation, LED luminaires on 35' single arm roadway standards and 100' high mount standards as detailed in these Special Provisions.

The Contractor shall supply Holophane LED high mount luminaires, part number HMLED144KASGL5, or approved equal. Any alternate high mount luminaire submitted for approval will require luminaire samples to be submitted to the Department, at no cost to the Department, for evaluation prior to approval.

Evaluation will consist of installation of samples on existing Department owned facilities for a period no shorter than two (2) months prior to approval. Photometric data files in Illuminating Engineering Society (IES) format will be evaluated to determine if proposed alternate high mount luminaire meets or exceeds design critera prior to samples being sent.

High mount luminaire retrofit LED kits are not an acceptable alternative.

For LED roadway luminaires installed on the bracket arm of single arm standards, Contractor shall include all LEDs/light bars, drivers, wiring inside the standard from the circuit conductors to the LED luminaire, in-line breakaway fuseholders with fuses and ground wiring at the pole on the light standards. Third party certified photometric files in IES format are required to be submitted with the catalog cuts for the proposed LED roadway luminaire. Photometric files must show that proposed luminaire will meet or exceed the design shown in the plans.

4.20 MATERIALS

4.21 LUMINAIRE REQUIREMENTS

A. General Requirements

- LM-79 photometric test reports shall be provided for all LED luminaires. LM-79 luminaire photometric reports shall be produced by an independent test laboratory and include the following:
  - Name of test laboratory. The test laboratory must hold National Voluntary Laboratory Accreditation Program (NVLAP) accreditation for the IES LM-79 test procedure or must be qualified, verified, and recognized through the U.S. Department of Energy's CALiPER program.
  - Report number
  - Date
  - Complete luminaire catalog number. Catalog number tested must match the catalog number of the luminaire submitted, except for variations which do not affect performance.
  - Description of luminaire, LED light source(s), and LED driver(s)
  - Goniophotometry
  - Colorimetry

- LM-80 lumen maintenance test report shall be provided for each respective LED light source.
- Roadway luminaire shall be constructed of a single piece die cast aluminum housing. High mount luminaire shall be constructed of low copper 356 cast aluminum. Each luminaire shall be finished gray in color unless otherwise noted.
- Luminaires shall have a minimum L70 rating of 100,000 hours at 25°C. Provide a summary of reliability testing performed for LED driver.
- Roadway luminaires shall have a maximum total power consumption of 200 watts (W) at 480VAC. High mount luminaires shall have a maximum total power consumption of 200W at 120VAC. Nominal luminaire input wattage shall account for nominal applied voltage and any reduction in driver efficiency due to sub-optimal driver loading.
- Roadway luminaire shall have an IESNA distribution Type II. High mount luminaire shall have an IESNA distribution Type V.
- Luminaire LED modules shall meet dust and moisture rating of IP-65, minimum.
- Luminaire shall have an external label per ANSI C136.15.
- Luminaires shall have an internal label per ANSI C136.22.
- Luminaires shall start and operate in -20°C to +40°C ambient.
- Roadway luminaire shall have an internal bubble level.
- Electrically test fully assembled luminaires before shipment from factory.

- Effective Projected Area (EPA) and weight of the luminaires shall not exceed 1.0 square feet and 46 lbs for roadway luminaires and 1.6 square feet and 80 lbs. for high mount luminaires.
- Luminaires shall be designed for ease of electrical component replacement.
- Luminaires shall be rated for minimum 2G vibration, minimum, per ANSI C136.31-2010
- LED light sources and drivers shall be RoHS compliant.
- The luminaire manufacturer shall have no less than five (5) years of experience in manufacturing LED-based lighting products and the manufacturing facility must be ISO 9001 certified.
- Roadway luminaire shall have a 1.25" to 2.0" adjustable tenon mount for connection to luminaire bracket arm assembly.
- Pole hardware, nuts, bolts, and washers, etc. shall be made from 18-8 stainless steel, or steel conforming to ASTM A307 galvanized in accordance with ASTM A153.

B. Driver
- Rated case temperature shall be suitable for operation in the luminaire operating in the ambient temperature range of -20°C to +40°C.
- Shall be rated for 120VAC at 50/60 Hz, and shall operate normally for input voltage fluctuations of ± 10%.
- Shall have a minimum Power Factor (PF) of 0.90 at full input power and across specified voltage range.
- Roadway luminaires shall have maximum 600mA driver operating current.

C. Surge Suppression
- Integral surge protection shall meet ANSI/IEEE C62.45 procedures based on ANSI/IEEE C62.41.2 definitions for standard and optional waveforms for location category C-High 10kV/10kA test, IEC 61000-4-2 (Electrostatic Discharge) 8kV Air/4kV Contact test and IEC 61000-4-4 (Fast Transients).

D. Electromagnetic interference
- Luminaires shall have a maximum Total Harmonic Distortion (THD) of 20% at full input power and across specified voltage range.
- Luminaires shall comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.

E. Electrical safety testing
- Luminaires shall be listed for wet locations.
- Luminaires shall be UL listed and labeled.

F. Finish
- Luminaires shall be painted with a corrosion resistant polyester powdered paint with a minimum 2.0 mil thickness.

- Luminaires shall exceed a rating of six per ASTM D1654 after 1000 hours of salt spray fog testing per ASTM B117.
- The coating shall exhibit no greater than 30% reduction of gloss per ASTM D523, after 500 hours of QUV testing at ASTM G154 Cycle 6.

G. Thermal management
- Mechanical design of protruding external surfaces (heat sink fins) on roadway luminaries shall facilitate hose-down cleaning and discourage debris accumulation.
- High mount luminaires shall feature a perforated aluminum environmental guard between the optical housing and the driver housing.

H. Color Quality
- Minimum Color Rendering Index (CRI) of 60 with a Correlated Color Temperature (CCT) of 4000K to 5000K

I. Optics
- High mount luminaire shall feature multi die LED chip on board (COB) technology.
- Transmissive optical components shall be applied in accordance with OEM design guidelines to ensure suitability for the thermal/mechanical/chemical environment.
- High Mount luminaire shall have prismatic glass optics in symmetric distribution and provide overlapping pattern on application space to eliminate darks spots.

J. The following shall be in accordance with corresponding sections of ANSI C136.37
- All internal components shall be assembled and pre-wired using modular electrical connections.
- Terminal blocks shall be used for incoming AC lines
- Latching and hinging

K. Manufacturer or local sales representative shall provide installation and troubleshooting support via telephone and/or email.

4.30 WARRANTY

Provide a minimum five-year warranty covering maintained integrity and functionality of the luminaire housing, wiring, and connections, LED light source(s) and LED driver. Negligible light output from more than 10 percent of the LED packages constitutes luminaire failure.

Warranty period shall begin after project acceptance by the Department.

4.40 CONSTRUCTION METHODS

Level and secure each luminaire in all directions. Securely terminate the wiring for each high mount luminaire and include an equipment grounding conductor to bond the housing to the supply cord grounding conductor.

Adjust any luminaires, as directed by the Engineer, to provide optimal illumination distribution.

All LED packages on all luminaires must be operating normally at contract completion. Any luminaire displaying improper operating characteristics prior to contract completion will be replaced by the Contractor at no additional cost to the Department.

4.50 MEASUREMENT AND PAYMENT

The roadway luminaries measured as provided above will be paid for at the contract unit price per each "Roadway Light Standard Luminaires – LED". Such price and payment will be considered full compensation for providing and installing the LED roadway luminaire on the bracket arm, wiring inside the standard from the circuit conductors to the LED roadway luminaire, in-line breakaway fuseholders with fuses and ground wiring at the pole on the light standard.

The high mount luminaires measured as provided above will be paid for at the contract unit price per each "High Mount Luminaires – LED". Such price and payment will be considered full compensation for providing and installing the LED high mount luminaire on the carrier ring tenon arm and connecting the LED high mount luminaire to the supply cord on the carrier ring.

Payment will be made under:

Roadway Light Standard Luminaire – LED.....	Each
High Mount Luminaire – LED	Each

5.00 LIGHT STANDARDS

5.10 DESCRIPTION

Furnish and install 35 ft. light standards, complete with bracket arm, impact attenuation device and light standard junction box as shown in the plans.

5.20 MATERIALS

Same as section 1404-2 of the Standard Specifications except an 18" polymer concrete (PC) junction box shall be provided with each of the single arm standards. See Section 6.00 below for junction box specifications.

5.30 CONSTRUCTION METHODS

Same as section 1404-3 of the Standard Specifications except install the junction box within two feet of the pole and foundation as shown in detail sheets 1404D01 and 1406D01 on sheet LE8 of the plans.

5.40 MEASUREMENT AND PAYMENT

The quantity of light standards to be paid for will be the actual number of light standards with arm assemblies and junction boxes which have been installed and accepted.

Such price and payment will be considered full compensation for furnishing and installing the standard, bracket arm assembly, impact attenuation device and junction box.

Payment will be made under:

Light Standard, Type MLTS, 35' MH, 6' SA.....Each

6.00 ELECTRICAL JUNCTION BOXES

6.10 DESCRIPTION

Same as Section 1411-1.

6.20 MATERIALS

Same as Section 1411-2, except modify referenced Section 1091-5 as follows:

- Page 10-202, revise paragraph starting on line 9 to read "Provide polymer concrete (PC) boxes which have bolted covers and open bottoms. Provide vertical extensions of 6" to 12" as required by project special provisions."
- Page 10-202, revise sentence beginning on line 14 to read "Other thermoplastic materials may be used for components which are not normally exposed to sunlight."

6.30 CONSTRUCTION METHODS

Same as Section 1411-3.

6.40 MEASUREMENT AND PAYMENT

Same as Section 1411-4.

7.00 EQUIPMENT DISCONNECT

7.10 DESCRIPTION

The work covered in this section involves installing an electrical disconnect for intelligent transportation system (ITS) equipment at the locations shown on the plans.

7.20 MATERIALS

Provide a single pole, 120 VAC circuit breaker (sized as shown on the plans) at all locations except the DMS sign. At the DMS sign provide a double pole 240 VAC circuit breaker. All breakers shall have an interrupting capacity of at least 14,000 A and be installed 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 Section 1400-8 of the Standard Specifications.

Provide an 8' long, 6" x 6" treated wood post and treated wood panel to mount the circuit breaker enclosure and provide a PC30 junction box within two feet of the post. Treated wood post shall conform to Section 1082 of the Standard Specifications.

Provide and install conduit from the circuit breaker enclosure to the junction box. Conduit shall be rigid galvanized steel (RGS) above ground and polyvinyl chloride (PVC) conduit once underground.

Install an 8' ground rod, 5/8" in diameter in the junction box.

7.30 CONSTRUCTION METHODS

Embed treated wood post a minimum of 3' in ground. Thoroughly compact and backfill in 6" layers around post. Remove all unneeded excavated material from the site.

Mount circuit breaker enclosure to wood post. If enclosure is wider than post, first attach a treated wood panel sized a minimum 1" larger, square, to the wood post using exterior grade screws for treated wood, and then attach circuit breaker enclosure to wood panel. Install a PC30 junction box within 2' of the treated wood post. See plan sheets LE5 and LE12 for circuit breaker sizes.

The circuit breaker enclosure shall provide access for two 2" RGS conduits and one ¾" RGS conduit as shown in sheet LE12 of plans. The ¾" conduit and one of the 2" conduits shall terminate in the junction box. The remaining 2" conduit shall terminate at the proposed ITS equipment cabinet. Rigid galvanized steel conduit shall be secured to wood post using galvanized conduit standoffs and brackets and will transition to PVC conduit once underground.

Install a ground rod in the junction box. Run a #4 bare copper grounding conductor in the ¾" conduit from the ground bar in the circuit breaker enclosure to the junction box. Grounding conductor shall be attached to the ground rod in the junction box using exothermic weld.

Due to voltage drops, large conductors have been specified. Refer to plan sheet LE5 for conductor sizes. The Contractor shall use appropriately sized terminal lugs for connecting the conductors to the breaker. Snipping stands of the conductor to fit the lug or the circuit breakers is not permitted.

Power for ITS equipment will be provided from the Main Distribution Panel in the Mechanical Room. See plan sheets LE5 & LE13 and Facilities Design Power Plan for panel positions.

7.40 MEASUREMENT AND PAYMENT

The quantity of equipment disconnects to be paid for will be the actual number of equipment disconnects mounted to treated wood posts, and junction boxes which have been installed and accepted.

Such price and payment will be considered full compensation for furnishing and installing the treated wood post, circuit breaker and enclosure, conduits and junction box.

Payment will be made under:

_____ Equipment Disconnect.....Each

8.00 POWER TRANSFORMER

8.10 DESCRIPTION

The work covered in this section involves installing a small, wall mounted power transformer in the mechanical room. This transformer is used to provide appropriate power to the proposed DMS sign located near the north-east corner of the weigh station building.

8.20 MATERIALS

Provide a power transformer in a NEMA 3R encapsulated enclosure designed to be mounted on a wall indoors. The transformer shall be rated for 15 kilovolt-amps (KVA) and have a line voltage of 208 VAC and a load voltage of 120/240 VAC, single-phase.

Install RGS conduit from the main distribution panel (MDP) to the power transformer.

8.30 CONSTRUCTION METHODS

Install the power transformer on the wall near the MDP in the mechanical room of the scale building. See sheet E3 of the Facilities Design plans for location.

Install 1-½" RGS conduit from the MDP to the power transformer. Include three #2 AWG THHN conductors in the conduit. Install 2" PVC conduit from the transformer to the junction box labeled "ITS/POWER" on sheet E3 of the Facilities Design plans. The 2" PVC conduit shall include two #2 USE power conductors and one #4 grounded conductor as shown on plan sheet LE13.

See plan sheet LE13 for phase connections.

8.40 MEASUREMENT AND PAYMENT

The quantity of power transformers to be paid for will be the actual number of power transformers installed and mounted with conduits and conductors as described above which have been installed and accepted.

Such price and payment will be considered full compensation for furnishing and installing the power transformer, conduits, conductors and any ancillary items required to connect the conductors to the breakers in the MDP and/or transformer housing.

Payment will be made under:

15KVA Power Transformer.....Each

9.00 HIGH MOUNT FOUNDATIONS

9.10 DESCRIPTION

High mount foundations for high mount standards consist of drilled piers or footings with pedestals, conduit and anchor rod assemblies. Construct high mount foundations in accordance with the contract and either Standard Drawing No. 1402.01 of the *2012 Roadway Standard Drawings* or the accepted submittals. Define "high mount standard foundation" as a drilled pier including the conduit and anchor rod assembly that meets Standard Drawing No. 1402.01.

9.20 MATERIALS

Use high mount foundation materials that meet the *Foundations and Anchor Rod Assemblies for Metal Poles* provision found in the Roadway Project Special Provisions.

9.30 HIGH MOUNT STANDARD FOUNDATIONS

Construct high mount standard foundations for the wind zone and high mount heights shown in the plans unless the following assumed site conditions are not applicable to high mount locations:

A. Soil with unit weight (γ) $\geq$ 120 lb/cf and friction angle (Φ) $\geq 30^{o}$,
B. Groundwater at least 7 ft below finished grade and
C. Slope of finished grade 6:1 (H:V) or flatter.

A subsurface investigation and high mount foundation design are required if the Engineer determines these assumed site conditions do not apply to a high mount location and the high mount cannot be moved. Subsurface conditions requiring a high mount foundation design include but are not limited to weathered or hard rock, boulders, very soft or loose soil, muck or shallow groundwater. No extension of completion date or time will be allowed for subsurface investigations or high mount foundation designs.

9.40 SUBSUFACE INVESTIGATIONS

Use a prequalified geotechnical consultant to perform one standard penetration test (SPT) boring in accordance with ASTM D1586 at each high mount location requiring a subsurface investigation. Rough grade high mount locations to within 2 ft of finished grade before beginning drilling. Drill borings to 2 drilled pier diameters below anticipated pier tip elevations or refusal, whichever is higher.

Use the computer software gINT version 8.0 or later manufactured by Bentley Systems, Inc. with the current NCDOT gINT library and data template to produce SPT boring logs. Provide boring logs sealed by a geologist or engineer licensed in the state of North Carolina.

9.50 HIGH MOUNT FOUNDATION DESIGNS

Design high mount foundations for the wind zone and high mount heights shown in the plans and the slope of finished grade and subsurface conditions at each high mount location. Design drilled piers, footings and pedestals in accordance with the 6th Edition of the *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*.

Design drilled piers for side resistance only in accordance with Section 4.6 of the *AASHTO Standard Specifications for Highway Bridges*. Use the computer software LPILE version 6.0 or later manufactured by Ensoft, Inc. to analyze drilled piers. Provide drilled pier designs with a horizontal deflection of less than 0.5" at top of piers.

Design footings in accordance with Section 4.4 of the *AASHTO Standard Specifications for Highway Bridges*. Do not use an allowable bearing pressure of more than 3,000 lb/sf for footings.

Submit boring logs, working drawings and design calculations for acceptance in accordance with Article 105-2 of the *2012 Standard Specifications*. Submit working drawings showing plan views, required foundation dimensions and elevations and typical sections with reinforcement, conduit and anchor rod assembly details. Include all boring logs, design calculations and LPILE output for high mount foundation design submittals. Have high mount foundations designed, detailed and sealed by an engineer licensed in the state of North Carolina.

9.60 CONSTRUCTION METHODS

Grade a 3 ft diameter level work area around high mount locations with cut and fill slopes as shown on Standard Drawing No. 1402.01. Construct drilled piers, footings and pedestals and install anchor rod assemblies for high mount foundations in accordance with the *Foundations and Anchor Rod Assemblies for Metal Poles* provision.

9.70 MEASUREMENT AND PAYMENT

High Mount Foundations will be measured and paid in cubic yards. High mount standard foundations will be measured as the cubic yards of concrete shown on Standard Drawing No. 1402.01 for the high mount height and wind zone shown in the plans. All other high mount foundations will be measured as the cubic yards of foundation concrete for drilled piers, footings and pedestals shown on the accepted submittals. The contract unit price for *High Mount Foundations* will be full compensation for providing labor, tools, equipment and foundation materials, stabilizing or shoring excavations and supplying concrete, reinforcing steel, conduit, anchor rod assemblies and any incidentals necessary to construct high mount foundations. Subsurface investigations and high mount foundation designs required by the Engineer will be paid as extra work in accordance with Article 104-7 of the *2012 Standard Specifications*.

Payment will be made under:

High Mount Foundations.....Cubic Yard

10.00 HIGH MOUNT STANDARD

10.10 DESCRIPTION

Same as Section 1401-1, except include a PC30 junction box.

10.20 MATERIALS

Same as Section 1401-2, except add the following text:

(F) Junction Box
Include a PC30 junction box designed to meet Section 6.00 above.

10.30 CONSTRUCTION METHODS

Same as Section 1401-3, except add the following:

Install PC30 junction box within 10' of the high mast foundation. This junction box shall be the final splice point for the conductor into the high mast standard. Install a ground rod for the high mast in the junction box as show in detail drawing 1401D01 as shown on sheet LE6 of the plans.

10.40 MEASUREMENT AND PAYMENT

Same as Section 1401-4, except a PC30 junction box will be included as part of the _____*High Mount Standards* pay item.

11.00 LIGHT CONTROL SYSTEM

11.10 DESCRIPTION

The work covered by this section includes the furnishing and installing of all materials necessary to provide a wall mounted lighting control system in the mechanical room of the weigh station scale building as shown on the plans. This section also includes running conduit from the mechanical room to the junction box labeled "Site Lighting" as shown on sheet E3 of the Facilities Design Power Plan

11.20 MATERIALS

Provide a 5/8" thick Exterior Grade AD plywood back panel slightly larger than the layout of the control system components.

Provide a 6" x 6" wire trough. The wire trough shall be long enough to accommodate all components and connections. The trough shall be constructed of formed and welded steel that is painted or galvanized, with one removable side plate that is secured in place with corrosion resistant screws, and has only the holes necessary for the conduits shown in the plans. Wire trough with knockouts is not acceptable.

Provide a lighting panel consisting of a surface mount load center, with copper bus, factory installed main breaker, 22,000 Amps short circuit current rating sized as shown in the plans, a minimum of 22 single-pole branch breaker spaces and an equipment ground bar. Use three-pole branch breakers with 10,000 Amps short circuit current rating sized as shown in the plans.

Provide electrically operated, mechanically held contactors with coil clearing contacts. Ensure latching without the use of hooks or semi-permanent magnets. Use contactors rated 208 VAC, 30 amps, with 120 VAC coils and 4 poles each.

Provide a control relay rated 600 VAC, with one normally open contact, one normally closed contact, and "continuous load" rating and "inductive make and break" rating greater than that required by the mechanically held contactors. Install control relay in a NEMA 1 enclosure.

Use a control selector switch for each circuit rated standard duty, with three positions, and maintained contacts, in a surface mount NEMA 1 enclosure. Provide contacts with an inductive rating of 5 amps continuous, 3600 VA make, and 3600 VA break. Provide a legend plate that indicates "On-Off-Auto" for each selector switch.

Use a "dual voltage" photocontrol with surge protection and single pole, single throw, contact with a minimum contact rating of 1000 watts. Provide a normally closed contact that is "daylight energized," with a turn on range of approximately 3 footcandles. Mount the photocontrol in a three-prong locking type receptacle, conforming to NEMA Standard C136.10.

Use number 8 AWG type THHN stranded copper conductors on the line side of the mechanically held contactors, and number 12 AWG stranded copper conductors for the control circuit, conforming to the requirements of Article 1400-2C of the Standard Specifications titled "Wire". Size all other conductors as shown in the plans.

Use rigid galvanized steel conduit in accordance with Article 1400-2B of the Standard Specifications titled "Conduit".

11.30 CONSTRUCTION METHODS

Use the plywood panel for mounting components on all walls other than masonry. Arrange the components as shown on the equipment layout detail in the plans.

Install conductors and conduit in accordance with Articles 1400-4F of the Standard Specifications titled "Wiring Methods" and 1400-4E "Conduit Installation". Clearly identify the phase, neutral, and contact conductors for the photocontrol in the wire trough.

Install flashing around the conduit extended through the roof to the photo control.

Securely fasten each component to the wall or panel with corrosion resistant bolts and inserts. Utilize all mounting holes in each component. Install a galvanized washer between the component and masonry walls to assure a minimum of ¼" air space.

Paint the plywood panel the same color as the wall. After the control system components are installed, clean, prime, and paint all exposed surfaces of enclosures and conduit with a premium quality paint that best matches the color of the adjacent walls. Mask all legend plates, nameplates, etc. while painting.

11.40 MEASUREMENT AND PAYMENT

The quantity of light control systems to be paid for will be the actual number of light control systems that have been installed and accepted.

The quantity of light control systems, measured as provided above, will be paid for at the contract unit price each for "Light Control Equipment _____ " of the appropriate type. Such price and payment will be full compensation for all work of furnishing and installing an entire control system, including mounting panel, control circuit, photocontrol, contactors, breakers, and selector switch.

Payment will be made under:

Light Control Equipment, Type WS, 120/208V..... Each

12.00 REINFORCED CONCRETE SLABS, PITS, AND PLATFORMS

12.10 DESCRIPTION

The work covered by this section consists of the construction of reinforced concrete static scale pits, decks, approach slabs, and weigh-in-motion (WIM) slabs in accordance with these specifications and the details shown on the plans.

12.20 MATERIALS

All materials shall meet the requirements of Division 10 of the *Standard Specifications for Roads and Structures* dated January, 2012 shown below:

Portland cement concrete	Section 1000
Curing agents	Section 1026
Reinforcing steel	Section 1070
Stone, No. 78M	Section 1005

Class AA concrete shall be used for all reinforced concrete.

Fabricated metal stay in place should be in accordance with the Standard Specification, articles 420-3 and 1074-12.

12.30 CONSTRUCTION METHODS

The subgrade shall be constructed in accordance with Section 500.

Reinforcement shall be fabricated and placed in accordance with Section 425.

The provisions of Section 420 shall be applicable to all concrete work except as otherwise provided herein.

The reinforced concrete slabs and decks shall be placed, screeded and finished in accordance with the requirements of this provision and shall be cured in accordance with the requirements of Article 420-15 that are applicable to bridge floors, except that curing with membrane curing compound will be permitted.

Dowels shall be provided in accordance with Section 1070-6 of the Standard Specifications between the reinforced concrete slabs and the roadway concrete. Installation shall be in conformance with details shown in the plans and NC DOT Roadway Standard Drawing No. 700.05.

12.31 Reinforced Concrete WIM Slabs

Immediately following the screed and while the concrete WIM slab is still workable, the Contractor shall test the slab surface for irregularities with a 10 foot straightedge. The testing shall be performed by holding the straightedge in successive positions parallel to the centerline of slab and in contact with the slab surface. The surface shall be tested five (5) feet from the slab edge (centerline of scale frames) and approximately 24 inches each side of these lines for a total of six lines 250 feet length each. Advancement along the slab shall be in stages of not more than 1/2 the length of straightedge. The surface shall also be tested transversely at the ends, quarter points and just either side of center of the slab.

Areas showing depressions or high spots of more than 1/10 inch in 10 feet shall be immediately corrected by filling depressions with fresh concrete or by striking off high spots. Corrections may be made by use of hand tools or a combination of hand tools and rescreeding. The straightedge shall not be used as a finishing tool.

Tests and corrections as described above do not relieve the Contractor of the requirement to pass the flatness test as specified in ASTM E 1318.

After the concrete has been cured in accordance with Article 420-15, the finished surface shall be tested as described in ASTM E 1318 Section 6.1.5 in lieu of the rolling straightedge method specified in the Standard Specifications. All high areas in the hardened surface, as indicated by testing, shall be removed by means of an approved grinding or cutting machine. Where variations are such that the corrections will extend below the limits of the top layer of grout, the Engineer may require the corrected surface to be sealed with an approved sealing agent. If approved by the Engineer, low areas shall be corrected in an acceptable manner. The corrected areas shall have a rough, uniform texture and shall present neat patterns. In all cases, a minimum of 4 inches of concrete cover over reinforcement shall be maintained.

The reinforced WIM slab surface shall be grooved. Direction of grooves shall be perpendicular to the centerline of roadway. Grooving shall not be started until final straightedge testing and when necessary, corrective measures acceptable to the

Engineer have been completed. The slab surface within 6 inches of the slab edge and 2 inches of scale frames and slab end shall not be grooved. The areas between the scale frames shall not be grooved.

12.32 WIM Slab Working Drawings

When sufficient information on the proposed weigh-in-motion system is provided the Engineer and approval is given for a system, the Engineer will prepare revised details of the contract plans, if necessary, to accommodate installation of the frames. Revisions shall include necessary changes in dimensions, reinforcing steel and concrete blockouts of contract plans. No adjustment will be made in the contract price for any bid item due to revisions necessary to accommodate the frames, but the entire cost of same shall be absorbed in the lump sum paid for furnishing and installing the system. The Contractor shall provide in advance of the scheduled installation time for the weigh-in-motion system, all complete drawings, specifications and necessary data for the preparation of revised contract plans and no claim for delays will be permitted due to his failure to provide complete detailed drawings specifications and necessary data promptly.

12.33 Reinforced Concrete Static Scale Decks

Scale decks shall be constructed in accordance with details shown in the plans, these special provisions and approved scale manufacturers drawings.

All structural steel including the check rods, holders, and stands shall be painted in accordance with Section 442 of the Standard Specifications, except payment will be considered incidental to the overall contract bid items.

The load cell holder/stands and all exposed metal surfaces in the pit (girders, stay in place forms, etc.) shall undergo either hot dipped galvanizing or covering in a corrosion resistant epoxy paint. Galvanizing or painting of all exposed metal surface shall be done in accordance with Section 442 of the Standard Specifications.

Anchor bolts, nuts and washers shall be hot dipped galvanized

Each deck shall be supported by a weighbridge and shall be installed in a common pit with each deck separated as shown in the plans. The decks shall be 12' x 54', 12' x 14' and 12' x 12' each with an 8" reinforced steel concrete deck enclosed in steel channels for protection of the deck edges.

The 12' x 14' and 12' x 12' deck and weighbridge units shall have a 30 ton minimum gross capacity with two sections and shall be rated for 100% end loading. The 12' x 54' deck and weighbridge shall have a 75 ton gross capacity with three sections rated not less than 37.5 tons each. Each deck and weighbridge shall have a longitudinal and lateral check system at each corner to prevent horizontal motion detrimental to the weighing operation.

Manholes with ladders shall be provided in the decks for access to the pits as indicated in the plans. The steel ladders shall be bolted to supports from the deck and shall extend downward to within 18" of the floor.

Plans for the concrete static scale decks are detailed for the use of metal stay-in-place forms; however, the Contractor shall have the option of constructing a cast-in-place deck using removable forms. Either one of the forming systems shall be used for all of the same type spans within the same scale deck.

All forms shall be installed in accordance with detailed fabrication plans submitted to the Engineer for approval. The fabrication plans shall clearly indicate locations where the forms are supported by steel beam flanges subject to tensile stresses. Within these locations, no welding to the flanges will be allowed.

Form sheets shall not be permitted to rest directly on the top of the beam or girder. Sheets shall be securely fastened to form supports and shall have a minimum bearing length of 1 inch at each end. Sheets shall be centered between the form supports. Form supports shall be placed in direct contact with the flange of girder or beam. All attachments shall be made by permissible welds, bolts, clips or other approved means. However, welding of form supports to flanges of steels not considered weldable and to those portions of a flange subject to tensile stresses shall not be permitted. All welding shall be in accordance with the Standard Specification, Article 1072-18, except 1/8" fillet welds will be permitted.

In the areas where the form sheets lap, the form sheets shall be securely fastened to one another by screws at a maximum spacing of 18 inches. The ends of the form sheets shall be securely attached to the support angles with screws at a maximum spacing of 18 inches.

Any exposed form metal where the galvanized coating has been damaged shall be thoroughly cleaned, wire brushed, then painted with two (2) coats of zinc oxide zinc dust primer, Federal Specification TT-P-64ld, Type II, no color added, to the satisfaction of the Engineer. Minor heat discoloration in areas of welds need not be touched up.

All cuts shall be made by a saw. No flame cutting will be permitted.

The Contractor's method of construction shall be carefully observed by the Engineer during all phases of the construction of the scale decks. These phases include installation of the forms; location and fastening of the reinforcement; composition of concrete items; mixing procedures, concrete placement and vibrations; and finishing of the scale deck.

Until such time as the Engineer is satisfied that the Contractor's concrete mix and procedures are obtaining the desired results, the Contractor may be required to

remove one form in every scale deck. This shall be done at a time selected by the Engineer and as soon after placing the concrete as practicable. When the Engineer is satisfied that the desired results are being consistently obtained, he may at his discretion reduce the amount of form to be removed for inspection.

After the deck concrete has been in place for a minimum period of two days, the concrete shall be tested for soundness and bonding of the forms by sounding with a hammer as directed by the Engineer. A minimum of one quarter of the individual form panels, selected at random by the Engineer, shall be hammer tested over at least one half of their area. If areas of doubtful soundness are disclosed by this procedure, the Contractor will be required to remove the forms from such areas for visual inspection after the pour has attained a minimum compressive strength of 3000 psi. This removal of the stay-in-place forms shall be at no additional cost to the Department of Transportation.

At locations where sections of the forms are removed, the Contractor will not be required to replace the forms, but the adjacent metal forms and supports shall be repaired to present a neat appearance and assure their satisfactory retention. As soon as the forms are removed, the concrete surfaces will be examined for cavities, honeycombing and other defects. If irregularities are found, and in the opinion of the Engineer these irregularities do not justify rejection of the work, the concrete shall be repaired as the Engineer may direct. If the concrete where the forms are removed is unsatisfactory, additional forms, as necessary, shall be removed to inspect and repair the slab, and the Contractor's methods of construction shall be modified as required to obtain satisfactory concrete in the slabs. All unsatisfactory concrete shall be removed or repaired as directed by the Engineer.

The Contractor shall provide all facilities as are reasonably required for the safe and convenient conduct of the Engineer's inspection procedures.

12.34 Static Scale Platform Drawings

The Contractor shall provide static scale deck and weigh-bridge "Certified for Construction" shop drawings for the Engineer's approval. The drawings shall be in agreement with the details shown in the plans and should conform to applicable portions of Section 440 of the Standard Specifications except for compensation. The shop drawings shall be "Certified for Construction" by the scale manufacturer. The scale manufacturer shall be responsible for the adequate design and function of the scale decks, weigh-bridges, check rods, load cells, and anchorage. The scale decks and weigh-bridge structural steel will be considered proprietary items and shall be the scale manufacturer's responsibility for acceptable design and function.

12.35 Static Scale Pit

The pit shall be in accordance with the details shown in the plans and shall meet the requirements of AASHTO "Standard Specifications for Bridges". The pit design

may include a subbase if subsurface investigation indicates that such is warranted due to the type or condition of soil upon which the pit will be constructed.

Electrical conduit, lights, receptacles and sleeves shall be provided in the pit as detailed in other sections of these Special Provisions.

12.36 Static Scale Pit Drawings

The Contractor shall provide pit "Certified for Construction" drawings for the Engineer's approval. The drawings shall be in agreement with the details shown in the plans. The pit drawings shall be "Certified for Construction" by the scale manufacturer. The Engineer's approval of the drawings shall not relieve the Contractor of the responsibility for the adequate design and function of the scale pits.

12.37 Scale Pit Approach Slabs

The approach slabs shall be in accordance with details shown in the plans and applicable portions of Section 422 of the Standard Specifications except for compensation.

12.40 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

A. General:

The quantity of concrete to be paid for will be the number of cubic yards of concrete which has been incorporated into the completed and accepted concrete WIM slabs, static scale pits, and approach slabs except as indicated below. The number of cubic yards of concrete will be computed from dimensions shown on the plans or from revised dimensions authorized by the Engineer. The quantity of concrete, measured as provided above will be paid for at the contract unit price per cubic yard for "Class AA Concrete".

The quantity of reinforcing steel and epoxy coated reinforcing steel in the WIM slabs, static scale pits, and approach slabs to be paid for shall be in accordance with Section 425-6 of the Standard Specifications. The quantity of reinforcing steel and epoxy coated reinforcing steel determined as provided above will be paid for at the contract unit price per pound for "Reinforcing Steel" and "Epoxy Coated Reinforcing Steel" in accordance with Section 425-6 of the Standard Specifications.

B. Grooving Reinforced Slab:

The quantity of grooving reinforced slab to be paid for will be the actual number of square feet of reinforced WIM slab, pit approach slab, and static scale deck which has been grooved and accepted. In measuring this quantity, measurement will be made along the surface of the reinforced slab and will be limited to that portion of the reinforced concrete surface which has been grooved in accordance with the plans and

specifications or as directed by the Engineer. The quantity of grooving slabs and decks, measured as provided above will be paid for at the contract unit price per square foot for "Grooving Concrete Slabs".

C. Pit Approach Slabs:

The work including concrete and reinforcing steel regarding pit approach slabs except for grooving will be paid for, as indicated in (A) above, at the contract price for "Class AA Concrete", "Reinforcing Steel", and "Epoxy Coated Reinforcing Steel". Such price and payment will be full compensation for work including but not limited to constructing the subgrade; furnishing and placing concrete, reinforcing steel, joint filler and sealer, and any other materials; finishing, tineing, and curing the concrete.

D. Static Scale Platforms

The work of furnishing and installing the reinforced concrete static scale decks and weigh-bridges when completed and accepted will be paid for at the contract lump sum price " _____ Static Scale Platforms" at the appropriate location. Such price and payment will be full compensation for all labor and materials including: concrete, forming, falsework, reinforcing steel, weigh-bridge structural steel mounted on load cell stands, anchor bolts, check rods, and painting. Load cells are to be paid for under section 2.00 of these Special Provisions.

12.41 Compensation

The above prices and payments will be full compensation for all work covered by this section including but not limited to constructing the subgrades, furnishing and placing concrete, curing agents, reinforcing steel, scale decks, weigh-bridge structural steel, setting anchor bolts, grooving concrete, erecting and removing falsework and forms; protecting concrete in wind, rain, low humidity, high temperatures, or other unfavorable weather; finishing and curing concrete.

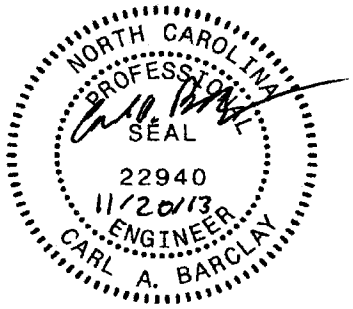
Payment will be made under:

Class AA Concrete (Weigh Bridge – Static Scale)	Cubic Yard
Reinforcing Steel (Weigh Bridge – Static Scale)	Pound
Epoxy Coated Reinforcing Steel (Weigh Bridge – Static Scale)	Pound
Grooving Concrete Slabs	Square Foot
_____ Static Scale Platforms	Lump Sum

PROJECT SPECIAL PROVISIONS
Utility Construction

NCDOT Utilities Unit
1555 MSC
Raleigh, NC 27699-1555

919-707-6690



Revise the 2012 Standard Specifications as follows:

Utility Owner's Contact Information:

Page 15-1, Sub-article 1500-2, Cooperation with the Utility Owner, paragraph 2: add the following sentences:

The utility is owned by Bessemer City and is maintained by Two Rivers Utilities. The contact person for Bessemer City is Mr. Jamie Ramsey at (704)-629-5398. The contact person for Two Rivers Utilities is Mr. Mike Bynum at (704)-866-6043.

Sanitary Sewer:

Page 15-11, Article 1520-3 (A) (2), Testing, line 5, replace the second paragraph with the following:

Test all 24" and smaller gravity sewer lines for leakage using infiltration, exfiltration or air test. Perform visual inspection on gravity sewer lines larger than 24". Perform line and grade testing and deflection testing on all gravity sewer lines.

Abandon or Remove Utilities:

Page 15-15, Article 1530-3 (A) Abandoning Pipe: add the following sentence:

The portion of the pipe located above grade, including within the culvert, shall be removed.

PROJECT SPECIAL PROVISIONS
Utilities by Others

General:

The following utility companies have facilities that will be in conflict with the construction of this project.

A) Duke Energy – Power Distribution
B) Williams Gas Pipeline Co. – Gas

The conflicting facilities of these concerns will be installed, adjusted prior to the date of availability, unless otherwise noted and are therefore listed in these special provisions for the benefit of the Contractor. All utility work listed herein will be done by the utility owner. All utilities are shown on the plans from the best available information.

The Contractor's attention is directed to Article 105-8 of the January 2012 Standard Specifications.

Utilities Requiring Adjustment:

A) Duke Energy – Power Distribution
   1) Duke Energy will abandon, adjust, relocate or remove its facilities prior to the date of availability, as shown on the Utilities by Others Plans.
   2) Contact person for Duke Energy is William Huffstetler at 704-866-5109.

B) Williams Gas Pipeline Co. – Gas
   1) Williams Gas Pipeline Co. will remove or relocate gas main location markers prior to the date of availability.
   2) Contact person for Williams Gas Pipeline Co. is Dave Dickerson at (434)-964-2122.

Project Special Provisions
Erosion Control

STABILIZATION REQUIREMENTS:

Stabilization for this project shall comply with the time frame guidelines as specified by the NCG-010000 general construction permit effective August 3, 2011 issued by the North Carolina Department of Environment and Natural Resources Division of Water Quality. Temporary or permanent ground cover stabilization shall occur within 7 calendar days from the last land-disturbing activity, with the following exceptions in which temporary or permanent ground cover shall be provided in 14 calendar days from the last land-disturbing activity:

- Slopes between 2:1 and 3:1, with a slope length of 10 ft. or less
- Slopes 3:1 or flatter, with a slope of length of 50 ft. or less
- Slopes 4:1 or flatter

The stabilization timeframe for High Quality Water (HQW) Zones shall be 7 calendar days with no exceptions for slope grades or lengths. High Quality Water Zones (HQW) Zones are defined by North Carolina Administrative Code 15A NCAC 04A.0105 (25). Temporary and permanent ground cover stabilization shall be achieved in accordance with the provisions in this contract and as directed.

SEEDING AND MULCHING: (West)

The kinds of seed and fertilizer, and the rates of application of seed, fertilizer, and limestone, shall be as stated below. During periods of overlapping dates, the kind of seed to be used shall be determined. All rates are in pounds per acre.

Shoulder and Median Areas

August 1 - June 1		**May 1 - September 1**	
20#	Kentucky Bluegrass	20#	Kentucky Bluegrass
75#	Hard Fescue	75#	Hard Fescue
25#	Rye Grain	10#	German or Browntop Millet
500#	Fertilizer	500#	Fertilizer
4000#	Limestone	4000#	Limestone

Areas Beyond the Mowing Pattern, Waste and Borrow Areas:

August 1 - June 1		**May 1 - September 1**	
100#	Tall Fescue	100#	Tall Fescue
15#	Kentucky Bluegrass	15#	Kentucky Bluegrass
30#	Hard Fescue	30#	Hard Fescue
25#	Rye Grain	10#	German or Browntop Millet
500#	Fertilizer	500#	Fertilizer
4000#	Limestone	4000#	Limestone

Approved Tall Fescue Cultivars

2nd Millennium	Duster	Magellan	Rendition
Avenger	Endeavor	Masterpiece	Scorpion
Barlexas	Escalade	Matador	Shelby
Barlexas II	Falcon II, III, IV & V	Matador GT	Signia
Barrera	Fidelity	Millennium	Silverstar
Barrington	Finesse II	Montauk	Southern Choice II
Biltmore	Firebird	Mustang 3	Stetson
Bingo	Focus	Olympic Gold	Tarheel
Bravo	Grande II	Padre	Titan Ltd
Cayenne	Greenkeeper	Paraiso	Titanium
Chapel Hill	Greystone	Picasso	Tomahawk
Chesapeake	Inferno	Piedmont	Tacer
Constitution	Justice	Pure Gold	Trooper
Chipper	Jaguar 3	Prospect	Turbo
Coronado	Kalahari	Quest	Ultimate
Coyote	Kentucky 31	Rebel Exeda	Watchdog
Davinci	Kitty Hawk	Rebel Sentry	Wolfpack
Dynasty	Kitty Hawk 2000	Regiment II	
Dominion	Lexington	Rembrandt	

Approved Kentucky Bluegrass Cultivars:

Alpine	Bariris	Envicta	Rugby
Apollo	Bedazzled	Impact	Rugby II
Arcadia	Bordeaux	Kenblue	Showcase
Arrow	Champagne	Midnight	Sonoma
Award	Chicago II	Midnight II	

Approved Hard Fescue Cultivars:

Chariot	Nordic	Rhino	Warwick
Firefly	Oxford	Scaldis II	
Heron	Reliant II	Spartan II	
Minotaur	Reliant IV	Stonehenge	

On cut and fill slopes 2:1 or steeper add 20# Sericea Lespedeza January 1 - December 31.

Fertilizer shall be 10-20-20 analysis. A different analysis of fertilizer may be used provided the 1-2-2 ratio is maintained and the rate of application adjusted to provide the same amount of plant food as a 10-20-20 analysis and as directed.

Native Grass Seeding And Mulching **(West)**

Native Grass Seeding and Mulching shall be performed on the disturbed areas of wetlands and riparian areas, and adjacent to Stream Relocation and/or trout stream construction within a 50 foot zone on both sides of the stream or depression, measured from top of stream bank or center of depression. The stream bank of the stream relocation shall be seeded by a method that does not alter the typical cross section of the stream bank. Native Grass Seeding and Mulching shall also be performed in the permanent soil reinforcement mat section of preformed scour holes, and in other areas as directed.

The kinds of seed and fertilizer, and the rates of application of seed, fertilizer, and limestone, shall be as stated below. During periods of overlapping dates, the kind of seed to be used shall be determined. All rates are in pounds per acre.

August 1 - June 1		**May 1 – September 1**	
18#	Creeping Red Fescue	18#	Creeping Red Fescue
8#	Big Bluestem	8#	Big Bluestem
6#	Indiangrass	6#	Indiangrass
4#	Switchgrass	4#	Switchgrass
35#	Rye Grain	25#	German or Browntop Millet
500#	Fertilizer	500#	Fertilizer
4000#	Limestone	4000#	Limestone

Approved Creeping Red Fescue Cultivars:

Aberdeen Boreal Epic Cindy Lou

Fertilizer shall be 10-20-20 analysis. A different analysis of fertilizer may be used provided the 1-2-2 ratio is maintained and the rate of application adjusted to provide the same amount of plant food as a 10-20-20 analysis and as directed.

Native Grass Seeding and Mulching shall be performed in accordance with Section 1660 of the *Standard Specifications* and vegetative cover sufficient to restrain erosion shall be installed immediately following grade establishment.

Measurement and Payment

Native Grass *Seeding and Mulching* will be measured and paid for in accordance with Article 1660-8 of the *Standard Specifications*.

TEMPORARY SEEDING:

Fertilizer shall be the same analysis as specified for *Seeding and Mulching* and applied at the rate of 400 pounds and seeded at the rate of 50 pounds per acre. German Millet, or Browntop Millet shall be used in summer months and rye grain during the remainder of the year. The Engineer will determine the exact dates for using each kind of seed.

FERTILIZER TOPDRESSING:

Fertilizer used for topdressing shall be 16-8-8 grade and shall be applied at the rate of 500 pounds per acre. A different analysis of fertilizer may be used provided the 2-1-1 ratio is maintained and the rate of application adjusted to provide the same amount of plant food as 16-8-8 analysis and as directed.

SUPPLEMENTAL SEEDING:

The kinds of seed and proportions shall be the same as specified for *Seeding and Mulching*, and the rate of application may vary from 25# to 75# per acre. The actual rate per acre will be determined prior to the time of topdressing and the Contractor will be notified in writing of the rate per acre, total quantity needed, and areas on which to apply the supplemental seed. Minimum tillage equipment, consisting of a sod seeder shall be used for incorporating seed into the soil as to prevent disturbance of existing vegetation. A clodbuster (ball and chain) may be used where degree of slope prevents the use of a sod seeder.

MOWING:

The minimum mowing height on this project shall be six inches.

RESPONSE FOR EROSION CONTROL:

Description

Furnish the labor, materials, tools and equipment necessary to move personnel, equipment, and supplies to the project necessary for the pursuit of any or all of the following work as shown herein, by an approved subcontractor.

Section	Erosion Control Item	Unit
1605	Temporary Silt Fence	LF
1606	Special Sediment Control Fence	LF/TON
1615	Temporary Mulching	ACR
1620	Seed - Temporary Seeding	LB
1620	Fertilizer - Temporary Seeding	TN
1631	Matting for Erosion Control	SY
SP	Coir Fiber Mat	SY
1640	Coir Fiber Baffles	LF
SP	Permanent Soil Reinforcement Mat	SY
1660	Seeding and Mulching	ACR
1661	Seed - Repair Seeding	LB

1661	Fertilizer - Repair Seeding	TON
1662	Seed - Supplemental Seeding	LB
1665	Fertilizer Topdressing	TON
SP	Safety/Highly Visible Fencing	LF
SP	Response for Erosion Control	EA

Construction Methods

Provide an approved subcontractor who performs an erosion control action as described in the NPDES Inspection Form SPPP30. Each erosion control action may include one or more of the above work items.

Measurement and Payment

Response for Erosion Control will be measured and paid for by counting the actual number of times the subcontractor moves onto the project, including borrow and waste sites, and satisfactorily completes an erosion control action described in Form 1675. The provisions of Article 104-5 of the *Standard Specifications* will not apply to this item of work.

Payment will be made under:

Pay Item	Pay Unit
Response for Erosion Control	Each

MINIMIZE REMOVAL OF VEGETATION:

The Contractor shall minimize removal of vegetation at stream banks and disturbed areas within the project limits as directed.

STOCKPILE AREAS:

The Contractor shall install and maintain erosion control devices sufficient to contain sediment around any erodible material stockpile areas as directed.

ACCESS AND HAUL ROADS:

At the end of each working day, the Contractor shall install or re-establish temporary diversions or earth berms across access/haul roads to direct runoff into sediment devices. Silt fence sections that are temporarily removed shall be reinstalled across access/haul roads at the end of each working day.

WASTE AND BORROW SOURCES:

Payment for temporary erosion control measures, except those made necessary by the Contractor's own negligence or for his own convenience, will be paid for at the appropriate contract unit price for the devices or measures utilized in borrow sources and waste areas.

No additional payment will be made for erosion control devices or permanent seeding and mulching in any commercial borrow or waste pit. All erosion and sediment control practices that may be required on a commercial borrow or waste site will be done at the Contractor's expense.

All offsite Staging Areas, Borrow and Waste sites shall be in accordance with "Borrow and Waste Site Reclamation Procedures for Contracted Projects" located at:

http://www.ncdot.gov/doh/operations/dp_chief_eng/roadside/fieldops/downloads/Files/ContractedReclamationProcedures.pdf

All forms and documents referenced in the "Borrow and Waste Site Reclamation Procedures for Contracted Projects" shall be included with the reclamation plans for offsite staging areas, and borrow and waste sites.

TEMPORARY DIVERSION:

This work consists of installation, maintenance, and cleanout of *Temporary Diversions* in accordance with Section 1630 of the *Standard Specifications*. The quantity of excavation for installation and cleanout will be measured and paid for as *Silt Excavation* in accordance with Article 1630-4 of the *Standard Specifications*.

SAFETY FENCE AND JURISDICTIONAL FLAGGING:

Description

Safety Fence shall consist of furnishing materials, installing and maintaining polyethylene or polypropylene fence along the outside riparian buffer, wetland, or water boundary, or other boundaries located within the construction corridor to mark the areas that have been approved to infringe within the buffer, wetland, endangered vegetation, culturally sensitive areas or water. The fence shall be installed prior to any land disturbing activities.

Interior boundaries for jurisdictional areas noted above shall be delineated by stakes and highly visible flagging.

Jurisdictional boundaries at staging areas, waste sites, or borrow pits, whether considered outside or interior boundaries shall be delineated by stakes and highly visible flagging.

Materials

(A) Safety Fencing

Polyethylene or polypropylene fence shall be a highly visible preconstructed safety fence approved by the Engineer. The fence material shall have an ultraviolet coating.

Either wood posts or steel posts may be used. Wood posts shall be hardwood with a wedge or pencil tip at one end, and shall be at least 5 ft. in length with a minimum nominal 2" x 2" cross section. Steel posts shall be at least 5 ft. in length, and have a minimum weight of 0.85 lb/ft of length.

(B) Boundary Flagging

Wooden stakes shall be 4 feet in length with a minimum nominal 3/4" x 1-3/4" cross section. The flagging shall be at least 1" in width. The flagging material shall be vinyl and shall be orange in color and highly visible.

Construction Methods

No additional clearing and grubbing is anticipated for the installation of this fence. The fence shall be erected to conform to the general contour of the ground.

(A) Safety Fencing

Posts shall be set at a maximum spacing of 10 ft., maintained in a vertical position and hand set or set with a post driver. If hand set, all backfill material shall be thoroughly tamped. Wood posts may be sharpened to a dull point if power driven. Posts damaged by power driving shall be removed and replaced prior to final acceptance. The tops of all wood posts shall be cut at a 30-degree angle. The wood posts may, at the option of the Contractor, be cut at this angle either before or after the posts are erected.

The fence geotextile shall be attached to the wood posts with one 2" galvanized wire staple across each cable or to the steel posts with wire or other acceptable means.

Place construction stakes to establish the location of the safety fence in accordance with Article 105-9 or Article 801-1 of the *Standard Specifications*. No direct pay will be made for the staking of the safety fence. All stakeouts for safety fence shall be considered incidental to the work being paid for as "Construction Surveying", except that where there is no pay item for construction surveying, all safety fence stakeout will be performed by state forces.

The Contractor shall be required to maintain the safety fence in a satisfactory condition for the duration of the project as determined by the Engineer.

(B) Boundary Flagging

Boundary flagging delineation of interior boundaries shall consist of wooden stakes on 25 feet maximum intervals with highly visible orange flagging attached. Stakes shall be installed a minimum of 6" into the ground. Interior boundaries may be staked on a tangent that runs parallel to buffer but must not encroach on the buffer at any location. Interior boundaries of hand clearing shall be identified with a different colored flagging to distinguish it from mechanized clearing.

Boundary flagging delineation of interior boundaries will be placed in accordance with Article 105-9 or Article 801-1 of the *Standard Specifications.* No direct pay will be made for delineation of the interior boundaries. This delineation will be considered incidental to the work being paid for as *Construction Surveying,* except that where there is no pay item or construction surveying the cost of boundary flagging delineation shall be included in the unit prices bid for the various items in the contract. Installation for delineation of all jurisdictional boundaries at staging areas, waste sites, or borrow pits shall consist of wooden stakes on 25 feet maximum intervals with highly visible orange flagging attached. Stakes shall be installed a minimum of 6" into the ground. Additional flagging may be placed on overhanging vegetation to enhance visibility but does not substitute for installation of stakes.

Installation of boundary flagging for delineation of all jurisdictional boundaries at staging areas, waste sites, or borrow pits shall be performed in accordance with Subarticle 230-4(B)(3)(d) or Subarticle 802-2(F) of the *Standard Specifications.* No direct pay will be made for this delineation, as the cost of same shall be included in the unit prices bid for the various items in the contract.

The Contractor shall be required to maintain alternative stakes and highly visible flagging in a satisfactory condition for the duration of the project as determined by the Engineer.

Measurement and Payment

Safety Fence will be measured and paid as the actual number of linear feet of polyethylene or polypropylene fence installed in place and accepted. Such payment will be full compensation including but not limited to furnishing and installing fence geotextile with necessary posts and post bracing, staples, tie wires, tools, equipment and incidentals necessary to complete this work.

Payment will be made under:

Pay Item	**Pay Unit**
Safety Fence	Linear Foot

SKIMMER BASIN WITH BAFFLES:

Description

Provide a skimmer basin to remove sediment from construction site runoff at locations shown in the erosion control plans. See the Skimmer Basin with Baffles Detail sheet provided in the erosion control plans. Work includes constructing sediment basin, installation of temporary slope drain pipe and coir fiber baffles, furnishing, installation and cleanout of skimmer, providing and placing stone pad on bottom of basin underneath skimmer device, providing and placing a geotextile spillway liner, providing coir fiber mat stabilization for the skimmer outlet, disposing of excess materials, removing temporary slope drain, coir fiber baffles, geotextile liner and skimmer device, backfilling basin area with suitable material and providing proper drainage when basin area is abandoned.

Materials

Item	Section
Stone for Erosion Control, Class B	1042
Geotextile for Soil Stabilization, Type 4	1056
Fertilizer for Temporary Seeding	1060-2
Seed for Temporary Seeding	1060-4
Seeding and Mulching	1060-4
Matting for Erosion Control	1060-8
Staples	1060-8
Coir Fiber Mat	1060-14
Temporary Slope Drain	1622-2
Coir Fiber Baffle	1640

Provide appropriately sized and approved skimmer device.

Provide Schedule 40 PVC pipe with a length of 6 ft. to attach to the skimmer and the coupling connection to serve as the arm pipe. For skimmer sizes of 2.5 in. and smaller, the arm pipe diameter shall be 1.5 inches. For skimmer sizes of 3 in. and larger, refer to manufacturer recommendation.

Provide 4" diameter Schedule 40 PVC pipe to attach to coupling connection of skimmer to serve as the barrel pipe through the earthen dam.

Anchors: Staples, stakes, or reinforcement bars shall be used as anchors.

Wooden Stakes:

Provide hardwood stakes 12"- 24" long with a 2" x 2" nominal square cross section. One end of the stake must be sharpened or beveled to facilitate driving through the coir fiber mat and down into the underlying soil. The other end of the stake needs to have a 1"- 2" long head at the top with a 1"- 2" notch following to catch and secure the coir fiber mat.

Steel Reinforcement Bars:

Provide uncoated #10 steel reinforcement bars 24" nominal length. The bars shall have a 4" diameter bend at one end with a 4" straight section at the tip to catch and secure the coir fiber mat.

Staples:

Provide staples made of 0.125" diameter new steel wire formed into a *u* shape not less than 12" in length with a throat of 1" in width.

Construction Methods

Excavate basin according to the erosion control plans with basin surface free of obstructions, debris, and pockets of low-density material. Install temporary slope drain pipe and construct the primary spillway according to the Skimmer Basin with Baffles Detail sheet in the erosion control plans. Temporary slope drain pipe at inlet of basin may be replaced by geotextile as directed. Construct the coir fiber baffles according to *Roadway Standard Drawings* No. 1640.01 and Section 1640 of the *Standard Specifications*.

Install skimmer device according to manufacturer recommendations. Install 4" Schedule 40 PVC pipe into dam on the lower side of basin 1 ft. from the bottom of the basin and according to the detail, and extend the pipe so the basin will drain. Attach a 6 ft. arm pipe to the coupling connection and skimmer according to manufacturer recommendations. Attach the rope included with the skimmer to the tee between the vent socket and the tube inlet, and the other end to a wooden stake or metal post. Clean out skimmer device when it becomes clogged with sediment and/or debris and is unable to float at the top of water in skimmer basin. Take appropriate measures to avoid ice accumulation in the skimmer device. Construct a stone pad of Class B stone directly underneath the skimmer device at bottom of basin. The pad shall be a minimum of 12" in height, and shall have a minimum cross sectional area of 4 ft. by 4 ft.

Line primary spillway with geotextile unrolled in the direction of flow and lay smoothly but loosely on soil surface without creases. Bury edges of geotextile in a trench at least 5" deep and tamp firmly. If geotextile for the primary spillway is not one continuous piece of material, make horizontal overlaps a minimum of 18" with upstream geotextile overlapping the downstream geotextile. Secure geotextile with eleven gauge wire staples shaped into a *u* shape with a length of not less than 12" and a throat not less than 1" in width. Place staples along outer edges and throughout the geotextile a maximum of 3 ft. horizontally and vertically. Geotextile shall be placed to the bottom and across the entire width of the basin according to the Skimmer Basin with Baffles detail. Place sealant inside basin around barrel pipe on top of geotextile with a minimum width of 6 in.

At the skimmer outlet, provide a smooth soil surface free from stones, clods, or debris that will prevent contact of the coir fiber matting with the soil. Unroll the matting and apply without stretching such that it will lie smoothly but loosely on the soil surface. Wooden stakes, reinforcement bars, or staples may be used as anchors in accordance with the details in the plans

and as directed. Place anchors across the matting at the ends approximately 1 ft. apart. Place anchors along the outer edges and down the center of the matting 3 ft. apart.

All bare side slope sections of the skimmer basin shall be seeded with a temporary or permanent seed mix as directed and in accordance with Articles 1620-3, 1620-4, 1620-5, 1660-4, 1660-5 and 1660-7 of the *Standard Specifications*. Straw or excelsior matting shall be installed on all bare side slope sections immediately upon the completion of seeding and in accordance with Article 1631-3 of the *Standard Specifications*.

Measurement and Payment

Silt Excavation will be measured and paid for in accordance with Article 1630-4 of the *Standard Specifications*, as calculated from the typical section throughout the length of the basin as shown on the final approved plans.

Geotextile for Soil Stabilization will be measured and paid for in accordance with Article 270-4 of the *Standard Specifications*.

Coir Fiber Baffles will be measured and paid for in accordance with Article 1640-4 of the *Standard Specifications*.

__" *Skimmer* will be measured in units of each. __" *Skimmer* will be measured and paid for as the maximum number of each size skimmer acceptably installed and in use at any one time during the life of the project. Barrel and arm pipe, cleanout, relocation and reinstallation of __" *Skimmer* is considered incidental to the measurement of the quantity of __" *Skimmer* and no separate payment will be made. No separate payment shall be made if __" *Skimmer*, barrel and/or arm pipe(s) are damaged by ice accumulation.

Coir Fiber Mat will be measured and paid for as the actual number of square yards measured along the surface of the ground over which coir fiber mat is installed and accepted.

Temporary Slope Drain will be measured and paid for in accordance with Article 1622-4 of the *Standard Specifications*.

Stone for Erosion Control, Class __ will be measured and paid for in accordance with Article 1610-4 of the *Standard Specifications*.

Seeding and Mulching will be measured and paid for in accordance with Article 1660-8 of the *Standard Specifications*.

Seed for Temporary Seeding will be measured and paid for in accordance with Article 1620-6 of the *Standard Specifications*.

Fertilizer for Temporary Seeding will be measured and paid for in accordance with Article 1620-6 of the *Standard Specifications*.

Matting for Erosion Control will be measured and paid for in accordance with Article 1631-4 of the *Standard Specifications*.

No measurement will be made for other items or for over excavation or stockpiling.

Payment will be made under:

Pay Item	Pay Unit
__" Skimmer	Each
Coir Fiber Mat	Square Yard

TIERED SKIMMER BASIN WITH BAFFLES:

Description

Provide a tiered skimmer basin to remove sediment from construction site runoff at locations shown in the erosion control plans. See the Tiered Skimmer Basin Detail sheet provided in the erosion control plans. Tiered Skimmer Basins shall be installed in areas where topography creates a large elevation difference between the inlet and outlet of a single skimmer basin. Work includes constructing sediment basins, installation of coir fiber baffles, installation of temporary slope drains, furnishing, installation and cleanout of skimmer, providing and placing stone pad on bottom of basin underneath skimmer device, providing and placing geotextile spillway liners, providing coir fiber mat stabilization for the skimmer outlet, disposing of excess materials, removing temporary slope drains, coir fiber baffles, geotextile liner and skimmer device, backfilling basin area with suitable material and providing proper drainage when basin area is abandoned.

Materials

Item	Section
Stone for Erosion Control, Class B	1042
Geotextile for Soil Stabilization, Type 4	1056
Fertilizer for Temporary Seeding	1060-2
Seed for Temporary Seeding	1060-4
Seeding and Mulching	1060-4
Matting for Erosion Control	1060-8
Staples	1060-8
Coir Fiber Mat	1060-14
Temporary Slope Drain	1622-2
Coir Fiber Baffle	1640

Provide appropriately sized and approved skimmer device.

Provide Schedule 40 PVC pipe with a length of 6 ft. to attach to the skimmer and the coupling connection to serve as the arm pipe. For skimmer sizes of 2.5 in. and smaller, the arm pipe

diameter shall be 1.5 inches. For skimmer sizes of 3 in. and larger, refer to manufacturer recommendation.

Provide 4" diameter Schedule 40 PVC pipe to attach to coupling connection of skimmer to serve as the barrel pipe through the earthen dam.

Anchors: Staples, stakes, or reinforcement bars shall be used as anchors.

Wooden Stakes:

Provide hardwood stakes 12"- 24" long with a 2" x 2" nominal square cross section. One end of the stake must be sharpened or beveled to facilitate driving through the coir fiber mat and down into the underlying soil. The other end of the stake needs to have a 1"- 2" long head at the top with a 1"- 2" notch following to catch and secure the coir fiber mat.

Steel Reinforcement Bars:

Provide uncoated #10 steel reinforcement bars 24" nominal length. The bars shall have a 4" diameter bend at one end with a 4" straight section at the tip to catch and secure the coir fiber mat.

Staples:

Provide staples made of 0.125" diameter new steel wire formed into a *u* shape not less than 12" in length with a throat of 1" in width.

Construction Methods

Excavate basins according to the erosion control plans with basin surface free of obstructions, debris, and pockets of low-density material. Install temporary slope drains and construct the primary spillways according to the Tiered Skimmer Basin Detail sheet in the erosion control plans. Construct the coir fiber baffles according to *Roadway Standard Drawings* No. 1640.01 and Section 1640 of the *Standard Specifications*. Multiple upper basins, or Modified Silt Basins Type 'B' as labeled on the detail, may be required based on site conditions and as directed.

Install skimmer device according to manufacturer recommendations. Install 4" Schedule 40 PVC pipe into dam on the lower side of basin 1 ft. from the bottom of the basin and according to the detail, and extend the pipe so the basin will drain. Attach a 6 ft. arm pipe to the coupling connection and skimmer according to manufacturer recommendations. Attach the rope included with the skimmer to the tee between the vent socket and the tube inlet, and the other end to a wooden stake or metal post. Clean out skimmer device when it becomes clogged with sediment and/or debris and is unable to float at the top of water in skimmer basin. Take appropriate measures to avoid ice accumulation in the skimmer device. Construct a stone pad of Class B stone directly underneath the skimmer device at bottom of basin. The pad shall be a minimum of 12" in height, and shall have a minimum cross sectional area of 4 ft. by 4 ft.

Install a minimum of 2 (two) temporary slope drains to dewater the upper basin to the lower basin. The slope drains shall be installed a minimum of 6 inches, or one radius width of the temporary slope drain pipe, below the base of the primary spillway section of the upper basin. The outlet of the slope drains shall be placed on the bottom elevation of the lower basin.

Line primary spillways with geotextile unrolled in the direction of flow and lay smoothly but loosely on soil surface without creases. Bury edges of geotextile in a trench at least 5" deep and tamp firmly. If geotextile for primary spillways is not one continuous piece of material, make horizontal overlaps a minimum of 18" with upstream geotextile overlapping the downstream geotextile. Secure geotextile with eleven gauge wire staples shaped into a *u* shape with a length of not less than 12" and a throat not less than 1" in width. Place staples along outer edges and throughout the geotextile a maximum of 3 ft. horizontally and vertically. Geotextile shall be placed to the bottom and across the entire width of the basin according to the Tiered Skimmer Basin with Baffles detail.

At the skimmer outlet, provide a smooth soil surface free from stones, clods, or debris that will prevent contact of the coir fiber matting with the soil. Unroll the matting and apply without stretching such that it will lie smoothly but loosely on the soil surface. Wooden stakes, reinforcement bars, or staples may be used as anchors in accordance with the details in the plans and as directed. Place anchors across the matting at the ends approximately 1 ft. apart. Place anchors along the outer edges and down the center of the matting 3 ft. apart. Place sealant inside basin around barrel pipe on top of geotextile with a minimum width of 6 in.

All bare side slope sections of the skimmer basin shall be seeded with a temporary or permanent seed mix as directed and in accordance with Articles 1620-3, 1620-4, 1620-5, 1660-4, 1660-5 and 1660-7 of the *Standard Specifications*. Straw or excelsior matting shall be installed on all bare side slope sections immediately upon the completion of seeding and in accordance with Article 1631-3 of the *Standard Specifications*.

Measurement and Payment

Silt Excavation will be measured and paid for in accordance with Article 1630-4 of the *Standard Specifications*, as calculated from the typical section throughout the length of the basin as shown on the final approved plans.

Geotextile for Soil Stabilization will be measured and paid for in accordance with Article 270-4 of the *Standard Specifications*.

Coir Fiber Baffles will be measured and paid for in accordance with Article 1640-4 of the *Standard Specifications*.

__" *Skimmer* will be measured in units of each. __" *Skimmer* will be measured and paid for as the maximum number of each size skimmer acceptably installed and in use at any one time during the life of the project. Barrel and arm pipe, cleanout, relocation and reinstallation of __" *Skimmer* is considered incidental to the measurement of the quantity of __" *Skimmer* and no

separate payment will be made. No separate payment shall be made if __" *Skimmer*, barrel and/or arm pipe(s) are damaged by ice accumulation.

Coir Fiber Mat will be measured and paid for as the actual number of square yards measured along the surface of the ground over which coir fiber mat is installed and accepted.

Temporary Slope Drain will be measured and paid for in accordance with Article 1622-4 of the *Standard Specifications*.

Stone for Erosion Control, Class __ will be measured and paid for in accordance with Article 1610-4 of the *Standard Specifications*.

Seeding and Mulching will be measured and paid for in accordance with Article 1660-8 of the *Standard Specifications*.

Seed for Temporary Seeding will be measured and paid for in accordance with Article 1620-6 of the *Standard Specifications*.

Fertilizer for Temporary Seeding will be measured and paid for in accordance with Article 1620-6 of the *Standard Specifications*.

Matting for Erosion Control will be measured and paid for in accordance with Article 1631-4 of the *Standard Specifications*.

No measurement will be made for other items or for over excavation or stockpiling.

Payment will be made under:

Pay Item	**Pay Unit**
__" Skimmer	Each
Coir Fiber Mat	Square Yard

WATTLES WITH POLYACRYLAMIDE (PAM):

Description

Wattles are tubular products consisting of excelsior fibers encased in synthetic netting. Wattles are used on slopes or channels to intercept runoff and act as a velocity break. Wattles are to be placed at locations shown on the plans or as directed. Installation shall follow the detail provided in the plans and as directed. Work includes furnishing materials, installation of wattles, matting installation, PAM application, and removing wattles.

Materials

Wattle shall meet the following specifications:

100% Curled Wood (Excelsior) Fibers	
Minimum Diameter	12 in.
Minimum Density	2.5 lb/ft^3 +/- 10%
Net Material	Synthetic
Net Openings	1 in. x 1 in.
Net Configuration	Totally Encased
Minimum Weight	20 lb. +/- 10% per 10 ft. length

Anchors: Stakes shall be used as anchors.

Wooden Stakes:

Provide hardwood stakes a minimum of 2-ft. long with a 2 in. x 2 in. nominal square cross section. One end of the stake must be sharpened or beveled to facilitate driving down into the underlying soil.

Matting shall meet the requirements of Article 1060-8 of the *Standard Specifications*, or shall meet specifications provided elsewhere in this contract.

Provide staples made of 0.125" diameter new steel wire formed into a *u* shape not less than 12" in length with a throat of 1" in width.

Polyacrylamide (PAM) shall be applied in powder form and shall be anionic or neutrally charged. Soil samples shall be obtained in areas where the wattles will be placed, and from offsite material used to construct the roadway, and analyzed for the appropriate PAM flocculant to be utilized with each wattle. The PAM product used shall be listed on the North Carolina Department of Environment and Natural Resources (NCDENR) Division of Water Quality (DWQ) web site as an approved PAM product for use in North Carolina.

Construction Methods

Wattles shall be secured to the soil by wire staples approximately every 1 linear foot and at the end of each section of wattle. A minimum of 4 stakes shall be installed on the downstream side of the wattle with a maximum spacing of 2 linear feet along the wattle, and according to the detail. Install a minimum of 2 stakes on the upstream side of the wattle according to the detail provided in the plans. Stakes shall be driven into the ground a minimum of 10 in. with no more than 2 in. projecting from the top of the wattle. Drive stakes at an angle according to the detail provided in the plans.

Only install wattle(s) to a height in ditch so flow will not wash around wattle and scour ditch slopes and according to the detail provided in the plans and as directed. Overlap adjoining sections of wattles a minimum of 6 in.

Installation of matting shall be in accordance with the detail provided in the plans, and in accordance with Article 1631-3 of the *Standard Specifications*, or in accordance with specifications provided elsewhere in this contract.

Apply PAM over the lower center portion of the wattle where the water is going to flow over at a rate of 2 ounces per wattle, and 1 ounce of PAM on matting on each side of the wattle. PAM applications shall be done during construction activities after every rainfall event that is equal to or exceeds 0.50 in.

The Contractor shall maintain the wattles until the project is accepted or until the wattles are removed, and shall remove and dispose of silt accumulations at the wattles when so directed in accordance with the requirements of Section 1630 of the *Standard Specifications*.

Measurement and Payment

Wattles will be measured and paid for by the actual number of linear feet of wattles which are installed and accepted. Such price and payment will be full compensation for all work covered by this section, including, but not limited to, furnishing all materials, labor, equipment and incidentals necessary to install the *Wattles*.

Matting will be measured and paid for in accordance with Article 1631-4 of the *Standard Specifications*, or in accordance with specifications provided elsewhere in this contract.

Polyacrylamide(PAM) will be measured and paid for by the actual weight in pounds of PAM applied to the wattles. Such price and payment will be full compensation for all work covered by this section, including, but not limited to, furnishing all materials, labor, equipment and incidentals necessary to apply the *Polyacrylamide(PAM)*.

Payment will be made under:

Pay Item	Pay Unit
Polyacrylamide(PAM)	Pound
Wattle	Linear Foot

TEMPORARY ROCK SILT CHECK TYPE A WITH EXCELSIOR MATTING AND POLYACRYLAMIDE (PAM):

Description

Temporary Rock Silt Checks Type A with Excelsior Matting and Polyacrylamide (PAM) are devices utilized in temporary and permanent ditches to reduce runoff velocity and incorporate PAM into the construction runoff to increase settling of sediment particles and reduce turbidity of runoff. Temporary Rock Silt Checks Type A with Excelsior Matting and PAM are to be placed at locations shown on the plans or as directed. Installation shall follow the detail provided in the plans and as directed. Work includes furnishing materials, installation of

Temporary Rock Silt Checks Type A, matting installation, PAM application, and removing Temporary Rock Silt Checks Type A with Excelsior Matting and PAM.

Materials

Structural stone shall be class B stone that meets the requirements of Section 1042 of the *Standard Specifications* for Stone for Erosion Control, Class B.

Sediment control stone shall be #5 or #57 stone, which meets the requirements of Section 1005 of the *Standard Specifications* for these stone sizes.

Matting shall meet the requirements of Excelsior Matting in Subarticle 1060-8(B) of the *Standard Specifications*, or shall meet specifications provided elsewhere in this contract.

Polyacrylamide (PAM) shall be applied in powder form and shall be anionic or neutrally charged. Soil samples shall be obtained in areas where the Temporary Rock Silt Checks Type A with Excelsior Matting and PAM will be placed, and from offsite material used to construct the roadway, and analyzed for the appropriate PAM flocculant to be utilized with each Temporary Rock Silt Check Type A. The PAM product used shall be listed on the North Carolina Department of Environment and Natural Resources (NCDENR) Division of Water Quality (DWQ) web site as an approved PAM product for use in North Carolina.

Construction Methods

Temporary Rock Silt Checks Type A shall be installed in accordance with Subarticle 1633-3(A) of the *Standard Specifications*, Roadway Standard Drawing No. 1633.01 and the detail provided in the plans.

Installation of matting shall be in accordance with the detail provided in the plans, and anchored by placing Class B stone on top of the matting at the upper and lower ends.

Apply PAM at a rate of 4 ounces over the center portion of the Temporary Rock Silt Checks Type A and matting where the water is going to flow over. PAM applications shall be done during construction activities and after every rainfall event that is equal to or exceeds 0.50 in.

The Contractor shall maintain the Temporary Rock Silt Checks Type A with Excelsior Matting and PAM until the project is accepted or until the Temporary Rock Silt Checks Type A with Excelsior Matting and PAM are removed, and shall remove and dispose of silt accumulations at the Temporary Rock Silt Checks Type A with Excelsior Matting and PAM when so directed in accordance with the requirements of Section 1630 of the *Standard Specifications*.

Measurement and Payment

Temporary Rock Silt Checks Type A will be measured and paid for in accordance with Article 1633-5 of the *Standard Specifications*, or in accordance with specifications provided elsewhere in this contract.

Matting will be measured and paid for in accordance with Article 1631-4 of the *Standard Specifications*, or in accordance with specifications provided elsewhere in this contract.

Polyacrylamide(PAM) will be measured and paid for by the actual weight in pounds of PAM applied to the Temporary Rock Silt Checks Type A. Such price and payment will be full compensation for all work covered by this section, including, but not limited to, furnishing all materials, labor, equipment and incidentals necessary to apply the *Polyacrylamide(PAM)*.

Payment will be made under:

Pay Item	Pay Unit
Polyacrylamide(PAM)	Pound

IMPERVIOUS DIKE:

Description

This work consists of furnishing, installing, maintaining, and removing an *Impervious Dike* for the purpose of diverting normal stream flow around the construction site. The Contractor shall construct an impervious dike in such a manner approved by the Engineer. The impervious dike shall not permit seepage of water into the construction site or contribute to siltation of the stream. The impervious dike shall be constructed of an acceptable material in the locations noted on the plans or as directed.

Materials

Acceptable materials shall include but not be limited to sheet piles, sandbags, and/or the placement of an acceptable size stone lined with polypropylene or other impervious geotextile.

Earth material shall not be used to construct an impervious dike when it is in direct contact with the stream unless vegetation can be established before contact with the stream takes place.

Measurement and Payment

Impervious Dike will be measured and paid as the actual number of linear feet of impervious dike(s) constructed, measured in place from end to end of each separate installation that has been completed and accepted. Such price and payment will be full compensation for all work including but not limited to furnishing materials, construction, maintenance, and removal of the impervious dike.

Payment will be made under:

Pay Item	Pay Unit
Impervious Dike	Linear Foot

COIR FIBER MAT:

Description

Furnish material, install and maintain coir fiber mat in locations shown on the plans or in locations as directed. Work includes providing all materials, excavating and backfilling, and placing and securing coir fiber mat with stakes, steel reinforcement bars or staples as directed.

Materials

Item	Section
Coir Fiber Mat	1060-14

Anchors: Stakes, reinforcement bars, or staples shall be used as anchors.

Wooden Stakes:

Provide hardwood stakes 12"- 24" long with a 2" x 2" nominal square cross section. One end of the stake must be sharpened or beveled to facilitate driving through the coir fiber mat and down into the underlying soil. The other end of the stake needs to have a 1"- 2" long head at the top with a 1"- 2" notch following to catch and secure the coir fiber mat.

Steel Reinforcement Bars:

Provide uncoated #10 steel reinforcement bars 24" nominal length. The bars shall have a 4" diameter bend at one end with a 4" straight section at the tip to catch and secure the coir fiber mat.

Staples:

Provide staples made of 0.125" diameter new steel wire formed into a *u* shape not less than 12" in length with a throat of 1" in width.

Construction Methods

Place the coir fiber mat immediately upon final grading. Provide a smooth soil surface free from stones, clods, or debris that will prevent the contact of the mat with the soil. Unroll the mat and apply without stretching such that it will lie smoothly but loosely on the soil surface.

For stream relocation applications, take care to preserve the required line, grade, and cross section of the area covered. Bury the top slope end of each piece of mat in a narrow trench at least 6 in. deep and tamp firmly. Where one roll of matting ends and a second roll begins, overlap the end of the upper roll over the buried end of the second roll so there is a 6 in. overlap. Construct check trenches at least 12 in. deep every 50 ft. longitudinally along the edges of the mat or as directed. Fold over and bury mat to the full depth of the trench, close and tamp firmly. Overlap mat at least 6 in. where 2 or more widths of mat are installed side by side.

Place anchors across the mat at the ends approximately 1 ft. apart. Place anchors along the outer edges and down the center of the mat 3 ft. apart.

Adjustments in the trenching or anchoring requirements to fit individual site conditions may be required.

Measurement and Payment

Coir Fiber Mat will be measured and paid for as the actual number of square yards measured along the surface of the ground over which coir fiber mat is installed and accepted.

No measurement will be made for anchor items.

Payment will be made under:

Pay Item	**Pay Unit**
Coir Fiber Mat	Square Yard

ITS PROJECT SPECIAL PROVISIONS

I-85 NB WEIGH STATION

N.C. Project No. I-4928 (WBS # 41188.3. FS1)
F.A. Project No. IMS-85-1(106)3
Gaston County

Prepared for:

North Carolina Department of Transportation
ITS and Signals Unit

Prepared by:

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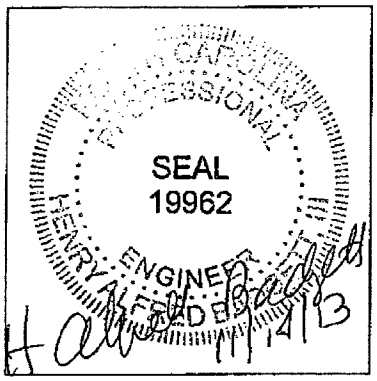
November 14, 2013



Project Special Provisions

Based On

NCDOT ITS and Signals Project Special Provisions

Version 12.2

Prepared by:

ATKINS

5200 Seventy Seven Center Drive, Suite 500
Charlotte, NC 28217 • NCBEES # F-0326

Contents

1. GENERAL REQUIREMENTS

1.1. DESCRIPTION

(A) General

Furnish, install, integrate, and test a Commercial Vehicle Information Systems and Networks (CVISN) compatible commercial vehicle weigh-in-motion system, advanced license plate reader (ALPR) system, ramp sorting system, closed circuit television (CCTV) cameras, lane control signals, DMS, and fiber-optic communications cable at locations shown in the Plans. The CVISN system must interface with the existing **NCPass** Transponder program. Integrate the components of this project into a fully operational system. When complete the weigh station will be operated by the State Highway Patrol (NCSHP).

(B) System Description

The CVISN compatible commercial vehicle weigh-in-motion system will be comprised of the following: Weigh-In-Motion (WIM) equipment, Automatic Vehicle Identification (AVI) equipment, vehicle classification equipment, over-height vehicle detection system, DMS, enforcement cameras, computers, servers, and control software. Furnish and install a fiber-optic communications network consisting of single-mode fiber optic cable. Furnish and install WIM electronics, and peripherals to integrate the new weigh station equipment. **Servers, computer workstations, and a printer called for in these Project Special Provisions will be furnished by NCSHP. If the Contractor's system requires additional servers, the Contractor shall notify Engineer so the Department can obtain the additional servers.** Provide an operational and integrated CVISN-compatible weigh station at the new I-85 northbound Weigh Station.

(C) Required System Operations

Provide a fully operational and integrated commercial vehicle processing system. All subsystems, including static scales (by others), lane control signals, ramp weigh-in-motion, classification equipment and communications networks must be compatible with each other and must be integrated into a working system. Configure the completed system in such a manner that failure of the proposed mainline WIM sensors do not interfere with the operation of the ramp WIM scales and vice versa. The CVISN must interface with the existing North Carolina **NCPass** Transponder program. Contact International Road Dynamics (IRD) at 336-261-5764 for further information.

The required operations of this system are based on processing transponder-equipped vehicles, meeting weight and credentials criteria, while the vehicles are traveling on the Interstate. Vehicles meeting the aforementioned criteria will be allowed to bypass the weigh station, thus ensuring greater efficiencies for both the commercial vehicles and the weigh station. Vehicles not meeting the criteria will be processed at the weigh station.

The CVISN equipment for the northbound I-85 Weigh Station can be described as a series of locations that process and communicate with commercial vehicles as the vehicles travel on northbound I-85. These locations include:

- Advance Location
- Notification Location
- Compliance Location

- Static Scale Location

(1) Advance Location

The Advance Location consists of two (2) automatic vehicle identification (AVI) readers and antennae, piezoelectric quartz sensors, piezo-electric axle sensors, inductive loops, and electronics, an over-height vehicle detector, ALPR with a freeze-frame CCTV camera, vehicle classification equipment, Ethernet edge switch, roadside operations controller, and other associated roadside electronics and communications equipment. The piezoelectric quartz sensors, piezo-electric axle sensors, inductive loops will be located on the entrance ramp from US 74 and the right two lanes of I-85 northbound. The vehicle classification equipment consists of inductive loops, piezo-electric axle sensors, and piezoelectric quartz sensors. Locate the Advance Location equipment as shown on the Plans.

(2) Notification Location

The Notification Location equipment consists of one (1) AVI antenna and reader, Ethernet edge switch, and associated roadside electronics and communications equipment.

(3) Compliance Location

The Compliance Location consists of an AVI reader and three antennae, inductive loops and piezoelectric quartz sensors, piezo-electric axle sensors, inductive loops, a freeze-frame CCTV camera and associated roadside electronics, roadside operations controller, and communications equipment. Locate the inductive loops, piezoelectric quartz sensors piezoelectric sensors in the two right mainline lanes and the ramp lane as shown on the Plans.

(4) CCTV Equipment

Furnish and install a video surveillance system at the US-74 interchange and within the weigh station as shown in the Plans. The video surveillance system shall consist of full-motion video, IP-based, closed-circuit television (CCTV) cameras installed at locations shown on the Plans. The video from this CCTV camera shall be transmitted to the scale house. Install a video workstation in the scale house. The cameras and workstations will all be integrated to allow control and viewing of all cameras from the scale house. The US-74 CCTV camera will be used by scale house operators to identify commercial vehicles that are attempting to bypass the weigh station via US-74.

Integrate with the central control equipment, roadside operations controllers, WIM server, workstations, communications equipment, and printing equipment to allow system operators to process commercial vehicles. The central control equipment shall allow operators to view, control and process commercial vehicles using the new equipment installed under this Contract.

(5) Ramp Sorting System

Furnish and install a ramp sorting system consisting of lane control signals WIM electronics, and roadside operations controller for electronic screening of vehicles. Install computer workstations and servers with all necessary database management software licensed appropriately for the anticipated usage.

(D) 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-85 by means of static signing located prior to the Advance Location.

2) As a truck first passes over the equipment at the Advance Location, the equipment in the right-most lane and entrance ramp from US 74 will collect axle weight and spacing, gross vehicle weight, vehicle speed, classification, vehicle length, over-height data and USDOT number. If the vehicle is equipped with an AVI transponder, the AVI transponder's unique identification number is read. All of the data is then sent to the roadside controller and server in the scale house for processing and database lookup. If the truck is in the lane immediately to the left of the WIM lane, the loops and piezoelectric sensors detect the truck and an alarm is activated in the station to alert operators that the truck was not weighed with the mainline WIM equipment, and was not read by the AVI system. System operators will define internal processes for handling these vehicles.

3) The freeze-frame CCTV camera located at the Advance Location captures images of each of truck as they travel past the location. Images of trucks that are not pre-cleared at the Notification Location are transmitted with the vehicle record (i.e. weight, vehicle length, over-height indication, AVI data, etc.) from the roadside controller for transmission to the scale house server.

4) At the Notification Location, vehicles equipped with AVI transponders are sent a message via the Notification Location's AVI system as to whether the vehicle has been pre-cleared, based on weight, credentials and other criteria, to bypass the weigh station. The pre-clearance criteria are identified in the section, "Central Control Software" of these Project Special Provisions. If a commercial vehicle is pre-cleared, a message is sent to the truck's transponder, which activates a green light on the transponder. If the weight or credentials need to be checked further, or the truck is selected for random inspection/weighing, a message is sent via the AVI system to activate a red light on the truck's transponder.

5) If the truck's transponder receives a green light, it proceeds along the Interstate passing under the Compliance Location's AVI antenna, which verifies that the truck was pre-cleared to bypass the station. The Compliance Location freeze-frame CCTV camera captures images of non-compliant trucks in the right-hand lane that were not pre-cleared. When non-compliant trucks are detected, an alarm message is sent to the workstations in the scale house. The image of the truck is transferred to the scale house workstations where operators can view the image.

6) If a truck is not pre-cleared, then it is required to report to the scale house. The WIM scale, loops, and sensors located on the station ramp detect that a truck has entered the weigh station and match the truck record to the Advance Location record. The AVI reader on the ramp will also be used for this matching. The scale house operator uses the information from the Advance Location, displayed on the workstation display, to identify why a truck was required to report to the station (i.e. no transponder, credentials check, weight check or random pull-in), and processes the truck accordingly. All AVI-equipped trucks that are not bypassed by the mainline CVISN equipment will automatically be directed to report to the scale house, where they are weighed on the static scales and inspected.

(E) Building Conduits and Conduits Entrances

Conduits within the scale house and inspection buildings and conduit entrances into the scale house and inspection buildings are being provided in the respective building plans. The building

plans include the conduit within and into the scale and inspection buildings. The pull boxes immediately outside each building is also shown in the respective plans for each group of conduits outside the building

1.2. MATERIALS

(A) General

Conform to these Project Special Provisions and the North Carolina Department of Transportation (NCDOT) *Standard Specifications for Roads and Structures*, dated January 2012, hereinafter referred to as the "*Standard Specifications*". Conform to the Codes and Regulations described in Section 1700 of the *Standard Specifications*.

Within these Project Special Provisions, the "Department" refers to the North Carolina Department of Transportation.

Conform to the requirements of the pay items included in these Project Special Provisions. All other pay items for items not described in these Project Special Provisions are included in the Standard Specifications and must be conformed to as described in those specifications unless modified herein.

Unless otherwise stated, furnish new equipment, materials, and hardware that meet the requirements of these Project Special Provisions. Permanently inscribe the 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. Ensure all materials are compatible with the existing equipment as specified in these Project Special Provisions.

(F) Coordination of Plans, Specifications, and Special Provisions

The *Standard Specifications*, the Plans, and these Project Special Provisions are essential parts of the contract, and a requirement occurring in one is as binding as though occurring in all. They are complementary and provide and describe the complete contract. In case of a discrepancy or conflict, the following will apply in ascending order:

- Calculated dimensions shall govern over scaled dimensions;
- Supplemental Specifications shall govern over *Standard Specifications*;
- Plans shall govern over Supplemental Specifications, *Standard Specifications* and *Roadway Standard Drawings*;
- Project Special Provisions shall govern over Standard Special Provisions, Plans, *Standard Specifications,* Supplemental Specifications, and *Roadway Standard Drawings*.

In the event of a contradiction within the Project Special Provisions as to the measurement and payment of any pay item, the text of the respective Measurement and Payment subsection for the pay item in question shall govern.

The Contractor shall not take advantage of any apparent error or omission in the contract. In the event such errors or omissions are discovered, the Engineer will make such corrections and interpretations as may be determined necessary for the fulfillment of the intent of the contract.

(B) 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.

2012 ITS and Signals Qualified Products List (QPL) is available on the North Carolina Department of Transportation's website at the following address:

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

Signal and communications equipment, material, and hardware shall be pre-approved on the QPL by the date of installation. Equipment, material, and hardware not pre-approved when required will not be allowed for use on the project. Consult the QPL website to obtain pre-approval procedures.

(G) Submittal Requirements

Furnish a Type 3 material certification in accordance with Article 106-3 of the *Standard Specifications*. When requested by the Department, provide additional certifications from independent testing laboratories and sufficient data to verify item meets applicable specifications. Ensure additional certification states the testing laboratory is independent of the material manufacturer and neither the laboratory nor the manufacturer has a vested interest in the other.

Identify all proprietary parts in Contractor-furnished material. The Department reserves the right to reject material that uses proprietary components not commercially available through electronic or electrical supply houses.

For Contractor-furnished material listed on the QPL, furnish submittals in the format defined by the QPL.

For Contractor-furnished material not on the QPL, furnish three copies of the equipment list including three copies of catalog cuts. Identify proposed material on catalog cuts by a reproducible means (highlighter pen does not transfer to copies). Ensure material lists contain material description, brand name, manufacturer's address and telephone number, stock number, size, identifying trademark or symbol, and other appropriate ratings.

Do not fabricate or order material until receipt of the Engineer's approval.

Refer to the "Submittal Data and Documentation" section of these Project Special Provisions for additional submittal requirements.

(H) Observation Period

Prior to final acceptance, all Contractor-furnished equipment and software shall successfully complete a 60-day Observation Period.

The 60-day Observation Period is considered to be part of the work included in the total contract time and must be completed prior to final acceptance of the project.

Final acceptance will occur following the successful completion of the 60-day Observation Period and after all documentation requirements have been fully satisfied.

Refer to the "Testing and Acceptance" section of these Project Special Provisions for additional requirements.

(I) Warranties

Unless otherwise required herein, provide manufacturer's warranties on Contractor-furnished equipment for material and workmanship that are customarily issued by the equipment manufacturer or that are at least one year in length, whichever is greater, from the date of final

acceptance of the project by the Department. 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.

Ensure all Contractor-furnished equipment, including pieces and components of equipment, hardware, firmware, software, middleware, internal components, and subroutines which perform any date or time data 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.

Upon receipt of the Department's written final acceptance of project, transfer manufacturer's warranties with proper validation by the manufacturer to the Department and the City. Provide warranties in the names of both the North Carolina Department of Transportation.

(J) Firmware Licensing, Source Code Escrow Requirements and Upgrades

Provide the Department with backups of the WIM and 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 the Department with an unlimited license to duplicate all central programs and remote site programs to facilitate the addition of future sites throughout North Carolina. 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 system support software, utility software, roadside operations controllers, and CCTV systems, and all other programmable devices provided by the Contractor.

(K) Wire and Cable

Furnish wire and cable on reels. When requested by the Department, furnish samples of wire and cable to the Department at no additional cost.

(L) Performance of Warranty Repair and Maintenance

Provide authorization to the Traffic Electronics Center of NCDOT to perform all warranty repairs after project acceptance. The decision to perform warranty work at the Traffic Electronics

Center by NCDOT electronics technicians or to have warranty work performed by the vendor shall be at the discretion of the Department. Provide any training required by the manufacturer to authorize the Traffic Electronics Center to perform warranty work and ensure manufacturer will furnish parts to the Traffic Electronics Center for all warranty repairs at no cost to the Department. In addition, ensure the manufacturer agrees to provide prompt technical support to the NCDOT electronics technicians for a period of one year after the end of the warranty period at no cost to the Department. Defective parts replaced under warranty by the Traffic Electronics Center will be returned to the vendor at the vendor's request. Provide schematics, part lists, and other documentation to perform bench repair to the Traffic Electronics Center within 2 weeks upon request. The Department agrees not to divulge any proprietary information in the schematics, part lists and other documentation upon request from the vendor. After project acceptance and at the request of the Department, the manufacturer shall perform warranty repairs to equipment, which fails during the warranty period at no cost to the Department including freight costs to ship repaired equipment back to the Traffic Electronics Center. Ensure all equipment is repaired and returned to the Traffic Electronics Center within 21 calendar days of receipt by the manufacturer.

1.3. 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.

(M) 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 must neither 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.

Notify the Engineer, local traffic enforcement agency, and local utility companies seven business days before operational shutdowns to coordinate connection or disconnection to an existing utility or system, unless otherwise instructed herein.

Install meter bases and service disconnects as required by the NESC, NEC, local utility companies, and local ordinances. Install standoffs only when required and approved by the local utility companies. Where a standoff must be used, obtain the local utility company's approval prior to installing the standoff.

(N) Utility Services

Coordinate all work to ensure electrical power of proper voltage, phase, frequency, and ampacity is available to complete the work for the ITS devices beyond the immediate weigh station site as shown in the Plans. Use electrical service cables with THWN insulation.

When electrical, telephone, and telecommunication service is not furnished by the Department and is required, contact the utility company and make application to ensure all work can be completed. Obtain authorization for service in the Department's name.

The Department will be responsible for direct payment of monthly utility company usage charges. The Contractor will be responsible for all expenses associated with utility installation costs, hookups, etc.

Coordinate all work involving electrical service 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.

(O) 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.

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.

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

(P) 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 or inside condulets in a riser using gel-filled splice connectors. 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 or condulets.

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.

(Q) Electrical Services and Grounding

Provide a grounding electrode system at all new electrical services. In addition to NEC requirements, test grounding electrode resistance for a maximum of 20 ohms. Furnish and install additional ground rods to grounding electrode system as necessary to meet test requirements.

Follow test equipment's procedures for measuring grounding electrode resistance. When using clamp-type ground resistance meters, readings of less than 1 ohm typically indicate a ground loop. Rework bonding and grounding circuits as necessary to remove ground loop circuits and retest. If a ground loop cannot be identified and removed to allow the proper use of a clamp-type ground resistance meter, use the three-point test method.

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.

(R) 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.

1.4. 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. UNDERGROUND CONDUIT

2.1. DESCRIPTION

Furnish and install conduit for underground installation with tracer wire, miscellaneous fittings, all necessary hardware, marker tape, backfill, graded stone, paving materials, and seeding and mulching.

2.2. MATERIALS

(A) General

Except for HDPE conduit, furnish material, equipment, and hardware under this section that is pre-approved on the ITS and Signals QPL.

Refer to the following articles of the *Standard Specifications*:

Backfill 1018-2

Graded Stone 545-2 and 545-3

(B) Conduit Bodies, Boxes and Fittings

Use conduit bodies, boxes, and fittings that meet UL Standard 514A or 514B for electrical and communications installations.

(C) Conduit Types

(1) Rigid Metallic Conduit

Provide rigid hot dipped galvanized steel conduit that meets UL Standard 6 with rigid full weight sherardized or galvanized threaded fittings.

(2) PVC Conduit

Provide non-metallic conduit and duct including associated couplings, approved for below ground use with or without concrete encasement in accordance with UL Standard 651A. Provide Schedule 40 conduit unless otherwise specified.

(3) Solid Wall HDPE Conduit

Use HDPE conduit that conforms to UL Standard 651B. Provide conduit meeting the requirements of the table below with minimum wall thickness ratios corresponding to EPEC-40 (Schedule 40), EPEC-80 (Schedule 80) or EPEC-B (SDR 13.5) as listed in UL Standard 651B, Table 5.1, 5.2 and 5.3.

Provide HDPE conduit with an outer diameter to minimum wall thickness ratio that complies with ASTM D 3035, Standard Dimension Ratio (SDR) 13.5.

HDPE CONDUIT SIZE	
Conduit Trade Size	**Furnish**
1"	EPEC-40
1-1/4"	EPEC-40
1-1/2"	EPEC-B (SDR 13.5)
2"	EPEC-B (SDR 13.5)
2-1/2"	EPEC-B (SDR 13.5)
3"	EPEC-B (SDR 13.5)
4"	EPEC-B (SDR 13.5)
5"	EPEC-80
6"	EPEC-80

Ensure the PE resin compounds used in manufacturing the conduit meet or exceed the cell classification PE 334420C (black with 2% minimum carbon black) or PE 334420E (colored conduit with UV inhibitors) in ASTM D3350 and the table below.

RESIN PROPERTIES		
Property	**Requirement**	**Test Method**
Density	0.940 - 0.947g/cm3	ASTM D1505 ASTM D792 ASTM D4883
Melt Index (condition 190/2.16 is acceptable)	< 0.4 grams/10 minutes	ASTM D1238
Flexural Modulus	80,000 psi, min.	ASTM D790
Tensile Strength	Tensile Strength 3,000 psi, min.	ASTM D638
Elongation	Elongation 400%, min.	ASTM D638
Slow Crack Growth Resistance	An ESCR as per condition B, 10% IGEPAL requirement of F50>24 hrs is allowable	ASTM D1693
Hydrostatic Design Basis	"0" for Non-Pressure Rated Pipe	ASTM D2837
UV Resistance (Outdoor Conduit Only)	Stabilize with at least 2% by weight carbon black or colored with UV Inhibitor	ASTM D4218

Furnish conduits in the colors for the applications shown in the table below. For conduits manufactured with stripes, ensure the stripes are uniformly located around the conduit with 120 degrees of separation. Do not use "Solid Yellow" or "Black with Yellow Stripes" conduit.

CONDUIT COLORS		
Conduit Contents	**Preferred Solid Color**	**Alternate**
Signal Cable	Black	None
Loop Lead-in Cable	White	Black with White Stripes
Communications Cable (Copper, Fiber Optic, Coaxial)	Orange	Black with Orange Stripes
Electrical Power Cable	Red	Black with Red Stripes

Ensure the HDPE conduit is resistant to benzene, calcium 1 chloride, ethyl alcohol, fuel oil, gasoline, lubricating oil, potassium chloride, sodium chloride, sodium nitrate and transformer oil and is protected against degradation due to oxidation and general corrosion.

Furnish factory lubricated, low friction, conduit with a coefficient of friction of 0.10 or less in accordance with Telcordia GR-356. Ensure the supplied conduit is identified and certified as meeting, UL Standard 651B. Ensure the conduit is marked at least with the following information on 10 ft or less intervals:

1) Material: HDPE
2) Trade Size: i.e., 2"
3) Conduit Type: SDR 13.5 or EPEC-B
4) Manufacturer's name or trademark
5) Manufacturer's identity code to identify manufacturing date, facility, etc.
6) UL symbol or UL listing number

Furnish coilable conduit that is supplied on reels in continuous lengths for transportation and storage outside. Ensure that the process of installing the coilable conduit on the reel does not alter the properties or performance of the conduit for its intended purpose.

(D) Conduit Plugs, Pull Line, and Tracer Wire

Furnish conduit plugs that provide a watertight barrier when installed in conduit. Furnish conduit plugs sized in accordance with conduit. Ensure conduit plug provides a means to secure a pull line to the end of the plug. Provide removable and reusable duct plugs. Conduit plugs are not required to be listed electrical devices.

For all spare conduits, furnish 3/4", pre-lubricated, woven polyester tape, pull line with minimum rated tensile strength of 2,500 lb. Pull lines are not required to be listed electrical devices.

Provide green insulated number 14 AWG, THWN, stranded copper wire to serve as tracer wire.

Furnish non-detectable underground marker tape with the wording "WARNING – Fiber-Optic Cable" in all trenches containing one or more conduits that will house fiber-optic communications cable.

(E) Mechanical Couplings for HDPE Conduit

Provide mechanical couplings that are both watertight and airtight for joining two segments of HDPE conduit of like diameter. Provide couplings designed to accommodate pneumatic methods of cable installation. Provide couplings suitable for burial underground and which meet the following requirements:

- The coupling shall not fail by leakage when subjected to sustained internal pressure testing as noted in ASTM F 2176.
- The coupling shall not fail by leakage when subjected to sustained external pressure testing as noted in ASTM F 2176.
- The coupling assemblies tested shall be able to comply with the tensile loading requirements as specified in ASTM F 2176.
- As specified in ASTM F 2176, the coupling shall not fail when conditioned at low temperature conditions of 10° F and tested by an impact with a force of 20 ft-lb using Type "B" as described in Test Method ASTM D 2444.

(F) Duct and Conduit Sealer

Use duct and conduit sealer or mastic which is a putty-like compound and:

- Is permanently non-hardening, non-oxidizing, and non-corrosive to metals, rubber, plastic, lacquer and paints;
- Is readily workable for thumbing into openings and forming into seals around wires inside conduits and openings around conduits;
- Has a service temperature range of minus 30°F to 200°F;
- Is clean, non-poisonous and non-injurious to human skin;
- Seals against water, dust and air and shall adhere to wood, glass, plastics, metal, rubber and painted surfaces; and
- Is non-conductive.

2.3. CONSTRUCTION METHODS

(A) General

Except where the Plans call for a specific installation method or where the Engineer directs otherwise, underground conduit may be installed by either trenching, directional drilling or plowing at the option of the Contractor but will be measured and paid for as "underground conduit," regardless of installation method (see "Measurement and Payment" subsection).

Ensure conduit is free of moisture and debris before pulling cables.

Where cable is not immediately installed or conduit is for future use (spare), seal the ends of the conduit with a conduit plug immediately following installation of the conduit. Secure a pull line to the conduit plug in such a manner that it will not interfere with installation of the conduit plug and provides a watertight seal.

Extend ends of conduit 2" to 4" above concrete surfaces and 4" above crushed stone bases. For metallic conduit, install metallic bushings and bond conduits.

All conduits installed in a common trench or bore must be the same size and all conduits in a continuous longitudinal run must be the same size. Do not intermix different size conduits in the same run.

Install junction boxes in underground conduit runs as shown on the Plans. Do not exceed 150 feet between junction boxes in any underground conduit route that conveys electrical service or equipment signal or lead-in cable and 1,500 feet between junction boxes in any underground conduit route that conveys communications cable without the prior approval the Engineer.

(1) Conduit Entering Junction Boxes

Terminate conduits installed for communications cables (fiber-optic, Ethernet and coaxial) in oversized or special-sized junction boxes as shown on the Plans. Do not install other conduits in these junction boxes unless otherwise specified.

Terminate conduits installed for loop lead-in cable in standard size junction boxes unless otherwise specified.

For all conduits entering junction boxes, seal spare conduits with approved conduit plugs. Seal all conduits containing cable with duct and conduit sealer.

(2) Tracer Wire

Install tracer wire in all conduits containing fiber-optic cable, unless otherwise indicated on the Plans or the Engineer directs otherwise. Pull tracer wire simultaneously in continuous length with the fiber-optic cable. Where multiple pulls of fiber-optic cable are required and conduit is placed in the same trench, only one tracer wire is required. Where multiple pulls of fiber-optic cable are required and conduits may separate into individual trenches, install a tracer wire in each conduit run. Splice tracer wire only in cabinets and junction boxes using waterproof butt splice connectors. Coil and store 10 feet of spare tracer wire in junction boxes. Label all tracer wires entering an equipment cabinet. For a given tracer wire run between two cabinets, bond the tracer wire to the equipment ground inside the cabinet at one end of run only; do not bond both ends of the tracer wire in a continuous run to cabinet grounds at each end of the run. Establish a consistent convention for which end the tracer wire will be bonded. For example, bond the end of the tracer wire on the north side of the wire run.

(3) Ground Surface Restoration

Upon completion of conduit installation and backfilling of all trenches and other excavations, restore the disturbed ground to its original condition as determined and approved by the Engineer. For paved areas, replace removed or damaged pavement with in kind materials, matching the elevation, color, texture/finish, and general appearance of the surrounding pavement. For unpaved areas, backfill excavations with removed material, tamp the backfilled material and rake smooth the top 1½ inches. Finish unpaved areas flush with surrounding natural ground and to match the original contour of the ground. Seed with same type of grass as surrounding area and mulch the newly seeded area. If unpaved area was not grassed, replace the original ground cover in kind as directed by the Engineer.

(4) Plan of Record Drawings

Upon completion of the conduit system for communications, furnish the Engineer with a plan of record drawing detailing both the horizontal and vertical (i.e. depth) locations of the conduit system.

(G) Trenching

(1) General

Install PVC, HDPE, or rigid metallic conduit for all underground runs as specified in the Plans. Bond all metallic conduits.

If more than one conduit is required between the same points, install conduit in one common trench.

Install non-detectable marker tape longitudinally in the trench 6 to 12 inches below the unpaved ground surface or below the underside of the paved surface.

Install longitudinal runs of conduit a minimum of 1 foot from back of curb or 6 feet from edge of pavement in the absence of curb. If ditches are present, install conduit a minimum of 4 feet from the bottom of the ditch line.

Maintain a minimum trench depth of 30" (or 12" in areas blocked by rock or impenetrable obstructions) below finished grade or 6" below roadway sub-base, whichever is deeper. Upon completion, restore surface to like-original condition within five consecutive calendar days of occurrence of damage. Remove all rock and debris from backfill material. Remove excess material from site and compact area according to Article 300-7 of the *Standard Specifications*. Backfill with excavated material and compact to 95% of original density.

Backfill trench at locations along the trench path where non-movable objects, such as rocks and boulders, cannot be avoided. The purpose of the backfill is to provide a gradual change in elevation of the trench, so that excessive bending and stress will not be transferred to conduits once underground conduit system is installed.

After installation of conduits and upon completion of tamping and backfilling, perform a mandrel test on each conduit to ensure no conduit has been damaged. Furnish a non-metallic mandrel having a diameter of approximately 50% of the inside diameter of the conduit in which it is to be pulled through. If damage has occurred, replace the entire length of conduit. Ensure pull line is re-installed.

Use HDPE conduit in trenched areas unless otherwise specified in the Plans. Use 2-inch PVC or rigid galvanized conduit between junction boxes adjacent to the cabinet and the 2-inch conduit stub-outs from the cabinet foundation.

Comply with the *NCDOT Policies and Procedures for Accommodating Utilities on Highway Rights-of-Way* in effect on the date of advertisement.

(5) Unpaved Trenching

Install conduit in unpaved areas. Rake smooth the top 1-1/2 inches and seed with same type of grass as surrounding area. Finish unpaved areas flush with the surrounding natural ground. Restore damaged grassed areas. Seed and mulch, using methods and material approved by the Engineer, within five consecutive calendar days following initial damage to grassed areas, unless the Engineer approves otherwise due to weather and soil conditions. Adapt operations to

variations in weather and soil conditions as necessary for the successful establishment and growth of the grasses. When the Engineer determines that weather and soil conditions are unfavorable, including but not limited to extremely wet or frozen soil, do not distribute any limestone or fertilizer and do not sow any seed. During seasons of the year when temperatures are not conducive to germination and growth of the type of grass seed to be planted, seed and mulch the disturbed areas with temporary seeding that will germinate and grow under the prevailing temperatures until such time that permanent seeding can be established, as approved and directed by the Engineer.

As directed by the Engineer, apply additional seed or completely reseed areas which have been previously seeded and mulched but which have been damaged, have failed to successfully establish a stand of vegetation or have an unsatisfactory cover of vegetation. Perform supplemental and repair seeding promptly at all locations and times as directed by the Engineer.

On concrete surfaces, replace the entire joint of concrete and match the original concrete as to color and finish unless otherwise specified. On all other surfaces, neatly cut and replace the width of trench with like material.

Finish paved areas with materials matching damaged areas. For conduit installed under roadways, cut neatly and replace the width of paved area damaged by trenching. For conduit installed under sidewalks and walkways, remove entire section of slab from joint to joint and replace. Place graded stone material to maintain traffic temporarily where repairs cannot be performed immediately. Comply with Article 545-4 of the *Standard Specifications*.

(H) Plowing (HDPE Conduit Only)

Direct plow HDPE ducts simultaneously using chute plow method. Direct plow ducts at a minimum depth so the top of the highest duct is 30 inches deep unless otherwise approved.

Provide sufficient personnel to feed chute, operate prime mover and equipment carrying reels (if separate equipment is used), observe chute feeding, observe plowing, and observe reel payout. Use chute with adequate dimensions to allow for passage of duct without damage. During plow operation, continuously check chute opening and path to be sure there are no obstructions and monitor payout reels to be sure reels are turning at a steady rate.

(I) Directional Drilling

(1) Pre-Approvals and Minimum Depth Requirements

Obtain approval before beginning drilling operations.

At all points where HDPE conduit will traverse under roadways, driveways, sidewalks, or Controlled Access Areas including entrance/exit ramps, maintain a minimum depth of 4 feet or 8 times the back reamer's diameter, whichever is deeper. For an installation that runs parallel to a controlled access area or entrance/exit ramps maintain a minimum depth of 30 inches below finished grade. Maintain a minimum clearance of 30 inches below finished grade when crossing ditch lines.

For the following structures, the minimum clearance requirements are:

MINIMUM CLEARANCE REQUIREMENTS FOR STRUCTURES	
Man-made Structure	**Minimum Clearance Requirement**
Bridge foundation	5' horizontal & 4' vertical (clearances greater than minimum horizontal should continue to use the 4V:5H ratio, i.e., 10' horizontal should be no deeper than 8')
Drainage pipes 60" or less	1' above or below [while maintaining a minimum depth of 30" below grade]
Drainage pipes greater than 60"	1' above or 4' below [while maintaining a minimum depth of 30" below grade]
Box Culverts	1' above or 4' below [while maintaining a minimum depth of 30" below grade]
Slope protection	2' below
Slope protection foundation footing	5' below

Guarantee the drill rig operator and digital walkover locating system operator are factory-trained to operate the make and model of equipment provided and have a minimum of one-year experience operating the make and model of drill rig. Submit documentation of the operators' training and experience for review at least two weeks before start of directional drilling operations.

Provide a means of collecting and containing drilling fluid/slurry that returns to the surface such as a slurry pit. Provide measures to prevent drilling fluids from entering drainage ditches and storm sewer systems. Prevent drilling fluid/slurry from accumulating on or flowing onto pedestrian walkways, driveways, and streets. Disposal on public or railroad right-of-way or railroad drainage ditches/facilities is prohibited. Immediately remove all drilling fluids/slurry that are accidentally spilled.

Directional Drill Operations

Provide grounding for the drill rig in accordance with the manufacturer's recommendations. Place excavated material near the top of the working pit and dispose of properly. Backfill pits and trenches to facilitate drilling operations immediately after drilling is completed.

No geotechnical investigations have been performed at the sites of proposed directional drill operations for this project. Prior to performing the directional drilling operation, field investigate the site of the proposed directional drill conduit, including but not limited to walking the bore path and talking to adjacent property owners, to ascertain the soil conditions that may be encountered and to review the site's topography. Ensure that the equipment, tooling, personnel expertise, and techniques used at each site are sufficient to complete the directional drill operation successfully, regardless of soil conditions encountered. At all times, have alternate drill heads available in case the soil conditions do not match expected conditions.

Use drill head suitable for type of material being drilled and sized no more than 2 inches larger than the outer diameter of the conduit. Direct drill to obtain proper depth and desired destination. Pressure grout with an approved bentonite/polymer slurry mixture to fill all voids. Do not jet alone or wet bore with water.

During drilling operation, locate drill head every 10 feet along drill path and before traversing underground utilities or structures. Within railroad right-of-ways, mark the location and depth 10 foot intervals and when traversing underground utilities and structures. Use digital walkover locating system to track drill head during directional drilling operation. Ensure locating system is capable of determining pitch, roll, heading, depth, and horizontal position of the drill head at any point.

Once drill head has reached final location, remove head, and install back reamer of appropriate size (no more than 2 inches larger than outer diameter of conduits) to simultaneously facilitate back reaming of drill hole and installation of conduit. Use back reamer that is sized larger than actual conduits to ensure conduits are not adversely subjected to deviations caused by the original drill operation and are as straight as practical in their final position.

The intent of these Project Special Provisions is to limit the diameter of the actual drill shaft/hole so that it is no more than 2 inches larger than the conduit outer diameter. This enlarged diameter may be accomplished either during the original bore or during the back reaming/conduit installation process.

Once installation of conduit has started, continue installation without interruption to prevent conduit from becoming firmly set. Apply bentonite/polymer slurry mixture during conduit installation.

Upon completion of conduit installation, perform a mandrel test on conduit system to ensure conduit has not been damaged. Furnish non-metallic mandrel with a diameter of approximately 50% of the inside diameter of the conduit in which it is to be pulled through. If damage has occurred, replace the entire length of conduit and ensure that pull line is re-installed.

Drilling Fluids

Use lubrication for subsequent removal of material and immediate installation of the conduit. The use of water and other fluids in connection with directional drilling operations will be permitted only to the extent necessary to lubricate cuttings. Do not jet alone or wet bore with water. Use drilling fluid/slurry consisting of at least 10% high-grade bentonite/polymer slurry to consolidate excavated material and seal drill hole walls.

Transport waste drilling fluid/slurry from site and dispose of in a method that complies with local, state and federal laws and regulations. Disposal on public right-of-ways or within public drainage ditches/facilities is prohibited.

(J) Maximum Length of Directional Drill

The length of a directional drill shall not exceed 1,500 feet measured horizontally along the route of the directionally drilled conduit(s), unless otherwise approved by the Engineer. For routes longer than 1,500 feet, begin a successive directional drill where the first directional drill reaches 1,500 feet and install an oversized heavy-duty junction box where the two directional drilled conduit runs meet. The spacing of junction boxes in a directionally drilled route shall not exceed 1,500 feet.

(K) Splicing and Coupling of HDPE Conduit

Install a continuous HDPE conduit free from splices or couplings between junction boxes whenever possible. However, splicing or coupling of HDPE conduit may be permitted, subject to

the prior approval of the Engineer, to complete an underground HDPE conduit run when the end of an HDPE reel is reached. Splicing in the middle of a directional drill operation is prohibited.

Join the HDPE conduit ends by installing mechanical couplings in accordance with the manufacturer's instructions or by splicing the conduits using either a butt-fusion welder or an electro-fusion welder. Submit the proposed method of coupling or splicing the conduits to the Engineer for review and approval prior to joining any HDPE conduits.

Otherwise, install an oversized junction box where the ends of the HDPE conduits meet in lieu of joining the ends through splicing and coupling. Install an oversized junction box where the number of conduits in the underground run changes and where a directionally drilled conduit meets a trenched conduit. For example, install an oversized junction box where two directionally drilled conduits meet a single run of trenched conduit.

2.4. MEASUREMENT AND PAYMENT

Tracer wire will be measured along the horizontal linear feet of tracer wire furnished, installed, and accepted. Measurement will be along the approximate centerline of the conduit system. Payment will be made in linear feet. No payment will be made for excess tracer wire in junction boxes and/or cabinets.

Underground conduit (qty)(size) will be measured in horizontal linear feet of underground conduit installation of each type furnished, installed, and accepted, without regard to the installation method. Measurement will be along the approximate centerline of the conduit system. Payment will be in linear feet.

No measurement will be made of 1" underground conduit that conveys electrical service wire between a service riser and a disconnect/meter and between a disconnect and an equipment cabinet as such work will be considered incidental to furnishing and installing a new electrical service, furnishing and installing and equipment cabinet disconnect or modifying an existing electrical service. (See "Electrical Service" section of these Project Special Provisions).

Directional drill (qty)(size) will be measured horizontal linear feet of directional drill for underground conduit installation furnished, installed, and accepted. Measurement will be along the approximate centerline of the conduit system. Payment will be made in linear feet. When directional drilling is used where the Plans call for "Underground Conduit", directional drilling will be measured and paid for as Underground Conduit. There will be no additional compensation for field-investigating site conditions nor for providing any specialized equipment, tooling, personnel, or techniques necessary to complete the installation of the underground conduit through directional drilling for the soil conditions encountered, including, but not limited to rock.

No measurement will be made of vertical segments, non-metallic conduit, metallic conduit, conduit sealing material, pull lines, duct plugs, marker tape, and miscellaneous fittings, as these will be considered incidental to conduit installation.

No measurement will be made of restoration of paved roadways/driveways and unpaved ground surfaces with like materials, including but not limited to backfill, graded stone, paved materials, seeding and mulching, as this work will be considered incidental to conduit installation. The Department will make no payment for a given underground conduit run until all repairs to paved and unpaved surfaces damaged/disturbed during the installation of the underground conduit have been completed and accepted.

No measurement will be made of horizontal segments between the base of a riser and an adjacent junction box or base-mounted cabinet foundation that are 10 feet or less in length measured from the center of the riser to the center of the junction box or from the center of the riser to the center of the vertical sweep through the cabinet foundation as these will be considered incidental to riser installation.

No measurement will be made of conduit segments between adjacent junction boxes that are 10 feet or less in length measured from center of junction box to center of junction box as these will be considered incidental to furnishing and installing the junction boxes.

Conduit will be paid for per linear foot based on quantity and size of conduits. As examples, an installation of a single 2" HDPE conduit would be paid as:

Directional Drill (1)(2") Linear Foot

No measurement or payment will be made for furnishing and installing and subsequently removing graded stone material for temporary maintenance of traffic where a portion of existing pavement has been removed as such work will be considered incidental to furnishing and installing underground conduit.

Payment will be made under:

Pay Item	**Pay Unit**
Tracer Wire	Linear Foot
Underground Conduit (1)(2")	Linear Foot
Underground Conduit (2)(2")	Linear Foot
Underground Conduit (3)(2")	Linear Foot
Underground Conduit (4)(2")	Linear Foot
Directional Drill (1)(2")	Linear Foot
Directional Drill (2)(2")	Linear Foot
Directional Drill (4)(2")	Linear Foot

3. JUNCTION BOXES

3.1. DESCRIPTION

Furnish and install junction boxes (pull boxes) with covers, washed stone, grounding systems, and all necessary hardware.

3.2. MATERIALS

(A) General

Provide electrical junction boxes with covers of the type and size indicated by the contract or the Plans for the termination of conduits, for splicing loop wires to loop lead-in cables and for splicing and storing fiber-optic communications cable.

Except for special-sized junction boxes, material, equipment, and hardware furnished under this section shall be pre-approved on the ITS and Signals QPL.

Provide #67 washed stone aggregates in conformance with Sections 545 and 1005 of the *Standard Specifications.*

(B) Polymer Concrete (PC) Junction Boxes

Provide polymer concrete (PC) boxes which are stackable, have bolted covers and have open bottoms. Ensure vertical extensions of 6" to 12" are available from the junction box manufacturer.

Use polymer concrete material made of an aggregate consisting of sand and gravel bound together with a polymer and reinforced with glass strands to fabricate box and cover components which are exposed to sunlight. Other thermosetting glass-reinforced materials may be used for components, which are not normally exposed to sunlight.

Provide certification that the polymer concrete boxes and covers meet Tier 15 requirements of ANSI/SCTE 77. Provide certification that testing methods are compliant with ANSI/SCTE 77.

Provide junction box covers with the required logos on the cover as follows:

- For standard size junction boxes, provide covers with the standard *Traffic Signal* logo.
- For oversized and special-sized junction boxes that house fiber-optic communications cable for the communications system, provide covers with the following log/imprint: *NCDOT FIBER* (line 1), *(XXX) XXX-XXXX* (line 2).

Provide at least two size 3/8" diameter hex head stainless steel cover bolts to match inserts in the box. Provide pull slot(s) with stainless steel pin(s). Polymer concrete junction boxes are not required to be listed electrical devices.

(C) Junction Box Sizes

Provide junction boxes and covers of the following sizes as called for in the Plans:

Junction Box Size	Minimum Inside Dimensions
Standard Size	28"(l) x 15"(w) x 22"(d)
Oversized	30"(l) x 15"(w) x 24"(d)
Special-Sized	36"(l) x 24"(w) x 24"(d)

3.3. CONSTRUCTION METHODS

(A) General

Install junction boxes flush with finished grade. Backfill beneath and around the junction box using #67 washed stone as shown in NCDOT Roadway Standard Drawing No. 1716.01. Do not install sealant compound between junction boxes and covers.

Upon completion of junction box installation and backfilling of all excavations, restore the disturbed ground to its original condition as determined and approved by the Engineer. For paved areas, replace removed or damaged pavement with in kind materials, matching the elevation, color, texture/finish, and general appearance of the surrounding pavement. For unpaved areas, backfill excavations with removed material, tamp the backfilled material and rake smooth the top 1½ inches. Finish unpaved areas flush with surrounding natural ground and to match the original contour of the ground. Seed with same type of grass as surrounding area and mulch the newly seeded area. If unpaved area was not grassed, replace the original ground cover in kind as directed by the Engineer.

Install standard size junction boxes as shown in the Plans and where underground splicing of electrical cables is necessary. Install standard size junction boxes within 3 feet of pole or pole foundation where transitioning from below ground to a riser assembly. Install standard size junction boxes within 5 ft of each end of each lateral run of conduit for electrical cables. When lateral runs for electrical cables are greater than 150 feet, install additional junction boxes to ensure distances between junction boxes does not exceed 150 feet.

Install oversized junction boxes as shown in the Plans in underground fiber-optic communications cable runs where the conduit run transitions from directionally drilled conduit to trenched conduit and where transitioning from below ground to a riser assembly. Install oversized junction boxes in underground fiber-optic communications cable runs at maximum intervals of 1,500 feet, or where shown in the Plans, whichever is less.

Install special-sized junction boxes at all underground splice enclosure locations in underground fiber-optic communications cable runs as shown in the Plans.

(B) GPS Coordinates

Provide real world coordinates for all junction boxes and equipment cabinets installed or utilized under this project. Provide the coordinates in feet units using the North Carolina State Plane coordinate system (1983 North American Datum also known as NAD '83). Furnish coordinates that do not deviate more than 1.7 feet in the horizontal plane and 3.3 feet in the vertical plane. Global positioning system (GPS) equipment able to obtain the coordinate data

within these tolerances may be used. Submit cut sheets on the GPS unit proposed to collect the data for approval by the Engineer.

Provide both a digital copy and hard copy of all information regarding the location (including to but not limited to manufacturer, model number, NCDOT inventory number) in the Microsoft Excel spreadsheet using the format shown in example below.

NCDOT Inv #	Name	Location	Latitude	Longitude	Manufacturer	Model #
12-0134	Equipment Cabinet	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5500	35.6873	McCain	Type-332
	Junction Box # 1 (Phase 2 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5516	35.6879	Quazite	PG1118BA12(Box) PG118HA00(Cover)
	Junction Box # 2 (Phase 2 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5506	35.6876	Quazite	PG1118BA12(Box) PG118HA00(Cover)
	Junction Box # 3 (Near Cabinet)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5501	35.6873	Quazite	PG1118BA12(Box) PG118HA00(Cover)
	Junction Box # 4 (Phase 6 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5486	35.6873	Quazite	PG1118BA12(Box) PG118HA00(Cover)
	Junction Box # 5 (Phase 6 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5493	35.6876	Quazite	PG1118BA12(Box) PG118HA00(Cover)
	Junction Box # 6 (Phase 4 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5503	35.6879	Quazite	PG1118BA12(Box) PG118HA00(Cover)

3.4. MEASUREMENT AND PAYMENT

Junction box (_____) will be measured and paid in actual number of junction boxes of each size and type furnished, installed, and accepted.

No measurement will be made of covers, washed stone, removal of existing junction boxes and grounding systems as these will be considered incidental to furnishing and installing junction boxes.

No measurement will be made of restoration of paved roadways/driveways and unpaved ground surfaces with like materials, including but not limited to backfill, washed stone, paved materials, seeding and mulching, as this work will be considered incidental to junction box installation. The Department will make no payment for a given junction box until all repairs to paved and unpaved surfaces damaged/disturbed during the installation of the junction box have been completed and accepted.

No measurement will be made of collecting and recording GPS coordinates for junction boxes and compiling this data in the prescribed Microsoft Excel spreadsheet as such work will be considered incidental to furnishing and installing junction boxes.

Payment will be made under:

Pay Item	Pay Unit
Junction Box (Standard Size)	Each
Junction Box (Oversized)	Each
Junction Box (Special-Sized)	Each

4. RISER ASSEMBLIES

4.1. DESCRIPTION

Furnish and install riser assemblies with clamp-on, aluminum weatherheads, heat shrink tubing, conduit sealing bushing, galvanized pole attachment fittings, stainless steel banding hardware, grounding and all necessary hardware.

4.2. MATERIALS

Furnish material, equipment, and hardware furnished under this section that is pre-approved on the ITS and Signals QPL.

Provide conduit for risers that is rigid hot dipped galvanized steel conduit that meets UL Standard 6 with rigid full weight sherardized or galvanized threaded fittings.

Refer to the following sections of the *Standard Specifications:*

- 1091-6, "Grounding Electrodes"
- 1091-2, "Wire and Cable"

Provide Schedule 40 PVC female adapter to connect an underground run of PVC conduit to the threaded end of a rigid metallic elbow/sweep at the base of a rigid metallic riser. Provide PVC adapters that have the same nominal diameter as the riser to join underground conduit of the same diameter to the riser. The interior surface of one end of the PVC female adapter shall be compatibly threaded to connect it to the threaded end of the rigid metallic riser without the aid of additional fittings, hardware or adhesives. The opposite end of the adapter shall be non-threaded to permit a slip fit, glued connection to the underground PVC conduit.

Furnish appropriately sized clamp-on aluminum weatherheads for electrical control and power cables.

Furnish heat shrink tubing for the installation of fiber-optic or coaxial cable in a new riser. Ensure the heat shrink tubing is made of modified polyolefin and includes a hot-melt adhesive. Provide tubing that has a length of at least 5" before heating. Ensure the heat shrink tubing will provide a watertight fit around individual cables and outer wall of the riser after heat is applied in accordance with the manufacturer's instructions.

Submit catalog cuts/manufacturer's literature for the conduit sealing bushing to the Engineer for approval prior to use.

4.3. CONSTRUCTION METHODS

Install risers with required weatherheads on poles using pole attachment fittings.

Use separate 1¼" riser with weatherhead for electrical service.

Use a 2-inch riser with weatherhead for composite cable routed to a CCTV camera.

Transition from rigid galvanized steel risers to underground PVC conduits using an approved rigid galvanized steel sweeping elbow with PVC female adapter. Use PVC female adapters that have the same nominal diameter as the riser to join underground conduit of the same diameter to the riser. Apply Teflon thread tape to the threads of rigid galvanized steel sweeping elbow before screwing the PVC adapter onto the threaded end of the elbow. Connect the threaded female end of the PVC adapter to the threaded male end of the rigid galvanized steel sweeping elbow

without the use of additional fittings, hardware, or adhesives. Connect the opposite, non-threaded end of the adapter to the underground PVC conduit using a slip fit, glued connection.

Bond all risers, a minimum of 10 feet above grade, to the pole ground using a #6 AWG minimum solid bare copper wire and an approved pipe clamp, a split-bolt connector or parallel groove clamp. On pole-mounted cabinets where the risers are connected to the cabinet, bond risers in the cabinet using ground bushings with a #6 AWG minimum solid bare copper wire to cabinet ground bus.

4.4. MEASUREMENT AND PAYMENT

__" *Riser with* _____ will be measured and paid as the actual number of risers of each type and size furnished, installed, and accepted.

No measurement will be made of weatherheads, conduit sealing bushings, bushings, conduit outlet bodies such as condulets, elbows, conduit fittings, PVC female adapters, and pole attachment fittings as these will be considered incidental to furnishing and installing risers.

No measurement will be made for horizontal sections of underground conduit that connect the riser to stub-outs in an adjacent cabinet foundation or to an adjacent junction box and that measure 10 feet or less in horizontal length from the center of the riser to the center of junction box or from the center of the riser to the center of the vertical sweep through the equipment cabinet foundation. Such conduit will be considered incidental to furnishing and installing the riser assembly.

No measurement will be made for vertical conduit segments (i.e., short risers) extending from an entrance in the bottom of a pole-mounted cabinet to ground level below the cabinet to tie directly onto an underground conduit as such conduits will be considered incidental to furnishing and installing the pole-mounted cabinet.

No measurement will be made of 1¼" risers with weatherheads furnished and installed as part of new electrical service, as they will be considered incidental to furnishing and installing new electrical services (see "Electrical Service" section of these Project Special Provisions).

Payment will be made under:

Pay Item	**Pay Unit**
2" Riser with Weatherhead	Each

5. WOOD POLES

5.1. DESCRIPTION

Furnish and install wood poles with grounding systems and all necessary hardware.

5.2. MATERIALS

(A) General

Material, equipment, and hardware furnished under this section shall be pre-approved on the ITS and Signals QPL.

Furnish treated timber poles that meet the requirements of ANSI O5.1, except the timber shall be treated Southern Pine or treated Douglas Fir.

Treat all poles in accordance with AWPA Standard U1, except require retention of preservative as below.

Give all poles a preservative treatment of either pentachlorophenol, or chromated copper arsenate. The same type of preservative shall be used throughout the entire length of the project.

Minimum retention for poles treated with pentachlorophenol will be 0.45 lb. by assay of dry chemical per cubic foot of wood. Minimum retention for poles treated with chromated copper arsenate will be 0.6 lb. by assay of dry chemical per cubic foot of wood.

Refer to the following sections of the *Standard Specifications:*

- 1091-6, "Grounding Electrodes"
- 1082, "Inspection Requirements"
- 1091-2, "Wire and Cable"
- 1082, "Structural Timber and Lumber"

(B) CCTV Wood Poles

Furnish Class 3 or better wood poles to mount CCTV cameras and cabinets that are of sufficient length to permit the CCTV camera to be mounted at the mounting height specified in the Plans. To provide for mounting heights of up to 35 feet above the ground at the base of the pole, furnish CCTV wood poles that are at least 50 feet in length. The Contractor is encouraged to visit the site of the proposed CCTV poles to confirm the length of pole required to attain the specified mounting prior to ordering the CCTV poles.

(C) Wood Poles

Furnish Class 4 or better 35' wood poles to mount overhead electric service as shown the Plans.

(D) Wood Pedestal Poles

Furnish 6" x 6" treated wood pedestal poles to mount electrical service disconnects that are of sufficient length to mount the disconnect four feet above the ground.

5.3. CONSTRUCTION METHODS

Install poles at locations shown on the Plans. If the Plans do not specify an exact locations, locate the pole as far as practical from the edge of the roadway, using the setback distances in the following table as a guide:

Speed Limit	Desirable Minimum Setback Distance	
	from face of curb in curb & gutter section	from edge of travel way in shoulder section (no curb)
≤ 25 mph	8 feet	10 feet
30-35 mph	10 feet	12 feet
40 mph	12 feet	16 feet
45 mph	16 feet	18 feet
50 mph	20 feet	22 feet
55 mph	22 feet	24 feet
≥ 60 mph	n/a	30 feet

Measure the setback distance from the face of curb or edge of travel lane to the face of the pole.

Field conditions and site-specific constraints may require the pole to be located at setback distances less than those listed above, subject to the approval of the Engineer.

Mark final pole locations and receive approval from the Engineer before installing poles.

Drill or auger a hole for placement of pole and to allow for compacting. Set CCTV wood poles at a minimum depth of 10 feet. Ensure the pole is within 2 degrees of vertical when fully loaded.

Backfill hole with pole installed and tamp backfill in 6 inch lifts with a mechanical tamp until compacted density is at least 95% of original density.

On new Department-owned poles, install a grounding system consisting of #6 AWG solid bare copper wire that is exothermically welded to a single ground rod installed at the base of the pole or to the electrical service grounding electrode system located within 10 feet of the pole. Install ground wire so as to minimize damage from vandalism and environmental exposures. Install ground wire up pole to a point adjacent to the uppermost span. Use hot-dipped galvanized 1.5" wire staples to secure ground wire to pole, spacing the staples along the ground as follows:

- 4 inches apart from ground level to 8 feet above ground level;
- 24 inches apart from 8 feet above ground level to point adjacent to uppermost span.

(A) Pole Grounding System

On Department-owned poles, install a grounding system consisting of #6 AWG solid bare copper wire that is exothermically welded to a single ground rod installed at the pole base or to the electrical service grounding electrode system located within 10 feet of the pole. Install #6 AWG solid bare copper ground wire up the pole to a point adjacent to the uppermost span. Staple the ground wire to the pole using hot dipped galvanized 1.5" staples. Staple the ground wire to the pole 4 inches apart from the ground level to 8 feet above the ground, and then 24 inches apart from 8 feet above ground level to a point adjacent to the span.

5.4. MEASUREMENT AND PAYMENT

CCTV wood pole will be measured and paid for as the actual number of CCTV wood poles furnished, installed, and accepted regardless of length.

Wood pole will be measured and paid for as the actual number of 35' wood poles furnished, installed, and accepted.

No measurement will be made for installing wood pedestal pole as these will be considered incidental to furnishing and installing electrical service disconnects.

No measurement will be made for installing pole-grounding systems, as these will be considered incidental to furnishing and installing wood poles.

Payment will be made under:

Pay Item	Pay Unit
CCTV Wood Pole	Each
Wood Pole	Each

6. FIBER-OPTIC CABLE

6.1. DESCRIPTION

Furnish and install single mode fiber-optic (SMFO) communications cable and drop cable assemblies, communications cable identification markers, and all necessary hardware.

6.2. MATERIALS

(A) General

Refer to the "Pole Line Hardware" subsection of the "Messenger Cable" section of these Project Special Provisions for lashing wire, wrapping tape and hardware used for installation of aerial fiber-optic cable.

(B) SMFO Communications Cable

Furnish single-mode fiber-optic communications cable that is pre-approved on the ITS and Signals QPL.

Furnish single-mode fiber-optic cable manufactured into a loose buffer tube design installed around a central strength member where the cable complies with RUS CFR 1755.900and ICEA 640 requirements. Ensure the manufacturer is ISO 9001 and TL9000 registered and that the manufacturer's cable is RUS listed. The operating temperature range of the cable shall be -40°F to +158°F.

Furnish individual fibers manufactured from silica and dopant materials with each fiber having a color coated finish that is compatible with local injection detection (LID) devices. Distinguish each fiber from others by color-coding that meets EIA/TIA-598. Furnish single mode fiber that does not exceed attenuation ratings of 0.25 dB/km at 1550 nm and 0.35 dB/km at 1310 nm and complies with ITU G.652D and IEC 60793-2-50 Type B.1.3 industry standards for low water peak, single mode fiber. Provide fibers that are useable and with a surface, sufficiently free of imperfections and inclusions to meet optical, mechanical and environmental requirements.

Ensure the core central strength member is a dielectric glass reinforced rod and that the completed cable assembly has a maximum pulling rating of 600 lbf during installation (short term) and 180 lbf long term installed.

Construct buffer tubes (nominal size of 2.5 mm) manufactured from a polypropylene copolymer material to provide good kink resistance and allows the buffer tube to maintain flexibility in cold temperature over the expected lifetime of the cable. Except for 6-fiber drop cables, provide exactly 12 fibers per buffer tube in all cables regardless of the total number of fibers the cables contain. Do not provide cables with any other fiber count per buffer tube. Ensure that that all buffer tubes are filled with a water-blocking gel or water swellable material. Construct the cable such that the buffer tubes are stranded around the central strength member in a reverse oscillating arrangement to allow for mid-span entry. Distinguish each buffer tube from others by color coding that meets EIA/TIA-598. Use filler tubes to maintain a circular cross-section of the cable. Ensure the filler tubes are the same nominal size as the buffer tubes. Apply binders (water swellable yarn, aramid fiber, etc.) with sufficient tension to secure buffer tubes and filler tubes to the central member without crushing the buffer tubes. Ensure that binding material is non-hygroscopic, non-wicking, and dielectric with low shrinkage. Ensure the binders are of a high tensile strength that is helically stranded evenly around cable core.

Ensure the cable core is protected from the ingress of moisture by a water swellable material or that is filled with a water-blocking compound that is non-conductive. Ensure the water swellable material (when activated) or the water blocking compound is free from dirt and foreign matter and is removable with conventional nontoxic solvents. Furnish at least one ripcord to aid in the process of removing the outer jacket. Furnish the outer jacket constructed of a medium-density polyethylene material to provide reduced friction and enhanced durability. Ensure the polyethylene material contains carbon black to provide UV protection and does not promote the growth of fungus. Ensure the cable jacket is free of slits, holes, or blisters and the nominal outer jacket thickness is > 0.050".

Ensure the completed cable assembly contains identifications markings printed along the outside cover of the jacket every 2 feet. Ensure the character height of the markings is approximately 0.10". Provide length markings in sequential feet and within one percent of actual cable length.

Mark each cable with the following:

(1) Sequential length marks in feet as specified
(2) The name of the manufacturer
(3) "OPTICAL CABLE"
(4) Month/year of manufacture
(5) Number(s) of and type(s) of fibers
(6) Cable ID Number for product traceability

(C) Drop Cable

Provide drop cable meeting the material requirements list in "SMFO Communications Cable" subsection above with the exceptions herein to provide communications links between splice enclosures and the Ethernet edge switches through interconnect centers mounted in equipment cabinets and in CCTV cabinets. Furnish drop cables containing a minimum of six individual fibers.

On one end of the cable, furnish LC connectors for termination of all drop cable fibers on connector panel mounted inside an equipment cabinet. Provide either factory preassembled drop cables with SMFO pigtails and LC connectors already attached or field install the pigtails and connectors. For field installed connectors, provide cabinet-mounted interconnect centers that are pre-equipped with factory-preassembled connector panels, SMFO pigtails with LC connectors and splice trays; then fusion splice all drop cable fibers to the SMFO pigtails.

Ensure attenuation of drop cable at 1310 nm does not exceed 0.4 dB/km and the attenuation at 1550 nm does not exceed 0.3 dB/km. Ensure attenuation loss for complete drop cable does not exceed a mean value of 1.5 dB.

(D) Communications Cable Identification Markers

Furnish communications cable identification markers that are resistant to fading when exposed to UV sources and changes in weather. Use markers designed to coil around fiber-optic cable that do not slide or move along the surface of the cable once installed. Ensure exposure to UV light and weather does not affect the markers natural coiling effect or deteriorate performance. Provide communications cable wraps that permit writing with an indelible marking pen.

Furnish cable identification markers with the following text for communications cables:

WARNING
N.C.D.O.T. FIBER-OPTIC
CALL: (704) 480-5423
WARNING
N.C.D.O.T. FIBER-OPTIC

Overall Marker Dimensions: 7(l) x 4 (w) inches
Lettering Height: 3/8 inch for "WARNING"; 1/4" for all other lettering
Colors: Black text on yellow background

6.3. CONSTRUCTION METHODS

(A) General

Provide cable manufacturer's attenuation and Optical Time Domain Reflectometer (OTDR) testing data for each reel of cable.

Install SMFO communications cable and all necessary hardware.

Comply with manufacturer's recommendations. Install communications cable in conduits as required to bring the fiber-optic cable into and, if necessary, out of each splice enclosure.

Take all precautions necessary to ensure cable is not damaged during storage, handling, and installation. Do not violate minimum bending radius of 20 times the radius of cable diameter or manufacturer's recommendation, whichever is greater. Do not step on cable nor run over cable with vehicles or equipment. Do not pull cable over or around obstructions, or along the ground.

Determine lengths of cable necessary to reach from termination-point to termination-point. Install cable in continuous lengths between approved splicing facilities. Additionally, provide a sufficient amount of slack cable to allow for an additional 20 feet of cable to be present after removal of outer sheath for termination. Store the 20 feet of spare cable inside the equipment cabinet. Measure slack cable by extending the cable straight out of the equipment cabinet door.

Keep cable ends sealed at all times during installation to effectively prevent the ingress of moisture. Use approved heat shrink cable end cap. Do not use tape to seal cable ends.

Before installing cable, provide three copies of cable manufacturer's recommended and maximum pulling tension. Do not exceed manufacturer's recommended pulling tension. Use pulling grips containing a breakaway rotating swivel. Coil cable in a figure-8 configuration whenever cable is unreeled for subsequent pulling.

Install fiber-optic cable in separate conduits. Do not share conduits containing fiber-optic cable with other non-fiber-optic cable unless the Plans specify otherwise or the Engineer directs or approves otherwise.

Seal all conduits containing fiber-optic communications cable in junction boxes and cabinet bases with duct and conduit sealer. Comply with the requirements for duct and conduit sealer in the "Underground Conduit" section of these Project Special Provisions.

(B) Underground Installation

Install fiber-optic cable underground in conduit using cable pulling lubricants recommended by the fiber-optic cable manufacturer.

Obtain approval of cable pulling lubricant and method of pulling before installing underground fiber-optic cable.

Use a breakaway swivel so as not to exceed 80% of the maximum allowable pulling tension specified by the cable's manufacturer if cable is pulled by mechanical means.

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

For pulling cable through junction boxes, feed cable by manually rotating the reel. Do not pull cable through intermediate junction boxes, handholds, or openings in conduit unless otherwise approved.

Inside all junction boxes, install communications cable identification markers on each communications cable entering the junction box.

In a junction box where no splice enclosure is required, store 50 feet of each fiber-optic cable on all cable runs as shown in the Plans.

(C) Indoor Installation

Install the fiber-optic cable in risers and conduit between the building entrance and the enclosed communications racks being installed inside the scale house using cable-pulling lubricants recommended by the fiber-optic cable manufacturer. Obtain approval of cable pulling lubricant and method of pulling before installing the fiber-optic cable.

Use a breakaway swivel so as not to exceed 80% of the maximum allowable pulling tension specified by the cable's manufacturer if cable is pulled by mechanical means. Keep tension on cable reel and pulling line at start of each pull. Do not release tension if pulling operation is halted. Restart pulling operation by gradually increasing tension until cable is in motion.

For pulling cable through junction boxes and cabinets, feed cable by manually rotating the reel. Do not pull cable through cabinets, junction boxes, handholds, or openings in conduit unless otherwise approved. Inside all junction boxes and cabinets, install communications cable identification markers on each communications cable entering the junction box.

Store 30 feet of each fiber-optic cable inside the enclosed communications racks inside the scale house after terminating the cables in the rack-mounted splice centers housed therein.

(D) Installation of Drop Cable

Verify the length of drop cable needed, including slack, to reach from termination point to termination point.

At aerial splice enclosures, install the aerial splice enclosure and corresponding cable storage guide 50 feet apart and store between the splice enclosure and corresponding cable storage guide 50 feet of slack cable for each cable entering and exiting the splice enclosure.

At below ground splice enclosures, coil 50 feet of slack cable for each cable entering and exiting the splice enclosure in the manhole or junction box where enclosure is located. Coil and

store any drop cable in excess of what is needed for storage in the manhole or junction box in the base of the equipment cabinet. Where fiber-optic cables are installed but not immediately spliced, store 50 feet of drop cable and 50 feet of fiber-optic trunk cable inside the manhole or junction box to facilitate subsequent splicing in the splice enclosure. Cap and seal ends of cables that have yet to be spliced or terminated with a waterproof heat-shrink cap/seal as approved by the Engineer.

At the equipment cabinet end of drop cable, terminate all fibers by splicing them to factory-assembled SMFO pigtails with LC connectors and connecting the pigtails to the connector panel in the rack-mounted interconnect center. Label all connectors, pigtails and the connector panel. At the aerial or underground splice location, cap off all unused fibers and label to correspond with the connector panel. After termination, coil and store in the base of the equipment cabinet 20 feet of drop cable plus any additional drop cable in excess of what is needed for overhead storage.

Using an OTDR, test the end-to-end connectivity of the drop cable from patch panel installed inside the signal or CCTV cabinet to the adjacent managed Ethernet switches. Comply with the OTDR testing and reporting requirements of the "Testing and Acceptance" section of these Project Special Provisions when testing drop cable.

6.4. MEASUREMENT AND PAYMENT

Communications cable (____-fiber) will be measured and paid as the actual linear feet of fiber-optic cable of each fiber count furnished, installed, and accepted. Measurement will be made by calculating the difference in length markings located on outer jacket from start of run to end of run for each run. Terminate all fibers before determining length of cable run.

Drop cable will be measured and paid as the actual linear feet of fiber-optic drop cable comprise of a minimum of 6 fibers that are furnished, installed, and accepted.

No measurement will be made for terminating, splicing, and testing fiber-optic cable, SMFO jumpers and pigtails, mechanical sealing devices and conduit seals/sealing putty, as these will be considered incidental to the installation of fiber-optic cable and drop cables.

Payment will be made under:

Pay Item	Pay Unit
Communications Cable (36-Fiber)	Linear Foot
Drop Cable (6-Fiber)	Linear Foot

7. FIBER-OPTIC SPLICE CENTERS

7.1. DESCRIPTION

Furnish and install fiber-optic interconnect centers, fiber-optic splice enclosures, and all necessary hardware.

7.2. MATERIALS

Furnish material, equipment, and hardware furnished under this section that is pre-approved on the ITS and Signals QPL.

(A) Interconnect Center

Furnish compact, modular interconnect centers designed to mount inside equipment cabinets. Design and size interconnect centers to accommodate all fibers entering cabinets. Provide interconnect centers for equipment cabinets and CCTV cabinets that are no more than three rack unit (RU) high.

Provide splice trays that hold, protect, organize optical fibers, and secure fibers inside splice tray. Design and size the splice trays to be dielectric, to accommodate all fibers entering splice tray, and to provide sufficient space to prevent microbending of optical fibers. Provide connector panels with LC-type connectors.

Furnish SMFO pigtails with each interconnect center. Provide pigtails are a maximum of 6 feet in length with factory-assembled LC connectors on one end. Ensure SMFO pigtails meet the operating characteristics of the SMFO cable with which it is to be coupled.

For connecting Ethernet edge switches to the interconnect center patch panels, furnish SMFO jumpers that are a minimum of 3 feet in length with factory-assembled LC connectors on one end (i.e., the interconnect center end) and, on the other end, factory-assembled connectors of the same type provided on the Ethernet edge switch. Ensure SMFO jumpers meet the operating characteristics of the SMFO cable with which it is to be coupled.

(B) Splice Center

Furnish a separate rack-mounted fiber-optic splice housing for the fiber-optic communications cable entering and terminated inside the scale house and at CCTV 1 and 5. Provide a splice center sized to accommodate fusion splicing of all fibers in the designated cable to pigtails in splice trays housed inside the splice center and terminating those pigtails on the splice center's connector panels (i.e., patch panels) as shown in the Plans. Equip the splice center with LC-compatible connector panels with 12 connectors on each panel (arranged in either a simplex or duplex arrangement) to terminate fibers from each buffer tube in the incoming cable on a unique connector panel (i.e., one connector panel per buffer tube).

Provide a splice housing that is either a one-piece unit designed to house the connector panels as well as the splice trays or a two-part unit comprised of a rack-mountable connector housing (i.e., distribution panel) and a matching splice housing. For a two-part unit, furnish a connector housing and splice housing made by the same manufacturer and designed by the manufacturer to work together as a unit. Provide a splice center designed to house a separate splice tray for each buffer tube in the cable and to store buffer tubes following splicing. The splice center, whether a single unit or a two-piece unit, shall occupy no more than four rack

units. Provide splice centers that have connector panels on the front of the unit that are protected by a transparent door or shield constructed of rigid, durable plastic or acrylic material.

Provide splice trays that hold, protect, organize optical fibers, and secure fibers inside splice tray. Design and size the splice trays to be dielectric, to accommodate all fibers entering splice tray, and to provide sufficient space to prevent microbending of optical fibers.

Furnish SMFO pigtails for the splice center. Provide pigtails are a maximum of 6 feet in length with factory-assembled LC connectors. Ensure SMFO pigtails meet the operating characteristics of the SMFO cable with which it is to be coupled. Factory pre-terminated and pre-assembled pigtailed connector panels may be furnished in lieu pigtails pre-assembled with LC connectors, subject to the Engineer's approval.

Provide all hardware needed to install the splice center in a rack inside the scale house.

(C) Splice Enclosure

Furnish splice enclosures that are re-enterable using a mechanical dome-to-base seal with a flash test valve, and are impervious to the entry of foreign material (water, dust, etc.). Ensure enclosures are manufactured in such a manner to be suitable for junction box installation.

Provide enclosures with a minimum of one oversized oval port that will accept two cables and with a minimum of four round ports (for single cables) that will accommodate all cables entering enclosure. Provide heat shrink cable shields with enclosure to ensure weather-tight seal where each cable enters enclosure.

Within enclosures, provide enough hinged mountable splice trays to store the number of splices required, plus the capacity to house six additional splices. Provide a fiber containment basket for storage of loose buffer tubes expressed (i.e., uncut and unspliced) through the enclosure. Ensure enclosures allow sufficient space to prevent microbending of buffer tubes when coiled.

Provide splice trays that hold, protect, organize optical fibers, and secure fibers inside splice tray. Provide splice trays that are dielectric.

7.3. CONSTRUCTION METHODS

(A) General (Workmanship Identification Information)

Include on the cover of each splice tray in a legible format the following workmanship identification information:

- Splice location reference # or identification information (e.g., 12-xxxx tray 1 of 3, 12-xxxx tray 2 of 3, etc.);
- Date the splice was made;
- Name of company that performed the splicing;
- Name of person who performed the splicing.

(B) Workmanship

Upon cutting the cable and removing the outer jacketing material down to the individual buffer tubes, secure the central strength member to the enclosure so that no tensile force is applied to the fibers. Secure the individual buffer tubes to the splice trays by a method recommended by the manufacturer. Determine the length of each buffer tube needed to ensure that the buffer tube can be looped a minimum of two times around the inside of the splice tray. Upon determining the length of buffer tube needed, remove the buffer tube to expose the

individual fibers for fusion splicing. Adjust individual fiber lengths as necessary to ensure that once the fusion splicing process in completed the finished splices will align with the "splice block organizer" supplied within the splice tray. Ensure the splice block organizer has individual fusion splice space holders for each fiber splice.

While prepping the individual fibers for splicing, install the heat shrink protective tube over the fiber and then perform the splicing operations, following the manufacturer's instructions. Verify that the newly formed splice does not exceed 0.05 dB of attenuation. If the attenuation is more than 0.05 dB, then remake the splice until it meets the 0.05 dB or less requirement. Finish the splicing operation by sliding the heat shrink tube over the splice and applying heat to active the heat shrink tubing. Secure the finished splice in the splice block organizer. Ensure each splice is properly secured in a space holder in the splice block organizer. Multiple splices secured to the same space holder are unacceptable.

Ensure all buffer tubes are contained within splice trays so that no bare fibers are outside of the tray. Do not damage the fibers or violate the minimum bend radius of the fiber.

Prior to installing the cover over the splice tray and placing it in its final resting location, take a MANDATORY digital photograph of the splice tray that shows the final workmanship. Ensure that the photograph shows the "Workmanship Identification Information" as well as the workmanship associated with installing and terminating the fiber. Include digital copies of each photograph on a compact disc as part of the OTDR Test results submittal.

(C) Termination and Splicing within Interconnect Centers & Splice Centers

Terminate and fusion splice all fibers as shown in the Plans.

Label all fiber-optic connectors, whether on jumpers, connector panels, or other equipment, to prevent improper connection. Obtain approval of fiber-optic connector labeling method.

For all fibers designated for termination to a connector panel within an interconnect center, fusion splice the fibers to pigtails.

For all fibers designated to pass through interconnect center, neatly coil, and express the fibers without cutting. For all buffer tubes designated to pass through interconnect center, neatly coil excess tubing inside interconnect center.

(D) Interconnect Centers in Equipment and CCTV Cabinets

Install interconnect centers with connector panels, splice trays, storage for slack cable or fibers, mounting and strain relief hardware, and all necessary hardware. Mount the interconnect center in the rack inside the equipment cabinet or CCTV cabinet at the location indicated in the Plans. Install SMFO jumpers between the appropriate connectors on the interconnect center and the edge switch.

(E) Splice Center

Install a splice center with connector panels, splice trays, storage for slack cable or fibers, mounting and strain relief hardware, and all necessary hardware inside the scale house at CCTV 1 and 5.

Install SMFO jumpers between the appropriate connectors on the connector panels of the splice center and the respective Ethernet switch.

(F) Termination and Splicing within Splice Enclosure

Install splice enclosures with splice trays, basket containment assemblies, racking for slack cable or fibers, mounting and strain relief hardware, and all other necessary hardware.

Fusion splice all fibers including fibers designated to be coupled with fibers from a drop cable. For all fibers designated to pass through splice enclosure, coil and express the fibers without cutting.

For all buffer tubes designated to pass through splice enclosure, neatly coil excess tubing inside basket provided with enclosure.

Label all fiber-optic splices. Obtain approval of fiber-optic connector labeling method.

Install heat shrink cable shields using methods recommended by the manufacturer of the enclosure. Perform a pressurization flash test on enclosure in accordance with manufacturer's recommended procedures at the conclusion of splicing procedure and before final placement of enclosure.

For underground junction box facility installations, place the enclosure along with required spare cables in the facility in a neat and workmanship like manner. Install underground splice enclosures only in special-sized junction boxes unless the Plans indicate otherwise or the Engineer approves otherwise.

(G) Testing

Provide written notification to the Engineer a minimum of 10 working days before beginning the OTDR tests.

After splicing is completed, perform bi-directional OTDR tests on each fiber, including unused fibers. Install a 1,000-foot pre-tested launch cable between the OTDR and fiber-optic cable to be tested and a 1,000-foot pre-tested destination cable on the end of the fiber-optic cable to be tested. Ensure each launch cable has been tested and is compatible with the fiber-optic cable being installed. Provide the Engineer with test results of the launch cable before use. Re-test or replace launch cable at the Engineer's request.

Ensure fusion splice losses do not exceed 0.05 dB and connectors have a loss of 0.5 dB or less. If any fiber exceeds maximum allowable attenuation or if fiber-optic properties of the cable have been impaired, take appropriate actions up to and including replacement of the fiber-optic cable. Corrective action will be at no additional cost to the Department.

Clearly label each OTDR trace identifying a starting and ending point for all fibers being tested. Record the attenuation level of each fiber and clearly indicate OTDR trace results in report format. Furnish two hard copies of each of the OTDR trace results and electronic copies of all trace results along with digital photographs showing workmanship for each splice on a compact disc. Furnish the manufacturer's make, model number, and software version of the OTDR used for testing.

Provide the Engineer with two copies of the software needed to view the OTDR traces electronically.

7.4. MEASUREMENT AND PAYMENT

Interconnect center will be measured and paid as the actual number of fiber-optic interconnect centers furnished, installed, and accepted.

Splice center (36-fiber) will be measured and paid as the actual number of fiber-optic splice centers of each fiber count furnished, installed in the scale house, and accepted.

Splice enclosure will be measured and paid as the actual number of fiber-optic splice enclosures that are furnished, installed, and accepted.

No measurement will be made of fusion splices, splice trays, splice protectors, pigtails, jumpers, connector panels, labeling, photographs, testing and corrective actions, repairs and replacements needed for exceeding the maximum allowable attenuation or other defects, as these will be considered incidental to furnishing and installing fiber-optic interconnect centers and splice enclosures, and modifying existing splices.

No measurement will be made for removal of existing interconnect centers as such work will be considered incidental to furnishing and installing fiber-optic interconnect centers.

Payment will be made under:

Pay Item	Pay Unit
Interconnect Center	Each
Splice Center (36-Fiber)	Each
Splice Enclosure	Each

8. CABLE MARKERS

8.1. DESCRIPTION

Furnish and install delineator markers (tubular marker posts), equipment cabinet decals, and curb/sidewalk markers/medallions with all necessary hardware and adhesives to warn of buried fiber-optic communications cable.

8.2. MATERIALS

Furnish material, equipment, and hardware under this section that is pre-approved on the ITS and Signals QPL.

Furnish delineator markers, also referred to as tubular marker posts that are approximately 6 feet long and constructed of Type III, high-density polyethylene (HDPE) material. Provide delineator assemblies that are ultraviolet stabilized to help prevent components from color fading, warping, absorbing water, and deterioration with prolonged exposure to the elements. Provide delineators designed to self-erect after being knocked down or pushed over. Provide orange delineator posts.

Provide text, including Department contact number, hot stamped in black on a yellow reflective background material that will not fade or deteriorate over time. Provide delineator markers with nominal message height of 15" that contain the following text visible from all directions approaching the assembly:

8.3. CONSTRUCTION METHODS

Submit sample of proposed delineator markers for approval before installation.

Install delineator markers using a method that firmly and securely anchors delineator marker in the ground to prohibit twisting and easy removal.

Install delineator markers at locations specified on the plans. Do not install delineator markers at locations other than those specified in the Plans without the prior approval of the Engineer.

8.4. MEASUREMENT AND PAYMENT

Delineator marker will be measured and paid for as the actual number of delineator markers (tubular marker posts) furnished, installed, and accepted.

No measurement will be made for cabinet decals, as they will be considered incidental to furnishing and installing underground conduit.

Payment will be made under:

Pay Item	Pay Unit
Delineator Marker	Each

9. ELECTRICAL SERVICE

9.1. DESCRIPTION

At locations called out in the Plans, install a new electrical service including an external disconnect and meter base.

Comply with the National Electrical Code (NEC), the National Electrical Safety Code (NESC), the *Standard Specifications*, these Project Special Provisions, and all local ordinances. Coordinate all work involving electrical service with the appropriate utility company and the Engineer.

9.2. MATERIALS

(A) Electrical Service

Provide material, equipment and hardware under this section that is pre-approved on the 2012 ITS and Signals QPL by the date of equipment installation.

Provide all materials necessary to form a complete electrical service assembly as shown in the Plans. Furnish new external electrical service disconnects, meter bases, and required grounding.

Fabricate the enclosure from galvanized steel and electrostatically apply dry powder finish, light grey in color, to yield a minimum thickness of 2.4 mils. All exterior surfaces must be powder coated steel.

Provide external electrical service disconnects at all new cabinet locations unless otherwise specified in the Plans.

Provide all electrical service disconnects with a space/expansion slots, covered by a knockout or removable blank cover, designed to allow the future installation of at least one additional circuit breaker.

Provide inverse time circuit breaker with at least 10,000 RMS symmetrical amperes short circuit current rating in a lockable NEMA 3R enclosure.

Furnish 4-wire stranded copper feeder conductors with THWN rating for supplying power to field equipment cabinets. Provide conductors with black, red, white, and green insulation that are intended for power circuits at 600 V 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.

(1) CCTV-01 Overhead Electric Service

Provide the following equipment for the CCTV camera cabinet:

- Overhead electric service with combo meter/disconnect panel
- 1 double-pole 100A main breaker
- 1 single-pole 20A breaker
- 1 spare slot/space (minimum)

(2) Crowders Mtn. Rd. Underground Electric Service

Provide the following equipment:

- Underground electric service with combo meter/disconnect panel on 6" x 6" wood pedestal
- 1 double-pole 200A main breaker
- 3 double pole 25 amp secondary breakers
- 1 spare slot/space (minimum)

(3) Feeder Conductors

Provide THWN rated conductors with black, red, white, and green insulation that are intended for power circuits at 600 V 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.

As indicated below, provide the following:

Furnish 2" rigid galvanized conduit between the disconnect and the device cabinets as required. For underground runs greater than 10 feet in length, the Contractor may transition from 2" rigid galvanized conduit to 2" PVC conduit for the remainder of the underground run beyond the initial 10 feet. Furnish PVC female adapters to connect the PVC conduit to the threaded end of the rigid galvanized conduit. The interior surface of one end of the PVC female adapter shall be compatibly threaded to connect it to the threaded end of the rigid metallic riser without the aid of additional fittings, hardware or adhesives. The opposite end of the adapter shall be non-threaded to permit a slip fit, glued connection to the underground PVC conduit.

(4) Meterbase and Disconnect

Ensure service disconnects are listed as meeting UL Standard UL-489 and marked as being suitable for use as service equipment. Fabricate enclosure from galvanized steel. Provide ground bus and neutral bus with a minimum of four terminals with minimum wire capacity range of number 8 through number 1/0 AWG.

Furnish NEMA Type 3R meter base rated 100A minimum for overhead service and 100A minimum for underground service and 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°. 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 four terminal, 600 volt, single phase, 4-wire meter base that complies with the following:

- Line, Load, and Neutral terminals accept #8 to 2/0 AWG copper/aluminum wire;
- Ringed or ringless type, with or without bypass;
- Made of galvanized steel;
- Listed as meeting UL Standard UL-414; and
- Overhead or underground service entrance as specified.

Provide electrical service disconnects, meter bases, combination panel enclosures and pedestals with electrostatically applied dry powder paint finish with minimum thickness of 2.4 mils and that is light gray in color. All exterior surfaces must be powder coated steel.

Furnish 1¼" watertight hub (i.e., meter socket hub) for threaded rigid galvanized conduit with meter base.

If meter base and electrical service disconnect are supplied in the same enclosure (i.e., combination panel), ensure assembly is marked as being suitable for use as service equipment. Ensure combination meter and disconnect mounted in a pedestal for underground service is listed as meeting UL Standard UL-231. Otherwise, ensure combination meter and disconnect is listed as meeting UL Standard UL-67.

Provide a grounding electrode system at all new electrical services. Provide underground marker tape above ground grounding electrodes and buried ground wire. Provide all grounding electrodes and ground wire necessary to ensure that grounding system, whether existing or new, complies with all grounding requirements of these Project Special Provisions.

(B) Grounding Electrodes (Ground Rods)

Furnish 5/8"x10' copper clad steel grounding electrodes (ground rods), #4 AWG solid bare copper conductors, and exothermic welding kits for grounding system installations. Comply with the NEC, the *Standard Specifications*, these Project Special Provisions and the Plans.

9.3. CONSTRUCTION METHODS

(A) General

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.

Run feeder conductors separately from all other conductors in a 2" rigid galvanized conduit. Do not allow feeder conductors to share conduits with any other conductors or cables. Do not route unfused electrical feeder conductors inside of metal poles. Permanently label conductors at all access points using nylon tags labeled with permanent ink. Ensure each conductor has a unique identifier. Label conductors immediately upon installation. Use component name and labeling scheme approved by the Engineer.

Use rigid galvanized conduit for all underground conduit runs 10 feet or less in length. For underground runs greater than 10 feet in length, the Contractor may transition from 2" rigid galvanized conduit to 2" PVC conduit for the remainder of the run beyond the initial 10 feet using an approved PVC female adapter. Apply thread seal tape to the threads of the rigid galvanized conduit before screwing the PVC adapter onto the threaded male end of the conduit. Connect the threaded female end of the PVC adapter to the threaded end of the rigid galvanized conduit, then connect the not threaded end of the adapter to the PVC conduit using a slip fit, glued connection.

Upon completion of electrical service installation and backfilling of all excavations, restore the disturbed ground to its original condition as determined and approved by the Engineer. For paved areas, replace removed or damaged pavement with in kind materials, matching the elevation, color, texture/finish and general appearance of the surrounding pavement. Refer to Section 1 of these Project Special Provisions for additional requirements concerning sidewalks and curbs in historic districts. For unpaved areas, backfill excavations with removed material, tamp the backfilled material and rake smooth the top 1½ inches. Finish unpaved areas flush with surrounding natural ground and to match the original contour of the ground. Seed with same type

of grass as surrounding area and mulch the newly seeded area. If unpaved area was not grassed, replace the original ground cover in kind as directed by the Engineer.

Install meter socket covers on new meter bases to block access to the wiring inside until the meter is attached to the meter base by the power company. Use only approved meter socket covers approved by the Engineer; do not use cardboard, paper, plywood, sheet plastic, tape, etc. to cover the meter socket opening. Do not leave a meter socket uncovered.

Provide all necessary stainless steel banding hardware and clamps for securely attaching service disconnects, meter bases, combination panels and service conduits and risers to metal poles. Submit catalog cuts/manufacturer's literature for banding hardware and clamps to the Engineer for approval.

(B) New Underground Electrical Service for Device Cabinets

At locations identified in the Plans, install a single new 4-wire 240-volt underground electrical service to serve the advance WIM, notification location, and the open/close sign. Comply with *Roadway Standard Drawing* Nos. 1700.01 and 1700.02.

Install a new electrical service comprised of an external service disconnect as well as a meter base with meter socket cover on the existing utility pole. After installation of the meter base with meter socket cover, the local power company will remove the meter socket cover, install a new meter, and make any necessary connections to the power lines.

(C) New Overhead Electrical Service for CCTV

As in the Plans, install a new 4-wire 240-volt new overhead electrical service for a CCTV cabinet in accordance with the details shown in the Plans. Install a new electrical service comprised of an external service disconnect and a meter base with meter socket cover housed in a combination panel on a new wood pole. Mount the combination panel on the wood pole. After installation of the meter base with meter socket cover, the local power company will remove the socket cover and transfer the existing meter or install a new meter and make any necessary connections to the power lines.

(D) Device Cabinet Service Disconnects

At the following locations, provide a device cabinet disconnect:

1) CCTV-1: Mounted on 6" x 6" treated wood pole
2) Advance WIM: mounted on 6" x 6" treated wood pole
3) Open/close sign: mounted on 6" x 6" treated wood pole
4) Notification Site: mounted on 6" x 6" treated wood pole

In the disconnect, terminate the four wire copper service conductors from the metered service. Install No. 10 conductors from the disconnect into the respective device cabinet.

(E) Grounding of Electrical Services

In addition to NEC requirements, test grounding electrode resistance for a maximum of 20 ohms. Furnish and install additional ground rods to grounding electrode system as necessary to meet test requirements. Furnish 5/8" x 10' copper clad steel grounding electrode system (ground rods), #4 AWG solid bare copper conductors, and exothermic welding kits for grounding system installations. Comply with NEC, the *Standard Specifications*, these Project Special Provisions, and the Plans.

Grounding electrode resistance test must be verified or witnessed by the Engineer or the Engineer's designated representative. Furnish and install additional ground rods to grounding electrode system as necessary to meet the requirements of these Project Special Provisions and test requirements.

Follow test equipment's procedures for measuring grounding electrode resistance. When using clamp-type ground resistance meters, readings of less than 1 ohm typically indicate a ground loop. Rework bonding and grounding circuits as necessary to remove ground loop circuits and retest. If a ground loop cannot be identified and removed to allow the proper use of a clamp-type ground resistance meter, use the three-point test method.

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

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

9.4. MEASUREMENT AND PAYMENT

New electrical service (type) will be measured and paid for as the actual number of complete, functional electrical service locations furnished, installed, and tested.

No measurement will be made of risers with weatherheads for electrical service, as they will be considered incidental to furnishing and installing a new electrical service.

No measurement will be made of short risers (i.e., from disconnect to underground conduit and from underground conduit to bottom of cabinet), meter bases, meter socket covers, service disconnects, additional circuit breakers in new service disconnects where required, underground conduit between service risers and disconnects/meters, conduit for feeder conductors between the service disconnect and the equipment cabinet, PVC female adapters, acquisition of service fees, service entrance conductors, feeder conductors, ground wire, and any remaining hardware and conduit to connect the electrical service to the cabinet as they will be considered incidental to furnishing and installing new electrical service.

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 as part of grounding systems for new and modified electrical services and equipment cabinet disconnects. No separate payment will be made for #4 AWG solid bare copper grounding conductors or exothermic welding kits as they will be considered incidental to furnishing and installing the ground rod. No measurement and payment for grounding electrodes furnished and installed for purposes other than electrical service grounding systems.

Service disconnect will be measured and paid for as the actual number of complete, functional pedestal-mounted electrical service disconnects furnished, installed and tested. Furnish and install a 6" x 6" treated wood pedestal to support the service disconnect at locations described in these Project Special Provisions. No measurement and payment for 6" x 6" treated wood pedestal for the disconnect furnished and installed as this work will be considered incidental to installation of a new service disconnect. No measurement and payment for No. 10 service conductors from the disconnect to the device cabinet furnished and installed as this work will be considered incidental to installation of a new service disconnect.

No measurement will be made of short risers (i.e., from disconnect to underground conduit and from underground conduit to bottom of cabinet), service disconnects, additional circuit breakers in new service disconnects where required, underground conduit between service risers and disconnects/meters, conduit for feeder conductors between the service disconnect and the equipment cabinet, PVC female adapters, feeder conductors, ground wire, and any remaining hardware and conduit to connect the service disconnect to the cabinet as they will be considered incidental to furnishing and installing new service disconnect.

Four-wire service copper service conductors will be measured and paid as the actual linear feet of 4-wire THWN stranded copper feeder conductors furnished, installed and accepted. Payment is for all four 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.

No measurement will be made of restoration of paved roadways/driveways and unpaved ground surfaces with like materials, including but not limited to backfill, graded stone, paved materials, seeding and mulching, as this work will be considered incidental to installation of a new electrical service.

The Department will make no payment for a given new electrical service until all repairs to paved and unpaved surfaces damaged/disturbed during the installation the electrical service have been completed and accepted.

Payment will be made under:

Pay Item	**Pay Unit**
New Electrical Service (Overhead)	Each
New Electrical Service (Underground)	Each
5/8" x 10' Grounding Electrode	Each
Service Disconnect	Each
Four-Wire Copper Feeder Conductors	Linear Feet

10. INDUCTIVE DETECTION LOOPS

10.1. DESCRIPTION

Furnish and install inductive detection loops with loop slot sealant, loop wire, conduit with fittings, and all necessary hardware.

10.2. MATERIALS

Furnish material, equipment, and hardware furnished under this section that is pre-approved on the ITS and Signals QPL.

(A) Loop Sealant

Provide the Engineer with a Type 3 material certifications and material safety data sheets (MSDS) for the sealant in accordance with Article 106-3 of the *Standard Specifications*.

Provide loop slot sealant that completely encapsulates loop wire when installed according to manufacturer's instructions. Provide loop sealant that does not generate temperatures greater than 220° F. Ensure sealant bonds with asphalt and concrete pavement saw slots so sealant and encapsulated loop wire do not come out of slot. Ensure sealant is self-leveling, but with sufficient viscosity to prevent exit from saw slot when installed along a 10% grade.

Provide sealant that protects loop wire by preventing the entrance of dirt, water, rocks, sticks, and other debris into saw slot, and is resistant to traffic, water, gasoline, chemical and chemical fumes, mild alkalis, oils, and mild acids. Ensure sealant will not be affected by water and sealant does not chemically interact with pavement and loop wire insulation.

Ensure loop sealant has sufficient flexibility to permit expected pavement expansion and contraction due to weather and to permit pavement movement due to traffic without cracking for a temperature range of -40 to 160° F.

Provide sealant with a usable life of at least ten minutes once mixed, when the ambient temperature is 75° F. Ensure sealant dries to tack-free state in less than 2 hours, and does not flow within or out of saw slot after exposed surface has become tack free. Tack free time will be determined by testing with a cotton ball until no sealant adheres to cotton ball and no cotton adheres to sealant.

Ensure two-part sealant cures within 48 hours to attain 95% of published properties for the cured material.

Ensure one part sealant cures within 30 days to attain 95% of published properties for the cured material.

(B) Loop Wire

Provide loop wire composed of 19-strand conductor insulated by a cross-linked polyethylene compound. Ensure insulated conductors are completely encased in tubes of low density polyethylene compound. Print manufacturer's name, manufacture year, and any applicable part number on encasing tube at intervals of 2 feet or less.

Provide #14 AWG copper conductors fabricated from 19 strands that comply with ASTM B3 before insulating. Ensure stranded conductors use either concentric or bunch stranding, and comply with circular mil area and physical requirements of ASTM B8 or ASTM B174 for bunch stranding.

Provide insulating compound that is cross-linked thermosetting black polyethylene in accordance with ASTM D 2655. Ensure insulation is applied concentrically about conductor. Provide insulation thickness not less than 0.026" at any point and minimum average thickness of 0.030" as measured by UL Standard 62.

Ensure insulation of finished conductor will withstand application of a 60 Hertz or 3,000 Hertz, 7,500 volt (RMS) essentially sinusoidal spark test potential as specified in UL Standard 83.

Provide insulated conductors that are factory-installed in protective encasing tube that complies with the following:

- Encasing tube fabricated of polyethylene compound conforming to ASTM D1248 for Type I, Class C, Grade E5.
- Minimum inside diameter of 0.150"
- Wall thickness of 0.040" ± 0.010"
- Outside diameter of 0.240" ± 0.010" Conduit

(C) Conduit

Comply with the "Underground Conduit" section of these Project Special Provisions for PVC conduit.

10.3. CONSTRUCTION METHODS

All work performed in this section shall be done in the presence of the Engineer.

Notify Engineer one week before installing inductive detection loops.

Coordinate sawcutting and loop placement with pavement markings. For new construction or for resurfacing, install inductive detection loops before placing final layer of surface course. On unmarked pavement, pre-mark locations of stop lines and lane lines before locating inductive detection loops.

Before sawcutting, pre-mark inductive detection loop locations and receive approval. Sawcut pavement at approved pre-marked locations. Do not allow vehicles to travel over unsealed loop slots.

Install conduit with bushings from edge of pavement to junction box. Do not sawcut through curb.

Remove all loose material and wash saw slots with a high-pressure method using an air and water mixture. Dry saw slots with compressed air. Clear saw slots of jagged edges and protrusions. Seat loop conductor at bottom of saw slot without damaging loop wire.

Before sealing loop conductors, test that impedance from the loop wire to ground is at least 100 megohms. For each location with inductive loops, submit a completed Inductive Detection Loop & Grounding Test Results form. Ensure all loops are included on form. The form is located on the Department's website at https://connect.ncdot.gov/resources/safety/Pages/ITS-and-Signals.aspx .

Embed loop conductors in saw slot with loop sealant. Seal saw slot and dispose of excess sealant in an environmentally safe manner.

Between where loop conductor pairs leave the saw cut in pavement and enter a junction box, twist loop conductor pairs a minimum of 5 turns per foot. Permanently label each twisted pair in the junction box with nylon cable tie using indelible ink. Indicate loop number and loop polarity on the tie.

10.4. MEASUREMENT AND PAYMENT

Inductive loop sawcut will be measured and paid as the actual linear feet of inductive loop sawcut furnished, installed, and accepted.

No measurement will be made of loop slot sealant, loop wire, conduit, and conduit fittings as these will be considered incidental to furnishing and installing inductive detection loops.

Payment will be made under:

Pay Item	Pay Unit
Inductive Loop Sawcut	Linear Foot

11. LEAD-IN CABLE

11.1. DESCRIPTION

Furnish and install lead-in cable with all necessary hardware to be used in conjunction with inductive detection loops.

11.2. MATERIALS

Furnish material, equipment, and hardware furnished under this section that is pre-approved on the ITS and Signals QPL.

Furnish lead-in cable with two conductors of #14 AWG fabricated from stranded tinned copper that complies with IMSA Specification 50-2 except as follows:

- Ensure conductor is twisted with a maximum lay of 2.0 inches, resulting in a minimum of 6 turns per foot.
- Provide a ripcord to allow cable jacket to be opened without using a cutter.

Provide length markings in a contrasting color showing sequential feet and within 1% of actual cable length. Ensure character height of the markings is approximately 0.10 inch.

11.3. CONSTRUCTION METHODS

For underground runs, install lead-in cable in 2-inch non-metallic conduit.

Splicing of lead-in cable will be allowed only for runs in excess of 750 feet. Splice lead-in cable in terminal splice boxes, junction boxes, condulets on poles or equipment cabinets.

Test each complete loop system from the equipment cabinet by using a megger to verify that impedance from the loop system to the ground is at least 50 megohms. After successful completion of megger test, test loop system resistance using an electronic ohmmeter to verify loop system resistance is less than 0.00885 ohms per foot.

11.4. MEASUREMENT AND PAYMENT

Lead-in cable will be measured and paid as the actual linear feet of lead-in cable furnished, installed, and accepted. Measurement will be made by calculating the difference in length markings located on outer jacket from start of run to end of run for each run. Terminate all cables before determining length of cable run.

If markings are not visible, measurement will be point to point with no allowance for sag.

Payment will be made under:

Pay Item	Pay Unit
Lead-in Cable	Linear Foot

12. BASE MOUNTED EQUIPMENT CABINET

12.1. DESCRIPTION

Furnish and install base and pole mounted equipment cabinets and all necessary hardware in accordance with the Plans and Project Special Provisions.

12.2. MATERIALS

(A) Standards

Ensure that the equipment cabinets comply with the following standards:

- ANSI;
- ASTM;
- IMSA ;
- ISO 9001;
- NEC;
- NEMA TS-2; and
- UL listed.

(B) Functional

Furnish equipment cabinets meeting the following minimum requirements:

- Caltrans Type 332 for base mount and Caltrans Type 336 series for pole mount;
- D doors on both front and rear of cabinet;
- Fiber-optic splice centers (paid separately);
- Grounding bus bar;
- 19-inch rack system for mounting of all devices in the cabinet;
- Pull-out shelf for laptop and maintenance use;
- Maintenance access connections;
- Fluorescent lighting;
- Ventilation fans;
- 120VAC power supply;
- 120VAC ground fault circuit interrupter (GFCI)-protected duplex outlets for tools;
- 120VAC surge-protected duplex outlets for equipment;
- Lightning and surge protection on incoming and outgoing electrical lines (power and data);
- Managed Ethernet switch (paid separately);
- Power strip along vertical rail;
- UPS with sufficient capacity to hold hub's electrical load for 4 hours, (paid separately).

(C) Physical Features

(1) General

Provide cabinets that are completely weatherproof to prevent the entry of water. Provide cabinet and door exterior seams that are continuously welded and all exterior welds are smooth. Provide cabinets with two full-size doors with three hinges, or a full-length stainless steel piano hinge, with stainless steel pins spot-welded at the top. Provide hinges that utilize stainless steel hinge pins. Provide hinges that are mounted so that they cannot be removed from the door or

cabinet without first opening the door. Provide door and hinges braced to withstand a 100-pound per vertical foot of door height load applied vertically to the outer edge of the door when standing open. Ensure that there is no permanent deformation or impairment of any part of the door or cabinet body when the load is removed. Provide cabinet door fitted with a #2 Corbin lock. Provide two keys for each cabinet. Provide cabinet doors that are also pad lockable. Provide door openings that are double flanged on all four sides.

Provide cabinets constructed of unpainted sheet aluminum alloy H5052-H32 with a minimum thickness of 0.125 inch.

Provide doorstops at 90 and 180-degree positions. Ensure that both the door and the doorstop mechanism are of sufficient strength to withstand a simulated wind load of five pounds per square foot of door area applied to the both inside and outside surfaces without failure, permanent deformation, or compromising of door position and normal operation. Do not provide auxiliary police doors.

Ensure that cabinet doors include a gasket to provide a dust and weather-resistant seal when closed. Ensure that the gasket material is closed-cell neoprene and maintains its resiliency after exposure to the outdoor environment. Ensure that the gasket shows no sign of rolling or sagging, and provide a uniform dust and weather-resistant seal around the entire door facing.

Provide rails to create a cage to mount hardware, wiring panels and miscellaneous mounting brackets. Provide rails constructed of .1345-inch steel or .105-inch stainless steel. Provide rails with a keyhole design with slots 2 inches on center with a top opening of 5/8 inch in diameter to allow the insertion of a .625-inch by 1-inch carriage bolt. Ensure that the rails are 1.5 to 2 inches wide by .5 inches deep. Drill and tap the rails for 10-32 screws or rack screws with EIA universal spacing.

Provide rack assemblies that have a removable, standard 19-inch EIA compliant rack. The rack shall have a clearance between the rails of 17.5 inches.

Equip each cabinet with an aluminum storage compartment mounted in the rack assembly with the following dimensions (±0.5 inch): 16 inches wide, 14 inches long, and 1.75 inches deep. Provide compartment with ball-bearing telescoping drawer guides to allow full extension from the rack assembly. Ensure that when extended, the storage compartment opens to provide storage space for cabinet documentation and other miscellaneous items. Ensure that the storage compartment is of adequate construction to support a weight of 20 pounds when extended without sagging. Provide a top to the storage compartment that is hinged aluminum. Provide two (2) removable metal shelves with each cabinet.

(2) Base Mount Cabinet

Provide cabinets that include predrilled holes of standard diameter and bolt pattern with four (4) anchor bolts with each cabinet unit as part of the unit price bid. Provide a panel with each cabinet that matches the rest of the cabinet; and is held in place by four bolts provided with the panel. Drill or punch the panel to accommodate the bolts; the drill holes shall match the bolt pattern of the base cabinet of the cabinet. Provide a panel designed to be fitted in the interior of the cabinet and fabricated of the same material and thickness as the cabinet bottom.

Furnish a cabinet base extender with each cabinet that complies with the requirements of the "Cabinet Base Extender" section of these Project Special Provisions.

(3) Pole Mount Cabinet

Provide Caltrans Type 336A or 336S pole mount cabinets with full height internal rack assemblies. Size the cabinet for the equipment to be housed in it.

(D) Lighting

Provide the field cabinet with one 20-watt fluorescent lamp and clear shatterproof shield assembly which are mounted on the inside front and rear top of the cabinet. Ensure that these lamps are unobstructed and able to cast light on the equipment. Equip the field cabinet with door-actuated switches so that the lamps automatically turn on when either cabinet door is opened and go off when the doors are closed.

(E) Electrical

Provide a service panel assembly to function as the entry point for AC power to the cabinet and the location for power filtering, transient suppression, and equipment grounding. Provide AC isolation within the cabinet. Configure cabinet to accept 120 VAC from the utility company.

Provide circuit breakers that are UL listed and have an interrupt capacity of 5,000 amperes and insulation resistance of 100 MΩ at 500 VDC. Provide power distribution blocks that are suitable for use as power feed and as junction points for two and three wire circuits. Ensure that the line side of each block is capable of handling up to 2/0 AWG conductors. Ensure that the AC neutral and equipment ground wiring and terminal blocks are isolated from the line wiring by an insulation resistance of at least 10 MΩ when measured at the AC neutral.

Provide UL listed surge protection devices according to the UL 1449, 2nd edition standard that comply with the NEMA requirements as detailed in the NEMA LS 1 (1992) standard.

Provide branch circuits, surge protection devices, and grounding for the ITS device-connected load served by the cabinet, including ventilation fans, internal lights, electrical receptacles, etc., as shown on the Plans. Terminate field wiring on terminal blocks with the voltage and current rating of the terminal block is greater than the voltage and current rating of the wire fastened to it.

Furnish a power distribution assembly that fits in the EIA 19-inch rack and provides for protection and distribution of 120VAC power.

Ensure that ground bus bars are fabricated from a copper alloy material compatible with copper wire. Use ground bus bars that have at least two positions where a #6 AWG stranded copper wire can be attached.

Mount the ground bus bar on the side of the cabinet wall adjacent to the service panel assembly for the connection of AC neutral wires and chassis ground wires. If more than one ground bus bar is used in a cabinet, use a minimum of a #10 AWG copper wire to interconnect them.

Wire into the cabinet's circuitry the connector harnesses for the field equipment and other accessory equipment to be housed therein.

Terminate conductors on terminal blocks using insulated terminal lugs large enough to accommodate the conductor to be terminated. When two or more conductors are terminated on field wiring terminal block screws, use a terminal ring lug for termination of those conductors.

Number all terminal block circuits and cover the blocks with a clear insulating material to prevent inadvertent contact.

(F) Ventilation

Ensure the cabinet assembly can maintain the temperature and humidity within the environmental requirements of the Ethernet edge switches and other roadside equipment.

Include two cooling fans with 100 CFM, minimum capacity. Provide thermostats to be incorporated into the ventilation system. Mount fans in the top of the cabinet.

Provide the cabinets with vent openings in the lower portion of the door to allow convection cooling of electronic components. Cover them fully on the inside with a commercially available disposable three layer graded type filter. All air entering the cabinet must pass through the air filter.

(G) Environmental Requirements

Ensure the cabinet assembly can maintain the temperature and humidity within the environmental requirements of the equipment.

12.3. CONSTRUCTION METHODS

(A) General

Install equipment cabinets at locations identified in the Plans. Install the cabinets on foundations as identified in the Plans and the Standard Specifications.

Ground all cabinets in accordance with the requirements of these Project Special Provisions. Keep the ground wire from the cabinet ground bus bar to the ground rod assembly or array as short as possible. Ensure the ground wire is not in contact with any other part of the cabinet.

Ensure all cabinet wiring is tagged and identified by the use of insulated pre-printed sleeves and follows the project's cable identification scheme. Ensure that the wire markers identify usage in plain words with sufficient details without abbreviations or codes.

Use stranded copper for all conductors, including those in jacketed cables. Neatly arrange all wiring, firmly lace or bundle it, and mechanically secure the wiring without the use of adhesive fasteners. Route and secure all wiring and cabling to avoid sharp edges and to avoid conflicts with other equipment or cabling. Terminate all wiring on a terminal block, strip, bus bar, device clamp, lug, or connector. Do not splice any wiring. Label all wiring, cables, terminal strips, and distribution blocks with permanent and waterproof tags. Provide strain relief for all cabling with connectors, all cabling entering knockouts or ports at the equipment, and where appropriate.

Fasten all components of the cabinet assembly to be mounted on cabinet side panels with hex-head or Phillips-head machine screws. Install the screws into tapped and threaded holes in the panels. The components include, but are not limited to, terminal blocks; bus bars, panel and socket mounted TVSS, circuit breakers, accessory and equipment outlets, and DC power supply chassis. Configure each cabinet mounted UPS unit for remote monitoring from the scale house

Fasten all other cabinet components with hex-head or Phillips-head machine screws installed with nuts (with locking washer or insert) or into tapped and threaded holes. Fasten stud-mounted components to a mounting bracket providing complete access to the studs and mounting nuts. Ensure that all fastener heads and nuts (when used) are fully accessible within a complete cabinet

assembly, and any component is removable without requiring removal of other components, panels or mounting rails. Do not use self-tapping or self-threading fasteners.

Furnish and install a 48" 120 VAC power strip vertically along one of the rear rails of the communications rack. Provide a power strip that has at least eight outlets along its length.

Provide a cabinet that is ISO 9001 certified at the time of bid letting.

Equip cabinets with lightning and surge protection described separately in these Project Special Provisions.

Mount surge protection devices in the cabinet for the particular field devices that will be connected to that cabinet.

Terminate power service wire, video, and data cabling on the appropriate terminal strips, surge protection devices or jacks in the cabinet with insulated terminal lugs or connectors. Use a calibrated ratchet-type crimping tool to install the insulated terminal lugs onto the field wires.

Label spare circuits of the data cables and connect them to the cabinet ground bus bar.

Neatly bundle and identify all field wiring cables in the cabinet with permanent waterproof tags.

(B) Base Mount Cabinet

Locate cabinets so as not to obstruct sight distance of vehicles turning on red.

Install base mounted cabinets as shown on the Plans and as approved by the Engineer. Refer to the "Equipment Cabinet Foundations" section of these Project Special Provisions for installation requirements for the cabinet foundations. Install only the required number of conduits as shown on the Plans plus one additional spare stub out conduit. Position the ends of conduits approximately 2 inches above the finished surface of the concrete base.

Mount the cabinets on cabinet base extenders in accordance with the "Cabinet Base Extender" section of these Project Special Provisions.

(C) Pole Mount Cabinet

Mount the cabinet to a steel pole with approved hardware and attachment brackets. Mount the cabinet 4 feet from the ground to the center of the cabinet. Do not mount cabinets where one of its doors opens into a street, driveway, or other area subject to vehicular traffic or where an existing physical feature such as a pole, sign post, down guy, shrub or tree prevents its doors from being opened at least 90 degrees.

Ground all cabinets in accordance with the requirements of these Project Special Provisions. Keep the ground wire from the cabinet ground bus bar to the ground rod assembly or array as short as possible. Ensure the ground wire is not in contact with any other part of the cabinet.

12.4. 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.

Pole mounted equipment cabinet will be measured and paid as the actual number of pole 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 field equipment cabinet and integrate it with the CCTV equipment and / or wireless communications equipment as these will be considered incidental to furnishing and installing base mounted equipment cabinets.

Payment will be made under:

Pay Item	Pay Unit
Base Mounted Equipment Cabinet	Each
Pole Mounted Equipment Cabinet	Each

13. CABINET BASE EXTENDER

13.1. DESCRIPTION

Furnish and install cabinet base extenders with all necessary hardware.

13.2. MATERIALS

Fabricate base extenders from the same materials and with the same finish as cabinet housing. Fabricate base extender in the same manner as equipment cabinets, Provide base extenders that have a minimum height of 12".

13.3. CONSTRUCTION METHODS

Where the plans require a cabinet to be base mounted, install extender, as required. Use permanent, flexible waterproof sealing material to:

- Seal between cabinet base and cabinet base extender, and
- Seal space between cabinet base extender and foundation.

13.4. MEASUREMENT AND PAYMENT

Cabinet base extender will be measured and paid as the actual number of cabinet base extenders furnished, installed, and accepted.

Payment will be made under:

Pay Item	Pay Unit
Cabinet Base Extender	Each

14. EQUIPMENT CABINET FOUNDATIONS

14.1. DESCRIPTION

Furnish and install foundations for base-mounted equipment cabinets and all necessary hardware.

Furnish either poured concrete foundations or preformed cabinet pad foundations and all necessary hardware. Obtain approval of foundation type.

14.2. MATERIALS

Furnish preformed cabinet pad foundation material, equipment, and hardware under this section that is pre-approved on the ITS and Signals QPL.

Provide preformed cabinet pad foundations with 7"(l) x 18"(w) minimum opening for the entrance of conduits. For precast equipment cabinet foundations, include steel reinforcement to ensure structural integrity during shipment and placing of item. Include four 3/4" coil thread inserts for lifting. Comply with Article 1077-16 of the *Standard Specifications.*

Furnish cabinet foundations with chamfered top edges. Provide minimum Class B concrete in accordance with Article 1000-4, "Portland Cement Concrete for Structures and Incidental Construction", of the *Standard Specifications.*

Provide standard cabinet foundations in unpaved areas with a minimum pad area that extends 24" from front and back of cabinet base extenders, and 3" from sides of cabinet base extenders and adapters.

14.3. CONSTRUCTION METHODS

Comply with Section 825, "Incidental Concrete Construction – General," of the *Standard Specifications.*

Obtain approval for final cabinet foundation locations before pouring concrete base or installing a preformed cabinet base. Maintain 12 inches minimum from service pole to closest point on foundation unless otherwise approved.

Do not install foundations over uncompacted fill or muck. When using poured concrete foundations, use procedures, equipment, and hardware as follows:

- Hand tamp soil before placing concrete or preformed cabinet base and ensure ground is level.
- Use a minimum of four 1/2-inch diameter expanding type anchor bolts to secure cabinet to foundation.
- In unpaved areas, install cabinet foundations a minimum 4 inches above and 4 inches below finished grade. In paved areas, install foundations 1 inch above the paved surface at its highest point and 4 inches below the paved surface at its lowest point.
- Locate external stubbed out conduit at cabinet foundation so conduit is in middle of cabinet. Provide service conduit as the rightmost conduit coming into cabinet. Provide two spare conduits stubbed out; one pointed toward service pole and the other toward direction of lead-in cable. Inscribe identification arrow in foundation indicating direction of spare conduits.
- Ensure that conduits extend 2" to 3" above finished cabinet foundation.

- Give cabinet foundation a broom finish. Seal space between cabinet base and foundation with permanent, flexible, waterproof sealing material.
- If using preformed cabinet pad, use loop sealant to seal the conduit stub-outs within the knock-out.

Restore the disturbed ground surrounding the new cabinet foundation to its original, preconstruction condition as determined and approved by the Engineer.

- For paved areas, replace removed or damaged pavement with in kind materials, matching the elevation, color, texture/finish, and general appearance of the surrounding pavement. Replace concrete sidewalk in whole slabs from joint to joint and comply with Article 848-3 of the *Standard Specifications*. Replace sidewalk pavers using pavers of the same color, texture, shape, dimensions and materials as the damaged or modified items. Place graded stone material temporarily to maintain pedestrian traffic where repairs cannot be performed immediately. Comply with Article 545-4 of the *Standard Specifications.*
- For unpaved areas, backfill excavations with removed material, tamp the backfilled material and rake smooth the top 1½ inches. Finish unpaved areas flush with surrounding natural ground and to match the original contour of the ground. Seed with same type of grass as surrounding area and mulch the newly seeded area. If unpaved area was not grassed, replace the original ground cover in kind as directed by the Engineer.

14.4. MEASUREMENT AND PAYMENT

Equipment cabinet foundation will be measured and paid as the actual number of equipment cabinet foundations furnished, installed, and accepted.

No measurement or payment will be made for restoration of the surrounding unpaved ground surfaces in accordance with these Project Special Provisions as such work will be considered incidental to furnishing and installing equipment cabinet foundations.

Payment will be made under:

Pay Item	Pay Unit
Equipment Cabinet Foundation	Each

15. ENCLOSED COMMUNICATIONS RACK

15.1. DESCRIPTION

Furnish and install freestanding enclosed communications rack in the scale house net rack room.

15.2. MATERIALS

Provide an enclosed communications rack meeting these minimum performance requirements:

- All equipment shall comply with ANSI/EIA RS-310D,
- Provide frame and external components with zinc coating per ASTM B633,
- Paint interior and exterior components per RAL 7035, and
- The thermostatically controlled fans shall provide up to 300 cubic feet per minute (cfm) of exhaust. Thermostats shall monitor both humidity and temperature.

Provide enclosed communications racks meeting the following minimum material requirements:

- Full size rack cabinet for scale house net rack room 42 rack units high (approx. 78 inches nominal height of less base and wheels),
- Nominal depth: 30 inches,
- 19-inch EIA single-bay,
- Nominal 4-inch-high ventilated base,
- All-metal components,
- Full-height locking window door on the front,
- Urethane gaskets for window sealing,
- ¼-inch-thick lightweight thermoplastic shatter-resistant acrylic glass,
- Solid metal removable side panels with bottom vents,
- Full-height solid metal door for the back of each cabinet, and
- Vented top with three integral, thermostatically controlled, prewired fans.
- Set of four (4) heavy-duty, locking casters on base.

Mechanical: Construct all rack frames from 12-gauge, cold-formed steel. Construct all side panels and door panels of 14-gauge steel. Construct the vented base from 16-gauge steel. Construct the 19-inch electrical rack angles from 12-gauge steel.

Doors: Equip all doors with grounding brackets and doorstop kits. Door hinges shall have a maximum opening range of 130-140 degrees. Hinge kits shall permit left or right side mounting. Furnish the racks with tamper-proof hinges and removable hinge pins.

Provide the rack with flush swing handles with tamper resistant locks on all doors. Key all locks to the same key with two sets of keys provided for each unit. Locks shall have a three-point latch mechanism.

Wall Panels: Provide removable solid side panels with hanger tabs for easy alignment and assembly. Provide vents on front and rear panels, along with wire entry access plates with dust-tight seals.

Finish: Furnish factory-applied paint or powder-coating that is black in color on the exterior and interior of all components.

Furnish and install one metal shelf kit per communications rack. Provide each shelf the full width and depth of the rack angles and attach directly to the rack angles. Furnish and install one metal keyboard slide out drawer per full-height communications rack.

15.3. CONSTRUCTION METHODS

Ground the rack to a building ground.

Furnish and install an outlet strip and 10-foot power cord along one rear vertical rack frame. Furnish and install strips that use 120 VAC 60 Hz power and shall contain at least 10 outlets over the 70 inches for full size racks. Furnish and install grounding bus bar system to ground the rack-mounted electrical equipment. Equip door with grounding studs.

Furnish and install cable management hardware for attachment vertically along the rack frame and horizontally between 19-inch rack angles. Cable management hardware shall run vertically up one rear rack frame and shall include six horizontal runs per rack. Provide hardware including cable organizers and clamps to provide strain relief and cable mounting.

Install a communications rack cabinets in the scale house net rack room as shown in the Plans.

Install a keyboard shelf at a height comfortable for operator use when sitting on a stool. Provide tamper-resistant but removable screws through hinges and exterior panels. Furnish any special tools required to remove tamper resistant screws.

15.4. MEASUREMENT AND PAYMENT

Enclosed communications rack will be measured and paid as the actual number of enclosed communications racks furnished, installed, and accepted.

No separate measurement and payment will be made for rack set-up and assembly, mounting of all accessories and equipment specified for installation within the rack, all brackets, fasteners, and hardware required for properly mounting equipment in the rack, as such materials and work will be considered incidental to furnishing and installing the communications racks.

Payment will be made under:

Pay Item	Pay Unit
Enclosed Communications Rack	Each

16. METAL POLE SUPPORTS

16.1. DESCRIPTION

Furnish and install metal poles with hinged mast arms, monotube gantry structures, grounding systems, and all necessary hardware. The work covered by this special provision includes requirements for the design, fabrication, and installation of custom/site specifically designed metal pole supports and associated foundations.

Provide metal pole support systems that contain no guy assemblies, struts, or stay braces. Provide designs of completed assemblies with hardware that equals or exceeds AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals* 6th Edition, 2013 (hereafter called 6th Edition AASHTO), including the latest interim specifications. Provide assemblies with a round or near-round (18 sides or more) cross-section, or a multi sided cross section with no less than six sides. The sides may be straight, convex, or concave.

Pole heights and dimensions of mast arms and gantry monotubes shown in the Plans are estimated from available data for bid purposes. Prior to submitting shop drawings for approval, use field measurements and adjusted cross-sections to determine the pole dimensions (i.e. pole height, arm attachment height) necessary to obtain required clearances and adjust the dimensions on the Plans accordingly as necessary.

Ensure that metal poles permit cables to be installed inside poles and any required mast arms. For holes in the poles and arms used to accommodate cables, provide full-circumference grommets. Arm flange plate wire access holes should be deburred, non grommeted, and oversized to fit around the 2" diameter shaft flange plate wire access hole.

After fabrication, have steel poles, required mast arms, and all parts used in the assembly hot-dip galvanized per section 1076 of the *Standard Specifications*. Design structural assemblies with weep holes large enough and properly located to drain molten zinc during galvanization process. Provide hot-dip galvanizing on structures that meets or exceeds ASTM Standard A-123. Provide galvanizing on hardware that meets or exceeds ASTM Standard A-153. Ensure that threaded material is brushed and re-tapped as necessary after galvanizing. Perform repair of damaged galvanizing that complies with the following:

Repair of Galvanizing .....Article 1076-7

Applicable Standard Drawings for Metal Poles are available that supplement these Project Special Provisions. These drawings are located on the Department's website:
https://connect.ncdot.gov/resources/safety/pages/ITS-Design-Resources.aspx

Comply with article 1098-1B of the *Standard Specifications* for submittal requirements. Furnish shop drawings for approval. Provide the copies of detailed shop drawings for each type of structure as summarized below. Ensure that shop drawings include material specifications for each component and identify welds by type and size on the drawing details, not in table format. **Do not release structures for fabrication until shop drawings have been approved by NCDOT.** Provide an itemized bill of materials for all structural components and associated connecting hardware on the drawings.

Comply with article 1098-1A of the *Standard Specifications* for Qualified Products List (QPL) submittals. All shop drawings must include project location description, metal pole inventory number(s) and a project number or work order number on the drawings.

Summary of information required for metal pole review submittal:

Item	Hardcopy Submittal	Electronic Submittal	Comments / Special Instructions
Sealed, Approved ITS Plan/Pole Loading Diagram	1	1	Submit field elevation data that support dimensions shown on pole loading diagrams. All structure design information needs to reflect the latest approved ITS plans.
Custom Pole Shop Drawings	4 sets	1 set	Submit drawings on 11" x 17" format media. Show NCDOT inventory number(s) in or above the title block
Structure Calculations	1 set	1 set	Not required for Standard QPL Poles
Custom Foundation Drawings	4 sets	1 set	Submit drawings on 11" x 17" format media.
Foundation Calculations	1	1	**Submit LPile calculations per "Metal Pole Foundations" section of these Project Special Provisions.** Not required for Standard QPL Poles
Soil Boring Logs and Report	1	1	Report should include a location plan and a soil classification report including soil capacity, water level, hammer efficiency, soil bearing pressure, soil density, etc. for each pole.

NOTE – All shop drawings and custom foundation design drawings must be sealed by a Professional Engineer licensed in the state of North Carolina. All geotechnical information must be sealed by either a Professional Engineer or geologist licensed in the state of North Carolina. Include a title block and revision block on the shop drawings and foundation designs showing the NCDOT inventory number.

Shop drawings and foundation drawings may be submitted together or separately for approval. However, shop drawings must be approved before foundations can be reviewed. Foundation designs will be returned without review if the associated shop drawing has not been approved. Incomplete submittals will be returned without review.

16.2. MATERIALS

(A) General

Fabricate metal pole and arm shaft from coil or plate steel to meet the requirements of ASTM A 595 Grade A tubes. For structural steel shapes, plates and bars use A572 Gr 50 min or ASTM A709 Gr 50 min. Provide pole and arm shafts that are round in cross section or multisided tubular shapes and have a uniform linear taper of 0.14 in/ft. Construct shafts from one piece of single ply plate or coil so there are no circumferential weld splices. Galvanize in accordance with AASHTO M 111 or an approved equivalent.

Use the submerged arc process or other NCDOT previously approved process suitable for pole shaft and arms to weld continuously pole shafts and arm shafts along their entire length. The longitudinal seam weld will be finished flush to the outside contour of the base metal. Ensure shafts have no circumferential welds except at the lower end joining the shaft to the pole base and arm base. Provide welding that conforms to Article 1072-18 of the *Standard Specifications*, except that no field welding on any part of the pole will be permitted unless approved by a qualified engineer.

Refer to Metal Pole Standard Drawing Sheets M2 through M5 for fabrication details. Fabricate anchor bases from plate steel meeting, as a minimum, the requirements of ASTM A 36M or cast steel meeting the requirements of ASTM A 27M Grade 485-250, AASHTO M270 Gr 36 or an approved equivalent. Conform to the applicable bolt pattern and orientation as shown on Metal Pole Standard Drawing Sheet M2.

Ensure all hardware is galvanized steel or stainless steel. The Contractor is responsible for ensuring that the designer/fabricator specifies connecting hardware and/or materials that do not create a dissimilar metal corrosive reaction.

Provide a minimum of four (4) 1-1/2" diameter high strength bolts for connection between arm plate and pole plate. Increase number of bolts to six (6) 1-1/2" diameter high-strength bolts when arm lengths are greater than 50'-0" long.

Unless otherwise required by the design, ensure each anchor rod is 2" diameter and 60" length. Provide 10" minimum thread projection at the top of the rod, and 8" minimum at the bottom of the rod. Use anchor rod assembly and drilled pier foundation materials that meet the *Foundations and Anchor Rod Assemblies for Metal Poles* provision (SP09-R005) located at:

https://connect.ncdot.gov/resources/Specifications/Pages/Specifications-and-Special-Provisions.aspx

For each structural bolt and other steel hardware, hot dip galvanizing shall conform to the requirements of AASHTO M 232 (ASTM A 153). Ensure end caps for poles or mast arms are constructed of cast aluminum conforming to Aluminum Alloy 356.0F.

Provide a circular anchor bolt lock plate that will be secured to the anchor bolts at the embedded end with two washers and two nuts. Provide a base plate template that matches the bolt circle diameter of the anchor bolt lock plate. Construct plates and templates from ¼" minimum thick steel with a minimum width of 4". Galvanizing is not required for both plates.

Provide four heavy hex nuts and four flat washers for each anchor bolt. For nuts, use AASHTO M291 grade 2H, DH, or DH3 or equivalent material. For flat washers, use AASHTO M293 or equivalent material.

(B) Metal Pole

Provide steel poles as indicated on the plans. Comply with the following for Steel Poles:

- Have shafts of the tapered tubular type and fabricated of steel conforming to ASTM A-595 Grade A or an approved equivalent.
- Have galvanization in accordance with AASHTO M 111 or an approved equivalent.
- Have shafts that are continuously welded for the entire length by the submerged arc process, and with exposed welds ground or rolled smooth and flush with the base metal. Provide welding that conforms to Article 1072-18 of the *Standard Specifications* except that no field welding on any part of the pole will be permitted.
- Have anchor bases for steel poles fabricated from plate steel meeting as a minimum the requirements of ASTM A 36M or cast steel meeting the requirements of ASTM A 27M Grade 485-250 or an approved equivalent.

Provide a grounding lug near the base of the pole near the hand hole. Lugs must accept #4 or #6 AWG solid bare copper wire grounding conductor. Refer to Metal Pole Standard Drawing Sheet M6 for metal pole grounding details.

Have poles permanently stamped above the hand holes with the identification tag details as shown on Metal Pole Standard Drawing Sheet M2.

Fabricate poles from a single piece of steel with single line seam weld with no transverse butt welds. Fabrication of two-ply pole shafts is unacceptable with the exception of fluted shafts. Provide tapers for all shafts that begin at base and that have diameters, which decrease uniformly at the rate of not more than 0.14 inch per foot (11.7 millimeters per meter) of length.

Ensure that allowable pole deflection does not exceed that allowed per 6th Edition AASHTO. For mast arm poles (with primarily moment loads), ensure that maximum angular rotation of the top of the pole does not exceed 1° 40'.

Provide four anchor nuts and four washers for each anchor bolt. Ensure that anchor bolts have required diameters, lengths, and positions, and will develop strengths comparable to their respective poles.

Provide a terminal compartment with cover and screws in each pole that encompasses the hand hole and contains a 12-terminal barrier type terminal block. Provide two terminal screws with a removable shorting bar between them for each termination. Furnish terminal compartment covers attached to the pole by a sturdy chain or cable approved by the Engineer. Ensure that the chain or cable is long enough to permit the cover to hang clear of the compartment opening when the cover is removed, and is strong enough to prevent vandals from being able to disconnect the cover from the pole. Ensure that the chain or cable will not interfere with service to the cables in the pole base.

For each pole, provide a 1/2 inch minimum thread diameter, coarse thread stud, and nut for grounding which will accommodate #6 AWG ground wire. Ensure that the lug is electrically bonded to the pole and is conveniently located inside the pole at the hand hole.

Provide a removable pole cap with stainless steel attachment screws for the top of each pole. Ensure that the cap is cast aluminum conforming to Aluminum Association Alloy 356.0F. Furnish cap attached to the pole with a sturdy chain or cable approved by the Engineer. Ensure that the chain or cable is long enough to permit the cap to hang clear of the pole-top opening when the cap is removed.

(C) Monotube Gantry Structures

Provide pole support assemblies. Comply with the previous Section – Metal Pole—except as noted herein.

Provide pole plates and associated gussets and fittings for attachment of required monotube gantries. As part of each monotube gantries attachment, provide a cable passage hole in the pole to allow passage of cables from the pole to the arm.

Ensure that allowable monotube gantry deflection does not exceed that allowed per 6th Edition AASHTO.

Furnish all monotube gantry plates and necessary attachment hardware, including bolts and brackets.

Provide two extra bolts for each arm.

Provide grommet holes on the arms to accommodate cables for the equipment.

Provide monotube gantries with weatherproof connections for attaching to the shaft of the pole.

Provide hardware that is galvanized steel, stainless steel, or corrosive-resistant aluminum.

Fabrication of two ply pole shafts and monotube gantries is unacceptable with the exception of fluted members.

After all fabricating, cutting, punching, and welding are completed, hot-dip galvanize the structure in accordance with the AASHTO M 111 or an approved equivalent

(D) Metal Pole with Hinged Mast Arm

Provide pole support assemblies. Comply with the previous section – Metal Pole – except as noted herein. Provide hinged mast arm assemblies.

Provide pole plates and associated gussets and fittings for attachment of required mast arms. As part of each mast arm attachment, provide a cable passage hole in the pole to allow passage of cables from the pole to the arm.

Ensure allowable mast arm deflection does not exceed that allowed by 6th Edition AASHTO. Also, when arm is fully loaded, tip of the arm shall not go below the arm attachment point with the pole for all load conditions per 6th Edition AASHTO.

Furnish all arm plates and necessary attachment hardware, including bolts and brackets.

Provide two extra bolts for each arm.

Provide grommet holes on the arms to accommodate cables for the equipment.

Provide arms with weatherproof connections for attaching to the shaft of the pole.

Provide hardware that is galvanized steel, stainless steel, or corrosive-resistant aluminum.

Provide a removable end cap with stainless steel attachment screws for the end of each mast arm. Ensure that the cap is cast aluminum conforming to Aluminum Association Alloy 356.0F. Furnish cap attached to the arm with a sturdy chain or cable approved by the Engineer. Ensure that the chain or cable is long enough to permit the cap to hang clear of the arm end opening when the cap is removed.

Design and construct the metal poles with a hinge plate assembly as shown on the Plans. The hinge assembly shall allow maintenance crews to swing the mast arm horizontally away from the roadway for servicing of equipment attached to the mast arm from the shoulder. A metal pole with hinged mast arm of this type can be purchased from:

Union Metal Corporation
1432 Maple Ave., NE
PO Box 9920
Canton, OH 44705
(330) 456-7653

Atlantic Technical Sales
14522 – K Lee Road
Chantilly, VA 20151-1639
Tel: 703-631-6661

(E) Custom Design of Metal Pole Supports

(1) General:

Design metal pole supports with foundations consisting of metal poles with mast arms and monotube gantry structures.

The lengths of the metal poles shown on the plans are estimated from available data for bid purposes. Determine the actual length of each pole from field measurements and adjusted cross-sections. Furnish the pole heights to the Engineer. Use all other dimensional requirements shown on the Plans.

Ensure each pole includes an identification tag with information and location positions as defined on Metal Pole Standard Drawing Sheets M2, M3 and M4. All pole shaft tags must include the pole number shown on the ITS plan.

Design all metal pole support structures using the following 6th Edition AASHTO specifications:

- Design for a 50-year service life as recommended by Table 3-3.
- Use the wind pressure map developed from 3-second gust speeds, as provided in Article 3.8.
- Ensure support structures include natural wind gust loading and truck-induced gust loading in the fatigue design, as provided for in Articles 11.7.3 and 11.7.4, respectively. Designs need not consider periodic galloping forces.
- Assume the natural wind gust speed in North Carolina is 11.2 mph. For natural wind fatigue stress calculations, utilize a drag coefficient (C_d) computed for 11.2 mph wind velocity and not the basic wind speed velocity.
- Design for Category II fatigue, as provided for in Article 11.6, unless otherwise specified.
- Calculate all stresses using applicable equations from Section 5. The maximum allowable stress ratios for all support designs are 0.9.
- Conform to article 10.4.2 and 11.8 for all deflection requirements.

Ensure that the design permits cables to be installed inside poles, mast arms and gantry monotubes.

Unless otherwise specified by special loading criteria, compute ice load for all attachments to the mast arm in accordance with article 3.7 of AASHTO. Use projected areas and weights of loads defined in the Mast Arm Loading Schedule on the metal pole loading diagram shown on the Plans.

Ensure that designs provide a removable pole cap with stainless steel attachment screws for each pole top and mast arm end.

(2) Metal Poles:

Submit design drawings for approval. Show all the necessary details and calculations for the metal poles including the foundation and connections. Include pole inventory number on design drawings. Include as part of the design calculations the ASTM specification numbers for the materials to be used. Provide the types and sizes of welds on the design drawings. Include a Bill of Materials on design drawings. Ensure design drawings and calculations are signed, dated, and sealed by the responsible Professional Engineer licensed in the state of North Carolina.

Immediately bring to the attention of the Engineer any structural deficiency that becomes apparent in any assembly or member of any assembly because of the design requirements imposed by these specifications, the plans, or the typical drawings. Said Professional Engineer is wholly responsible for the design of all poles, arms, and monotubes. Review and acceptance of these designs by the Department does not relieve the said Professional Engineer of his responsibility. Do not fabricate the assemblies until receipt of the Department's approval of the design drawings.

For mast arm poles and monotube gantry structures, provide designs with provisions for pole plates and associated gussets and fittings for mast arm and monotube attachment. As part of each mast arm and monotube attachment, provide a grommeted 2" diameter hole on the shaft side of the connection to allow passage of cables from the pole to the arm/monotube.

Where ice is present, assume wind loads as shown in Figure 3-5 of the 6th Edition AASHTO Specification for Group III loading.

Design tapers for all pole shafts that begin at the base with diameters that decrease uniformly at the rate of 0.14 inch per foot of length.

Design a base plate on each pole. The minimum base plate thickness for all poles is determined by the following criteria:

Case 1: Circular or rectangular solid base plate with the upright pole welded to the top surface of base plate with full penetration butt weld, and where no stiffeners are provided. A base plate with a small center hole, which is less than 1/3 of the upright diameter, and located concentrically with the upright pole, may be considered as a solid base plate.

The magnitude of bending moment in the base plate, induced by the anchoring force of each anchor bolt is $M = (P \times D_1) / 2$, where

M = bending moment at the critical section of the base plate induced by one anchor bolt

P = anchoring force of each anchor bolt

D_1 = horizontal distance between the anchor bolt center and the outer face of the upright, or the difference between the bolt circle radius and the outside radius of the upright

Locate the critical section at the face of the anchor bolt and perpendicular to the bolt circle radius. The overlapped part of two adjacent critical sections is considered ineffective.

Case 2: Circular or rectangular base plate with the upright pole socketed into and attached to the base plate with two lines of fillet weld, and where no stiffeners are provided, or any base plate with a center hole that is larger in diameter than 1/3 of the upright diameter.

The magnitude of bending moment induced by the anchoring force of each anchor bolt is $M = P \times D_2$, where

P = anchoring force of each anchor bolt

D_2 = horizontal distance between the face of the upright and the face of the anchor bolt nut

Locate the critical section at the face of the anchor bolt top nut and perpendicular to the radius of the bolt circle. The overlapped part of two adjacent critical sections is considered ineffective.

If the base plate thickness calculated for Case 2 is less than Case 1, use the thickness calculated for Case 1.

The following additional owner requirements apply concerning pole base plates.

- Ensure that whichever case governs as defined above, the anchor bolt diameter is set to match the base plate thickness. If the minimum diameter required for the anchor bolt exceeds the thickness required for the base plate, set the base plate thickness equal to the required bolt diameter.
- For metal poles supporting a mast arm or monotube that is 50' or greater length, use a minimum 8-bolt orientation with 2" diameter anchor bolts, and a 2" thick base plate.
- For all metal poles with mast arms and gantry monotubes, use a full penetration groove weld with a backing ring to connect the pole upright component to the base. Refer to Metal Pole Standard Drawing Sheet M4.

Ensure that designs have anchor bolt holes with a diameter 1/4 inch larger than the anchor bolt diameters in the base plate.

Ensure that the anchor bolts have the required diameters, lengths, and positions, and will develop strengths comparable to their respective poles.

Provide designs with a 6 x 12-inch hand hole with a reinforcing frame for each pole.

Provide designs with a terminal compartment with cover and screws in each pole that encompasses the hand hole and contains provisions for a 12-terminal barrier type terminal block.

For each pole, provide designs with provisions for a 1/2 inch minimum thread diameter, coarse thread stud and nut for grounding which will accommodate a #6 AWG ground wire. Ensure the lug is electrically bonded to the pole and is conveniently located inside the pole at the hand hole.

(3) Mast Arms and Monotubes:

Design all arm plates and necessary attachment hardware, including bolts and brackets as required by the plans.

Design for grommeted holes on the arms and monotubes to accommodate the cables for the equipment mounted on the arms and monotubes.

Design arms and monotubes with weatherproof connections for attaching to the shaft of the pole.

Always use a full penetration groove weld with a backing ring to connect the mast arm or monotube to the pole. Refer to Metal Pole Standard Drawing Sheet M5.

Capacity of tapped flange plate must be sufficient to develop the full capacity of the connecting bolts. In all cases, the flange plate of both arm/monotube and shaft must be at least as thick as the arm connecting bolts are in diameter.

16.3. CONSTRUCTION METHODS

(A) General

Erect metal pole structure only after concrete has attained a minimum allowable compressive strength of 3000 psi. Install anchor rod assemblies in accordance with the *Foundations and Anchor Rod Assemblies for Metal Poles* provision (SP09-R005) located at:

https://connect.ncdot.gov/resources/Specifications/Pages/Specifications-and-Special-Provisions.aspx.

For further construction methods, see construction methods for Metal Poles, Metal Pole with Mast Arm, and Monotube Gantry Structure subsections below.

Connect poles to grounding electrodes and bond them to the electrical service grounding electrodes.

For holes in the poles used to accommodate cables, install grommets before wiring pole or arm. Do not cut or split grommets.

Attach the terminal compartment cover to the pole by a sturdy chain or cable. Ensure the chain or cable is long enough to permit the cover to hang clear of the compartment opening when the cover is removed, and is strong enough to prevent vandalism. Ensure the chain or cable will not interfere with service to the cables in the pole base.

Attach cap to pole with a sturdy chain or cable. Ensure the chain or cable is long enough to permit the cap to hang clear of the opening when the cap is removed.

Perform repair of damaged galvanizing that complies with the *Standard Specifications*, Article 1076-7 "Repair of Galvanizing".

Install galvanized wire mesh around the perimeter of the base plate to cover the gap between the base plate and top of foundation for debris and pest control.

Install a ¼" thick plate for concrete foundation tag to include: concrete grade, depth, diameter, and reinforcement sizes of the installed foundation.

(B) Metal Poles

Install metal poles, hardware, and fittings as shown on the manufacturer's installation drawings. Install metal poles so that when the pole is fully loaded it is within 2 degrees of vertical. Install poles with the manufacturer's recommended "rake". Use threaded leveling nuts to establish rake if required.

(C) Metal Pole With Hinged Mast Arm

Install horizontal-type arms with sufficient manufactured rise to keep arm from deflecting below the arm attachment height.

Attach cap to the mast arm with a sturdy chain or cable. Ensure that the chain or cable is long enough to permit the cap to hang clear of the arm opening when the cap is removed.

For mast arm poles, use full penetration welds with back-up ring at the pole base and at the arm base connection.

(D) Monotube Gantry Structure

Install monotube gantry with sufficient manufactured rise to keep arm from deflecting below the arm attachment height.

For monotube gantries, use full penetration welds with back-up ring at the pole base and at the arm base connection.

16.4. POLE NUMBERING SYSTEM

Attach an identification tag to each pole shaft, monotube gantry, and mast arm section as shown on Metal Pole Standard Drawing Sheet M2 "Typical Fabrication Details Common To All Metal Poles".

16.5. MEASUREMENT AND PAYMENT

Metal pole with hinged mast arm will be measured and paid as the actual number of metal poles with hinged mast arms furnished, installed, and accepted.

Metal poles with monotube gantry structure will be measured and paid as the actual number of metal poles with monotube gantry structures furnished, installed, and accepted.

Metal pole with hinged mast arm design will be measured and paid for as the actual number of designs for mast arms with metal poles furnished and accepted.

Metal pole with monotube gantry structure design will be measured and paid for as the actual number of designs for metal poles with monotube gantry structure furnished and accepted.

No measurement will be made for metal pole foundation designs as these will be considered incidental to furnishing and installing the metal pole foundations (see "Metal Pole Foundations" section of these Project Special Provisions).

Payment will be made under:

Pay Item	Pay Unit
Metal Pole with Hinged Mast Arm	Each
Metal Poles with Monotube Gantry Structure	Each
Metal Pole with Hinged Mast Arm Design	Each
Metal Poles with Monotube Gantry Structure Design	Each

17. METAL POLE FOUNDATIONS

17.1. DESCRIPTION

Furnish and install foundations for metal poles with mast arms and metal poles supporting monotube gantry structures with all necessary hardware in accordance with the Plans and specifications.

17.2. GENERAL REQUIREMENTS

Analysis procedures and formulas shall be based on AASHTO, ACI code and per FHWA manuals. Design methods based on engineering publications or research papers needs to have prior approval from NCDOT. The Department reserves the right to accept or disapprove any method used for the analysis.

Use a Factor of Safety of 1.33 for torsion and 2.0 for bending for the foundation design.

Foundation design for lateral load shall not exceed 1" lateral deflection at top of foundation.

Design all custom foundations to carry the maximum capacity of each metal pole.

When poor soil conditions are encountered which could create an excessively large foundation design, consideration may be given to allowing an exemption to the maximum capacity design. The contractor must gain approval from the engineer before reducing a foundation's capacity. On projects where poor soil is known to be present, it is advisable that the contractor consider getting foundations approved before releasing poles for fabrication.

Notify the Engineer if the proposed foundation is to be installed on a slope other than 8H: 1V or flatter.

Design the foundation to conform to the applicable provisions in the NCDOT Metal Pole Standards and Section 17.3 (D) (Non-Standard Foundation Design) below.

17.3. DRILLED PIER FOUNDATIONS FOR METAL POLES

(A) General

Drilled piers are reinforced concrete sections, cast-in-place against in situ, undisturbed material. Drilled piers are of straight shaft type and vertical.

For non-standard site-specific poles, the contractor-selected pole fabricator will determine if the addition of wing walls is necessary for the supporting foundations to resist torsional rotation. If wing walls are found to be necessary, contact the Engineer.

(B) Soil Test

Perform a soil test at each proposed metal pole location. Complete all required fill placement and excavation at each pole location to finished grade before drilling each boring. Soil tests performed that are not in compliance with this requirement may be rejected and will not be paid. Drill one boring to a depth of 26 feet within a 25-foot radius of each proposed foundation.

Perform standard penetration tests (SPT) in accordance with ASTM D 1586 at depths of 1, 2.5, 5, 7.5, 10, 15, 20, and 26 feet. Discontinue the boring if one of the following occurs:

- A total of 100 blows have been applied in any 2 consecutive 6-in. intervals, or
- A total of 50 blows have been applied with < 3-in. penetration.

Describe each soil test location with the following information: "Intersection of *(Route or SR #), (Street Name)* and *(Route or SR #), (Street Name)*," or "Route *#, STA # or Mile #, travel direction (i.e., NB/SB/EB/WB, if divided roadway) offset distance and direction (left or right)* "_____ *County, Pole Inventory No.* _____". In lieu of intersection-based information, the Contractor may use device number from the Plans. Pole numbers should be made available to the Drill Contractor. Include pole numbers in the boring label if they are available. If they are not available, ensure the boring labels can be cross-referenced to corresponding pole numbers. For each boring, submit a legible (handwritten or typed) boring log signed by a licensed Geologist or Professional Engineer registered in North Carolina. Include on each boring the SPT blow counts and N-values at each depth, depth of the boring, hammer efficiency and a general description of the soil types encountered.

(C) Determination of Design N Value:

Use the following method for determining the Design N-value:

$$N_{AVG} = \frac{(N@1' + N@2.5' + \ldots\ldots N@\text{Deepest Boring Depth})}{\text{Total Number of N-values}}$$

$$Y = (N@1')^2 + (N@2.5')^2 + \ldots\ldots (N@\text{Deepest Boring Depth})^2$$

$$Z = (N@1' + N@2.5' + \ldots\ldots N@\text{Deepest Boring Depth})$$

$$N_{STD\ DEV} = \left[\frac{(\text{Total Number of N-values} \times Y) - Z^2}{(\text{Total Number of N-values}) \times (\text{Total Number of N-values} - 1)} \right]^{0.5}$$

Design N-value equals lesser of the following two conditions:

$N_{AVG} - (N_{STD\ DEV} \times 0.45)$

Or

$$\text{Average of First Four N-Values} = \frac{(N@1' + N@2.5' + N@5' + N@7.5')}{4}$$

Note: If less than 4 N-values are obtained because of criteria listed in Section (B) above, use average of N-values collected for second condition. Do not include the N-value at the deepest boring depth for above calculations if the boring is discontinued at or before the required boring depth because of criteria listed in Section (B) above. Use N-value of zero for weight of hammer or weight of rod. If N-value is greater than 50, reduce N-value to 50 for calculations.

Submit completed boring logs collected in accordance with Section (B) (Soil Test) above along with pole loading diagrams from the Plans to the contractor-selected pole fabricator to assist in the pole and foundation design.

If one of the following occurs, contact the Engineer.

- The Design N-value is less than 4.
- The drilled pier length, "L" is greater than the depth of the corresponding boring.

Foundation designs are based on level ground around the pole. If the slope around the edge of the drilled pier is steeper than 8:1 (H:V) or the proposed foundation will be less than 10 feet

from the top of an embankment slope, the Contractor is responsible for providing slope information to the foundation designer and to the Engineer so it can be considered in the design.

If assistance is needed, contact the Engineer.

(D) Non-Standard Foundation Design:

Design non-standard foundations based upon site-specific soil test information collected in accordance with Section (B) (Soil Test) above. Design drilled piers for side resistance only in accordance with Section 4.6 of the *AASHTO Standard Specifications for Highway Bridges*. Use the computer software LPILE version 5.0 or later manufactured by Ensoft, Inc. to analyze drilled piers. Use the computer software gINT version 8.0 or later manufactured by Bentley Systems, Inc. with the current NCDOT gINT library and data template to produce SPT boring logs. Provide a drilled pier foundation for each pole with a length and diameter that result in a horizontal lateral movement of less than 1 inch at the top of the pier and a horizontal rotational movement of less than 1 inch at the edge of the pier. Submit foundation designs including drawings, calculations, and soil boring logs to the Engineer for review and approval before construction. Foundations installed without prior approval may be rejected.

17.4. DRILLED PIER CONSTRUCTION

(A) General

Construct drilled pier foundations in accordance with the *Foundations and Anchor Rod Assemblies for Metal Poles* provision (SP09-R005). This provision is located at:

https://connect.ncdot.gov/resources/Specifications/Pages/Specifications-and-Special-Provisions.aspx

17.5. MEASURMENT AND PAYMENT

Soil test will be measured and paid as the actual number of soil tests with SPT borings drilled, furnished, and accepted.

Drilled pier foundation will be measured and paid as the actual volume of concrete poured in cubic yards of drilled pier foundation furnished, installed, and accepted.

No measurement will be made for structural design analysis as this will be considered incidental to the soil test and drilled pier foundation or foundation with wing walls.

Payment will be made under:

Pay Item	Pay Unit
Soil Test	Each
Drilled Pier Foundation	Cubic Yard

18. ETHERNET CABLE

18.1. DESCRIPTION

Furnish and install copper Ethernet cable, as shown in the Plans, for interconnecting various hardware in an Ethernet network located between the equipment cabinets, CCTV cabinets and the scale house.

18.2. MATERIALS

(A) Ethernet Cable

Provide Category 5 Enhanced (5e) Ethernet cable that complies with ANSI/TIA-568-A-5 standards for four-pair shielded twisted copper for Ethernet communications. The cable shall meet all of the mechanical requirements of ANSI/ICEA S-80-576 applicable to four-pair inside wiring cable for plenum or general cabling.

Furnish Ethernet cable meeting the following minimum performance requirements:

- Specified frequency range: 1-100 MHz
- Attenuation: 24 dB
- NEXT: 37.1 dB
- ACR: 3.1 dB
- ELFEXT: 17 dB
- Power-sum ELFEXT: 14.4 dB
- Return loss: 8 dB
- Propagation delay: 548 nsec
- Delay skew: 50 nsec

Furnish Ethernet cable meeting the following physical requirements:

- Jacket: PVC, UV resistant
- Insulation: Polyolefin
- Core: Gel-filled or flooded core
- Binder: Clear mylar with 100% coverage
- Shield: Aluminum/mylar with 100% coverage
- Drain Wire: 24 AWG, seven stranded tinned copper
- Conductors: Annealed bare copper
- Conductor size: 24 AWG

For Ethernet cable installed in outdoors in underground conduits, provide the cable rated for such conditions (i.e., UV-resistant, wet conditions, etc.).

(B) Connectors

Provide RJ-45 connectors with gold wire conductors terminated according EIA/TIA-568-A/568-B standards. Provide connectors with eight contacts. Furnish connectors appropriately rated for the cable being installed. Provide cables with factory-installed connectors for interior cables.

(C) LAN Patch Panel

Furnish a 24-port LAN patch panel in the scale house net rack room. All ITS Ethernet cabling in the scale house and scale booth shall terminate in this LAN patch panel. The quantity of Ethernet ports may be provided in 12 increment size patch panels. The patch panels shall be designed for Category 5e cable and shall meet TIA/EIA-568-A-5 Category 5e and ISO 11801 Class D standards. The cables shall terminate on the patch panel with Type 110 insulation displacement connectors. All ports shall be RJ-45 eight-wire jacks.

Furnish patch panel with write-on areas for port and panel identification.

(D) Ethernet Patch Cords

Furnish Fast Ethernet patch cords meeting the following physical requirements:

- Minimum of five (5)-foot length,
- Category 5e,
- RJ-45 connectors on both ends,
- Molded anti-snag hoods over connectors, and
- Gold plated connectors.

Furnish Ethernet patch cords meeting the following minimum performance requirements:

- TIA/EIA-568-A-5, Additional Transmission Performance Specifications for 4-pair 100 Ω Enhanced Category 5e Cabling.
- Frequency Range: 1-100 MHz.
- Near-End Crosstalk (NEXT): 30.1 dB.
- Power-sum NEXT: 27.1 dB.
- Attenuation to Crosstalk Ratio (ACR): 6.1 dB.
- Power-sum ACR: 3.1 dB.
- Return Loss: 10 dB. and
- Propagation Delay: 548 nsec.

(E) Network Interface Boxes

Network interface boxes for the Ethernet Category5e cabling is included in the building plans as shown in the Plans. Provide faceplates and RJ-45 with dual jacks in each network interface box shown in the Plans. Faceplate colors shall match those of other electrical and network outlet boxes in the scale house. Label the boxes as ITS.

(F) Environmental Requirements

(1) Outdoor Cable

Provide 4-pair twisted copper Ethernet cable and connectors rated for an ambient operating temperature range of -30° to 165° 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.

(2) Interior Cable

Provide 4-pair twisted copper Ethernet cable and connectors rated for an ambient operating temperature range of -30° to 165° F. Furnish factory pre-terminated/pre-connectorized Ethernet cables whenever possible. Provide factory pre-connectorized Ethernet cables for all cables that are less than or equal to 12 feet in length.

18.3. CONSTRUCTION METHODS

(A) General

Install Category 5e Ethernet cable for equipment cabinets, CCTV cabinets, and network devices in the scale house.

Furnish all tools, equipment, materials, supplies, and hardware necessary to install an operational Ethernet cable system as depicted in the Plans. Install the Ethernet cable according to the latest version of the manufacturer's cable installation procedures and the industry accepted installation standards, codes, and practices, or as directed by the Engineer.

Take all precautions necessary to ensure the Ethernet cable is not damaged during storage and installation. Do not step on the cable nor run over the cable with vehicles or equipment. Do not pull the cable over or around obstructions or along the ground.

Immediately cease work and notify the Engineer and the affected owner should damage to existing cables or equipment occur. Make the required repairs at no additional cost to the Department.

Provide the Engineer with three copies of the Ethernet cable manufacturer's recommended and maximum pulling tensions for each Ethernet cable size before the installation of Ethernet cable.

Install Ethernet cable in continuous lengths with no splices outside cabinets.

Cut cables to length to minimize coils of spare cable. Cut outer jacket and trim conductors per manufacturer's recommendations. Ensure all conductors extend to the end of the channel and make solid electrical contact with the gold connectors. Crimp the RJ-45 connector body to lock conductors in channels.

(B) Underground Installation

Install underground Ethernet cable as shown in the Plans using cable-pulling lubricants approved by the Ethernet cable manufacturer and the Engineer. Obtain the Engineer's approval of the cable lubricant and method of pulling before the installation of underground Ethernet cable.

Do not exceed 80 percent of the manufacturer's maximum pulling tension when installing underground Ethernet cable.

Use a clutch device (dynamometer) with breakaway swivel 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.

Set cable reels up on the same side of the junction box as the conduit section in which the cable is to be installed. Place the reel level and align the reel with the conduit section such that the cable will pass from the top of the reel in a smooth bend into the conduit without twisting. Do not pull the cable from the bottom of the reel. Manually feed the cable by rotating the reel. Do

not pull the cable through intermediate junction boxes, pull boxes, handholes, or openings in conduit unless otherwise approved by the Engineer.

Crimp the RJ-45 connector body to lock conductors in channels. Test each connector from end to end.

(C) LAN Patch Panel

Install the rack mounted patch panel in scale house net rack room. All ITS Ethernet cabling in the scale house and scale booth shall terminate in this LAN patch panel.

Terminate the cable from the ITS network interface boxes on the proposed patch panel.

Remove one inch of cable jacket. Fan out all four twisted pairs in the specified wiring sequence. Minimize removal of cable jacket. Follow manufacturer's installation instructions for cable termination and panel assembly. Punch down the conductors using a manufacturer's recommended tool. Terminate field wiring and secure with cable management hardware.

(D) Network Interface Boxes

For the ITS network interface boxes, install faceplates and RJ-45 with dual jacks in each network interface box shown in the Plans.

(E) Ethernet Patch Cords

Install Ethernet patch cords between Ethernet patch panels and devices and network interface box and devices.

18.4. MEASUREMENT AND PAYMENT

Ethernet cable will be measured and paid as the actual linear feet of Ethernet cable furnished, installed, and accepted. Measurement will be made by calculating the difference in length markings located on network interface boxes outer jacket from start of run to end of run for each run. No measurement will be made for , RJ-45 jacks and faceplates and as such work is considered incidental to installing the Ethernet cable.

Patch panel (Ethernet) will be measured and paid as the actual number of Ethernet LAN patch panels furnished, installed, and accepted.

No measurement will be made of the following Ethernet patch cables, as they will be considered incidental to furnishing and installing the equipment that they connect:

- Ethernet patch cables that connect adjacent devices/equipment (e.g., between an edge switch and a network device housed in the same cabinet);
- Ethernet patch cables between equipment housed in the same or adjacent equipment racks in the scale house net rack room or in the under counter cabinet racks in the scale room;
- Ethernet patch cables between a computer or server and a network interface box; and
- Ethernet patch cables between equipment housed in the same room such in the scale house scale room.
- Ethernet patch cables between equipment housed in the scale booth.
- Ethernet patch cables between any two pieces of equipment in roadside cabinets.

Payment will be made under:

Pay Item	Pay Unit
Ethernet Cable	Linear Foot
Patch Panel (Ethernet)	Each

19. CCTV FIELD EQUIPMENT

19.1. DESCRIPTION

Furnish and install CCTV field equipment, cabinets, and local camera control software described in this Section.

Furnish dome cameras for locations identified on the Plans for mounting on wood poles. Furnish one dome camera for wall mounting in the inspection building. Furnish three cameras with barrel enclosure for mounting in the inspection pit in the inspection building

Furnish and install new electrical service for CCTV-01 as shown in the Plans.

Provide a system to protect field devices and electronic equipment from lightning and surge protection using UL listed surge protection devices.

19.2. MATERIALS

(A) General

Provide new CCTV camera assemblies with composite cable and CCTV cabinets as shown in the Plans.

Each CCTV camera assembly shall consist of the following:

- NEMA environmental dome enclosure,
- CCTV color digital signal processing camera unit with zoom lens, filter, control circuit, and accessories,
- Control receiver/driver that complies with the NTCIP specifications listed below,
- Motorized pan, tilt, and zoom,
- Power supplies,
- Pole-mount camera attachment hardware,
- All necessary cable, connectors and incidental hardware to make a complete and operable system,
- NEMA Type 4, IP 66 enclosure constructed of aluminum with a clear acrylic dome or approved equal camera unit housing,
- 60-foot composite cable for power supply and video and data transmission, and
- Surge protection devices.

Each CCTV cabinet assembly, except where noted on the Plans, shall consist of the following:

- Type 336A pole-mounted cabinet.
- Local interface panel,
- Power supplies/transformers,
- Transient voltage surge suppressors, and
- All necessary cable, connectors, and incidental hardware to make a complete and operable system.

(B) Standards

- ANSI,
- ASTM,

- CE, Class B,
- EIA Standards 170, 232, 422, 250C and 485,
- FCC Rules Part 15, Sub-part J,
- FCC Class A,
- FCC, Class B,
- IEEE,
- ICEA,
- IMSA,
- ISO 9001,
- NEC,
- NEMA 4X, IP 66,
- NEMA Type 1,
- NTSC, and
- UL Listed.

Provide UL listed surge protection devices according to the UL 1449, 2nd edition standard that comply with the NEMA requirements as detailed in the NEMA LS 1 (1992) standard.

Provide a means to ground all equipment as called for in the Standard Specifications, these Project Special Provisions, and the Plans.

(C) Camera Assembly

(1) Cameras

General

Provide new charged-coupled device (CCD) color day/night cameras. Provide cameras with automatic gain control (AGC) for clear images in varying light levels. The camera must meet the following minimum requirements:

- Video signal format: NTSC composite color video output, 1 volt peak to peak,
- Min. horiz. resolution: 540 TV Lines,
- Min. image sensor resolution: 768 horizontal pixels by 752 vertical pixels,
- White balance: Automatic through the lens with manual override,
- Gain control: Automatic and manual,
- Sync system: Internal AC line lock, phase adjustable using remote control, V-sync,
- Overexposure protection: Built-in circuitry or a protection device to prevent any damage to the camera when pointed at strong light sources, including the sun,
- Video output connection: 1-volt peak to peak, 75 ohms terminated, BNC connector,
- Primary voltage: 120 VAC, and
- Camera voltage: 24 VDC.

Dome Camera

Provide new ¼-inch CCD. The dome camera must meet the following minimum requirements:

- Image sensor resolution: 768 horizontal pixels by 752 vertical pixels,

- Automatic gain control (AGC): 0-20 dB, peak-average adjustable,
- Electronic-shutter: Dip-switch selectable NTSC electronic shutter with speed range from 1/2 of a second (off) to 1/30,000 of a second (NTSC),
- Sensitivity: 1.5 lux at 90% scene reflectance,
- Signal to noise ratio: Greater than 50 dB,
- Camera power: 73 VA with heater at 24 VAC or 3A at 24 VDC.

Barrel Camera

Provide new 1/3 CCD. The barrel cameras must meet the following minimum requirements:

- Automatic gain control (AGC): 0-20 dB, peak-average adjustable,
- Sensitivity: .25 lux at 90% scene reflectance,
- Electronic-shutter: Dip-switch selectable NTSC electronic shutter with speed range from 1/60 of a second (off) to 1/10,000 of a second (NTSC), and
- Signal to noise ratio: Greater than 48 dB.

(2) Lens

a) Dome Camera

Provide each dome camera with a motorized zoom lens with automatic iris control with manual override and neutral density spot filter. Provide lenses that meet the following optical specifications:

- Automatic focus: Automatic with manual override,
- Horizontal angle of view: 54 degrees at 3.6 mm wide zoom and 2.5 degrees at 82 mm telephoto zoom,
- Focal length: 3.6 mm to 124 mm, 35X optical zoom, 12X electronic zoom,
- Zoom Speed: 2.9, 4.2 and 5.8 seconds,
- Lens aperture: Minimum of f/1.6,
- Maximum Sensitivity at 35 IRE: .025 lux at ½ second color, .1 lux at 1/60 second black and white, .004 lux at ½ sec. black and white,
- Preset positioning: Minimum of 128 presets.

The lens must be capable of both automatic and remote manual control iris and focus override operation. The lens must be equipped for remote control of zoom and focus, including automatic movement to any of the preset zoom and focus positions. Provide mechanical or electrical means to protect the motors from overrunning in extreme positions. The operating voltages of the lens must be compatible with the outputs of the camera control.

b) Barrel Camera

Provide each barrel camera with a fixed focus lens with automatic iris control with manual override and neutral density spot filter. Provide lenses that meet the following optical specifications:

- Automatic focus: Automatic with manual override,
- Angle of view: Horizontal 72 degrees, vertical 52 degrees,
- Focal length: 5.5 to 82 mm, and

- Zoom ratio: 15x
- Lens aperture: Minimum of f/1.8.

The lens must be capable of both automatic and remote manual control iris and focus override operation. The lens must be equipped for remote control of zoom and focus, including automatic movement to any of the preset zoom and focus positions. Provide mechanical or electrical means to protect the motors from overrunning in extreme positions. The operating voltages of the lens must be compatible with the outputs of the camera control.

(3) Pan and Tilt Unit

Equip each new dome style assembly with a pan and tilt unit. Equip each new dome style assembly with a pan and tilt unit. The pan and tilt unit must be integral to dome system. The pan and tilt unit must be rated for outdoor operation, provide dynamic braking for instantaneous stopping, prevent drift, and have minimum backlash. The dome must have an auto flip dome rotation to rotate and reposition camera for viewing objects passing below camera. Provide electronic image stabilization. The pan and tilt units must meet or exceed the following specifications:

- Pan: Continuous 360 degrees,
- Tilt: +2 to -92 degrees minimum,
- Presets: Minimum of 128 presets,
- Preset accuracy: .1 degree,
- Preset pan speed: .1 degrees/second to 200 degrees/second,
- Preset tilt speed: .1 degrees/second to 400 degrees/second,
- Privacy zones: Minimum of eight user configurable shapes,
- Input voltage: 24 VDC or 24 VAC, and
- Motors: Two-phase induction type, continuous duty, instantaneous reversing.

(4) Fixed Barrel Camera

Barrel cameras shall not have a pan-tilt unit but they shall be fixed and mounted in an indoor rated enclosure for wall mounting.

(5) Power Supplies

Provide all power supplies necessary for the camera and its pan tilt unit. Mount power supplies in the camera cabinet and utilize composite cable to supply power the camera and pan tilt unit.

(6) Control Receiver/Driver

Each new camera unit must contain a control receiver/driver that is integral to the CCTV assembly. The control receiver/driver must receive serial asynchronous data initiated from a camera control unit, decode the command data, perform error checking, and drive the pan/tilt unit, camera controls, and motorized lens. As a minimum, the control receiver/drivers must provide the following functions:

- Zoom in/out,
- Automatic focus with manual override,
- Tilt up/down,
- Automatic iris with manual override,

- Pan right/left, and
- Minimum of 128 preset positions for pan, tilt, and zoom.

In addition, each control receiver/driver must accept status information from pan/tilt unit and motorized lens for preset positioning of those components. The control receiver/driver must relay pan, tilt, zoom, and focus positions from the field to remote camera control units. The control receiver/driver must accept "goto" preset commands from the camera control unit, decode the command data, perform error checking, and drive the pan/tilt and motorized zoom lens to the correct preset position. The preset commands from the camera control unit will consist of unique values for the desired pan, tilt, zoom, and focus positions.

(7) Camera Housing

a) General

Provide surge protectors for all ungrounded conductors that will enter the CCTV enclosure as described below. House the surge protectors within the CCTV housing in a manner approved by the Engineer.

The enclosures shall have a NEMA 4X/IP-66 rating.

A dome-type environmental housing shall have a sustained ambient operating temperature of -50 degrees F to 122 degrees F, with 100 percent non-condensing relative humidity as defined within the NEMA TS-2 (1998) standard.

b) Dome Camera

Provide new dome style enclosure for assemblies with a high performance integrated dome system or approved equal. Provide the dome housing with a 1½" NPT threaded cable entry. Equip each camera housing with a mounting assembly for attachment to the CCTV camera pole. The enclosures must be equipped with a strip heater. Provide a sunshield fabricated from corrosion resistant aluminum and finished in a neutral color of weather resistant enamel. The viewing area of the enclosure must be tempered glass.

c) Barrel Camera

Provide new die-cast aluminum, integrated barrel or bullet style enclosures. The enclosures shall be a rugged, vandal resistant design. Provide the housing with an adaptor plate for a 6" nominal size conduit box mounting.

(D) Composite Cable

Provide a composite cable for carrying the CCTV power, analog video and serial data between the camera and CCTV cabinet. The composite cable shall consist of:

- Outer jacket composed of UV resistant PVC,
- RG-59U coaxial cable
  - Maximum outer diameter .75 in.,
  - PVC jacket,
  - 75 ohm rating,
  - Nominal capacitance of 17.5 pF/ft.,
  - 22 AWG stranded copper center conductor,
  - Bare copper stranded shield.

- Data cable
  - 22 AWG stranded cable,
  - Two twisted pairs,
  - Nominal capacitance of 26 pF/ft.,
  - Nominal impedance of 55 ohms,
  - Common shield/drain wire.
- Power Cable,
  - 16 AWG,
  - Four wire, and
  - THWN stranded.

(E) Camera Mounting Bracket

a) Dome Camera

Provide attachment assemblies for the CCTV dome camera unit to mount on walls, wood poles, metal poles, and metal mast arms. The attachment assemblies shall use stainless steel banding around the pole approved by the Engineer.

Provide the CCTV attachment assembly that allows for the removal and replacement of the CCTV enclosure as well as providing a weatherproof, weather-tight, seal that does not allow moisture to enter the enclosure.

Provide CCTV camera attachment assembly that is able to withstand wind loading at the maximum wind speed and gust factor called for in the interim revision of the 2013 ASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals* and can support a minimum camera unit dead load of 45 pounds.

b) Barrel Camera

Provide an attachment assembly for the CCTV barrel camera unit to mount to the underside of the metal stair tread and connect to an electrical conduit box. The attachment assembly shall be approved by the Engineer.

Provide the CCTV attachment assembly that allows for the removal and replacement of the CCTV enclosure as well as providing a weatherproof, weather-tight, seal that does not allow moisture to enter the enclosure.

(F) Camera Cabinet

(1) General

Provide cabinets to house CCTV related and communications equipment described herein. Provide the cabinets with a 19-inch communications rack for all equipment.

Provide Type 336A CCTV cabinets that provide for and meet the following minimum requirements:

- Ethernet edge switch (paid for separately),
- Digital video encoder (paid for separately),
- Termination of the composite cable to the camera,
- Local interface panel with maintenance access points for data and video connections to observe camera images and program/monitor camera status,
- Fiber-optic interconnect center (paid for separately),
- Grounding bus bar,

- 19-inch rack system for mounting of all devices in the cabinet,
- Pull-out shelf for laptop and maintenance use,
- Stationary shelf for shelf-mounting the digital video encoder and Ethernet edge switch,
- Fluorescent lighting,
- Ventilation fan,
- Thermostats,
- 120 VAC power supply,
- 120 VAC GFCI-protected duplex outlets for tools,
- 120 VAC surge protected duplex outlets for equipment,
- Surge protection on incoming and outgoing electrical lines (power and data),
- Transformers/power supplies, and
- Power strip along vertical rail.

Provide cabinets complete with a prefabricated cabinet shell, and all internal components and equipment, back and side panels, front and back doors, terminal strips, cabling and harnesses, surge protection for power and communication circuits, power distribution blocks or assemblies, shelves, connectors and all mounting hardware necessary for installation of equipment.

Provide the cabinets using unpainted sheet aluminum with a minimum thickness of 0.125 inch.

Provide the rack assembly with a removable, standard 19-inch EIA compliant rack. Equip each cabinet with an aluminum storage compartment mounted in the rack assembly with the following dimensions (±0.5 inch): 16 inches wide, 14 inches long, and 1.75 inches deep. Provide the compartment with a ball bearing telescoping drawer guides to allow full extension from the rack assembly. The storage compartment shall open to provide a full-depth storage space for cabinet documentation and other miscellaneous items. The storage compartment shall be of adequate construction to support a weight of 20 pounds without sagging when extended. The top of the storage compartment shall be hinged aluminum. Provide at least one removable metal a full-depth shelf with each cabinet.

Provide all cabinets and exterior door seams with continuously welded seams and with smooth exterior welds. Provide all cabinets with two (2) full-size doors (one front, one back). Provide the doors with three hinges, or a full-length stainless steel piano hinge, with stainless steel pins spot-welded at the top. The hinges shall utilize stainless steel hinge pins. Mount the hinges so that they cannot be removed from the door or cabinet without first opening the door. Brace the door and hinges to withstand a 100-pound per vertical foot of door height load applied vertically to the outer edge of the door when standing open. There shall be no permanent deformation or impairment of any part of the door or cabinet body when the load is removed. Provide the cabinet door with a #2 Corbin lock. Provide two keys for each cabinet. Provide the cabinet doors so they can be padlocked. Provide door openings with double flanges on all four sides.

Doorstops shall be included at 90° and 180° positions. Provide both the door and the doorstop mechanism of sufficient strength to withstand a simulated wind load of five pounds per square foot of door area applied to the both inside and outside surfaces without failure,

permanent deformation, or compromising of door position and normal operation. Provide the cabinets without auxiliary police doors.

Ensure that cabinet doors include a gasket to provide a dust and weather-resistant seal when closed. Provide the gasket material with closed-cell neoprene and shall maintain its resiliency after exposure to the outdoor environment. The gasket shall show no sign of rolling or sagging, and shall ensure a uniform dust and weather-resistant seal around the entire door facing.

Provide pole-mounted versions of the 336A CCTV cabinet as required by the Plans.

(2) Ventilation

Provide a cooling fan in all cabinets with a minimum capacity of 100 CFM. Provide a thermostat to control the ventilation system.

Provide the cabinets with vent openings in the door to allow convection cooling of electronic components. Locate the vent opening on the lower portion of the cabinet door and cover fully on the inside with a commercially available disposable three layer graded type filter.

Provide cabinets with a serial number unique to the manufacturer. Engrave the entire identification code on a metallic plate that is epoxied to the cabinet on the upper right hand sidewall.

(3) Electrical

Provide a power distribution assembly that consists of power filters, transient voltage suppression, equipment grounding, main and branch circuit breakers for equipment, electrical outlets, lighting and ventilation.

Provide AC isolation within the cabinet. Configure all cabinets to accept 120 VAC from the utility company.

Provide UL listed circuit breakers with an interrupt capacity of 5,000 amperes and insulation resistance of 100 MΩ at 500 VDC. Provide power distributions blocks for use as power feed and junction points for two and three wire circuits. The line side of each shall be capable of handling up to 2/0 AWG conductors. Isolate the AC neutral and equipment ground wiring and terminal blocks from the line wiring by an insulation resistance of at least 10 MΩ when measured at the AC neutral.

For components that are furnished by the Contractor that are mounted on cabinet side panels, fasten with hex-head or Phillips-head machine screws. Install the screws into tapped and threaded holes in the panels. The components include, but are not limited to, terminal blocks, bus bars, and DC power supply chassis.

Tag and identify all cabinet wiring installed by the Contractor by the use of insulated pre-printed sleeves. The wire markers shall identify in plain words with sufficient details without abbreviations or codes.

Neatly arrange all wiring in the cabinet, firmly lace or bundle it, and mechanically secure the wiring without the use of adhesive fasteners. Route and secure all wiring and cabling to avoid sharp edges and to avoid conflicts with other equipment or cabling. Terminate all wiring on a terminal block, strip, bus bar, device clamp, lug; or connector, do not splice any wiring. Label all wiring, cables, terminal strips, and distribution blocks provided by the Contractor. Provide strain

relief for all cabling with connectors, all cabling entering knockouts or ports at the equipment, and where appropriate.

(4) Cable Terminations

Terminate all field cabling on the respective surge protection devices for composite coaxial video, 4-wire EIA 422 data communications, and 24 VAC power cable.

Provide an interface panel to permit a technician to connect a laptop and video monitor to the front side to control the camera locally and view live CCTV video without disconnecting the field wiring. All field wiring shall be routed through the surge protection units before the interface panel. Clearly label all connections on the interface panel.

Provide three adaptor cables to convert USB data to RS-422/RS-232.

Provide a video splitter on the video cable to simultaneous provide video to the video monitor port and to the encoder. Provide a switch for selecting and local camera PTZ control.

(5) Surge Suppression

Provide surge protection both ahead of and behind the ITS device electronics for the cameras. All surge protection devices shall have an ambient operating temperature of -40 degrees F to 165 degrees F with 95 percent non-condensing relative humidity. All surge protection devices shall comply with the following standards:

- UL 1449 version 3 for electrical power,
- UL 497B for paired data communications, and
- UL 497C for coaxial communications.

For those CCTV cabinets with Ethernet communications over twisted-pair copper cable, provide surge protection devices meeting UL 497A.

a) Grounding

Provide a cabinet grounding system as shown in the Plans. Incorporate a means to bond (i.e., connected) all metal components of the camera and cabinets to the grounding system with a grounding cable that uses a mechanical connection on the equipment side and an exothermic welded connection at the down cable.

b) Line Side CCTV Power

Each cabinet must be provided with a hybrid-type, power line surge protection device mounted inside the power distribution assembly. The protector must be installed between the applied line voltage and earth ground. The surge protector must be capable of reducing the effect of lighting transient voltages applied to the AC line. The protector must be mounted inside the power distribution assembly housing facing the rear of the cabinet. The protector must include the following features and functions:

- Maximum AC line voltage: 140 VAC,
- Twenty pulses of peak current, each of which must rise in 8 microseconds and fall in 20 microseconds to ½ the peak: 20,000 Amperes,
- The protector must be provided with the following terminals:
  - Main line (AC line first stage terminal),
  - Main neutral (AC neutral input terminal),
  - Equipment line out (AC line second state output terminal, 19 amps),

- Equipment neutral out (neutral terminal to protected equipment),
- Ground (earth connection),

- The main AC line in and the equipment line out terminals must be separated by a 200 Microhenry (minimum) inductor rated to handle the 10 Amp AC service,
- The first stage clamp must be between main line and ground terminals,
- The second stage clamp must be between equipment line out and equipment neutral,
- The protector for the first and second stage clamp must have an MOV or similar solid-state device rated at 20 KA and must be of a completely solid-state design (i.e., no gas discharge tubes allowed),
- The main neutral and equipment neutral out must be connected together internally and must have an MOV similar solid-state device or gas discharge tube rated at 20 KA between main neutral and ground terminals,
- Peak clamp voltage: 350 volts at 20 KA (voltage measured between equipment line out and equipment neutral out terminals. Current applied between main line and ground terminals with ground and main neutral terminals externally tied together),
- Voltage must never exceed 350 volts, and
- The protector must be epoxy-encapsulated in a flame-retardant material.
- Continuous service current: 10 Amps at 120 VAC RMS.
- The equipment line out must provide power to cabinet CCTV and communications equipment and to the 24V power supply.

c) Load Side CCTV Power

Load side protection is designed to restrict surge current transients from entering the power source from the CCTV device and/or site. The surge protection for the CCTV power source shall have an operating voltage of 120 volts single phase and a maximum continuous operating voltage of 150 volts single phase.

The device's surge protection shall be rated at a minimum of 90,000 amps per phase and have maximum clamping voltage ratings of 330 volts at 500 amps, 395 volts at 3,000 amps, and 533 volts at 10,000 amps. The surge protection shall also be UL listed for a minimum suppressed voltage of 330 volts per line to the neutral/ground. The suppression device shall be of the metal oxide varistor (MOV) type.

d) Load Side CCTV Data/Video

Provide specialized surge protection devices at the supply and load sides of all low voltage connections to the CCTV device and its operating subsystems. Provide specialized surge protection devices at the supply and load sides of all low voltage Ethernet data connections between a CCTV and traffic signal cabinet. These connections include, but are not limited to, coaxial video cables and low voltage control serial and Ethernet data cables that comply with EIA requirements as detailed in the EIA-232/422/485 standards.

The surge protection shall have an operating voltage to match the characteristics of the CCTV, such as 24 volts of direct current (VDC) or 24 volts of alternating current and less than 5 VDC for data and video functions. These specialized surge protection units shall be UL listed according to the UL 497B (paired-date cable) and UL 497C (coaxial cable) standards. The minimum surge current rating for the surge protection shall be 2,000 amps for data and telecommunications, 2,000 amps for twisted pair video, and 4,000 amps for binary network connectors (BNC).

(G) Grounding

Provide a minimum of four grounding electrodes with a minimum length of 10 feet each and listed according to UL requirements as detailed in the *UL 467J* standard. Provide copper clad or solid copper electrodes.

(H) Software

Provide Vendor-supplied GUI-based software to setup, configure, and operate the cameras in the field. This software shall include features to set communications addresses and protocols, define camera ID lens control, digital signal processing (DSP) settings, azimuth configuration, presets, tours, and privacy zones. The software shall allow the user to control all functions of the camera locally from the CCTV cabinet at the base of the pole with a serial or USB cable.

19.3. CONSTRUCTION METHODS

(A) Electrical and Mechanical Requirements

Ground all equipment as called for in the *Standard Specifications*, these Project Special Provisions, and the Plans.

Install surge protectors on all ungrounded conductors entering the CCTV enclosure as described below. House the protectors in a small, ventilated weatherproof cabinet attached near the CCTV attachment point in a manner approved by the Engineer. The air terminal ground wire must not pass through this cabinet.

(B) CCTV Camera Assembly

Mount CCTV dome camera units on poles at a height sufficient to adequately see traffic in all direction and as approved by the Engineer. Mount dome cameras on poles at the attachment heights shown on Special Details in the Plans.

Mount CCTV camera on the side of pole that is nearest to the intended field of view, to avoid occlusion of the view by the pole or utility lines. Obtain approval of camera orientation from the Engineer. Comply with the "Wood Poles" section of these Project Special Provisions.

Mount CCTV dome camera unit on the wall at a height sufficient to adequately see a clear view of the interior of the inspection building and as approved by the Engineer.

Mount CCTV barrel camera unit on the underside of steel steps to adequately see traffic clearly in the in section pit and as approved by the Engineer.

(C) CCTV Camera Attachment to Pole

Have the Engineer approve the pole location prior to setting a new pole. At locations shown in the Plans, assemble the camera attachment hardware for the CCTV camera unit and attach to the pole using stainless steel banding approved by the Engineer. Submit shop drawings for review and approval by the Engineer prior to installation.

Install the camera attachment assembly to the pole in a manner that allows for the removal and replacement of the CCTV enclosure as well as providing a weatherproof, weather-tight seal that does not allow moisture to enter the enclosure.

Install CCTV camera attachment assembly that is able to withstand wind loading at the maximum wind speed and gust factor called for in the AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*, 6th Edition, 2013 Interim, and can support a minimum camera unit dead load of 45 pounds.

(D) CCTV Cabinet

Mount the CCTV cabinet on the pole supporting the CCTV camera it controls using approved hardware and attachment brackets. Mount the cabinet 4 feet from the ground to the center of the cabinet. Avoid mounting cabinets where they will overhang and encroach upon an adjacent sidewalk or pedestrian path. Where a minor overhang of the sidewalk or pedestrian path cannot be reasonably avoided, ensure that that a minimum of 4 feet of clear sidewalk width will remain once the cabinet is installed. Do not mount cabinets above pedestrian pushbuttons or where they will hinder access to pedestrian pushbuttons. Have the Engineer approve the proposed mounting position prior to attaching the CCTV cabinet to the pole.

Ground all cabinets in accordance with the requirements of these Project Special Provisions. Keep the ground wire from the cabinet ground bus bar to the ground rod assembly or array as short as possible. Ensure the ground wire is not in contact with any other part of the cabinet.

Tag and identify all cabinet wiring installed by the Contractor by the use of insulated pre-printed sleeves. The wire markers shall identify in plain words with sufficient details without abbreviations or codes.

Neatly arrange all wiring, firmly lace or bundle it, and mechanically secure the wiring without the use of adhesive fasteners. Route and secure all wiring and cabling to avoid sharp edges and to avoid conflicts with other equipment or cabling. Terminate all wiring on a terminal block, strip, bus bar, device clamp, lug, or connector, do not splice any wiring. Label all wiring, cables, terminal strips, and distribution blocks installed by the Contractor. Provide strain relief for all cabling with connectors, all cabling entering knockouts or ports at the equipment, and where appropriate.

Fasten all components installed by the Contractor to be mounted on cabinet side panels with hex-head or Phillips-head machine screws. Install the screws into tapped and threaded holes in the panels. The components include, but are not limited to, terminal blocks, bus bars, and DC power supply chassis.

Connect the CCTV camera cabinet to the CCTV camera assembly using a composite cable carrying the video, serial data and power. Terminal strips shall be provided with the cabinets to support 4-wire EIA 422 communications and the 24 VAC power as will be required for power and data.

Mount the digital video encoder on a shelf in the 19" equipment rack inside the cabinet in accordance with the "Digital Video Encoder" section of these Project Special Provisions. Mount the fiber-optic interconnect center in accordance with the "Fiber-Optic Communications Cable" section of these Project Special Provisions.

Install the Ethernet edge switch inside the cabinet in accordance with the "Communications Hardware" section of these Project Special Provisions. Mount the edge switch on the same shelf in the CCTV cabinet as the video encoder. Connect the appropriate connectors on the interconnect center with those on the Ethernet edge switch using SMFO jumpers.

(E) Power Service

For CCTV-1 provide 120 VAC power from the existing sign electrical service as shown on the Plans. Comply with the "Electrical Service" section of these Project Special Provisions and the details shown in the Plans.

(F) Grounding

Ground the CCTV pole and subsystems in accordance with the special details (i.e., "SD" sheets) in the Plans.

(1) Device Line Side

Connect the surge protection devices on the CCTV power source on the line side. This device shall provide protection between line-to-neutral, line-to-ground, line-to-line, and neutral-to-ground.

(2) Device Load Side

Connect the surge protection devices in the power line side ahead of all CCTV electronic equipment. This installation technique is designed to restrict earth current transients induced within the ground or directly from the power source from entering the ITS device through the incoming 120/240-volt power circuit. This device shall provide protection between line-to-neutral, line-to-ground, line-to-line, and neutral to ground.

(3) Device Data/Video Supply

Connect the specialized surge protection devices at the supply and line sides of all low voltage connections to the CCTV device and its operating subsystems. These connections include, but are not limited to, Category 5E data cables, coaxial video cables, twisted pair video cables, and low voltage control cables that comply with EIA requirements as detailed in the EIA-232/422/485 standards.

(G) Software

If Vendor software is provided to program and operate the cameras, install the Vendor-supplied GUI-based software to setup, configure and operate the cameras on each laptop supplied with the project.

(H) GPS Coordinates

Provide real world coordinates for all junction boxes and equipment cabinets installed or utilized under this project. Provide the coordinates in feet units using the North Carolina State Plane coordinate system (1983 North American Datum also known as NAD '83). Furnish coordinates that do not deviate more than 1.7 feet in the horizontal plane and 3.3 feet in the vertical plane. Global positioning system (GPS) equipment able to obtain the coordinate data within these tolerances may be used. Submit cut sheets on the GPS unit proposed to collect the data for approval by the Engineer.

Provide both a digital copy and hard copy of all information regarding the location (including to but not limited to manufacturer, model number, and NCDOT inventory number) in the Microsoft Excel spreadsheet using the format shown in example below.

NCDOT Inv #	Name	Location	Latitude	Longitude	Manufacturer	Model #
05-0134	Equipment Cabinet	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5500	35.6873	McCain	Type-332
	Junction Box # 1 (Phase 2 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5516	35.6879	Quazite	PG1118BA12(Box) PG118HA00(Cover)
	Junction Box # 2 (Phase 2 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5506	35.6876	Quazite	PG1118BA12(Box) PG118HA00(Cover)
	Junction Box # 3 (Near Cabinet)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5501	35.6873	Quazite	PG1118BA12(Box) PG118HA00(Cover)
	Junction Box # 4 (Phase 6 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5486	35.6873	Quazite	PG1118BA12(Box) PG118HA00(Cover)
	Junction Box # 5 (Phase 6 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5493	35.6876	Quazite	PG1118BA12(Box) PG118HA00(Cover)
	Junction Box # 6 (Phase 4 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5503	35.6879	Quazite	PG1118BA12(Box) PG118HA00(Cover)

19.4. MEASUREMENT AND PAYMENT

CCTV camera assembly will be measured and paid as the actual number of CCTV camera assemblies (dome or barrel) furnished, installed, and accepted.

No separate measurement will be made for composite cabling, connectors, CCTV camera attachment assemblies (including luminaire mast arms), software, grounding equipment, surge protector devices, composite cable, other cabling, and conduit, or any other equipment or labor required to install the CCTV assembly and integrate it with the fiber-optic communications equipment as they are considered incidental to furnishing and installing the CCTV camera assembly and the CCTV cabinet.

CCTV cabinet will be measured and paid as the actual number of pole-mounted CCTV cabinets furnished, installed, and accepted.

No separate measurement and payment will be made for hardware, fasteners and brackets required to mount CCTV cabinets to a pole as shown in the Plans as such work with be considered incidental to furnishing and installing the CCTV cabinets.

Installation of Ethernet edge switches and digital video encoders will be measured and paid for in accordance with the "Communications Hardware" and "Digital Video Equipment" sections of these Project Special Provisions.

Payment will be made under:

Pay Item	Pay Unit
CCTV Camera Assembly	Each
CCTV Camera Assembly (Fixed Mount)	Each
CCTV Cabinet	Each

20. COMMUNICATIONS HARDWARE

20.1. DESCRIPTION

Furnish and install all equipment described below for a fully functional 100 megabit Ethernet network for communication to the weigh station system ITS devices and CCTV.

(A) Managed Ethernet Switch

Furnish and install managed Ethernet switch in the scale house. Ensure that the managed Ethernet switch provides wire-speed, Ethernet connectivity at transmission rates of 100 megabits per second to/from each device on the switch to the core switch.

(B) 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 ITS device location to the managed Ethernet switch.

(C) Network Management Software

For the communications network, utilize network management software (NMS) for configuration, troubleshooting, security, and system monitoring. The Contractor shall perform the initial system integration of all Ethernet switches installed on the project.

Install the network management software on all relevant communications hardware, including workstations and servers, as recommended by the manufacturer's instructions. Ensure that the network management software is compatible with all elements of the network, including all Ethernet switches, workstations, and servers. Ensure the system meets the minimum technical requirements and is capable of handling expansion within the network. Ensure that the software manages third party switches and hardware via Simple Network Management Protocol (SNMP) v1 or v3.

Provide system that has a graphical user interface (GUI) for the operator and shall graphically depict the equipment and maintenance/operational status using a graphical map of the system. Include setup and diagnostic utility software for both the server and client computers (licenses to be provided by the Contractor). Ensure that the system is interoperable with all end-to-end communications elements (video encoder, edge switch, and managed Ethernet switch), that connect each CCTV camera to digital video monitors.

(D) UPS

Furnish and install rack-mounted uninterruptible power supply (UPS) units as described in this Project Special Provision for the equipment cabinets, video monitors, managed Ethernet switches, and servers in the scale house and the managed Ethernet edge switch in the inspection building. 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.

For the UPS located in the buildings, size the UPS units to provide at least 20 minutes of UPS power. For the ITS 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.

20.2. MATERIALS

(A) General

Ensure that the edge switches are fully compatible and interoperable with the trunk 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 existing managed Ethernet switches and proposed edge switches with the connector panels of fiber-optic splice centers. Provide SMFO jumpers with factory-assembled LC connectors one end (i.e., the fiber-optic interconnect center/connector housing end) and, on the other end, factory-assembled connectors of the same type provided on the existing managed Ethernet switch and edge switches. Provide SMFO jumpers that are a minimum of 3 feet in length for edge switches inside equipment cabinets and CCTV cabinets. Ensure SMFO jumpers meet the operating characteristics of the SMFO cable with which it is to be coupled.

(B) Managed Ethernet Switch

(1) Standards

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

- IEEE 802.1D Spanning Tree Protocol (STP),
- IEEE 802.1P Quality of Service (QoS),
- IEEE 802.1Q Virtual Local Area Networks (VLAN Tagging),
- IEEE 802.1Q-2005 Multiple Spanning Tree Protocol (MSTP),
- IEEE 802.1X Port-Based Network Access Control,
- IEEE 802.1W Rapid Spanning Tree Protocol (RSTP),
- IEEE 802.3u supplement standard regarding 100 Base TX/100 Base FX,
- IEEE 802.3X Flow Control,
- IEEE 802.3ad Link Aggregation,
- RFC 821 – Simple Mail Transfer Protocol,
- RFC 854 – Telnet Protocol Specification,
- RFC 1112 – IGMP v1,
- RFC 2131 – Dynamic Host Configuration Protocol for IPv4,
- RFC 2236 – IGMP v2,
- RFC 3315 – Dynamic Host Configuration Protocol for IPv6 (DCHCPv6),
- RFC 3376 – IGMP v3,
- RFC 2362 – Protocol Independent Multicast Sparse Mode (PIM-SM),
- RFC 3973 – Protocol Independent Multicast Dense Mode (PIM-DM),

- RFC 2328 – Open Shortest Path First (OSPF) v2,
- RFC 2338 – Virtual Router Redundancy Protocol (VRRP),
- RFC 2570:2575 – SNMP v3,
- RFC 2030 – Simple Network Time Protocol (SNTP), and
- RFC 2267 – Denial of Service (DoS).

Ensure that the managed Ethernet switch has 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.

(1) Functional

Ensure that the managed Ethernet switch supports all Layer 2 management features and certain Layer 3 features related to multicast data transmission and routing. 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,
- Support port-based VLAN and support VLAN tagging that meets or exceeds specifications as published in the IEEE 802.1Q standard, and have a minimum 4-kilobit VLAN address table,
- 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, Secure Shell (SSHv2), 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 remote monitoring (RMON-I) of the Ethernet agent, and
- Support of the TFTP and SNTP. Ensure that the managed Ethernet switches support port mirroring for troubleshooting purposes when combined with a network analyzer.

(2) Physical Features

Mounting: Provide a 19" rack mount managed Ethernet switch that does not exceed a height of two RU.

Optical Ports: Ensure that all single mode 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 as specified in the Plans or by the Engineer. Do not use mechanical

transfer registered jack (MTRJ) or ST type connectors. Ensure that each optical port consists of a pair of fibers: one fiber will transmit (TX) data and the other fiber will receive (RX) data.

Provide fully functional single mode fiber-optic 10/100/1000 Mbps ports with optical transceivers installed in the proposed managed Ethernet switch. Each optical transceiver shall consist of fiber pairs; one fiber will transmit (TX) data and one fiber will receive (RX) data. Provide 18 single mode fiber-optic 100 Mbps ports in the proposed managed Ethernet switch.

Copper Ports: Provide 24 10/100/1000 Base TX ports. Provide Type RJ-45 copper ports and that auto-negotiate speed (i.e., 10/100/100 Base) and duplex (i.e., full or half). Ensure that all 10/100 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.

Ensure that the managed Ethernet switch (10/100/1000 Mbps ports) supports jumbo frames and full Layer 3 routing. Ensure that the switch includes support for dynamic unicast routing protocols such as RIPv1/v2 and OSPF, and support for multicast routing protocols, including PIM-SM, PIM-DM, and DVMRP.

Port Security: Ensure that the managed Ethernet switch supports/complies with the following 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 data for pre-defined / learned MAC addresses.
- 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 managed Ethernet switch that supports/complies with the following minimum requirements:

- Have a non-blocking architecture,
- Route and switch unicast and multicast traffic simultaneously at wire speed,
- Support port mirroring and monitoring to aid in troubleshooting,
- Support QoS queue management using weighted round robin (WRR) and strict priority (SP),
- Support 10/100 BaseTX ports (RJ-45),
- Provide support for the following RMON–I groups, at a minimum,
    - Part 1: Statistics
    - Part 2: History
    - Part 3: Alarm
    - Part 9: Event
- Capable of mirroring any port to any other port within the switch,
- 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
- Be managed through console (RS-232), telnet, and Web interface, and
- Supports download and upload of images and configurations via TFTP.
- Full implementation of RFC 783 (TFTP) to allow remote firmware upgrades.

- Support port mirroring and monitoring to aid in troubleshooting,

Network Security: Provide managed Ethernet 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 managed Ethernet 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 managed Ethernet switch supports port mirroring for troubleshooting purposes when combined with a network analyzer.

(3) Electrical Specifications

Ensure that the managed Ethernet switch has a redundant power supply and operates on power is supplied with 115 VAC. Ensure that the maximum power consumption does not exceed 350 watts.

Ensure that the managed Ethernet switch has diagnostic light emitting diodes (LEDs), including link, port activity, duplex mode, speed (for Category 5e ports only), and power LEDs.

(4) Management Capabilities

Ensure that the managed Ethernet switch includes management capabilities, as defined in the following:

- Incorporate an internal temperature sensor capable of sending system log and/or SNMP traps should the switch exceed a specified warning level,
- Support automatic powering off should the temperature exceed a specified level to prevent damage to the switch,
- Support port mirroring and monitoring to aid in troubleshooting,
- Be capable of utilizing the following standard protocols:
  - Support VLAN (IEEE 802.1Q),
  - Support Multiple Spanning Tree Protocol (IEEE 802.1Q-2005)
  - Support Rapid Spanning Tree Protocol (IEEE 802.1W),
  - Support IGMP Versions 1 and 2 (RFC 1112 and 2236),
  - Support RIP Versions 1 and 2 (RFC 1058 and 1723),
  - Support OSPF Version 2 (RFC 1583 and 2328),
  - Support PIM (SM & DM),
  - Support IGMP Version 1 and 2 (RFC 1112 and 2236),
  - Support DVMRP,
  - Support VRRP (RFC 2338),
  - Support ToS/DSCP mapping to priority queue,
  - Support QoS queue management using weighted round robin (WRR) and strict priority (SP),
  - Support 10/100 BaseTX ports (RJ-45),
  - Support Flow Control (IEEE 802.3x),

- Support Gigabit Ethernet (IEEE 802.3z),
- Support SNMP Version 1 and 3,
- Support 4 groups of RMON-I (Groups 1-3, 9),
- Be managed through console (RS-232), telnet, and Web interface, and
- Supports download and upload of images and configurations via TFTP.

Ensure that the managed Ethernet switch fully supports all Layer 2 and Layer 3 management features related to multicast data transmission and routing, including, but not be limited to:

- An STP healing/convergence rate that meets or exceeds specifications published in the IEEE 802.1 D standards.
- An RSTP healing/convergence rate that meets or exceeds specifications published in the IEEE 802.1w standard.
- A multicast forwarding database that supports a minimum of 2048 entries in hardware.
- 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.
- Support of Traffic Class Expediting and Dynamic Multicast Filtering.
- Support of, at a minimum, Version 2 of the Internet Group Management Protocol (IGMP).
- Support of remote and local setup and management via telnet, Secure Shell (SSHv2), or secure Web-based GUI and command line interfaces.
- Support of the SNMP protocol.
- Port security through controlling access by the users. Ensure that the Ethernet core switch has the capability to generate an alarm and shut down ports when an unauthorized user accesses the network.
- Support of the TFTP-and the SNTP. Ensure that the Ethernet core switch supports port mirroring for troubleshooting purposes when combined with a network analyzer.

(5) Environmental Specifications

Provide managed Ethernet switches that adhere to the following environmental constraints if located within a climate-controlled environment:

- Operating temperature range: -40°F to 130°F,
- Storage temperature range: -40°F to 185°F, and
- Operating relative humidity range: 5% to 90%, non-condensing.

(C) 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.

(6) 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.

(7) 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 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 edge switches having a minimum of two optical 100 Base FX ports capable of transmitting data at 100 megabits per second. Ensure that each optical port consists of a pair of fibers, one fiber will transmit (TX) data and one fiber will receive (RX) data.

Provide 10/100 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 Base) and duplex (i.e., full or half). Ensure that all 10/100 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.

(8) Electrical Specifications

Ensure that the edge switches operate and power is supplied with 115 current 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 Category 5e ports only), and power LEDs.

(9) 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).

(D) Network Management Software

Provide network management software that provides configuration, troubleshooting, security and system monitoring for the communications network. Ensure that the system includes the following features:

- Able to create and maintain system and user identification and passwords,
- GUI interface,
- Syslog and SNMP alarm manager,
- Distributed server support for scalable management,
- Physical and logical topology for viewing every element on the network and how it is connected,
- Fault management and alarm view to see the health and status of every element on the network,
- Configuration management for configuring multiple elements and images, perform multi-step upgrades and archive device configurations,
- HTML report generator for Web-based reports,
- Switch configuration and monitoring,
- Inventory tool for the managed devices,
- VLAN manager,
- IP/MAC Address finder,
- Administration tool,
- Abstract Type Library for adding support for future hardware and software in the field,
- Spanning Tree monitor,
- Monitoring of third-party devices,
- Support industry standard protocols such as SNMP, ANS.1, and XML,
- Handle commands from system clients via ASN.1 and/or XML-defined protocol over a standard TCP/IP connection,
- Command underlying nodes (devices such as decoders, encoders, and switches),
- Report status of system nodes and alarms,
- Monitor system node connections,
- Store recent alarms in an internal database,
- Cooperate with another server in redundant set (when working in redundant configuration),
- Receive SNMP traps generated by network infrastructure, translate SNMP traps as system alarms, and send alarms as SNMP traps,
- Support remote configuration and diagnostics, and
- Restore video and connections in case of system component restarts.

Interface: Ensure that the network management software interface meets the following requirements:

- Network interface: Any network/telecom adapter supporting MS Windows TCP/IP stack.
- Network: Microsoft TCP/IP service software must be installed and configured correctly in the project's network environment.

Furnish client-server based application that supports installed client application and browser based client.

(E) UPS

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

Each UPS shall provide adequate capacity to run its respective workstation, roadside computer and associated equipment without commercial power for twenty minutes. Provide load calculations for each configuration of equipment connecting to a UPS.

(1) Standards

Ensure that the UPS units comply with the following standards:

- ANSI,
- ASTM,
- CSA, and
- UL.

(2) 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.

(3) 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 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.

(4) 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%.

20.3. 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.

Receive approval for the System Design Report described in these Project Special Provisions before submitting product submittal data, purchasing, installing and configuring the computer and communications hardware at each facility.

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.

(B) Managed Ethernet Switches

(1) General

Ensure that the managed Ethernet switch includes Layer 2+ capability providing architecture standardization, open connectivity (i.e., interoperability), bandwidth management, rate limiting, security filtering, and general integration management of an advanced Ethernet switching architecture.

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, Unicast Routing protocols, and Multicast Routing protocols. Ensure unused switch ports are disabled.

Ensure that the managed Ethernet switch is fully accessible by technicians without blocking access to other equipment. Verify that fiber-optic jumpers consist of a length of cable that is connectorized on both ends, primarily used for interconnecting termination or patching facilities and/or 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.

(2) Managed Ethernet Switch

Mount and secure the managed Ethernet switch inside a communications rack scale house net rack room. Connect the managed Ethernet switch to the following items in the scale house: WIM server, UPS units, and WIM electronics units. In addition, connect this managed Ethernet switch to the workstations and printer.

(3) Ethernet Edge Switch

Ensure that the network administrator will be able to manage each edge switch individually or as a group/cluster for switch configuration, performance monitoring, and troubleshooting. Note that these specifications require additional minimum management intelligence (i.e., Layer 2+) typical of most current industrial Ethernet deployments. Ensure that the edge switch includes Layer 2+ capability providing architecture standardization, open connectivity (i.e., interoperability), bandwidth management, rate limiting, security filtering, and general integration management of an advanced Ethernet switching architecture.

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. Verify that fiber-optic jumpers consist of a length of cable that is connectorized on both ends, primarily used for interconnecting termination or patching facilities and/or 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.

(C) Network Management Software

Install the NMS server application on the application server. Configure the NMS to monitor and manage the servers, and Ethernet switches. Install software to provide access to the NMS software from the workstations connected to the network. The Engineer will designate the network administrator. Establish user access rights and monitoring rights. Build the database through an automatic utility within the NMS or manually enter the data. Establish groupings of devices with like functions or features; this would include geographically related, device types, owners. Setup automatic database and configuration backups. Setup system and device alarms and alarm notifications.

Setup graphical network views. Use mapping images provided by manufacturers to locate geographically the devices.

(D) 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.

20.4. MEASUREMENT AND PAYMENT

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.

Managed Ethernet switch will be measured and paid as the actual number of managed Ethernet switches furnished, installed, and accepted. No separate measurement will be made for fiber-optic port modules, GBICs, and Ethernet ports, as they will be considered incidental to furnishing and installing the managed Ethernet switch.

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

Network management software will be measured and paid as lump sum furnished, installed, and accepted.

UPS will be measured and paid as the actual number of UPS units described in this section of the Project Special Provisions furnished, installed, and accepted in the equipment cabinets and scale house. No separate measurement will be made for UPS units supplied with the computer workstations, as they will be considered incidental to furnishing and installing the computer workstations.

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**
Managed Ethernet Switch	Each
Ethernet Edge Switch	Each
Network Management Software	Lump Sum
UPS	Each

21. ENCLOSED COMMUNICATIONS RACK

21.1. DESCRIPTION

Furnish and install wall-mounted enclosed communication rack inspection building.

21.2. MATERIALS

(A) Wall-Mounted Communications Rack

Furnish a wall-mounted EIA 19-inch equipment rack cabinet for mounting in the inspection building to house a fiber-optic cable termination, managed Ethernet edge switch, UPS, and video encoders. The unit shall be an enclosed rack at least 20 rack units high with approximate dimensions of 36"H x 21" W x 26" D. The rear mounting plate that attaches the cabinet to the wall shall be hinged along one side with latches on the opposite side so that the cabinet can be swung open to access the rear of the cabinet.

Provide a power strip inside that uses 120 VAC 60 Hz power; the power strip shall contain at least six outlets and a six-foot power cord. Provide grounding bus bar system to ground rack-mounted electrical equipment.

Provide racks constructed of all metal components. Supply all screws, nuts, washers, lock nuts, brackets and hardware necessary to assemble equipment described herein. Vents shall be on front and rear panels. Furnish wire entry access plates with dust tight seals.

Provide cable management hardware for attachment to rack frame and between 19-inch rack angles. The hardware shall include cable organizers and clamps to provide strain relief and cable mounting. Provide one shelf.

Construct all rack frames and rack angles of 12-gauge steel or greater. Construct the sides, top and bottom panels of 16-gauge steel or greater.

Paint the panels, rack frames, and rack angles with black polyester powder coating or baked on paint.

21.3. CONSTRUCTION METHODS

(A) General

Ground the racks to a building ground.

(B) Wall-Mounted Communications Rack

Install the wall-mounted communications rack cabinet on the wall of the inspection building as shown in the Plans. Install the fiber-optic splice center, managed Ethernet switch, video encoders and rack-mounted UPS in the rack inside the cabinet.

Furnish and install a power strip and 10-foot power cord on the rear of the rack frame. Furnish and install strip that uses 120 VAC 60 Hz power and that contains at least five outlets. Furnish and install grounding bus bar system to ground the rack-mounted electrical equipment. Equip door with grounding studs.

Furnish and install cable management hardware for attachment vertically along the rack frame and horizontally between 19-inch rack angles. Cable management hardware shall run vertically up one rear rack frame. Provide hardware including cable organizers and clamps to provide strain relief and cable mounting.

21.4. MEASUREMENT AND PAYMENT

Wall-mounted communications rack will be measured and paid as the actual number of wall-mounted communications racks furnished, installed, and accepted.

No separate measurement and payment will be made for rack set-up and assembly, mounting of all accessories and equipment specified for installation within the rack, all brackets, fasteners, and hardware required for properly mounting equipment in the rack, as such materials and work will be considered incidental to furnishing and installing the communications racks.

Payment will be made under:

Pay Item	Pay Unit
Wall-Mounted Communications Rack	Each

22. DIGITAL VIDEO EQUIPMENT

22.1. DESCRIPTION

Furnish and install digital video encoders for converting analog and digital video.

22.2. MATERIALS

(A) Digital Hardware Video Encoder (DVE)

Furnish and install digital hardware video encoder hardware to create a video-over-IP network system, as shown in the Plans. The video encoder units may be shelf or rack-mounted.

Furnish digital hardware video encoder components that utilize the Moving Picture Experts Group's MPEG-4 Part 10/H.264 video compression technology in accordance with the International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) requirements detailed in the ISO/IEC 13818 and 14496-14 standards, respectively. Provide the ability for the user to select the video compression technology. Ensure that the hardware video encoder is capable of unicast and multicast operation, and that they support the Session Announcement Protocol (SAP) as recommended by the Internet Engineering Task Force (IETF) RFC 2974, and Differentiated Services/Quality of Service (DiffServ/QoS) software components. Ensure that the digital video encoder provides 99.999% error-free operation.

Provide a DVE that is a hardware-based network device able to accept a minimum of one analog National Television System Committee (NTSC) video input and digitize it for transport across IP networks. Use a digital video encoder that provides a minimum of two serial data interfaces for transmission of command and control data to other devices (typically camera PTZ commands), as well as console and configuration functions. Provide compatible decoder software along with the digital video encoder at no additional cost.

(1) Video Specifications

Ensure that any video input utilizes a BNC connector and delivers one-volt peak-to-peak (Vp-p) NTSC composite video signals for encoding. Ensure that the DVE operates with both color and monochrome video, and that they allow the user to select and adjust video resolution. Ensure that the DVE support resolutions that include, but are not limited to those in table below. Ensure that the MPEG-4 DVE is capable of delivering color and monochrome video at 30 fps regardless of resolution, and that they can do so using variable, programmable bit rates from 32 Kbps to 4 Mbps. Ensure that the DVE provides fixed and variable bit rate modes.

Resolution Specifications

Compression Technology	Resolution	NTSC Requirements
MPEG-4	QCIF	176 horizontal x 120 vertical
MPEG-4	CIF	352 horizontal x 240 vertical
MPEG-4	2CIF	704 horizontal x 288 vertical

Note: The resolutions attained depend on the data transmission rate.

(2) Environmental Specifications

Unless stated otherwise in the Plans, provide digital video encoders that meet all specifications during and after being subjected to an ambient operating temperature range of -30°F to 165°F as defined in the environmental requirements section of the NEMA TS 2 standard, with a maximum non-condensing relative humidity of 95%.

Ensure that cabinets housing system components comply with the environmental requirements detailed in the NEMA TS 2 standard. House the digital video encoder in a field cabinet with protection from moisture and airborne contaminants, blowing rain, wind, blowing sand, blowing dust, humidity, roadside pollutants, vandalism, and theft. Ensure that the digital video encoder is resistant to vibration and shock, and conforms to Sections 2.1.9 and 2.1.10, respectively, of the NEMA TS 2 standard.

22.3. CONSTRUCTION METHODS

(A) General

Receive approval for the System Design Report described in these Project Special Provisions before submitting products submittal data, purchasing, installing and configuring the central video equipment described in this section of the Project Special Provisions.

(B) Digital Hardware Video Encoder

(1) Serial Interface

Use hardware-based digital video encoders having a minimum of two serial data interfaces and connectors that conform to EIA-232/422/485 standards. Ensure that the serial interfaces support EIA-232 as well as 2-wire and 4-wire EIA-422/485 connections. Ensure that the serial port(s) support data rates up to 115.2 Kbps. Serial interface parameters, such as data format, number of bits, handshaking, and parity, shall be software programmable through local connection to the digital video encoders and through connections over the network. Serial interface ports may utilize RJ-45 connectors, D-sub connectors, or screw terminals.

(2) Network Interface

Ensure that the digital video encoder local area network (LAN) connection supports the requirements detailed in the IEEE 802.3 standard for 10/100 Ethernet connections. Provide a DVE having a minimum of one Ethernet port, which shall be a 10/100 Base-TX connection. Ensure that the connector complies with the EIA and Telecommunications Industry Association (TIA) requirements as detailed in the EIA/TIA-568-A standard. Provide copper-based network interface ports that utilize RJ-45 connectors.

Ensure that all Category 5e unshielded twisted pair/shielded twisted pair network cables are compliant with the EIA/TIA-568-B standard. Ensure that the network communication conforms to User Datagram Protocol (UDP), Version 4 of the Internet Protocol (IP) and Version 2 of the Internet Group Multicast Protocol (IGMP).

(3) Front Panel Status Indicators

Ensure the digital video encoders have light-emitting diode (LED) displays, liquid crystal displays (LCDs), or similar illuminated displays to configuration and management. Provide digital video encoders that support local and remote configuration and management. Configuration and management functions shall include access to all user-programmable features, including but not limited to addressing, serial port configuration, video settings, device monitoring, diagnostic utilities, and security functions. Ensure that the digital video encoders and digital video decoders support configuration and management via serial login, telnet login, and Simple Network Management Protocol (SNMP).

(4) Electrical Specifications

Ensure that all wiring meets NEC requirements and standards. Provide equipment that operates on a nominal voltage of 120 VAC. The equipment shall operate within a voltage range of 89 VAC to 135 VAC. The operating frequency range for power shall be 60-hertz ±3 Hz. If the device requires operating voltages of less than 120 VAC, supply the appropriate voltage converter.

Furnish, install, and integrate the digital video encoders in each CCTV cabinet shown in the Plans. Connect the analog input of the digital video encoder to the CCTV camera as defined above. Connect the Ethernet output of the digital video encoder to Ethernet edge switch. Use standard coax cable with BNC (gold-plated center pin) connectors. Connect the RS-422 PTZ serial communications from the camera to the serial port of the digital video encoder. Configure ports and IP addresses for multicast broadcast and VLANs.

22.4. MEASUREMENT AND PAYMENT

The materials provided in this section include all appropriate ports, cabling, grounding, redundancies, labeling, and any integration between the devices and the communications network as necessary to make a working installation.

All power supplies, power cords, adapters, mounting hardware, connectors, serial cables, signs, decals, installation materials, and configuration software necessary to complete this work, are to be included and will be incidental.

Digital hardware video encoder will be measured and paid as the actual number of digital hardware video encoders furnished, installed, and accepted.

No separate measurement will be made for coaxial or DVI-D cables, cable connectors, communication cables, Ethernet cables between equipment housed within the same room/rack/cabinet, electrical cables, video display monitor mounts, mounting hardware, nuts, bolts, brackets, connectors, grounding equipment, surge suppression or documentation as these will be considered incidental to the pay items listed above.

Payment will be made under:

Pay Item	Pay Unit
Digital Hardware Video Encoder	Each

23. CCTV SOFTWARE

23.1. DESCRIPTION

Furnish a network-ready, client-server CCTV system software package that operates over the LAN. The software shall be configurable and scalable to add and delete devices.

23.2. MATERIALS

(A) General

Provide the CCTV system software that will allow users to:

- Select and control selected analog and IP-based cameras via software based graphical controls, including PTZ and other advance features of cameras,
- Assign CCTV images to specific output devices (monitors) and component device inputs,
- Facilitate video sharing,
- Video display control such as individual monitors,
- Video image capture, and
- Video archiving.

The system software shall support TCP/IP and SNMP.

Software shall be a scalable product that controls both analog and IP video streams.

The software shall provide the capability for up to 16 videos per windows. A window can span one or more display monitors. Provide the following features:

- Zoom in and out feature,
- Pan/tilt control of cameras, and
- Presets for setting camera positions.

(B) Access Controlled Privileges

Provide up to 20 unique operator identification passwords. Operator privileges shall be definable by the system administrator. The software shall allow these privileges to be assigned by time of day/week and year. At a minimum, the following privileges shall be definable for each operator:

- Individual workspace definition (content, size, position, and number of windows),
- Device access,
- Camera pan, tilt, zoom camera control, and
- Device programming control.

Provide the ability to configure the access privileges of individual and groups of users.

(C) Programming Control

Provide user-defined programming scripts of up to 100 timed events. Provide the user with the option to associate an alphanumeric name with each event. Provide 7-day, 24-hour programming ability. At a minimum, programmed events shall include:

- Windows based user interfaces for client server architecture,

- Simple-to-use Telnet hook commands for incorporation into map based GUI,
- Quad displays for viewing of four (4) individual video signals to be displayed in one full screen view,
- Video server and camera to any monitor (including remote monitors),
- Command pan/tilt unit to a defined pre-set,
- Programming of time-based execution of actions or events,
- Alarms and notifications,
- Defining and initiating video tours, and
- Activate (or deactivate) a relay to turn the NVR on or off.

The software shall allow for up to four (4) events to be initiated per timed event. The software shall permit the manual override of the scheduled events.

(D) Graphical User Interface

The graphical user interface (GUI) shall consist of an interface for configuring all devices and variables of the system, the configuration GUI shall permit those users with access privileges to add, delete, or modify devices.

The GUI shall also consist of the users' normal operational interface. At a minimum, include the users' GUI with available device list and viewer to see current events.

(1) Device List

Clicking on an icon in the CCTV system software shall produce a scrollable, drop-down list that contains the name of all video outputs (such as monitors, NVR, encoders, etc.) that are connected to the system. A subsequent click on the appropriate video output name shall select the device on which the video is to be displayed or transmitted and provide access to that device's controls available to the user. Output devices presently in use shall not be available for use until they have been de-selected.

Programming an alarm on the map shall include the ability to include animation, program scripts.

The same user GUI shall provide access to retrieve archived video.

The Client application shall automatically discover the server upon login. When a user logs into the system the client workstation and server shall automatically synchronize maps, databases and other configuration variables.

(2) Event Viewer

Provide an event viewer to show a log of events that have occurred and are scheduled to occur. Provide a means to search the event log.

(E) Device Drivers

Provide device drivers for each device in the system including cameras and monitors, provided with this project. Provide the ability to share device drivers. Device drivers may run as an executable program or window service.

23.3. CONSTRUCTION METHODS

Install the CCTV central software on the workstation in the scale room dedicated to CCTV. Install the client software on the other workstations in the scale room.

Install up to three (3) machines of the CCTV system client application in scale room. Verify that the software is fully operable on the applicable workstations included in the project and designated by the Engineer. Provide licenses for the CCTV devices described in this project and for up to four simultaneous users. Provide free software upgrades for three years.

For each camera, assign names consistent with the existing system. Configure presets and tours for each camera.

Assign operator rights to staff provided by the Engineer. Assign a SHP staff person with administrator rights. Provide NCDOT staff access for those provided by the Engineer.

23.4. MEASUREMENT AND PAYMENT

CCTV Software shall be measured and paid as a lump sum. This shall include the furnishing, installation, and all materials, equipment, labor, tools, storage, shipping, and incidentals necessary to install the software, complete system integration, and provide a complete operating system. No payment will be made for providing software license and source code as required in these Project Special Provisions.

Payment will be made under:

Pay Item	Pay Unit
CCTV Software	Lump Sum

24. LANE USE CONTROL SIGNALS

24.1. DESCRIPTION

Furnish and install LED lane use control signs signal heads, wire entrance fittings, mounting assemblies, signal cable, grounding systems, visors, and all necessary hardware.

24.2. MATERIALS

(A) General

When power is applied to the signal, the desired double stroke red "X" or green arrow symbol will be displayed with 5 mm LEDs. The overall image will be progressively dimmed relative to the ambient light level changes detected by the photo sensor installed in the sign. The sign control consists of one power control board with opti-coupler isolated input control. The opti-coupler inputs can be used to activate externally controlled dimming, flashing, and multiple message functions as required. This is a two message signal where the image is displayed with LEDs mounted directly on a black powder coated aluminum doorplate.

A sealed polycarbonate protective slide out lens shields the LEDs from the environment. The assembly is housed in a hinged 8" deep cabinet with 7" visors. The display of the signal message is configured so that no latent image is visible under any lighting conditions when the signal is off. Optional aluminum louvers can be installed over the front of the signal face to provide additional sun shading.

(B) Electronic Requirements

The LED circuitry will consist of two main sub-circuits: the signal power control system and the LED power bus system. The power control circuitry shall be supplied with 115VAC (optional 12 or 24VDC). Protection components to guard the system against power surges and short circuits are built into the input power circuitry. The power supply will maintain regulation over the input voltage range of 90-130VAC (115VAC version). Opto-coupler isolated inputs provide control for LED functions such as dimming, flashing, and multiple messages as required. Progressive dimming is activated when an integrated photo-diode sensor is installed. The output of the signal is then adjusted proportional to the changes in the ambient light conditions over time. The flash function is activated by connecting an external sync signal to the opti-coupler input of the sign control or by setting a jumper that causes the sign to self-flash whichever is required. Individual messages are selected by applying power to the opti-coupler isolated control inputs, which can control as many as five different sign states.

All the features such as maximum dimming level, current sense level, and flash rate are factory set and user programmable. Special features like adjustable dimming for each channel (used to control brightness of one color or one image), and individual channel flashing (used to flash part of the image while the rest remains steady) allows for customized configurations with a standard interchangeable power control board. Consult the factory for specific ranges and limitations.

All the sub-circuits are designed in a modular fashion, allowing the replacement of any defective circuit strip or supply/control by a qualified technician without the use of a soldering iron. The circuit strips and boards are conformal coated to protect the individual devices and connections against moisture and corrosion.

The LED's that are used for displaying messages or creating traffic control signals are available in several viewing angle and color combinations. The appropriate devices are selected according to the installation and application requirements specified by the customer. Standard viewing angles available from most manufacturers for 5mm (T1-3/4) LEDs are 6°, 15°, 23°, and 30°. Luminous intensity in milli-candela (mcd) output varies based on color and viewing angle. The following device specifications reflect one manufacturer's data sheets for the components used in this application. Any alternate manufacturer's components used will meet or exceed these specifications.

(C) LED Specifications

AlInGaP (yellow & red) and InGaN (green) devices have a luminous intensity degradation of approximately 20% over 100,000 hours (11 years) when operated at a non-pulsed 20ma level.

Color	Dominant Wavelength	Min. Lum. Int. @ 20ma	Max. Lum. Int. @ 20ma	Viewing Angle
Green	520 nm	4600 mcd	9200 mcd	30°
Red	626 nm	4180 mcd	8200 mcd	30°

(D) Enclosures and Finishes

The final enclosure, slide-in panels, visors, and associated hardware will be fabricated from aluminum or stainless steel as specified. The exterior aluminum enclosure, panels, and visors will have a black powder coated finish as well as the interior faceplates. All openings shall be gasketed or sealed and drain holes will be located in the lower corners of the enclosure to control condensation. The signals will be mounted with a user defined, optional mounting fixture. A textured polycarbonate panel will be incorporated into the sign to provide better blanking.

(E) Power Requirements

The power consumption for the red LEDs is 4 watts per 100 LEDs and for green LEDs it is 8 watts per 100. Input power and controls are designed for accept 120 VAC and total power will not exceed 15 watts when any single message is activated. A terminal strip is provided and is clearly marked by an in-cabinet circuit diagram for easy installation and service.

(F) Operator Control

Provide a rotary manual switch in each lane control signal cabinet for a technician to select the messages described below. Provide in the scale house a manual switch for the operator or officer to perform the same message selection. The switch position shall clearly align with labels so it is clear what message has been selected.

For the lane control signals at the beginning of the bypass lane, the switches describe above shall include the following messages:

- Bypass – station open and sign displays green arrow, system software does not sort vehicles, all vehicles bypass static lanes
- Auto - station open and sign displays green arrow or red "X" as system software sorts vehicles

- Report – station open and sign displays red "X", system software does not sort vehicles, all vehicles diverted to static scales
- Off – sign displays no message

For the lane control signals at the beginning of the bypass lane, the switches describe above shall include the following messages:

- Front – station open and signal directs traffic to front static scale
- Both - station open and signal directs traffic to both static scales
- Rear – station open and signal directs traffic to rear static scale
- Off – sign displays no message

The scale house operator panel in the scale house and the technician switches in the lane control signal cabinets shall be housed in metal boxes. The switches shall be permanently labeled. Provide strain relief and grommets on all cable entrances into the switch housings.

24.3. CONSTRUCTION METHODS

(A) General

The LED lane use control signals shall be manufactured in accordance with the requirements set forth in the Manual on Uniform Traffic Control Devices, Chapter 4M. The overall requirements include legibility at a minimum distance of 300 feet, message blackout regardless of lighting conditions, limited viewing angles based on application requirements, and readability in all specified lighting conditions. The product shall be able to operate within specifications over an ambient temperature range of -35°F to +165°F.

Mount the lane control signals on the monotube gantry structures using stainless steel band clamps.

(B) Operator Control

Install manual switches in the lane use vehicle signal cabinet for a technician to select the "open" or "closed" message. Install in the scale house the manual switch for the operator or officer to select any the message described above.

Permanently secure the manual switches in the open/closed sign cabinet to the cabinet wall or shelf.

24.4. MEASUREMENT AND PAYMENT

Lane control signal will be measured and paid for as the actual number of lane control signals furnished, installed, and accepted.

No measurement will be made for visors, wire entrance fittings, interconnecting brackets, mounting assemblies, and control panels as these will be considered incidental to furnishing and installing the lane control signs.

Signal cable will be measured and paid for as actual linear feet of signal cable furnished, installed, and accepted. Measurement will be point to point with no allowance for sag. Twenty-five feet will be allowed for vertical segments up or down poles.

Payment will be made under:

Pay Item **Pay Unit**

Lane Control Signal	Each
Signal Cable	Linear Foot

25. SIGNAL HEADS

25.1. DESCRIPTION

Furnish and install vehicle LED signal heads, visors, interconnecting brackets, wire entrance fittings, mounting assemblies, signal cable, grounding systems, and all necessary hardware.

25.2. MATERIALS

(A) General

Fabricate vehicle signal head housings and end caps from die-cast aluminum. Fabricate tunnel and traditional visors for die-cast aluminum signal heads from sheet aluminum.

Paint all surfaces inside and outside of signal housings and doors. Paint outside surfaces of tunnel and traditional visors, messenger cable mounting assemblies, pole and pedestal mounting assemblies, and pedestrian pushbutton housings. Use electrostatically-applied, fused-polyester paint a minimum of 2.5 to 3.5 mils thick. Do not apply paint to the latching hardware or rigid vehicle signal head mounting brackets for mast arm attachments.

For signals at all other locations, paint the signal housings highway yellow (Federal Standard 595C, Color Chip Number 13538).

Have the interior surfaces of tunnel and traditional visors painted an alkyd urea black synthetic baking enamel with a minimum gloss reflectance and that meets the requirements of MIL-E-10169, "Enamel Heat Resisting, Instrument Black."

For pedestal mounting, provide a post-top slipfitter mounting assembly that matches the positive locking device on the signal head with serrations integrally cast into the slipfitter. Provide stainless steel hardware, screws, washers, etc. Provide a minimum of six 3/8 X 3/4-inch long square head bolts for attachment to pedestal. Provide a center post for multi-way slipfitters. Furnish post-top slipfitter mounting assemblies that are either the same color as the housing of the pedestrian or vehicle signal head that will be attached to them (e.g., furnish black assemblies for black signal heads and yellow assemblies for yellow signal heads) or which have a natural aluminum finish. Comply with the painting requirements for signal heads listed above.

For light emitting diode (LED) traffic signal modules, provide the following requirements for inclusion on the ITS & Signals Qualified Products List (QPL) for traffic signal equipment.

1. Sample submittal,
2. Third-party independent laboratory testing results for each submitted module with evidence of testing and conformance with all of the Design Qualification Testing specified in Section 6.4 of each of the following Institute of Transportation Engineers (ITE) specifications:

   - Vehicle Traffic Control Signal Heads – Light Emitting Diode (LED) Circular Signal Supplement
   - Vehicle Traffic Control Signal Heads – Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Supplement

   (Note: The Department currently recognizes two approved independent testing laboratories. They are Intertek ETL Semko and Light Metrics, Incorporated with

Garwood Laboratories. Independent laboratory tests from other laboratories may be considered as part of the QPL submittal at the discretion of the Department.

3. Evidence of conformance with the requirements of these specifications,
4. A manufacturer's warranty statement in accordance with the required warranty, and
5. Submittal of manufacturer's design and production documentation for the model, including but not limited to, electrical schematics, electronic component values, proprietary part numbers, bill of materials, and production electrical and photometric test parameters,
6. Evidence of approval of the product to bear the Intertek ETL Verified product label for LED traffic signal modules.

In addition to meeting the performance requirements for the minimum period of 60 months, provide a written warranty against defects in materials and workmanship for the modules for a period of 60 months after installation of the modules. During the warranty period, the manufacturer must provide replacement modules at no cost to the City within 45 days of receipt of modules that have failed. Repaired or refurbished modules may not be used to fulfill the manufacturer's warranty obligations. Provide manufacturer's warranty documentation to the Department during evaluation of product for inclusion on the Department's QPL.

(B) Vehicle Signal Heads

Comply with the ITE standard "Vehicle Traffic Control Signal Heads". Provide housings with provisions for attaching backplates.

Provide visors that are 8 inches in length for 8-inch vehicle signal head sections. Provide visors that are 10 inches in length for 12-inch vehicle signal heads.

Provide a termination block with one empty terminal for field wiring for each indication plus one empty terminal for the neutral conductor. Have all signal sections wired to the termination block. Provide barriers between the terminals that have terminal screws with a minimum Number 8 thread size and that will accommodate and secure spade lugs sized for a Number 10 terminal screw.

Mount termination blocks in the yellow signal head sections on all in-line vehicle signal heads. Mount the termination block in the red section on five-section vehicle signal heads.

Furnish vehicle signal head interconnecting brackets. Provide one-piece aluminum brackets less than 4.5 inches in height and with no threaded pipe connections. Provide hand holes on the bottom of the brackets to aid in installing wires to the signal heads. Lower brackets that carry no wires and are used only for connecting the bottom signal sections together may be flat in construction.

For mast arm mounting, provide rigid vehicle signal head mounting brackets and all other hardware necessary to make complete, watertight connections of the vehicle signal heads to the mast arms and to provide a means for vertically adjusting the vehicle signal heads to proper alignment. Fabricate the mounting assemblies from malleable iron or aluminum, and provide serrated rings made of aluminum.

Provide LED vehicular traffic signal modules (hereafter referred to as modules) that consist of an assembly that uses LEDs as the light source in lieu of an incandescent lamp for use in traffic signal sections. Use LEDs that are aluminum indium gallium phosphorus (AlInGaP)

technology for red and yellow indications and indium gallium nitride (InGaN) for green indications. Install the ultra bright type LEDs that are rated for 100,000 hours of continuous operation from -40°F to +165°F. Design modules to have a minimum useful life of 60 months and to meet all parameters of this specification during this period of useful life.

For the modules, provide spade terminals crimped to the lead wires and sized for a #10 screw connection to the existing terminal block in a standard signal head. Do not provide other types of crimped terminals with a spade adapter.

Ensure the power supply is integral to the module assembly. On the back of the module, permanently mark the date of manufacture (month & year) or some other method of identifying date of manufacture.

Tint the red, yellow, and green lenses to correspond with the wavelength (chromaticity) of the LED. Transparent tinting films are unacceptable. Provide a lens that is integral to the unit with a smooth outer surface.

Provide modules in the following configurations: 12-inch circular sections. All makes and models of LED modules purchased for use on this project shall appear on the current NCDOT ITS & Signals Qualified Products List (QPL).

Provide the manufacturer's model number and the product number assigned by the Department for each module that appears on the 2006 or most recent ITS & Signals QPL. In addition, provide manufacturer's certification in accordance with Article 106-3 of the *Standard Specifications,* that each module meets or exceeds the ITE "Vehicle Traffic Control Signal Heads – Light Emitting Diode (LED) Circular Signal Supplement" dated June 27, 2005 (hereafter referred to as VTCSH Circular Supplement) and other requirements stated in this specification.

Provide modules that meet the following requirements when tested under the procedures outlined in the VTCSH Circular Supplement:

Module Type	Max. Wattage at 165° F	Nominal Wattage at 77° F
12-inch red circular	17	11
12-inch green circular	15	15

For yellow circular signal modules, provide modules tested under the procedures outlined in the VTCSH Circular Supplement to insure power required at 77° F is 22 Watts or less for the 12-inch circular module and 13 Watts or less for the 8-inch circular module.

Note: Use a wattmeter having an accuracy of ±1% to measure the nominal wattage and maximum wattage of a circular traffic signal module. Power may also be derived from voltage, current and power factor measurements.

(C) Operator Control

Provide a manual pushbutton switch with a ten-foot extension in the scale house for each static scale for a scale house operator to switch the red/green signals in the respective static scale lane. A single push of the switch the signals to the other color. Provide strain relief and grommets on all cable entrances into the pushbutton, its extension cable and where the extension cable connects to the system electronics, interface panel or termination panel.

25.3. CONSTRUCTION METHODS

Bag new signal heads with burlap bags or bags made of non-ripping material specifically designed for covering signal heads until signal heads are placed in operation. Do not use trash bags of any type.

Adjust each signal head vertically and horizontally so that light output will be of maximum effectiveness for traffic and pedestrians. Do not tilt signal heads forward.

Install vehicle signal heads at the heights required in the *North Carolina Supplement to the MUTCD* in effect on the date of advertisement.

Where vehicle signal heads are installed on mast arms, install mounting hardware consisting of rigid vehicle signal head mounting brackets.

Install signal cable in continuous lengths between equipment cabinets and lane use control signals and signal heads. Route signal cable to minimize the length of cable installed and the number of cables and conductors in each run. Pull 36 inches of additional signal cable into equipment cabinets.

Make electrical connections inside each signal head, equipment cabinet, and termination compartment in metal poles. Do not splice cable at any other point between signal heads and equipment cabinet.

Coil sufficient signal cable beside each vehicle signal head to accommodate head shifts during various construction phases. For final signal head locations, coil 36 inches on each side of signal head if signal cable comes from both directions. If signal cable terminates at the signal head, coil 36 inches of signal cable on the same side as the cable run.

25.4. MEASUREMENT AND PAYMENT

Vehicle signal head (_____) will be measured and paid for as the actual number of signal heads of each type, size, and number of sections furnished, installed, and accepted.

No measurement will be made of visors, wire entrance fittings, interconnecting brackets, mounting assemblies, as these will be considered incidental to furnishing and installing signal heads.

Signal cable will be measured and paid for in accordance with the "Lane Use Control Signs" section of these Project Special Provisions. No measurement will be made for drip loops, coiled sections, or lashing wire as these will be considered incidental to furnishing and installing signal cable.

Payment will be made under:

Pay Item	Pay Unit
Vehicle Signal Head (12" 2-Section, Red-Green)	Each

26. OPEN/CLOSED DMS PANELS

26.1. DESCRIPTION

Furnish and install LED OPEN/CLOSED DMS panels, communications cable, DMS control electronics, wire entrance fittings, grounding, and mounting brackets, and all necessary hardware.

26.2. MATERIALS

(A) General

When power is applied to the sign, the desired text "OPEN" or "CLOSED" will be displayed with .20" LEDs. The overall image will be progressively dimmed relative to the ambient light level changes detected by the photo sensor installed in the sign. The sign control consists of one power control board with opto-coupler isolated input control. The opto-coupler inputs can be used to activate externally controlled dimming, flashing, and multiple message functions as required. This is a two message sign where the image is displayed with LEDs mounted directly on a black powder coated aluminum doorplate.

A sealed polycarbonate protective slide out lens shields the LEDs from the environment. The assembly is housed in a hinged 8" deep cabinet with 7" visors. Provide a housing constructed of .125" extruded aluminum with welded corners. The display of the sign message is configured so that no latent image is visible under any lighting conditions when the sign is off. Optional aluminum louvers can be installed over the front of the sign face to provide additional sun shading.

(B) Electronic Requirements

The LED circuitry will consist of two main sub-circuits; the sign power control system and the LED power bus system. The power control circuitry shall be supplied with 115VAC (optional 12 or 24VDC). Protection components to guard the system against power surges and short circuits are built into the input power circuitry. The power supply will maintain regulation over the input voltage range of 90-130VAC (115VAC version). Opto-coupler isolated inputs provide control for LED functions such as dimming, flashing, and multiple messages as required. Progressive dimming is activated when an integrated photo-diode sensor is installed. The output of the sign is then adjusted proportional to the changes in the ambient light conditions over time. The flash function is activated by connecting an external sync signal to the opto-coupler input of the sign control or by setting a jumper that causes the sign to self-flash whichever is required. Individual messages are selected by applying power to the opto-coupler isolated control inputs, which can control as many as five different sign states.

All the features such as maximum dimming level, current sense level, and flash rate are factory set and user programmable. Special features like adjustable dimming for each channel (used to control brightness of one color or one image), and individual channel flashing (used to flash part of the image while the rest remains steady) allows for customized configurations with a standard interchangeable power control board. Consult the factory for specific ranges and limitations.

All the sub-circuits are designed in a modular fashion, allowing the replacement of any defective circuit strip or supply/control by a qualified technician without the use of a soldering

iron. The circuit strips and boards are conformal coated to protect the individual devices and connections against moisture and corrosion.

The LED's that are used for displaying messages or creating traffic control signals are available in several viewing angle and color combinations. The appropriate devices are selected according to the installation and application requirements specified by the customer. Standard viewing angles available from most manufacturers for 5mm (T1-3/4) LEDs are 6°, 15°, 23°, and 30°. Luminous intensity in milli-candela (mcd) output varies based on color and viewing angle. The following device specifications reflect one manufacturer's data sheets for the components used in this application. Any alternate manufacturer's components used will meet or exceed these specifications.

(C) LED Specifications

AlInGaP (yellow & red) and InGaN (green) devices have a luminous intensity degradation of approximately 20% over 100,000 hours (11 years) when operated at a non-pulsed 20ma level.

Color	Dominant Wavelength	Min. Lum. Int. @ 20ma	Max. Lum. Int. @ 20ma	Viewing Angle
Green	520 nm	4600 mcd	9200 mcd	30°
Red	626 nm	4180 mcd	8200 mcd	30°

(D) Enclosures and Finishes

The final enclosure, slide-in panels, visors, and associated hardware will be fabricated from aluminum or stainless steel as specified. The exterior aluminum enclosure, panels, and visors will have a black powder coated finish as well as the interior faceplates. All openings shall be gasketed or sealed and drain holes will be located in the lower corners of the enclosure to control condensation. The signs will be mounted with a user defined, optional mounting fixture. A textured polycarbonate panel will be incorporated into the sign to provide better blanking.

(E) Power Requirements

The power consumption for the red LEDs is 4 watts per 100 LEDs and for green LEDs it is 8 watts per 100. Input power and controls are designed for accept 120 VAC and total power will not exceed 15 watts when any single message is activated. A terminal strip is provided and is clearly marked by an in-cabinet circuit diagram for easy installation and service.

(F) Operator Control

Provide in the scale house a rotary manual switch for the operator or officer to perform the same message selection. The switch position shall clearly align with labels so it is clear what message has been selected. There shall be a "lockout" so the technician and scale house switches cannot be used to select conflicting messages.

Provide a rotary manual switch in the DMS cabinet for a technician to select the messages described below. Provide in the scale house a rotary manual switch for the operator or officer to perform the same message selection. The switch position shall clearly align with labels so it is clear what message has been selected.

The manual switches shall select one of the following messages:

- Open – station open and sign displays "Open" message
- Auto - station open and sign displays "Open" message as long as queue detectors do not determine stations should be closed.
- Closed – station closed, sign displays "Closed" message
- Off – sign displays no message

The scale house operator panel and technician switches in the open/closed sign cabinet shall be housed in metal boxes. The switches shall be permanently labeled. Provide strain relief and grommets on all cable entrances into the switch housings.

26.3. CONSTRUCTION METHODS

(A) General

The overall requirements include legibility at a minimum distance of 300 feet, message blackout regardless of lighting conditions, limited viewing angles based on application requirements, and readability in all specified lighting conditions. The product shall be able to operate within specifications over an ambient temperature range of -35°F to +165°F.

Mount the DMS panel to an overhead static sign as shown in the Plans.

(B) Operator Control

Install a manual rotary switch in the DMS cabinet for a technician to select the "open" or "closed" message. Install in the scale house a manual rotary switch for the operator or officer to select any the message described above.

Permanently secure the manual switch in the open/closed sign cabinet to the cabinet wall or shelf.

26.4. MEASUREMENT AND PAYMENT

Open/Closed DMS Panel will be measured and paid lump sum for the DMS, sign controller, cabling and mounting hardware furnished, installed, and accepted.

No measurement will be made for communications cable, DMS control electronics, manual rotary switches, wire entrance fittings, grounding, and mounting brackets, as these will be considered incidental to furnishing and installing the DMS panel.

Payment will be made under:

Pay Item	Pay Unit
Open/Closed DMS Panel	Lump Sum

27. DYNAMIC MESSAGE SIGN (DMS)

27.1. DESCRIPTION

The DMS used on the State Highway System shall be preapproved on the current NCDOT ITS & Signals 2012 Qualified Products List (QPL) by the date of installation. DMSs not preapproved will not be allowed for use on the project. To ensure compatibility with the existing DMS Control Software deployed in the State, furnish a NTCIP compliant DMS that is fully compatible with Daktronics, Inc. Vanguard Version 4 software (also referred to hereinafter as the "Control Software"). The QPL is available on the Department's website. The QPL website is:

http://www.ncdot.org/doh/preconstruct/traffic/ITSS/SMS/qpl/

Furnish and install a DMS compliant with UL standards 48, 50, 879, and 1433.

Add and configure the new DMS in the system using the Control Software and computer system. Furnish, install, test, integrate, and make operational the new DMS at the location shown in the Plans.

Furnish an operating DMS system consisting of, but not limited to, the following:

- Full Matrix, 66 mm, 27 pixel high and 60 pixels wide LED DMS, 12" border
- Front Access, 8' x 15'
- DMS mounting hardware
- DMS controllers, Uninterruptible Power Supplies (UPS), cabinets and accessories with interconnect and power cabling and conduit
- Branch circuit conductors and related equipment
- DMS operator control panel in the scale house
- All other equipment and incidentals required for furnishing, installing, and testing the DMS system and system components

Use only UL listed and approved electronic and electrical components in the DMS system.

27.2. MATERIALS

(A) Environmental Requirements

Construct the DMS and DMS controller cabinet so the equipment within is protected against moisture, dust, corrosion, and vandalism.

Design the DMS system to comply with the requirements of Section 2.1 (Environmental and Operating Standards) of NEMA TS 4-2005.

(B) Full Matrix LED Dynamic Message Sign (DMS)

Construct the DMS to display at least three lines of text that, when installed, are clearly visible and legible to a person with 20/20 corrected vision from a distance of 900 feet in advance of the DMS at an eye height of 3.5 feet along the axis.

When displaying three lines, each line must display at least 10 equally spaced and equally sized alphanumeric individual characters. Each character must be at least 18 inches in height and composed from a luminous dot matrix. Provide an entire LED matrix that is a minimum of 27 pixels high and 60 pixels wide.

(1) DMS Enclosure

Construct the enclosure of welded aluminum type 6061-T6, 5052-H38, 5052-H34, or of an Engineer approved alternate at least 1/8-inch thick. Perform all welding of aluminum and aluminum alloys in accordance with the latest edition of AWS D1.2, Structural Welding Code - Aluminum. Continuously weld the seams using Gas Metal Arc Welding (GMAW).

Provide all exterior and interior DMS enclosure surfaces with natural, mill-finish aluminum. Remove all grind marks and discoloration from the surfaces.

Provide corrosion resistant nuts, bolts, washers, and other mounting and bonding parts and components used on the exterior of the DMS enclosure and ensure they are sealed against water intrusion.

Provide one front access door for each 10-15 pixel wide section of the sign enclosure. Vertically hinge the doors and design to swing out from the face to provide access to the enclosure interior. Extend each door the full height of the display matrix. Provide a retaining latch mechanism for each door to hold the door open at a 90-degree angle. Each door will form the face panel for a section of the sign. Mount the LED modules to the door such that they can be removed from the door when in the open position. Other sign components can be located inside the sign enclosure and be accessible through the door opening. Provide for each door a minimum of two (2) screw-type captive latches to lock them in the closed position and pull the door tight and compress a gasket located around the perimeter of each door. Install the gasket around the doors to prevent water from entering the cabinet.

Furnish the sign face, excluding the front panel with a flat black, UV treated, colorfast material. Prepare all surfaces for application according to the sheeting manufacturer's recommendations prior to applying the sheeting. Furnish DMS with UV-treated, colorfast border with a minimum width of 12 inches.

Do not place a manufacturer name, logo, or other information on the front face of the DMS or shield visible to the motorist.

Provide power supply monitoring circuitry to detect power failure in the DMS and to automatically report this fault to the Control Software. This requirement is in addition to reporting power failure at the controller cabinet.

Do not paint the stainless steel bolts on the Z-bar assemblies used for mounting the enclosure.

(2) DMS Interior Environment Control for Front Access Enclosures

Install a minimum of one (1) temperature sensor that is mounted near the top of the DMS interior. The sensor(s) will measure the temperature of the air in the enclosure over a minimum range of -40°F to +176°F. Ensure the DMS controller will continuously monitor the internal temperature sensor output and report to the DMS control software upon request.

Design the DMS with systems for enclosure ventilation, face panel fog and frost prevention, and safe over-temperature shutdown.

Design the DMS ventilation system to be thermostatically controlled and to keep the internal DMS air temperature lower than +140°F, when the outdoor ambient temperature is +115°F or less.

The ventilation system will consist of two or more air intake ports located near the bottom of the DMS rear wall. Cover each intake port with a filter that removes airborne particles measuring 500 microns in diameter and larger. Mount one or more ball bearing-type fans at each intake port. These fans will positively pressure the DMS enclosure.

Design the fans and air filters to be removable and replaceable from inside the DMS housing. To ease serviceability, mount the fans no more than four (4) feet from the floor of the DMS enclosure.

Provide each ventilation fan with a sensor to monitor its rotational speed, measured in revolutions per minute and report this speed to the sign controller upon request.

The ventilation system will move air across the rear of the LED modules in a manner such that heat is dissipated from the LED's. Design the airflow system to move air from the bottom of the enclosure towards the top to work with natural convection to move heat away from the modules.

Install each exhaust port near the top of the rear DMS wall. Provide one exhaust port for each air intake port. Screen all exhaust port openings to prevent the entrance of insects and small animals.

Cover each air intake and exhaust port with an aluminum hood attached to the rear wall of the DMS. Thoroughly seal all intakes and exhaust hoods to prevent water from entering the DMS.

Provide a thermostat near the top of the DMS interior to control the activation of the ventilation system.

The DMS shall automatically shut down the LED modules to prevent damaging the LEDs if the measured internal enclosure air temperature exceeds a maximum threshold temperature. The threshold temperature shall be configurable and shall have a default factory setting of 140°F.

(3) Front Panel

Protect the DMS face with contiguous, weather-tight, removable panels. These panels must be a polycarbonate material that are ultraviolet protected, have an antireflection coating, and are a minimum of 1/8- inch thick.

Furnish polycarbonate panels with the following characteristics:

- Tensile Strength, Ultimate: 10,000 PSI
- Tensile Strength, Yield: 9,300 PSI
- Tensile Strain at Break: 125%
- Tensile Modulus: 330,000 PSI
- Flexural Modulus: 330,000 PSI
- Impact Strength, Izod (1/8", notched): 17 ft-lbs/inch of notch

- Rockwell Hardness: M75, R118
- Heat Deflection Temperature Under Load: 264 PSI at 270F and 66 PSI at 288F
- Coefficient of Thermal Expansion: 3.9X10-5 in/in/F
- Specific Heat: 0.30 BTU/lb/F
- Initial Light Transmittance: 85% minimum
- Change in Light Transmittance, 3 years exposure in a Southern latitude: 3%
- Change in Yellowness Index, 3 years exposure in a Southern latitude: less than 5%

For substitutes, submit one 12" x 12" sample of the proposed material together with a description of the material attributes to the Engineer for review and approval. Install a .09" aluminum mask on the front of the panel (facing the motorists) that contains a circular opening for each LED pixel. Prime and coat the front side of the aluminum mask, which faces the viewing motorists, with automotive-grade flat black acrylic enamel paint or an approved equivalent. Guarantee all painted surfaces provide a minimum outdoor service life of 20 years.

Design the panels so they will not warp nor reduce the legibility of the characters. Differential expansion of the DMS housing and the front panel must not cause damage to any DMS component or allow openings for moisture or dust. Glare from sunlight, roadway lighting, commercial lighting, or vehicle headlights must not reduce the legibility or visibility of the DMS. Install the panels so that a maintenance person can easily remove or open them for cleaning.

(4) Display Modules

Manufacture each display module with a standard number of pixels, not to exceed an array of 9 x 5, which can be easily removed. Assemble the modules onto the DMS assemblies contiguously to form a continuous matrix to display the required number of lines, characters, and character height.

Design display modules that are interchangeable and replaceable without using special tools. Provide plug-in type power and communication cables to connect to a display module.

Construct each display module as a rectangular array of 5 horizontal pixels by 7 to 9 vertical pixels. Provide the module with an equal vertical and horizontal pitch between pixels, and columns that are perpendicular to the rows (i.e., no slant). Design each module to display:

- All upper and lower case letters.
- All punctuation marks.
- All numerals 0 to 9.
- Special user-created characters.

Display upper-case letters and numerals over the complete height of the module. Optimize the LED grouping and mounting angle within a pixel for maximum readability.

(5) Discrete LEDs

Provide discrete LEDs with a nominal viewing cone of **30 degrees** with a half-power angle of 15 degrees measured from the longitudinal axis of the LED. Make certain, the viewing cone tolerances are as specified in the LED manufacturer's product specifications and do not exceed +/- 3 degrees half-power viewing angle of 30 degrees.

Provide LEDs that are untinted, non-diffused, high output solid state lamps utilizing indium gallium aluminum phosphide (InGaAlP) technology. Provide T1 ¾, 0.2 inch size LEDs that emit a true amber color at a wavelength of 590 ± 5 nm.

Provide LEDs with a MTBF (Mean Time Before Failure) of at least 100,000 hours of permanent use at an operating point of 140° F or below at a specific forward current of 20mA. Discrete LED failure is defined as the point at which the LED's luminous intensity has degraded to 50% or less of its original level.

Obtain the LEDs used in the display from a single LED manufacturer that have a single part number. Obtain them from batches sorted for luminous output, where the highest luminosity LED is not more than fifty percent more luminous than the lowest luminosity LED when the LEDs are driven at the same forward current. Do not use more than two successive and overlapping batches in the LED display. Document the procedure to be used to comply with this requirement as part of the material submittal.

Individually mount the LEDs on circuit boards that are at least 1/16" thick FR-4 fiberglass, flat black printed circuit board in a manner that promotes cooling. Protect all exposed metal on both sides of the LED pixel board (except the power connector) from water and humidity exposure by a thorough application of acrylic conformal coating. Design the boards so bench level repairs to individual pixels, including discrete LED replacement and conformal coating repair is possible.

Operate the LED display at a low internal DC voltage not to exceed 24 Volts.

Design the LED display operating range to be –20° F to +140° F at 95% relative humidity, non-condensing.

Supply the LED manufacturer's technical specification sheet with the material submittals.

(6) LED Power Supplies

Power the LED Display by means of multiple regulated switching DC power supplies that operate from 120 volts AC input power and have an output of 48 volts DC or less. Wire the supplies in a redundant parallel configuration that uses multiple power supplies per display. Provide the supplies with current sharing capability that allows equal amounts of current to their portion of the LED display. Provide power supplies rated such that if one supply fails the remaining supplies will be able to operate their portion of the display under full load conditions (i.e. all pixels on at maximum brightness) and at a temperature of 140° F.

Provide power supplies to operate within a minimum input voltage range of +90 to +135 volts AC and within a temperature range of –22° F to 140° F. Power supply output at 140° F must not deteriorate to less than 65% of its specified output at 70° F. Provide power supplies that are overload protected by means of circuit breakers, that have an efficiency rating of at least 75%, a power factor rating of at least .95, and are UL listed. Provide all power supplies from the same manufacturer and with the same model number. Design the power driver circuitry to minimize power consumption.

Design the field controller to monitor the operational status (normal or failed) of each individual power supply and be able to display this information on the Client Computer screen.

(7) LED Pixels

A pixel is defined as the smallest programmable portion of a display module that consists of a cluster of closely spaced discrete LEDs. Design each pixel to be a maximum of 2 inches in diameter.

Construct the pixels with two strings of LEDs. It is the manufacturer's responsibility to determine the number of LEDs in each string to produce the candela requirement as stated herein.

Ensure each pixel produces a luminous intensity of 40 Cd when driven with an LED drive current of 20 mA per string.

Power the LEDs in each pixel in strings. Use a redundant design so that the failure of an LED in one string does not affect the operation of any other string within the pixel. Provide the sign controller with the ability to detect the failure of any LED string and identify which LED string has failed. Submit a complete schematic of the LED power and driver circuits with the material submittals.

(8) Character Display

Design display modules to be easily removable without the use of tools. Position cooling fans so they do not prevent removal of an LED pixel board or driver board.

Use continuous current to drive the LEDs at the maximum brightness level. Design the light levels to be adjustable for each DMS / controller so the Engineer may set levels to match the luminance requirements at each installation site.

Design the controller to automatically detect failed LED strings or drivers and initiate a report of the event to the Control Software. Design the controller to be able to read the internal temperature of the DMS enclosure and the ambient temperature outside the DMS enclosure and report these to the Control Software.

(9) Display Capabilities

Design the DMS with at least the following message displays:

- Static display
- Flashing display with Dynamic flash rates
- At least two alternating Static and / or Flashing sequences (multi-page messages)

(10) DMS Mini Controller

Furnish and install a mini controller inside the DMS that is interconnected with the main controller using a fiber optic cable, CAT-5 cable, or an approved alternate. The mini controller will enable a technician to perform all functions available from the main controller. Provide the mini controller with an LCD/keypad interface. Size the LCD display screen to allow preview of an entire one-page message on one screen. Provide a 4 X 4 keypad.

Alternatively, install an EIA/TIA-232E port inside the DMS enclosure to enable a maintenance technician to communicate with the DMS main controller and obtain access to and perform all functions of the main controller using a laptop computer.

(11) DMS Enclosure Structure Mounting

Mount the DMS enclosure and interconnect system securely to the supporting structures of the type specified in the Plans. Design the DMS enclosure supports and structure to allow full access to the DMS inspection panels.

Furnish and install U-bolt connections of hanger beams to overhead assembly truss chords with a double nut at each end of the U-bolt. Bring the double nuts tight against each other by the use of two wrenches.

Submit plans for the DMS enclosure, mounting description and calculations to the Engineer for approval. Have such calculations and drawings approved by a Professional Engineer registered in the state of North Carolina, and bear his signature, seal, and date of acceptance.

Provide removable lifting eyes or the equivalent on the DMS enclosure rated for its total weight to facilitate handling and mounting the DMS enclosure.

Design the DMS structure to conform to the applicable requirements of the 6th edition of the AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires*, and the section titled "DMS Assemblies" of these Project Special Provisions.

(12) DMS / DMS Controller Interconnect

Furnish and install all necessary cabling, conduit, and terminal blocks to connect the DMS and the DMS controller. Use approved manufacturer's specifications and the Plans for cable and conduit types and sizes. Use fiber optic cable to interconnect sign and controller. Install fiber optic interconnect centers in the sign enclosure and cabinet to securely install and terminate the fiber optic cable. Submit material submittal cut sheets for the interconnect center.

(13) DMS Controller and DMS Cabinet

Furnish and install one DMS controller with accessories per DMS in a new equipment cabinet. Mount the controller cabinet on the DMS support structure. Install cabinet so that the height from the ground to the middle of the cabinet is four feet. Ensure a minimum of three feet level working surface under each cabinet that provides maintenance technicians with a safe working environment.

Provide the DMS controller as a software-oriented microprocessor and with resident software stored in non-volatile memory. The Control Software, controller, and communications must comply with the NTCIP Standards identified in these Project Special Provisions. Provide sufficient non-volatile memory to allow storage of at least 500 multi-page messages and a test pattern program.

- Furnish the controller cabinet with, but not limited to, the following:
- Power supply and distribution assemblies
- Power line filtering hybrid surge protectors
- Radio Interference Suppressor
- Communications surge protection devices
- Industrial-Grade UPS system and local disconnect
- Microprocessor-based controller
- Display driver and control system (unless integral to the DMS)
- Industrial-grade dial-up modem and interface cable
- Industrial-grade telephone line surge and lightning protector

- Serial interface port for local laptop computer
- Local user interface
- Interior lighting and duplex receptacle
- Adjustable shelves as required for components
- Temperature control system
- All interconnect harnesses, connectors, and terminal blocks
- All necessary installation and mounting hardware

Furnish the DMS controller and associated equipment completely housed in a NEMA 3R cabinet made from 5052-H32 sheet aluminum at least 1/8" thick. Use natural aluminum cabinets. Perform all welding of aluminum and aluminum alloys in accordance with the latest edition of AWS D1.2, Structural Welding Code - Aluminum. Continuously weld the seams using Gas Metal Arc Welding (GMAW).

Slant the cabinet roof away from the front of the cabinet to prevent water from collecting on it.

Do not place a manufacturer name, logo, or other information on the faces of the controller cabinet visible to the motorist.

Provide cabinets capable of housing the components and sized to fit space requirement. Design the cabinet layout for ease of maintenance and operation, with all components easily accessible. Submit a cabinet layout plan for approval by the Engineer.

Locate louvered vents with filters in the cabinet to direct airflow over the controller and auxiliary equipment, and in a manner that prevents rain from entering the cabinet. Fit the inside of the cabinet, directly behind the vents, with a replaceable, standard-size, commercially available air filter of sufficient size to cover the entire vented area.

Provide a torsionally rigid door with a continuous stainless steel hinge on the side that permits complete access to the cabinet interior. Provide a gasket as a permanent and weather resistant seal at the cabinet door and at the edges of the fan / exhaust openings. Use a non-absorbent gasket material that will maintain its resiliency after long-term exposure to the outdoor environment. Construct the doors so that they fit firmly and evenly against the gasket material when closed. Provide the cabinet door with louvered vents and air filters near the bottom as described in the paragraph above.

The cabinet shall contain a full-height standard EIA 19-inch rack. The rack shall be secured within the cabinet by mounts at the top and bottom.

The rack shall contain a minimum of one (1) pullout drawer. The drawer shall be suitable for storing manuals and small tools, such as screwdrivers. The drawer shall be able to latch in the out position to function as a laptop/utility shelf.

Provide a convenient location on the inside of the door to store the cabinet wiring diagrams and other related cabinet drawings. Provide a Corbin #2 main door lock made of non-ferrous or stainless steel material. Key all locks on the project alike, and provide 10 keys to the Engineer. In addition, design the handle to permit pad-locking.

Provide the interior of the cabinet with ample space for housing the controller and all associated equipment and wiring; use no more than 75% of the useable space in the cabinet.

Provide ample space in the bottom of the cabinet for the entrance and exit of all power, communications, and grounding conductors and conduit.

Arrange the equipment to permit easy installation of the cabling through the conduit so that they will not interfere with the operation, inspection, or maintenance of the unit. Provide adjustable metal shelves, brackets, or other support for the controller unit and auxiliary equipment. Leave a 3-inch minimum clearance from the bottom of the cabinet to all equipment, terminals, and bus bars.

Provide power supply monitoring circuitry to detect power failure and to report automatically the occurrence to the Control Software.

Install two 15-watt fluorescent light strips with shields, one in the top of the cabinet and the other under the bottom shelf. Design both lights to automatically turn on when the cabinet door is opened and turn off when the door closes.

Mount and wire a 120V (±10%) GFCI duplex receptacle of the 3-wire grounding type in the cabinet in a location that presents no electrical hazard when used by service personnel for the operation of power tools and work lights.

No cabinet resident equipment may utilize the GFCI receptacle. Furnish one spare non-GFCI receptacle for future equipment.

Mount a bug-proof and weatherproof thermostatically controlled fan and safety shield in the top of the cabinet. Size the fan to provide at least for two air exchanges per minute. Fuse the fan at 125% of the capacity of the motor. The magnetic field of the fan motor must not affect the performance of the control equipment. Use a fan thermostat that is manually adjustable to turn on between 80°F and 160°F with a differential of not more than 10°F between automatic turn-on and turn-off. Mount it in an easily accessible location, but not within 6 inches of the fan.

Install additional fans and/or heaters as needed to maintain the temperature inside the cabinet within the operating temperature range of the equipment within the cabinet as recommended by equipment manufacturer(s).

a) Wiring

The requirements stated herein apply wherever electrical wiring is needed for any DMS system assemblies and subassemblies such as controller cabinet, DMS enclosure, electrical panel boards and etc.

Neatly arrange and secure the wiring inside the cabinet. Where cable wires are clamped to the walls of the control cabinet, provide clamps made of nylon, metal, plastic with rubber or neoprene protectors, or similar. Lace and jacket all harnesses, or tie them with nylon tie wraps spaced at 6 inches maximum to prevent separation of the individual conductors.

Individually and uniquely label all conductors. Ensure all conductor labels are clearly visible without moving the conductor. Connect all terminal conductors to the terminal strip in right angles. Remove excess conductor before termination of the conductor. Mold the conductor in such a fashion as to retain its relative position to the terminal strip if removed from the strip. Do not run a conductor across a work surface with the exception of connecting to that work surface. No conductor bundles can be support by fasteners that support work surfaces. Install all connectors, devices, and conductors in accordance to manufactures guidelines. Comply with the latest NEC guideline in effect during installation. No conductor or conductor bundle may hang

loose or create a snag hazard. Protect all conductors from damage. Ensure all solder joints are completed using industry accepted practices and will not fail due to vibration or movement. Protect lamps and control boards from damage.

No splicing will be allowed for feeder conductors and communication cables from the equipment cabinet to the DMS enclosure.

Insulate all conductors and live terminals so they are not hazardous to maintenance personnel.

Route and bundle all wiring containing line voltage AC and / or shield it from all low voltage control circuits. Install safety covers to prevent accidental contact with all live AC terminals located inside the cabinet.

Use industry standard, keyed-type connectors with a retaining feature for connections to the controller.

Label all equipment and equipment controls clearly.

Supply each cabinet with one complete set of wiring diagrams that identify the color-coding or wire tagging used in all connections. Furnish a water-resistant packet adequate for storing wiring diagrams, operating instructions, and maintenance manuals with each cabinet.

b) Power Supply and Circuit Protection

Design the DMS and controller for use on a system with a line voltage of 120V $\pm$ 10% at a frequency of 60 Hz $\pm$ 3 Hz. Under normal operation, do not allow the voltage drop between no load and full load of the DMS and its controller to exceed 3% of the nominal voltage.

Blackout, brownout, line noise, chronic over-voltage, sag, spike, surge, and transient effects are considered typical AC voltage defects. Protect the DMS system equipment so that these defects do not damage the DMS equipment or interrupt their operation. Equip all cabinets with devices to protect the equipment in the cabinet from damage due to lightning and external circuit power and current surges.

c) Circuit Breakers

Protect the DMS controller, accessories, and cabinet utilities with thermal magnetic circuit breakers. Provide the controller cabinet with a main circuit breaker sized according to the NEC. Use appropriately sized branch circuit breakers to protect the controller and accessories and for servicing DMS equipment and cabinet utilities.

d) Surge Suppressor

Install and clearly label filtering hybrid power line surge protectors on the load side of the branch circuit breakers in a manner that permits easy servicing. Ground and electrically bond the surge protector to the cabinet within 2 inches.

Provide power line surge protector that meets the following requirements:

Peak surge current occurrences	20 minimum
Peak surge current for an 8 x 20 microsecond waveshape	50,000 amperes
Energy absorption	> 500 Joules

Clamp voltage	240 volts
Response time	<1 nanosecond
Minimum current for filtered output	15 amperes for 120VAC*
Temperature range	-40°F to +158°F

*Capable of handling the continuous current to the equipment

e) Radio Interference Suppressor

Provide each controller cabinet with sufficient electrical and electronic noise suppression to enable all equipment in it to function properly. Provide one or more radio interference suppressors (RIS) connected between the stages of the power line surge suppressor that minimize interference generated in the cabinet in both the broadcast and the aircraft frequencies. Each RIS must provide a minimum attenuation of 50 decibels over a frequency range of 200 KHz to 75 MHz. Clearly label the suppressor(s) and size them at least at the rated current of the main circuit breaker but not less than 50 amperes.

Provide RIS that are hermetically sealed in a substantial metal case, which is filled with a suitable insulating compound and have nickel-plated 10/24 brass stud terminals of sufficient external length to provide space to connect #8 AWG wires. Mount them so that the studs cannot be turned in the case. Properly insulate ungrounded terminals from each other, and maintain a surface linkage distance of not less than ¼" between any exposed current conductor and any other metallic parts. The terminals must have an insulation factor of 100-200 MΩ, dependent on external circuit conditions. Use RIS designed for 120 VAC ± 10%, 60Hz, and which meet the standards of UL and the Radio Manufacturers Association.

f) Communications Surge Protector

Equip the cabinet with properly labeled hybrid data line surge protectors that meet the following general requirements:

Surge current occurrences at 2000 ampere, 8 x 20 microsecond waveform	> 80
Surge current occurrences at 400 ampere, 10x700 microsecond waveform	> 80
Peak surge current for 8 x 20 microsecond waveform	10,000 A (2500 A/line)
Peak surge current for 10x700 microsecond waveform	500 A/line
Response time	< 1 nanosecond
Series resistance	< 15 Ω
Average capacitance	1500 pF
Temperature range	-10°F to 150°F
Clamp Voltage	As required to match equipment in application

g) Lightning Arrester

Protect the system with an UL-approved lightning arrester installed at the main service disconnect that meets the following requirements:

Type of design	Silicon Oxide Varistor
Voltage	120/240 Single phase, 3 wires
Maximum current	100,000 amps
Maximum energy	3000 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

h) Uninterruptible Power Supply (UPS)

Provide the cabinet with an industrial grade power conditioning UPS unit to supply continuous power to operate the equipment connected to it if the primary power fails. The UPS must detect a power failure and provide backup power within 20 milliseconds. Transition to the UPS source from primary power must not cause loss of data or damage to the equipment being supplied with backup power. Provide an UPS with at least three outlets for supplying conditioned AC voltage to the DMS controller and modem. Provide a unit to meet the following requirements:

- Input Voltage Range: 120VAC +12%, -25%
- Power Rating: 1000 VA, 700 Watts
- Input Frequency: 45 to 65 Hz
- Input Current: 7.2A
- Output Voltage: 120VAC +/- 3%
- Output Frequency: 50/60 +/-1 Hz
- Output Current: 8.3A
- Output Crest Factor Ration: @50% Load Up to 4.8:1
@75% Load Up to 3.2:1
@100% Load Up to 2.4:1
- Output THD: 3% Max. (Linear)
5% Max. (Non-Linear)
- Output Overload: 110% for 10 min; 200% for 0.05 sec.
- Output Dynamic Response: +/- 4% for 100% Step Load Change
0.5 ms Recovery Time.
- Output Efficiency @ 100% Load: 90% (Normal Mode)
- Operating Temperature: -40° F to +165° F
- Humidity: 0% to 95% Non-condensing

- Remote Monitoring Interface: RS-232
- Protection: Input/Output Short Circuit
  Input/Output Overload
  Excessive Battery Discharge
- Specifications: UL1778, FCC Class A, IEEE 587

Provide the UPS unit capable of supplying 30 minutes of continuous backup power to the equipment connected to it when the equipment is operating at full load.

i) Controller Communications Interface

Provide the controller with the following interface ports:

- An EIA/TIA-232E port for remote communication using NTCIP
- An 10/100 Ethernet port for remote communication using NTCIP
- An EIA/TIA-232E port for onsite access using a laptop
- An EIA/TIA-232E auxiliary port for communication with a field device such as a UPS
- Fiber Optic ports for communication with the sign
- RJ45 ports for communication with the sign using CAT-5 cable
- RJ45 ports for communication with mini-controller located inside the sign enclosure

j) Controller Local User Interface

Provide the controller with a Local User Interface (LUI) for at least the following functions:

- On / Off Switch: controls power to the controller.
- Control Mode Switch: for setting the controller operation mode to either remote or local mode.
- LCD Display and Keypad: Allow user to navigate through the controller menu for configuration (display, communications parameter, etc.) running diagnostics, viewing peripherals status, message creation, message preview, message activation, and etc. Furnish a LCD display with a minimum size of 240x64 dots with LED back light.

k) Controller Address

Assign each DMS controller a unique address. Preface all commands from the Control Software with a particular DMS controller address. The DMS controller compares its address with the address transmitted, if the addresses match, then the controller processes the accompanying data.

l) Controller Functions

Design the DMS controller to continuously control and monitor the DMS independent of the Control Software. Design the controller to display a message on the sign sent by the Control Software, a message stored in the sign controller memory, or a message created on-site by an operator using the controller keypad.

Provide the DMS controller with a watchdog timer to detect controller failures and to reset the microprocessor, and with a battery backed-up clock to maintain an accurate time and date reference. Set the clock through an external command from the Control Software or the Local User Interface.

m) DMS Controller Memory

Furnish each DMS controller with non-volatile memory. Use the non-volatile memory to store and reprogram at least one test pattern sequence and 500 messages containing a minimum of two pages of 45 characters per page. The Control Software can upload messages into and download messages from each controller's non-volatile memory remotely.

Messages uploaded and stored in the controller's non-volatile memory may be erased and edited using the Control Software and the controller. New messages may be uploaded to and stored in the controller's non-volatile memory using the Control Software and the controller.

n) Photo-Electric Sensors

Install three photoelectric sensors with ½-inch minimum diameter photosensitive lens inside the DMS enclosure. Use sensors that will operate normally despite continual exposure to direct sunlight. Place the sensors so they are accessible and field adjustable. Point one sensor north or bottom of the sign. Place the other two, one on the back wall and one on the front wall of the sign enclosure. Alternate designs maybe accepted, provided the sensor assemblies are accessible and serviceable from inside the sign enclosure.

Provide controls so that the Engineer can field adjust the following:

- The light level emitted by the pixels elements in each Light Level Mode.
- The ambient light level at which each Light Level Mode is activated.

(14) Equipment List

Provide a general description of all equipment and all information necessary to describe the basic use or function of the major system components. Include a general "block diagram" presentation. Include tabular charts listing auxiliary equipment, if any is required. Include the nomenclature, physical and electrical characteristics, and functions of the auxiliary equipment unless such information is contained in an associated manual; in this case include a reference to the location of the information. Include an itemized list of equipment costs.

Include a table itemizing the estimated average and maximum power consumption for each major piece of equipment.

(15) Physical Description

Provide a detailed physical description of size, weight, center of gravity, special mounting requirements, electrical connections, and all other pertinent information necessary for proper installation and operation of the equipment.

(16) Parts List

Provide a parts list that contains all information needed to describe the characteristics of the individual parts, as required for identification. Include a list of all equipment within a group and a list of all assemblies, sub-assemblies, and replacement parts of all units. Arrange this data in a table, in alpha-numerical order of the schematic reference symbols, which gives the associated description, manufacturer's name, and part number, as well as alternate manufacturers and part numbers. Provide a table of contents or other appropriate grouping to identify major components, assemblies, etc.

(17) Character Set Submittal

Submit an engineering drawing of the DMS character set including 26 upper case and lower case letters, 10 numerals, an asterisk (*), a dash, a plus sign (+), a designated lane diamond, a slash, an ampersand, and arrows at 0, 45, 90, 135, 180, 225, 270, and 315 degrees.

(18) Wiring Diagrams

Provide a wiring diagram for each DMS and each controller cabinet, as well as interconnection wiring diagrams for the system as a whole.

Provide complete and detailed schematic diagrams to component level for all DMS assemblies and subassemblies such as driver boards, control boards, DMS controller, power supplies, and etc. Ensure that each schematic enables an electronics technician to successfully identify any component on a board or assemblies and trace its incoming and outgoing signals.

(19) Routine of Operation

Describe the operational routine, from necessary preparations for placing the equipment into operation to securing the equipment after operation. Show appropriate illustrations with the sequence of operations presented in tabular form wherever applicable. Include in this section a total list of the test instruments, aids, and tools required to perform necessary measurements and measurement techniques for each component, as well as set-up, test, and calibration procedures.

(20) Maintenance Procedures

Specify the recommended preventative maintenance procedures and checks at pre-operation, monthly, quarterly, semi-annual, annual, and "as required" periods to assure equipment operates reliably. List specifications (including tolerances) for all electrical, mechanical, and other applicable measurements and / or adjustments.

(21) Repair Procedures

Include in this section all data and step-by-step procedures necessary to isolate and repair failures or malfunctions, assuming the maintenance technicians are capable of analytical reasoning using the information provided in the section titled "Wiring Diagrams and Theory of Operation."

Describe accuracy, limits, and tolerances for all electrical, physical, or other applicable measurements. Include instructions for disassemblies, overhaul, and re-assemblies, with shop specifications and performance requirements.

Give detailed instructions only where failure to follow special procedures would result in damage to equipment, improper operation, danger to operating or maintenance personnel, etc. Include such instructions and specifications only for maintenance that specialized technicians and engineers in a modern electromechanical shop would perform. Describe special test set-up, component fabrication, and the use of special tools, jigs, and test equipment.

(22) Field Trial

At the request of the Engineer, supply a three-character demonstration module with characters of the size and type specified for the project, an appropriate control device and power supply to allow character display within 30 working days of the request. Perform a field trial on this module at a time and location selected by the Engineer.

This trial will allow the Engineer or his selected representatives to test the readability of the DMS at the maximum distance required for specified character size. Test the module with the sun directly above the DMS, and near the horizon in front of and behind the DMS (washout and back-lit conditions).

(C) Operator Control

Provide a rotary manual switch in the DMS cabinet for a technician to select the messages described below.

Provide in the scale house a rotary manual switch for the operator or officer to perform the same message selection. The switch position shall clearly align with labels so it is clear what message has been selected. There shall be a "lockout" so the technician and scale house switches cannot be used to select conflicting messages.

The switches shall select one of the messages:

Control Panel Selection	Message	Purpose
Inspection	Proceed to Inspection Area →	Proceed to inspection area
Containment	Proceed to Inspection Area →	Proceed to containment area
Off	(Sign dark)	Sign dark, proceed
Parking	Proceed to Parking Area →	Proceed to parking area

The scale house operator panel and technician switches in the DMS cabinet shall be housed in metal boxes. The switches shall be permanently labeled. Provide strain relief and grommets on all cable entrances into switch housing.

27.3. CONSTRUCTION METHODS

(A) Description

This article establishes practices and procedures and gives minimum standards and requirements for the installation of Dynamic Message Sign systems, auxiliary equipment, and the construction of related structures.

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. Express wire sizes according to the American Wire Gauge (AWG).

Provide stainless steel screws, nuts, and locking washers in all external locations. Do not use self-tapping screws unless specifically approved by the Engineer. 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.

(B) Layout

The Engineer will establish the actual location of each Dynamic Message Sign assemblies. It is the Contractor's responsibility to ensure proper elevation, offset, and orientation of all DMS assemblies. The location of service poles as well as conduit lengths shown in the Plans, are approximate based on available project data. Make actual field measurements to place conduit and equipment at the required location.

(C) Construction Submittal

When the work is complete, submit "as built" plans, inventory sheets, and any other data required by the Engineer to show the details of actual construction and installation and any modifications made during installation.

The "as built" plans will show: the DMS, controller, and service pole locations; DMS enclosure and controller cabinet wiring layouts; and wire and conduit routing. Show all underground conduits and cables dimensioned from fixed objects.

Include detailed drawings that identify the routing of all conductors in the system by cable type, color code, and function. Clearly label all equipment in the DMS system, controller cabinet, and DMS enclosure.

(D) Conduit

Install the conduit system in accordance with section 1715 of Standard Specification and NEC requirements for an approved watertight raceway.

Make bends in the conduit so as not to damage it or change its internal diameter. Install watertight and continuous conduit with as few couplings as standard lengths permit.

Clean conduit before, during, and after installation. Install conduit in such a manner that temperature changes will not cause elongation or contraction that might damage the system.

Attach the conduit system to and install along the structural components of the DMS structure assemblies with beam clamps or stainless steel strapping. Install strapping according to the strapping manufacturer's recommendations. Do not use welding or drilling to fasten conduit to structural components. Space the fasteners at no more than four feet for conduit 1.5 inches and larger or six feet for conduit smaller than 1.25 inches. Place fasteners no more than 3 feet from the center of bends, fittings, boxes, switches, and devices.

Flexible conduit will only be allowed when the conduits transition from the horizontal structure segment to the horizontal truss segment and from the horizontal truss segment to the rear entrance of the DMS when installing the DMS communications and feeder cables. The maximum length of flexible conduit allowed at each transition will be 5 feet.

Locate underground conduit as shown in the Plans in a manner consistent with these Project Special Provisions.

Do not exceed the appropriate fill ratio on all cable installed in conduit as specified in the NEC.

(E) Wiring Methods

Do not pull permanent wire through a conduit system until the system is complete and has been cleaned.

Color-code all conductors per the NEC. Use approved marking tape, paint, sleeves or continuous colored conductors for No.8 AWG and larger. Do not mark a white conductor in a cable assemblies any other color.

Bury underground circuits at the depth shown in the Plans and surround it with at least 3 inches of sand or earth back-fill free of rocks and debris. Compact backfill in 6-inch layers. Do not splice underground circuits unless specifically noted in the Plans.

(F) Equipment and Cabinet Mounting

Mount equipment securely at the locations shown in the Plans, in conformance with the dimensions shown. Install fasteners as recommended by the manufacturer and space them evenly. Use all mounting holes and attachment points for attaching DMS enclosures and controller cabinets to the structures.

Drill holes for expansion anchors of the size recommended by the manufacturer of the anchors and thoroughly clean them of all debris.

Provide one key-operated, pin tumbler, dead bolt padlock, with brass or bronze shackle and case, conforming to Military Specification MIL-P-17802E (Grade I, Class 2, Size 2, Style A) for each electrical panel and switch on the project. Key all padlocks alike, and provide 10 keys to the Engineer.

Provide cabinets with all mounting plates, anchor bolts, and any other necessary mounting hardware in accordance with these Project Special Provisions and the Plans.

Seal all unused conduit installed in cabinets at both ends to prevent water and dirt from entering the conduit and cabinet with approved sealing material.

Install a ground bushing attached inside the cabinet on all metal conduits entering the cabinet. Connect these ground bushings to the cabinet ground bus.

(C) Operator Control

Install the rotary manual switch in the DMS cabinet for a technician to select the "inspection", "containment" "off", or "parking" messages. Provide in the scale house a manual switch for the operator or officer to select each message described above.

(G) Work Site Clean-Up

Clean the site of all debris, excess excavation, waste packing material, wire, etc. Clean and clear the work site at the end of each workday. Do not throw waste material in storm drains or sewers.

27.4. MEASUREMENT AND PAYMENT

DMS will be measured and paid as the actual number of DMS furnished, installed, and accepted. Each DMS consists of a LED Dynamic Message Sign, communications equipment, strapping hardware, controller, UPS, controller cabinet, conduit, fittings, couplings, sweeps, conduit bodies, wire, flexible conduit, feeder conductors and communications cable between the controller cabinet and the DMS enclosure, DMS operator control panel in the scale house, connectors, circuit protection equipment, 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 DMS system.

Payment will be made under:

Pay Item	Pay Unit
DMS	Lump Sum

28. NTCIP REQUIREMENTS

This section defines the detailed NTCIP requirements for the DMSs covered by these Project Special Provisions and Plans.

28.1. REFERENCES

This specification references several standards through their NTCIP designated names. The following list provides the full reference to the current version of each of these standards.

Implement the most recent version of the standard including any and all Approved or Recommended Amendments to these standards for each NTCIP Component covered by these project specifications.

Table 1: NTCIP Standards

Abbreviated Number	Full Number	Title
NTCIP 1101	**NTCIP 1101:1997**	*Simple Transportation Management Framework*
NTCIP 1201	**NTCIP 1201:1997**	*Global Object Definitions*
NTCIP 1203	**NTCIP 1203:1997**	*Object Definitions for Dynamic Message Signs*
NTCIP 2001	**NTCIP 2001:1997**	*Class B Profile*
NTCIP 2101	**NTCIP 2101**	*SP-PMPP/232* *Subnet Profile for PMPP over RS-232*
NTCIP 2102	**NTCIP 2102**	*SP-PMPP/FSK* *Subnet Profile for PMPP over FSK Modem*
NTCIP 2103	**NTCIP 2103**	*SP-PPP/232* *Subnetwork Profile for PPP over RS232 (Dial Up)*
NTCIP 2104	**NTCIP 2104**	*SP-Ethernet* *Subnet Profile for Ethernet*
NTCIP 2201	**NTCIP 2201**	*TP-Null* *Transport Profile*
NTCIP 2202	**NTCIP 2202**	*TP-Internet*

Abbreviated Number	Full Number	Title
		Internet Transport Profile (TCP/IP and UDP/IP)
NTCIP 2301	**NTCIP 2301**	AP-STMF AP for Simple Transportation Management Framework

(A) General Requirements

(1) Subnet Level

Ensure each serial port on each NTCIP Component supports NTCIP 2103 over a dial-up connection with a contractor provided external modem with data rates of 28.8 kbps, 19.2 kbps, 14.4 kbps, 9600 bps, 4800 bps, 2400 bps, 1200 bps, 600 bps, and 300 bps. Enable the NTCIP Component to make outgoing and receive incoming calls as necessary and support the following modem command sets:

- Hayes AT - Command Set
- MNP5
- MNP10
- V.42bis

Ensure each serial port on each NTCIP Component supports NTCIP 2103 over a null-modem connection with data rates of 19.2 kbps, 14.4 kbps, 9600 bps, 4800 bps, 2400 bps, 1200 bps, 600 bps, and 300 bps.

Ensure each serial port on each NTCIP Component supports NTCIP 2101 with data rates of 9600 bps, 4800 bps, 2400 bps, 1200 bps, 600 bps, and 300 bps.

Ensure NTCIP components support NTCIP 2102 and NTCIP 2104.

NTCIP Components may support additional Subnet Profiles at the manufacturer's option. At any one time, make certain only one Subnet Profile is active on a given serial port of the NTCIP Component. Ensure the NTCIP Component can be configured to allow the field technician to activate the desired Subnet Profile and provide a visual indication of the currently selected Subnet Profile.

(2) Transport Level

Ensure each NTCIP Component complies with NTCIP 2201 and 2202.

NTCIP Components may support additional Transport Profiles at the manufacturer's option. Ensure response datagrams use the same Transport Profile used in the request. Ensure each NTCIP Component supports the receipt of datagrams conforming to any of the identified Transport Profiles at any time.

(3) Application Level

Ensure each NTCIP Component complies with NTCIP 1101 and 2301 and meets the requirements for Conformance Level 1 (NOTE - See Amendment to standard).

Ensure each NTCIP Component supports SNMP traps. An NTCIP Component may support additional Application Profiles at the manufacturer's option. Ensure Responses use the same Application Profile used by the request. Ensure each NTCIP Component supports the receipt of Application data packets at any time allowed by the subject standards.

(4) Information Level

Guarantee each NTCIP Component provides Full, Standardized Object Range Support of all objects required by these Special Provisions unless otherwise indicated below. Make certain the maximum Response Time for any object or group of objects is 200 milliseconds.

Design the DMS to support all mandatory objects of all mandatory Conformance Groups as defined in NTCIP 1201 and NTCIP 1203. Table 2 indicates the modified object requirements for these mandatory objects.

Table 2: Modified Object Ranges for Mandatory Objects

Object	Reference	Project Requirement
ModuleTableEntry	NTCIP 1201 Clause 2.2.3	Contains at least one row with moduleType equal to 3 (software). The moduleMake specifies the name of the manufacturer, the moduleModel specifies the manufacturer's name of the component and the modelVersion indicates the model version number of the component.
MaxGroupAddresses	NTCIP 1201 Clause 2.7.1	At least 1
CommunityNamesMax	NTCIP 1201 Clause 2.8.2	At least 3
DmsNumPermanentMsg	NTCIP 1203 Clause 2.6.1.1.1.1	At least 1*
DmsMaxChangeableMsg	NTCIP 1203 Clause 2.6.1.1.1.3	At least 21
DmsFreeChangeableMemory	NTCIP 1203 Clause 2.6.1.1.1.4	At least 20 when no messages are stored.
DmsMessageMultiString	NTCIP 1203 Clause 2.6.1.1.1.8.3	The DMS supports any valid MULTI string containing any subset of those MULTI tags

Object	Reference	Project Requirement
		listed in Table 4
DmsControlMode	NTCIP 1203 Clause 2.7.1.1.1.1	Support at least the following modes: Local External central CentralOverride

* Ensure the Permanent Messages display the content shown in Table 3.

Ensure the sign blanks if a command to display a message contains an invalid Message CRC value for the desired message.

Table 3: Content of Permanent Messages

Perm. Msg. Num.	Description
1	Permanent Message #1 blanks the display (i.e., consist of and empty string). It has a run-time priority of one (1).

Table 4: Required MULTI Tags

Code	Feature
f1	field 1 - time (12hr)
f2	field 2 - time (24hr)
f8	field 8 – day of month
f9	field 9 – month
f10	field 10 - 2 digit year
f11	field 11 - 4 digit year
fl (and /fl)	Flashing text on a line-by-line basis with flash rates controllable in 0.5-second increments.
fo	Font
jl2	Justification – line – left
jl3	Justification – line – center
jl4	Justification – line – right
jl5	Justification – line – full

jp2	Justification – page – top
jp3	Justification – page – middle
jp4	Justification – page – bottom
Mv	Moving text
Nl	New line
Np	New page, up to 2 instances in a message (i.e., up to 3 pages/frames in a message counting first page)
Pt	Page times controllable in 0.5-second increments.

The NTCIP Component implements all mandatory and optional objects of the following optional conformance groups with FSORS.

(5) Test Heading

i. Time Management

As defined in NTCIP 1201

ii. Timebase Event Schedule

As defined in NTCIP 1201. The following list indicates the modified object requirements for this conformance group.

Table 5: Modified Object Ranges for the Timebase Event Schedule Conformance Group

Object	Reference	Project Requirement
MaxTimeBaseScheduleEntries	NTCIP 1201 Clause 2.4.3.1	At least 28
maxDayPlans	NTCIP 1201 Clause 2.4.4.1	At least 14
maxDayPlanEvents	NTCIP 1201 Clause 2.4.4.2	At least 10

iii. Report

As defined in NTCIP 1201. The following list indicates the modified object requirements for this conformance group.

Table 6: Modified Object Ranges for the Report Conformance Group

Object	Reference	Project Requirement
maxEventLogConfigs	NTCIP 1201 Clause 2.5.1	At least 50
eventConfigurationMode	NTCIP 1201 Clause 2.4.3.1	The NTCIP Component supports the following Event

Object	Reference	Project Requirement
		Configuration Modes: 1) onChange, 2) greaterThanValue and 3) smallerThanValue
MaxEventLogSize	NTCIP 1201 Clause 2.5.3	At least 200
MaxEventClasses	NTCIP 1201 Clause 2.5.5	At least 16

iv. PMPP

v. Font Configuration

As defined in NTCIP 1203. The following list indicates the modified object requirements for this conformance group.

Table 7: Modified Object Ranges for the Font Configuration Conformance Group

Object	Reference	Project Requirement
NumFonts	NTCIP 1203 Clause 2.4.1.1.1.1	At least 4*
MaxFontCharacters	NTCIP 1203 Clause 2.4.1.1.1.3	At least 127**

*Upon delivery, the first font is a standard 18" font. The second font is a double-stroke 18" font. The third font is a 28" font. The fourth font is empty.

**Upon delivery, the first three font sets are configured in accordance with the ASCII character set for the following characters:

- "A" thru "Z"- All upper case letters.
- "0" thru "9"- All decimal digits.
- Space (i.e., ASCII code 0x20).
- Punctuation marks shown in brackets [. , ! ? - ' ' " " / ( )]
- Special characters shown in brackets [# & * +< >]

vi. DMS Configuration

As defined in NTCIP 1203.

vii. MULTI Configuration

As defined in NTCIP 1203. The following list indicates the modified object requirements for this conformance group.

Table 8: Modified Object Ranges for the MULTI Configuration Conformance Group

Object	Reference	Project Requirement
DefaultBackgroundColor	NTCIP 1203 Clause 2.5.1.1.1.1	The DMS supports the following background colors: black
DefaultForegroundColor	NTCIP 1203 Clause 2.5.1.1.1.2	The DMS supports the following foreground colors: amber
DefaultJustificationLine	NTCIP 1203 Clause 2.5.1.1.1.6	The DMS supports the following forms of line justification: left center right full
defaultJustificationPage	NTCIP 1203 Clause 2.5.1.1.1.7	The DMS supports the following forms of page justification: top middle bottom
defaultPageOnTime	NTCIP 1203 Clause 2.5.1.1.1.8	The DMS supports the full range of these objects with step sizes no larger than 0.5 seconds
defaultPageOffTime	NTCIP 1203 Clause 2.5.1.1.1.9	The DMS supports the full range of these objects with step sizes no larger than 0.5 seconds
defaultCharacterSet	NTCIP 1203 Clause 2.5.1.1.1.10	The DMS supports the following character sets: eightBit

viii. Default Message Control as defined in NTCIP 1203

ix. Pixel Service Control as defined in NTCIP 1203

x. MULTI Error Control as defined in NTCIP 1203

xi. Illumination/Brightness Control

As defined in NTCIP 1203. The following list indicates the modified object requirements for this conformance group.

Table 9: Modified Object Ranges for the Illumination/Brightness Control Conformance Group

Object	Reference	Project Requirement
dmsIllumControl	NTCIP 1203 Clause 2.8.1.1.1.1	The DMS supports the following illumination control modes: photocell timer manual
dmsIllumNumBrightLevels	NTCIP 1203 Clause 2.8.1.1.1.4	At least 16

a) Auxiliary I/O

b) Scheduling

As defined in NTCIP 1203. The following list indicates the modified object requirements for this conformance group.

Table 10: Modified Object Ranges for the Scheduling Conformance Group

Object	Reference	Project Requirement
NumActionTableEntries	NTCIP 1203 Clause 2.9.1.1.1.1	At least 21

c) Sign Status as defined in NTCIP 1203

d) Status Error as defined in NTCIP 1203

e) Pixel Error Status as defined in NTCIP 1203

f) Fan Error Status as defined in NTCIP 1203

g) Power Status as defined in NTCIP 1203

h) Temperature Status as defined in NTCIP 1203

Install necessary hardware for the support of items q, r, and s above.

Table 11: Some Optional Object Requirements

Object	Reference	Project Requirement
DefaultFlashOn	NTCIP 1203 Clause 2.5.1.1.1.3	The DMS supports the full range of these objects with step sizes no larger than 0.5 seconds
DefaultFlashOff	NTCIP 1203 Clause 2.5.1.1.1.4	The DMS supports the full range of these objects with step sizes no larger than 0.5 seconds

Object	Reference	Project Requirement
DmsMultiOtherErrorDescription	NTCIP 1203 Clause 2.7.1.1.1.20	If the vendor implements any vendor-specific MULTI tags, the DMS shall provide meaningful error messages within this object whenever one of these tags generates an error.

(6) Documentation

Supply software with full documentation, including a CD-ROM containing ASCII versions of the following MIB files in Abstract Syntax Notation 1 (ASN.1) format:

- The relevant version of each official standard MIB Module referenced by the device functionality.
- If the device does not support the full range of any given object within a Standard MIB Module, a manufacturer specific version of the official Standard MIB Module with the supported range indicated in ASN.1 format in the SYNTAX and/or DESCRIPTION fields of the associated OBJECT TYPE macro. Name this file identical to the standard MIB Module, except that it will have the extension ".man".
- A MIB Module in ASN.1 format containing any and all manufacturer-specific objects supported by the device with accurate and meaningful DESCRIPTION fields and supported ranges indicated in the SYNTAX field of the OBJECT-TYPE macros.
- A MIB containing any other objects supported by the device.

Allow the use of any and all of this documentation by any party authorized by the Department for systems integration purposes at any time initially or in the future, regardless of what parties are involved in the systems integration effort.

(B) NTCIP Acceptance Testing

Test the NTCIP requirements outlined above by a third party testing firm. Submit to the Engineer for approval a portfolio of the selected firm. Include the name, address, and a history of the selected firm in performing NTCIP testing along with references. Also, provide a contact person's name and phone number. Submit detailed NTCIP testing plans and procedures, including a list of hardware and software, to the Engineer for review and approval 10 days in advance of a scheduled testing date. Develop test documents based on the NTCIP requirements of these Project Special Provisions. The acceptance test will use the NTCIP Exerciser, and/or other authorized testing tools and will follow the guidelines established in the ENTERPRISE Test Procedures. Conduct the test in North Carolina on the installed system in the presence of the Engineer. Document and certify the results of the test by the firm conducting the test and submit the Engineer for review and approval. In case of failures, remedy the problem and have the firm retest in North Carolina. Continue process until all failures are resolved. The Department reserves the right to enhance these tests as deemed appropriate to ensure device compliance.

28.2. MEASUREMENT AND PAYMENT

There will be no direct payment for the work covered by this section.

Payment for this work will be covered in the applicable sections of these Project Special Provisions at the contract unit price for "DMS" and will be full compensation for all work listed above.

29. DMS TESTING REQUIREMENTS

29.1. GENERAL TEST PROCEDURE

Test the DMS system in a series of design approval and functional tests. The results of each test must meet the specified requirements. These tests should not damage the equipment. The Engineer will reject equipment that fails to fulfill the requirements of any test. Resubmit rejected equipment after correcting non-conformities and re-testing; completely document all diagnoses and corrective actions. Modify all equipment furnished under this contract, without additional cost to the North Carolina Department of Transportation, to incorporate all design changes necessary to pass the required tests.

Provide four copies of all test procedures and requirements to the Engineer for review and approval at least 30 days prior to the testing start date.

Only use approved procedures for the tests. Include the following in the test procedures:

- A step-by-step outline of the test sequence, showing a test of every function of the equipment or system tested
- A description of the expected nominal operation, output, and test results, and the pass / fail criteria
- An estimate of the test duration and a proposed test schedule
- A data form to record all data and quantitative results obtained during the test
- A description of any special equipment, setup, manpower, or conditions required by the test

Provide all necessary test equipment and technical support. Use test equipment calibrated to National Institute of Standards and Technology (NIST) standards. Provide calibration documentation upon request.

Conform to these testing requirements and the requirements of these specifications. The Engineer will reject all equipment not tested according to these requirements. It is the Contractor's responsibility to ensure the DMS system functions properly even after the Engineer accepts the DMS test results.

Provide four copies of the quantitative test results and data forms containing all data taken, highlighting any non-conforming results and remedies taken, to the Engineer for approval. An authorized representative of the manufacturer must sign the test results and data forms.

29.2. DESIGN APPROVAL TESTS

Design Approval Tests are applicable to DMS systems not currently on the QPL.

The Design Approval Tests consists of all tests described in Section 2.2 "DMS Equipment Tests" of NEMA TS 4-2005 (Hardware Standards for Dynamic Message Signs with NTCIP Requirements). Perform all tests and submit certified results for review and approval.

PROTOTYPE – Manufacture a prototype DMS and controller of the type and size described in the Project Special Provisions. In the presence of the Engineer, test the prototype according to the Design Approval and Operational Tests. When all corrections and changes (if any) have been made, the Department may accept the prototype DMS and controller as the physical and

functional standard for the system furnished under this contract. You may use the prototype units on this project if, after inspection and rework (if necessary), they meet all physical and functional specifications. In the case of standard product line equipment, if the Contractor can provide test results certified by an independent testing facility as evidence of prior completion of successful design approval tests, then the Engineer may choose to waive these tests.

In each Design Approval Test, successfully perform the Functional Tests described below. Apply the extreme conditions to all associated equipment unless stated otherwise in these Project Special Provisions.

29.3. OPERATIONAL FIELD TEST (ON-SITE COMMISSIONING)

Conduct an Operational Field Test of the DMS system installed on the project to exercise the normal operational functions of the equipment. The Operational Field Test will consist of the following tests as a minimum:

(A) Physical Examination

Examine each piece of equipment to verify that the materials, design, construction, markings, and workmanship comply with the mechanical, dimensional, and assembly requirements of these Project Special Provisions.

Perform the following tests as a minimum:

- Verify that all surfaces are free of dents, scratches, weld burns, or abrasions. Round sharp edges and corners.
- Verify bend radius of cables is not excessive or could potentially cause damage.
- Verify all modules, lamps, and components are properly secured.
- Verify that there are no exposed live terminals.

(B) Continuity Tests

Check the wiring to assure it conforms to the requirements of these Project Special Provisions.

(C) Functional Tests

Perform the following functional tests:

- Start-up and operate the DMS locally using a laptop computer.
- Use automatic (photo-electric sensor controlled) DMS Control Software to switch between "dim", "normal", and "bright" light levels.
- Operate the DMS with all display elements flashing continuously for 10 minutes at the maximum flash rate.
- Exercise the DMS by displaying static messages, flashing messages, and alternating static and flashing message sequences.
- Automatic poll the DMS by the Control Software at various intervals and verify the data received by Control Software from DMS.
- Download and edit messages using Control Software.
- Execute status request on the DMS controller.
- Observe normal operations during uploading and downloading messages.
- Input and select messages from the sign controller's local user interface.

- Test sequence activation at chosen intervals.
- Display and verify all stored messages.
- Verify resumption of standard operation upon interruption of electrical power.
- Demonstrate detected failures and response functions.
- Demonstrate proper operation of the Failure Log.
- Set controller clock using the Control Software.
- Execute system shutdown using the Control Software and local user interface.
- Verify detection of a power failure in the DMS enclosure and the report feature of the failure to the Control Software.

Approval of Operational Field Test results does not relieve the Contractor to conform to the requirements in these Project Special Provisions. If the DMS system does not pass these tests, document a correction or substitute a new unit as approved by the Engineer. Re-test the system until it passes all requirements.

30. DMS ASSEMBLIES

30.1. DESCRIPTION

This section includes all design, fabrication, furnishing, and erection of the DMS assemblies, DMS mounting assemblies, and maintenance platforms for access to the DMS inspection panels, and attachment of the DMS enclosures to the structures in accordance with the requirements of these Project Special Provisions and the Plans. Fabricate the supporting DMS assemblies from tubular steel. Furnish pedestal type DMS assemblies as shown in the Plans. Cantilevered and Monotube (horizontal truss) DMS structures will not be allowed.

Provide pedestal type DMS assembly structures with a minimum of 20 feet from the high point of the road to the bottom of the DMS enclosure.

Design the DMS assemblies (including footings), DMS mounting assemblies, and maintenance platforms and submit shop drawings to the Engineer for acceptance. A Professional Engineer that is registered in the state of North Carolina will prepare such computations and drawings. These must bear his signature, seal, and date of acceptance.

The provisions of Section 900 of the Standard Specifications apply to all work covered by this section.

30.2. MATERIAL

Use materials that meet the following requirements of the Standard Specifications:

Structural Steel	Section 1072
Overhead Sign Structures	Section 1096
Signing Materials	Section 1092
Organic-Zinc Repair Paint	Article 1080-9
Reinforcing Steel	Sub-article 1070
Direct Tension Indicators	Sections 440 and 1072

30.3. CONSTRUCTION METHODS

(A) General

Fabricate the new DMS assemblies, DMS mounting assemblies, and maintenance platforms in accordance with the details shown in the approved shop drawings and the requirements of these Project Special Provisions.

No welding, cutting, or drilling in any manner will be permitted in the field, unless approved by the Engineer.

Drill bolt holes and slots to finished size. Holes may also be punched to finished size, provided the diameter of the punched holes is at least twice the thickness of the metal being punched. Flame cutting of bolt holes and slots is not permitted.

Erect DMS in accordance with the requirements indicated on the Plans and in these Project Special Provisions. Field drill two holes per connection in the Z bars for attaching the DMS to the structure. Use two bolts at each connection. Provide two (2) U-bolts at each U-bolt connection such as 1) each truss chord to sign hanger, or 2) each truss chord to platform support.

Provide two (2) U-bolts at each U-bolts connection where ends of truss chords are supported. Minimum diameter of all U-bolts is to be ½ inch.

Use two coats of a zinc-rich paint to touch up minor scars on all galvanized materials. See Standard Specifications for Roads and Structures Section 1076-7.

For high strength bolted connections, provide direct tension indicator washer.

(B) Shop Drawing

Submit to the Engineer for approval a complete design for the DMS assemblies (including footings), DMS mounting assemblies, DMS assembly hardware, and brackets for supporting the DMS. Base the design on the line drawings and correct wind speed in accordance with the latest edition of AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals, 6th Edition, 2013".

The manufacturer of the DMS assembly must ensure that design of the assembly is compatible with the DMSs for mounting and attachment.

Submit six copies of complete detailed shop drawings and one copy of the design computations for the DMS assembly to the Engineer for approval prior to fabrication. Show in the shop drawings complete design and fabrication details including foundations, provisions for attaching the DMS, maintenance platform and access ladders to supporting structures, applicable material specifications, and any other information necessary for procuring and replacing any part of the complete DMS assembly.

Allow a minimum of 40 working days for shop drawing approval after the Engineer receives them. If revised drawings are necessary, allow appropriate additional time for review and approval of final shop drawings.

Approval of shop drawings by the Engineer will not relieve the Contractor of his responsibility for the correctness of drawings, or for the fit of all shop and field connections and anchors.

(C) Design and Fabrication

(1) Dynamic Message Sign Assembly and Dynamic Message Sign Mounting Assembly

- Design must be in accordance with the Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, 6th Edition, 2013, and the latest Interim Specifications.
- The wind pressure map that is developed from the 3-second gust speeds, as provided in Article 3.8, shall be used.
- The natural wind gust speed in North Carolina shall be assumed to be 5 meters per second or 11.6 mph for inland areas, and 7 meters per second or 15.7 mph for coastal areas. The coastal area shall be defined as any area within 2 miles from the waterfront facing the ocean or sound and all area where the design basic wind speed is above 120 mph, as shown in Figure 3-2.
- The fatigue importance category used in the design, for each type of structure, as provided for in Article 11.6, Fatigue Importance Factors, shall be Category II unless otherwise shown on the contract plans.

- Wind drag coefficient for Dynamic Message Sign enclosures shall be 1.7.

The following Specification interpretations or criteria shall be used in the design of overhead sign assemblies:

- For design of supporting upright posts or columns, the effective length factor for columns "K", as provided for in Appendix B, Section B.5, shall be taken as the following, unless otherwise approved by the Engineer:

  Case 1 For a single upright post of span type overhead sign structure, the effective column length factor, "K", shall be taken as 2.0.

  Case 2 For twin post truss-type upright post with the post connected to one chord of a horizontal truss, the effective column length factor for that column shall be taken as 2.0.

  Case 3 For twin post truss-type upright post with the post connected to two truss chords of a horizontal tri-chord or box truss, the effective column length factor for that column shall be taken as 1.65.

- For twin post truss-type upright post, the unbraced length shall be from the chord to post connection to the top of base plate.

- For twin post truss-type upright post that is subject to axial compression, bending moment, shear, and torsion the post shall satisfy Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals Equations 5-17, 5-18 and 5-19. To reduce the effects of secondary bending, in lieu of Equation 5-18, the following equation may be used:

$$\frac{f_a}{F_a} + \frac{f_b}{\left(1 - \frac{0.6 f_a}{F_{\acute{e}}}\right) F_b} + \left(\frac{f_v}{F_v}\right)^2 \leq 1.0$$

Where

fa = Computed axial compression stress at base of post

The base plate thickness for all uprights and poles shall be a minimum of 2" but not less than that determined by the following criteria and design.

Case 1 Circular or rectangular solid base plates with the upright pole welded to the top surface of base plate with full penetration butt weld, and where no stiffeners are provided. A base plate with a small center hole, which is less than 1/5 of the upright diameter, and located concentrically with the upright pole, may be considered as a solid base plate.

The magnitude of bending moment in the base plate, induced by the anchoring force of each anchor bolt shall be calculated using equation $M = (P \times D_1) / 2$.

Case 2 Circular or rectangular base plate with the upright pole socketed into and attached to the base plate with two lines of fillet weld, and where no

stiffeners are provided, or any base plate with a center hole that is larger in diameter than 1/5 of the upright diameter.

The magnitude of bending moment induced by the anchoring force of each anchor bolt shall be calculated using equation $M = P \times D_2$.

- M, bending moment at the critical section of the base plate induced by one anchor bolt
- P, anchoring force of each anchor bolt
- D_1, horizontal distance between the center of the anchor bolt and the outer face of the upright, or the difference between the radius of the bolt circle and the outside radius of the upright
- D_2, horizontal distance between the face of the upright and the face of the anchor bolt nut

- The critical section shall be located at the face of the anchor bolt and perpendicular to the radius of the bolt circle. The overlapped part of two adjacent critical sections shall be considered ineffective.
- The thickness of base plate of Case 1 shall not be less than that calculated based on formula for Case 2.
- Uprights, foundations, and trusses shall be designed in accordance with the DMS Foundation Special Provision for the effects of torsion. Torsion shall be considered from dead load eccentricity of these attachments, as well as for attachments such as maintenance platforms, supporting brackets, etc., that add to the torsion in the assembly. Truss vertical and horizontal truss diagonals in particular and any other assembly members shall be appropriately sized for these loads.
- Uprights, foundations, and trusses shall be designed for the proposed sign wind area and future wind areas. The design shall consider the effect of torsion induced by the eccentric force location of the center of wind force above (or below) the center of the supporting truss. Truss vertical and horizontal truss diagonals in particular and any other assembly members shall be appropriately sized for these loads.

Fabricate the supporting structures using tubular members of either aluminum or steel, using only one type of material throughout the project.

Horizontal components of the supporting structures for overhead DMS must be of a truss design to support the DMS. Truss centerline must coincide with centerline of the DMS design area shown on the structure line drawing. Provide permanent camber in addition to dead load camber in accordance with the "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals". Indicate on the shop drawings the amount of camber provided and the method employed in the fabrication of the support to obtain the camber.

For all U-bolt connections of hanger beams to overhead assembly truss chords, provide all U-bolts with a flat washer, a lock washer and double nuts at each end of the U-bolts. All double nuts that are on any U-bolt shall be the same thickness and weight. When assembled, the double nuts shall be brought tight against each other by the use of two wrenches.

Fabricate attachment assemblies for the mounting DMS in a manner that allows easy removal of the sign.

30.4. MEASUREMENT AND PAYMENT

DMS Pedestal Type Structure will be measured and paid as the actual number of dynamic message sign assemblies furnished, installed, and accepted. Payment includes all design (including S-dimensions), fabrication, construction, transportation, and attachment of the dynamic message sign assemblies (including Z-bars and U-bolts), supporting structure, hardware, direct tension indicators, preparing and furnishing shop drawings, additional documentation, incidentals, and all other equipment and features necessary to furnish the system described above.

Payment will be made under:

Pay Item	Pay Unit
DMS Pedestal Type Structure	Each

31. FOUNDATIONS AND ANCHOR ROD ASSEMBLIES FOR METAL POLES

SP9 R05REV

31.1. DESCRIPTION

Foundations for metal poles include foundations for signals, cameras, overhead and dynamic message signs (DMS) and high mount and low-level light standards supported by metal poles or upright trusses. Foundations consist of footings with pedestals and drilled piers with or without grade beams or wings. Anchor rod assemblies consist of anchor rods (also called anchor bolts) with nuts and washers on the exposed ends of rods and nuts and a plate or washers on the other ends of rods embedded in the foundation.

Construct concrete foundations with the required resistances and dimensions and install anchor rod assemblies in accordance with the contract and accepted submittals. Construct drilled piers consisting of cast-in-place reinforced concrete cylindrical sections in excavated holes. Provide temporary casings or polymer slurry as needed to stabilize drilled pier excavations. Use a prequalified Drilled Pier Contractor to construct drilled piers for metal poles. Define "excavation" and "hole" as a drilled pier excavation and "pier" as a drilled pier.

This provision does not apply to materials and anchor rod assemblies for standard foundations for low-level light standards. See Section 1405 of the *2012 Standard Specifications* and Standard Drawing No. 1405.01 of the *2012 Roadway Standard Drawings* for materials and anchor rod assemblies for standard foundations. For construction of standard foundations for low-level light standards, standard foundations are considered footings in this provision.

This provision does not apply to foundations for signal pedestals; see Section 1743 of the *2012 Standard Specifications* and Standard Drawing No. 1743.01 of the *2012 Roadway Standard Drawings*.

31.2. Materials

Refer to the 2012 Standard Specifications.

Item	Section
Conduit	1091-3
Grout, Nonshrink	1003
Polymer Slurry	411-2(B)
Portland Cement Concrete	1000
Reinforcing Steel	1070
Rollers and Chairs	411-2(C)
Temporary Casings	411-2(A)

Provide Type 3 material certifications in accordance with Article 106-3 of the 2012 Standard Specifications for conduit, rollers, chairs and anchor rod assemblies. Store steel materials on blocking at least 12" above the ground and protect it at all times from damage; and when placing in the work make sure it is free from dirt, dust, loose mill scale, loose rust, paint, oil or other foreign materials. Load, transport, unload and store foundation and anchor rod assembly materials so materials are kept clean and free of damage. Damaged or deformed materials will be rejected.

Use conduit type in accordance with the contract. Use Class A concrete for footings and pedestals, Class Drilled Pier concrete for drilled piers and Class AA concrete for grade beams and wings including portions of drilled piers above bottom of wings elevations. Corrugated temporary casings may be accepted at the discretion of the Engineer. A list of approved polymer slurry products is available from:

www.ncdot.org/doh/preconstruct/highway/geotech/leftmenu/Polymer.html

Provide anchor rod assemblies in accordance with the contract consisting of the following:

- Straight anchor rods,
- Heavy hex top and leveling nuts and flat washers on exposed ends of rods, and
- Nuts and either flat plates or washers on the other ends of anchor rods embedded in foundations.

Do not use lock washers. Use steel anchor rods, nuts, and washers that meet ASTM F1554 for Grade 55 rods and Grade A nuts. Use steel plates and washers embedded in concrete with a nominal thickness of at least 1/4". Galvanize anchor rods and exposed nuts and washers in accordance with Article 1076-4 of the 2012 Standard Specifications. It is not necessary to galvanize nuts, plates, and washers embedded in concrete.

31.3. Construction Methods

Install the required size and number of conduits in foundations in accordance with the plans and accepted submittals. Construct top of piers, footings, pedestals, grade beams and wings flat, level and within 1" of elevations shown in the plans or approved by the Engineer. Provide an Ordinary Surface finish in accordance with Subarticle 825-6(B) of the *2012 Standard Specifications* for portions of foundations exposed above finished grade. Do not remove anchor bolt templates or pedestal or grade beam forms or erect metal poles or upright trusses onto foundations until concrete attains a compressive strength of at least 3,000 psi.

(A) Drilled Piers

Before starting drilled pier construction, hold a predrill meeting to discuss the installation, monitoring, and inspection of the drilled piers. Schedule this meeting after the Drilled Pier Contractor has mobilized to the site. The Resident or Division Traffic Engineer, Contractor and Drilled Pier Contractor Superintendent will attend this predrill meeting.

Do not excavate holes, install piles, or allow equipment wheel loads or vibrations within 20 ft of completed piers until 16 hours after Drilled Pier concrete reaches initial set.

Check for correct drilled pier alignment and location before beginning drilling. Check plumbness of holes frequently during drilling.

Construct drilled piers with the minimum required diameters shown in the plans. Install piers with tip elevations no higher than shown in the plans or approved by the Engineer.

Excavate holes with equipment of the sizes required to construct drilled piers. Depending on the subsurface conditions encountered, drilling through rock and boulders may be required. Do not use blasting for drilled pier excavations.

Contain and dispose of drilling spoils and waste concrete as directed and in accordance with Section 802 of the *2012 Standard Specifications*. Drilling spoils consist of all materials and fluids removed from excavations.

If unstable, caving, or sloughing materials are anticipated or encountered, stabilize holes with temporary casings and/or polymer slurry. Do not use telescoping temporary casings. If it becomes necessary to replace a temporary casing during drilling, backfill the excavation, insert a larger casing around the casing to be replaced or stabilize the excavation with polymer slurry before removing the temporary casing.

If temporary casings become stuck or the Contractor proposes leaving casings in place, temporary casings should be installed against undisturbed material. Unless otherwise approved, do not leave temporary casings in place for mast arm poles and cantilever signs. The Engineer will determine if casings may remain in place. If the Contractor proposes leaving temporary casings in place, do not begin drilling until a casing installation method is approved.

Use polymer slurry and additives to stabilize holes in accordance with the slurry manufacturer's recommendations. Provide mixing water and equipment suitable for polymer slurry. Maintain polymer slurry at all times so slurry meets Table 411-3 of the *2012 Standard Specifications* except for sand content.

Define a "sample set" as slurry samples collected from mid-height and within 2 ft of the bottom of holes. Take sample sets from excavations to test polymer slurry immediately after filling holes with slurry, at least every 4 hours thereafter and immediately before placing concrete. Do not place drilled pier concrete until both slurry samples from an excavation meet the required polymer slurry properties. If any slurry test results do not meet the requirements, the Engineer may suspend drilling until both samples from a sample set meet the required slurry properties.

Remove soft and loose material from bottom of holes using augers to the satisfaction of the Engineer. Assemble rebar cages and place cages, and drilled pier concrete in accordance with Subarticle 411-4(E) of the *2012 Standard Specifications* except for the following:

- Inspections for tip resistance and bottom cleanliness are not required,
- Temporary casings may remain in place if approved, and
- Concrete placement may be paused near the top of pier elevations for anchor rod assembly installation and conduit placement or
- If applicable, concrete placement may be stopped at bottom of grade beam or wings elevations for grade beam or wing construction.

If wet placement of concrete is anticipated or encountered, do not place Drilled Pier concrete until a concrete placement procedure is approved. If applicable, temporary casings and fluids may be removed when concrete placement is paused or stopped in accordance with the exceptions above provided holes are stable. Remove contaminated concrete from exposed Drilled Pier concrete after removing casings and fluids. If holes are unstable, do not remove temporary casings until a procedure for placing anchor rod assemblies and conduit or constructing grade beams or wings is approved.

Use collars to extend drilled piers above finished grade. Remove collars after Drilled Pier concrete sets and round top edges of piers.

If drilled piers are questionable, pile integrity testing (PIT) and further investigation may be required in accordance with Article 411-5 of the *2012 Standard Specifications*. A drilled pier will be considered defective in accordance with Subarticle 411-5(D) of the *2012 Standard Specifications* and drilled pier acceptance is based in part on the criteria in Article 411-6 of the *2012 Standard Specifications* except for the top of pier tolerances in Subarticle 411-6(C) of the *2012 Standard Specifications*.

If a drilled pier is under further investigation, do not grout core holes, backfill around the pier or perform any work on the drilled pier until the Engineer accepts the pier. If the drilled pier is accepted, dewater and grout core holes and backfill around the pier with approved material to finished grade. If the Engineer determines a pier is unacceptable, remediation is required in accordance with Article 411-6 of the *2012 Standard Specifications*. No extension of completion date or time will be allowed for remediation of unacceptable drilled piers or post repair testing.

Permanently embed a plate in or mark top of piers with the pier diameter and depth, size and number of vertical reinforcing bars and the minimum compressive strength of the concrete mix at 28 days.

(B) Footings, Pedestals, Grade Beams and Wings

Excavate as necessary for footings, grade beams, and wings in accordance with the plans, accepted submittals and Section 410 of the *2012 Standard Specifications*. If unstable, caving or sloughing materials are anticipated or encountered, shore foundation excavations as needed with an approved method. Notify the Engineer when foundation excavation is complete. Do not place concrete or reinforcing steel until excavation dimensions and foundation material are approved.

Construct cast-in-place reinforced concrete footings, pedestals, grade beams and wings with the dimensions shown in the plans and in accordance with Section 825 of the *2012 Standard Specifications*. Use forms to construct portions of pedestals and grade beams protruding above finished grade. Provide a chamfer with a 3/4" horizontal width for pedestal and grade beam edges exposed above finished grade. Backfill and fill in accordance with Article 410-8 of the *2012 Standard Specifications*. Proper compaction around footings and wings is critical for foundations to resist uplift and torsion forces. Place concrete against undisturbed soil and do not use forms for standard foundations for low-level light standards.

(C) Anchor Rod Assemblies

Size anchor rods for design and the required projection above top of foundations. Determine required anchor rod projections from nut, washer and base plate thicknesses, the protrusion of 3 to 5 anchor rod threads above top nuts after tightening and the distance of one nut thickness between top of foundations and bottom of leveling nuts.

Protect anchor rod threads from damage during storage and installation of anchor rod assemblies. Before placing anchor rods in foundations, turn nuts onto and off rods past leveling nut locations. Turn nuts with the effort of one workman using an ordinary wrench without a cheater bar. Report any thread damage to the Engineer that requires extra effort to turn nuts.

Arrange anchor rods symmetrically about center of base plate locations as shown in the plans. Set anchor rod elevations based on required projections above top of foundations. Securely brace and hold rods in the correct position, orientation, and alignment with a steel template. Do not weld to reinforcing steel, temporary casings or anchor rods.

Install top and leveling (bottom) nuts, washers and the base plate for each anchor rod assembly in accordance with the following procedure:

a) Turn leveling nuts onto anchor rods to a distance of one nut thickness between the top of foundation and bottom of leveling nuts. Place washers over anchor rods on top of leveling nuts.

b) Determine if nuts are level using a flat rigid template on top of washers. If necessary, lower leveling nuts to level the template in all directions or if applicable, lower nuts to tilt the template so the metal pole or upright truss will lean as shown in the plans. If leveling nuts and washers are not in full contact with the template, replace washers with galvanized beveled washers.

c) Verify the distance between the foundation and leveling nuts is no more than one nut thickness.

d) Place base plate with metal pole or upright truss over anchor rods on top of washers. High mount luminaires may be attached before erecting metal poles but do not attach cables, mast arms or trusses to metal poles or upright trusses at this time.

e) Place washers over anchor rods on top of base plate. Lubricate top nut bearing surfaces and exposed anchor rod threads above washers with beeswax, paraffin or other approved lubricant.

f) Turn top nuts onto anchor rods. If nuts are not in full contact with washers or washers are not in full contact with the base plate, replace washers with galvanized beveled washers.

g) Tighten top nuts to snug-tight with the full effort of one workman using a 12" wrench. Do not tighten any nut all at once. Turn top nuts in increments. Follow a star pattern cycling through each nut at least twice.

h) Repeat (g) for leveling nuts.

i) Replace washers above and below the base plate with galvanized beveled washers if the slope of any base plate face exceeds 1:20 (5%), any washer is not in firm contact with the base plate or any nut is not in firm contact with a washer. If any washers are replaced, repeat (g) and (h).

j) With top and leveling nuts snug-tight, mark each top nut on a corner at the intersection of two flats and a corresponding reference mark on the base plate. Mark top nuts and base plate with ink or paint that is not water-soluble. Use the turn-of-nut method for pretensioning. Do not pretension any nut all at once. Turn top nuts in increments for a total of one flat (1/6 revolution) for anchor rod diameters greater than 1 1/2" and two flats (1/3 revolution) for anchor rod diameters 1 1/2" or less. Follow a star pattern cycling through each top nut at least twice.

k) Ensure nuts, washers and base plate are in firm contact with each other for each anchor rod. Cables, mast arms, and trusses may now be attached to metal poles and upright trusses.

l) Between 4 and 14 days after pretensioning top nuts, use a torque wrench calibrated within the last 12 months to check nuts in the presence of the Engineer. Completely erect

mast arm poles and cantilever signs and attach any hardware before checking top nuts for these structures. Check that top nuts meet the following torque requirements:

TORQUE REQUIREMENTS	
Anchor Rod Diameter, inch	**Requirement, ft-lb**
7/8	180
1	270
1 1/8	380
1 1/4	420
≥ 1 1/2	600

If necessary, retighten top nuts in the presence of the Engineer with a calibrated torque wrench to within ± 10 ft-lb of the required torque. Do not over tighten top nuts.

m) Do not grout under base plate.

31.4. MEASUREMENT AND PAYMENT

Foundations and anchor rod assemblies for metal poles and upright trusses will be measured and paid for elsewhere in the contract.

No payment will be made for temporary casings that remain in drilled pier excavations. No payment will be made for PIT. No payment will be made for further investigation of defective piers. Further investigation of piers that are not defective will be paid as extra work in accordance with Article 104-7 of the *2012 Standard Specifications*. No payment will be made for remediation of unacceptable drilled piers or post repair testing.

32. OVERHEAD AND DYNAMIC MESSAGE SIGN FOUNDATIONS

32.1. DESCRIPTION

Sign foundations include foundations for overhead and dynamic message signs (DMS) supported by metal poles or upright trusses. Sign foundations consist of footings with pedestals or drilled piers with or without grade beams or wings, conduit and anchor rod assemblies. Construct sign foundations in accordance with the contract and accepted submittals. Define "cantilever sign" as an overhead cantilever sign support in accordance with Figure 1-1 of the 6th edition of the AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*.

32.2. MATERIAL

Use sign foundation materials that meet the *Foundations and Anchor Rod Assemblies for Metal Poles* provision.

(A) Assumed Subsurface Conditions

Assume the following soil parameters and groundwater elevation for sign foundations unless these subsurface conditions are not applicable to sign locations:

- Unit weight (γ) = 120 lb/cf,
- Friction angle (ϕ) = 30°,
- Cohesion (c) = 0 lb/sf, and
- Groundwater 7 ft below finished grade.

A subsurface investigation is required if the Engineer determines these assumed subsurface conditions do not apply to a sign location and the sign cannot be moved. Subsurface conditions requiring a subsurface investigation include but are not limited to weathered or hard rock, boulders, very soft or loose soil, muck, or shallow groundwater. No extension of completion date or time will be allowed for subsurface investigations.

(B) Subsurface Investigations

Use a prequalified geotechnical consultant to perform one standard penetration test (SPT) boring in accordance with ASTM D1586 at each sign location requiring a subsurface investigation. Rough grade sign locations to within 2 ft of finished grade before beginning drilling. Drill borings to two drilled pier diameters below anticipated pier tip elevations or refusal, whichever is higher.

Use the computer software gINT version 8.0 or later manufactured by Bentley Systems, Inc. with the current NCDOT gINT library and data template to produce SPT boring logs. Provide boring logs sealed by a geologist or engineer licensed in the state of North Carolina.

(C) Sign Foundation Designs

Design sign foundations for the wind zone and clearances shown in the plans and the slope of finished grade at each sign location. Use the assumed soil parameters and groundwater elevation above for sign foundation designs unless a subsurface investigation is required. For sign locations requiring a subsurface investigation, design sign foundations for the subsurface conditions at each sign location. Design footings, pedestals, drilled piers, grade beams, and wings in accordance with the 6th Edition of the AASHTO *Standard Specifications for Structural*

Supports for Highway Signs, Luminaires and Traffic Signals. In some instances, conflicts with drainage structures may dictate sign foundation types.

Design footings in accordance with Section 4.4 of the AASHTO *Standard Specifications for Highway Bridges*. Do not use an allowable bearing pressure of more than 3,000 lb/sf for footings.

Design drilled piers for side resistance only in accordance with Section 4.6 of the *AASHTO Standard Specifications for Highway Bridges* except reduce ultimate side resistance by 25% for uplift. Use the computer software LPILE version 5.0 or later manufactured by Ensoft, Inc. to analyze drilled piers. Provide drilled pier designs with a horizontal deflection of less than 1" at top of piers. For cantilever signs with single drilled pier foundations supporting metal poles, use wings to resist torsion forces. Provide drilled pier designs with a factor of safety of at least 2.0 for torsion.

For drilled pier sign foundations supporting upright trusses, use dual drilled piers connected with a grade beam having a moment of inertia approximately equal to that of either pier. The Broms' method is acceptable to analyze drilled piers with grade beams instead of LPILE. Use a safety factor of at least 3.5 for the Broms' design method in accordance with C13.6.1.1 of the AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*.

Submit boring logs, if any, working drawings and design calculations for acceptance in accordance with Article 105-2 of the *2012 Standard Specifications*. Submit working drawings showing plan views, required foundation dimensions and elevations and typical sections with reinforcement, conduit, and anchor rod assembly details. Include all boring logs, design calculations, and LPILE output for sign foundation design submittals. Have sign foundations designed, detailed, and sealed by an engineer licensed in the state of North Carolina.

32.3. CONSTRUCTION METHODS

Construct footings, pedestals, drilled piers, grade beams, and wings and install anchor rod assemblies for sign foundations in accordance with the *Foundations and Anchor Rod Assemblies for Metal Poles* provision.

32.4. MEASUREMENT AND PAYMENT

DMS Overhead Footings will be measured and paid in cubic yards. Sign foundations will be measured as the cubic yards of foundation concrete for footings, pedestals, drilled piers, grade beams, and wings shown on the accepted submittals. The contract unit price for DMS *Overhead Footings* will be full compensation for providing labor, tools, equipment and foundation materials, stabilizing or shoring excavations and supplying concrete, reinforcing steel, conduit, anchor rod assemblies, and any incidentals necessary to construct sign foundations. Subsurface investigations required by the Engineer will be paid as extra work in accordance with Article 104-7 of the *2012 Standard Specifications*.

Payment will be made under:

Pay Item	Pay Unit
DMS Overhead Footings	Cubic Yard

33. OVER-HEIGHT VEHICLE DETECTION SYSTEM

33.1. DESCRIPTION

Furnish and install the over-height detection system with all necessary hardware in accordance with the Plans and Special Provision.

The over-height vehicle detection system consists of a transmitter and a receiver. The transmitter and receiver system will be mounted on poles or mast arm poles on each side of the roadway. The pole or mast arms will be paid separately. A beam of infrared light from the transmitter is aimed at two light detectors in the receiver. When the light reaching the two detectors is interrupted in the proper sequence, the receiver closes an electrical contact. The transmitter and receiver are mounted at such a height that over-height vehicles break the beam but other vehicles do not. The receiver's contact closure output is connected to the WIM computer at the Advance Location, and any truck breaking the beam is flagged as over-height in the message about the truck that the Advance Location roadside computer sends to the server.

33.2. MATERIALS

(A) Over-Height Detector

Furnish the over-height detector assembly to include the transmitter and receiver with the following characteristics:

- Power: 120 VAC power,
- Output: Form C dry relay contact closure with contacts rated 115 VAC, 10 amps. Protected by an 8 amp circuit breaker,
- Weight : 30 pounds or less, each unit,
- Operating temperature: -40° F to +135° F,
- Response: Within 1 second of beam break,
- Enclosure: NEMA 6P, ALMAG casting and sheet aluminum at least 1/8-inch thick,
- Range: 10-700 feet under ideal conditions; 200 feet in bad weather.
- Reaction Speed: 1 to 75 mph for 2.5-inch diameter object that is one inch above the detection height,
- Two LEDs, bore sight, and meter for alignment,
- Bird perch denial rod for each eye cone, and
- Furnish the transmitter and receiver with mounting hardware, power and communication cables, connectors, and power connection.

(B) Overheight Detector Cable

The overheight detector cable shall include conductors to carry power and data. The Contractor shall determine the number and type, and size of the conductors according to the overheight detector furnished.

(C) Mounting

Mount the over-height detector and receiver units on either a galvanized steel pole or mast arm pole as shown in the Plans.

(D) Steel Pedestal Pole

Provide a galvanized steel pole that conforms to Section 1098-14 of the Standard Specifications with the following modifications to the standard:

- Bracket arms and transformer bases shall not be required,
- Design the standard to support the over-height detection equipment specified herein, and
- Furnish the pole with a height as shown on the Plans.

(E) Steel Pedestal Foundations

Construct the steel pedestal pole on a standard foundation as defined in Section 1743 of the Standard Specifications. Design the foundation type and depth and submit for approval by the Department.

33.3. CONSTRUCTION METHODS

Mount the over-height detector transmitter unit to the proposed mast arm pole supporting the AVI antenna at the Advance Location using stainless steel band clamps at the heights shown in the Plans.

Mount the other over-height detector transmitter and detector units on steel pedestal poles.

Install the over-height vehicle detectors and align in accordance with the recommendations of the detector manufacturer. Mount the detector units so the beam is parallel to the cross slope of the roadway. Field verify the detector mounting to assure that the infrared beam is transmitted at 13'-6" above the lowest point of each travel lane that is equipped with the WIM sensors.

33.4. MEASUREMENT AND PAYMENT

Over-height vehicle detection system will be measured and paid as the actual number of over-height vehicle detector systems, furnished, installed, and accepted. Payment includes detectors and their mounting brackets.

Steel pedestal pole will be measured and paid as the actual number of steel pedestal poles and foundations, furnished, installed and accepted. Payment includes steel pedestal pole and steel pedestal pole foundation.

No measurement will be made for mounting hardware, overheight detector cables, electrical conductors, connectors, surge protectors, documentation, and testing as these will be considered incidental to furnishing and installing over-height vehicle detector systems.

Payment will be made under:

Pay Item	Pay Unit
Over-height Vehicle Detection System	Each
Steel Pedestal Pole	Each

34. AUTOMATIC VEHICLE IDENTIFICATION EQUIPMENT

34.1. DESCRIPTION

Furnish and install automatic vehicle identification (AVI) equipment with all necessary hardware and software in accordance with the Plans and Project Special Provisions.

34.2. MATERIALS

(A) General

Furnish AVI readers that are user-configurable RF and data processing units that support two-way communications with in-vehicle transponders using ASTM V6 Slotted-Aloha Time Division Multiple Access (TDMA) protocol. The physical layer must be compatible with ASTM PS111-98.

Integrate the AVI system into the operation of the WIM System. Furnish the AVI systems with hardware and software interfaces for communications with the WIM system. Design the AVI system to transmit AVI transponder information to the roadside electronics. Include the transponder ID into the roadside electronics as part of the vehicle record.

At a minimum, design the AVI system to read transponders and cause the transponder to activate red or green signals and audible alerts on the transponder. The AVI system shall be able to direct a specific trigger to a specific target transponder.

(B) AVI Reader

Install AVI readers (Telematics FP-300x or approved equivalent) at the Advance, Notification, and the Compliance Locations as shown on the Plans. Furnish readers that automatically identify passing transponders. Additionally, readers must be able to retrieve information from the transponder and instruct it to alert the driver by audio or visual means (beeps, red/yellow/green indicators, etc.).

With an accuracy of 99.95%, design the AVI reader to read and write to transponders at vehicle operating speeds up to 125 mph and correctly report the transponder ID to the WIM computer system.

Furnish AVI readers meeting the following requirements:

- voltage range: 9 to 30 VDC,
- Average power consumption: 5 W (maximum peak current 2A @ 12 VDC),
- Transmit frequency: 912 MHz to 918 MHz,
- Receiver frequency: 915 MHz,
- Data rate: 500 kbps, with ASK modulation,
- Communications interface: n EIA-232 or EIA-422, and
- Minimum data rate: 9600 baud asynchronous.

(C) AVI Antennae

Provide an antenna compatible with AVI readers described herein. Use a dipole 915 MHz antenna at the Advance, Notification, and Compliance Locations and on the ramp into the weigh station. Provide lane discrimination with the dipole antenna where transponders installed in vehicles in adjacent lanes will not be read by the antenna. This functionality is required at the Advance Location because the AVI record for the vehicle shall be matched up with the WIM and other in-lane sensors to create a complete vehicle record for processing. The functionality is

required at the Notification and Compliance Locations to clearly identify a violating vehicle's lane position and capture the image of violating vehicles using the freeze-frame CCTV camera at this location.

Provide flat panel antennae meeting the following requirements:

- Antenna type: Panel,
- Frequency: 900-060 MHz,
- Gain: 10 dB,
- Input VSWR: 1.5:1,
- Polarization: Horizontal,
- Pattern: Directional,
- Horizontal beam width: 20 degrees,
- Vertical beam width: 95 degrees,
- Lightning Protection: DC grounded,
- Bandwidth: 60 MHz, and
- Front-to-back ratio: 25 dB.

Provide antennae meeting the following environmental requirements:

- Temperature range: -40 to 158 degree F,
- Wind load velocity (no ice): 100 mph,
- Wind load velocity (1/2" radial ice): 85 mph,
- Lateral thrust (100 mph): 116 pounds,
- Torsional moment: 50 ft/lbs.

Provide AVI antenna with DC source capable of providing a required supply voltage (9 to 30 VDC) at maximum 5 W.

Provide a means for communicating with the host (serial asynchronous communication link).

(D) AVI Cable

The AVI cable shall include conductors to carry power and data. The Contractor shall determine the number and type, and size of the conductors according to the AVI reader and antenna furnished.

34.3. CONSTRUCTION METHODS

Complete an RF survey at the locations where the AVI system is to be installed. Identify with the RF survey all potential interference effects caused by permanent RF sources, operating within the same frequency bandwidth as the AVI. Report the survey results to the Department and provide recommendations on the installation of the AVI system to ensure that the system meets the requirements of these Project Special Provisions. Do not install AVI equipment until the completion of the RF survey and acceptance by the Department of AVI installation recommendations.

To remove interference effects between AVI readers, designate one of the readers as the master reader and the other reader as slave reader. A synchronization signal shall be transmitted from the master reader to synchronize readers for the purposes of removing the interference effects.

Mount the AVI readers in cabinets as identified on the Plans. Install the AVI antenna per AVI reader manufacturer's specifications. Mount the AVI antenna at a height and angle to ensure the lane coverage as identified in this Special Provision for each antenna type. At a minimum, mount the antenna at a sufficient height to meet Department requirements for vertical clearances of sign and bridge structures.

Prepare all forms and complete all necessary requirements on behalf of the Department to obtain any FCC licenses required for the AVI equipment provided under this Contract.

34.4. MEASUREMENT AND PAYMENT

AVI reader will be measured and paid as the actual number of AVI readers furnished, installed, and accepted.

AVI antenna will be measured and paid as the actual number of AVI antennas furnished, installed, and accepted.

No measurement will be made for the FCC license or of AVI cables as these will be considered incidental to furnishing and installing AVI readers and AVI Antennas.

Payment will be made under:

Pay Item	Pay Unit
AVI Reader	Each
AVI Antenna	Each

35. PIEZOELECTRIC QUARTZ SENSORS

35.1. DESCRIPTION

Furnish and install the piezoelectric quartz sensors with all necessary hardware and software in accordance with the Plans and Project Special Provisions. The piezoelectric quartz sensors shall meet or exceed the performance criteria of Type I Weigh-In-Motion (WIM) Systems, ASTM E 1318-02 Standard Specification for Highway WIM Systems with User Requirements and Test Methods.

35.2. MATERIALS

(A) Piezoelectric Quartz Sensors

Install piezoelectric quartz sensors manufactured by Kistler Instruments, or approved equivalent. Furnish piezoelectric quartz sensors that have an uncompensated temperature coefficient of sensitivity of no more than +/-0.02%/°C.

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 (96%) 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	± 10% of actual weight
Axle Group (2 or more) Weight	± 6% of actual weight
Gross Weight	± 4% of actual weight
Axle Spacing	± 6 inches
Vehicle Speed	± 2 mph
Temperature Coefficient of Sensitivity	-.02% per degree C

The actual weight is defined as that 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 80 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.

(B) 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}

35.3. CONSTRUCTION METHODS

(A) General

Install piezoelectric quartz sensors as shown in the Plans and as recommended by the manufacturer.

The piezoelectric quartz sensor configurations shall consist of two sets (4 sensors in each set) of piezoelectric quartz sensors in a single traffic lane, as shown in the Plans. Each set of four sensors shall occupy the entire lane and be positioned such that each sensor set weighs one side of the vehicle thus obtaining weight information sufficient to determine any side-to-side balance condition of the vehicle.

Space the piezoelectric quartz sensors as shown in the Plans.

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 coaxial cable in a 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 two years against defects in materials or workmanship.

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

(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 weigh 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 a 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 I. 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.

35.4. MEASUREMENT AND PAYMENT

Piezoelectric quartz sensor set will be measured and paid as the actual number of piezoelectric quartz sensor sets furnished, installed, and accepted. No measurement will be made for cables, amplifiers, epoxy, temperature sensors, electrical conductors, or conduit fittings as this will be considered incidental to furnishing and installing the piezoelectric quartz sensor sets.

Piezoelectric axle sensor will be measured and paid as the actual number of piezoelectric axle sensors furnished, installed, and accepted. No measurement will be made for cables, amplifiers, epoxy, temperature sensors, electrical conductors, or conduit fittings as this will be considered incidental to furnishing and installing the piezoelectric axle sensors.

Payment will be made under:

Pay Item	Pay Unit
Piezoelectric Quartz Sensor Set	Each
Piezoelectric Axle Sensor	Each

36. COMPUTER HARDWARE AND PERIPHERALS

36.1. DESCRIPTION

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.

The Engineer will provide the Contractor all workstations, servers and printer described in the section. Assemble and install new products obtained from the Engineer. **If the Contractor's system requires additional servers, the Contractor shall notify Engineer so the NCSHP can obtain the additional servers.** Provide commercial off-the-shelf materials, equipment, and components.

Install two servers, one printer, and three computer workstations in the scale house. Ensure that all workstation and servers can access the LAN and can be used to monitor, interact, and control all weigh station operations.

(A) Servers

Install servers in the scale house net rack room as described in the Plans and these Project Special Provisions. Furnish and install one application server for the weigh station operations, and one video application server. Connect the servers to the managed Ethernet switch and the respective UPS unit.

(B) Computer Workstations

Install computer workstations consisting of a CPU, monitor(s), keyboard, UPS, and mouse in the scale house scale room.

(C) Printer

Install one laser printer in the scale house scale room.

36.2. MATERIALS

All materials described in this subsection will be furnished by the Engineer off the State contract. If the equipment described herein does not meet the Contractor's requirements to support the software, then the Contractor shall add the appropriate components to do so.

(A) Servers

(1) Functional

The servers shall integrate the workstations shall enable video and data accessibility and exchange between various systems. The servers will meet the following functional requirements:

- Handle commands from system clients via ASN.1 and/or XML defined protocol over standard TCP/IP connection.
- Command underlying nodes (devices such as encoders, video servers).
- Report status of system nodes and alarms.
- Monitor system nodes connections.
- Store recent alarms in internal database.

- Receive Simple Network Management Protocol (SNMP) traps generated by network infrastructure, translate SNMP traps as system alarms, and send alarms as SNMP traps.
- Support remote configuration and diagnostics.
- Restore video and connections in case of system component restarts.
- Support protocols: TCP, UDP, NTP, and IP Multicast IGMP.

(2) Performance

The application servers will meet the following minimum requirements:

- Processer: Six core at 2.0 GHz or greater, 15 MB cache processor, Turbo, L2 cache at 1333 MHz,
- Memory: Minimum 4 GB single-ranked RDIMMS at 1333 MHz,
- Power Supply: Redundant power supplies with separate cords,
- Riser: Riser with two PICe x 8 and two PICe x slots
- Drive Controller: PERC H310 RAID controller,
- Hard Drives: 4x146 GB, 15k RPM serial SCSI drives, 6 Gbps, 3.5 inch,
- CD-ROM: DVD +/-RW SATA Drive, internal,
- Video Card: Integrated video chipset controller 8 MB SD RAM with 480 MB/s memory bandwidth and DirectX 5.0,
- Video Adaptor: SGVA,
- Mounting: Slide ready rails and cable management
- Network: Dual-port Gigabit Network Adaptor with TOE, PCIe-4, and
- Operating System: Microsoft Server 2008 Release 2 with Service Pack 2, Standard Edition and 5 CALs, and Microsoft SQL 2008 Standard Edition.

(3) Physical Features

The rack-mounted servers will be a maximum size of three RUs each.

The servers will meet the minimum following power requirements:

- Power supply: 110-130 VAC.
- Power consumption: Typical 600-800 W per power supply.

The servers will meet the following data port requirements:

- Serial: One standard serial port,
- Audio: Three jacks – channel out, line in, and microphone.
- Ethernet: Dual 1000 Base T Ethernet with RJ-45 connectors as described above and
- USB port: Six USB 2.0 ports.

The servers will have at least one direct 10/100/1000 Base T Ethernet LAN interface. The network connector will be RJ-45 for Category 5e UTP for interfacing with the Managed Ethernet switch.

(B) Computer Workstations

(1) Functional

The computer workstations will operate the central control software and the video control software over an Ethernet network in the scale house. Each computer will be provided with dual monitors.

(2) Performance

The computer workstations will meet the following requirements:

- Processor: Dual core processor at 3.10 GHz with Turbo Boost 2.0 up to 3.5 GHz or greater, 8 MB cache, L2 cache at 1333 MHz,
- Memory: 4 GB Dual Channel DDR3 SDRAM, 1600 MHz,
- Network: 10/100/1000 Base T Ethernet PCI Express with RJ-45 connector,
- Hard Drive Controller: C1, All SATA drives, non-RAID,
- Hard Drive: 500 GB SATA, 3.0 Gbp/s, operating at 7200 RPM, 8 MB data burst cache,
- CD-ROM: 16X DVD and 16x DVD+/- RW,
- Keyboard: USB 104-key model,
- Mouse: USB 3-button optical mouse with center scroll,
- Sound: 16-bit integrated audio with external speakers,
- Video Card: 128-bit, DDR3 memory interface, 2560 x 1600 digital resolution, two DVI video outputs, open GL 4.1, PCI Express 2.0 bus, DirectX 11
- Video Output: Two DVI connectors,
- Desktop Monitor Color: 16.7 million colors,
- Operating System: Windows® 7 Professional, latest version,
- Application software: Microsoft Office (latest version), Antivirus software compatible with State requirements, and DVD burning software, and
- Desktop Monitor: Two LED, 24-inch, digital flat panel display, DVI-D and HDCP display ports,
  - USB Ports: One USB upstream port and three downstream ports,
  - Resolution: 1,920 x 1,080 dpi,
  - Pixel Pitch: 0.265 mm
  - Viewing Angle: 178 degrees vertically and horizontally
  - Contrast Ratio: 1,000:1 (typical) and 10,000:1 (dynamic)
  - Brightness: 300 cd/m^2
  - Colors: 16.7 million colors.

(3) Physical Features

The computer workstations will meet the minimum power requirements:

- Input voltage: 90-135 V at 50/60 Hz,
- Output wattage: 460 W, and
- Heat Dissipation: 93.1 BTU/hour (fully loaded computer without monitor).

The computer workstations will have the following minimum ports:

- Keyboard: One USB connection,
- Mouse: One USB connection,
- Audio: Miniature phono jacks – line out, line in, and microphone,
- Ethernet: 10/100 Base T Ethernet with RJ-45 connector, and
- USB Port: At least 4 rear and 2 front USB 2.0 ports (min. 6 total)

The computer workstations will have at least one direct 10/100 Base T Ethernet LAN interface. The network connector shall be RJ-45 for Category 5e or 6 UTP for interfacing with the managed Ethernet switch.

(C) Printer

The laser printer will have the following features:

- Memory: Minimum of 16 MB of RAM,
- Communications: Ethernet 10/100 Base-T network card with RJ-45 connector, bi-directional IEEE 1284 ECP-compliant parallel interface, and one (1) open EIO expansion slot,
- Typefaces: Latest version of Windows print typefaces,
- Printer Language: PCL 6 with commands for fully integrated HP-GL/2 vector graphics and advanced imagery/special effects printing with a minimum of 80 internal and scaleable fonts,
- Printer Speed: 17 pages per minute (ppm),
- Paper Tray Capacity: 1,100 sheet capacity, and
- Tray Sizes: 8.5 x 11 inch.

36.3. CONSTRUCTION REQUIREMENTS

(A) General

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

Furnish all tools, equipment, materials, supplies, manufactured hardware, and perform all operations and equipment integration necessary to provide a complete, operational network. Mount all equipment as shown in plans in enclosed 19" communications racks. 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) Servers

Install the servers in the proposed enclosed 19-inch communications rack located in the scale house net rack room. 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 existing and proposed servers to the managed Ethernet switch. 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. Power up and run diagnostics.

(C) Computer Workstation

Install the computer workstations in locations as shown in the Plans. Install the client software packages described in these Project Special Provisions.

Connect the workstations to the LAN by installing Ethernet patch cords between the Ethernet patch panel and the 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 room 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.

36.4. MEASUREMENT AND PAYMENT

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

Printer will be measured and paid as the actual number of printers installed and accepted

No separate measurement will be made for coaxial cables, communication cables, electrical cables, mounting hardware, 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 will be considered incidental to the pay items for installing servers and workstation computers.

No separate measurement will be made for UPS units supplied with each workstation computer.

Payment will be made under:

Pay Item	Pay Unit
Server (Install)	Each
Computer Workstation (Install)	Each
Printer (Install)	Each

37. CENTRAL CONTROL SOFTWARE

37.1. 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, without the need for human intervention, weighing and screening trucks, collecting other data, controlling the lane control signs, making that data available electronically to the operators. Furnish and install an integrated software package under this Contract, which provides, at a minimum, the functionality described in Section 1 of these Project Special Provisions and described herein.

Information security and accountability must meet Federal and State Information Security Directives, Laws, and Policies. Security Architecture must be approved by North NCSHP and the NC Department of Justice Information Security office prior to installation.

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.

Capture transponder data and ALPR data for each vehicle in the deceleration lane and entrance ramp as shown in the Plans approaching the weigh station. Furnish and install software that distinguishes high safety risk motor carriers and vehicles from the real-time traffic stream based on an automatic screening algorithm that indicates the presence of safety risks, credentials, or other criteria described in these Project Special Provisions.

(B) Screening Criteria

(1) Operation Overview

Interface the roadside operations controllers to the WIM Sorting System and preclearance program. The only vehicles that will be notified by the roadside operations system will be commercial vehicles that possess a preclearance transponder; not all other vehicles will be affected. The ROS system must match the data structure used of the existing Hillsborough roadside operations system so the Department can use their existing data transfer procedures. The system must be upgradeable to the newest version of SAFER.

The roadside operations system will provide two-way communications between vehicle-mounted active transponders and a roadside-based reader unit. The roadside operations system shall have the capability to read transponders and cause the transponder to activate red or green signals and audible alerts on the transponder. The roadside operations system shall be able to direct a specific trigger to a specific target transponder.

The roadside operations system interfaces to three locations: Advance, Notification, and Compliance locations.

The advance location purpose is to read transponders of specific carriers. Carrier identification is obtained from the transponder at this location. This information is cross-referenced with valid transponders in the preclearance system to determine credential and load information.

As the driver passes the notification location, the preclearance system will send a signal to the in-cab transponder, which conveys the response. This notification is presented to the driver

visually and/or audibly. The driver will either receive a green light to bypass the weigh station or a red light and audible sound to enter the weigh station.

The final AVI location that a preclearance user will encounter is the Compliance location. This location is used to verify that the user has performed the action as communicated to them via their transponder.

If a commercial vehicle continues down the mainline, bypassing the weigh station exit ramp, the vehicle will pass by a sensor configuration of loop-axle sensor-loop -axle sensor-loop. This sensor configuration is used for the purpose of vehicle tracking and data collection. An alarm will sound on the scale house manual console in the event that a commercial vehicle bypasses an "open" station.

Provide a roadside operations system that consists of three major components:

- A snapshot database containing a local copy of CVIEW and SAFER data,
- A credential processing and screening software algorithms, and
- A Windows-based graphical user interface (GUI) for accessing the snapshots and credential screening components.

The specific major functions fulfilled by the baseline roadside operations 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
- Allow the operator to view vehicle screening results and CVIEW snapshot information.

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). 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.

(2) Roadside Operations System Characteristics

a) Roadside Operations Requirements

Provide the roadside operations system with the following functions:

- Vehicle screening,
- Vehicle display,
- Vehicle reporting,
- CVIEW interface, and
- Station controls (CMS, VMS, LCS1, LCS2, static scales)

Furnish the roadside operations system to produce printed reports detailing vehicle activity at the weigh station. This function is known as vehicle reporting.

Furnish the roadside operations system to provide an interface to the state CVIEW system to update the local credential and safety database. This function is known as the CVIEW interface.

Furnish the roadside operations system maintain a vehicle record for each vehicle entered into the system.

Furnish the roadside operations system vehicle record to contain the following information about each vehicle (when available):

- Unique vehicle identifier,
- Vehicle number,
- Time and date stamp,
- Lane,
- Axle counts,
- Vehicle classification,
- Overall vehicle weight,
- Maximum gross vehicle weight,
- Vehicle length,
- Error code,
- Vehicle speed,
- Axle record type,
- ESAL 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.

Retain a configurable number of months in the roadside operations system, minimum 3 months, and maximum 12 months, of historical vehicle records.

Interface the roadside operations system to the CVIEW system for receiving commercial vehicle data as described below.

b) Screening Requirements

Design the roadside operations system to maintain an operator-defined hot list of carriers that are required to report to the scale house regardless of their weight or safety credential status.

Include on the carrier hot list 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,
- Comments – the user can enter what action to take when the vehicle reports or any other information that would be useful,
- Start date – when the hot list status starts, and
- End date – when the hot list status ends.

Design the roadside operations system to maintain an operator-defined hot list of vehicles that are required to report to the scale house regardless of their weight or safety credential status.

Include on the vehicle hot list an active date range for each entry defining the period in which the entry is valid.

Include the following information on the vehicle hot list:

- Vehicle ID (which could be the VIN or license plate number),
- Comments – the user can enter what action to take when the vehicle reports or any other information that would be useful,
- Start date – when the hot list status starts,
- End date – when the hot list status ends, and
- Jurisdiction – identifies registering jurisdiction.

Program the roadside operations system to maintain a local database of carrier snapshot data received from CVIEW.

Program the roadside operations system to maintain a local database of vehicle snapshot data received from CVIEW.

Program the roadside operations system to permit the operator to override each specific credential/safety screening check on a carrier-by-carrier basis. Any credential or safety item that is overridden is not checked as part of the screening process for the designated carrier.

Program the roadside operations system to permit the operator to override each specific credential/safety screening check on a vehicle-by-vehicle basis. Any credential or safety item that is overridden is not checked as part of the screening process for the designated vehicle.

c) Display Requirements

Program the roadside operations system to provide a screening results display screen that permits the operator to do the following:

- 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), and
- Display whether the vehicle was directed to report as a result of appearing on a particular hot list.

Design the roadside operations system to permit an operator with the proper authority to:

- 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 CVIEW and store it in the local 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 through the station in the last three months, and
- Edit each of the hot lists.

d) Reporting Requirements

Program the roadside operations 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, and
- 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 roadside operations system to produce two specific reports that are based on data stored in the roadside operations system. These reports include:

- Number of vehicles traveling down each lane, and
- Listing of a carrier's vehicles passing the station during a specific period, include when the vehicle passed the station, whether it was given a bypass or report signal, and the reason a report signal was given.

e) Intra-State Credential Enforcement Screening

All of the Intra-State credential enforcement screening items identified below shall be capable of being enabled and disabled by the operator in the screening setup screen and the vehicle display screen:

- Direct a vehicle to report if the vehicle's Intra-state vehicle registration expired prior to a user-definable number of days ago,
- Direct a vehicle to report if the vehicle's measured GVW is greater than the vehicle's registered GVW plus 1000 lbs,
- Direct a vehicle to report if the vehicle is registered to use six axles and the WIMS detects fewer than six axles and the vehicle's measured GVW is greater than 73,280 lbs, and
- Direct a vehicle to report if the Intra-state enforcement registration is suspended.

Program the roadside operations system to display the registered weight of the vehicle at the operator workstation.

f) Single State Registration System (SSRS) Credential Enforcement Screening

All of the SSRS credential enforcement screening items identified below shall be capable of being enabled and disabled by the operator in the screening setup screen and the vehicle display screen:

- Direct a vehicle to report if the carrier has an MC (ICC) number in CVIEW and does not have an SSRS credential in State. When the MC or ICC numbers are eliminated, the same rule will apply with the USDOT number,
- Direct a vehicle to report if the SSRS credential is suspended, and
- Display the HazMat status in SSRS at the operator workstation to aid in operator inspections.

g) Exempt Credential Enforcement Screening

All of the exempt credential enforcement screening items identified below shall be capable of being enabled and disabled by the operator in the screening setup screen and the vehicle display screen:

- Direct a vehicle to report if the vehicle's Exempt credential is revoked, and
- Direct a vehicle to report if the vehicle's Exempt credential is cancelled.

h) HazMat Credential Enforcement Screening

All of the HazMat credential enforcement screening items identified below shall be capable of being enabled and disabled by the operator in the screening setup screen and the vehicle display screen:

- Direct a vehicle to report if the vehicle's HazMat credential is revoked,
- Direct a vehicle to report if the vehicle's HazMat credential is suspended,
- Direct a vehicle to report if the vehicle's HazMat status is expired,
- Use a separate random screening adjustment to decide whether to direct vehicles with HazMat credentials to report. This random screening is used to direct a percentage of vehicles to report when no other screening rule results in an inspection, and
- Display the HazMat permit number and type at the operator workstation to aid in operator inspections.

i) IRP Credential Enforcement Screening

All of the IRP credential enforcement screening items identified below shall be capable of being enabled and disabled by the operator in the screening setup screen and the vehicle display screen. IRP enforcement only applies to inter-state carriers.

- Direct a vehicle to report if the vehicle's IRP credential expired prior to a user-definable number of days ago,
- Direct a vehicle to report if the vehicle's IRP credential is suspended,
- Direct a vehicle to report if it is an out-of-state vehicle, the measured GVW is greater than 26,000 lbs. and it does not have an IRP credential,
- Direct a vehicle to report if the GVW measured by the WIM is greater than the IRP registered GVW plus 1000 lbs.,
- Direct a vehicle to report if the vehicle is registered to use six axles and the WIM detects fewer than six axles and the WIM measures a GVW greater than 73,280 lbs., and
- Direct a vehicle to report if the HVUT status is unsatisfactory.

j) IFTA Credential Enforcement Screening

All of the IFTA credential enforcement screening items identified below shall be capable of being enabled and disabled by the operator in the screening setup screen and the vehicle display screen. IFTA enforcement only applies to inter-state carriers.

- Direct a vehicle to report if the IFTA credential is suspended for the carrier,
- Display the reason for suspension of a carrier's IFTA credential at the operator workstation,
- Direct a vehicle to report if the IFTA credential for the carrier expired prior to a user-definable number of days ago, and
- Direct a vehicle to report if the carrier is an out-of-state carrier and no IFTA credentials are found for the carrier.

k) Safety Enforcement Screening

All of the safety enforcement screening items identified below shall be capable of being enabled and disabled by the operator in the screening setup screen and the vehicle display screen.

- Direct a vehicle to report if the SCE/ISS safety score is greater than an operator defined threshold for screening,

- Display the vehicle SAFESTAT score at the operator workstation,
- Exclude a vehicle from the random pull-in process if the vehicle has a current CVSA decal in the vehicle snapshot and the vehicle does not have a current HazMat credential,
- Direct a vehicle to report if the carrier is designated as currently OOS, and
- Direct a vehicle to report if the vehicle has been designated as OOS within the last user-definable number of days.

l) Oversize/Overweight Enforcement Screening

All of the oversize/overweight enforcement screening items identified below shall be capable of being enabled and disabled by the operator in the screening setup screen and the vehicle display screen.

Direct a vehicle to report if the vehicle has a current over-width permit and the WIM measured gross vehicle weight (GVW) is greater than the empty weight on the permit plus a user settable tolerance,

Direct a vehicle to report if the WIM measures a vehicle length greater than the length allowed in any current over-length permit for the vehicle,

Direct a vehicle to report if the over-height detection feature of the WIM is disabled and the vehicle has a current over-height permit and the WIM measured GVW is greater than the empty weight on the permit plus a user settable tolerance,

Direct a vehicle to report, regardless of any current over-height permits issued for the vehicle, if the WIM makes an over-height determination,

Direct a vehicle to report if the WIM measures a GVW that is equal to or greater than the GVW permitted in any current over-weight permits for the vehicle,

Direct a vehicle to report if the vehicle fails the bridge formula for legal sized loads and does not have a current oversize/overweight or overweight permit,

Treat vehicles with a current single trip or annual permit that have a WIM measured GVW less than the empty vehicle permit weight plus a user settable tolerance as if the vehicle does not have a permit. Specifically, the vehicle will be checked using "legal" height, weight, and length settings and will be directed to report if any legal settings are violated.

Direct a vehicle to report if the vehicle does not have a current single trip permit and it has a current annual permit with a height, width, length or weight category greater than the user specified maximums for reduced restrictions and a current route approval does not exist and the empty permit weight has been exceeded by more than a user settable tolerance, and

Direct a vehicle to report if the vehicle has a current annual permit and no current single trip permit and the vehicle violates any of the following:

- the WIM measured distance between any 2 axles is less than the minimum allowed for annual permits where the minimum is user settable,
- the WIM measured distance between the steering axle and the next axle is less than the minimum allowed for annual permits where the minimum is user settable,

- the WIM measured distance from the front axle to the rearmost axle is greater than the maximum allowed for annual permits where the maximum is user settable,
- the WIM measured spacing on any tridem is greater than the maximum allowed for annual permits where the maximum is user settable,
- the WIM measured spacing on any quadrem is greater than the maximum allowed for annual permits where the maximum is user settable,
- the WIM measured spacing on any tandem is greater than the maximum allowed for annual permits where the maximum is user settable,
    - the permit is an "overweight" or "oversize/overweight" permit and the number of axles detected by the WIM is less than the minimum number allowed for annual permits where the minimum is user settable, and
    - the permit is an "overweight" or "oversize/overweight" permit and the number of axles detected by the WIM is greater than the maximum number allowed for annual permits where the maximum is user settable;
    - Direct a vehicle to report if the vehicle has a current single trip permit or a current annual permit with an approved route that required actual axle spacings and axle group weights to be specified and the vehicle violates any of the following,
        - Axle spacing detected by the WIM is greater than the axle spacing on the permit plus a user specified tolerance,
        - Axle spacing detected by the WIM is less than the axle spacing on the permit minus a user specified tolerance, and
        - Axle group weights detected by the WIM are greater than the axle group weights specified on the permit;
    - Allow the weight tolerance for permits to be adjusted in a way similar to how the weight tolerance for non-permitted vehicles is adjusted in the existing system,
    - Direct a vehicle to report if the vehicle has a current single trip permit or a current annual permit and the weight distribution on the axles within any axle group is uneven and it is uneven by more than a user specified tolerance,
    - Allow a user to enter the maximum single axle weight that is allowed for each axle group (single, tandem, tridem, quadrem) in each of the annual permit axle load weight categories (A, B, C),
    - Direct a vehicle to report if the vehicle has a current annual permit and no current single trip permit and the WIM detected axle group weights exceed the maximum for the annual permit axle load weight category specified in the route approval or in the annual permit, if no route approval exists,
    - Allow a user to enter the maximum GVW that is allowed for a vehicle in each of the annual permit axle load weight categories (A, B, C) when the vehicle has 5 axles, 6 axles, 7 axles with 2 tridem groups, 7 axles with tandem and quad groups, or 8 axles, and

- Direct a vehicle to report if the vehicle has a current annual permit and no current single trip permit and the WIM detected GVW exceeds the maximum allowed for the vehicle's axle configuration in the annual permit axle load weight category specified in the route approval or in the annual permit, if no route approval exists.

(C) External Interface Requirements

Program the roadside operations system to support the receipt of carrier and vehicle snapshot data from the State CVIEW system.

Program the roadside operations 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.

(D) Operator Interface and System Controls

(1) General Operation

A system operator shall be able to view and control system operations via the workstations; two located in the scale house and one located in the static scale booth. Using a workstation, the operator will view vehicle data collected by each of the detectors and sensors in the system, view, and print reports, identify and respond to system alarms, view freeze-frame images of violating vehicles and control the pull-in multipliers. At a minimum, the operator display screens shall allow the system operator to view the following information:

(2) ALPR Data

Vehicle records for the screening system. Program the system to show data and images collected.

(3) Transponder Data

Vehicle records for the screening system. Program the system to show data and images collected.

(4) Vehicle Queue Data

Design the system to allow operators to view vehicle records for each of the queues at the weigh station (left lane static scales, right lane static scales, and ramp bypass queue. Program the system to show data collected by the mainline and in-station detectors and the piezoelectric quartz sensors.

(5) Individual Vehicle Data

Program the system to display all information on a specific vehicle collected by the new equipment installed on the Interstate as well as all ramp equipment. Have the system identify why a vehicle was not provided mainline bypass (i.e. no transponder, overweight, over-height, etc.). Program the system to allow operators to view snapshot photographs taken of vehicles via the ALPR's freeze-frame CCTV camera at the Advance Location and AVI reader. Program the system to allow operators to view all credential information (for transponder-equipped vehicles).

(6) Alarms

Program the system to allow operators to review alarms reported by the Advance Location and the Compliance Location and to allow operators to view snapshot photographs taken by the freeze-frame CCTV camera of violating vehicles at the Compliance Location.

(7) Back-Up Types

- Static Scale Queue > 4, increase weight threshold to 110% automatically. When < 3 weight threshold, return to original setting,
- Report Lane Loop on > 30 seconds, automatically bypass vehicles. Operator manually re-opens report lane when queue has shortened, and
- Ramp WIM Loop > 30 seconds, automatically close the station. Operator manually re-opens station when queue has shortened.

(8) Summary Data

Program the system to allow operators to review summary data for all lanes equipped with system devices. 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, and credentials).

(9) Periods of Inactivity

Design the workstation software interface such that following a user-specified period of inactivity (i.e., no keystrokes and no mouse movements) such that the operator workstation will lock out. An operator may regain access by 1) either striking any key or moving the mouse, and 2) entering a valid user ID, and 3) entering the appropriate password for the user. The user will then be immediately reconnected to the WIM system. Protracted delays and/or multiple steps, beyond those just described, to reconnect the operator workstation to the WIM system are unacceptable.

(E) System Reports

Design the software to provide all of the reports available from the existing system software and to provide the following additional reports for the new system components, as a minimum:

- Violations,
- ALPR record data
- Transponder data,
- 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) by Hour,
- Weight violations (by hour and by class),
- Weight violations count,
- % of transponder-equipped vehicles,
- % of vehicles bypassed by the mainline equipment,
- % of vehicles bypassed by the in-station equipment,
- 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 heights (by class and by hour), and
- Vehicle lengths.

(F) Database Queries

Design the software to provide an operator at any operator workstation the ability to perform data queries on any database item and combination of database items. Furnish the ability to view the results of database queries on the operator workstation screen and to print optionally the database queries on the laser printer in a format acceptable to the Department.

(G) System Updates

During the course of project construction, as system components are made operational and brought online for the weigh station, perform software updates. Continue to update the WIM software of the weigh station throughout the project and through to the end of the warranty period.

37.2. MATERIALS

Provide reproducible copies of all software on CD-ROM. Furnish all software pre-installed on workstation, roadside operations controllers, and WIM server hardware prior to installation. Provide source code for the portions of the software that must be changed in order to change the screening criteria.

WIM server, roadside operations controllers, and WIM electronics hardware used to run the software described in this 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.

37.3. MEASUREMENT AND PAYMENT

Central control software will be paid for at the contract lump sum price for central control software including the roadside operations and WIM software.

NCSHP will supply the necessary Oracle tools to compile screening criteria portion of software.

Payment will be made under:

Pay Item	Pay Unit
Central Control Software	Lump Sum

38. AUTOMATED LICENSE PLATE RECOGNITION (ALPR) SYSTEM

38.1. DESCRIPTION

Furnish, install, and integrate a license plate recognition system that will automatically detect the presence of commercial vehicles on the exit ramp at the I-85 northbound Weigh Station; capture an image containing the license plate; provide an overview image of the vehicle and automatically locate and identify the corresponding alphanumeric information and jurisdiction/location of issue.

Ensure the software is compatible with Windows 7 operating systems.

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

Integrate the ALPR system with the screening software. Provide at least one reference from an accredited law enforcement agency currently using the proposed ALPR system.

Furnish an ALPR system that automatically captures, identifies, and looks up alphanumeric code, state of origin, and county of origin as available from the CVIEW database. Configure the system to identify and differentiate plates by jurisdiction from the following states (as a minimum):

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 illumination and no other external lighting source.

Furnish ALPRs that can identify and interpret a minimum of two license plates simultaneously in the field of view.

Furnish an ALPR system with a plate read rate better than 80% (all characters correctly read for 80% of readable license plates) at speeds up to 60 miles per hour.

Provide a system with an operator interface to include database remote query functionality for multiple ALPR state locations and multiple databases.

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 SAFER screening database.

Automatically screen against North Carolina's FuelTaCS database of targeted vehicles.

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

Uniquely display each vehicle record associated with the screening components of the ALPR.

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.

The system must provide the following reports in addition to the existing reports: targeted as Federal out-of-service by the PRISM file; targeted vehicles from the FuelTaCS file; vehicles reported stolen by NCIC.

38.2. MATERIAL

(A) Camera

Furnish one side fired overview and one overhead ALPR camera per lane as shown in the Plans that complies with the following:

- Dual lens camera incorporating high-resolution monochrome and color.
- Self-illuminating Infrared (IR) illumination utilizing driver safe non-visible light (no less than 800nm).
- Capable of being "pulsed" as needed.
- Provide documentation that the camera illumination is certified to be "eye safe" by the IR manufacturer.
- Enhanced low light resolution (4 MP or higher).
- Produces at a minimum, a single license plate image per vehicle with varying flash, shutter, and gain settings to ensure a high quality image regardless of weather or lighting conditions.
- Operates during typical rain and snow events.
- An overview camera with day/night capabilities is required. Image must be integrated with the ALPR image taken by the ALPR camera. Night overview images will be black and white. Daylight images will be in color.
- The camera is triggered by an embedded loop in the roadway.

(B) Mounting Bracket

Provide the camera-mounting brackets to be a horizontal arm when mounted on vertical pole, which meets the following requirements:

- Cable feed through hole,
- Designed to mount on a vertical pole,
- Maximum supported weight: 40 lbs.,
- Separation between center of camera housing and pole: 15 inches,
- Attachment to pole: Minimum of two (2) stainless steel bands, approximately five inches apart,
- Pan adjustment: Unlimited (360 degrees),

- Tilt adjustment: +/- 75 degrees, and
- Housing: All aluminum with polyester powder coat finish

(C) ALPR System Software

Integrate the ALPR System Software into the screening system. Furnish the ALPR system software meeting the following requirements:

- Provide variants of the Optical Character Recognition (OCR) engine that are designed specifically for NC and regional license plates.
- Utilizes internal camera controls to facilitate automated settings for optimum flash, gain and shutter configurations.
- Integrates into a wide variety of systems via TCP/IP Ethernet with socket and FTP protocols, as well as IP connectivity.
- Offer standard software JPEG compression.
- Captures a live, corresponding color overview image (B/W at night) of the vehicle and simultaneously displaying the captured license plate, along with the date and time stamp of the image and a percentage confidence rated 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.
- Provides a permanent record of all interpretations and captured images in a chronological order at a rate of up to 45 images per minute 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.
- The operator can directly input whether the License Plate interpretation is correct while viewing the image. 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 with the WS data.
- Provide a still image capture of each commercial 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 screening system data collected.
- Provides a system with an operator interface to include database remote query functionality for multiple ALPR station locations and multiple databases.

(D) Camera Housing

Furnish the camera housing to meet the following requirements:

- LPR camera enclosure must be rated IP-65 or higher.
- Equipped with tempered glass front window.
- Equipped with sunshield.
- Equipped with surge suppressors on all ungrounded conductors.

Include mounting hardware to match mounting bracket. Provide mounting hardware specifically for the vendor's ALPR.

(E) ALPR Cable

The overheight cable shall include conductors to carry power and data. The Contractor shall determine the number and type, and size the conductors according to the overheight detector furnished.

38.3. CONSTRUCTION METHODS

Comply with the manufacturer's recommendations for installation, conforming to the *Standard Specifications* and the following requirements:

- Install the overview camera on the metal pole supporting the overhead mast arm.
- Install the APLR camera on an overhead metal mast arm.
- Install cameras with a fixed focal point or target distance.
- Furnish all cabling and camera connectors from the same manufacturer as the ALPR system.

38.4. MEASUREMENT AND PAYMENT

ALPR system will be measured and paid as the complete ALPR system furnished, installed, integrated, and accepted. This payment will be for all equipment, software, and integration required for detecting and screening commercial vehicles.

No separate measurement will be made for the APLR cameras and overview cameras, database search engines, software, IR illumination, ALPR cables, connectors, attachment assemblies, condulets, grounding equipment, surge protectors, or any other equipment required to install the ALPR system as these will be considered incidental to furnishing and installing the ALPR system. Metal mast arm poles will be paid for separately.

Payment will be made under:

Pay Item	Pay Unit
ALPR System	Lump Sum

39. WEIGH STATION ELECTRONICS

39.1. DESCRIPTION

Design and install the WIM electronics, along with inductive loops, piezoelectric axle sensors, piezoelectric quartz sensors, over-height vehicle detector, and AVI reader to work as a single, integrated system in the creation of a vehicle record, and in the processing of commercial vehicles. The WIM electronics shall collect and process data and control various roadside devices. It shall include any vendor specific hardware and firmware to communicate with the various sensors and detectors and collected for transmission to either the roadside computer or a server. The data shall be transmitted over an Ethernet network on single mode fiber-optic cable to the scale house.

Furnish and install the WIM electronics with all necessary hardware and software in accordance with the Plans and Project Special Provisions.

39.2. MATERIALS

(A) General

Furnish the WIM Electronics with the interface, signal conditioning for the in-road sensors, an integral power supply within a single chassis, and integrate a roadside computer. Provide all material necessary for set-up and operation of the system, including all mounting hardware and cabling. Provide the system with the required software pre-loaded so that it will automatically execute when the system is powered up. Make the electronics modular in design to facilitate easy maintenance, troubleshooting and on-site servicing.

(B) Frame Grabber

Furnish a frame grabber card inserted in the roadside controller where necessary. When triggered by the roadside controller software, design it to capture a frame of the video coming from the ALPR overview camera, digitizing it and storing it in memory.

(C) Advance Location

Unless otherwise specified, provide and integrate the following:

- Roadside controller ,
- Frame grabber,
- Interfaces for piezoelectric sensors, inductive loops, over-height detector, piezoelectric quartz sensors, and AVI readers, and
- Uninterruptible power supply.

(D) Compliance Location

Unless otherwise specified, provide and integrate the following:

- Roadside controller ,
- Frame grabber,
- Interfaces for the piezoelectric sensors, inductive loops, over-height detector, piezoelectric quartz sensors, and AVI readers, and
- Uninterruptible power supply.

(E) Scale House

Unless otherwise specified, provide and integrate the following:

- Servers and workstations and printer,
- Roadside operations controller to interface with roadside devices,
- Two operator workstations for weighing operations and one workstation for CCTV monitoring,
- Interfaces for the scales, loops, sensors, signs, and manual control panel, and
- Uninterruptible power supply.

Interface the server and workstations to the central control system, which together shall contain the central database that maintains vehicle records and provides the bypass screening logic as defined in the section, "Central Control Software" receiving, transmit and process AVI credentials information from the North Carolina Statewide CVISN database with these systems as well.

39.3. CONSTRUCTION METHODS

Prior to installing the WIM electronics, submit and receive approval of a plan for installing the new equipment. In addition, successfully complete the pre-installation test at the Contractor's facility (see the section, "Testing and Acceptance") on the new equipment and software.

39.4. MEASUREMENT AND PAYMENT

Advance location WIM electronics will be paid at the contract lump sum price for advance location WIM electronics. Contract work includes the roadside operation controller, software, frame grabber, and interfaces for: piezoelectric axle sensors, piezoelectric quartz sensors, inductive loops, the over-height detector, and AVI readers. The work includes all materials, electrical conductors, integration, documentation, and testing. The work includes all WIM electronics required at the notification location.

Compliance location WIM electronics will be paid at the contract lump sum price for compliance location WIM electronics. Contract work includes the roadside operation controller, software, frame grabber, and interfaces for: piezoelectric axle sensors, piezoelectric quartz sensors, and AVI reader, inductive loops, uninterruptible power supply. The work includes all materials, electrical conductors, integration, documentation, and testing.

Scale house WIM electronics will be paid at the contract lump sum price for scale house WIM electronics. Contract work includes the interfaces for the roadside operation controller, inductive loops, signs, and manual control panel. The work includes all materials, electrical conductors, integration, documentation, and testing.

Payment will be made under:

Pay Item	Pay Unit
Advance Location WIM Electronics	Lump Sum
Compliance Location WIM Electronics	Lump Sum
Scale House WIM Electronics	Lump Sum

40. SUBMITTAL DATA AND DOCUMENTATION

40.1. DESCRIPTION

Provide project documentation for Department review and approval as described below.

40.2. SUBMITTALS

(A) General

The intent of this subsection of the Project Special Provisions is to provide the requirements for submittal data (i.e., shop drawings, catalogue cuts, manufacturers' literature, proposed changes to splice drawings, construction schedule, system design report, etc.) and the process by which submittal data will be reviewed.

Provide all submittal documentation in either 8½" x 11" or 11" x 17" format. No documentation smaller than 8½" x 11" will be accepted. No documentation larger than 11" x 17" will be accepted without the prior approval of the Engineer. All submittals will be reviewed and approved by the Department. Absence of comment will not grant approval.

(B) 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.

The ITS & Signals Qualified Products List (QPL) is available on the North Carolina Department of Transportation's Website. Certain signal and communications equipment, material, and hardware shall be pre-approved on the QPL by the date of installation. Equipment, material, and hardware not pre-approved when required will not be allowed for use on the project. Consult the QPL Website to obtain pre-approval procedures.

(C) System Design Report

Prepare a System Design Report to describe the proposed network architecture and its configuration. Provide schematics to illustrate the network architecture and configuration, in addition to the written description. Provide a detailed description of the hardware and software to be installed. The report shall depict and describe the entire layout of the equipment and their connectivity. Provide a detailed listing of the hardware including brand and model numbers, functions and descriptions. Provide a detailed listing of the VLAN configuration and IP addresses.

Submit the report and obtain approval before providing material submittals for the following packages of items as described below: central video equipment, software, piezoelectric quartz sensors, piezoelectric axle sensors, bending plate scales, AVI antennas, AVI readers, computer hardware, and communications equipment. If the Contractor identifies a need to add equipment or components to the computer workstations or servers provided by the Engineer it must be identified in this report.

(D) Fiber-optic Splicing Drawings

Submit drawings that illustrate any proposed changes to the fiber-optic splicing details for Department review and approval at least 10 working days prior to beginning fiber-optic splicing. Do not perform any fiber-optic splicing until the Department approves the proposed changes.

(E) Submittal Requirements

Provide written certification to the Department that all Contractor-furnished material is in accordance with the contract. When requested by the Department, provide additional certifications from independent testing laboratories and sufficient data to verify item meets applicable specifications. Ensure additional certification states the testing laboratory is independent of the material manufacturer and neither the laboratory nor the manufacturer has a vested interest in the other.

The intent of submittals is to show completely the materials meet the requirements of the Plans and Project Special Provisions and how the Contractor intends to construct or configure the materials. The Contractor shall clearly demonstrate in the submittals that the desired materials shall meet or exceed the requirements of the Plans and Project Special Provisions. Each submittal shall be sufficiently complete and detailed for the Department to review and approve the submittal. If the Department deems the submittal insufficient in detail or completeness for review or approval, the submittal will be returned as rejected. Additional time will not be granted for re-submittal.

Before material submittal data begins, provide to the Department a list of all submittals with approximate dates of submission that the Contractor intends to make. It is incumbent upon the Contractor to schedule reviews in a timely manner that will not delay his schedule.

Certain groups of materials are related in function and operate as a subsystem together. To ensure individual and subsystem compliance with the project requirements materials shall be submitted as packages as follows:

Submittal Package	Description
System Design Report	See "System Design Report" subsection above.
Cabinets	Cabinets, Base Extenders, Cabinet Foundations
Fiber-optic Cable	Fiber-optic Cable, Drop Cables, Splice Enclosures, Interconnect Centers, Rack-mounted Splice Housing and Connector Housings, Splice Trays, Delineator Markers, Underground Cable Markers
CCTV Equipment*	Composite Video Cable, CCTV camera, CCTV cabinet
Video Equipment*	Encoders, frame grabbers
Communications Equipment*	Ethernet Edge Switches, Managed Ethernet Switch, (see "Communications Hardware" section of these Project Special Provisions for further requirements)
Field Infrastructure	Conduit, Junction Boxes, Electrical Service Equipment (Disconnects, Meter Bases, Combination Panels), Riser Seals, Conduit Sealing Bushings, Stainless Steel Banding Hardware, and Misc. Hardware, Lane Control

Submittal Package	Description
	Signals, signal heads, metal poles with mast arms, metal pole foundations, monotube gantry pole, pedestals (poles) and foundations for overheight detectors and freeze-frame video cameras, open/closed DMS panels,
Weighing Equipment*	Piezoelectric quartz sensors, piezoelectric axle sensors, inductive loops, overheight detectors, WIM electronics, roadside operations controller, and additional computer or server components
Truck Communication Infrastructure*	AVI antennas, AVI readers, ramp sorter signals.

* Indicates submittal packages that cannot be submitted for review until the System Design Report has been submitted and approved.

Identify all proprietary parts in Contractor-furnished material. The Department reserves the right to reject material that uses proprietary components not commercially available off-the-shelf products.

For Contractor-furnished material listed on the QPL, furnish submittals in the format defined by the QPL.

For Contractor-furnished material not on the QPL, furnish three copies of the equipment list including three copies of catalog cuts. Identify proposed material on catalog cuts by a reproducible means (highlighter pen does not transfer to copies). Ensure material lists contain material description, brand name, manufacturer's address and telephone number, stock number, size, identifying trademark or symbol, and other appropriate ratings. For submittals showing a variety of models and parts available from the manufacturer, clearly identify by circles, marking our other means the specific materials for which approval is requested.

Allocate 40 consecutive calendar days for the Department to review and respond to a submittal. Do not deviate from what is approved without approval by the Department. Do not fabricate or order material until receipt of the Department's approval. All submittals will be returned as either "Approved (as submitted)", "Approved as Noted" or "Rejected". The Contractor may proceed with fabrication or ordering for items marked "Approved". If an item is marked "Approved as Noted" without any stipulation for resubmittal, then the Contractor may proceed with fabrication or ordering. For any other notations, the Contractor shall revise the submittal, address comments and resubmit for approval.

40.3. DOCUMENTATION

(A) General

Provide all manuals and plan of record (i.e., "as-built") documentation. All as-built plans and documentation shall be reviewed and accepted by the Engineer prior to final acceptance of the project. All documentation, except as otherwise specifically approved by the Engineer, must meet the following requirements:

1. Provide final as-built plans on 11" x 17" paper along with a PDF of each as-built plan sheet. Provide draft as-built plans for Department review on 22" x 34" paper. No documentation for as-built plans smaller than 11" x 17" will be accepted.
2. Provide any documentation that exceeds the size of 11" x 17" paper in a reproducible format 22" x 34" in size.
3. For electrical schematics and cabinet wiring diagrams not bound into printed manuals, provide paper copies at least 22" x 34" in size.
4. No non-plan documentation smaller than 8.5" x 11" will be accepted.
5. Do not fold or crease reproducibles.

As a minimum, provide the documentation described in the paragraphs below.

(B) Plan of Record Documentation

Provide as-built drawings that depict any changes of components, measurement or layout of the Plans. Show all construction changes, with the final location and depth of conduits, wiring external to the cabinet, locations of splice closures, loop locations, and SMFO cable terminations, etc., in detail in a reproducible format. Submit as-built construction changes within 10 consecutive calendar days after the Observation Period begins. Note and date each change on the drawings. Failure to revise as-built documentation to reflect current work may result in withholding of payments until the as-built documentation is brought current. The submitted as-built documentation may be field-checked by the Engineer at his discretion. If the as-built documentation is found to have an unacceptable number of inaccuracies, the Engineer may withhold payment until the as-built plans are corrected. Include all field installation including the SMFO cable network installed on the drawings.

For underground conduit systems that house communications cable, furnish the Engineer with a plan of record drawing detailing the locations of the conduit system, including junction boxes and their corresponding GPS coordinates. For directionally-drilled underground conduit systems, identify the vertical location (i.e., depth) of the conduits along the run.

Store documentation for all roadside cabinet installations in a manila envelope placed in a weatherproof holder inside the cabinet drawer. Store all documentation furnished with the cabinets, including manuals, electrical schematic diagram, and cabinet wiring diagram inside the envelope in the weatherproof holder.

For CCTV camera assemblies, provide two copies of a parts list(s) that includes serial and model numbers of all Contractor-furnished equipment prior to final acceptance. All equipment and appurtenances shall be identified by name, model number, serial number, technical support, and warranty telephone numbers, and any other pertinent information required to facilitate equipment maintenance.

The Department will provide the Contractor one electronic copy of the Plans for his use in developing the as-built drawings. Modify the original electronic file such that all changes are marked with callout boxes or other method approved by the Engineer. Any other base maps that may be necessary for the Contractor to prepare the as-built drawings in accordance with these Project Special Provisions will be the Contractor's responsibility. Use CADD conventions that are consistent with those used on the original plans.

Within 10 consecutive calendar days after the Observation Period begins, furnish one reproducible copy of the draft as-built plans in hard copy format for review. Provide draft hard copy as-built drawings on 22"x 34" bond plan sheets.

Upon receipt of review comments from the Engineer, correct any errors and make all necessary revisions to the draft as-built plans prior to final acceptance of the project. Submit final as-built plans in electronic and hard copy format. Provide final hard copy as-built drawings on 11"x 17" bond plan sheets. Provide electronic plans in MicroStation (latest release in use by the Department) format. Provide the electronic files on CD or DVD.

(C) Manuals

Provide at least five hard copies along with one electronic copy (on CD or DVD) of the manuals described below:

- Operator's manuals that contain detailed operating instructions for each different type or model of equipment. Ensure that manuals contain instructions for possible modification to equipment.
- Maintenance procedures manuals that contain detailed preventative and corrective maintenance procedures and troubleshooting procedures for each different type of model of equipment.
- Installation, operations, and training manuals for all Contractor-provided software.

The manuals provided above shall be in addition to manuals provided with and stored inside each equipment cabinet.

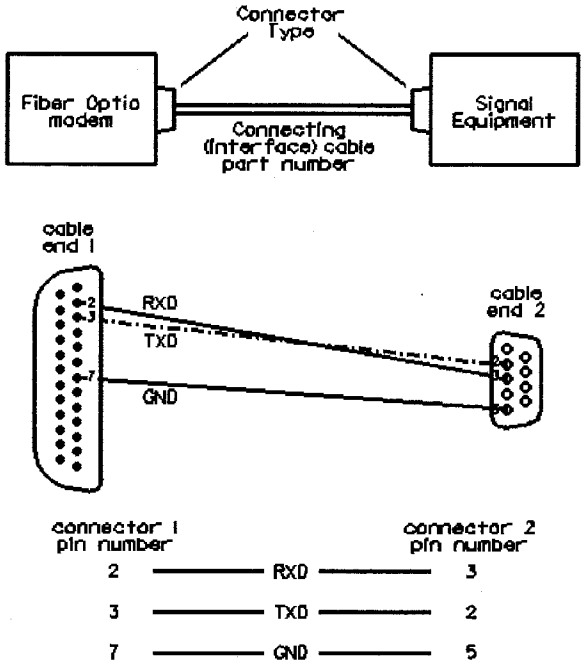
(D) Block Diagrams and Wiring Diagrams

Provide block diagrams with the material submittals for those items listed below.

- Field equipment, including ALPR system, and freeze-frame camera system
- equipment cabinets
- Roadside operations controller
- Piezoelectric quartz sensors
- Other system's boards/assemblies that help in understanding, troubleshooting, and repairing the system and/or system's components.

Provide detailed wiring diagrams that include interconnection (wired and wireless) of equipment with pin-out configurations, pin functions, and cable parts numbers. This includes configuration at each field equipment cabinet and scale house. Provide two copies of system connection diagrams showing system interconnection cables and associated terminations. Use naming convention approved by the Engineer and conforming to Belcore standards. Provide one electronic copy of the wiring diagrams in MicroStation format.

Example:



(E) Splice Diagrams

Prepare as-built splice diagrams that depict the communications cable plant as constructed. Depict the splices made at each splice enclosure by identifying spliced fiber and buffer tube. Ensure the splice diagram is in a similar format to those provided with the project Plans. Identify all expressed fibers, spare fibers, used fibers and capped fibers.

Original splice diagrams will be provided in electronic format in MicroStation format. Designate any changes to these diagrams by using a method approved by the Engineer. Furnish as-built splice diagrams in MicroStation format. Provide the electronic files on CD or DVD.

(F) Software Documentation

(1) Weigh Station Software

Furnish software manuals for the new weigh station CVISN-compatible system. For each screen, the manual shall explain the controls and parameters that are associated with the screen, including the acceptable range of parameter values; any default values that may exist; and a procedure for modifying these ranges and default values. Present these screens and messages in logical sequence.

Submit the software manual to the Department for approval. Provide five hard copy sets and an electronic copy. The manuals required by this Subsection are in addition to any material given to participants in the operator training course. The System Acceptance Test will not begin until the user's manual has been approved by the Department.

(2) Standard Software Packages

For each standard software package incorporated into the system or used to create software for that system, provide the manuals and other documentation that the software package's vendor

normally provides with the product. Deliver standard software packages on CD-ROM. Provide one set of documentation for each computer and server on which the software is installed.

Provide system software user's manuals that cover the proper use of all applications software furnished for all computers and servers. Ensure the user's manuals are written for use by personnel who have no understanding of the operation of a WIM system.

(G) Operating Procedures

Prepare a document that describes the proper operating procedures of the system. In addition to describing how an operator interacts with the system, detail the procedures by which the various WIM systems are powered up and down and the proper sequence for doing so. Describe in the procedures manual the operation of the system from the perspective of the operator sitting at the operator workstation in the scale house. Identify all of the screens and messages, including error messages, which may be seen by the operator. Present the procedures in a logical sequence.

Submit the operating procedures documentation to the Department for approval. Provide five hard copy sets and an electronic copy. The System Acceptance Test will not begin until the operating procedures documentation has been approved by the Department.

(H) 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 two-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 a proprietary part if it is designed and manufactured exclusively for a specific application 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 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.

(I) Use by NCDOT and 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.

40.4. 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.

41. TRAINING

41.1. DESCRIPTION

Provide training for the installation, operation, and maintenance of:

- Managed Ethernet switch,
- Ethernet edge switches,
- Servers,
- Network configuration,
- Fiber-optic communications cable,
    - Fiber-optic interconnect centers,
    - Splice enclosures (aerial and underground)
    - Splice trays and other related fiber-optic equipment in accordance with the Plans and Project Special Provisions,
- CCTV field equipment,
- Digital video equipment,
- CCTV Software,
- Weigh Station hardware and software:
    - Weigh in motion electronics,
    - Roadside computers,
    - Cabinets,
    - Over-height detectors,
    - Piezoelectric quartz sensors,
    - Piezoelectric axle sensors
    - AVI Antenna/reader,
    - Freeze-frame camera,
    - Bending plate scales,
    - Inductive loop detectors,
    - Open/closed signs, and
    - Control software,
- UPS.

41.2. GENERAL

Prepare training outline, agenda, training manuals, training exercises, instructor resumes, and any other teaching aids and submit them for approval by the Department prior to conducting training. For each course, provide a training exercise to demonstrate through hands-on activities the subject matter covered in the course lecture or course section. For exercises requiring computers, furnish enough computers to have one computer per two students.

Provide all laptop computers, projectors, and projector screens needed for the training. Provide all audiovisual equipment needed for presentations and demonstrations, including video players. Furnish all power cords, extension cords, power strips and other cables required for the equipment used in the training.

Provide draft-training material to the Department for review and approval at least 60 days prior to the scheduled training. Provide adequate time for review and revision of the draft training materials. Furnish all audio-visual equipment, demonstration equipment, and "hands-on"

equipment in support of the envisioned training. Each training participant shall receive a copy of course materials including both comprehensive and presentation manuals. Assume there will be a maximum of 15 students in each class session. Provide two additional copies of these documents to the Department.

Utilize training personnel well versed in the subject matter and with extensive field experience dealing with real world problems. Utilize training personnel that have been certified by the respective manufacturers.

The Contractor shall provide the training facility. Provide the Department with a 30-day notification to carry out the training so that arrangements can be made for attendance. Coordinate a mutually agreeable date, time, and location with the Engineer. The Engineer shall approve the training schedule time and location. A "day" of training shall consist of 8 hours of training.

41.3. WEIGH STATION OPERATOR TRAINING

This training course shall train weigh station personnel to use all features and functions of the software and new hardware. Divide the training course into two parts. Conduct each part of the course twice. Provide each part of the course for up to fifteen (15) people. Provide course lengths and content as described below.

Include both classroom instruction and practical experience on the central equipment. Design the first part of the course to provide students with an introduction to the system and the theory of its operation. At a minimum, the first part of the course must include the components of the system, central software operation, and the configuration of the central and field equipment. The second part of the course shall provide each trainee with hand-on experience with the computer and WIM system and the video surveillance system. The course shall cover the operation of all software provided in this project. The course shall also cover the proper operating techniques and user maintenance procedures for each piece of equipment, including modification and/or fine-tuning of the system thresholds. Particular attention shall be paid to precautions that should be observed in operating or handling the equipment or materials.

41.4. TECHNICIAN TRAINING

Design the technician training courses to train technician-level personnel in the maintenance of Contractor-installed equipment. Extend the courses from the basic equipment operating theory to the detection and identification of malfunctions in the equipment through use of diagnostic programs and the Contractor-supplied test equipment. Include field level troubleshooting, as well as bench repair. Also, include the proper use of all test and maintenance equipment supplied in this Contract.

Provide each course for up to 15 people.

- The training shall cover all Department serviceable equipment with a separate course on each of the following categories of equipment:
- Sensors including the piezoelectric quartz sensors, piezoelectric axle sensors, bending plate scales, and over-height sensors. Provide course lengths and content as described below.
- Communication system, including fiber-optic cable and transceivers, Ethernet equipment, AVI equipment, and ramp sorting equipment. The emphasis shall be on troubleshooting. Provide course lengths and content as described below.

- CCTV system, including camera and housing maintenance, communication equipment, surge suppression, and the central equipment. Provide course lengths and content as described below.
- Threshold modification and fine tuning. Provide course lengths and content as described below.

Each training course shall consist of a presentation of the functional operation and programming of the equipment, followed by a "hands-on" workshop. A second presentation shall cover routine maintenance and troubleshooting procedures. This shall be followed by a "hands-on" workshop wherein personnel troubleshoot simulated faults to the component level. Finally, the trainees will be taken to the weigh station and given a tour, in which every cabinet (indoor and outdoor) will be opened and every component identified.

41.5. MATERIALS

Provide course lengths as follows:

Course	Type of Training	Total Students	No. of Sessions	Length (Hours)
Ethernet Communications and Networking*	Lecture and Hands-on Exercises	15	1	4
Fiber-Optic Communications	Lecture and Hands-on Exercises	15	1	4
CCTV Field Equipment*	Lecture and Hands-on Exercises	15	1	2
Digital Video Equipment*	Lecture and Hands-on Exercises	15	1	2
CCTV Central Software	Lecture and Hands-on Exercises	15	1	2
WIM Hardware*	Lecture and Hands-on Exercises	15	1	4
WIM Control Software*	Lecture and Hands-on Exercises	15	1	8
WIM Control Software*	Lecture and Hands-on Exercises	15	1	8

* Do not conduct any training on this topic until the System Design Report has been submitted for review and subsequently approved by the Department.

Provide specific training as described below.

(A) Ethernet Communications and Networking

Provide training using the test and repair equipment furnished for the project. The training session shall be presented by field service specialist(s) employed by the suppliers of the communications system components. Provide training for the Ethernet communications and networking for the following categories and for the minimum number of hours shown:

Course	Type of Training	Length (Hours)
Ethernet Communications and Networks		2
Terminology	Lecture	
Theory of design	Lecture	
Network configuration	Lecture	
VLANs	Lecture	
Equipment overview	Lecture	
Network maintenance	Lecture, Demonstration and Hands-on	
System backup, data archiving, routine procedures	Hands-on	
Troubleshooting procedures	Hands-on	
Testing	Hands-on	
System restart and recovery	Hands-on	
Question and answer session	Lecture	
Ethernet Switches (all types and configurations)		1
Introduction	Lecture	
Configuration and programming	Lecture and Hands-on	
Review of Maintenance Manual	Lecture and Hands-on	
Review of Operations Manual	Lecture and Hands-on	
Maintenance	Lecture, Demonstration and Hands-on	
Routine	Hands-on	
Troubleshooting procedures	Hands-on	
Testing	Hands-on	
System restart and recovery	Hands-on	
Question and answer session	Lecture	
Network Management Software		1
Introduction	Lecture	
Network Configuration (changes in network only)	Lecture and Hands-on	
Question and answer session.	Lecture	

(B) Fiber-Optic Cable

Provide training using the test and repair equipment furnished for the project. Provide training for the fiber-optic system for the following categories and for the minimum number of hours shown:

Course	Type of Training	Length (Hours)
Ethernet Switches – Optics		1.5
Safety	Lecture	
Introduction to Ethernet switch optics	Lecture	
Review of Maintenance Manual – optics	Lecture	
Review of Operations Manual - optics	Lecture	
Question and answer session	Lecture	
Fiber-Optic Cable System		2.5
Safety	Lecture	
Introduction to fiber-optics, theory, and principles	Lecture	
Fiber and cable types	Lecture and Hands-on	
National Electrical Code considerations	Lecture and Hands-on	
Plenum and riser type cable		
Outdoor cable, etc.		
Introduction to terminating hardware, end equipment, and applications	Lecture, Demonstration and Hands-on	
Connectors (ST, SC, LC, etc.)		
Splice enclosure, splice trays, and connector panels		
Cable placement techniques		
Question and answer session		
Cable handling and preparation (sheath removal, grip installation, etc.)	Lecture, Demonstration and Hands-on	
Splicing and terminating methods	Lecture, Demonstration and Hands-on	
Mechanical splicing using various techniques		
Fusion splicing		
Field termination of connector types		
Introduction to cable plant testing procedures	Lecture, Demonstration and Hands-on	
Proper usage of optical light generator and power meter		
Class project (build working system using cables/connectors made by attendees)	Lecture, Demonstration and Hands-on	
Question and answer session.		
Class project -- Testing and troubleshooting	Lecture, Demonstration and Hands-on	
Cable system maintenance and restoration	Lecture	

Course	Type of Training	Length (Hours)
Question and answer session.		

(C) CCTV Field Equipment

Provide CCTV field equipment training if the equipment supplied is not the exact same equipment as the City currently has. Provide training that includes operational theory and procedures of the field components of the CCTV system. This training shall be oriented towards the users and maintenance personnel of the system. The training session shall be presented by field service specialist(s) employed by the suppliers of the CCTV field components. This training session shall include exercises that should take one-half of the day. Provide training for the CCTV field equipment and the local CCTV camera software as described below:

Course	Type of Training	Length (Hours)
Operations	Lecture	1
Theory of operation	Lecture, Demonstration	
Local camera programming	Lecture, Demonstration and Hands-on	
Camera addresses		
Privacy zones		
Other features		
Maintenance	Lecture	1
Routine maintenance	Lecture, Demonstration and Hands-on	
Testing	Lecture, Demonstration and Hands-on	
Troubleshooting	Lecture, Demonstration and Hands-on	

(D) Digital Video Equipment

Provide digital video equipment training if the equipment supplies is not the exact same equipment as the City currently has. Provide training that includes operational theory and procedures of the central components of the CCTV system. This training shall be oriented towards users and maintenance personnel of the system. This training session shall include hands-on exercises that should take approximately one-half of the session. The training shall address the use of, but not limited to, the following devices: encoders, monitors, and the video server. Provide training for the digital video equipment as described below:

Course	Type of Training	Length (Hours)
Operations and theory of operations	Lecture	1
Programming	Lecture, Demonstration and Hands-on	1
Maintenance	Lecture	
Routine maintenance	Lecture, Demonstration and Hands-on	

Course	Type of Training	Length (Hours)
Testing	Lecture, Demonstration and Hands-on	
Troubleshooting	Lecture, Demonstration and Hands-on	

(E) CCTV Software

Provide CCTV central software training that includes operational theory and procedures of the central CCTV software. This training shall be oriented towards maintenance personnel of the system. This training session shall include hands-on exercises that should take one-half of the total session. Provide training for the CCTV central software as described below:

Course	Type of Training	Length (Hours)
Programming	Lecture, Demonstration and Hands-on	2
Database updates		
Adding and deleting devices		
Tours		
Macros		
Data backups		
Operator and access rights		
Alarms		
Operations	Lecture	
Theory of operation	Lecture, Demonstration	
Testing	Lecture, Demonstration and Hands-on	
Maintenance	Lecture	
Routine maintenance	Lecture, Demonstration and Hands-on	
Troubleshooting	Lecture, Demonstration and Hands-on	

(F) WIM Hardware

Provide three identical training sessions in the basic theory, operation, routine maintenance and troubleshooting of the over-height detectors, piezoelectric quartz sensors, piezoelectric axle sensors, AVI antenna/reader, ALPR, bending plate scales, inductive loop detectors, open/closed signs and other related equipment. Assume the attendees have no working knowledge of WIM equipment.

Provide training, both lecture (i.e., classroom instruction) and hands-on exercise in the use of the hardware. Provide one computer for every two students for the hands-on exercises.

The WIM hardware session shall include, but not be limited to, the following:

The lecture, demonstration, and hands-on class shall include the following sessions:

Course	Type of Training	Length (Hours)
Theory of operation	Lecture, Demonstration and Hands-on	2
Installation		
Calibration		
Testing,		
Operations	Lecture	2
Maintenance	Lecture	2
Routine maintenance	Lecture, Demonstration and Hands-on	
Troubleshooting	Lecture, Demonstration and Hands-on	

(G) WIM Control Software

Provide WIM control software training that includes operational theory and procedures of the central WIM control software. This training shall be oriented towards maintenance personnel of the system. This training session shall include hands-on exercises that should take one-half of the total session. Provide training for the WIM control software as described below:

Course	Type of Training	Length (Hours)
Programming	Lecture, Demonstration and Hands-on	8
Database updates		
Data backups		
Operator and access rights		
Alarms		
Operations	Lecture	
Theory of operation	Lecture, Demonstration	
Testing	Lecture, Demonstration and Hands-on	
Maintenance	Lecture	
Routine maintenance	Lecture, Demonstration and Hands-on	
Troubleshooting	Lecture, Demonstration and Hands-on	

41.6. MEASUREMENT AND PAYMENT

Training will be measured and paid for at the contract lump sum price for the work detailed in this section. No measurement will be made of instructors, materials, 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

42. TESTING AND ACCEPTANCE

42.1. GENERAL

Conduct and complete successfully the following progressive series of tests before acceptance: field demonstration test prior to installation, installed standalone tests, system test of the network hardware, network management software and an operational test. Develop a comprehensive series of test plans for each device to determine the equipment was correctly installed and meets the requirements of materials, workmanship, performance, and functionality required in the plans and project special provisions. The test plans shall describe the functions to be tested, purpose of test, setup requirements, procedures to be followed, any inputs and expected outputs for each test, criteria for pass/fail and any required tools or test equipment. Any software testers shall be pre-approved by the Department.

Develop as part of the Test Plan a Traceability Matrix of all the individual subsystem functional requirements to be used to cross-reference each planned test to a specific contract requirement to be verified. This Test Evaluation/Traceability Matrix shall be used by the Engineer to crosscheck the functional requirements and the results.

A key element of test plans, where appropriate, is the introduction of forced errors into the functional test. The test plan shall check the actual result of the forced error against the anticipated result. Tests will be performed by the Contractor and witnessed by the Department. No deviation from the written test procedure shall be permitted without approval from the Engineer. Any changes to the approved test procedure to accommodate unforeseen events during the time of testing shall be documented in a copy of the master test procedure. Immediately following the conclusion of each test, the Department and the Contractor shall meet to agree on the results observed and recorded during the testing. This will form the basis for the conclusions reported in the test plan. All test results, notes, and observations shall be maintained in both electronic and hard copy. Maintain complete records of all test results during all stages of testing.

Test all equipment, cable, and software furnished and installed under this Contract and 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 specified in the Project Special Provisions and Plans.

42.2. PREINSTALLATION TEST

The Contractor must conduct a test of the new equipment and software at a location near the project area in the presence of the Department. Demonstrate that all the equipment and software are working together in full compliance with the Project Special Provisions.

During the test, interconnect all the electronics and some of the sensors just as they will be interconnected at the Screening System, except that all the devices will be in the same room. Load all microprocessors with all of the software and configuration parameters that will be integrated at the Screening System.

At a minimum, test the following items:

- Roadside operations controllers and cabinets
- WIM server and workstations
- WIM electronics

- ALPR system with infrared illumination
- AVI reader system
- Freeze-frame camera equipment, including frame grabber
- CCTV cameras
- Overheight vehicle detectors
- Piezoelectric quartz sensors
- Piezoelectic axle sensors
- Inductive loops
- Lane control signals

42.3. INSTALLED SITE TESTS

Conduct an approved, standalone equipment installation test at the field site. Test all standalone functions of the field equipment using equipment installed as detailed in the plans, or as directed by the Engineer.

Complete approved test plan forms and turn them over to the Engineer for review as a basis for rejection or acceptance. Provide a minimum notice of 30 calendar days prior to all tests to permit the Engineer or his representative to observe each test.

If any unit fails to pass its stand-alone test, correct the unit or substitute another unit in its place, then repeat the test.

If a unit has been modified as a result of a standalone test failure, prepare a report describing the nature of the failure and the corrective action taken and deliver it to the Engineer prior to re-testing the unit. If a failure pattern develops, the Engineer may direct that design and construction modifications be made to all units without additional cost to the Department or an extension of the contract period.

Utilize vendor supplied device software to perform diagnostic tests of each device. The vendor supplied diagnostic software shall be provided to the Department before final acceptance. Test the following features of each competent as described below.

(A) Fiber-Optic Cable

Conduct optical time domain reflectometer (OTDR) tests on the cable on the reel and after the cable is installed and terminated. Provide written notification a minimum of ten days before beginning fiber-optic cable testing.

After splicing is completed, perform bi-directional OTDR tests on each fiber, including unused fibers, to ensure the following:

- Fusion splice loss does not exceed 0.05 dB,
- Terminations and connections have a loss of 0.5 dB or less, and
- Reflection loss is 40 dB or greater for each connector.

Install a 1000-foot pre-tested launch cable between the OTDR and fiber-optic cable to be tested.

If exceeded, remake splices until the loss falls below 0.05 dB. The Engineer will record each attempt for purposes of acceptance.

Test the fiber-optic cable at both 1310 and 1550 nm.

Furnish durable labeled plots and electronic copies on a CD or DVD of test results for each fiber including engineering calculations demonstrating that OTDR test results meet or exceed the attenuation requirements and that optical properties of the cable have not been impaired. Clearly label each OTDR trace identifying a starting and ending point for all fibers being tested.

Provide engineering calculations and tests for fiber-optic cable that demonstrate the loss budget where the fiber originates and where the fiber meets an electronic device. The calculations shall summarize the optical losses versus the allowable losses for the communications equipment between each pair of communications hardware. Provide a summary section or spreadsheet with a labeled tabular summary showing each test segment with begin and end points and actual versus allowable losses. Label the manufacturer's make, model number, and software version of the OTDR used for testing.

Furnish one hard copy of each of the OTDR trace results and electronic copies of all trace results on a CD or DVD.

If any fiber exceeds the maximum allowable attenuation or if the fiber-optic properties of the cable have been impaired, take approved corrective action including replacement of complete segments of fiber-optic cable if required. Corrective action will be at no additional cost to the Department.

(B) Ethernet Communications System

Test any cable installed as part of this project per TIA 568 specifications for continuity, opens, shorts, split pairs, miss-wiring and reversed pairs. Test for DC resistance, impedance, and line capacitive loading. Correct any faults and retest. If retest fails, replace defective cable or connectors.

Once the Ethernet edge switches have been installed, conduct local field acceptance tests of the Ethernet edge switch field site according to the submitted test plan. Perform the following:

- Verify that physical construction has been completed as detailed in the Plans,
- Inspect the quality and tightness of ground and surge protector connections,
- Verify proper voltages for all power supplies and related power circuits,
- Connect devices to the power sources,
- Verify all connections, including correct installation of communication and power cables, and
- Perform testing on multicast routing functionality.

Repair or replace defective or failed equipment and retest.

Upon satisfactory completion of operational test, begin an Observation Period of 60 days prior to system acceptance.

(C) CCTV Field Equipment

Develop an operational test plan that demonstrates all requirements of the equipment and software. Submit for approval before conducting tests.

Notify the Department at least 14 calendar days prior to the proposed date for the tests. The Department shall have the right to witness such tests, or to designate an individual or entity to witness such tests.

Perform the following local field operational tests at the camera assembly field site in accordance with the test Plans. A laptop computer shall provide camera control and positioning. After completing the installation of the camera assembly, including the camera hardware, power supply, and connecting cables, the Contractor shall:

- Furnish all equipment, appliances, and labor necessary to test the installed cable and to perform the following tests before any connections are made,
- Verify that physical construction has been completed,
- Inspect the quality and tightness of ground and surge protector connections,
- Check the power supply voltages and outputs,
- Connect devices to the power sources,
- Perform continuity tests on the surveillance camera's stranded conductor element using a meter having a minimum input resistance of 20,000 ohms per volt and show that each conductor has a resistance of not more than 16 ohms per 984.3 feet of conductor;
- Measure the insulation resistance between the conductors, and between each conductor, ground, and shield using a megger. The resistance must be infinity. Perform all resistance testing after final termination and cable installation, but prior to the connection of any electronics or field devices; and
- Replace any cable that fails to meet these parameters, or if any testing reveals defects in the cable, and retest new cable as specified; and
- Verify installation of specified cables and connections between the camera, PTZ, camera control receiver, and cabinet,
- Perform the CCTV assembly manufacturer's initial power-on test in accordance with the manufacturer's recommendation,
- Set the camera control address,
- Verify the presence and quality of the video image in the field cabinet with a portable NTSC-approved monitor or laptop computer
- Exercise the pan, tilt, zoom, focus, iris opening, and manual iris control selections, and the operation, preset positioning, and power on/off functions,
- Demonstrate the pan and tilt speeds and extent of movement to meet all applicable standards, specifications, and requirements,
- Verify proper voltage of all power supplies, and
- Interconnect the communication interface device with the communication network's assigned fiber-optic trunk cable and verify that there is a transmission LED illuminated.

Test the grounding system per ANSI/IEEE C62.41 and ANSI/IEEE C62.45 as applicable. Measure the ground impedance utilizing an instrument designed specifically to measure and document the ground impedance. Provide written test results of the ground impedance for each location to the engineer prior to backfilling the grounding electrode. The test results shall include the instrument model, date of instrument calibration, and local environmental conditions at the time of testing. Certify and sign the test results by the Contractor.

Repair or replace defective or failed equipment and retest.

(D) Digital Video Equipment

Test the components of the digital video equipment as follows:

- Check all ground, power, data, Ethernet and digital video connections,
- Run power up self test on each piece of equipment,
- Run all available vendor-supplied self-diagnostics.

(E) Weighing Subsystem Equipment

Test the components of the vehicle weighing subsystem as follows:

- Run power up self-test on each piece of equipment.
- Run all available vendor-supplied self-diagnostics.
- Calibrate and test the piezoelectric quartz sensors in accordance with "Piezoelectric Quartz Sensors" section of these Project Special Provisions.
- Calibrate and test the piezoelectric quartz sensors in accordance with "Piezoelectric Quartz Sensors" section of these Project Special Provisions.
- Test the ability for the system to read transponders, convert and lookup transponders for valid CVISN credentials.
- Test the ability for the entire weighing system including static and weigh-in motion to track commercial vehicles and identify violators who attempt to bypass scales.

Develop an operational test plan that demonstrates all requirements of the equipment and software. Submit for approval before conducting tests.

Notify the Department at least 14 calendar days prior to the proposed date for the tests. The Department shall have the right to witness such tests, or to designate an individual or entity to witness such tests.

42.4. SYSTEM TESTING

(A) General

Conduct tests as described below of the WIM, ramp sorting, and CCTV subsystems. Conduct approved device subsystem tests on the field equipment with the scale house equipment including, at a minimum, all remote communications hardware monitoring and control functions. These tests shall be a demonstration of overall system stability. During this test period, limit downtime due to mechanical, electrical, or other malfunctions to a maximum of eight hours. The Engineer has the right to suspend the test to correct deficiencies and restart the test or to extend the test period by time equal to the downtime in excess of eight hours.

Conduct device and subsystem tests of any repaired or replaced equipment.

Display the event log from the WIM, ramp sorting, and CCTV software for a minimum of seven days. Complete approved data forms and turn them over to the Engineer for review, and as a basis for rejection or acceptance.

The Engineer has the right to suspend the test to correct deficiencies and restart the test or to extend the test period by time equal to the downtime in excess of eight hours. If a component has been modified as a result of a test failure, prepare a report and deliver it to the Engineer prior to retesting.

(B) CCTV Subsystem

After completing the integration of the CCTV cameras into the CCTV subsystem software, conduct a minimum of a seven-day test of the CCTV subsystem hardware and software. This will include that portion of the communications network serving the CCTV subsystem. The

Engineer has the right to suspend the test to correct deficiencies and restart the test or to extend the test period by time equal to the downtime in excess of eight hours. If during that time it is determined by the Department there are hardware or software failures that are the responsibility of the Contractor, the Contractor shall make repairs or replacements to the satisfaction of the Department.

Test the following features of each competent as described below.

(1) CCTV Field Equipment

The following items, not otherwise required to be tested elsewhere, shall be tested for each CCTV site from the scale house:

- Power-up self-tests,
- Iris control,
- Preset functions,
- Presence and quality of the video image,
- Preset positioning, and power on/off functions,
- Camera and controller access and security from all laptops and workstations,
- Disconnect camera and take local control and reconnect camera at local cabinet to the communications and verify scale house control is regained,
- Confirm ability to change camera ID,
- Verify unique camera identifier and icons on GUI,
- Viewing of camera image on each monitor.

(2) Digital Video Equipment

Verify that all CCTV images can be displayed correctly on each monitor using the CCTV central software.

(3) CCTV Central Software

Thoroughly test all functions of the software from the scale house to ensure correct operation. Test the components of the CCTV central equipment from scale house as follows:

- Use the GUI interface to select and view each camera,
- Use and the GUI interface to test the ability to control the pan-tilt-zoom and iris settings of each camera,
- Use the GUI interface and test the ability to select and place any camera on any monitor,
- Use the image capture software to test the ability to capture video images.

(C) Weighing Subsystem

After completing the integration of the vehicle Weigh-In-Motion (WIM) subsystem and static weighing system into the Roadside operations controller (ROC) system, conduct a minimum of a seven-day test of the WIM subsystem hardware and software. This will include that portion of the communications network serving the WIM subsystem. The Engineer has the right to suspend the test to correct deficiencies and restart the test or to extend the test period by time equal to the downtime in excess of eight hours. If during that time it is determined by the Department there are hardware or software failures that are the responsibility of the Contractor, the Contractor shall make repairs or replacements to the satisfaction of the Department.

Test the following features of each component as described below.

(1) Piezoelectric Axle WIM

The following items, not otherwise required to be tested elsewhere, shall be tested for each piezoelectric axle WIM scale from the scale house:

- Provide notification in the scale house of a truck crossing over the piezoelectric axle WIM scale,

(2) Piezoelectric Quartz WIM

The following items, not otherwise required to be tested elsewhere, shall be tested for each piezoelectric quartz WIM scale from the scale house:

- Provide notification in the scale house of a truck crossing over the piezoelectric quartz WIM scales,
- Piezoelectric quartz WIM scales send measured weight information to the AVI system,

(3) Ramp Sorting Subsystem

After completion of the integration of the ramp sorting subsystem into the ROC system, conduct a minimum of a seven-day test of the ramp sorting subsystem hardware and software. This will include that portion of the communications network serving the ramp sorting subsystem. The Engineer has the right to suspend the test to correct deficiencies and restart the test or to extend the test period by time equal to the downtime in excess of eight hours. If during that time it is determined by the Department that there are failures that are the responsibility of the Contractor, the Contractor shall make repairs or replacements to the satisfaction of the Department.

Test the following features of each component as described below.

(4) Lane Control Signal Upstream Location

The following items, not otherwise required to be tested elsewhere, shall be tested for the Lane Control Signal One from the scale house:

- Power-up self-tests,
- Automatic sorting of trucks to the static scales ramp or to the bypass ramp.

(5) Lane Control Signal Downstream Location

The following items, not otherwise required to be tested elsewhere, shall be tested for the Lane Control Signal Two from the scale house:

- Power-up self-tests,
- Manual sorting of trucks to the inboard or outboard static scales.

42.5. OBSERVATION PERIOD

After all equipment and software comprising the system has been accepted, satisfactory completion of the system acceptance test, and after the training is complete, a 60-day observation period begins. This observation period shall serve to evaluate full operation of the system under normal conditions. The Department will be responsible for operating the system during this period. The goal of the observation period is to demonstrate that the system has been properly installed and integrated, performs properly, and complies with the Contract Documents.

The following conditions apply to the observation period:

- During the entire observation period, the system shall monitor all the vehicle detectors and sensors (both mainline and ramp devices), WIM scales, ramp sorting system and CCTV cameras, static weighing system, and perform all the functions described in these Project Special Provisions,
- If any hardware item provided under this Contract fails (with the exception of expendable items such as printer cartridges), repair the item at the Contractor's expense, and then the observation period for the failed item begins again for the full 60-day duration,
- During the observation period, have personnel responding to the problem within two (2) hours after being notified of a problem by the Department. Within one day, have personnel on-site, with replacement equipment, addressing problems encountered with the central computers, operator workstations, field devices, and communications network at the earliest possible time,
- If any other problem is discovered, such as intermittent communication or erroneous computations, the observation period will be suspended until the Contractor fixes 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 entire 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 communication system, which causes the system to cease normal operation. If total system "down time" exceeds 30 hours, a full duration of the observation period shall begin again, and
- 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 all failed hardware items.

Upon successful completion of the observation period, the Department will accept the system, providing that all errors and omissions in Contractor-supplied documentation have been fixed and all other requirements of the Contract Documents have been met. Final acceptance will be in writing from the Department.

42.6. 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.

42.7. FINAL ACCEPTANCE

Final system acceptance is defined as the time when all work and materials described in the Plans and these Project Special Provisions have been furnished and completely installed by the Contractor; all parts of the work have been approved and accepted by the Engineer; and the WIM, ramp sorting, and CCTV subsystems have been operated continuously and successfully for the 60-day Observation Period.

- Final acceptance shall not occur until:
- All field demonstration, installed site, system, and operational tests have been satisfactorily completed;
- All punch-list discrepancies have been rectified;
- All documentation has been delivered and accepted; and
- All required training has been completed.

43. SYSTEM WARRANTY

43.1. DESCRIPTION

(A) General

Unconditionally warrant the performance of all systems and subsystems installed under this contract, including all equipment, hardware, and software for a period of one (1) year from the successful completion of the 60-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. Consider this warranty period to be part of the work required to be completed by the final completion date of the project.

(1) Period of Performance

The period of performance for the Warranty shall be one (1) year from the successful completion of the 60-day observation period.

The warranty coverage will be renewable on an annual basis for an additional three (3) years by mutual consent of both parties at the lump sum bid price for "System Warranty". This will be considered the annual payment. The additional three (3) year warranty payment will not be a part of this contract.

(2) 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 repair (if needed) at the six (6) month interval. Preventative maintenance shall be completed in accordance with 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:
- Test signal level and lead-in cable of piezoelectric quartz sensors and loops. Repair or replace as required.
- Verify all loop and sensor performance and reliability. Adjust calibration on devices to meet the specifications defined herein for each device. Repair or replace equipment as required to meet specifications.
- 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.
- Check the calibration of and clean (if needed) the transponder antenna.
- Clean the interior and exterior of WIM electronics, power supplies, roadside operations controllers, and communications equipment in the equipment cabinet. Repair or replace as required.

- Check condition of all WIM cables and connectors, terminal strips, and back-up batteries. Repair or replace as required.
- Perform visual inspection of the equipment cabinet. Repair or replace 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 ALPR system. Adjust, repair, or replace as required.
- Calibrate the piezoelectric quartz sensors at the six (6) month interval or according to manufacturer's recommendations. Ensure the calibration includes verifying system and interface operations. Vehicles to be used for calibrating the sensors will be provided by the Department.
- 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 days to repair equipment and return system functionality. 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 form that facilitates sorting the records by time period and/or device type. Submit a proposed format for this database for the Department's approval. Include, as a minimum:
    - 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 request
    - 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 screening 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 will not be used as a basis of payments to the Contractor. 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 Contractor (at no additional cost to the Department), if any operation fails or any system degradation is encountered as a result of a software upgrade.

(B) Warranty Evaluation

One (1) month prior to the end of the warranty period, the Department will inspect the system thoroughly for potential system defects. 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 Contractor 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 Contractor. Document all repairs or replacements completed, providing the documentation to the Department prior to the end of the warranty period. .

(C) 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 Contractor.

(D) Traffic Control

Provide traffic control for all maintenance activities requiring lane closures. Traffic control activities shall be in accordance with NCDOT standards. When lane closures are required for preventative maintenance, document the proposed traffic control plan and coordinate lane closure activities with the Department thirty (30) days prior to the preventative maintenance activities. When lane closures are required for emergency maintenance, coordinate lane closure activities with the Department as soon as practicable.

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

43.3. CONSTRUCTION METHODS

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

43.4. MEASUREMENT AND PAYMENT

System Warranty will be measured and paid for at the contract lump sum price for system warranty.

No measurement will be made for providing labor, parts, materials, shipping, vehicles, tools, test equipment, traffic control, 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