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

PROPOSAL

INCLUDES ADDENDUM No.4 DATED 07-12-2019

DATE AND TIME OF BID OPENING: **JULY 16, 2019 AT 2:00 PM**

CONTRACT ID	C204266
WBS	36030.3.GV4

FEDERAL-AID NO.	NHPP-026-1(199)6
COUNTY	BUNCOMBE, HENDERSON
T.I.P. NO.	I-4700
MILES	7.490
ROUTE NO.	I 26
LOCATION	I-26 FROM NC-280 (EXIT 40) TO I-40.

TYPE OF WORK GRADING, DRAINAGE, PAVING, SIGNALS, AND STRUCTURES.

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 ROADWAY & STRUCTURE PROPOSAL

5% BID BOND OR BID DEPOSIT REQUIRED

PROPOSAL FOR THE CONSTRUCTION OF

CONTRACT No. C204266 IN BUNCOMBE AND HENDERSON COUNTIES, 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. **C204266** 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 2018 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. **C204266** in **Buncombe and Henderson Counties**, 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 2018* 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

DocuSigned by:
Ronald E. Davenport, Jr.
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PROJECT SPECIAL PROVISIONS

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 **August 26, 2019**, 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 **April 29, 2024**.

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, BONUS CLAUSE 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*, 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 **August 26, 2019**.

The completion date for this intermediate contract time is **November 1, 2023**.

The Department desires that this intermediate contract work be completed by this date and that the Contractor pursue the work with such labor, equipment and materials as necessary to ensure that the intermediate date will be met without regard to time extensions and time reliefs provided for in the Specifications. Therefore, as full compensation for all extra costs involved, the Department agrees to pay as a bonus, the sum of **Two Million Dollars ($ 2,000,000.00)** to the Contractor for satisfactorily completing this intermediate contract work on or prior to **November 1, 2023.** Should the Contractor fail to complete this intermediate contract work by this date, then normal time extension and time reliefs provided in the Specifications will apply and no bonus will be allowed.

The liquidated damages for this intermediate contract time are **Five Thousand Dollars ($ 5,000.00)** 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*. 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-26 (including associated Ramps), NC-280 (Airport Road), Blue Ridge Parkway and NC-146 (Long Shoals Road)** during the following time restrictions:

DAY AND TIME RESTRICTIONS
Monday thru Friday
6:00 AM to 9:00 PM

Saturday and Sunday
9:00 AM to 9:00 PM

In addition, the Contractor shall not close or narrow a lane of traffic on **I-26 (including associated Ramps), NC-280 (Airport Road), Blue Ridge Parkway and NC-146 (Long Shoals Road)**, 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 **Christmas and New Year's Day**, between the hours of **6:00 AM** December 18th and **9:00 PM** the third weekday following New Year's Day.
3. For **Easter**, between the hours of **6:00 AM** Thursday and **9:00 PM** Monday.
4. For **Memorial Day**, between the hours of **6:00 AM** Friday and **9:00 PM** Tuesday.
5. For **Independence Day**, between the hours of **6:00 AM** the day before Independence Day and **9:00 PM** the day after Independence Day.

   If **Independence Day** is on a Friday, Saturday, Sunday or Monday, then between the hours of **6:00 AM** the Thursday before Independence Day and **9:00 PM** the Tuesday after Independence Day.
6. For **Labor Day**, between the hours of **6:00 AM** Thursday and **9:00 PM** Tuesday.
7. For **Thanksgiving**, between the hours of **6:00 AM** the Friday before Thanksgiving and **9:00 PM** the Monday following Thanksgiving.
8. For the **Christmas Retail Season (any Thursday thru Sunday)**, between the hours of **9:00 PM** the Thursday following Thanksgiving until **6:00 AM** December 18th.
9. For the **North Carolina Mountain State Fair** (typically held for 10 days starting the Friday after Labor Day), between the hours of **6:00 AM** the Friday following Labor Day and **9:00 PM** the following Monday after the Fair concludes.

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 3 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 **Glen Bridge Road** during the following time restrictions:

DAY AND TIME RESTRICTIONS
Monday thru Sunday
5:00 AM to 11:00 PM

The maximum allowable time for **Bridge Girder Removal and/or Bridge Girder Installation** is **thirty (30)** minutes for **Glen Bridge Road**. 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 time of availability for this intermediate contract time will be the time the Contractor begins to install traffic control devices required for 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 **One Thousand Dollars ($ 1,000.00)** per hour.

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-26 (including associated Ramps), NC-280 (Airport Road), Blue Ridge Parkway and NC-146 (Long Shoals Road)** during the following time restrictions:

DAY AND TIME RESTRICTIONS
Monday thru Sunday
5:00 AM to 11:00 PM

The maximum allowable time for **overhead sign structure installation** is **thirty (30)** minutes for **I-26 (including associated Ramps), NC-280 (Airport Road), Blue Ridge Parkway and NC-146 (Long Shoals Road)**. 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 **Five Thousand Dollars ($ 5,000.00)** per fifteen **(15)** minute time period.

INTERMEDIATE CONTRACT TIME NUMBER 5 AND LIQUIDATED DAMAGES:

The Contractor shall complete the work required of **the Snow and Ice Removal Special Provision included in this Contract. All equipment, including any specified appurtenances (plows, spreaders, etc.) shall be rigged, fitted and ready for operation (loading, plowing, etc.) and delivered to the pre-designated Department of Transportation Facilities**.

The time of availability for this intermediate contract time **for each piece of equipment** is the time that the Contractor **is notified by a designated Department staff member that each individual piece of equipment with operator is required. The Contractor will be notified a minimum of three (3) hours before the piece of equipment with operator is needed** to begin work.

The completion time for this intermediate contract time is the time **that each piece of equipment is no longer required, as determined by a designated Department staff member**.

The liquidated damages **for failure to satisfactorily furnish equipment and operators as specified** are **Two Hundred Dollars ($ 200.00)** per hour **per piece of equipment**.

PROSECUTION OF WORK FOR PERMIT REQUIREMENTS:
(7-24-13)

The Contractors attention is directed to the fact that there are specific Permit requirements that the require work to proceed in a continuous and uninterrupted manner from the time work begins until completion of each phase of structure construction, structure demolition, and completion of the structures. At the Preconstruction conference, the contractor shall submit a schedule for approval by the Engineer for the construction, demolition, and completion of these structures, including mile stone dates that will be used to determine if work is being pursued in a continuous manner and with sufficient effort to comply with permit requirements.

The Contractor shall prosecute the work in a continuous and uninterrupted manner from the time he begins the work until completion of each phase of structure construction, demolition and completion. The contractor will not be permitted to suspend his operations except for reasons beyond his control or except where the Engineer has authorized a suspension of the Contractors' operations in writing.

In the event that the Contractor's operations are suspended in violation of the above provisions or it is determined the Contractor is not deemed to be pursuing the work in a continuous manner in accordance with his submitted and approved schedule, the sum of **$1,000.00** will be charged the Contractor for each and every calendar day that such suspensions take place. The said amount is hereby agreed upon as liquidated damages due to extra engineering and maintenance costs and due

to increased public hazard, and violation of contract permit requirements. Liquidated damages chargeable due to suspension of the work will be additional to any liquidated damages that may become chargeable due to failure to complete the work on time.

AWARD OF CONTRACT:

Revise the 2018 *Standard Specifications* as follows:

Page 1-23, Subarticle 103-4 (A) General, first paragraph, replace the 3rd and 4th sentences with the following:

Where award is to be made, the notice of award will be issued within 60 days after the opening of bids or upon issuance of any necessary debt instrument, whichever is later, but not to exceed 120 days; except with the consent of the lowest responsible bidder the decision to award the contract to such bidder may be delayed for as long a time as may be agreed upon by the Department and such bidder. In the absence of such agreement, the lowest responsible bidder may withdraw his bid at the expiration of 120 days without penalty if no notice of award has been issued.

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 *2018 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 *2018 Standard Specifications*. No additional compensation will be made for maintenance and removal of temporary erosion control items.

CONSTRUCTION MORATORIUM:

(1-19-16) SP1 G18C

National Park Service land:

No tree cutting will be allowed on National Park Service land from **May 15** through **August 15** of any year.

Blue Ridge Parkway:

Emergence and/or acoustic surveys are required by the Department prior to any tree clearing on the Blue Ridge Parkway that must occur between **April 1** and **May 15** or **August 15** and **November 15** of any year.

NCDOT, NPS, and FHWA-EFL will coordinate to ensure, to the extent possible, that temporary or nighttime closures necessary for construction of the Blue Ridge Parkway realignment and bridge replacement over I-26 will only be permitted from **November 1** until **April 31** and not during summer months. The NPS will provide detour signage to safely guide users of the Mountains-to-Sea Trail out of the construction area and into safe locations.

No significant tree removal on the Blue Ridge Parkway can occur within 5 miles of known bat hibernacula as determined by the Department between April 1 and November 15.

French Broad River Bridge Area:

No causeway material at the French Broad River shall be installed at night from **April 15** to **October 1** of any year.

All construction related lighting will be limited to whatever is necessary to maintain safety in active work areas closest to the French Broad River between **April 15** and **October 15** of any year. Construction related lighting will not project into adjacent wooded areas or over the water surface of the river.

No night work shall occur between **June 1** and **June 14** in the vicinity of the French Broad River.

From **June 15** to **August 1**, the contractor is restricted to no more than 28 total nights of work with no more than four consecutive nights in the vicinity of the French Broad River. During this time, lighting is limited to what is necessary to maintain safety and will only be directed toward active work areas.

Other Areas:

Construction related lighting will not project into adjacent wooded areas or over the water surface of the river. This applies to locations between NC 191 (Brevard Road) and SR 3495 (Glenn Bridge Road) with the exceptions of the construction area associated with the access roads at the Blue Ridge Parkway and the existing brightly lit area associated with the NC 146 (Long Shoals Road) interchange.

MANDATORY PRE-BID CONFERENCE (Prequalifying To Bid):

(7-18-06) (Rev. 3-25-13) SPI 1-14

In order for all prospective bidders to have an extensive knowledge of the project, all prospective bidders shall attend a mandatory pre-bid conference at **9:00 A.M., Monday, June 24, 2019** at:

AB Tech Community College – Asheville Campus
Ferguson Auditorium
340 Victoria Road
Asheville, NC 28801
Nathan Moneyham
828-250-3000

The pre-bid conference will include a thorough discussion of the plans, contract pay items, special provisions, etc.

Only bidders who have attended and properly registered at the above scheduled pre-bid conference and who have met all other prequalification requirements will be considered prequalified to bid on this project. A bid received from a bidder who has not attended and properly registered at the above scheduled pre-bid conference will not be accepted and considered for award.

Attendance at the pre-bid conference will not meet the requirements of proper registration unless the individual attending has registered at the pre-bid conference in accordance with the following:

(A) The individual has signed his name on the official roster no later than 30 minutes after the above noted time for the beginning of the conference.

(B) The individual has written in the name and address of the company he or she represents.

(C) Only one company has been shown as being represented by the individual attending.

(D) The individual attending is an officer or permanent employee of the company they are representing.

Attendance at any prior pre-bid conference will not meet the requirement of this provision.

DELAY IN RIGHT OF ENTRY:
(7-1-95) 108 SP1 G22 A

The Contractor will not be allowed right of entry to the parcels listed below before July 2, 2019 unless otherwise permitted by the Engineer.

Parcel No.	Property Owner
19	Mission Hospital

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 *2018 Standard Specifications*):

Line #		Description
73	—	Class IV Subgrade Stabilization
91	—	13-1/2” Port Cem Conc Pavement, Through Lanes (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 *2018 Standard Specifications*).

Line #	Description
157 - 169	Guardrail
170 - 176	Fencing
181 - 219	Signing
250 - 252, 259 - 262, 268	Long-Life Pavement Markings
263 - 264	Work Zone Performance Pavement Marking
253	Removable Tape
269 - 270	Permanent Pavement Markers
271 - 279, 281	Lighting
282 - 317, 319 - 323, 325 - 333	Erosion Control
318, 324	Reforestation
334 - 405	Signals/ITS System
442 - 444, 446	Drilled Piers

FUEL PRICE ADJUSTMENT:

(11-15-05) (Rev. 2-18-14) 109-8 SP1 G43

Revise the *2018 Standard Specifications* as follows:

Page 1-87, Article 109-8, Fuel Price Adjustments, add the following:

The base index price for DIESEL #2 FUEL is **$ 2.1851** 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

PAYOUT SCHEDULE:

(1-19-10) (Rev. 1-17-12) 108 SP1 G57

Submit an Anticipated Monthly Payout Schedule prior to beginning construction. The Anticipated Monthly Payout Schedule will be used by the Department to monitor funding levels for this project. Include a monthly percentage breakdown (in terms of the total contract amount) of the work anticipated to be completed. The schedule should begin with the date the Contractor plans to begin construction and end with the anticipated completion date. Submit updates of the Anticipated Monthly Payout Schedule on March 15, June 15, September 15, and December 15 of each calendar year until project acceptance. Submit the original Anticipated Monthly Payout Schedule and all subsequent updates to the Resident Engineer with a copy to the State Construction Engineer at 1 South Wilmington Street, 1543 Mail Service Center, Raleigh, NC 27699-1543.

SCHEDULE OF ESTIMATED COMPLETION PROGRESS:

(7-15-08) (Rev. 6-19-18) 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)**
2020	(7/01/19 - 6/30/20)	**29**% of Total Amount Bid
2021	(7/01/20 - 6/30/21)	**29**% of Total Amount Bid
2022	(7/01/21 - 6/30/22)	**23**% of Total Amount Bid
2023	(7/01/22 – 6/30/23)	**15**% of Total Amount Bid
2024	(7/01/23 – 6/30/24)	**4%** of Total Amount Bid

The Contractor shall also furnish his own progress schedule in accordance with Article 108-2 of the *2018 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. 2-19-19) 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.

Replacement / Substitution – A full or partial reduction in the amount of work subcontracted to a committed (or an approved substitute) DBE firm.

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. https://connect.ncdot.gov/business/Turnpike/Documents/Form%20DBE-IS%20Subcontractor%20Payment%20Information.pdf

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 estimated amount (based on quantities and unit prices) 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).docx

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 **7.0** %

(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:// www.ebs.nc.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 the electronic submittal file.

(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 the electronic submittal file, 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 10:00 a.m. 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 10:00 a.m. 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 10:00 a.m. 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 10:00 a.m. 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 10:00 a.m. on 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 10:00 a.m. on the next official state business day. If the contractor cannot send the information electronically, then one complete set and 5 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, 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 Opportunity and Work Force Development Unit at BOWD@ncdot.gov 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 Contractual Services 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 subcontractor (or an approved substitute DBE subcontractor) to meet all or part of a contract goal requirement, the contractor shall not terminate the DBE subcontractor 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.

The Contractor must give notice in writing both by certified mail and email to the DBE subcontractor, with a copy to the Engineer of its intent to request to terminate and/or substitute, and the reason for the request. The Contractor must give the DBE subcontractor five (5) business days to respond to the Contractor's Notice of Intent to Request Termination and/or Substitution. If the DBE subcontractor objects to the intended termination/substitution, the DBE, within five (5) business days must advise the Contractor and the Department of the reasons why the action should not be approved. The five-day notice period shall begin on the next business day after written notice is provided to the DBE subcontractor.

A committed DBE subcontractor may only be terminated after receiving the Department's written approval based upon a finding of good cause for the proposed termination and/or substitution. For purposes of this section, good cause shall include the following circumstances:

(a) The listed DBE subcontractor fails or refuses to execute a written contract;

(b) The listed DBE subcontractor fails or refuses to perform the work of its subcontract in a way consistent with normal industry standards. Provided, however, that good cause does not exist if the failure or refusal of the DBE subcontractor to perform its work on the subcontract results from the bad faith or discriminatory action of the prime contractor;
(c) The listed DBE subcontractor fails or refuses to meet the prime contractor's reasonable, nondiscriminatory bond requirements;
(d) The listed DBE subcontractor becomes bankrupt, insolvent, or exhibits credit unworthiness;
(e) The listed DBE subcontractor is ineligible to work on public works projects because of suspension and debarment proceedings pursuant to 2 CFR Parts 180, 215 and 1,200 or applicable state law;
(f) The listed DBE subcontractor is not a responsible contractor;
(g) The listed DBE voluntarily withdraws from the project and provides written notice of withdrawal;
(h) The listed DBE is ineligible to receive DBE credit for the type of work required;
(i) A DBE owner dies or becomes disabled with the result that the listed DBE contractor is unable to complete its work on the contract;
(j) Other documented good cause that compels the termination of the DBE subcontractor. Provided, that good cause does not exist if the prime contractor seeks to terminate a DBE it relied upon to obtain the contract so that the prime contractor can self-perform the work for which the DBE contractor was engaged or so that the prime contractor can substitute another DBE or non-DBE contractor after contract award.

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).

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.

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.

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

Failure to Meet Contract Requirements

Failure to meet contract requirements in accordance with Subarticle 102-15(J) of the *2018 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.

CARGO PREFERENCE ACT:
(2-16-16)

Privately owned United States-flag commercial vessels transporting cargoes are subject to the Cargo Preference Act (CPA) of 1954 requirements and regulations found in 46 CFR 381.7. Contractors are directed to clause (b) of 46 CFR 381.7 as follows:

(b) Contractor and Subcontractor Clauses. "Use of United States-flag vessels: The contractor agrees-

" (1) To utilize privately owned United States-flag commercial vessels to ship at least 50 percent of the gross tonnage (computed separately for dry bulk carriers, dry cargo liners, and tankers) involved, whenever shipping any equipment, material, or commodities pursuant to this contract, to the extent such vessels are available at fair and reasonable rates for United States-flag commercial vessels.

(2) To furnish within 20 days following the date of loading for shipments originating within the United States or within 30 working days following the date of loading for shipments originating outside the United States a legible copy of a rated, 'on-board' commercial ocean bill-of-lading in English for each shipment of cargo described in paragraph (b) (1) of this section to both the Contracting Officer (through the prime contractor in the case of subcontractor bills-of-lading) and to the Division of National Cargo, Office of Market Development, Maritime Administration, Washington, DC 20590.

(3) To insert the substance of the provisions of this clause in all subcontracts issued pursuant to this contract."

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

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

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 *2018 Standard Specifications* have been furnished to the Engineer.

The provisions of Subarticle 109-5(B) of the *2018 Standard Specifications* will apply to the portable concrete barrier.

REMOVABLE PAVEMENT MARKINGS - (Partial Payments for Materials):
(7-1-95) (Rev. 8-16-11) 1205-10 SP1 G124

When so authorized by the Engineer, partial materials payments will be made up to 95 percent of the delivered cost of pavement marking tape, provided that these materials have been delivered on or in the vicinity of the project, stored in an acceptable manner, not to exceed the shelf life recommended by the manufacturer, and further provided the documents listed in Subarticle 109-5(C) of the *2018 Standard Specifications* have been furnished to the Engineer.

The Contractor shall be responsible for the material and the satisfactory performance of the material when used in the work.

The provisions of Article 109-6 of the *2018 Standard Specifications* will not apply to removable pavement marking materials.

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

Revise the *2018 Standard Specifications* as follows:

Page 1-39, 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 1-39, 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 1-39, 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. 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.

COOPERATION BETWEEN CONTRACTORS:

(7-1-95) 105-7 SP1 G133

The Contractor's attention is directed to Article 105-7 of the *2018 Standard Specifications*.

I-4400C / I-4400BB (C204265) is anticipated for the September 17, 2019 Letting and located adjacent to this project.

I-5504 (C203754) is currently under construction and located adjacent to this project. I-5504 is not anticipated to be complete prior to the letting of this project.

The Contractor on this project shall cooperate with the Contractor working within or adjacent to the limits of this project to the extent that the work can be carried out to the best advantage of all concerned.

ELECTRONIC BIDDING:

(2-19-19) 101, 102, 103 SP1 G140

Revise the *2018 Standard Specifications* as follows:

Page 1-4, Article 101-3, DEFINITIONS, BID (OR PROPOSAL) ***Electronic Bid,*** **line 1,** replace "Bid Express®" with "the approved electronic bidding provider".

Page 1-15, Subarticle 102-8(B), Electronic Bids, lines 39-40, replace "to Bid Express®" with "via the approved electronic bidding provider".

Page 1-15, Subarticle 102-8(B)(1), Electronic Bids, line 41, delete "from Bid Express®"

Page 1-17, Subarticle 102-9(C)(2), Electronic Bids, line 21, replace "Bid Express® miscellaneous folder within the .ebs" with "electronic submittal".

Page 1-29, Subarticle 103-4(C)(2), Electronic Bids, line 32, replace ".ebs miscellaneous data file of Expedite" with "electronic submittal file"

BID DOCUMENTATION:

(1-1-02) (Rev.8-18-15) 103 SP1 G142

General

The successful Bidder (Contractor) shall submit the original, unaltered bid documentation or a certified copy of the original, unaltered bid documentation used to prepare the bid for this contract to the Department within 10 days after receipt of notice of award of contract. Such documentation shall be placed in escrow with a banking institution or other bonded document storage facility selected by the Department.

The Department will not execute the contract until the original, unaltered bid documentation or a certified copy of the original, unaltered bid documentation has been received by the Department.

Terms

Bid Documentation - Bid Documentation shall mean all written information, working papers, computer printouts, electronic media, charts, and all other data compilations which contain or reflect information, data, and calculations used by the Bidder in the preparation of the bid. The term *bid documentation* includes, but is not limited to, contractor equipment rates, contractor overhead rates, labor rates, efficiency or productivity factors, arithmetical calculations, and quotations from subcontractors and material suppliers to the extent that such rates and quotations were used by the Bidder in formulating and determining the bid. The term *bid documentation* also includes any manuals, which are standard to the industry used by the Bidder in determining the bid. Such manuals may be included in the bid documentation by reference. Such reference shall include the name and date of the publication and the publisher. *Bid Documentation* does not include bid documents provided by the Department for use by the Bidder in bidding on this project. The Bid Documentation can be in the form of electronic submittal (i.e. thumb drive) or paper. If the Bidder elects to submit the Bid Documentation in electronic format, the Department requires a backup submittal (i.e. a second thumb drive) in case one is corrupted.

Contractor's Representative - Officer of the Contractor's company; if not an officer, the Contractor shall supply a letter signed and notarized by an officer of the Contractor's company, granting permission for the representative to sign the escrow agreement on behalf of the Contractor.

Escrow Agent - Officer of the select banking institution or other bonded document storage facility authorized to receive and release bid documentation.

Escrow Agreement Information

A draft copy of the Escrow Agreement will be mailed to the Bidder after the notice of award for informational purposes. The Bidder and Department will sign the actual Escrow Agreement at the time the bid documentation is delivered to the Escrow Agent.

Failure to Provide Bid Documentation

The Bidder's failure to provide the original, unaltered bid documentation or a certified copy of the original, unaltered bid documentation within 10 days after the notice of award is received may be just cause for rescinding the award of the contract and may result in the removal of the Bidder from the Department's list of qualified bidders for a period of up to 180 days. Award may then be made to the next lowest responsible bidder or the work may be readvertised and constructed under the contract or otherwise, as the Department may decide.

Submittal of Bid Documentation

(A) Appointment – Email specs@ncdot.gov or call 919.707.6900 to schedule an appointment.

(B) Delivery - A representative of the Bidder shall deliver the original, unaltered bid documentation or a certified copy of the original, unaltered bid documentation to the

Department, in a container suitable for sealing, within 10 days after the notice of award is received.

(C) Packaging – The container shall be no larger than 15.5 inches in length by 12 inches wide by 11 inches high and shall be water resistant. The container shall be clearly marked on the face and the back of the container with the following information: Bid Documentation, Bidder's Name, Bidder's Address, Date of Escrow Submittal, Contract Number, TIP Number if applicable, and County.

Affidavit

Bid documentation will be considered a certified copy if the Bidder includes an affidavit stating that the enclosed documentation is an EXACT copy of the original documentation used by the Bidder to determine the bid for this project. The affidavit shall also list each bid document with sufficient specificity so a comparison may be made between the list and the bid documentation to ensure that all of the bid documentation listed in the affidavit has been enclosed for escrow. The affidavit shall attest that the affiant has personally examined the bid documentation, that the affidavit lists all of the documents used by the Bidder to determine the bid for this project, and that all bid documentation has been included. The affidavit shall be signed by a chief officer of the company, have the person's name and title typed below the signature, and the signature shall be notarized at the bottom of the affidavit.

Verification

Upon delivery of the bid documentation, the Department's Contract Officer and the Bidder's representative will verify the accuracy and completeness of the bid documentation compared to the affidavit. Should a discrepancy exist, the Bidder's representative shall immediately furnish the Department's Contract Officer with any other needed bid documentation. The Department's Contract Officer upon determining that the bid documentation is complete will, in the presence of the Bidder's representative, immediately place the complete bid documentation and affidavit in the container and seal it. Both parties will deliver the sealed container to the Escrow Agent for placement in a safety deposit box, vault, or other secure accommodation.

Confidentiality of Bid Documentation

The bid documentation and affidavit in escrow are, and will remain, the property of the Bidder. The Department has no interest in, or right to, the bid documentation and affidavit other than to verify the contents and legibility of the bid documentation unless the Contractor gives written notice of intent to file a claim, files a written claim, files a written and verified claim, or initiates litigation against the Department. In the event of such written notice of intent to file a claim, filing of a written claim, filing a written and verified claim, or initiation of litigation against the Department, or receipt of a letter from the Contractor authorizing release, the bid documentation and affidavit may become the property of the Department for use in considering any claim or in litigation as the Department may deem appropriate.

Any portion or portions of the bid documentation designated by the Bidder as a *trade secret* at the time the bid documentation is delivered to the Department's Contract Officer shall be protected from disclosure as provided by *G.S. 132-1.2*.

Duration and Use

The bid documentation and affidavit shall remain in escrow until 60 calendar days from the time the Contractor receives the final estimate; or until such time as the Contractor:

(A) Gives written notice of intent to file a claim,
(B) Files a written claim,
(C) Files a written and verified claim,
(D) Initiates litigation against the Department related to the contract; or
(E) Authorizes in writing its release.

Upon the giving of written notice of intent to file a claim, filing a written claim, filing a written and verified claim, or the initiation of litigation by the Contractor against the Department, or receipt of a letter from the Contractor authorizing release, the Department may obtain the release and custody of the bid documentation.

The Bidder certifies and agrees that the sealed container placed in escrow contains all of the bid documentation used to determine the bid and that no other bid documentation shall be relevant or material in litigation over claims brought by the Contractor arising out of this contract.

Release of Bid Documentation to the Contractor

If the bid documentation remains in escrow 60 calendar days after the time the Contractor receives the final estimate and the Contractor has not filed a written claim, filed a written and verified claim, or has not initiated litigation against the Department related to the contract, the Department will instruct the Escrow Agent to release the sealed container to the Contractor.

The Contractor will be notified by certified letter from the Escrow Agent that the bid documentation will be released to the Contractor. The Contractor or his representative shall retrieve the bid documentation from the Escrow Agent within 30 days of the receipt of the certified letter. If the Contractor does not receive the documents within 30 days of the receipt of the certified letter, the Department will contact the Contractor to determine final dispersion of the bid documentation.

Payment

The cost of the escrow will be borne by the Department. There will be no separate payment for all costs of compilation of the data, container, or verification of the bid documentation. Payment at the various contract unit or lump sum prices in the contract will be full compensation for all such costs.

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.

EROSION AND SEDIMENT CONTROL/STORMWATER CERTIFICATION:

(1-16-07) (Rev 11-22-16) 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 and within 24 hours after a rainfall event of 0.5 inch that occurs within a 24 hour period. Additional monitoring may be required at the discretion of Division of Water Resources personnel if the receiving stream is 303(d) listed for turbidity and the project has had documented problems managing turbidity.

(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 *2018 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: https://connect.ncdot.gov/resources/roadside/FieldOperationsDocuments/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.

NOTES TO CONTRACTOR:

- Prior to beginning work on the Blue Ridge Parkway Bridge, the contractor will need to be pre-qualified for the new work code "Segmental Bridge Construction".

- For asphalt, aggregate and concrete deliveries for the Blue Ridge Parkway, limit the load restrictions as shown in table below.

LOAD RESTRICTIONS

Single Units	**Gross Vehicle Weight, pounds**
2 axles	40,000
3 axles	48,000
4 or more axles	52,000
Combination Units	**Gross Vehicle Weight, pounds**
3 axles	57,000
4 axles	62,000
5 or more axles	66,000

  Prepare load rating calculations using Load and Resistance Factor Rating (LRFR) for all existing bridges on the Blue Ridge Parkway along the planned route for transporting equipment and materials. Check the adequacy of the existing bridges based on the Inventory Level load rating for the Strength and Service Limit States. Submit load rating calculations that are signed and sealed by a Professional Engineer registered in the State of North Carolina.

- Altering the final appearance of the bridge on the Blue Ridge Parkway from what is shown in the provided contract documents will not be accepted or considered. In addition, any proposals to change the substructure and superstructure components that are identified as precast in the provided contract documents from precast to cast-in-place concrete will not be accepted or considered.

- The contractor will be required to be an active participant in the Project Management Plan and Incident Management Plan that is being developed for this project.

- Any bat roost trees that are documented within 0.25 miles of the project area, regardless of the time of the year, the National Park Service will seek consultation with the US Fish and Wildlife Service before work proceeds.

- The United States Fish and Wildlife Service (USFWS) shall be notified of any injured or dead bats are found on the project. In addition, the USFWS shall be notified of any new information regarding the gray bats.

- In the area between the Blue Ridge Parkway and NC 191 (Brevard Road), trees will only be cleared to establish the permanent project footprint, temporary piping of streams SEE and SFG (as identified in Table 15 of the Biological Assessment), establish associated sediment and erosion control devices and to create temporary construction access roads at the Blue Ridge Parkway.

- Lighting shall only be used in areas where active construction is occurring. For paving operations conducted at night, the area to be lit shall be directly adjacent to the paving machine.

- All Sediment and Erosion Control measures throughout the project limits shall be cleaned out when half full of sediment.

- Sediment and Erosion Control devices associated with the French Broad River bridge replacement shall be inspected daily.

- The contractor shall adhere to all conditions on pages 15 and 16, Section 2.3.2.3 FBR Bridge Replacement, of the Biological Opinion.

- The United States Fish and Wildlife Service (USFWS) shall be notified of any project modifications.

- The United States Fish and Wildlife Service (USFWS) shall be provided the demolition plans for the French Broad River Bridge replacement and allowed 15 days for review.

- All other resource agencies shall be invited to review the French Broad River bridge demolition plan and will be notified prior to start of demolition so that a representative may be on-site.

- A United States Fish and Wildlife Service (USFWS) biologist shall invited (with a 7 day notice) to any preconstruction meetings to review the permit conditions and discuss any questions regarding the implementation of the project. The biologist will review and provide comments on any plans submitted by the contractor and invited to attend any meetings to discuss implementation of the plans.

- During construction, the culvert inlets and outlets will be evaluated by the Department with regard to stream stability immediately following installation and quarterly for 1 year at each location. Indicators of instability, such as head cutting, scour, aggradation or degradation, shall be used to determine the need for corrective action.
- A final field inspection shall be held to evaluate the culvert placement and stream stability before the project is considered complete. If instability is detected, corrective actions shall be performed as directed by the Engineer.
- The area of the project from Brevard Road (Approximate Station 1078+00) to Blue Ridge Parkway (Approximate Station 1230+67) shall adhere to the following requirements:
  - A comprehensive grading plan shall be submitted prior to beginning any grading for approval by the Engineer. The plan shall include:
    1) The number and makeup of the crews working in this area
    2) A narrative outlining a systematic approach to removing cut and placing fill including a proposed time for each operation
  - No more than 10 acres of cut and fill shall be open in this area without prior approval of the Engineer.
  - All access roads shall be covered with railroad ballast or larger stone.
  - An access road construction plan for the Blue Ridge Parkway access road shall be submitted for review and approval by the Engineer.
  - All slopes shall be matted in this area

MAINTENANCE OF TRAFFIC:

Revise the *2018 Standard Specifications* as follows:

Page 1-89, Article 150, add the following after line 35:

150-1 HAULING RESTRICTIONS

No hauling or deliveries allowed on the Blue Ridge Parkway during commuter periods, Monday through Friday, from 7:00 am to 9:00 am and 4:00 pm – 6:00 pm. Outside of the commuter periods, no more than 2 haul or delivery round trips will be allowed in a single hour on the Blue Ridge Parkway.

Do not allow public traffic to pass under the bridge construction zone during post-tensioning operations on superstructure. Use rolling stops, and limit construction-caused delays to public traffic to a maximum of 30 minutes per passage through the project. Rolling stops will be allowed from 12 a.m. to 5 a.m.

150-2 LANE CLOSURES

Install traffic control for the Blue Ridge Parkway as shown on the plans. No lane closures or daytime deliveries during the month of October.

Use single lane closures with flaggers on the Blue Ridge Parkway and as shown in the plans. Open roadway within 24 hours after completion of work or as directed by Engineer.

Limit construction-caused delays to public traffic along the Blue Ridge Parkway to a maximum of 15 minutes per passage through a lane closure.

Limit lane closures to 2,500 feet unless otherwise approved by the Engineer. If short-duration Blue Ridge Parkway closure is required for delivery of large items, i.e. pre-cast segments, the contractor will submit a proposed schedule no less than 2 weeks in advance for review and approval by Engineer. Closures will not be allowed during commuter periods, are to be scheduled and prosecuted to minimize duration and are to include public notifications with variable message boards.

ON-SITE PRECAST PLANT:

An on-site precast plant may be utilized provided it meets all applicable requirements contained in these contract documents.

PROJECT SPECIAL PROVISIONS

ROADWAY

RESPONSE FOR GUARDRAIL/GUIDERAIL MAINTENANCE:

Description

Furnish the labor, materials, tools and equipment necessary to move personnel, equipment, and supplies to the project necessary for guardrail/guiderail maintenance.

Construction Methods

In accordance with Article 104-10 of the 2018 Standard Specifications and the Maintenance of the Project Special Provision 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 must be repaired or replaced as a result of maintaining the project, such repair or replacement shall be preformed within 7 consecutive calendar days of such inspection report.

Measurement and Payment

Response for Guardrail/Guiderail Maintenance will be measured and paid for by counting the actual number of times the contractor moves onto the project specifically for guardrail/guiderail maintenance. Payment for the labor, materials, and equipment necessary to complete the repair or replacement will be made with the various guardrail/guiderail contract items. No additional payment will be made for traffic control for guardrail/guiderail maintenance outside of the various contract items included in the contract.

Payment will be made under:

Pay Item	**Pay Unit**
Response for Guardrail/Guiderail Maintenance	Each

SNOW AND ICE REMOVAL:

Description

Performance of snow and ice removal in accordance with the contract.

Materials

The Department of Transportation will provide all necessary deicing chemical materials and/or abrasives necessary for snow and ice control operations. The Contractor’s Equipment will be loaded with deicing materials. abrasives in the same manner, and at the same locations as the Department of Transportation’s equipment. The contractor shall return all unused materials to the Department.

Equipment

The Contractor shall provide the following types of equipment:

A minimum of 4 multi-rear-axel dump trucks, with operators, equipped with 12.0-ft. snowplow, tire chains, and 10.0 cubic yard (minimum truck capacity) material spreader. (*spreaders with tanks that allow the application of liquid chemicals at the spinner are required*)

- A minimum of 4 trucks, as described above, will be assigned to I-26 within the project limits or as determined by the Engineer.

Upon approval of the Engineer, the Contractor may provide additional units in accordance with the terms and conditions of this contract. The Engineer reserves the right to reassign equipment within the routes and maintenance yards as needs dictate.

All snowplows provided under this agreement shall be hydraulic powered, reversible, hydraulic angling, moldboard type plows, with a dual trip spring assembly, which will automatically return the plow to the normal plowing position. The trip spring assembly is intended to reduce the potential for damage to the plowing equipment resulting from collision with roadway structure, such as, but not limited to, manholes and valve boxes. The Department will not be responsible for damage to the Contractor's equipment resulting from collisions with such structures. Also, the snowplow operating, heights will be determined by the NCDOT. In some cases, the Contractor may be directed to have the snowplow in direct contact with the pavement surface.

All material spreaders provided under this agreement shall be truck engine driven, hydraulic pump powered, in-body style spreaders with a calibrated, adjustable, locking feed gate, which controls the amount of material being discharged.

All vehicles provided by the Contractor shall be equipped with permanent mounted Global Positioning Devices (GPS) such as the Motorola Locator 2000 or equivalent model.

The GPS units must be accompanied with an annual monitoring subscription that will begin and cover the period between October 15 and April 15 of each year. The GPS unit and monitoring subscription must demonstrate the following capabilities:

- Generate reports in a spreadsheet format
- Generate mapping
- Report every two (2) minutes or less
- Turn-by-turn tracking
- Roadway surface temperature monitoring (Vaisala surface patrol pavement temperature sensor or equivalent model)
- Internet monitoring with NCDOT management access
- Ability to track vehicle operating speed
- Software must send alert via email or text message when desired speed has been exceeded Software or web application must be capable of Zone Assignments and notification
- Tampering alert notification

- Operate during extreme temperatures
- Battery backup system

If, at any time, the Engineer finds that the monitoring software subscription does not satisfactorily meet the requirements set forth in this contract, or is not in operation for the specified timeframe, the Contractor will update or renew the GPS monitoring software system at the Contractor's expense.

A copy of the DOT specifications for snowplows and material spreaders will be made available to the contractor upon request.

All equipment provided by the Contractor shall be equipped with warning lights visible from 360 degrees in accordance with NCDOT standards. All trucks shall have headlights mounted to provide forward lighting over the snowplow/blade. Lighting shall be installed and adjusted to minimize glare. Communication devices shall be available in each piece of equipment to accommodate continuous communication between operators and the Contractors designated supervisor. All equipment shall also be equipped with operable, audible back-up warning devices. Each vehicle shall be equipped with a set of tire chains for at least one drive axle.

The Contractor shall be responsible for all cost or changes incurred in the operation and maintenance of the equipment during the term of the contract including but not limited to fuel, oil, snowplow blades, tire chains, equipment repairs, communication equipment, etc.

Construction Methods

(A) Supervisor

The Contractor will provide a designated supervisor that will coordinate this work with the County Maintenance Engineer and Department of Transportation's snow and ice removal operations

(B) Operators

Operators of all trucks shall have a valid Commercial's Driver's License of the appropriate class. The Contractor shall provide enough operators, per piece of equipment provided under this provision, to operate 24 hours per day during a storm event. Operators are limited to a maximum 12-hour shift within a 24-hour period.

(C) Training

The Department of Transportation shall provide training session(s) to familiarize all Contractor personnel (both operators and supervisors) with snow removal and ice control methods, equipment, and assigned routes. Training sessions consist of classroom style instruction on snow removal and ice control method and materials, snowplow and spreader operation, calibration and safety issues. Training session(s) will be scheduled and completed as determined by the Engineer and the Contractor will be given a minimum of 2 weeks' notice of scheduled training.

(D) Outfitting Fee

A capital recovery fee for the investment and administrative costs associated with the purchase, installation, maintenance and storage of the equipment appurtenances (spreaders, snow plows, plow blades, etc.) specified herein will be paid to the Contractor. All equipment covered by this pay item will remain the property of the Contractor upon the completion of the project.

The snowplows and material spreaders will be inspected and approved by the Engineer during the scheduled dry run(s). The Engineer will also periodically inspect all equipment provided. If, at any time, the Engineer finds that the equipment in not satisfactory, or has not been maintained in operating condition, the Contractor will repair or replace the unsatisfactory equipment at the Contractor's cost.

The Department of Transportation shall conduct dry run(s) to familiarize all the Contractor's personnel (both operators and supervisors) with snow removal and ice control methods, equipment, and assigned routes. Dry runs include the use of equipment. At a dry run, equipment is inspected; calibrated, and plowing routes are reviewed and driven for operators to note potential plowing patterns and changes. Dry run(s) will be scheduled and completed as determined by the Engineer, typically held during the months of October and November each year. The Department will provide the Contractor with a minimum two (2) week notice of scheduled dry runs.

(E) Response for Snow and Ice Removal

The Engineer will notify the Contractor when impending inclement weather is forecasted, and when and where, according to the forecast, to mobilize his/her equipment in preparation for snow and ice removal. The Engineer will notify the Contractor a minimum of three (3) hours before the equipment is needed to begin the work.

Payment for Response for Snow and Ice Removal shall include rigging the dump truck with the specified appurtenances and having the trucks ready for operation (loading and plowing) at the designated Department facility. Payment for Response for Snow in Ice Removal shall include the cleanup of the trucks and appurtenances at the conclusion of the current storm event and unrigging the specified appurtenances from the dump trucks.

All equipment, including any specified appurtenances (plows, spreaders, etc.), shall be rigged fitted and ready for operation (loading, plowing, etc.) and delivered to the pre-designated Department of Transportation Facilities within three (3) hours of notification.

Measurement and Payment

Outfitting Fee will be paid at the contract unit price per each, for each piece of equipment provided, approved, and accepted under this contract. Payment for Outfitting Fee includes furnishing, operating, repairing, and maintaining all required equipment and subscription fees as defined in the contract. Payment for Outfitting Fee will be made for each piece of equipment upon satisfactory inspection and the completion of all scheduled training sessions and dry runs established by the Engineer. Payment for *Outfitting Fees* will be made on the following schedule:

A. 50% of the unit bid upon completion of the first dry run
B. 30% of the unit bid when the project is 50% complete
C. 20% of the unit bid when the project is 100% complete

Response for Snow and Ice Removal will be measured and paid per each for each piece of equipment mobilized at the request of the Engineer and ready for operation within the timeframe established in this provision.

Equipment Operating Rate for Snow and Ice Removal will be measured and paid for the actual number of hours of satisfactory operation of each piece of equipment per hour. All charges shall be determined to the nearest one-quarter (1/4) hour based upon the time the equipment was in actual productive operation or authorized stand-by time. The Contractor will not be paid for downtime due to meals, equipment failure, accidents, or other conditions. Costs associated with the maintenance and repair of the equipment and appurtenances shall be considered incidental to the operating costs of the equipment.

Payment will be made under:

Pay Item	**Pay Unit**
Outfitting Fee	Each
Response for Snow and Ice Removal	Each
Equipment Operating Rate for Snow and Ice Removal	Hour

VACUUM SWEEPING:

Description

The work consist of sweeping, cleaning, vacuuming, shoveling, removing or picking up of all foreign material not intentionally bonded to the shoulder pavement surface which is not required for the operation or maintenance of the highway as directed.

Equipment

The Contractor shall furnish a “Vacuum Sweeper Unit” of sufficient type, capacity, and quantity to safely and efficiently perform and complete the sweeping work as specified in this provisions with acceptable levels of prosecution and progress.

All sweepers shall be equipped with the following: adequate water systems for dust control, dual steering and dual brooms.
The Contractor shall display the Company name on each piece of equipment.

The Contractor must demonstrate to the satisfaction of the Engineer that the sweeping equipment to be used in the work is in good working condition and suitable for performing the work required within the required cycle schedule. All such equipment is subject to inspection and final approval by the Engineer. Such approval will require an onsite demonstration of the capability of any proposed equipment.

Support vehicles, including safety trucks, debris transfer vehicles, pick-up trucks, sweeper truck, and any other vehicles used in the sweeping operation, shall be properly equipped in accordance with the 2018 Roadway Standard Drawings and the 2018 Standard Specifications.

Operation of Equipment

The Contractor shall operate the equipment in a safe manner so as not to create a hazard to the traveling public.

Crossing lanes of traffic and erratic driving between the median and outside shoulders shall be strictly prohibited.

Insofar as possible, the equipment wheels are to remain off the travel way during sweeping operations.

The Department shall, at its discretion, establish and/or change schedules because of citizen complaints of noise or similar discomforts affecting their property adjacent to the roadway. Special events may delay or cause the postponement of sweeping on a given period of time.

All sweeping operations shall be accomplished “with” or in the same direction as the traffic flow. Sweeping against or opposing the traffic shall not be permitted.

The sweeping operation shall not cause material to be thrown into travel lane. Material shall not be swept across a travel lane.

If an accident occurs as a result of or in the vicinity of the sweeping operation, the Contractor shall be responsible for notifying the Engineer immediately.

No work is to be performed during adverse weather such as heavy rains, fog, high winds, snow and ice storms, and other inclement weather conditions.

Construction Method

The Contractor shall sweep the designated pavement areas identified on each Sweeping Request. The designated area will be a swath along paved shoulders, areas adjacent to a barrier wall, curb and gutter, shoulder berm and gutter, bridge curb/rail, and median. A swath shall be a minimum of eight (8) feet in width.

Foreign material to be swept includes, but is not limited to: loose aggregate, any undesirable grasses, and other accumulated material or foreign matter, from designated pavement areas and the disposal of such material at a location outside of the right-of way.

When foreign material, too large for the sweeper to remove, are encountered, the Contractor shall remove this larger material by hand. Such larger foreign material may include, but are not limited to: tires, tire parts, hub caps, large stones, boxes, tree limbs/bark, wood, cable, and large silt & grass combination accumulations.

The Contractor will not be responsible for the clean-up and removal of dead animals. If this situation is encountered, the Contractor shall contact the Engineer as directed.

The Contractor will be responsible for the disposal of all debris.

This provision is not intended as payment for and does not alleviate the Contractor from the requirements of Article 104-10 of the 2018 Standard Specifications "Maintenance of the Project"

Measurement and Payment

Sweeping will be measured and paid for as the actual number of shoulder miles, measured along the surface of the ground which have been swept and accepted.

Sweeping will be paid for at the contract unit price per shoulder mile for the various highway systems included in the contract. Such price and payment will be full compensation for the work covered by this provision, including but not limited to, supervision, labor, transportation, support vehicles, fuels, lubricants, repair parts, equipment, signage, machinery, tools, traffic control, disposal of debris, and any incidentals necessary for the prosecution and completion of the work.

Payment will be made under:

Pay Item	**Pay Unit**
Vacuum Sweeping	Shoulder Mile

CLEARING AND GRUBBING - METHOD II:

(9-17-02) (Rev.8-18-15) 200 SP2 R02A

Perform clearing on this project to the limits established by Method "II" shown on Standard Drawing No. 200.02 of the *2018 Roadway Standard Drawings*. Conventional clearing methods may be used except where permit drawings or conditions have been included in the proposal which require certain areas to be cleared by hand methods.

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.

TEMPORARY DETOURS:

(7-1-95) (Rev. 11-19-13) 1101 SP2 R30B(Rev)

Construct temporary detours required on this project in accordance with the typical sections in the plans or as directed.

After the detours have served their purpose, remove the portions deemed unsuitable for use as a permanent part of the project as directed by the Engineer. Notify NCDOT Buncombe County Maintenance at 828-298-0390 at least 48 hours prior to removal of aggregate base course from the detour. Aggregate base course shall be delivered by the contractor to the Buncombe County Maintenance Yard at 11 Old Charlotte Highway, Asheville, NC 28803. Place pavement and earth material removed from the detour in embankments or dispose of in waste areas furnished by the Contractor.

Aggregate base course, drainage structures, concrete barrier, concrete curb, and earth material that is removed will be measured and will be paid at the contract unit price per cubic yard for *Unclassified Excavation*. Pavement that is removed will be measured and will be paid at the contract unit price per square yard for *Removal of Existing _____ Pavement*. Pipe culverts removed from the detours remain the property of the Contractor. Pipe culverts that are removed will be measured and will be paid at the contract unit price per linear foot for *Pipe Removal*. Payment for the construction of the detours will be made at the contract unit prices for the various items involved.

Such prices and payments will be full compensation for constructing the detours and for the work of removing, salvaging, and stockpiling aggregate base course; removing pipe culverts; and for placing earth material, concrete, and pavement in embankments or disposing of earth material and pavement in waste areas.

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 *2018 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 *2018 Standard Specifications*.

COAL COMBUSTION PRODUCTS IN EMBANKMENTS:

(4-16-02) (Rev. 5-19-15) 235 SP02 R70

Description

This specification allows the Contractor an option, with the approval of the Engineer, to use coal combustion products (CCPs) in embankments as a substitute for conventional borrow material. The amount of CCPs allowed to be used for this project will be less than 80,000 tons total and less than 8,000 tons per acre.

Materials

Supply coal combustion products from the Department list of potential suppliers maintained by the Value Management Unit. Site specific approval of CCP material will be required prior to beginning construction.

The following CCPs are unacceptable:

(A) Frozen material,
(B) Ash from boilers fired with both coal and petroleum coke, and
(C) Material with a maximum dry unit weight of less than 65 pounds per cubic foot when tested in accordance with AASHTO T-99 Method A or C.

Collect and transport CCPs in a manner that will prevent nuisances and hazards to public health and safety. Moisture condition the CCPs as needed and transport in covered trucks to prevent dusting.

Preconstruction Requirements

When CCPs are to be used as a substitute for earth borrow material, request written approval from the Engineer at least ninety (90) days in advance of the intent to use CCPs and include the

following details using the NCDOT Form #CCP-2015-V1 in accordance with NCGS § 130A-309.219(b)(1):

(A) Description, purpose and location of project.
(B) Estimated start and completion dates of project.
(C) Estimated volume of CCPs to be used on project with specific locations and construction details of the placement.
(D) Toxicity Characteristic Leaching Procedure analysis from a representative sample of each different CCP source to be used in the project for, at minimum, all of the following constituents: arsenic, barium, cadmium, lead, chromium, mercury, selenium, and silver.
(E) The names, address, and contact information for the generator of the CCPs.
(F) Physical location of the project at which the CCPs were generated.

Submit the form to the Engineer and the State Value Management Engineer at valuemanagementunit@ncdot.gov for review. The Engineer and the State Value Management Engineer will coordinate the requirements of NCGS § 130A-309.219(a)(1) and notify the Contractor that all the necessary requirements have been met before the placement of structural fill using coal combustion products is allowed.

Construction Methods

In accordance with the detail in the plans, place CCPs in the core of the embankment section with at least 4 feet of earth cover to the outside limits of the embankments or subgrade and at least 5 feet above the seasonal high ground-water table. CCPs used in embankments shall not be placed as follows:

(A) Within 50 feet of any property boundary.
(B) Within 300 horizontal feet of a private dwelling or well.
(C) Within 50 horizontal feet of the top of the bank of a perennial stream or other surface water body.
(D) Within a 100-year floodplain except as authorized under NCGS § 143-215.54A(b). A site located in a floodplain shall not restrict the flow of the 100-year floodplain or result in washout of solid waste so as to pose a hazard to human life, wildlife or land and water resources.
(E) Within 50 horizontal feet of a wetland, unless, after consideration of the chemical and physical impact on the wetland, the United States Army Corps of Engineers issues a permit or waiver for the fill.

Construct embankments by placing CCPs in level uniform lifts with no more than a lift of 10 inches and compacted to at least a density of 95 percent as determined by test methods in AASHTO T-99, Determination of Maximum Dry Density and Optimum Moisture Content, Method A or C depending upon particle size of the product. Provide a moisture content at the time of compaction of within 4 percent of optimum but not greater than one percent above optimum as determined by AASHTO T-99, Method A or C.

Divert surface waters resulting from precipitation from the CCPs placement area during filling and construction activities. Construct embankments such that rainfall will not run directly off of the CCPs. Provide dust control to minimize airborne emissions. Construct fill in a manner that

prevents water from accumulating and ponding and do not pump nor discharge waters from CCP's filling and construction areas.

Measurement and Payment

Borrow Excavation will be measured by truck volume and paid in cubic yards in accordance with Article 230-5 of the *2018 Standard Specifications*.

MANUFACTURED QUARRY FINES IN EMBANKMENTS:

(01-17-17) 235 SP02 R72

Description

This specification addresses the use of manufactured quarry fines that are not classified as select materials. The specification allows the Contractor an option, with the approval of the Engineer, to use manufactured quarry fines (MQFs) in embankments as a substitute for conventional borrow material. Furnish and place geotextile for pavement stabilization in accordance with the Geotextile for Pavement Stabilization special provision and detail. Geotextile for pavement stabilization is required to prevent pavement cracking and provide separation between the subgrade and pavement section at embankment locations where manufactured quarry fines are utilized and as directed by the Engineer.

Materials

Manufactured Quarry Fines.
Site specific approval of MQFs material will be required prior to beginning construction as detailed in the preconstruction requirements of this provision.

The following MQFs are unacceptable:
(A) Frozen material,
(B) Material with a maximum dry unit weight of less than 90 pounds per cubic foot when tested in accordance with AASHTO T-99 Method A or C.
(C) Material with greater than 80% by weight Passing the #200 sieve

Collect and transport MQFs in a manner that will prevent nuisances and hazards to public health and safety. Moisture condition the MQFs as needed and transport in covered trucks to prevent dusting. If MQFs are blended with natural earth material, follow Borrow Criteria in Section 1018 of the *Standard Specifications.*

Geotextiles

Areas of embankment where MQFs are incorporated, Geotextile for Pavement Stabilization shall be used. If the Geotextile for Pavement Stabilization special provision is not included elsewhere in this contract, then it along with a detail will be incorporated as part of the contractors request to use. Notification of subgrade elevation, sampling and waiting period as required in the Construction Methods section of the Geotextile for Pavement Stabilization special provision are not required.

Preconstruction Requirements

When MQFs are to be used as a substitute for earth borrow material, request written approval from the Engineer at least ninety (90) days in advance of the intent to use MQFs and include the following details:

(A) Description, purpose and location of project.
(B) Estimated start and completion dates of project.
(C) Estimated volume of MQFs to be used on project with specific locations and construction details of the placement.
(D) The names, address, and contact information for the generator of the MQFs.
(E) Physical location of the site at which the MQFs were generated.

The Engineer will forward this information to the State Materials Engineer for review and material approval.

Construction Methods

Place MQFs in the core of the embankment section with at least 4 feet of earth cover to the outside limits of the embankments or subgrade.

Construct embankments by placing MQFs in level uniform lifts with no more than a lift of 10 inches and compacted to at least a density of 95 percent as determined by test methods in AASHTO T-99, Determination of Maximum Dry Density and Optimum Moisture Content, Method A or C depending upon particle size of the product. Provide a moisture content at the time of compaction of within 4 percent of optimum but not greater than one percent above optimum as determined by AASHTO T-99, Method A or C.

Areas of embankment where MQFs are incorporated, Geotextile for Pavement Stabilization shall be used. See Geotextile for Pavement Stabilization special provision for geotextile type and construction method.

Measurement and Payment

Borrow Excavation will be measured by truck volume and paid in cubic yards in accordance with Article 230-5 of the *2018 Standard Specifications*. As an alternate weigh tickets can be provided and payment made by converting weight to cubic yards based on the verifiable unit weight.

Where the pay item of *Geotextile for Pavement Stabilization* is included in the original contract the material will be measured and paid in square yards (see Geotextile for Pavement Stabilization special provision). Where the pay item of *Geotextile for Pavement Stabilization* is not included in the original contract then no payment will be made for this item and will be considered incidental to the use of MQFs in embankment.

FLOWABLE FILL:

(9-17-02) (Rev 1-17-12) 300, 340, 1000, 1530, 1540, 1550 SP3 R30

Description

This work consists of all work necessary to place flowable fill in accordance with these provisions, the plans, and as directed.

Materials

Refer to Division 10 of the *2018 Standard Specifications*.

Item	Section
Flowable Fill	1000-6

Construction Methods

Discharge flowable fill material directly from the truck into the space to be filled, or by other approved methods. The mix may be placed full depth or in lifts as site conditions dictate. The Contractor shall provide a method to plug the ends of the existing pipe in order to contain the flowable fill.

Measurement and Payment

At locations where flowable fill is called for on the plans and a pay item for flowable fill is included in the contract, *Flowable Fill* will be measured in cubic yards and paid as the actual number of cubic yards that have been satisfactorily placed and accepted. Such price and payment will be full compensation for all work covered by this provision including, but not limited to, the mix design, furnishing, hauling, placing and containing the flowable fill.

Payment will be made under:

Pay Item	Pay Unit
Flowable Fill	Cubic Yard

SPECIAL PROVISION FOR PIPE REHABILITATION

I. DESCRIPTION

This work shall consist of the rehabilitation of existing storm water pipes, or culverts by the method or methods specified at the designated locations described in the Contract.

Pipe liner systems used for rehabilitation shall be from the NCDOT Approved Products List and may be subject to limitations for use as specified herein, by site-specific limitations for those locations listed in the Contract, or limitations as shown on the NCDOT Approved Products List for the specific liner system. The Contractor shall consult the Contract to determine the method or methods that are permitted at each rehabilitation location.

Liners provided per this special provisions shall be designed per the *NCDOT Manual for Pipe Rehabilitation*.

The Contractor shall receive approval from NCDOT in writing for substituting the type or size of the liner specified for any specific location prior to procurement of said liner.

The Contractor shall provide contract submittals as called for herein to the Engineer a minimum of 10 days prior to start of installation.

Designated Locations and Allowable Methods Location of pipes to be lined are shown in the I-4700 Plan Sheets and the Drainage Summary Sheets

The liners as specified for the two existing pipes on Plan Sheet 10 near Station 914+15 shall not be changed without written approval from both the Engineer of Record and the NCDOT Division Construction Engineer.
Category A (CIPP) liners may be substituted for Category C and Category F liners with written approval from the NCDOT Division Construction Engineer.

Category C and Category F liners may be substituted for Category A (CIPP)liners with written approval from both the Engineer of Record and the NCDOT Division Construction Engineer.

II. MATERIALS

Category A - Cured-In-Place Pipe (CIPP) liners are lining an existing culvert by either pulling or inverting a resin-impregnated fabric tube and curing the tube in place. When CIPP liners are specified, the liner system supplied by the Contractor shall conform to the following requirements as supported by contract submittals:

- Must list host pipe diameter ranges for which the product is applicable.
- Must indicate corrosion potential/acid reaction potential.
- Must list cure method (e.g., UV, steam, hot water, etc.).
- Must list typical, minimum, maximum application thicknesses.
- Calculated minimum thickness of liner
- Designation of air or water inversion or pull-in-place method
- Maximum allowable pulling force
- Site specific cure time
- Minimum pressure to hold liner tight against the host pipe
- Maximum pressure to ensure liner does not sustain damage
- Maximum and minimum cure temperatures
- Ambient temperature range allowable during installation
- Post cure temperature
- Temperature cure profile.
- Sample of temperature and pressure log to be used for monitoring the curing process
- Certification on manufacturer's letterhead indicating that the contractor is approved by the fabric tube and resin manufacturer to perform CIPP installation work.
- Manufacturer moisture limitations (e.g. installation in the dry, humidity restrictions, etc.).

- Material safety data sheets for all hazardous chemicals that will be used on the job site including resin, catalyst, cleaners, and repair agents. Identify the proposed use for each hazardous chemical and where it will be used in the work.
- Must provide and comply with specification for installation, and provide NCDOT Type 1 or Type 4 Certificates of compliance with material specifications as applicable to the below, or equivalent as approved by the Engineer:
    - ASTM D5813
    - ASTM F1216 for inverted CIPP
    - ASTM F1743 for pulled-in-place CIPP
    - ASTM F2019 for pulled-in-place GRP CIPP
    - ASTM F2599 for sectional inverted CIPP (applies to pipe sections, not full length)

- Long Term Modulus of Elasticity for calculations = 150,000 psi. NCDOT Type 2 or Type 5 certifications may be submitted by vendors or contractors for proof of alternate Long Term Modulus of Elasticity extrapolated from ASTM D2990, 10000-hour test. Design value of Long Term Modulus of Elasticity may be no greater than 50% of Initial Modulus of Elasticity. Tested value must be greater than or equal to value used in design equations.

- Initial Modulus of Elasticity for calculations = 300,000 psi. NCDOT Type 2 or Type 5 certifications may be submitted by vendors or contractors for proof of alternate Initial Modulus of Elasticity based on ASTM D790. Tested value must be greater than or equal to value used in design equations.

- Long Term Flexural Strength = 2250 psi. NCDOT Type 2 or Type 5 certifications may be submitted by vendors or contractors for proof of alternate Long Term Flexural Strength extrapolated from ASTM D2990, 10000-hour test. Tested value must be greater than or equal to value used in design equations.

When **Category C HDPE, PE, PP, solid wall slip liners** are specified, the liner system supplied by the Contractor shall conform to the following requirements as supported by contract submittals **(NO PVC ALLOWED on this Contract)**:

- Must list host pipe diameter ranges for which the product is applicable.
- Must indicate corrosion potential/acid reaction potential.
- Must be closed profile; i.e. no definable bell and spigot that protrudes from the outer wall of the pipe.
- Certification on manufacturer's letterhead indicating that the contractor is approved by the manufacturer to perform installation work.
- Material safety data sheets for all hazardous chemicals that will be used on the job site. Identify the proposed use for each hazardous chemical and where it will be used in the work.
- Calculated minimum thickness of liner.
- Maximum allowable pulling and/or pushing force
- Grouting mix design and manufacturer recommendations
- Installation procedures and recommendations.
- Must provide inside diameter and outside diameter of pipe.

- Must provide and comply with specification for installation, and provide NCDOT Type 1 or Type 4 Certificates of compliance with material specifications as applicable to the below, or equivalent as approved by the Engineer:
    - ASTM D3350 defines PE cell class referenced below
    - ASTM F714 for solid wall polyethylene min cell classification 345464 and 2–4% carbon black
    - AASHTO M326 for solid wall polyethylene
    - ASTM F585 for polyethylene slip-line
    - ASTM F2620 for polyethylene heat fusion joining

- NCDOT Type 2 or Type 5 certifications must be submitted by vendors or contractors for proof of Long Term Modulus of Elasticity, 50-year sustained loading value, if the following values are not used in design calculations: 22,000 psi shall be used for HDPE, PE, and PP per AASHTO LRFD Bridge Design Specifications 8th ed., Table 12.12.3.3-1.

Category F - Smooth-wall steel pipe liner rehabilitation materials shall conform to 1032-5 of the Standard Specifications, except as altered herein.

Grade B pipe shall be used with minimum wall thicknesses as listed in the *NCDOT Manual for Pipe Rehabilitation*.

The Contractor shall submit the following items to the Engineer:

- Material safety data sheets for all hazardous chemicals that will be used on the job site. Identify the proposed use for each hazardous chemical and where it will be used in the work.
- Grouting mix design and manufacturer recommendations.

III. CONSTRUCTION

Pre-Installation Inspection – The Contractor shall perform a pre-installation video inspection of pipe using NASSCO certified personnel. The camera shall be situated at the centerline of the pipe and shall be mounted on a rubber tired or tracked pipe rover that allows for a 360-degree inspection. Inspection equipment shall be capable of measuring protrusions and obstructions of ½ inch or greater. Provide a pipe profile, on which deflections that may affect the installation of the liner are located and noted. The inspection shall be performed in the presence of the Engineer, unless waived by the Engineer. Dewater the host pipe to the satisfaction of the Engineer, and in accordance with NCDOT Best Management Practices for Construction and Maintenance Activities. A thorough culvert inspection is required to determine the number of existing "pipe to pipe" connections and the extent, if any, of obstruction removal and voids. The inspection shall be performed by experienced personnel trained in locating breaks, obstacles, voids and service connections. Video inspections shall be clearly labeled on the media with the time, date, and location of the pipe inspected. A copy of the video inspection shall be furnished to the Engineer at least 10 days prior to the start of rehabilitative construction. In the event the Contractor's inspection shows the method of rehabilitation the Contractor has selected is no longer viable at that location as verified by the Engineer, the Contractor shall select another allowable method, if specified, from those designated in the Contract.

Pipe Clean-out - The Contractor shall clear the existing pipe(s) designated for rehabilitation of any debris, sediment, protrusions greater than ½ inch in height, and any other potential obstructions prior to the start of rehabilitation efforts. The Contractor shall then thoroughly clean and prepare the host pipe prior to the liner installation. Cleaning shall conform to the recommendations of the liner manufacturer, and any additional requirements of this special provision. In the absence of manufacturer recommendations, the Contractor shall submit his/her proposed method for cleaning and preparing the host pipe for the Engineer's review and acceptance at least 10 working days prior to beginning the work at that location.

Grouting Host Pipe - The Contractor shall perform grouting work described in the contract, prior to pipe liner installation to correct existing deficiencies, such as voids.

Inlet & Outlet Sealing – All pipe liner installations shall be sealed to the host pipe at the terminal ends of the liner to prevent flow between the liner and host pipe.

De-Watering – All pipe liners and grout shall be installed in dry conditions. The Contractor shall de-water by diverting, pumping, or bypassing any water flow through an existing pipe or drainage system prior to and during the lining process. The method of de-watering is to be determined by the contractor but must be approved by the Engineer prior to implementing. No separate measurement or payment will be made for dewatering site as cost shall be included in contract price per linear foot. ((Size inches) Pipe Rehabilitation _____)

Disposal Plan – The Contractor shall submit a Disposal Plan to the Engineer a minimum of 10 days prior to installation. The Disposal Plan shall indicate how by-products and waste are to be contained, captured, transported offsite, and disposed of in accordance with project permits and local, state and federal regulations. It shall be the Contractor's responsibility to report and take appropriate corrective actions to remediate any water quality alteration resulting from lining operations in accordance with project permits and applicable local, state or federal regulations. The cost for such remediation shall be at the Contractor's expense.

Category A – Cured-In-Place Pipe liner method. The Cured-In-Place Pipe liner system shall be fabricated and installed in such a manner as to result in a maintained full contact tight fit to the internal circumference of the host pipe for its entire length. The installation shall adhere to the cure times and temperatures stipulated in the manufacturer's recommended installation and cure specifications and the finished product shall be free of de-lamination, bubbling, rippling or other signs of installation failure.

Install per specification or standard practice for installation (ASTM F1216 inverted CIPP, or F1743 pulled-in-place CIPP, or F2019 pulled-in-place GRP CIPP, or F2599 sectional inverted CIPP for example).

Pulled-in-place liner installation must be accomplished without significant liner twisting or stretching the liner greater than 1% of its original length during installation. At no time shall the pulling force, as measured by a contractor-provided dynamometer or load cell, exceed that established by the liner manufacturer. For liner lengths greater than 100 feet, protect the pipe liner end using a device that uniformly distributes the applied load around the perimeter of the liner.

Curing for styrene-based, epoxy-based, and vinyl ester-based CIPP may be accomplished by water, steam or ultraviolet light and shall be in accordance with the liner manufacturer's recommendations.

Installation and curing requirements of pipe sections shall be in accordance with the manufacturer's recommendations for the specific product, as applicable. The Contractor shall furnish installation and curing requirements for the various flexible liners including individual components of the system, tube type (reinforced or non-reinforced), manufacturer name and type of resin including catalyst, volume of resin required to achieve proper impregnation and curing. All components of the systems shall be as recommended by the manufacturer for the specific system used, and all components shall include lot numbers and expiration dates.

The Contractor shall place an impermeable barrier immediately upstream and downstream of the host pipe, prior to liner insertion, to capture any possible raw resin spillage during installation and shall dispose of any materials in accordance with the submitted disposal plan.

Where the pulled-in-place method of installation is used, the Contractor shall install a semi-rigid plastic slip sheet over any interior portions of the host pipe that could tear the outer film or over any significant voids in the host pipe.

Reconnect the existing storm drain lateral connections immediately after the liner has been cured in place. Use robotic cutting devices to re-establish tie-ins in non-man accessible pipes.

The Contractor shall monitor temperature via a minimum of three thermocouples on the outer surface (interface between the host pipe and liner) of the liner (one each at the upstream and downstream ends and one approximately mid-length of the host pipe). The Contractor shall monitor pressure during inversion and curing and maintain pressure between minimum and maximum allowable pressures as provided by the manufacturer. The Contractor shall automatically log cure time-temperature and time-pressure data at 30 second intervals with a data logger and provide such information in a format acceptable to the Engineer.

Submit the tape and log of recorded temperatures and pressure to the Engineer within 48 hours after completing the resin-curing process.

The Contractor shall thoroughly rinse the cured lined pipe with clean water prior to re-introducing flow.
The Contractor shall capture all cure water and/or steam condensate and rinse water and dispose of, in accordance with the submitted disposal plan.
Within 21 days of completing the resin curing at a given culvert location, submit the test results from an ISO 17025 lab suitable to the Engineer. The report must be signed by a representative of the independent testing lab. The report must include:

- Flexural strength and flexural modulus test results for field samples.
- Thickness measurements for the liner using prepared core samples.
- Description of the defects in the tested samples in terms of the effect on CIPP performance.

Make cured samples from the identical materials (tube, resin and catalyst) to be used for the CIPP. Identify each sample by date, contract number, drainage system number of the corresponding culvert, thickness, name of resin, and name of catalyst.

The samples must be 6 by 16 inches in size: Comply with the following sampling procedures unless UV cured:

- Place 3 aluminum-plate clamped molds, each containing a flat plate sample, inside the downtube when heated circulated water is used, and in the silencer when steam is used during the resin curing period
- Seal each flat plate sample in a heavy-duty plastic envelope inside the mold
- Remove the 3 cured flat plate samples after draining all the moisture from the cured CIPP

If UV cured, comply with field sampling procedures under ASTM F2019, Section 7: Recommended Inspection Practices.

Test the samples for flexural properties under ASTM D790, ASTM D5813, ASTM F1216, ASTM F1743, or ASTM F2019. Verify that physical properties of the field samples comply with the minimum values under:

- ASTM F1216, Table 1 (modified values), for heat cured polyester, vinyl ester, and epoxy resins. The flexural strength must be at least 5,000 psi. The flexural modulus must be at least 300,000 psi.
- ASTM F2019, Table 1, for UV cured CIPP. The flexural strength must be at least 6,500 psi. The flexural modulus must be at least 725,000 psi. Comply with sampling and testing procedures under ASTM F2019, Section 7: Recommended Inspection Practices.

Take core samples in the presence of the Engineer. Comply with the following core sample requirements:

- Take 2 samples. Take the samples at least 1 foot from each end of the culvert at a location near the top of the culvert. Samples must be at least 2 inches in diameter.
- If culvert material is corrugated metal, obtain samples at the corrugation crests.

Prepare the core samples by separating the CIPP material from the culvert material. If heat cured, remove the film from the inner lining or preliner. If UV cured, remove the film from the inner and outer foil.

Measure the thickness of the liner at 3 spots on each sample. If the culvert material is corrugated metal, measure the thickness at 3 spots that are along a line corresponding to the corrugation crests. Calculate the thickness as an average of at least 6 measurements.

If UV cured, comply with sampling and testing procedures under ASTM F2019, Section 7: Recommended Inspection Practices. If the culvert material is corrugated metal, measure the thickness at 3 spots that are along a line corresponding to the corrugation crests. Calculate the thickness as an average of at least 6 measurements.

All voids from core samples are to be filled with TYPE 1 epoxy resin as specified in NCDOT Standard Specifications for Road and Structures (2018)– Section 1081.

CIPP may be rejected if any of:

- Actual temperature and curing time and schedule do not comply with those shown in the authorized work plan
- Pressure deviates more than 1 psi from the required pressure
- At any time during installation the manufacturer's required minimum cool-down time or maximum cool-down rate is violated
- There are defects including:

  - Concentrated ridges, including folds and wrinkles exceeding 8 percent of the CIPP diameter
  - Dry spots
  - Lifts
  - Holes
  - Tears
  - Soft spots
  - Blisters or bubbles
  - Delaminations
  - Gaps in the length of the CIPP
  - Gaps or a loose fit between the exterior of the CIPP and the culvert
- Test results indicate one of the following:
  - If heat cured, 2 of the 3 flat plate samples do not have any of the following:
    - the specified modulus of elasticity
    - the specified flexural strength
    - either the specified modulus of elasticity or the specified flexural strength
  - If UV cured, 2 of the 3 cured samples do not have any of the following:
    - the specified modulus of elasticity
    - the specified flexural strength
    - either the specified modulus of elasticity or the specified flexural strength
- The liner thickness is less than the greater of either one of the following:
  - Specified thickness
  - Calculated minimum thickness shown in your authorized work plan
- Materials and installation methods are not those shown in your authorized installation plan
- Defects are excessive or unrepairable
- CIPP is not continuous or does not fit tightly for the full length of the culvert

If UV cured, and post installation inspections reveal signs of incomplete curing (dripping resin, etc.), contractor will trim liner obscuring uncured liner, re-wet, and re-cure with UV.

Category C – HDPE, PE, or PP solid wall slip liner shall be installed per specification or standard practice for installation (ASTM F585 polyethylene slip-line, ASTM F2620 polyethylene heat fusion joining, for example).

Installation requirements of pipe sections shall be according the manufacturer recommendations for the specific product as applicable. All components of the systems shall be as recommended by the manufacturer for the specific system used, and all components shall include lot numbers.

Before lining, pull or push a mandrel through the existing pipe or perform laser survey to verify liner clearance. The liner must be positioned and secured to facilitate its complete encapsulation by grout. Follow the Manufacturer's recommendations for handling and assembling the pipe, and all provisions included in the design calculations. Reconnect the existing storm drain lateral connections immediately after the liner has been installed in place. Use robotic cutting devices to re-establish tie-ins in non-man accessible pipes. Prior to filling the annular space, connect and seal all laterals between the new liner pipe and the existing lateral.

Grout the entire annular space with non-shrink grout or an expansive admixture approved by the Manufacturer for use with the liner system. In the absence of Manufacturer recommendations for

grout, refer to Section 1003 of Standard Specifications. Provide a minimum annular space of 1 inch for grouting between the new and existing pipes. Provide details on how to hold the liner pipe to line and grade until the grout has set. Ensure the maximum pressure developed by the grout does not exceed the manufacturer's recommendation for the maximum allowable external pressure for the liner pipe. If the volume of the grout used is less than the anticipated (calculated) volume, or an inspection of the relined culvert indicates that there are voids in the annular space, the Contractor must provide the Engineer with a plan to rehabilitate all identified voids. Depending on the location and size of the voids, additional grouting may be required in these areas. This may be accomplished by re-grouting in those areas from within the culvert. The voids must be filled to the satisfaction of the Engineer at no additional cost. Grouting is included with the cost of pipe liner installation.

Lining with HDPE or PP: Field cuts will be permitted only at the terminal ends. No pipe sections less than 3 feet long will be allowed in any lining projects. Perform all butt fusion, welding and extrusion welding of pipe in accordance with the Manufacturer's recommendation. Based on existence of alignment breaks or pinch points in the host pipe, all joints shall be butt fusion welded, or extrusion welded unless alternate joining methods are approved by the Engineer, in which case limit joint separations to less than ½ inch between adjoining sections.

Category F – Smooth wall steel pipe liner rehabilitation methods shall conform to Section 330 of the Standard Specifications, except as altered herein. The work shall be rehabilitation by the insertion of a smooth wall steel pipe into a host pipe. Where field welding is required, pipe shall be joined by butt welds in accordance with AWWA C-206. Field welded butt joints shall be complete joint penetration (CJP) and the adjoining members shall be assembled so that the seams in the adjacent pipe sections are offset from each other by at least five (5) times the thickness of the thinner member.

Welding procedures employed for welding shall be qualified by testing or prequalified in accordance with AWS D1.1

Personnel performing field welding operations shall have been tested and qualified by the Department.

The contractor shall provide a Certified Welding Inspector (CWI) on site during all welding and inspection operations to perform the necessary quality control examinations. Non-destructive testing/examination for testing to include visual outlined in the AWWA C-206 shall be provided at the contractor's expense.

Personnel performing these functions shall be qualified in accordance with AWS QC1 and/or the recommendations of the current edition of ASNT SNT-TC-1A. Radiographic and Hydrostatic testing is not required.

Before lining, pull or push a mandrel through the existing pipe to verify liner clearance. The liner must be positioned and secured to facilitate its complete encapsulation by grout. Follow the Manufacturer's recommendations for handling and assembling the pipe, and all provisions included in the design calculations. Reconnect the existing storm drain lateral connections after the liner has been installed in place. Use robotic cutting devices to re-establish tie-ins in non-man

accessible pipes. Prior to filling the annular space, connect and seal all laterals between the new liner pipe and the existing lateral.

Grout the entire annular space with non-shrink grout approved by the Manufacturer for use with the liner system. In the absence of Manufacturer recommendations for grout, refer to Section 1003 of Standard Specifications. Provide a minimum annular space of 1 inch for grouting between the new and existing pipes. Provide details on how to hold the liner pipe to line and grade until the grout has set. Ensure the maximum pressure developed by the grout does not exceed the manufacturer's recommendation for the maximum allowable external pressure for the liner pipe. If the volume of the grout used is less than the anticipated (calculated) volume, or an inspection of the relined culvert indicates that there are voids in the annular space, the Contractor must provide the Engineer with a plan to rehabilitate all identified voids. Depending on the location and size of the voids, additional grouting may be required in these areas. This may be accomplished by re-grouting in those areas from within the culvert. The voids must be filled to the satisfaction of the Engineer at no additional cost. Grouting is included with the cost of pipe liner installation.

Post Installation Inspection – In addition to the inspection performed by the Department, the Contractor shall perform two post-installation video inspections using NASSCO certified personnel. The first inspection shall take place between 90 and 100 calendar days after completion of installation for each culvert or system to a single outfall. The second inspection shall take place 30 calendar days prior to the end of the liner warranty period (5 years, secured by construction bond). The camera shall be situated at the centerline of the pipe and shall be mounted on a rubber tired or tracked pipe rover that allows for a 360-degree inspection. Inspection equipment shall be capable of measuring protrusions and obstructions of ½ inch or greater. The inspection shall be performed in the presence of the Engineer. Dewater the host pipe to the satisfaction of the Engineer. Video inspections shall be clearly labeled on the media with the time, date, and location of the pipe inspected. A copy of the video inspection shall be furnished to the Engineer prior to acceptance of the work.

The finished liner may be rejected if not continuous over its entire length and free from visual defects such as foreign inclusions, joint separation, cracks, insufficient liner thickness, material loss, roughness, deformation, dry spots, pinholes, insufficient bonding to host pipe, delamination, or other material or installation deficiencies as described herein.

Remedies for rejection of liner - In the event the first post inspection of the installation reveals defects in localized areas of the liner pipe (comprising less than 20 percent of the pipe length) the localized defects shall be repaired as specified by the manufacturer. Where defects occur on 20 percent or more of the pipe length the defects shall be repaired, however, the Contractor will not be allowed to continue with his methodology of installation and/or the liner system used until he/she can demonstrate to the Engineer that he/she has remedied his/her operations to a sufficient level of quality as determined by the engineer. All such remedial efforts shall be at the Contractor's expense. Further failure(s) to perform a proper installation may result in the disallowance of the use of that liner system and an adjustment in the cost or non-payment of the failed installations depending on the severity of the failure.

In the event the first post installation inspection is not conducted until all or most of the locations in the Contract permitting this methodology have been performed, and the inspection reveals defects on 20 percent or more of the host pipe's length, then an adjustment in the cost or non-

payment of the failed installations may be made by the Engineer depending on the severity of the failure.

In the event the second post inspection of the installation reveals defects, the Department may execute the option to call the construction bond to reimburse the Department for repairs or corrections, or to act as an adjustment in the cost, or both.

IV. MEASUREMENT AND PAYMENT

Pre Installation Inspection will be measured and paid for as the actual number of linear feet of pipe inspected, including mobilization of equipment, and production of records. Linear footage is not increased for multiple passes of inspection equipment through a length of pipe.

Pipe Rehabilitation will be measured and paid for as the actual number of linear feet of pipe for the Size, and Method that has been incorporated into the completed and accepted work. Note: At locations shown in the Contract where multiple methods are permitted, the Contractor may select any of the methods specified, however, if only one method is specified, this will be the only method permitted at that location. This price shall include post installation inspection, cleaning and preparation of the host pipe, furnishing and installing the liner, lateral reconnection, coupling and expansion devices, annular cement grout, design (if necessary) and shop drawing preparation, furnishing and installing liner and all components of the liner system, capturing any discharges or releases during installation or curing operations, furnishing any documentation or fees required for effluent or condensate disposal, all testing and sampling including furnishing reports and pre and post installation video inspections, waste disposal costs, excavation, sheeting, shoring, disposing of surplus and unsuitable material; backfilling and backfill material; compaction, restoring existing surfaces, and clearing debris and obstructions.

De-Watering, water diversions or bypasses required to complete Pipe Rehabilitation work shall not be measured or paid separately. All materials, equipment, labor, or other resources required to de-watering a site shall be incidental to the Linear Foot unit cost for Pipe Rehabilitation.

Payment will be made under:

Pay Item	**Pay Unit**
Pre Installation Inspection	Linear Foot
___” Pipe Rehabilitation CIPP Liner	Linear Foot
___” OD Pipe Rehabilitation Solid Wall Thermoplastic Slip Liner	Linear Foot
___” Pipe Rehabilitation Smooth Wall Steel Slip Liner	Linear Foot

SPECIAL PROVISION FOR GROUTING RCP PIPE JOINTS

Description

This work shall consist of the rehabilitation of existing storm water pipe joints, or culverts by the method or methods specified at the designated locations described in the Contract.
This Special Provision includes specifications for grouting and sealing existing pipe joints and filling voids below and around a culvert that have been found during cleaning and inspection or are apparent by ground water intrusion through the pipe joints either mid-pipe or at the ends.
Pipe joint grouting systems used for rehabilitation shall be from the NCDOT Approved Products List and may be subject to limitations for use as specified herein, by site-specific limitations for those locations listed in the Contract, or limitations as shown on the NCDOT Approved Products List. The Contractor shall consult the Contract to determine the method or methods that are permitted at each rehabilitation location.
The Contractor shall receive approval from NCDOT in writing for substituting the type of material specified for any specific location prior to procurement.
The Contractor shall provide contract submittals the Engineer a minimum of 10 days prior to start of installation.

Designated Locations and Allowable Methods Location of pipes to be grouted are shown in the I-4700 Plan Sheets and the Drainage Summary Sheets

Materials

- Hydrophobic Polyurethane Grout (Hydroactive) for joint grouting
  - NSF 61 Potable water approved
  - Contains no volatile solvents
  - Single component
  - High elongation (creates tight seal in moving cracks)
  - Controllable cure time
  - Free foam expansion up to 15 to 20 times its liquid volume
  - Very low viscosity permits injection into hairline cracks
  - Resistant to most corrosive environments

Solids	100%	ASTM D 2369 B
Viscosity at 77 deg. F	150-250 cps	ASTM D 2196 A
Color	Pale Yellow	
Density	9.0 – 9.15 lbs/gal	ASTM D 3574
Flashpoint	>130 deg C	ASTM D 92
Corrosiveness	Non-corrosive	
Influence of pH	No influence between 2-11	
Appearance	Transparent Liquid	
Viscosity at 77 deg. F	5-16 cps	ASTM D 2196
Density	8.50-8.60 lbs/gal	ASTM D 3574
Flashpoint	>200 deg C	ASTM D 92
Influence of pH	No influence when pH < 7	
Density	8.76 – 9.20 lbs/gal	ASTM D 3574
Tensile Strength	174 psi	ASTM D 3574

Elongation	250%	ASTM D 3574
Shrinkage	Less than 4%	ASTM D 1042
Influence of pH	No influence between 2-11	
Toxicity	Non-Toxic	

- Polyurethane elastomeric sealant for joint caulking
  - Premium-grade, high-performance, moisture-cured, 1-component,polyurethane-based, non-sag elastomeric sealant.
  - Meets Federal specification TT-S-00230C, Type II, Class A.
  - Meets ASTM C-920, Type S, Grade NS, Class 35, use T, NT, O, M, G, I;
  - Canadian standard CAN/CGSB 19.13-M87.
  - Designed for all types of joints where maximum depth of sealant will not exceed ½"
  - Suitable for vertical and horizontal joints;
  - Readily placeable at 40°F.
  - Applications as an elastic adhesive between materials with dissimilar coefficients of expansion.
  - Submerged conditions, such as canal and reservoir joints.

Technical Data				
Shelf Life	15 Months			
Storage Conditions	Store at 40° to 95°F (4° - 35°C). Condition material to 65° - 75°F before using.			
Colors				
Application Temperature	40° to 100°F. Sealant should be installed when joint is at mid-range of its anticipated movement.			
Service Range	-40° to 170°F			
Curing Rate	Tack-free time.....4 hours			
	Tack-free to touch.....3 hours			
	Final cure.....4 to 7 days			
Tear Strength (ASTM D-624)	55 lb./in.			
Shore A Hardness (ASTM D-2240)	21 day 40±5			
Tensile Properties (ASTM D-412)	21 day	Tensile Stress		175 psi (1.21 MPa)
		Elongation at Break		550%
		Modulus of Elasticity	25%	35 psi (0.24 MPa)
			50%	60 psi (0.41)
			100%	85 psi (0.59 MPa)
Adhesion in Peel (TT-S-00230C, ASTM C 794)	**Substrate**	**Peel Strength**		**Adhesion Loss**
	Concrete	20 lb.		0%
	Aluminum	20 lb.		0%
	Glass	20 lb.		0%
Weathering Resistance	Excellent			
Chemical Resistance	Good resistance to water, diluted acids, and diluted alkalines			

- Refer to Section 1003 of Standard Specifications

Construction

Prevent the flow of polyurethane grout and cementitious material and water from construction activities into waterways and drainage facilities. Follow provisions of the NCDOT Best Management Practices for Construction and Maintenance Activities manual.

Surfaces and joints to be sealed must be clean and sound. Remove all deteriorated concrete, dirt, oil, grease, sediment, mineral precipitate and other bond-inhibiting materials from the area to be repaired. To ensure optimum repair results, the effectiveness of decontamination and preparation should be assessed by a pull-off test.

If voids are found at open lift holes, utilize existing hole to install grout ports as directed. Otherwise drill port to address voids near joints. Install valves or removable plugs at grout ports. Probe at each grout port location. The probe must be at least 3 feet long, fit through the grout ports, and be rigid enough to sense probe refusal. Grout ports must be watertight.

Follow manufacturer's recommendations for preparation of grout and mixing of accelerator catalyst, surface preparation, storage and handling, and temperature/pH requirements.

Utilizing Hydrophobic Polyurethane Grout inject or pump into voids until it appears that all water and air has been ejected. Where possible, pump until grout escapes from adjacent, unplugged ports or joint. Plug grout ports or close port valves as soon as pumping the grout ceases.

Block or sandbag culvert ends to retain grout during grouting procedure. Remove sandbags or blockages after curing.

Finish grout that surcharges from perforations or cracks to a smooth surface.

The maximum injection pressure at the nozzle must not exceed manufactures recommendation. Pressure shall be monitored by a pressure gauge.

Monitor the culvert for deformation and cracks. If cracking occurs in a concrete culvert, reduce the grout injection pressure. If deformation of the existing structure exceeds 1/2 inch at any location, reduce the injection pressure.

Repair any permanent deformations or cracks resulting from your grouting work. Such work is incidental to grouting.

Once grout is fully cured, excess removed, and surfaces cleaned as noted above, seal joints with Polyurethane Elastomeric Sealant for joint caulking. Consult manufacturer recommendations on priming prior to sealing, maximum thickness and use of backer rods at joints, handling, storage and temperature range for installation and other installation requirements. Avoid air entrapment during filling of joints with sealant.

Measurement and Payment

Record the pre-expansion quantity of grout, and length of joint for sealant, that is installed and submit this quantity. No payment will be made for grout that leaks through to the inside of the culvert. No payment will be made for grout or sealant that is wasted, disposed of, or remaining on hand after completion of the work.

Payment will be made under:

Pay Item	**Pay Unit**
Grouting	Gallons
Sealant	Linear Foot

BRIDGE APPROACH FILLS:
(10-19-10) (Rev. 1-16-18) 422 SP4 R02A

Description

Bridge approach fills consist of backfilling behind bridge end bents with select material or aggregate to support all or portions of bridge approach slabs. Install drains to drain water from bridge approach fills and geotextiles to separate approach fills from embankment fills, ABC and natural ground as required. For bridge approach fills behind end bents with mechanically stabilized earth (MSE) abutment walls, reinforce bridge approach fills with MSE wall reinforcement connected to end bent caps. Construct bridge approach fills in accordance with the contract, accepted submittals and 2018 Roadway Standard Drawing Nos. 422.01 or 422.02 or Roadway Detail Drawing No. 422D10.

Define bridge approach fill types as follows:

Approach Fills – Bridge approach fills in accordance with 2018 Roadway Standard Drawing Nos. 422.01 or 422.02 or Roadway Detail Drawing No. 422D10;

Standard Approach Fill – Type I Standard Bridge Approach Fill in accordance with 2018 Roadway Standard Drawing No. 422.01;

Modified Approach Fill – Type II Modified Bridge Approach Fill in accordance with 2018 Roadway Standard Drawing No. 422.02 and

Reinforced Approach Fill – Type III Reinforced Bridge Approach Fill in accordance with Roadway Detail Drawing No. 422D10.

Materials

Refer to Division 10 of the *2018 Standard Specifications*.

Item	Section
Geotextiles, Type 1	1056
Portland Cement Concrete	1000
Select Materials	1016
Subsurface Drainage Materials	1044

Provide Type 1 geotextile for separation geotextiles and Class B concrete for outlet pads. Use Class V or Class VI select material for standard and modified approach fills. For an approach fill behind a bridge end bent with an MSE abutment wall, backfill the reinforced approach fill with the same aggregate type approved for the reinforced zone in the accepted MSE wall submittal. For MSE wall aggregate, reinforcement and connector materials, see the *Mechanically Stabilized Earth Retaining Walls* provision. Provide PVC pipes, fittings and outlet pipes for subsurface drainage materials. For PVC drain pipes, use pipes with perforations that meet AASHTO M 278.

Construction Methods

Excavate as necessary for approach fills in accordance with the contract. Notify the Engineer when foundation excavation is complete. Do not place separation geotextiles or aggregate until approach fill dimensions and foundation material are approved.

For reinforced approach fills, cast MSE wall reinforcement or connectors into end bent cap backwalls within 3" of locations shown in the accepted MSE wall submittals. Install MSE wall reinforcement with the orientation, dimensions and number of layers shown in the accepted MSE wall submittals. If a reinforced approach fill is designed with geogrid reinforcement embedded in an end bent cap, cut geogrids to the required lengths and after securing ends of geogrids in place, reroll and rewrap portions of geogrids not embedded in the cap to protect geogrids from damage. Before placing aggregate, pull geosynthetic reinforcement taut so that it is in tension and free of kinks, folds, wrinkles or creases.

Attach separation geotextiles to end bent cap backwalls and wing walls with adhesives, tapes or other approved methods. Overlap adjacent separation geotextiles at least 18" with seams oriented parallel to the roadway centerline. Hold geotextiles in place with wire staples or anchor pins as needed. Contact the Engineer when existing or future obstructions such as foundations, pavements, pipes, inlets or utilities will interfere with separation geotextiles or MSE wall reinforcement.

Install continuous perforated PVC drain pipes with perforations pointing down in accordance with 2018 Roadway Standard Drawing Nos. 422.01 or 422.02. Connect drain pipes to outlet pipes just beyond wing walls. Connect PVC pipes, fittings and outlet pipes with solvent cement in accordance with Article 815-3 of the *2018 Standard Specifications* and place outlet pads in accordance with 2018 Roadway Standard Drawing No. 815.03.

Install drain pipes so water drains towards outlets. If the groundwater elevation is above drain pipe elevations, raise drains up to maintain positive drainage towards outlets. Place pipe sleeves in or under wing walls so water drains towards outlets. Use sleeves that can withstand wing wall loads.

Place select material or aggregate in 8" to 10" thick lifts. Compact fine aggregate for reinforced approach fills in accordance with Subarticle 235-3(C) of the *2018 Standard Specifications* except compact fine aggregate to a density of at least 98%. Compact select material for standard or modified approach fills and coarse aggregate for reinforced approach fills with a vibratory compactor to the satisfaction of the Engineer. Do not displace or damage geosynthetics, MSE wall reinforcement or drains when placing and compacting select material or aggregate. End dumping directly on geosynthetics is not permitted. Do not operate heavy equipment on geosynthetics or drain pipes until they are covered with at least 8" of select material or aggregate. Replace any damaged geosynthetics or drains to the satisfaction of the Engineer. When approach fills extend beyond bridge approach slabs, wrap separation geotextiles over select material or aggregate as shown in 2018 Roadway Standard Drawing No. 422.01 or 2018 Roadway Detail Drawing No. 422D10.

Measurement and Payment

Type I Standard Approach Fill, Station ____, *Type II Modified Approach Fill, Station ____* and *Type III Reinforced Approach Fill, Station ____* will be paid at the contract lump sum price. The lump sum price for each approach fill will be full compensation for providing labor, tools, equipment and approach fill materials, excavating, backfilling, hauling and removing excavated materials, installing geotextiles and drains, compacting backfill and supplying select material, aggregate, separation geotextiles, drain pipes, pipe sleeves, outlet pipes and pads and any incidentals necessary to construct approach fills behind bridge end bents.

The contract lump sum price for *Type III Reinforced Approach Fill, Station ____* will also be full compensation for supplying and connecting MSE wall reinforcement to end bent caps but not designing MSE wall reinforcement and connectors. The cost of designing reinforcement and connectors for reinforced approach fills behind bridge end bents with MSE abutment walls will be incidental to the contract unit price for *MSE Retaining Wall No. __*.

Payment will be made under:

Pay Item	Pay Unit
Type I Standard Approach Fill, Station ____	Lump Sum
Type II Modified Approach Fill, Station ____	Lump Sum
Type III Reinforced Approach Fill, Station ____	Lump Sum

ALTERNATE BRIDGE APPROACH FILLS FOR INTEGRAL ABUTMENTS:

(1-16-18) 422 SP4 R02B

Description

At the Contractors option, use Type A Alternate Bridge Approach Fills instead of Type I or II Bridge Approach Fills to support bridge approach slabs for integral bridge abutments. An alternate bridge approach fill consists of constructing an approach fill with a temporary geotextile wall before placing all or a portion of the concrete for the backwall and wing walls of the integral end bent cap. The temporary geotextile wall is designed for a crane surcharge, remains in place and aligned so the wall face functions as a form for the end bent cap backwall and wing walls. Install drains, welded wire facing and geotextiles and backfill approach fills and temporary walls with select material as required. Define "geotextiles" as separation or reinforcement geotextiles, "temporary wall" as a temporary geotextile wall and "alternate approach fill" as a Type A Alternate Bridge Approach Fill in accordance with 2018 Roadway Standard Drawing No. 422.03.

Materials

Refer to Division 10 of the *2018 Standard Specifications*.

Item	Section
Geotextiles	1056
Portland Cement Concrete	1000
Select Materials	1016
Subsurface Drainage Materials	1044
Welded Wire Reinforcement	1070-3

For temporary walls, use welded wire reinforcement for welded wire facing and Type 5 geotextile for reinforcement geotextiles. Use Type 5 geotextile with lengths and an ultimate tensile strength as shown in 2018 Roadway Standard Drawing No. 422.03. Provide Type 1 geotextile for separation geotextiles and Class B concrete for outlet pads. Use Class V or Class VI select material for alternate approach fills and temporary walls. Provide PVC pipes, fittings and outlet pipes for subsurface drainage materials. For PVC drain pipes, use pipes with perforations that meet AASHTO M 278.

Construction Methods

Excavate as necessary for alternate approach fills and temporary walls in accordance with the contract. Notify the Engineer when foundation excavation is complete. Do not place geotextiles until approach fill dimensions and foundation material are approved.

Install geotextiles as shown in 2018 Roadway Standard Drawing No. 422.03. Attach separation geotextiles to end bent cap backwalls and wing walls as needed with adhesives, tapes or other approved methods. Overlap adjacent geotextiles at least 18" with seams oriented parallel to the roadway centerline. Hold geotextiles in place with wire staples or anchor pins as needed. Contact the Engineer when existing or future obstructions such as foundations, pavements, pipes, inlets or utilities will interfere with geotextiles.

Install continuous perforated PVC drain pipes with perforations pointing down in accordance with 2018 Roadway Standard Drawing No. 422.03. Connect drain pipes to outlet pipes just beyond wing walls. Connect PVC pipes, fittings and outlet pipes with solvent cement in accordance with Article 815-3 of the *2018 Standard Specifications* and place outlet pads in accordance with 2018 Roadway Standard Drawing No. 815.03.

Install drain pipes so water drains towards outlets. If the groundwater elevation is above drain pipe elevations, raise drains up to maintain positive drainage towards outlets. Place pipe sleeves in or under wing walls so water drains towards outlets. Use sleeves that can withstand wing wall loads.

At the Contractor's option, construct bottom portion of integral end bents before temporary walls as shown in 2018 Roadway Standard Drawings No. 422.03. Erect and set welded wire facing so facing functions as a form for the end bent cap backwall. Place welded wire facing adjacent to each other in the horizontal and vertical directions to completely cover the temporary wall face. Stagger welded wire facing to create a running bond by centering facing over joints in the row below.

Wrap reinforcement geotextiles at the temporary wall face in accordance with 2018 Roadway Standard Drawing No. 422.03 and cover geotextiles with at least 3" of select material. Place layers of reinforcement geotextiles within 3" of locations shown in 2018 Roadway Standard Drawing No. 422.03. Before placing select material, pull reinforcement geotextiles taut so they are in tension and free of kinks, folds, wrinkles or creases. Install reinforcement geotextiles with the direction shown in 2018 Roadway Standard Drawing No. 422.03. Do not splice or overlap reinforcement geotextiles so seams are parallel to the temporary wall face.

Place select material in 8" to 10" thick lifts and compact select material with a vibratory compactor

to the satisfaction of the Engineer. Do not displace or damage geotextiles or drains when placing and compacting select material. End dumping directly on geotextiles is not permitted. Do not operate heavy equipment on geotextiles or drain pipes until they are covered with at least 8" of select material. Replace any damaged geotextiles or drains to the satisfaction of the Engineer. When alternate approach fills extend beyond bridge approach slabs, wrap separation geotextiles over select material as shown in 2018 Roadway Standard Drawing No. 422.03.

Temporary walls are designed for a surcharge pressure in accordance with 2018 Roadway Standard Drawing No. 422.03. If the crane surcharge will exceed the wall design, contact the Engineer before positioning the crane over reinforcement geotextiles.

Measurement and Payment

Alternate approach fills will be paid at the contract lump sum for either *Type I Standard Approach Fill, Station* ____ or *Type II Modified Approach Fill, Station* ____ based on the approach fill type that the alternate approach fill is replacing. The lump sum price for each approach fill will be full compensation for providing labor, tools, equipment and alternate approach fill materials, excavating, backfilling, hauling and removing excavated materials, constructing temporary walls, installing wall facing, geotextiles and drains, compacting backfill and supplying select material, separation and reinforcement geotextiles, welded wire facing, drain pipes, pipe sleeves, outlet pipes and pads and any incidentals necessary to construct alternate approach fills for integral abutments.

AUTOMATED FINE GRADING:

(1-16-96) 610 SP5 R05

On mainline portions and ramps of this project, prepare the subgrade and base beneath the pavement structure in accordance with the applicable sections of the *2018 Standard Specifications* except use an automatically controlled fine grading machine using string lines, laser controls or other approved methods to produce final subgrade and base surfaces meeting the lines, grades and cross sections required by the plans or established by the Engineer.

No direct payment will be made for the work required by this provision as it will be considered incidental to other work being paid for by the various items in the contract.

AGGREGATE SUBGRADE:

(5-15-18) 505 SP5 R8

Revise the *2018 Standard Specifications* as follows:

Page 5-8, Article 505-1 DESCRIPTION, lines 4-6, replace the paragraph with the following:

Construct aggregate subgrades in accordance with the contract. Install geotextile for soil stabilization and place Class IV subgrade stabilization at locations shown in the plans and as directed.

Undercut natural soil materials if necessary to construct aggregate subgrades. Define “subbase” as the portion of the roadbed below the Class IV subgrade stabilization. For Type 2 aggregate subgrades, undercut subbases as needed. The types of aggregate subgrade with thickness and compaction requirements for each are as shown below.

Type 1 – A 6 to 24 inch thick aggregate subgrade with Class IV subgrade stabilization compacted to 92% of AASHTO T 180 as modified by the Department or to the highest density that can be reasonably obtained.

Type 2 – An 8 inch thick aggregate subgrade on a proof rolled subbase with Class IV subgrade stabilization compacted to 97% of AASHTO T 180 as modified by the Department.

Page 5-8, Article 505-3 CONSTRUCTION METHODS, line 12, insert the following after the first sentence of the first paragraph:

For Type 2 aggregate subgrades, proof roll subbases in accordance with Section 260 before installing geotextile for soil stabilization.

Page 5-8, Article 505-3 CONSTRUCTION METHODS, lines 16-17, replace the last sentence of the first paragraph with the following:

Compact ABC as required for the type of aggregate subgrade constructed.

Page 5-8, Article 505-4 MEASUREMENT AND PAYMENT, line 26, insert the following after the last sentence of the first paragraph:

Undercut Excavation of natural soil materials from subbases for Type 2 aggregate subgrades will be measured and paid in accordance with Article 225-7 or 226-3. No measurement will be made for any undercut excavation of fill materials from subbases.

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 *2018 Standard Specifications.*

The base price index for asphalt binder for plant mix is **$ 524.09** per ton.

This base price index represents an average of F.O.B. selling prices of asphalt binder at supplier's terminals on **May 1, 2019**.

MILLING ASPHALT PAVEMENT:

(1-15-19) 607 SP6 R59

Revise the *2018 Standard Specifications* as follows:

Page 6-5, Article 607-2, EQUIPMENT, lines 14-16, delete the seventh sentence of this Article and replace with the following:

Use either a non-contacting laser or sonar type ski system with a minimum of three referencing stations mounted on the milling machine at a length of at least 24 feet.

ASPHALT CONCRETE PLANT MIX PAVEMENTS:
(2-20-18) (Rev.1-15-19) 610, 1012 SP6 R65

Revise the *2018 Standard Specifications* as follows:

Page 6-14, Table 609-3, LIMITS OF PRECISION FOR TEST RESULTS, replace with the following:

TABLE 609-3 LIMITS OF PRECISION FOR TEST RESULTS	
Mix Property	**Limits of Precision**
25.0 mm sieve (Base Mix)	± 10.0%
19.0 mm sieve (Base Mix)	± 10.0%
12.5 mm sieve (Intermediate & Type P-57)	± 6.0%
9.5 mm sieve (Surface Mix)	± 5.0%
4.75 mm sieve (Surface Mix)	± 5.0%
2.36 mm sieve (All Mixes, except S4.75A)	± 5.0%
1.18 mm sieve (S4.75A)	± 5.0%
0.075 mm sieve (All Mixes)	± 2.0%
Asphalt Binder Content	± 0.5%
Maximum Specific Gravity (G_{mm})	± 0.020
Bulk Specific Gravity (G_{mb})	± 0.030
TSR	± 15.0%
QA retest of prepared QC Gyratory Compacted Volumetric Specimens	± 0.015
Retest of QC Core Sample	± 1.2% (% Compaction)
Comparison QA Core Sample	± 2.0% (% Compaction)
QA Verification Core Sample	± 2.0% (% Compaction)
Density Gauge Comparison of QC Test	± 2.0% (% Compaction)
QA Density Gauge Verification Test	± 2.0% (% Compaction)

Page 6-17, Table 610-1, MIXING TEMPERATURE AT THE ASPHALT PLANT, replace with the following:

TABLE 610-1 MIXING TEMPERATURE AT THE ASPHALT PLANT	
Binder Grade	**JMF Temperature**
PG 58-28; PG 64-22	250 - 290°F
PG 76-22	300 - 325°F

Page 6-17, Subarticle 610-3(C), Job Mix Formula (JMF), lines 38-39, delete the fourth paragraph.

Page 6-18, Subarticle 610-3(C), Job Mix Formula (JMF), line 12, replace "SF9.5A" with "S9.5B".

Page 6-18, Table 610-3, MIX DESIGN CRITERIA, replace with the following:

TABLE 610-3
MIX DESIGN CRITERIA

Mix Type	Design ESALs millions [A]	Binder PG Grade	Compaction Levels G_{mm} @ N_{ini}	Compaction Levels G_{mm} @ N_{des}	Max. Rut Depth (mm)	Volumetric Properties [B] VMA % Min.	VTM %	VFA Min.-Max.	%G_{mm} @ N_{ini}
S4.75A	< 1	64 - 22	6	50	11.5	16.0	4.0 - 6.0	65 - 80	≤ 91.5
S9.5B	0 - 3	64 - 22	6	50	9.5	16.0	3.0 - 5.0	70 - 80	≤ 91.5
S9.5C	3 - 30	64 - 22	7	65	6.5	15.5	3.0 - 5.0	65 - 78	≤ 90.5
S9.5D	> 30	76 - 22	8	100	4.5	15.5	3.0 - 5.0	65 - 78	≤ 90.0
I19.0C	ALL	64 - 22	7	65	-	13.5	3.0 - 5.0	65 - 78	≤ 90.5
B25.0C	ALL	64 - 22	7	65	-	12.5	3.0 - 5.0	65 - 78	≤ 90.5
	Design Parameter					**Design Criteria**			
All Mix Types	Dust to Binder Ratio ($P_{0.075}$ / P_{be})					0.6 - 1.4 [C]			
	Tensile Strength Ratio (TSR) [D]					85% Min. [E]			

A. Based on 20 year design traffic.
B. Volumetric Properties based on specimens compacted to N_{des} as modified by the Department.
C. Dust to Binder Ratio ($P_{0.075}$ / P_{be}) for Type S4.75A is 1.0 - 2.0.
D. NCDOT-T-283 (No Freeze-Thaw cycle required).
E. TSR for Type S4.75A & B25.0C mixes is 80% minimum.

Page 6-20, Table 610-5, BINDER GRADE REQUIREMENTS (BASED ON RBR%), replace with the following:

TABLE 610-5
BINDER GRADE REQUIREMENTS (BASED ON RBR%)

Mix Type	%RBR ≤ 20%	21% ≤ %RBR ≤ 30%	%RBR ≥ 30%
S4.75A, S9.5B, S9.5C, I19.0C, B25.0C	PG 64-22	PG 64-22[A]	PG-58-28
S9.5D, OGFC	PG 76-22[B]	n/a	n/a

A. If the mix contains any amount of RAS, the virgin binder shall be PG 58-28.
B. Maximum Recycled Binder Replacement (%RBR) is 18% for mixes using PG 76-22 binder.

Page 6-20, Table 610-6, PLACEMENT TEMPERATURES FOR ASPHALT, replace with the following:

TABLE 610-6
PLACEMENT TEMPERATURES FOR ASPHALT

Asphalt Concrete Mix Type	Minimum Surface and Air Temperature
B25.0C	35°F
I19.0C	35°F
S4.75A, S9.5B, S9.5C	40°F [A]
S9.5D	50°F

A. For the final layer of surface mixes containing recycled asphalt shingles (RAS), the minimum surface and air temperature shall be 50°F.

Page 6-21, Article 610-8, SPREADING AND FINISHING, lines 34-35, delete the second sentence and replace with the following:

Use an MTV for all surface mix regardless of binder grade on Interstate, US Routes, and NC Routes (primary routes) that have 4 or more lanes and median divided.

Page 6-21, Article 610-8, SPREADING AND FINISHING, lines 36-38, delete the fourth sentence and replace with the following:

Use MTV for all ramps, loops, Y-line that have 4 or more lanes and are median divided, full width acceleration lanes, full width deceleration lanes, and full width turn lanes that are greater than 1000 feet in length.

Page 6-23, Table 610-7, DENSITY REQUIREMENTS, replace with the following:

TABLE 610-7 DENSITY REQUIREMENTS	
Mix Type	**Minimum % G_{mm} (Maximum Specific Gravity)**
S4.75A	85.0 [A]
S9.5B	90.0
S9.5C, S9.5D, I19.0C, B25.0C	92.0

A. Compaction to the above specified density will be required when the S4.75A mix is applied at a rate of 100 lbs/sy or higher.

Page 6-24, Article 610-13, FINAL SURFACE TESTING, lines 35-36, delete the second sentence and replace with the following:

Final surface testing is not required on ramps, loops and turn lanes.

Page 6-26, Subarticle 610-13(A)(1), Acceptance for New Construction, lines 29-30, delete the second sentence and replace with the following:

Areas excluded from testing by the profiler may be tested using a 10-foot straightedge in accordance with Article 610-12.

Page 6-27, Subarticle 610-13(B), Option 2- North Carolina Hearne Straightedge, lines 41-46, delete the eighth and ninth sentence of this paragraph and replace with the following:

Take profiles over the entire length of the final surface travel lane pavement exclusive of structures, approach slabs, paved shoulders, tapers, or other irregular shaped areas of pavement, unless otherwise approved by the Engineer. Test in accordance with this provision all mainline travel lanes, full width acceleration or deceleration lanes and collector lanes.

Page 6-28, Subarticle 610-13(B), Option 2- North Carolina Hearne Straightedge, lines 1-2, delete these two lines.

Page 6-32, Article 610-16 MEASUREMENT AND PAYMENT, replace with the following:

Pay Item	**Pay Unit**
Asphalt Concrete Base Course, Type B25.0C	Ton
Asphalt Concrete Intermediate Course, Type I19.0C	Ton
Asphalt Concrete Surface Course, Type S4.75A	Ton
Asphalt Concrete Surface Course, Type S9.5B	Ton

Asphalt Concrete Surface Course, Type S9.5C	Ton
Asphalt Concrete Surface Course, Type S9.5D	Ton

Page 10-30, Table 1012-1, AGGREGATE CONSENSUS PROPERTIES, replace with the following:

TABLE 1012-1
AGGREGATE CONSENSUS PROPERTIES[A]

Mix Type	Coarse Aggregate Angularity[B]	Fine Aggregate Angularity % Minimum	Sand Equivalent % Minimum	Flat and Elongated 5 : 1 Ratio % Maximum
Test Method	*ASTM D5821*	*AASHTO T 304*	*AASHTO T 176*	*ASTM D4791*
S4.75A; S9.5B	75 / -	40	40	-
S9.5C; I19.0C; B25.0C	95 / 90	45	45	10
S9.5D	100 / 100	45	50	10
OGFC	100 / 100	45	45	10
UBWC	100 / 85	45	45	10

A. Requirements apply to the design aggregate blend.
B. 95 / 90 denotes that 95% of the coarse aggregate has one fractured face and 90% has 2 or more fractured faces.

PAVEMENT DESIGN MIX TYPE MODIFICATIONS:

(2-20-18) 610 SP6 R66

Description

In an effort to reduce the number of asphalt concrete pavement mix types, the department has made the following changes:

Where the "Pavement Schedule" in the plans calls for Asphalt Concrete Surface Course Type SF9.5A, Asphalt Concrete Surface Course Type S9.5B shall be used.

Where the "Pavement Schedule" in the plans calls for either Asphalt Concrete Intermediate Course Type B, C or D, Asphalt Concrete Intermediate Course Type I19.0C shall be used.

Where the "Pavement Schedule" in the plans call for Asphalt Concrete Base Course Type B25.0B, Asphalt Concrete Base Course Type B25.0C shall be used.

In addition, see the project special provision entitled "Asphalt Concrete Plant Mix Pavements" contained elsewhere in the proposal.

Measurement and Payment

The pay items in this proposal reflects these changes. The pavement schedule in the plans will not be revised to reflect these changes.

DIAMOND GRINDING CONCRETE PAVEMENT:

(4-15-08) (Rev 08-16-16) SPI 7-9A

Description

Perform the work covered by this provision including but not limited to diamond grinding and regrinding concrete pavement to meet final surface acceptable smoothness requirements detailed in Article 710-7, selecting diamond tipped saw blades and configuration of cutting head; continual removal of residual slurry from pavement and disposal; furnishing all labor, materials, supplies, tools, equipment and incidentals as necessary. Perform this work on all new concrete pavement or as directed by the Engineer.

Prior to beginning any diamond grinding operations, schedule a pre-grind meeting with grinding subcontractor, Division Construction Engineer, Project Engineer, Area Roadway Engineer, State Pavement Construction Engineer, representatives from the Roadside Environmental Unit and the Materials and Tests Unit.

Equipment

Use equipment with diamond tipped saw blades gang mounted on a power driven self-propelled machine with a minimum wheel base length of 15 feet that is specifically designed to smooth and texture Portland Cement Concrete pavement. Utilize equipment that does not cause ravels; aggregate fracture; spalls or disturbance to the longitudinal or transverse joints; or damage and/or strain to the underlying surface of the pavement. Should any of the above problems occur immediately suspend operations.

Provide a minimum 3 feet wide grinding head with 50 to 60 evenly spaced grooves per foot. Prior to designing the grinding head, evaluate the aggregate hardness of the concrete pavement and select the appropriate diamond size, diamond concentration and bond hardness for the individual saw blades.

Provide vacuuming equipment to continuously remove slurry residue and excess water from the pavement as part of the grinding operation. Transport slurry material off-site and dispose of this material appropriately. Do not allow the slurry material to flow into a travel lane occupied by traffic or into any drainage facility.

Method of Construction

Grind the pavement surface to a uniform appearance with a high skid resistant longitudinal corduroy type texture. Provide grooves between 0.09 and 0.15 inches wide with the land area between the grooves between 0.06 and 0.13 inches wide. Ensure a ridge peak of approximately 0.0625 inches higher than the bottom of the grooves.

Begin and end diamond grinding at lines normal to the pavement centerline. Grind only in the longitudinal direction. All grooves and adjacent passes shall be parallel to each other with no variation. Completely lap adjacent passes with no unground surface remaining between passes and no overlap of more than 1½ inches. Adjacent passes shall be within 1/8 inch of the same

height as measured with a 3 foot straightedge. Maintain positive cross-slope drainage for the duration of the grinding operation.

Grind all travel lanes to include auxiliary lanes, ramps and loops with not less than 98 percent of the specified surface being textured by grinding. Grinding of the bridge decks and concrete shoulders will not be required. Remove a minimum 0.0625 inches at all locations except dips. Extra grinding to eliminate minor depressions is not required. It is anticipated that extra grinding will be required on the high side of existing faults in the pavement. There shall be no ridge between lanes. In a separate operation, transition the grinding of any remaining ridges greater than 1/8 inch in height on the outside edge next to the shoulder or at a tie to an existing facility to the satisfaction of the Engineer.

Final surface testing is required on this project in accordance with Article 710-7 of the *2012 Standard Specifications.*

Disposal of Residual Slurry

Diamond grinding slurry disposal shall be in accordance with the Statewide Permit for Land Application of Diamond Grinding Slurry (DGS), Permit No. WQ0035749 dated June 3, 2014. Submit a slurry disposal plan to the Engineer detailing method of handling and disposing of slurry from the diamond grinding operation a minimum of 60 days prior to beginning the diamond grinding operation. Engineer shall review the slurry disposal plan. Plan must be accepted prior to beginning the diamond grinding operation. DGS shall be transported beyond the project limits to an approved permitted site. No additional payment will be made for transporting this slurry material for disposal.

Disposal options are:

(A) Concrete grinding residues (CGR) that are not liquid and otherwise not hazardous may be disposed of in a municipal solid waste landfill or utilized as an alternate daily cover (ADC). The sanitary landfill operator that requests the use of this material as ADC shall contact the N.C. Department of Environmental Quality (DEQ) inspector for approval. The definition of a solid, for solid waste disposal purposes, is a material that passes a Paint Filter test. CGR's may be eligible for disposal or use as ADC in an unlined sanitary landfill or a construction and demolition debris landfill. If CGR is disposed in an unlined-landfill, the Contractor shall submit samples of the material to a certified laboratory to verify that the CGR does not exceed Resource Conservation and Recovery Act (RCRA) regulatory limits for the following metals: Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium and Silver.

(B) Upon the Engineer's approval, dewatered CGR's may be beneficially reused within the DOT project boundary or areas under DOT control at agronomic rates suitable for the establishment of vegetation. Dewatered CGR's that meet the solid waste definition for inert debris, North Carolina General Statute 130A-290(a)(14), may also be used within the roadbed at rates approved by the Engineer for soil modification purposes. If CGR is disposed as beneficial reuse within DOT project boundaries, the Contractor shall submit samples of the material to a certified laboratory to verify that the CGR does not exceed

RCRA regulatory limits for the following metals: Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium and Silver.

To prevent the migration of any direct discharge from the diamond grinding machine DGS from entering a drainage inlet or structure, the contractor shall install coir fiber wattles and silt fence at the direction of the Engineer. Silt Fence shall be installed in accordance with Section 1605 of the NCDOT *2018 Standard Specifications*

Measurement and Payment

The quantity of *Diamond Grinding PCC Pavement* to be paid for will be the actual number of square yards of pavement which has been satisfactorily diamond ground, measured along the final top surface of the pavement. No separate payment will be made for any overlapping, regrinding, or for extra grinding on the high side of existing faults.

Payment will be full compensation for the work, including but is not limited to grinding, disposal of slurry, final surface testing, furnishing all materials, equipment, labor and all incidentals necessary to satisfactorily complete the work.

Payment will be made under:

Pay Item	**Pay Unit**
Diamond Grinding PCC Pavement	Square Yard

13.5" STAMPED CONCRETE PAVEMENT

Description

Furnish and install 13.5" Stamped Concrete Pavement in accordance with Section 710 of the Standard Specifications, this provision, and as directed by the Engineer.

Materials

Concrete Pavement materials shall be in accordance with Article 710-2 of the *Standard Specifications*.

Stamping materials shall be in accordance with the manufacturer's recommendations.

Construction Methods

Concrete Pavement construction shall be in accordance with Section 710 of the *Standard Specifications*.

Concrete shall be finished with a stamped red brick/black joint pattern. The pattern and color shall be approved by the Engineer prior to construction.

Measurement and Payment

Stamped Concrete will be in the actual number of square yards of concrete pavement completed and accepted. In measuring this quantity, the width of the pavement will be as called for on the plans or as directed. The length will be the actual length constructed, measured along the centerline of the pavement.

Payment will be made under:

Pay Item	**Pay Unit**
Stamped Concrete	Square Yard

AUTOMATED MACHINE GUIDANCE

(1-2-11) 801 SP8 R01

General

This Special Provision contains requirements to be followed if the Contractor elects to use Global Positioning System (GPS) machine control grading and shall be used in conjunction with Section 801 of the *Standard Specifications*. The use of this technology is referenced as Automated Machine Guidance (AMG).

All equipment using AMG shall be able to generate end results that meet the *Standard Specifications*. Perform test sections for each type of work to be completed with AMG to demonstrate that the system has the capability to achieve acceptable results. If acceptable results cannot be achieved, conform to the requirements for conventional stakeout.

The Contractor shall be responsible for all errors resulting from the use of AMG and shall correct deficiencies to the satisfaction of the Engineer at no cost to the Department.

Submittals

If the Contractor elects to use AMG, a Digital Terrain Model (DTM) of the design surface and all intermediate surfaces shall be developed and submitted to the Engineer for review.

At least 90 days prior to beginning grading operations, the Contractor shall submit to the Engineer an AMG work plan to include, but not limited to, proposed equipment, control software manufacturer and version, types of work to be completed using AMG, project site calibration report, repetitive calibration methods for construction equipment and rover units to be used for the duration of the project, and local GPS base station to be used for broadcasting differential correction data to rover units (this may include the NC Network RTK). All surveys must be tied to existing project control as established by NCDOT.

Inspection

The Engineer will perform quality assurance checks of all work associated with AMG. If it is determined that work is not being performed in a manner that will assure accurate results, the Engineer may require corrective action at no cost to the Department.

The Contractor shall provide the Engineer with two (2) GPS rover unit for use during the duration of the contract. The rover will be loaded with the same model that is used with the AMG and have the same capability as rover units used by the Contractor. The rover will be kept in the possession of the Engineer and will be returned to the Contractor upon completion of the contract. Any maintenance or repairs required for the rover will be the responsibility of the Contractor. Formal training of at least 8 hours shall be provided to the Engineer by the Contractor on the use of the proposed AMG system.

Subgrade and Base Controls

If the Contractor elects to use AMG for fine grading and placement of base or other roadway materials, the GPS shall be supplemented with a laser or robotic total station. Include details of the proposed system in the AMG work plan. In addition, the following requirements apply for the use of AMG for subgrade and base construction.

Provide control points at intervals along the project not to exceed 1,000 feet. The horizontal position of these points shall be determined by static GPS sessions or by traverse connection from the original base line control points. The elevation of these control points shall be established using differential leveling from project benchmarks, forming closed loops where practical. A copy of all new control point information shall be provided to the Engineer prior to construction activities.

Provide control points and conventional survey grade stakes at 500 foot intervals and at critical points such as, but not limited to, PCs, PTs, superelevation transition points, and other critical points as requested by the Engineer.

Provide hubs at the top of the finished subgrade at all hinge points on the cross section at 500 foot intervals. These hubs shall be established using conventional survey methods for use by the Engineer to check the accuracy of construction.

Measurement and Payment

No direct payment will be made for work required to utilize this provision. All work will be considered incidental to various grading operations.

C.S. SLOTTED DRAIN:

Description

Furnish and install __" C. S. Slotted Drain, __" Thick, that has been fabricated in accordance with the requirements of Section 310 of the *Standard Specifications* and the details in the plans. Install the slotted drain in accordance with the requirements of Section 300 of the *Standard Specifications* except as noted in this provision. Embed the slotted drain in a bedding of lean grout, consisting of a mixture of 1 part portland cement to 6 parts of mortar sand with no more water added than is necessary to make a workable mixture.

Measurement and Payment

__ *" C. S. Slotted Drain, __"* will be measured and paid for as the actual number of linear feet of slotted drain which have been incorporated into the completed and accepted work. Measurement will be made in accordance with Article 310-6. Such price and payment will be full compensation for all work, including but not limited to furnishing, hauling, placing the slotted drain, bedding the drain in grout, making all joint connections, all excavation and backfill.

Payment will be made under:

Pay Item	Pay Unit
__ " C. S. Slotted Drain, __" Thick	Linear Foot

ENERGY DISSIPATOR:

(1-1-02) SPI

Description

Construct a concrete energy dissipator according to the details and in the locations shown on the plans. Provide all excavation, backfill, labor and material to complete this item of work. Structure may be cast-in-place or precast.

Material

Provide all material in accordance with Section 840-2 or Section 1077-3 as applicable. Use Class B concrete for cast-in-place or 4000 psi (27.6 Mpa) for precast.

Construction Methods

Perform all work in accordance with Section 840 or Section 1077 of the *Standard Specifications* as applicable.

Measurement and Payment

Energy Dissipator will be measured and paid for on an each basis completed and accepted.

Payment will be made under:

Pay Item	Pay Unit
Energy Dissipator	Each

MEDIAN HAZARD PROTECTION

Description

Furnish and install *Median Hazard Protection* at the concrete barrier transition sections as shown on the plans in accordance with the detail in the plans and as directed by the Engineer.

Measurement and Payment

Median Hazard Protection will be measured and paid for per linear foot that are completed and accepted. Such price and payment will be full compensation for all labor, materials (including, but not limited to concrete barrier, earth material, #57 stone, concrete cover, galvanized bar and grout) and all incidentals necessary construct the Median Hazard Protection.

Concrete barrier transition sections will be measured and paid for as provided elsewhere in the contract. No separate measurement or payment will be made for concrete cover at barrier transition sections as the cost of such shall be included in the unit price bid per each for *Concrete Barrier Transition Section.*

Payment will be made under:

Pay Item	**Pay Unit**
Median Hazard Protection	Linear Foot

CONCRETE CAP FOR SINGLE FACED BARRIER FILL

Description

Furnish and install *Concrete Cap for Single Faced Barrier Fill* as shown on the plans, in accordance with the detail in the plans, and as directed by the Engineer.

Measurement and Payment

Concrete Cap for Single Faced Barrier Fill will be measured and paid for per linear foot that are completed and accepted. Such price and payment will be full compensation for all labor, materials (including, but not limited to concrete barrier, earth material, #57 stone, and concrete cover) and all incidentals necessary to construct the Concrete Cap for Single Faced Barrier Fill.

Payment will be made under:

Pay Item	**Pay Unit**
Concrete Cap for Single Faced Barrier Fill	Linear Foot

GUARDRAIL END UNITS, TYPE - TL-3:

(4-20-04) (Rev. 7-1-17) 862 SP8 R65

Description

Furnish and install guardrail end units in accordance with the details in the plans, the applicable requirements of Section 862 of the *2018 Standard Specifications*, and at locations shown in the plans.

Materials

Furnish guardrail end units listed on the NCDOT Approved Products List at https://apps.dot.state.nc.us/vendor/approvedproducts/ or approved equal.

Prior to installation the Contractor shall submit to the Engineer:

(A) FHWA acceptance letter for each guardrail end unit certifying it meets the requirements of the AASHTO Manual for Assessing Safety Hardware, Test Level 3, in accordance with Article 106-2 of the *2018 Standard Specifications*.

(B) Certified working drawings and assembling instructions from the manufacturer for each guardrail end unit in accordance with Article 105-2 of the *2018 Standard Specifications*.

No modifications shall be made to the guardrail end 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 *2018 Standard Specifications* and is incidental to the cost of the guardrail end unit.

Measurement and Payment

Measurement and payment will be made in accordance with Article 862-6 of the *2018 Standard Specifications*.

Payment will be made under:

Pay Item	**Pay Unit**
Guardrail End Units, Type TL-3	Each

GUARDRAIL ANCHOR UNITS AND TEMPORARY GUARDRAIL ANCHOR UNITS:

(1-16-2018) 862 SP8 R70

Guardrail anchor units will be in accordance with the details in the plans and the applicable requirements of Section 862 of the *2018 Standard Specifications*.

Revise the *2018 Standard Specifications* as follows:

Page 8-42, Article 862-6 MEASUREMENT AND PAYMENT, add the following:

Guardrail Anchor Units, Type ___ and Temporary Guardrail Anchor Units Type ___ will be measured and paid as units of each completed and accepted. No separate measurement will be made of any rail, terminal sections, posts, offset blocks, concrete, hardware or any other components of the completed unit that are within the pay limits shown in the plans for the unit as all such components will be considered to be part of the unit.

Payment will be made under:

Pay Item	Pay Unit
Guardrail Anchor Units, Type ____	Each
Temporary Guardrail Anchor Units, Type ___	Each

TEMPORARY WOVEN WIRE FENCE:

(7-1-95) (Rev. 1-19-16) 866 SP8 R85

Description

Construct a temporary woven wire fence, posts, gates, and barbed wire at locations shown on the plans.

Materials

Use only fabric and posts that have been approved by the Engineer. Materials shall meet the requirements of Article 866-2 of the *2018 Standard Specifications*.

Construction Methods

Construct the fence in accordance with Subarticle 866-3(C) and the *Roadway Standard Drawing* 866.02. The fence shall be maintained with fabric taut and securely fastened to the posts at all times. Barbed wire shall be installed along the top of the posts and at any ditch locations as determined by the Engineer.

After the fence has served its purpose and is no longer needed, as determined by the Engineer, it will become the property of the Contractor and shall be removed and disposed of by him.

Measurement and Payment

Temporary __" Woven Wire Fence, Complete with Posts will be measured and paid as the actual number of linear feet of fence constructed and accepted, measured in place from center of end post to center of end post. Such price and payment will be full compensation for all materials, labor, fence maintenance, and incidentals including fence, posts, gates, and barbed wire necessary to satisfactorily complete the work.

Payment will be made under:

Pay Item	Pay Unit
Temporary __" Woven Wire Fence, Complete with Posts	Linear Foot

16’ STEEL PIPE GATE

Description

Furnish and install a welded steel pipe access gate in accordance with the plans and details, and as directed by the Engineer.

Measurement and Payment

16' Steel Pipe Gate will be measured and paid for as the actual number gates installed and accepted. Such price and payment shall be full compensation for fabricating, furnishing, installing and all incidentals necessary to satisfactorily install each gate.

Payment will be made under:

Pay Item	Pay Unit
16' Steel Pipe Gate	Each

FOUNDATIONS AND ANCHOR ROD ASSEMBLIES FOR METAL POLES:

(1-17-12) (Rev. 1-16-18) 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 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 foundations for signal pedestals; see Section 1743 of the *2018 Standard Specifications* and 2018 Roadway Standard Drawing No. 1743.01.

Materials

Refer to the *2018 Standard Specifications*.

Item	Section
Conduit	1091-3
Grout, Type 2	1003
Polymer Slurry	411-2(B)(2)
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 *2018 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 *2018 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 *2018 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 *2018 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 the required slurry properties at all times 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 polymer 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 *2018 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 *2018 Standard Specifications*. A drilled pier will be considered defective in accordance with Subarticle 411-5(D) of the *2018 Standard Specifications* and drilled pier acceptance is based in part on the criteria in Article 411-6 of the *2018 Standard Specifications* except for the top of pier tolerances in Subarticle 411-6(C) of the *2018 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 *2018 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 *2018 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 *2018 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. Place concrete against undisturbed soil or backfill and fill in accordance with Article 410-8 of the *2018 Standard Specifications*. Proper compaction around footings and wings is critical for foundations to resist uplift and torsion forces.

(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 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 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 *2018 Standard Specifications*. No payment will be made for remediation of unacceptable drilled piers or post repair testing.

OVERHEAD AND DYNAMIC MESSAGE SIGN FOUNDATIONS:

(1-16-18) SP9 R07

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.

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 pcf,
(B) Friction angle (ϕ) = 30°,
(C) Cohesion (c) = 0 psf and
(D) Groundwater 7 feet 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 feet 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 *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 psf 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 2016 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 *2018 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 in 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, supplying and placing 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 *2018 Standard Specifications*.

Payment will be made under:

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

THERMOPLASTIC PAVEMENT MARKING MATERIAL – COLOR TESTING:

3-19-19 1087 SP10 R05

Revise the *2018 Standard Specifications* as follows:

Pages 10-183 and 10-184, Subarticle 1087-7(D)(1)(b) Yellow, lines 9-11, delete and replace with the following:

Obtain Color Values Y,x,y per ASTM E1349 using C/2° illuminant/observer.
Results shall be Y ≥ 45%, and x,y shall fall within PR#1 chart chromaticity limits.

POLYUREA PAVEMENT MARKING MATERIAL – TYPE 2 TYPICAL CERTIFIED MILL TEST REPORT:

3-19-19 1087 SP10 R06

Amend the *2018 Standard Specifications* as follows:

Page 10-184, Subarticle 1087-8 Material Certification, in accordance with Subarticle 106-3 provide a Type 2 Typical Certified Mill Test Report and a Type 3 Manufacturer's Certification for Polyurea pavement marking material.

When tested, the material shall meet the physical and chemical characteristics provided by the manufacturer. NCDOT reserves the right to compare these test results to baseline test results gathered by the NCDOT Materials and Test Unit.

TEMPORARY SHORING:

(2-20-07) (Rev. 1-16-18) SP11 R02

Description

Temporary shoring includes cantilever, braced and anchored shoring and temporary mechanically stabilized earth (MSE) walls. Temporary shoring does not include trench boxes. At the Contractor's option, use any type of temporary shoring unless noted otherwise in the plans or as directed. Design and construct temporary shoring based on actual elevations and shoring dimensions in accordance with the contract and accepted submittals. Construct temporary shoring at locations shown in the plans and as directed. Temporary shoring is required to maintain traffic when a 2:1 (H:V) slope from the top of an embankment or bottom of an excavation will intersect the existing ground line less than 5 feet from the edge of pavement of an open travelway. This provision does not apply to pipe, inlet or utility installation unless noted otherwise in the plans.

Positive protection includes concrete barrier and temporary guardrail. Provide positive protection for temporary shoring at locations shown in the plans and as directed. Positive protection is required if temporary shoring is located in the clear zone in accordance with the *AASHTO Roadside Design Guide.*

(A) Cantilever and Braced Shoring

Cantilever shoring consists of steel sheet piles or H-piles with timber lagging. Braced shoring consists of sheet piles or H-piles with timber lagging and bracing such as beams, plates, walers, struts, rakers, etc. Define "piles" as sheet piles or H-piles.

(B) Anchored Shoring

Anchored shoring consists of sheet piles with walers or H-piles with timber lagging anchored with ground or helical anchors. Driven anchors may be accepted at the discretion of the Engineer. A ground anchor consists of a grouted steel bar or multi-strand tendon with an anchorage. A helical anchor consists of a lead section with a central steel shaft and at least one helix steel plate followed by extensions with only central shafts (no helixes) and an anchorage. Anchorages consist of steel bearing plates with washers and hex nuts for bars or steel wedge plates and wedges for strands. Use a prequalified Anchored Wall Contractor to install ground anchors. Define "anchors" as ground, helical or driven anchors.

(C) Temporary MSE Walls

Temporary MSE walls include temporary geosynthetic and wire walls. Define "temporary wall" as a temporary MSE wall and "Temporary Wall Vendor" as the vendor supplying the temporary MSE wall. Define "reinforcement" as geotextile, geogrid, welded wire grid or metallic strip reinforcement.

Temporary geosynthetic walls consist of geotextile or geogrid reinforcement wrapped behind welded wire facing. Define "temporary geotextile wall" as a temporary geosynthetic wall with geotextile reinforcement and "temporary geogrid wall" as a temporary geosynthetic wall with geogrid reinforcement.

Temporary wire walls consist of welded wire grid or metallic strip reinforcement connected to welded wire facing. Define "Wire Wall Vendor" as the vendor supplying the temporary wire wall.

(D) Embedment

Define "embedment" for cantilever, braced and anchored shoring as the pile depth below the grade in front of shoring. Define "embedment" for temporary walls as the wall height below the grade in front of walls.

(E) Positive Protection

Define "unanchored or anchored portable concrete barrier" as portable concrete barrier (PCB) that meets 2018 Roadway Standard Drawing No. 1170.01. Define "concrete barrier" as unanchored or anchored PCB or an approved equal. Define "temporary guardrail" as temporary steel beam guardrail that meets 2018 Roadway Standard Drawing No. 862.02.

Materials

Refer to the *2018 Standard Specifications*.

Item	Section
Concrete Barrier Materials	1170-2
Flowable Fill, Excavatable	1000-6
Geosynthetics	1056
Neat Cement Grout	1003
Portland Cement Concrete	1000
Select Materials	1016
Steel Beam Guardrail Materials	862-2
Steel Plates	1072-2
Steel Sheet Piles and H-Piles	1084
Untreated Timber	1082-2
Welded Wire Reinforcement	1070-3

Provide Type 6 material certifications for shoring materials in accordance with Article 106-3 of the *2018 Standard Specifications*. Use Class IV select material for temporary guardrail. Use neat cement grout for Type 2 grout for ground anchors. Use Class A concrete that meets Article 450-2 of the *2018 Standard Specifications* or Type 1 grout for drilled-in piles. Provide untreated timber with a thickness of at least 3 inches and a bending stress of at least 1,000 pounds per square inch for timber lagging. Provide steel bracing that meets ASTM A36.

(A) Shoring Backfill

Use Class II, Type 1, Class III, Class V or Class VI select material or material that meets AASHTO M 145 for soil classification A-2-4 with a maximum PI of 6 for shoring backfill except do not use A-2-4 soil for backfill around culverts.

(B) Anchors

Store anchor materials on blocking a minimum of 12 inches 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 anchor materials so materials are kept clean and free of damage. Bent, damaged or defective materials will be rejected.

(1) Ground Anchors

Use high-strength deformed steel bars that meet AASHTO M 275 or seven-wire strands that meet ASTM A886 or Article 1070-5 of the *2018 Standard Specifications*. Splice bars in accordance with Article 1070-9 of the *2018 Standard Specifications*. Do not splice strands. Use bondbreakers, spacers and centralizers that meet Article 6.3.5 of the *AASHTO LRFD Bridge Construction Specifications*.

(2) Helical Anchors

Use helical anchors with an ICC Evaluation Service, Inc. (ICC-ES) report. Provide couplers, thread bar adapters and bolts recommended by the Anchor Manufacturer to connect helical anchors together and to piles.

(3) Anchorages

Provide steel plates for bearing plates and steel washers, hex nuts, wedge plates and wedges recommended by the Anchor Manufacturer.

(C) Temporary Walls

(1) Welded Wire Facing

Use welded wire reinforcement for welded wire facing, struts and wires. For temporary wire walls, provide welded wire facing supplied by the Wire Wall Vendor or a manufacturer approved or licensed by the vendor. For temporary wire walls with separate reinforcement and facing components, provide connectors (e.g., bars, clamps, plates, etc.) and fasteners (e.g., bolts, nuts, washers, etc.) required by the Wire Wall Vendor.

(2) Geotextiles

Provide Type 2 geotextile for separation and retention geotextiles. Provide Type 5 geotextile for geotextile reinforcement with ultimate tensile strengths in accordance with the accepted submittals.

(3) Geogrid Reinforcement

Use geogrids with a roll width of at least 4 feet and an "approved" or "approved for provisional use" status code. The list of approved geogrids is available from: connect.ncdot.gov/resources/Materials/Pages/Materials-Manual-by-Material.aspx

Provide geogrids for geogrid reinforcement with design strengths in accordance with the accepted submittals. Geogrids are typically approved for ultimate tensile strengths in the machine direction (MD) and cross-machine direction (CD) or short-term design strengths for a 3-year design life in the MD based on material type. Define material type from the website above for shoring backfill as follows:

Material Type	**Shoring Backfill**
Borrow	A-2-4 Soil
Fine Aggregate	Class II, Type 1 or Class III Select Material
Coarse Aggregate	Class V or VI Select Material

(4) Welded Wire Grid and Metallic Strip Reinforcement

Provide welded wire grid and metallic strip reinforcement supplied by the Wire Wall Vendor or a manufacturer approved or licensed by the vendor. Use welded wire grid reinforcement ("mesh", "mats" and "ladders") that meet Article 1070-3 of the *2018 Standard Specifications* and metallic strip reinforcement ("straps") that meet ASTM A572 or A1011.

Preconstruction Requirements

(A) Concrete Barrier

Define "clear distance" behind concrete barrier as the horizontal distance between the barrier and edge of pavement. The minimum required clear distance for concrete barrier is shown in the plans. At the Contractor's option or if the minimum required clear distance is not available, set concrete barrier next to and up against traffic side of temporary shoring except for barrier above temporary walls. Concrete barrier with the minimum required clear distance is required above temporary walls.

(B) Temporary Guardrail

Define "clear distance" behind temporary guardrail as the horizontal distance between guardrail posts and temporary shoring. At the Contractor's option or if clear distance for cantilever, braced and anchored shoring is less than 4 feet, attach guardrail to traffic side of shoring as shown in the plans. Place ABC in clear distance and around guardrail posts instead of pavement. Do not use temporary guardrail above temporary walls.

(C) Temporary Shoring Designs

Before beginning temporary shoring design, survey existing ground elevations in the vicinity of shoring locations to determine actual design heights (H). Submit PDF files of working drawings and design calculations for temporary shoring designs in accordance with Article 105-2 of the *2018 Standard Specifications*. Submit working drawings showing plan views, shoring profiles, typical sections and details of temporary shoring design and construction sequence. Do not begin shoring construction until a design submittal is accepted.

Have cantilever and braced shoring designed, detailed and sealed by an engineer licensed in the state of North Carolina. Use a prequalified Anchored Wall Design Consultant to design anchored shoring. Provide anchored shoring designs sealed by a Design Engineer approved as a Geotechnical Engineer (key person) for an Anchored Wall Design Consultant. Include details in anchored shoring working drawings of anchor locations and lock-off loads, unit grout/ground bond strengths for ground anchors or minimum installation torque and torsional strength rating for helical anchors and if necessary, obstructions extending through shoring or interfering with anchors. Include details in the anchored shoring construction sequence of pile and anchor installation, excavation and anchor testing.

Provide temporary wall designs sealed by a Design Engineer licensed in the state of North Carolina and employed or contracted by the Temporary Wall Vendor. Include details in temporary wall working drawings of geotextile and reinforcement types, locations and directions and obstructions extending through walls or interfering with reinforcement.

(1) Soil Parameters

Design temporary shoring for the assumed soil parameters and groundwater elevations shown in the plans. Assume the following soil parameters for shoring backfill:

(a) Unit weight (γ) = 120 pcf;

(b)

Friction Angle (ϕ)	**Shoring Backfill**
30°	A-2-4 Soil
34°	Class II, Type 1 or Class III Select Material
38°	Class V or VI Select Material

(c) Cohesion (c) = 0 psf.

(2) Traffic Surcharge

Design temporary shoring for a traffic surcharge of 250 pounds per square foot if traffic will be above and within H of shoring. This traffic surcharge does not apply to construction traffic. Design temporary shoring for any construction surcharge if construction traffic will be above and within H of shoring. For LRFD shoring designs, apply traffic (live load) surcharge in accordance with Figure C11.5.5-3 of the *AASHTO LRFD Bridge Design Specifications*.

(3) Cantilever, Braced and Anchored Shoring Designs

Use shoring backfill for fill sections and voids between cantilever, braced and anchored shoring and the critical failure surface. Use concrete or grout for embedded portions of drilled-in H-piles. Do not use drilled-in sheet piles.

Define "top of shoring" for cantilever, braced and anchored shoring as where the grade intersects the back of sheet piles or H-piles and timber lagging. Design cantilever, braced and anchored shoring for a traffic impact load of 2,000 pounds per foot applied 18 inches above top of shoring if concrete barrier is above and next to shoring or temporary guardrail is above and attached to shoring. For anchored shoring designs, apply traffic impact load as horizontal load (P_{H1}) in accordance with Figure 3.11.6.3-2(a) of the AASHTO LRFD specifications.

Extend cantilever, braced and anchored shoring at least 32 inches above top of shoring if shoring is designed for traffic impact. Otherwise, extend shoring at least 6 inches above top of shoring.

Design cantilever, braced and anchored shoring for a maximum deflection of 3 inches if the horizontal distance to the closest edge of pavement or structure is less than H. Otherwise, design shoring for a maximum deflection of 6 inches. Design

cantilever and braced shoring in accordance with the plans and *AASHTO Guide Design Specifications for Bridge Temporary Works*.

Design anchored shoring in accordance with the plans and Article 11.9 of the *AASHTO LRFD Bridge Design Specifications*. Use a resistance factor of 0.80 for tensile resistance of anchors with bars, strands or shafts. Extend the unbonded length for ground anchors and the shallowest helix for helical anchors at least 5 feet behind the critical failure surface. Do not extend anchors beyond right-of-way or easement limits. If existing or future obstructions such as foundations, guardrail posts, pavements, pipes, inlets or utilities will interfere with anchors, maintain a clearance of at least 6 inches between obstructions and anchors.

(4) Temporary Wall Designs

Use shoring backfill in the reinforced zone of temporary walls. Separation geotextiles are required between shoring backfill and backfill, natural ground or culverts along the sides of the reinforced zone perpendicular to the wall face. For Class V or VI select material in the reinforced zone, separation geotextiles are also required between shoring backfill and backfill or natural ground on top of and at the back of the reinforced zone.

Design temporary walls in accordance with the plans and Article 11.10 of the *AASHTO LRFD Bridge Design Specifications*. Embed temporary walls at least 18 inches except for walls on structures or rock as determined by the Engineer. Use a uniform reinforcement length throughout the wall height of at least 0.7H or 6 feet, whichever is longer. Extend the reinforced zone at least 6 inches beyond end of reinforcement. Do not locate the reinforced zone outside right-of-way or easement limits.

Use the simplified method for determining maximum reinforcement loads in accordance with the AASHTO LRFD specifications. For geotextile reinforcement, use geotextile properties approved by the Department or default values in accordance with the AASHTO LRFD specifications. For geogrid reinforcement, use approved geogrid properties available from the website shown elsewhere in this provision. If the website does not list a short-term design strength for an approved geogrid, use a short-term design strength equal to the ultimate tensile strength divided by 3.5 for the geogrid reinforcement. Use geosynthetic properties for the direction reinforcement will be installed, a 3-year design life and shoring backfill to be used in the reinforced zone.

Do not use more than 4 different reinforcement strengths for each temporary geosynthetic wall. Design temporary geotextile walls for a reinforcement coverage ratio (R_c) of 1.0. For temporary geogrid walls with an R_c of less than 1.0, use a maximum horizontal clearance between geogrids of 3 feet and stagger reinforcement so geogrids are centered over gaps in the reinforcement layer below.

For temporary geosynthetic walls, use “L” shaped welded wire facing with 18 to 24 inch long legs. Locate geotextile or geogrid reinforcement so reinforcement

layers are at the same level as the horizontal legs of welded wire facing. Use vertical reinforcement spacing equal to facing height. Wrap geotextile or geogrid reinforcement behind welded wire facing and extend reinforcement at least 3 feet back behind facing into shoring backfill.

For temporary wire walls with separate reinforcement and facing components, attach welded wire grid or metallic strip reinforcement to welded wire facing with a connection approved by the Department. For temporary geogrid and wire walls, retain shoring backfill at welded wire facing with retention geotextiles and extend geotextiles at least 3 feet back behind facing into backfill.

(D) Preconstruction Meeting

The Engineer may require a shoring preconstruction meeting to discuss the construction, inspection and testing of the temporary shoring. If required and if this meeting occurs before all shoring submittals have been accepted, additional preconstruction meetings may be required before beginning construction of temporary shoring without accepted submittals. The Resident, District or Bridge Maintenance Engineer, Area Construction Engineer, Geotechnical Operations Engineer, Contractor and Shoring Contractor Superintendent will attend preconstruction meetings.

Construction Methods

Control drainage during construction in the vicinity of shoring. Direct run off away from shoring and shoring backfill. Contain and maintain backfill and protect material from erosion.

Install positive protection in accordance with the contract and accepted submittals. Use PCB in accordance with Section 1170 of the *2018 Standard Specifications* and 2018 Roadway Standard Drawing No. 1170.01. Use temporary guardrail in accordance with Section 862 of the *2018 Standard Specifications* and 2018 Roadway Standard Drawing Nos. 862.01, 862.02 and 862.03.

(A) Tolerances

Construct shoring with the following tolerances:

(1) Horizontal wires of welded wire facing are level in all directions,

(2) Shoring location is within 6 inches of horizontal and vertical alignment shown in the accepted submittals, and

(3) Shoring plumbness (batter) is not negative and within 2 degrees of vertical.

(B) Cantilever, Braced and Anchored Shoring Installation

If overexcavation behind cantilever, braced or anchored shoring is shown in the accepted submittals, excavate before installing piles. Otherwise, install piles before excavating for shoring. Install cantilever, braced or anchored shoring in accordance with the construction

sequence shown in the accepted submittals. Remove piles and if applicable, timber lagging when shoring is no longer needed.

(1) Pile Installation

Install piles with the minimum required embedment and extension in accordance with Subarticles 450-3(D) and 450-3(E) of the *2018 Standard Specifications* except that a pile driving equipment data form is not required. Piles may be installed with a vibratory hammer as approved by the Engineer.

Do not splice sheet piles. Use pile excavation to install drilled-in H-piles. After filling holes with concrete or grout to the elevations shown in the accepted submittals, remove any fluids and fill remaining portions of holes with flowable fill. Cure concrete or grout at least 7 days before excavating.

Notify the Engineer if refusal is reached before pile excavation or driven piles attain the minimum required embedment. When this occurs, a revised design submittal may be required.

(2) Excavation

Excavate in front of piles from the top down in accordance with the accepted submittals. For H-piles with timber lagging and braced and anchored shoring, excavate in staged horizontal lifts with a maximum height of 5 feet. Remove flowable fill and material in between H-piles as needed to install timber lagging. Position lagging with at least 3 inches of contact in the horizontal direction between the lagging and pile flanges. Do not excavate the next lift until timber lagging for the current lift is installed and if applicable, bracing and anchors for the current lift are accepted. Backfill behind cantilever, braced or anchored shoring with shoring backfill.

(3) Anchor Installation

If applicable, install foundations located behind anchored shoring before installing anchors. Fabricate and install ground anchors in accordance with the accepted submittals, Articles 6.4 and 6.5 of the *AASHTO LRFD Bridge Construction Specifications* and the following unless otherwise approved:

(a) Materials in accordance with this provision are required instead of materials conforming to Articles 6.4 and 6.5.3 of the AASHTO LRFD Specifications,

(b) Encapsulation-protected ground anchors in accordance with Article 6.4.1.2 of the AASHTO LRFD specifications are not required, and

(c) Corrosion protection for unbonded lengths of ground anchors and anchorage covers are not required.

(d) Measure grout temperature, density and flow during grouting with at least the same frequency grout cubes are made for compressive strength. Perform density and flow field tests in the presence of the Engineer in accordance with American National Standards Institute/American Petroleum Institute Recommended Practice 13B-1 (Section 4, Mud Balance) and ASTM C939 (Flow Cone), respectively.

Install helical anchors in accordance with the accepted submittals and Anchor Manufacturer's instructions. Measure torque during installation and do not exceed the torsional strength rating of the helical anchor. Attain the minimum required installation torque and penetration before terminating anchor installation. When replacing a helical anchor, embed last helix of the replacement anchor at least 3 helix plate diameters past the location of the first helix of the previous anchor.

(4) Anchor Testing

Proof test and lock-off anchors in accordance with the accepted submittals and Article 6.5.5 of the *AASHTO LRFD Bridge Construction Specifications* except for the acceptance criteria in Article 6.5.5.5. For the AASHTO LRFD specifications, "ground anchor" refers to a ground or helical anchor and "tendon" refers to a bar, strand or shaft.

(a) Anchor Acceptance

Anchor acceptance is based in part on the following criteria.

(i) For ground and helical anchors, total movement is less than 0.04 inches between the 1 and 10 minute readings or less than 0.08 inches between the 6 and 60 minute readings.
(ii) For ground anchors, total movement at maximum test load exceeds 80% of the theoretical elastic elongation of the unbonded length.

(b) Anchor Test Results

Submit PDF files of anchor test records including movement versus load plots for each load increment within 24 hours of completing each row of anchors. The Engineer will review the test records to determine if the anchors are acceptable.

If the Engineer determines an anchor is unacceptable, revise the anchor design or installation methods. Submit a revised anchored shoring design for acceptance and provide an acceptable anchor with the revised design or installation methods. If required, replace the anchor or provide additional anchors with the revised design or installation methods.

(C) Temporary Wall Installation

Excavate as necessary for temporary walls in accordance with the plans and accepted submittals. If applicable, install foundations located in the reinforced zone before placing shoring backfill or reinforcement unless otherwise approved. Notify the Engineer when foundation excavation is complete. Do not place shoring backfill or reinforcement until excavation dimensions and foundation material are approved.

Erect welded wire facing so the wall position is as shown in the plans and accepted submittals. Set welded wire facing adjacent to each other in the horizontal and vertical direction to completely cover the wall face with facing. Stagger welded wire facing to create a running bond by centering facing over joints in the row below.

Wrap geotextile reinforcement and retention geotextiles behind welded wire facing as shown in the plans and accepted submittals and cover geotextiles with at least 3" of shoring backfill. Overlap adjacent geotextile reinforcement and retention and separation geotextiles at least 18 inches with seams oriented perpendicular to the wall face. Hold geotextiles in place with wire staples or anchor pins as needed.

Place reinforcement within 3 inches of locations shown in the plans and accepted submittals. Before placing shoring backfill, pull reinforcement taut so it is in tension and free of kinks, folds, wrinkles or creases. Install reinforcement with the direction shown in the plans and accepted submittals. For temporary wire walls with separate reinforcement and facing components, attach welded wire grid or metallic strip reinforcement to welded wire facing as shown in the accepted submittals. Do not splice or overlap reinforcement so seams are parallel to the wall face. Contact the Engineer when unanticipated existing or future obstructions such as foundations, pavements, pipes, inlets or utilities will interfere with reinforcement.

Place shoring backfill in the reinforced zone in 8 to 10 inch thick lifts. Compact A-2-4 soil and Class II, Type 1 and Class III select material in accordance with Subarticle 235-3(C) of the *2018 Standard Specifications*. Use only hand operated compaction equipment to compact backfill within 3 feet of welded wire facing. At a distance greater than 3 feet, compact shoring backfill with at least 4 passes of an 8 to 10 ton vibratory roller in a direction parallel to the wall face. Smooth wheeled or rubber tired rollers are also acceptable for compacting backfill. Do not use sheepsfoot, grid rollers or other types of compaction equipment with feet. Do not displace or damage reinforcement when placing and compacting shoring backfill. End dumping directly on geotextile or geogrid reinforcement is not permitted. Do not operate heavy equipment on reinforcement until it is covered with at least 8 inches of shoring backfill. Replace any damaged reinforcement to the satisfaction of the Engineer.

Backfill for temporary walls outside the reinforced zone in accordance with Article 410-8 of the *2018 Standard Specifications*. Bench temporary walls into the sides of excavations where applicable. For temporary geosynthetic walls with top of wall within 5 feet of finished grade, remove top facing and incorporate top reinforcement layer into fill when placing fill in front of wall. Temporary walls remain in place permanently unless otherwise required.

Measurement and Payment

Temporary Shoring will be measured and paid in square feet. Temporary walls will be measured as the square feet of exposed wall face area. Cantilever, braced or anchored shoring will be measured as the square feet of exposed shoring face area with the shoring height equal to the difference between the top and bottom of shoring elevations. Define "top of shoring" as where the grade intersects the back of sheet piles or H-piles and timber lagging. Define "bottom of shoring" as where the grade intersects front of sheet piles or H-piles and timber lagging. No measurement will be made for any embedment, shoring extension above top of shoring or pavement thickness above temporary walls.

The contract unit price for *Temporary Shoring* will be full compensation for providing shoring designs, submittals and materials, excavating, backfilling, hauling and removing excavated materials and supplying all labor, tools, equipment and incidentals necessary to construct temporary shoring.

No payment will be made for temporary shoring not shown in the plans or required by the Engineer including shoring for OSHA reasons or the Contractor's convenience. No value engineering proposals will be accepted based solely on revising or eliminating shoring locations shown in the plans or estimated quantities shown in the bid item sheets as a result of actual field measurements or site conditions.

PCB will be measured and paid in accordance with Section 1170 of the *2018 Standard Specifications*. No additional payment will be made for anchoring PCB for temporary shoring. Costs for anchoring PCB will be incidental to temporary shoring.

Temporary guardrail will be measured and paid for in accordance with Section 862 of the *2018 Standard Specifications*.

Payment will be made under:

Pay Item	**Pay Unit**
Temporary Shoring	Square Foot

TEMPORARY SHORING FOR DRAINAGE PIPE INSTALLATION

Description

Furnish and install *Temporary Shoring for Drainage Pipe Installation* as cantilever shoring that meets the standard temporary shoring detail (Standard Detail No. 1801.01), this provision, and as directed by the Engineer. Provide positive protection for *Temporary Shoring for Drainage Pipe Installation* at locations shown in the plans and as directed.

Materials

Provide materials in accordance with the special provision for *Temporary Shoring.*

Construction Methods

Construct *Temporary Shoring for Drainage Pipe Installation* in accordance with the special provision for *Temporary Shoring*.

Measurement and Payment

Temporary Shoring for Drainage Pipe Installation will be measured and paid per square foot in accordance with the special provision for Temporary Shoring.

Payment will be made under:

Pay Item	**Pay Unit**
Temporary Shoring for Drainage Pipe Installation	Square Foot

EXTRUDED THERMOPLASTIC PAVEMENT MARKING THICKNESS:

3-19-19 1205 SP12 R05

Revise the *2018 Standard Specifications* as follows:

Page 12-6, Subarticle 1205-4(A)(1) General, lines 5-8, delete the second sentence and replace with the following:

Use application equipment that provides multiple width settings ranging from 4 inches to 12 inches and multiple thickness settings to achieve a minimum pavement marking thickness of 0.090 inch above the surface of the pavement.

Page 12-7, Table 1205-3, THICKNESS REQUIREMENTS FOR THERMOPLASTIC, replace with the following:

TABLE 1205-3
MINIMUM THICKNESS REQUIREMENTS FOR THERMOPLASTIC

Thickness	Location
240 mils	In-lane and shoulder-transverse pavement markings (rumble strips). May be placed in 2 passes.
90 mils	Center lines, skip lines, transverse bands, mini-skip lines, characters, bike lane symbols, crosswalk lines, edge lines, gore lines, diagonals, and arrow symbols

ROADWAY LIGHTING FOUNDATIONS:

(1-16-18) SP14 R04

Description

Roadway lighting foundations include foundations for high mount and light standards. High mount foundations for high mount standards and standard foundations for light standards consist of drilled piers or footings with pedestals, conduit and anchor rod assemblies. Construct roadway lighting foundations in accordance with the contract, *2018 Roadway Standard Drawings* and accepted submittals. Define "high mount foundation" as a drilled pier including the conduit and anchor rod assembly that meets 2018 Roadway Standard Drawing No. 1402.01. Define "standard foundation" as a drilled pier or footing with pedestal including the conduit and anchor rod assembly that meets 2018 Roadway Standard Drawing No. 1405.01.

Materials

Use roadway lighting foundation materials that meet the *Foundations and Anchor Rod Assemblies for Metal Poles* provision. Provide metal shrouds for median mounted light standards in accordance with Subarticle 1400-4(I) of the *2018 Standard Specifications*.

Roadway Lighting Foundations

(A) High Mount Foundations

Construct high mount 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:

(E) Soil with unit weight (γ) $\geq$ 120 pcf and friction angle (ϕ) $\geq$ 30°,
(F) Groundwater at least 7 feet below finished grade and
(G) 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.

(B) Standard Foundations

Construct standard foundation types for the light standard types shown in the plans and the site conditions at each light standard location. When weathered or hard rock, boulders or obstructions conflict with standard foundations, submit an alternate standard foundation design for acceptance in accordance with Article 105-2 of the *2018 Standard Specifications*. No extension of completion date or time will be allowed for alternate standard foundations.

Subsurface 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 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.

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 *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 2016 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 psf for footings. Submit boring logs, working drawings and design calculations for acceptance in accordance with Article 105-2 of the *2018 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.

Construction Methods

Grade around roadway lighting locations with cut and fill slopes as shown on 2018 Roadway Standard Drawing No. 1402.01 or 1405.01. Construct drilled piers, footings and pedestals and install anchor rod assemblies for roadway lighting foundations in accordance with the *Foundations and Anchor Rod Assemblies for Metal Poles* provision.

For median mounted light standards, place concrete for median barriers and underlying pedestals in the same pour. Construct concrete barriers in accordance with the contract and make concrete median barriers continuous through standard foundations. Coordinate construction of median mounted light standards with sign structures, concrete barriers, drainage structures, etc. to avoid conflicts.

Measurement and Payment

High Mount Foundations will be measured and paid in cubic yards. High mount foundations will be measured as the cubic yards of concrete shown on 2018 Roadway 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 in the accepted submittals. 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 *2018 Standard Specifications*.

Standard Foundation ____ will be measured and paid in units of each. Standard foundations will be measured as the number of each standard foundation type. Alternate standard foundations will be measured as 1.5 times the number of each standard foundation type replaced.

The contract unit prices for *High Mount Foundations* and *Standard Foundation* ____ will be full compensation for providing labor, tools, equipment and foundation materials, stabilizing or shoring excavations, supplying and placing concrete, reinforcing steel, conduit, anchor rod assemblies and any incidentals necessary to construct roadway lighting foundations.

Payment will be made under:

Pay Item	**Pay Unit**
High Mount Foundations	Cubic Yard
Standard Foundation ____	Each

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 *2018 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.

IMPACT ATTENUATOR UNITS, TYPE TL-2:

(4-20-04) (Rev. 12-18-18) SP8 R75(Revised)

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

Furnish impact attenuator units listed on the Approved Products List at https://apps.dot.state.nc.us/vendor/approvedproducts/ or approved equal. 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 the Manual for Assessing Safety Hardware (MASH-16), Test Level 2, in accordance with Article 106-2 of the *2018 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 *2018 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 NON-GATING Impact Attenuator Units.

If the median width is greater than 40 feet, the Contractor may use GATING or NON-GATING Impact Attenuator Units.

Measurement and Payment

Impact Attenuator Unit, Type TL-2 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 TL-2	Each

STANDARD SPECIAL PROVISION
AVAILABILITY OF FUNDS – TERMINATION OF CONTRACTS

(5-20-08) Z-2

General Statute 143C-6-11. (h) Highway Appropriation is hereby incorporated verbatim in this contract as follows:

(h) Amounts Encumbered. – Transportation project appropriations may be encumbered in the amount of allotments made to the Department of Transportation by the Director for the estimated payments for transportation project contract work to be performed in the appropriation fiscal year. The allotments shall be multiyear allotments and shall be based on estimated revenues and shall be subject to the maximum contract authority contained in *General Statute 143C-6-11(c)*. Payment for transportation project work performed pursuant to contract in any fiscal year other than the current fiscal year is subject to appropriations by the General Assembly. Transportation project contracts shall contain a schedule of estimated completion progress, and any acceleration of this progress shall be subject to the approval of the Department of Transportation provided funds are available. The State reserves the right to terminate or suspend any transportation project contract, and any transportation project contract shall be so terminated or suspended if funds will not be available for payment of the work to be performed during that fiscal year pursuant to the contract. In the event of termination of any contract, the contractor shall be given a written notice of termination at least 60 days before completion of scheduled work for which funds are available. In the event of termination, the contractor shall be paid for the work already performed in accordance with the contract specifications.

Payment will be made on any contract terminated pursuant to the special provision in accordance with Subarticle 108-13(D) of the *2018 Standard Specifications*.

STANDARD SPECIAL PROVISION
NCDOT GENERAL SEED SPECIFICATION FOR SEED QUALITY

(5-17-11) Z-3

Seed shall be sampled and tested by the North Carolina Department of Agriculture and Consumer Services, Seed Testing Laboratory. When said samples are collected, the vendor shall supply an independent laboratory report for each lot to be tested. Results from seed so sampled shall be final. Seed not meeting the specifications shall be rejected by the Department of Transportation and shall not be delivered to North Carolina Department of Transportation warehouses. If seed has been delivered it shall be available for pickup and replacement at the supplier's expense.

Any re-labeling required by the North Carolina Department of Agriculture and Consumer Services, Seed Testing Laboratory, that would cause the label to reflect as otherwise specified herein shall be rejected by the North Carolina Department of Transportation.

Seed shall be free from seeds of the noxious weeds Johnsongrass, Balloonvine, Jimsonweed, Witchweed, Itchgrass, Serrated Tussock, Showy Crotalaria, Smooth Crotalaria, Sicklepod, Sandbur, Wild Onion, and Wild Garlic. Seed shall not be labeled with the above weed species on the seed analysis label. Tolerances as applied by the Association of Official Seed Analysts will NOT be allowed for the above noxious weeds except for Wild Onion and Wild Garlic.

Tolerances established by the Association of Official Seed Analysts will generally be recognized. However, for the purpose of figuring pure live seed, the found pure seed and found germination percentages as reported by the North Carolina Department of Agriculture and Consumer Services, Seed Testing Laboratory will be used. Allowances, as established by the NCDOT, will be recognized for minimum pure live seed as listed on the following pages.

The specifications for restricted noxious weed seed refers to the number per pound as follows:

Restricted Noxious **Weed**	Limitations per Lb. Of Seed	Restricted Noxious **Weed**	Limitations per Lb. of Seed
Blessed Thistle	4 seeds	Cornflower (Ragged Robin)	27 seeds
Cocklebur	4 seeds	Texas Panicum	27 seeds
Spurred Anoda	4 seeds	Bracted Plantain	54 seeds
Velvetleaf	4 seeds	Buckhorn Plantain	54 seeds
Morning-glory	8 seeds	Broadleaf Dock	54 seeds
Corn Cockle	10 seeds	Curly Dock	54 seeds
Wild Radish	12 seeds	Dodder	54 seeds
Purple Nutsedge	27 seeds	Giant Foxtail	54 seeds
Yellow Nutsedge	27 seeds	Horsenettle	54 seeds
Canada Thistle	27 seeds	Quackgrass	54 seeds
Field Bindweed	27 seeds	Wild Mustard	54 seeds
Hedge Bindweed	27 seeds		

Seed of Pensacola Bahiagrass shall not contain more than 7% inert matter, Kentucky Bluegrass, Centipede and Fine or Hard Fescue shall not contain more than 5% inert matter whereas a maximum of 2% inert matter will be allowed on all other kinds of seed. In addition, all seed shall

not contain more than 2% other crop seed nor more than 1% total weed seed. The germination rate as tested by the North Carolina Department of Agriculture shall not fall below 70%, which includes both dormant and hard seed. Seed shall be labeled with not more than 7%, 5% or 2% inert matter (according to above specifications), 2% other crop seed and 1% total weed seed.

Exceptions may be made for minimum pure live seed allowances when cases of seed variety shortages are verified. Pure live seed percentages will be applied in a verified shortage situation. Those purchase orders of deficient seed lots will be credited with the percentage that the seed is deficient.

FURTHER SPECIFICATIONS FOR EACH SEED GROUP ARE GIVEN BELOW:

Minimum 85% pure live seed; maximum 1% total weed seed; maximum 2% total other crop seed; maximum 144 restricted noxious weed seed per pound. Seed less than 83% pure live seed will not be approved.

Sericea Lespedeza
Oats (seeds)

Minimum 80% pure live seed; maximum 1% total weed seed; maximum 2% total other crop; maximum 144 restricted noxious weed seed per pound. Seed less than 78% pure live seed will not be approved.

Tall Fescue (all approved varieties)
Kobe Lespedeza
Korean Lespedeza
Weeping Lovegrass
Carpetgrass
Bermudagrass
Browntop Millet
German Millet – Strain R
Clover – Red/White/Crimson

Minimum 78% pure live seed; maximum 1% total weed seed; maximum 2% total other crop seed; maximum 144 restricted noxious weed seed per pound. Seed less than 76% pure live seed will not be approved.

Common or Sweet Sundangrass

Minimum 76% pure live seed; maximum 1% total weed seed; maximum 2% total other crop seed; maximum 144 restricted noxious weed seed per pound. Seed less than 74% pure live seed will not be approved.

Rye (grain; all varieties)
Kentucky Bluegrass (all approved varieties)
Hard Fescue (all approved varieties)
Shrub (bicolor) Lespedeza

Minimum 70% pure live seed; maximum 1% total weed seed; maximum 2% total other crop seed; maximum 144 noxious weed seed per pound. Seed less than 70% pure live seed will not be approved.

Centipedegrass
Crownvetch
Pensacola Bahiagrass
Creeping Red Fescue
Japanese Millet
Reed Canary Grass
Zoysia

Minimum 70% pure live seed; maximum 1% total weed seed; maximum 2% total other crop seed; maximum 5% inert matter; maximum 144 restricted noxious weed seed per pound.

Barnyard Grass
Big Bluestem
Little Bluestem
Bristly Locust
Birdsfoot Trefoil
Indiangrass
Orchardgrass
Switchgrass
Yellow Blossom Sweet Clover

STANDARD SPECIAL PROVISION

ERRATA

(10-16-18) (Rev.1-15-19) Z-4

Revise the *2018 Standard Specifications* as follows:

Division 6

Page 6-7, Article 609-1 DESCRIPTION, line 29, replace article number "609-10" with "609-9".

Division 7

Page 7-27, Article 725-1 MEASUREMENT AND PAYMENT, line 4, replace article number "725-1" with "724-4".

Page 7-28, Article 725-1 MEASUREMENT AND PAYMENT, line 10, replace article number "725-1" with "725-3".

Division 10

Page 10-78, Article 1056-4 GEOTEXTILES, TABLE 1056-1, Permittivity, Type 2, replace "Table 6[D]" with "Table 7[D]" and **Permittivity, Type 3[B],** replace "Table 7[D]" with "Table 8[D]".

Page 10-162, Article 1080-50 PAINT FOR VERTICAL MARKERS, line 1, replace article number "1080-50" with "1080-10".

Page 10-162, Article 1080-61 EPOXY RESIN FOR REINFORCING STEEL, line 5, replace article number "1080-61" with "1080-11".

Page 10-162, Article 1080-72 ABRASIVE MATERIALS FOR BLAST CLEANING STEEL, line 22, replace article number "1080-72" with "1080-12".

Page 10-163, Article 1080-83 FIELD PERFORMANCE AND SERVICES, line 25, replace article number "1080-83" with "1080-13".

Division 17

Page 17-15, Article 1715-4 MEASUREMENT AND PAYMENT, lines 42-44, replace the second sentence with the following:

An example is an installation of a single 1.25 inch HDPE conduit would be paid as:

Directional Drill (1)(1.25″) Linear Foot

STANDARD SPECIAL PROVISION

PLANT AND PEST QUARANTINES
(Imported Fire Ant, Gypsy Moth, Witchweed, Emerald Ash Borer, Guava Root Knot Nematode, And Other Noxious Weeds)

(3-18-03) (Rev. 5-21-19) Z-04a

Within Quarantined Area

This project may be within a county regulated for plant and/or pests. If the project or any part of the Contractor's operations is located within a quarantined area, thoroughly clean all equipment prior to moving out of the quarantined area. Comply with federal/state regulations by obtaining a certificate or limited permit for any regulated article moving from the quarantined area.

Originating in a Quarantined County

Obtain a certificate or limited permit issued by the N.C. Department of Agriculture/United States Department of Agriculture. Have the certificate or limited permit accompany the article when it arrives at the project site.

Contact

Contact the N.C. Department of Agriculture/United States Department of Agriculture at 1-800-206-9333, 919-707-3730, or *https://www.ncagr.gov/plantindustry/Plant/quaran/table2.htm* to determine those specific project sites located in the quarantined area or for any regulated article used on this project originating in a quarantined county.

Regulated Articles Include

1. Soil, sand, gravel, compost, peat, humus, muck, and decomposed manure, separately or with other articles. This includes movement of articles listed above that may be associated with cut/waste, ditch pulling, and shoulder cutting.
2. Plants with roots including grass sod.
3. Plant crowns and roots.
4. Bulbs, corms, rhizomes, and tubers of ornamental plants.
5. Hay, straw, fodder, and plant litter of any kind.
6. Clearing and grubbing debris.
7. Used agricultural cultivating and harvesting equipment.
8. Used earth-moving equipment.
9. Any other products, articles, or means of conveyance, of any character, if determined by an inspector to present a hazard of spreading imported fire ant, gypsy moth, witchweed, emerald ash borer, guava root knot nematode, or other noxious weeds.

STANDARD SPECIAL PROVISION

TITLE VI AND NONDISCRIMINATION:

(6-28-77)(Rev 6/19/2018) Z-6

Revise the *2018 Standard Specifications* as follows:

Replace Article 103-4(B) with the following:

The North Carolina Department of Transportation is committed to carrying out the U.S. Department of Transportation's policy of ensuring nondiscrimination in the award and administration of contracts.

The provisions of this section related to United States Department of Transportation (US DOT) Order 1050.2A, Title 49 Code of Federal Regulations (CFR) part 21, 23 United States Code (U.S.C.) 140 and 23 CFR part 200 (or 49 CFR 303, 49 U.S.C. 5332 or 49 U.S.C. 47123) are applicable to all North Carolina Department of Transportation (NCDOT) contracts and to all related subcontracts, material supply, engineering, architectural and other service contracts, regardless of dollar amount. Any Federal provision that is specifically required not specifically set forth is hereby incorporated by reference.

(1) **Title VI Assurances (USDOT Order 1050.2A, Appendix A)**

During the performance of this contract, the contractor, for itself, its assignees, and successors in interest (hereinafter referred to as the "contractor") agrees as follows:

(a) Compliance with Regulations

The contractor (hereinafter includes consultants) shall comply with the Acts and the Regulations relative to Nondiscrimination in Federally-assisted programs of the U.S. Department of Transportation, Federal Highway Administration (FHWA), as they may be amended from time to time, which are herein incorporated by reference and made a part of this contract.

(b) Nondiscrimination

The contractor, with regard to the work performed by it during the contract, shall not discriminate on the grounds of race, color, or national origin in the selection and retention of subcontractors, including procurements of materials and leases of equipment. The contractor shall not participate directly or indirectly in the discrimination prohibited by the Acts and the Regulations, including employment practices when the contract covers any activity, project, or program set forth in Appendix B of 49 CFR Part 21.

(c) Solicitations for Subcontractors, Including Procurements of Materials and Equipment

In all solicitations, either by competitive bidding, or negotiation made by the contractor for work to be performed under a subcontract, including procurements of materials, or leases of equipment, each potential subcontractor or supplier shall be notified by the contractor of the contractor's obligations under this contract and the Acts and the Regulations relative to Nondiscrimination on the grounds of race, color, or national origin.

(d) Information and Reports

The contractor shall provide all information and reports required by the Acts, the Regulations, and directives issued pursuant thereto and shall permit access to its books, records, accounts, other sources of information, and its facilities as may be determined by the Recipient or the FHWA to be pertinent to ascertain compliance with such Acts,

Regulations, and instructions. Where any information required of a contractor is in the exclusive possession of another who fails or refuses to furnish the information, the contractor shall so certify to the Recipient or the FHWA, as appropriate, and shall set forth what efforts it has made to obtain the information.

(e) Sanctions for Noncompliance:
In the event of a contractor's noncompliance with the Non-discrimination provisions of this contract, the Recipient will impose such contract sanctions as it and/or the FHWA may determine to be appropriate, including, but not limited to:
(i) Withholding payments to the contractor under the contract until the contractor complies; and/or
(ii) Cancelling, terminating, or suspending a contract, in whole or in part.

(f) Incorporation of Provisions
The contractor shall include the provisions of paragraphs (a) through (f) in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Acts, the Regulations and directives issued pursuant thereto. The contractor shall take action with respect to any subcontract or procurement as the Recipient or the FHWA may direct as a means of enforcing such provisions including sanctions for noncompliance. Provided, that if the contractor becomes involved in, or is threatened with litigation by a subcontractor, or supplier because of such direction, the contractor may request the Recipient to enter into any litigation to protect the interests of the Recipient. In addition, the contractor may request the United States to enter into the litigation to protect the interests of the United States.

(2) **Title VI Nondiscrimination Program (23 CFR 200.5(p))**
The North Carolina Department of Transportation (NCDOT) has assured the USDOT that, as a condition to receiving federal financial assistance, NCDOT will comply with Title VI of the Civil Rights Act of 1964 and all requirements imposed by Title 49 CFR part 21 and related nondiscrimination authorities to ensure that no person shall, on the ground of race, color, national origin, limited English proficiency, sex, age, or disability (including religion/creed or income-level, where applicable), be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any programs, activities, or services conducted or funded by NCDOT. Contractors and other organizations under contract or agreement with NCDOT must also comply with Title VI and related authorities, therefore:

(a) During the performance of this contract or agreement, contractors (e.g., subcontractors, consultants, vendors, prime contractors) are responsible for complying with NCDOT's Title VI Program. Contractors are not required to prepare or submit Title VI Programs. To comply with this section, the prime contractor shall:
1. Post NCDOT's Notice of Nondiscrimination and the Contractor's own Equal Employment Opportunity (EEO) Policy in conspicuous locations accessible to all employees, applicants and subcontractors on the jobsite.
2. Physically incorporate the required Title VI clauses into all subcontracts on federally-assisted and state-funded NCDOT projects, and ensure inclusion by subcontractors into all lower-tier subcontracts.
3. Required Solicitation Language. The Contractor shall include the following notification in all solicitations for bids and requests for work or material, regardless of funding source:
"The North Carolina Department of Transportation, in accordance with the provisions of Title VI of the Civil Rights Act of 1964 (78 Stat. 252, 42 US.C. §§

2000d to 2000d-4) and the Regulations, hereby notifies all bidders that it will affirmatively ensure that any contract entered into pursuant to this advertisement, disadvantaged business enterprises will be afforded full and fair opportunity to submit bids in response to this invitation and will not be discriminated against on the grounds of race, color, or national origin in consideration for an award. In accordance with other related nondiscrimination authorities, bidders and contractors will also not be discriminated against on the grounds of sex, age, disability, low-income level, creed/religion, or limited English proficiency in consideration for an award."

4. Physically incorporate the FHWA-1273, in its entirety, into all subcontracts and subsequent lower tier subcontracts on Federal-aid highway construction contracts only.
5. Provide language assistance services (i.e., written translation and oral interpretation), free of charge, to LEP employees and applicants. Contact NCDOT OCR for further assistance, if needed.
6. For assistance with these Title VI requirements, contact the NCDOT Title VI Nondiscrimination Program at 1-800-522-0453.

(b) Subrecipients (e.g. cities, counties, LGAs, planning organizations) may be required to prepare and submit a Title VI Plan to NCDOT, including Title VI Assurances and/or agreements. Subrecipients must also ensure compliance by their contractors and subrecipients with Title VI. (23 CFR 200.9(b)(7))

(c) If reviewed or investigated by NCDOT, the contractor or subrecipient agrees to take affirmative action to correct any deficiencies found within a reasonable time period, not to exceed 90 calendar days, unless additional time is granted by NCDOT. (23 CFR 200.9(b)(15))

(d) The Contractor is responsible for notifying subcontractors of NCDOT's External Discrimination Complaints Process.

1. Applicability
   Title VI and related laws protect participants and beneficiaries (e.g., members of the public and contractors) from discrimination by NCDOT employees, subrecipients and contractors, regardless of funding source.
2. Eligibility
   Any person—or class of persons—who believes he/she has been subjected to discrimination based on race, color, national origin, Limited English Proficiency (LEP), sex, age, or disability (and religion in the context of employment, aviation, or transit) may file a written complaint. The law also prohibits intimidation or retaliation of any sort.
3. Time Limits and Filing Options
   Complaints may be filed by the affected individual(s) or a representative and must be filed no later than 180 calendar days after the following:
   (i) The date of the alleged act of discrimination; or
   (ii) The date when the person(s) became aware of the alleged discrimination; or
   (iii) Where there has been a continuing course of conduct, the date on which that conduct was discontinued or the latest instance of the conduct.

   Title VI and related discrimination complaints may be submitted to the following entities:

- North Carolina Department of Transportation, Office of Civil Rights, Title VI Program, 1511 Mail Service Center, Raleigh, NC 27699-1511; toll free 1-800-522-0453
- Federal Highway Administration, North Carolina Division Office, 310 New Bern Avenue, Suite 410, Raleigh, NC 27601, 919-747-7010
- US Department of Transportation, Departmental Office of Civil Rights, External Civil Rights Programs Division, 1200 New Jersey Avenue, SE, Washington, DC 20590; 202-366-4070

4. Format for Complaints
   Complaints must be in writing and signed by the complainant(s) or a representative, and include the complainant's name, address, and telephone number. Complaints received by fax or e-mail will be acknowledged and processed. Allegations received by telephone will be reduced to writing and provided to the complainant for confirmation or revision before processing. Complaints will be accepted in other languages, including Braille.
5. Discrimination Complaint Form
   Contact NCDOT Civil Rights to receive a full copy of the Discrimination Complaint Form and procedures.
6. Complaint Basis
   Allegations must be based on issues involving race, color, national origin (LEP), sex, age, disability, or religion (in the context of employment, aviation or transit). "Basis" refers to the complainant's membership in a protected group category.

TABLE 103-1
COMPLAINT BASIS

Protected Categories	Definition	Examples	Applicable Nondiscrimination Authorities
Race and Ethnicity	An individual belonging to one of the accepted racial groups; or the perception, based usually on physical characteristics that a person is a member of a racial group	Black/African American, Hispanic/Latino, Asian, American Indian/Alaska Native, Native Hawaiian/Pacific Islander, White	Title VI of the Civil Rights Act of 1964; 49 CFR Part 21; 23 CFR 200; 49 U.S.C. 5332(b); 49 U.S.C. 47123. *(Executive Order 13166)*
Color	Color of skin, including shade of skin within a racial group	Black, White, brown, yellow, etc.	
National Origin *(Limited English Proficiency)*	Place of birth. Citizenship is not a factor. (*Discrimination based on language or a person's accent is also covered)*	Mexican, Cuban, Japanese, Vietnamese, Chinese	
Sex	Gender. The sex of an individual. *Note:* Sex under this program does not include sexual orientation.	Women and Men	1973 Federal-Aid Highway Act; 49 U.S.C. 5332(b); 49 U.S.C. 47123.
Age	Persons of any age	21-year-old person	Age Discrimination Act of 1975 49 U.S.C. 5332(b); 49 U.S.C. 47123.
Disability	Physical or mental impairment, permanent or temporary, or perceived.	Blind, alcoholic, para-amputee, epileptic, diabetic, arthritic	Section 504 of the Rehabilitation Act of 1973; Americans with Disabilities Act of 1990

Religion (in the context of employment) *(Religion/ Creed in all aspects of any aviation or transit-related construction)*	An individual belonging to a religious group; or the perception, based on distinguishable characteristics that a person is a member of a religious group. In practice, actions taken as a result of the moral and ethical beliefs as to what is right and wrong, which are sincerely held with the strength of traditional religious views. ***Note:*** Does not have to be associated with a recognized religious group or church; if an individual sincerely holds to the belief, it is a protected religious practice.	Muslim, Christian, Sikh, Hindu, etc.	Title VII of the Civil Rights Act of 1964; 23 CFR 230; FHWA-1273 Required Contract Provisions. *(49 U.S.C. 5332(b);* *49 U.S.C. 47123)*

(3) **Pertinent Nondiscrimination Authorities**

During the performance of this contract, the contractor, for itself, its assignees, and successors in interest agrees to comply with the following non-discrimination statutes and authorities, including, but not limited to:

(a) Title VI of the Civil Rights Act of 1964 (42 U.S.C. § 2000d et seq., 78 stat. 252), (prohibits discrimination on the basis of race, color, national origin); and 49 CFR Part 21.

(b) The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, (42 U.S.C. § 4601), (prohibits unfair treatment of persons displaced or whose property has been acquired because of Federal or Federal-aid programs and projects);

(c) Federal-Aid Highway Act of 1973, (23 U.S.C. § 324 et seq.), (prohibits discrimination on the basis of sex);

(d) Section 504 of the Rehabilitation Act of 1973, (29 U.S.C. § 794 et seq.), as amended, (prohibits discrimination on the basis of disability) and 49 CFR Part 27;

(e) The Age Discrimination Act of 1975, as amended, (42 U.S.C. § 6101 et seq.), (prohibits discrimination on the basis of age);

(f) Airport and Airway Improvement Act of 1982, (49 USC § 471, Section 47123), as amended, (prohibits discrimination based on race, creed, color, national origin, or sex);

(g) The Civil Rights Restoration Act of 1987, (PL 100-209), (Broadened the scope, coverage and applicability of Title VI of the Civil Rights Act of 1964, The Age Discrimination Act of 1975 and Section 504 of the Rehabilitation Act of 1973, by expanding the definition of the terms "programs or activities" to include all of the programs or activities of the Federal-aid recipients, sub-recipients and contractors, whether such programs or activities are Federally funded or not);

(h) Titles II and III of the Americans with Disabilities Act, which prohibit discrimination on the basis of disability in the operation of public entities, public and private transportation systems, places of public accommodation, and certain testing entities (42 U.S.C. §§ 12131-12189) as implemented by Department of Transportation regulations at 49 C.F.R. parts 37 and 38;

(i) The Federal Aviation Administration's Nondiscrimination statute (49 U.S.C. § 47123) (prohibits discrimination on the basis of race, color, national origin, and sex);

(j) Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, which ensures Nondiscrimination against minority populations by discouraging programs, policies, and activities with

disproportionately high and adverse human health or environmental effects on minority and low-income populations;

(k) Executive Order 13166, Improving Access to Services for Persons with Limited English Proficiency, and resulting agency guidance, national origin discrimination includes discrimination because of Limited English proficiency (LEP). To ensure compliance with Title VI, you must take reasonable steps to ensure that LEP persons have meaningful access to your programs (70 Fed. Reg. at 74087 to 74100);

(l) Title IX of the Education Amendments of 1972, as amended, which prohibits you from discriminating because of sex in education programs or activities (20 U.S.C. 1681 et seq).

(m) Title VII of the Civil Rights Act of 1964 (42 U.S.C. § 2000e et seq., Pub. L. 88-352), (prohibits employment discrimination on the basis of race, color, religion, sex, or national origin).

(4) **Additional Title VI Assurances**

***The following Title VI Assurances (Appendices B, C and D) shall apply, as applicable*

(a) Clauses for Deeds Transferring United States Property (1050.2A, Appendix B)

The following clauses will be included in deeds effecting or recording the transfer of real property, structures, or improvements thereon, or granting interest therein from the United States pursuant to the provisions of Assurance 4.

NOW, THEREFORE, the U.S. Department of Transportation as authorized by law and upon the condition that the North Carolina Department of Transportation (NCDOT) will accept title to the lands and maintain the project constructed thereon in accordance with the North Carolina General Assembly, the Regulations for the Administration of the Federal-Aid Highway Program, and the policies and procedures prescribed by the Federal Highway Administration of the U.S. Department of Transportation in accordance and in compliance with all requirements imposed by Title 49, Code of Federal Regulations, U.S. Department of Transportation, Subtitle A, Office of the Secretary, Part 21, Nondiscrimination in Federally-assisted programs of the U.S Department of Transportation pertaining to and effectuating the provisions of Title VI of the Civil Rights Act of 1964 (78 Stat. 252; 42 U.S.C. § 2000d to 2000d-4), does hereby remise, release, quitclaim and convey unto the NCDOT all the right, title and interest of the U.S. Department of Transportation in and to said lands described in Exhibit A attached hereto and made a part hereof.

(HABENDUM CLAUSE)

TO HAVE AND TO HOLD said lands and interests therein unto the North Carolina Department of Transportation (NCDOT) and its successors forever, subject, however, to the covenants, conditions, restrictions and reservations herein contained as follows, which will remain in effect for the period during which the real property or structures are used for a purpose for which Federal financial assistance is extended or for another purpose involving the provision of similar services or benefits and will be binding on the NCDOT, its successors and assigns.

The NCDOT, in consideration of the conveyance of said lands and interests in lands, does hereby covenant and agree as a covenant running with the land for itself, its successors and assigns, that (1) no person will on the grounds of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination with regard to any facility located wholly or in part on, over, or under such lands hereby conveyed [,] [and]* (2) that the NCDOT will use the lands and interests in lands and interests in lands so conveyed, in compliance with all requirements imposed by or pursuant to Title 49, Code of Federal Regulations, U.S. Department of Transportation, Subtitle A, Office of the Secretary, Part 21, Non-discrimination in Federally-assisted programs of the U.S. Department of Transportation, Effectuation of Title VI of the Civil Rights Act of 1964, and as said Regulations and Acts may be amended [, and (3) that in the event of breach of any of the above-mentioned nondiscrimination conditions, the Department will have a right to enter or re-enter said lands and facilities on said land, and that above described land and facilities will thereon revert to and vest in and become the absolute property of the U.S. Department of Transportation and its assigns as such interest existed prior to this instruction].*

(*Reverter clause and related language to be used only when it is determined that such a clause is necessary in order to make clear the purpose of Title VI.)

(b) Clauses for Transfer of Real Property Acquired or Improved Under the Activity, Facility, or Program (1050.2A, Appendix C)

The following clauses will be included in deeds, licenses, leases, permits, or similar instruments entered into by the North Carolina Department of Transportation (NCDOT) pursuant to the provisions of Assurance 7(a):

1. The (grantee, lessee, permittee, etc. as appropriate) for himself/herself, his/her heirs, personal representatives, successors in interest, and assigns, as a part of the consideration hereof, does hereby covenant and agree [in the case of deeds and leases add "as a covenant running with the land"] that:
   (i.) In the event facilities are constructed, maintained, or otherwise operated on the property described in this (deed, license, lease, permit, etc.) for a purpose for which a U.S. Department of Transportation activity, facility, or program is extended or for another purpose involving the provision of similar services or benefits, the (grantee, licensee, lessee, permittee, etc.) will maintain and operate such facilities and services in compliance with all requirements imposed by the Acts and Regulations (as may be amended) such that no person on the grounds of race, color, or national origin, will be excluded from participation in, denied the benefits of, or be otherwise subjected to discrimination in the use of said facilities.
2. With respect to licenses, leases, permits, etc., in the event of breach of any of the above Nondiscrimination covenants, the NCDOT will have the right to terminate the (lease, license, permit, etc.) and to enter, re-enter, and repossess said lands and facilities thereon, and hold the same as if the (lease, license, permit, etc.) had never been made or issued. *
3. With respect to a deed, in the event of breach of any of the above Nondiscrimination covenants, the NCDOT will have the right to enter or re-enter the lands and facilities thereon, and the above described lands and facilities will there upon revert to and vest in and become the absolute property of the NCDOT and its assigns. *

(*Reverter clause and related language to be used only when it is determined that such a clause is necessary to make clear the purpose of Title VI.)

(c) Clauses for Construction/Use/Access to Real Property Acquired Under the Activity, Facility or Program (1050.2A, Appendix D)

The following clauses will be included in deeds, licenses, permits, or similar instruments/ agreements entered into by the North Carolina Department of Transportation (NCDOT) pursuant to the provisions of Assurance 7(b):

1. The (grantee, licensee, permittee, etc., as appropriate) for himself/herself, his/her heirs, personal representatives, successors in interest, and assigns, as a part of the consideration hereof, does hereby covenant and agree (in the case of deeds and leases add, "as a covenant running with the land") that (1) no person on the ground of race, color, or national origin, will be excluded from participation in, denied the benefits of, or be otherwise subjected to discrimination in the use of said facilities, (2) that in the construction of any improvements on, over, or under such land, and the furnishing of services thereon, no person on the ground of race, color, or national origin, will be excluded from participation in, denied the benefits of, or otherwise be subjected to discrimination, (3) that the (grantee, licensee, lessee, permittee, etc.) will use the premises in compliance with all other requirements imposed by or pursuant to the Acts and Regulations, as amended, set forth in this Assurance.
2. With respect to (licenses, leases, permits, etc.), in the event of breach of any of the above Non¬ discrimination covenants, the NCDOT will have the right to terminate the (license, permit, etc., as appropriate) and to enter or re-enter and repossess said land and the facilities thereon, and hold the same as if said (license, permit, etc., as appropriate) had never been made or issued. *
3. With respect to deeds, in the event of breach of any of the above Nondiscrimination covenants, the NCDOT will there upon revert to and vest in and become the absolute property of the NCDOT and its assigns. *

(*Reverter clause and related language to be used only when it is determined that such a clause is necessary to make clear the purpose of Title VI.)

STANDARD SPECIAL PROVISION

MINORITY AND FEMALE EMPLOYMENT REQUIREMENTS

Z-7

NOTICE OF REQUIREMENTS FOR AFFIRMATIVE ACTION TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY (*EXECUTIVE NUMBER 11246*)

1. The goals and timetables for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, see as shown on the attached sheet entitled "Employment Goals for Minority and Female participation".

These goals are applicable to all the Contractor's construction work (whether or not it is Federal or federally assisted) performed in the covered area. If the Contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for such geographical area where the work is actually performed. With regard to this second area, the Contractor also is subject to the goals for both its federally involved and nonfederally involved construction.

The Contractor's compliance with the Executive Order and the regulations in *41 CFR Part 60-4* shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in *41 CFR 60-4.3(a)*, and its effort to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade and the Contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, the executive Order and the regulations *in 41 CFR Part 60-4*. Compliance with the goals will be measured against the total work hours performed.

2. As used in this Notice and in the contract resulting from this solicitation, the "covered area" is the county or counties shown on the cover sheet of the proposal form and contract.

EMPLOYMENT GOALS FOR MINORITY AND FEMALE PARTICIPATION

Economic Areas

Area 023 29.7%
Bertie County
Camden County
Chowan County
Gates County
Hertford County
Pasquotank County
Perquimans County

Area 024 31.7%
Beaufort County
Carteret County
Craven County
Dare County
Edgecombe County
Green County
Halifax County
Hyde County
Jones County
Lenoir County
Martin County
Nash County
Northampton County
Pamlico County
Pitt County
Tyrrell County
Washington County
Wayne County
Wilson County

Area 025 23.5%
Columbus County
Duplin County
Onslow County
Pender County

Area 026 33.5%
Bladen County
Hoke County
Richmond County
Robeson County
Sampson County
Scotland County

Area 027 24.7%
Chatham County
Franklin County
Granville County
Harnett County
Johnston County
Lee County
Person County
Vance County
Warren County

Area 028 15.5%
Alleghany County
Ashe County
Caswell County
Davie County
Montgomery County
Moore County
Rockingham County
Surry County
Watauga County
Wilkes County

Area 029 15.7%
Alexander County
Anson County
Burke County
Cabarrus County
Caldwell County
Catawba County
Cleveland County
Iredell County
Lincoln County
Polk County
Rowan County
Rutherford County
Stanly County

Area 0480 8.5%
Buncombe County
Madison County

Area 030 6.3%
Avery County
Cherokee County
Clay County
Graham County
Haywood County
Henderson County
Jackson County
McDowell County
Macon County
Mitchell County
Swain County
Transylvania County
Yancey County

SMSA Areas

Area 5720 26.6%
Currituck County

Area 9200 20.7%
Brunswick County
New Hanover County

Area 2560 24.2%
Cumberland County

Area 6640 22.8%
Durham County
Orange County
Wake County

Area 1300 16.2%
Alamance County

Area 3120 16.4%
Davidson County
Forsyth County
Guilford County
Randolph County
Stokes County
Yadkin County

Area 1520 18.3%
Gaston County
Mecklenburg County
Union County

Goals for Female

Participation in Each Trade

(Statewide) 6.9%

STANDARD SPECIAL PROVISION

REQUIRED CONTRACT PROVISIONS FEDERAL - AID CONSTRUCTION CONTRACTS

FHWA - 1273 Electronic Version - May 1, 2012 Z-8

I. General
II. Nondiscrimination
III. Nonsegregated Facilities
IV. Davis-Bacon and Related Act Provisions
V. Contract Work Hours and Safety Standards Act Provisions
VI. Subletting or Assigning the Contract
VII. Safety: Accident Prevention
VIII. False Statements Concerning Highway Projects
IX. Implementation of Clean Air Act and Federal Water Pollution Control Act
X. Compliance with Governmentwide Suspension and Debarment Requirements
XI. Certification Regarding Use of Contract Funds for Lobbying

ATTACHMENTS

A. Employment and Materials Preference for Appalachian Development Highway System or Appalachian Local Access Road Contracts (included in Appalachian contracts only)

I. GENERAL

1. Form FHWA-1273 must be physically incorporated in each construction contract funded under Title 23 (excluding emergency contracts solely intended for debris removal). The contractor (or subcontractor) must insert this form in each subcontract and further require its inclusion in all lower tier subcontracts (excluding purchase orders, rental agreements and other agreements for supplies or services).

   The applicable requirements of Form FHWA-1273 are incorporated by reference for work done under any purchase order, rental agreement or agreement for other services. The prime contractor shall be responsible for compliance by any subcontractor, lower-tier subcontractor or service provider.

   Form FHWA-1273 must be included in all Federal-aid design-build contracts, in all subcontracts and in lower tier subcontracts (excluding subcontracts for design services, purchase orders, rental agreements and other agreements for supplies or services). The design-builder shall be responsible for compliance by any subcontractor, lower-tier subcontractor or service provider.

   Contracting agencies may reference Form FHWA-1273 in bid proposal or request for proposal documents, however, the Form FHWA-1273 must be physically incorporated (not referenced) in all contracts, subcontracts and lower-tier subcontracts (excluding purchase orders, rental agreements and other agreements for supplies or services related to a construction contract).
2. Subject to the applicability criteria noted in the following sections, these contract provisions shall apply to all work performed on the contract by the contractor's own organization and with the assistance of workers under the contractor's immediate superintendence and to all work performed on the contract by piecework, station work, or by subcontract.
3. A breach of any of the stipulations contained in these Required Contract Provisions may be sufficient grounds for withholding of progress payments, withholding of final payment, termination of the contract, suspension / debarment or any other action determined to be appropriate by the contracting agency and FHWA.
4. Selection of Labor: During the performance of this contract, the contractor shall not use convict labor for any purpose within the limits of a construction project on a Federal-aid highway unless it is labor performed by convicts who are on parole, supervised release, or probation. The term Federal-aid highway does not include roadways functionally classified as local roads or rural minor collectors.

II. NONDISCRIMINATION

The provisions of this section related to 23 CFR Part 230 are applicable to all Federal-aid construction contracts and to all related construction subcontracts of $10,000 or more. The provisions of 23 CFR Part 230 are not applicable to material supply, engineering, or architectural service contracts.

In addition, the contractor and all subcontractors must comply with the following policies: Executive Order 11246, 41 CFR 60, 29 CFR 1625-1627, Title 23 USC Section 140, the Rehabilitation Act of 1973, as amended (29 USC 794), Title VI of the Civil Rights Act of 1964, as amended, and related regulations including 49 CFR Parts 21, 26 and 27; and 23 CFR Parts 200, 230, and 633.

The contractor and all subcontractors must comply with: the requirements of the Equal Opportunity Clause in 41 CFR 60-1.4(b) and, for all construction contracts exceeding $10,000, the Standard Federal Equal Employment Opportunity Construction Contract Specifications in 41 CFR 60-4.3.

Note: The U.S. Department of Labor has exclusive authority to determine compliance with Executive Order 11246 and the policies of the Secretary of Labor including 41 CFR 60, and 29 CFR 1625-1627. The contracting agency and the FHWA have the authority and the responsibility to ensure compliance with Title 23 USC Section 140, the Rehabilitation Act of 1973, as amended (29 USC 794), and Title VI of the Civil Rights Act of 1964, as amended, and related regulations including 49 CFR Parts 21, 26 and 27; and 23 CFR Parts 200, 230, and 633.

The following provision is adopted from 23 CFR 230, Appendix A, with appropriate revisions to conform to the U.S. Department of Labor (US DOL) and FHWA requirements.

1. **Equal Employment Opportunity:** Equal employment opportunity (EEO) requirements not to discriminate and to take affirmative action to assure equal opportunity as set forth under laws, executive orders, rules, regulations (28 CFR 35, 29 CFR 1630, 29 CFR 1625-1627, 41 CFR 60 and 49 CFR 27) and orders of the Secretary of Labor as modified by the provisions prescribed herein, and imposed pursuant to 23 U.S.C. 140 shall constitute the EEO and specific affirmative action standards for the contractor's project activities under this contract. The provisions of the Americans with Disabilities Act of 1990 (42 U.S.C. 12101 et seq.) set forth under 28 CFR 35 and 29 CFR 1630 are incorporated by reference in this contract. In the execution of this contract, the contractor agrees to comply with the following minimum specific requirement activities of EEO:
   a. The contractor will work with the contracting agency and the Federal Government to ensure that it has made every good faith effort to provide equal opportunity with respect to all of its terms and conditions of employment and in their review of activities under the contract.
   b. The contractor will accept as its operating policy the following statement:

"It is the policy of this Company to assure that applicants are employed, and that employees are treated during employment, without regard to their race, religion, sex, color, national origin, age or disability. Such action shall include: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship, pre-apprenticeship, and/or on-the-job training."

2. **EEO Officer:** The contractor will designate and make known to the contracting officers an EEO Officer who will have the responsibility for and must be capable of effectively administering and promoting an active EEO program and who must be assigned adequate authority and responsibility to do so.
3. **Dissemination of Policy:** All members of the contractor's staff who are authorized to hire, supervise, promote, and discharge employees, or who recommend such action, or who are substantially involved in such action, will be made fully cognizant of, and will implement, the contractor's EEO policy and contractual responsibilities to provide EEO in each grade and classification of employment. To ensure that the above agreement will be met, the following actions will be taken as a minimum:
   a. Periodic meetings of supervisory and personnel office employees will be conducted before the start of work and then not less often than once every six months, at which time the contractor's EEO policy and its implementation will be reviewed and explained. The meetings will be conducted by the EEO Officer.
   b. All new supervisory or personnel office employees will be given a thorough indoctrination by the EEO Officer, covering all major aspects of the contractor's EEO obligations within thirty days following their reporting for duty with the contractor.
   c. All personnel who are engaged in direct recruitment for the project will be instructed by the EEO Officer in the contractor's procedures for locating and hiring minorities and women.
   d. Notices and posters setting forth the contractor's EEO policy will be placed in areas readily accessible to employees, applicants for employment and potential employees.
   e. The contractor's EEO policy and the procedures to implement such policy will be brought to the attention of employees by means of meetings, employee handbooks, or other appropriate means.
4. **Recruitment:** When advertising for employees, the contractor will include in all advertisements for employees the notation: "An Equal Opportunity Employer." All such advertisements will be placed in publications having a large circulation among minorities and women in the area from which the project work force would normally be derived.
   a. The contractor will, unless precluded by a valid bargaining agreement, conduct systematic and direct recruitment through public and private employee referral sources likely to yield qualified minorities and women. To meet this requirement, the contractor will identify sources of potential minority group employees, and establish with such identified sources procedures whereby minority and women applicants may be referred to the contractor for employment consideration.
   b. In the event the contractor has a valid bargaining agreement providing for exclusive hiring hall referrals, the contractor is expected to observe the provisions of that agreement to the extent that the system meets the contractor's compliance with EEO contract provisions. Where implementation of such an agreement has the effect of discriminating against minorities or women, or obligates the contractor to do the same, such implementation violates Federal nondiscrimination provisions.
   c. The contractor will encourage its present employees to refer minorities and women as applicants for employment. Information and procedures with regard to referring such applicants will be discussed with employees.
5. **Personnel Actions:** Wages, working conditions, and employee benefits shall be established and administered, and personnel actions of every type, including hiring, upgrading, promotion, transfer, demotion, layoff, and termination, shall be taken without regard to race, color, religion, sex, national origin, age or disability. The following procedures shall be followed:
   a. The contractor will conduct periodic inspections of project sites to insure that working conditions and employee facilities do not indicate discriminatory treatment of project site personnel.
   b. The contractor will periodically evaluate the spread of wages paid within each classification to determine any evidence of discriminatory wage practices.
   c. The contractor will periodically review selected personnel actions in depth to determine whether there is evidence of discrimination. Where evidence is found, the contractor will promptly take corrective action. If the review indicates that the discrimination may extend beyond the actions reviewed, such corrective action shall include all affected persons.
   d. The contractor will promptly investigate all complaints of alleged discrimination made to the contractor in connection with its obligations under this contract, will attempt to resolve such complaints, and will take appropriate corrective action within a reasonable time. If the investigation indicates that the discrimination may affect persons other than the complainant, such corrective action shall include such other persons. Upon completion of each investigation, the contractor will inform every complainant of all of their avenues of appeal.
6. **Training and Promotion:**
   a. The contractor will assist in locating, qualifying, and increasing the skills of minorities and women who are applicants for employment or current employees. Such efforts should be aimed at developing full journey level status employees in the type of trade or job classification involved.
   b. Consistent with the contractor's work force requirements and as permissible under Federal and State regulations, the contractor shall make full use of training programs, i.e., apprenticeship, and on-the-job training programs for the geographical area of contract performance. In the event a special provision for training is provided under this contract, this subparagraph will be superseded as indicated in the special provision. The contracting agency may reserve training positions for persons who receive welfare assistance in accordance with 23 U.S.C. 140(a).
   c The contractor will advise employees and applicants for employment of available training programs and entrance requirements for each.
   d. The contractor will periodically review the training and promotion potential of employees who are minorities and women and will encourage eligible employees to apply for such training and promotion.
7. **Unions:** If the contractor relies in whole or in part upon unions as a source of employees, the contractor will use good faith efforts to obtain the cooperation of such unions to increase opportunities for minorities and women. Actions by the contractor, either directly or through a contractor's association acting as agent, will include the procedures set forth below:
   a. The contractor will use good faith efforts to develop, in cooperation with the unions, joint training programs aimed toward qualifying more minorities and women for membership in the unions and increasing the skills of minorities and women so that they may qualify for higher paying employment.
   b. The contractor will use good faith efforts to incorporate an EEO clause into each union agreement to the end that such union will be contractually bound to refer applicants without regard to their race, color, religion, sex, national origin, age or disability.
   c. The contractor is to obtain information as to the referral practices and policies of the labor union except that to the extent such information is within the exclusive possession of the labor union and such labor union refuses to furnish such information to the contractor, the contractor shall so certify to the contracting agency and shall set forth what efforts have been made to obtain such information.

d. In the event the union is unable to provide the contractor with a reasonable flow of referrals within the time limit set forth in the collective bargaining agreement, the contractor will, through independent recruitment efforts, fill the employment vacancies without regard to race, color, religion, sex, national origin, age or disability; making full efforts to obtain qualified and/or qualifiable minorities and women. The failure of a union to provide sufficient referrals (even though it is obligated to provide exclusive referrals under the terms of a collective bargaining agreement) does not relieve the contractor from the requirements of this paragraph. In the event the union referral practice prevents the contractor from meeting the obligations pursuant to Executive Order 11246, as amended, and these special provisions, such contractor shall immediately notify the contracting agency.

8. **Reasonable Accommodation for Applicants / Employees with Disabilities:** The contractor must be familiar with the requirements for and comply with the Americans with Disabilities Act and all rules and regulations established there under. Employers must provide reasonable accommodation in all employment activities unless to do so would cause an undue hardship.
9. **Selection of Subcontractors, Procurement of Materials and Leasing of Equipment:** The contractor shall not discriminate on the grounds of race, color, religion, sex, national origin, age or disability in the selection and retention of subcontractors, including procurement of materials and leases of equipment. The contractor shall take all necessary and reasonable steps to ensure nondiscrimination in the administration of this contract.
   a. The contractor shall notify all potential subcontractors and suppliers and lessors of their EEO obligations under this contract.
   b. The contractor will use good faith efforts to ensure subcontractor compliance with their EEO obligations.
10. **Assurance Required by 49 CFR 26.13(b):**
   a. The requirements of 49 CFR Part 26 and the State DOT's U.S. DOT-approved DBE program are incorporated by reference.
   b. The contractor or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of DOT-assisted contracts. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the contracting agency deems appropriate.
11. **Records and Reports:** The contractor shall keep such records as necessary to document compliance with the EEO requirements. Such records shall be retained for a period of three years following the date of the final payment to the contractor for all contract work and shall be available at reasonable times and places for inspection by authorized representatives of the contracting agency and the FHWA.
   a. The records kept by the contractor shall document the following:
      (1) The number and work hours of minority and non-minority group members and women employed in each work classification on the project;
      (2) The progress and efforts being made in cooperation with unions, when applicable, to increase employment opportunities for minorities and women; and
      (3) The progress and efforts being made in locating, hiring, training, qualifying, and upgrading minorities and women;
   b. The contractors and subcontractors will submit an annual report to the contracting agency each July for the duration of the project, indicating the number of minority, women, and non-minority group employees currently engaged in each work classification required by the contract work. This information is to be reported on Form FHWA-1391. The staffing data should represent the project work force on board in all or any part of the last payroll period preceding the end of July. If on-the-job training is being required by special provision, the contractor will be required to collect and report training data. The employment data should reflect the work force on board during all or any part of the last payroll period preceding the end of July.

III. NONSEGREGATED FACILITIES

This provision is applicable to all Federal-aid construction contracts and to all related construction subcontracts of $10,000 or more.

The contractor must ensure that facilities provided for employees are provided in such a manner that segregation on the basis of race, color, religion, sex, or national origin cannot result. The contractor may neither require such segregated use by written or oral policies nor tolerate such use by employee custom. The contractor's obligation extends further to ensure that its employees are not assigned to perform their services at any location, under the contractor's control, where the facilities are segregated. The term "facilities" includes waiting rooms, work areas, restaurants and other eating areas, time clocks, restrooms, washrooms, locker rooms, and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing provided for employees. The contractor shall provide separate or single-user restrooms and necessary dressing or sleeping areas to assure privacy between sexes.

IV. DAVIS-BACON AND RELATED ACT PROVISIONS

This section is applicable to all Federal-aid construction projects exceeding $2,000 and to all related subcontracts and lower-tier subcontracts (regardless of subcontract size). The requirements apply to all projects located within the right-of-way of a roadway that is functionally classified as Federal-aid highway. This excludes roadways functionally classified as local roads or rural minor collectors, which are exempt. Contracting agencies may elect to apply these requirements to other projects.

The following provisions are from the U.S. Department of Labor regulations in 29 CFR 5.5 "Contract provisions and related matters" with minor revisions to conform to the FHWA-1273 format and FHWA program requirements.

1. **Minimum wages**
   a. All laborers and mechanics employed or working upon the site of the work, will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

      Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph 1.d. of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in 29 CFR 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph 1.b. of this section) and the Davis-Bacon poster (WH–1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

b. (1) The contracting officer shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The contracting officer shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:
(i) The work to be performed by the classification requested is not performed by a classification in the wage determination; and
(ii) The classification is utilized in the area by the construction industry; and
(iii) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(2) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(3) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Wage and Hour Administrator for determination. The Wage and Hour Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(4) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs 1.b.(2) or 1.b.(3) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

c. Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

d. If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

2. **Withholding.** The contracting agency shall upon its own action or upon written request of an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor under this contract, or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the contracting agency may, after written notice to the contractor, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

3. **Payrolls and basic records**

a. Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

b. (1) The contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the contracting agency. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g. , the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH–347 is available for this purpose from the Wage and Hour Division Web site at http://www.dol.gov/esa/whd/forms/ wh347instr.htm or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the contracting agency for transmission to the State DOT, the FHWA or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the contracting agency.

(2) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:
(i) That the payroll for the payroll period contains the information required to be provided under §5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under §5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete;
(ii) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;
(iii) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(3) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH–347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph 3.b.(2) of this section.

(4) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

c. The contractor or subcontractor shall make the records required under paragraph 3.a. of this section available for inspection, copying, or transcription by authorized representatives of the contracting agency, the State DOT, the FHWA, or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the FHWA may, after written notice to the contractor, the contracting agency or the State DOT, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

4. **Apprentices and trainees**

a. Apprentices (programs of the USDOL). Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice.

The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed.

Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination.

In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

b. Trainees (programs of the USDOL). Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration.

The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration.

Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed.

In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

c. Equal employment opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

d. Apprentices and Trainees (programs of the U.S. DOT). Apprentices and trainees working under apprenticeship and skill training programs which have been certified by the Secretary of Transportation as promoting EEO in connection with Federal-aid highway construction programs are not subject to the requirements of paragraph 4 of this Section IV. The straight time hourly wage rates for apprentices and trainees under such programs will be established by the particular programs. The ratio of apprentices and trainees to journeymen shall not be greater than permitted by the terms of the particular program.

5. **Compliance with Copeland Act requirements.** The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.

6. **Subcontracts.** The contractor or subcontractor shall insert Form FHWA-1273 in any subcontracts and also require the subcontractors to include Form FHWA-1273 in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

7. **Contract termination:** debarment. A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

8. **Compliance with Davis-Bacon and Related Act requirements.** All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.

9. **Disputes concerning labor standards.** Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

10. **Certification of eligibility.**

a. By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

b. No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).
c. The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

V. CONTRACT WORK HOURS AND SAFETY STANDARDS ACT

The following clauses apply to any Federal-aid construction contract in an amount in excess of $100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by 29 CFR 5.5(a) or 29 CFR 4.6. As used in this paragraph, the terms laborers and mechanics include watchmen and guards.

1. **Overtime requirements.** No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.
2. **Violation; liability for unpaid wages; liquidated damages.** In the event of any violation of the clause set forth in paragraph (1.) of this section, the contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (1.) of this section, in the sum of $10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (1.) of this section.
3. **Withholding for unpaid wages and liquidated damages.** The FHWA or the contacting agency shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (2.) of this section.
4. **Subcontracts.** The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (1.) through (4.) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (1.) through (4.) of this section.

VI. SUBLETTING OR ASSIGNING THE CONTRACT

This provision is applicable to all Federal-aid construction contracts on the National Highway System.

1. The contractor shall perform with its own organization contract work amounting to not less than 30 percent (or a greater percentage if specified elsewhere in the contract) of the total original contract price, excluding any specialty items designated by the contracting agency. Specialty items may be performed by subcontract and the amount of any such specialty items performed may be deducted from the total original contract price before computing the amount of work required to be performed by the contractor's own organization (23 CFR 635.116).
   a. The term “perform work with its own organization” refers to workers employed or leased by the prime contractor, and equipment owned or rented by the prime contractor, with or without operators. Such term does not include employees or equipment of a subcontractor or lower tier subcontractor, agents of the prime contractor, or any other assignees. The term may include payments for the costs of hiring leased employees

from an employee leasing firm meeting all relevant Federal and State regulatory requirements. Leased employees may only be included in this term if the prime contractor meets all of the following conditions:
(1) the prime contractor maintains control over the supervision of the day-to-day activities of the leased employees;
(2) the prime contractor remains responsible for the quality of the work of the leased employees;
(3) the prime contractor retains all power to accept or exclude individual employees from work on the project; and
(4) the prime contractor remains ultimately responsible for the payment of predetermined minimum wages, the submission of payrolls, statements of compliance and all other Federal regulatory requirements.

b. "Specialty Items" shall be construed to be limited to work that requires highly specialized knowledge, abilities, or equipment not ordinarily available in the type of contracting organizations qualified and expected to bid or propose on the contract as a whole and in general are to be limited to minor components of the overall contract.

2. The contract amount upon which the requirements set forth in paragraph (1) of Section VI is computed includes the cost of material and manufactured products which are to be purchased or produced by the contractor under the contract provisions.
3. The contractor shall furnish (a) a competent superintendent or supervisor who is employed by the firm, has full authority to direct performance of the work in accordance with the contract requirements, and is in charge of all construction operations (regardless of who performs the work) and (b) such other of its own organizational resources (supervision, management, and engineering services) as the contracting officer determines is necessary to assure the performance of the contract.
4. No portion of the contract shall be sublet, assigned or otherwise disposed of except with the written consent of the contracting officer, or authorized representative, and such consent when given shall not be construed to relieve the contractor of any responsibility for the fulfillment of the contract. Written consent will be given only after the contracting agency has assured that each subcontract is evidenced in writing and that it contains all pertinent provisions and requirements of the prime contract.
5. The 30% self-performance requirement of paragraph (1) is not applicable to design-build contracts; however, contracting agencies may establish their own self-performance requirements.

VII. SAFETY: ACCIDENT PREVENTION

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

1. In the performance of this contract the contractor shall comply with all applicable Federal, State, and local laws governing safety, health, and sanitation (23 CFR 635). The contractor shall provide all safeguards, safety devices and protective equipment and take any other needed actions as it determines, or as the contracting officer may determine, to be reasonably necessary to protect the life and health of employees on the job and the safety of the public and to protect property in connection with the performance of the work covered by the contract.
2. It is a condition of this contract, and shall be made a condition of each subcontract, which the contractor enters into pursuant to this contract, that the contractor and any subcontractor shall not permit any employee, in performance of the contract, to work in surroundings or under conditions which are unsanitary, hazardous or dangerous to his/her health or safety, as determined under construction safety and health standards (29 CFR 1926) promulgated by the Secretary of Labor, in accordance with Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 3704).
3. Pursuant to 29 CFR 1926.3, it is a condition of this contract that the Secretary of Labor or authorized representative thereof, shall have right of entry to any site of contract performance to inspect or investigate the matter of compliance with the construction safety and health standards and to carry out the duties of the Secretary under Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C.3704).

VIII. FALSE STATEMENTS CONCERNING HIGHWAY PROJECTS

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

In order to assure high quality and durable construction in conformity with approved plans and specifications and a high degree of reliability on statements and representations made by engineers, contractors, suppliers, and workers on Federal-aid highway projects, it is essential that all persons concerned with the project perform their functions as carefully, thoroughly, and honestly as possible. Willful falsification, distortion, or misrepresentation with respect to any facts related to the project is a violation of Federal law. To prevent any misunderstanding regarding the seriousness of these and similar acts, Form FHWA-1022 shall be posted on each Federal-aid highway project (23 CFR 635) in one or more places where it is readily available to all persons concerned with the project:

18 U.S.C. 1020 reads as follows:

"Whoever, being an officer, agent, or employee of the United States, or of any State or Territory, or whoever, whether a person, association, firm, or corporation, knowingly makes any false statement, false representation, or false report as to the character, quality, quantity, or cost of the material used or to be used, or the quantity or quality of the work performed or to be performed, or the cost thereof in connection with the submission of plans, maps, specifications, contracts, or costs of construction on any highway or related project submitted for approval to the Secretary of Transportation; or

Whoever knowingly makes any false statement, false representation, false report or false claim with respect to the character, quality, quantity, or cost of any work performed or to be performed, or materials furnished or to be furnished, in connection with the construction of any highway or related project approved by the Secretary of Transportation; or

Whoever knowingly makes any false statement or false representation as to material fact in any statement, certificate, or report submitted pursuant to provisions of the Federal-aid Roads Act approved July 1, 1916, (39 Stat. 355), as amended and supplemented;

Shall be fined under this title or imprisoned not more than 5 years or both."

IX. IMPLEMENTATION OF CLEAN AIR ACT AND FEDERAL WATER POLLUTION CONTROL ACT

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

By submission of this bid/proposal or the execution of this contract, or subcontract, as appropriate, the bidder, proposer, Federal-aid construction contractor, or subcontractor, as appropriate, will be deemed to have stipulated as follows:

1. That any person who is or will be utilized in the performance of this contract is not prohibited from receiving an award due to a violation of Section 508 of the Clean Water Act or Section 306 of the Clean Air Act.
2. That the contractor agrees to include or cause to be included the requirements of paragraph (1) of this Section X in every subcontract, and further agrees to take such action as the contracting agency may direct as a means of enforcing such requirements.

X. CERTIFICATION REGARDING DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION

This provision is applicable to all Federal-aid construction contracts, design-build contracts, subcontracts, lower-tier subcontracts, purchase orders, lease agreements, consultant contracts or any other covered transaction requiring FHWA approval or that is estimated to cost $25,000 or more – as defined in 2 CFR Parts 180 and 1200.

1. **Instructions for Certification – First Tier Participants:**
   a. By signing and submitting this proposal, the prospective first tier participant is providing the certification set out below.
   b. The inability of a person to provide the certification set out below will not necessarily result in denial of participation in this covered transaction. The prospective first tier participant shall submit an explanation of why it cannot provide the certification set out below. The certification or explanation will be considered in connection with the department or agency's determination whether to enter into this transaction. However, failure of the prospective first tier participant to furnish a certification or an explanation shall disqualify such a person from participation in this transaction.
   c. The certification in this clause is a material representation of fact upon which reliance was placed when the contracting agency determined to enter into this transaction. If it is later determined that the prospective participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the contracting agency may terminate this transaction for cause of default.
   d. The prospective first tier participant shall provide immediate written notice to the contracting agency to whom this proposal is submitted if any time the prospective first tier participant learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.
   e. The terms "covered transaction," "debarred," "suspended," "ineligible," "participant," "person," "principal," and "voluntarily excluded," as used in this clause, are defined in 2 CFR Parts 180 and 1200. “First Tier Covered Transactions” refers to any covered transaction between a grantee or subgrantee of Federal funds and a participant (such as the prime or general contract). “Lower Tier Covered Transactions” refers to any covered transaction under a First Tier Covered Transaction (such as subcontracts). “First Tier Participant” refers to the participant who has entered into a covered transaction with a grantee or subgrantee of Federal funds (such as the prime or general contractor). “Lower Tier Participant” refers any participant who has entered into a covered transaction with a First Tier Participant or other Lower Tier Participants (such as subcontractors and suppliers).
   f. The prospective first tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency entering into this transaction.
   g. The prospective first tier participant further agrees by submitting this proposal that it will include the clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transactions," provided by the department or contracting agency, entering into this covered transaction, without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions exceeding the $25,000 threshold.
   h. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant is responsible for ensuring that its principals are not suspended, debarred, or otherwise ineligible to participate in covered transactions. To verify the eligibility of its principals, as well as the eligibility of any lower tier prospective participants, each participant may, but is not required to, check the Excluded Parties List System website (https://www.epls.gov/), which is compiled by the General Services Administration.
   i. Nothing contained in the foregoing shall be construed to require the establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of the prospective participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.
   j. Except for transactions authorized under paragraph (f) of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency may terminate this transaction for cause or default.

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2. **Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion – First Tier Participants:**
   a. The prospective first tier participant certifies to the best of its knowledge and belief, that it and its principals:
      (1) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participating in covered transactions by any Federal department or agency;
      (2) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
      (3) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (a)(2) of this certification; and
      (4) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default.
   b. Where the prospective participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

2. **Instructions for Certification - Lower Tier Participants:**
(Applicable to all subcontracts, purchase orders and other lower tier transactions requiring prior FHWA approval or estimated to cost $25,000 or more - 2 CFR Parts 180 and 1200)
   a. By signing and submitting this proposal, the prospective lower tier is providing the certification set out below.
   b. The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the prospective lower tier participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the department, or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.
   c. The prospective lower tier participant shall provide immediate written notice to the person to which this proposal is submitted if at any time the prospective lower tier participant learns that its certification was erroneous by reason of changed circumstances.
   d. The terms "covered transaction," "debarred," "suspended," "ineligible," "participant," "person," "principal," and "voluntarily excluded," as used in this clause, are defined in 2 CFR Parts 180 and 1200. You may contact the person to which this proposal is submitted for assistance in obtaining a copy of those regulations. “First Tier Covered Transactions” refers to any covered transaction between a grantee or subgrantee of

Federal funds and a participant (such as the prime or general contract). “Lower Tier Covered Transactions” refers to any covered transaction under a First Tier Covered Transaction (such as subcontracts). “First Tier Participant” refers to the participant who has entered into a covered transaction with a grantee or subgrantee of Federal funds (such as the prime or general contractor). “Lower Tier Participant” refers any participant who has entered into a covered transaction with a First Tier Participant or other Lower Tier Participants (such as subcontractors and suppliers).

e. The prospective lower tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency with which this transaction originated.

f. The prospective lower tier participant further agrees by submitting this proposal that it will include this clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transaction," without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions exceeding the $25,000 threshold.

g. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant is responsible for ensuring that its principals are not suspended, debarred, or otherwise ineligible to participate in covered transactions. To verify the eligibility of its principals, as well as the eligibility of any lower tier prospective participants, each participant may, but is not required to, check the Excluded Parties List System website (https://www.epls.gov/), which is compiled by the General Services Administration.

h. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

i. Except for transactions authorized under paragraph e of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

* * * * *

Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion--Lower Tier Participants:

1. The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participating in covered transactions by any Federal department or agency.
2. Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

* * * * *

XI. CERTIFICATION REGARDING USE OF CONTRACT FUNDS FOR LOBBYING

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts which exceed $100,000 (49 CFR 20).

1. 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.
2. 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 31 U.S.C. 1352. 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.
3. The prospective participant also agrees by submitting its bid or proposal that the participant shall require that the language of this certification be included in all lower tier subcontracts, which exceed $100,000 and that all such recipients shall certify and disclose accordingly.

STANDARD SPECIAL PROVISION

ON-THE-JOB TRAINING

(10-16-07) (Rev. 4-21-15) Z-10

Description

The North Carolina Department of Transportation will administer a custom version of the Federal On-the-Job Training (OJT) Program, commonly referred to as the Alternate OJT Program. All contractors (existing and newcomers) will be automatically placed in the Alternate Program. Standard OJT requirements typically associated with individual projects will no longer be applied at the project level. Instead, these requirements will be applicable on an annual basis for each contractor administered by the OJT Program Manager.

On the Job Training shall meet the requirements of 23 CFR 230.107 (b), 23 USC – Section 140, this provision and the On-the-Job Training Program Manual.

The Alternate OJT Program will allow a contractor to train employees on Federal, State and privately funded projects located in North Carolina. However, priority shall be given to training employees on NCDOT Federal-Aid funded projects.

Minorities and Women

Developing, training and upgrading of minorities and women toward journeyman level status is a primary objective of this special training provision. Accordingly, the Contractor shall make every effort to enroll minority and women as trainees to the extent that such persons are available within a reasonable area of recruitment. This training commitment is not intended, and shall not be used, to discriminate against any applicant for training, whether a member of a minority group or not.

Assigning Training Goals

The Department, through the OJT Program Manager, will assign training goals for a calendar year based on the contractors' past three years' activity and the contractors' anticipated upcoming year's activity with the Department. At the beginning of each year, all contractors eligible will be contacted by the Department to determine the number of trainees that will be assigned for the upcoming calendar year. At that time the Contractor shall enter into an agreement with the Department to provide a self-imposed on-the-job training program for the calendar year. This agreement will include a specific number of annual training goals agreed to by both parties. The number of training assignments may range from 1 to 15 per contractor per calendar year. The Contractor shall sign an agreement to fulfill their annual goal for the year.\

Training Classifications

The Contractor shall provide on-the-job training aimed at developing full journeyman level workers in the construction craft/operator positions. Preference shall be given to providing training in the following skilled work classifications:

Equipment Operators	Office Engineers
Truck Drivers	Estimators
Carpenters	Iron / Reinforcing Steel Workers
Concrete Finishers	Mechanics
Pipe Layers	Welders

The Department has established common training classifications and their respective training requirements that may be used by the contractors. However, the classifications established are not all-inclusive. Where the training is oriented toward construction applications, training will be allowed in lower-level management positions such as office engineers and estimators. Contractors shall submit new classifications for specific job functions that their employees are performing. The Department will review and recommend for acceptance to FHWA the new classifications proposed by contractors, if applicable. New classifications shall meet the following requirements:

Proposed training classifications are reasonable and realistic based on the job skill classification needs, and

The number of training hours specified in the training classification is consistent with common practices and provides enough time for the trainee to obtain journeyman level status.

The Contractor may allow trainees to be trained by a subcontractor provided that the Contractor retains primary responsibility for meeting the training and this provision is made applicable to the subcontract. However, only the Contractor will receive credit towards the annual goal for the trainee.

Where feasible, 25 percent of apprentices or trainees in each occupation shall be in their first year of apprenticeship or training. The number of trainees shall be distributed among the work classifications on the basis of the contractor's needs and the availability of journeymen in the various classifications within a reasonable area of recruitment.

No employee shall be employed as a trainee in any classification in which they have successfully completed a training course leading to journeyman level status or in which they have been employed as a journeyman.

Records and Reports

The Contractor shall maintain enrollment, monthly and completion reports documenting company compliance under these contract documents. These documents and any other information as requested shall be submitted to the OJT Program Manager.

Upon completion and graduation of the program, the Contractor shall provide each trainee with a certification Certificate showing the type and length of training satisfactorily completed.

Trainee Interviews

All trainees enrolled in the program will receive an initial and Trainee/Post graduate interview conducted by the OJT program staff.

Trainee Wages

Contractors shall compensate trainees on a graduating pay scale based upon a percentage of the prevailing minimum journeyman wages (Davis-Bacon Act). Minimum pay shall be as follows:

60 percent	of the journeyman wage for the first half of the training period
75 percent	of the journeyman wage for the third quarter of the training period
90 percent	of the journeyman wage for the last quarter of the training period

In no instance shall a trainee be paid less than the local minimum wage. The Contractor shall adhere to the minimum hourly wage rate that will satisfy both the NC Department of Labor (NCDOL) and the Department.

Achieving or Failing to Meet Training Goals

The Contractor will be credited for each trainee employed by him on the contract work who is currently enrolled or becomes enrolled in an approved program and who receives training for at least 50 percent of the specific program requirement. Trainees will be allowed to be transferred between projects if required by the Contractor's scheduled workload to meet training goals.

If a contractor fails to attain their training assignments for the calendar year, they may be taken off the NCDOT's Bidders List.

Measurement and Payment

No compensation will be made for providing required training in accordance with these contract documents.

STANDARD SPECIAL PROVISION
MINIMUM WAGES
GENERAL DECISION NC190087 01/04/2019 NC87

Z-087

Date: January 4, 2019

General Decision Number: NC190087 01/4/2019 NC87

Superseded General Decision Numbers: NC20180100

State: North Carolina

Construction Type: HIGHWAY

COUNTIES:

Alexander	Caldwell	Henderson
Buncombe	Catawba	Madison
Burke	Haywood	

HIGHWAY CONSTRUCTION PROJECTS (excluding tunnels, building structures in rest area projects & railroad construction; bascule, suspension & spandrel arch bridges designed for commercial navigation, bridges involving marine construction; and other major bridges).

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.60 for calendar year 2019 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.60 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract for calendar year 2019. If this contract is covered by the EO and a classification considered necessary for performance of work on the contract must pay workers in that classification at least the wage rate determined through the conformance process set forth in 29 CFR.5.5(a)(1)(ii) (or the EO minimum wage rate, if it is higher than the conformed wage rate). The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2) – (60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/04/2019

SUNC2014-002 11/13/2014

	Rates	Fringes
BLASTER	20.93	
CARPENTER	13.48	
CEMENT MASON/CONCRETE FINISHER	14.40	
ELECTRICIAN		
Electrician	18.79	2.62
Telecommunications Technician	14.67	1.67
IRONWORKER	12.48	
LABORER		

	Rates	Fringes
Asphalt Raker and Spreader	11.76	
Asphalt Screed/Jackman	15.38	.08
Carpenter Tender	10.50	
Cement Mason/Concrete Finisher Tender	11.04	
Common or General	11.90	
Guardrail/Fence Installer	13.09	
Pipelayer	12.87	
Traffic Signal/Lighting Installer	15.33	.22
PAINTER		
Bridge	20.67	
POWER EQUIPMENT OPERATORS		
Asphalt Broom Tractor	10.00	
Bulldozer Fine	16.28	
Bulldozer Rough	14.51	
Concrete Grinder/Groover	19.20	
Crane Boom Trucks	18.19	
Crane Other	18.69	
Crane Rough/All-Terrain	19.19	
Drill Operator Rock	15.00	
Drill Operator Structure	21.07	
Excavator Fine	16.02	
Excavator Rough	14.67	
Grader/Blade Fine	19.86	
Grader/Blade Rough	15.12	
Loader 2 Cubic Yards or Less	12.38	
Loader Greater Than 2 Cubic Yards	17.91	
Material Transfer Vehicle (Shuttle Buggy)	15.44	
Mechanic	17.86	
Milling Machine	15.08	
Off-Road Hauler/Water Tanker	11.95	
Oiler/Greaser	15.05	
Pavement Marking Equipment	11.99	
Paver Asphalt	17.84	.08
Paver Concrete	18.20	
Roller Asphalt Breakdown	15.00	.08
Roller Asphalt Finish	16.08	.07
Roller Other	12.51	.03
Scraper Finish	12.86	
Scraper Rough	13.83	
Slip Form Machine	20.38	
Tack Truck/Distributor Operator	14.81	.02
TRUCK DRIVER		
GVWR of 26,000 Lbs or Greater	13.65	
GVWR of 26,000 Lbs or Less	12.48	

Welders – Receive rate prescribed for craft performing operation to which welding is incidental.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave

for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29 CFR 5.5(a)(1)(ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than "SU" or "UAVG" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the "SU" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union

average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U. S. Department of Labor
200 Constitution Avenue, N.W.
Washington, D.C. 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, D.C. 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, D.C. 20210

4.) All decisions by the Administrative Review Board are final.

END OF GENERAL DECISION

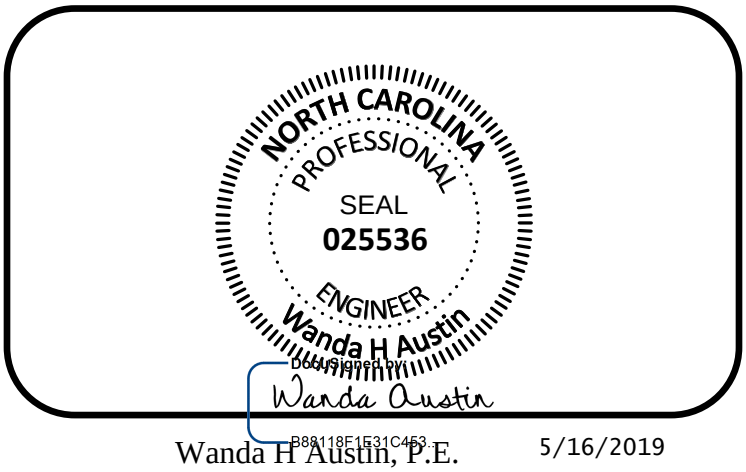
C204266 Buncombe/Henderson County

U.S. Department of Transportation
Federal Highway Administration

Subject: Project Blue Ridge Parkway Over I-26 Date: December 21, 2018

PROJECT SPECIAL PROVISIONS

GENERAL SPECIAL PROVISIONS	SHEETS BLRI 2 – 52
STRUCTURE SPECIAL PROVISIONS	SHEETS BLRI 53 - 173



Wanda H Austin, P.E. 5/16/2019
NC License No. 025536

-Responsible for the General, Roadway and Erosion Control Special Provisions

PROJECT SPECIAL PROVISIONS

STONE HEADWALL REMOVAL

Description

The contractor shall remove existing stone masonry headwalls and deliver removed stone in sound condition that is not reset or reused to the National Park Service Oteen maintenance yard located at Mile Post 382 on the Blue Ridge Parkway as directed by the Engineer. All other stone in sound condition to be used during the project will be stockpiled and stored as directed by the Engineer

Measurement and Payment

Stone Headwall Removal will be measured and paid as the actual number of stone headwalls removed.

Such price and payment will be full compensation for all work covered by this provision including but not limited to removal of headwall, stockpiling and hauling of stone.

Payment will be made under:

Pay Item	**Pay Unit**
Stone Headwall Removal	Each

ASPHALT CONCRETE PLANT MIX PAVEMENTS:

(3-02-18) 610 SP03 R610

Revise *2018 Standard Specifications* as follows:

Page 6-24, Subarticle 610-2, delete lines 43 and 44 and replace with the following:

For the Blue Ridge Parkway over I-26, use a Hearne straightedge (Option 2) for smoothness acceptance.

OBLITERATION OF MOUNTAIN TO SEA TRAIL

Description

The work covered by this section consists of the obliteration of the existing mountain to sea trail as shown in the plans.

Construction Methods

Scarify surface and add 4 inches of decomposed leaf litter. Add Various size branches and brush to block and disguise the ground for 50 feet beyond the intersection with the new connector.

Scarify or rip gravel, crushed stone or other nonrigid surface, base and subbase material. Mix the scarified or ripped material with he underlying soil. Bury the mixture under at least 12 inches of soil.

Measurement and Payment

Obliteration of Existing Mountain to Sea Trail will be measured and paid in square yards of existing trail restored and accepted by the Engineer.

The work includes, but not limited to all grading and excavation necessary to reshape the trail; all work and materials excavated in obliterating the trail and all work and materials required to complete the reshaping of the trail.

All seeding and mulching performed will be paid at the contract unit prices for the items established in the contract.

Payment will be made under:

Pay Item	**Pay Unit**
Obliteration of Existing Mountain to Sea Trail	Square Yards

MINOR DRAINAGE STRUCTURES:

(3-02-18) 850 SP08 R808

Revise *2018 Standard Specifications* as follows:

Page 8-11, Subarticle 840-1, add the following after line 15:

For the 3'x5' concrete catch basins, submit drainage cross sections prior to installation for approval by the Engineer.

CONCRETE SIDEWALKS, DRIVEWAYS AND CURB RAMPS:

(3-02-18) 850 SP08 R848

Revise *2018 Standard Specifications* as follows:

Page 8-30, Subarticle 848-2, add the following after line 25:

Submit color sample of detectable warning to Engineer for review and approval.

STONE MASONRY:

Description

This work consists of constructing or rehabilitating stone masonry structures and the stone masonry portions of composite structures.

(A) Masonry class is designated as follows:

(1) Dimensioned masonry. Stones are cut in two or more dimensions and laid in a broken-course pattern in mortar;

(2) Class A masonry. Stones are shaped, dressed to within ¼ inch of true line, and laid in mortar;

(3) Class B masonry. Stones are shaped, dressed to within ¾ inch true line, and laid in mortar; and

(4) Rubble masonry. Stones vary in size and shape, are roughly dressed, and laid in random courses in mortar.

Materials

Refer to the *2018 Standard Specifications* and the *Grout Production and Delivery Special Provision, Joint Materials Special Provision and Masonry Special Provision* found elsewhere in this contract.

Item	**Section**
Minor Concrete	825
Mortar	1040-9
Reinforcing Steel	1070

Provide Class B masonry for stone masonry headwalls, guardwalls, retaining walls, sidewalls, wingwalls, and curbs. Use finishes as shown in Table 1.

TABLE 1
STONE MASONRY FINISHES

Location	Stone masonry finish
Headwalls	RF2-4
Guardwall traffic-side face stones	RF 1.5
Guardwall and parapet wall capstone (1)	RF 2-6
Parapet wall traffic-side face stones	RF 1.5
Curbs	RF 0.5 or heavy thermal finish as directed by the Engineer
All other stone masonry	RF2-4

Notes
(1) For each wall, provide an equal number of stones with the same maximum RF dimension measured in 1" increments for the range given. For example, provide the same number or RF 2 stones as RF 3's, RF 4's, etc.

Uniformly distribute stones of similar RF dimensions (same height of projection) throughout the stone masonry item.

Construction Methods

Submit stone samples representing the range of colors, sizes and finishes to be used 14 days before beginning work.

Keep an adequate inventory of stone on the site to provide a variety of stones. When additional stone is need, mix new stone with existing stone to produce a uniform pattern and color.

Perform excavation and embankment according to Articles 225 and 235.

Take digital photos of the existing stone masonry prior to construction and provide copies to the Engineer. Use the digital photos to match new stone masonry work to existing.

Construct new stone masonry to match the appearance of existing masonry of nearby headwalls. When constructing new headwalls, reuse existing masonry to the greatest extent possible.

For headwalls, install a single intact stone containing no construction or mortar joints above and below culvert inlets or outlets. Provide a ½-inch maximum joint width between the pipe and the face of stone at the vertical chord of the pipe. Provide a ½-inch maximum distance between the inside wall of the pipe and the face of stone at the horizontal chord of the pipe.

(A) Dressing Rock.

Remove thin or weak portions of rock. Dress face rock bed and joint lines to a maximum variation from true line as follows:

(1) Dimensioned masonry	Reasonably true
(2) Class A masonry	¼ in
(3) Class B masonry	¾ in
(4) Rubble masonry	1½ in

(a) Bed surfaces. Dress face rock bed surfaces normal to the face to a depth of 3 inches (75 millimeters). Beyond that point, do not exceed 1 inch in 12 inches the departure from normal for dimensioned masonry or 2 inches in 12 inches for other classes.

(b) Joint surfaces. For dimensioned masonry, dress face rock joint surfaces normal to the bed surface. For other classes of masonry, dress face rock joint surfaces to form an angle with the bed surface of not less than 45 degrees. Do not exceed more than 10% of total joints that are greater than 5 degrees from vertical.

Dress face rock joint surfaces normal to the face to a depth of 2 inches. Beyond that point, do not exceed 1 inch in 12 inches departure from normal.

Do not round corners at the meeting of the bed and joint lines more than the following radii:

(i) Dimensioned masonry	No rounding
(ii) Class A masonry	No rounding
(iii) Class B masonry	1 inch
(iv) Rubble masonry	1½ inches

(c) Arch ring rock joint surfaces. Dress ring rock joint surfaces radial to the arch or normal to the front face to a depth of 3 inches. Beyond that point, the departure from the radial or normal may not exceed ¾ inch in 12 inches.

Dress the back surface adjacent to the arch barrel concrete parallel to the front face and normal to the intrados to a depth of 6 inches. When concrete is placed after the masonry is constructed, vary adjacent ring stones at least 6 inches in depth.

(d) Finish for exposed faces**.** Remove drill or quarry marks from exposed faces. Pitch face stones to the line along beds and joints. Finish the exposed faces as specified in the contract. The following abbreviations are used to represent the type of surface or dressing specified:

(i) Fine pointed (F.P.). Make point depressions approximately ⅜ inch apart. Limit surface variations to ⅛ inch or less from the pitch line.

(ii) Medium pointed (M.P.). Make point depressions approximately ⅝ inch apart. Limit surface variations to ¼ inch or less from the pitch line.

(iii) Coarse pointed (C.P.). Make point depressions approximately 1⅛ inches apart. Limit surface variations to ⅜ inch or less from the pitch line.

(iv) Split or seam face (S.). Provide a smooth appearance, without tool marks, with no depressions below the pitch line, and no projection exceeding ¾ inch beyond the pitch line.

(v) Rock faced (R.F.). Provide an irregular projecting surface without tool marks, concave surfaces below the pitch line, and projections beyond the specified pitch line. For example, the specification "1.50 R.F." ("38 R.F") means no projections 1½ inches beyond the pitch line. Where a "*variable rock face*" is specified, uniformly distribute stones of the same height of projection.

When top or bottom bed surface of a stone is saw cut, groove the surface to provide roughness for adequate mortar adherence. Submit method and extent of grooving for approval by the Engineer.

(B) Placing Stone. Do not place stone masonry when the ambient temperature is below 32 °F.

Clean stones and moisten before placing. Use hand tools to clean the exposed faces of the stones of mortar when removing and resetting stone masonry. Clean and moisten the bed. Clean the bearing surface and moisten before spreading the mortar bed on footings.

Level the cross beds for vertical walls. Lay beds for battered walls from level to normal to the batter line of the face of the wall.

Place stone to provide a consistent pattern and color. Lay stones with the longest face horizontal and the exposed face parallel to the masonry face.

Construct masonry joints to the thicknesses shown in Table 2 for face stones. Construct ring stone joints on the faces and soffits between ¼ inch and 1½ inches thick, otherwise, make the bed of each course of a uniform thickness throughout the stone masonry item. Construct head joints vertically in dimensioned masonry. Construct head joints in other masonry classes at angles with the vertical from 0 to 45 degrees. Do not exceed more than 10% of total head joints that are not greater than 5 degrees from vertical.

Maintain completed masonry at a temperature above 40 °F for 24 hours after construction.

Remove stones loosened after the mortar has taken initial set, clean off the mortar, and relay the stone with fresh mortar.

Rake mortar joints to a depth of 1-inch and brush finish. Provide a rock faced finish to all exposed stone surfaces in the joints.

Install a minimum of 4 tie-backs (through stones) for headwalls 10 feet wide or less and a minimum of 6 tie-backs (through stones) for headwalls greater than 10 feet wide. Submit the number of tie-back (through stones) for approval by the Engineer.

Clean excess mortar from the face of the stone masonry before it hardens. Once mortar is thoroughly set and hardened, clean excess mortar using masonry cleaner. Wet the stone masonry surface and clean the stone masonry surface according to manufacturer's recommendations. Rinse the cleaner from the wall by bucket and brush method or a low-pressure wash of not more than 300 pounds per square inch. Do not high-pressure wash stone masonry.

Table 2
Masonry Joint Thicknesses

Class	Bed Joint	Head Joints
Dimensioned	⅜ – 1 inches	¾ – 1 inches
Class A	½ – 2 inches	½ – 1½ inches
Class B	½ – 2 inches	½ – 2 inches
Rubble	½ – 2½ inches	½ – 2½ inches

(C) Pointing

(1) Pointing new joints. Crown the joint mortar slightly on top surfaces to provide drainage.

Where raked joints are required, squarely rake mortar in exposed face joints and beds to the required depth. Slightly rake the mortar where weather joints are required. Do not leave the mortar flush with the stone faces.

Clean stone faces of mortar stains while the mortar is fresh. After the mortar sets, clean stone faces again using wire brushes and acid. Protect masonry during hot or dry weather by keeping it moist for at least 3 days after the work is completed.

(2) Repointing joints. Remove loose mortar from joints using a small mason's chisel, small pneumatically-power chisel, or other raking tool approved by the Engineer. Do not use power saws or grinders. Demonstrate proficiency if power equipment is used before removing mortar from the structure. Remove mortar to a depth of two and one-half times the width of the joint. Remove dirt or vegetation with a wire brush or other approved tools. Clean joint of loose fragments and dust with pressurized air or water.

Construct a 36-inch test section of joint along the structure for approval before continuing with work. Approved test section may be incorporated into the work. Moisten adjacent stone before filling the joint. Do not place mortar to a depth greater than two and one-half times the joint width. Place mortar in layers of approximately ¼ inch for joints deeper than ⅛ inch. Add successive layers once mortar has reached thumb-print hardness. Tool the final layer to match the approved joint appearance.

Clean excess mortar and stain from stone masonry using a bristle brush after the mortar has dried, but before the initial set. Do not use chemicals for cleaning. Protect masonry during hot or dry weather by keeping it moist for at least 3 days after the work is completed.

(D) Constructing Walls

Construct an L-shaped test section of wall at least 5 feet high and 8 feet long; showing examples of face wall, top wall, method of turning corners, and method of forming joints. Do not construct masonry other than the foundation masonry before the test section is approved.

Set face stones to produce the effect demonstrated in the approved test section. Do not extend bed joints in an unbroken line through more than five stones and head joints through more than two stones. Bond each face stone with contiguous face stones at least 6 inches longitudinally and 2 inches vertically. Do not allow the corners of four stones to be adjacent to each other.

Do not bunch small stones or stones of the same size, color, or texture. Construct walls using stones that decrease in size from the bottom to the top. Use large stones for the bottom course and large selected stones in corners.

(1) Headers. Distribute headers uniformly throughout the walls of structures to form at least 20 percent of the faces.

(2) Backing. Construct the backing out of large stones. Bond the individual stones composing the backing and heart with the stones in the face wall and with each other. Fill openings and interstices in the backing with mortar or with spalls surrounded by mortar.

(3) Coping. Finish with coping when shown in the plans. Where copings are not called for, finish the top of the wall (headwalls, guardwalls, parapet walls, and all other stone masonry walls) with stones wide enough to cover the top of the wall from 1.5 feet to 5 feet in length, and of thickness between 4 inches and 7 inches. Distribute top stones of same thickness randomly throughout the length of the wall. Stone thickness is measured from the bottom pitch line to the top pitch line and does not include the RF finish projection beyond the pitch line. Lay stones in a manner that the top course is an integral part of the wall. Pitch the tops of the top courses of stone to line in both vertical and horizontal planes.

(4) Parapet walls. Use stones squared and pitched to line and with heads dressed in the ends of parapet walls and in exposed angles and corners. Interlock spreaders with as many headers as possible. Extend headers through the entire wall thickness. Interlock both the headers and stretchers in the two faces of the wall. Use headers and stretchers to comprise a majority of the wall volume. Fill openings and interstices with mortar or with spalls surrounded by mortar.

(5) Weep holes. Place weep holes at the lowest points where free outlets can be obtained. Space holes no more than 10 feet apart. unless otherwise shown on the plans.

(E) Facing for Concrete

Concrete placed before stone. Set galvanized metal anchor slots flush with the projected face of concrete. Set the slots vertically at maximum horizontal spacings of 24 inches foam filled slots to prevent filling with concrete.

Fit the metal anchors in the slots at a maximum vertical spacing of 24 inches. Extend the anchors to within 2 inches of the face of the stones.

If the shape of the concrete face is unsuitable for the use of metal slots, use 9 gage galvanized iron wire ties at a rate of six ties for each square yard (seven ties for each square meter) of exposed surface.

Keep the concrete face continuously wet for 2 hours preceding the placing of the stone and fill interstices with mortar or with spalls surrounded by mortar.

(G) Guardwall

Use Class B masonry. Construct cast-in-place or precast concrete corewalls according to Section 825. Use concrete with a minimum 28-day compressive strength of 3,500 pounds per square inch Construct a 25-foot test section of guardwall. Do not construct additional guardwall until the test section is approved.

Construct the guardwall true and uniform along its length with no stone projecting more than 1½ inches beyond the face of the guardwall or more than the specified finish allows. Construct masonry beds and joints for face stones to the thicknesses shown in Table 877-1. Rake the joints and beds to a depth of 2 inches on the front and top sides and to a depth of 1½ inches on the back.

Use a one-piece capstone for the full width of the guard wall.

Place stones (including the capstones) randomly to avoid a pattern. Lay stones to reflect the width of the expansion joints. Do not leave a gap or a mortar edge at the expansion joint. Use various size stones to coin or key the corners of the guardwall.

Acceptance

Rock for masonry structures will be evaluated under Article 106.

Material for mortar will be evaluated under Article 106.

Mortar placement will be evaluated under Article 106.

Construction or rehabilitation of stone masonry will be evaluated under Article 106.

Minor concrete will be evaluated under Article 825.

Excavation and backfill will be evaluated under Article 225 and 235.

Measurement and Payment

When measuring stone masonry by the cubic yard (cubic meter), measure in the structure.

When measuring stone masonry guardwall, measure along the gutter line including terminal sections.

When measuring remove and reset stone masonry by the cubic yard (cubic meter), measure in the structure after resetting.

When measuring repointing of stone masonry, measure along the centerline of joint.

Do not measure test wall sections not incorporated in the work.

Payment will be made under:

Pay Item	**Pay Unit**
Stone Masonry Headwall for ___” Pipe Culvert	Each
Stone Masonry Guardwall	Linear Foot
Stone Masonry for Wingwall, Parapet, and Abutment	Cubic Yard

STONE CURB

Description

This work consists of constructing stone curb.

Material

Refer to the *2018 Standard Specifications* and the *Grout Production and Delivery Special Provision, Joint Materials Special Provision and Masonry Special Provision* found elsewhere in the contract.

Item	Section
Bedding Material	1010
Minor Concrete	825
Mortar	1040-9
Reinforcing Steel	1070

Construction Methods

Perform excavation and embankment according to Articles 225 and 235.

Place and compact the bedding material. Compact the bedding material with at least three passes of a lightweight mechanical tamper, roller, or vibratory system.

(A) Stone Curb.

Do not use stone with visible drill marks on the exposed faces.

(1) Type 1. Provide an RF 0.5 or heavy thermal finish to the top surface of vertical stone curb to an approximate true plane with no depression or projection on that surface of over ¼ inch. Pitch the front and back axis lines straight and true. Limit projections or depressions on the back surface to not exceed a batter of 1 inch horizontal to 3 inches vertical.

Provide smooth quarry split finish on the front exposed face of the vertical stone curb and form to an approximately true plane. Limit projections or depressions on the remaining face distance to 1 inch or less from the plane of the exposed face.

Square the ends of vertical stone curb with the top back and face and finish so when the sections are placed end to end, shows no space more than ½ inch in the joint for the full width of the top surface and for the entire exposed front face. The remainder of the end may break back no more than 4 inches from the plane of the joint. Cut the joints of circular or curved stone curb on radial lines.

Make stone curb segments at least 48 inches long, but the length may vary where a depressed or modified section of curb is required for driveways, crossings, or closures. Provide shorter curb segments to meet smooth layout and grade as approved by the Engineer.

(2) Type 2**.** Conform to the requirements of Type 1 stone curb for slope stone curb, except as follows:

The maximum allowable projection or depression on a horizontal top surface is limited to ½ inch. On other exposed faces, the maximum allowable projection or depression is limited to 1 inch.

For unexposed surfaces, the maximum allowable projection or depression from a true plane on a 24-inch length is 3 inches.

The maximum allowable space showing on exposed faces between adjacent segments of slope stone curb is ¾ inch. Make slope stone curb segments at least 24 inches long.

Clean the curb material thoroughly and wet it just before setting. Set the curb in bedding material so the face and top lines are to line and grade. Make the joints ½ to 1 inchwide and fill the joints with mortar.

Complete the first 25 feet of curb to demonstrate the ability to build a curb conforming to these requirements. Do not continue construction until the 25-foot test section is approved.
Where a concrete pavement is constructed contiguous to the curb, construct the joints in the curb directly in line with the pavement expansion joints.

Make the curb joint ¾ inch wide and fill it with expansion joint filler of the same nominal thickness as the pavement joint. Fill voids between the joint filler and the curb with mortar.

Acceptance. See Table 3 for sampling, testing, acceptance requirements.

Material for mortar will be evaluated under Article 106.

Mortar will be evaluated under Article 106.

Bedding material will be evaluated under Article 106.

Stone for stone curbing will be evaluated under Article 106.

Construction of curb will be evaluated under Article 106.

Excavation and backfill will be evaluated under Section 410.

Minor concrete will be evaluated under Section 825.

Table 3

Sampling and Testing, Acceptance Requirements.

Material or Product (Subsection)	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time	Remarks
Source									
Bedding material (1010)	Measured and tested for conformance	Gradation	-	Subsection xxx	1 per soil type and source of material	Source of material	Yes	Before using in work	Not required when using Government provided sources
		Liquid limit	-	AASHTO R 58 & T 89, Method A	"	"	"	"	"
Production									
Bedding material (1010)	Measured and tested for conformance	Gradation	-	AASHTO T 27 & T11	1 per 600 yd^3	Product output or stock pile	Yes	4 hours	-
		Liquid limit	-	AASHTO R 58 & T 89, Method A	"	"	"	"	-

Measurement

When measuring for curb or curb and gutter, make no deduction in length for drainage structures installed in the curb section or for driveway and handicap access ramp openings where the gutter is continuous across the opening.

Payment

Payment will be made under:

Pay Item	**Pay Unit**
Granite Curb	Linear Foot

STEEL BACKED TIMBER GUARDRAIL:

Description

This work consists of installing guardrail systems and modifying, removing and resetting, and raising existing guardrail systems.

(A) Guardrail systems are designated as follows:
SBT — Steel-backed timber
SBTA — SBT guardrail/timber posts and block-out
SBTB — SBT guardrail/timber posts and no block-out

(B) Steel guardrail classes are designated as follows:
A — Metal thickness — 0.105 inches (12-guage)
B — Metal thickness — 0.135 inches (10-guage)

(C) Terminals consist of posts, railing, hardware, and anchorage assembly necessary to construct the type of terminal specified. Terminal types are designated as follows:
SBT-BAT — Back slope anchor terminal
SBT-FAT — Flared SBT anchor terminal
SBT-Tangent — Tangent SBT terminal

Material

Refer to the *2018 Standard Specifications* and the *GuardrailMaterials Special Provision* and *Structural Timber and Lumber Special Provision* found elsewhere in the contract.

Minor concrete	825

Construction Methods

Furnish guardrail systems and terminals that are crashworthy. When flared or tangent terminals are required, submit drawings from the manufacturer for the terminals according to Article 105.

Place concrete according to Section 825.

Perform welding according to Article 1072-18.

(A) Post Installation. Treat field cuts for wood posts with two coats of preservative specified in Article 1082-3. Do not place field cuts in contact with the ground.

Install the posts plumb and at the location, spacing, and elevation specified, or as directed by the Engineer.

When the pavement surface is within 36 inches of the guardrail face, install posts before placing the pavement surface. Protect posts from traffic by attaching the rail elements or by a method approved by the Engineer.

Posts may be installed by either drilling or driving. Ensure posts installed by drilling have sufficiently sized holes to permit thorough compaction of backfill material around the post. Backfill in compacted layers not exceeding 12 inches. Replace posts damaged during driving operations.

When a post cannot be placed at its normal location due to an impenetrable object an additional blockout may be added. If the post cannot be offset, follow the post in rock detail or use the long span detail as shown in the plans or as approved by the Engineer. Do not change the post lengths or spacings in terminal sections.

When it is not possible to maintain a 24-inch minimum distance between the back of the guardrail post and the top of a 1V:2H or steeper slope, increase the standard post length by 12 inches.

(B) Rail Element Installation. Do not modify specified hole diameters or slot dimensions.

Treat field cuts with two coats of preservative.

(C) Terminal Sections. Do not connect the guardrail to cast-in-place anchors until the concrete has cured 7 days. Install end anchor cables without slack.

(D) Connection to Structure. Install posts, railing, hardware, and anchorage assembly necessary to construct the type of connection to structure specified.

(E) Guardrail Construction Exposed to Traffic. When a roadway is open to traffic during construction, complete guardrail installations within 5 days from the day the structure, pavement, shoulder, or whichever is the controlling item of work is sufficiently completed to allow guardrail installation. In areas where guardrail construction is not restricted by other construction, complete removal of existing guardrail and construct new guardrail within 48 hours of starting work.

At the end of each day, securely bolt a rounded end section to the exposed end of the guardrail.

Schedule guardrail installation so work is finished before work suspension or other extended periods of time.

(F) Removing and Resetting Guardrail. Remove and store the existing rail elements, posts, and appurtenances. Remove and dispose of posts that are set in concrete. Replace guardrail, posts, and hardware damaged during removal, storage, or resetting. Backfill holes resulting from the removal of guardrail posts and anchors with material approved by the Engineer. Dispose of material not used in resetting guardrail according to Article 210.

(G) Raising Guardrail. Remove the existing rail elements and appurtenances. Replace and reset posts as needed. Replace rail elements, posts, and hardware damaged during the removal and raising. Dispose of damaged material according to Article 210.

Acceptance

Material for guardrail will be evaluated under Article 106.

Construction of guardrail will be evaluated under Article 106.

Welding will be evaluated under Article 1072.

Measurement

Measure transition sections from G9 rail to G4 rail as G9 rail.

Measure removing and resetting guardrail and raising guardrail including reset terminal sections.

Measure replacement posts (except replacement posts for posts damaged by construction operations) used in the removing and resetting, or raising guardrail.

Payment

Payment will be made under:

Pay Item	Pay Unit
Guardrail System, Steel-Backed Timber, Type A (SBTA)	Linear Foot
Guardrail Terminal Section, Type SBT-Tangent	Each

ASPHALT PAVED WATERWAY:

Description

This work consists of constructing paved waterways not contiguous to the traveled way in accordance with the detail and plans.

Material

Asphalt shall be I19.0C.

Furnish a suitable, well-graded, free draining bedding material conforming to the following:

Maximum particle size	½ in (12.5 mm) or half the corrugation depth,
Material passing No. 200 (75-µm) sieve according to AASHTO T 27 and AASHTO T 11	, 10.0 percent max.

Construction Methods

Excavate and backfill according to Articles 225 and 235. Place and compact the bedding material with at least three passes of a lightweight mechanical tamper, roller, or vibratory system.

Perform the work according to Section 403.

Acceptance

See Table 4 for sampling, testing, and acceptance requirements.

Material for grout and mortar will be evaluated under Article 106.

Bedding material and sand will be evaluated under Article 106.

Construction of paved waterways will be evaluated under Article 106.

Excavation and backfill will be evaluated under Articles 225 and 235.

Asphalt concrete will be evaluated under Section 403.

Table 4
Sample, Testing and Acceptance Requirements

Material or Product (Subsection)	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time	Remarks
Source									
Bedding material	Measured and tested for conformance	Gradation	-	Subsection XX	1 per soil type and source of material	Source of material	Yes	Before using in work	Not required when using Government – provided sources
		Liquid limit	-	AASHTO R 58 & T 89, Method A	"	"	"	"	"
Sand	"	Gradation & deleterious material	"	AASHTO M 6	"	"	"	"	"
Production									
Bedding material	Measured and tested for conformance	Gradation	-	AASHTO T 27 & T11	1 per 600 yd^3	Production output or stockpile	Yes	4 hours	"
		Liquid limit	-	AASHTO R 58 & T 89, Method A	"	"	"		
Sand	"	Gradation & deleterious material	"	AASHTO T 27 & T11	"	"	"	"	"

Measurement and Payment

When measuring the area, measure the width horizontally to include the total width. Measure the length parallel to the flow line.

When measuring paved waterway lengths, measure from the front face of the curb along the flow line of the paved waterway.

Pay Item	Pay Unit
Paved waterway, Type 5, Asphalt	Square Yard

GROUT PRODUCTION AND DELIVERY:

(3-02-18) 1003 SP10 R1003

Revise *2018 Standard Specifications* as follows:

Page 10-21, Article 1003-1 Description, add the following after line 29:

Type 6 – Furnish a grout consisting of a mixture of hydraulic cement, water, and admixtures. Do not exceed a water/cementitious material ratio of 0.44. Do not exceed 20 percent of the cement by mass if fly ash is used. Admixtures to reduce water content, improve the flowability, control bleeding, or control shrinkage may be added according to the manufacturer's recommendations. Furnish admixtures free of chlorides, fluorides, sulphites, and nitrates.

JOINT MATERIALS:

(3-02-18) 1003 SP10 R1028

Revise *2018 Standard Specifications* as follows:

Page 10-53, Article 1028-1, delete lines 42 to 44 and replace with the following:

Provide grey elastomeric joint sealant conforming to ASTM C920, Type M, Grade P, Class 25, and use T_1 or T_2.

MASONRY:

(3-02-18) 1040 SP10 R1040

Revise *2018 Standard Specifications* as follows:

Page 10-65, Subarticle 1040-9, line 25, add the following after line 25:

ROCK FOR STONE MASONRY

Conform to the size and shape specified. Furnish sound, durable rock of the texture and color specified and has been proven satisfactory for the intended use. Do not furnish rock containing reeds, rifts, seams, laminations, and minerals that may cause discoloration or deterioration from weathering.

Do not use rock with depressions or projections that might weaken it or prevent it from being properly bedded.

When no dimensions are shown on the plans, furnish the rocks in the sizes and face areas necessary to produce the general characteristics and appearance indicated on the plans.

Unless otherwise specified, furnish rock fragments conforming to requirements in Table 5

TABLE 5 MINIMUM ROCK FRAGMENTS	
Minimum thickness	5 inches
Minimum width	12 inches or 1.5 times the thickness, whichever is greater
Minimum length	1.5 times the width
Rocks with volume greater than or equal to 1 cubic foot	50% min

When headers are required, furnish headers with lengths no less than the width of bed of the widest adjacent stretcher plus 12 inches.

Obtain granite for new stone masonry from quarries located in Elberton, Georgia as approved by the Engineer.

GUARDRAIL MATERIALS:

(3-02-18) 1046 SP10 R1046

Revise *2018 Standard Specifications* as follows:

Page 10-67, Subarticle 1046-2, line 41, add the following after line 41:

Steel-backed timber rail shall be of timber conforming to AASHTO M 168. Fabricate the timber rail from dry, seasoned, and dressed rough sawn Douglas fir, southern pine, or other species having a stress grade of at least 1,500 pounds per square inch. Do not use refractory species (such as larch or Rocky Mountain Douglas fir). Treat according to AASHTO M 133.

Fabricate steel backing elements according to ASTM A242.

Page 10-68, Subarticle 1046-3(C), line 23, add the following after line 23:

Furnish posts that do not have a thorough check, shake, or end slit in the same plane as, or a plane parallel to the bolt hole and extending from the top of the post to within 3 inches or the bolt hole. Treat according to AASHTO M 133.

Steel-backed timber guardrail posts shall be of timber conforming to AASHTO M 168. Fabricate the timber rail from dry, seasoned, and dressed rough sawn Douglas fir, southern pine, or other

species having a stress grade of at least 1,500 pounds per square inch. Do not use refractory species (such as larch or Rocky Mountain Douglas fir). Treat according to AASHTO M 133.

Fabricate steel backing elements according to ASTM A242.

Page 10-68, Subarticle 1046-3(D), line 37, add the following after line 37:

Provide wood offset blocks as shown in the plans. Wood for offset blocks shall be of timber conforming to AASHTO M 168. Fabricate the timber rail from dry, seasoned, and dressed rough sawn Douglas fir, southern pine, or other species having a stress grade of at least 1,500 pounds per square inch. Do not use refractory species (such as larch or Rocky Mountain Douglas fir). Treat according to AASHTO M 133.

Fabricate steel backing elements according to ASTM A242.

Page 10-69, Subarticle 1046-4, line 3, add the following after line 3:

Furnish hardware for steel-backed timber guardrail that conforms to AASHTO-AGC-ARTBA, A Guide to Standardized Highway Barrier Hardware.

For angles, channels, wide flanges, and plates not contained in the above standard, conform to ASTM A36 for non-weathering steel or ASTM A242 for weathering steel. For structural tubing for short steel posts, conform to ASTM A500 or ASTM A513, Grade 1008.

Galvanize soil plates and structural tubing according to AASHTO M 111. Do not punch, drill, cut, or weld the metal after galvanizing.

Manufacture reflector tabs from 0.15-inch (4-millimeter) aluminum or plastic. Use an adhesive that resists peeling with a force of 5 pounds per inch (0.89 kilograms per centimeter) of width. Use mildew-resistant adhesive that has no staining effect on retroreflective sheeting. Furnish retroreflective sheeting conforming to ASTM D4956, including supplementary requirements.

Furnish galvanized nuts conforming to ASTM A563, Grade A. Furnish bolts conforming to ASTM A307, Grade A.

STRUCTURAL TIMBER AND LUMBER

(3-02-18) 1082 SP10 R1082

Revise *2018 Standard Specifications* as follows:

Page 10-173, Subarticle 1082-3(C), line 6, add the following after line 26:

Timber for steel-backed timber guardrail posts shall conform to AASHTO M 168. Fabricate the timber rail from dry, seasoned, and dressed rough sawn Douglas fir, southern pine, or other species having a stress grade of at least 1,500 pounds per square inch. Do not use refractory species (such as larch or Rocky Mountain Douglas fir). Treat according to AASHTO M 133.

Fabricate steel backing elements according to ASTM A242.

Page 10-173, Subarticle 1082-3, line 26, add the following after line 26:

(G) Guardrail Block

Timber for steel-backed timber guardrail blocks shall conform to AASHTO M 168. Fabricate the timber rail from dry, seasoned, and dressed rough sawn Douglas fir, southern pine, or other species having a stress grade of at least 1,500 pounds per square inch. Do not use refractory species (such as larch or Rocky Mountain Douglas fir). Treat according to AASHTO M 133.

Fabricate steel backing elements according to ASTM A242.

WORK ZONE TRAFFIC CONTROL GENERAL REQUIREMENTS

(3-02-18) 1101 SP11 R1101

Revise *2018 Standard Specifications* as follows:

Page 11-2, Article 1101-7, add the following after line 25:

Once haul routes are identified, prepare load rating calculations using Load and Resistance Factor Rating (LRFR) for all existing bridges on the Blue Ridge Parkway along the planned route for transporting equipment and materials. Check the adequacy of the existing bridges based on the Inventory Level load rating for the Strength and Service Limit States. Submit load rating calculations that are signed and sealed by a Professional Engineer registered in the State of North Carolina.

Space loaded hauling vehicles at 500 feet minimum intervals, and do not allow more than one (1) loaded hauling vehicle at a time on a bridge on the Blue Ridge Parkway.

Page 11-2, Article 1101-8, add the following after line 34:

Do not stage materials or equipment in areas that are not mowed regularly throughout the growing season unless prior approval from the Engineer is obtained. Only close half the overlook at a time when using overlooks as staging areas.

Page 11-2, Article 1101-9, 89, Article 150, add the following after line 39:

Do not park vehicles in areas that are not mowed regularly throughout the growing season unless prior approval from the Engineer is obtained.

GENERAL UTILITY REQUIREMENTS

(3-02-18) 1082 SP15 R1500

Revise *2018 Standard Specifications* as follows:

Page 15-1, Subarticle 1500-3, line 24, add the following after line 24:

Contact the North Carolina One Call Center at 811 or 202-265-7177, at least 48 hours before any excavation to have the utilities marked in the field. If the North Carolina One Call Center does not perform this service at the project site, contact and ensure that a commercial utility location service marks underground utilities in the field before any excavation begins. Notify the Engineer 48 hours before any excavation and provide a copy of the written confirmation to the Engineer that no utility conflicts exist within the proposed excavation.

PROJECT SPECIAL PROVISIONS
EROSION CONTROL AND ROADSIDE DEVELOPMENT

TOPSOIL:

Description

Use shoulder and slope material to construct shoulders and plate slopes with materials capable of supporting vegetation. Material that contains roots, root mats, stumps or other unsatisfactory material will not be acceptable.

Use borrow sources in accordance with Article 1018-2.

Materials

Use fertile, friable, free draining, sandy loam soil that is free of subsoil, refuse, stumps, roots, brush, weeds, rocks larger than 1 inch (25 millimeters), or other substances detrimental to the development of vegetative growth. Demonstrate that the soil can sustain healthy crops of grass, shrubs, or other plant growth. Conform to Table 6:

TABLE 6 TOPSOIL	
Organic matter, AASHTO T 267	3.0 to 10.0 percent
Sand, AASHTO T 88	20 to 70 percent
Silt, AASHTO T 88	10 to 60 percent
Clay, AASHTO T 88	5 to 30 percent
pH, AASHTO T 289	6.0 to 8.0

Construction Methods

Treat existing and furnished soils to eradicate weeds using methods approved by the Engineer.

Submit a soil analysis report for existing and furnished soil. Soil analysis report should be from the State University Agricultural Extension Service or other approved soil testing laboratory. Include in the report the soil textural classification (percentage of sand, silt, clay, and organic matter), gradation, pH, cation exchange capacity and additive recommendations.

Amend soil in accordance to recommendations provided in the soil analysis report. Apply limestone as recommended by the soil analysis. Use a maximum of 0.17 pounds of limestone per cubic foot of topsoil to adjust an acidic condition.

For soils with pH lower than 5.5, evenly apply dolomitic lime at the rate recommended by the soil testing agency to modify pH to be within 5.5-6.5. For soils with pH higher than 6.5, evenly apply elemental sulfur at the rate recommended by the soil testing agency to modify pH to be within 5.5-6.5.

Thoroughly clean all equipment used for seeding prior to use according to Article 107. All equipment will be subject to inspection at the Engineer's discretion to preclude the introduction of exotic vegetation into the Park. Make restitution, as described in Article 107, for the introduction of exotic vegetation into the Park.

Deliver seed, fertilizer, and limestone in acceptable condition in original, unopened containers. Clearly label container with botanic name (genus and species) of the seed, common name, and quantity of contents. Prior to seed placement, allow the Engineer to review properly labeled containers of seed brought on-site for conformance to Article 1660.

Obtain approval of the topsoil source from the Engineer, after inspection by the NPS. Provide the Engineer with 14 days advance notification for inspecting the source. If the source is found unsuitable, locate another source and provide the Engineer the same number of days to inspect the new source. Stockpiled material in Contractor's yard or supplier's yard area will not be considered suitable. Do not excavate material prior to approval of the source. Once excavated, do not allow stockpile to remain uncovered for longer than 7 days.

Measurement and Payment

Topsoil will be measured and paid as the actual number of tons of this material weighed in trucks on certified platform scales or other certified weighing devices.

Payment will be made under:

Pay Item	**Pay Unit**
Topsoil	Tons

AGGREGATE TOPSOIL

Description

Use shoulder and slope material to construct shoulders and plate slopes with materials capable of supporting vegetation. Material that contains roots, root mats, stumps or other unsatisfactory material will not be acceptable.

Use borrow sources in accordance with Article 1018-2.

Materials

Use topsoil that conforms to Topsoil Special Provision

Use aggregate that conforms to AASHTO M 80, Class E and AASHTO M 43, Size Number 67.

Use seed in accordance with the plans and the Landscape and Development Materials Special Provision.

Use water that is free of substances injurious to plant life (such as oils, acids, alkalis, or salts).

Construction Methods

(A) Preparing Surface – Complete the adjoining pavement before placing an aggregate-topsoil course on the shoulder. Scarify the area where the mixture is to be placed to a depth of 3 inches. Reduce clods and sod to a maximum size of 4 inches.

(B) Mixing, Placing and Compacting – Furnish a mixture of 50±10 percent aggregate and 50±10 percent topsoil by volume with sufficient water for compaction.

Mix the components into a uniform mixture. Spread the mixture on the prepared surface in a uniform layer. Shape the mixture to the line, grade, and cross-section. Remove clods and stones greater than 2 inches in diameter. Before compaction, dry seed the mixture surface at a rate of 75 pounds per acre.

Uniformly compact the mixture to ensure it does not exhibit heaving, pumping, rutting, or shearing. After compaction, dry seed the surface again at a rate of 75 pounds per acre.

Measurement and Payment

Aggregate Topsoil will be measured and paid as the actual number of tons of this material weighed in trucks on certified platform scales or other certified weighing devices.

Payment will be made under:

Pay Item	**Pay Unit**
Aggregate Topsoil	Tons

LANDSCAPE DEVELOPMENT MATERIALS:

Revise *2018 Standard Specifications* as follows:

Page 10-80, Subarticle 1060-2, line 23 to 26, delete lines 23 to 26 and replace with the following:

Furnish a natural fertilizer with a high organic content that is long acting, slow release, sterilized, and free of weed seeds. Furnish fertilizer meeting the minimum available nutrient requirements of Table 7.

Table 7
Minimum Percentages of Available Nutrients

Nutrient	Minimum Percent
Total nitrogen	7
Nitrogen (water soluble)	0.5
Phosphoric acid	2
Water-soluble potash	3

Supply the fertilizer in new, clean, sealed, and properly labeled containers with name, mass, and guaranteed analysis of contents clearly marked.

Liquid fertilizer containing the minimum percentage of available nutrients may be used.

Page 10-81, Subarticle 1060-3, line 5 to 12, delete lines 5 to 12 and replace with the following:

(a) Purity (calcium and magnesium) carbonates 75 percent min.

(b) Gradation per Table 8

Table 8
Agricultural Limestone Gradation

Sieve Size	Minimum Percent by Mass Passing Designated Sieve (AASHTO T 27)
No. 10 (2 mm)	90
No. 40 (425 µm)	50

Page 10-81, Subarticle 1060-4, line 24, add the following:

Furnish each seed type in separate sealed container. Clearly label each container with the following:

(a) Botanic name and type of seed;

(b) Lot number;

(c) Net mass;

(d) Percent of purity, germination, and hard seed;

(e) Percent of maximum weed seed content;

(f) Seed origin;

(g) Noxious weeds present;

(h) Other crop seed;

(i) Inert matter;

(j) Name and address of seed distributor; and

(k) Mixture percent of each component.

Inoculate legume seed with approved cultures according to the manufacturer's instructions.

Page 10-81, Subarticle 1060-4, line 46, add the following:

Furnish seed as shown on the plans.

Submit a 1 pound sample clearly labeled with botanic name and grower's figures on pure live seed ratio for each type of grass to be seeded.

Page 10-81, Subarticle 1060-5, Mulch for Erosion Control, delete and replace with the following:

Mulch of erosion control shall consist of biodegradable wood fiber**.**

Furnish biodegradable wood fiber mulch. All mulch will need to be conforming to the following:

(1) 100 percent virgin wood fiber hydromulch with, or without, preblended tackifier;

(2) 100 percent natural plant-based tackifier (e.g. guar or alpha plantago);

(3) 100 percent aspen wood fiber (virgin wood) at 2000 lbs. per acre;

(4) 50 percent of the fibers equal to or greater than 0.15 inch;

(5) 75 percent or more material sized to retain on a 28-mesh screen; and

(6) Additional requirements of Table 9.

Table 9
Wood Fiber Mulch

Property	Percentages
Moisture	10.0% +\-3.0%
pH	5.4% +\- 0.1%
Organic matter	99.3% +\- 0.2%
Inorganic ash	0.7% +\- 0.2%
Water holding	14.01%

Page 10-82, Subarticle 1060-8(A), delete the first sentence and replace with the following:

Matting for erosion control shall be excelsior matting.

Page 10-82, Subarticle 1060-8(B), delete the last two sentences and replace with the following:

Cover one side of excelsior matting with an extruded biodegradable mesh. Use cotton, jute or other non-plastic material for mesh.

Page 10-82, Subarticle 1060-8(C), delete the Article.

Page 10-83, Subarticle 1060-8(D), line 6, add the following:

(E) Temporary Rolled Erosion Control Product (RECP)

(1) Type 2.B, short term single net erosion control blanket

Short term single net-less erosion control blanket shall be a temporary degradable RECP composed of processed natural fibers mechanically, structurally or chemically adhered together to form a continuous matrix. The RECP shall provide erosion control and facilitate vegetation establishment.

Textile shall conform to Table 10

(2) Type 2.C, short term single net erosion control blanket or open weave textile

Short term single net erosion control blanket shall be a temporary degradable RECP composed of processed natural fibers mechanically, structurally or chemically bound together by a single natural fiber netting to form a continuous matrix. The RECP shall provide erosion control and facilitate vegetation establishment.

Short term single net open weave textile shall be temporary degradable RECP composed of natural yarns or twines woven into a continuous matrix. The RECP shall provide erosion control and facilitate vegetation establishment.

Textile shall conform to Table 10

(3) Type 2.D, short term double net erosion control blanket

Short term double net erosion control blanket shall be a temporary degradable RECP composed of processed natural fibers mechanically, structurally or chemically bound together by two natural fibers nettings to form a continuous matrix. The RECP shall provide erosion control and facilitate vegetation establishment.

Textile shall conform to Table 10

(4) Type 3.B extended term erosion control blanket or open weave

Extended term erosion control blanket shall be a temporary slow degrading RECP composed of processed natural fibers mechanically, structurally or chemically bound together between two natural fiber nettings to form a continuous matrix. The RECP shall provide erosion control and facilitate vegetation establishment.

Short term single net open weave textile shall be temporary slow degrading RECP composed of natural yarns or twines woven into a continuous matrix. The RECP shall provide erosion control and facilitate vegetation establishment.

(5) Type 4 long-term erosion control blanket or open weave

Long-term erosion control blanket shall be a temporary slow degrading RECP composed of processed natural fibers mechanically, structurally or chemically bound together between two natural fiber nettings to form a continuous matrix. The RECP shall provide erosion control and facilitate vegetation establishment.

Long-term open weave textile shall be temporary slow degrading RECP composed of natural yarns or twines woven into a continuous matrix. The RECP shall provide erosion control and facilitate vegetation establishment.

Textile shall conform to Table 10

Table 10
Temporary Rolled Erosion Control Products

		Rolled Erosion Control Product Type										
Property	**Test Method**	**1.A(1)**	**1.B**	**1.C**	**1.D**	**2.A (1)**	**2.B**	**2.C**	**2.D**	**3.A (1)**	**3.B**	**4**
Typical functional longevity (2) (months)	N/A	3	3	3	3	12	12	12	12	24	24	36
Minimum tensile strength	ASTM D6818	5 lb/ft (0.73 kN/m)	5 lb/ft (0.73 kN/m)	50 lb/ft (0.73 kN/m)	75 lb/ft (0.73 kN/m)	5 lb/ft (0.73 kN/m)	5 lb/ft (0.73 kN/m)	50 lb/ft (0.73 kN/m)	75 lb/ft (1.09 kN/m)	25 lb/ft (0.36 kN/m)	100 lb/ft (1.45 kN/m)	125 lb/ft (1.82 kN/m)
Maximum "C" factor at maximum gradient for slope applications (3)	ASTM D6459 or other qualified independent test (6)	0.10 at 1V:5H	0.10 at 1V:4H	0.15 at 1V:3H	0.20 at 1V:2H	0.10 at 1V:5H	0.10 at 1V:4H	0.15 at 1V:3H	0.20 at 1V:2H	0.10 at 1V:5H	0.25 at 1V:1½H	0.25 at 1V:1H
Minimum shear stress for channel applications (4)(5)	ASTM D7207 or other qualified independent test (6)	0.25 lb/ft^2 (12 Pa)	0.50 lb/ft^2 (24 Pa)	1.50 lb/ft^2 (72 Pa)	1.75 lb/ft^2 (84 Pa)	0.25 lb/ft^2 (12 Pa)	0.50 lb/ft^2 (24 Pa)	1.50 lb/ft^2 (72 Pa)	1.75 lb/ft^2 (84 Pa)	0.25 lb/ft^2 (12 Pa)	2.00 lb/ft^2 (96 Pa)	2.25 lb/ft^2 (108 Pa)

(1) Obtain max "C" factor and allowable shear stress for mulch control nettings with the netting used in conjunction with pre-applied mulch material.
(2) Functional longevities are for guidance only. Actual functional longevities may vary based on site and climatic conditions.
(3) "C" factor calculated as ratio of soil loss from rolled erosion control product protected slope (tested at specified or greater gradient, v:h) to ratio of soil loss from unprotected (control) plot in large-scale testing. These performance test values should be supported by periodic bench scale testing under similar test conditions and failure criteria using Erosion Control Technology Council (ECTC), Test Method #2.
(4) Minimum shear stresses the rolled erosion control product (un-vegetated) can sustain without physical damage or excess erosion (> ½-inch (> 12.7-millimeter) soil loss) during a 30-minute flow event in large-scale testing. These performance test values should be supported by periodic bench scale testing under similar test conditions and failure criteria using ECTC, Test Method #3.
(5) The permissible shear stress levels established for each performance category are based on historical experience with products characterized by Manning's roughness coefficients in the range of 0.01 to 0.05.
(6) Other large-scale test methods determined acceptable by the Engineer.

Mushroom Compost or Spent Mushroom Substrate (SMS)

Provide mushroom compost, or spent mushroom substrate (SMS), that is the composted organic material remaining after a commercial Agricus species mushroom crop is harvested.

Provide SMS that has been directly removed from a commercial Agricus species mushroom production facility. Static-aged, or material stock-piled outdoors will NOT be accepted.

Provide SMS that has been pasteurized through composting prior to mushroom production to a minimum temperature of 140 °F AND has been pasteurized by steam-injection after mushroom production to a minimum temperature of 140 °F and for a period of at least 24 hours.

Provide SMS from a facility that obtains chemical analyses from a laboratory certified by the US Composting Council at regular intervals, no less than every 6 months, and has documentation of such analyses going back a minimum of 3 years from contract award date. The chemical analyses is to include pH, organic matter, moisture, total nitrogen, nitrogen ammonium, organic nitrogen, total phosphorus, potassium, carbon, C: N ratio, soluble salts, calcium, magnesium, sulfur, copper, iron, manganese, zinc, aluminum, sodium and sodium absorption rate.

Provide SMS that meets the following: pH 6-7, Sodium Absorption Rate (SAR) < 3 and organic matter > 20%.

Submit manufacturer's product information and chemical analysis from a laboratory certified by the US Composting Council for review and approval prior to proceeding. Submit the most recent chemical analyses and the cumulative analyses for three years prior (minimum.)

Once the chemical analysis has been reviewed and approved, provide soil analysis reports from the State University Agricultural Extension Service or other approved soil testing laboratory for three different mixtures of the SMS and the existing soil. Produce mixtures for analysis at the specified ratio of existing soil with 1" depth, 2" depth and 3" depth of SMS. Provide the following data for each sample: pH, sodium, calcium, magnesium, sodium absorption rate, total nitrogen, phosphorus, potassium, percent organic matter and cation exchange capacity.

Apply up to 3" depth of SMS, as determined by the Engineer, and thoroughly mix the SMS into the existing soil to a depth of 6" using a tiller or similar cultivating equipment and employing a minimum of two passes in different directions.

GRAVEL CONSTRUCTION ENTRANCE

(3-02-18) 300,1607 SP16 R1607

Revise *2018 Standard Specifications* as follows:

Page 16-3, Subarticle 1607-3, delete the first sentence and replace with the following:
Install a gravel construction entrance in accordance with the plans and at the locations as directed by the Engineer.

Page 16-3, Subarticle 1607-4, add the following after line 15:

There will be no direct payment for temporary pipe as they are considered incidental to the work being performed.

TEMPORARY SLOPE DRAINS

Rev. 3-13-18 1622 SP16 R1622

Page 16-7, Subarticle 1622-3, line 23, delete line 23 and replace with the following:

Install temporary slope drains in accordance to the plans during all phases of grading operations and adjust as needed to properly direct water flow.

ROLLED EROSION CONTROL PRODUCTS

(3-02-18) 300,1631 SP16 R1631

Rolled Erosion Control Products shall meet the requirements of the *Landscape and Development Materials Special Provision* and Section 1631 of the *2018 Standard Specifications* as follows:

Revise *2018 Standard Specifications* as follows:

Page 16-9, Subarticle 1631-3, line 39, add the following

Longer staples may be necessary in sandy, loose, or wet soils.

Page 16-9, Subarticle 1631-3, delete line 40 and replace with the following:

Install product with netting on the top side when excelsior is used

Page 16-9, Subarticle 1631-3, add the following after line 40:

In areas to be mowed soon after installation, use temporary rolled erosion control product consisting of rapidly degrading netting with a functional longevity of 3 months or less. Do not use straw or plastic netting in the product.

Page 16-10, Subarticle 1631-3, add the following after line 2:

For erosion control blanket and open weave textile, complete turf establishment work before installing RECP unless soil in- filling is required.

If soil in-filling is required, first install RECP. Then apply seed and lightly brush or rake ¼ to ¾ inches of topsoil into the voids in the RECP filling the full product thickness.

(1) Slope installations. At the top of slope, anchor the matting by one of the following methods:

(a) Staples. Install the matting 36 inches over the shoulder of the slope onto flat final grade.

Secure with a single row of staples on 12-inch centers;

(b) Anchor trench. Construct an 18- by 6-inch trench. Extend the upslope terminal end of the matting 36 inches past the trench. Use staples on 12-inch centers to fasten the RECP into the trench. Backfill the trench and compact the soil. Secure the terminal end with a single row of staples on 12-inch centers and cover the end with soil. Apply turf establishment; or

(c) Check slot. Install two rows of staples 4 inches apart on 4-inch centers across the top edge of the matting. Drive staple heads flush with soil surface.

Securely fasten RECP to the soil by installing staples at a minimum rate of 1.5 per square yard.

(2) Channel installations**.** At the beginning of the channel, construct a full width anchor trench according to Article 1631. Construct additional anchor trenches or check slots at intervals along the channel reach and at the channel end according to Article 1631 and the manufacturer's installation guidelines.

Securely fasten matting to the soil by installing staples at a minimum rate of 2 per square yard. Significantly higher anchor rates may be necessary in sandy, loose, or wet soils and in severe applications.

Repair damaged areas immediately by restoring soil to finished grade, re-applying turf establishment, and replacing the RECP.

Measurement and Payment

Matting for Erosion Control, RECP Type ___ will be measured and paid in square yards as measured along the surface of the ground, over which matting has been acceptably placed.

Payment will be made under:

Pay Item	**Pay Unit**
Matting for Erosion Control, RECP Type___	Square Yard

BLRI SEEDING AND MULCHING

The kinds of seed and rates of application shall be as stated in the plans for both the Permanent Vegetation Establishment – Meadow Seed Mix and Road Shoulder Mix.

BLRI Seeding and Mulching shall meet the requirements of the *Landscape Development Materials Special Provision, Revegetation Special Provision* and Section 1660 of the *2018 Standards* except as follows. Seed shall be of

Revise the *2018 Standard Specifications* as follows:

Page 16-23, Subarticle 1660-2, line 2, add the following after line 2,

Item	Section
Herbicide	1060-13

Page 16-23, Subarticle 1660-4, line 30, delete first sentence of third paragraph and replace with the following,

Scarify, groove, tranche or puncture all slope surfaces perpendicular to the natural flow of water.

Page 16-24, Subarticle 1660-5(A), line 5, add the following:

Submit manufacturer specifications for fertilizer for Engineer approval.

Page 16-24, Subarticle 1660-5(B), line 22, add the following after line 22

Apply fertilizer as recommended by the soil analysis and by hydro-seeding method.

Page 16-24, Subarticle 1660-5(C), line 23, add the following after line 23

Furnish hydro-type equipment capable of providing a uniform application using water as the carrying agent with newly furnished hoses.

Page 16-24, Subarticle 1660-5(C), line 33 to line 35, delete lines 33 to 35 and replace with the following:

Perform hydro-seeding by adding 400 pounds per acre of hydro-mulch consisting of wood fiber mulch as a tracer material to the water. Add seed to the water no more than 30 minutes before application. Direct high-pressure spray upward, allowing mixture to fall in a uniform spray without missing or overlapping areas. Seed applied by spray method need not be raked. Seed by hand areas inaccessible to seeding equipment. Do not use seed that has become wet, moldy, or otherwise contaminated or damaged. Apply the seed mixture at the specified rate of pure live seed per acre within the project limits.

Using the same equipment, make a second pass, applying mulch only, at a rate of 1500 pounds per acre.

Broadcast seed areas inaccessible to hydro-seeding at a rate 1 ½ times the hydro-seeding rate. Seed any other areas to be broadcast seeded at the same rate. Sow seed with mechanical device that spreads evenly over a given area at the specified rate of coverage per square foot or acre.

Page 16-25, Subarticle 1660-6(A), line 14 to line 18, delete lines 14 to 18 and replace the following:

Use wood fiber mulch in accordance to Special Provisions. Mulch will be accepted when areas is uniformly covered and no less than ¼” in thickness.

Page 16-25, Subarticle 1660-6(B), line 19, add the following:

Apply the mulch in a manner to preclude the application of mulch on tree trunks, signs and signposts, guardrail, guardwalls, headwalls, etc. Remove the mulch and clean the above items accordingly.

Page 16-25, Subarticle 1660-7, line 45, add the following:

Submit a Pesticide Use Log to the NPS and the Engineer.

Measurement and Payment

BLRI Seeding and Mulching will be measured and paid in acres, measured along the surface of the ground completed and accepted. No direct payment will be made for furnishing and applying the mushroom compost or spent mushroom substrate or any additional amendments as required in this provision or on the plans, as such work and materials will be incidental to the work covered by *BLRI Seeding and Mulching.*

Payment will be made under:

Pay Item	Pay Unit
BLRI Seeding and Mulching	Acre

WATTLE

Description

Wattles are tubular products consisting of wood fibers encased in biodegradable mesh 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, and removing wattles.

Materials

Wattle shall meet the following specifications:

100% Curled Wood (Excelsior) Fibers	
Minimum Diameter	8 in. (12 in. for drain inlet protection)
Minimum Density	2.5 lb/ft^3 +/- 10%
Net Material	Biodegradable mesh
Net Openings	3/8 in. x 3/8 in.
Net Configuration	Totally Encased
Minimum Weight	20 lb. +/- 10% per 10 ft. length

Stakes shall be used as anchors.

Provide hardwood stakes a minimum of 2-ft. long with a 2" x 2" 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 *2018 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.

For gravel bags, provide woven fabric bags with a minimum water flow rating of 145 gallons per minute per foot as tested by ASTM D4491. Fill the bags with clean coarse aggregate.

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 8 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 12" with no more than 3" 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 12".

Installation of matting shall be in accordance with the detail provided in the plans, and in accordance with Article 1631-3 of the *2018 Standard Specifications*, or in accordance with specifications provided elsewhere in this contract.

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 *2018 Standard Specifications*.

Measurement and Payment

Wattle 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 *Wattle*.

Matting will be measured and paid for in accordance with Article 1631-4 of the *2018 Standard Specifications*, or in accordance with specifications provided elsewhere in this contract.

Payment will be made under:

Pay Item	Pay Unit
Wattle	Linear Foot

TEMPORARY INLET PROTECTION

Description

Install Temporary Inlet Protection in accordance with the plans and details and as directed by the Engineer.

Measurement and Payment

Temporary Inlet Protection Type ___ will be measure and paid for as the actual number of temporary inlet protection installed and accepted. Such price and payment shall be full compensation for work, materials and incidentals necessary to satisfactorily install the gates.

Payment will be made under:

Pay Item	Pay Unit
Temporary Inlet Protection Type ___	Each

REVEGETATION

Description

Revegetation is the establishment of trees, shrubs, permanent turf establishment and road shoulder stabilization after a large earth disturbance.

Materials

Soil shall meet the requirements of the *Topsoil Special Provision* found elsewhere in this contract.

Mushroom compost, Spent Mushroom Substrate, Mulch and Rolled Erosion Control Products shall meet the requirements as specified in the *Landscape Development Materials Special Provision* found elsewhere in this contract.

Construction Methods

(A) General

Contractor shall provide 1 week notice to the Engineer before moving equipment into the park.

All vehicles and equipment including rental equipment will be inspected by the Engineer before entering project limits for mud, weeds, soil, debris, plant material and other unwanted substances. Power-wash all equipment before loading for transport to the project limits and

conduct secondary inspection before off-loading equipment at the project. Equipment will be rejected and need to be re-cleaned and re-inspected before entry into the park is allowed.

All hydro-seeding/mulching equipment including the interior of the hydroseeding equipment used in the project will be free of all seed and mulch materials upon entry of project limits. Use propose OSHA requirements to ensure equipment is free of seed and mulch materials.

At a minimum all equipment including tanks, trailers, and all associated hydromulching parts will be triple rinsed with clean water. All equipment and parts will be inspected by Engineer to assure no residual seed, mulch, or foreign material is present.

All hydro- seeding/mulching hoses shall be newly purchased for this project. Contractor shall submit receipts to Engineer prior to use in the Blue Ridge Parkway.

(B) Soil

During revegetation and grading, collect 1 gallon volume soil samples from a minimum of 4 locations throughout the limits of grading as directed by the Engineer. The 1 gallon volumes shall then be thoroughly mixed together. The sample shall be taken from the mixture for testing as described in the *Topsoil Special Provision.*

All soils shall be thoroughly loosened to a minimum depth of 8" with tillers, agricultural discs, rippers, or other equipment approved by the Engineer. Complete a minimum of two passes in different directions with the scarification equipment. Equipment shall not damage the surrounding site or vegetation.

Apply up to 3" depth of mushroom compost or spent mushroom substrate as determined by the soil analysis report and the Engineer and thoroughly mix the amendment into the existing soil to a depth of 6" using a tiller or similar cultivating equipment and employing a minimum of two passes in different directions.

(C) Erosion control during revegetation

Install erosion control measures during revegetation as shown on the plans and directed by the Engineer. Provide Secale cereale (rye grain) applied at 20 lbs/acre and apply evenly erosion control cover seed using the hydroseeding.

Use a hydromulch tracer in the hydroseed application. Apply hydromulch in a separate application.

(D) Permanent revegetation seeding (meadow seed mix)

Provide contractor-supplied permanent seed at the lbs/acre quantity as specified in the permanent seed mix. Combine contractor-supplied permanent revegetation seed with NPS-supplied permanent revegetation seed and mix thoroughly.

Evenly apply the permanent seed mix using the hydroseeding method. Segregate the total quantity

of seed into smaller amounts, corresponding with application equipment capacities to ensure equal distribution across the entire area required for permanent seeding.

If applying permanent seed between June 1-October 31, increase the quantity for each seed species by 20%.

Use a hydromulch tracer in the hydroseed application. Apply hydromulch in a separate application.

Minimize ground disturbance, including excessive walking, in the areas following the seeding.

Provide an additional 15% of the contractor-supplied seed mix to NPS

(E) Stabilizing Emulsion Tackifiers Standards

Provide Non-asphalt emulsions having a water soluble, natural guar gum base, blended with dispersal and hardening agents. All ingredients are non-toxic, 100% environmentally safe and natural and biodegradable. The emulsion can be used with a variety of mulch types or fibers. The emulsion shall have good cover and adherence to soil. The cured product has high resistance to wind and rain drop impacts. Apply emulsions at a rate of 80 lbs per acre on slopes less than 3H:1V. Apply at a rate of 100 lbs per acre on slopes greater than 3H:1V.

(F) Trees and Shrubs

For trees and shrubs, install containerized trees and shrubs between October 15-November 15 and as shown in the plans. Mark individual planting locations with wire flags in the general locations shown on the plans. Label each wire flag with plant name or symbol. Receive approval of marked locations from Engineer prior to proceeding

Provide 18" height trees and 12" height shrubs in #1 containers unless otherwise noted on plans. Plant material shall meet the latest standards of the American Standard for Nursery Stock (ANSI Z60.1.).

Plant material shall be propagated from seed collected within 20 miles of the project site. Contractor shall submit documentation of the collection site for each species including location with coordinates, time of year collected, and collection crew supervisor name and contact. The plant growing facility shall be located within USDA plant hardiness zone 6 and shall be open for inspection by NPS representatives upon request. The contractor shall provide a report every 6 months until planting on the status of the plant production including the following information for each species: viable plant quantity, stage of production and container size, average height, representative in-pot photos of plant crown, out-of-pot photos of root development, notes on items of concern and observations.

Planting soil amendment to be decomposed pine bark fines. Submit minimum 1 gallon sample to Engineer for approval.

Provide slow-release fertilizer tablets with N-P-K composition of 20-10-5. Tablets are to be 10

gm, tightly compressed with a non-leaching nitrogen source of urea formaldehyde.

After plant is positioned in hole. Place 2 tablets beside the root ball about 1 inch from the root tips. Do not place tablets underneath root ball. Backfill, tamp and water-in plant.

Mulch to be shredded pine bark. Submit minimum 3-gallon sample to Engineer for approval.

(G) Protective tree tube

Each tree shall have a protective tree tube made of Rigid, twin-wall polyethylene construction with mesh covering. Tube should burst as tree reaches maximum diameter of the tube. Submit tube color for approval by the Engineer.

Table 11
Protective tree tube

Height [ft]	5
Outside diameter [inches]	3.9

Install protective tree tube with 74" stake anchored 1' deep. Stake to have flex strength equal to 110% of a ½" diameter fiberglass stake. Secure tube to stake with wire ties per manufacturer's recommendation.

Install mesh top covering over the opening of each protective tree tube per manufacturer's recommendation.

Countersink protective tree tube into mulch minimum 2" depth.

Measurement and Payment

BLRI Seeding and Mulching, *BLRI Temporary Seeding*, *BLRI Temporary Mulching* and *BLRI Reforestation* will be measured and paid for as specified elsewhere in this contract.

BLRI TEMPORARY MULCHING

Description

Furnish, place and secure mulch material to prevent excessive soil erosion during construction operations where it is impossible or impractical to perform permanent seeding and mulching. The actual conditions which occur during the construction of the project will determine the quantity of mulching. The quantity of mulching may be increased, decreased or eliminated entirely as directed. Such variations in quantity will not be considered as alterations in the details of construction or a change in the character of work.

Materials

Mulch shall meet the requirements as specified in the Landscape Development Materials Special Provision found elsewhere in this contract.

Construction Methods

Place mulch in accordance with the requirements as specified in plans, BLRI Seeding and Mulching Special Provision and Revegetation Special Provision found elsewhere in this contract

Measurement and Payment

BLRI Temporary Mulching will be measured and paid in Acres, measured along the surface of the ground over which temporary mulch has been placed as directed and accepted.

Payment will be made under:

Pay Item	Pay Unit
BLRI Temporary Mulching	Acre

BLRI TEMPORARY SEEDING

Description

Seed and mulch selected areas in advance of the permanent seeding and mulching operations to minimize erosion of graded areas during construction operations. The work includes preparing seedbeds; furnishing, placing and covering fertilizer and seed; furnishing and placing mulch; and other operations necessary for seeding the required areas.

Perform temporary seeding promptly as noted in the BLRI plans and as directed by the Engineer.

Materials

Temporary Seed and Temporary Mulch shall meet the requirements as specified in the Landscape Development Materials Special Provision found elsewhere in this contract.

Construction Methods

Perform temporary seeding in accordance with the requirements as specified in plans, the BLRI Seeding and Mulching Special Provision and Revegetation Special Provisions found elsewhere in this contract

Measurement and Payment

BLRI Temporary Mulching will be measured and paid as specified elsewhere in this contract

BLRI Temporary Seeding will be measured and paid in pounds. The weight of seed will be determined by bag count of standard weight bags or by weighing the seed.

Payment will be made under:

Pay Item	Pay Unit
BLRI Temporary Seeding	Pound

BLRI REFORESTATION

Description

BLRI Reforestation is the planting of trees and shrubs in areas designated on the plans and as directed. See BLRI Landscaping plan for areas and species of trees and shrubs to be planted.

Materials

All materials shall meet the requirements as specified in the plans and in the Revegetation Special Provision found elsewhere in this contract.

Construction Methods

Perform BLRI Reforestation in accordance with the plans and the Revegetation Special Provision found elsewhere in this contract.

Measurement and Payment

BLRI Reforestation will be measured and paid in Acres, measured along the surface of the ground where reforestation has been accepted.

Such price and payment will be full compensation for all work including but not limited to trees, shrubs, fertilizer and mulch.

Payment will be made under:

Pay Item	Pay Unit
BLRI Reforestation	Acre

RISER BASIN

Description

Construct, maintain and remove riser basin devices as shown in the plans and in accordance with the *2018 Standard Drawing 1630.01*.

Materials

All materials shall meet the requirements as specified in the plans and the *2018 Standard Specifications.*

Construction Methods

Construct the Riser Basin in accordance with the plans, standard drawings and as directed by the Engineer.

Measurement and Payment

Riser Basin, ___ CF Volume Capacity will be measured and paid for per each riser basin installed and accepted.

Such price and payment will be full compensation for all work and materials necessary to construct, maintain and remove the riser basin.

Payment will be made under:

Pay Item	**Pay Unit**
Riser Basin, ___ CF Volume Capacity	Each

PROJECT SPECIAL PROVISIONS
GEOTECHNICAL

REINFORCED SOIL SLOPES:

Description

Construct reinforced soil slopes (RSS) consisting of select material and geogrid reinforcement in the reinforced zone with gabion (rock-filled wire baskets) facing. Construct RSS in accordance with the plans. RSS are required to reinforce embankments and stabilize slopes at locations shown in the plans and as directed by the Engineer.

Materials

Refer to the *2018 Standard Specifications* and the *Select Materials Special Provision, Geogrids Special Provisions and Gabions Special Provisions* found elsewhere in the contract.

Refer to Division 10 of the *Standard Specifications*.

Item	**Section**
Outlet pipe	1044-8

Use plastic nonperforated pipe for collector outlet pipe.

Use Class II, Type 1 select material in the reinforced zone of RSS.

Use a PVC coating on the gabions and provide a color coating sample for approval by the Engineer.

Handle and store geogrids in accordance with Article 1056-2 of the *Standard Specifications*. Define "machine direction" (MD) and "cross-machine direction" (CD) for geogrids per Article 1056-3 of the *Standard Specifications*. Provide Type 1 material certifications and identify geogrids in accordance with Article 1056-3 of the *Standard Specifications*.

Use geogrids with a roll width of at least 4 ft. Use geogrids with an "approved" status code.

Do not use geogrids with an "approved for provisional use" status code for geogrids. The list of approved geogrids is available from:
connect.ncdot.gov/resources/Materials/Pages/Materials-Manual-by-Material.aspx

Provide geogrids with design strengths in accordance with the plans. Provide geogrids with long-term design strengths in accordance with the plans. Geogrids are typically approved for ultimate tensile strengths in the MD and CD or long-term design strengths for a 75-year design life in the MD based on material type. Define material type from the website above for select material as Class II Select Material:

If the website does not list a long-term design strength in the MD for an approved geogrid, do not use the geogrid for geogrid. If the website does not list a long-term design strength in the CD for an approved geogrid, use a long-term design strength equal to the ultimate tensile strength divided by 7 for the secondary geogrid.

Construction Methods

Before starting RSS construction, the Engineer may require a preconstruction meeting to discuss the construction and inspection of the RSS. If this meeting is required and occurs before all RSS submittals and material certifications have been accepted, additional preconstruction meetings may be required before beginning construction of RSS without accepted submittals. The Resident or District Engineer, Area Construction Engineer, Geotechnical Operations Engineer, Contractor and RSS Contractor Superintendent will attend preconstruction meetings.
Control drainage during construction near RSS. Direct run off away from RSS, select material and backfill. Contain and maintain select material and backfill and protect material from erosion.

Excavate as necessary for RSS in accordance with the contract. Maintain a horizontal clearance of at least 12" between the ends of geogrids and limits of reinforced zone as shown in the plans. When excavating existing slopes, bench slopes in accordance with Subarticle 235-3(A) of the *Standard Specifications*. Notify the Engineer when excavation is complete. Do not place geogrids until excavation dimensions and in-situ material are approved.

Place geogrids within 3" of locations shown in the plans. Install geogrids with the orientation,

dimensions and number of layers shown in the plans. Before placing select material, pull geogrids taut so they are in tension and free of kinks, folds, wrinkles or creases. Contact the Engineer when existing or future obstructions such as foundations, pavements, pipes, inlets or utilities will interfere with geogrids. If necessary, the top geogrid layer may be lowered up to 9" to avoid obstructions. Extend geogrids to slope faces.

Install geogrids with the MD perpendicular to the embankment centerline. The MD is the direction of the length or long dimension of the geogrid roll. Unless shown otherwise in the plans, do not splice or overlap geogrids in the MD so splices or overlaps are parallel to toe of RSS. Unless shown otherwise in the plans and except for clearances at the ends of geogrids, completely cover select material at each geogrid layer with geogrid so geogrids 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 geogrid roll.

Place select material in the reinforced zone in 8" thick lifts and compact material in accordance with Subarticle 235-3(C) of the *Standard Specifications*. Do not use sheepsfoot, grid rollers or other types of compaction equipment with feet. Do not displace or damage geogrids when placing and compacting select material. End dumping directly on geogrids is not permitted. Do not operate heavy equipment on geogrids until they are covered with at least 8" of select material. To prevent damaging geogrids, minimize turning and avoid sudden braking and sharp turns with compaction equipment. Replace any damaged geogrids to the satisfaction of the Engineer. Construct remaining portions of embankments outside the reinforced zone in accordance with Section 235 of the *Standard Specifications*.

Install outlet pipe according to Article 300. Immediately place and secure a screen made of 0.055-inch diameter galvanized wire having approximately ½- by ½-inch openings over the outlet ends of exposed pipes and weep holes.

Measurement and Payment
Reinforced Soil Slopes will be measured and paid in square yards. RSS will be measured along the slope faces of RSS. No payment will be made for repairing damaged RSS or slope faces.

The contract unit price for *Reinforced Soil Slopes* will be full compensation for providing labor, tools, equipment and RSS materials, compacting select materials and supplying and placing geogrids and geotextiles, select material, gabions, gabion rocks, collector pipes and any incidentals necessary to construct RSS.

The contract unit price for *Reinforced Soil Slopes* will also be full compensation for excavating and hauling and removing excavated materials to install RSS.

Payment will be made under:

Pay Item	**Pay Unit**
Reinforced Soil Slopes	Square Yard

SELECT MATERAILS

Revise *2018 Standard Specifications* as follows:

Page 10-40, Subarticle 1016-3, add the following after line 19,

Use material that is in the brown to warm gray range. Provide samples of the material to be used for the reinforced soil slopes to the Engineer for approval prior to ordering or delivering material to the project site.

GEOGRIDS

Furnish reinforcement geogrid manufactured as a regular network of integrally-connected longitudinal and transverse polymer tensile elements with a geometry that permits significant mechanical interlock with the backfill. Provide geogrid composed of fibers or ribs that are at least 95 percent by mass polypropylene, polyethylene, or polyester. The geogrid structure must remain dimensionally stable under construction stresses and have a high resistance to damage during construction, to ultraviolet degradation, and to chemical and biological degradation encountered in the soil being reinforced.

Conform to Tables 12. Property values represent MARV (that is average test results of any roll in a lot sampled for conformance or quality assurance testing must meet or exceed the minimum specified values).

The nominal long-term strength (T_{al}) is based on:

$T_{al} = T_{ult}/RF$

where $RF = RF_{ID} \times RF_{CR} \times RF_{D}$.

RF_{ID}, RF_{CR}, and RF_{D} values must be substantiated by evaluation of independent test results by Highway Innovative Technology Evaluation Center (HITEC), AASHTO National Transportation Product Evaluation Program (NTPEP), or an equivalent third-party report. Provide a copy of the report to the Engineer. Determine RF_{ID}, RF_{CR}, and RF_{D} according to the following:

(a) RF_{ID}: Determine the reduction factor for installation damage from the results of full scale construction damage tests conducted according to ASTM D5818. Conduct the tests with a soil having the same maximum particle size, D_{50}, and angularity as the soil to be used for construction. Tests using coarser soils (same or larger maximum particle size and D_{50}) may be an acceptable substitution. The Engineer will make the final determination as to whether the test data based on the substitute soil is acceptable. Interpolation of RF_{ID} will not be allowed, the results for the coarser soils will be used. The Contractor may elect to perform a test using project specific fill, placement, and compaction techniques and equipment to determine the RF_{ID}. Use a default value of 3.0 if no installation damage testing has been conducted. The minimum value for RF_{ID} is 1.1.

(b) RF_{CR}. Determine the creep reduction factor according to one of the following:

(1) Conventional creep testing according to ASTM D5262; or

(2) A combination of Stepped Isothermal Method (SIM) according to ASTM D6992 and conventional creep testing. Perform testing and determine creep reduction factors for a 75-year design life according to the procedures in Appendix D of FHWA-NHI-10-025, *Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes – Volume II*. If testing has not been conducted, default values for RF_{CR} are 2.5 for polyester polymer, and 5.0 for polypropylene or polyethylene polymer.

(c) RF_D. For polypropylene or polyethylene geosynthetics conforming to the requirements of Table 12, a default reduction factor of 1.1 may be used for RF_D. For polyester geosynthetics conforming to the requirements of Table 12, a default reduction factor of 1.15 may be used for RF_D if the soil has a pH between 5 and 8; and a reduction factor of 1.3 may be used if the soil pH is between 3 and 5 or between 8 and 9.

TABLE 12
REINFORCEMENT GEOTEXTILE AND GEOGRID POLYMER REQUIREMENTS

Polymer Type	Property	Test Method	Specifications
Polypropylene and polyethylene	Thermo-oxidation resistance	ENV ISO 13438, Method A (polypropylene) or Method B (polyethylene)	Minimum 50% retained strength after 28 days (polypropylene) or 56 days (polyethylene)
Polyester	Hydrolysis resistance	Inherent Viscosity Method ASTM D4603 & GRI (1) GG8	Minimum number average molecular weight (M_n) of 25,000
	"	GRI (1) GG7	Maximum carboxyl end group (CEG) of 30
All polymers	Ultraviolet stability	ASTM D4355	Minimum 70% retained strength after 500 hours of exposure
	Mass per unit area	ASTM D5261	Minimum 8 oz/yd^2 (270 g/m^2)
	Percent post consumer recycled material by mass	Certification of material used	Maximum 0%

(1) Geosynthetic Research Institute.

he specified strength is in the principal direction of reinforcement (that is perpendicular to the wall or slope

.

GABIONS

Description

The work in this Special Provision governs the construction of the gabion facing for the RSS in accordance with the details and dimensions shown on the plans and this special provision. The term gabion is used generically in this special provision to refer to any proprietary system able to satisfy this special provision and the contract plans.

Gabions are baskets manufactured from 8x10 double twisted hexagonal woven steel wire mesh, as per ASTM A975-97. To reinforce the structure, all mesh panel edges are selvedge with a wire having a greater diameter. The steel wire used in the manufacture of the gabions is heavily zinc coated soft temper steel. A polyvinyl chloride (PVC) coating is then applied to a nominal thickness of 0.02 inch to provide additional protection.

Gabions are manufactured and shipped with all components mechanically connected at the production facility.

Materials

All materials shall be as specified or better, and approved by the Engineer. Submit requests for substitutions to the Engineer 14 days before intended installation. Materials used for the construction of the gabion retaining wall must satisfy the following requirements:

(A) Wire

Use wire for the manufacture of the gabions and lacing wire that has a maximum tensile strength of 75,000 psi (515 MPa) as per ASTM A641/A641-03. Perform all tests on the wire prior to manufacturing the mesh. Use wire that complies with ASTM A975-97, style 3 coating, galvanized and PVC coated steel wire.

(B) Woven Wire Mesh Type 8x10

Use mesh and wire for the manufacture of the gabions with characteristics that meet the requirements of ASTM A975-97 Table 1, Mesh type 8x10 and PVC coated. The nominal mesh opening, D = 3.25 in. (83 mm.) The minimum mesh properties for strength and flexibility shall be in accordance with the following:

(1) A minimum Mesh Tensile Strength of 2,900 lb/ft when tested in accordance with ASTM A975-97 section 13.1.1 is required

(2) A minimum Punch Test resistance of 5,300 lb when tested in compliance with ASTM A975-97 section 13.1.4 is required.

(3) A minimum Connection to Selvedges of 1,200 lb/ft when tested in accordance with ASTM A975-97 is required.

(C) Polyvinyl Chloride (PVC) Coating

Submit color sample for gabion coating for approval by the Engineer.

The technical characteristics and the resistance of the PVC to aging shall meet the relevant standards. The main values for the PVC material are as follows:

(1) The initial property of the PVC coating shall be in compliance with ASTM A975-97 section 8.2.

(2) Prior to UV and abrasion degradation, the PVC polymer coating shall have a projected minimum durability of 60 years when tested in accordance with UL 746B Polymeric Material – Long Term Property Evaluation for heat aging test.

(D) Fabrication at Manufacturing Facility

Manufacture and ship gabions with all components mechanically connected at the production facility. The front, base, back, and lid of the gabions shall be woven into a single unit. Factory connect the ends and diaphragm(s) to the base. Selvedge all perimeter edges of the mesh forming the basket and top, or lid, with wire having a greater diameter. The gabion is divided into cells by means of diaphragms positioned at approximately 3 foot centers. Secure the diaphragms in position to the base so that no additional lacing is necessary at the jobsite.

(1) Lacing Wire

Use lacing wire meeting all of the physical characteristics outlined herein and having a minimum diameter of 0.127 inch

(2) Ring Fasteners

Stainless steel ring fastener may be used instead of, or to compliment the lacing wire. Use ring fasteners meeting the requirements of ASTM A975-97 section 6.3. Use ring fasteners with a minimum open dimension of 1.75 inch, a maximum closed diameter of 0.75 inch, and a nominal overlap of one in. after closure. Do not exceed a spacing of 6 inches between each ring fastener.

(3) Preformed Stiffeners

Use preformed stiffeners manufactured for supporting the exposed face of a gabion. The exposed face is any side of a gabion cell that will be exposed or unsupported after the structure is completed.

(4) Cross Tie/ Stiffener Wire

Cross tie/stiffener wire may be used instead of or to compliment the preformed stiffeners. Use cross tie/stiffener wire (lacing wire) meeting all of the physical characteristics outlined herein and having a minimum diameter of 0.127 inch.

(E) Gabion Rock

Furnish stone from a rock quarry or cut that is hard, angular, durable and of such quality that they shall not disintegrate on exposure to water or weathering during the life of the structure. Not more than 5% by weight of clean spalls resulting from loading and shipment will be allowed in any truckload. The rock may be unwashed quarry material provided it meets all requirements of these special provisions and is placed in conformance with all requirements of the Department's construction permits (including water quality requirements). Conform to the following:

(a) Durability index (course), AASHTO T 210	50 min.
(b) Density of a filled basket	100 lb/ft^3 min.

(c) Gradation. Furnish rock with breadth and thickness at least one-third its length.

(a) Maximum dimension	8 in
(b) Minimum dimension	4 in
(d) Los Angeles abrasion, AASHTO T 96	50 percent max.

Stone sizes less than 4 inches shall not be permitted and hand sorting by the contractor shall be performed if required by the Engineer.

The range in stone sizes shall allow for a variation of 5% oversize and/or 5% undersize stone, provided it is not placed on the gabion exposed surface. The size shall be such that a minimum of three layers of rock are achieved when filling the gabion. Submit to the Resident Engineer, testing results and certification that all proposed construction materials meet all requirements of the *Standard Specifications* prior to construction.

Only crystalline rock obtained by quarrying shall be allowed.

Rock containing organic matter or soft, friable particles in quantities considered objectionable to the Engineer will be rejected.

Use material that is in the brown to warm gray range. Provide samples of the material to be used for gabion rock to the Engineer for approval prior to ordering or delivering material to the project site.

(F) Geotextile

Provide Type 2 geotextile for filtration geotextiles.

Construction Methods

The Contractor shall use reasonable care in handling, assembling and installing the gabions to prevent damage including damage to the PVC coating. Gabions damaged shall be repaired in a manner satisfactory to the Engineer or replaced at no cost to the Department.

(A) Assembly

Gabions are supplied folded flat and packed in bundles. The units are assembled individually by erecting the sides, ends, and diaphragms, ensuring that all panels are in the correct position, and the tops of all the sides are aligned. First, connect the four corners, followed by the internal diaphragms to the outside walls. Use lacing wire or fasteners for all connections.

The procedure for using lacing wire consists of cutting a sufficient length of wire, and first looping and/or twisting to secure the lacing wire to the wire mesh. Proceed to lace with alternating double and single loops through every mesh opening approximately every 6 in (150 mm), pulling each loop tight and finally securing the end of the lacing wire to the wire mesh by looping and/or twisting.

(B) Installation

After initial assembly, the gabions shall be carried to their final position and are securely joined together along vertical and top edges of their contact surfaces using the same connecting procedure(s) previously described. Whenever a structure requires more than one layer, the upper empty baskets shall also be connected to the top of the lower layer along the front and back edges of the contact surface using the same connecting procedure(s) previously described.

(C) Filling Gabions

Fill gabions with stones as specified above. During the filling operation, some manual rock placement may be required to minimize voids. The exposed faces of vertical structures may be carefully hand-placed to give a neat, flat and compact appearance. Care shall be taken when placing fill material to ensure that the sheathing on the PVC coated baskets is not damaged.

Fill the cells in stages so that local deformation is avoided. Do not fill any one cell to a depth exceeding one foot higher than an adjoining cell. It is also recommended to slightly overfill the baskets by 1 to 2 inches to allow for settlement of the stones. Compact the backfill material behind gabion walls simultaneously to the same level as the filled gabions.

(D) Preformed Stiffeners/Internal Connecting Wires

For gabions, use preformed stiffeners or lacing wire as internal connecting wires when a structure requires more than one layer of gabions to be stacked on top of each other. Connect internal connecting wires to the exposed face of a cell to the adjacent side of the cell. Preformed stiffeners shall be installed at 45 degrees to the face/side of the unit, extending an equal distance along each side to be braced (approximately one foot). Cross tie/stiffener wire (lacing wire) may be used instead of, or to compliment to preformed stiffeners. An exposed face is any side of a gabion cell that will be exposed or unsupported after the structure is completed.

(E) 3 Feet High Gabions

The Contractor shall fill 3 feet gabions in three layers, one foot at a time. Install preformed stiffeners/connecting wire after the placement of each layer, that is, at one foot high and 2 feet high.

(F) 1.5 Feet High Gabions

1.5 feet high gabions do not require preformed stiffeners/connecting wire unless the baskets are used to build vertical structures and turned on their side. In some cases, these units shall be filled in two layers, 9 inches at a time. Connecting wires shall be installed after the placement of the first layer, which is 9 inches high.

(G) Lid Closing

Once the gabion baskets are completely full, the Contractor shall pull the lids tight until the lid meets the perimeter edges of the basket. A tool such as a lid closer may be used. Tightly lace and/or fasten the lid along all edges, ends, and tops of diaphragm(s) in the same manner previously described.

(H) Mesh Cutting and Folding

Where shown on the plans or other areas as directed by the Engineer, the Contractor shall cut the gabion, fold and fasten together to suit the existing site conditions. Cleanly cut the mesh, fold back the surplus mesh, and neatly wire to an adjacent basket face. Securely fasten the cut edges of the mesh with lacing wire or fasteners in the manner previously described. Assemble, install, fill and close any reshaped gabion baskets as specified in the previous sections.

Memorandum

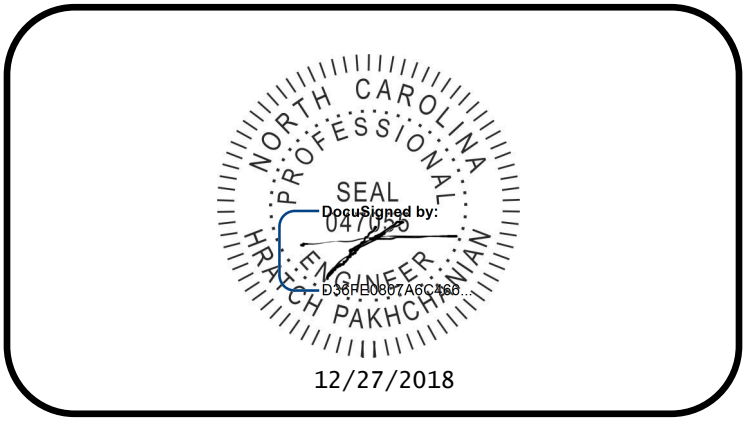
U.S. Department of Transportation
Federal Highway Administration

Subject: Project Blue Ridge Parkway Over I-26
Status: Bridge Project Special Provisions
Cover Sheet

Date: December 17, 2018

Reply to
Attn of: HFBR-15

From: Hratch Pakhchanian
FLH Bridge Engineer



Hratch Pakhchanian, P.E.
NC License No. 047055

-Responsible for Bridge-related Special Provisions Package for BLRI Over I-26 Work

Blue Ridge Parkway Over I-26
Project Special Provisions

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MAINTENANCE AND PROTECTION OF TRAFFIC BENEATH PROPOSED STRUCTURE AT STATION 514+86.30 **(8-13-04)**

1.0 GENERAL

Maintain traffic on I-26 as shown in Traffic Control Plans and as directed by the Engineer.

Provide a minimum temporary vertical clearance of 20'0" at all times during construction.

Submit plans and calculations for review and approval for protecting traffic and bracing girders, as described herein, at the above station before beginning work at this location. Have the drawings and design calculations prepared, signed, and sealed by a North Carolina Registered Professional Engineer. The approval of the Engineer will not relieve the Contractor of the responsibility for the safety of the method or equipment.

2.0 PROTECTION OF TRAFFIC

Protect traffic from any operation that affords the opportunity for construction materials, equipment, tools, etc. to be dropped into the path of traffic beneath the structure. Based on Contractor means and methods determine and clearly define all dead and live loads for this system, which, at a minimum, shall be installed between beams or girders over any travelway or shoulder area where traffic is maintained. Install the protective system before beginning any construction operations over traffic. In addition, for these same areas, keep the overhang falsework in place until after the rails have been poured.

3.0 BRACING GIRDERS

Brace girders to resist wind forces, weight of forms and other temporary loads, especially those eccentric to the vertical axis of the member during all stages of erection and construction. Before casting of intermediate diaphragms, decks, or connecting steel diaphragms do not allow the horizontal movement of girders to exceed ½ inch.

4.0 BASIS OF PAYMENT

Payment at the contract unit prices for the various pay items will be full compensation for the above work.

THERMAL SPRAYED COATINGS (METALLIZATION) (12-1-2017)

1.0 DESCRIPTION

Apply a thermal sprayed coating (TSC) and sealer to metal surfaces in accordance with the Thermal Sprayed Coatings (Metallization) Program and as specified herein when called for on the plans or by other Special Provisions. Use only Arc Sprayed application methods to apply TSC. The Engineer must approve other methods of application.

The Thermal Sprayed Coatings (Metallization) Program is available on the Materials and Tests Unit website.

2.0 QUALIFICATIONS

Only use NCDOT approved TSC Contractors meeting the requirements outlined in the Thermal Sprayed Coatings (Metallization) Program.

3.0 MATERIALS

Use only materials meeting the requirements of Section 7 of the Thermal Sprayed Coatings (Metallization) Program.

4.0 SURFACE PREPARATION AND TSC APPLICATION

Surface preparation of TSC surfaces shall meet the requirements of Section 8 of the Thermal Sprayed Coatings (Metallization) Program. Apply TSC with the alloy to the thickness specified on the plans or as required by Thermal Sprayed Coatings (Metallization) Program.

5.0 INSPECTION AND TESTING

The TSC Contractor must conduct inspections and tests listed in the Thermal Sprayed Coatings (Metallization) Program.

6.0 REPAIRS

Perform all shop repairs in accordance with the procedures outlined in the Thermal Sprayed Coatings (Metallization) Program.

Repairs associated with field welding shall be made by removing the existing metallizing by blast or power tool cleaning. Affected areas shall be addressed as follows:

- For Marine Environments, incorporate a minimum surface preparation in accordance with SSPC SP-11 (Power Tool Cleaning to Bare Metal) and require an approved epoxy mastic coating applied in accordance with the manufacturer's recommendation. Apply a minimum of two (2) coats at a rate of 5-7 (WFT) per coat to the affected area.

- For Non-Marine Environments, incorporate a minimum surface preparation in accordance with SSPC SP-11 (Power Tool Cleaning to Bare Metal) and require an approved organic zinc-rich coating applied in accordance with the manufacturer's recommendation. Apply a minimum of two (2) coats at a rate of 5-7 (WFT) per coat to the affected area.

    1. Minor localized areas less than or equal to 0.1 ft^2 with exposed substrate shall be repaired as outlined above for marine and non-marine environments.

    2. Large localized areas greater than 0.1 ft^2 with exposed substrate shall require the Contractor to submit a detailed repair procedure to the Engineer for review and approval.

- Repair methods for areas where the substrate has not been exposed shall be mutually agreed upon between the Contractor and TSC Contractor as approved by the Engineer.

7.0 TWELVE MONTH OBSERVATION PERIOD

All TSC materials applied under the Thermal Sprayed Coatings (Metallization) Program shall be evaluated twelve (12) months after project acceptance for defective materials and workmanship.

8.0 BASIS OF PAYMENT

The contract price bid for the metal component to which the TSC is applied will be full compensation for the thermal sprayed coating.

POST TENSIONING (SPECIAL)

1.0 DESCRIPTION

Furnish and install all post-tensioning systems and any other pertinent items necessary for the particular post-tensioning system used, including but not limited to ducts, anchorage assemblies, vents, local zone reinforcement, and stressing and grouting post-tensioning strands/bars in accordance with the approved details. Both temporary and permanent post-tensioning shall comply with the requirements of this provision. Furnish all components of a post-tensioning system, including steel pipes, from a single supplier. Install post-tensioning steel, which may be strands or bars, through ducts in the concrete. Stress to a predetermined load and anchor directly against the hardened concrete. Grout ducts to fill all voids and install protection at end anchorages. Submit shop and working drawings and manuals in accordance with this provision, and referenced documents. The supplier shall produce, sign and seal all shop drawings related to post-tensioning.

Post-tensioning details shall be in accordance with the plans.

2.0 GENERAL

A. Qualifications and Inspection

Perform all post-tensioning field operations under the direct supervision (crew foreman) of a qualified post-tensioning and grouting technician. Additionally, the contractor and personnel shall comply with the SEGMENTAL BRIDGE CONTRACTOR AND PERSONNEL Special Provision. Provide project personnel, a crew foreman and crew members in accordance with Article 105-6 of *Standard Specifications*. All stressing and grouting operations shall be conducted in the presence of the Engineer.

B. Shop Drawings

Prepare shop drawings to address all requirements stated in the plans and the requirements stated herein. Shop drawings are required for the integration of the post-tensioning system, reinforcement and other embedded items, including those for the Contractor's means and methods of construction for precast and cast-in-place components. Submit detailed shop drawings that address the requirements of Plans and Specifications as follows:

(a) A complete description of, and details covering, each of the prestressing systems to be used for permanent and temporary tendons, including, but not necessarily limited to:

1. Designation of the specific prestressing steel, dimensions, details and materials for all manufactured components such as anchorage devices, wedges, nuts, bar

couplers, ducts, materials and accessories according to the post-tensioning system to be used.

2. Tendon profile and clearances, duct supports, connections of ducts, connections at temporary bulkheads and the like, complying with the plans and the limitations of the selected post-tensioning system.

3. Location and details of grout inlets and outlets, at anchorages, low-points, high-points and other required inspection points and the direction of grouting.

4. Size, type, connections and sealing details for permanent grout caps.

5. Protection system materials and application limits.

6. Details covering assembly and installation of each type of prestressing tendon.

7. Equipment, dimensions and clearances to be used in the prestressing operations.

8. Procedure and sequence of operations for prestressing and securing tendons.

9. Procedure for releasing temporary or permanent prestressing steel elements.

10. Parameters to be used to calculate the typical tendon force such as; expected friction coefficients, anchor set and prestress steel relaxation curves.

(b) A table detailing the prestressing jacking sequence, jacking forces and initial elongations of each tendon at each stage of erection for all prestressing.

(c) Complete details of the anchorage system for prestressing including certified copies of the reports covering tests performed on prestress anchorage devices as required herein, and details for any reinforcing steel needed due to stresses imposed in the concrete by anchorage plates.

(d) For the operation of grouting prestressing tendons; the materials and proportions for grout,
details of equipment for mixing and placing grout and methods of mixing and placing grout (also, locations and details of inlets and outlets for grouting and the direction of grouting).

(e) Calculations to substantiate the prestressing system and procedures to be used including stress-strain curves typical of the prestressing steel to be furnished, required jacking forces, elongation of tendons during tensioning, seating losses, short-term prestress losses, long term prestress losses, temporary overstress, stresses in prestress anchorages including distribution plates and reinforcing steel needed in the concrete to resist stresses imposed by prestress anchorages. These calculations shall show a typical

tendon force and anticipated losses from friction, wobble, anchor set, and anticipated adjustment for thermal affects.

Elongation calculations shall be revised when necessary to properly reflect the modulus of elasticity of strand tendons as determined from in-place friction testing.

(f) Details of the apparatus and method to be used by the Contractor for the Testing of Prestressing Tendons by the Contractor as required by the Materials Section of this Specification.

(g) Calculations and shop drawings for the post-tensioning system shall be signed and sealed by a Professional Engineer registered in the State of North Carolina.

C. Material Storage

Store all materials in a weatherproof building, shed or container until time of use.

D. Certification of Post-tensioning Systems

Use only post-tensioning systems that are approved by the NCDOT's Structure Design Unit. Manufacturers seeking evaluation of their post-tensioning systems shall submit test results to the Engineer and include certified test reports from an independent laboratory audited by AASHTO Materials Reference Laboratory (AMRL) which shows the post-tensioning system meets all the requirements specified herein.

Test plastic components in a certified independent laboratory accredited through the laboratory accreditation program of the Geosynthetic Accreditation Institute (GAI) or the American Association for Laboratory Accreditation (A2LA). Certification of test reports may be performed by an independent laboratory located outside the U.S., if the independent laboratory is approved by the Department's Materials and Test Unit. If any component of the post-tensioning system is modified or replaced, the appropriate component test and entire system test, if needed, shall be retested in accordance with the requirements herein and an updated application made to the Structure Design Unit containing the test reports and revised system drawings. Before attempting to change post-tensioning system components contact the Structure Design Unit for direction.

Perform certification test for the plastic on a sample formed or cut from the finished product. Provide the Engineer with certification that the plastic from the duct sample complies with all requirements of the specified cell class, stress crack rating and the specified amount of antioxidant. Certify to the Engineer that the post-tensioning system being furnished is in compliance with all requirements stated herein.

Ensure that all components of a system are stamped with the suppliers name, trademark model number and size corresponding to catalog designation. Post-tensioning systems consist of an assembly of components for various sizes of strand or bars assembled and

pressure tested. Post-tensioning systems will have to be developed and tested both internal (corrugated duct) and external (smooth duct) applications for each of the following:

Prior to installing any post-tensioning hardware, furnish the Engineer with a certification from the PT supplier that the PT system chosen for the project meets the requirements of this provision and is a Department approved PT system. Upon completion of post-tensioning installation, provide a certification that the PT system supplied was installed without modification and met the requirements of the contract documents.

E. Definitions

Anchorage Assembly: An assembly of various hardware components which secures a tendon at its ends after it has been stressed and, imparts the tendon force into the concrete.

Anticipated Set: The wedge set assumed to occur in the design calculation of the post-tensioning forces at the time of load transfer.

Bar: Post-tensioning bars are high strength steel bars, normally available from 5/8 to 1 3/4 inch diameter and usually threaded with very coarse thread.

Bearing Plate: Any hardware that transfers the tendon or bar force directly into a structure or the ground.

Bleed: The autogenous flow of mixing water within or its emergence from, newly placed grout, caused by the settlement of the solid materials within the mass.

Coupler: A device used to transfer the prestressing force from one partial length bar or prestressing tendon to another. (Strand couplers are not permitted.)

Duct: Material forming a conduit to accommodate prestressing steel installation and provide an annular space for the grout which protects the prestressing steel.

Family of Systems: Group of post-tensioning tendon assemblies of various sizes which use common anchorage devices and design. All components within the family of systems shall be furnished by a single supplier and shall have a common design with varying sizes.

Fluidity: A measure of time, expressed in seconds necessary for a stated quantity of grout to pass through the orifice of a flow cone.

Grout: A mixture of cementitious materials and water with or without mineral additives or admixtures, proportioned to produce a pumpable consistency without segregation of the constituents, when injected into the duct to fill the space around the prestressing steel.

Grout Cap: A device that contains the grout and forms a protective cover sealing the post-tensioning steel at the anchorage.

Inlet: Tubing or duct used for injection of the grout into the duct.

Outlet: Tubing or duct to allow the escape of air, water, grout and bleed water from the duct.

Post-tensioning: A method of prestressing where tensioning of the tendons or bars occurs after the concrete has reached a specified strength.

Prestressing Steel: The steel element of a post-tensioning tendon, which is elongated and anchored to provide the necessary permanent prestressing force.

Post-tensioning Scheme or Layout: The pattern, size and locations of post-tensioning tendons or bars provided on the plans.

Post-tensioning System: An assembly of specific models of hardware, including but not limited to anchorage assembly, local zone reinforcement, wedge plate, wedges, bearing plates, washers, nuts, inlet, outlet, couplers, duct, duct connections and grout cap, used to construct a tendon or bar of a particular size and type. The entire assembly shall meet the system pressure testing requirement. Internal and external systems are considered independent of one another.

Pressure Rating: The estimated maximum pressure that water in a duct or in a duct component can exert continuously with a high degree of certainty that failure of the duct or duct component will not occur (commonly referred to as working pressure).

Set (Also Anchor Set or Wedge Set): Set is the total movement of a point on the strand just behind the anchoring wedges during load transfer from the jack to the permanent anchorages. Set movement is the sum of slippage of the wedges with respect to the anchorage head and the elastic deformation of the anchor components. For bars, set is the total movement of a point on the bar just behind the anchor nut at transfer and is the sum of slippage of the bar and the elastic deformation of the anchorage components.

Strand: An assembly of several high strength steel wires wound together. Strands usually have six outer wires helically wound around a single straight wire of a similar diameter.

Tendon: A single or group of prestressing steel elements and their anchorage assemblies imparting prestress forces to a structural member or the ground. Also, included are ducts, grouting attachments, grout and corrosion protection filler materials or coatings.

Tendon Size: The number of individual strands of a certain strand diameter or the diameter of a bar.

Tendon Type: The relative location of the tendon to the concrete shape, internal or external.

Thixotropic: The property of a material that enables it to stiffen in a short time while at rest, but to acquire a lower viscosity when mechanically agitated.

Wedge Plate: The hardware that holds the wedges of a multi-strand tendon and transfers the tendon force to the anchorage assembly. (Commonly referred to as anchor head.)

Wedge: A conically shaped device that anchors the strand in the wedge plate.

ASBI: American Segmental Bridge Institute.

PTI: Post-Tensioning Institute.

Segmental duct coupler: The special duct coupler is used for internal tendon duct connection at segment match cast joint meets the requirement of Section 3.0(B)(5)(e)(iii) of this provision.

3.0 MATERIALS

Meet the requirements of following:

Items	**Articles**
Wire Strand	ASTM A416
Standard Bar	ASTM A722
Water	1024-4 Standard Specifications
Grout	"Post-tensioning Grout" Special Provision
Epoxy Grout	Section 12.0
Magnesium Ammonium Phosphate Concrete	Section 11.0(A) (1)
Elastomeric Coating System	Section 12.0
Methacrylate	Section 11.0(A) (2)

A. Prestressing Steel

1. Strand

   Unless otherwise noted on the plans, use uncoated strand meeting requirements of ASTM A416 (Grade 270, low relaxation 7-wire strand).

2. Standard Bar

   Unless otherwise noted on the plans, provide uncoated Grade 150, high strength, deformed bar meeting the requirements of ASTM A722, Type II.

B. Post-tensioning System

Use approved post-tensioning systems, of the proper size and type to construct tendons shown on the Design Plans. Substitution of components of approved post-tensioning systems is not permitted. For permanent applications, the use and location of bar couplers is subject to approval by the Engineer. Use only post-tensioning systems that utilize tendons fully encapsulated in anchorages and ducts. Systems which transfer prestress force by bonding the prestressing steel strand directly to concrete are not permitted. Embedded anchors for bars are permitted. Strand or tendon couplers are not permitted.

1. Post-tensioning Anchorages

Ensure that the anchorages develop at least 95% of the actual ultimate tensile strength of the prestressing steel, when tested in an unbonded state, without exceeding the anticipated set.

Design anchorages so that the average concrete bearing stress is in compliance with the AASHTO LRFD Bridge Design Specifications. Test and provide written certification that anchorages meet or exceed the testing requirements in the AASHTO LRFD Bridge Construction Specifications.

For standard bars provide bearing plates, washers, nuts, and other miscellaneous hardware compatible with the system being used. Equip all bearing plates with key holes to facilitate grouting operations.

Galvanize the embedded body of the anchorage in accordance with ASTM A123. Other components of the anchorage including wedges, wedge plate and local zone reinforcement are not required to be galvanized. Construct the bearing surface and wedge plate from ferrous metal. Equip all anchorages with a permanent grout cap that is vented and bolted to the anchorage.

Provide wedge plates with centering lugs or shoulders to facilitate alignment with the bearing plate.

Cast anchorages with grout outlets suitable for inspection from either the top or front of the anchorage. The grout outlet will serve a dual function of grout outlet and post-grouting inspection access. The geometry of the grout outlets shall facilitate being drilled using a 3/8” diameter straight bit to facilitate endoscope inspection directly behind the anchor plate. Anchorages may be fabricated to facilitate both inspection locations or may be two separate anchorages of the same type each providing singular inspection entry locations.

Trumpets associated with anchorages will be made of polypropylene plastic material conforming to the requirements stated in Section 3.0(B)(5)(e) of this provision. The thickness of the trumpet at the transition location (choke point) will not be less than the thickness of the duct as established in Section 3.0(B)(5)(e) of

this provision. Alternately, the trumpet material may be polyolefin containing antioxidant(s) with a minimum Oxidation Induction Time (OIT) according to ASTM D3895 of not less than 20 minutes. Perform OIT test on samples taken from the finished product. Test the remolded finished polyolefin material for stress crack resistance using ASTM F2136 at an applied stress of 348 psi resulting in a minimum failure time of 3 hours.

2. Bar Couplers

   Use couplers meeting the requirements of AASHTO LRFD Bridge Design Specifications and AASHTO LRFD Bridge Construction Specifications. Test and provide written certification that the couplers meet or exceed the testing requirements in the AASHTO LRFD Bridge Construction Specifications.

3. Inlets, Outlets, Valves and Plugs

   Provide permanent grout inlets, outlets, and threaded plugs made of ASTM A240 Type 316 stainless steel, nylon or polyolefin materials. For products made from nylon, the cell class of the nylon according to ASTM D5989 shall be S-PA0141 (weather resistant), S-PA0231 or S-PA0401 (ultimate strength not less than 10,000 psi with UV stabilizer added). Products made from polyolefin shall contain antioxidant(s) with a minimum Oxidation Induction Time (OIT) according to ASTM D3895 of not less than 20 minutes.

   Perform OIT test on samples taken from the finished product. Test the remolded finished polyolefin material for stress crack resistance using ASTM F2136 at an applied stress of 348 psi resulting in a minimum failure time of 3 hours. All inlets and outlets will be equipped with pressure rated mechanical shut-off valves or plugs. Inlets, outlets, valves and plugs will be rated for a minimum pressure rating of 150 psi. Use inlets and outlets with a minimum inside diameter of 3/4 inch for strand and 3/8 inch for single bar tendons and four-strand duct. Provide dual mechanical shutoff valves when performing vertical grouting. Specifically designate temporary items, not part of the permanent structure, on the PT System drawings. Temporary items may be made of any suitable material.

4. Permanent Grout Caps

   Use permanent grout caps made from approved polymer or ASTM A240 Type 316L stainless steel. The approved resins used in the polymer shall be nylon, Acrylonitrile Butadiene Styrene (ABS) or polyester. For products made from nylon, the cell class of the nylon according to ASTM D5989 shall be S-PA0141 (weather resistant), S-PA0231 or S-PA0401 (ultimate strength not less than 10,000 psi with UV stabilizer added). Seal the cap with “O” ring seals or precision fitted flat gaskets placed against the bearing plate. Place a grout vent on the top of the cap. Grout caps shall be rated for a minimum pressure rating of 150 psi. Use ASTM A593 Type 316 stainless steel bolts to attach the cap to the anchorage. When stainless steel grout caps are supplied, provide certified test reports documenting the

chemical analysis of the steel. Use O-ring seals or precision fitted flat gaskets which meet the requirements of this section.

5. Duct and Pipe

   a. General: Use only plastic duct, steel pipe or a combination of plastic duct and steel pipe. Ensure that all connectors, connections and components of post-tensioning system hardware are air and water tight and pass the pressure test requirements herein. Use smooth plastic duct in all post-tensioning systems used for external tendons. Use corrugated plastic duct in all post-tensioning systems used for all internal tendons except where steel pipe is required.

   b. Duct or Pipe Minimum Diameter: For prestressing bars, provide duct with a minimum internal diameter of at least 1/2 inch larger than the outside diameter, measured across the deformations. For prestressing bars with couplers, size the duct to be 1/2 inch larger than the diameter of the bar and/or coupler.

      For multi-strand tendons, provide ducts with a minimum cross-sectional area 2 1/2 times the cross-sectional area of the prestressing steel.

   c. Connection Tolerance between Pipe and Duct: Steel pipe and plastic duct may be connected directly to each other when the outside diameters do not vary more than ±0.08 inch. Use a reducer when the diameters of the steel pipe and the plastic duct are outside of this tolerance.

   d. Steel Pipes: Use galvanized Schedule 40 steel pipes where shown in the plans and in all deviation blocks and diaphragms.

   e. Corrugated Plastic Duct: Do not use ducts manufactured from recycled material. Use seamless fabrication methods to manufacture ducts.

      Use corrugated duct manufactured from non-colored, unfilled polypropylene meeting the requirements of ASTM D4101 “Standard Specification for Polypropylene Plastic Injection and Extrusion Materials” with a cell classification range of PP0340B44541 to PP0340B67884. The duct shall be white in color containing antioxidant(s) with a minimum Oxidation Induction Time (OIT) according to ASTM D3895 of 20 minutes and containing a non-yellowing light stabilizer. Perform OIT test on samples from the finished product. Furnish duct with a minimum thickness as defined in the following table:

Duct Shape	Duct Diameter	Min. Duct Thickness
Flat	any size	0.08 inch
Round	0.9 inch	0.08 inch
Round	2.375 inches	0.08 inch
Round	3.0 inches	0.10 inch
Round	3.35 inches	0.10 inch
Round	4.0 inches	0.12 inch
Round	4.5 inches	0.14 inch
Round	5.125 inches	0.16 inch
Round	5.71 inches	0.16 inch

(i) Testing Requirements for Corrugated Plastic Duct: Ensure that the duct system components and accessories meet the requirements of Chapter 4, Articles 4.1 through 4.1.8 of International Federation of Structural Concrete (FIB) Technical Report, Bulletin 7, titled "Corrugated Plastic Duct for Internal Bonded Post-tensioning" as modified herein.

The requirements in FIB Technical Report, Bulletin 7, are modified as follows: Conduct the lateral load resistance test (FIB 4.1.4), without the use of a duct stiffener plate, using a load of 150 lbs. for all sizes; Wear resistance of duct (FIB 4.1.7) shall not be less than 0.06 inch for duct up to

3.35 inches in diameter and not less than 0.08 inch for duct greater than 3.35 inches in diameter; Bond length test (FIB 4.1.8) shall achieve 40 % GUTS in a maximum length of 16 duct diameters.

(ii) Minimum Bending Radius for Corrugated Plastic Duct: In addition to the component testing stated herein, the manufacturer shall establish, through testing, the minimum bending radius for the duct. The test consist of a modified duct wear test as described in Chapter 4, Article 4.1.7 of FIB Technical Report, Bulletin 7, titled "Corrugated Plastic Duct for Internal Bonded Post-tensioning". The test apparatus shall be identical to the wear test apparatus with the same clamping force as a function of the number of strands in the duct; however, modify the procedure as follows: do not move the sample along the strand to simulate wear; the test duration will be 7 days. Upon completion of the test duration, remove the duct and the minimum wall thickness along the strand path shall not be less than 0.06 inch for duct up to 3.35 inches diameter and not less than 0.08 inch for duct greater than 3.35 inches in diameter.

(iii) Corrugated Duct Connections and Fittings: Make all splices, joints, joints between segments (segmental construction), couplings and connections to anchorages with devices or methods (i.e. mechanical couplers, plastic

sleeves in conjunction with shrink sleeve) producing a smooth interior alignment with no lips or kinks. Design all connections and fittings to be airtight. Duct tape is not permitted to join or repair duct connections.

Construct connections and fittings from polyolefin materials containing antioxidant stabilizer(s) meeting the requirements established in Sections 3.0(B)(3) or 3.0(B)(5)(e) of this provision.

For post-tensioned systems intended for use with segmental constructed box girder bridges, the post-tensioning system shall include duct couplers at the segment joints (segmental duct coupler). The tendon duct coupler located at the segment joint shall be mounted perpendicular to the bulkhead and designed to receive a duct at an angle of 6 degrees deviation from perpendicular. The coupler shall be able to accommodate angular deviation of the duct without the tendon strands touching the duct or coupler on either side of the segment joint.

f. Smooth Duct: Use smooth duct manufactured from 100% virgin polyethylene resin meeting the requirements of ASTM D3350 with a minimum cell class of 344464C. Use resin containing antioxidant(s). Perform OIT test on samples taken from the finished product resulting in a minimum Oxidative Induction Time (OIT) according to ASTM D3895 of 40 minutes. Manufacture duct with a dimension ratio (DR) of 17.0 or less as established by either ASTM D3055 or ASTM F714 as appropriate for the manufacturing process used.

Use smooth duct meeting the minimum pressure rating (working pressure) of 100 psi and manufactured to either of the following Specifications: ASTM D3035 “Standard Specifications for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter” or ASTM F714 “Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter”.

(i) External Smooth Duct Connections: Use heat welding techniques to make splices between sections of plastic duct, in accordance with the duct manufacturer’s instructions or make connections with electrofusion coupler or other mechanical couplers meeting the material requirements of this Specification. Ensure all connections have a minimum pressure rating (working pressure) of 100 psi, produce a smooth interior alignment and a connection with no lips or kinks.

(ii) Ensure all connections between steel pipe embedded in concrete and plastic duct are made by using a mechanical coupler or a circular sleeve made of Ethylene Propylene Deine Monomer (EPDM), having a minimum pressure rating (working pressure) of 100 psi. Use EPDM materials having 100% quality retention as defined by ASTM D1171 Ozone Chamber Exposure Method B.

(iii) Use EPDM sleeves having a minimum wall thickness of 3/8 inch and be reinforced with a minimum of four ply polyester reinforcement. Use a 3/8 inch wide power seated band and clamps constructed from 316 stainless steel on each end of the boot to seal against leakage of grout. Install the band with an 80 to 120 lb seating force.

g. Corrugated Ferrous Metal Ducts: Do not use corrugated ferrous metal ducts in any location.

h. Shipping and Storage of Ducts: Furnish duct with end caps to seal the duct interior from contamination. Ship in bundles which are capped and covered during shipping and storage. Protect ducts against ultraviolet degradation, crushing, excessive bending, dirt contamination and corrosive elements during transportation, storage and handling. Do not remove end caps supplied with the duct until the duct is incorporated into the bridge component. Store duct in a location that is dry and protected from the sun. Storage shall be on a raised platform and completely covered to prevent contamination. If necessary, wash duct before use to remove any contamination.

6. Internal Duct Mechanical Couplers, O-Rings, Segment Seal Assemblies and Heat Shrink Sleeve Requirements: Ducts for prestressing bars used exclusively for temporary post-tensioning are not required to be coupled across segment joints.

a. Mechanical Couplers: Construct mechanical internal duct couplers with stainless steel, plastic or a combination of these materials. Use plastic resins meeting the requirements for of Sections 3.0(B)(3) or 3.0(B)(5)(e) of this provision to construct plastic couplers. Use ASTM A240 Type 316 stainless steel to make metallic components.

b. O-rings: Provide O-ring duct coupling assemblies and segment seal mounting assemblies made from plastic resins meeting the requirements of Sections 3.0(B)(3) or 3.0(B)(5)(e) of this provision.

Furnish standard O-ring material (diameter < 0.25 inch) conforming with the following requirements:

Mechanical Properties

Shore hardness, A ASTM D2240..... 50-75
Ultimate elongation %, ASTM D412.....250% Min.
Tensile strength, ASTM D412 ..... 1400 psi Min.

Accelerated Testing

Thermal Deterioration 70 hours @ 257°F, ...ASTM D573
Change in tensile strength .....±30%
Change of elongation.....-50%
Change of hardness.....±15 points
Compression Set Method B 22 hours @ 257° F,

ASTM D395 ..... 50%
Volume change due to absorption of H2O, Method D,
for 70 hours @ 212° F, ASTM D471.....+10%

Environmental Resistance

Ozone Resistance Exposure Method B,
ASTM D1171 ..... Pass
Low Temp. Non-brittle after 3 Min. @ -40° F,
ASTM D2137 ..... Pass

Furnish segment seal assemblies for large diameter compression seals, used to couple ducts at segment joints, which conform with the requirements stated above and with the following additions and changes:

Mechanical Properties

Shore hardness, A ASTM D2240..... 30-40
Tensile strength, ASTM D412 ..... 600 psi Min.
Compression Set Method B 22 hours @ 257° F,
ASTM D395 ..... 60%

Compression Force - The maximum force to compress the O-ring to its final compressed position shall not be greater than 25 psi times the area encircled by the O-ring.

Voided Area - The seal shall be designed to accommodate the material flow within its own cross-sectional area by using a hollow or voided design.

Mounting Assemblies - Assemblies holding the O-ring shall mount to the form bulkhead and provide for duct alignment.

c. Heat Shrink Sleeves: Furnish heat shrink sleeves having unidirectional circumferential recovery manufactured specifically for the size of the duct being coupled consisting of an irradiated and cross linked high-density polyethylene backing for external applications and linear-density polyethylene for internal applications. Furnish adhesive having the same bond value to steel and polyolefin plastic materials. Ensure the heat shrink sleeves have an adhesive layer that will withstand 150°F operating temperature and meet the requirements of the following table:

Property	Test Method	Minimum Requirements	
		Internal Application	External Application
Minimum Fully Recovered Thickness		92 mils	111 mils
Peel Strength	ASTM D1000	29 pli	46 pli
Softening Point	ASTM E28	162°F	216°F
Lap Shear	DIN 30 672M	87 psi	58 psi
Tensile Strength	ASTM D638	2,900 psi	3,480 psi
Hardness	ASTM D2240	46 Shore D	52 Shore D
Water Absorption	ASTM D570	Less than 0.05%	Less than 0.05%
Color		Yellow	Black
Minimum Recovery	Heat Recovery Test	33%	23%

Install heat shrink sleeves using procedures and methods in accordance with the manufacturer's recommendations.

7. System Test Requirements: For each family of post-tensioning systems, assemble systems and perform the pressure test defined herein. For each family of post-tensioning systems test two assemblies (largest and smallest) from the family. The post-tensioning assembly includes at least one of each component required to make a tendon from grout cap to grout cap. If applicable, include plastic duct to steel pipe connections and segment duct couplers.

   a. Grouting Component Assembly Pressure Test: Assemble anchorage and grout cap with all required grouting attachments (grout tube, valves, plugs, etc.). Seal the opening in the anchorage where the duct connects. Condition the assembly by maintaining a pressure of 150 psi in the system for 3 hours. After conditioning, the assembly shall sustain a 150 psi internal pressure for five minutes with no more than 15 psi reduction in pressure. For systems using the same anchorages, grout caps and grouting attachments as a previously approved system, the Grouting Component Assembly Pressure Test may include documentation from a previous submittal with written certification that the same components are being utilized in both anchorages.

   b. External Duct Systems: System testing for external duct requires two additional tests. (1) The anchorage and its connection to the duct/pipe assembly shall be tested in accordance with and meet the requirements for internal duct systems (duct/pipe assembly consists of all components internal to the diaphragm concrete). Test the assembly at 1.5 psi. (2) The duct and pipe assembly consisting of all external duct connections (welded duct splices, duct-pipe, etc.) and a grout vent shall comply with the following test. Condition the assembly by maintaining a pressure of 150 psi in the system for 3 hours. After conditioning, the assembly shall sustain a 150 psi internal pressure for five minutes with no

more than 15 psi reduction in pressure. The length of the test pipe assembly for the second test is 15 feet.

c. Internal Duct Systems: Perform a system test of the assembly for compliance with the requirements of Chapter 4, Article 4.2, Stage 1 and Stage 2 Testing contained in FIB Technical Report, Bulletin 7, titled "Corrugated Plastic Duct for Internal Bonded Post-tensioning". For bar systems modify the system test length to 15 feet. For systems being tested for use in precast segmental construction, modify this test to include one duct coupler (or O-ring assembly) which is to be used at the segment joint. Test the coupler for proper function by casting the coupler into a two part concrete test block using match cast techniques. Use blocks that are at least 12 inch x 12 inch x 12 inches. After the concrete has hardened, pull the blocks apart and clean the surface of any bond breaker materials. Using an external apparatus clamp the blocks together and maintain 40 psi pressure on the block cross-section during the pressure test. Do not apply epoxy between the blocks for this portion of the test. Pressurize the duct within the test block to 5 psi and lock-off the outside air source. The assembly shall sustain a 5 psi internal pressure for five minutes with no more than a 0.5 psi reduction in pressure. Separate the duct coupler blocks from the duct system remove the clamping device and place a 1/16 inch layer of epoxy on the face of both blocks, clamp the blocks together and maintain a pressure of 40 psi on the block cross-section for 24 hours. Upon removal of the clamping force, demolish the blocks. The coupler and the attached ducts should be intact and free of epoxy, and properly attached without crushing, tearing or other signs of failure.

C. Grout

Use only grouts that meeting the requirements of "Post-tensioning Grout" Special Provision. Select the post-tensioning grout for use by the proper application either repair, horizontal or vertical. Grout will be mixed with potable water meeting the requirements of the meeting the requirements of Article 1024-4 *Standard Specifications*. Maintain grout fluidity in strict compliance with the grout manufacturer's recommendations and test with a flow cone.

Store grout in a location that is both dry and convenient to the work. Storage in the open shall be on a raised platform and with adequate waterproof covering to protect the material. On site storage of grout is limited to a maximum period of one month.

D. Samples for Testing and Identification

1. General

Testing shall conform to the applicable ASTM Specifications for the prestressing material used.

Furnish all material samples for testing at no cost to the Department. Consider the job site or site referred to herein, as the location where the prestressing steel is to be installed, whether at the bridge site or at the casting yard.

2. Prestressing Steel

   Furnish samples for testing as described below for each manufacturer of prestressing strand and bar to be used on the project.

   With each sample of prestressing steel strand or bar furnished for testing, submit a certification stating the manufacturer's minimum guaranteed ultimate tensile strength of the sample furnished.

   Obtain sample the following materials, at the plant or jobsite, from the prestressing steel used for post-tensioning operations in the presence of the Engineer:

   a. For strand: three randomly selected samples, 5 feet long, per manufacturer, per size of strand, per shipment, with a minimum of one sample for every ten reels delivered.

   b. For bars: three randomly selected samples, 5 feet long, per manufacturer, per size of bar, per heat of steel, with a minimum of one sample per shipment.

   One of each of the samples furnished to represent a LOT will be tested. The remaining sample(s), properly identified and tagged, will be stored by the Engineer for future testing. In the event of loss or failure of the component the stored sample will be utilized to evaluate for minimum strength requirements. For acceptance of the LOT represented, test results shall show 100% of the guaranteed ultimate tensile strength.

3. LOTs and Identification

   A LOT is that parcel of components as described herein. All bars, of each size from each mill heat of steel, and all strand from each manufactured reel to be shipped to the site shall be assigned an individual LOT number and shall be tagged in such a manner that each such LOT can be accurately identified at the job site. Submit records to the Engineer identifying assigned LOT numbers with the heat, or reel of material represented. All unidentified prestressing steel, or bars received at the site will be rejected. Also, loss of positive identification of these items at any time will be cause for rejection.

   Provide a copy of the grout Quality Control Data Sheet to the Engineer, from the manufacturer, for each LOT number and shipment sent to the job site. Materials with a total time from manufacturer, in excess of six months, shall be retested and certified by the supplier before use or be removed from the project and replaced.

E. Approval of Materials

   The approval of any material by the Engineer will not preclude subsequent rejection if the material is damaged in transit or later damaged or found to be defective.

4.0 TESTING BY THE CONTRACTOR

A. Tendon Modulus of Elasticity Test

This test will not be required if it can be demonstrated to the satisfaction of the Engineer, from valid results for the tendon modulus of elasticity from previous projects or based on results from manufacturer tests. Such results shall be for the same type of strand, size, material and complement of strands per tendon as required for this project and shall have been performed under test conditions equal to or better than those describe below.

For the purpose of accurately determining the tendon elongations while stressing, bench test two samples of each size of tendon to determine the modulus of elasticity prior to stressing the initial tendon.

For the purpose of this test, the bench length between anchorages shall be at least 40 feet and the tendon duct at least 2 inches clear of the tendon all around. The test procedure shall consist of stressing the tendon at an anchor assembly with a load cell at the dead end. Tension the test specimen to 80% of ultimate in ten increments and then detention from 80% of ultimate to zero in ten decrements. For each increment and decrement, record the gauge pressure, elongations and load cell force. Note elongations of the tendon for both ends and the central 30 feet, measured to an accuracy of ±1/32 inch. Correct the elongations for the actual anchorage set of the dead end.

Calculate the modulus as follows:

$E = PL/Adl$
where;
P= force in tendon.
L= distance between pulling wedges and dead end wedges or exact length in center 30 feet of the tendon.
A= cross sectional area of the tendon based on nominal area.
dl= strand elongation for load P.

If the bench test varies from the modulus of elasticity used for the shop or working drawings by more than 1%, submit revisions to the theoretical elongations to the Engineer for approval.

When the observed elongations of the tendons in the erected structure fall outside the acceptable tolerances, or to otherwise settle disputes, additional Tendon Modulus of Elasticity Tests may be required to the satisfaction of the Engineer.

If the source of prestressing steel changes during the project, additional test series or substantiation from previous projects, not to exceed two per source will be required.

The apparatus and methods used to perform the test shall be submitted to the Engineer for approval. Tests shall be conducted in the Engineer's presence.

B. In Place Friction Test

For tendons in excess of 100 feet long, test in place a minimum of one tendon in each tendon group performing the same function. Functional tendon groups are cantilever tendons, continuity tendons, draped external tendons or continuous profiled tendons passing through one or more spans. The selected tendon will represent the size and length of the group of tendons being tested. The in-place friction test is not required for straight tendons used in flat slabs or precast voided slabs.

The test procedure consists of stressing the tendon at an anchor assembly with a load cell or a second certified jack at the dead end. Stress the test specimen to 80% of ultimate tendon strength in eight equal increments. For each increment, record the gauge pressure, elongations and load cell force. Take into account any wedge seating in both the live end (i.e., back of jack) and the dead end (i.e., back of load cell) and any friction within the anchorages, wedge plates and jack as a result of slight deviations of the strands through these assemblies. For long tendons requiring multiple jack pulls with intermediate temporary anchoring, keep an accurate account of the elongation at the jacking end allowing for intermediate wedge seating and slip of the jack's wedges.

If the elongation's fall outside the ±5% range compared to the anticipated elongations, investigate the reason and make detailed calculations confirming the final tendon forces are in agreement with the requirements of the approved plans.

In reconciling theoretical and actual elongations, do not vary the value of the expected friction and wobble coefficients by more than ±10%. Significant shortfall in elongations is indicative of poor duct alignments and/or obstructions. Correct or compensate for such elongations in a manner proposed by the Contractor and reviewed and approved by the Engineer at no additional cost to the Department.

The Engineer will require one successful friction test for each tendon group for the project.

If there are irreconcilable differences between forces and elongations, or other difficulties during the course of routine stressing operations, the Engineer may require additional in place friction tests.

The apparatus and methods used to perform the test shall be submitted to the Engineer for approval. Tests shall be conducted in the Engineer's presence.

C. Tests Reports Required

Submit two test reports of the "Tendon Modulus of Elasticity Test" to the Engineer at least 30 days before installing the tendon.

Submit two test reports of the "In Place Friction Test" to the Engineer within two weeks after successful installation of the tested tendon.

D. Application of Test Results

Reevaluate the theoretical elongations shown on the post-tensioning shop or working drawings using the results of the tests for Tendon Modulus of Elasticity and In Place Friction as appropriate and correct as necessary. Submit revisions to the theoretical elongations to the Engineer for approval.

5.0 PROTECTION OF PRESTRESSING STEEL

A. Shipping, Handling and Storage

Protect all prestressing steel against physical damage and corrosion at all times, from manufacturer to final grouting or encasing in the concrete. The Engineer will reject prestressing steel that has sustained physical damage. Carefully inspect any reel that is found to contain broken wires during use and remove and discard lengths of strand containing broken wires. The wire shall be bright and uniformly colored, having no foreign matter or pitting on its surface.

Prestressing steel shall be packaged in containers for protection of the steel against physical damage and corrosion during shipping and storage. A corrosion inhibitor, which prevents rust, shall be placed in the package, or be incorporated in a corrosion inhibitor carrier type packaging material. The corrosion inhibitor shall have no deleterious effect on the steel or the concrete or bond strength of steel to concrete. Inhibitor carrier type packaging material shall conform to the provisions of Federal Specification MIL-P-3420. Immediately replace or restore packaging damaged from any cause, to the original condition.

The shipping package shall be clearly marked with a statement that the package contains high-strength prestressing steel, the care to be used in handling, and the type, kind and amount of corrosion inhibitor used, including the date when placed, safety orders and instructions for use. Specifically designate low relaxation (stabilized) strands per requirements of ASTM A416. Strands not so designated will be rejected.

B. During Installation in the Structure

For bars located in superstructures and all strands, the time between the first installation of the prestressing steel in the duct and the completion of the stressing and grouting operations shall not exceed seven calendar days. For bars located in substructures, the time between the first installation of the prestressing steel in the duct and the completion of the stressing and grouting operations shall not exceed fourteen calendar days. Any light surface corrosion forming during this period of time will not be cause for rejection of the prestressing steel.

If the exposure period is to exceed the limits listed above, additional temporary corrosion protection measures shall be taken. Additional measures may include the use of vapor-phase inhibitors applied on site prior to exceeding the stipulated time limits. The proposed measures and materials shall be submitted for review and approval by the Engineer prior to the start of construction.

Flushing of grout is not permitted and vacuum grouting equipment is required to repair all voids and blockages as defined in Section 10.0(D)(4) of this provision. Flushing of ducts is only permitted as defined in Section 8.0 of this provision. When flushing is permitted, use flush water containing slack lime (calcium hydroxide) or quicklime (calcium oxide) in the amount of 0.17 lb/gal.

Except when waived by the Engineer in writing, failure to grout tendons within the seven calendar days specified will result in stoppage of the affected work in accordance with Article 108-7 of the *Standard Specifications*.

6.0 FABRICATION

A. General

Accurately and securely fasten all post-tensioning anchorages, ducts, inlet and outlet pipes, miscellaneous hardware, reinforcing bars, and other embedments at the locations shown on the plans or on the approved Shop or Working Drawings or as otherwise approved by the Engineer. Construct tendons using the minimum number of duct splices possible.

B. Ducts

Accurately align ducts and position at the locations shown on the plans or according to the approved Shop or Working Drawings or as otherwise approved by the Engineer. Securely fasten all internal ducts in position at regular intervals not exceeding 30 inches for steel pipes, 24 inches for round plastic duct and 12 inches for flat ducts to prevent movement, displacement or damage from concrete placement and consolidation operations. Show the method and spacing of duct supports on appropriate Shop Drawings. Ensure that ducts for external tendons are straight between connections to internal ducts at anchorages, diaphragms and deviation saddles and are supported at intermediate locations according to the plans or approved shop drawings.

Ensure that all alignments, including curves and straight portions, are smooth and continuous with no lips, kinks or dents. This also applies to curves in pre-bent steel pipe.

Carefully check and repair all ducts as necessary before placing any concrete.

After installing the ducts and until grouting is complete, ensure that all ends of ducts, connections to anchorages, splices, inlets and outlets are sealed at all times. Provide an absolute seal of anchorage and duct termination locations by using plumber’s plugs or equal. Grout inlets and outlets shall be installed with plugs or valves in the closed position. Leave low point outlets open. The use of duct tape is not permitted.

C. Splices and Joints

All splices, joints, couplings, connections (inlet and outlet) and valves shall be part of the approved post-tensioning system. Approved shrink-sleeve material may be used to repair duct. The use of any tape to repair or seal duct is not permitted.

D. Location of Grout Inlets and Outlets

Place grout inlets and outlets at locations as shown on the plans and shop drawings. Equip all grout inlets and outlets with positive shut-off devices. At a minimum, grout inlets and outlets shall be placed in the following positions:

1. Top of the tendon anchorage;
2. Top of the grout cap;
3. At the high points of the duct when the vertical distance between the highest and lowest point is more than 20 inches;
4. At a location 3 feet past high points of the duct on the down-stream side opposite the direction of grouting;
5. At all low points;
6. At major changes in the cross section of the duct;
7. At other locations required by the Engineer.

Extend grout tubes a sufficient distance out of the concrete member to allow for proper closing of the valves. Grout tubes shall be properly tagged for identification of associated tendons for grouting purposes.

E. Tolerances

Ensure that post-tensioning ducts in their final position are within the following tolerances:

Table of Duct Position Tolerances		
Tolerances	**Vertical Position (Inches)**	**Lateral Position (Inches)**
Horizontal tendons in slabs or in slab regions of larger members	±1/4 [±6]	±1/2
Longitudinal draped super-structure tendons in webs: Tendon over supports or in middle third of span	±1/4	±1/4
Tendon in middle half of web depth	±1/2	±1/4
Longitudinal, generally horizontal, superstructure tendons usually in top or bottom of member	±1/4	±1/4
Horizontal tendons in substructures and foundations	±1/2	±1/2
Vertical tendons in webs	Longitudinal position ±1	Transverse position ±1/4
Vertical tendons in bent columns	±1/2	±1/4

In all other cases, ensure that tendons are not out of position by more than ±¼ inch in any direction.

Ensure entrance and exit angles of tendon paths at anchorages and/or at faces of concrete are within ±3 degrees of desired angle measured in any direction and any deviations in the alignment are accomplished with smooth transitions without any kinks.

Angle changes at duct joints shall not be greater than ±3 degrees in any direction and shall be accomplished with smooth transitions without any kinks.

Locate anchorages within ±1/4 inch of desired position laterally and ±1 inch along the tendon except that minimum cover requirements shall be maintained.

Position anchorage confinement reinforcement in the form of spirals, multiple U-shaped bars or links, to be properly centered around the duct and to start within 1/2 inch of the back of the main anchor plate.

If conflicts exist between the reinforcement and post-tensioning duct, the position of the post-tensioning duct shall prevail and the reinforcement shall be adjusted locally with the Engineer's approval.

F. Internal Duct Pressure Test

Pressure test each different type and size of duct assembly at the site of casting before its first time use on the project. Pressure test all assemblies used in a single component constructed for the first time on the project, and thereafter, in groups of not more than 50 components. The Engineer shall randomly select one component per group, but not less than a total of two per project, for testing. Types of components include all post-tensioned components including but not limited to transversely post-tensioned slabs, longitudinally post-tensioned girders, post-tensioned box girder segments, pier and bent caps, and columns. In the presence of the Engineer, pressurize the duct to 1.5 psi and

lock-off the outside air source then record the pressure loss for a duration of one minute. If the pressure loss exceeds 0.15 psi, find and repair the leaks in the duct assembly using repair methods approved by the Department and retest.

Prior to concrete placement of the segments in the casting yard the following measures shall be implemented at a minimum to ensure duct alignment and to keep slurry from blocking the duct.

1. Longitudinal Tendons (Casting Yard); no duct pressure test is required if the duct installed in a single piece.

    a. For termination ends (anchor head location); an air mandrel shall be placed in the duct and inflated prior to concrete placement. This will be used to secure the duct location and to ensure no cement paste enters the duct. Ducts shall be visibly inspected prior to erection to ensure that there are no blockages in the duct.

    b. For straight ducts (no curvature); a steel pipe or similar material will be installed in the duct for alignment and rigidity to ensure there is no movement. Ducts shall be visibly inspected prior to erection to ensure that there are no blockages in the duct.

2. Continuity Tendons (Casting Yard); no duct pressure test is required if the duct installed in a single piece.

    a. For termination ends (anchor head location); an air mandrel shall be placed in the duct and inflated prior to concrete placement. This will be used to secure the duct location and to ensure no cement paste enters the duct. Ducts shall be visibly inspected prior to erection to ensure that there are no blockages in the duct.

    b. For straight ducts (no curvature); a steel pipe or similar material will be installed in the duct for alignment and rigidity to ensure there is no movement. Ducts shall be visibly inspected prior to erection to ensure that there are no blockages in the duct.

3. Transverse tendons (casting yard); no duct pressure test is required if the duct installed in a single piece.

7.0 PLACING CONCRETE

A. Precautions

Use methods to place and consolidate concrete which will not displace or damage any of the post-tensioning ducts, anchorage assemblies, splices and connections, reinforcement or other embedments. Fabricate all duct splices to prevent duct kinks during concrete placement. Use mandrels as needed to maintain duct alignment and shape.

B. Proving of Post-tensioning Ducts

Upon completion of concrete placement, prove that the post-tensioning ducts are free and clear of any obstructions or damage and are able to accept the intended post-tensioning tendons by passing a torpedo through the ducts. Use a torpedo having the same cross-sectional shape as the duct and that is a 1/4 inch smaller all around than the clear, nominal inside dimensions of the duct. Make no deductions to the torpedo section dimensions for tolerances allowed in the manufacture or fixing of the ducts. For straight ducts, use a torpedo at least 2 feet long. For curved ducts, determine the length so that when both ends touch the outermost wall of the duct, the torpedo is 1/4 inch clear of the innermost wall. If the torpedo will not travel completely through the duct, the Engineer will reject the member, unless a workable repair can be made to clear the duct. The torpedo shall pass through the duct easily, by hand, without resorting to excessive effort or mechanical assistance.

C. Problems and Remedies

The Engineer will reject ducts or any part of the work found to be deficient. The contractor shall develop a remedial action plan for approval by the Engineer.

8.0 INSTALLING TENDONS

A high-quality, water-tight seal is expected for all ducts at the bridge site. For all tendons that may have been subject to contamination, in the Engineer's sole discretion, flush the duct before placing the prestressing strands, with lime treated potable water and test for presence of chlorides and oils. It is anticipated that the permitting agencies will require any fluids expelled during flushing at the bridge site will need to be contained. Chlorides in the water shall be less than 600 ppm. When chloride levels are in excess of 600 ppm, continue to flush the duct until the chloride level is below 250 ppm. Blow oil-free compressed air through the duct to remove any excess water in the duct.

Push or pull post-tensioning strands through the ducts to make up a tendon using methods which will not snag on any lips or joints in the ducts. Strands which are pushed should be rounded off the end of the strand or fitted with a smooth protective cap. During the installation of the post-tensioning strand into the duct, the strand shall not be intentionally rotated by any mechanical device.

Alternatively, strands may be assembled to form the tendon and pulled through the duct using a special steel wire sock (“Chinese finger”) or other device attached to the end. The ends of the strands may not be electric arc welded together for this purpose. Strands may be brazed together for pulling as long as 1 foot of strand from the brazed end is removed after installation. Round the end of the pre-assembled tendon for smooth passage through the duct. Cut strands using an abrasive saw or equal. Flame cutting is not allowed.

Do not install permanent tendons before the completion of testing as required by these Specifications or plans. As a sole exception, the tendon to be tested in the “In Place Friction Test” may be installed for the test.

9.0 POST-TENSIONING OPERATIONS

A. General

Do not apply post-tensioning forces until the concrete has attained the specified compressive strength as determined by cylinder tests. Conduct all stressing operations in the presence of the Engineer.

B. Stressing Tendons

Tension all post-tensioning steel with hydraulic jacks so that the post-tensioning force is not less than that required by the plans or approved shop drawings, or as otherwise approved by the Engineer. Do not utilize monostrand jacks to stress tendons with five or more strands.

1. Maximum Stress at Jacking

The maximum temporary stress (jacking stress) in the post-tensioning steel shall not exceed 80% of its specified minimum ultimate tensile strength. Do not overstress tendons to achieve the expected elongation.

2. Initial and Permanent Stresses

The post-tensioning steel shall be anchored at initial stresses that will result in the long-term retention of permanent stresses or forces of no less than those shown on the plans or the approved shop drawings. Unless otherwise approved by the Engineer, the initial stress after anchor set shall not exceed 70% of the specified ultimate tensile strength of the post-tensioning steel.

Permanent stress and permanent force are the stress and force remaining in the post-tensioning steel after all losses, including long term creep and shrinkage of concrete, elastic shortening of concrete, relaxation of steel, losses in the post- tensioning steel from the sequence of stressing, friction and unintentional wobble of the ducts, anchor set, friction in the anchorages and all other losses peculiar to the post-tensioning system.

3. Stressing Sequence

Except as noted on the approved plans or the approved shop drawings and for the vertical bars in the bent columns, permanent post-tensioning tendons shall be stressed from both ends. The required force may be applied at one end and subsequently at the other end or simultaneously at both ends.

Single end stressing is permitted when the following are satisfied:

a. Space limitations prohibit double end stressing.

b. The calculated elongation of the post-tensioning steel at the second end is 1/2 inch or less and wedges are power seated.

c. Single end stressing applied at alternate ends of paired adjacent post- tensioning tendons is required to produce a symmetrical force distribution in agreement with the plan design.

For construction in stages where some tendons are required to be stressed before others, install and stress in accordance with the plans or approved shop drawings or as otherwise approved by the Engineer.

C. Stressing Equipment

Only use equipment furnished by the supplier of the post-tensioning system (tendons, hardware, anchorages, etc.).

1. Stressing Jacks and Gauges

Each jack shall be equipped with a pressure gauge for determining the jacking pressure. The pressure gauge shall have an accurate reading gauge with a dial at least 6 inches in diameter.

2. Calibration of Jacks and Gauges

Calibrate each jack and its gauge(s) as a unit. The calibration shall consist of three test cycles with the cylinder extension of the jack in various positions (i.e. 2 inch, 4 inch, 8 inch stroke). At each pressure increment, average the forces from each test cycle to obtain an average force. Perform the calibration with the equipment (jack, pump, hoses, etc.) setup in the same configuration that is intended to be used at the job site. The post-tensioning supplier or an independent laboratory shall perform initial calibration of jacks and gauge(s). Use load cells calibrated within the past 12 months to calibrate stressing equipment. For each jack and gauge unit used on the project, furnish certified calibration charts and curves to the Engineer prior to stressing. Supply documentation denoting the load cell(s) calibration date and tractability to NIST (National Institute of Standards and Technology) along with the jack/gauge calibration.

Provide the Engineer with certified calibration charts and curves prior to the start of the work and every six months thereafter, or as requested by the Engineer. Calibrations subsequent to the initial calibration with a load cell may be accomplished by the use of a master gauge. Supply the master gauge to the Engineer in a protective waterproof container capable of protecting the calibration of the master gauge during shipment to a laboratory. Provide a quick-attach hydraulic manifold to enable quick and easy installation of the master gauge to verify the permanent gauge readings. The master gauge shall be calibrated and provided to the Engineer. The master gauge will remain in the possession of the Engineer for the duration of the project.

Any jack repair, such as replacing seals or changing the length of the hydraulic lines, is cause for recalibration using a load cell.

D. Elongations and Agreement with Forces

Ensure that the forces being applied to the tendon and the elongation of the post-tensioning tendon can be measured at all times.

Elongations shall be measured to the nearest 1/16 inch.

For the required tendon force, the observed elongation shall agree within 7% of the theoretical elongation (for tendons shorter than 40 feet, elongations shall fall within 7% +/- ¼ inch of the theoretical elongation) or the entire operation shall be checked and the source of error determined and remedied to the satisfaction of the Engineer before proceeding further. Do not overstress the tendon to achieve the theoretical elongation.

In the event that agreement between the observed and theoretical elongations at the required force falls outside the acceptable tolerances, the Engineer may, at his discretion and without additional compensation to the Contractor, require additional tests for "Tendon Modulus of Elasticity" and/or "In-Place Friction" in accordance with Sections 4.0(A) and 4.0(B) of this provision.

E. Friction

The Design Plans shall be prepared based on the assumed friction and wobble coefficients and anchor set noted on the plans. Submit calculations and show a typical tendon force diagram, after friction, wobble and anchor set losses, on the shop drawings based upon the expected actual coefficients and values for the post-tensioning system to be used. Show these coefficients and values on the shop drawings.

If, in the opinion of the Engineer, the actual friction significantly varies from the expected friction, revise post-tensioning operations so the final tendon force is in agreement with the plans.

When friction shall be reduced, graphite may be used as a lubricant, subject to the approval of the Engineer.

F. Wire Failures in Post-tensioning Tendons

Multi-strand post-tensioning tendons, having wires which fail, by breaking or slippage during stressing, may be accepted provided the following conditions are met:

1. The completed structure shall have a final post-tensioning force of at least 98% of the design total post-tensioning force.
2. For precast or cast-in-place segmental construction and for any similar construction that has members post-tensioned together across a common joint face, at any stage of erection, the post-tensioning force across a mating joint shall be at least 98% of the post-tensioning required for that mating joint for that stage of erection.

3. Any single tendon shall have no more than a 7% reduction in cross-sectional area of post-tensioning steel due to wire failure.

Any of the above conditions may be waived with approval of the Engineer, when conditions permit the Contractor to propose acceptable alternative means of restoring the post-tensioning force lost due to wire failure.

G. Cutting of Post-tensioning Steel

Cut post-tensioning steel with an abrasive saw or plasma torch within 3/4 to 1 1/2 inches away from the anchoring device. Flame cutting of post-tensioning steel is not allowed.

H. Record of Stressing Operations

Keep a record of the following post-tensioning operations for each tendon installed:

1. Project name, Project ID;
2. Contractor and/or subcontractor;
3. Tendon location, size and type;
4. Date tendon was first installed in ducts;
5. Reel number for strands and heat number for bars;
6. Tendon cross-sectional area;
7. Modulus of elasticity;
8. Date Stressed;
9. Jack and Gauge numbers per end of tendon;
10. Required jacking force;
11. Gauge pressures;
12. Elongations (theoretical and actual);
13. Anchor sets (anticipated and actual);
14. Stressing sequence (i.e. tendons to be stressed before and after;
15. Stressing mode (one end/ two ends/ simultaneous);
16. Witnesses to stressing operation (Contractor and inspector);
17. Date grouted.

Record any other relevant information. Provide the Engineer with a complete copy of all stressing and grouting operations.

I. Duct Pressure Field Test

Longitudinal and Continuity tendons (project site); after stressing and before grouting internal or external tendons, install all grout caps, inlets and outlets and test the tendon with compressed air to determine if duct connections require repair. In the presence of the Engineer, the duct system shall be pressurized with dry, oil-free air to 30 PSI, locked off from the air source, and inspected for leaks. The air pressure test is not intended to be an air-tightness test of the duct system; rather it is test to identify leaks and/or crossover at segment joints or pipe connections. Leaks or crossover shall be indicated by the inability to reach 30 PSI on the tendon, or a rapid loss of pressure on the gauge as soon as the tendon is locked off. Discovered leaks or crossover shall be repaired using methods approved by the Engineer and the tendon shall be subsequently retested.

J. Tendon Protection

Within four hours after stressing, install grout caps and seal all other tendon openings. If acceptance of the tendon is delayed, seal all tendon openings and temporally weatherproof the open ends of the anchorage. If tendon contamination occurs, remove and replace the tendon.

10.0 GROUTING OPERATIONS

A. Grouting Operations Plan

Submit a grouting operations plan for approval at least six weeks in advance of any scheduled grouting operations. Written approval of the grouting operations plan by the Engineer is required before any grouting of the permanent structure takes place.

At a minimum, the plan will address and provide procedures for the following items:

1. Names and proof of training for the grouting crew and the crew supervisor in conformance with this specification;
2. Type, quantity, and brand of materials used in grouting including all certifications required;
3. Type of equipment furnished, including capacity in relation to demand and working condition, as well as back-up equipment and spare parts;
4. General grouting procedure; Duct pressure test and repair procedures;
5. Method to be used to control the rate of flow within ducts;
6. Theoretical grout volume calculations;
7. Mixing and pumping procedures;
8. Direction of grouting;
9. Sequence of use of the inlets and outlet pipes;

10. Procedures for handling blockages;

11. Procedures for possible post grouting repair.

Before grouting operations begin, a joint meeting of the Contractor, grouting crew and the Engineer will be conducted. At the meeting the grouting operation plan, required testing, corrective procedures and any other relevant issues will be discussed.

B. Grout Inlets and Outlets

Ensure the connections from the grout pump hose to inlets are free of dirt and are air-tight. Inspect valves to be sure that they can be opened and closed properly.

C. Supplies

Before grouting operations start, provide an adequate supply of water and compressed air for clearing and testing the ducts, mixing and pumping the grout. Where water is not supplied through the public water supply system, a water storage tank of sufficient capacity shall be provided.

D. Equipment

1. General

Provide grouting equipment consisting of measuring devices for water, a high-speed shear colloidal mixer, a storage hopper (holding reservoir) and a pump with all the necessary connecting hoses, valves, and pressure gauge. Provide pumping equipment with sufficient capacity to ensure that the post-tensioning ducts to be grouted can be filled and vented without interruption at the required rate of injection in not more than 30 minutes.

Provide an air compressor and hoses with sufficient output to perform the required functions.

Provide vacuum grouting equipment (volumetric measuring type) and experienced operators within 48 hours notice.

2. Mixer, Storage Hopper

Provide a high speed shear colloidal mixer capable of continuous mechanical mixing producing a homogeneous and stable grout free of lumps and un-dispersed cement. The colloidal grout machinery will have a charging tank for blending and a holding tank. The blending tank shall be equipped with a high shear colloidal mixer. The holding tank shall be kept agitated and at least partially full at all times during the pumping operation to prevent air from being drawn into the post- tensioning duct.

Add water during the initial mixing by use of a flow meter or calibrated water reservoir with a measuring accuracy equal to one percent of the total water volume.

3. Grout Pumping Equipment

Provide pumping equipment capable of continuous operation which will include a system for circulating the grout when actual grouting is not in progress.

The equipment will be capable of maintaining pressure on completely grouted ducts and will be fitted with a valve that can be closed off without loss of pressure in the duct.

Grout pumps will be positive displacement type, will provide a continuous flow of grout, and will be able to maintain a discharge pressure of at least 145 psi.

Pumps will be constructed to have seals adequate to prevent oil, air or other foreign substances entering the grout and to prevent loss of grout or water. The capacity will be such that an optimal rate of grouting can be achieved.

A pressure gauge having a full-scale reading of no more than 300 psi will be placed at the duct inlet. If long hoses (in excess of 100 ft) are used, place two gauges, one at the pump and one at the inlet.

The diameter and rated pressure capacity of the grout hoses shall be compatible with the pump output.

4. Vacuum Grouting Equipment

Provide vacuum grouting equipment consisting of the following:

a. Volumeter for the measurement of void volume.

b. Vacuum pump with a minimum capacity of 10 cfm and equipped with flow-meter capable of measuring amount of grout being injected.

c. Manual colloidal mixers and/or dissolvers (manual high speed shear mixers), for voids less than 5.28 gal. in volume.

d. Standard colloidal mixers, for voids 5.28 gal. and greater in volume.

5. Stand-by Equipment

During grouting operations, provide a stand-by colloidal grout mixer and pump.

E. Field Testing

Field Trial Tests

Field trial batching and testing shall be performed with the same materials, personnel, and equipment used in production grouting. Field trial tests shall be conducted at least 1 week prior to initiation of production grouting.

Chloride ion content shall be independently tested on a trial batch to be shown it is below the limits of this specification for the mixed grout. All materials, including the water, shall be the same source as will be used for the production grouting.

One chloride ion concentration test shall be performed on the mixed grout once per project at a minimum prior to start of grouting operations, with an additional test for each 40,000 lb of dry weight material.

F. Grouting

1. General

Perform test to confirm the accuracy of the volume measuring component of the vacuum grouting equipment each day when in use before performing any grouting operations. Use either water or grout for testing using standard testing devices with volumes of 0.5 gal and 6.5 gal and an accuracy of equal to or less than 4 oz. Perform one test with each device. The results shall verify the accuracy of the void volume measuring component of the vacuum grouting equipment within 1% of the test devise volume and shall verify the accuracy of the grout volume component of the vacuum grouting equipment within 5% of the test devise volume. Ensure the Engineer is present when any tests are performed.

Grout tendons in accordance with the procedures set forth in the approved grouting operation plan. Grout all empty ducts except ducts provided for future or contingency post-tensioning.

2. Temperature Considerations

Maximum grout temperature shall not exceed 90°F at the grout inlet. Use chilled water and/or pre-cooling of the bagged material to maintain mixed grout temperature below the maximum allowed temperature. Grouting operations are prohibited when the ambient temperature is below 40°F or is 40°F and falling. Postpone grouting operations if freezing temperatures are forecasted within the next two days and it is expected the concrete temperature surrounding the duct will fall below 40°F.

3. Mixing and Pumping

Mix the grout with a metered amount of water. The materials will be mixed to produce a homogeneous grout.

Continuously agitate the grout until grouting is complete. Reject bags of grout that contain clumps / wood chips.

The weight of grout bag shall be randomly verified prior to use; verify the weight of one bag of grout per day of grouting operations. If the weight of grout bag varies by

more than 2%, adjust the volume of water to be mixed with each bag to achieve the manufacturer's specified water/grout ratio.

If the weight of grout bag varies by more than 1%, then weigh another bag from the same pallet. If that bag varies by more 1% then weigh every bag used in that day's production, if not then reject that single bag and continue the operation.

4. Grout Production Test

During grouting operations the fluidity of the grout shall be strictly maintained within the limits established by the grout manufacturer. A target fluidity rate will be established by the manufacturer's representative, based on ambient weather conditions. Determine grout fluidity by use of either test method found in "Post-tensioning Grout" Special Provision. Perform fluidity test for each tendon to be grouted and maintain the correct water to cementitious ratio. Do not use grout which tests outside the allowable flow rates.

Prior to grouting empty ducts condition the grout materials as required to limit the grout temperature at the inlet end of the grout hose to 90°F. Prior to performing repair grouting operations with vacuum grouting, condition the grout materials to limit the grout temperature at the inlet end of the grout hose to 85°F. Check the temperature of the grout at the inlet end of the grout hose hourly.

At the beginning of each day's grouting operation, obtain a representative sample of grout from the first production batch of grout and perform a wick induced bleed test in accordance with "Post-tensioning Grout" Special Provision using this sample. Begin grouting operations after the sample is obtained. If zero bleed is not achieved in the wick induced bleed test at any time during the required test time period, complete the grouting of any partially grouted tendons and do not begin grouting of any new or additional tendons until the grouting operations have been adjusted and further testing shows the grout meets the specified requirements.

5. Grout Operations

Open all grout outlets before starting the grouting operation. Grout tendons in accordance with the Grouting Operations Plan.

Unless approved otherwise by the Engineer, pump grout at a rate of 16 feet to 50 feet of duct per minute. Conduct normal grouting operations at a pressure range of 10 psi to 50 psi measured at the grout inlet. Do not exceed the maximum pumping pressure of 145 psi at the grout inlet for round ducts and 75 psi for flat ducts in deck slabs.

Use grout pumping methods which will ensure complete filling of the ducts and complete encasement of the steel. Grout shall flow from the first and subsequent

outlets until any residual water or entrapped air has been removed prior to closing the outlet.

Pump grout through the duct and continuously discharge it at the anchorage and grout cap outlets until all free water and air are discharged and the consistency of the grout is equivalent to that of the grout being pumped into the inlet. Close the anchorage outlet and discharge a minimum of 2 gallons of grout from the grout cap into a clean receptacle. Close the grout cap outlet.

For each tendon, immediately after uncontaminated uniform discharge begins, perform a fluidity test using the flow cone on the grout discharged from the anchorage outlet. The measured grout efflux time will not be less than the efflux time measured at the pump or minimum acceptable efflux time as established in "Post-tensioning Grout" Special Provision. Alternately, check the grout fluidity using the Wet Density method contained in "Post-tensioning Grout" Special Provision. The measured density shall fall within the values established in "Post- tensioning Grout" Special Provision. The density at the final outlet shall not be less than the grout density at the inlet. If the grout fluidity is not acceptable, discharge additional grout from the anchorage outlet and test the grout fluidity. Continue this cycle until an acceptable grout fluidity is achieved. Discard grout used for testing fluidity. After all outlets have been bled and sealed, elevate the grout pressure to plus or minus 75 psi, seal the inlet valve and wait two minutes to determine if any leaks exist. If leaks are present, fix the leaks using methods approved by the Engineer. Repeat the above stated process until no leaks are present. If no leaks are present, bleed the pressure to 5 psi and wait a minimum of 10 minutes for any entrapped air to flow to the high points. After the minimum 10 minute period has expired, increase the pressure as needed and discharge grout at each high point outlet to eliminate any entrapped air or water.

If the actual grouting pressure exceeds the maximum allowed, the inlet will be closed and the grout will be pumped at the next outlet, which has just been, or is ready to be closed as long as a one-way flow is maintained. Grout will not be pumped into a succeeding outlet from which grout has not yet flowed. If this procedure is used, the outlet/inlet, which is to be used for pumping will be fitted with a positive shut-off and pressure gage.

When complete grouting of the tendon cannot be achieved by the steps stated herein, stop the grouting operation. After waiting 48 hours, fill the tendon with grout in accordance with the procedure outlined in Section 10.0(E)(8) of this provision.

6. Vertical Grouting

Grouting of cable stays is not covered by this specification. For all vertical tendons, provide a standpipe at the upper end of the tendon to store bleed water and grout, maintain the grout level above the level of the prestressing plate and anchorage. This device will be designed and sized to maintain the level of the grout at an elevation which will assure that bleeding will at no time cause the level of the grout to

drop below the highest point of the upper anchorage device. Design the standpipe to allow all bleed water to rise into the standpipe, not into the uppermost part of the tendon and anchorage device.

Discharge grout and check grout fluidity as described in Section 10.0(E)(5) of this provision. As grouting is completed, the standpipe will be filled with grout to a level which assures that, as settlement of the grout occurs, the level of the grout will not drop below the highest point in the upper anchorage device. If the level of the grout drops below the highest point in the anchorage device, immediately add grout to the standpipe. After the grout has hardened, the standpipe will be removed. In the presence of the Engineer, visually inspect for voids using an endoscope or probe. Fill all voids found in the duct using volumetric measuring vacuum grouting processes.

For vertical tendons in excess of 100 feet or if the grouting pressure exceeds the maximum recommended pumping pressure, then grout will be pumped at increasingly higher outlets which have been or are ready to be closed as long as a one-way flow of grout is maintained. Grout will be allowed to flow from each outlet until all air and water have been purged prior to using that outlet for pumping.

7. Construction Traffic and Operations Causing Vibrations

During grouting and for a period of 4 hours upon completion of grouting, eliminate vibrations from all sources such as moving vehicles, jackhammers, compressors, generators, pile driving operations, soil compaction, etc., that are operating within 300 feet down-station and 300 feet up-station of the ends of the span in which grouting is taking place.

8. Post-grouting Operations and Inspection

Do not remove or open inlets and outlets until the grout has cured for 24 to 48 hours. Remove all outlets located at anchorages and high points along the tendon to facilitate inspection and perform inspections within one hour after the removal of the inlet/outlet. Drill and inspect all high points along the tendon as well as the inlets or outlets located at the anchorages. Depending on the geometry of the grout inlets, drilling may be required to penetrate to the inner surface of the trumpet or duct. Use drilling equipment that will automatically shut-off when steel is encountered. Unless grout caps are determined to have voids by sounding, do not drill into the cap. Perform inspections in the presence of the Engineer using endoscopes or probes. Within four hours of completion of the inspections, fill all duct and anchorage voids using the volumetric measuring vacuum grouting process.

Seal and repair all anchorage and inlet/outlet voids that are produced by drilling for inspection purposes as specified in Section 11.0(B) of this provision. Remove the inlet/outlet to a minimum depth of 2 inches. Use an injection tube to extend to the bottom of the drilled holes for backfilling with epoxy.

Post grouting inspection of tendons may utilize the following statistical frequency for inspection:

a. For the first 20 tendons, inspect all outlets located at anchors and tendon high points by drilling and probing with an endoscope or probe. If one or more of the inspection locations are found to contain a defect (void), continue testing all tendons until 20 consecutive tendons have been inspected and no voids have been found.

b. When no defects are detected as defined in No. 1 above, the frequency of inspection can be reduced to inspect every other tendon (50%). If a defect is located, inspect the last five tendons grouted. Return to Step 1 above and renew the cycle of 100% tendon inspections.

If tendon grouting operations were prematurely terminated prior to completely filling the tendon, drill into the duct and explore the voided areas with an endoscope. Probing is not allowed. Determine the location and extent of all voided areas. Install grout inlets as needed and fill the voids using volumetric measuring vacuum grouting equipment.

9. Grouting Report

Provide a grouting report signed by the Contractor and/or the Subcontractor within 72 hours of each grouting operation for review by the Engineer.

Report the theoretical quantity of grout anticipated as compared to the actual quantity of grout used to fill the duct. Notify the Engineer immediately of shortages or overages.

Information to be noted in the records shall include but not necessarily be limited to the following: identification of the tendon; date grouted; number of days from tendon installation to grouting; type of grout; injection end and applied grouting pressure, ratio of actual to theoretical grout quantity; number of bags of grout mixed; total quantity of water used to mix the grout; summary of any problems encountered and corrective action taken.

11.0 FORMING AND REPAIRS OF HOLES

A. Repair of Lifting and Access Holes

1. Repair all holes with Magnesium Ammonium Phosphate Concrete (MAPC) meeting the physical properties requirements below. Prepare surface per manufacturer's recommendations. Flush surface with water and blow dry. Form, mix, place and cure the material in strict compliance with the manufacturer's recommendations.

The MAPC material shall meet or exceed the following physical properties.

Requirement	Test Method	Test Value
Minimum Compressive Strength (at 28 days), psi	ASTM C109	8,500
Minimum Flexural Strength (at 28 days), psi	ASTM C348	600
Minimum Slant Shear Bond (at 14 days), psi	ASTM C882	2,500
Time of Setting (Initial), minutes	ASTM C191	15 to 60
Maximum Scaling Resistance	ASTM C672	No scaling
Maximum Length Change (at 28 days), %		
Allowable expansion in water cured compared to length at one day	ASTM C157	0.03
Allowable shrinkage in air cured compared to length at one day		-0.03
Maximum Expansion due to Sulfate Resistance (after 52 week of immersion), %	ASTM C1012	0.1
Maximum Chloride Absorption at 21 days, %	NCHRP 12-19A*	1.5
* Use cube specimens meeting the requirements of ASTM C109.		

2. Prior to placing the deck overlay, coat the repaired holes, block-outs and an area extending 6 inches outside the perimeter of the repair with a High Molecular Weight Methacrylate (HMWM).

   The methacrylate system shall be a three component system consisting of:

   a. Methacrylate monomer;

   b. Cumene hydroperoxide (CHP) initiator;

   c. Cobalt promoter.

   Use initiator and promoter approved by the monomer manufacturer.

   Use a methacrylate material that meets the following physical and performance requirements:

Physical Properties of Methacrylate Resin	
Viscosity (Brookfield RVT)	14-20 cps at 50 rpm
Density (ASTM D1481)	8.5 – 9.0 lb/gal at 77° F
Flash Point (ASTM D93)	>200 ° F (Pensky Martens CC)
Order	Low
Bulk Cure Speed	3 Hours @ 73°F (max)
Surface Cure	8 Hours @ 73°F (max)
Gel Time (ASTM D2471)	60 minutes (max)
Tack Free Time	5 Hours (max) (at 72°F and 50% RH)
Compressive Strength (AASHTO T106)	6,500 psi (min)
Tensile Strength (ASTM C307)	1,300 psi (min)
Shear Bond Adhesion (ASTM C882)	600 psi (min)
Wax Content	0%

The monomer shall have a shelf life of no less than 12 months and shall be no more than 8 months old at the time of application. Provide each container shipped to the job site with the following information on a manufacturer's label: manufacturer's name, product name, lot or batch number, date of production, and drum serial number. Identify the catalysts by their generic classification and provide the date of manufacture.

3. Use uniformly graded 6-20 (or similar), clean, bagged, blast sand for spreading over the applied polymer on bridge decks and other riding surfaces. Certify that the sand has a maximum moisture content that does not exceed 0.25% and that the maximum amount of dust or other material that may pass through a No. 200 sieve (-200 content) is not greater than 0.75%.

   Store the sand at a location that will preserve the above described conditions and characteristics of the sand until applied.

4. On the day of application, thoroughly power sweep the area to be treated to remove all dust, dirt or debris present. On bridge decks and other riding surfaces, use a tractor mounted (or similar) power broom with non-metallic bristles suitable for the intended purpose.

   Use a power vacuum after sweeping when sealing cracks on grooved bridge decks. Re-clean the deck as necessary just prior to the application as debris may be blown back onto the work area by adjacent traffic or other means. If present, remove oils and oil based substances from the concrete surface using an approved solvent.

5. Provide adequate containment to prevent the sealer material from flowing beyond the designated area of application. Plug any drain holes or openings within the work area. Prevent airborne material from dispersing.

B. Repair of Grout Inlets and Outlets

Place threaded plastic caps in all inlet/outlet locations required in the plans. Repair inlets/outlets as shown on the plans using an epoxy grout, Type 5 epoxy meeting the requirements of Article 1081 *Standard Specifications*. Prepare the surface to receive the epoxy material in strict compliance with the manufacturer's recommendations.

12.0 PROTECTION OF POST-TENSIONING ANCHORAGES

A. Epoxy Grout

1. Within seven days upon completion of the grouting, protect the anchorage of post-tensioning bars and tendons as indicated in the plans. The application of the elastomeric coating may be delayed up to 90 days after grouting. Use plastic or stainless steel threaded caps to plug all grout inlets/outlets. Use an epoxy grout to construct all pourbacks located at anchorages meeting the following requirements.

2. These epoxy materials are to be used to protect the anchorages of post-tensioning tendons or bars and other uses indicated in the plans. The material shall produce a low exothermic reaction and have flow and fill characteristics suitable for machine base plate applications. The material will be extended with the aggregate supplied by the manufacturer. Mix with the full aggregate loading unless the use of less aggregate is approved by the Engineer.

3. The material shall be factory pre-proportioned including factory supplied aggregate. Deliver products in original containers with manufacturer's name, date of manufacture, product identification label and batch numbers. Materials shall be within the manufacturer's recommended shelf life. Store and condition the product in full compliance with manufacturer's recommendations.

Property	Test Value	Test Method
Compressive Strength, Cubes (7 day cure at 77ºF)	> 10,000 psi	ASTM C579B
Tensile Strength at 7 days	> 2,100 psi	ASTM C307
Flexural Strength (7 day cure at 77ºF)	> 3,600 psi	ASTM C580
Modulus of Elasticity (7 day cure at 77ºF)	< 2,100,000 psi	ASTM C580
Coefficient of Thermal Expansion at 74 to 210ºF	< 20 x 10^{-6} in/in/ºF	ASTM C531
Peak Exotherm, Specimen, 12 x 12 x 3 in.	< 150ºF	ASTM D2471
Slant Shear at 7 days (Bond Strength to Concrete)	> 3000 psi	ASTM C882
Thermal Compatibility	5 Cycles Passed	ASTM C884
Linear Shrinkage at 7 days	0.025%	ASTM C531
Flowability and Bearing Area	90% Contact area	ASTM C1339
Gel Time, Specimen 12 x 12 x 3 in.	< 4:00 (hr.)	ASTM D2471

4. The epoxy grout plus aggregate mix shall meet or exceed the specified physical properties stated herein as determined by the following standard ASTM test methods.

5. Prepare surface per manufacturer's recommendations. In case of dispute, use ACI 503 for substrate testing and develop a minimum of 175 psi. tension (pull-off value).

6. Mix and apply epoxy as per manufacturer's current standard technical guidelines. Construct all pourbacks in leak proof forms creating neat lines. The epoxy grout may require pumping for proper installation. Construct forms to maintain a liquid head to insure intimate contact with the concrete surface. Use vents as needed to provide for the escape of air to insure complete filling of the forms.

B. Elastomeric Coating

1. After the epoxy pourback has cured per the manufacturer's recommendations, coat the exposed surfaces of pourbacks plus at least 12 inches of concrete surrounding the pourback with a 30 to 45 mils thick elastomeric coating system meeting the following requirements. Epoxy pourbacks to receive an elastomeric coating include, but are not limited to, those pourbacks beneath expansion joints and those pourbacks at anchorages within the interior of the box girder. Pourbacks located on the visible exterior surface of the bridge superstructure shall not receive an elastomeric coating.

2. The elastomeric coating system shall provide a waterproof barrier over the designated post-tensioning anchorages and or other areas designated in the plans. The components of the coating system shall be supplied by a single manufacturer and sold as a waterproof coating system. The surface preparation and application of the coating system shall be applied in strict accordance with the manufacturer's specifications.

3. The use of an epoxy prime coat is dependent upon the requirements of the manufacturer's waterproofing system. The polyurethane chemistry may be either waterborne aromatic (moisture-curing) or aromatic (moisture-sensitive). The minimum thickness of the system shall not be less than 30 mils. The cured coating system shall meet the following requirements:

Property	Test Value	Test Method
Hardness, Shore A	Between 60 and 90	ASTM D2240
Tensile Strength	≥750 psi	ASTM D412
Elongation	≥400%	ASTM D412
Tear Strength	>70 pli	ASTM C957
Abrasion Resistance H-18 wheels 1,000 gm/wheel	≤350 mg loss / 1,000 revs.	ASTM C957
Crack Bridging 1,000 Cycles	System Passes	ASTM C957
Elongation Recovery	≥94%	ASTM C957

4. Supply the elastomeric coating system with an aliphatic polyurethane top coating for use on epoxy pourbacks in the bridge substructure.

5. Field Qualification Testing: Attain a numerical rating of not less than 9 in accordance with ASTM D610 and ASTM D1654 and 9F in accordance with ASTM D714; the coating should not blister, soften or loosen bond at the end of the test period; there will be no corrosion in the field per ASTM D610; color retention, $\Delta E \leq 3$, in accordance with ASTM D2244; and 10% max gloss loss in accordance with ASTM D523 when applied to test location and exposed at the Department's beach corrosion test site or applied at a test location. The coatings will be evaluated initially following an exposure period of 18 months. The coatings shall continue to provide acceptable protection and performance for a period of 5 years. Application characteristics shall be judged acceptable prior to beach testing.

6. Assure concrete or other substrates are structurally sound, clean and dry. Concrete shall be a minimum of 28 days old. Prepare surface per manufacturer's recommendations. Blow the surface with compressed air to remove the dust or water. Construct a 2 x 4 ft concrete test block with a similar surface texture to the surfaces to be coated and coat a vertical face with the elastomeric coating system chosen. Determine the number of coats required to achieve a coating thickness between 30 to 45 mils without runs and drips. Mix and apply elastomeric coating as per manufacturer's current standard technical specifications. Spray or roller application is permitted (spray application preferred). Have the coating manufacturer representative on site to supervise and comment on the application of the elastomeric coating onto the test block.

Post-tension details (vertical profile, anchorage and grouting, and an anchorage protection) shall be in accordance with the plans.

13.0 MEASUREMENT AND PAYMENT

Post-Tensioning Steel will be measured and paid as the number of pounds of permanent post-tensioning steel tendons/bars entered into the completed structure and accepted. Measurement will be the theoretical plan length measured from anchorage to anchorage (measured from front face of the bearing plate) with no allowance made for waste or extension past the bearing faces. No measurement will be made for temporary post-tensioning which will be considered incidental to the item Post-Tensioning Tendons.

No measurement will be made for temporary tendons/PT bars which are approved to be left in the structure, either stressed or unstressed, for the convenience of the Contractor's operations.

No measurement will be made for tendons/PT bars necessitated by approved modifications to the segments or structure for the purposes of the Contractor's construction method.

Post-tensioning tendons/bars will be paid for at the Contract unit price per pound of steel tendon, completed and accepted. Payment will be full compensation for furnishing, installing, stressing and grouting all permanent post-tensioning tendons/bars. Payment also includes anchorage assemblies and associated supplemental reinforcing steel required by the supplier, post-tensioning system hardware which is not embedded in concrete, ducts, grout and grouting, all testing, protection of post-tensioning anchorages, vents, inlets, outlets and all labor, materials, tools, equipment and incidentals necessary for completing the work in accordance with the Contract Documents. This payment also includes lubricants in the tendon ducts for friction control and flushing lubricants or contaminants from the ducts. Anchorage components, ducts and similar items of post-tensioning system hardware embedded within precast components or cast-in-place concrete will be deemed to be included in the cost of the precast components or cast-in-place concrete.

Payment for *Post-Tensioning Steel* will be made following successful placement, stressing, grouting, inspection, protection and approval by the Engineer.

Payment will be made under:

Pay Item	**Pay Unit**
Post-Tensioning Steel	Pound

PRECAST SEGMENTAL BRIDGE CONSTRUCTION (SPECIAL)

This provision governs any portion of the bridge that utilizes precast segmental construction.

1.0 DESCRIPTION

Fabricate, store, transport and erect precast structural concrete superstructure and/or substructure segments on a prepared foundation, to the established lines and grades, in accordance with the design, dimensions and details shown on the plans and in accordance with this provision. Cast-in-place closure joints, reinforcing steel, embedded items and all appurtenant items are included.

2.0 GENERAL

A. Qualification and certification requirements:

1. **Requirements for Supervisory Personnel.** Meet the requirements of Article 105-6 *Standard Specifications*. Qualifications including years of experience and experience on related projects shall be submitted for all personnel in supervisory positions. In addition to the above requirements, perform all post-tensioning field operations with personnel meeting the qualifications outlined in SEGMENTAL BRIDGE CONTRACTOR AND PERSONNEL Special Provision.

2. **Plant Certification Requirement.** Cast concrete at a Precast/Prestressed Concrete Institute (PCI) certified plant or casting yard with a "B4- Prestressed Deflected-Strand Bridge Members" certification. Certification must be current and not expire prior to the completion of the precast concrete segmental sections. In addition, show that the pre-casting plant has performed at least one precast segmental superstructure concrete box girder project in the past eight years similar in scope to this project.

B. Definitions

The following definitions apply to segmental bridge construction:

1. Plans

   Approved design plans prepared by the Engineer of Record.

2. Segment

   A modular section of the superstructure and/or substructure consisting of a certain cross-section shape and length as detailed on the plans.

3. Match-Cast

   A precast concrete fabrication process whereby a segment is cast against the preceding segment producing a matching interface which permits the re-establishment

of the cast geometry at erection time. Match-casting is accomplished by either the short line or long line casting method.

4. Short Line Casting

   Casting segments one at a time in a casting cell between a bulkhead at one end and a previously cast segment at the other. The first segment is cast between the bulkhead and another, temporary bulkhead.

5. Long Line Casting

   Casting segments on a casting bed of sufficient length to permit the cumulative casting of segments for the entire length of a span or cantilever between field closure pours without repositioning the segments on the casting bed. With this method, the first segment is cast between bulkheads and successive segments are cast between a movable bulkhead on one end and the previously cast segment on the other.

6. Casting Cell

   A special formwork arrangement usually consisting of a fixed vertical bulkhead of the cross section shape at one end and adjustable soffit, side and core forms all designed and assembled into a machine for making a single superstructure segment. A casting cell for a substructure pier shaft segment consists of exterior and interior side forms and a soffit form of the cross section shape.

7. Wet Joint System

   Where segments are made in a casting cell between two bulkheads and are not match cast. The segments are then erected in the superstructure with a narrow cast-in-place joint between each segment. (During erection, all the segments of a span or multiple spans are supported by falsework, truss or other technique until the joints have gained strength and the longitudinal post-tensioning installed to make them self supporting.)

8. Balanced Cantilever (Erection)

   The segments are sequentially erected alternately on either side of the pier in cantilever to a point where a closure is cast-in-place.

9. Progressive Cantilever (Erection)

   The segments are erected progressively in cantilever, in one direction, from one pier to the next, using temporary intermediate piers, or other systems as required to support the advancing cantilever between piers.

10. Casting Curve

The curve of casting geometry that has to be followed in the casting cell or bed for achieving the theoretical bridge profile and alignment after all the final structural and time dependent (creep and shrinkage) deformations have taken place. The casting curve is a combination of the theoretical bridge geometrical profile grade, alignment and the camber.

11. Camber

    The amount by which the concrete profile at casting time shall differ from the theoretical geometric profile grade to compensate for all structural dead load, post-tensioning, all long term and time dependent deformations (creep and shrinkage) including all the intermediate erection stages and effects (the opposite of deflections).

12. Erection Elevation

    The elevation at which a segment is set in the structure at the time it is erected. (This is profile grade corrected by the amount of deflection calculated to occur from that stage onwards.)

13. Segmental Duct Coupler

    The special duct coupler used for internal tendon duct connections at segment match cast joints meeting the requirement of the "Post-tensioning" Special Provision.

C. Shop Drawings, Calculations and Manuals

Use methods and procedures providing adequate safety to the general public from construction/erection activities and/or falsework placed over or adjacent to traveled roadways, navigational or recreational waterways or any existing commercial, industrial or other facility.

Submit detailed shop drawings, calculations and manuals which include, but are not necessarily limited to, the following:

1. A schedule of the timing and sequence of segment casting and erection including the sequence of making cast-in-place closures and continuity between spans.

2. Revised camber diagram (including calculations) based on the age of segments at time of erection, the anticipated construction sequence and schedule, and the means and methods of construction.

3. Details to achieve deformation compatibility and the closure joints.

4. Details of the disposition and use of special erection equipment, falsework, temporary supports and the like, including all loads or reactions from such equipment applied to the structure during erection and the sequences and timings of these effects in accordance with the erection schedule.

5. Details of the forms and casting cells for the manufacture of the segments.

6. Layout of the casting yard showing operational features, casting cells, rebar fabrication and material storage areas, movable rain and sun sheds, geometry control stations, segment handling and storage facilities and the like.
7. Calculations and details for lifting, storage or stacking of the segments.
8. Details of inserts or lifting holes including any necessary localized strengthening and the materials and methods to fill and finish such holes.
9. Details and calculations for any localized strengthening for concentrated supports, loads or reactions from any special erection equipment placed in locations not already allowed for in the plans.
10. Details and complete description of post-tensioning hardware components and any other embedments to be cast into the segments.
11. In order to accommodate variations from the views and dimensions shown on the plans, fully and accurately dimensioned views showing the revised geometry of the segment including projections, recesses, notches, opening, block outs, and the like with clear and concise cross-reference to the appropriate plans to which the variations apply.
12. Where variations are made to segment geometry and dimensions, appropriate details of changes to reinforcing clearly showing the size, spacing and location, including any special reinforcing required but not shown on the plans, with clear and concise cross reference to the appropriate plans to which the variations apply.
13. The size, type, and components of the post-tensioning system to be used. The duct type, size and support spacing. Locate all relevant details and grout inlets/outlets and segmental duct couplers and the method of maintaining the position and alignment of duct couplers at the segment joints. Ensure all post-tensioning alignments are in accordance with the plans, unless the Contractor's proposed variations require changes in which case horizontal and vertical profiles shall be fully detailed.
14. Details of and supporting calculations for any modifications to reinforcement at anchorages, deviation saddles, diaphragms and the like, made necessary for accommodating the elected post-tensioning system hardware.
15. Casting curves and erection elevations, prepared in accordance with chosen construction methods, sequence and schedule. In this respect, the construction methods, sequence and schedule include, but are not limited to, Contractor adopted general construction techniques, the erection equipment, its deployment and effect upon the structure, the introduction or removal of temporary supports, falsework, closure devices and the like, their deployment and effect upon the structure, the order (sequence) in which all casting, construction methods and step-by-step erection operations are executed, including post-tensioning, and the timing (schedule) of all such operations, with respect to the maturity of the concrete and affect thereon.
16. A manual for the casting and geometry control of the segments or as required by this Specification. (This is referred to as the "Casting Manual".)

17. A manual for the detailed step by step erection of the segments including all intermediate procedures relating to any erection equipment, falsework, movement of equipment, support jacking, stressing of temporary post-tensioning bars, closure operations including any partial stressing across the closure during concrete curing, main post-tensioning tendon sequences, stressing loads and elongations, erection elevations, a method for the field survey and alignment control for setting initial and subsequent segments and any other relevant operations. (This is referred to as the "Erection Manual".)
18. Fully integrated drawings to scale and in sufficient detail to show the relative positions of all the items that are to be embedded in the concrete, and their embedment depth. Such embedded items include the post-tensioning ducts, vents, grout tubes, anchorage reinforcement and anchorage hardware, reinforcing steel, anchor bolts, drainage assemblies, utility conduits, inserts, and other such items. Such drawings shall be adequate to ensure that there will be no conflicts between the planned positions of any embedded items, and that the concrete cover and all rebar clearances are adequate and allow for proper placement and consolidation of concrete.
19. Method of mixing and placing grout; equipment capacity; mix design.
20. The volume of concrete, the weight of reinforcement and weight of post-tensioning in each precast segment and the totals of these for both the superstructure and substructure summarized and tabulated on the shop drawings.

All submittals listed above shall be prepared and sealed by the Contractor's Specialty Engineer, as appropriate, for the Engineer's approval. Any revision to materials, components, construction loads or erection sequencing indicated on the plans and/or to previously approved shop drawings shall be prepared and sealed by the Contractor's Engineer of Record for the Engineer's approval. No work shall begin on any item covered by a shop drawing until the final review and approval by the Engineer is completed.

3.0 MATERIALS

A. General

Use materials which conform to this provision and the requirements prescribed in Division 10 of *Standard Specifications*, for the particular kind and type of material specified.

B. Concrete

Use concrete as specified in Section 1000 except as specifically modified herein. Gradation for coarse aggregate utilized in the concrete for precast segments will be such that 100% passes a 1 inch sieve. Use coarse aggregate as specified in Section 1005 to meet this gradation requirement. Screenings are not allowed as a substitute for silica sand for use in concrete for Precast Superstructure Segments.

C. Reinforcing Steel

Use ASTM A615, Grade 60 reinforcing steel which meets the requirements of Section 1070. If welding of reinforcing steel is necessitated by the design, use ASTM A706 reinforcing steel and meet the requirements of the American Welding Society's Structural Welding Code D1.4. Field welding of reinforcing steel is not allowed. Any reinforcing steel chosen shall meet the requirements of Section 1070.

D. Post-tensioning Systems

Use post-tensioning hardware components meeting the requirements of the "Post-tensioning" Special Provision. Components are not interchangeable and shall comply with the details of the approved shop drawings.

4.0 CASTING REQUIREMENTS

A. General

Ensure that all materials, details, and procedures are as specified herein, as noted on the plans. Do not begin casting segments until the Engineer approves the relevant shop drawings, calculations, casting manuals, concrete forms, concreting operations, and post-tensioning system components. (Approval of post-tensioning stressing elongations and forces for field erection operations is not required at this stage but is required prior to erection). To use wet joints to join cantilevers or for corrective measures, obtain the Engineer's written approval. Give each segment an erection mark indicating its location, orientation and order in the erection sequence. Match mark abutting edges of adjacent segments. Show erection marks on the erection plans or in the erection manual.

B. Forms

The Contractor shall be responsible for furnishing steel forms for precast concrete segments, and for the design and engineering of the steel forms as well as their construction. The use of plywood forms will not be permitted. Form all exposed formed surfaces of each element of the structure with the same material to produce similar concrete surface textures, color, and appearance. Obtain the Engineer's approval of forms prior to initiating casting operations. Build the details shown on the plans or as amended by approved Shop Drawings into the forms. Repair worn, damaged, or otherwise unacceptable forms and obtain the Engineer's approval before casting any segment. Where sections of forms are joined, ensure that offsets in flat surfaces do not exceed 1/16 inch and that offsets with corners and bends do not exceed 1/8 inch. Ensure that all joints in the forms and contact points with bulkheads and existing segments have good fitting seals to prevent loss of fine material and cement grout. Check and inspect forms on a regular weekly basis to ensure proper alignment and geometric accuracy. Do not use forms which fail to meet the specified casting tolerances until such corrections are made to produce segments within the specified tolerances. Use a small block-out at all locations where an external tendon enters or exits the face of the concrete at deviation blocks and diaphragms except at anchorage locations. The block-out will be approximately 2 inches larger in diameter or overall

dimensions than the tendon duct and have a depth equal to at least the minimum prescribed concrete cover dimension. Blockouts shall be provided around the outside perimeter of steel pipe interfacing with deviators or diaphragms to mitigate cracking of the concrete due to steel pipe deformation when stressing post-tensioning tendons. Each blockout shall be sealed with sealant or epoxy following the stressing operation.

C. Casting Control (Geometry)

Before commencing the casting operation, submit the proposed method of geometry control for all segment casting operations to the Engineer for approval. This submittal shall be in the form of a "Casting Manual" and include but not necessarily be limited to:

1. All measuring equipment, procedures and the location of control points to be established on each segment.

2. The location and values of all permanent benchmarks and reference points in the precasting yard.

3. A geometry control procedure for the vertical and horizontal alignment control for the precasting of segments; including survey controls and procedures, observations, checks, computational and/or graphical methods and correction techniques.

4. The casting curves which include the theoretical geometric horizontal alignment, profile grade and superelevation appropriately combined with the camber. Ensure that the casting manual covers all geometry control operations necessary and is compatible with the chosen methods of casting and erection, including erection survey, elevation and alignment control. Prepare the manual in accordance with submittal requirements of this provision. Do not begin casting without the Engineer's approval of the geometry control method. In the precasting yard, use instruments for the geometry control which are mounted on a permanent platform of sufficient height to sight on all control points. In addition, establish and maintain permanent benchmarks and reference points throughout the casting operations. During casting, make all corrections required in the geometry of the segments from the control points established on each segment. With a match cast system, after casting and before bond breaking to separate the segments, check the position of the new cast and match cast segments again. If positions are not as desired, make corrections in the next segment. In general, and unless otherwise approved by the Engineer, make observations on the geometry control reference hardware cast into the segments (i.e. elevation bolts, alignment offsets and lengths) to a precision of ±0.01 foot. During casting operations, produce and maintain on a daily basis a graphical plot of the vertical and horizontal "as cast" alignments along each vertical and horizontal control line to an exaggerated scale in order to clearly highlight variations. Depict these against both the theoretical geometric vertical and horizontal alignment casting curves on a continuous layout of an entire unit of the bridge between expansion joints. Maintain this plot in good condition so that it may be used and referenced during erection. Keep all geometry control hardware cast into any segments, such as

elevation bolts and alignment hairpins, in place during erection for reference and checking purposes. Remove the hardware after completion of erection of the unit in the bridge between expansion joints. Use experienced personnel to operate the instruments and supervise the casting operation. Prior to the commencement of casting, obtain the Engineer's approval of the experience and/or qualifications of the supervisory and instrument operating personnel, particularly with regard to the observational precision required.

D. Preparation for Match Casting

When match casting is used, take great care in positioning of the match cast (previously cast) segment in relation to the segment to be cast. Ensure that the match cast segment is not twisted. Ensure that all materials to be embedded in the concrete of the new cast segment are properly positioned and supported in order to maintain their position and withstand concrete placement and consolidation without damage. Make provisions for all projections, recesses, notches, openings, block-outs and the like in accordance with the plans and approved shop drawings. Cover the abutting surface of the match cast segment with a thin film of a bond breaker consisting of flax soap and talc, or other material approved by the Engineer. Use a soap and talc mixture consisting of five parts flax soap to one part talc. The Engineer will base acceptance of a material other than soap and talc prior to casting any segments by demonstration on a large specimen consisting of a precast piece and a new cast piece with a contact facial area of at least 4 ft^2.

E. Embedded Items

Embedded items shall be in accordance with specifications for prestressed and post- tensioned construction and the requirements herein.

1. Embedded Post-tensioning Ducts

Ensure that embedded ducts for post-tensioning tendons and bars are positioned accurately to their required alignment. Properly fabricate and identify all ducts so that proper positioning is assured and can be verified after casting. Utilize positive methods to ensure that ducts will not be displaced or damaged during concrete placement and consolidation. Adequately secure all embedded post-tensioning ducts to the reinforcement cage at intervals not exceeding 30 inches for steel pipes and 24 inches for plastic ducts. (Small ducts and very flexible ducts may require closer supports.) Prevent the concrete cover requirements from being violated by any auxiliary ties and support bars. After installation in the forms, ensure that the ends of the ducts are sealed at all times to prevent entry of water, debris and fine material. Following each pour of concrete, demonstrate that all empty ducts are free of water and are unobstructed and undamaged. Immediately prior to installation of the prestressing steel, again demonstrate to the satisfaction of the Engineer that all ducts are unobstructed and free of water and debris.

2. Anchor Plates and Castings

Prior to placing concrete in the forms, fix all tendon anchor plates and anchor castings in their respective position in the forms, connected to their duct and sealed to prevent mortar intrusion. Ensure that anchor plates and castings are rigidly fixed in the forms to maintain their correct alignment and position during concrete placement and consolidation.

3. Reinforcing Steel

Fabricate and place reinforcing steel in accordance with the plans or as superseded by the Approved Shop Drawings and as required herein. Do not cut out or remove reinforcing steel to permit proper alignment of post-tensioning ducts. Replace any bar that cannot be fabricated to clear the ducts by additional bars with adequate lap lengths and submit the details to the Engineer for approval. In the plane of the reinforcement parallel to the nearest surface of the concrete, ensure that bars do not vary from plan placement by more than 1 inch, nor by more than one-eighth of the spacing between bars, whichever is less. In the direction perpendicular to this plane of reinforcement, ensure that bars do not vary from plan placement by more than 1/4 inch. The top and bottom cover of reinforcing steel shall be within 1/4 inch of the cover dimensioned on the plans. The edge cover of the reinforcing steel shall be within 1/2 inch of the cover dimensioned on the plans.

F. Concrete Placement, Consolidation and Finishing

1. General

Do not deposit concrete into the forms until the entire set-up of the forms, reinforcement, ducts, anchorages and embedded items have been thoroughly inspected and checked. Do not place concrete until the Engineer is satisfied that all the above items have been properly inspected and checked, and the rate of producing and placing the concrete will be sufficient to complete the casting and finishing operations within the scheduled time, that experienced concrete finishers are available where required for finish work and that all necessary finishing tools and equipment are on hand at the site of the work and are in satisfactory condition for use. During conveying and placement, protect concrete against undue drying or rise in temperature and inclement weather.

2. Concrete Placement Equipment

Use concrete placement equipment of a size and design which permits placing concrete within the specified time. Clean all equipment at the end of each operation or workday and, just prior to reuse, check the equipment again and clean off hardened concrete and foreign materials. Place concrete in accordance with Section 420 of *Standard Specifications*.

3. Concrete Placement Sequence

a. Superstructure Box Segments

First place concrete in the central portion of the bottom slab between the inside edges of the internal web forms, leaving a narrow gap of 6 to 12 inches for

inspection and consolidation of the bottom corners when the next load is placed in the webs. Then place the concrete in the bottom corners of each web to connect and consolidate with that already placed in the bottom slab. Then place concrete in the remainder of the webs in lifts not exceeding 24 inches at a time up to the top of the webs but not into the slab over the webs. Place concrete in the top slab in the outer wing and mid slab regions between webs before placing, completing and consolidating zones over the top of the webs.

b. Substructure and Pier Shaft Segments

Cast hollow precast pier shaft (column) segments vertically. Place the concrete in uniform lifts of approximately 24 to 36 inches and consolidate well.

Cast solid precast pier shaft (column) segments horizontally.

c. Obtain the Engineer's approval on any alternative sequences to the above, or for any other precast components.

4. Concrete Placement and Consolidation

Discharge individual loads of concrete into the forms, and place and consolidate in the required locations. After discharge into the forms, do not bodily move concrete from place to place within the forms by mechanical vibrators or other similar equipment. Place and consolidate concrete with care so that post-tensioning ducts, anchorages and any other embedded items are maintained in their proper positions and are not damaged. Consolidate all concrete using approved vibrators together with any other equipment necessary to perform the work as specified. Use internal vibrators having a minimum frequency of 8,000 vibrations per minute and sufficient amplitude to consolidate the concrete effectively. Provide at least two stand-by vibrators in working condition for emergency use in case of malfunction. Use external vibrators for consolidating concrete when the concrete is inaccessible for adequate consolidation by internal means. When external vibration is used, construct the forms sufficiently rigid to resist displacement or damage. Vibrate concrete in a manner which avoids displacement or damage to reinforcement, post-tensioning ducts, anchorages and other embedded items. No construction joints are allowed within a segment, except as detailed on the plans.

5. Finishing

Strike off the roadway surface of the segment with an approved mechanical screed operated by a self contained power source. Furnish and use a straightedge at least 24 inches longer than the segment while finishing the concrete deck surface of superstructure box girder segments. Use the straightedge approximately parallel to the centerline of the segment to strike an accurate surface between the bulkhead and the top of the match cast segment at all positions across the segment width.

Finish the concrete deck surface in a way to insure adequate bonding with the Latex Modified Concrete overlay.

G. Curing

1. General

Where casting cells are intended to operate on a short (daily) cycle and it can be demonstrated to the satisfaction of the Engineer that the required initial concrete strengths for the removal of the forms, application of prestress, moving and handling of the segments and that the final concrete strength can be achieved in a timely and consistent manner, then steam curing will not be required. However, take precautions to promote proper curing by methods approved by the Engineer and in accordance with Section 420 of *Standard Specifications*. Such precautions shall meet or exceed the following:

a. To prevent moisture loss, cover all exposed surfaces (those not in contact with a form or match cast segment) as soon as possible after casting with a moisture tight covering (wet curing blankets or other approved equal systems). Avoid spoiling the deck surface finish. Keep the cover on or within 12 inches of the deck surface.

b. Keep the moisture-tight covering substantially in place throughout succeeding operations such as geometry control survey, stripping of internal forms, wing forms and shifting of and working with a segment in a match cast position. Keep the concrete surface wet throughout these operations.

c. After stripping of the side and core forms, continue curing of the precast concrete by the application of membrane curing compound as specified in Section 420 of *Standard Specifications* to all exposed surfaces except the tops surface of segments (including segment exterior once exposed by removal from the form). Apply an approved debonding compound to match cast surfaces to serve both as a bond breaker and seal for curing.

d. Maintain the moisture tight covering for at least 72 hours. As an alternative, steam curing may be used. After stripping of the side and core forms, the application of curing compound on the outer web and wings in combination with covering the top deck surface with wet burlap will be considered moisture tight.

e. While the new cast segment is in contact with the match cast segment, cover the match cast segment with curing blankets, or other approved equal system, to minimize the effects of differential temperature between the segments.

2. Steam Curing

Meet the requirements of Section 420 of *Standard Specifications* modified by the following requirements when steam curing is used.

a. Accelerated curing of the concrete shall be achieved by use of low pressure steam curing. If accelerated curing is completed before the 72 hour curing period has

elapsed, continue curing for the remaining part of the 72 hour curing period in accordance with the curing methods listed above.

b. If accelerated curing is used, furnish temperature recording devices that will provide accurate, continuous and permanent records of the time and temperature relationship throughout the entire curing period. Initially calibrate recording thermometers and recalibrate at least annually.

c. The preheating period shall equal or exceed the time of initial set as determined by ASTM C 403 and shall not be less than 4 hours. When the ambient air temperature is above 50ºF, allow the member to remain undisturbed in the ambient air for the preheating period. If the ambient air temperature is below 50ºF, apply heat during the preheating period to hold the air surrounding the member at a temperature of 50ºF to 90ºF.

d. To prevent moisture loss from exposed surfaces during the preheating period, enclose members as soon as possible after casting or keep the surfaces wet by fog mist or wet blankets. Use enclosures for heat curing that allow free circulation of heat about the member with a minimum moisture loss. The use of tarpaulins or similar flexible covers may be used provided they are kept in good repair and secured in such a manner to prevent the loss of heat and moisture. Use enclosures that cover the entire placement.

e. During the application or removal of the heat, do not allow the temperature rise or fall within the enclosure to exceed 40ºF/hr. Do not allow the curing temperature throughout the enclosure to exceed 160ºF. Maintain the curing temperature within a temperature range of 130ºF to 160ºF until the concrete has reached the required form removal strength for precast and cast-in-place components or the required release strength for prestressed concrete components.

f. The steam used shall be in a saturated condition. Do not allow steam jets to impinge directly on the concrete, test cylinders, or forms. Cover control cylinders to prevent moisture loss and place them in a location where the temperature is representative of the average temperature of the enclosure.

g. Temperature recording devices shall simultaneously record the temperature of three widely separated locations per casting cell. Locate the three temperature sensors near the top, middle and bottom of the enclosure or as otherwise approved by the Engineer. Identify the charts with the hours, dates and segment number and deliver to the Engineer immediately after steam curing is completed unless otherwise approved.

h. Apply an approved debonding compound to match cast surfaces to serve both as a bond breaker and seal for curing.

i. Expose match cast segments to the same curing environment (temperature and humidity) as the new cast segment until the new segment reaches the required strength to allow the removal of the forms.

H. Removal of Forms

Prior to removing the forms, protect the plastic concrete from adverse weather effects. Keep supporting forms in place until the concrete has reached the required strength for form removal as specified on the plans, by this provision, or as approved by the Engineer. Test cylinders, made and cured in the same manner as the segment, to confirm the form release strength prior to removing form. Avoid cracking or damaging the segment when removing the forms, especially match cast surfaces and shear keys. Notify the Engineer of any damage which occurs and repair in an approved manner.

I. Test Samples

Provide additional test samples and testing for compressive strength on precast segments and field closure joints to control the construction activities and to ensure adequate strength of these components at various stages of their manufacture and assembly. Make test cylinders, in accordance with Article 1078-4, cured in the same manner as the structural components to ensure adequate compressive strength has been achieved in accordance with the plan requirements for the following conditions:

1. Prior to release of prestressing for components which are to be pre-tensioned.

2. Prior to form release and/or moving the components to storage.

3. Prior to post-tensioning transverse tendons if the component is less than 28 days old.

4. Prior to placing a component into position in the structure and/or stressing of longitudinal post-tensioning tendons if the component is less than 28 days old.

5. Determine the number of cylinders in accordance with the proposed method for casting, transporting and erecting the various components. Provide the results of the compression testing of one or more test cylinders for controlling the time of execution of the various construction operations. Obtain the Engineer's approval for meeting the Specification requirements on casting, curing and testing of concrete test cylinders.

J. Age at Erection

Unless otherwise approved by the Engineer, precast components shall be at least 90 days old prior to incorporating into the structure.

K. Tolerances

1. General

The following tolerances apply to the fabrication of precast components:

(1) Superstructure Box Segments:	
Width of web	±1/4 inch
Depth of bottom slab	±3/16 inch
Depth of top slab Overall	±3/16 inch
depth of segment	±3/16 inch
Overall width of segment	±1/4 inch
Length of segment	±3/8 inch
Diaphragm dimensions	±3/8 inch

(2) Precast Box Bent Segments:	
Height of segment	±1/4 inch
Width and breadth of segment	±1/4 inch
Thickness of wall	±1/4 inch

(3) All Fabricated Segments:	
Ends (deviation from a plane per 20 ft width or depth	±1/4 inch per 20 ft not to exceed 1/2 inch.
Flat Surface (deviation from a plane at any location)	±0.025 in/ft not to exceed a total of 1/4 in.

2. Corrections

Control dimensions from segment to segment, including cast-in place segments, and compensate for any deviations within a single segment or series of segments so that the overall dimensions of the completed structure meet the dimensions and overall erection tolerances allowed by this provision.

L. Damaged or Defective Segments

1. General. Isolated defects are imperfections or damage that may occur randomly and infrequently. Recurring defects are imperfections or damages of the same general type and nature, which continue to be found in the same general location of the segments at an unacceptable frequency, as determined by the Engineer.

   As a minimum, the first five segments cast will be jointly inspected by the Engineer, the Precaster, the Contractor and the Contractor's Engineer after casting, after moving to storage from the casting machine, before and after erection. All segment defects shall be identified and categorized during this inspection. The Contractor, and Contractor's Engineer shall examine the defects and propose to the Engineer, in writing:

   a. The measures to be taken to prevent recurring defects in future segments.

   b. The method of repair of all defects discovered as a result of the inspection as required herein.

If recurring defects continue following implementation of preventive measures, or as detected at any time during the construction, the Engineer will instruct the Contractor, in writing, to cease operations producing such defective segments.

The Precaster, Contractor and Contractor's Engineer shall examine the defects and propose to the Engineer, in writing: (1) measures he shall take to prevent recurring defects in future segments, and (2) the method of repairing all defects discovered as a result of the inspection as required herein.

2. Classification of Damage or Defects. The Engineer will determine what constitutes damage or defect, whether the damage or defect is isolated or recurring, and will categorize it according to the following:

   a. Cosmetic: Cosmetic defects or damages are those which do not affect the ability of the segment to resist construction or service-loads or reduce the life expectancy of the structure. This category includes superficial discontinuities such as non-structural cracks less than 0.024" wide, small spalls or honeycombed areas, entrapped air pockets (bug holes) or any defect that does not extend beyond the concrete cover of any reinforcing steel, or to any elements of the post-tensioning system. However, cosmetic defects of other types and causes may also be designated by the Engineer.

      Repair of cosmetic or superficial defects shall be made in such a manner that the aesthetics and the structural integrity of the segments are restored to the satisfaction of the Engineer.

      Finish the repaired areas to match the surrounding concrete.

   b. Structural: This includes any defect which will impair the ability of the segment to adequately resist construction or service loads or reduce the life expectancy of the structure. Any defect or damage that extends beyond the concrete cover any reinforcing steel or into any element of the post-tensioning system or occurs in the deck portion of the segment is considered a structural defect. Examples of such defects include cracks wider than 0.025", large spalls and honeycombed areas, major segregation or breakage of concrete. However, structural defects of other types and causes may also be designated by the Engineer.

      The Contractor's Engineer shall be responsible for construction load analysis, service load analyses and life expectancy determinations.

      Repair of structural defects shall be such that the aesthetics and structural integrity of the segment shall be completely restored to a condition to be expected had the defect or damage had not occurred.

      Finish the repaired areas to match the surrounding concrete.

c. Rejectable: These are any defects or damage, as determined by the Engineer, that will impair the ability of the segment to adequately resist service loads or construction loads, or will reduce the life expectancy of the structure and which cannot be successfully repaired such that the structural integrity is completely restored.

Any segment with a rejectable defect shall be removed from the work and replaced at no additional cost.

Damaged or defective segments may be rejected by the Engineer for the following reasons:

(1) Failure of the Contractor's Engineer to approve proposed repair procedures.

(2) Failure of the Contractor to execute the repair according to the approved procedure.

(3) Rejection by the Engineer of the proposed repair procedure or repair.

(4) Failure of the Contractor to provide the required certification or demonstration that the repair was successful and that the defect no longer exists, as required below.

(5) Failure of the Contractor to eliminate recurring defects.

(6) Determination by the Engineer that the work or materials used in the work does not meet other requirements of the Contract Documents and is not acceptable.

(7) Full depth crack of any size or length.

(8) If more than 20% of the total contact surface of all shear keys in any single web is broken, spalled or honeycombed.

3. Repairs. Cosmetic repairs shall only be made following procedures prepared by the Contractor, submitted in writing to and approved by the Engineer. The Contractor's repair procedure shall identify those areas required to be repaired prior to post-tensioning, and those that must be repaired after post-tensioning.

Structural repairs shall be made in accordance with the approved repair procedures prepared by the Contractor. The repair procedure shall be signed and sealed by the Contractor's Engineer and shall be submitted to the Engineer for review and approval. The proposal shall include the following minimum information:

a. A detailed description and sketch or picture of the defect.

b. The magnitude and type of the most critical construction loading condition to which the defective area will be subjected.

c. Detailed reinforcement requirements, material types, surface treatments, curing methods and repair procedures proposed. The procedure shall clearly indicate those areas required to be repaired before erection, and those areas to be repaired after erection.

d. The nondestructive testing method and procedure by which the Contractor shall demonstrate that the defect no longer exists and the segment has been restored to a condition to be expected had the defect or damage not occurred. In lieu of physical demonstration, on a case-by-case basis, the Contractor may be allowed to substitute a written certification by the Contractor's Engineer that the repair has been performed satisfactorily and that the defect no longer exists.

4. Repairs to Shear Keys. Repairs to the shear keys along the webs shall be made only after the segments have been erected. If no more than 20% of the total contact surface of all shear keys in any single web is broken, spalled or honeycombed, the Contractor shall advise and provide a repair method to the Engineer for approval. The Engineer shall make an assessment and decide to accept the proposed repair method or to consider the segment unsatisfactory for use. The Engineer will consider the segment unsatisfactory for use if more than 20% of the total contact surface of all shear keys in any single web is broken, spalled or honeycombed.

5.0 PRECAST SEGMENT HANDLING, STORAGE AND SHIPMENT

Handle segments with care to prevent damage. Handle segments using only the devices shown on the shop drawings for this purpose. Store all precast segments level in the upright position. Firmly support all precast segments for storage and shipment on an approved three point bearing system which does not introduce a twist under self weight. Do not stack superstructure segments one upon another. Prior to shipment the Engineer will thoroughly inspect each segment for damage. Thoroughly clean the faces of all joints of laitance, bond breaking compound and any other foreign material by light sand blasting prior to shipment. Make no repairs of minor spalls or chipped areas on the joint surfaces until after erection of the segment. Segments should be at least 5 days old and meet 28-day strength requirements before they can be shipped. Upon arrival at the bridge site the Engineer will inspect each segment again. If in the Engineer's opinion, any damage has occurred during shipment that will impair the function of the segment (structurally, aesthetically, etc.), the segment will be rejected. Replace any rejected segment with an approved segment. Provide firm support at bearing locations noted above. Fully secure the segments against shifting during transport.

Provide a storage area of suitable stability for the segments to prevent differential settlement of the segment supports during the entire period of storage.

6.0 ERECTION

A. General

An erection sequence for erecting segments is shown in the plans. The erection sequence is a concept only, consistent with the overall bridge design. It is presented to aid the Contractor in developing his method of construction that is also to be consistent with the overall bridge design. The Contractor shall be solely responsible for design, fabrication, assembly and operation of all equipment to be used for handling and erecting segments.

Erection of segments shall not begin until the required shop drawings, design calculations have been reviewed and approved by the Engineer. No extra payment will be made to the Contractor for any cost incurred in modifying the permanent structure due to temporary loadings induced by the Contractor's handling and erection equipment or his erection scheme.

B. Erection Manual

Before commencing erection operations, submit proposals for all segment erection operations to the Engineer for approval. This submittal shall be in the form of an "Erection Manual" and include but not necessarily be limited to:

1. A detailed step-by-step sequence for the erection of each segment including all intermediate procedures relating to erection equipment, temporary and permanent post-tensioning and making of closures between spans and/or cantilevers etc.

2. Positioning, use and sequencing of falsework, jacking and/or releasing of falsework, temporary towers, supports, tie-downs, counterweights, closure devices and the like.

3. Positioning, use and sequencing of erection equipment such as cranes, beam and winch devices, gantries, trusses and the like, both on and off the structure, including the movement, introduction and/or removal of any supports onto or connections with the structure. Include drawings and calculations for the structural effects of erection equipment on the structure.

4. Detailed scheduling of all temporary and permanent post-tensioning operations and sequences in accordance with the segment erection and closure operations and other required scheduling.

5. Stressing forces and elongations for post-tensioning.

6. Sequencing of grouting operations.

7. A method for the field survey control for establishing and checking the erected geometry (elevations and alignments) with particular attention to the setting of critical segments such as, for example, pier segments for balanced cantilever erection.

8. Any other relevant operations as required and applicable to the structure type and construction method. Do not start erection without the Engineer's approval of the erection manual.

C. Erection Geometry Control

1. General

Numerical or graphical methods may be used for alignment control and checking during erection. Establish the key stages for checking of the erection in the erection manual and obtain the Engineer's review and approval. Key stages would include, for example, setting a pier segment during cantilever erection and various intermediate points during subsequent segment erection, at span closure and upon completion. Prepare a table of elevations and alignments required at each key stage of erection in accordance with the plans, as cast geometry, camber and erection elevations for establishing erection controls and submit to the Engineer for approval. Carefully check elevations and alignments at each stage of erection and correct as required to avoid any possible accumulation of errors. If geometric corrective measures are necessary, the Engineer will require the Specialty Engineer to develop the means and methods to ensure the epoxy joint remains watertight and free from localized stress concentrations. The Specialty Engineer will be required to submit the corrective measures to the Engineer for approval. Use shims made of ASTM A240 Type 304 wire cloth (roving) with a maximum of 1/8 inch thickness.

2. Balanced Cantilever and Progressive Cantilever Erection

Check the alignment and elevations of the cantilever(s), using two independent surveys, within one hour of sunrise on each day that segments are to be erected. Check the measurements made by each survey and ensure they agree to within 1/4 inch. When measurements do not agree, discontinue erection of segments until discrepancies in measurements are resolved to the satisfaction of the Engineer. Accurate positioning of the pier segments is very important as it will establish the line and grade for cantilevers in each direction. Position each bent segment according to the final longitudinal alignment, grade and cross-slope and ensure no further erection continues until and unless these segments are properly located on the bent by the means provided. Keep the horizontal and vertical alignments of the bent segment within 1/16 inch of the alignment values required to control points as established by the approved erection plans. Check at each key stage of erection, in accordance with approved erection procedures, the ends of cantilevers for required elevations and alignment. Correct any deviation from the required alignment by a method approved by the Engineer.

D. Erection Tolerances

1. Ensure that maximum differential between outside faces of adjacent segments in the erected position does not exceed 3/16 inch.
2. Ensure that transversely, the angular deviation from the theoretical slope difference between two successive segment joints not exceed 0.001 rad.
3. Ensure that longitudinally, the angular deviation from the theoretical slope change between two successive segments does not exceed 0.003 rad.
4. Dimensions from segment to segment will compensate for any deviations within a single segment so that the overall dimensions of the completed structure meets the dimensions shown on the plans such that the accumulated maximum error does not exceed 1/1000 of the span length for either vertical profile and/or horizontal alignment. Carefully check elevations and alignments at each stage of erection and correct as required to avoid any possible accumulation of errors.

E. Other Miscellaneous Erection Requirements

1. Balanced Cantilever and Progressive Cantilever Erection

a. Deformations

For computing deformations due to time dependent stress variations, the erection time assumptions shall be shown on the plans. Deformations due to creep and shrinkage and the concrete modulus of elasticity shall be computed using the CEB-FIP Model Code 1990.

b. Temperature Restrictions

Meet the requirements of “Epoxy Jointing of Precast Segment” Special Provision Section 3.0 for substrate temperatures, epoxy formulation and thermal controls where precast segments are jointed with epoxy. Measure the substrate temperature at the mid-depth of the top slab for box girder sections or 4 inches from the top surface for slabs and other sections.

c. Permissible Loads on Cantilever

During balanced cantilever erection, unbalance the cantilever by only one segment at any time. In addition to the unbalanced load due to one segment, the cantilevers are designed for loads applied by the erection equipment as shown in the approved erection manual.

d. Span Closure Joints

Use concrete for closure joints which comply with the same specifications and criteria as the concrete in the segments. Ensure that concrete reaches the minimum required strength as shown on the plans or in the Specifications prior to stressing the transverse or continuity post-tensioning. Ensure that the closure joint forms provide tolerances as specified for precast segments. The concrete shall be placed in the

closure at a time when the temperature differential between the top and bottom slab is minimum.

e. Falsework and Formwork

Support falsework and formwork at closure pours by the cantilever ends or terminating segments of each series of segments to be joined. Secure cantilever together vertically, longitudinally, and transversely so that the applied loads will yield equal deflections to both cantilevers. Do not remove securing devices until the closure pour concrete has reached its required strength and longitudinal continuity tendons are tensioned. Submit calculations and details to verify that the devices and methods have adequate rigidity and do not impose excessive loads and stresses on the structure.

2. Precast Box Bent Construction - Erection Tolerances

a. Ensure that maximum differential between outside faces of adjacent segments in the erected position do not exceed 3/16 inch.

b. Ensure that the rotational angular deviation, measured about a vertical line, between two successive segment joints does not exceed 0.001 rad.

c. Ensure that the maximum angular deviation of a segment from a vertical line does not exceed 0.003 rad. and that the maximum overall deviation from the vertical, measured in any direction, does not exceed 0.01 in/ft of height.

d. Ensure the base precast segment is within 1/2 inch of the plan location.

3. Special Requirements

a. During erection, alignments and elevations shall be checked by the Erector. If measured elevations and alignments deviate by more than the allowed tolerances, from those given on the approved erection plans or in the Erection Manual, the Erector shall notify the Engineer. Reasons for any discrepancies shall be investigated and appropriate corrective action shall be taken by the Erector at no additional payment or time.

b. If measured elevations deviate from the table of elevations, the Engineer has the right to suspend further erection of superstructure segments until the cause of the deviation is discovered and a corrective action plan, submitted by the Contractor, is approved by the Engineer. No additional payment or time will be made to the Contractor as a result of this suspension for unacceptable erection deviation.

F. Epoxy Jointing of Precast Segments

Meet the requirements of "Epoxy Jointing of Precast Segments" Special Provision. Select the appropriate epoxy material based on the job requirements as either normal or

slow set epoxy within the formulation temperature range based on the substrate temperature.

G. High Performance Grout for Bearing Plinths and for Setting Bent Column Segments

High performance grout for bearing plinths and for setting bent column segments as shown in the plans shall be High Performance Grout that is ready-to-use, non- shrink, non-corrosive, non-metallic and achieves a high early strength (5000 psi in one day). High Performance Grout shall meet the requirements of ASTM C 1107 Specification for Non-Shrink Grout, Grades A, B, & C and requirements of ASTM C 827.

7.0 BARRIER SETTING

Prior to forming the barriers, accurately establish the as-constructed gutter line elevations at intervals not exceeding 10 feet. Then form the base of the barrier and median to provide an inside vertical face which extends from the surface of the concrete structure to an elevation located 3 inches above the theoretical gutter line elevations. Maintain the plan vertical height of the barriers as a minimum when variations exist between the plan profile and the actual profile of the gutter.

8.0 WATERTIGHT DECKS

Prior to placing the deck overlay, check all segment joints, closure joints and deck hole repairs to assure every location is watertight.

Repair all locations showing evidence of leaks by cutting a 3/8” wide x 5/8” deep groove along the leak interface. Clean and completely fill the groove with epoxy meeting the requirements of “Epoxy Jointing of Precast Segments” Special Provision. Dispense the epoxy into the groove using a pneumatic gun and epoxy cartridges. Clean all excess epoxy bonding agent from external visible surfaces in a way not to damage or stain the concrete surface. Do not smear epoxy over areas located more than 1 inch from each side of the groove.

9.0 FINAL CLEAN-UP

Before final acceptance, the Contractor shall clean the interior of the concrete box of all rubbish, excess materials, loose concrete, dirt and debris. The interior of the box girders shall then be swept out. The final clean up shall be performed after all work on the interior of the box girders, including grouting of all tendons and utility work included in the contract, has been completed.

10.0 MEASUREMENT AND PAYMENT

Precast Segmental Bridge will be measured and paid as the number of cubic yards that is incorporated into the completed and accepted structure. The number of cubic yards of concrete is computed from the dimensions shown in the plans.

No measurement will be made for the reinforcing steel, and all the post-tensioning components in precast superstructure and substructure segments, including cast-in-place joints. Payment at the contract unit price for the Precast Segmental Bridge will be full compensation for all materials, equipment, tools, labor and incidentals necessary to complete the work.

No measurement will be made for Access Doors and Vermin Doors and associated components detailed in the plans.

No measurement will be made for the any extra concrete necessitated by approved modifications to the segments or structure for the purposes of the Contractor's construction method.

Payment will be made under:

Pay Item	**Pay Unit**
Precast Segmental Bridge	Cubic Yard

HIGH STRENGTH CONCRETE (SPECIAL)

1.0 DESCRIPTION

Concrete members with specified concrete strengths equal or greater than 6000 psi shall meet the requirements of Section 1078 of the *Standard Specifications*, with the following exceptions.

2.0 MATERIALS

The coarse aggregate shall have a Los Angeles abrasion loss of not more than 40% and a sodium sulfate soundness loss at five cycles of not more than 8%.

Portland cement shall be pretested and come from a single source. Strength uniformity of the cement shall be certified by the manufacturer in accordance with ASTM C917. The certification shall be submitted to the Engineer with the Contractor's proposed mix design.

3.0 PORTLAND CEMENT COMPOSITION AND DESIGN

All concrete shall develop the minimum compressive strength shown on the plans at the age of 28 days. Concrete shall be air entrained to provide an air content of 5 ± 2%. Concrete shall have a maximum slump of 3 ½" before the addition of high range water reducer and 6" with high range water reducer; this slump requirement may be waived with the permission of the Engineer if self consolidating concrete is used. The maximum water-cementitious material ratio shall not exceed 0.40. Fly ash, microsilica and ground granulated blast furnace slag, or their combinations may be used as part of the cementitious material at a rate consistent with industry practice and with the approval of the Engineer. High range water reducer shall be used at a rate not to exceed the manufacturer's recommended dosage.

All concrete shall include mineral admixtures in the mix designs. Mineral admixtures should replace the cement content at a 1:1 ratio by weight. For concrete other than mass concrete:

- The superstructure shall contain a minimum of 25 percent fly ash Class F or a minimum of 40% ground granulated blast furnace slag (GGBFS).

- The substructure shall contain a minimum of 25 percent fly ash Class F or a minimum of 40% ground granulated blast furnace slag (GGBFS). In addition, silica fume at a minimum of 5% shall be used in footings and columns.

Calcium nitrite shall be used in the superstructure and substructure precast concrete (including piles) and cast-in-place concrete fill for precast bent cap voids and cast-in-place concrete barrier rail parapets at a rate of 4 gallons per cubic yard.

Cast-in-place sand lightweight concrete decks shall include either the use of calcium nitrite at a rate of 4 gallons per cubic yard or a minimum of 5% silica fume.

For mass concrete elements, reference the MASS CONCRETE Special Provisions for additional ranges of pozzolan substitution.

Laboratory test results of at least six 4" x 8" cylinders at 28 days shall accompany Form 312. The cylinders shall have been made in steel molds. The average strength based on test results of the six cylinders shall be not less than 1500 psi above the minimum strength required by the plans.

4.0 TESTING

For the purpose of testing for the required 28 day compressive strength and also for the required compressive strength for the transfer of load, the Contractor shall furnish, at no cost to the Department, a minimum of nine concrete cylinders made from a sample of concrete placed near the live end of the bed and a minimum of nine concrete cylinders made from a sample of concrete placed near the dead end of the bed (prestressed elements) or a minimum of nine concrete cylinders from each end of the bed (nonprestressed elements).

Two cylinders from each end shall be tested to determine release strength. The strength of the two cylinders from one end will be averaged and the strength of the two cylinders from the other end will be averaged. Both of these averages shall meet or exceed the required release strength. No cylinder shall have a strength less than 200 psi below the required release strength.

Three cylinders from each end shall be tested to determine 28 day strength. The strength of the three cylinders from one end will be averaged and the strength of the three cylinders from the other end will be averaged. Both of these averages shall meet or exceed the required 28 day strength. If the coefficient of variation of the 28 day cylinders exceeds 15%, the Engineer may require additional tests.

Cylinders shall be made in 4" x 8" steel molds in accordance with AASHTO T23, except that the cylinders shall be cured in the same manner as the members represented until the strands have been released. Cylinders shall be placed in clusters at random points along the casting bed. After the strands have been released, cylinders shall be air cured in an approved common area near the testing apparatus for the remainder of the 28 day curing period. Cylinders shall be tested in accordance with AASHTO T22 except that the neoprene caps may be used. Approved apparatus for testing the transfer strength of the cylinders shall be provided by the Contractor. This apparatus shall be maintained to within 1.0% accuracy and shall be calibrated at intervals not to exceed 12 months by an approved testing company at no cost to the Department. The Engineer reserves the right to require verification immediately after a testing machine is relocated and whenever there is reason to doubt the accuracy of the indicated load, regardless of the time interval since the last verification.

5.0 MIXING

If truck mixing is used, trucks shall be loaded to within at least 1 cy of rated capacity, and concrete shall be mixed at a speed of 16 - 18 revolutions per minute.

6.0 MEASUREMENT AND PAYMENT

High Strength Concrete in pier footings will be measured and paid as the number of cubic yards that is incorporated into the completed and accepted structure. The number of cubic yards of concrete is computed from the dimensions shown in the plans.

No measurement will be made for the *High Strength Concrete* in the bridge rail, as it is incidental to the Caltrans Barrier Rail pay item.

No measurement will be made for the *High Strength Concrete* in the superstructure and precast piers, as it is incidental to the Precast Segmental Bridge pay item.

Payment will be made under:

Pay Item	**Pay Unit**
High Strength Concrete	Cubic Yard

POST-TENSIONING GROUT (SPECIAL)

1.0 DESCRIPTION

This provision covers grouts to be used to protect post-tensioning steel. Grout applications are differentiated into three applications: horizontal, vertical and repair. Grouts shall be prepackaged in moisture proof containers. Grout bags shall indicate application, date of manufacture, LOT number and mixing instructions. Any change of materials or material sources requires new testing and certification of the conformance of the grout with this specification. A copy of the Quality Control Data Sheet for each lot number and shipment sent to the job site shall be provided to the Contractor by the grout supplier and furnished to the Engineer. Materials with a total time from manufacture to usage in excess of six months shall be tested and certified by the supplier that the product meets the QC Control Specifications before use or the material shall be removed and replaced.

2.0 MATERIALS

Refer to Division 10 of the *Standard Specifications*.

Prepackaged Grout (meet the requirements of this provision).
Portland cement shall have a Blaine value between 3.85 and 5.14 square yards per pound.

3.0 REQUIREMENTS

A. Grout Physical Properties

1. Gas Generation

The grout shall not contain aluminum or other components which produce hydrogen, carbon dioxide or oxygen gas.

2. Laboratory Test

The grout shall meet or exceed the specified physical properties stated herein as determined by the following standard and modified ASTM test methods conducted at normal laboratory temperature (65-78°F) and conditions. Conduct all grout tests with grout mixed to produce the minimum time of efflux. Establish the water content to produce the minimum and maximum time of efflux.

Property	Test Value	Test Method
Total Chloride Ions	Max. 0.08% by weight of mixed grout	ASTM C1152
Fine Aggregate (if utilized)	99% passing the No. 50 Sieve (300 micron)	ASTM C136*
Hardened Height Change @ 24 hours and 28 days	0.0% to +0.2%	ASTM C1090**
Expansion	≤2.0% for up to 3 hours	ASTM C940
Wet Density – Laboratory	Report maximum and minimum obtained test value 1b/cu ft	ASTM C185
Wet Density – Field	Report maximum and minimum obtained test value 1b/cu ft	ASTM C138
Compressive Strength 28 day (Average of 3 cubes)	≥7,000 psi (superstructure) ≥8,000 psi (substructure)	ASTM C942
Initial Set of Grout	Min. 3 hours Max. 12 hours	ASTM C953
Time of Efflux***		
(a) Immediately after mixing	Min. 20 sec Max. 30 sec	ASTM C939
	or Min. 9 sec Max. 20 sec	ASTM C939****
(b) 30 minutes after mixing with remixing for 30 sec	Max. 30 sec	ASTM C939
	or Max. 30 sec	ASTM C939****
Bleeding @ 3 hours	Max. 0.0 percent	ASTM C940*****
Permeability @ 28 days	Max. 2,500 coulombs at 30 V for 6 hours	ASTM C1202

*Use ASTM C117 procedure modified to use a #50 sieve. Determine the percent passing the #50 sieve after washing the sieve.

**Modify ASTM C1090 to include verification at both 24 hours and 28 days.

***Adjustments to flow rates will be achieved by strict compliance with the manufacturer's recommendations. The time of efflux is the time to fill a one liter container placed directly under the flow cone.

****Modify the ASTM C939 test by filling the cone to the top instead of to the standard level.

*****Modify ASTM C940 to conform with the wick induced bleed test as follows:

a. Use a wick made of a 20 inch length of ASTM A416 seven wire 0.5 inch diameter strand. Wrap the strand with 2 inch wide duct or electrical tape at each end prior to cutting to avoid splaying of the wires when it is cut. Degrease (with acetone or hexane solvent) and wire brush to remove any surface rust on the strand before temperature conditioning.

b. Condition the dry ingredients, mixing water, prestressing strand and test apparatus overnight at 65°F to 75°F.

c. Mix the conditioned dry ingredients with the conditioned mixing water and place 800 ml of the resulting grout into the 1,000 ml graduate cylinder. Measure and record the level of the top of the grout.

d. Completely insert the strand into the graduated cylinder. Center and fasten the strand so it remains essentially parallel to the vertical axis of the cylinder. Measure and record the level of the top of the grout.

e. Store the mixed grout at the temperature range listed above in (b).

f. Measure the level of the bleed water every 15 minutes for the first hour and hourly for two successive readings thereafter.

g. Calculate the bleed water, if any, at the end of the three hour test period and the resulting expansion per the procedures outlined in ASTM C940, with the quantity of bleed water expressed as a percent of the initial grout volume. Note if the bleed water remains above or below the top of the original grout height. Note if any bleed water is absorbed into the specimen during the test.

******Modify ASTM C109 (referenced by ASTM C942) to allow non-metal (plastic) 2” molds for forming grout compressive strength test cubes.

4.0 ACCELERATED CORROSION TEST METHOD (ACTM)

Perform the ACTM as outlined in Appendix B of the “Specification for Grouting of Post-Tensioning Structures” published by the Post-Tensioning Institute. Report the time to corrosion for both the grout being tested and the control sample using a 0.45 water-cement ratio neat grout.

A grout that shows a longer average time to corrosion in the ACTM than the control sample and the time to corrosion exceed 1,000 hours is considered satisfactory.

5.0 VARIATION IN TESTING FOR SPECIFIC APPLICATIONS

A. Horizontal Applications

Horizontal grout applications are defined as grouting of all superstructure tendons and tendons in struts, etc. All physical requirements defined in Section 3(A) of this provision are applicable for grouts used in horizontal applications.

B. Vertical Applications

Vertical grout applications are defined as grouting of substructure column tendons and post tensioning bars. All physical requirements defined in Section 3(A) of this provision are applicable for grouts used in vertical applications. In addition, perform the Schupack Pressure Bleed Test Procedure for Cement Grouts for Post-Tensioned Structures as outlined in Appendix C of the "Specification for Grouting of Post-Tensioned Structures" published by the Post-Tensioning Institute. Report the percent bleed for the

grout tested. Test grout at the specified pressure of 100 psi. An acceptable test will result in no bleed water (0.0 percent).

C. Repair Applications

Repair applications are used to augment grouting operations which did not completely fill the duct or anchorage. For new construction, repairs may be made with the same grout approved for use in the tendon as long as the volume of the void is less 0.5 gal. In all other cases, use a non-sanded grout meeting the requirements of Section 3(A) of this provision with a modified maximum permeability of 2,800 coulombs (ASTM C1202 at 30 volts). Non-sanded grouts shall have 95% passing on the #100 sieve and 90% passing the #170 sieve as determined by ASTM C33. Each sieve may be washed and dried before weighing in accordance with the procedure in ASTM C117 modified for sieve size.

6.0 GROUT MIXING

The material shall be mixed in accordance with the manufacturer's recommendations.

7.0 MEASUREMENT AND PAYMENT

No measurement will be made for the Post-Tensioning Grout as it is incidental to the Post-tensioning pay item.

DISC BEARINGS (SPECIAL)

1.0 GENERAL

This item consists of furnishing, fabrication and installation of disc bearings in accordance with AASHTO LRFD Bridge Design Specifications, the Standard Specifications, the recommendations of the manufacturer, the details shown on the plans and as specified herein. Disc Bearings consist of a polyether urethane structural element (elastomeric disc) confined by upper and lower steel bearing plates. Equip disc bearings with a shear restriction mechanism (shear pin) to prevent movement of the disc. Supply disc bearings as fixed bearings and guided expansion bearings as designated by the Contract Documents.

Fixed disc bearings allow rotation but no longitudinal or transverse movement in the bearing plane. Fixed bearings consist of a steel sole plate, an elastomeric disc, a shear pin, a steel upper bearing plate, a steel lower bearing plate, a steel masonry plate, a preformed bearing pad, anchor bolts, nuts and washers.

Guided expansion disc bearings allow rotation and only longitudinal movement in the bearing plane. Guided expansion disc bearings consist of a steel sole plate, a polished stainless steel sheet welded to the bottom of the sole plate within the sliding region, a steel upper bearing plate, a layer of virgin polytetrafluoroethylene (PTFE) material bonded to the top and sides of the upper plate within the sliding regions, guide bars welded to the bottom of the sole plate surrounding the sliding region to restrict transverse movement, polished stainless steel sheets welded to the sides of the guide bars within the sliding regions, an elastomeric disc, a shear pin, a steel lower bearing plate, a steel masonry plate, a preformed bearing pad, anchor bolts, nuts, washers, pipe sleeves, a closure plate, grout and various sizes of standard pipe, and any other necessary material as detailed on the plans. Align the stainless steel sheet on the bottom of the sole plate with the PTFE material on the top of the upper bearing plate. Align the PTFE material on the sides of the upper bearing plate with the stainless steel sheets on the sides of the guide bars.

2.0 MATERIALS

Use disc bearings produced by the same manufacturer.

Use AASHTO M270 Grade 50W or Grade 50 for all steel plates except the stainless steel sheets in the disc bearings. Clean, coat, and seal the plates in the disc bearing assemblies except for the areas with special facings and the areas that come in contact with the elastomer disc, in accordance with the Special Provision for “Thermal Sprayed Coatings (Metallization)”. The surfaces shall be coated to a thickness of 8 mils minimum on all external parts. Repair surfaces that are abraded or damaged after the application of metallizing in accordance with the Special Provision for “Thermal Sprayed Coatings (Metallization)”.

Provide anchor bolts and nuts in accordance with the details and notes on the plans.

When the maximum plan dimension of the sheet is 12" or less, provide a stainless steel sheet in expansion disc bearings that is at least 16 gage or 1/16". When the maximum plan

dimension is greater than 12", provide a stainless steel sheet that is at least 11 gage or 1/8". Ensure that all stainless steel sheets are in conformance with ASTM A240/A167 Type 304 and polished to a minimum #8 mirror surface finish.

Blast clean the surfaces of the steel sole plate and the steel guide bars that will be attached to the stainless steel sheets to a near white condition in accordance with the Standard Specifications. Position and clamp the back of the stainless steel sheets in contact with the steel sole plate and the steel guide bars. Apply the stainless steel sheets to the blast cleaned surfaces of the steel sole plate and the steel guide bars as soon as possible after blasting and before any visible oxidation of the blast cleaned surfaces occurs. Weld the stainless steel sheets continuously around the perimeter using a tungsten inert gas, wire-fed welder.

For the PTFE sheets bonded to the top and side sliding surfaces of the steel upper bearing plate, used as mating surfaces for the stainless steel sheets attached to the steel sole plate and the guide bars, provide an unfilled virgin PTFE sheet (recessed) or a glass-fiber filled PTFE sheet, resulting from skiving billets formed under hydraulic pressure and heat. Provide resin that conforms to the requirements of ASTM D4894 or D4895.

To bond the PTFE sheets and the steel upper bearing plate, use heat cured high temperature epoxy capable of withstanding temperature of –320°F to 500°F.

Weld the guide bars in expansion bearings to the bottom of the sole plate. Alternatively, integrate the guide bars and sole plate from the same piece of steel, ensuring that the required dimensions are provided. Provide 1/16” clearances between the stainless steel sheets attached to the side sliding surfaces of the guide bars and the PTFE sheet attached to the side sliding surface of the steel upper bearing plate.

Mold the polyether urethane structural element (elastomeric disc) from a polyether urethane compound. The top and bottom surfaces of the disc shall be roughened. Ensure that the physical properties of the polyether urethane conform to the following requirements:

Physical Property	ASTM Test Method	Requirements	
		Min.	Max.
Hardness, Type D Durometer	D2240	60	64
Tensile Stress psi At 100% elongation At 200% elongation	D412	 2000 3700	 - - - -
Tensile Strength psi	D412	5000	- - - -
Ultimate Elongation %	D412	220	- - - -
Compression Set % 22 hrs. at 158°F	D395	- - - -	40

3.0 DESIGN

Design the disc bearings for the loads and movements shown on the contract plans. Either combine and cast the sole plate and upper bearing plate (for fixed bearings), the sole plate and guide bars (for expansion bearings), and the lower bearing plate and masonry plate (for fixed and expansion bearings) as a single unit or weld together prior to the installation of the disc.

Ensure access and removal of anchor bolt nut is not in conflict with the upper bearing plate, guide bars or sole plate.

When designing the bearings, use the following allowable bearing stresses:

On polyether urethane structural element: 5000 psi

On PTFE Sliding Surface, filled or unfilled PTFE (recessed): 3500 psi

Submit an electronic set of shop drawings and design calculations for review, comments and acceptance. Have a North Carolina Registered Professional Engineer check and seal the shop drawings and design calculations.

After the Engineer reviews the drawings and, if necessary, corrections are made, submit one 22" x 34" set of electronic working drawings.

4.0 SAMPLING AND TESTING

Sampling

The manufacturer is responsible for randomly selecting and testing sample bearings from completed lots of bearings. The manufacturer is also responsible for certifying that the completed bearings and their components have been tested and are in compliance with the requirements of this Special Provision. The manufacturer shall furnish the results of the tests to the Materials and Tests Engineer.

B. Testing

1. Proof Load Test

   Load a test bearing to 150% of the bearing's rated design capacity and simultaneously subject it to a rotational range of 0.02 radians (1.146°) for a period of 1 hour.

   Have the bearing visually examined both during the test and upon disassembly after the test. Any resultant visual defects, such as extruded or deformed elastomer or PTFE, damaged seals or rings, or cracked steel is cause for rejection.

Keep continuous and uniform contact between the polyether urethane element and the bearing plates and between the stainless steel sheets and the PTFE sheets (for expansion bearings) for the duration of the test. Any observed lift-off or separation is cause for rejection.

2. Sliding Coefficient of Friction

   For all guided expansion bearings, measure the sliding coefficient of friction at the bearing's design capacity in accordance with the test method described below, and on the fifth and fiftieth cycles, at a sliding speed of 1 in/min.

   Calculate the sliding coefficient of friction as the horizontal load required to maintain continuous sliding of one bearing, divided by the bearing's vertical design capacity.

   The test results are evaluated as follows:

   A maximum measured sliding coefficient of friction of 3%.

   A visual examination both during and after the test. Any resultant visual defects, such as bond failure, physical destruction, cold flow of PTFE to the point of debonding, or damaged components is cause for rejection of the lot.

   Using undamaged test bearings in the work is permitted.

3. Test Method

   The test method and equipment shall meet the following requirements:

   a. Arrange the test to determine the coefficient of friction on the first movement of the manufactured bearing.

   b. Clean the bearing surface prior to testing.

   c. Conduct the test at maximum working stress for the PTFE surface with the test load applied continuously for 12 hours prior to measuring friction.

   d. Determine the first movement static and dynamic coefficient of friction of the test bearing at a sliding speed of less than 1 in/min, not to exceed:
      0.04 unfilled PTFE
      0.08 filled PTFE

   e. Subject the bearing specimen to 100 movements of at least 1 inch of relative movement and, if the test facility permits, the full design movement at a speed of less than 1 ft/min. Following this test determine the static and kinetic coefficient of friction again. The specimen is considered a failure if it exceeds the values measured in (d) above or if it shows any signs of bond failure or other defects.

Bearings represented by test specimens passing the above requirements are approved for use in the structure subject to on-site inspection for visible defects.

5.0 INSTALLATION

Store disc bearings delivered to the bridge site upright and under cover on a platform above the ground surface. Protect the bearings from injury at all times and, before placing the bearings, dry and clean all dirt, oil, grease or other foreign substances from the bearing. Do not disassemble the bearings during installation, except at the manufacturer's direction. Lift bearing assemblies by their bottom surfaces only, unless lifting brackets that have been designed and approved by the manufacturer are used. Ensure that the polyether urethane disc is not exposed to direct flame or sparks. Place the bearings in accordance with the recommendations of the manufacturer, Contract Drawings, and as directed by the Engineer. If there is any discrepancy between the recommendations of the manufacturer, Special Provisions, and Contract Drawings, the Engineer is the sole judge in reconciling any such discrepancy.

Provide preformed bearing pads under the masonry plates in accordance with Article 1079-1 of the Standard Specifications.

Do not install any bearing before the Engineer approves it.

6.0 BASIS OF PAYMENT

Payment for all disc bearings will be at the lump sum contract price bid for "Disc Bearings" which includes full compensation for furnishing all disc bearings, labor, materials, tools, equipment, testing and incidentals required to complete the work in accordance with the Standard Specifications, this Special Provision, the manufacturer's requirements and as directed by the Engineer.

MODULAR EXPANSION JOINT SEALS (SPECIAL)

1.0 GENERAL

Furnish and install modular expansion joint seals within the limits indicated on the plans.

Obtain modular expansion joint seals from Fabricators that are AISC certified in Simple Steel Bridge Structures (SBR), and certified to ISO 9001-2008.

Use a modular expansion joint seal that is a waterproof system such as WABOMODULAR as manufactured by Watson Bowman and Acme Corporation of Amherst New York, BROWN/MAURER as manufactured by the D. S. Brown Company of North Baltimore, Ohio or an approved equal. Do not use aluminum components in the modular expansion joint. Use a modular expansion joint seal consisting of one or more transverse rails holding two or more elastomeric seals in place and a support mechanism that ensures the rails maintain parallel and equidistant spacing. Centerbeam to support bar connections shall be complete joint penetration welds. Do not use bolts to connect the transverse rails to the support bars.

Modular expansion joint systems submitted as a proposed approved equal shall provide above certifications, previous test results in conformance to AASHTO LRFD Bridge Construction Specification, Appendix A19, calculations stamped by a professional engineer registered in North Carolina, in conformance to AASHTO LRFD Bridge Design Specification Section 14, and a documented minimum five (5) year history of providing modular expansion joints of equal or greater number of seals and exact joint type as shown on the contract plans.

Provide an elastomeric component for each modular expansion joint seal that is one continuous unit for the entire length of the joint. Do not field splice the elastomeric component. Only vulcanized shop splicing of the elastomeric component is permitted. Provide an elastomeric component that is clearly shop marked to indicate the top side and joint location of the elastomeric component. On skewed bridges, or under unsymmetrical conditions, clearly mark the left side of the elastomeric component also. Left is defined as being on the left when facing in the direction of increasing station. Inspect the seals upon receipt to ensure that the marks are clearly visible upon installation.

Provide modular expansion joint seals capable of handling a total movement measured parallel to the centerline of the roadway as shown on plans. Limit clear distance between centerbeams, and edgebeams and centerbeams, to 3½". Limit centerbeam spans to approximately 48".

2.0 DRAWING AND SPECIFICATION SUBMITTAL

Submit Shop Drawings for Fabrication and Installation Procedure and Revised Contract Plan Sheets, showing revised details of the Structure contract plans.

A. Shop Fabrication and Installation Procedure Drawings

The deck slab is detailed in the contract plans with a required full depth transverse construction joint separating the main slab pour from the blockout area for the modular joint assembly. Position the modular joint assembly in the blockout area only after the main slab pours adjacent to the blockout area have been made and the girder rotation, deflection, and longitudinal movement due to slab pours have occurred.

Detail the method of positioning and securing the modular assembly in the blockout prior to the closure pour on the working drawings.

Submit two complete sets of working drawings for review. Submit these drawings well in advance of the scheduled installation time for the modular expansion joint seals. Include material requirements and installation procedures and specifications in the drawings.

After the drawings have been reviewed and, if necessary, corrections have been made, submit nine additional sets of the working drawings.

B. Revised Contract Plan Sheets

Concurrent with the submission of the working drawings, submit two sets of revised Structure plans for review. In the revised plans, include necessary changes in dimensions, reinforcing steel, and concrete blockouts to accommodate modular expansion joint seals. Have a North Carolina Registered Professional Engineer prepare and seal the revised plans. No adjustment will be made in the contract price for any bid item due to revisions necessary to accommodate the modular expansion joint seals. This cost is included in the lump sum price bid for furnishing and installing the modular expansion joint seal.

After the revised plans have been reviewed and, if necessary, corrections have been made, submit one 22" x 34" reproducible set of revised structure contract plans.

C. Design Calculations and Test Report Data

In addition to submittal requirements outlined within this section, modular expansion joint systems submitted as an approved equal shall submit all information outlined in Section 1.0 above.

3.0 FABRICATION AND INSTALLATION

Protect the components of the modular expansion joint seal in the following manner. Upon completion of any shop fabrication, commercially blast clean (SP-6) all steel components, excluding stainless steel parts. Metallize to a minimum thickness of 8 mils on these surfaces. Metallize in accordance with the Special Provision for “Thermal Sprayed Coatings (Metallization)”.

Install the modular expansion joint seals according to the procedures and recommendations of the manufacturer, except as amended in the next paragraph.

The expansion joint system shall be continuous across the full width of the roadway and turned up into the curb or sidewalk. Transverse joints in the seals and/or seal retaining elements are not allowed.

For shop splices, full penetration welds are required for center beam splices. For shop splices, partial penetration welds are not allowed for center beam splices, except at barrier rail upturns or sidewalk upturns. Field splices of joints are not allowed.

When indicated on the plans, provide special snowplow protection, such as a snowplow blade guide or steel ribs, to prevent the blade from entering the joint recess.

If the Engineer deems any aspects of the modular expansion joint seals unacceptable, make necessary corrections.

Watertight Integrity Test

- Upon completion of each modular expansion joint seal, perform a water test on the top surface to detect any leakage. Cover the roadway section of the joint from curb to curb, or barrier rail to barrier rail, with water, either ponded or flowing, not less than 1 inch above the roadway surface at all points. Block sidewalk sections, block the barrier rail opening and secure an unnozzled water hose delivering approximately 1 gallon of water per minute to the inside face of the bridge railing, trained in a downward position about 6 inches above the sidewalk, such that there is continuous flow of water across the sidewalk and down the curb face of the joint.
- Maintain the ponding or flowing of water on the roadway and continuous flow across sidewalks and curbs for a period of 5 hours. At the conclusion of the test, the underside of the joint is closely examined for leakage. The modular expansion joint seal is considered watertight if no obvious wetness is visible on the Engineer's finger after touching a number of underdeck areas. Damp concrete that does not impart wetness to the finger is not considered a sign of leakage.
- If the joint system leaks, locate the place(s) of leakage and take any repair measures necessary to stop the leakage at no additional cost to the Department. Use repair measures recommended by the manufacturer and approved by the Engineer prior to beginning corrective work.
- If measures to eliminate leakage are taken, perform a subsequent water integrity test subject to the same conditions as the original test. Subsequent tests carry the same responsibility as the original test and are performed at no additional cost to the Department.

4.0 BASIS OF PAYMENT

Basis of payment for all modular expansion joint seals will be at the lump sum contract price for "Modular Expansion Joint Seals" which price and payment will be full compensation for furnishing all material, including steel accessory plates for sidewalks, medians and rails, labor, tools, and incidentals necessary for installing the modular expansion joint seals in place and

including all materials, labor, tools and incidentals for performing the original watertight integrity test.

FALSEWORK AND FORMWORK (SPECIAL)

1.0 DESCRIPTION

Use this Special Provision as a guide to develop temporary works submittals required by the Standard Specifications or other provisions; no additional submittals are required herein. Such temporary works include, but are not limited to, falsework and formwork.

Falsework is any temporary construction used to support the permanent structure until it becomes self-supporting. Formwork is the temporary structure or mold used to retain plastic or fluid concrete in its designated shape until it hardens. Access scaffolding is a temporary structure that functions as a work platform that supports construction personnel, materials, and tools, but is not intended to support the structure. Scaffolding systems that are used to temporarily support permanent structures (as opposed to functioning as work platforms) are considered to be falsework under the definitions given. Shoring is a component of falsework such as horizontal, vertical, or inclined support members. Where the term "temporary works" is used, it includes all of the temporary facilities used in bridge construction that do not become part of the permanent structure.

Design and construct safe and adequate temporary works that will support all loads imposed and provide the necessary rigidity to achieve the lines and grades shown on the plans in the final structure.

2.0 MATERIALS

Select materials suitable for temporary works; however, select materials that also ensure the safety and quality required by the design assumptions. The Engineer has authority to reject material on the basis of its condition, inappropriate use, safety, or nonconformance with the plans. Clearly identify allowable loads or stresses for all materials or manufactured devices on the plans. Revise the plan and notify the Engineer if any change to materials or material strengths is required.

3.0 DESIGN REQUIREMENTS

A. Working Drawings

Provide working drawings for items as specified in the contract, or as required by the Engineer, with design calculations and supporting data in sufficient detail to permit a structural and safety review of the proposed design of the temporary work.

On the drawings, show all information necessary to allow the design of any component to be checked independently as determined by the Engineer.

When concrete placement is involved, include data such as the drawings of proposed sequence, rate of placement, direction of placement, and location of all construction joints. Submit the number of copies as called for by the contract.

Have the drawings and calculations prepared under the guidance of, and sealed by, a North Carolina Registered Professional Engineer who is knowledgeable in temporary works design.

If requested by the Engineer, submit with the working drawings manufacturer's catalog data listing the weight of all construction equipment that will be supported on the temporary work. Show anticipated total settlements and/or deflections of falsework and forms on the working drawings. Include falsework footing settlements, joint take-up, and deflection of beams or girders.

Note on the working drawings any anchorages, connectors, inserts, steel sleeves or other such devices used as part of the falsework or formwork that remains in the permanent structure. If the plan notes indicate that the structure contains the necessary corrosion protection required for a Corrosive Site, epoxy coat, galvanize or metalize these devices. Electroplating will not be allowed. Any coating required by the Engineer will be considered incidental to the various pay items requiring temporary works

Design falsework and formwork requiring submittals in accordance with the 1995 AASHTO *Guide Design Specifications for Bridge Temporary Works* except as noted herein.

1. Wind Loads

   Table 2.2 of Article 2.2.5.1 is modified to include wind velocities up to 110 mph. In addition, Table 2.2A is included to provide the maximum wind speeds by county in North Carolina.

Table 2.2 - Wind Pressure Values

Height Zone feet above ground	Pressure, lb/ft^2 for Indicated Wind Velocity, mph				
	70	80	90	100	110
0 to 30	15	20	25	30	35
30 to 50	20	25	30	35	40
50 to 100	25	30	35	40	45
over 100	30	35	40	45	50

2. Time of Removal

   The following requirements replace those of Article 3.4.8.2.

Do not remove forms until the concrete has attained strengths required in Article 420-16 of the Standard Specifications and these Special Provisions.

Do not remove forms until the concrete has sufficient strength to prevent damage to the surface.

Table 2.2A - Steady State Maximum Wind Speeds by Counties in North Carolina

COUNTY	25 YR (mph)	COUNTY	25 YR (mph)	COUNTY	25 YR (mph)
Alamance	70	Franklin	70	Pamlico	100
Alexander	70	Gaston	70	Pasquotank	100
Alleghany	70	Gates	90	Pender	100
Anson	70	Graham	80	Perquimans	100
Ashe	70	Granville	70	Person	70
Avery	70	Greene	80	Pitt	90
Beaufort	100	Guilford	70	Polk	80
Bertie	90	Halifax	80	Randolph	70
Bladen	90	Harnett	70	Richmond	70
Brunswick	100	Haywood	80	Robeson	80
Buncombe	80	Henderson	80	Rockingham	70
Burke	70	Hertford	90	Rowan	70
Cabarrus	70	Hoke	70	Rutherford	70
Caldwell	70	Hyde	110	Sampson	90
Camden	100	Iredell	70	Scotland	70
Carteret	110	Jackson	80	Stanley	70
Caswell	70	Johnston	80	Stokes	70
Catawba	70	Jones	100	Surry	70
Cherokee	80	Lee	70	Swain	80
Chatham	70	Lenoir	90	Transylvania	80
Chowan	90	Lincoln	70	Tyrell	100
Clay	80	Macon	80	Union	70
Cleveland	70	Madison	80	Vance	70
Columbus	90	Martin	90	Wake	70
Craven	100	McDowell	70	Warren	70
Cumberland	80	Mecklenburg	70	Washington	100
Currituck	100	Mitchell	70	Watauga	70
Dare	110	Montgomery	70	Wayne	80
Davidson	70	Moore	70	Wilkes	70
Davie	70	Nash	80	Wilson	80
Duplin	90	New Hanover	100	Yadkin	70
Durham	70	Northampton	80	Yancey	70
Edgecombe	80	Onslow	100		
Forsyth	70	Orange	70		

B. Review and Approval

The Engineer is responsible for the review and approval of temporary works' drawings.

Submit the working drawings sufficiently in advance of proposed use to allow for their review, revision (if needed), and approval without delay to the work.

The time period for review of the working drawings does not begin until complete drawings and design calculations, when required, are received by the Engineer.

Do not start construction of any temporary work for which working drawings are required until the drawings have been approved. Such approval does not relieve the Contractor of the responsibility for the accuracy and adequacy of the working drawings.

4.0 CONSTRUCTION REQUIREMENTS

All requirements of Section 420 of the Standard Specifications apply.

Construct temporary works in conformance with the approved working drawings. Ensure that the quality of materials and workmanship employed is consistent with that assumed in the design of the temporary works. Do not weld falsework members to any portion of the permanent structure unless approved. Show any welding to the permanent structure on the approved construction drawings.

Provide tell-tales attached to the forms and extending to the ground, or other means, for accurate measurement of falsework settlement. Make sure that the anticipated compressive settlement and/or deflection of falsework does not exceed 1 inch. For cast-in-place concrete structures, make sure that the calculated deflection of falsework flexural members does not exceed 1/240 of their span regardless of whether or not the deflection is compensated by camber strips.

A. Maintenance and Inspection

Inspect and maintain the temporary work in an acceptable condition throughout the period of its use. Certify that the manufactured devices have been maintained in a condition to allow them to safely carry their rated loads. Clearly mark each piece so that its capacity can be readily determined at the job site.

Perform an in-depth inspection of an applicable portion(s) of the temporary works, in the presence of the Engineer, not more than 24 hours prior to the beginning of each concrete placement or the placement of the first precast concrete segment. Inspect temporary works at least once a month to ensure that they are functioning properly. Have a North Carolina Registered Professional Engineer inspect the cofferdams, shoring, sheathing, support of excavation structures, and support systems for load tests prior to loading.

B. Foundations

Determine the safe bearing capacity of the foundation material on which the supports for temporary works rest. If required by the Engineer, conduct load tests to verify proposed bearing capacity values that are marginal or in other high-risk situations.

The use of the foundation support values shown on the contract plans of the permanent structure is permitted if the foundations are on the same level and on the same soil as those of the permanent structure.

Allow for adequate site drainage or soil protection to prevent soil saturation and washout of the soil supporting the temporary works supports.

If piles are used, the estimation of capacities and later confirmation during construction using standard procedures based on the driving characteristics of the pile is permitted. If preferred, use load tests to confirm the estimated capacities; or, if required by the Engineer conduct load tests to verify bearing capacity values that are marginal or in other high risk situations.

The Engineer reviews and approves the proposed pile and soil bearing capacities.

5.0 REMOVAL

Unless otherwise permitted, remove and keep all temporary works upon completion of the work. Do not disturb or otherwise damage the finished work.

Remove temporary works in conformance with the contract documents. Remove them in such a manner as to permit the structure to uniformly and gradually take the stresses due to its own weight.

6.0 METHOD OF MEASUREMENT

Unless otherwise specified, temporary works will not be directly measured.

7.0 BASIS OF PAYMENT

Payment at the contract unit prices for the various pay items requiring temporary works will be full compensation for the above falsework and formwork.

SUBMITTAL OF WORKING DRAWINGS (6-28-17)

1.0 GENERAL

Submit working drawings in accordance with Article 105-2 of the *Standard Specifications* and this provision. For this provision, "submittals" refers to only those listed in this provision. The list of submittals contained herein does not represent a list of required submittals for the project. Submittals are only necessary for those items as required by the contract. Make submittals that are not specifically noted in this provision directly to the Engineer. Either the Structures Management Unit or the Geotechnical Engineering Unit or both units will jointly review submittals.

If a submittal contains variations from plan details or specifications or significantly affects project cost, field construction or operations, discuss the submittal with and submit all copies to the Engineer. State the reason for the proposed variation in the submittal. To minimize review time, make sure all submittals are complete when initially submitted. Provide a contact name and information with each submittal. Direct any questions regarding submittal requirements to the Engineer, Structures Management Unit contacts or the Geotechnical Engineering Unit contacts noted below.

In order to facilitate in-plant inspection by NCDOT and approval of working drawings, provide the name, address and telephone number of the facility where fabrication will actually be done if different than shown on the title block of the submitted working drawings. This includes, but is not limited to, precast concrete items, prestressed concrete items and fabricated steel or aluminum items.

2.0 ADDRESSES AND CONTACTS

For submittals to the Structures Management Unit, use the following addresses:

Via US mail:

Mr. B. C. Hanks, P. E.
State Structures Engineer
North Carolina Department
of Transportation
Structures Management Unit
1581 Mail Service Center
Raleigh, NC 27699-1581

Attention: Mr. J. L. Bolden, P. E.

Via other delivery service:

Mr. B. C. Hanks, P. E.
State Structures Engineer
North Carolina Department
of Transportation
Structures Management Unit
1000 Birch Ridge Drive
Raleigh, NC 27610

Attention: Mr. J. L. Bolden, P. E.

Submittals may also be made via email.

Send submittals to:

jlbolden@ncdot.gov (James Bolden)

Send an additional e-copy of the submittal to the following address:

eomile@ncdot.gov (Emmanuel Omile)

mrorie@ncdot.gov (Madonna Rorie)

For submittals to the Geotechnical Engineering Unit, use the following addresses:

For projects in Divisions 1-7, use the following Eastern Regional Office address:

Via US mail:

Mr. Chris Kreider, P. E.
Eastern Regional Geotechnical Manager
North Carolina Department of Transportation
Geotechnical Engineering Unit
Eastern Regional Office
1570 Mail Service Center
Raleigh, NC 27699-1570

Via other delivery service:

Mr. Chris Kreider, P. E.
Eastern Regional Geotechnical Manager
North Carolina Department of Transportation
Geotechnical Engineering Unit
Eastern Regional Office
3301 Jones Sausage Road, Suite 100
Garner, NC 27529

Via Email: EastGeotechnicalSubmittal@ncdot.gov

For projects in Divisions 8-14, use the following Western Regional Office address:

Via US mail or other delivery service:

Mr. Eric Williams, P. E.
Western Regional Geotechnical Manager
North Carolina Department of Transportation
Geotechnical Engineering Unit
Western Regional Office
5253 Z Max Boulevard
Harrisburg, NC 28075

Via Email: WestGeotechnicalSubmittal@ncdot.gov

The status of the review of structure-related submittals sent to the Structures Management Unit can be viewed from the Unit's website, via the "Drawing Submittal Status" link.

The status of the review of geotechnical-related submittals sent to the Geotechnical Engineering Unit can be viewed from the Unit's website, via the "Geotechnical Construction Submittals" link.

Direct any questions concerning submittal review status, review comments or drawing markups to the following contacts:

Primary Structures Contact: James Bolden (919) 707 – 6408

(919) 250 – 4082 facsimile
jlbolden@ncdot.gov

Secondary Structures Contacts: Emmanuel Omile (919) 707 – 6451
Madonna Rorie (919) 707 – 6508

Eastern Regional Geotechnical Contact (Divisions 1-7):
Chris Kreider (919) 662 – 4710
ckreider@ncdot.gov

Western Regional Geotechnical Contact (Divisions 8-14):
Eric Williams (704) 455 – 8902
ewilliams3@ncdot.gov

3.0 SUBMITTAL COPIES

Furnish one complete copy of each submittal, including all attachments, to the Engineer. At the same time, submit the number of hard copies shown below of the same complete submittal directly to the Structures Management Unit and/or the Geotechnical Engineering Unit.

The first table below covers "Structure Submittals". The Engineer will receive review comments and drawing markups for these submittals from the Structures Management Unit. The second table in this section covers "Geotechnical Submittals". The Engineer will receive review comments and drawing markups for these submittals from the Geotechnical Engineering Unit.

Unless otherwise required, submit one set of supporting calculations to either the Structures Management Unit or the Geotechnical Engineering Unit unless both units require submittal copies in which case submit a set of supporting calculations to each unit. Provide additional copies of any submittal as directed.

STRUCTURE SUBMITTALS

Submittal	Copies Required by Structures Management Unit	Copies Required by Geotechnical Engineering Unit	Contract Reference Requiring Submittal [1]
Arch Culvert Falsework	5	0	Plan Note, SN Sheet & "Falsework and Formwork"
Box Culvert Falsework [7]	5	0	Plan Note, SN Sheet & "Falsework and Formwork"
Cofferdams	6	2	Article 410-4
Foam Joint Seals [6]	9	0	"Foam Joint Seals"

Expansion Joint Seals (hold down plate type with base angle)	9	0	"Expansion Joint Seals"
Expansion Joint Seals (modular)	2, then 9	0	"Modular Expansion Joint Seals"
Expansion Joint Seals (strip seals)	9	0	"Strip Seals"
Falsework & Forms [2] (substructure)	8	0	Article 420-3 & "Falsework and Formwork"
Falsework & Forms (superstructure)	8	0	Article 420-3 & "Falsework and Formwork"
Girder Erection over Railroad	5	0	Railroad Provisions
Maintenance and Protection of Traffic Beneath Proposed Structure	8	0	"Maintenance and Protection of Traffic Beneath Proposed Structure at Station ___"
Metal Bridge Railing	8	0	Plan Note
Metal Stay-in-Place Forms	8	0	Article 420-3
Metalwork for Elastomeric Bearings [4,5]	7	0	Article 1072-8
Miscellaneous Metalwork [4,5]	7	0	Article 1072-8
Disc Bearings [4]	8	0	"Disc Bearings"
Overhead and Digital Message Signs (DMS) (metalwork and foundations)	13	0	Applicable Provisions
Placement of Equipment on Structures (cranes, etc.)	7	0	Article 420-20
Precast Concrete Box Culverts	2, then 1 reproducible	0	"Optional Precast Reinforced Concrete Box Culvert at Station ___"
Prestressed Concrete Cored Slab (detensioning sequences) [3]	6	0	Article 1078-11

Prestressed Concrete Deck Panels	6 and 1 reproducible	0	Article 420-3
Prestressed Concrete Girder (strand elongation and detensioning sequences)	6	0	Articles 1078-8 and 1078-11
Removal of Existing Structure over Railroad	5	0	Railroad Provisions
Revised Bridge Deck Plans (adaptation to prestressed deck panels)	2, then 1 reproducible	0	Article 420-3
Revised Bridge Deck Plans (adaptation to modular expansion joint seals)	2, then 1 reproducible	0	"Modular Expansion Joint Seals"
Sound Barrier Wall (precast items)	10	0	Article 1077-2 & "Sound Barrier Wall"
Sound Barrier Wall Steel Fabrication Plans [5]	7	0	Article 1072-8 & "Sound Barrier Wall"
Structural Steel [4]	2, then 7	0	Article 1072-8
Temporary Detour Structures	10	2	Article 400-3 & "Construction, Maintenance and Removal of Temporary Structure at Station ____"
TFE Expansion Bearings [4]	8	0	Article 1072-8

FOOTNOTES

1. References are provided to help locate the part of the contract where the submittals are required. References in quotes refer to the provision by that name. Articles refer to the *Standard Specifications*.
2. Submittals for these items are necessary only when required by a note on plans.
3. Submittals for these items may not be required. A list of pre-approved sequences is available from the producer or the Materials & Tests Unit.
4. The fabricator may submit these items directly to the Structures Management Unit.
5. The two sets of preliminary submittals required by Article 1072-8 of the *Standard Specifications* are not required for these items.
6. Submittals for Fabrication Drawings are not required. Submittals for Catalogue Cuts of Proposed Material are required. See Section 5.A of the referenced provision.

7. Submittals are necessary only when the top slab thickness is 18" or greater.

GEOTECHNICAL SUBMITTALS

Submittal	Copies Required by Geotechnical Engineering Unit	Copies Required by Structures Management Unit	Contract Reference Requiring Submittal [1]
Drilled Pier Construction Plans [2]	1	0	Subarticle 411-3(A)
Crosshole Sonic Logging (CSL) Reports [2]	1	0	Subarticle 411-5(A)(2)
Pile Driving Equipment Data Forms [2,3]	1	0	Subarticle 450-3(D)(2)
Pile Driving Analyzer (PDA) Reports [2]	1	0	Subarticle 450-3(F)(3)
Retaining Walls [4]	1 drawings, 1 calculations	2 drawings	Applicable Provisions
Temporary Shoring [4]	1 drawings, 1 calculations	2 drawings	"Temporary Shoring" & "Temporary Soil Nail Walls"

FOOTNOTES

1. References are provided to help locate the part of the contract where the submittals are required. References in quotes refer to the provision by that name. Subarticles refer to the *Standard Specifications*.

2. Submit one hard copy of submittal to the Engineer. Submit a second copy of submittal electronically (PDF via email), US mail or other delivery service to the appropriate Geotechnical Engineering Unit regional office. Electronic submission is preferred.

3. The Pile Driving Equipment Data Form is available from:
https://connect.ncdot.gov/resources/Geological/Pages/Geotech_Forms_Details.aspx
See second page of form for submittal instructions.

4. Electronic copy of submittal is required. See referenced provision.

EPOXY JOINTING OF PRECAST SEGMENTS (SPECIAL)

1.0 DESCRIPTION

Furnish, mix and apply a two-component epoxy bonding system to the match cast faces of joints between precast concrete superstructure and/or substructure segments in accordance with the requirements herein.

In its workable state, or open time, the epoxy bonding agent shall function as a lubricant for joining the segments. In its hardened state, the epoxy bonding agent shall provide a watertight seal between the precast concrete segments. The hardened epoxy bonding agent shall provide intimate contact for stress transfer by completely filling all interstitial space between the match cast
segment faces.

This provision applies to precast segmental structures with multiple shear joints in webs and joints with suitable shear keys in precast substructure segments.

2.0 GENERAL

A. Acceptance of Epoxy Bonding System

Use only epoxy systems that meet the requirements of this provision. The epoxy system should be approved by the engineer-of-record and reviewed and approved by the department before it is used by the contractor.

B. Qualifications of Contractor's Personnel

For mixing, handling and applying the epoxy bonding agent, provide direct supervision by a person with knowledge and experience, or trained by a technical representative of the manufacturer in the use of this material. These qualifications should be submitted for each person providing direct supervision of the use of epoxy bonding agent. Arrange for a technical representative of the manufacturer to be at the site as an advisor at the beginning of this work.

Ensure that all personnel who will be working with the epoxy bonding agent are thoroughly familiar with the safety precautions necessary for use of this material.

3.0 MATERIAL

A. General

Use only epoxy bonding agents for match-cast joints between precast segments which are thermosetting 100% solid compositions that do not contain solvent or any non- reactive organic ingredient except for pigment required for coloring and meet the requirements of ASTM C881, Type VI Grade 3 as modified below. Use epoxy bonding agents composed of

two components, a resin and a hardener, with each component distinctly pigmented so that mixing produces a third color similar to the concrete in the segments.

Epoxy bonding agents shall be insensitive to damp conditions during application and, after curing, shall exhibit high bonding strength to cured concrete, good water resistivity, low creep characteristics and tensile strength greater than the concrete.

B. Packaging, Identification and Use

Use only components packaged in two parts, in sealed containers, proportioned in the proper reacting ratio, ready for combining and mixing in accordance with the manufacturer's instructions. Each container shall bear a label and/or stamp designating the manufacturer's name, brand name, the component type (resin or hardener), the range of substrate (surface of concrete) temperature over which the application is suitable, material classification, the date of formulation, the shelf life of the material, and the manufacturer's lot number.

Provide instructions, furnished by the manufacturer, for the safe storage, handling, mixing and application of the material.

Do not use any material from containers which are damaged or have been previously opened. Combining of epoxy bonding components from bulk supplies will not be permitted. Only full packets of components will be mixed.

C. Classification of Epoxy Material

Epoxy bonding agents which remain workable for a short open time (about one hour) are referred to herein as "normal set epoxy".

Epoxy bonding agents which remain workable over an extended open time (about eight hours) are referred to herein as "slow set epoxy".

D. Formulation for Temperature Range

Epoxy bonding agents shall be formulated to provide application temperature ranges which are suitable for the erection of match cast segments with substrate temperatures between 40ºF and 115ºF with a minimum of at least two, but preferably three, formulations dividing the range into approximately equal sub-ranges which overlap by at least 5ºF.

E. Physical Requirements

1. General

Epoxy bonding agents proportioned as designated by the manufacturer and mixed in accordance with the manufacturer's recommendations shall meet the requirements of ASTM C881. For the properties listed below, modify the ASTM test procedures as noted.

The components of the epoxy-bonding agent shall be conditioned to the temperature at which testing is to be done prior to mixing the test specimen.

2. Contact Time (open Time) and Contact Strength

The contact time (open time) of the mixed epoxy-bonding agent shall be:

Normal-Set Epoxy ..... 60 Minutes, Minimum
Slow-Set Epoxy ..... 8 Hours, Minimum

The above contact time (open time) will be deemed acceptable if a slant cylinder test specimen, prepared and tested in accordance with the conditions below, sustains the following stress (contact strength) on the slant plane calculated as the axial (vertical) load divided by the area of the slant ellipse:

Normal-Set Epoxy ..... 1,000 psi at 48 hours after joining
Slow-Set Epoxy ..... 1,000 psi at 14 days after joining

The cement mortar/concrete material for the slant-cylinder test shall have a compressive strength of at least 4,500 psi at 28 days when tested to ASTM C39. The slant-cylinder test procedure shall be in accordance with ASTM C882 with the following modifications:

a. Joining of the sloped surfaces shall be delayed for the following period of time, measured from the time the epoxy was mixed:

Normal-Set Epoxy ..... 60 Minutes
Slow-Set Epoxy ..... 8 Hours

b. During the period between mixing of the epoxy and joining of the sloped surfaces, the specimens will be uncovered and maintained at the maximum temperature of the application range for the formulation tested.

c. Assemble the specimens together and cure at the maximum temperature of the formulation range (48 hours for normal set and 14 days for slow set epoxies) prior to testing.

For slow-set epoxy, an additional test specimen shall be made and tested to failure at 24 hours. The formulation of the slow set epoxy is acceptable only if the epoxy- bonding agent exhibits a brittle break.

3. Compressive Yield Strength

The compressive yield strength of the epoxy-bonding agent shall be in accordance with ASTM C881 when tested using ASTM Method D 695 with the following conditions:

a. Epoxy bonding agent shall be poured into the mold for forming specimens within ten minutes after starting mixing of the components.

b. The specimens shall be cured at the minimum temperature of the formulation range for a period of 24 hours.

4. Bond Strength

Bond strength shall be in accordance with ASTM C 881 and the test is conducted on a slant cylinder according to ASTM C 882 with the following modifications.

a. The test cylinder of concrete shall have a compressive strength of at least 6,000 psi at seven days age.
b. The specimens shall be prepared as defined in Section 3.0(E)(2) of this provision.

4.0 CONSTRUCTION REQUIREMENTS

A. General

Apply an epoxy bonding agent meeting the requirements of this provision to mating surfaces of all match-cast precast concrete segments.

Prior to the manufacture of epoxy for the project, a site meeting will be held with representatives from the Engineer, Contractor and epoxy manufacturer to discuss the selection of the proper formulations, storage and handling, mixing and application of the epoxy.

Have the necessary cleaning materials immediately available at the location of the segment joining, in the event that the segments shall be separated and cleaned or epoxy reapplied.

Include in the erection manual required by "Precast Segmental Bridge Construction" Special Provision, details of erection and post-tensioning operations which assure that the time elapsing between mixing components of the first batch of epoxy bonding agent applied to the joining surfaces of precast concrete segments and the application of a compressive contact pressure across the joint does not exceed 70% of the open time for the particular formulation of epoxy bonding agent used. Also, include details of how the minimum, closing, contact pressure of approximately 40 psi will be applied uniformly to each joint to which epoxy is applied during the epoxy curing period. Contact pressure may be attained through combinations of weight and temporary and/or permanent post-tensioning.

B. Cleanliness of Surfaces to be Joined

Ensure that the application surfaces are free from oil, form release agent, laitance or any other deleterious material that would prevent the epoxy bonding agent from bonding to the concrete surface. Remove laitance by light sandblasting, wire brushing. Do not destroy the surface shape and profile of the mating surfaces.

Ensure that the surfaces have no free moisture on them at the time the epoxy bonding agent is applied. Free moisture will be considered present if a dry rag, after being wiped over the surface, becomes damp.

C. Substrate Temperatures and Epoxy Formulation

Apply the epoxy bonding agent only when the substrate temperature of both surfaces to be joined is between 40ºF and 115ºF. The formulation of the epoxy bonding agent shall have an application temperature range that conforms to the substrate temperature of the surfaces being joined. If the mating surfaces have different substrate temperatures, then use the formulation for the higher temperature in hot weather periods. In cold weather periods, use the formulation for the lower temperature. Thermal control precautions may be taken in accordance with Section 4.0(H) of this provision below.

D. Mixing of Epoxy Bonding Agent

Mix the two components of the epoxy bonding agent in strict accordance with the manufacturer's instructions, using only full and undamaged containers. Only open the containers immediately before being combined and do not use any which have an expired shelf life. Thoroughly stir each container of component before combining the components. Combine the two components and thoroughly mix until a uniform color is achieved. Mix with a properly sized mechanical mixer operating at no more than 600 rpm and/or in accordance with the recommendations of the epoxy manufacturer.

Do not mix until the segments to be joined are within approximately 18 inches of their final position. Schedule mixing of the epoxy bonding agent so that the material in a batch is applied to the face of a joint within a maximum of 20 minutes after combining the components.

The Engineer, at his discretion, may require a dry run to check the fit of two surfaces before applying the epoxy.

E. Application and Amount of Epoxy

Begin application immediately after a batch has been mixed. Uniformly apply the epoxy bonding agent in accordance with the manufacturer's recommendations by spatula or gloved hand a nominal thickness of 1/16 inch.

Apply the epoxy to all areas of both faces to be joined. Do not exclude epoxy from around holes formed by ducts. Apply additional epoxy thickness, equal to the shim thickness, to segment faces when shims are placed in a joint.

The amount of epoxy may be adjusted provided that a sufficient amount is applied to completely fill all interstitial space in the joint and to extrude a small bead from the joint after application of the compressive contact pressure.

If a bead of epoxy is not extruded all around the joint, then determine the reason why before proceeding.

Do not use an epoxy bonding agent from a batch for which the time since combining the components has exceeded 20 minutes.

F. Mating of Segments

Immediately after each mating surface is covered with epoxy bonding agent, bring the segments together and apply the specified compressive contact pressure in accordance with the approved erection procedures. The contact pressure may be increased at any time after the epoxy has taken an initial set. Do not reduce the contact pressure until the epoxy in the joint has properly hardened and cured. If the contact pressure is reduced, do not subject the joint to tensile stress.

A discernable bead line of extruded epoxy bonding agent shall be apparent along the exposed edges of the joint. Fill all areas of the joint which do not show a bead of epoxy by dispensing additional epoxy, meeting the requirements of this specification, into the joint using a pneumatic gun with epoxy cartridges. Inject epoxy to a minimum depth of 1 inch.

Catch and retain epoxy which is squeezed out of the joint in areas over waterways, roadways, buildings, etc.

Clean all extruded epoxy bonding agent from external visible surfaces in a way not to damage or stain the concrete surface. Do not smear surplus extruded epoxy bonding agent over large areas (areas more than 1 inch from each side of the joint), visible surfaces.

Immediately after the segments are joined, swab all embedded (internal) post- tensioning ducts or conduits passing through the joints to smooth out any extruded epoxy bonding agent.

If the time between combining the components of the epoxy bonding agent and applying the compressive contact pressure exceeds 70% of the minimum open time, immediately separate the segments and clean in accordance with Section 4.0(H) of this provision.

G. Thermal Controls

1. Cooling in Hot Weather

If the substrate temperature exceeds 115ºF, do not proceed with epoxy jointing. The Contractor may take precautions to keep the mating substrate surfaces cool by shading and/or wetting with clean water except that the above requirements for no moisture at the time of application shall be strictly adhered to.

2. Artificial Heating in Cold Weather

If electing to erect segments in cold weather when the substrate temperature of the mating concrete surfaces is below 40ºF, an artificial environment may be used to increase the substrate temperature subject to the following:

a. Make the artificial environment by an enclosure surrounding the joint through which warm air is circulated, or heating is provided by radiant heaters.

b. Raise the temperature of the concrete substrate across the entire joint surface to at least 40ºF.

c. Prevent localized heating and the temperature of the substrate exceeding 95ºF at any point on the surface. Direct flame heating of the concrete is not allowed.

d. Maintain the temperature of the substrate surfaces between 40ºF and 95ºF for at least 24 hours after joining the surfaces.

e. The Contractor may propose, for review by the Engineer, an optional method of raising and maintaining the substrate temperature of the mating surfaces. Any optional method shall meet the thermal restrictions above.

Epoxy jointing operations may proceed if the air temperature is above 45ºF and rising and the limitations above are met.

H. Failure to comply with Time Limits or Incomplete Jointing

If the time limit between mixing of the epoxy-bonding agent and the application of the contact pressure is exceeded, or if the joint is incompletely filled and sealed, separate the segments and remove all epoxy from the faces using spatulas and approved solvent. Do not re-apply epoxy until the faces have been properly cleaned and solvents dispersed, for a period of 24 hours.

5.0 REMOVAL OF SUPPORT TO SEGMENTS

A. Cantilever Erection

Independent support to a newly erected cantilever segment may be removed when the epoxy bonding agent in the third previous mating joint has set. It is not necessary for the epoxy bonding agent in the new joint or the immediately previous joint to be set prior to removing the independent support of the new segment provided that the temporary and/or permanent post-tensioning has been installed to carry the load of the new and previous segment along with any applied construction loading as per the requirements of the erection system.

6.0 RECORD OF JOINTING

Record and submit to the Engineer on a weekly basis the following information:

A. General

1. Date and time of jointing.
2. Segment numbers or spans jointed.
3. Weather conditions.

B. For each joint (identified by location or segment numbers)

1. Manufacturer's lot number of epoxy bonding agent components.
2. Temperature of the concrete on the joint surface at the middle of each segment when application of the epoxy bonding agent began.
3. Time of mixing first batch of epoxy bonding agent applied to the joint and completion of application.
4. Time of applying the required compressive contact pressure.

C. Details of any repairs performed including:

1. Reason for repair.
2. Joint location.
3. Volume of epoxy.
4. Method of application.
5. Additional details as applicable.

7.0 MEASUREMENT AND PAYMENT

No measurement will be made for the *Epoxy Jointing of Precast Segments* as it is incidental to the Precast Segmental Bridge pay item.

CRANE SAFETY **(8-15-05)**

Comply with the manufacturer specifications and limitations applicable to the operation of any and all cranes and derricks. Prime contractors, sub-contractors, and fully operated rental companies shall comply with the current Occupational Safety and Health Administration regulations (OSHA).

Submit all items listed below to the Engineer prior to beginning crane operations involving critical lifts. A critical lift is defined as any lift that exceeds 75 percent of the manufacturer's crane chart capacity for the radius at which the load will be lifted or requires the use of more than one crane. Changes in personnel or equipment must be reported to the Engineer and all applicable items listed below must be updated and submitted prior to continuing with crane operations.

Crane Safety Submittal List

A. Competent Person: Provide the name and qualifications of the "Competent Person" responsible for crane safety and lifting operations. The named competent person will have the responsibility and authority to stop any work activity due to safety concerns.

B. Riggers: Provide the qualifications and experience of the persons responsible for rigging operations. Qualifications and experience should include, but not be limited to, weight calculations, center of gravity determinations, selection and inspection of sling and rigging equipment, and safe rigging practices.

C. Crane Inspections: Inspection records for all cranes shall be current and readily accessible for review upon request.

D. Certifications: **By July 1, 2006**, crane operators performing critical lifts shall be certified by NC CCO (National Commission for the Certification of Crane Operators), or satisfactorily complete the Carolinas AGC's Professional Crane Operator's Proficiency

Program. Other approved nationally accredited programs will be considered upon request. All crane operators shall also have a current CDL medical card. Submit a list of anticipated critical lifts and corresponding crane operator(s). Include current certification for the type of crane operated (small hydraulic, large hydraulic, small lattice, large lattice) and medical evaluations for each operator.

MASS CONCRETE **(SPECIAL)**

This special provision applies to substructure components (footings, columns or caps) when the smallest dimension of that component is equal or more than 5 feet but less than eight feet.

The mass concrete temperature after placement shall not exceed 158°F and the temperature difference between the core and exterior surfaces shall not exceed 35°F. Mass concrete should remain covered and monitored until the difference between the core temperature and the average daily ambient temperature is below 35°F. All mass concrete pours shall remain covered and protected a minimum of 7 days unless otherwise directed by the Engineer.

Submit an analysis, for review and approval, of the anticipated thermal developments in the mass concrete based on the proposed mix design, materials and casting procedures. At a minimum, the analysis shall provide: an anticipated range of peak temperatures, temperature gradients, time to peak temperature and recommended cure time. The submittal shall also describe the measures and procedures that will be taken to limit the temperature differential to 35°F or less between the core and exterior surfaces.

Methods for reducing thermal differential may involve but are not limited to a combination of the following:

A. Selecting materials that minimize the heat generated by hydration of the cement.

B. Cooling materials to reduce the temperature of the concrete in its plastic state.

C. Controlling the rate of concrete placement.

D. Insulating the concrete surface to prevent heat loss.

E. Providing supplemental heat at the concrete surface to prevent heat loss.

F. Other acceptable methods which may be developed by the Contractor.

The temperature of mass concrete at the time of placement shall not be less than 40°F nor more than 75°F.

Mass concrete shall contain an approved set-retarding, water-reducing admixture, and flyash or ground granulated blast furnace slag in the amount of 25% by weight of the total cementitious material (portland cement plus flyash). Flyash or ground granulated blast furnace slag used in the mass concrete mix shall meet the requirements of Articles 1024-5 and 1024-6 of the Standard Specifications. Portland Cement shall meet the requirements of AASHTO M85 for Type II. The total cementitious material shall not exceed 600 lbs. per cubic yard of concrete. The Contractor shall test and submit results for the compressive strength of his proposed mix design for review and approval. The strength must be taken as the average of at least three cylinders made in the laboratory and meet the minimum 28 day strength requirements noted in the contract plans.

The Contractor shall provide and install a minimum of six temperature sensing devices in each mass concrete pour to monitor temperature differentials between the core and exterior surfaces. These devices shall have an accuracy of ±2°F within the temperature range of 40°F to 180°F. One temperature sensing probe shall be placed near the core of the pour, and the remaining temperature sensing probes shall be placed at approximately two inches clear from the surface of the concrete furthest from the core. The Engineer shall approve the locations of the temperature sensing probes.

Readings from the temperature sensing devices shall be recorded at one-hour intervals, from the time casting is complete until the maximum temperature is established. After the maximum temperature is established, record readings from temperature sensing devices at two-hour intervals until consecutive readings indicated the temperature difference between the core and all exterior surfaces is less than 35°F. At the option of the Contractor, the temperature may be recorded by an approved strip-chart recorder furnished by the Contractor.

If monitoring indicates the 35°F differential has been exceeded, the Contractor shall take immediate action to reduce the temperature differential to less than 35°F and revise the thermal plan to ensure future mass concrete pours meet the temperature limits. All revisions to the approved plan must be approved by the Engineer prior to implementation.

At the discretion of the Engineer, all temperature monitoring requirements may be waived provided the Contractor has proven to the satisfaction of the Engineer that the temperature after placement will not exceed 158°F and the temperature difference between the core and all exterior surfaces will not exceed 35°F.

Placement of mass concrete shall be continuous resulting in a footing, column or cap that is monolithic and homogeneous.

The entire cost of this work shall be included in the unit contract price bid for the class of concrete associated with the mass concrete.

DEMOLITION OF EXISTING BRIDGE (SPECIAL)

Remove the existing structure in accordance with Section 402 of the Standard Specifications with the following exceptions and/or additions.

1. Submit to the Engineer for his approval one set of electronic plans sealed by a Professional Engineer registered in North Carolina, detailing the method of demolition of the existing bridge. Ensure that demolition does not damage the adjacent newly constructed bridge.

2. The plan should include temporary support frames and containment systems to keep debris from falling on I-26. Contain saw slurry and prevent it from falling on I-26 using a method approved by the Engineer.

3. The use of explosives will not be allowed.

4. Notify the Engineer at least two weeks prior to beginning demolition of the existing bridge.

BRIDGE DECK AND APPROACH SLAB RIDEABILITY (IRI) (8-9-18)

1.0 GENERAL

Perform the smoothness acceptance testing, diamond grinding, transverse grooving and all other related work associated with obtaining satisfactory rideability and surface texture of the bridge deck surface. Provide a surface finish in accordance with Article 420-14(B) of the *Standard Specifications*.

2.0 TESTING REQUIREMENTS

Perform smoothness acceptance testing using an Inertial Profiler of the longitudinal profile of the finished bridge deck and approach slabs in the presence of the Engineer. Submit a proposed plan of action and schedule for profiler testing to the Engineer.

Prior to smoothness testing, placement of the bridge deck, approach slabs, joints, and barrier rail within the section to be tested shall be complete. Remove all obstructions from the bridge deck and sweep the surface clean of debris prior to profiler testing.

Use a profiler with line laser technology to perform this work. Use testing and recording software to produce International Roughness Index (IRI) and Mean Roughness Index (MRI) values and locate areas of localized roughness accurately. The Inertial Profiler shall conform to AASHTO M 328, *Standard Specification for Inertial Profiler*. Provide certification documentation that the profiler meets AASHTO M 328 to the Engineer prior to the first day the Inertial Profiler is used on the project.

Equip the Inertial Profiling system with automatic data reduction capabilities for determining the IRI values unless otherwise authorized by the Engineer. Provide IRI data in accordance with most current version of ASTM E 1926.

Provide a competent operator, trained in the operation of the Inertial Profiler and evaluation of the IRI. Operation of the Inertial Profiling system shall conform to AASHTO R 57, *Standard Specification for Operating Inertial Profiling Systems.*

Utilize a properly calibrated and documented Inertial Profiler. Provide the user selected Inertial Profiler settings to the Engineer for the project records. Certification of the Inertial Profiling system shall conform to AASHTO R 56, *Standard Specification for Certification of Inertial Profiling Systems.*

Perform equipment calibrations and verifications as described in AASHTO M 328. Do not use the profiler's internal IRI calculation mode. The profile data shall be filtered with a cutoff wavelength of 300 feet. The interval at which relative profile elevations are reported shall be one inch. Surface openings may be excluded in the IRI measurement by masking with dark non-reflective tape.

Operate the Inertial Profiler in the direction of the final traffic pattern. Collect IRI data from both wheel paths during the same run. Define a "wheel path" as 3 feet from the edge of the travel lane. MRI values are the average of the IRI values from both wheel paths. When using an inertial profiler that collects a single trace per pass, take care to ensure that the measurements from each trace in a travel lane start and stop at the same longitudinal locations. Unless otherwise specified, multiple runs are not necessary for data collection.

Operate the automatic triggering method at all times unless impractical. The profiler should reach operating speed before entering the test section. The runup and runout distances should be sufficient to obtain operating speed and to slow down after testing is completed. Operate the profiler at any speed as per the manufacturer's recommendations, however, the speed must be constant to within ± 3 MPH of the intended speed and any required acceleration should be as gradual as possible.

The evaluation of the profiles will be performed on a section basis. A section is 0.05 mile (264.0 feet) of a single travel lane.

After testing, transfer the electronic profile data from the profiler's portable computer hard drive to a USB flash drive or media approved by the Engineer. Submit electronic data on the approved media to the Engineer, labeled with the Project number, Contract number, Route, Bridge number, County, date of run(s), and termini of the profile data. This media will not be returned to the Contractor.

Use the most current version of ProVAL (***Pro***file ***V***iewing and ***A***na***l***ysis Software) to determine the IRI and areas of localized roughness. Perform smoothness tests on the finished surface of the completed project or at the completion of a major stage of construction as approved by the Engineer. Coordinate with and receive authorization from the Engineer before starting smoothness testing. Perform smoothness tests within seven days after receiving authorization and submit raw data results to the Engineer within 24 hours of data collection. Any testing performed without the Engineer's presence, unless otherwise authorized, may be ordered retested at the Contractor's expense.

Submit an evaluation for each section to the Engineer within ten days after completion of the smoothness testing. Submit the electronic files compatible with ProVAL and the evaluation in tabular form with each 0.05-mile segment occupying a row. Include each row with the beginning and ending station for the section, the length of the section, the IRI values from each wheel path, and the MRI value for the section. Each continuous run for a section will occupy a separate table and each table will have a header that includes the following: the project contract number, county, the roadway number or designation, a lane designation, bridge number, the dates of the smoothness runs, and the beginning and ending station of the continuous run. Summarize each table at the bottom. The signature of the Operator shall be included with the submitted IRI trace and electronic files.

If necessary, traffic control and all associated activities included in the smoothness testing of the bridge deck surface will be the responsibility of the Contractor.

IRI and MRI numbers in inches per mile will be established for each 0.05-mile section (264.0 feet) for each travel lane of the bridge deck.

The following table provides the acceptance quality rating scale of the bridge deck and approach slabs, based on the final rideability determination.

MRI after Completion [Inches Per Mile]	Acceptance Per Travel Lane (0.05-mile section)
Less than or equal to 120.0	Acceptable
Greater than 120.0	Corrective Work Required

Localized Roughness:

Report local IRI values for each wheel path using IRI measurements and a 25-foot sliding baseline. Report areas of localized roughness for each wheel path. Areas of localized roughness are defined as being one of the following two types:

Type 1: Area having a local IRI value greater than 180 in/mile based on a 25-foot analysis segment not containing a bridge expansion joint.

Type 2: Area having a local IRI value greater than 250 in/mile based on a 25-foot analysis segment containing a bridge expansion joint.

Corrective Action Plan:

For areas of localized roughness and non-conforming segment roughness, submit a proposed corrective action plan to the Engineer for review. Include proposed repair locations, limits, and procedures. Repair procedures such as diamond grinding, full or partial deck replacement, joint replacement, etc. may be considered. In order to produce a uniform cross section, the Engineer may require correction to the adjoining traffic lanes or shoulders. Grinding may not be permitted to areas where it may be detrimental to the structure or to ride quality. Do not begin corrective action until submittal acceptance. Notify the Engineer 5 days prior to commencement of the corrective action. Following repair, repeat surface testing and submit IRI and MRI measurements to verify segment MRI is 120 in/mile or less and wheel paths no longer contain areas of localized roughness as defined herein.

Diamond Grinding:

If the deck does not meet the smoothness acceptance testing requirements, and diamond grinding is required, diamond grind the full width of all lanes in the direction of travel. If 30 percent or more of the bridge deck surface requires corrective action, then the Contractor shall diamond grind the entire bridge deck surface.

Submit grinding equipment specifications to the Engineer for approval before any grinding is performed. Use a grinding machine with diamond tipped saw blades gang mounted on a power driven self-propelled machine capable of removing a minimum of 3 feet of width with each pass.

Multiple passes may be needed to achieve the required depth of removal. In addition, hand grinding may be required to remove vertical steps between passes.

The ground surface shall consist of between 50 and 60 grooves per foot (305 mm) of width. The grooves shall be between 0.09" (2.3 mm) and 0.15" (3.8 mm) in width and 0.0625" (1.6 mm) in depth. The area between the grooves shall be between 0.06" (1.5 mm) and 0.13" (3.3 mm) in width. The final concrete texture shall be uniform.

Construct and operate the grinding machine such that it will not cause strain or damage to the deck surface, excessive ravels, aggregate fractures, spalls, or disturbance of transverse joints. Do not perform corrective diamond grinding within 1.5 feet of a steel armored expansion joint system installed prior to the corrective action. Longitudinally grind the deck parallel to the roadway centerline.

Continuously remove all slurry or other debris resulting from the grinding operations by vacuum pick-up or other approved methods. Prevent the slurry from flowing into floor drains, onto the ground or into the body of water under the bridge. Dispose of all residues in accordance with the project permits, applicable local and federal laws, and as approved by the Engineer.

In completing all corrective work on the deck surface to satisfy the rideability criteria stated herein, limit grinding such that the final reinforcement cover is not less than the plan cover minus ½" (12mm). In cases where this cannot be achieved, other corrective work may be required as directed by the Engineer.

3.0 GROOVING BRIDGE FLOORS

After the final concrete surface profile has been accepted by the Engineer, groove the bridge deck in accordance with Article 420-14(B) of the *Standard Specifications*.

Grooving of the entire bridge deck surface will be required if less than 30 percent of the bridge deck has been corrected with diamond grinding. Grooving will not be required if the entire bridge deck surface is diamond grinded. Payment for grooving in accordance with Section 420 of the *Standard Specifications* will be made when grooving has been performed, or when diamond grinding of the entire bridge deck surface is performed, either condition being an acceptable, final riding surface.

4.0 BASIS OF PAYMENT

No separate payment will be made for smoothness testing, retesting or corrective action work required to meet the requirements established herein. The cost of the testing procedure, equipment, grinding operation, and removal and disposal of slurry and debris resulting from the grinding operation or demolition is considered incidental to the contract bid price for "Latex Modified Concrete".

LATEX MODIFIED CONCRETE (SPECIAL)

1.0 DESCRIPTION

This special provision addresses the requirements for furnishing and placing an overlay of latex modified concrete (LMC) over existing concrete or repair concrete on bridge decks and approach pavement. Perform this work in accordance with this special provision and the applicable parts of the *Standard Specifications*.

2.0 QUALITY CONTROL

The Contractor is responsible for scheduling a pre-construction meeting with the Resident Engineer and the Area Construction Engineer.

Submit a Quality Control Plan to the Engineer for approval which, at a minimum, describes the methods of: storing materials, calibrating mixers, controlling moisture content in the aggregate, maintaining proper mix temperature, retarder usage, curing and curing time, controlling evaporation rate, cleaning and removing excess water.

Before beginning any work, obtain approval for all equipment to be used for deck preparation, mixing, placing, finishing and curing the LMC.

3.0 MATERIALS

For materials, equipment, and proportioning and mixing of modified compositions, see Article 1000-7 of the *Standard Specifications*.

Provide aggregates for use in the LMC that are free from ice, frost, frozen particles or other contaminants when introduced into the mixer.

The *Standard Specifications* shall be revised as follows:

1000-7(A) – Add the following paragraph to the end of the section:

Submit the LMC mix design, including laboratory compressive strength data for a minimum of six (6) 4-inch by 8-inch cylinders at seven (7) days for normal setting concrete to the Engineer for review. Include test results for the slump and air content of the laboratory mix. Perform tests in accordance with AASHTO T 22, T 119 and T 152.

4.0 PREPARATION OF SURFACE

Completely clean all surfaces within 48 hours prior to placing the overlay unless otherwise approved by the Engineer.

Thoroughly soak the clean surface and maintain a wet surface for at least 12 hours immediately prior to placing the LMC. After soaking the surface for at least 12 hours, cover it with a layer of white opaque polyethylene film that is at least 4 mils thick. Immediately prior to placing the LMC, remove standing water from the surface using an approved vacuum system.

The surface of concrete substrate and repaired areas shall be prepared for application of the overlay by shotblasting in order to remove all existing grease, slurry, oils, paint, dirt, striping, curing compound, rust, membrane, weak surface mortar, or any other contaminants that could interfere with the proper adhesion of the overlay system. The final prepared surface shall adhere to the following requirements:

1. If expansion joints are not being replaced or have been replaced prior to shotblasting they shall be protected from damage from the shotblasting operation. Deck drains and areas of curb or railing above the proposed surface shall be protected from the shotblasting operation.

2. The areas to receive overlay shall be cleaned by shotblasting, or abrasive sandblasting in the event that the shotblaster cannot access areas to be prepared. Do not begin shotblasting until all grinding or milling operations are completed. Cleaning shall not commence until all work involving the repair of the concrete deck surface has been completed and the deck is dry. All contaminants shall be picked up and stored in the vacuum unit and no dust shall be created during the blasting operation that will obstruct the view of motorists in adjacent roadways. The travel speed and/or number of passes of the shotblasting unit shall be adjusted, so as to result in all weak or loose surface mortar being removed, aggregates within the concrete being exposed, and open pores in the concrete exposed, as well as a visible change in the concrete color. Cleaned surfaces shall not be exposed to vehicular traffic unless approved by the Engineer. If the deck becomes contaminated before placing the overlay, the Contractor shall shotblast or abrasive sandblast the contaminated areas to the satisfaction of the Engineer at no additional cost.

3. Prior to the overlay placement, any loose particles shall be removed by magnets and oil free compressed air and vacuuming, such that no trapped particles remain. Power washing will not be allowed.

4. The areas to be overlaid shall be blown off with oil and moisture free compressed air just prior to placement of the primer and shall be completely dry.

5. Cleaning methods other than those detailed by specification may be suggested by the LMC System Provider and approved by the Engineer.

6. All steel surfaces that will be in contact with the LMC overlay shall be cleaned in accordance with SSPC-SP No. 10, Near-White Blast Cleaning, except that wet blasting methods shall not be allowed.

5.0 PLACING AND FINISHING

Add reinforcing fibers to the concrete mixture following the manufacturer's recommendations. Add fibers to the concrete mixture gradually to ensure the fibers are uniformly distributed throughout

the concrete mixture. Use fully oriented, collated, fibrillated, white, ¾-inch long fibers of 100 percent virgin polyolefin conforming to ASTM D7508. Dose at 1.5 to 3 pounds per cubic yard of concrete.

Prior to placing LMC, install a bulkhead of easily compressible material at expansion joints to the required grade and profile.

Construction joints other than those shown on the plans will not be permitted unless approved by the Engineer. At construction joints, remove 4" of previously placed LMC prior to placing the adjacent latex concrete. Also, for staged construction, 4" of previously poured LMC shall be scarified, hydro-demolitioned and recast with the next stage.

Place and fasten screed rails in position to ensure finishing the new surface to the required profile. Fasten screed into position in a way not to cause any damage to the concrete deck or the post-tensioning system. Submit the screed fastening plan to the Engineer for approval. Do not treat screed rails with parting compound to facilitate their removal. Prior to placing the overlay attach a filler block to the bottom of the screed and pass it over the area to be repaired to check the thickness. The filler block thickness shall be equal to the design overlay thickness as shown in the plans. Remove all concrete that the block does not clear. Individual aggregates left after hydro-demolition may be allowed to project above the base of the filler block. Remove aggregate that does not provide a 1" clear cover to the top of the overlay.

Brush a latex cement mixture onto all vertical surfaces and do not let the brushed material dry before it is covered with the additional material required for the final grade. Remove all loose aggregate from the latex cement brushed surface prior to latex concrete placement (NOTE: For surfaces not prepared with hydro-demolition brush the lean latex mixture over horizontal and vertical surfaces).

Do not place the LMC until the burlap is saturated and approved by the Engineer. Drain excess water from the wet burlap before placement.

Place the LMC in one operation. Provide a minimum overlay thickness as shown in the plans.

Once LMC placement begins a single layer of wet burlap shall be placed five (5) feet behind the screed's burlap drag. In the event of a delay of ten (10) minutes or more, temporarily cover all exposed latex concrete with wet burlap and white opaque polyethylene.

When a tight, uniform surface is achieved and before the concrete becomes non-plastic, further finish the surface of the floor by burlap dragging or another acceptable method that produces an acceptable uniform surface texture.

Within 1 hour of covering with wet burlap, place a layer of 4 mil white opaque polyethylene film on the wet burlap and cure the surface for 48 hours. Then remove the curing material for an additional 48 hours air cure.

Screed rails or construction dams shall be separated from the newly placed concrete by passing a pointing trowel along the face of the formwork and the newly placed concrete. Carefully make

this trowel cut for the entire depth and length of rails or dams after the LMC has sufficiently stiffened and cannot flow back.

As soon as practical, after the concrete has hardened sufficiently, test the finished surface with an approved rolling straightedge that is designed, constructed, and adjusted so that it will accurately indicate or mark all deck areas which deviate from a plane surface by more than ⅛" in 10'. Remove all high areas in the hardened surface in excess of ⅛" in 10' with an approved grinding or cutting machine. Additionally, the final LMC deck surface shall not deviate from the line and elevation indicated on the plans by more than 0.3" over any 50' length. Where variations are such that the corrections extend below the limits of the top layer of grout, seal the corrected surface with an approved sealing agent as required by the Engineer. If approved by the Engineer, correct low areas in an acceptable manner.

Unless otherwise indicated on the plans, groove the bridge floor in accordance with Subarticle 420-14(B) of the *Standard Specifications*.

6.0 LIMITATIONS OF OPERATIONS

The mixer is not permitted on the bridge deck unless otherwise approved.

No traffic is permitted on the finished LMC surface until the total specified curing time is completed and until the concrete reaches the minimum specified compressive strength.

Do not place LMC if the temperature of the concrete surface on which the overlay is to be placed is below 50°F or above 85°F. Measure the surface temperature by placing a thermometer under the insulation against the surface.

Prior to placing LMC, the air temperature, wind speed and evaporation rate shall be determined by Contractor and verified by the Engineer. Do not place LMC if the ambient air temperature is below 50°F or above 85°F, or if the wind velocity is greater than 10 mph.

Do not place LMC when the temperature of the LMC is below 45°F or above 85°F.

Do not place LMC if the rate of evaporation of surface moisture from the LMC determined by the Engineer or Contractor exceeds 0.05 pounds per square foot per hour during placement. The evaporation rate is calculated using the following formula:

$$E = (T_c^{2.5} - r*T_a^{2.5})*(1+0.4V)*(10^{-6})$$

where,

E = Evaporation Rate,

T_c = Concrete Temp (°F),

r = Relative Humidity (%/100)

T_a = Air Temp (°F),

V=Wind Velocity (mph)

Do not place LMC if the National Weather Service predicts the air temperature at the site to be below 35°F during the next 72 hours. If the predicted air temperature is above 35°F but below 50°F, then use insulation to protect the LMC for a period of at least 48 hours. Use insulation that meets the requirements of Subarticle 420-7(C) of the *Standard Specifications* and, if required, place it on the LMC as soon as initial set permits. When using insulation to protect LMC during the wet curing period, do not remove the insulation until the ambient air temperature is at least 50°F and rising. Leave the LMC uncovered for the 48 hour air curing period.

Stop all placement operations during periods of precipitation. Take adequate precautions to protect freshly placed LMC from sudden or unexpected precipitation. Keep an adequate quantity of protective coverings at the worksite to protect the freshly placed pavement from precipitation.

If working at night, provide approved lighting.

7.0 MEASUREMENT AND PAYMENT

Latex Modified Concrete will be measured and paid for in cubic yards of LMC satisfactorily placed on the completed deck.

Placing and Finishing Latex Modified Concrete will be paid for at the contract unit price bid per square yard which includes compensation for furnishing all labor, tools, equipment and incidentals necessary to complete the work in accordance with the contract documents.

Grooving Bridge Floors will be measured and paid in accordance with Article 420-21 of the *Standard Specifications*.

Payment will be made under:

Pay Item	**Pay Unit**
Latex Modified Concrete Overlay	Cubic Yard
Placing & Finishing of Latex Modified Concrete Overlay	Square Yard
Grooving Bridge Floors	Square Feet

CALTRANS BARRIER RAIL (SPECIAL)

1.0 DESCRIPTION

Furnish and place metal, pipe or concrete barrier bridge rails, concrete curbs and concrete end posts in accordance with these specifications and as shown in the plans. Furnish posts, rail bars, pipe fittings, hardware, color treatment, concrete, reinforcing steel, admixtures, forms, falsework and all other materials; galvanize; apply color treatment; fabricate and erect rail; and place, finish and cure concrete.

2.0 MATERIALS

Refer to Division 10.

Item	Section
Epoxy Coated Reinforcing Steel	1070-7
Galvanized Steel Rail	1074-5
High Strength Concrete	SP
Portland Cement Concrete	1000
Reinforcing Steel	1070
Steel Bar Reinforcement	1070

Use high strength concrete for concrete barrier rails, concrete curbs, and end posts. Use epoxy coated reinforcing steel for concrete barrier rails in accordance with Article 1070-7.

3.0 CONSTRUCTION METHODS

Adhere to the construction load limitations of Article 420-20 while placing concrete for all bridge rails.

(A) Metal Rail

Use galvanized steel rail.

Use shims if necessary to obtain correct post alignment.

(B) Concrete Barrier

This subarticle applies to the construction of concrete barrier rail, vertical concrete barrier rail, concrete curbs, median barrier rail, and concrete parapet, referred to collectively as concrete barrier rail.

Plans for the concrete barrier rail are detailed for slip-formed CIP concrete. Unless otherwise noted, construct concrete barrier rail detailed in the plans using conventional forms or by slip-forming using an approved self-propelled extrusion machine. Except as noted herein, construct in accordance with Section 420.

Construct joints in the barrier rails at the locations and of the type shown in the plans.

Construct concrete barrier rail to the shape, line, grade, and dimensions shown in the plans, except that when slip-forming rails, either radius or chamfer the corners. Check slip-formed rail concrete directly behind the extrusion machine using successive overlapping applications of the 10 foot straightedge. Correct high and low areas while the concrete is still workable. Limit horizontal and vertical deviation form plan line and grade to no more than 1/4 inches in 10 feet.

Provide sufficient internal vibrators to consolidate the concrete along the faces of forms and adjacent to joints. Consolidate the concrete by internal vibration in one pass of the extrusion machine. Produce a dense and homogeneous barrier free of voids and honeycomb with minimum hand finishing. Coordinate concrete delivery and placement to provide uniform progress while minimizing stopping and starting of the extrusion machine.

When plans require horizontal deck drains through the barrier rails, use drain coupling with slip-formed rails.

Correct all exposed surfaces that are not satisfactory to the Engineer as to uniformity of color and texture or because of excessive patching as required. Give the roadway face of barrier rails constructed using conventional forms a Class 2 surface finish in accordance with Subarticle 420-17(F). Use a broom finish on the roadway face of slip-formed barrier rails.

4.0 MEASUREMENT AND PAYMENT

Caltrans Barrier Rail will be measured and paid as the actual number of linear feet of bridge railing and concrete curb. The price and payment will be in full compensation for all materials, labor, equipment, tools, and incidentals necessary to construct the bridge railing, steel handrail, concrete curb, sidewalk, and curtain.

Payment will be made under:

Item	**Pay Unit**
Caltrans Barrier Rail	Linear Foot

SEGMENTAL BRIDGE CONTRACTOR AND PERSONNEL (Special)

1.0 Contractor

The contractor performing the work, whether the prime contractor or subcontractor, must be prequalified by the Department specifically for Segmental Bridge Construction.

2.0 Segmental Bridge Construction Contractor Personnel

A. Project Engineer: The Contractor/subcontractor's engineer, responsible for all engineering decisions, judgments and work at the site. The Project Engineer shall be a registered Professional Engineer with five years of experience of bridge construction of which three years is in precast post-tensioned concrete box girder segmental bridges. Experience should include post-tensioning and grouting operations including at least one year in responsible charge of post-tensioning related engineering activities.

B. Project Superintendent / Manager: The Project Superintendent/Manager shall have either a minimum of ten years of bridge construction experience or be a registered Professional Engineer with five years of bridge construction experience. This experience shall include at least three years of construction experience in precast post-tensioned concrete box girder segmental bridges and grouting operations, including at least one year in responsible charge of segmental post-tensioning related operations. The superintendent shall also be certified in accordance with PTI's Level 2 Multistrand PT Specialist program.

C. Foreman: The Foreman shall have a minimum of five years bridge construction experience including two years in post-tensioning related operations and a minimum of one year as a foreman in responsible charge of post-tensioning related operations. The foreman shall also be certified in accordance with PTI's Level 2 Multistrand PT Specialist program.

3.0 Crews for Tendon Installation and Stressing

A. Tendon Installation and Stressing: At a minimum, fifty percent of personnel shall be certified in accordance with PTI's Level 1 Multistrand PT Installation program, or higher. A minimum of Twenty-five percent shall be certified as Level 2 Multistrand PT Specialist. Those uncertified must be working with an individual that is certified.

B. Tendon Grouting: At a minimum, Fifty percent of personnel shall be certified in accordance with PTI's Level 1 Multistrand PT Installation program, or higher. Grouting operations shall be supervised and under the immediate control of a person certified in accordance with PTI's Level 2 Multistrand PT Specialist program and ASBI Certified Grouting Technician. Those uncertified must be working with an individual that is certified. For vacuum grouting operations, either the grouting crew foreman or the foreman of a specialist (sub-contractor) vacuum grouting crew should have received training and experience in the use of vacuum grouting equipment.

4.0 Payment

A. There will be no payment for this section as it is considered incidental to the other items of work.



6/20/2019

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PROJECT SPECIAL PROVISIONS

GEOTECHNICAL

ROCK EMBANKMENT (SPECIAL)	GT-1.1 - GT-1.2
SCARIFY/MIX EXISTING ABC AND SAND LAYERS (SPECIAL)	GT-2.1 - GT-2.1
GEOTEXTILE FOR PAVEMENT STABILIZATION (SPECIAL)	GT-3.1 - GT-3.2
STANDARD SHORING - (1/16/2018)	GT-4.1 - GT-4.4
TEMPORARY SOIL NAIL WALLS - (1/16/2018)	GT-5.1 - GT-5.9
ARCHTECTURAL CONCRETE SURFACE TREATMENT (SPECIAL)	GT-6.1 - GT-6.6
MSE RETAINING WALLS (LRFD) - (1/16/2018)	GT-7.1 - GT-7.12
SOIL NAIL RETAINING WALLS (SPECIAL)	GT-8.1 - GT-8.12

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ROCK EMBANKMENT: **(SPECIAL)**

Description

Construct rock buttress embankments for fill slopes designated as 1.5:1.0 (H:V) with the contract and Section 235 of the Standard Specifications

Materials

Refer to Division 10 of the *Standard Specifications*.

Item	Section
Geotextile, Type 4	1056
Geotextile, Type 5	1056
Select Material, Class VII	1016
Select Material, Class IV	1016

Use Class VII Select Material and Class IV for rock embankments. Class VII Select Material must be mechanically sorted to Specification and placed rock embankment construction as described below. Use Class IV select material to cap top of embankment to fill remaining voids in rock embankments.

Provide Type 4 and 5 geotextiles as shown on plans.

Construction Methods

Provide an embankment that is uniform in construction and free of debris and groups of large rocks that could cause voids in embankments.

Construct rock embankments in accordance with the slopes, dimensions and elevations shown in the plans and Section 235 of the *Standard Specifications*. Place Type V Geotextile as shown on the Rock Embankment Typical drawing before placing Select Material. General undercutting will not be required except in unsuitable or high PI soils as determined by the Engineer.

Place stable rock embankments as shown in plans beginning with Class VII Select Material and continue placing the materials until the proposed roadway width has been established. Cap the Class VII layer with Type 4 Geotextiles and place a 3 foot layer of compacted Select Material, Class IV stone filler material over rock fill to fill remaining voids and protect filtration geotextiles against damage.

Measurement and Payment

Payment will not be made for Rock Embankment Construction. See Section 235 of the Standard Specifications.

Select Material, Class VII and *Select Material, Class IV* will be measured and paid for in tons. Select material will be measured by weighing material in trucks in accordance with Article 106-7 of the *Standard Specifications*. The contract unit prices for *Select Material, Class VII* and *Select Material, Class IV* will be full compensation for providing, hauling, handling, placing, compacting and maintaining select material.

Rip Rap, Class A/B will be measured and paid for in tons. Rip Rap materials will be measured by weighing material in trucks in accordance with Article 106-7 of the *Standard Specifications*. The

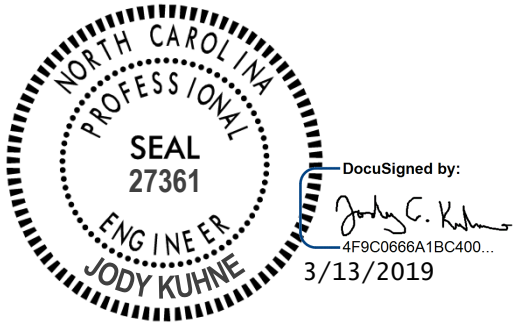
contract unit prices for *Rip Rap, Class A/B* will be full compensation for providing, hauling, handling, placing, compacting and maintaining select material.

Class VI Select Material will be measured by weighing material in trucks in accordance with Article 106-7 of the *Standard Specifications*. The contract unit price for *Class VI Select Material* will be full compensation for providing, hauling, handling, placing, compacting and maintaining select material and rip rap.

Geotextile, Type 4 and 5 will be measured and paid in square yards. Type 4 and 5 Geotextiles will be measured along the top or bottom of rock embankments as the square yards of exposed geotextiles before placing embankment fill material. No measurement will be made for overlapping geotextiles. The contract unit price for *Geotextile Type 4 and Type 5* will be full compensation for providing, transporting and installing geotextiles.

Payment will be made under:

Pay Item	**Pay Unit**
Select Material, Class VII	Ton
Select Material, Class IV	Ton
Geotextile Type 4	Square Yard
Geotextile, Type 5	Square Yard



SCARIFY/MIX EXISTING ABC AND SAND LAYERS (SPECIAL)

1.0 GENERAL

Upon removal of the existing concrete pavement, incorporate the existing ABC and sand layers into the underlying soils to a minimum depth of 12 inches. The existing ABC and sand should be scarified into the proposed subgrade to a minimum depth of 12 inches. Scarification will require a minimum of 2 passes over the same area to create a homogenous mixture of ABC, Sand and soil or to the discretion of the Engineer.

2.0 MEASUREMENT AND PAYMENT

Work is incidental to fine grading and payment will be made in accordance with Article, 500-5 of the Standard Specifications.



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GEOTEXTILE FOR PAVEMENT STABILIZATION: (SPECIAL)

Description

Supply and install geotextile for pavement stabilization in accordance with the contract. Geotextile for pavement stabilization may be required above chemically stabilized subgrades or below Class IV subgrade stabilization to prevent pavement cracking at locations shown in the plans and as directed. Define "subbase" as the portion of the roadbed below the Class IV subgrade stabilization.

Materials

Refer to Division 10 of the *Standard Specifications*.

Item	Section
Geotextiles	1056
Select Material, Class IV	1016

Use Class IV select material for Class IV subgrade stabilization. Provide Type 5 geotextile for geotextile for pavement stabilization that meets the following tensile strength requirements in the machine direction (MD) and cross-machine direction (CD):

GEOTEXTILE FOR PAVEMENT STABILIZATION REQUIREMENTS		
Tensile Strength	**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

A. MD, CD and MARV per Article 1056-3 of the *Standard Specifications*.

Construction Methods

Geotextile for pavement stabilization may be required at locations shown in the plans and other locations as directed. For locations with ABC on chemically stabilized subgrades, use of geotextile for pavement stabilization will be based on sampling and testing for chemical stabilization**. For all other locations, notify the Engineer when the embankment is completed to within 12 inches of subgrade elevation and allow 15 days for the Engineer to determine if geotextile for pavement stabilization is required.**

Before placing geotextile for pavement stabilization below Class IV subgrade stabilization, proof roll subbases in accordance with Section 260 of the *Standard Specifications*. Place geotextile for pavement stabilization above chemically stabilized subgrades or below Class IV subgrade stabilization as shown in the plans. Pull geotextiles taut so they are in tension and free of kinks, folds, wrinkles or creases. Install geotextile for pavement stabilization perpendicular to the survey or lane line in the MD and adjacent to each other in the CD as shown in the plans. Continuous geotextiles are required in the MD, i.e., do not splice or overlap geotextiles so seams are parallel to the survey or lane line. Completely cover stabilized subgrades or subbases with geotextile for pavement stabilization. Overlapping geotextiles in the CD is permitted but not required. Overlap geotextiles in the direction that aggregate will be placed to prevent lifting the edge of the top geotextile. Hold geotextiles in place with wire staples or anchor pins as needed.

Do not damage geotextile for pavement stabilization when placing ABC or Class IV subgrade stabilization. Place and compact ABC in accordance with the contract and *Standard*

Specifications. Place, compact and maintain Class IV subgrade stabilization in accordance with Article 505-3 of the *Standard Specifications* for a Type 2 aggregate subgrade. Do not operate heavy equipment on geotextiles any more than necessary to construct base courses or subgrades. 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 or subbases as the square yards of exposed geotextiles installed before placing ABC or Class IV subgrade stabilization. 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 installing geotextiles, wire staples and anchor pins.

Class IV Subgrade Stabilization will be measured and paid in accordance with Article 505-4 of the *Standard Specifications*. No measurement will be made for any undercut excavation of fill materials from subbases.

Payment will be made under:

Pay Item	**Pay Unit**
Geotextile for Pavement Stabilization	Square Yard

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STANDARD SHORING: **(1-16-18)**

Description

Standard shoring includes standard temporary shoring and standard temporary mechanically stabilized earth (MSE) walls. At the Contractor's option, use standard shoring as noted in the plans or as directed. When using standard shoring, a temporary shoring design submittal is not required. Construct standard shoring based on actual elevations and shoring dimensions in accordance with the contract and Geotechnical Standard Detail No. 1801.01 or 1801.02.

Define "standard temporary shoring" as cantilever shoring that meets the standard temporary shoring detail (Geotechnical Standard Detail No. 1801.01). Define "standard temporary wall" as a temporary MSE wall with geotextile or geogrid reinforcement that meets the standard temporary wall detail (Geotechnical Standard Detail No. 1801.02). Define "standard temporary geotextile wall" as a standard temporary wall with geotextile reinforcement and "standard temporary geogrid wall" as a standard temporary wall with geogrid reinforcement.

Provide positive protection for standard shoring at locations shown in the plans and as directed. See *Temporary Shoring* provision for positive protection types and definitions.

Materials

Refer to the *Standard Specifications*.

Item	Section
Concrete Barrier Materials	1170-2
Flowable Fill, Excavatable	1000-6
Geosynthetics	1056
Neat Cement Grout, Type 1	1003
Portland Cement Concrete, Class A	1000
Select Materials	1016
Steel Beam Guardrail Materials	862-2
Steel Sheet Piles and H-Piles	1084
Untreated Timber	1082-2
Welded Wire Reinforcement	1070-3

Provide Type 6 material certifications for shoring materials. Use Class IV select material for temporary guardrail. Use Class A concrete that meets Article 450-2 of the *Standard Specifications* or grout for drilled-in piles.

Based on actual shoring height, positive protection, groundwater elevation, slope or surcharge case and traffic impact at each standard temporary shoring location, use sheet piles with the minimum required section modulus or H-piles with the sizes shown in Geotechnical Standard Detail No. 1801.01. Use untreated timber with a thickness of at least 3" and a bending stress of at least 1,000 psi for timber lagging.

(A) Shoring Backfill

Use Class II, Type 1, Class III, Class V or Class VI select material or material that meets AASHTO M 145 for soil classification A-2-4 with a maximum PI of 6 for shoring backfill except do not use the following:

(1) A-2-4 soil for backfill around culverts,

(2) A-2-4 soil in the reinforced zone of standard temporary walls with a back slope and

(3) Class VI select material in the reinforced zone of standard temporary geotextile walls.

(B) Standard Temporary Walls

Use welded wire reinforcement for welded wire facing, struts and wires with the dimensions and minimum wire sizes shown in Geotechnical Standard Detail No. 1801.02. Provide Type 2 geotextile for separation and retention geotextiles. Do not use more than 4 different reinforcement strengths for each standard temporary wall.

(1) Geotextile Reinforcement

Provide Type 5 geotextile for geotextile reinforcement with a mass per unit area of at least 8 oz/sy in accordance with ASTM D5261. Based on actual wall height, groundwater elevation, slope or surcharge case and shoring backfill to be used in the reinforced zone at each standard temporary geotextile wall location, provide geotextiles with ultimate tensile strengths as shown in Geotechnical Standard Detail No. 1801.02.

(2) Geogrid Reinforcement

Use geogrids with a roll width of at least 4 ft and an "approved" or "approved for provisional use" status code. The list of approved geogrids is available from: connect.ncdot.gov/resources/Materials/Pages/Materials-Manual-by-Material.aspx

Based on actual wall height, groundwater elevation, slope or surcharge case and shoring backfill to be used in the reinforced zone at each standard temporary geogrid wall location, provide geogrids for geogrid reinforcement with short-term design strengths as shown in Geotechnical Standard Detail No. 1801.02. Geogrids are typically approved for ultimate tensile strengths in the machine direction (MD) and cross-machine direction (CD) or short-term design strengths for a 3-year design life in the MD based on material type. Define material type from the website above for shoring backfill as follows:

Material Type	Shoring Backfill
Borrow	A-2-4 Soil
Fine Aggregate	Class II, Type 1 or Class III Select Material
Coarse Aggregate	Class V or VI Select Material

If the website does not list a short-term design strength for an approved geogrid, use a short-term design strength equal to the ultimate tensile strength divided by 3.5 for the geogrid reinforcement.

Preconstruction Requirements

(A) Concrete Barrier

Define "clear distance" behind concrete barrier as the horizontal distance between the barrier and edge of pavement. The minimum required clear distance for concrete barrier is shown in the plans. At the Contractor's option or if the minimum required clear

distance is not available, set concrete barrier next to and up against traffic side of standard shoring except for barrier above standard temporary walls. Concrete barrier with the minimum required clear distance is required above standard temporary walls.

(B) Temporary Guardrail

Define "clear distance" behind temporary guardrail as the horizontal distance between guardrail posts and standard shoring. At the Contractor's option or if clear distance for standard temporary shoring is less than 4 ft, attach guardrail to traffic side of shoring as shown in the plans. Place ABC in clear distance and around guardrail posts instead of pavement. Do not use temporary guardrail above standard temporary walls.

(C) Standard Shoring Selection Forms

Before beginning standard shoring construction, survey existing ground elevations in the vicinity of standard shoring locations to determine actual shoring or wall heights (H). Submit a standard shoring selection form for each location at least 7 days before starting standard shoring construction. Standard shoring selection forms are available from: connect.ncdot.gov/resources/Geological/Pages/Geotech_Forms_Details.aspx

Construction Methods

Construct standard shoring in accordance with the *Temporary Shoring* provision.

(A) Standard Temporary Shoring Installation

Based on actual shoring height, positive protection, groundwater elevation, slope or surcharge case and traffic impact at each standard temporary shoring location, install piles with the minimum required embedment and extension for each shoring section in accordance with Geotechnical Standard Detail No. 1801.01. For concrete barrier above and next to standard temporary shoring and temporary guardrail above and attached to standard temporary shoring, use "surcharge case with traffic impact" in accordance with Geotechnical Standard Detail No. 1801.01. Otherwise, use "slope or surcharge case with no traffic impact" in accordance with Geotechnical Standard Detail No. 1801.01. If refusal is reached before driven piles attain the minimum required embedment, use drilled-in H-piles with timber lagging for standard temporary shoring.

(B) Standard Temporary Walls Installation

Based on actual wall height, groundwater elevation, slope or surcharge case, geotextile or geogrid reinforcement and shoring backfill in the reinforced zone at each standard temporary wall location, construct walls with the minimum required reinforcement length and number of reinforcement layers for each wall section in accordance with Geotechnical Standard Detail No. 1801.02. For standard temporary walls with pile foundations in the reinforced zone, drive piles through reinforcement after constructing temporary walls.

For standard temporary walls with interior angles less than 90°, wrap geosynthetics at acute corners as directed by the Engineer. Place geosynthetics as shown in Geotechnical Standard Detail No. 1801.02. Place separation geotextiles between shoring backfill and backfill, natural ground or culverts along the sides of the reinforced zone perpendicular to the wall face. For Class V or VI select material in the reinforced zone, place separation geotextiles between shoring backfill and backfill or natural ground on top of and at the

back of the reinforced zone.

Measurement and Payment

Standard shoring will be measured and paid in accordance with the *Temporary Shoring* provision.



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TEMPORARY SOIL NAIL WALLS: **(1-16-18)**

Description

Construct temporary soil nail walls consisting of soil nails spaced at a regular pattern and connected to a reinforced shotcrete face. A soil nail consists of a steel bar grouted in a drilled hole inclined at an angle below horizontal. At the Contractor's option, use temporary soil nail walls instead of temporary shoring for full cut sections. Design and construct temporary soil nail walls based on actual elevations and wall dimensions in accordance with the contract and accepted submittals. Use a prequalified Anchored Wall Contractor to construct temporary soil nail walls. Define "soil nail wall" as a temporary soil nail wall and "Soil Nail Wall Contractor" as the Anchored Wall Contractor installing soil nails and applying shotcrete. Define "nail" as a soil nail.

Provide positive protection for soil nail walls at locations shown in the plans and as directed. See *Temporary Shoring* provision for positive protection types and definitions.

Materials

Refer to Division 10 of the *Standard Specifications*.

Item	**Section**
Geocomposites	1056
Neat Cement Grout, Type 2	1003
Reinforcing Steel	1070
Shotcrete	1002
Select Material, Class IV	1016
Steel Plates	1072-2

Use Class IV select material for temporary guardrail. Provide soil nails consisting of grouted steel bars and nail head assemblies. Use deformed steel bars that meet AASHTO M 275 or M 31, Grade 60 or 75. Splice bars in accordance with Article 1070-9 of the *Standard Specifications*.

Fabricate centralizers from schedule 40 PVC plastic pipe or tube, steel or other material not detrimental to steel bars (no wood). Size centralizers to position bars within 1" of drill hole centers and allow tremies to be inserted to ends of holes. Use centralizers that do not interfere with grout placement or flow around bars.

Provide nail head assemblies consisting of nuts, washers and bearing plates. Use steel plates for bearing plates and steel washers and hex nuts recommended by the Soil Nail Manufacturer.

Provide Type 6 material certifications for soil nail materials in accordance with Article 106-3 of the *Standard Specifications*. 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 soil nail wall materials so materials are kept clean and free of damage. Bent, damaged or defective materials will be rejected.

Preconstruction Requirements

(A) Concrete Barrier

Define "clear distance" behind concrete barrier as the horizontal distance between the

barrier and edge of pavement. The minimum required clear distance for concrete barrier is shown in the plans. At the Contractor's option or if the minimum required clear distance is not available, set concrete barrier next to and up against traffic side of soil nail walls except for barrier above walls. Concrete barrier with the minimum required clear distance is required above soil nail walls.

(B) Temporary Guardrail

Define "clear distance" behind temporary guardrail as the horizontal distance between guardrail posts and soil nail walls. At the Contractor's option or if clear distance for soil nail walls is less than 4 ft, use temporary guardrail with 8 ft posts and a clear distance of at least 2.5 ft. Place ABC in clear distance and around guardrail posts instead of pavement.

(C) Soil Nail Wall Designs

Before beginning soil nail wall design, survey existing ground elevations in the vicinity of wall locations to determine actual design heights (H). Use a prequalified Anchored Wall Design Consultant to design soil nail walls. Provide designs sealed by a Design Engineer approved as a Geotechnical Engineer (key person) for the Anchored Wall Design Consultant.

Submit PDF files of working drawings and design calculations for soil nail wall designs in accordance with Article 105-2 of the *Standard Specifications*. Submit working drawings showing plan views, wall profiles, typical sections and details of soil nail wall design and construction sequence. Include details in working drawings of soil nail locations, unit grout/ground bond strengths, shotcrete reinforcement and if necessary, obstructions extending through walls or interfering with nails. Include details in construction sequence of excavation, grouting, installing reinforcement, nail testing and shotcreting with mix designs and shotcrete nozzleman certifications. Do not begin soil nail wall construction until a design submittal is accepted.

Design soil nail walls in accordance with the plans and allowable stress design method in the *FHWA Geotechnical Engineering Circular No. 7 "Soil Nail Walls"* (Publication No. FHWA-IF-03-017) unless otherwise required.

Design soil nails that meet the following unless otherwise approved:

(1) Horizontal and vertical spacing of at least 3 ft,

(2) Inclination of at least 12° below horizontal and

(3) Diameter of 4" to 10".

Do not extend nails beyond right-of-way or easement limits. If existing or future obstructions such as foundations, pavements, pipes, inlets or utilities will interfere with nails, maintain a clearance of at least 6" between obstructions and nails.

Design soil nail walls for a traffic surcharge of 250 psf if traffic will be above and within H of walls. This traffic surcharge does not apply to construction traffic. Design soil nail walls for any construction surcharge if construction traffic will be above and within H of walls. For temporary guardrail with 8 ft posts above soil nail walls, analyze walls for a horizontal load of 300 lb/ft of wall.

Place geocomposite drain strips with a horizontal spacing of no more than 10 ft and center strips between adjacent nails. Attach drain strips to excavation faces. Use shotcrete at least 4" thick and reinforce shotcrete with #4 waler bars around nail heads. Two waler bars (one on each side of nail head) in the horizontal and vertical directions are required for a total of 4 bars per nail.

(D) Preconstruction Meeting

Before starting soil nail wall construction, hold a preconstruction meeting to discuss the construction, inspection and testing of the soil nail walls. If this meeting occurs before all soil nail wall submittals have been accepted, additional preconstruction meetings may be required before beginning construction of soil nail walls without accepted submittals. The Resident, District or Bridge Maintenance Engineer, Area Construction Engineer, Geotechnical Operations Engineer, Contractor and Soil Nail Wall Contractor Superintendent will attend preconstruction meetings.

(E) Preconstruction Meeting

Before beginning wall construction, provide preconstruction test panels in accordance with Subarticle 1002-3(D) of the *Standard Specifications*.

Construction Methods

Control drainage during construction in the vicinity of soil nail walls. Direct run off away from soil nail walls and areas above and behind walls.

Install foundations located behind soil nail walls before beginning wall construction. Do not excavate behind soil nail walls. If overexcavation occurs, repair walls with an approved method and a revised soil nail wall design may be required.

Install positive protection in accordance with the contract and accepted submittals. Use PCB in accordance with Section 1170 of the *Standard Specifications* and Roadway Standard Drawing No. 1170.01. Use temporary guardrail in accordance with Section 862 of the *Standard Specifications* and Roadway Standard Drawing No. 862.01, 862.02 and 862.03.

(A) Excavation

Excavate for soil nail walls from the top down in accordance with the accepted submittals. Excavate in staged horizontal lifts with no negative batter (excavation face leaning forward). Excavate lifts in accordance with the following:

(1) Heights not to exceed vertical nail spacing,

(2) Bottom of lifts no more than 3 ft below nail locations for current lift and

(3) Horizontal and vertical alignment within 6" of location shown in the accepted submittals.

Remove any cobbles, boulders, rubble or debris that will protrude more than 2" into the required shotcrete thickness. Rocky ground such as colluvium, boulder fills and weathered rock may be difficult to excavate without leaving voids.

Apply shotcrete to excavation faces within 24 hours of excavating each lift unless otherwise approved. Shotcreting may be delayed if it can be demonstrated that delays will not adversely affect excavation stability. If excavation faces will be exposed for

more than 24 hours, use polyethylene sheets anchored at top and bottom of lifts to protect excavation faces from changes in moisture content.

If an excavation becomes unstable at any time, suspend soil nail wall construction and temporarily stabilize the excavation by immediately placing an earth berm up against the unstable excavation face. When this occurs, repair walls with an approved method and a revised soil nail wall design may be required.

Do not excavate the next lift until nail installations and testing and shotcrete application for the current lift are accepted and grout and shotcrete for the current lift have cured at least 3 days and 1 day, respectively.

(B) Soil Nails

Drill and grout nails the same day and do not leave drill holes open overnight. Control drilling and grouting to prevent excessive ground movements, damaging structures and pavements or fracturing rock and soil formations. If ground heave or subsidence occurs, suspend soil nail wall construction and take corrective action to minimize movement. If property damage occurs, make repairs with an approved method and a revised soil nail wall design may be required.

(1) Drilling

Use drill rigs of the sizes necessary to install soil nails and with sufficient capacity to drill through whatever materials are encountered. Drill straight and clean holes with the dimensions and inclination shown in the accepted submittals. Drill holes within 6" of locations and 2° of inclination shown in the accepted submittals unless otherwise approved.

Stabilize drill holes with temporary casings if unstable, caving or sloughing material is anticipated or encountered. Do not use drilling fluids to stabilize drill holes or remove cuttings.

(2) Steel Bars

Center steel bars in drill holes with centralizers. Securely attach centralizers along bars at no more than 8 ft centers. Attach uppermost and lowermost centralizers 18" from excavation faces and ends of holes.

Do not insert steel bars into drill holes until hole locations, dimensions, inclination and cleanliness are approved. Do not vibrate, drive or otherwise force bars into holes. If a steel bar cannot be completely and easily inserted into a drill hole, remove the bar and clean or redrill the hole.

(3) Grouting

Remove oil, rust inhibitors, residual drilling fluids and similar foreign materials from holding tanks/hoppers, stirring devices, pumps, lines, tremie pipes and any other equipment in contact with grout before use. Measure grout temperature, density and flow during grouting with at least the same frequency grout cubes are made for compressive strength. Perform density and flow field tests in the presence of the Engineer in accordance with American National Standards Institute/American Petroleum Institute Recommended Practice 13B-1 (Section 4,

Mud Balance) and ASTM C939 (Flow Cone), respectively.

Inject grout at the lowest point of drill holes through tremies, e.g., grout tubes, casings, hollow-stem augers or drill rods, in one continuous operation. Fill drill holes progressively from ends of holes to excavation faces and withdraw tremies at a slow even rate as holes are filled to prevent voids in grout. Extend tremies into grout at least 5 ft at all times except when grout is initially placed in holes.

Provide grout free of segregation, intrusions, contamination, structural damage or inadequate consolidation (honeycombing). Cold joints in grout are not allowed except for test nails. Remove any temporary casings as grout is placed and record grout volume for each drill hole.

(4) Nail Heads

Install nail head assemblies after shotcreting. Before shotcrete reaches initial set, seat bearing plates and tighten nuts so plates contact shotcrete uniformly. If uniform contact is not possible, install nail head assemblies on mortar pads so nail heads are evenly loaded.

(C) Drain Strips

Install geocomposite drain strips as shown in the accepted submittals. Before installing shotcrete reinforcement, place drain strips with the geotextile side against excavation faces. For highly irregular faces and at the discretion of the Engineer, drain strips may be placed after shotcreting over weep holes through the shotcrete. Hold drain strips in place with anchor pins so strips are in continuous contact with surfaces to which they are attached and allow for full flow the entire height of soil nail walls. Discontinuous drain strips are not allowed. If splices are needed, overlap drain strips at least 12" so flow is not impeded. Cut off excess drain strip length and expose strip ends below shotcrete when soil nail wall construction is complete.

(D) Shotcrete

Clean ungrouted zones of drill holes and excavation faces of loose materials, mud, rebound and other foreign material. Moisten surfaces to receive shotcrete. Install shotcrete reinforcement in accordance with the contract and accepted submittals. Secure reinforcing steel so shooting does not displace or vibrate reinforcement. Install approved thickness gauges on 5 ft centers in the horizontal and vertical directions to measure shotcrete thickness.

Apply shotcrete in accordance with the contract, accepted submittals and Subarticle 1002-3(F) of the *Standard Specifications*. Use approved shotcrete nozzlemen who made satisfactory preconstruction test panels to apply shotcrete. Direct shotcrete at right angles to excavation faces except when shooting around reinforcing steel. Rotate nozzle steadily in small circular patterns and apply shotcrete from bottom of lifts up.

Make shotcrete surfaces uniform and free of sloughing or sagging. Completely fill ungrouted zones of drill holes and any other voids with shotcrete. Taper construction joints to a thin edge over a horizontal distance of at least the shotcrete thickness. Wet joint surfaces before shooting adjacent sections.

Repair surface defects as soon as possible after shooting. Remove any shotcrete which

lacks uniformity, exhibits segregation, honeycombing or lamination or contains any voids or sand pockets and replace with fresh shotcrete to the satisfaction of the Engineer. Protect shotcrete from freezing and rain until shotcrete reaches initial set.

(E) Construction Records

Provide 2 copies of soil nail wall construction records within 24 hours of completing each lift. Include the following in construction records:

(1) Names of Soil Nail Wall Contractor, Superintendent, Nozzleman, Drill Rig Operator, Project Manager and Design Engineer;

(2) Wall description, county, Department's contract, TIP and WBS element number;

(3) Wall station and number and lift location, dimensions, elevations and description;

(4) Nail locations, dimensions and inclinations, bar types, sizes and grades and temporary casing information;

(5) Date and time drilling begins and ends, steel bars are inserted into drill holes, grout and shotcrete are mixed and arrives on-site and grout placement and shotcrete application begins and ends;

(6) Grout volume, temperature, flow and density records;

(7) Ground and surface water conditions and elevations if applicable;

(8) Weather conditions including air temperature at time of grout placement and shotcrete application; and

(9) All other pertinent details related to soil nail wall construction.

After completing each soil nail wall or stage of a wall, provide a PDF file of all corresponding construction records.

Nail Testing

"Proof tests" are performed on nails incorporated into walls, i.e., production nails. Define "test nail" as a nail tested with a proof test. Proof tests are typically required for at least one nail per nail row per soil nail wall or at least 5% of production nails, whichever is greater. More or less test nails may be required depending on subsurface conditions encountered. The Engineer will determine the number and locations of proof tests required. Do not test nails until grout and shotcrete attain the required 3 day compressive strength.

(A) Test Equipment

Use the following equipment to test nails:

(1) Two dial gauges with rigid supports,

(2) Hydraulic jack and pressure gauge and

(3) Jacking block or reaction frame.

Provide dial gauges with enough range and precision to measure the maximum test nail movement to 0.001". Use pressure gauges graduated in 100 psi increments or less. Submit identification numbers and calibration records for load cells, jacks and pressure gauges with the soil nail wall design. Calibrate each jack and pressure gauge as a unit.

Align test equipment to uniformly and evenly load test nails. Use a jacking block or reaction frame that does not damage or contact shotcrete within 3 ft of nail heads. Place dial gauges opposite each other on either side of test nails and align gauges within 5° of bar inclinations. Set up test equipment so resetting or repositioning equipment during nail testing is not needed.

(B) Test Nails

Test nails include both unbonded and bond lengths. Grout only bond lengths before nail testing. Provide unbonded and bond lengths of at least 3 ft and 10 ft, respectively.

Steel bars for production nails may be overstressed under higher test nail loads. If necessary, use larger size or higher grade bars with more capacity for test nails instead of shortening bond lengths to less than the minimum required.

(C) Proof Tests

Determine maximum bond length (L_B) using the following:

$$L_B \leq (C_{RT} \times A_t \times f_y) / (Q_{ALL} \times 1.5)$$

Where,
L_B = bond length (ft),
C_{RT} = reduction coefficient, 0.9 for Grade 60 and 75 bars or 0.8 for Grade 150 bars,
A_t = bar area (in^2),
f_y = bar yield stress (ksi) and
Q_{ALL} = allowable unit grout/ground bond strength (kips/ft).

Determine design test load (DTL) based on as-built bond length and allowable unit grout/ground bond strength using the following:

$$DTL = L_B \times Q_{ALL}$$

Where,
DTL = design test load (kips).

Perform proof tests by incrementally loading nails to failure or a load of 150% of DTL based on the following schedule:

Load	Hold Time
AL*	Until movement stabilizes
0.25 DTL	Until movement stabilizes
0.50 DTL	Until movement stabilizes
0.75 DTL	Until movement stabilizes
1.00 DTL	Until movement stabilizes
1.25 DTL	Until movement stabilizes
1.50 DTL	10 or 60 minutes (creep test)
AL*	1 minute

* Alignment load (AL) is the minimum load needed to align test equipment and should not exceed 0.05 DTL.

Reset dial gauges to zero after applying alignment load. Record test nail movement at

each load increment and monitor test nails for creep at the 1.5 DTL load increment. Measure and record movement during creep test at 1, 2, 3, 5, 6 and 10 minutes. If test nail movement between 1 and 10 minutes is greater than 0.04", maintain the 1.5 DTL load increment for an additional 50 minutes and record movement at 20, 30, 50 and 60 minutes. Repump jack as needed to maintain load during hold times.

(D) Test Nail Acceptance

Submit 2 copies of test nail records including load versus movement and time versus creep movement plots within 24 hours of completing each proof test. The Engineer will review the test nail records to determine if test nails are acceptable. Test nail acceptance is based in part on the following criteria.

(1) Total movement during creep test is less than 0.04" between the 1 and 10 minute readings or less than 0.08" between the 6 and 60 minute readings and creep rate is linear or decreasing throughout hold time.

(2) Total movement at maximum load exceeds 80% of the theoretical elastic elongation of the unbonded length.

(3) Pullout failure does not occur at or before the 1.5 DTL load increment. Define "pullout failure" as the inability to increase load while movement continues. Record pullout failure load as part of test nail data.

Maintain stability of unbonded lengths for subsequent grouting. If a test nail is accepted but the unbonded length cannot be satisfactorily grouted, do not incorporate the test nail into the soil nail wall and add another production nail to replace the test nail.

If the Engineer determines a test nail is unacceptable, either perform additional proof tests on adjacent production nails or revise the soil nail design or installation methods for the production nails represented by the unacceptable test nail as determined by the Engineer. Submit a revised soil nail wall design for acceptance, provide an acceptable test nail with the revised design or installation methods and install additional production nails for the nails represented by the unacceptable test nail.

After completing nail testing for each soil nail wall or stage of a wall, provide a PDF file of all corresponding test nail records.

Measurement and Payment

Temporary soil nail walls will be measured and paid in square feet. Temporary soil nail walls will be paid for at the contract unit price for *Temporary Shoring*. Temporary soil nail walls will be measured as the square feet of exposed wall face area. No measurement will be made for any embedment or pavement thickness above soil nail walls.

The contract unit price for *Temporary Shoring* will be full compensation for providing soil nail wall designs, submittals, labor, tools, equipment and soil nail wall materials, excavating, hauling and removing excavated materials, installing and testing soil nails, grouting, shotcreting and supplying drain strips and any incidentals necessary to construct soil nail walls. No additional payment will be made and no extension of completion date or time will be allowed for repairing property damage, overexcavations or unstable excavations, unacceptable test nails or thicker shotcrete.

No payment will be made for temporary shoring not shown in the plans or required by the Engineer including shoring for OSHA reasons or the Contractor's convenience. No value engineering proposals will be accepted based solely on revising or eliminating shoring locations shown in the plans or estimated quantities shown in the bid item sheets as a result of actual field measurements or site conditions.

PCB will be measured and paid in accordance with Section 1170 of the *Standard Specifications*. No additional payment will be made for anchoring PCB for soil nail walls. Costs for anchoring PCB will be incidental to soil nail walls.

Temporary guardrail will be measured and paid for in accordance with Section 862 of the *Standard Specifications*.



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Scott A. Hidden
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3/5/2019

ARCHITECTURAL CONCRETE SURFACE TREATMENT (SPECIAL)

1.0 GENERAL

The work covered by this special provision consists of constructing textured surfaces on formed reinforced concrete surfaces as indicated on the Plans and in this Special Provision. The wall faces will be textured and the copings will be smooth, natural concrete, or as directed by the Engineer. The Contractor shall furnish all materials, labor, equipment, and incidentals necessary for the construction of architectural concrete surface treatment using simulated stone masonry form liners (molds) and a compatible concrete coloring system.

The architectural concrete surface treatment should match the appearance (stone size and shape, stone color, and stone texture, pattern, and relief) of natural stone and rock, in the project vicinity, or as directed by the Engineer. Grout pattern joints (mortar joints) and bed thickness should re-create the appearance and color of natural stone on the cast-in-place and/or precast concrete panels for the Soil Nail Retaining Wall No. -Y- as indicated in the Plans, this Special Provision, or as directed by the Engineer.

2.0 SUBMITTALS

Shop Drawings - The Contractor shall submit for review and acceptance, plan and elevation views and details showing overall simulated stone pattern, joint locations, form tie locations, and end, edge or other special conditions. The drawings should include typical cross sections of applicable surfaces, joints, corners, stone relief, stone size, pitch/working line, mortar joint and bed depths. If necessary, the Contractor shall revise the shop drawings until the proposed form liner patterns and arrangement have been accepted by the Engineer. Shop drawings should be of sufficient scale to show the detail of all stone and joints patterns. The size of the sheets used for the shop drawings shall be 22" x 34".

The form liner shall be patterned such that long continuous horizontal or vertical lines do not occur on the finished exposed surface. The line pattern shall be random in nature and shall conceal construction joint lines. Special attention should be given to details for wrapping form liners around corners.

Shop drawings shall be reviewed and accepted prior to fabrication of form liners.

Sample Panels – After the shop drawings have been reviewed and accepted by the Engineer, the Contractor shall construct 24” x 24” transportable sample panel(s) at the project site. The materials used in construction of the sample panel(s) shall comply with section 420 of the Standard Specifications. The sample panel(s) shall be constructed using approved form liners. Sample panels will be required for each different form liner pattern that is to be used on the project. Any sample panel that is not accepted by the Engineer is to be removed from the project site and a new sample panel produced at no additional expense to the Department.

Architectural surface treatments and patterns of the finished work shall achieve the same final effect as demonstrated on the accepted sample panel(s). Upon acceptance by the

Engineer, the sample panel(s) shall be used as the quality standard for the project. After the acceptance of the completed structure, the Contractor shall dispose of the sample panels as directed by the Engineer.

3.0 MATERIAL REQUIREMENTS

Form Liner – The form liner shall be a high quality, re-useable product manufactured of high strength urethane rubber or other approved material which attaches easily to the form work system, and shall not compress more than ¼" when concrete is poured at a rate of 10 vertical feet (3 vertical meters) per hour. The form liners shall be removable without causing deterioration of the surface or underlying concrete.

The Contractor is required to use the same source of form liner for all required elements. The architectural concrete surface treatment should match the appearance (stone size and shape, stone texture, pattern and relief) of cut and mortared natural stone to resemble a pattern similar to the #439 Sierra Drystack by Sika Corporation, as shown below.



All texture is to be in addition to the nominal thickness of each element within tolerances. Maximum relief of the textured surface shall be 1 1/2 inch or less.

The form liners are to be patterned as referenced above and as directed by the Engineer.

The Contractor may choose one of the following manufactures to supply the stone-textured surface treatment as specified above. One form liner pattern will be used on this project.

- Sika Corporation http:www.sika.com
- Architectural Polymers http://www.apformliner.com/
- Custom Rock http://www.customrock.com/
- Fitzgerald http://www.formliners.com/
- Scott System http://www.scottsystem.com/
- Spec Formliners http://www.specformliners.com/
- U.S. Formliner http://www.usformliner.com/
- American Formliners http://www.americanformliners.com/

Form Release Agent – Form release agent shall be a nonstaining petroleum distillate free from water, asphaltic, and other insoluble residue, or an equivalent product. Form release agents shall be compatible with the color system applied and any special surface finish.

Form Ties - Form ties shall be set back a minimum of 2" from the finished concrete surface. The ties shall be designed so that all material in the device to a depth of at least 2" back of the concrete face (bottom of simulated mortar groove) can be disengaged and removed without spalling or damaging the concrete. The Contractor shall submit the type of form ties to the Engineer for approval.

Concrete Color – The final coloration of the wall is to consist of a two tone mix of Federal Colors #36373 and 36173 and shall be placed in such a way as to appear as natural stone. Stain the sample panel using the proposed colors and once approved by the Engineer they can be used on the wall.

Color stains shall be a special penetrating stain mix as provided by the manufacturer and shall be in multiple colors of gray, brown, white, and black to achieve a full, natural color variation in the finished surface. The stain shall create a surface finish that is breathable (allowing water vapor transmission), and that resists deterioration from water, acid, alkali, fungi, sunlight, or weathering. Stain mix shall meet the requirements for mildew resistance of Federal Test Method Standard 144, Method 6271, and requirements for weathering resistance of 1.000 hours accelerated exposure measures by Weatherometer in accordance with ASTM G 26. Color samples must be submitted for approval. Concrete stains shall be supplied by one of the following or as approved by the Engineer.

Sherwin Williams
H & C Shield Plus
101 Prospect Ave., NW
Cleveland, OH 44115

Canyon Tone Stain
United Coatings
E 1901 Cataldo
Green Acres, Washington 90016

Cementrate Acrylic Stain
Fosroc, Inc.
55 Skyline Drive
Plainview, New York 11803

Hydroshield Stain
Robson-Downes Associates, Inc.
Oxford, Maryland 21654

Anti-Graffiti Coating Application – The coating shall be eapplied after full cure of the color coating. Apply the anti-graffiti coating by brush, roller or airless spray when ambient temperature is between 45 and 90 degrees F, and the surface temperature is between 50 and 100 degrees F. Ensure the surface is clean and dry before apply ing the anti-graffiti coating. The minimum dry film thickness of the anti-graffiti coating shall be 2.0 mils.

Quality Standards - Manufacturer of simulated stone masonry form liners and custom coloring system shall have at least five years experience making stone masonry molds and color stains to create formed concrete surfaces to match natural stone shapes, surface textures and colors. The Contractor shall schedule

A pre-installation conference with manufacturer representative and the Engineer to assure understanding of simulated stone masonry form liner use, color application, requirements for construction of sample panel(s), and to coordinate the work. The Contractor shall be required to disclose their source of simulated stone masonry manufacturer and final coloration contractor at the Preconstruction Conference.

4.0 CONSTRUCTION

Simulated Stone Form Liner System and Surface Finish

The Contractor shall demonstrate his workmanship by first constructing a sample panel of the simulated stone masonry form liner pattern and coloration. The sample panel shall be constructed on site a minimum of six weeks prior to the construction of the walls. The sample panel shall measure 3’ height by 5’ length by 8” thick and shall be unreinforced, vertically cast, and of concrete construction to determine the surface texture resulting from the use of form liners. Sample panels shall be cast, finished, and stained until approved by the Engineer. The approved sample panel shall remain on site as the basis for comparison for work constructed on the project. The architectural surface treatment and pattern of the finished work shall achieve the same final effect as demonstrated on the approved sample panel. Upon completion of all work, the panel shall be removed from the site.

The simulated stone form liners are to be capable of withstanding anticipated concrete pour pressures without leakage or without causing physical or visual defects. The

simulated stone form liners are to be removable without causing concrete surface deterioration or weakness in the substrate. Form release agents, form stripping methods, patching materials, as well as related construction are to be in accordance with the manufacturer's recommendations or as directed by the Engineer.

Linear butt joints shall be carefully blended into the approved pattern and finished off the final concrete surface. No visible vertical or horizontal seams or conspicuous form marks created by butt joining will be permitted.

The Contractor shall submit the type of form ties to be used in this construction to the Engineer for approval prior to use. Form tie holes shall be finished in accordance with standard concreting practices and shall be acceptable to the Engineer. All patching material shall exactly match the color and appearance of the poured concrete surface.

Concrete surfaces shall be clean, free of laitance, dirt, dust, grease, efflorescence, paint, or other foreign material, following manufacturer's specifications for surface preparation prior to application of color stain. The surface area shall also be free of blemishes, discolorations, surface voids, and unnatural form marks. The Contractor is advised that sandblasting will not be allowed for cleaning concrete surfaces. Pressure washing for removal of laitance shall be used.

If required on the plans, the Contractor shall provide a Color Application Artist who is trained in the special techniques to achieve realistic surface appearances, if requested by the Engineer. To avoid contaminating or damaging the wall surfaces, color stain application shall be scheduled when all concrete work is completed, the concrete has cured a minimum of 28 days, the surface has been determined to be acceptable for coloring, and after adjacent earthwork is complete. The Contractor is to coordinate coloring applications without interference from other work. The Contractor is required to apply coloring to an appropriate test area of 50 square feet and as designated by the Engineer, which will serve as a quality standard for the remaining surface to be colored. Upon approval of the test area by the Engineer, the remaining surfaces may be colored. Stains shall be applied when ambient air temperatures are in accordance with manufacturer's specifications or as directed by the Engineer. The number of coats of stain applied shall be in accordance with manufacturer's specifications or as directed by the Engineer. Treated surfaces located adjacent to exposed soil or pavement shall be temporarily covered to prevent dirt or soil splatter from rain.

Following the completion of all work, repairs of any damage made by other construction operations shall be made to the form lined and colored surfaces as directed by the Engineer.

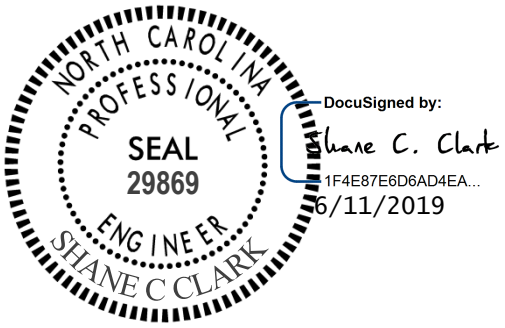
Experience and Qualifications - The Contractor shall have a minimum of three consecutive years of experience in architectural concrete surface treatment construction on similar types of projects. The Contractor shall furnish to the Engineer 5 references who were responsible for supervision of similar projects and will testify to the successful completion of these projects. Include name, address, telephone number, and specific type of application.

5.0 MEASUREMENT AND PAYMENT

Architectural concrete surface treatment as described in this Special Provision will be paid for at the contract unit price bid for "Architectural Concrete Surface Treatment". The payment quantity will be equal to the final installed wall quantity. Payment will include the furnishing and use of all form liners, the construction, finishing, staining, anti-graffiti coating and removal of all sample panels, and all equipment, materials, labor, and incidentals necessary to complete the work in conformance with the Contract Documents.

Payment will be made under:

Architectural Concrete Surface Treatment……...Square Feet



MECHANICALLY STABILIZED EARTH RETAINING WALLS (1-16-18)

1.0 GENERAL

Construct mechanically stabilized earth (MSE) retaining walls consisting of steel or geosynthetic reinforcement in the reinforced zone connected to vertical facing elements. Use precast concrete panels for vertical facing elements and coarse aggregate in the reinforced zone unless noted otherwise in the plans. Provide reinforced concrete coping and pile sleeves as required. Design and construct MSE retaining walls based on actual elevations and wall dimensions in accordance with the contract and accepted submittals. Use a prequalified MSE Wall Installer to construct MSE retaining walls.

Define MSE wall terms as follows:
Geosynthetic or *Geogrid Reinforcement* – Polyester Type (PET), HDPE or Polypropylene (PP) geogrid reinforcement,
Geogrid – PET, HDPE or PP geogrid,
Reinforcement – Steel or geogrid reinforcement,
Aggregate – Coarse or fine aggregate,
Panel – Precast concrete panel,
Coping – Precast or CIP concrete coping,
MSE Wall – Mechanically stabilized earth retaining wall,
MSE Wall Vendor – Vendor supplying the chosen MSE wall system,
MSE Panel Wall – MSE wall with panels,
MSE Segmental Wall – MSE wall with segmental retaining wall (SRW) units and
Abutment Wall – MSE wall with bridge foundations in any portion of the reinforced zone or an MSE wall connected to an abutment wall (Even if bridge foundations only penetrate a small part of the reinforced zone, the entire MSE wall is considered an abutment wall).

For bridge approach fills behind end bents with MSE abutment walls, design reinforcement connected to end bent caps in accordance with the plans and this provision. Construct Type III Reinforced Bridge Approach Fills in accordance with the *Bridge Approach Fills* provision and Roadway Detail Drawing No. 422D10.

Use an approved MSE wall system in accordance with the plans and any NCDOT restrictions or exceptions for the chosen system. Value engineering proposals for other MSE wall systems will not be considered. Do not use MSE wall systems with an "approved for provisional use" status for abutment walls or MSE walls subject to scour, walls with design heights greater than 35 ft or walls supporting or adjacent to railroads or interstate highways. The list of approved MSE wall systems with approval status is available from:
connect.ncdot.gov/resources/Geological/Pages/Products.aspx

2.0 MATERIALS

Refer to the *Standard Specifications*.

Item	Section
Aggregate	1014

Corrugated Steel Pipe	1032-3
Epoxy, Type 3A	1081
Geosynthetics	1056
Grout, Type 3	1003
Joint Materials	1028
Portland Cement Concrete, Class A	1000
Precast Retaining Wall Coping	1077
Reinforcing Steel	1070
Retaining Wall Panels	1077
Segmental Retaining Wall Units	1040-4
Select Material, Class V	1016
Shoulder Drain Materials	816-2
Steel Pipe	1036-4(A)

Use galvanized corrugated steel pipe with a zinc coating weight of 2 oz/sf (G200) for pile sleeves. Provide Type 2 geotextile for filtration and separation geotextiles. Use Class A concrete for CIP coping, leveling concrete and pads. Use galvanized steel pipe, threaded rods and nuts for the PET geogrid reinforcement vertical obstruction detail. Provide galvanized Grade 36 anchor rods and Grade A hex nuts that meet AASHTO M 314 for threaded rods and nuts.

Use panels and SRW units from producers approved by the Department and licensed by the MSE Wall Vendor. Provide steel strip connectors embedded in panels fabricated from structural steel that meets the requirements for steel strip reinforcement. Unless required otherwise in the contract, produce panels with a smooth flat final finish that meets Article 1077-11 of the *Standard Specifications*. Accurately locate and secure reinforcement connectors in panels and maintain required concrete cover. Produce panels within 1/4" of the panel dimensions shown in the accepted submittals.

Damaged panels or SRW units with excessive discoloration, chips or cracks as determined by the Engineer will be rejected. Do not damage reinforcement connection devices or mechanisms in handling or storing panels and SRW units.

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. Handle and store geotextiles and geogrids in accordance with Article 1056-2 of the *Standard Specifications*. Load, transport, unload and store MSE wall materials so materials are kept clean and free of damage. Bent, damaged or defective materials will be rejected.

A. Aggregate

Use standard size No. 57, 57M, 67 or 78M that meets Table 1005-1 of the *Standard Specifications* for coarse aggregate and the following for fine aggregate:

1. Standard size No. 1S, 2S, 2MS or 4S that meets Table 1005-2 of the *Standard Specifications* or

2. Gradation that meets Class III, Type 3 select material in accordance with Article 1016-3 of the *Standard Specifications*.

Fine aggregate is exempt from mortar strength in Subarticle 1014-1(E) of the *Standard Specifications*. Use fine aggregate with a maximum organic content of 1.0%. Provide aggregate with electrochemical properties that meet the following requirements:

AGGREGATE pH REQUIREMENTS		
Aggregate Type (in reinforced zone)	**Reinforcement or Connector Material**	**pH**
Coarse or Fine	Steel	5 – 10
Coarse or Fine	PET	5 – 8
Coarse or Fine	Polyolefin (HDPE or Polypropylene)	4.5 – 9

AGGREGATE CHEMICAL REQUIREMENTS (Steel Reinforcement/Connector Materials Only)			
Aggregate Type (in reinforced zone)	**Resistivity**	**Chlorides**	**Sulfates**
Coarse	≥ 5,000 Ω · cm	≤ 100 ppm	≤ 200 ppm
Fine	≥ 3,000 Ω · cm		

Use aggregate from sources participating in the Department's Aggregate QC/QA Program as described in Section 1006 of the *Standard Specifications*. Sample and test aggregate in accordance with the *Mechanically Stabilized Earth Wall Aggregate Sampling and Testing Procedures*. Electrochemical testing is only required for coarse aggregate from sources in the Coastal Plain as defined by Subarticle 1018-2(B)(1).

B. Reinforcement

Provide steel or geosynthetic reinforcement supplied by the MSE Wall Vendor or a manufacturer approved or licensed by the vendor. Use reinforcement approved for the chosen MSE wall system. The list of approved reinforcement for each MSE wall system is available from the website shown elsewhere in this provision.

1. Steel Reinforcement

Provide Type 1 material certifications in accordance with Article 106-3 of the *Standard Specifications* for steel reinforcement. Use welded wire grid reinforcement ("mesh", "mats" and "ladders") that meet Article 1070-3 of the *Standard Specifications* and steel strip reinforcement ("straps") that meet ASTM A572, A1011 or A463. Use 10 gauge or heavier structural steel Grade 50 or higher for steel strip reinforcement. Galvanize steel reinforcement in accordance with Section 1076 of the *Standard Specifications* or provide aluminized steel strip reinforcement that meet ASTM A463, Type 2-100.

2. Geosynthetic Reinforcement

Use HDPE or PP geogrid for geogrid reinforcement connected to backwalls of end bent caps. Use PET or HDPE geogrid for geogrid reinforcement connected to SRW units and only HDPE geogrid for geogrid reinforcement connected to panels.

Define machine direction (MD) and cross-machine direction (CD) for geogrids per Article 1056-3 of the *Standard Specifications*. Provide Type 1 material certifications and identify geogrid reinforcement in accordance with Article 1056-3 of the *Standard Specifications*.

Provide extruded geogrids manufactured from punched and drawn polypropylene sheets for PP geogrids that meet the following:

PP GEOGRID REQUIREMENTS		
Property	**Requirement[1]**	**Test Method**
Aperture Dimensions[2]	1" x 1.2"	N/A
Minimum Rib Thickness[2]	0.07" x 0.07"	N/A
Tensile Strength @ 2% Strain[2]	580 lb/ft x 690 lb/ft	ASTM D6637, Method A
Tensile Strength @ 5% Strain[2]	1,200 lb/ft x 1,370 lb/ft	
Ultimate Tensile Strength[2]	1,850 lb/ft x 2,050 lb/ft	
Junction Efficiency[3] (MD)	93%	ASTM D7737
Flexural Rigidity[4]	2,000,000 mg–cm	ASTM D7748
Aperture Stability Modulus[5]	0.55 lb–ft/degrees	ASTM D7864
UV Stability (Retained Strength)	100% (after 500 hr of exposure)	ASTM D4355

1. MARV per Article 1056-3 of the *Standard Specifications* except dimensions and thickness are nominal.
2. Requirement for MD x CD.
3. Junction Efficiency (%) = (Average Junction Strength ($X_{j_{ave}}$) / Ultimate Tensile Strength in the MD from ASTM D6637, Method A) × 100.
4. Test specimens two ribs wide, with transverse ribs cut flush with exterior edges of longitudinal ribs, and sufficiently long to enable measurement of the overhang dimension.
5. Applied moment of 17.7 lb–inch (torque increment).

C. Bearing Pads

For MSE panel walls, use bearing pads that meet Section 3.6.1.a of the *FHWA Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes – Volume I* (Publication No. FHWA-NHI-10-024) except durometer hardness for rubber pads may be 60 or 80 ± 5 and density testing for HDPE pads may be in accordance with ASTM D1505 or D792. Provide bearing pads with thicknesses that meet the following:

BEARING PAD THICKNESS	
Facing Area per Panel (A)	**Minimum Pad Thickness After Compression (based on 2 times panel weight above pads)**

$A \leq 30$ sf	1/2"
30 sf $< A \leq 75$ sf	3/4"

D. Miscellaneous Components

Miscellaneous components may include connectors (e.g., anchors, bars, clamps, pins, plates, ties, etc.), fasteners (e.g., bolts, nuts, washers, etc.) and any other MSE wall components not included above. Galvanize steel components in accordance with Section 1076 of the *Standard Specifications*. Provide miscellaneous components approved for the chosen MSE wall system. The list of approved miscellaneous components for each MSE wall system is available from the website shown elsewhere in this provision.

3.0 PRECONSTRUCTION REQUIREMENTS

A. MSE Wall Surveys

The Retaining Wall Plans show a plan view, typical sections, details, notes and an elevation or profile view (wall envelope) for each MSE wall. Before beginning MSE wall design, survey existing ground elevations shown in the plans and other elevations in the vicinity of MSE wall locations as needed. For proposed slopes above or below MSE walls, survey existing ground elevations to at least 10 ft beyond slope stake points. Based on these elevations, finished grades and actual MSE wall dimensions and details, submit revised wall envelopes for acceptance. Use accepted wall envelopes for design.

B. MSE Wall Designs

For MSE wall designs, submit PDF files of working drawings and design calculations at least 30 days before the preconstruction meeting. Note name and NCDOT ID number of the panel or SRW unit production facility on working drawings. Do not begin MSE wall construction until a design submittal is accepted.

Use a prequalified MSE Segmental Wall Design Consultant to design MSE segmental walls. Provide MSE segmental wall designs sealed by a Design Engineer approved as a Geotechnical Engineer (key person) for the MSE Segmental Wall Design Consultant. Provide MSE panel wall designs sealed by a Design Engineer licensed in the state of North Carolina and employed or contracted by the MSE Wall Vendor.

Design MSE walls in accordance with the plans, *AASHTO LRFD Bridge Design Specifications* and any NCDOT restrictions for the chosen MSE wall system unless otherwise required. Design MSE walls for seismic if walls are located in seismic zone 2 based on Figure 2-1 of the *Structure Design Manual*. Connect reinforcement to panels or SRW units with methods or devices approved for the chosen system. Use a uniform reinforcement length throughout the wall height of at least 0.7H with H as shown in the plans or 6 ft, whichever is longer, unless noted otherwise in the plans. Extend the reinforced zone at least 6" beyond end of reinforcement. Do not locate

drains, the reinforced zone or leveling pads outside right-of-way or easement limits.

Use the simplified method for determining maximum reinforcement loads and design parameters approved for the chosen MSE wall system or default values in accordance with the AASHTO LRFD specifications. Design steel components including reinforcement and connectors for the design life noted in the plans and aggregate type in the reinforced zone. If an MSE wall system with geogrid reinforcement includes any steel parts for obstructions, bin walls, connections or other components, design steel exposed to aggregate for the design life noted in the plans and aggregate type in the reinforced zone. Use "loss of galvanizing" metal loss rates for nonaggressive backfill in accordance with the AASHTO LRFD specifications for galvanized and aluminized steel and metal loss rates for carbon steel in accordance with the following:

CARBON STEEL CORROSION RATES	
Aggregate Type (in reinforced zone)	**Carbon Steel Loss Rate (after coating depletion)**
Coarse	0.47 mil/year
Fine (except abutment walls)	0.58 mil/year
Fine (abutment walls)	0.70 mil/year

For PET or HDPE geogrid reinforcement and geosynthetic connectors, use approved geosynthetic properties for the design life noted in the plans and aggregate type in the reinforced zone. For geogrid reinforcement connected to end bent caps, embed geosynthetic reinforcement or connectors in caps as shown in the plans. For PP geogrid reinforcement connected to end bent caps, use the following design parameters for the aggregate type in the reinforced approach fill.

PP GEOGRID REINFORCEMENT DESIGN PARAMETERS				
Aggregate Type (in reinforced zone)	**T_{al} (MD)**	**F***	**α**	**ρ**
Coarse	400 lb/ft	0.70	0.8	32.0°
Fine	428 lb/ft	0.54	0.8	28.35°

Where,

T_{al} = long-term design strength (LTDS),
F* = pullout resistance factor,
α = scale effect correction factor and
ρ = soil-geogrid friction angle.

When noted in the plans, design MSE walls for a live load (traffic) surcharge of 250 psf in accordance with Figure C11.5.6-3(b) of the AASHTO LRFD specifications. For steel beam guardrail with 8 ft posts or concrete barrier rail above MSE walls, analyze top 2 reinforcement layers for traffic impact loads in accordance with Section 7.2 of the FHWA MSE wall manual shown elsewhere in this provision except use the following for geosynthetic reinforcement rupture:

$$\phi\, T_{al}\, R_c \geq T_{max} + (T_I / RF_{CR})$$

Where,

ϕ = resistance factor for tensile resistance in accordance with Section 7.2.1 of the FHWA MSE wall manual,

T_{al} = long-term geosynthetic design strength approved for chosen MSE wall system,

R_c = reinforcement coverage ratio = 1 for continuous geosynthetic reinforcement,

T_{max} = factored static load in accordance with Section 7.2 of the FHWA MSE wall manual,

T_I = factored impact load in accordance with Section 7.2 of the FHWA MSE wall manual and

RF_{CR} = creep reduction factor approved for chosen MSE wall system.

When shown in the plans for abutment walls, use pile sleeves to segregate piles from aggregate in the reinforced zone. If existing or future obstructions such as foundations, guardrail, fence or handrail posts, moment slabs, pavements, pipes, inlets or utilities will interfere with reinforcement, maintain a clearance of at least 3" between obstructions and reinforcement unless otherwise approved. Design reinforcement for obstructions and locate reinforcement layers so all of reinforcement length is within 3" of corresponding connection elevations. Modify PET geogrid reinforcement for obstructions as shown in the plans.

Use 6" thick CIP unreinforced concrete leveling pads beneath panels and SRW units that are continuous at steps and extend at least 6" in front of and behind bottom row of panels or SRW units. Unless required otherwise in the plans, embed top of leveling pads in accordance with the following requirements:

EMBEDMENT REQUIREMENTS		
Front Slope[1] (H:V)	**Minimum Embedment Depth[2] (whichever is greater)**	
6:1 or flatter (except abutment walls)	H/20	1 ft for H ≤ 10 ft 2 ft for H > 10 ft
6:1 or flatter (abutment walls)	H/10	2 ft
> 6:1 to < 3:1	H/10	2 ft
3:1 to 2:1	H/7	2 ft

1. Front slope is as shown in the plans.

2. Define "H" as the maximum design height plus embedment per wall with the design height and embedment as shown in the plans.

When noted in the plans, locate a continuous aggregate shoulder drain along the base of the reinforced zone behind the aggregate. Provide wall drainage systems consisting of drains and outlet components in accordance with Roadway Standard Drawing No. 816.02.

For MSE panel walls, cover joints at back of panels with filtration geotextiles at least 12" wide. If the approval of the chosen MSE wall system does not require a minimum

number of bearing pads, provide the number of pads in accordance with the following:

NUMBER OF BEARING PADS		
Facing Area per Panel (A)	**Maximum Wall Height Above Horizontal Panel Joint**	**Minimum Number of Pads per Horizontal Panel Joint**
A ≤ 30 sf	25 ft	2
	35 ft[1]	3
30 sf < A ≤ 75 sf	25 ft	3
	35 ft[1]	4

1. Additional bearing pads per horizontal panel joint may be required for wall heights above joints greater than 35 ft.

For MSE segmental walls, coarse aggregate is required in any SRW unit core spaces and between and behind SRW units for a horizontal distance of at least 18". Separation geotextiles are required between the aggregate and overlying fill or pavement sections except when concrete pavement, full depth asphalt or cement treated base is placed directly on aggregate. When noted in the plans, separation geotextiles are also required at the back of the reinforced zone between the aggregate and backfill or natural ground. Unless required otherwise in the plans, use reinforced concrete coping at top of walls that meets the following requirements:

1. Coping dimensions as shown in the plans,
2. At the Contractor's option, coping that is precast or CIP concrete for MSE panel walls unless CIP coping is required as shown in the plans,
3. CIP concrete coping for MSE segmental walls and
4. At the Contractor's option and when shown in the plans, CIP concrete coping that extends down back of panels or SRW units or connects to panels or SRW units with dowels.

For MSE segmental walls with dowels, attach dowels to top courses of SRW units in accordance with the following:

1. Set dowels in core spaces of SRW units filled with grout instead of coarse aggregate or
2. Embed adhesively anchored dowels in holes of solid SRW units with epoxy.

For MSE panel walls with coping, connect CIP concrete coping or leveling concrete for precast concrete coping to top row of panels with dowels cast into panels. When concrete barrier rail is required above MSE walls, use concrete barrier rail with moment slab as shown in the plans.

Submit working drawings and design calculations for acceptance in accordance with Article 105-2 of the *Standard Specifications*. Submit working drawings showing plan views, wall profiles with foundation pressures, typical sections with reinforcement and

connection details, aggregate locations and types, geotextile locations and details of leveling pads, panels or SRW units, coping, bin walls, slip joints, pile sleeves, etc. If necessary, include details on working drawings for concrete barrier rail with moment slab, reinforcement splices if allowed for the chosen MSE wall system, reinforcement connected to end bent caps, curved MSE walls with tight (short) radii and obstructions extending through walls or interfering with reinforcement, leveling pads, barriers or moment slabs. Submit design calculations for each wall section with different surcharge loads, geometry or material parameters. At least one analysis is required for each wall section with different reinforcement lengths. When designing MSE walls with computer software other than MSEW, use MSEW, version 3.0 with update 14.96 or later, manufactured by ADAMA Engineering, Inc. to verify the design. At least one MSEW analysis is required per 100 ft of wall length with at least one analysis for the wall section with the longest reinforcement. Submit electronic MSEW input files and PDF output files with design calculations.

C. Preconstruction Meeting

Before starting MSE wall construction, hold a preconstruction meeting to discuss the construction and inspection of the MSE walls. If this meeting occurs before all MSE wall submittals have been accepted, additional preconstruction meetings may be required before beginning construction of MSE walls without accepted submittals. The Resident or Bridge Maintenance Engineer, Area Construction Engineer, Geotechnical Operations Engineer, Contractor and MSE Wall Installer Superintendent will attend preconstruction meetings.

4.0 CORROSION MONITORING

Corrosion monitoring is required for MSE walls with steel reinforcement. The Engineer will determine the number of monitoring locations and where to install the instrumentation. Contact M&T before beginning wall construction. M&T will provide the corrosion monitoring instrumentation kits and if necessary, assistance with installation.

5.0 SITE ASSISTANCE

Unless otherwise approved, an MSE Wall Vendor representative is required to assist and guide the MSE Wall Installer on-site for at least 8 hours when the first panels or SRW units and reinforcement layer are placed. If problems are encountered during construction, the Engineer may require the vendor representative to return to the site for a time period determined by the Engineer.

6.0 CONSTRUCTION METHODS

Control drainage during construction in the vicinity of MSE walls. Direct run off away from MSE walls, aggregate and backfill. Contain and maintain aggregate and backfill and protect material from erosion.

Excavate as necessary for MSE walls in accordance with the accepted submittals. If applicable and at the Contractor's option, use temporary shoring for wall construction

instead of temporary slopes to construct MSE walls. Define "temporary shoring for wall construction" as temporary shoring not shown in the plans or required by the Engineer including shoring for OSHA reasons or the Contractor's convenience.

Unless required otherwise in the plans, install foundations and if required, pile sleeves located in the reinforced zone before placing aggregate or reinforcement. Brace piles in the reinforced zone to maintain alignment when placing and compacting aggregate. Secure piles together with steel members near top of piles. Clamp members to piles instead of welding if bracing is at or below pile cut-off elevations.

Notify the Engineer when foundation excavation is complete. Do not place leveling pad concrete, aggregate or reinforcement until excavation dimensions and foundation material are approved.

Construct CIP concrete leveling pads at elevations and with dimensions shown in the accepted submittals and in accordance with Section 420 of the *Standard Specifications*. Cure leveling pads at least 24 hours before placing panels or SRW units.

Erect and support panels and stack SRW units so the final wall position is as shown in the accepted submittals. Stagger SRW units to create a running bond by centering SRW units over joints in the row below as shown in the accepted submittals. Space bearing pads in horizontal panel joints as shown in the accepted submittals and cover all panel joints with filtration geotextiles as shown in the accepted submittals. Attach filtration geotextiles to back of panels with adhesives, tapes or other approved methods.

Construct MSE walls with the following tolerances:

A. SRW units are level from front to back and between units when checked with a 4 ft long level,

B. Vertical joint widths are 1/4" maximum for SRW units and 3/4", ±1/4" for panels,

C. Final wall face is within 3/4" of horizontal and vertical alignment shown in the accepted submittals when measured along a 10 ft straightedge and

D. Final wall plumbness (batter) is not negative (wall face leaning forward) and within 0.5° of vertical unless otherwise approved.

Place reinforcement at locations and elevations shown in the accepted submittals and within 3" of corresponding connection elevations. Install reinforcement with the direction shown in the accepted submittals. Before placing aggregate, pull geogrid reinforcement taut so it is in tension and free of kinks, folds, wrinkles or creases. Reinforcement may be spliced once per reinforcement length if shown in the accepted submittals. Use reinforcement pieces at least 6 ft long. Contact the Engineer when unanticipated existing or future obstructions such as foundations, guardrail, fence or handrail posts, pavements, pipes, inlets or utilities will interfere with reinforcement. To avoid obstructions, deflect, skew or modify reinforcement as shown in the accepted submittals.

Place aggregate in the reinforced zone in 8" to 10" thick lifts. Compact fine aggregate in accordance with Subarticle 235-3(C) of the *Standard Specifications*. Use only hand

operated compaction equipment to compact aggregate within 3 ft of panels or SRW units. At a distance greater than 3 ft, compact aggregate with at least 4 passes of an 8 ton to 10 ton vibratory roller in a direction parallel to the wall face. Smooth wheeled or rubber tired rollers are also acceptable for compacting aggregate. Do not use sheepsfoot, grid rollers or other types of compaction equipment with feet. Do not displace or damage reinforcement when placing and compacting aggregate. End dumping directly on geogrids is not permitted. Do not operate heavy equipment on reinforcement until it is covered with at least 8" of aggregate. Replace any damaged reinforcement to the satisfaction of the Engineer.

Backfill for MSE walls outside the reinforced zone in accordance with Article 410-8 of the *Standard Specifications*. If a drain is required, install wall drainage systems as shown in the accepted submittals and in accordance with Section 816 of the *Standard Specifications*. If pile sleeves are required, fill sleeves with loose uncompacted sand before constructing end bent caps.

Install dowels as necessary for SRW units and place and construct coping and leveling concrete as shown in the accepted submittals. Construct leveling concrete in accordance with Section 420 of the *Standard Specifications*. Construct CIP concrete coping in accordance with Subarticle 452-4(B) of the *Standard Specifications*. When single faced precast concrete barrier is required in front of and against MSE walls, stop coping just above barrier so coping does not interfere with placing barrier up against wall faces. If the gap between a single faced barrier and wall face is wider than 2", fill gap with Class V select material (standard size No. 78M stone). Otherwise, fill gap with backer rod and seal joint between barrier and MSE wall with silicone sealant.

When separation geotextiles are required, overlap adjacent geotextiles at least 18" and hold geotextiles in place with wire staples or anchor pins as needed. Seal joints above and behind MSE walls between coping and concrete slope protection with silicone sealant.

7.0 MEASUREMENT AND PAYMENT

MSE Retaining Wall No. __ will be measured and paid in square feet. MSE walls will be measured as the square feet of wall face area with the pay height equal to the difference between top of wall and top of leveling pad elevations. Define “top of wall” as top of coping or top of panels or SRW units for MSE walls without coping.

The contract unit price for *MSE Retaining Wall No. __* will be full compensation for providing designs, submittals, labor, tools, equipment and MSE wall materials, excavating, backfilling, hauling and removing excavated materials and supplying site assistance, leveling pads, panels, SRW units, reinforcement, aggregate, wall drainage systems, geotextiles, bearing pads, coping, miscellaneous components and any incidentals necessary to construct MSE walls. The contract unit price for *MSE Retaining Wall No. __* will also be full compensation for reinforcement and connector design for reinforcement connected to end bent caps, wall modifications for obstructions, pile sleeves filled with sand, joints sealed with silicone sealant and gaps between barriers and MSE walls filled with backer rod or No. 78M stone, if required.

No separate payment will be made for temporary shoring for wall construction. Temporary shoring for wall construction will be incidental to the contract unit price for *MSE Retaining Wall No. __*.

The contract unit price for *MSE Retaining Wall No. __* does not include the cost for ditches, fences, handrails, barrier or guardrail associated with MSE walls as these items will be paid for elsewhere in the contract. The contract unit price for *MSE Retaining Wall No. __* also does not include the cost for constructing bridge approach fills behind end bents with MSE abutment walls. See *Bridge Approach Fills* provision for measurement and payment of Type III Reinforced Bridge Approach Fills.

Where it is necessary to provide backfill material behind the reinforced zone from sources other than excavated areas or borrow sources used in connection with other work in the contract, payment for furnishing and hauling such backfill material will be paid as extra work in accordance with Article 104-7 of the *Standard Specifications*. Placing and compacting such backfill material is not considered extra work but is incidental to the work being performed.

Payment will be made under:

Pay Item	**Pay Unit**
MSE Retaining Wall No. __	Square Foot



DocuSigned by:
Scott A. Hidden
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4/22/2019

SOIL NAIL RETAINING WALLS (SPECIAL)

1.0 GENERAL

Construct soil nail retaining walls consisting of soil nails spaced at a regular pattern and connected to a CIP reinforced concrete face. A soil nail consists of a steel bar grouted in a drilled hole inclined at an angle below horizontal. Use shotcrete for temporary support of excavations during construction. Design and construct soil nail retaining walls based on actual elevations and wall dimensions in accordance with the contract and accepted submittals. Use a prequalified Anchored Wall Contractor to construct soil nail retaining walls. Define "soil nail wall" as a soil nail retaining wall and "Soil Nail Wall Contractor" as the Anchored Wall Contractor installing soil nails and applying shotcrete. Define "nail" as a soil nail and "concrete facing" as a CIP reinforced concrete face.

Soil nail wall AASHTO design references and soil nail AASHTO material and testing requirements referred to in this provision are included in the 8th Edition of the *AASHTO LRFD Bridge Design Specifications* and the 4th Edition of the *AASHTO LRFD Bridge Construction Specifications*, respectively as approved AASHTO ballot items available from: connect.ncdot.gov/resources/Geological/Pages/Geotech_Requirements_References.aspx

2.0 MATERIALS

Refer to the *Standard Specifications*.

Item	Section
Geosynthetics	1056
Joint Materials	1028
Masonry	1040
Portland Cement	1024-1
Portland Cement Concrete, Class A	1000
Reinforcing Steel	1070
Select Material, Class VI	1016
Shotcrete	1002
Shoulder Drain Materials	816-2
Steel Plates	1072-2
Water	1024-4
Welded Stud Shear Connectors	1072-6

Provide Class VI select material (standard size No. 57 stone) for leveling pads. Use neat cement grout that only contains cement and water with a water cement ratio of 0.4 to 0.5 which is approximately 5.5 gallons of water per 94 lb of Portland cement. Provide grout with a compressive strength at 3 and 28 days of at least 1,500 psi and 4,000 psi, respectively.

Provide soil nails consisting of grouted steel bars and nail head assemblies. Use deformed steel bars that meet AASHTO M 275 or M 31, Grade 60, 75 or 80. Splice bars in accordance with Article 1070-9 of the *Standard Specifications*.

Provide epoxy coated bars that meet Article 1070-7 of the *Standard Specifications*. Provide

Class A corrosion protection (encapsulated bar) or Class B corrosion protection (epoxy coated bar only, no galvanized bar) for soil nails in accordance with Article X.3.3 of the *AASHTO LRFD Bridge Construction Specifications*. Use centralizers that meet Article X.3.4 of the AASHTO LRFD specifications.

Provide nail head assemblies consisting of nuts, washers and bearing plates with welded stud shear connectors. Use steel plates for bearing plates and steel washers and hex nuts recommended by the Soil Nail Manufacturer.

Provide Type 3 material certifications for soil nail materials in accordance with Article 106-3 of the *Standard Specifications*. 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 soil nail wall materials so materials are kept clean and free of damage. Do not crack, fracture or otherwise damage grout inside sheaths of encapsulated nails. Bent, damaged or defective materials will be rejected.

3.0 PRECONSTRUCTION REQUIREMENTS

A. Soil Nail Wall Surveys

The Retaining Wall Plans show a plan view, typical sections, details, notes and an elevation or profile view (wall envelope) for each soil nail wall. Before beginning soil nail wall design, survey existing ground elevations shown in the plans and other elevations in the vicinity of soil nail wall locations as needed. For proposed slopes above or below soil nail walls, survey existing ground elevations to at least 10 ft beyond slope stake points. Based on these elevations, finished grades and actual soil nail wall dimensions and details, submit revised wall envelopes for acceptance. Use accepted wall envelopes for design.

B. Soil Nail Wall Designs

For soil nail wall designs, submit PDF files of working drawings and design calculations at least 30 days before the preconstruction meeting. Do not begin soil nail wall construction until a design submittal is accepted.

Use a prequalified Anchored Wall Design Consultant to design soil nail walls. Provide designs sealed by a Design Engineer approved as a Geotechnical Engineer (key person) for the Anchored Wall Design Consultant.

Design soil nail walls in accordance with the plans and the *AASHTO LRFD Bridge Design Specifications* unless otherwise required. Design soil nail walls for seismic if walls are located in seismic zone 2 based on Figure 2-1 of the *Structure Design Manual*.

Design soil nails that meet the following unless otherwise approved:

1. Horizontal and vertical spacing of at least 3 ft,
2. Inclination of at least 12° below horizontal,

3. Clearance between ends of bars and drill holes of at least 6",
4. Grout cover between epoxy coated bars and drill hole walls of at least 1" or in accordance with Article 11.12.8 of the AASHTO LRFD specifications for encapsulated bars and
5. Diameter of 6" to 10".

Four inch diameter soil nails may be approved for nails in rock at the discretion of the Engineer. Do not extend nails beyond right-of-way or easement limits. If existing or future obstructions such as foundations, guardrail, fence or handrail posts, pavements, pipes, inlets or utilities will interfere with nails, maintain a clearance of at least 6" between obstructions and nails.

When noted in the plans, design soil nail walls for a live load (traffic) surcharge of 250 psf. For steel beam guardrail with 8 ft posts above soil nail walls, analyze walls for a nominal horizontal load of 300 lb/ft of wall with a load factor of 1.0. For concrete barrier rail above soil nail walls, analyze walls for a nominal horizontal load of 500 lb/ft of wall with a load factor of 1.0.

Provide wall drainage systems consisting of geocomposite sheet drains, an aggregate shoulder drain and outlet components. Place sheet drains with a horizontal spacing of no more than 10 ft and center drains between adjacent nails. Attach sheet drains to excavation faces and connect drains to aggregate leveling pads. Locate a continuous aggregate shoulder drain along the base of concrete facing in front of leveling pads. Provide aggregate shoulder drains and outlet components in accordance with Roadway Standard Drawing No. 816.02.

Use No. 57 stone for aggregate leveling pads. Use 6" thick leveling pads beneath concrete facing. Unless required otherwise in the plans, embed top of leveling pads at least 12" below bottom of walls shown in the plans.

Design shotcrete and concrete facing in accordance with the plans and Article 11.12.6.2 of the *AASHTO LRFD Bridge Design Specifications*. Use shotcrete and concrete facing with the dimensions shown in the plans and attach facing to nail heads with welded stud shear connectors. When concrete barrier rail is required above soil nail walls, use concrete barrier rail with moment slab as shown in the plans.

Submit working drawings and design calculations including unit grout/ground bond strengths for acceptance in accordance with Article 105-2 of the *Standard Specifications*. Submit working drawings showing plan views, wall profiles with nail locations including known test nail locations, typical sections and details of nails, drainage, shotcrete, leveling pads and concrete facing. If necessary, include details on working drawings for concrete barrier rail with moment slab and obstructions extending through walls or interfering with nails, barriers or moment slabs. Submit design calculations for each wall section with different surcharge loads, geometry or material parameters. Include analysis of temporary conditions in design calculations. At least one analysis is required for each wall section with different nail lengths. Analyze internal and compound stability with a

computer software program that uses limit equilibrium methods and submit all PDF output files from the program with the design calculations. See Article C11.12.2 of the AASHTO LRFD specifications for determining the maximum soil nail force, T_{maxsn}.

When designing soil nail walls with computer software Snail manufactured by the California Department of Transportation (CALTRANS), use Snail, version 2.2.0 or later, to calculate factors of safety and T_{maxsn} values in accordance with the following:

1. Allowable Stress Design for Analysis Method,

2. Perform Below Toe Search option selected when any soil layer has a friction angle less than 30° and

3. Default value of 0.33 for Interface Friction Reduction Factor.

When designing soil nail walls with computer software other than Snail, use bi-linear (or tri-linear, as applicable) search surfaces intended to reproduce Snail results. Factors of safety and T_{maxsn} values are acceptable if they are within 5% of the factors of safety and T_{maxsn} values calculated by the Engineer using the computer software Slide2 manufactured by Rocscience, Inc.

C. Soil Nail Wall Construction Plan

Submit a PDF file of a soil nail wall construction plan at least 30 days before the preconstruction meeting. Do not begin soil nail wall construction until the construction plan submittal is accepted. Provide detailed project specific information in the soil nail wall construction plan that includes the following:

1. Overall description and sequence of soil nail wall construction;
2. List and sizes of excavation equipment, drill rigs and tools, tremies and grouting equipment;
3. Procedures for excavations, drilling and grouting, soil nail and wall drainage system installation and facing construction;
4. Details of shotcrete equipment and application including mix process, test panels, thickness gauges and shooting methods;
5. Shotcrete nozzleman with certification in accordance with Article 1002-1 of the *Standard Specifications*;
6. Plan and methods for nail testing with calibration certificates dated within 90 days of the submittal date;
7. Examples of construction and test nail records to be used in accordance with Sections 4.0(F) and 5.0(E) of this provision;
8. Grout mix design with acceptable ranges for grout flow and density;
9. Shotcrete mix design that meets Section 1002 of the *Standard Specifications*; and
10. Other information shown in the plans or requested by the Engineer.

If alternate construction procedures are proposed or necessary, a revised soil nail wall construction plan submittal may be required. If the work deviates from the accepted submittal without prior approval, the Engineer may suspend soil nail wall construction until a revised plan is accepted.

D. Preconstruction Meeting

Before starting soil nail wall construction, hold a preconstruction meeting to discuss the construction, inspection and testing of the soil nail walls. If this meeting occurs before all soil nail wall submittals have been accepted, additional preconstruction meetings may be required before beginning construction of soil nail walls without accepted submittals. The Resident or Bridge Maintenance Engineer, Area Construction Engineer, Geotechnical Operations Engineer, Contractor and Soil Nail Wall Contractor Superintendent will attend preconstruction meetings.

4.0 CONSTRUCTION METHODS

Control drainage during construction in the vicinity of soil nail walls. Direct run off away from soil nail walls and areas above and behind walls.

Notify the Engineer before blasting in the vicinity of soil nail walls. Perform blasting in accordance with the contract. Unless required otherwise in the plans, install foundations located behind soil nail walls before beginning wall construction.

Install soil nail walls in accordance with the accepted submittals and as directed. Do not excavate behind soil nail walls. If overexcavation occurs, repair walls with an approved method and a revised soil nail wall design or construction plan may be required.

A. Excavation

Excavate for soil nail walls from the top down in accordance with the accepted submittals. Excavate in staged horizontal lifts with no negative batter (excavation face leaning forward). Excavate lifts in accordance with the following:

1. Heights not to exceed vertical nail spacing,
2. Bottom of lifts no more than 3 ft below nail locations for current lift and
3. Horizontal and vertical alignment within 2" of location shown in the accepted submittals.

Remove any cobbles, boulders, rubble or debris that will protrude more than 2" into the required shotcrete thickness. Rocky ground such as colluvium, boulder fills and weathered rock may be difficult to excavate without leaving voids.

Apply shotcrete to excavation faces within 24 hours of excavating each lift unless otherwise approved. Shotcreting may be delayed if it can be demonstrated that delays will not adversely affect excavation stability. If excavation faces will be exposed for more than 24 hours, use polyethylene sheets anchored at top and bottom of lifts to protect

excavation faces from changes in moisture content.

If an excavation becomes unstable at any time, suspend soil nail wall construction and temporarily stabilize the excavation by immediately placing an earth berm up against the unstable excavation face. When this occurs, repair walls with an approved method and a revised soil nail wall design or construction plan may be required.

Do not excavate the next lift until nail installations and testing and shotcrete application for the current lift are accepted and grout and shotcrete for the current lift have cured at least 3 days and 1 day, respectively.

B. Soil Nails

Install soil nails in the same way as acceptable test nails. Drill and grout nails the same day and do not leave drill holes open overnight.

Control drilling and grouting to prevent excessive ground movements, damaging structures and pavements or fracturing rock and soil formations. If ground heave or subsidence occurs, suspend soil nail wall construction and take corrective action to minimize movement. If property damage occurs, make repairs with an approved method and a revised soil nail wall design or construction plan may be required.

1. Drilling

Use drill rigs of the sizes necessary to install soil nails and with sufficient capacity to drill through whatever materials are encountered. Drill straight and clean holes with the dimensions and inclination shown in the accepted submittals. Drill holes within 6" of locations and 2° of inclination shown in the accepted submittals unless otherwise approved.

Stabilize drill holes with temporary casings if unstable, caving or sloughing material is anticipated or encountered. Do not use drilling fluids to stabilize drill holes or remove cuttings.

2. Steel Bars

Center steel bars in drill holes with centralizers. Securely attach centralizers along bars at no more than 8 ft centers. Attach uppermost and lowermost centralizers 18" from excavation faces and ends of holes.

Do not insert steel bars into drill holes until hole locations, dimensions, inclination and cleanliness are approved. Do not vibrate, drive or otherwise force bars into holes. If a steel bar cannot be completely and easily inserted into a drill hole, remove the bar and clean or redrill the hole.

3. Grouting

Mix and place grout in accordance with Subarticles 1003-5, 1003-6 and 1003-7 of

the *Standard Specifications*. Remove oil, rust inhibitors, residual drilling fluids and similar foreign materials from holding tanks/hoppers, stirring devices, pumps, lines, tremie pipes and any other equipment in contact with grout before use. Measure grout temperature, density and flow during grouting with at least the same frequency grout cubes are made for compressive strength. Perform density and flow field tests in the presence of the Engineer in accordance with American National Standards Institute/American Petroleum Institute Recommended Practice 13B-1 (Section 4, Mud Balance) and ASTM C939 (Flow Cone), respectively.

Inject grout at the lowest point of drill holes through tremies, e.g., grout tubes, casings, hollow-stem augers or drill rods, in one continuous operation. Fill drill holes progressively from ends of holes to excavation faces and withdraw tremies at a slow even rate as holes are filled to prevent voids in grout. Extend tremies into grout at least 5 ft at all times except when grout is initially placed in holes.

Provide grout free of segregation, intrusions, contamination, structural damage or inadequate consolidation (honeycombing). Cold joints in grout are not allowed except for test nails. Remove any temporary casings as grout is placed and record grout volume for each drill hole.

4. Nail Heads

Weld stud shear connectors to bearing plates of nails in accordance with Article 1072-6 of the *Standard Specifications*. Install nail head assemblies after shotcreting. Before shotcrete reaches initial set, seat bearing plates and tighten nuts so plates contact shotcrete uniformly. If uniform contact is not possible, install nail head assemblies on mortar pads so nail heads are evenly loaded.

C. Wall Drainage Systems

Install wall drainage systems as shown in the accepted submittals and in accordance with Section 816 of the *Standard Specifications*. Before installing shotcrete reinforcement, place geocomposite sheet drains with the geotextile side against excavation faces. For highly irregular faces and at the discretion of the Engineer, sheet drains may be placed after shotcreting over weep holes through the shotcrete. Hold sheet drains in place with anchor pins so drains are in continuous contact with surfaces to which they are attached and allow for full flow the entire height of soil nail walls. Discontinuous sheet drains are not allowed. If splices are needed, overlap sheet drains at least 12" so flow is not impeded. Connect sheet drains to aggregate leveling pads by embedding drain ends at least 4" into No. 57 stone.

D. Shotcrete

Clean ungrouted zones of drill holes and excavation faces of loose materials, mud, rebound and other foreign material. Moisten surfaces to receive shotcrete. Install shotcrete reinforcement in accordance with the contract and accepted submittals. Secure reinforcing steel so shooting does not displace or vibrate reinforcement. Install approved thickness gauges on 5 ft centers in the horizontal and vertical directions to measure

shotcrete thickness.

Apply shotcrete in accordance with the contract, accepted submittals and Subarticle 1002-3(F) of the *Standard Specifications*. Use approved shotcrete nozzlemen who made satisfactory preconstruction test panels to apply shotcrete. Direct shotcrete at right angles to excavation faces except when shooting around reinforcing steel. Rotate nozzle steadily in small circular patterns and apply shotcrete from bottom of lifts up.

Make shotcrete surfaces uniform and free of sloughing or sagging. Completely fill ungrouted zones of drill holes and any other voids with shotcrete. Taper construction joints to a thin edge over a horizontal distance of at least the shotcrete thickness. Wet joint surfaces before shooting adjacent sections.

Repair surface defects as soon as possible after shooting. Remove any shotcrete which lacks uniformity, exhibits segregation, honeycombing or lamination or contains any voids or sand pockets and replace with fresh shotcrete to the satisfaction of the Engineer. Protect shotcrete from freezing and rain until shotcrete reaches initial set.

E. Leveling Pads and Concrete Facing

Construct aggregate leveling pads at elevations and with dimensions shown in the accepted submittals. Compact leveling pads with a vibratory compactor to the satisfaction of the Engineer.

Construct concrete facing in accordance with the accepted submittals and Section 420 of the *Standard Specifications*. Do not remove forms until concrete attains a compressive strength of at least 2,400 psi. Unless required otherwise in the plans, provide a Class 2 surface finish for concrete facing that meets Subarticle 420-17(F) of the *Standard Specifications*. Construct concrete facing joints at a spacing of 10 ft to 12 ft unless required otherwise in the plans. Make 1/2" thick expansion joints that meet Article 420-10 of the *Standard Specifications* for every third joint and 1/2" deep grooved contraction or sawed joints that meet Subarticle 825-10(B) or 825-10(E) respectively for the remaining joints. Stop reinforcing steel for concrete facing 2" on either side of expansion joints.

If a brick veneer is required, construct brick masonry in accordance with Section 830 of the *Standard Specifications*. Anchor brick veneers to soil nail walls in accordance with Subarticle 453-4 of the *Standard Specifications*. Seal joints above and behind soil nail walls between concrete facing and slope protection with silicone sealant.

F. Construction Records

Provide 2 copies of soil nail wall construction records within 24 hours of completing each lift. Include the following in construction records:

1. Names of Soil Nail Wall Contractor, Superintendent, Nozzleman, Drill Rig Operator, Project Manager and Design Engineer;
2. Wall description, county, Department’s contract, TIP and WBS element number;

3. Wall station and number and lift location, dimensions, elevations and description;
4. Nail locations, dimensions and inclinations, bar types, sizes and grades, corrosion protection and temporary casing information;
5. Date and time drilling begins and ends, steel bars are inserted into drill holes, grout and shotcrete are mixed and arrives on-site and grout placement and shotcrete application begins and ends;
6. Grout volume, temperature, flow and density records;
7. Ground and surface water conditions and elevations if applicable;
8. Weather conditions including air temperature at time of grout placement and shotcrete application; and
9. All other pertinent details related to soil nail wall construction.

After completing each soil nail wall or stage of a wall, provide a PDF file of all corresponding construction records.

5.0 NAIL TESTING

Test soil nails in accordance with the contract and as directed. "Verification tests" are performed on nails not incorporated into soil nail walls, i.e., sacrificial nails and "proof tests" are performed on nails incorporated into walls, i.e., production nails. Define "verification test nail" and "proof test nail" as a nail tested with either a verification or proof test, respectively. Define "test nails" as verification or proof test nails.

Verification tests are typically required for at least one nail per soil type per soil nail wall or 2 nails per wall, whichever is greater. Proof tests are typically required for at least one nail per nail row per soil nail wall or at least 5% of production nails, whichever is greater. More or less test nails may be required depending on subsurface conditions encountered. The Engineer will determine the number and locations of verification and proof tests required. The approximate known test nail locations may be shown in the plans.

Do not test nails until grout and shotcrete attain the required 3-day compressive strength. Do not install any production nails until verification tests are accepted.

A. Test Equipment

Use the following equipment to test nails:

1. Two dial gauges with rigid supports,
2. Hydraulic jack and pressure gauge,
3. Jacking block or reaction frame and
4. Electrical resistance load cell (verification tests only).

Provide dial gauges with enough range and precision to measure the maximum test nail movement to 0.001". Use pressure gauges graduated in 100 psi increments or less.

Submit identification numbers and calibration records for load cells, jacks and pressure gauges with the soil nail wall construction plan. Calibrate each jack and pressure gauge as a unit.

Align test equipment to uniformly and evenly load test nails. Use a jacking block or reaction frame that does not damage or contact shotcrete within 3 ft of nail heads. Place dial gauges opposite each other on either side of test nails and align gauges within 5° of bar inclinations. Set up test equipment so resetting or repositioning equipment during nail testing is not needed.

B. Test Nails

Test nails include both unbonded and bond lengths. Grout only bond lengths before nail testing. Provide unbonded and bond lengths of at least 3 ft and 10 ft, respectively.

Steel bars for production nails may be overstressed under higher test nail loads. If necessary, use larger size or higher grade bars with more capacity for test nails instead of shortening bond lengths to less than the minimum required.

C. Nail Tests

Install verification test nails with the same equipment, installation methods and drill hole diameter and inclination as production nails. Test verification and proof test nails in accordance with the accepted submittals and Articles X.5.5.2 and X.5.5.3, respectively of the *AASHTO LRFD Bridge Construction Specifications*.

D. Test Nail Acceptance

Submit 2 copies of test nail records including load versus movement and time versus creep movement plots within 24 hours of completing each verification or proof test. The Engineer will review the test nail records to determine if test nails are acceptable. Test nail acceptance is based in part on the acceptance criteria in Article X5.5.4 of the *AASHTO LRFD Bridge Construction Specifications*.

For proof test nails, maintain stability of unbonded lengths for subsequent grouting. If a proof test nail is accepted but the unbonded length cannot be satisfactorily grouted, do not incorporate the proof test nail into the soil nail wall and add another production nail to replace the test nail.

If the Engineer determines a verification test nail is unacceptable, revise the soil nail design or installation methods. Submit a revised soil nail wall design or construction plan for acceptance and provide acceptable verification test nails with the revised design or installation methods.

If the Engineer determines a proof test nail is unacceptable, either perform additional proof tests on adjacent production nails or revise the soil nail design or installation

methods for the production nails represented by the unacceptable proof test nail as determined by the Engineer. Submit a revised soil nail wall design or construction plan for acceptance, provide an acceptable proof test nail with the revised design or installation methods and install additional production nails for the nails represented by the unacceptable proof test nail.

After completing nail testing for each soil nail wall or stage of a wall, provide a PDF file of all corresponding test nail records.

6.0 MEASUREMENT AND PAYMENT

Soil Nail Retaining Walls will be measured and paid in square feet. Soil nail walls will be measured as the square feet of wall face area with the pay height equal to the difference between top of wall and top of leveling pad elevations. Define "top of wall" as top of concrete facing.

The contract unit price for *Soil Nail Retaining Walls* will be full compensation for providing designs, submittals, labor, tools, equipment and soil nail wall materials, excavating, hauling and removing excavated materials, installing soil nails, grouting, shotcreting and supplying wall drainage systems, leveling pads, concrete facing and any incidentals necessary to construct soil nail walls. The contract unit price for *Soil Nail Retaining Walls* will also be full compensation for brick veneers, if required. No additional payment will be made and no extension of completion date or time will be allowed for repairing property damage, overexcavations or unstable excavations, unacceptable test nails or thicker shotcrete or concrete facing.

The contract unit price for *Soil Nail Retaining Walls* does not include the cost for ditches, fences, handrails, barrier or guardrail associated with soil nail walls as these items will be paid for elsewhere in the contract.

Soil Nail Verification Tests and *Soil Nail Proof Tests* will be measured and paid in units of each. Soil nail testing will be measured as the number of initial verification or proof tests performed. The contract unit prices for *Soil Nail Verification Tests* and *Soil Nail Proof Tests* will be full compensation for initial nail testing. No payment will be made for subsequent nail testing performed on the same or replacement test nails.

Payment will be made under:

Pay Item	**Pay Unit**
Soil Nail Retaining Walls	Square Foot
Soil Nail Verification Tests	Each
Soil Nail Proof Tests	Each



DocuSigned by:
Shane C. Clark
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4/29/2019

PM-1

NON-CAST IRON SNOWPLOWABLE PAVEMENT MARKERS:

DESCRIPTION

Furnish, install and maintain non-cast iron snowplowable pavement markers in accordance with the contract.

MATERIALS

Epoxy shall meet the requirements of Section 1081 of the *2018 Standard Specifications.*

Revise the *2018 Standard Specifications* as follows:

Pages 10-177 and 10-178, Subarticle 1086-3 SNOWPLOWABLE PAVEMENT MARKERS, delete items (A), (B) and (C)(1) and replace with the following:

(A) General

Use non-cast iron snowplowable pavement markers evaluated by NTPEP. The non-cast iron snowplowable pavement marker shall consist of a housing with one or more glass or plastic face lens type reflective lenses to provide the required color designation. Plastic lens faces shall use an abrasion resistant coating.

Use recycled non-cast iron snowplowable pavement markers that meet all the requirements of new non-cast iron snowplowable pavement markers except Subarticle 1086-3(B)(1). Recycled non-cast iron snowplowable pavement markers with minimal variation in dimensions are acceptable only when the reflector fits in the housing of the recycled non-cast iron snowplowable pavement marker as originally designed.

(B) Housings

(1) Dimensions

The dimension, slope and minimum area of reflecting surface shall conform to dimensions as shown in the plans. The minimum area of each reflecting surface shall be 1.44 sq.in.

(2) Materials

Use non-cast iron snowplowable pavement markers that are on the NCDOT Approved Products List.

(3) Surface

The surface of the housing shall be free of scale, dirt, rust, oil, grease or any other contaminant which might reduce its bond to the epoxy adhesive.

(4) Identification

Mark the housing with the manufacturer's name and model number of marker.

(C) Reflectors

(1) General

Laminate the reflector to an elastomeric pad and attach with adhesive to the housing. The thickness of the elastomeric pad shall be 0.04".

CONSTRUCTION METHODS

(A) General

Bond marker housings to the pavement with epoxy adhesive. Mechanically mix and dispense epoxy adhesives as required by the manufacturer's specifications. Place the markers immediately after the adhesive has been mixed and dispensed.

Install snowplowable pavement marker housings into slots sawcut into the pavement. Make slots in the pavement to exactly duplicate the shape of the housing of the snowplowable pavement markers.

Promptly remove all debris resulting from the saw cutting operation from the pavement surface. Install the marker housings within 7 calendar days after saw cutting slots in the pavement. Remove and dispose of loose material from the slots by brushing, blow cleaning or vacuuming. Dry the slots before applying the epoxy adhesive. Fill the cleaned slots totally with epoxy adhesive flush with the surface of the existing pavement. Install snowplowable pavement markers according to the manufacturer’s recommendations.

Protect the snowplowable pavement markers until the epoxy has initially cured and is track free.

(B) Reflector Replacement

In the event that a reflector is damaged, replace the damaged reflector by using adhesives and methods recommended by the manufacturer of the markers and approved by the Engineer. This work is considered incidental if damage occurs during the initial installation of the marker housings and maintenance of initial snowplowable markers specified in this section. This work will be paid for under the pay item for the type of reflector replacement if the damage occurred after the initial installation of the snowplowable pavement marker.

Missing housings shall be replaced. Broken housings shall be removed and replaced. In both cases the slot for the housings shall be properly prepared prior to installing the new housing. Removal of broken housings and preparation of slots will be considered incidental to the work of replacing housings.

(C) Recycled Snowplowable Pavement Marker Housings

Use properly refurbished snowplowable pavement marker housings as approved by the Engineer such that approved new reflectors can be installed inside the housings.

MAINTENANCE

PM-3

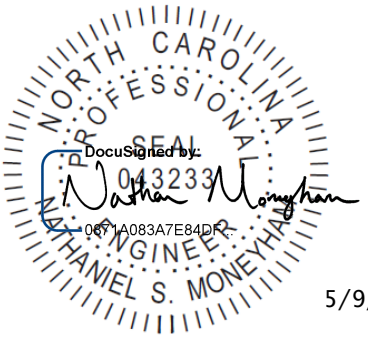
Maintain all installed snowplowable pavement markers before acceptance.

MEASUREMENT AND PAYMENT

Non-cast iron Snowplowable Pavement Markers will be measured and paid as the actual number of non-cast iron snowplowable pavement markers satisfactorily placed and accepted by the Engineer.

Payment will be made under:

Pay Item	**Pay Unit**
Non-cast iron Snowplowable Pavement Marker	Each



5/9/2019

WORK ZONE TRAFFIC CONTROL
Project Special Provisions
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DocuSigned by:
Don A. Parker
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6/17/2019

SEQUENTIAL FLASHING WARNING LIGHTS:
(10/08/2016)

Description

Furnish and install Sequential Flashing Warning Lights on drums used for merging tapers during nightly work activities on interstates and freeways with speed limits greater than 55 MPH and or facilities that have significant traffic volumes.

The purpose of these lights is to assist the motorist in determining which direction to merge when approaching a lane closure. It's also designed to reduce the number of late merges resulting in devices being struck and having to be reset to maintain positive guidance at the merge point. The successive flashing of the lights shall occur from the upstream end of the merging taper to the downstream end of the merging taper in order to identify the desired vehicle path.

Materials

The Sequential Flashing Warning Lights shall meet all of the requirements for warning lights within the current edition of the Manual of Uniform Traffic Control Devices (MUTCD).

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

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

Supply a Type 3 Certification (Independent Test Lab results) documenting all actual test results for the specified parameters contained in the Institute of Transportation Engineer's (ITE's) *Purchase Specification for Flashing and Steady Burn Warning Lights*. The laboratory shall also identify all manufacturer codes and part numbers for the incandescent lamp or LED clusters, lenses, battery, and circuitry, and the total width of the light with the battery in place. The complete assembly shall be certified as crashworthy when firmly affixed to the channelizing device.

All Sequential Flashing Warning Lights shall be on the NCDOT Work Zone Traffic Control Approved Products List.

Construction Methods

Sequential Flashing Warning Lights are to be used for night time lane closures.

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

The Sequential Flashing Warning Lights shall automatically flash in sequence when placed on the drums that form the merging taper.

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

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

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

The Sequential Flashing Warning Lights shall automatically sequence when placed in line in an open area with a distance between lights of 10 to 100 feet. A 10 foot stagger in the line of lights shall have no adverse effect on the operation of the lights.

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

When lane closures are not in effect, the Sequential Flashing Warning Lights shall be deactivated.

Measurement and Payment

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

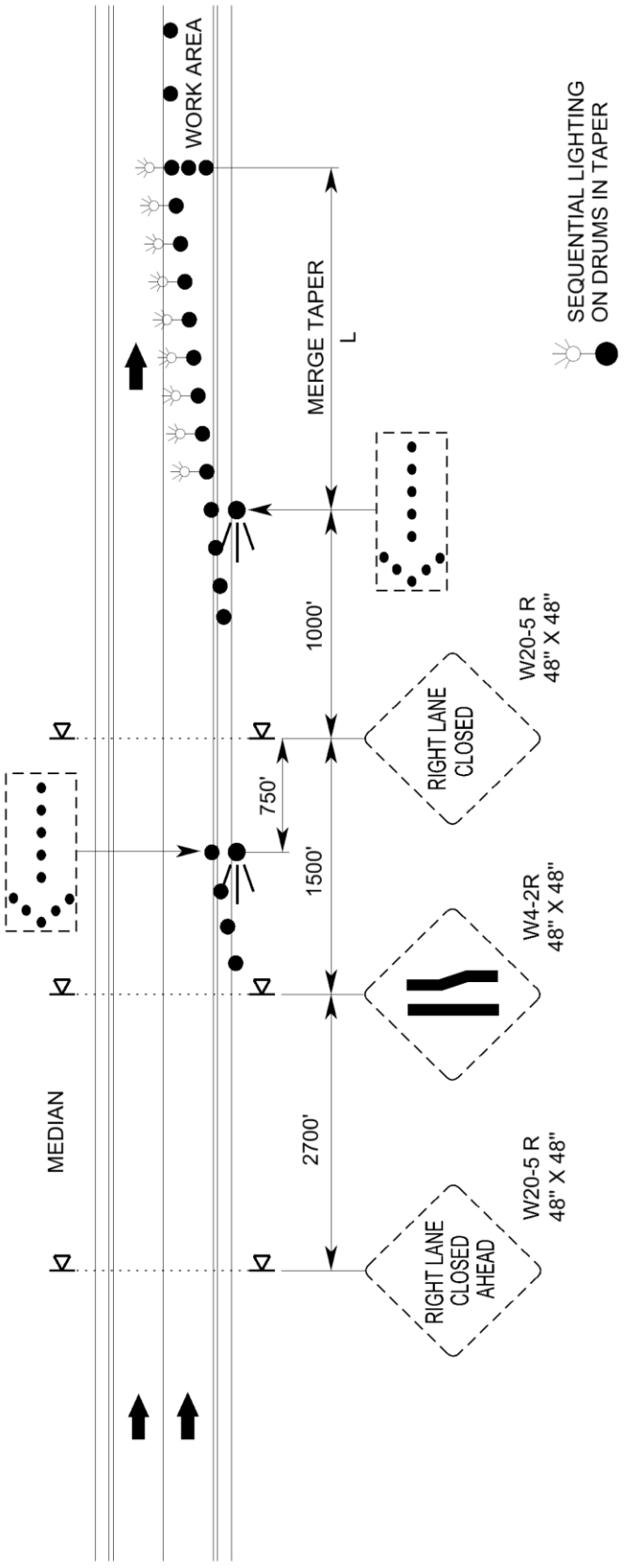
This includes all materials and labor to install, maintain and remove all the Sequential Flashing Warning Lights.

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

TC-4

I-4700 Buncombe and Henderson Counties

SEQUENTIAL FLASHING WARNING LIGHTS



WORK ZONE PRESENCE LIGHTING:
(05/31/18)

DESCRIPTION

Furnish and install Work Zone Presence Lighting to supplement the Contractor's construction/task (Portable Construction Lighting) and equipment lighting during nightly work activities on high speed (greater than 55 MPH) facilities and/or facilities that have significant traffic volumes and impacts. The purpose of Work Zone Presence Lighting is to alert the motorist to the existence of an active work zone, improve worker visibility, and to assist in compliance of the work zone speed limit by providing lighting throughout the length of the lane closure.

MATERIALS

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

All Work Zone Presence Lighting shall be supplied with a power source to provide the light output as described in the chart below.

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

Each light unit support base or mounting stand shall have the capability of being leveled.

Provide Work Zone Presence Lighting listed on the NCDOT APL.

CONSTRUCTION METHODS

The purpose of Work Zone Presence Lighting is to illuminate areas of the lane closure where construction/task lights are not located. Typical use is during lane closures for resurfacing and milling operations in locations where the pavement is being prepped for paving or milling, as well as where these operations have passed through that involve remaining work items such as rolling, coring/inspecting, shoulder and striping activities.

In addition, Work Zone Presence Lighting is permitted to be installed after the necessary traffic control has been installed for the lane closure(s). Once the lane(s) is closed and the Contractor's operations have begun, the Work Zone Presence Lights can be installed according to the installation locations below.

At the end of the work night, the Work Zone Presence Lights may be removed, up to 1 hour, before the lane closure(s) is removed or removed after the lane(s) has been reopened since the lights are located outside of the travel lanes and do not give any misinformation to the traveling public.

Immediately replace any lighting unit that is not operational.

Installation Locations

1. Standard Lane Closure Lengths of 2 miles or less

Position #1: Initially, place the work zone presence lighting starting 1 mile downstream of the merge taper and continue until the end of the lane closure. See attached detail-Position #1.

Position #2: Once paving operations progress to the point where the construction/task lighting has to be relocated to finish paving for the night, the Work Zone Presence Lighting shall be relocated to the beginning of the lane closure. See Attached Drawing-Position #2.

2. Lane Closures exceeding 2 miles (Must be approved by the Engineer)

Single Work Operations: If the lane closure is longer than 2 miles within a single work operation, begin installing the work zone presence lighting at the halfway point of the lane closure length and continue placing the lights until the end of the lane closure. Same procedure for relocation shall be followed as described above.

3. Multiple Work Operations exceeding 2 miles (Must be approved by the Engineer)

If the lane closure is longer than 2 miles and 2 separate operations are working concurrently, treat as 2 separate locations. The Work Zone Presence Lights are installed at the halfway point in each operation. The lights in the 1st operation will end where the 2nd operation begins. The lights in the 2nd operation will terminate with the end of the lane closure. Same procedure for relocation shall be followed as described above.

Lighting Unit Installation Requirements

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

SPACING CHART

Light Output (Lumens)	Illuminated Fixture Area-Minimum (Square Feet)	Maximum Spacing (Feet)	Light Units (Per Mile)
14,000 to 35,000	4’	750’	7
35,001 to 59,999	5’	1,000’	5
60,000 and above	6’ or greater	1,320	4

Whenever possible, each light unit shall be placed on the 10’ paved shoulder according to the above spacing based on the amount of light output for each unit.

Each light unit shall be installed and moved as necessary to allow for efficient paving operations to take place as well as to not interfere with the Contractor's ability to light the work area. At no time shall Work Zone Presence Lighting be located in the same area as the Contractor's construction/task lighting or conflict with his work operations.

If the Contractor provides sufficient construction/task lighting to meet the luminance requirements of Section 1413-3 for the full length of the lane closure or if sufficient existing overhead lighting is present, Work Zone Presence Lighting may be eliminated as directed by the Engineer.

MEASUREMENT AND PAYMENT

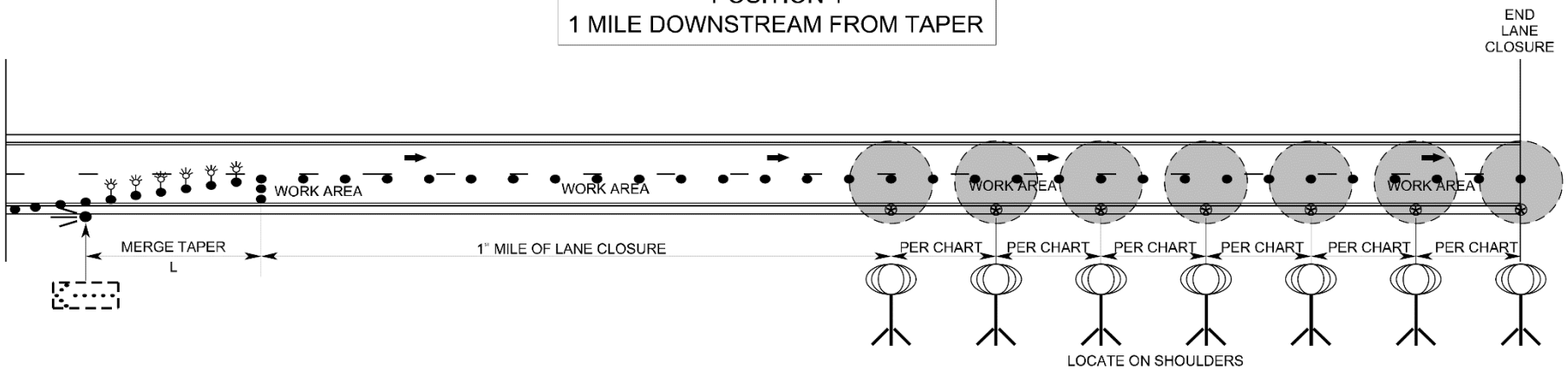
Work Zone Presence Lighting will be measured and paid as the maximum number of lighting units satisfactorily placed, accepted by the Engineer, and in use at any one time during the life of the project.

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

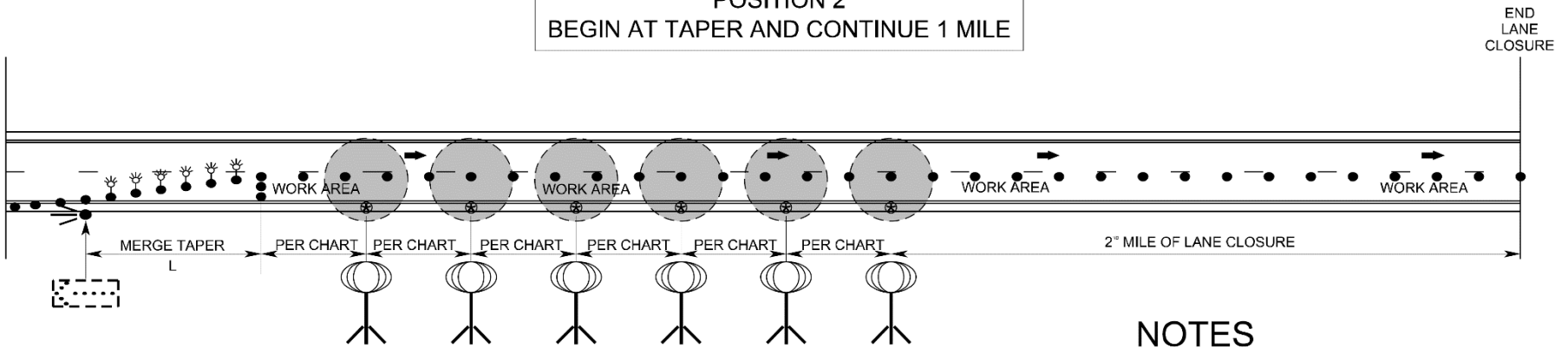
Pay Item	**Pay Unit**
Work Zone Presence Lighting	Each

SEQUENTIAL FLASHING WARNING LIGHTS AND WORK ZONE PRESENCE LIGHTING

POSITION 1
1 MILE DOWNSTREAM FROM TAPER



POSITION 2
BEGIN AT TAPER AND CONTINUE 1 MILE



SPACING CHART

LIGHT OUTPUT (LUMENS)	MINIMUM LIGHTED FIXTURE AREA (SQUARE FEET)	MAXIMUM SPACING (FEET)	MAXIMUM LIGHT UNITS (PER MILE)
14,000 TO 35,000	4	750	7
35,001 TO 60,000	5	1,000	5
ABOVE 60,000	6 AND GREATER	1,320	4

NOTES

1) WORK ZONE PRESENCE LIGHTING MAY BE OMITTED FOR THE ENTIRE LANE CLOSURE IF THE CONTRACTOR PROVIDES SUFFICIENT CONSTRUCTION/ TASK LIGHTING TO MEET THE LUMINANCE REQUIREMENTS OF SECTION 1413-3 FOR THE FULL LENGTH OF THE LANE CLOSURE. IF EXISTING OVERHEAD ROADWAY LIGHTING IS FUNCTIONAL AND EXTENDS FOR THE FULL LENGTH OF THE LANE CLOSURE, OR AS DIRECTED BY THE ENGINEER.

2) PLACE ON PAVED OUTSIDE SHOULDER IF POSSIBLE.

3) IF THE LANE CLOSURE IS LONGER THAN 2 MILES USE ADDITIONAL PRESENCE LIGHTING AT THE RECOMMENDED SPACING. BEGIN INSTALLING WORK ZONE PRESENCE LIGHTING AT THE HALFWAY POINT OF THE LANE CLOSURE LENGTH FOR POSITION 1. POSITION 2 WILL BE THE FIRST HALF OF THE LANE CLOSURE LENGTH.

WORK ZONE PERFORMANCE PAVEMENT MARKINGS:
(10/08/2016)
(Rev. 10/9/18)

Description

Furnish and install Work Zone Performance pavement markings that delineate the travel way for work zone traffic patterns on interstates and freeways along with the ramps and loops. They may also be used on roadways with significant alterations of traffic patterns. The purpose of Work Zone Performance pavement marking is to provide a more durable work zone pavement marking that lasts the full duration of a traffic pattern without requiring replacement or reapplication for a period of up to 12 months. Work Zone Performance pavement markings shall also provide a higher performance level in terms of retroreflectivity throughout the required 12 month duration than standard traffic paints to improve nighttime work zone visibility.

Materials

A) General

Use materials in accordance with the Manufacturer's recommendations that will retain both durability and a minimum retroreflectivity as described elsewhere in this RFP for a period of at least 12 months.

The Work Zone Performance pavement markings shall be manufactured to bond successfully to both concrete and asphalt pavements. The following are approved materials to be used for Work Zone Performance pavement markings:

- Polyurea
- Thermoplastic (Extruded and Sprayed)
- Epoxy
- Polymer (Single System)
- Cold Applied Plastic (Type IV)

B) Material Qualifications/Certifications

Use Work Zone Performance pavement marking materials, as listed above, which are on the NCDOT Approved Products List at the time of installation.
In accordance with Article 106-3, and Section 1087-4 of the 2018 NCDOT Standard Specifications for Roads and Structures, provide a Type 3 Material Certification for all materials and a Type 3 and Type 4 certification for all reflective media.

(C) Performance

Poor performance of a Work Zone Performance pavement marking material at any site, whether or not related to a specific contract, may be grounds for removing the material from any project under contract and the NCDOT Approved Products List.

Construction Methods

Do not use hand applied methods or any other non-truck mounted application equipment /device to install Work Zone Performance pavement markings for applications longer than 1000 feet.

All Work Zone Performance pavement markings are to be installed in a single application. Multiple passes are not allowed.
"No track" dry times shall be 10 minutes or less. Traffic shall not be placed on any material until it's sufficiently dry/cured to eliminate wheel tracking.

A) Testing Procedures

All Work Zone Performance pavement marking installations will be tested by the Department through an independent Mobile Retroreflective Contractor. The Work Zone Performance pavement markings will be scanned to ensure the retroreflectivity requirements in Section C below are met.

B) Application Equipment

Application equipment shall be in accordance with Section 1205 of the 2018 NCDOT Standard Specifications for Roads and Structures.

C) Material Application

The Work Zone Performance pavement marking material shall be applied at the following minimum thicknesses:

Polyurea =	20 mils wet
Epoxy =	20 mils wet
Thermoplastic =	50 mils (Extruded or Sprayed)
Polymer =	20 mils wet
Cold Applied Plastic (IV) =	Manufacturer's recommendation

The Work Zone Performance pavement marking line widths for interstates and freeways shall be as follows:

Edge lines, Solid Lane Lines, Skip and Mini-Skip Lines =	6"

Gorelines = 12”

All other facilities shall utilize 4” line widths.

D) Retroreflectivity Requirements

Retroreflectivity Requirements for Work Zone Performance Pavement Markings

Color	Initial	6 Months	12 Months
White	375 mcd/lux/m2	275 mcd/lux/m2	150 mcd/lux/m2
Yellow	250 mcd/lux/m2	150 mcd/lux/m2	100 mcd/lux/m2

The minimum level of retroreflectivity for any Work Zone Performance pavement marking system selected shall meet the initial requirements in the chart above. In addition, the Work Zone Performance pavement markings shall maintain the corresponding retroreflectivity requirements for a period of up to 12 months.

The Contractor shall notify the Engineer a minimum of 7-10 days prior to the installation of Work Zone Performance pavement markings.

The Department will measure initial retroreflectivity within 30 days after placement to ensure compliance with the initial retroreflectivity levels in the chart above.

If the markings appear to be non-performing, the Engineer may request additional retroreflectivity readings. If measured and found to be noncompliant, the Contractor shall replace the Work Zone Performance pavement markings at no cost to the Department. Non-compliant retroreflectivity occurs when the average readings for the project are more than 15% below the requirements in the chart. Pay deductions are appropriate for deficiencies up to the 15% level.

If the Work Zone Performance pavement markings need to remain in place longer than 12 months, the markings are to be scanned by the Mobile Retroreflective Contractor to determine if they are meeting the minimum retroreflectivity levels. If they remain at or above these levels, the Work Zone Performance pavement markings may remain in place. If not, they shall be replaced by the Contractor within 15 days of the 12 month duration and compensation will be made at the contract unit price.

If and when this becomes necessary, the same notification procedure as described above shall be used to have the Work Zone Performance pavement markings scanned for the required retroreflectivity.

E) Snowplow Damage

All Work Zone Performance pavement markings shall be durable enough to withstand a single snow event requiring snow plowing without showing excessive fatigue in either bonding or retroreflectivity.

The Contractor shall replace the Work Zone Performance pavement markings if a single snowplow occurrence results in more than 25% of the pavement marking edgelines or skips being physically removed and/or the Work Zone Performance pavement markings do not meet the following minimum retroreflectivity values:

Retroreflective Requirements for Work Zone Performance Pavement Markings after a Single Snowplow Occurrence

Color	MINIMUM
White	150 mcd/lux/m2
Yellow	100 mcd/lux/m2

Unless the temporary traffic pattern is to be modified within 30 days, the Contractor shall replace all non-compliant Work Zone Performance pavement markings within 30 days of determining they are non-compliant.

If the work zone experiences more than one snow event requiring snow plowing, the retroreflectivity values in the chart above will no longer apply. The Engineer will determine if the pavement markings are performing adequately and/or if replacement is necessary due to excessive damage caused solely by snowplow activities.

If the Work Zone Performance pavement markings are found to be deficient, they shall be replaced. In such case, compensation will be made at the contract unit price. Unless the temporary traffic pattern is to be modified within 30 days, the Contractor shall replace all Work Zone Performance pavement markings damaged due to multiple snowplow events within 30 days.

F) Surface Preparation

Prior to installation, all pavement surfaces to receive Work Zone Performance pavement markings shall be swept clean and prepared in accordance with the Manufacturer’s recommendation.

G) Temperature and Weather Limitations

Work Zone Performance pavement markings shall only be applied unless the ambient air temperature and the pavement temperature is 50°F or higher for thermoplastic and is 40°F or higher for all other materials. Do not install unless the pavement surface is completely dry and

not within 4 hours of a heavy rain event such as a thunderstorm with rainfall intensities greater than 1 inch/per hour.

In the event a traffic shift has to take place when the air and pavement temperatures are below the required minimums or if a rain event occurs prior to or during a planned traffic shift, upon approval by the Engineer, an acceptable alternative is to install temporary pavement markings. Use 1 application of standard traffic paint to produce a 4" line at 15 mils (wet). Beads shall also be applied to provide proper retroreflectivity until the performance material can be installed. NCDOT will provide compensation for the 4",15 mil temporary paint. The Work Zone Performance pavement markings shall be applied within 90 days of installation of the temporary pavement markings.

Maintenance

Replace any Work Zone Performance pavement material that prematurely fails due to debonding or excessive wearing where it doesn't maintain its retroreflectivity for the required 12 month duration. Any traffic control and Work Zone Performance pavement marking costs due to replacement is at no cost to the Department unless it's due to excessive damage caused by snowplow damage.

Measurement and Payment

Work Zone Performance pavement marking lines will be measured and paid by the linear foot that's satisfactorily placed and accepted by the Engineer. The quantity of Work Zone Performance pavement marking-solid lines, will be the summation of the linear feet of solid line measured end-to-end of the line. The quantity of skip or broken lines will be the summation of the linear feet derived by multiplying the nominal length of a line by the number of broken lines satisfactorily placed.

Work Zone Performance Pavement Marking *Symbols* will be measured as the actual number of pavement marking symbols satisfactorily placed and accepted by the Engineer. Payment for Work Zone Performance Pavement Marking *Symbols* will be made at the same contract unit price used for the Pavement Marking Symbol pay items used on the final wearing surface.

Work Zone Performance Pavement Marking *Characters* will be measured as the actual number of pavement marking characters satisfactorily placed and accepted by the Engineer. A character is considered to be one letter or one number of a word message. Payment for Work Zone Performance Pavement Marking *Characters* will be made at the same contract unit price used for the Pavement Marking Character pay item used on the final wearing surface.

Payment will be made under:

TC-14

I-4700 Buncombe and Henderson Counties

Pay Item	Pay Unit
Work Zone Performance Pavement Marking Lines, 4”	Linear Foot
Work Zone Performance Pavement Marking Lines, 6”	Linear Foot
Work Zone Performance Pavement Marking Lines, 12”	Linear Foot

HIGH VISIBILITY DEVICES:
(5/10/18)

Description

Furnish and install High Visibility devices for projects on Interstates and Freeways with durations of 24 months or more. High Visibility devices include drums, stationary work zone signs and portable work zone signs. All of these devices shall be new. Used devices are not acceptable.

The purpose of High Visibility devices is to enhance the conspicuity of the devices in order to improve both safety and mobility through the Interstate and Freeway work zones. In addition, using new devices help to ensure they remain in compliance with required retroreflective properties for the full life of the project and to improve the overall appearance of Significant Work Zones throughout the State.

Materials

A) General

Use materials in accordance with the Manufacturer’s recommendations that will retain both durability and retroreflectivity as described elsewhere in this specification for a period of at least 36 months.

The following are required High Visibility devices to be used for Work Zone Performance applications.

- Drums (Type XI fluorescent orange sheeting)
- Stationary Work Zone Signs
- Rigid Portable Work Zone Signs

All drums shall be new and meet the existing requirements of Section 1089-5 of the North Carolina Standard Specifications for Roads and Structures and shall have Type XI fluorescent orange sheeting that meets the retroreflective requirements of Section 1092-2.

All stationary work zone signs shall be new and meet the existing requirements of Section 1089-1. Legend overlays are prohibited and shall not be accepted on the Interstate/Freeway or associated intersecting roadways.

All portable work zone signs shall be new and have composite substrates as described in Section 1089-1. The remainder of the existing requirements of Section 1089-1 remain. Used sign stands are acceptable.

B) Material Qualifications/Certifications

Only use materials as listed above that are on the NCDOT Approved Products List. In addition, provide a Type 3 Material Certification for all materials in accordance with Section 106-3 and Section 1087-4.

(C) Performance

Poor performance of any device or sign at any site, whether or not related to a specific contract may be grounds for removing the material from the NCDOT Approved Products List and/or removing from any project under contract.

Construction Methods

All requirements of Section 1110-3 and Section 1130-3 shall apply except roll up signs are not permitted for use.

The use of skinny drums are prohibited for any nighttime lane closures on Interstates and Freeways.

Maintenance

Replace any sign or drum that prematurely fails due to any damage or defect that causes it to perform unsatisfactorily with an “in kind” device of similar quality and age according to the guidelines set forth in the American Traffic Safety Service Association’s (ATSSA) Quality Guidelines for Work Zone Traffic Control Devices. An “in kind” replacement sign or drum is not required to be new, however, it shall be less than 1 year old and have 100% of its original sheeting area and at least 85% of the retroreflective qualities of a new device, so that it is undetectable adjacent to the original devices and signs placed on the project.

Measurement and Payment

High Visibility Drums will be measured and paid as the maximum number of drums placed and in use at any one time during the life of the project.

High Visibility Stationary Signs will be measured as the actual number of square feet satisfactorily installed at each location and accepted by the Engineer. Where a particular sign is used at more than one location, measurement will be made at each location.

High Visibility Work Zone Signs will be measured and paid as the actual number of square feet satisfactorily installed and accepted by the Engineer. Payment will be made for the initial installation only. Relocation of signs, will incidental the measurement of the quantity of signs.

No direct payment will be made for stationary work zone sign supports or portable work zone sign stands. All stationary work zone sign support or portable work zone sign stands will be incidental to the work of providing work zone signs.

Payment will be made under:

Pay Item	**Pay Unit**
High Visibility Drums	Each
High Visibility Stationary Signs	Square Foot
High Visibility Portable Signs	Square Foot

CONNECTED LANE CLOSURE DEVICES:
(10/29/2018)

Description

Furnish, install, operate, maintain, relocate, and remove connected lane closure devices for use on Interstate and Freeway lane closures. The connected lane closure devices shall transmit the location of the lane closure to navigational companies such as WAZE, Google Maps, Inrix, Here, TrafficCast, TomTom, Apple Maps, Panasonic, the Statewide Transportation Operations Center, (STOC), and any other navigational companies that requests it. A connected lane closure device shall be installed on the flashing arrow board identifying the beginning of a lane closure, and another connected lane closure device shall be installed on a crashworthy traffic control device (such as a drum) at the end of the same lane closure.

Materials

The connected lane closure devices shall be designed and built to transmit the location of the lane closure to the navigational companies as well as the STOC. The format of the information received by each of these shall be approved by each entity, and at minimum, consist of an XML file. The connected lane closure devices shall be capable of obtaining wireless communication by either cellular or satellite technology.

The initial connected device shall be designed and attached to the flashing arrow board in such a manner that it is only activated when either the left or right arrows are displayed, not when the flashing arrow board is operated in caution mode. When the lane closure is removed, and the flashing arrow board turned off or changed to caution mode, the connected device shall automatically turn off simultaneously.

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

The devices shall have battery life sufficient to maintain operation for the duration of the lane closure, or have the ability to be recharged without deactivating the device.

Construction Methods

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

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

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

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

Technical Requirements

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

The GPS within the connected devices shall have a horizontal accuracy of 50 feet, 95% of the time.

The connected device information, including the location, transmission status, and battery status shall be transmitted within five (5) minutes of initiation and updated every fifteen (15) minutes. In addition to transmitting information to the Department, the Contractor shall keep the retain device information for one (1) year after the contract ends. Information shall include timestamps, device name, and GPS location. This information shall be made available to the Department upon request.

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

The connected devices shall emit an audible an alert if a device is not transmitting its position for a period of 1 hour.

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

Measurement and Payment

Connected Lane Closure Devices will be measured and paid as the maximum number of connected devices acceptably placed and in use at any one time during the life of the project. Each group of lane closures will require two (2) connected lane closure devices; one connected to the flashing arrow board and the other on a crashworthy device at the downstream end of the lane closure. No payment will be made for either device unless both devices are satisfactorily installed.

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

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

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

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

TYPICAL MEDIAN ACCESS AREAS:
(12/18/18)

Description

Perform the work covered by this section including, but not limited to, constructing, maintaining, and removing Typical Median Access Areas for construction vehicle ingress to and egress from the median to/from active travel lanes on controlled access facilities.

Typical Median Access Areas are not required when construction vehicle ingress and egress is conducted using lane closures as shown on detail 1101.05, Sheet 2 of 2 of the *2018 Roadway Standard Drawings*.

Materials

Refer to Divisions 5, 6, 10, 11, 12, and 17 in the *2018 Standard Specifications for Roads and Structures.*

Provide temporary traffic control devices listed on the NCDOT Approved Products List (APL).

Provide Work Zone Performance Pavement Markings. (Refer to Work Zone Performance Pavement Markings Special Provisions)

Provide High Visibility Devices. (Refer to High Visibility Devices Special Provision)

Flashing Beacon and Detection System:

(A) General

Provide flashing beacon and detection system components listed on the NCDOT ITS and Signals Qualified Products List (QPL).

Provide a trailer mounted flashing beacon and warning sign assembly that meets or exceeds the physical and operational requirements of the MUTCD, or other mounting method approved by the Department. The following specifications supplement those basic requirements.

Provide a totally mobile complete unit capable of being located as traffic conditions demand.

The warning sign height shall comply with detail 1110.01, sheet 1 of 3 of the *2018 Roadway Standard Drawings* when raised in the upright position.

The flashing beacon housing assembly shall be of weather resistant construction.

(B) Power System

Provide a unit that is solar powered and supplemented with a battery backup system that includes a 110/120 VAC powered on-board charging system. The unit shall also be capable of being powered by standard 110/120 VAC power source.

The batteries, when fully charged, shall be capable of powering the display for 20 continuous days with no solar power. Store the battery bank and charging system in a lockable, weather, and vandal resistant box.

(C) Controller

Provide automatic brightness/dimming of the display and a manual override dimming switch. The controller shall provide a battery-charge status indicator. Mobile radio or any other radio transmissions shall not affect the controller. Store the controller in a lockable, weather and vandal resistant box.

(D) Trailer

Finish all exterior metal surfaces with Federal orange enamel per Federal Standard 595a, color chip ID# 13538 or 12473 respectively. The trailer shall be able to support a 100 mph wind load with the display fully extended.

The trailer shall be equipped with leveling jacks capable of stabilizing the unit in a horizontal position when located on slopes 6:1 or flatter.

The trailer shall be properly equipped in compliance with North Carolina Law governing motor vehicles.

Provide a minimum 4 inch wide strip of fluorescent orange retroreflective sheeting to the frame of the trailer. Apply the sheeting to all sides of the trailer. The retroreflective sheeting shall be Grade B that conforms to Article 1092-2 in the *2018 Standard Specifications for Roads and Structures.* Drums may be supplemented around the unit in place of the sheeting.

(E) Reliability

Provide a sign unit, flashing beacons, and detection system with all components rated to operate at temperatures ranging from -30°F to 165°F.

Construction Methods

See Typical Median Access Detail (attached).

Temporary Acceleration Lane

Construct a temporary acceleration lane with a minimum length of 1720’ and a minimum clear width of 12’ for the full length of the Temporary Acceleration Lane. At least 920’ of parallel merge/diverge area is required adjacent to the active travel lanes. The detection zone will be located from the beginning of the paved area to within 100’ of the end of the PCB. It shall have protection separating it from the active travel lanes for the first 500’.

The Temporary Acceleration Lane shall use either existing or proposed pavement, where available. If existing or proposed pavement is not available, construct temporary pavement. For truck volumes that do not exceed 100 trucks per day for a duration that does not exceed 1 year, use the following temporary pavement design: 1.25” S9.5B, 2.5” I19.0C, and 8” ABC. For truck volumes/durations that exceed the parameters stated above, contact the State Work Zone Engineer at 919-814-4937. Install and maintain pavement in accordance with Division 6.

Using Work Zone Performance Pavement Markings, install 12” yellow diagonals lines (2:1 slope) at 100’ intervals throughout the upstream half of the parallel merge/diverge area, and at 55’ intervals throughout the downstream half of the parallel merge/diverge area. Remove any conflicting markings in accordance with Section 1205.

Flashing Beacons and Detection System

Flashing Beacons and Detection System are required only at active median access locations and may be relocated to other median access locations as necessary.

Provide High Visibility advance warning signage as shown in the attached detail. Provide a flashing beacon system with two (2) flashing lights per sign to alert motorists in the active travel lanes of work vehicles entering from the median.

Provide a non-intrusive detection system capable of detecting vehicles in the work area in advance of the parallel merge/diverge area. The detection system shall be programmed such that passing public traffic in active travel lanes and vehicles in the work area not intending to use the parallel merge/diverge area are not detected.

Once detection occurs, the beacons on the advance warning sign(s) shall begin flashing immediately at a rate of not less than 50 or more than 60 times per minute. The beacons on the advance warning sign(s) shall flash continuously in an alternating pattern at all times that work vehicles are detected. The beacons shall continue flashing for thirty (30) seconds after detection ceases before turning off, and personnel on site shall have the ability to adjust this time based on field conditions. The flashing beacon system shall remain dark when idle.

Expedite repairs due to failure, malfunction or damage to the flashing beacons and/or detection system. Furnish another flashing beacon system or detection system approved by the Department during the repair time. Repair or replace flashing beacon system and/or detection systems immediately; otherwise, suspend all construction activities requiring the use of the Median Access Area until the flashing beacon system and/or detection system is restored to operation.

Perform all maintenance operations recommended by the manufacturer of the flashing beacon system and detection system.

Location, Placement, and Use

Typical Median Access Areas shall not be located within one-half (1/2) mile of any interchange acceleration or deceleration lanes, unless approved by the Department. All proposed locations for Typical Median Access Areas shall be reviewed and approved by the Engineer prior to installation.

Work vehicles using a particular Median Access Area shall not utilize any interchange ramp (on-ramp or off-ramp) within one (1) mile of the Median Access area.

Typical Median Access Areas installed in accordance with this section will not require the use of temporary lane closures for ingress/egress of work vehicles.

The Contractor shall comply with multiple and single vehicle hauling restrictions as shown in the TMP when performing hauling of equipment or materials to or from the project while using Typical Median Access Areas.

Measurement and Payment

Typical Median Access Area will be measured and paid as the actual number of *Flashing Beacon and Detection Systems* satisfactorily installed and accepted by the Engineer as described in this provision. Payment will be made for the initial installation only. Relocation of the system(s) will be incidental to the measurement of the quantity of systems.

Aggregate Base Course will be measured and paid in accordance with Article 520-11.

Asphalt Concrete Intermediate Course, Type I19.0C and Asphalt Concrete Surface Course, Type S9.5B will be measured and paid for in accordance with Article 610-16.

High Visibility Drums, Stationary Signs and Portable Signs will be measured and paid for in accordance with the High Visibility Devices Special Provision found elsewhere in the contract.

Portable Concrete Barrier will be measured and paid in accordance with Article 1170-4.

Temporary Crash Cushion will be measured and paid in accordance with Article 1160-4.

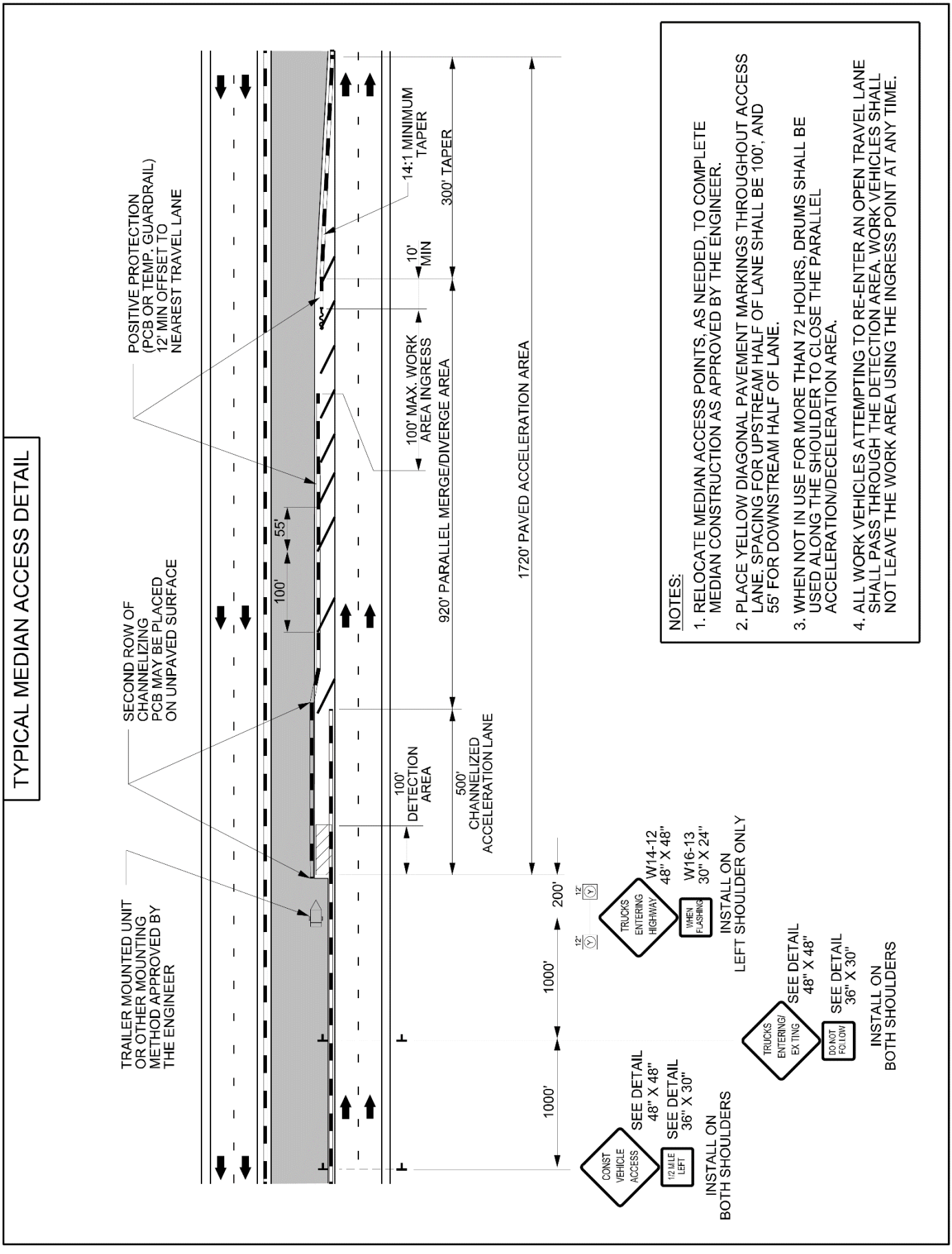
Work Zone Performance Pavement Marking Lines, 12” will be measured and paid for in accordance with the Work Zone Performance Pavement Markings Special Provision found elsewhere in the contract.

Payment will be made under:

Pay Item	**Pay Unit**
Flashing Beacons and Detection System	Each

TC-23

I-4700 Buncombe and Henderson Counties



SIGN NUMBER: WZTC
TYPE: STATIONARY
QUANTITY: SEE PLANS

SIGN WIDTH: 5'-6"
HEIGHT: 5'-6"
TOTAL AREA: 30.3 Sq.Ft.

BORDER TYPE: INSET
RECESS: 0"
WIDTH: 0"
RADII: 0"

NO. Z BARS: 2
LENGTH: 58.0

BACKG COLOR: Fluorescent Orange
COPY COLOR: Black

SYMBOL	X	Y	WID	HT

MAT'L: 0.080" (2.0 mm) ALUMINUM

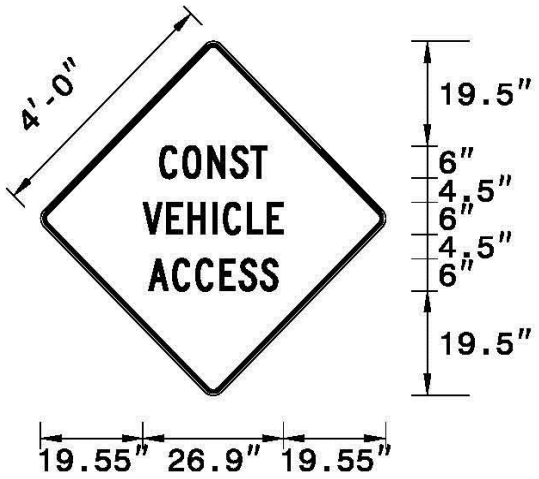
USE NOTES: 1,2

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

DESIGN BY: J.Navarrete
PROJECT ID: I5922

CHECKED BY:
LOCATION:

Mar 14, 2018
DIV:WZTC



Spacing Factor is 1 unless specified otherwise

LETTER POSITIONS

Letter spacings are to start of next letter

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		V	E	H	I	C	L	E																			C 2000
	19.6	4.6	4.1	4.7	2	4.6	3.9	3.1	19.6																		26.9
		A	C	C	E	S	S																				C 2000
	20.6	4.6	4.4	4.6	3.8	4.1	3.4	20.6																			24.8

FILENAME: I5922 Sign Designs

NORTH CAROLINA D.O.T. SIGN DETAIL

I-4700

TC-24

Buncombe and Henderson Counties

SIGN NUMBER: WZTC
TYPE: STATIONARY
QUANTITY: SEE PLANS

SIGN WIDTH: 3′-0″
HEIGHT: 2′-6″
TOTAL AREA: 7.5 Sq.Ft.

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

NO. Z BARS:
LENGTH:

BACKG COLOR: Fluorescent Orange
COPY COLOR: Black

SYMBOL	X	Y	WID	HT

MAT'L: 0.080″ (2.0 mm) ALUMINUM

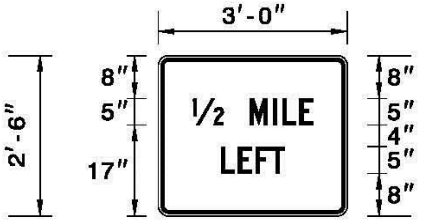
USE NOTES: 1,2

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

DESIGN BY: J.Navarrete
PROJECT ID: I5922

CHECKED BY:
LOCATION:

Mar 14, 2018
DIV:WZTC



BORDER
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TH=0.63″
IN=0.47″

Spacing Factor is 1 unless specified otherwise

LETTER POSITIONS

Letter spacings are to start of next letter

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		L	E	F	T																						C 2000
	12	3.3	3.4	2.8	2.6	12																					12.1

FILENAME: I5922 Sign Designs

NORTH CAROLINA D.O.T. SIGN DETAIL

I-4700

TC-25

Buncombe and Henderson Counties

SIGN NUMBER: WZTC
TYPE: STATIONARY
QUANTITY: SEE PLANS

SIGN WIDTH: 5'-6"
HEIGHT: 5'-6"
TOTAL AREA: 30.3 Sq.Ft.

BORDER TYPE: INSET
RECESS: 0"
WIDTH: 0"
RADII: 0"

NO. Z BARS: 2
LENGTH: 58.0

BACKG COLOR: Fluorescent Orange
COPY COLOR: Black

SYMBOL	X	Y	WID	HT

MAT'L: 0.080" (2.0 mm) ALUMINUM

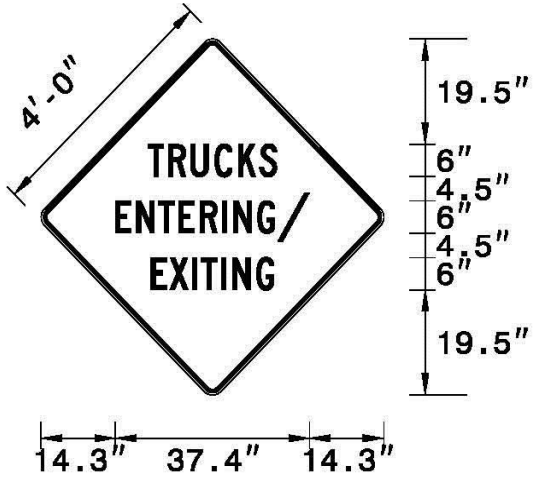
USE NOTES: 1,2

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

DESIGN BY: J.Navarrete
PROJECT ID: I5922

CHECKED BY:
LOCATION:

Mar 14, 2018
DIV: DIV



Spacing Factor is 1 unless specified otherwise

LETTER POSITIONS

Letter spacings are to start of next letter

																										Series/Size Text Length
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		E	N	T	E	R	I	N	G	/																	C 2000
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		E	X	I	T	I	N	G																		C 2000
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FILENAME: I5922 Sign Designs

NORTH CAROLINA D.O.T. SIGN DETAIL

I-4700

TC-26

Buncombe and Henderson Counties

SIGN NUMBER: WZTC
TYPE: STATIONARY
QUANTITY: SEE PLANS

SIGN WIDTH: 3′-0″
HEIGHT: 2′-6″
TOTAL AREA: 7.5 Sq.Ft.

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

NO. Z BARS:
LENGTH:

BACKG COLOR: Fluorescent Orange
COPY COLOR: Black

SYMBOL	X	Y	WID	HT

MAT′L: 0.080″ (2.0 mm) ALUMINUM

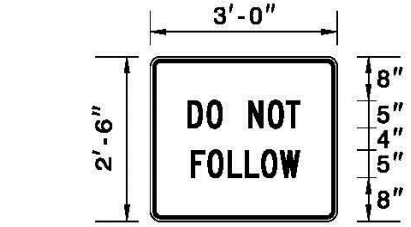
USE NOTES: 1,2

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

DESIGN BY: J.Navarrete
PROJECT ID: I5922

CHECKED BY:
LOCATION:

Mar 14, 2018
DIV:WZTC



BORDER
R=1.5″
TH=0.63″
IN=0.47″

Spacing Factor is 1 unless specified otherwise

LETTER POSITIONS

Letter spacings are to start of next letter																											Series/Size Text Length
		D	O		N	O	T																					C 2000
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		F	O	L	L	O	W																					C 2000
	7.9	3.1	3.9	3.3	3.2	3.6	3.8	7.2																			20.9

FILENAME: I5922 Sign Designs

NORTH CAROLINA D.O.T. SIGN DETAIL

I-4700

TC-27

Buncombe and Henderson Counties

TRAFFIC CONTROL SUPERVISOR
(12/12/2018)

This provision supersedes the requirements of Article 1101-13.

Provide the services of at least one Traffic Control Supervisor for the project who is knowledgeable of TMP design, devices and application, and has full authority to ensure traffic is maintained in accordance with the plans and specifications and ensure all employees working inside NCDOT right of way have received the proper training appropriate to the job decisions each individual is required to make.

The Traffic Control Supervisor shall be on the project site overseeing all lane and road closures and median crossover operations to ensure traffic control devices are properly installed and adjusted as necessary. The Traffic Control Supervisor shall also make necessary changes to the traffic control operations and aide in the monitoring of traffic queuing.

At the Pre-Construction Conference, the Contractor shall identify a Traffic Control Supervisor that has the following qualifications:

(1) A minimum 24 months of On-the-Job Training in supervision and work zone set up and implementation on similar projects.

(2) Be certified by responsible party (contractor or NCDOT) to have the required experience and training and is qualified to perform the duties of this position. If certified by the Contractor, a notarized certification letter shall be furnished to the Engineer at the preconstruction meeting. The letter shall state the Traffic Control Supervisor is qualified, and state that the Traffic Control Supervisor has the authority to ensure traffic is maintained in accordance with the contract documents.

The Traffic Control Supervisor for the project shall perform the following:

(1) During construction, be available or on call 24 hours per day, 7 days per week to address mobility and / or safety concerns within the work zone and direct / make any necessary changes in the traffic control operations in a timely and safe manner. The Contractor shall provide NCDOT the name of the Traffic Control Supervisor and support personnel, and the phone number(s) where they can be reached 24 hours per day, seven days per week.

(2) Coordinate and cooperate with traffic control supervisors of adjacent, and overlapping construction projects, as well as construction projects in proximity to the subject project, to ensure safe and adequate traffic control setup is maintained throughout the project at all times, including periods of construction inactivity.

(3) Coordinate and Cooperate with the Engineer, the Regional Traffic Management Center (RTMC), and the Statewide Operations Center (STOC) for the utilization of RTMC/STOC Managed Portable Changeable Message Signs on I-26 and along alternate routes for the purpose of Incident Management.

(3) Coordinate with the Engineer, Law Enforcement, first responders, and other city and state agencies during emergencies.

(4) Provide traffic control setup that ensures safe traffic operations and workers' safety throughout the construction area.

(5) Attend all scheduled traffic control coordination meetings, as required by the Engineer.

(6) Monitor traffic delays and backups within the work zone.

RTMC/STOC MANAGED PCMS
01/23/2019

DESCRIPTION

Furnish, install, operate, maintain, relocate and remove RTMC/STOC Managed Portable Changeable Signs (PCMSs) for the purpose of Incident Management within the I-26 work zone. These are separate and in addition to any Portable Changeable Message Signs required by the *NCDOT Roadway Standard Drawings* for temporary traffic control.

MATERIALS

RTMC/STOC Managed Portable Changeable Signs (PCMSs) shall meet all the requirements of sections 1089-7 and 1120-2 of the *Standard Specifications*.

In addition, the CMSs shall also be equipped with the functionality to be operated locally in the field and controlled remotely by Department staff at the Regional Traffic Management Center (RTMC) and the Statewide Transportation Operation Center (STOC).

The CMSs shall be fully NTCIP compliant and operate with full functionality via remote communications from the RTMC and STOC.

The CMSs shall be capable of being controlled remotely using the existing software utilized by the RTMC and STOC staff at the time of deployment. No vendor specific or third-party software will be allowed.

The CMSs must be approved for use in freeway incident management before they are deployed.

CONSTRUCTION METHODS

RTMC/STOC Managed Portable Changeable Signs shall meet all the requirements of article 1120-3 of the *Standard Specifications*.

In addition, the Contractor shall coordinate with the RTMC and the STOC when alternate route information needs to be displayed. In the event of an incident, the RTMC and STOC will take remote control of the CMSs to provide incident management information to motorists. Upon incident clearance and resumption of normal traffic flow, the RTMC and the STOC will allow the Contractor to regain control of the CMSs.

Contractor shall not begin construction on I-26 prior to the deployment and acceptance of CMSs.

Alternate routes for the purpose of incident management shall be determined by the Department. Install CMS's in the following locations unless directed otherwise by the Engineer:

- I-26 Westbound CMS 1 - MM 57.5
- I-26 Westbound CMS 2 - MM 45
- I-26 Westbound CMS 3 - MM 40.5
- I-26 Westbound CMS 4 - MM 35.5
- I-26 Eastbound CMS 5 - MM 36.5
- I-26 Eastbound CMS 6 - MM 41.5
- I-26 Eastbound CMS 7 - MM 46
- I-26 Eastbound CMS 8 - MM 52
- US-25 Southbound CMS 9
- US-64 Westbound CMS 10: Prior to US-25 BUS
- US-25 BUS Northbound CMS 11: Prior to US-64
- NC-280 Eastbound CMS 12: At US-25
- NC-146 Eastbound CMS 13: At US-25
- NC-191 Southbound CMS 14: North of I-40
- Upward Rd CMS 15: East of US-176
- US-25 BUS Southbound CMS 16: Prior to US-64
- US-25 Northbound CMS 17: At NC-280
- US-25 Southbound CMS 18: Prior to NC-146
- US-25 BUS Northbound CMS 19: Prior to I-26
- US-25 Southbound CMS 20: Prior to I-26

MEASUREMENT AND PAYMENT

RTMC/STOC Managed Portable Changeable Message Signs will be measured and paid as the maximum number of changeable message signs acceptably placed, in operation, and communicating properly, at any one time during the life of the project. Payment for *RTMC/STOC Operated Portable Changeable Message Signs* will be made on the following schedule:

(A) 70% of the unit bid upon placing the unit in service
(B) 20% of the unit bid when the project is 50% complete

(C) 10% of the unit when the project is 100% complete

Replacement, repair, maintenance, and relocation of TMC Operated Changeable Message Signs will be incidental to the work of this section

Pay Item	**Pay Unit**
RTMC/STOC Managed PCMS	Each

ADA COMPLIANT PEDESTRIAN TRAFFIC CONTROL DEVICES:
(10/31/2017)

Description

Furnish, install, and maintain all ADA compliant pedestrian traffic control devices for existing sidewalks that are disrupted, closed, or relocated by planned work activities.
The ADA compliant pedestrian traffic control devices used to either close, redirect, divert or detour pedestrian traffic are Pedestrian Channelizing Devices, Audible Warning Devices and Temporary Curb Ramps.

Construction Methods

The ADA compliant pedestrian traffic control devices involved in the closing or redirecting of pedestrians as designated on the Transportation Management Plan (TMP) shall be manufactured and assembled in accordance with the requirements of the Americans with Disabilities Act (ADA) and be on the NCDOT approved products list.

Pedestrian Channelizing Devices shall be manufactured and assembled to be connected as to eliminate any gaps that allow pedestrians to stray from the channelizing path. Any Pedestrian Channelizing Devices used to close or block a sidewalk shall have a "SIDEWALK CLOSED" sign affixed to it and any audible warning devices, if designated on the TMP.

Audible Warning Devices shall be manufactured to include a locator tone activated by a motion sensor and have the ability to program a message for a duration of at least 1 minute. The motion sensor shall have the ability to detect pedestrians a minimum of 10' away. The voice module may be automatic or it may be push button activated. If push button activated, it shall be at the appropriate height to meet the ADA regulations.

Temporary Curb Ramps shall be manufactured and assembled to meet all of the requirements for persons with walking disabilities, including wheelchair confinement, according to the ADA regulations and Roadway Standard Drawing 848.05. All detectable warning features are to be included with these installations.

Measurement and Payment

The measurement and payment for the ADA Compliant Pedestrian Traffic Control Devices shall be measured and paid on a per each basis for the Audible Warning Devices and Temporary Curb Ramps. Payment for Temporary Curb Ramps includes all necessary detectable warning features. The measurement and payment for the Pedestrian Channelizing Devices will be by the linear foot.

Payment for each of these devices is dependent upon satisfactory installation and acceptance by the Engineer. The unit prices include any costs associated with installation, maintenance and removal of the devices from the project.

Payment will be made under:

Pay Item	**Pay Unit**
Pedestrian Channelizing Devices	Linear Foot
Audible Warning Devices	Each
Temporary Curb Ramps	Each

WORK ZONE TRAFFIC PATTERN MASKING:
(10/1/2018)

Description

Furnish and install Work Zone Traffic Pattern Masking material for placement on existing asphalt pavements during work zone operations. The Work Zone Traffic Pattern Masking material shall be black in color and used during traffic pattern changes to completely cover the entire pavement surface; thus masking/concealing the existing pavement markings and allowing the revised work zone pavement markings to be placed on a newly applied black surface. Its purpose is to eliminate the grind marks and "ghost markings" on pavement surfaces which can create motorist confusion and pavement damage while providing an incomparable contrast between the revitalized black pavement color and newly applied pavement markings for work zone patterns of up to a year.

Materials

A) General

Use materials in accordance with Manufacturer's recommendations that will retain a black color for a period of up to 12 months. The black material shall be a flat black color when fully cured and shall completely mask/conceal the existing pavement markings for the same 12-month period.

The material shall not exhibit glare or retroreflectance in either day or night conditions. To ensure the material provides ample concealment and does not exhibit excessive glare, the material

opaqueness shall be a minimum of 95% and the retroreflective properties shall not exceed 4 mcd/lux/m^2.

It shall not adversely affect the ability of the pavement to drain water or make the pavement adversely slick in either dry and wet conditions and shall meet the skid properties as described in Section C below.

The material shall not contain any petroleum components and shall not contain any Volatile Organic Compounds (VOC's).

The material shall not exhibit excessive cracking or create excessive cracking to the pavement surface after placement.

It shall be manufactured to bond successfully to both concrete and asphalt pavements and allow resurfacing treatments to be applied directly over its surface without having to be removed for successful bonding of the new asphalt or concrete overlays.

It should also be manufactured to receive any type of polyurea, epoxy, polymer, cold applied plastic, or thermoplastic pavement marking materials.

B) Material Qualifications/Certifications

Use Work Zone Traffic Pattern Masking materials that are on the NCDOT Approved Products List. Provide a Type 3 (Manufacturers) Certification in accordance with Article 106-3 in the North Carolina Standard Specifications for Roads and Structures to ensure the material meets or exceeds the requirements in this specification.

In addition, provide a Type 5 (Typical Certified Test Report) Certification in accordance with Article 106-3 in the North Carolina Standard Specifications for Roads and Structures that ensures the material has been tested by an independent testing company that meets or exceeds the braking/skid requirements as described in Section (C) below.

C) Performance

The Work Zone Pattern Masking material shall be tested by an independent test laboratory for skid properties according to the test standards in ASTM E274 or ASTM E303-93 (2008). The material shall provide minimum frictional resistance numbers when tested with either test standard. The minimum average Skid Number (SN) for ASTM E274 is 37. The minimum average British Pendulum Number (BPN) for ASTM E303-93 (2008) is 37.

The work zone travel lane shall retain its black distinguishable appearance throughout the life of the traffic pattern. Normal wearing is expected in the wheel paths of the travel lanes, but the work

zone travel lanes shall always have a noticeable black appearance at all times during the expected 12-month traffic pattern life.

At any time this material fails to keep previously installed pavement markings concealed, resulting in conflicting traffic patterns or does not retain its black color contrast for the required 12-month duration, it is not meeting the requirements and intention of this specification and shall be replaced immediately.

The Work Zone Pattern Masking material shall retain its black color and continue to conceal the pavement markings underneath after a single snowplow event within its 12-month expected life. If the work zone experiences more than 1 snowplowing event, the Engineer will determine if the Work Zone Pattern Masking is still performing adequately or if replacement is necessary due to excessive damage caused by snowplow activities. If the material is damaged to the point where 20% or more of the concealed pavement markings are revealed, it shall be replaced, at an 8" width to re-conceal the exposed pavement markings, at the contract unit price unless the traffic pattern is to change within 30 days.

Poor performance of Work Zone Pattern Masking material at any site, whether or not related to a specific contract may be grounds for removing the material from the NCDOT Approved Products List and or removing from any project under contract.

Construction Methods

A) Application Equipment

The equipment to apply Work Zone Traffic Pattern Masking material shall be truck mounted pneumatic or airless spray machines with suitable arrangement of atomizing nozzles and controls to cover the entire pavement surface to achieve uniform coverage with consistent thickness as required in this specification. Do not use hand applied methods or any other non-truck mounted application equipment or device to install material for applications longer than 1,000 feet.

The application spray equipment shall be set up in such a manner to apply the Work Zone Traffic Pattern Masking material in spray pattern widths to ensure complete and uniform coverage of the entire travelway and to reduce the overlap from multiple passes. If the application equipment is not equipped to spray a full 12' travel lane in a single pass, it shall be set-up to spray a 6 foot minimum width. No more than 2 passes per travel lane will be allowed. A 1" overlap width is required when applying the material in less than the full width of the travel lane.

B) Material Application

The Work Zone Traffic Pattern Masking material is to be applied to the full width and length of the pavement surface where traffic patterns are to change, thus masking/concealing the existing

pavement markings, as well as providing a new black surface for the placement of the revised pavement markings.

The Work Zone Pattern Masking material shall be applied to the pavement markings being concealed in 2 separate applications. The first application shall be applied directly onto the existing pavement markings at a width equivalent to the width of the markings being concealed plus 6 inches on each side at a uniform thickness of 20 mils. This application does not require the application of anti-skid elements.

Upon drying of the first application, the second application shall be applied on the pavement markings being concealed, as well as the entire pavement width, at a uniform thickness of 20 mils along with the anti-skid elements at a rate of 8 lbs/gallon or greater.

The material shall be set and/or cured track free within 15 minutes of installation when ambient temperatures are 65 degrees or higher. When applications take place between 40 and 65 degrees, the material shall be set and/or cured in no more than 25 minutes.

During the cure time period, no vehicles are allowed to drive on the masking material. Coordination between the Engineer, Contractor, Sub-Contractors, and inspectors is essential to make sure no one drives on the material during its cure time period, as this will affect the performance of the masking.

C) Surface Preparation

i) The existing asphalt pavement surface shall be swept clean and prepared in accordance with the Manufacturer's recommendations to receive the Work Zone Traffic Pattern Masking material. In addition, the existing markings to be concealed shall be machine broomed, or other scarification method, as directed by the Manufacturer to remove any loose or flaking pavement marking material, as well as raised glass beads remaining in the existing markings.

NOTE: For newly placed concrete pavements, newly installed concrete bridge decks or existing concrete pavements that do not receive a surface treatment, Work Zone Traffic Pattern Masking Material shall not be placed. The conflicting pavement marking lines shall be removed by water blasting methods only.

D) Temperature and Weather Limitations

Do not apply Work Zone Traffic Pattern Masking material unless the ambient air temperature and the pavement temperature is 40°F or higher. Do not install unless the pavement surface is completely dry and not within 4 hours of a significant rain event such as a thunderstorm with rainfall intensities greater than 1 inch/per hour. Always follow the Manufacturer's recommendations for placement during periods of excessive humidity.

Maintenance

There should be no required maintenance of the Work Zone Traffic Pattern Masking material. Replace any Work Zone Traffic Pattern Masking material that prematurely fails to keep pavement markings masked/concealed for the full 12 month duration.

Any traffic control or material costs due to replacement will be at no cost to the Department, unless it is due to excessive damage caused by snowplow operations.

Measurement and Payment

Work Zone Traffic Pattern Masking material will be measured and paid by the square foot. The quantity of material to be paid is calculated by multiplying the length by the width of the masking installed to conceal all edgelines, skip lines, lane lines, and gore lines **plus** product of multiplying the length by the width of all lanes masked by each work zone traffic pattern change.

Pay Item	**Pay Unit**
Work Zone Traffic Pattern Masking	Square Foot

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WATERCRAFT SAFETY

DESCRIPTION

Furnish, install, maintain, remove, and replace temporary traffic control devices for French Broad River watercraft. Devices shall be used to delineate and to inform boaters of restricted access to the work areas during the replacement of Bridge **100211** over the French Broad River.

Furnish, install, maintain, and remove a protective canopy system under the bridge to prevent falling debris when boater access under the bridge is open.

See the special provision titled *Temporary River Traffic Warning Signs* for river signing requirements during construction.

MATERIALS

Watercraft temporary traffic control devices will include items such as buoys, rope, lighting, or any other devices necessary to delineate and restrict the closure area to boater access. Ensure that the delineation is visible at all hours of the day or night.

Lighting will include solar-powered, steady-state, red, safety lights on the causeways for river user safety. Generators will not be used to provide power to avoid additional noise that may disturb bats flying through the work zone.

Protective canopy system will include items necessary to protect boaters from falling debris when work is occurring above the open waterway. The canopy system will include a rigid, non-drooping, catchment device on the overhead structure from south of Old River Road to the opposite side of the river to prevent material from falling on river users, equestrians, bicyclists, or in the water.

CONSTRUCTION METHODS

Furnish the Engineer with a plan outlining how watercraft safety will be maintained, prior to the preconstruction conference.

Inform the Engineer and French Broad River Authority of the dates of implementation of the watercraft safety plan and coordinate public information efforts.

Maintain the watercraft temporary traffic control devices throughout the duration of the contract and repair or replace any damaged or stolen devices within 24 hours.

Maintain the protective canopy system throughout the duration of use and repair any damage within 24 hours. At no time shall materials or equipment be stored on the canopy roof. All waster of falling debris shall be removed from the canopy roof on a daily basis or as directed by the Engineer.

Remove the watercraft temporary traffic control devices within two days of completion of work requiring the use of the devices to restrict boater access.

Remove the protective canopy system within two days of completion of work requiring the use of the system.

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Deployment of Temporary Traffic Control Devices

Full Closure of Waterway

Install watercraft temporary traffic control devices to fully close the waterway at the bridge site for operation that include bridge demolition and girder installation only. Other operations requesting full closure of waterway need approval by the Engineer.

Closures shall not last more than two days. Care will be taken to not close the river during known peak business times, particularly the Memorial Day, Fourth of July, and Labor Day weekends.

Full closure of waterway shall be prohibited on Saturdays and Sundays.

Notify the Engineer a minimum two weeks in advance of full closure.

Partial Closure of Waterway

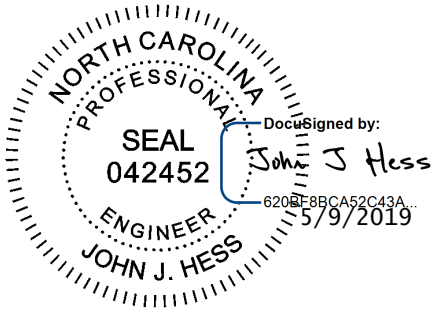
As directed by the Engineer, install watercraft temporary traffic control devices to partially close the waterway at the bridge site for operations not including demolition or girder installation. The portion of waterway not closed shall remain open to watercraft.

MEASUREMENT AND PAYMENT

The lump sum bid for Watercraft Safety shall include but not be limited to all necessary devices and all labor, tools, equipment, and incidentals necessary to furnish install, maintain, replace, and remove watercraft traffic control devices and protective canopy system when no longer required.

Payment will be made under:

Pay Item	**Pay Unit**
Watercraft Safety	Lump Sum (LS)



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TEMPORARY RIVER TRAFFIC WARNING SIGNS:

DESCRIPTION

Furnish, erect, maintain, and remove stationary Temporary River Traffic Warning Signs in accordance with the contract and plans.

MATERIALS

Refer to Division 10.

Item	Section
Work Zone Signs	1089-1
Work Zone Sign Supports	1089-2

Furnish the Temporary River Traffic Warning Signs per Section 1089-1(A)(1). Furnish supports for the Temporary River Traffic Warning Signs per Section 1089-2(A)(1).

CONSTRUCTION METHODS

A written agreement provided by the Engineer with the property owner shall be executed prior to a sign erection.

Erect Temporary River Traffic Warning Sign panel per location identified in the plans. The exact placement of the Temporary River Traffic Warning Sign within an individual property shall be approved by the Engineer.

All Temporary River Traffic Warning Signs shall be erected on stationary supports.

Install Temporary River Traffic Warning Signs to stand within 2° of plumb in all directions and under all conditions.

Splicing of Temporary River Traffic Warning Signs posts is acceptable. Splice Temporary River Traffic Warning Signs posts according to *Roadway Standard Drawings*. Remove entire post when removing signs with spliced posts.

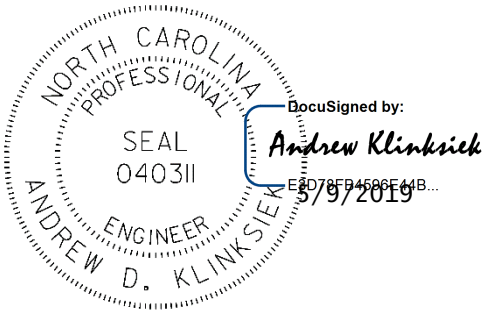
MEASUREMENT AND PAYMENT

Temporary River Traffic Warning Signs will be measured and paid for as the actual number of signs satisfactorily installed and accepted by the Engineer.

No direct payment will be made for Temporary River Traffic Warning Sign supports. All Temporary River Traffic Warning Sign supports will be incidental to the work of furnishing, erecting, maintaining and removal of the Temporary River Traffic Warning Signs.

Payment will be made under:

Pay Item	**Pay Unit**
Temporary River Traffic Warning Signs	EA



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I-26 Improvements

STIP Project Nos. I-4400 & I-4700

US 25 (exit 54) in Henderson County to I-40/I-240 in Buncombe County
including Blue Ridge Parkway Bridge over I-26

RIVER SAFETY PLAN
FOR THE CONSTRUCTION OF THE I-26 BRIDGE OVER THE FRENCH BROAD RIVER

To ensure the safe passage of river users during the construction and demolition of the I-26 bridge over the French Broad River NCDOT has developed this River Safety Plan (RSP) to be used in conjunction with the Strategic Communications Plan (SCP) for the Construction of the I-26 Bridge over the French Broad River.

- NCDOT has created and implanted the SCP, which specifically addresses the construction of the I-26 bridge over the French Broad River as part of its larger I-26 Widening Communication Plan. The SCP includes, but is not limited to:
    - Information Outreach Campaign:
        - Coordination with known river users including businesses, paddle groups, civic groups, etc.
        - Coordination with media outlets when river needs to be closed due to safety concerns.
    - Provide signage upstream and downstream of the bridge to alert river users to construction. These signs will note that the last public pull out is at Bent Creek River Park, 1 mile upstream of the bridge. These signs will be placed at the following locations; all are public with the exception of the privately owned launches marked with an asterisk (*):
        - Headwaters Outfitters* – 25 Parkway Road, Rosman
        - Champion Park River Access (Transylvania County Parks and Recreation) – Old Turnpike Road, Rosman (1st public access from the headwaters)
        - Hannah Ford Campground - Headwaters Outfitters* - Green Road (SR 1127), Rosman
        - Island Ford River Access (Transylvania County Parks and Recreation) – Island Ford Road, Brevard
        - Hap Simpson Park (Brevard Parks and Recreation) – 968 Greenville Hwy, Brevard
        - Wilson Road River Access (Transylvania County Parks and Recreation) – Wilson Road, Pisgah Forest
        - Penrose Boat Ramp (NC Wildlife Resources Commission) – 170 Apac Drive, Penrose
        - Blantyre Park (Henderson County Parks and Recreation) – 500 Cliff Road, Penrose
        - Horse Shoe River Access Park (Henderson County Parks and Recreation) – Horse Shoe

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        - Westfeldt Park (Henderson County Parks and Recreation) – 83 Old Fanning Bridge Road, Fletcher
        - Glen Bridge River Park (Buncombe County Parks and Recreation) – 77 Pinners Road, Arden
        - Corcoran Paige River Park (Buncombe County Parks and Recreation) – 9 Pinners Road, Arden
        - Bent Creek River Park (Buncombe County Parks and Recreation) – 1592 Brevard Road, Asheville
        - Hominy Creek River Park (Buncombe County Parks and Recreation) – 194 Hominy Creek Road, Asheville
        - Mills River Park (Town of Mills River) – 124 Town Center Drive, Mills River *(This park is near the confluence of Mills River and French Broad River and a common starting point for paddlers of the French Broad River.)*
    - Signage on the causeways to warn river users away and prevent river users from using the causeway as a stopping point.
- Physical restrictions
    - Use of a floating navigational aide to mark the safe passage lane.
    - NCDOT shall commit to including a rigid, non-drooping, catchment device on the overhead structure from south of Old River Road to the opposite side of the river to prevent material from falling on river users, equestrians, bicyclists, or in the water.
    - NCDOT shall place steady-state red lights that are solar-powered on the causeway to alert river user to its location. Generators will not be used to provide power. These lights will be atop permanent structures, such as a pole, on each causeway for the duration of the project. The contractor will be responsible for maintaining these lights at all times during construction, replacing them as necessary.
- Contractor requirements:
    - Develop a river traffic plan to include below items:
        - Provide one or more flaggers upstream as needed to stop river use at limited times when working over the river (e.g. setting beams, demolition of the structure)
        - Training of construction staff to teach skills in aiding a distressed boater – This is meant as an extra precaution for both staff and river users. It does NOT imply that the contractor will provide “lifeguard” type services.
        - Must have a life vest and/or boat on site.

PROJECT SPECIAL PROVISIONS
LIGHTING

1.00 DESCRIPTION

The work covered by this Section consists of furnishing, installing, connecting, and placing into satisfactory operating condition roadway lighting 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" (*2018 Standard Specifications*).

Perform all work in conformance with Division 14 of the *2018 Standard Specifications* except as modified or added to by these Special Provisions. Install all bore pits outside the clear zone, as defined in the AASHTO Roadside Design Guide or as directed by the Engineer.

In addition to the requirements of Division 1400, other specific Sections of the *2018 Standard Specifications* applicable to the work on this project are listed below.

Section 1409	Electrical Duct
Section 1410	Feeder Circuits
Section 1411	Electrical Junction Boxes

2.00 RELOCATE LIGHT STANDARDS

2.10 DESCRIPTION

The work covered by this section consists of providing all equipment, labor and materials necessary to move an existing light standard to a new foundation at locations shown on the plans. The standard to be relocated may be near the proposed final location, or may be one removed from another location. This section also includes storage of materials to be reused, and removal of the existing foundation. Construction of a new foundation is not included in this section.

2.20 MATERIALS

Reuse existing materials, including the light standard, breakaway base, arm and luminaire. Shims and washers may be reused, but new connecting bolts are required. Replace materials that are to be reused if they are damaged during relocation or storage. Materials damaged during relocation or storage will be replaced with new materials at no additional cost to the Department.

The Contractor is responsible for the storage and protection of the reused materials against loss or damage.

2.30 CONSTRUCTION METHODS

Maintain operation of the existing lighting system until such time that it becomes in conflict with the actual construction work, or it becomes a hazard to traffic as determined by the Engineer.

Coordinate work with the NC DOT Traffic Services Supervisor to assure that circuits can be de-energized where and when necessary.

Dismount the light standard from the existing standard foundation. Reassemble and reinstall light standards on a new foundation and reuse the existing breakaway base. Replace the connecting bolts joining the standard to the breakaway base and attachment hardware for the standard-to-arm connection. Use rope or web slings when hoisting or lifting the light standard, to prevent damage or marking. If the light standards are to be stored between dismounting and reinstalling, provide proper transportation and supports to prevent warping. Provide protection against the elements.

Remove or abandon existing concrete light standard foundations. Dispose of the removed concrete, reinforcing steel, and anchor bolts in manner acceptable to the Engineer. Backfill the holes with suitable material and compact the material as required.

Abandon or remove the underground feeder circuit conductors and conduit as detailed in the plans. Install new breakaway fuse holders in the breakaway base of the light standard and install new underground feeder circuitry and conduit as shown on the plans.

2.40 MEASUREMENT AND PAYMENT

The quantity of relocated light standards to be paid for will be the actual number, which have been removed from existing locations and installed at proposed locations in a satisfactory manner and have been accepted by the Engineer.

Relocated light standards measured as provided above will be paid for at the contract unit bid price per each “Relocate Light Standard”. Such price and payment will be considered full compensation for disconnecting circuitry, disassembly, transportation, storage, reassembly, installing new connecting bolts, installing new breakaway fuse holders, removal of existing foundation, disposing of concrete, backfilling, compaction and all incidentals necessary to complete the work.

Payment will be made under:

Relocate Light Standard …… Each



DocuSigned by:
Paul Chan
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2/11/2019

DOCUMENT NOT CONSIDERED FINAL
UNLESS ALL SIGNATURES COMPLETED

PROJECT SPECIAL PROVISIONS
Utility Special



3/11/2019

Utility Coordinator

Description:
The contractor shall provide a Utility Coordinator to coordinate the physical utility relocations and the protection of utility facilities with the highway project construction. The Coordinator shall facilitate and provide construction oversight through completion of the utility relocations with the highway project construction to resolve all utility conflicts, expedite the project schedule and to maintain the safety of the workers and roadway users. The Coordinator shall promote communications between parties, i.e. the Contractor's personnel, the utility owners' personnel and contractors, and the Department's personnel.

The Utilities by Others (UbO) plans and special provisions detail the utility relocations to be performed by others, and the Utility Construction (UC) plans and special provisions detail the utility relocations to be constructed under this contract. The Utility Coordinator is responsible for oversight and fulfillment of this provision in regard to all utilities detailed in the UbO plans, UC plans, and corresponding special provisions. In accordance with 105-8, the Department has coordinated the design and construction of the relocations up to the date of the UO Special Provisions.

Tasks include:
- Facilitate the exchange of information on the status of the work, the upcoming plans, and the needs of the parties.
- Maintain a schedule of activities and of relationships between the parties.
- Document the status and events as they occur and the effect of events upon the parties, reporting weekly to the Engineer.
- Participate in monthly status meeting per the Project Management Plan.
- Provide decision makers of the parties with information to assure that timely decisions are made, and actions are taken.
- Inspect daily operations and coordinating utility relocations with project construction.

- Ensure compliance with the "Underground Utility Safety and Damage Prevention Act" for damage prevention.
- Review Utility Owners' plans for conflict resolution and constructability
- Ensure utilities are located (vertically and horizontally) per plans or plans as modified to ensure conflicts with construction are resolved.
- Communicate closely with Division 13 Utility Engineer and the Construction Management Team.
- Coordinate conflict resolution with construction activities.
- Arrange for the provision of surveying information as needed to assist with utility relocations.
- Identify and coordinating field adjustments necessary due to site conditions and construction operations.
- Ensure that all Traffic Control and Erosion Control requirements are adhered to by the Utility Owners and their Agents.

Recommended Methods for accomplishing the tasks include:

- Provide facilities for meetings.
- Conduct meetings as required and/or recommended by the Engineer.
- Provide schedules and documents to all parties, as recommended by the Engineer.
- Provide minutes of meetings to all parties within 1 week of meeting.
- Obtain and update NC811 Notices for damage prevention.
- Inspect for maintenance of utility location markings on the ground.
- Coordinate the traffic controls of the Contractor and Utility Owners.
- Be a clearinghouse for utility related information exchange.

Submittals:

Provide monthly reports at the monthly status meeting to the Construction Management Team detailing:

- Utility relocation activities completed for the month separated by utility owner.
- Utility relocation activities planned for the next month separated by utility owner.
- An overall assessment of utility relocation progress and the effect on the highway project.
- Critical needs and recommended actions to maintain the contract schedule.
- Establish and provide a clearly defined timeline for utility relocations to occur which identifies the critical path.

Measurement and Payment:

The work of this provision will be paid for at the contract lump sum price for "Utility Coordinator." Partial payments will be made on each particular payment estimate based upon the percentage complete of the utility relocations. The Contractor shall submit a certified statement each month indicating the percentage of work completed. The Resident

Engineer will determine if the amount indicated is reasonably correct and the Resident Engineer will pay accordingly on the next partial pay estimate.

Payment will be made under:

Utility Coordinator: ……Lump Sum

UbO-1

KCI TECHNOLOGIES
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General:

The following utility companies have facilities that will be in conflict with the construction of this project:

A. Duke Power – Power (Distribution)
B. ATT – Communications
C. Charter – Communications
D. PSNC – Gas
E. City of Asheville – Water
F. MSD – Sewer

The conflicting facilities of these concerns will be 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 owners with the exception of Water & Sewer which have been incorporated into the contract and also stated below. All utilities are shown on the plans from the best available information.

The Contractor's attention is directed to Article 105-8 of the 2018 Standard Specifications.

Utilities Requiring Adjustment:

Utility relocations are shown on the Utility by Others Plans.

A) Duke Power – Power (Distribution)
Contact Information: Mr. Larry Morris
4690 Simms Creek Road
Raleigh, NC 27616
803-283-5084
Larry.morris@duke-energy.com

1) See Utilities by Others Plans.
2) Duke Power will install new aerial power lines as shown in the UBO's.
3) All work will be completed prior to April 15, 2020.

B) ATT - Communications
Contact Information: Mr. Kevin Hogsed
100 S. Eugene Street
Greensboro, NC 27401-
2224ATT.NC.PRIVATE.ROW
@ATT.COM 336-379-0505

1) See Utilities by Others Plans.
2) ATT will install underground cables and attach to new Duke Poles.
3) AT&T will need for Duke to complete relocations prior to beginning.
4) ATT will be completed prior to April 15, 2020.

C) Charter – Communications

Contact Information: Joshua Biggs
Joshua.biggs@charter.com
828-230-9250

1) See Utilities by Others Plans.
2) Charter will be attaching to new Duke Poles.
3) Charter will need 2 weeks' notice from contractor to mobilize and to complete their relocations.
4) All work will be completed prior to April 15, 2020.

D) PSNC – Gas

Contact Information: William Lewis
William.lewis@scana.com
828-670-3550

1) PSNC is proposing NO CONFLICT for this project.
2) PSNC will adjust all valves to final grade as needed during construction.

E) City of Asheville – Water

Contact Information: William (Chad) Pierce
PO Box 7148
Asheville, NC 28801
828-529-5420
cpierce@ashevillenc.gov

1) The City of Asheville relocations have been incorporated into the contract and will be handled by NCDOT contractor.

F) MSD Engineering – Sewer

Contact Information: Kevin Johnson, PE
2028 Riverside Drive
Asheville, NC 28804
828-225-8289

kevinj@msdbc.org

1) MSD relocations have been incorporated into the contract and will be handled by NCDOT contractor.

Project Special Provisions
Erosion Control

STABILIZATION REQUIREMENTS:
(3-11-2016)

Stabilization for this project shall comply with the time frame guidelines as specified by the NCG-010000 general construction permit effective August 1, 2016 issued by the North Carolina Department of Environmental Quality Division of Water Resources. 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: **(WestEd)**

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

06 Dust	Escalade	Justice	Serengeti
2nd Millennium	Essential	Kalahari	Shelby
3rd Millennium	Evergreen 2	Kitty Hawk 2000	Sheridan
Apache III	Falcon IV	Legitimate	Signia
Avenger	Falcon NG	Lexington	Silver Hawk
Barlexas	Falcon V	LSD	Sliverstar
Barlexas II	Faith	Magellan	Shenandoah Elite
Bar Fa	Fat Cat	Matador	Sidewinder
Barrera	Festnova	Millennium SRP	Skyline
Barrington	Fidelity	Monet	Solara
Barrobusto	Finelawn Elite	Mustang 4	Southern Choice II
Barvado	Finelawn Xpress	Ninja 2	Speedway
Biltmore	Finesse II	Ol' Glory	Spyder LS
Bingo	Firebird	Olympic Gold	Sunset Gold
Bizem	Firecracker LS	Padre	Taccoa
Blackwatch	Firenza	Patagonia	Tanzania
Blade Runner II	Five Point	Pedigree	Trio
Bonsai	Focus	Picasso	Tahoe II
Braveheart	Forte	Piedmont	Talladega
Bravo	Garrison	Plantation	Tarheel
Bullseye	Gazelle II	Proseeds 5301	Terrano
Cannavaro	Gold Medallion	Prospect	Titan ltd
Catalyst	Grande 3	Pure Gold	Titanium LS
Cayenne	Greenbrooks	Quest	Tracer
Cessane Rz	Greenkeeper	Raptor II	Traverse SRP
Chipper	Gremlin	Rebel Exeda	Tulsa Time
Cochise IV	Greystone	Rebel Sentry	Turbo
Constitution	Guardian 21	Rebel IV	Turbo RZ
Corgi	Guardian 41	Regiment II	Tuxedo RZ
Corona	Hemi	Regenerate	Ultimate
Coyote	Honky Tonk	Rendition	Venture
Darlington	Hot Rod	Rhambler 2 SRP	Umbrella
Davinci	Hunter	Rembrandt	Van Gogh
Desire	Inferno	Reunion	Watchdog
Dominion	Innovator	Riverside	Wolfpack II
Dynamic	Integrity	RNP	Xtremegreen
Dynasty	Jaguar 3	Rocket	
Endeavor	Jamboree	Scorpion	

Approved Kentucky Bluegrass Cultivars:

4-Season	Blue Velvet	Gladstone	Quantum Leap
Alexa II	Blueberry	Granite	Rambo
America	Boomerang	Hampton	Rhapsody
Apollo	Brilliant	Harmonie	Rhythm
Arcadia	Cabernet	Impact	Rita
Aries	Champagne	Jefferson	Royce
Armada	Champlain	Juliet	Rubicon
Arrow	Chicago II	Jump Start	Rugby II
Arrowhead	Corsair	Keeneland	Shiraz
Aura	Courtyard	Langara	Showcase
Avid	Delight	Liberator	Skye
Award	Diva	Madison	Solar Eclipse
Awesome	Dynamo	Mercury	Sonoma
Bandera	Eagleton	Midnight	Sorbonne
Barduke	Emblem	Midnight II	Starburst
Barnique	Empire	Moon Shadow	Sudden Impact
Baroness	Envicta	Moonlight SLT	Total Eclipse
Barrister	Everest	Mystere	Touche
Barvette HGT	Everglade	Nu Destiny	Tsunami
Bedazzled	Excursion	NuChicago	Unique
Belissimo	Freedom II	NuGlade	Valor
Bewitched	Freedom III	Odyssey	Voyager II
Beyond	Front Page	Perfection	Washington
Blacksburg II	Futurity	Pinot	Zinfandel
Blackstone	Gaelic	Princeton 105	
Blue Note	Ginney II	Prosperity	

Approved Hard Fescue Cultivars:

Aurora II	Eureka II	Oxford	Scaldis II
Aurora Gold	Firefly	Reliant II	Spartan II
Berkshire	Granite	Reliant IV	Stonehenge
Bighorn GT	Heron	Rescue 911	
Chariot	Nordic	Rhino	

On cut and fill slopes 2:1 or steeper add 20# Sericea Lespedeza and 15# Crown Vetch January 1 - December 31.

The Crown Vetch Seed should be double inoculated if applied with a hand seeder. Four times the normal rate of inoculant should be used if applied with a hydroseeder. If a fertilizer-seed slurry is used, the required limestone should also be included to prevent fertilizer acidity from killing the inoculant bacteria. Caution should be used to keep the inoculant below 80° F to prevent harm to the bacteria. The rates and grades of fertilizer and limestone shall be the same as specified for *Seeding and Mulching*.

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.

LAWN TYPE APPEARANCE:

All areas adjacent to lawns must be hand finished as directed to give a lawn type appearance. Remove all trash, debris, and stones ¾" and larger in diameter or other obstructions that could interfere with providing a smooth lawn type appearance. These areas shall be reseeded to match their original vegetative conditions, unless directed otherwise by the Field Operations Engineer.

REFORESTATION:

Description

Reforestation will be planted in areas as directed. *Reforestation* is not shown on the plan sheets. See the Reforestation Detail Sheet.

All non-maintained riparian buffers impacted by the placement of temporary fill or clearing activities shall be restored to the preconstruction contours and revegetated with native woody species.

The entire *Reforestation* operation shall comply with the requirements of Section 1670 of the *Standard Specifications*.

Materials

Reforestation shall be bare root seedlings 12"-18" tall.

Construction Methods

Reforestation shall be shall be planted as soon as practical following permanent S*eeding and Mulching*. The seedlings shall be planted in a 16-foot wide swath adjacent to mowing pattern line, or as directed.

Root dip: The roots of reforestation seedlings shall be coated with a slurry of water, and either a fine clay (kaolin) or a superabsorbent that is designated as a bare root dip. The type, mixture ratio, method of application, and the time of application shall be submitted to the Engineer for approval.

With the approval of the Engineer, seedlings may be coated before delivery to the job or at the time of planting, but at no time shall the roots of the seedlings be allowed to dry out. The roots shall be moistened immediately prior to planting.

Seasonal Limitations: *Reforestation* shall be planted from November 15 through March 15.

Measurement and Payment

Reforestation will be measured and paid for in accordance with Article 1670-17 of the *Standard Specifications*.

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

ENVIRONMENTALLY SENSITIVE AREAS:

Description

This project is located in an *Environmentally Sensitive Area*. This designation requires special procedures to be used for clearing and grubbing, temporary stream crossings, and grading operations within the Environmentally Sensitive Areas identified on the plans and as designated by the Engineer. This also requires special procedures to be used for seeding and mulching and staged seeding within the project.

The Environmentally Sensitive Area shall be defined as a 50-foot buffer zone on both sides of the stream or depression measured from top of streambank or center of depression.

Construction Methods

(A) Clearing and Grubbing

In areas identified as Environmentally Sensitive Areas, the Contractor may perform clearing operations, but not grubbing operations until immediately prior to beginning grading operations as described in Article 200-1 of the *Standard Specifications*. Only clearing operations (not grubbing) shall be allowed in this buffer zone until immediately prior to beginning grading operations. Erosion control devices shall be installed immediately following the clearing operation.

(B) Grading

Once grading operations begin in identified Environmentally Sensitive Areas, work shall progress in a continuous manner until complete. All construction within these areas shall progress in a continuous manner such that each phase is complete and areas are permanently stabilized prior to beginning of next phase. Failure on the part of the Contractor to complete any phase of construction in a continuous manner in Environmentally Sensitive Areas will be just cause for the Engineer to direct the suspension of work in accordance with Article 108-7 of the *Standard Specifications*.

(C) Temporary Stream Crossings

Any crossing of streams within the limits of this project shall be accomplished in accordance with the requirements of Subarticle 107-12 of the *Standard Specifications*.

(D) Seeding and Mulching

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.

Seeding and mulching shall be performed on the areas disturbed by construction immediately following final grade establishment. No appreciable time shall lapse into the contract time without stabilization of slopes, ditches and other areas within the Environmentally Sensitive Areas.

(E) Stage Seeding

The work covered by this section shall consist of the establishment of a vegetative cover on cut and fill slopes as grading progresses. Seeding and mulching shall be done in stages on cut and fill slopes that are greater than 20 feet in height measured along the slope, or greater than 2 acres in area. Each stage shall not exceed the limits stated above.

Additional payments will not be made for the requirements of this section, as the cost for this work shall be included in the contract unit prices for the work involved.

MINIMIZE REMOVAL OF VEGETATION:

The Contractor shall minimize removal of vegetation within project limits to the maximum extent practicable. Vegetation along stream banks and adjacent to other jurisdictional resources outside the construction limits shall only be removed upon approval of Engineer. No additional payment will be made for this minimization work.

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:

https://connect.ncdot.gov/resources/roadside/FieldOperationsDocuments/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 1630-3 of the *Standard Specifications*.

CLEAN WATER DIVERSION:

Description

This work consists of installing, maintaining, and removing any and all material required for the construction of clean water diversions. The clean water diversions shall be used to direct water flowing from offsite around/away from specific area(s) of construction.

Materials

Refer to Division 10

Item	Section
Geotextile for Soil Stabilization, Type 4	1056

Construction Methods

The Contractor shall install the clean water diversions in accordance with the details in the plans and at locations indicated in the plans, and as directed. Upon installation, the excavated material shall be immediately stabilized as provided in Section 1620 of the *Standard Specifications*. Other stabilization methods may be utilized with prior approval from the Engineer.

Line clean water diversion with geotextile unrolled in the direction of flow and lay smoothly but loosely on soil surface without creases. Bury top of slope geotextile edge in a trench at least 5" deep and tamp securely. Make vertical 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 6" 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.

Measurement and Payment

Silt Excavation will be measured and paid for in accordance with Article 1630-4 of the *Standard Specifications*.

Geotextile for Soil Stabilization will be measured and paid for in accordance with Article 270-4 of the *Standard Specifications*.

Stabilization of the excavated material will be paid for as *Temporary Seeding* as provided in Section 1620 of the *Standard Specifications*.

Such price and payment shall be considered full compensation for all work covered by this section including all materials, construction, maintenance, and removal of the clean water diversions.

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. Posts shall be installed a minimum of 2 ft. into the ground. 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)(5) 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. The coupling shall be rigid and non-buoyant and not exceed a diameter of 4” and 12” in length. 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 drain pipe, 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 drain pipe, 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 drain pipe 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. The coupling shall be rigid and non-buoyant and not exceed a diameter of 4” and 12” in length. 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 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

EARTHEN DAM WITH SKIMMER:

Description

Provide an earthen dam with a skimmer attached to a barrel pipe at the outlet of a proposed roadway ditch to remove sediment from construction site runoff at locations shown in the erosion control plans. See the Earthen Dam with Skimmer Detail sheet provided in the erosion control plans. Work includes constructing earthen dam, installation of coir fiber baffles, furnishing, installation and cleanout of skimmer, providing and placing stone pad on bottom of ditch underneath skimmer device, providing and placing geotextile spillway liner, providing coir fiber mat stabilization for the skimmer outlet, removing earthen dam, coir fiber baffles, geotextile liner and skimmer device, and disposing of excess materials.

Materials

Item	Section
Stone for Erosion Control, Class B	1042
Geotextile for Soil Stabilization, Type 4	1056
Staples	1060-8
Coir Fiber Mat	1060-14
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 proposed ditch according to the roadway plans and cross sections with ditch surface free of obstructions, debris, and pockets of low-density material. Construct earthen dam and install the primary spillway according to the Earthen Dam with Skimmer 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*. Accumulated silt behind the earthen dam and baffles shall be removed regularly 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. The coupling shall be rigid and non-buoyant and not exceed a diameter of 4" and 12" in length. 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 impounded in the ditch. 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 ditch. 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 ditch according to the Earthen Dam with Skimmer 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.

Measurement and Payment

The construction of the earthen dam will be paid for as *Borrow Excavation* as provided in Section 230 of the *Standard Specifications* or included in the lump sum price for grading.

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 ditch 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.

Stone for Erosion Control, Class __ will be measured and paid for in accordance with Article 1610-4 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

COIR FIBER WATTLES WITH POLYACRYLAMIDE (PAM):

Description

Coir Fiber Wattles are tubular products consisting of coir fibers (coconut fibers) encased in coir fiber netting. Coir Fiber Wattles are used on slopes or channels to intercept runoff and act as a velocity break. Coir Fiber 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 coir fiber wattles, matting installation, PAM application, and removing wattles.

Materials

Coir Fiber Wattle shall meet the following specifications:

100% Coir (Coconut) Fibers	
Minimum Diameter	12 in.
Minimum Density	3.5 lb/ft^3 +/- 10%
Net Material	Coir Fiber
Net Openings	2 in. x 2 in.
Net Strength	90 lbs.
Minimum Weight	2.6 lbs./ft. +/- 10%

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 Environmental Quality Division of Water Resources web site as an approved PAM product for use in North Carolina.

Construction Methods

Coir Fiber 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 coir fiber 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 coir fiber 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 coir fiber 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

Coir Fiber 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 *Coir Fiber 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 coir fiber 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
Coir Fiber Wattle	Linear Foot

COIR FIBER WATTLE BARRIER:

(5-20-13) 1630

Description

Coir fiber wattle barriers are tubular products consisting of coir fibers (coconut fibers) encased in coir fiber or synthetic netting and used at the toe of fills or on slopes to intercept runoff. Coir fiber wattle barriers 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, maintenance and removing coir fiber wattle barriers.

Materials

Coir fiber wattle shall meet the following specifications:

Inner Material	100% Coir (Coconut) Fibers
Minimum Diameter	18"
Minimum Length	10 ft.
Minimum Density	5 lb./c.f. ± 10%
Net Material	Coir (Coconut) or Synthetic
Net Openings	2" x 2"
Net Strength	90 lb.
Minimum Weight	10 lb./ft. ± 10%

Stakes shall be used as anchors. Provide hardwood stakes a minimum of 2-ft long with a 2" x 2" nominal square cross section. One end of the stake shall be sharpened or beveled to facilitate driving down into the underlying soil.

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

Align coir fiber wattle barriers in an overlapping and alternating pattern. Excavate a trench the entire length of each wattle with a depth of 2" to 3" for the wattle to be placed. Secure coir fiber wattle barriers to the soil by wire staples approximately every linear foot and at the end of each wattle. Install at least 4 stakes on the downslope side of the wattle with a maximum spacing of 2 linear feet and according to the detail. Install at least 2 stakes on the upslope side of the coir fiber wattle barriers according to the detail provided in the plans. Drive stakes into the ground at least 10" with no more than 2" projecting from the top of the wattle. Drive stakes at an angle according to the detail provided in the plans.

For coir fiber wattle barriers used to reduce runoff velocity for large slopes, use a maximum spacing of 25 ft. for the barrier measured along the slope.

Maintain the coir fiber wattle barriers until the project is accepted or until the coir fiber wattle barriers are removed, and remove and dispose of silt accumulations at the coir fiber wattle barriers when so directed in accordance with Section 1630 of the *Standard Specifications*.

Measurement and Payment

Coir Fiber Wattle Barrier will be measured and paid as the actual number of linear feet of coir fiber wattle barrier installed and accepted. Such price and payment will be full compensation for all work covered by this provision, including, but not limited to, furnishing all materials, labor, equipment and incidentals necessary to install the coir fiber wattle barrier.

Payment will be made under:

Pay Item	**Pay Unit**
Coir Fiber Wattle Barrier	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 Environmental Quality Division of Water Resources 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

TEMPORARY PIPE FOR CULVERT CONSTRUCTION:

Description

This work consists of furnishing, installing, maintaining and removing any and all temporary pipe used on this project in conjunction with the culvert construction.

Construction Methods

The Contractor shall install temporary pipe in locations shown on the plans in such a manner approved by the Engineer. The temporary pipe shall provide a passageway for the stream through the work-site. The minimum size requirements will be as stated on the erosion control plans.

Measurement and Payment

__" *Temporary Pipe* will be measured and paid for at the contract unit price per linear foot of temporary pipe approved by the Engineer and measured in place from end to end. Such price and payment will be full compensation for all work covered by this section including but not limited to furnishing all materials required for installation, construction, maintenance, and removal of temporary pipe.

Payment will be made under:

Pay Item	Pay Unit
__" Temporary Pipe	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

FLOATING TURBIDITY CURTAIN:

Description

This work consists of furnishing a *Floating Turbidity Curtain* to deter silt suspension and movement of silt particles during construction. The floating turbidity curtain shall be constructed at locations as directed.

Materials

The curtain material shall be made of a tightly woven nylon, plastic or other non-deteriorating material meeting the following specifications:

Property	Value
Grab tensile strength	*md-370 lbs *cd-250 lbs
Mullen burst stength	480 psi
Trapezoid tear strength	*md-100 lbs *cd-60 lbs
Apparent opening size	70 US standard sieve
Percent open area	4% permittivity 0.28 sec-1

*md - machine direction
*cd - cross machine direction

In the event that more than one width of fabric is required, a 6" overlap of the material shall also be required.

The curtain material shall be supported by a flotation material having over 29 lbs/ft buoyancy. The floating curtain shall have a 5/16" galvanized chain as ballast and dual 5/16" galvanized wire ropes with a heavy vinyl coating as load lines.

Construction Methods

The Contractor shall maintain the *Floating Turbidity Curtain* in a satisfactory condition until its removal is requested by the Engineer. The curtain shall extend to the bottom of the jurisdictional resource. Anchor the curtain according to manufacturer recommendations.

Measurement and Payment

Floating Turbidity Curtain will be measured and paid for as the actual number of square yards of curtain furnished as specified and accepted. Such price and payment will be full compensation for

the work as described in this section including but not limited to furnishing all materials, tools, equipment, and all incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Floating Turbidity Curtain	Square Yard

ZOYSIA MEDIAN SODDING:
(5-2-19)

Description

This work consists of installing sod in in vegetated medians in accordance with this section and as directed. The sod shall be prepared in accordance with the requirements of Section 1664 of the *Standard Specifications* and the requirements of this provision.

Materials

Only "approved sod" (trade designation) consisting of 100% Meyer, El Toro, Crowne or Compadre Zoysia sod shall be used. The sod, machine cut to the supplier's standard "big roll" sod width (36" to 42") and length, shall be a 5/8" minimum depth, excluding top growth and thatch, at the time of cutting. Before cutting, the sod shall be uniformly mowed at a height of ¾" to 1". Standard sod sections shall be sufficiently strong to support their own weight and retain their size and shape when suspended vertically from a firm grasp on the upper 10% of the section.

The Contractor shall obtain a certificate or limited permit issued by the North Carolina Department of Agriculture and Consumer Services (1-800-206-9333) or (919-733-6932) stating that the sod has been found to be free of injurious plant pests.
Sod shall be delivered on site within 24 hours of being cut (harvested) and be covered by acceptable means during delivery. A certificate from the sod producer stating the date and time of sod cutting shall accompany the sod when it arrives at the project site.

The Contractor shall provide sufficient water to meet the requirements of this provision.

Construction Methods

(A) Soil Preparation

Remove litter and other debris. Mow and satisfactorily dispose of weeds or other unacceptable growth on the areas to be sodded.

Prior to beginning preparation of the soil to receive sod, all eroded, uneven and rough areas shall be contour graded and/or filled with soil as directed. The soil shall be scarified or otherwise loosened to a depth of not less than 3". Clods shall be broken and the top 2" to 3" of soil shall be worked into an acceptable soil bed by the use of soil pulverizers, drags, or harrows.

After soil preparation, lime and fertilizer shall be uniformly distributed by mechanical means and thoroughly mixed with the top 3" of the soil by disking, harrowing, or other approved methods.

The Contractor shall be responsible for taking sufficient soil samples - at least one sample per sodding area or mile, which ever is less - for testing by the North Carolina Department of Agriculture and Consumer Services, Agronomic Division, Soil Testing Section, to determine the soil pH and nutrient content. Samples shall be taken in the presence of the Engineer. Results shall be received by the Engineer directly from the North Carolina Department of Agriculture and Consumer Services.

Limestone: Based on these results the Contractor shall add limestone, if required, to bring the soil pH to 6.0 to 6.5. The amount of limestone to be applied will be approved by the Engineer prior to application.

Sulfur: Based on these results the Contractor shall add sulfur if the pH is greater than 7.0, to bring the soil pH to 6.0 to 6.5. The amount of sulfur to be applied will be approved by the Engineer prior to application.

Fertilizer: Fertilizer shall be 10-20-20 analysis and applied at a rate of 300 pounds per acre or as directed based on the NCDA Consumer Services soil analysis and recommendation.

Application of limestone, sulfur, and fertilizer will be considered incidental to the work of *Zoysia Guardrail and Median Sodding* and no direct payment will be made for such.

At the Engineers discretion, in lieu of an NCDA CS soil report, the rates of lime and fertilizer per acre are as follows:

300#	10-20-20 Fertilizer
4000#	Limestone

The area shall then be harrowed, dragged, raked, or prepared by other approved methods which will give a lawn type finish. All trash, debris and stones larger that 1-½" in diameter or other obstructions that could interfere with the placing of the sod shall also be removed. The finished surface shall be moistened with water prior to placing the sod as directed.

(B) Sod Placement

Sod shall be installed during the dormant period from February 1 through April 15. Sod handling and placement shall be a continuous process of cutting, transporting and installing including repairing seams and voids. Sod shall always be installed within 36 hours after being harvested. Sod shall be watered within 2 hours of installation.

Install sod rolls in vegetated medians parallel to the direction of the roadway. Cease sodding operations in areas where damage to drainage structures may occur, additional clearing is needed, or in locations as directed. The soil should be furrowed the approximate width and depth of the sod roll for placement. Sod installed in vegetated medians should be installed using the entire width

of the big roll and installed offset a minimum of 3 feet from the edge of pavement or curb along one side of the median.

Any sod or portions of sod rejected by the Engineer during the initial placement shall be removed from the project and replaced with acceptable sod within 24 hours of notification. The Contractor shall cease any and all other placement of sod on the project until rejected sod has been replaced.

After sod has been placed, and staked where necessary, according to Section 1664 of the *Standard Specifications*, it shall then be rolled or tamped carefully and firmly by means acceptable to the Engineer to ensure proper soil contact. If rolled, roller shall have a minimum weight of 150 lb/ft of roller width. Use of rubber tired equipment to roll shall not be allowed. Metal staples, 12" long unless otherwise approved, shall be made of 11-gauge new steel wire so as not to bend when pinned or driven through the sod. Extreme care shall be taken to prevent the installed sod from being torn or displaced. After rolling or tamping the sod, it shall be watered uniformly and thoroughly with a minimum of 1" of water, 5.6 gallons per square yard, applied immediately after installation of sod. In no case shall the time interval between sod placement and initial watering exceed 2 hours. Water shall be placed to the required quantity through sequential passes to insure proper coverage and to prevent runoff. A minimum of ¼" should be placed on each pass.

(C) Maintenance

The Contractor shall be responsible for all watering and other maintenance (except mowing) required to maintain the livability and health of the sod from installation until completion of the 60-day observation period, including monitoring the sod to ensure all watering and other maintenance is performed as required. Additional water shall be applied as needed and as directed to maintain the livability of the sod. Each additional watering event shall be a minimum of 0.5" of water, 2.8 gallons per square yard, uniformly applied over the sodded area and may be placed in a series of passes to prevent runoff, with a minimum of ¼" on each pass.

Any sod or portions of sod rejected by the Engineer after placement, but prior to beginning the observation period, shall be removed from the project and replaced with acceptable sod. Satisfactory replacement of sod shall begin within 10 days of notification. Failure to replace and repair damaged or dead sod as directed may result in sanctions under Article 108-7 or Article 108-8 of the *Standard Specifications*.

(D) Observation Period

The Contractor shall maintain responsibility for the sod for a 60-day observation once the zoysia sod comes out of dormancy. Sodding shall be inspected by the Engineer to begin and end the 60-day observation period. The Contractor shall guarantee the sod under the payment and performance bond in accordance with Article 109-10 of the *Standard Specifications*.

After the first 30 days of the 60-day observation period, the Contractor and Engineer shall meet to review the project and identify dead or damaged sod to be replaced. The Contractor, at no additional expense to the Department, shall satisfactorily replace any sod that is not in a living and healthy condition as determined by the Engineer. Replacement sod shall be furnished and installed

in accordance with the same requirements as for initial sodding operation, except that the amounts of limestone, sulfur, and water may be readjusted as directed. Satisfactory replacement of sod shall begin within 10 days of notification. Failure to replace and repair damaged or dead sod as directed may result in sanctions under Article 108-7 or Article 108-8 of the *Standard Specifications*. Upon completion and acceptance of the sod repairs, the remaining 30 days of the observation period shall begin.

(E) Acceptance

At the end of the 60-day observation period, the sod furnished and installed under this contract must be in a living and healthy condition, as determined by the Engineer. Acceptance of sod will be either at the end of the 60-day observation period or at final acceptance of the project, whichever is later. The sod shall be weed free at time of final acceptance.

Measurement and Payment

Zoysia Median Sodding will be measured and paid for as *Sodding* in accordance with Article 1664-5 of the *Standard Specifications*.

Water will be measured and paid for in accordance with Article 1664-5 of the *Standard Specifications*.

CONCRETE WASHOUT:
(05-09-19)

Description

Concrete washouts are temporary enclosures above grade to contain concrete wash water and associated concrete mix from washing out ready-mix trucks, drums, pumps, or other equipment. Concrete washouts must collect and retain all the concrete washout water and solids, so that this material does not migrate to surface waters or into the ground water. These enclosures are not intended for concrete waste not associated with wash out operations.

Materials

The concrete washout may include devices constructed above ground and or commercially available devices designed specifically to capture concrete wash water.

Constructed concrete washouts may be comprised of wooden or metal forms or metal containers, such as a roll off container, with a 10 mil thick polypropylene or polyethylene geomembrane liner. The geomembrane liner shall be free of holes or punctures.

Commercially available concrete washout products specifically designed to capture concrete wash water may be used. Commercially available concrete washout bags, bins, or containers with supporting forms capable of containing concrete wash water without seepage shall be submitted for review and approval prior to installation.

Safety Fence shall meet the specifications as provided elsewhere in this contract.

Construction Methods

Constructed devices shall be of sufficient size, minimum, 10 ft. x 10 ft x 2.5 ft or equivalent volume as directed, to contain wash water from a continuous concrete pouring operation. Constructed forms or tanks shall be of sufficient structural integrity to contain the total volume of the of the concrete washout without failure. Install the geomembrane liner and overlap and seal seams in accordance with the manufacturers specifications to prevent seepage. Fasten the liner to the exterior of the form or tank or to manufacturer's specifications.

Commercially available concrete washouts shall be of sufficient size to contain wash water from a continuous concrete pouring operation. Install commercial concrete washouts per manufacturer's specifications at locations as directed.

The concrete washouts shall be reused within the project limits in accordance with manufacturers specifications. At the discretion of the Engineer, additional concrete washouts may be used during a continuous concrete operation to provide additional capacity to contain concrete wash water.

Post a sign with the words "Concrete Washout" in close proximity of the concrete washout area, so it is clearly visible to site personnel. Install safety fence as directed for visibility to construction traffic.

Alternate designs for accommodating concrete washout may be submitted for review and approval. The alternate designs shall include the method used to retain and dispose of the concrete wash water within the project limits and in accordance with the minimum setback requirements. (5 feet above groundwater, 50 feet from top of bank of perennial stream, other surface water body, or wetland.)

Maintenance and Removal

Maintain the constructed concrete washout device(s) to provide adequate holding capacity. Remove and dispose of hardened concrete and return the structure to a functional condition after reaching 75% capacity or per manufacturer's instructions.

Inspect concrete washouts for damage and maintain for effectiveness. Remove the concrete washouts and sign upon project completion.

Measurement and Payment

Concrete Washout will be paid for per each washout installed in accordance with this specification and will be full compensation for the construction, maintenance and removal of the device and signage. If alternate designs are approved, then those details will also be paid for per each approved and installed device in accordance with *Concrete Washout*.

Safety Fence will be paid for as provided elsewhere in the contract.

Payment will be made under:

Pay Item	**Pay Unit**
Concrete Washout	Each

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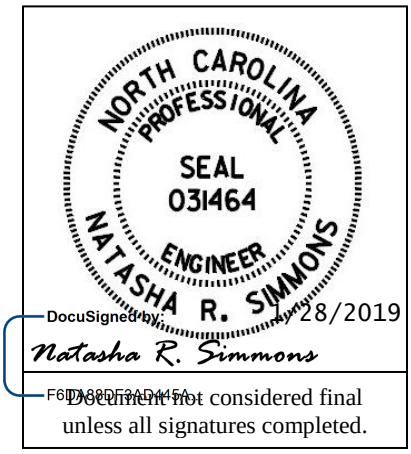

I-4700
Signals and Intelligent Transportation Systems
Project Special Provisions
(Version 18.2)

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28-Jan-19

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1. 2018 STANDARD SPECIFICATIONS FOR ROADS & STRUCTURES

The 2018 Standard Specifications are revised as follows:

1.1. GENERAL REQUIREMENTS – Construction Methods (1700-3(K))

Page 17-4, revise sentence starting on line 14 to read "Modify existing electrical services, as necessary, to meet the grounding requirements of the NEC, these *Standard Specifications, Standard Drawings,* and the project plans."

Page 17-4, revise sentence beginning on line 21 to read "Furnish and install additional ground rods to grounding electrode system as necessary to meet the *Standard Specifications, Standard Drawings*, and test requirements."

1.2. WOOD POLES – Construction Methods (1720-3)

Page 17-18, revise sentence starting on line 13 to read "On new Department-owned poles, install a grounding system consisting of #6 AWG solid bare copper wire that is mechanically crimped using an irreversible compression tool with die to a single ground rod installed at base of pole or to the electrical service grounding electrode system located within 10 feet of the pole."

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2. SIGNAL HEADS

2.1. MATERIALS

A. General

Fabricate vehicle signal head housings and end caps from die-cast aluminum. Fabricate 16-inch pedestrian signal head housings and end caps from die-cast aluminum. Provide visor mounting screws, door latches, and hinge pins fabricated from stainless steel. Provide interior screws, fasteners, and metal parts fabricated from stainless steel.

Fabricate tunnel and traditional visors from sheet aluminum.

Paint all surfaces inside and outside of signal housings and doors. Paint outside surfaces of tunnel and traditional visors, wire outlet bodies, wire entrance fitting brackets and end caps when supplied as components of pole and pedestal mounting assemblies, and pedestrian pushbutton housings. Have electrostatically-applied, fused-polyester paint in black, per Project Plans, a minimum of 2.5 to 3.5 mils thick. Do not apply paint to the latching hardware, rigid vehicle signal head mounting brackets for mast-arm attachments, messenger cable hanger components or balance adjuster components.

Have the interior surfaces of tunnel and traditional visors painted an alkyd urea black synthetic baking enamel with a minimum gloss reflectance and meeting the requirements of MIL-E-10169, "Enamel Heat Resisting, Instrument Black."

Where required, provide polycarbonate signal heads and visors that comply with the provisions pertaining to the aluminum signal heads listed on the QPL with the following exceptions:

Fabricate signal head housings, end caps, and visors from virgin polycarbonate material. Provide UV stabilized polycarbonate plastic with a minimum thickness of 0.1 ± 0.01 inches that is black per Project Plans. Ensure the color is incorporated into the plastic material before molding the signal head housings and end caps. Ensure the plastic formulation provides the following physical properties in the assembly (tests may be performed on separately molded specimens):

Test	Required	Method
Specific Gravity	1.17 minimum	ASTM D 792
Flammability	Self-extinguishing	ASTM D 635
Tensile Strength, yield, PSI	8500 minimum	ASTM D 638
Izod impact strength, ft-lb/in [notched, 1/8 inch]	12 minimum	ASTM D 256

For pole mounting, provide side of pole mounting assemblies with framework and all other hardware necessary to make complete, watertight connections of the signal heads to the poles and pedestals. Fabricate the mounting assemblies and frames from aluminum with all necessary hardware, screws, washers, etc. to be stainless steel. Provide mounting fittings that match the positive locking device on the signal head with the serrations integrally cast into the brackets. Provide upper and lower pole plates that have a 1 ¼-inch vertical conduit entrance hubs with the hubs capped on the lower plate and 1 ½-inch horizontal hubs. Ensure that the assemblies provide rigid attachments to poles and pedestals so as to allow no twisting or swaying of the signal heads. Ensure that all raceways are free of sharp edges and protrusions, and can accommodate a minimum of ten Number 14 AWG conductors.

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

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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.

For light emitting diode (LED) traffic signal modules, provide the following requirements for inclusion on the Department's Qualified Products List 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
   - Pedestrian Traffic Control Signal Indications –Light Emitting Diode (LED) Signal Modules.

   (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 new replacement modules within 45 days of receipt of modules that have failed at no cost to the State. 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 Qualified Products List (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 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

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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 aluminum, and provide serrated rings made of aluminum. Provide stainless steel cable attachment assemblies to secure the brackets to the mast arms. Ensure all fastening hardware and fasteners are fabricated from stainless steel.

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.

1. LED Circular Signal Modules

Provide modules in 12-inch circular sections configurations. All makes and models of LED modules purchased for use on the State Highway System shall appear on the current NCDOT Traffic Signal 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 2018 or most recent Qualified Products List. 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.

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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.

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.

2. LED Arrow Signal Modules

Provide 12-inch omnidirectional arrow signal modules. All makes and models of LED modules purchased for use on the State Highway System shall appear on the current NCDOT Traffic Signal 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 2018 or most recent Qualified Products List. In addition, provide manufacturer's certification in accordance with Article 106-3 of the *Standard Specifications*, that each module meets or exceeds the requirements for 12-inch omnidirectional modules specified in the ITE "Vehicle Traffic Control Signal Heads – Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Supplement" dated July 1, 2007 (hereafter referred to as VTCSH Arrow Supplement) and other requirements stated in this specification.

Provide modules that meet the following requirements when tested under the procedures outlined in the VTCSH Arrow Supplement:

Module Type	Max. Wattage at 165 F	Nominal Wattage at 77 F
12-inch red arrow	12	9
12-inch green arrow	11	11

For yellow arrow signal modules, provide modules tested under the procedures outlined in the VTCSH Arrow Supplement to insure power required at 77° F is 12 Watts or less.

Note: Use a wattmeter having an accuracy of ±1% to measure the nominal wattage and maximum wattage of an arrow traffic signal module. Power may also be derived from voltage, current and power factor measurements.

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C. Pedestrian Signal Heads

Provide pedestrian signal heads with international symbols that meet the MUTCD. Do not provide letter indications.

Comply with the ITE standard for "Pedestrian Traffic Control Signal Indications" and the following sections of the ITE standard for "Vehicle Traffic Control Signal Heads" in effect on the date of advertisement:

- Section 3.00 - "Physical and Mechanical Requirements"
- Section 4.01 - "Housing, Door, and Visor: General"
- Section 4.04 - "Housing, Door, and Visor: Materials and Fabrication"
- Section 7.00 - "Exterior Finish"

Provide a double-row termination block with three empty terminals and number 10 screws for field wiring. Provide barriers between the terminals that accommodate a spade lug sized for number 10 terminal screws. Mount the termination block in the hand section. Wire all signal sections to the terminal block.

Where required by the plans, provide 16-inch pedestrian signal heads with traditional three-sided, rectangular visors, 6 inches long.

Provide 2-inch diameter pedestrian push-buttons with weather-tight housings fabricated from die-cast aluminum and threading in compliance with the NEC for rigid metal conduit. Provide a weep hole in the housing bottom and ensure that the unit is vandal resistant.

Provide push-button housings that are suitable for mounting on flat or curved surfaces and that will accept 1/2-inch conduit installed in the top. Provide units that have a heavy duty push-button assembly with a sturdy, momentary, normally-open switch. Have contacts that are electrically insulated from the housing and push-button. Ensure that the push-buttons are rated for a minimum of 5 mA at 24 volts DC and 250 mA at 12 volts AC.

Provide standard R10-3 signs with mounting hardware that comply with the MUTCD in effect on the date of advertisement. Provide R10-3E signs for countdown pedestrian heads and R10-3B for non-countdown pedestrian heads.

Design the LED pedestrian traffic signal modules (hereafter referred to as modules) for installation into standard pedestrian traffic signal sections that do not contain the incandescent signal section reflector, lens, eggcrate visor, gasket, or socket. Provide modules that consist of an assembly that uses LEDs as the light source in lieu of an incandescent lamp. Use LEDs that are of the latest aluminum indium gallium phosphorus (AlInGaP) technology for the Portland Orange hand and countdown displays. Use LEDs that are of the latest indium gallium nitride (InGaN) technology for the Lunar White walking man displays. 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.

Design all modules to operate using a standard 3 - wire field installation. Provide spade terminals crimped to the lead wires and sized for a #10 screw connection to the existing terminal block in a standard pedestrian signal housing. Do not provide other types of crimped terminals with a spade adapter.

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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.

Provide modules in 16-inch displays which have the solid hand/walking man overlay on the left and the countdown on the right configuration. All makes and models of LED modules purchased for use on the State Highway System shall appear on the current NCDOT Traffic Signal 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 2018 or most recent Qualified Products List. In addition, provide manufacturer's certification in accordance with Article 106-3 of the *Standard Specifications,* that each module meets or exceeds the ITE "Pedestrian Traffic Control Signal Indicators - Light Emitting Diode (LED) Signal Modules" dated August 04, 2010 (hereafter referred to as PTCSI Pedestrian Standard) and other requirements stated in this specification.

Provide modules that meet the following requirements when tested under the procedures outlined in the PTCSI Pedestrian Standard:

Module Type	Max. Wattage at 165 F	Nominal Wattage at 77 F
Hand Indication	16	13
Walking Man Indication	12	9
Countdown Indication	16	13

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.

Provide module lens that is hard coated or otherwise made to comply with the material exposure and weathering effects requirements of the Society of Automotive Engineers (SAE) J576. Ensure all exposed components of the module are suitable for prolonged exposure to the environment, without appreciable degradation that would interfere with function or appearance.

Ensure the countdown display continuously monitors the traffic controller to automatically learn the pedestrian phase time and update for subsequent changes to the pedestrian phase time.

Ensure the countdown display begins normal operation upon the completion of the preemption sequence and no more than one pedestrian clearance cycle.

D. Signal Cable

Furnish 16-4 and 16-7 signal cable that complies with IMSA specification 20-1 except provide the following conductor insulation colors:

- For 16-4 cable: white, yellow, red, and green
- For 16-7 cable: white, yellow, red, green, yellow with black stripe tracer, red with black stripe tracer, and green with black stripe tracer. Apply continuous stripe tracer on conductor insulation with a longitudinal or spiral pattern.

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Provide a ripcord to allow the cable jacket to be opened without using a cutter. IMSA specification 19-1 will not be acceptable. Provide a cable jacket labeled with the IMSA specification number and provide conductors constructed of stranded copper.

E. Louvers

Material, equipment, and hardware furnished under this section must be pre-approved on the Department's QPL by the date of installation.

Provide louvers made from sheet aluminum. Paint the louvers alkyd urea black synthetic baked enamel with a minimum gloss reflectance and meeting the requirements of MIL-E-10169, "Enamel Heat Resisting, Instrument Black."

Ensure that the louvers have a 0-degree horizontal viewing angle. Provide a minimum of 5 vanes.

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3. CONTROLLERS WITH CABINETS

3.1. DESCRIPTION

Furnish all detector sensor cards and all necessary hardware.

3.2. MATERIAL

Furnish material, equipment and hardware under this section that is pre-approved on the ITS and Signals QPL.

3.3. MATERIALS – TYPE 170 DETECTOR SENSOR UNITS

Furnish detector sensor units that comply with Chapter 5 Section 1, "General Requirements," and Chapter 5 Section 2, "Model 222 & 224 Loop Detector Sensor Unit Requirements," of the CALTRANS "Transportation Electrical Equipment Specifications" dated March 12, 2009 with Erratum 1.

3.4. CONSTRUCTION METHODS

A. General

Install detector sensor units and hardware that provide required phasing, color sequence, flash sequence, and interconnection.

3.5. MEASUREMENT AND PAYMENT

Detector Card ( ) will be measured and paid as the actual number furnished, installed and accepted.

Payment will be made under:

Pay Item	**Pay Unit**
Detector Card (2070E)	Each

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4. MICROWAVE VEHICLE DETECTION SYSTEM - MULTIPLE DETECTION ZONES

4.1. DESCRIPTION

Design, furnish and install a microwave vehicle detection system with the manufacturer recommended cables and hardware in accordance to the plans and specifications. Ensure the detection system provides multiple detection zones.

4.2. MATERIALS

Provide design drawings showing design details and microwave sensor locations for review and acceptance before installation. Provide mounting height and location requirements for microwave sensor units on the design based on a site survey. Design microwave vehicle detection system with all necessary hardware. Indicate all necessary poles, spans, mast arms, luminaire arms, cables, microwave sensor mounting assemblies and hardware to achieve the required detection zones where Department owned poles are not adequate to locate the microwave sensor units. Do not design for the installation of poles in medians.

Obtain the Engineer's approval before furnishing microwave vehicle detection system. The contractor is responsible for the final design of microwave vehicle detection system. Review and acceptance of the designs by the Department does not relieve the contractor from the responsibility to provide fully functional systems and to ensure that the required detection zones can be provided. With the exception of contractor-furnished poles, mast arms, and luminaire arms, furnish material, equipment, and hardware under this section that is pre-approved on the ITS and Signals QPL. Submit and obtain Engineer's approval of shop drawings for any poles, mast arms, and luminaire arms provided by the contractor prior to ordering from manufacturer.

Provide a detector for either side-fire or forward-fire configuration. Ensure the detector will detect vehicles in sunny, cloudy, rainy, snowy, and foggy weather conditions. Ensure the detector can operate from the voltage supplied by a NEMA TS-1/TS-2 or Type 332 or 336 traffic signal cabinet. Ensure the detector can provide detection calls to the traffic signal controller within a NEMA TS-1/TS-2 or Type 332 or 336 cabinet. Ensure the detection system provides a constant call in the event of a component failure or loss of power. Ensure the detector has an operating temperature range of -30 to 165 degrees F and operates within the frequency range of 10 to 25 GHz. Ensure the detector is provided with a water-tight housing offering NEMA 4X protection and operates properly in up to 95% relative humidity, non-condensing.

Provide each detector unit to allow the placement of at least 8 detection zones with a minimum of 8 detection channel outputs. When the microwave vehicle detection system requires an integrated card rack interface(s), provide only enough interface cards to implement the vehicle detection shown on the signal plans. Provide a means acceptable to the Engineer to configure traffic lanes and detection zones. Provide each channel output with a programmable means to delay the output call upon activation of a detection zone that is adjustable in one second increments (maximum) over the range of 0 to 25 seconds. Provide each channel output with a programmable means to extend the output call that is adjustable in one second increments (maximum) over the range of 0 to 25 seconds. Ensure both delay and extend timing can be set for the same channel output.

For advance detection system, ensure the detector senses vehicles in motion at a range of 50 to 400 feet from the detector unit for forward-fire configuration and a range of 50 to 200 feet from the detector unit for side-fire configuration with an accuracy of 95% for both configurations. Ensure the advance detection system provides each channel output call of at least 100 ms in duration.

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For stop bar presence detection system, ensure the detector outputs a constant call while a vehicle is in the detection zone and removes the call after all vehicles exit the detection zone. Ensure the presence detector unit can cover a detection zone as shown on the plans and has an effective range of 10 to 120 feet from the detector unit.

For units without an integrated card rack interface, provide Form C output relay contacts rated a minimum of 3A, 24VDC.

If a laptop is used to adjust detector settings, ensure that software is licensed for use by the Department and by any other agency responsible for maintaining or operating the microwave detection system. Provide the Department with a license to duplicate and distribute the software as necessary for design and maintenance support.

After initial detector configuration and installation, ensure routine adjustments or calibration are not needed to maintain acceptable performance.

4.3. CONSTRUCTION METHODS

Install the microwave vehicle detection system in accordance with the manufacturer's recommendations.

Monitor and maintain each detector unit during construction to ensure microwave vehicle detection system is functioning properly and aimed for the detection zone shown in the plans. Refer to Subarticle 1700-3 (D) Maintenance and Repair of Materials of the *Standard Specifications* for failure to maintain the microwave detection system.

After the final signal construction is complete, remove the Microwave Vehicle Detection System – Multiple Zones shown in the Project Plans. Return the equipment to the Department between 8:00 a.m. and 12:00 p.m., Monday through Thursday.

4.4. MEASUREMENT AND PAYMENT

Microwave Vehicle Detection System – Multiple Zones will be measured and paid for as the actual number of microwave vehicle detection systems – multiple zones furnished, installed, accepted and eventually removed.

No measurement will be made of cables or hardware, as these will be considered incidental to furnishing and installing microwave vehicle detection systems.

Payment will be made under:

Pay Item	Pay Unit
Microwave Vehicle Detection System – Multiple Zones	Each

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5. TRAFFIC SIGNAL SUPPORTS

5.1. METAL TRAFFIC SIGNAL SUPPORTS – ALL POLES

A. General

Furnish and install metal poles with mast arms, grounding systems, and all necessary hardware. The work covered by this special provision includes requirements for the design, fabrication, and installation of both standard and custom/site specifically designed metal traffic signal supports and associated foundations.

Provide metal traffic signal 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 shown on signal plans are estimated from available data for bid purposes. Prior to furnishing metal signal poles, use field measurements and adjusted cross-sections to determine whether pole heights are sufficient to obtain required clearances. If pole heights are not sufficient, the Contractor should immediately notify the Engineer of the required revised pole heights.

Ensure that metal signal 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 grommeted 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. Design structural assemblies with weep holes large enough and properly located to drain molten zinc during the 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 retapped as necessary after galvanizing. Perform repair of damaged galvanizing that complies with the following:

Repair of Galvanizing.....Article 1076-7

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 detail drawing only, 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.

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Comply with article 1098-1A of the *Standard Specifications* for Qualified Products List (QPL) submittals. All shop drawings must include project location description, signal 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 Signal Plan/Loading Diagram	1	1	All structure design information needs to reflect the latest approved signal plans
Custom Pole Shop Drawings	4 sets	1 set	Show NCDOT inventory number(s), contractor's name and relevant revision number in the title block. All drawings must have a unique drawing number for each project and identified for multiple pages.
Standard Pole Shop Drawings (from the QPL)	4 sets	1 set	Submit drawings on 11" x 17" format media. Show NCDOT inventory number(s), contractor's name and relevant revision number in the title block. All drawings must have a unique drawing number for each project and identified for multiple pages.
Structure Calculations	1 set	1 set	Not required for Standard QPL Poles
Standard Pole Foundation Drawings	1 set	1 set	Submit drawings on 11" x 17" format media. Submit a completed Standard Foundation Selection form for each pole using foundation table on Metal Pole Drawing M-8.
Custom Foundation Drawings	4 sets	1 set	Submit drawings on 11" x 17" format media. Show NCDOT inventory number(s), contractor's name and relevant revision number in the title block. All drawings must have a unique drawing number for each project and identified for multiple pages. If QPL Poles are used, include the corresponding QPL pole shop drawings with this submittal.
Foundation Calculations	1	1	**Submit copies of LPILE input, output and pile tip deflection graph per Section 11.4 of this specification for each foundation.** 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.

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Include a title block and revision block on the shop drawings and foundation drawings 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. Boring reports should include the following: Engineer's summary, boring location maps, soil classification per AASHTO Classification System, hammer efficiency, and Metal Pole Standard Foundation Selection Form. Incomplete submittals will be returned without review. The Reviewer has the right to request additional analysis and copies of the calculations to expedite the approval process.

B. Materials

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 continuously weld 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. Use full penetration groove welds with backing ring for all tube-to-transverse-plate connections in accordance with 6th Edition AASHTO. 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 and mast arm connecting plates from plate steel meeting, as a minimum, the requirements of ASTM A572 Gr 50, AASHTO M270 Gr 50, ASTM A709 Gr50, 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.

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.

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Provide a circular anchor bolt lock plate that will be secured to the anchor bolts at the embedded end with 2 washers and 2 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 4 heavy hex nuts and 4 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.

C. Construction Methods

Erect signal support poles 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.

For further construction methods, see construction methods for Metal Pole with Mast Arm.

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.

5.2. METAL POLE UPRIGHTS (VERTICAL MEMBERS)

A. Materials

- Provide tapered tubular shafts and fabricated of steel conforming to ASTM A-595 Grade A or an approved equivalent.
- Hot-dip galvanize poles 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 Specification* except that no field welding on any part of the pole will be permitted.
- Have Shafts with no circumferential welds except at the lower end joining the shaft to the base.

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- Have anchor bases for steel poles fabricated from plate steel meeting as a minimum the requirements of ASTM A572 Gr 50, AASHTO M270 Gr 50, ASTM A709 Gr 50, or an approved equivalent.

Provide a grounding lug(s) in the approximate vicinity of the messenger cable clamp for bonding and grounding messenger cable. Lugs must accept #4 or #6 AWG wire to bond messenger cables to the pole in order to provide an effective ground fault circuit path. Refer to Metal Pole Standard Drawing Sheet M6 for construction details.

Have poles permanently stamped above the hand holes with the identification tag details as shown on Metal Pole Standard Drawing Sheet M2.

Provide liquid tight flexible metal conduit (Type LFMC), liquid tight flexible nonmetallic conduit (Type LFNC), high density polyethylene conduit (Type HDPE), or approved equivalent to isolate conductors feeding luminaires.

Fabricate poles from a single piece of steel or aluminum 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.

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.

Install grounding lugs that will accept #4 or #6 AWG wire to electrically bond messenger cables to the pole. Refer to Metal Pole Standard Drawing Sheet M6 for construction details.

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.

When required by the plans, furnish couplings 42 inches above the bottom of the base for mounting of pedestrian pushbuttons. Provide mounting points consisting of 1-1/2 inch internally threaded half-couplings that comply with the NEC and that are mounted within the poles. Ensure that couplings are essentially flush with the outside surfaces of the poles and are installed before any required galvanizing. Provide a threaded plug in each mounting point. Ensure that the surface

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of the plug is essentially flush with the outer end of the mounting point when installed and has a recessed hole to accommodate a standard wrench.

1. MAST ARM POLE SHAFTS

Ensure that allowable pole deflection does not exceed that allowed per 6th Edition AASHTO. Ensure that maximum angular rotation of the top of the mast arm pole does not exceed 1 degree 40 minutes (1°40').

B. Construction Methods

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 1 degree 40 minutes (1°40') of vertical. Install poles with the manufacturer's recommended "rake." Use threaded leveling nuts to establish rake if required.

5.3. MAST ARMS

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 signal cables from the pole to the arm.

Ensure that allowable mast arm deflection does not exceed that allowed per 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 signals.

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.

A. Materials

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.

B. Construction Methods

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.

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5.4. DRILLED PIER FOUNDATIONS FOR METAL TRAFFIC SIGNAL POLES

Analysis procedures and formulas shall be based on AASHTO 6th Edition, latest ACI code and the *Drilled Shafts: Construction Procedures and Design Methods* FHWA-NHI-10-016 manual. 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.

For lateral analysis, use LPILE Plus V6.0 or later. Inputs, results and corresponding graphs are to be submitted with the design calculations.

Skin Friction is to be calculated using the α-method for cohesive soils and the β-method for cohesion-less soils (**Broms method will not be accepted**). Detailed descriptions of the "α" and "β" methods can be found in *FHWA-NHI-10-016.*

Omit first 2.5ft for cohesive soils when calculating skin friction.

When hammer efficiency is not provided, assume a value of 0.70.

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.

Have the contractor notify the engineer if the proposed foundation is to be installed on a slope other than 8H: 1V or flatter.

A. Description

Furnish and install site-specific, non-standard foundations for NCDOT metal poles with all necessary hardware in accordance with the plans and specifications.

B. Soil Test and Foundation Determination

1. General

Drilled piers are reinforced concrete sections, cast-in-place against in situ, undisturbed material. Drilled piers are of straight shaft type and vertical.

Some standard drilled piers for supporting poles with mast arms may require wing walls to resist torsional rotation. Based upon this provision and the results of the required soil test, a drilled pier length and wing wall requirement may be determined and constructed in accordance with the plans.

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.

2. Soil Test

Perform a soil test at each proposed metal pole location. Complete all required fill placement and excavation at each signal pole location to finished grade before drilling each boring. Soil tests

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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.
- A total of 50 blows have been applied with < 3-in. penetration.

Describe each intersection as the "Intersection of (*Route or SR #*), *(Street Name)* and (*Route or SR #*), *(Street Name)*, _____ County, Signal Inventory No. _____". Label borings with "B-*N, S, E, W, NE, NW, SE or SW*" corresponding to the quadrant location within the intersection. 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 (hand written or typed) boring log signed and sealed 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, depth of water table and a general description of the soil types encountered using the AASHTO Classification System.

3. Standard Foundation Determination

Use the following method for determining the Design N-value:

$$N_{AVG} = \frac{(N@1' + N@2.5' + \ldots\ldots\ldots N@\text{Deepest Boring Depth})}{\text{Total Number of N-values}}$$

$$Y = (N@1')^2 + (N@2.5')^2 + \ldots\ldots\ldots (N@\text{Deepest Boring Depth})^2$$

$$Z = (N@1' + N@2.5' + \ldots\ldots\ldots N@\text{Deepest Boring Depth})$$

$$N_{STD\ DEV} = \left(\frac{(\text{Total Number of N-values} \times Y) - Z^2}{(\text{Total Number of N-values}) \times (\text{Total Number of N-values} - 1)} \right)^{0.5}$$

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 2 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 2 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.

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If non-standard site-specific poles are shown on the plans, submit completed boring logs collected in accordance with Section 2 (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, the Standard Foundations Chart shown on the plans may not be used and a non-standard foundation may be required. In such case, contact the Engineer.

- The Design N-value is less than 4.
- The drilled pier length, "L", determined from the Standard Foundations Chart, is greater than the depth of the corresponding boring.

In the case where a standard foundation cannot be used, the Department will be responsible for the additional cost of the non-standard foundation.

Foundation designs are based on level ground around the traffic signal 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.

The "Metal Pole Standard Foundation Selection Form" may be found at:

https://connect.ncdot.gov/resources/Geological/Pages/Geotech_Forms_Details.aspx

If assistance is needed, contact the Engineer.

4. Non-Standard Foundation Design

Design non-standard foundations based upon site-specific soil test information collected in accordance with Section 2 (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-6.0 or later manufactured by Ensoft, Inc. to analyze drilled piers. Use the computer software gINT V8i 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. Contact the Engineer for pole loading diagrams for standard poles to be used for non-standard foundation designs. Submit any non-standard foundation designs including drawings, calculations, and soil boring logs to the Engineer for review and approval before construction.

C. Drilled Pier Construction

Construct drilled pier foundations in accordance with the *Foundations and Anchor Rod Assemblies for Metal Poles* provision.

5.5. CUSTOM DESIGN OF TRAFFIC SIGNAL SUPPORTS

A. General

Design traffic signal supports with foundations consisting of metal poles with mast arms.

The lengths of the metal signal 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

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cross-sections. Furnish the revised 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 NCDOT Inventory number followed by the pole number shown on the traffic signal or ITS (non-signalized locations) plan.

Design all traffic signal support structures using the following 6th Edition AASHTO specifications:

- Design for a 50 year service life as recommended by Table 3.8.3-2.
- Use the wind pressure map developed from 3-second gust speeds, as provided in Article 3.8.
- Ensure signal support structures include natural wind gust loading and truck-induced gust loading in the fatigue design, as provided for in Articles 11.7.1.2 and 11.7.1.3, 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 signal 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 and mast arms.

Unless otherwise specified by special loading criteria, the computed surface area for ice load on signal heads is:

- 3-section, 12-inch, Surface area: 26.0 ft^2 (17.0 ft^2 without back plate)
- 4-section, 12-inch, Surface area: 32.0 ft^2 (21.0 ft^2 without back plate)
- 5-section, 12-inch, Surface area: 42.0 ft^2 (29.0 ft^2 without back plate)

The ice loading for signal heads defined above includes the additional surface area that back plates will induce. Special loading criteria may be specified in instances where back plates will not be installed on signal heads. Refer to the Loading Schedule on each Metal Pole Loading Diagram for revised signal head surface areas. The pole designer should revise ice loads accordingly in this instance. Careful examination of the plans when this is specified is important as this may impact sizing of the metal support structure and foundation design which could affect proposed bid quotes. All maximum stress ratios of 0.9 still apply.

Assume the combined minimum weight of a messenger cable bundle (including messenger cable, signal cable and detector lead-in cables) is 1.3 lbs/ft. Assume the combined minimum diameter of this cable bundle is 1.3 inches.

Ensure that designs provide a removable pole cap with stainless steel attachment screws for each pole top and mast arm end.

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B. Metal Poles

Submit design drawings for approval including pre-approved QPL pole drawings. Show all the necessary details and calculations for the metal poles including the foundation and connections. Include NCDOT 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 as a result 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 and arms. 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, provide designs with provisions for pole plates and associated gussets and fittings for mast arm attachment. As part of each mast arm attachment, provide a grommeted 2" diameter hole on the shaft side of the connection to allow passage of the signal cables from the pole to the arm.

Where ice is present, assume wind loads as shown in Figure 3.9.4.2-3 of the 6th Edition AASHTO Specification for Group III loading.

Provide a grounding lug(s) in the approximate vicinity of the messenger cable clamp for bonding and grounding messenger cable. Lugs must accept #4 or #6 AWG wire to bond messenger cables to the pole in order to provide an effective ground fault circuit path. Refer to Metal Pole Standard Drawing Sheet M6 for construction details.

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.

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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 dual mast arm supports, or for single mast arm supports 50’ or greater, use a minimum 8 bolt orientation with 2” diameter anchor bolts, and a 2” thick base plate.
- For all metal poles with mast arms, 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.

When required, design couplings on the pole for mounting pedestrian pushbuttons at a height of 42 inches above the bottom of the base. Provide mounting points consisting of 1-1/2 inch internally threaded half-couplings that comply with the NEC that are mounted within the poles. Ensure the couplings are essentially flush with the outside surfaces of the poles and are installed before any required galvanizing. Provide a threaded plug for each half coupling. Ensure that the

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surface of the plug is essentially flush with the outer end of the mounting point when installed and has a recessed hole to accommodate a standard wrench.

C. Mast Arms

Design all arm plates and necessary attachment hardware, including bolts and brackets as required by the plans.

Design for grommeted holes on the arms to accommodate the cables for the signals if specified.

Design arms 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 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 and shaft must be at least as thick as the arm connecting bolts are in diameter.

5.6. METAL SIGNAL POLE REMOVALS

A. Description

Remove and dispose of existing metal signal poles including mast arms, and remove and dispose of existing foundations, associated anchor bolts, electrical wires and connections.

B. Construction Methods

1. Foundations

Remove and promptly dispose of the metal signal pole foundations including reinforcing steel, electrical wires, and anchor bolts to a minimum depth of two feet below the finished ground elevation. At the Contractor’s option, remove the complete foundation.

2. Metal Poles

Assume ownership of the metal signal poles, remove the metal signal poles, and promptly transport the metal signal poles from the project. Use methods to remove the metal signal poles and attached traffic signal equipment that will not result in damage to other portions of the project or facility. Repair damages that are a result of the Contractor's actions at no additional cost to the Department.

Transport and properly dispose of the materials.

Backfill and compact disturbed areas to match the finished ground elevation. Seed unpaved areas.

Use methods to remove the foundations that will not result in damage to other portions of the project or facility. Repair damages that are a result of the Contractor's actions at no cost to the Department.

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5.7. POLE NUMBERING SYSTEM

A. New Poles

Attach an identification tag to each pole shaft and mast arm section as shown on Metal Pole Standard Drawing Sheet M2 “Typical Fabrication Details Common To All Metal Poles”.

5.8. MEASUREMENT AND PAYMENT

Metal Pole with Single Mast Arm will be measured and paid for as the actual number of metal poles with single mast arms furnished, installed, and accepted.

Soil Test will be measured and paid for as the actual number of soil tests with SPT borings drilled furnished and accepted.

Drilled Pier Foundation will be measured and paid for as the actual volume of concrete poured in cubic yards of drilled pier foundation furnished, installed and accepted.

Mast Arm with Metal Pole Design will be measured and paid for as the actual number of designs for mast arms with metal poles furnished and accepted.

Metal Pole Foundation Removal will be measured and paid for as the actual number of metal signal pole foundations removed and disposed.

Metal Pole Removal will be measured and paid for as the actual number of metal signal poles removed and disposed.

No measurement will be made for foundation designs prepared with metal pole designs, as these will be considered incidental to designing signal support structures.

Payment will be made under:

Pay Item	**Pay Unit**
Metal Pole with Single Mast Arm	Each
Soil Test	Each
Drilled Pier Foundation	Cubic Yard
Mast Arm with Metal Pole Design	Each
Metal Pole Foundation Removal	Each
Metal Pole Removal	Each

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6. PROTECTIVE COATING FOR METAL POLES

6.1. DESCRIPTION

Protective coating for metal poles is a supplemental durable color coating that is applied to galvanized steel and aluminum traffic signal structures installed in locations where maintaining an aesthetic appearance is important. Powder Coating is the preferred supplemental protective coating process for coating galvanized steel and aluminum structures. However, for the purposes of this special provision, an Acrylic Primer and top coat paint system is included as an acceptable alternative when protective color coating is required.

Provide protective coating over galvanization for all steel poles including all necessary hardware in accordance with the plans and specifications. Any aluminum components do not need to be galvanized before application of protective coating.

6.2. MATERIALS

With the exception of aluminum components, furnish all metal poles with galvanic protection along with a tough and durable application of protective coating. Aluminum components shall have a durable powder coating application. Galvanization is not required for aluminum components.

Furnish pole caps that have a low gloss powder finish applied over a hot-dipped galvanized surface. Comply with the applicable provisions of Section 442-10 and 442-12 of the *Standard Specifications*.

Ensure the selected color for protective coating has been verified and approved by the Engineer prior to fabrication.

6.3. COATING SHOP APPROVAL

Approve the coating shop facility prior to the application of any coating process. Submit all requests, procedures and documents electronically to:

- Mr. Brian Hunter, P.E., Chemical Testing Engineer
- bhunter@ncdot.gov

A) Submit a quality control procedure that the company has established to ensure a quality and durable coating. The quality control procedure shall contain at a minimum the following:

- Qualified / Certified personnel to manage the QC Program and to conduct Quality Control tests
- Qualified / certified coaters
- Source and type of powder
- How the powder will be stored
- Powder application facility (heated or unheated)
- Surface pre-treatment
- Surface preparation including profile
- Application methods
- Curing conditions (conventional or infrared)

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- Curing Temperature
- Adhesion & Holiday Detection
- Repair Procedure
- Storage and protection of coated items
- Shipping and handling (packing, protection, and wrapping)

B) Submit a powder certification from the manufacturer

C) Submit the following to the Chemical Testing Engineer a minimum of four weeks prior to coating application.

1. Two test panels of ASTM A36 steel, ¼ or greater in thickness measuring 8 inches by 11 inches using the proposed color of the final coat; a powder coated over galvanized test panel and a powder coated over un-galvanized test panel.
2. In addition, provide two (2) samples of the same or comparable material and thickness as production pieces. Ensure production piece replicas do not exceed twelve inches (12") in length and width nor 50 pounds in weight.
3. Submit all test panels with inspection reports and records according to *Standard Specifications*, Section 442, Section 1072, Section 1076, and Section 1080.
4. Acceptance of the panels is determined by meeting the requirements of ASTM D-4541 of 800 psi for both galvanized and un-galvanized and production piece test panels.
5. Send all panels to:

   Materials and Tests Unit
   1801 Blue Ridge Road
   Raleigh, NC 27607
   Attn: Chemical Testing Engineer

6.4. POWDER COATING

A. Galvanizing

Galvanize steel products in accordance with Section 1076 of the *Standard Specifications*. Ensure the fabricator or designated representative(s) that is supplying the components to be galvanized communicates with the galvanizer to indicate that the galvanized pieces will be powder coated to avoid water or chromate quenching.

B. Surface Preparation

Comply with manufacturer's recommended surface coating specifications, Steel Structure Painting Council (SSPC) specifications and applicable articles of Section 442 (Painting Steel Structures) of the *Standard Specifications*. Ensure that surface preparations and treatments are performed and meet the requirements of the above referenced specifications.

Some pole components, specifically steel plates ¾ inches or more in thickness, may need blast cleaning prior to structure assembly to remove impurities and non-metallic foreign materials. Mechanically remove all weld flux after structure is assembled.

Degrease and prepare steel structure for zinc coating after assembly using full immersion baths and pickling processes in heat controlled caustic and acid solutions. Rinse and clean structure to

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remove caustic or acid solutions by immersion in a circulating fresh water bath. Immerse structure in a heat controlled concentrated zinc ammonium chloride flux solution and air dry as a final prep before hot-dip galvanization.

Ensure that the surface preparation is no less than specified by the powder manufacturer's recommendations. Prepare all components to be coated in accordance with SSPC SP-2 (Hand Tool Cleaning) and/or SSPC SP-3 (Power Tool Cleaning). Remove all drainage spikes, high spots, protrusions or other surface defects using hand or power tools. Do not remove the galvanization below the limits set forth in AASHTO M111.

Remove grease, oils, moisture, scale, rust or any other foreign matter prior to powder coating to ensure ideal adhesion and coating performance. Prepare and coat the galvanized surface as soon as possible after the galvanization process.

C. Powder Coating Application and Curing

Prepare galvanized finish for powder coating by brush blasting in accordance with SSPC-SP7. Ensure all threaded components of the structure are protected from damage during blasting process.

Use thermosetting powder resin that meets 5A or 5B classifications of ASTM D3359. Apply powder coating electrostatically. Follow manufacturer's recommended preheating requirements. Ensure the top coat finish is applied uniformly to all surfaces with a dry film thickness of between 3.0 to 5.0 mils. Cure the top coat by heating the structure to manufacturer recommended temperatures at the duration required to ensure complete and uniform bond.

D. Quality Control

Ensure the applicator provides all test reports and documentation and inspects all coated material as outlined in the *Standard Specifications*, Section 442, Section 1072, Section 1076, and Section 1080. Ensure the quality control inspection is kept separate from the production functions.

E. Storage, Shipping, and Handling

Store all powder coated material inside or as directed by the Engineer.

Protect the product from incurring damage during all shipping, handling, and storing activities. Do not store the product directly on the ground or in areas where water may pool; the Engineer determines the effectiveness of all storage, shipping and handling methods.

F. Repair of Powder Coated Material

Repair all damage to the coating by the original method of application as outlined in the coating facility's repair procedure. Ensure all repair areas meet the original requirements for adhesion as stated in this Project Special Provision.

Photograph, document, and report all damages upon delivery to the project site prior to unloading. Provide documented damage notifications to the Engineer or to their authorized representative so the application firm can be notified. The Engineer has the authority to accept or reject the material as outlined in the *Standard Specifications*.

Submit to the Engineer a repair procedure for damaged coatings which occur during storage, transporting, handling and or installation. Utilize a liquid paint approved by the Department, compatible with the powder applied product. Ensure all repair areas demonstrate an adhesion rating of 400 psi in accordance with ASTM D-4541. Obtain Engineer's acceptance of the final finish.

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6.5. ACRYLIC PRIMER AND TOP COAT PAINT SYSTEM 4 (MODIFIED)

A. Description

Follow NCDOT procedures for Powder Coating over Galvanizing. Provide an Acrylic Primer and top coat when a substitute for powder coating is necessary.

Provide supplemental coating for all mast arms with metal signal poles, signal pedestals, and all necessary hardware for the signalized intersection in accordance with *Standard Specifications* Sections 442 and 1080, as contained herein, and as shown on the plans.

Ensure all painting work for new structures, except field touch-up and bolt painting is performed in the shop.

B. Surface Preparation

Ensure all surface preparation is not less than that specified by the paint manufacturer's recommendations.

Ensure all components to be coated are prepared in accordance with SSPC SP2 (Hand Tool Cleaning and or SSPC SP-3 (Power Tool Cleaning). Remove all drainage spikes, high spots, protrusions or other surface defects using hand or power tools. Do not remove the galvanization below the limits set forth in AASHTO M111.

Perform abrasive sweep blasting in accordance with ASTM D6386. Refer to this section for a description of the abrasive blast material to be used. Use a material and technique capable of stripping action to remove corrosion products and to provide a rough surface profile while leaving base zinc layers intact.

Blow down all blasted surfaces with clean compressed air to provide a clean, dry surface.

Ensure all surfaces are free of visible zinc oxides or zinc hydroxides.

C. Materials

Use an approved/qualified waterborne paint meeting the requirements of *Standard Specifications* Section 1080. Do not apply paint until each batch has been tested by the Department. Provide color as specified in the contract documents.

Ensure all paint used on this contract is produced by the same manufacturer.

D. Painting

Apply paint in accordance with the requirements of Section 1080 and Section 442 of the *Standard Specifications* using System 4 as modified herein.

System 4 (Modified)
Acrylic Primer and Top Coats

Coat	Material	Mils Dry/Wet Film Thickness	Mils Dry/Wet Film Thickness
		Minimum	Maximum
Primer	1080-12 White	3.0 DFT	5.0 DFT
Stripe	1080-12 Brown	4.0 WFT	7.0 WFT
Topcoat	1080-12 Brown	2.0 DFT	4.0 DFT
Total		5.0 DFT	9.0 DFT

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Shop paint all galvanized surfaces within 8 hours after surface preparation with the exception of field touch-up and bolt painting.

Mask off and do not paint all data plates and faying surfaces prior to application.

Spray apply all coatings except for the stripe coat. Brush apply the stripe coat to all plate edges, welds, bolt holes and bolts prior to applying the finish coat.

E. Curing

Store all material in a heated shop for a period no less than 24 hours once top coat has been applied. Continue storing material until requirements of ASTM D-1640 have been met.

F. Inspection

Provide inspection records showing the initial average thickness of the hot dipped galvanizing as well as the final average DFT measurement.

Ensure all material is of a uniform appearance free of runs, drips, and sags.

G. Handling

Do not handle, ship, or erect coated members until paint is thoroughly dry.

Protect all shipping and handling either from the coating facility to project site and or storage site to area(s) to construction location from incurring damage to product. Wood blocks and nylon slings are recommended for securing, loading, hoisting or storing members.

H. Repair of Damaged Coating

Repair damage occurring to the galvanized portion of the coating during shipment or installation in accordance with Articles 1076-6 and 1080-9 of the *Standard Specifications*. Repair damage occurring to the painted portion of the coating during shipment or installation by applying 4.0-7.0 wet mils of topcoat with a brush or roller and feather or taper this to be level with the surrounding areas.

6.6. MEASUREMENT AND PAYMENT

Protective Coating for Single Mast Arm Pole will be measured and paid as the actual number of single mast arm poles with powder coat applied furnished, installed, and accepted.

Protective Coating for Signal Pedestal Type II will be measured and paid as the actual number of signal pedestals type II with powder coat applied furnished, installed, and accepted.

Payment will be made under:

Pay Item	**Pay Unit**
Protective Coating for Single Mast Arm Pole (_____)	Each
Protective Coating for Signal Pedestal Type II (_____)	Each

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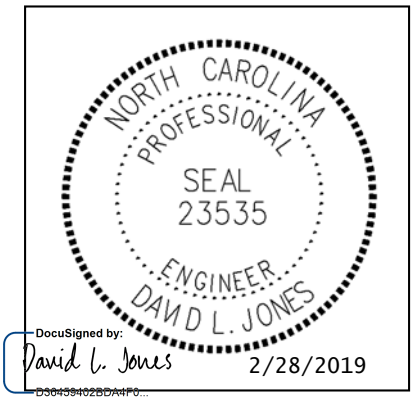

Document not considered final unless all signatures completed.

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Signals and Intelligent Transportation Systems
Project Special Provisions
(Version 18.2)

Prepared By: DLJ
28-Feb-19

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1. GENERAL REQUIREMENTS

1.1. DESCRIPTION

A. General

Conform to these Project Special Provisions, Project Plans, the *2018 Standard Specifications for Roads and Structures* (also referred to hereinafter as the "*Standard Specifications*") and the *2018 Roadway Standard Drawings* (also referred hereinafter as the "*Standard Drawings*"). The current edition of these specifications and publications in effect on the date of advertisement will apply.

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

Conform to the NCDOT and NC Statewide IT Policies and Standards as described at http://it.nc.gov. The architecture of the IT modules must be approved by NCDOT IT and the NC Office of Information Technology architecture groups.

B. Scope

The scope of this project includes the installation of eight (8) new IP (Internet Protocol) based, closed-circuit television (CCTV) cameras, and four (4) new pedestal-mounted dynamic message signs (DMS). The scope also includes installing fiber-optic trunk line and drop cables to interconnect the ITS devices.

Communication between the cameras, DMSs and the existing Division 13 Traffic Services Office in Asheville, NC will be accomplished over fiber-optic cable.

Electrical service to the CCTV cameras and DMSs will consist of new electrical service installations and solar power service as designated in the Project Plans. The Contractor shall coordinate with the appropriate electric utility company in the area to establish new service.

Note that the locations of each proposed device shown in the Project Plans are an approximation. Locate and mark proposed device locations in the field and receive approval from the appropriate Deputy Division Traffic Engineer before performing any construction. Do not construct any conduits or junction boxes to proposed devices until the device locations are approved by the Deputy Division Traffic Engineer. The Deputy Division 13 Traffic Engineer can be reached at (828) 251-6171.

Conduct device and system tests as described in these Project Special Provisions.

1.2. CONSTRUCTION METHODS

A. Ground Surface Restoration

Upon completion of the installation of all conduit and the backfilling of all trenches and other excavations, restore the disturbed ground to its original condition as determined and approved by the Engineer. Backfill the excavation areas with removed material, tamp the backfilled material, and rake smooth the top 1-1/2 inches. Finish unpaved areas flush with surrounding natural ground and to match the original contour of the ground. Seed with the same type of grass as the surrounding areas and mulch the newly seeded areas. If unpaved area was not grassed, replace the original ground cover in kind as directed by the Engineer.

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B. Information Technology Compliance

Conform to the State of North Carolina Information Technology (IT) policy and standards as described at http://it.nc.gov. The architecture of the IT modules must be approved by the NC- DOT IT and NC Office of Information Technology architecture groups.

C. Plan of Record Documentation

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

D. Cell Modems

Communication between portable CCTV cameras and CMS, and the existing Division 13 Traffic Services office will be accomplished over cellular modems. The cellular modems will be furnished and installed by the Department. Submit a request to the Engineer for the modems be installed a minimum of six (6) weeks prior to anticipated integration.

Integrate the new cellular modems (furnished and installed by the Department) with existing and new communications infrastructure so that the portable CCTVs and DMSs are all accessible and can be controlled by computer and network hardware and software at the NCDOT Division 13 office in Asheville, NC, as well as shared for access and control from the State Traffic Operations Center (STOC) in Raleigh.

E. Portable Changeable Message Signs

For existing DMS sites to be replaced, provide each site with a portable changeable message sign trailer, to be fully operational between the time of the removal of the existing DMS and the completion of the installation of the new DMS. Return Portable CMS to the Division, undamaged and in good working order, upon completion of the project.

F. Portable CCTV Cameras

For existing CCTV camera sites to be replaced or taken out of service for any period of time, provide each site with a portable CCTV camera, to be fully operational between the time of the removal from service of the existing CCTV camera and the completion of the installation of (or restoration of service to) the new CCTV camera. Return Portable CCTV cameras to the Division, undamaged and in good working order, upon completion of the project.

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2. 2018 STANDARD SPECIFICATIONS FOR ROADS & STRUCTURES

The 2018 Standard Specifications are revised as follows:

2.1. GENERAL REQUIREMENTS – Construction Methods (1700-3(K))

Page 17-4, revise sentence starting on line 14 to read "Modify existing electrical services, as necessary, to meet the grounding requirements of the NEC, these *Standard Specifications, Standard Drawings,* and the project plans."

Page 17-4, revise sentence beginning on line 21 to read "Furnish and install additional ground rods to grounding electrode system as necessary to meet the *Standard Specifications, Standard Drawings*, and test requirements."

2.2. WOOD POLES – Construction Methods (1720-3)

Page 17-18, revise sentence starting on line 13 to read "On new Department-owned poles, install a grounding system consisting of #6 AWG solid bare copper wire that is mechanically crimped using an irreversible compression tool with die to a single ground rod installed at base of pole or to the electrical service grounding electrode system located within 10 feet of the pole."

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3. PORTABLE CHANGEABLE MESSAGE SIGN

3.1. DESCRIPTION

Furnish and install portable trailer-mounted changeable message signs at sites where existing DMS are replaced or taken out of service for any period of time. Upon project completion, turn over and deliver the portable changeable message signs to the Division 13 office and relinquish ownership to the Department.

3.2. MATERIALS

Furnish portable changeable message signs that are on the NCDOT Statewide CMS Contract. To ensure compatibility with the existing DMS Control Software deployed in the State, furnish NTCIP compliant CMSs that are fully compatible with Daktronics, Inc. Vanguard V4 software.

Obtain cellular modems from NCDOT for communications between the portable CMS and the Division 13 Traffic Services Office. The Contractor shall request the cell modem from the Engineer six (6) weeks in advance of anticipated deployment of a portable device. Return the cell modem to the Division 13 Traffic Services Offices upon project completion.

Provide warranty coverage for all parts and materials through the deployment on the project. The portable CCTV camera must be controllable from the Division 13 Traffic Services Office using the Department's existing software.

3.3. CONSTRUCTION

Install, operate, maintain, relocate and remove portable changeable message signs in accordance with Section 1120 of the *Standard Specifications*.

3.4. MEASUREMENT AND PAYMENT

Portable changeable message signs will be measured and paid as the maximum number of portable changeable message signs acceptably placed and in operation during the life of the project. Payment for Portable Changeable Message Signs will be made on the following schedule:

- 60% of the unit bid upon placing the unit in service,
- 20% of the unit bid when the project is 50% complete, and
- 20% of the unit bid when the project is 100% complete and signs are delivered to the Division.

Replacement, repair and maintenance of changeable message signs will be incidental to the work of this section.

Upon project completion, portable changeable message signs shall be delivered, undamaged and in good working order, to the Division.

Payment will be made under:

Pay Item	Pay Unit
Portable Changeable Message Sign	Each

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4. PORTABLE TRAILER-MOUNTED CCTV CAMERA

4.1. DESCRIPTION

While any existing CCTV camera on the project is out of service, provide a portable trailer-mounted CCTV camera for that location. Provide Integrated Corridor Management (ICM) portable trailer-mounted CCTV cameras to assist with traffic management for detour routes and other purposes, as directed by the Engineer.

4.2. MATERIALS

Provide a trailer mounted, solar powered CCTV camera with wireless communications during the period any existing CCTV camera is out of service, in order to monitor traffic along I-26.

Provide two trailer-mounted, solar powered CCTV camera with wireless communications during the period that the two existing CCTV cameras on I-40 will lose connectivity when the Pond Rd. existing CCTV camera is re-spliced.

Provide ICM trailer-mounted, solar powered CCTV cameras with wireless communications to assist with traffic management for detour routes.

The portable CCTV camera image must be viewable on standard computer monitors and controllable from the Division 13 Traffic Services Office.

Provide a trailer mounted, solar powered CCTV camera with the following features:

- Industrial grade trailer
- Fully adjustable solar array (360 degrees)
- Extendable mast (up to 32 feet minimum) with 360 degree lockable rotation
- With day/night, adjustable PTZ, IP-addressable camera, providing streaming and snapshot video capability
- 30-day minimum battery bank
- Accommodates digital cellular modem communications

Obtain cellular modems from NCDOT for communications between the portable CCTV camera assembly and the Division 13 Traffic Services Office. The Contractor shall request the cell modem from the Engineer six (6) weeks in advance of anticipated deployment of a portable device. Return the cell modem to the Division 13 Traffic Services Offices upon project completion.

Provide warranty coverage for all parts and materials through the deployment on the project. Ensure that the equipment is fully compatible with all features of the existing VideoPro video management software currently in use by NCDOT in this Region. The portable CCTV camera must be controllable from the Division 13 Traffic Services Office using the Department's existing software.

4.3. CONSTRUCTION

Assist the Department with integrating the portable CCTV cameras into the regional system and with establishing communications with the Division 13 Traffic Services Office.

A. Portable Trailer-Mounted CCTV Camera

Do not take the existing CCTV camera out of service until the portable CCTV camera has been fully integrated into the regional system and is communicating effectively with the Division 13 Traffic

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Services Office. When the existing CCTV camera site is placed back into service, remove the portable CCTV camera from the site.

Upon project completion, turn over and deliver the portable trailer-mounted CCTV camera to the Division 13 office and relinquish ownership to the Department.

B. ICM Portable Trailer-Mounted CCTV Camera

Place and relocate the ICM portable trailer-mounted CCTV cameras as directed by the Engineer. Upon project completion, retain possession of the ICM portable trailer-mounted CCTV camera.

4.4. MEASUREMENT AND PAYMENT

Portable trailer-mounted CCTV camera will be measured and paid as the actual number of portable trailer-mounted CCTV units furnished, installed, maintained and accepted. Payment will not include acquisition of cellular modems and payments for monthly cell phone service for the duration of the deployment. Payment will include assisting the Department with integrating the device into the regional system, delivering the unit to Division 13 Traffic Services office, and relinquishing ownership of the unit to the Department at the conclusion of the project. The portable trailer-mounted CCTV camera shall be undamaged and in good working order when delivered to the Division.

ICM portable trailer-mounted CCTV camera will be measured and paid as the actual number of ICM portable trailer-mounted CCTV units furnished, installed, maintained and accepted. Payment will not include acquisition of cellular modems and payments for monthly cell phone service for the duration of the deployment. Payment will include assisting the Department with integrating the device into the regional system and relocating as directed by the Engineer. The ICM portable trailer-mounted CCTV camera shall be retained by the Contractor at the conclusion of the project.

Payment will be made under:

Pay Item	Pay Unit
Portable Trailer-Mounted CCTV Camera	Each
ICM Portable Trailer-Mounted CCTV Camera	Each

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5. UNDERGROUND CONDUIT

5.1. 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 in accordance with Section 1715 of the *Standard Specifications*.

5.2. MATERIALS

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

Refer to Articles 1091-3 (Conduit), 1091-4 (Duct and Conduit Sealer), 1018-2 (Backfill), and 545-2 and 545-3 (Graded Stone) of the *Standard Specifications*.

Furnish conduits in the following colors according to contents and quantity:

Conduit Contents	Number of Conduits	Conduit Colors
Electrical Power	1	Red
	2	Red and Black w/ Red Stripes
Communications	1	Orange
	2	Orange and Black

Furnish underground PVC and HDPE conduits as shown in the Project Plans. All vertical conduits (entrance to electrical service and equipment disconnect and pole mounted cabinet) must be rigid galvanized steel.

5.3. CONSTRUCTION METHODS

Install underground conduit in compliance with all requirements of Section 1715-3 of the *Standard Specifications*.

Do not install conduits or junction boxes to ITS devices (CCTV cameras and DMSs) until the location of the ITS devices has been confirmed by the Deputy Division Traffic Engineer.

5.4. MEASUREMENT AND PAYMENT

Install underground conduit in compliance with all requirements of Section 1715-3 of the *Standard Specifications*.

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.

Unpaved Trenching (qty) (size) & (qty) (size) will be measured horizontal linear feet of trenching for underground conduit installation of each type furnished, installed, and accepted. Measurement will be along the approximate centerline of the conduit system. Payment will be in linear feet.

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Directional Drill (qty)(size)&(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 in linear feet.

No measurement will be made of vertical segments, non-metallic conduit, metallic conduit, conduit sealing material, backfill, graded stone, paved materials, miscellaneous fittings, non-detectable marker tape, pull lines, seeding and mulching as these will be considered incidental to conduit installation.

Payment will be made under:

Pay Item	**Pay Unit**
Tracer Wire	Linear Foot
Unpaved Trenching (1) (1”)	Linear Foot
Unpaved Trenching (1) (2”)	Linear Foot
Unpaved Trenching (2) (2”)	Linear Foot
Directional Drill (1) (2”)	Linear Foot
Directional Drill (2) (2”)	Linear Foot

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6. JUNCTION BOXES

6.1. DESCRIPTION

Furnish and install junction boxes (pull boxes) with covers, graded stone, grounding systems and all necessary hardware.

6.2. MATERIAL

Refer to Division 3.

Item	Section
Junction Box	1098-5
Graded Stone	545

Furnish material, equipment and hardware under this section that is pre-approved on the ITS and Signals QPL.

A. Standard Size Junction Box

Provide standard size junction boxes and covers with minimum inside dimensions of 16"(l) x 10"(w) x 10"(d).

B. Oversized Heavy-Duty Junction Box

Provide oversized junction boxes and covers with minimum inside dimensions of 28"(l) x 15"(w) x 22"(d).

C. Special Oversized Heavy-Duty Junction Box

Provide special oversized heavy-duty junction boxes and covers with minimum inside dimensions of 36"(l) x 24"(w) x 24"(d).

6.3. CONSTRUCTION METHODS

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 feet 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 for fiber-optic cables at locations shown in the plans. Install special oversized junction boxes at underground splice locations as shown in the plans.

Provide real world coordinates for all junction boxes and equipment cabinets installed or used 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, but not limited to, manufacturer, model number, and NCDOT inventory number) in the Microsoft® spreadsheet provided by the Department, shown by example below.

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Submit coordinate information in a spreadsheet provided by the Department and in accordance with the below table.

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
05-0134	Junction Box # 1 (Phase 2 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5516	35.6879	Quazite	PG1118BA12(Box) PG118HA00(Cover)
05-0134	Junction Box # 2 (Phase 2 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5506	35.6876	Quazite	PG1118BA12(Box) PG118HA00(Cover)
05-0134	Junction Box # 3 (Near Cabinet)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5501	35.6873	Quazite	PG1118BA12(Box) PG118HA00(Cover)
05-0134	Junction Box # 4 (Phase 6 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5486	35.6873	Quazite	PG1118BA12(Box) PG118HA00(Cover)
05-0134	Junction Box # 5 (Phase 6 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5493	35.6876	Quazite	PG1118BA12(Box) PG118HA00(Cover)
05-0134	Junction Box # 6 (Phase 4 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5503	35.6879	Quazite	PG1118BA12(Box) PG118HA00(Cover)

6.4. 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 and grounding systems as these will be incidental to furnishing and installing junction boxes.

Payment will be made under:

Pay Item **Pay Unit**

Junction Box (Standard Size).....Each

Junction Box (Oversized Heavy Duty).....Each

Junction Box (Special Oversized Heavy Duty).....Each

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7. WOOD POLE

7.1. DESCRIPTION

Furnish and install wood poles and wood pedestals with grounding systems and all necessary hardware in accordance with Section 1720 of the Standard Specifications.

Remove wood poles from existing CCTV camera sites that will be upgraded with new CCTV camera poles and equipment.

7.2. MATERIALS

A. General

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

Refer to Articles 1082-3 (Treated Timber and Lumber), 1082-4 (Preservative Treatment), 1091-2 (Wire), and 1091-6 (Grounding Electrodes) of the *Standard Specifications*.

B. Wood Pedestal

Furnish 6" x 6" x 8' wood pedestals for electrical service equipment as shown in the Project Plans.

C. Wood Pole

Furnish 40' Class 4 or better wood poles for attaching messenger cable and communications cable or for mounting electrical service equipment as shown in the Project Plans.

7.3. CONSTRUCTION METHODS

Install wood pedestals and wood poles in compliance with all requirements of Section 1720-3 of the *Standard Specifications*.

Where wood poles have been removed, backfill hole to 95% of surrounding density. Promptly backfill and compact areas disturbed with suitable materials and match the finished ground elevation. Seed disturbed areas in accordance with Section 1661 of the *Standard Specifications*.

7.4. MEASUREMENT AND PAYMENT

Wood pole will be measured and paid as the actual number of 40' wood poles furnished, installed, and accepted.

Remove wood pole will be measured and paid as the actual number of wood poles at existing CCTV camera sites removed. Contractor shall dispose of wood poles removed from existing CCTV camera sites.

There will be no direct payment for the installation of wood pedestals, as these will be incidental to the electric service.

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Payment will be made under:

Pay Item	**Pay Unit**
Wood Pole	Each
Remove Wood Pole	Each

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8. GUY ASSEMBLY

8.1. DESCRIPTION

Furnish and install guy assemblies with all necessary hardware.

8.2. MATERIALS

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

Refer to 1098-6 (Pole Line Hardware) and 1098-7 (Guy Assembly) of the *Standard Specifications*.

8.3. CONSTRUCTION METHODS

When installing messenger cable for supporting only communications cable, use approved one-bolt attachment method for attaching messenger cable and guy assembly.

Bond guy assembly to existing pole ground using parallel groove clamp or equivalent. If existing poles do not have a grounding system, install new grounding system for bonding guy assembly that complies with Article 1720-3 of the *Standard Specifications*.

Do not attach to existing guy assemblies unless specifically approved by owner.

8.4. MEASUREMENT AND PAYMENT

Guy Assembly will be measured and paid as the actual number of guy assemblies furnished, installed and accepted.

No measurement will be made of guy cable, guy guards, anchors, clamps, grounding systems or fittings as these will be incidental to furnishing and installing guy assemblies.

Payment will be made under:

Pay Item	Pay Unit
Guy Assembly	Each

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9. RISER ASSEMBLIES

9.1. DESCRIPTION

Furnish and install riser assemblies with clamp-on, aluminum weatherheads or heat shrink tubing, galvanized pole attachment fittings and all necessary hardware.

9.2. MATERIALS

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

Refer to 1091-2 (Wire), 1091-3 (Rigid Metallic Conduit), 1091-6 (Grounding Electrodes), 1098-4 (Riser Sealing Devices), and 1098-6 (Pole Line Hardware) of the *2018 Standard Specifications*.

9.3. CONSTRUCTION

Install riser assemblies in compliance with all requirements of Section 1722-3 of the *2018 Standard Specifications*.

9.4. 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 heat shrink tubing or pole attachment fittings as these will be incidental to furnishing and installing risers.

No measurement will be made for vertical conduit segments (i.e., short risers) extending from an entrance in the bottom of a pole-mounted equipment cabinet to ground level below the cabinet to tie directly onto an underground conduit as such vertical conduits will be considered incidental to the pole-mounted equipment cabinet.

Payment will be made under:

Pay Item	Pay Unit
2" Riser with Heat Shrink Tubing	Each

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10. MESSENGER CABLE

10.1. DESCRIPTION

Furnish and install messenger cable (spanwire) with cable clamps, machine bolts, eye bolts, 3-bolt clamps, eye nuts, split-bolt connectors and all necessary hardware.

10.2. MATERIALS

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

Refer to 1091-2 (Wire), 1091-6 (Grounding Electrode), 1098-3 (Messenger Cable), and 1098-6 (Pole Line Hardware) of the *2018 Standard Specifications*.

10.3. CONSTRUCTION

Comply with Section 1710-3 of the *Standard Specifications*.

10.4. MEASUREMENT AND PAYMENT

Messenger cable (____) will be measured and paid as actual horizontal linear feet of messenger cable furnished, installed and accepted. Measurement will be point to point with no allowance for sag.

No measurement will be made of cable clamps, machine bolts, eye bolts, 3-bolt assemblies, eye nuts, split bolt connectors and pole grounding systems as these will be incidental to furnishing and installing messenger cable.

Payment will be made under:

Pay Item	Pay Unit
Messenger Cable (1/4")	Linear Foot

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11. RCCTV CAMERA METAL POLE AND FOUNDATION

11.1. DESCRIPTION

A. Metal Poles

Furnish and install metal poles, grounding systems, and all necessary hardware. The work covered by this Project Special Provision includes requirements for the design, fabrication, and installation of custom-designed metal poles for solar power assemblies, and for metal poles with CCTV cameras for IP (Internet Protocol) cameras, all with custom-designed foundations.

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 revisions. 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.

Standard Drawings for metal poles and metal pole foundations 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

B. Drilled Pier Foundations

Furnish and install foundations for metal poles with all necessary hardware in accordance with the Project Plans and Project Special Provisions. The work covered by these Project Special Provisions includes requirements for the design, fabrication, and installation of custom designed foundations for metal poles.

Analysis procedures and formulas shall be based on AASHTO 6th Edition, latest ACI code and the Drilled Shafts: Construction Procedures and Design Methods FHWA-NHI-10-016 manual. Design methods based on engineering publications or research papers needs to have prior approval from NCDOT, who reserves the right to accept or disapprove any method used for the analysis.

It is assumed that all foundation designs will be drilled pier foundations unless site-specific soil test information does not allow for a drilled pier foundation design. If an alternative foundation design is required, notify the Engineer immediately. Prior approval from the Engineer is required to receive additional compensation for an alternate foundation design.

Design all metal pole foundations using actual soil conditions at each metal pole location. Perform soil tests in accordance with sub-section (1) (b) Soil Test of these Project Special Provisions.

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.

For lateral analysis, use LPILE Plus V6.0 or later. Inputs, results and corresponding graphs are to be submitted with the design calculations.

Skin Friction is to be calculated using the α-method for cohesive soils and the β-method for cohesion-less soils (Broms method will not be accepted). Detailed descriptions of the "α" and "β" methods can be found in FHWA-NHI-10-016.

Omit first 2.5ft for cohesive soils when calculating skin friction.

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When hammer efficiency is not provided, assume a value of 0.70.

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. Where poor soil is known to be present, it is advisable that the contractor receive approval for foundation designs before releasing metal poles for fabrication.

1. Soil Test

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.

The contractor-selected metal pole fabricator is responsible for determining if the addition of wing walls is necessary for the supporting foundations.

b. Soil Test

Perform a soil test at each proposed metal pole location. Complete all required fill placement and excavation at each metal 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
- A total of 50 blows have been applied with < 3-in. penetration

Submit completed boring logs collected in accordance with these Project Special Provisions along with metal pole loading diagrams to the contractor-selected metal pole fabricator to assist in the metal pole and foundation design.

Describe each metal pole location along the project corridor in a manner that is easily discernible to both the contractor's designer and NCDOT reviewers. If a metal pole is at an intersection, label the boring the "Intersection of (Route or SR #), (Street Name) and (Route or SR #), (Street Name), _____ County. Label borings with "B- N, S, E, W, NE, NW, SE or SW" corresponding to the quadrant location within the intersection.

Metal pole numbers should be made available to the geotechnical drilling Contractor. Include metal 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 or pole locations.

For each boring, submit a legible (hand written or typed) boring log signed and sealed by a licensed Geologist or Professional Engineer registered in North Carolina.

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Include on each boring the SPT blow counts and N-values at each depth, depth of the boring, and a general description of the soil types encountered.

Borings that can't be easily related to their specific metal pole location will be returned to the contractor for clarification, or if approved by the Engineer, the foundation may be designed using the worst case soil condition obtained as part of this project.

2. Foundation Determination

Use the following method for determining the Design N-value:

$$N_{AVG} = \frac{(N@1' + N@2.5' + \ldots\ldots\ldots N@\text{Deepest Boring Depth})}{\text{Total Number of N-values}}$$

$$Y = (N@1')^2 + (N@2.5')^2 + \ldots\ldots\ldots (N@\text{Deepest Boring Depth})^2$$

$$Z = (N@1' + N@2.5' + \ldots\ldots\ldots N@\text{Deepest Boring Depth})$$

$$N_{STD\ DEV} = \left(\frac{(\text{Total Number of N-values} \times Y) - Z^2}{(\text{Total Number of N-values}) \times (\text{Total Number of N-values} - 1)} \right)^{0.5}$$

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 2 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 1 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 sub-section (1) (b) Soil Test above along with metal pole loading diagrams to the Contractor-selected metal pole fabricator to assist in the metal pole and foundation design.

3. Foundation Design

Design foundations based upon site-specific soil test information collected in accordance with sub-section **(1) (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 6.0 or latest version manufactured by Ensoft, Inc. to analyze drilled piers.

Use the computer software gINT V8i or latest manufactured by Bentley Systems, Inc. with the current NCDOT gINT library and data template to produce SPT boring logs.

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Provide a drilled pier foundation for each metal 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.

Base foundation designs on level ground around the metal 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.

11.2. MATERIAL AND REQUIREMENTS

A. Metal Poles

Furnish metal poles that are 50 feet tall as indicated in the Project Plans.

Provide tapered, tubular shafts fabricated from coil or plate steel to meet the requirements of ASTM A595 Grade A. For structural steel shapes, plates and bars use A572 Gr 50 min or ASTM A709 Gr 50 min. Design tapers for all metal pole shafts that begin at the base with diameters that decrease uniformly at the rate of 0.14 inch per foot of length. Construct shafts from one piece of single ply plate or coil so there are no circumferential weld splices.

Ensure that allowable metal pole deflection does not exceed that allowed per 6th Edition AASHTO. Ensure that maximum deflection at the top of the metal pole does not exceed 2.5 percent of the metal pole height at the maximum wind speed as prescribed for the project area.

Use the submerged arc process or other NCDOT previously approved process suitable for metal pole shafts to continuously weld metal pole shafts along their entire length. Ground or roll smooth and flush any exposed welds flush with the base metal. 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 metal pole base. Use full penetration groove welds with backing ring for all tube-to-transverse-plate connections in accordance with the 6th Edition AASHTO. Provide welding that conforms to Article 1072-18 of the *Standard Specifications*, except that no field welding on any part of the metal pole will be permitted unless approved by a qualified engineer.

Fabricate anchor bases from plate steel meeting, as a minimum, the requirements of ASTM A572 Gr 50, AASHTO M 270 Gr 50, ASTM A709 Gr50, or an approved equivalent. Conform to the applicable bolt pattern and orientation as shown on Metal Pole Standard Drawing Sheet M2.

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.

Provide a circular anchor bolt lock plate that will be secured to the anchor bolts at the embedded end with 2 washers and 2 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 inches. Galvanizing is not required for anchor bolt lock plates.

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Provide 4 heavy hex nuts and 4 flat washers for each anchor bolt. For nuts, use AASHTO M 291 grade 2H, DH, or DH3 or equivalent material. For flat washers, use AASHTO M 293 or equivalent material. Ensure that anchor bolts have required diameters, lengths and positions, and will develop strengths comparable to their respective metal poles.

Provide a 2-inch hole equipped with an associated coupling and conduit fittings/bodies approximately 18 inches above the base of the metal pole to accommodate passage of cables from the field equipment cabinet to the inside of the metal pole. Refer to Metal Pole Standard Drawing Sheet M3 for fabrication details.

Have metal poles permanently stamped above the base hand hole with the identification tag details as shown on Metal Pole Standard Drawing Sheet M2.

For each metal 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 metal pole and is conveniently located inside the metal pole at the hand hole.

Provide a removable metal pole cap with stainless steel attachment screws for the top of each metal pole. Ensure that the cap is cast aluminum conforming to Aluminum Association Alloy 356.0F. Furnish cap attached to the metal 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 metal pole-top opening when the cap is removed.

Ensure that metal pole designs permit cables to be installed inside the metal poles. For holes in the metal poles used to accommodate cables, provide full-circumference grommets.

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.

For each structural bolt and other steel hardware, hot dip galvanizing shall conform to the requirements of AASHTO M 232 (ASTM A153). Ensure end caps for metal poles are constructed of cast aluminum conforming to Aluminum Alloy 356.0F.

After fabrication, have metal poles 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 A123. Provide galvanizing on hardware that meets or exceeds ASTM A153. Ensure that threaded material is brushed and retapped as necessary after galvanizing.

Perform repair of damaged galvanizing that complies with Article 1076-7 of the *Standard Specifications*.

Where ice is present, assume wind loads as shown in Figure 3.9.4.2-3 of the 6th Edition AASHTO Specification for Group III loading.

Design a base plate for each metal pole. The minimum base plate thickness for all metal poles is determined by the following criteria:

Case 1 Circular or rectangular solid base plate with the upright metal 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 metal pole, may be considered as a solid base plate.

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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 metal 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 requirements apply to metal pole base plate designs:

- 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.
- Ensure that designs have anchor bolt holes with a diameter 1/4 inch larger than the anchor bolt diameters in the base plate.

Furnish shop drawings for approval. Comply with Article 1098-1B of the *Standard Specifications* for submittal requirements. Furnish necessary details and calculations for the metal poles including the foundation and connections. Ensure that shop drawings include material specifications for each component and identifies welds by type and size on the drawing details, not in table format. Provide an itemized bill of materials for all structural components and associated connecting hardware on the drawings.

Provide the copies and summary of information as summarized below for metal pole and foundation design reviews:

Item	Hardcopy Submittal	Electronic Submittal	Comments / Special Instructions
Sealed, Approved Signal Plan/Loading Diagram	1	1	All structure design information needs to reflect the latest approved signal plans

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Custom Pole Shop Drawings	4 sets	1 set	Show NCDOT inventory number(s), contractor's name and relevant revision number in the title block. All drawings must have a unique drawing number for each project and identified for multiple pages.
Standard Pole Shop Drawings (from the QPL)	4 sets	1 set	Submit drawings on 11" x 17" format media. Show NCDOT inventory number(s), contractor's name and relevant revision number in the title block. All drawings must have a unique drawing number for each project and identified for multiple pages.
Structure Calculations	1 set	1 set	Not required for Standard QPL Poles
Standard Pole Foundation Drawings	1 set	1 set	Submit drawings on 11" x 17" format media. Submit a completed Standard Foundation Selection form for each pole using foundation table on Metal Pole Drawing M-8.
Custom Foundation Drawings	4 sets	1 set	Submit drawings on 11" x 17" format media. Show NCDOT inventory number(s), contractor's name and relevant revision number in the title block. All drawings must have a unique drawing number for each project and identified for multiple pages. If QPL Poles are used, include the corresponding QPL pole shop drawings with this submittal.
Foundation Calculations	1	1	**Submit copies of LPILE input, output and pile tip deflection graph per Section 11.4 of this specification for each foundation.** 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.

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.

Immediately bring to the attention of the Engineer any structural deficiency that becomes apparent in any assembly or member of any assembly as a result of the design requirements imposed by these Project Special Provisions, the Project Plans, or the typical drawings. Said Professional Engineer is wholly responsible for the design of all metal poles. 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.**

Include a title block and revision block on the shop drawings and foundation designs showing the NCDOT inventory number.

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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.

Boring reports should include the following: Engineer's summary, boring location maps, soil classification per AASHTO Classification System, hammer efficiency, and Metal Pole Standard Foundation Selection Form located at the following website:

https://connect.ncdot.gov/resources/Geological/Geotech%20Forms/2012_METAL%20POLES%20-%20Standard%20Foundation%20Selection.pdf

Incomplete submittals will be returned without review. The reviewer has the right to request additional analysis and copies of the calculations to expedite the approval process.

11.3. CONSTRUCTION METHODS

A. Metal Poles

Install anchor rod assemblies in accordance with the Foundations and Anchor Rod Assemblies for Metal Poles provision (SP09-R005) located on the Department's 2018 Specifications and Special Provisions website:

https://connect.ncdot.gov/resources/Specifications/Pages/2018-Specifications-and-Special-Provisions.aspx

Erect metal poles only after concrete has attained a minimum allowable compressive strength of 3,000 psi. Connect metal poles to grounding electrodes and bond them to the electrical service grounding electrodes.

For holes in the metal poles used to accommodate cables, install grommets before wiring metal pole. Do not cut or split grommets.

Attach hand hole covers to the metal pole by a sturdy chain or cable. Ensure the chain or cable is long enough to permit the cover to hang clear of the 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 metal pole.

Attach cap to metal 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.

Install metal poles, hardware, and fittings as shown on the manufacturer's shop drawings. Install metal poles so that when the metal pole is fully loaded it is within 1 degree 40 minutes (1° 40') of vertical. Install metal poles with the manufacturer's recommended "rake." Use threaded leveling nuts to establish rake if required.

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B. Drilled Pier Foundations

Construct drilled pier foundations in accordance with the Foundations and Anchor Rod Assemblies for Metal Poles provision.

11.4. MEASUREMENT AND PAYMENT

CCTV Camera Metal Pole will be measured and paid for as the actual number of CCTV camera metal strain poles (without regard to height or load capacity) furnished, installed and accepted.

Soil Test will be measured and paid for as the actual number of soil tests with SPT borings drilled furnished and accepted.

Drilled Pier Foundation will be measured and paid for as the actual volume of concrete poured in cubic yards of drilled pier foundation furnished, installed and accepted. Anchor rod assemblies shall be considered incidental to the drilled pier foundation.

Metal Pole Foundation Removal will be measured and paid for as the actual number of metal pole foundations removed and disposed.

Metal Pole Removal will be measured and paid for as the actual number of metal poles removed and disposed. Removal of the existing CCTV camera cabinet shall be considered incidental to removal of the pole.

No measurement will be made for foundation designs prepared with metal pole designs, as these will be considered incidental to designing signal support structures.

Payment will be made under:

Pay Item	Pay Unit
CCTV Camera Metal Pole	Each
Soil Test	Each
Drilled Pier Foundation	Cubic Yard
Metal Pole Foundation Removal	Each
Metal Pole Removal	Each

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12. FIBER-OPTIC CABLE

12.1. DESCRIPTION

Furnish and install single mode fiber-optic (SMFO) communications cable, communications cable identification markers, and all necessary hardware, as shown in the Project Plans.

12.2. MATERIALS

Comply with the following *Standard Specifications:*

Article 1098-10 (A), "SMFO Communications Cable"

Article 1098-10 (B), "Drop Cable"

Article 1098-10 (C), "Communications Cable Identification Markers"

12.3. CONSTRUCTION METHODS

Install fiber-optic cables along underground routes as shown in the Project Plans.

Comply with the *Standard Specifications*:

Section 1730-3, "Fiber-optic Cable"

Do not install any communications cables in the same conduit or junction box as power cables.

Store 30 feet of each fiber-optic cable entering a junction box. Store 100 feet of each fiber-optic cable being spliced in an underground splice enclosure located in a junction box. Coil all stored cable in the bottom of the junction box and in a manner that does not violate the maximum bending radius of the cable.

Perform bidirectional OTDR testing on all fibers and submit test result to the Engineer for review and acceptance.

12.4. 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 (____-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.

No measurement will be made for terminating, splicing and testing fiber-optic cable, communications cable identification markers or fiber-optic cable storage racks, as these will be incidental to the installation of fiber-optic cable.

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Payment will be made under:

Pay Item	**Pay Unit**
Communications Cable (144-fiber)	Linear Foot
Drop Cable (12-fiber)	Linear Foot

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13. REMOVE EXISTING COMMUNICATIONS CABLE

13.1. DESCRIPTION

Remove existing fiber-optic communications cable.

13.2. CONSTRUCTION METHODS

Remove existing fiber-optic drop cables and feeder conductors entering ITS cabinets that are to be abandoned. Cut all conduits entering the cabinets to a minimum depth of 2 feet below the finished ground elevation.

Removal of existing underground communications cable includes proper disposal of communications cable and junction boxes. Where junction boxes have been removed, backfill hole to 95% of surrounding density. Promptly backfill and compact areas disturbed with suitable materials and match the finished ground elevation. Seed disturbed areas in accordance with Section 1661 of the *Standard Specifications*.

Do not reuse any removed communications cable, messenger cable, junction boxes, pole attachment hardware or abandoned risers on the project, unless otherwise specified. In the event that any of the removed communications cable, junction boxes or pole attachment hardware is to be returned to the Engineer, it will be so noted in the Project Plans.

13.3. MEASUREMENT AND PAYMENT

Remove Existing Communications Cable will be measured in horizontal linear feet of existing communications cable removed and accepted. Payment will be in linear feet. Sag, vertical segments or spare segments of communications cable will not be paid as these distances will be incidental to the removal of existing communications cable.

No additional measurement will be made for multiple cables being removed from the same conduit or same pole. Where multiple adjacent conduits exist (each containing multiple cables), each conduit will be measured and paid separately. No payment will be made for cable that cannot be removed and is abandoned in place.

No measurement will be made of the removal of messenger cable, pole attachment hardware and junction boxes, as these will be incidental to removing existing communications hardware.

Payment will be made under:

Pay Item	Pay Unit
Remove Existing Communications Cable	Linear Foot

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14. FIBER-OPTIC SPLICE CENTERS

14.1. DESCRIPTION

Furnish and install fiber-optic interconnect centers, fiber-optic splice enclosures and all necessary hardware.

Refer to manufacturer's recommendations for opening, modifying and re-sealing the existing fiber-optic interconnect center and/or fiber-optic splice enclosures.

14.2. MATERIALS

A. Interconnect Centers

Furnish compact, modular interconnect centers designed to mount inside equipment cabinets. Design and size interconnect centers to accommodate all fibers entering cabinets.

Provide splice trays that hold, protect, and organize optical fibers, and secure fibers inside splice tray. Design and size 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 connector panels containing pigtails that are no more than 6 ft in length with a factory assembled PC-LC connector on panel end. Ensure SMFO pigtails meet the operating characteristics of the SMFO cable with which it is to be coupled.

Furnish SMFO jumpers that are at least 3 ft in length with factory assembled PC-LC connectors on each end. Ensure SMFO jumpers meet the operating characteristics of the SMFO cable with which it is to be coupled.

B. Splice Enclosures

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

Refer to Article 1098-11 (B) Splice Enclosure of the *Standard Specifications*.

C. Modify Splice Enclosure Center

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

Refer to Article 1098-11 (B) Splice Enclosure of the *Standard Specifications*.

14.3. CONSTRUCTION METHODS

Comply with the *Standard Specifications*:

Section 1731-3, "Fiber-optic Splice Centers"

14.4. MEASUREMENT AND PAYMENT

Splice enclosure will be measured and paid as the actual number of fiber-optic splice enclosures furnished, installed, and accepted. No measurement will be made between aerial, underground, manhole, or junction box installation of the fiber-optic splice enclosure.

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Modify splice enclosure will be measured and paid as the actual number of existing splice enclosures modified and accepted.

Interconnect center will be measured and paid as the actual number of fiber-optic interconnect centers of the type specified furnished, installed, and accepted.

No measurement will be made of splice trays, pigtails, jumpers, connector panels, testing and any corrective actions, repairs and replacements needed for exceeding maximum allowable attenuation or other defects, as these will be considered incidental to furnishing and installing fiber-optic splice enclosures and interconnect centers.

Payment will be made under:

Pay Item	**Pay Unit**
Splice Enclosure	Each
Modify Splice Enclosure	Each
Interconnect Center	Each

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15. DELINEATOR MARKERS

15.1. DESCRIPTION

Furnish and install delineator markers with all necessary hardware.

15.2. MATERIALS

Material, equipment, and hardware furnished under this section shall be pre-approved on the Department's QPL. Refer to Article 1098-13 (Delineator Markers) of the *Standard Specifications*.

Provide delineator markers with **828-298-0094** as the contact telephone number.

15.3. CONSTRUCTION METHODS

Install delineator markers in compliance with all requirements of Section 1733-3 of the *Standard Specifications*.

Comply with the *Standard Specifications*:

Section 1733, "Delineator Markers"

Install delineator markers at new and existing junction boxes as shown in the Project Plans. If necessary, use electronic locating equipment to locate existing junction boxes shown of the Project Plans.

15.4. MEASUREMENT AND PAYMENT

Delineator marker will be measured and paid as the actual number furnished, installed, and accepted.

No measurement will be made for the use of electronic locating equipment to locate existing junction boxes shown on the Project Plans as this is considered incidental to furnishing and installing delineator markers.

Payment will be made under:

Pay Item	Pay Unit
Delineator Marker	Each

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16. ELECTRICAL SERVICE FOR ITS DEVICE

16.1. DESCRIPTION

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

16.2. MATERIALS

A. Meter Base/Disconnect Combination Panel

Furnish and install new meter base/disconnect combination panels as shown in the Project Plans. Provide meter base/disconnect combination panels that have a minimum of eight (8) spaces in the disconnect. Furnish a single pole 15A circuit breaker at each CCTV camera location. Furnish a double pole 50A circuit breaker at each DMS location. Furnish each with a minimum of 10,000 RMS symmetrical amperes short circuit current rating in a lockable NEMA 3R enclosure. Ensure meter base/disconnect combination panel is listed as meeting UL Standard UL-67 and marked as being suitable for use as service equipment. Ensure circuit breakers are listed as meeting UL-489. Fabricate enclosure from galvanized steel and electrostatically apply dry powder paint finish, light gray in color, to yield a minimum thickness of 2.4 mils. All exterior surfaces must be powder coated steel. Provide ground bus and neutral bus with a minimum of four terminals and a minimum wire capacity range of number 12 through number 2/0 AWG.

Furnish NEMA Type 3R combinational panels rated 100 Ampere minimum for overhead services and 200 Ampere minimum for underground services that meet the requirements of the local utility. Provide meter base with sockets' ampere rating based on sockets being wired with a minimum of 167°F insulated wire. Furnish 4 terminal, 600 volt, single phase, 3-wire meter bases that comply with the following:

- Line, Load, and Neutral Terminals accept 2/0 AWG and smaller Copper/Aluminum wire,
- With or without horn bypass,
- Made of galvanized steel,
- Listed as meeting UL Standard US-414,
- Overhead or underground service entrance specified.

At overhead service locations, furnish 1.25" watertight hub for threaded rigid conduit with meter base.

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

- Type of design.....Silicon Oxide Varistor
- Voltage.....120/240 Single Phase, 3 wire
- Maximum current.....100,000 amps
- Maximum energy.....3,000 joules per pole
- Maximum number of surges.....Unlimited

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- Response time one milliamp test .....5 nanoseconds
- Response time to clamp 10,000 amps.....10 nanoseconds
- Response time to clamp 50,000 amps.....25 nanoseconds
- Leak current at double the rated voltage.....None
- Ground wire .....Separate

B. Step-Up Step-Down Transformer

When a transformer is needed to step up and then step down the power service from 120V to 480V and then back down, furnish a double-wound, dry type 10kVA single phase step-up step-down general purpose transformer as shown in the plans. Provide the transformer with the following specifications:

- Primary Volts: 480 with 20 Amps Max. 60Hz.
- Secondary Volts: 120/240 with 83/41 Amps Max. 60Hz.
- 10kVA power rating.
- Electrostatic shielding between primary and secondary windings.
- Epoxy-silica encapsulated core and coil.
- Copper windings and copper lead wire terminations.
- Multiple front and bottom knockouts for conduit entry/exit.
- Ground studs for conduit bonding.
- Deep red color 480V danger/warning message label.

Provide the transformer in a lockable NEMA 3R enclosure suitable for mounting on a metal pole or wooden pedestal post.

C. Equipment Cabinet Disconnect

Provide new equipment cabinet disconnects at the locations shown in the Project Plans. Furnish double pole 50A circuit breakers at DMS locations. Furnish single pole 15A circuit breaker at CCTV locations. Furnish panels that have a minimum of four (4) spaces in the disconnect. Furnish circuit breakers with a minimum of 10,000 RMS symmetrical amperes short circuit current rating in a lockable NEMA 3R enclosure. Ensure circuit breakers are listed as meeting UL-489. Fabricate enclosure from galvanized steel and electrostatically apply dry powder paint finish, light gray in color, to yield a minimum thickness of 2.4 mils. All exterior surfaces must be powder coated steel. Provide ground bus and neutral bus with a minimum of four terminals and a minimum wire capacity range of number 8 through number 1/0 AWG.

D. 3-Wire Copper Service Entrance Conductors

Furnish 3-wire, 3 AWG stranded copper service entrance conductors with THWN rating. Provide conductors with black, red, and white insulation that are intended for power circuits at 600 Volts or less and comply with the following:

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

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E. 4-Wire Copper Feeder Conductors

Furnish 4-wire stranded copper feeder conductors with THWN rating for supplying power to DMS field equipment cabinets. Provide conductors with black, red, white, and green insulation that are intended for power circuits at 600 Volts or less and comply with the following:

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

See the Project Plans for wire sizes and quantities.

F. 3-Wire Copper Feeder Conductors

Furnish 3-wire stranded copper feeder conductors with THWN rating for supplying power to CCTV camera field equipment cabinets. Provide conductors with black or red, white, and green insulation that are intended for power circuits at 600 Volts or less and comply with the following:

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

See the Project Plans for wire sizes and quantities.

G. Grounding System

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

H. Modify Existing Electrical Service Equipment

Modify the existing electrical service by installing an additional 15A, single pole circuit breaker in an existing service disconnect enclosure. Remove the existing service disconnect and install new service disconnect. Furnish circuit breakers with a minimum of 10,000 RMS symmetrical amperes short circuit current rating. Ensure circuit breakers are listed as meeting UL-489. Install conduit between the existing service disconnect enclosure and an adjacent junction box as shown in the Project Plans.

16.3. CONSTRUCTION METHODS

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

A. Meter Base/Disconnect Combination Panel

Install meter base/disconnect combination panels with lightning arrestors as called for in the Project Plans. At all new CCTV camera and DMS locations, route the feeder conductors from the meter base/disconnect to the CCTV camera and DMS equipment cabinet in conduit. Provide rigid galvanized conduit for above ground and either PVC or HDPE for below ground depending on the installation method required by the Project Plans.

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B. Step-Up Step-Down Transformer

As shown on the plans, install a single-phase general-purpose step-up step-down transformer in a NEMA 3R enclosure. Route the conductors from the transformer secondary to the DMS equipment cabinet or equipment cabinet disconnect in rigid galvanized conduit. Bond the equipment cabinet disconnect in accordance with the NEC. Provide all mounting hardware and other parts and labor necessary to install the transformer on a 6"x 6" treated wood post or the DMS structure upright.

When mounted on the DMS structure upright:

- Mount approximately 5’-0” above grade
- Mount on side facing away from on-coming traffic
- Use all stainless steel strapping
- Use galvanized mounting hardware
- Use rain-tight conduit fittings

C. Equipment Cabinet Disconnect

Install equipment cabinet disconnects and circuit breakers as called for in the Project Plans. Install THWN stranded copper feeder conductors as shown in Project Plans between the electrical service disconnect and the equipment cabinet disconnect. Route the conductors from the equipment cabinet disconnect to the equipment cabinet in rigid galvanized steel conduit. Bond the equipment cabinet disconnect in accordance with the NEC. Ensure that the grounding system complies with the grounding requirements of these Project Special Provisions, the *Standard Specifications* and the Project Plans.

D. 3-Wire Copper Service Entrance Conductors

At locations shown in the Project Plans, furnish and install 3-wire THWN stranded copper service entrance conductors in 1.25-inch rigid galvanized risers as shown in the Project Plans. Install a waterproof hub on top of the electrical service disconnect for riser entrance/exit. Size the conductors as specified in the Project Plans. Comply with the *Standard Specifications*, the *Standard Drawings* and all applicable electrical codes.

E. 4-Wire Copper Feeder Conductors

At locations shown in the Project Plans, install 4-wire THWN stranded copper feeder conductors to supply 240/120 VAC to the DMS field equipment cabinets. Size the conductors as specified in the Project Plans. Comply with the *Standard Specifications* and *Standard Drawings* and all applicable electrical codes.

F. 3-Wire Copper Feeder Conductors

At locations shown in the Project Plans, install 3-wire THWN stranded copper feeder conductors to supply 120 VAC to the CCTV camera field equipment cabinets. Size the conductors as specified in the Project Plans. Comply with the *Standard Specifications,* the *Standard Drawings* and all applicable electrical codes.

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G. Grounding System

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

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

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

H. Modify Existing Electrical Service Equipment

Coordinate with the Engineer and the utility company to de-energize the existing service temporarily prior to starting the modification.

Measure the existing grounding system for ground resistance. If the ground resistance is greater than 20 ohms, abandon the existing grounding system and install a new grounding system as described in this section. Ensure the existing grounding electrode conductor is removed or disconnected from the system.

Install a new conduit system between the existing service disconnect and the new cabinet or equipment cabinet disconnect as shown in the Project Plans. All above ground conduits, conduit bodies and fittings must be rigid galvanized steel. Underground conduits and fittings can be PVC or HDPE. Transition from rigid galvanized steel to PVC using rigid galvanized steel sweeping elbows or in junction boxes. Install stranded copper feeder conductors from the service disconnect to the new cabinet or equipment cabinet disconnect sized as shown in the Project Plans.

16.4. MEASUREMENT AND PAYMENT

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

Step-up step-down transformer will be measured and paid as the actual number of complete and functional step-up step-down transformers furnished, installed and accepted.

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

3-Wire copper service entrance conductors will be measured and paid as the actual linear feet of 3-wire, #3 gauge stranded copper service entrance conductors with THWN rating furnished, installed and accepted. Payment is for all three conductors. Measurement will be for the actual linear footage of combined conductors after all terminations are complete. No separate payment will be made for each individual conductor.

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4-Wire copper feeder 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.

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

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

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

Modify electrical service will be measured and paid as the actual number of complete and functional modified existing electrical services furnished, installed and accepted. Breakers, lightning arresters, above ground rigid galvanized steel conduit from the new service disconnect to below ground, and any remaining hardware and conduit bodies to modify the existing service are considered incidental to modifying existing electrical service equipment.

Payment will be made under:

Pay Item	**Pay Unit**
Meter Base/Disconnect Combination Panel	Each
Step-Up Step-Down Transformer	Each
Equipment Cabinet Disconnect	Each
3-Wire Copper Service Entrance Conductors	Linear Foot
4-Wire Copper Feeder Conductors	Linear Foot
3-Wire Copper Feeder Conductors	Linear Foot
5/8" X 10' Grounding Electrode	Each
#4 Solid Bare Grounding Conductor	Linear Foot
Modify Electrical Service	Each

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17. SOLAR POWER ASSEMBLY

17.1. DESCRIPTION

Furnish and install new solar power assembly equipment in a NEMA Type 3R enclosure and all necessary hardware in accordance with these Project Special Provisions and the Project Plans. Comply with the provisions of Section 1700 of the *Standard Specifications*.

Furnish material and workmanship conforming to the National Electrical Code (NEC), the National Electrical Safety Code (NESC), Underwriter's Laboratories (UL) or a third-party listing agency accredited by the North Carolina Department of Insurance, and all local safety codes in effect on the date of advertisement.

17.2. MATERIALS

Furnish and install new solar power assemblies. Install solar power equipment as shown in the Project Plans. Provide wiring, disconnect, and all other required equipment as required by Article 690 of the NEC.

A. General

Furnish a Solar Power Assembly consisting of the following:

- Solar Array
- Solar Charge Controller
- Batteries
- NEMA 3R Equipment Cabinet
- Concrete Cabinet Pad

Ensure that DC disconnects are supplied between the solar array and the solar charge controller, and between the solar charge controller and the batteries, and between the batteries and any other equipment.

B. Solar Power System Design Requirements

Provide to the Engineer for approval, a submittal package with Engineering Calculations consisting of, as a minimum, schematic drawing, technical data sheets, and supporting documentation. Ensure the documentation demonstrates, in theory, that the batteries will provide for continuous operation for a minimum of ten (10) consecutive days with no additional charging.

Provide drawings showing dimension, location of required equipment, cabinet electrical diagrams, part numbers and descriptions of required equipment and accessories to the Engineer.

C. Solar Array

Furnish solar modules made in North America and have a minimum 20-year factory warranty. The solar array should have a minimum peak output of 135 Watts. Solar modules must be UL listed, FM Class I, Div. II, Group C&D approved. For the solar array, power wiring should be 10-2, stranded copper, double insulated, sunlight resistant, 600V 90C rated cable. Ensure the solar array mount is manufactured from an aluminum alloy or stainless steel and is capable of withstanding 125 mph winds.

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D. Solar Charger Controller

Furnish a Pulse Width Modulation (PWM) solar charge controller that is UL listed, with a minimum 20A solid state, low voltage disconnect. The solar charge controller must be sealed with internal temperature compensation, lightning protection, reverse polarity protection, and LED indicators. Furnish controllers with the capability of 3 functions: battery charging, load control, and diversion regulation. Controllers must be furnished with fully adjustable DIP switches and RS-232 communications port to adjust the unit's operational modes. Ensure the solar charge controller is listed as a FM Class I, Div. II, Groups ABCD device and has the CE mark.

E. Batteries

Provide a 12V gel electrolyte, non-spillable, maintenance free battery. The batteries should be able to provide power for 10 days without being charged by the Solar Array. Furnish batteries with a minimum operating temperature of -76 F to 140 F.

F. NEMA 3R Equipment Cabinet

Provide a NEMA 3R type equipment cabinet enclosure that is of a base mount design, with compartments to house the batteries and electronic components separately. Ensure that the equipment installed inside the cabinet does not occupy more than 60% of the total cabinet volume.

Ensure that the battery compartment and the electronic equipment compartments are ventilated with a screen and louvered vents. Equip vents with standard-size, replaceable furnace type vent filters. Size the filter tray to adequately house and secure the filter in place. Ensure there are no obstructions on the interior face of the door to interfere with easy removal and replacement of filter.

Provide an enclosure that is fabricated with unpainted, natural, aluminum that complies with Section 7 of NEMA TS-2-1998. Ensure the equipment cabinet enclosure shell is fitted with one (1) Corbin Number 2 Key, lifting handles, and exhaust ports. Provide all necessary hardware to secure the battery cabinet to the base of the CCTV metal pole. Provide hardware that is stainless steel or a Department approved non-corrosive alternate including the hinges and lifting handle.

Provide roof with slope (from front to back) at a minimum ratio of 1" drop per 2 feet. Ensure roof is flush with front of the door. Ensure each exterior cabinet plane surface is constructed of a single sheet of seamless aluminum.

Provide a handle and three-point latching mechanism designed to be disassembled using hand tools. Provide a shaft connecting the latching plate to the door handle by passing through the door within a bushing, bearing, or equivalent device. Provide a latching plate at least 1/8-inch thick and that mates securely with the lock bolt. Provide a lock bolt with a flat end (no bevel) and that has at least 1/4 inch of length in contact with the latching plate.

Ensure that the handle and lock are positioned so that the lock does not lie in the path of the rotating handle as the door is unlatched and that the handle points down in the latched position.

Provide a main door opening that encompasses the full frontal area of the cabinet shell. Ensure that the cabinet shell is sturdy and does not exhibit noticeable flexing, bending or distortion under normal conditions, except that a minor amount of flexing is permitted in the

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main door when the cabinet is open. In such case, the flexing must not result in permanent deformation of the door.

A police panel door is not required for these cabinets.

Equipment in the equipment cabinet enclosure will be shelf mounted. Provide one equipment shelf in the cabinet that extends the practical width of the cabinet. Ensure that the shelf can be moved up and down within the cabinet. Do not locate permanently mounted equipment in such a way that will restrict access to terminals. Ensure all components are arranged for easy access during servicing. When modular in construction, provide guides and positive connection devices to ensure proper pin alignment and connection.

Arrange equipment and terminals within the cabinet so that they will not interfere with the entrance, tracing and connection of conductors or other cables. Ensure all incoming and outgoing conductors are connected to terminal blocks. Ensure all field terminals are readily accessible without having to remove equipment to gain access. Ensure terminals are not located on the underside of shelf or at any other place where they are not readily visible or where they may present a hazard to personnel who might inadvertently touch them.

Provide terminal blocks that are made of electrical grade thermoplastic or thermosetting plastic. Ensure each terminal block is of closed back design and has recessed-screw terminals with molded barriers between terminals. Ensure each terminal consists of two terminal screws with removable shorting bar between them. Ensure all terminal blocks and terminals are labeled with their intended functions. Provide labels that are visible and easy to read when the terminal blocks are wired.

17.3. CONSTRUCTION METHODS

Furnish and install new solar power assemblies. Install solar power equipment as shown in the Project Plans. Provide wiring, disconnect, and all other required equipment as required by Article 690 of the NEC.

Mount the cabinet on a concrete pad. Do not obstruct the sight distance of vehicles when locating and installing the equipment cabinet.

Ensure that the equipment cabinet along with solar array(s) and its mounting hardware are capable of surviving sustains winds of 125 MPH. Ensure the solar array(s) does not obstruct the view of traffic and that the array(s) are arranged for optimal sunlight exposure for charging of the batteries. Mount the array(s) at a minimum height of 25 feet above ground level.

Run field wiring from the solar power array(s) to the equipment cabinet through 1-inch riser with weatherhead and make connections inside the equipment cabinets as required. Install separate DC disconnects between the solar array and the solar charger controller and between the solar charger controller and the batteries, and between the batteries and any other equipment. Ensure the DC disconnect allows personnel working on the system to safely isolate critical items from each other while performing maintenance and trouble shooting. Ensure that all wiring including grounding of the solar photovoltaic system meets the requirements of Article 690 of the National Electric Code (NEC) and these Project Special Provisions.

To protect against high voltage power surges, furnish and install one grounding electrode at the equipment cabinet.

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Terminate all wires using spade connectors under binding screws on terminal blocks. Label all terminal blocks and terminals for easy identification. Label all wires and harnesses for easy identification. Neatly secure all wiring and harness inside the cabinet in a method approved by the Engineer.

Provide and leave all data interface cables, installation manuals, and specifications and materials used to program any equipment in the equipment cabinet. Program all equipment for operation.

17.4. MEASUREMENT AND PAYMENT

Solar power assembly will be measured and paid as the actual number of solar power assemblies furnished, installed and accepted. No measurement will be made for solar arrays, controllers, solar power assembly equipment cabinet, install breakers, temperature sensors, concrete cabinet pad, mounting system, grounding system, conduits, risers, wiring, and hardware as these will be considered incidental to furnishing and installing the solar power assembly.

Payment will be made under:

Pay Item	Pay Unit
Solar Power Assembly	Each

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18. CCTV CAMERA ASSEMBLY

18.1. DESCRIPTION

Furnish and install High Definition (1080p) CCTV camera field equipment described in these Project Special Provisions. Ensure that the equipment is fully compatible with all features of the existing VideoPro video management software currently in use by the Department in this Region. Contact the Division 13 Deputy Division Traffic Engineer to confirm the CCTV camera locations prior to beginning construction.

18.2. MATERIALS

A. General

Furnish and install new CCTV camera assemblies at the locations shown on the Project Plans. Each assembly consists of the following:

- One Dome CCTV camera that contains, in a single enclosed unit, the following functionality and accessories:
  - CCTV color digital signal processing camera unit with zoom lens, filter, control circuit, and accessories.
  - Motorized pan, tilt, and zoom.
  - Pole-mount camera attachment assembly.
  - All necessary cable, connectors and incidental hardware to make a complete and operable system.
  - Built-in video encoder capable of H.264/MPEG-4 compression for video-over-IP transmission.
- A lightning arrestor installed in-line between the CCTV camera and the equipment cabinet components,
- A NEMA Type 4 enclosure constructed of aluminum with a clear acrylic dome or approved equal Camera Unit housing.

B. Camera and Lens

1. Camera

Furnish new Complementary Metal-Oxide-Semiconductor (CMOS) sensor-equipped color cameras. Furnish cameras that meet the following minimum requirements:

- Video format: NTSC compatible resolution, user selectable up to a maximum of 1920x1080 (1080p),
- Focus: Automatic with manual override, Electronic Image Stabilization (EIS),
- White balance: Automatic through the lens with manual override,
- Shutter: Electronic shutter with manual control from 1/2 of a second to 1/30,000th of a second,

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- Overexposure protection: The camera must have built-in circuitry or a protection device to prevent any damage to the camera when pointed at strong light sources, including the sun,
- Sensitivity: 0.6 lux at 90% scene reflectance
- Input/Output Connection: Single 10BASE-T/100BASE-T compatible outdoor-rated Cat5e cable for video, control, and Power over Ethernet; IP66-rated RJ45 connector,
- Power: High Power over Ethernet (High PoE), 74W max

2. Zoom Lens

Provide each 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 viewing angle:.....55.4 degrees at 3.6 mm wide zoom and 2.9 degrees at 82 mm telephoto zoom,
- Focal length:.....3.6 mm to 124 mm, 30X 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 30 IRE .07 lux at ½ second color, .2 lux at 1/60 second black and white, .015 lux at ½ second 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. Mechanical or electrical means must be provided 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.

C. Camera Housing

Furnish new dome style enclosure for the CCTV camera assemblies. Equip each housing with a mounting assembly for attachment to the camera pole. The enclosures must be equipped with a sunshield and a strip heater, and be fabricated from corrosion resistant aluminum and finished in a neutral color of weather resistant enamel. The enclosure must meet or exceed NEMA 4X and IP66 ratings. The viewing area of the enclosure must be constructed of clear acrylic, polycarbonate, or an approved equivalent.

Furnish removable dome enclosures that are secured to the camera housing using stainless steel set screws. Ensure that camera housing assembly is completely sealed with a rubber O-ring gasket to prevent dust and moisture intrusion.

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Environmental Operating Conditions: -50ºF to 122ºF, 10-100% RH (condensing) humidity.

D. 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 the high performance integrated 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 pan and tilt units must meet or exceed the following specifications:

- Pan: .....Continuous 360 Degrees,
- Tilt:.....Up/down 180 degrees minimum,
- Motors:.....Two-phase induction type, continuous duty, instantaneous reversing,
- Preset Positioning: .....64 PTZ presets per camera.

E. Video Ethernet Encoder

Furnish cameras with a built-in digital video Ethernet encoder to allow video-over-IP transmission. The encoder units must be built into the camera housing and require no additional equipment to transmit encoded video over IP networks.

Encoders must have the following minimum features:

- Network Interface: .....Ethernet 10/100Base-T (RJ-45 connector)
- Protocols: .....IPv4, IPv6, HTTP, HTTPS, SSL, QoS, FTP, SMTP, UPnP, SNMP v2c/v3, DNS, NTP, RTSP, RTP, TCP, UDP, IGMP, and DHCP,
- Security: .....SSL, SSH, 802.1x, HTTPS encryption with password controlled browser interface
- Video Streams:.....2 simultaneous streams, user configurable
- Compression: .....H.264 (MPEG-4 Part 10/AVC)
- Resolution .....Scalable; NTSC-compatible 320x176 to 1920x1080 (HDTV 1080p, 16:9 aspect ratio)
- Frame Rate:.....1-30 FPS programmable (full motion)
- Bandwidth.....30 kbps – 6 Mbps, configurable depending on resolution
- Edge Storage: .....SD/SDHC/SDXC slot supporting up to 64GB memory card

F. Ethernet Cable

Provide, at a minimum, Category 5 Enhanced (5e) Ethernet cable that complies with ANSI/TIA-568-B-5 standards for four-pair shielded twisted copper for Ethernet communications. The cable shall meet all of the mechanical requirements of ANSI/ECEA S-

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80-576. The Ethernet cable must be rated for medium-power, network-powered broadband communications circuits and must be Type BMU network-powered broadband communications medium-power cable.

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

G. Surge Suppression

Protect all equipment with metal oxide varistors connecting each power conductor to ground.

18.3. CONSTRUCTION METHODS

A. General

Mount CCTV camera units at a height sufficient to adequately see traffic in all directions and as approved by the Engineer. The maximum attachment height for cameras is 45 feet above ground level.

Mount the CCTV camera units such that a minimum 5 feet of clearance is maintained between the camera and the top of the pole.

Obtain approval of the camera locations and orientation from the Engineer prior to installing the CCTV camera assemblies.

Mount CCTV cameras on the side of poles nearest intended field of view. Avoid occluding the view with the pole.

B. Electrical and Mechanical Requirements

Install Power over Ethernet (PoE) injector in the CCTV equipment cabinet and run an outdoor-rated Cat5e Ethernet cable from the cabinet, up the riser, to the CCTV camera assembly. 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. Install the cables 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.

Ground all equipment as called for in the *Standard Specifications*, these Special Provisions, and the Project Plans.

Install surge protectors on all ungrounded conductors entering the CCTV camera enclosure. House the protectors in a small, ventilated weatherproof cabinet attached near the CCTV camera attachment point in a manner approved by the Engineer.

Furnish all tools, equipment, materials, supplies, and hardware necessary to install a fully operational CCTV camera system as depicted in the Project Plans.

C. Existing CCTV Camera

Where shown on plans, remove existing CCTV cameras and ancillary equipment; do not re-use or relocate such equipment. Deliver removed uninstalled CCTV cameras and ancillary equipment to Division 13 Traffic Services, as appropriate.

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18.4. MEASUREMENT AND PAYMENT

CCTV camera assembly will be measured and paid as the actual number of CCTV camera assemblies furnished, installed, integrated, and accepted. No separate measurement will be made for Ethernet cables, connectors, CCTV camera attachment assemblies, conduit, condulets, risers, grounding equipment, surge protectors, CCTV camera control software, Power over Ethernet (PoE) injectors, or any other equipment or labor required to install the CCTV camera assembly.

No separate measurement or payment will be made for existing CCTV camera equipment removed and delivered to Division Traffic Services.

Payment will be made under:

Pay Item	Pay Unit
CCTV Camera Assembly	Each

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19. FIELD EQUIPMENT CABINET

19.1. DESCRIPTION

Furnish 336S pole mounted cabinets to house CCTV camera communication equipment. The cabinets must consist of a cabinet housing, 19-inch EIA mounting cage, and power distribution assembly (PDA #3 as described in the CALTRANS TSCES).

The cabinet housing must conform to sections 6.2.2 (Housing Construction), 6.2.3 (Door Latches and Locks), 6.2.4 (Housing Ventilation), and 6.2.5 (Hinges and Door Catches) of the CALTRANS TSCES. Do not equip the cabinet housings with a police panel.

The cabinet cage must conform to section 6.3 of the CALTRANS TSCES.

Terminal blocks on the PDA #3 Assembly have internal wiring for the Model 200 switch pack sockets. Do not use terminal blocks on PDA #3 as power terminals for cabinet devices. Do not furnish cabinet with "Input Panels" described in section 6.4.7.1 of the TSCES. Do furnish cabinet with "Service Panels" as described in section 6.4.7.1 of the TSCES and as depicted on drawing TSCES-9 in the TSCES. Use service panel #2.

Furnish terminal blocks for power for cabinet, CCTV cameras, and communications devices as needed to accommodate the number of devices in the cabinet.

Do not furnish cabinets with C1, C5, or C6 harness, input file, output file, monitor units, model 208 unit, model 430 unit, or switch packs.

Furnish all conduits, shelving, mounting adapters, and other equipment as necessary to route cabling, mount equipment, and terminate conduit in equipment cabinet.

Furnish a 332 base-mounted "shell" cabinet to house future equipment, as shown in the plans.

19.2. MATERIALS

A. Shelf Drawer

Provide a pull out, hinged-top drawer, having sliding tracks, with lockout and quick disconnect feature, such as a Vent-Rak Retractable Writing Shelf, #D-4090-13 or equivalent in the equipment cabinet. Furnish a pullout drawer that extends a minimum of 14 inches that is capable of being lifted to gain access to the interior of the drawer. Minimum interior dimensions of the drawer are to be 1 inch high, 13 inches deep and 16 inches wide. Provide drawers capable of supporting a 40-pound device or component when fully extended.

B. Cabinet Light

Furnish two (2) fluorescent lighting fixtures in each cabinet (one front, one back) mounted horizontally inside the top portion of the cabinet. Install 16 watt T-4 cool white lamps in the fluorescent fixtures. Provide a protective diffuser to cover exposed bulbs. The fixtures must be operated by normal power factor UL-listed ballast. Ensure that the fixtures illuminate all terminals, labels, and devices in the cabinet. Conveniently locate the fixtures so as not to interfere with a technician's ability to perform work on any devices or terminals in the cabinet. The lights must be mounted so as to not interfere with the upper door stay. Provide a front and rear door switch to provide power to each fixture when the respective door is open. Wire the fluorescent fixtures to the 15 amp ECB (equipment circuit breaker).

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C. Surge Protection for System Equipment

Each cabinet must be provided with devices to protect the CCTV camera and communications equipment from electrical surges and over voltages as described below.

1. Main AC Power Input

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: 20000 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),

  GND (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 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,
- The Protector must be epoxy-encapsulated in a flame-retardant material,
- Continuous service current: 10 Amps at 120 VAC RMS,

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- The Equipment Line Out must provide power to CCTV camera and communications equipment and to the 24V power supply.

2. Ground Bus

Provide a neutral bus that is not connected to the earth ground or the logic ground anywhere within the cabinet. Ensure that the earth ground bus and the neutral ground bus each have ten compression type terminals, each of which can accommodate wires ranging from number 14 through number 4 AWG.

D. Uninterruptible Power Supply (UPS)

Within each CCTV camera field equipment cabinet to be powered by the Duke Energy system furnish and install one rack mounted UPS that meets the following minimum specifications:

Output

- Output Power Capacity .....480 Watts / 750 VA,
- Max Configurable Power .....480 Watts / 750 VA,
- Nominal Output Voltage 120V,
- Output Voltage Distortion.....Less than 5% at full load,
- Output Frequency (sync to mains).....57 - 63 Hz for 60 Hz nominal,
- Crest Factor .....up to 5:1,
- Waveform Type .....Sine wave,
- Output Connections .....(4) NEMA 5-15R,

Input

- Nominal Input Voltage 120V,
- Input Frequency .....50/60 Hz +/- 3 Hz (auto sensing),
- Input Connections .....NEMA 5-15P,
- Cord Length .....6 feet,
- Input voltage range for main operations .....82 - 144V,
- Input voltage adjustable range for main operation .....75 -154 V,

Battery Type

Maintenance-free sealed Lead-Acid battery with suspended electrolyte, leak-proof.

- Typical recharge time .....2 hours,

Communications & Management

- Interface Port(s) .....DB-9 RS-232, USB,
- Control panel.....LED status display with load and battery bar-graphs,

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Surge Protection and Filtering

- Surge energy rating.....480 Joules,

Environmental

- Operating Environment.....32 - 104° F,
- Operating Relative Humidity.....0 - 95%,
- Storage Temperature.....5 - 113° F,
- Storage Relative Humidity.....0 - 95%,

Conformance

- Regulatory Approvals.....FCC Part 15 Class A, UL 1778.

E. DC to AC Inverter

Within each field equipment cabinet to be powered from a solar power assembly, furnish and install a DC to AC pure sine wave inverter to invert 12 VDC from the solar power assembly to 115 VAC, 60 Hz.

Furnish an inverter that is durable, has no internal cooling fan nor other moving parts and which generates good wave form throughout the range of input voltages.

Furnish an inverter that handles a 200% surge during load start-up, up to a maximum of 600 watts.

Furnish an inverter with a self-consumption rating of 450mA or less while powering loads. During no load conditions, the inverter must automatically power down to stand-by mode, thereby reducing self-consumption to 55mA or less.

Furnish an inverter constructed with epoxy encapsulation, conformal coating, stainless steel hardware, and an anodized aluminum enclosure to protect against harsh environments.

Furnish an inverter with LED indicators and digital meter to show system status and any fault conditions.

Furnish the inverter with an AC safety disconnect to shut off AC power from the inverter to the cabinet.

Furnish an inverter with user switches that provide adjustability of system parameters, and with additional user adjustability input/output ports to a PC running software provided by the manufacturer.

Furnish and install inverters that meet the following minimum specifications:

Electrical

- Continuous Power Rating 300 Watts @ 25°C
- Peak Power Rating (10 minutes) 600 Watts @ 25°C
- DC Input Voltage 10.0V – 15.5V
- Waveform Pure sine wave
- AC Output Voltage (RMS)* 115V +/– 10%

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- AC Output Frequency* 60 Hz +/– 0.1%
- Peak Efficiency 92%
- Total Harmonic Distortion (THD) < 4%
- Self-Consumption
  - Inverter On (no load) 450mA
  - Inverter Off 25mA
  - Stand-by 55mA
- Low Voltage Disconnect (LVD) 11.5 V or 10.5 V**
- Low Voltage Reconnect 12.6 V or 11.6 V**
- LVD Warning Threshold (buzzer) 11.8 V or 10.8 V**
- LVD Delay Period 4 minutes
- High Voltage Disconnect 15.5 V
- High Voltage Reconnect 14.5 V
- Standby On Threshold ~ 8 Watts
- Standby Off Threshold ~ 8 Watts
- High Temperature Disconnect 95°C
- High Temperature Reconnect 80°C

Electronic Protections

- Reverse Polarity (fused)
- AC Short Circuit
- AC Overload
- High Voltage Disconnect
- Low Battery Disconnect
- High Temperature Disconnect

Mechanical

- Dimensions 9.0 x 7.0 x 5.0 in maximum
- Weight 12.0 lbs maximum
- AC Terminals
  - Max. Wire Size 4 mm2 / 12 AWG
- DC Terminals
  - Max. Wire Size 2.5 to 35 mm2
    14 to 2 AWG
- Enclosure IP20 Cast anodized aluminum

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Environmental

▪ Ambient Operating Temp	–40°C to +45°C
▪ Storage Temperature	–55°C to +85°C
▪ Humidity	100% (non-condensing)
▪ Tropicalization	Conformal coating on printed circuit boards, Epoxy encapsulated transformer and inductors

F. 332 Shell Cabinet

Provide a 332 base-mounted "shell" cabinet for housing future electronics equipment. Do not provide power service and associated electronics to this cabinet.

19.3. CONSTRUCTION METHODS

A. 336S Pole-Mounted Cabinet

For each field equipment cabinet installation, use stainless steel banding or other method approved by the Engineer to fasten cabinet to metal pole. Install field equipment cabinets so that the height to the middle of the enclosure is 4 feet from ground level. No risers shall enter the top or sides of the equipment cabinet.

Install all conduits, condulets, and attachments to equipment cabinets in a manner that preserves the minimum bending radius of cables and creates water proof connections and seals.

Install a UPS and power all CCTV camera PoE injectors and Ethernet edge switches from the UPS.

Within CCTV field equipment cabinets to be powered from a solar power assembly, install a DC to AC inverter and power all CCTV camera PoE injectors and Ethernet field switches from the inverter.

Install a level concrete technician pad measuring a minimum 4 inches thick, 24 inches wide and 36 inches long at the front door of the field equipment cabinet as shown on the Typical Details sheet within the Project Plans.

B. 332 Base-Mounted Shell Cabinet

For the shell cabinet, install a level concrete technician pad measuring a minimum of 24 inches out from the front and back door of the cabinet.

Install all conduits entering the cabinet in a manner that preserves the minimum bending radius of cables and creates water proof connections and seals.

19.4. MEASUREMENT AND PAYMENT

Field equipment cabinet will be measured and paid as the actual number of field equipment cabinets furnished, installed and accepted.

No separate payment will be made for the UPS, inverters, software, cabling, connectors, cabinet attachment assemblies, conduit, condulets, risers, grounding equipment, surge protectors, concrete technician pad or any other equipment or labor required to install the field equipment cabinet and integrate the cabinets with the CCTV camera system.

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Payment will be made under:

Pay Item	**Pay Unit**
Field Equipment Cabinet (with UPS)	Each
Field Equipment Cabinet (with Inverter)	Each
Field Equipment Shell Cabinet	Each

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20. DYNAMIC MESSAGE SIGN (DMS)

20.1. DESCRIPTION

DMSs used on the State Highway System shall be preapproved on the current NCDOT ITS & Signals 2018 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 NTCIP compliant DMSs that are fully compatible with Daktronics, Inc. Vanguard V4 software (also referred to hereinafter as the "Control Software").

Furnish and install DMSs compliant with UL standards 48, 50 and 879.

Add and configure the new DMS into the existing DMS database at the Division 13 Traffic Operations Center using the Control Software and computer system. Furnish, install, test, integrate and make fully operational the new DMS at the location shown in the Project Plans.

Contact the Deputy Division Traffic Engineer to confirm all DMS locations prior to beginning construction.

Furnish operating DMS systems consisting of, but not limited to, the following:

- Walk-In Enclosure DMS
    - Full Matrix, 27 pixel high and 90 pixels wide LED Walk-In DMS
    - Pedestal type DMS support structures and mounting hardware
- DMS controllers, Uninterruptible Power Supplies (UPS), cabinets and accessories with interconnect and power cabling and conduit
- Branch circuit conductors and related equipment
- 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.

20.2. 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

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 15 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 90 pixels wide.

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1. DMS Enclosure

Comply with the requirements of Section 3 (Sign Mechanical Construction) of NEMA TS 4-2005 as it applies to walk-in enclosures. The following requirements complement TS 4-2005.

Construct the DMS with a metal walk-in enclosure excluding the face. Provide an aluminum walking platform inside the enclosure that is at least 28 inches wide. Ensure the width of the walking platform is free of obstructions to a height of 7 feet. 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 key lockable, hinged, gasket-sealed inspection door for service and maintenance along each side of the enclosure. Install one appropriately sized fire extinguisher within 12 inches of each maintenance door. Equip the DMS enclosure with internal fluorescent lighting controlled by timers installed close to each inspection door. Make certain no light emitted from the fluorescent tubes or any other light source inside the enclosure not comprising the display is leaked to the outside of the enclosure. Equip the door with a door-hold-open device. Install GFCI duplex utility receptacles every 6 feet along the width of the DMS in convenient locations for powered service tools.

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

Design the local field controller to monitor and control the interior DMS environment. Design environmental control to maintain the internal DMS temperature within +/- 10º F of the outdoor ambient temperature. Provide the DMS environmental control system with four primary subsystems as follows:

Internal Temperature Sensors – Provide the DMS with two internally mounted temperature sensors which are equipped with external thermocouples and which the field controller continuously monitors. Design the field controller to use this temperature information to determine when to activate and deactivate the environmental control systems described herein. Locate sensors on opposite ends of the upper 1/3 of the LED display matrix with their external thermocouples attached to and making contact with an LED pixel circuit board. Design the thermocouple and LED board to be easily

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detachable, in the event that one of the units requires removal and replacement. Provide sensors capable of measuring temperatures from -40° F to +185° F. Design the field controller to automatically shut down the LED display whenever one or both sensors indicates that LED board temperature has exceeded +140° F, and to automatically restart the LED display whenever the temperature falls below +130° F. Design both shutdown and re-start temperature thresholds to be user-programmable. Design the field controller to report sensor temperatures and DMS shutdown/re-start events to the DMS Control Software.

Housing Cooling System – Provide the DMS housing with a cooling system that circulates outside air into the DMS housing whenever the LED board temperature exceeds a user-programmable threshold. Provide this system with enough ventilation fans to exchange the internal DMS housing air volume at a minimum rate of 2 times per minute. Provide steel ball-bearing type fans. Mount fans in a line across the upper rear wall of the DMS housing to direct air out of the cabinet. Provide one filtered air intake port for each exhaust fan. Locate intake ports in a line across the lower rear wall of the DMS housing. Provide intake ports with a removable filter that will remove airborne particles measuring 500 microns in diameter and larger. Provide a filter that is of a size and style that is commercially readily available. Program the field controller to activate the DMS housing cooling system whenever the LED board temperature exceeds +90° F and to turn the cooling system off whenever LED board temperature falls below +85° F. On the DMS housing rear exterior wall, cover all air intake and exhaust ports on their top, front, and sides by an aluminum shroud fabricated from 0.090-inch aluminum sheeting. Taper the shrouds at the top. Securely fasten shrouds to the DMS housing, and provide gaskets at the interface to prevent water from entering the DMS. Design all air filters and fans to be removable from inside the DMS housing. Provide the DMS housing cooling system with an adjustable timer that will turn fans off after the set time has expired. Provide a timer that is adjustable to at least 4 hours, and locate it just inside the DMS housing door, within easy reach of a maintenance technician standing outside the DMS doorway.

LED Display Cooling System – Provide the DMS with an LED display cooling system which directs air across the LED display modules whenever LED board temperature exceeds a user-programmable threshold. Direct fan-forced air vertically across the backside of the entire LED display matrix using multiple ball-bearing fans. Program the field controller to activate the LED cooling fan system whenever LED board temperature exceeds +90° F and to deactivate the system whenever LED board temperature falls to +85° F. Locate cooling fans so as not to hinder removal of LED display modules and driver boards.

Front Face Panel Defog/Defrost System – Provide the DMS with a defog/defrost system which circulates warm, fan-forced air across the inside of the polycarbonate front face whenever LED board temperature falls below a user-programmable threshold. Provide multiple steel ball-bearing fans that provide uniform airflow across the face panel. Program the field controller to activate the defog/defrost system whenever LED board temperature falls below +40° F and to deactivate the defog/defrost system whenever LED board temperature exceeds +106° F. Mount a 100-watt pencil-style heating element in front of each defog/defrost fan to warm the air directed across the DMS face. Design heating elements to be on only when the defog/defrost fans are on.

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Install additional fans and/or heaters as needed to maintain the temperature inside the DMS enclosure within the operating temperature range of the equipment within the DMS enclosure as recommended by the equipment manufacturer(s).

3. Front Panel

Protect the DMS face with contiguous, weather-tight, removable panels. These panels must be a polycarbonate material that is 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

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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.

Furnish two (2) spare display modules per each DMS installed for emergency restoration.

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. No substitutions will be allowed. 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.

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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.

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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.

C. DMS Enclosure Structure Mounting

Mount the DMS enclosure and interconnect system securely to the supporting structures. Design the DMS enclosure supports and structure to allow full access to the DMS enclosure inspection door.

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, structure, 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 *Standard Specifications for Structural Supports for Highway Signs, Luminaires*, and the section titled “DMS Assemblies” of these Project Special Provisions.

D. 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 Project 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.

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E. DMS Controller and DMS Cabinet

Furnish and install one DMS controller with accessories per DMS in a protective 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 4 feet. Ensure a minimum of 3 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 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.

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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 so as 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 automatically report 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 80ºF and

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160ºF with a differential of not more than 10ºF 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).

1. 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.

2. Power Supply and Circuit Protection

Design the DMS and controller for use on a system with a line voltage of 120V + 10% at a frequency of 60 Hz + 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.

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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.

3. 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.

4. 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	-40ºF to +158ºF

*Capable of handling the continuous current to the equipment

5. 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.

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6. 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

7. 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

8. 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

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conditioned AC voltage to the DMS controller. 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 oF to +165 oF
- 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.

9. 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

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- 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

10. 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.

11. 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.

12. 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.

13. 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.

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F. 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.

G. 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.

H. 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.

I. 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.

J. 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.

K. 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

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that each schematic enables an electronics technician to successfully identify any component on a board or assemblies and trace its incoming and outgoing signals.

L. 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.

M. 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.

N. 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.

O. 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).

20.3. 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.

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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 Project 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 Specifications* 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 4 feet for conduit 1.5 inches and larger or 6 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

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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 Project 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 assembly with any other color.

Bury underground circuits 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 Project Plans.

F. Equipment and Cabinet Mounting

Mount equipment securely at the locations shown in the Project 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 Project 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.

G. Remove Existing DMS and Structure

Remove existing DMS, DMS-related equipment and DMS structure and foundation. Deliver the DMS-3 sign enclosure to the Division 13 Traffic Services office. Dispose of all other DMS equipment removed from the project site.

H. 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.

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20.4. MEASUREMENT AND PAYMENT

Dynamic Message Sign will be measured and paid as the actual number of 27 X 90 DMS furnished, installed, and accepted. Each DMS consists of an LED Dynamic Message Sign, communications equipment, strapping hardware, controller, UPS, controller cabinet, conduit, fittings, couplings, sweeps, conduit bodies, wire, flexible conduit, power conductors and communications cable between the controller cabinet and the DMS enclosure, 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.

Remove Existing DMS and Structure will be measured and paid as the actual number of DMS assemblies and the associated DMS structures and foundations removed. Each DMS consists of an LED Dynamic Message Sign, communications equipment, strapping hardware, controller, UPS, controller cabinet, conduit, fittings, couplings, sweeps, conduit bodies, wire, flexible conduit, power conductors and communications cable between the controller cabinet and the DMS enclosure, connectors, circuit protection equipment, and photo-electric sensors.

Payment will be made under:

Pay Item	Pay Unit
Dynamic Message Sign	Each
Remove Existing DMS and Structure	Each

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21. NTCIP REQUIREMENTS

This section defines the detailed NTCIP requirements for the DMSs covered by these Project Special Provisions and Project Plans.

21.1. 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 Internet Transport Profile (TCP/IP and UDP/IP)
NTCIP 2301	**NTCIP 2301**	AP-STMF AP for Simple Transportation Management Framework

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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, and

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.

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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 listed in Table 4
DmsControlMode	NTCIP 1203 Clause 2.7.1.1.1.1	Support at least the following modes: - Local - External Central - Central Override

* 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.

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Table 3: Content of Permanent Messages

Permanent Message Number	Description
1	Permanent Message #1 blanks the display (i.e., consist of and empty MULTI 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.

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5. Test Heading

1.1.A.5.1. Time Management

As defined in NTCIP 1201

1.1.A.5.2. 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

1.1.A.5.3. 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 Configuration Modes: onChange greaterThanValue smallerThanValue
MaxEventLogSize	NTCIP 1201 Clause 2.5.3	At least 200
MaxEventClasses	NTCIP 1201 Clause 2.5.5	At least 16

1.1.A.5.4. PMPP

1.1.A.5.5. Font Configuration

As defined in NTCIP 1203. The following list indicates the modified object requirements for this conformance group.

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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 [# & * +< >].

1.1.A.5.6. DMS Configuration

As defined in NTCIP 1203.

1.1.A.5.7. MULTI Configuration

As defined in NTCIP 1203. The following list indicates the modified object requirements for this conformance group.

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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

1.1.A.5.8. Default Message Control

As defined in NTCIP 1203.

1.1.A.5.9. Pixel Service Control

As defined in NTCIP 1203.

1.1.A.5.10. MULTI Error Control

As defined in NTCIP 1203.

1.1.A.5.11. Illumination/Brightness Control

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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

1.1.A.5.12. Auxiliary I/O

1.1.A.5.13. 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

1.1.A.5.14. Sign Status

As defined in NTCIP 1203.

1.1.A.5.15. Status Error

As defined in NTCIP 1203.

1.1.A.5.16. Pixel Error Status

As defined in NTCIP 1203.

1.1.A.5.17. Fan Error Status

As defined in NTCIP 1203.

1.1.A.5.18. Power Status

As defined in NTCIP 1203.

1.1.A.5.19. Temperature Status

As defined in NTCIP 1203.

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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
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

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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.

21.2. 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.

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22. DMS ASSEMBLIES

22.1. DESCRIPTION

This section includes all design, fabrication, furnishing, and erection of the DMS assemblies, platforms, walkways, ladders for access to the DMS inspection doors, and attachment of the DMS enclosures to the structures in accordance with the requirements of these Project Special Provisions and the Project Plans. Fabricate the supporting DMS assemblies from tubular steel. Furnish pedestal type DMS assemblies as shown in the Project Plans. Cantilevered and monotube (horizontal truss) DMS structures will not be allowed.

For DMS assemblies, provide pedestal structures with a minimum of 25 feet clearance from the high point of the road to the bottom of the DMS enclosure. DMS assemblies must allow for field adjustment with shims (horizontal & vertical tilting) +/- 3 degrees of the DMS enclosure to ensure optimum legibility from all travel lanes.

For DMS assemblies, design the new DMS assemblies (including footings), access platforms, new walkway platforms, and access ladders and submit shop drawings for approval. 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.

Provide pedestal DMS structures with ladders, safety cages and maintenance platforms at the locations shown in the Project Plans.

The provisions of Section 900 of the *Standard Specifications* apply to all work covered by this section.

It is the Contractor's responsibility to provide DMS S-dimension elevation drawings for the DMS locations to the Engineer for approval.

22.2. MATERIAL

Use materials that meet the following requirements of the *Standard Specifications*:

Item	Section
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

22.3. CONSTRUCTION METHODS

A. General

Fabricate the new DMS assemblies 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.

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Drill bolt holes and slots to finished size. Holes may also be punched to finished size, provided the diameter of the punched holes are 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 Project 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,* Section 1076-6.

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 assembly hardware, brackets for supporting the DMS and the access platform. 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*" with the latest interim revisions.

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, 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

- 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 Revisions.
- The wind pressure map that is developed from the 3-second gust speeds, as provided in Article 3.8 of the *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 6th Edition, 2013*, and the latest Interim Specifications 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

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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 Project 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:

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

  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.

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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 walkway 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,*

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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.

2. DMS Maintenance Platform (Walkway)

Provide a maintenance platform (walkway), a minimum of three feet wide with open skid-resistant surface and safety railing on the DMS assemblies for access to the DMS inspection door. Provide platforms with fixed safety railings along both sides from the beginning of the platform to the inspection door.

Ensure the design, fabrication and installation of the access platforms on new DMS structures complies with the following:

1. The top of the platform grading surface is vertically aligned with the bottom of the DMS door.
2. The DMS door will open 90-degrees from its closed position without any obstruction from the platform or safety handrails.
3. The platform is rigidly and directly connected to the walkway brackets and there is no uneven surface between sections.
4. Install a 4” x 4” safety angle parallel to and along both sides of the platform and extend it the entire length of the platform. Design the safety angle to withstand loading equivalent to the platform.
5. Ensure the platform design allows full access to the DMS enclosure inspection door with no interference or obstructions.

3. DMS Access Ladder

Provide a fixed ladder, of the same material as the pedestal structures, leading to and ending at the access platform. Equip the ladder with a security cover (ladder guard) and lock to prohibit access by unauthorized persons. Furnish locks to operate with a Corbin #2 key and furnish two keys per lock. Design the rungs on 12-inch center to center typical spacing. Start the first ladder rung no more than 18 inches above the landing pad. Attach the security cover approximately 6 feet above the finished ground. Design the ladder and security cover as a permanent part of the DMS assembly and include complete design details in the DMS assembly shop drawings. Fabricate the ladder and cover to meet all OSHA requirements and applicable state and local codes, including but not limited to providing a ladder cage.

Furnish and install a level concrete pad a minimum of 4 inches deep, 24 inches wide, and 36 inches long to service as a landing pad for accessing the ladder. Design the landing pad to be directly below the bottom rung. Access to the ladder shall not be obstructed by the DMS foundation. Provide pre-formed or cast-in place concrete pads.

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22.4. MEASUREMENT AND PAYMENT

DMS Pedestal Structure will be measured and paid as the actual number of dynamic message sign assemblies furnished, installed, and accepted. Payment includes all design, fabrication, construction, transportation, and attachment of the complete dynamic message sign assemblies, supporting structure, hardware, access platform, direct tension indicators, preparing and furnishing shop drawings, additional documentation, incidentals, and all other equipment and features necessary to furnish the system described above.

DMS Access Ladder will be measured and paid as the actual number of DMS access ladders furnished, installed and accepted. Payment includes design, fabrication, transportation, and attachment to the DMS assembly and the concrete landing pad as described above.

Payment will be made under:

Pay Item	Pay Unit
DMS Pedestal Structure	Each
DMS Access Ladder	Each

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23. SOIL TEST

23.1. DESCRIPTION

Perform a soil test for each DMS foundation location according to the requirements described below.

It is assumed that all foundation designs will be drilled pier foundations unless site-specific soil test information does not allow for a drilled pier foundation design. If an alternative foundation design is required, notify the Engineer immediately. Prior approval from the Engineer is required to receive additional compensation for an alternate foundation design.

Design all custom foundations to carry the maximum capacity of each DMS structure.

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. Where poor soil is known to be present, it is advisable that the contractor receive approval for foundation designs before releasing poles for fabrication.

23.2. SOIL TEST

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.

The contractor-selected pole fabricator is responsible for determining if the addition of wing walls is necessary for the supporting foundations.

B. Soil Test

Perform a soil test at each proposed DMS pedestal location. Complete all required fill placement and excavation at each pedestal 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
- A total of 50 blows have been applied with < 3-in. penetration

Submit completed boring logs collected in accordance with these Project Special Provisions DMS load information to the contractor-selected pedestal fabricator to assist in the pedestal and foundation design.

Describe each DMS pedestal location along the project corridor in a manner that is easily discernible to both the contractor's designer and NCDOT reviewers. If a DMS pedestal is at an intersection, label the boring the "Intersection of *(Route or SR #)*, *(Street Name)* and *(Route or SR #)*, *(Street Name)*, _____ County. Label borings with "B- *N, S, E, W, NE, NW, SE or SW*" corresponding to the quadrant location within the intersection.

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Pedestal numbers should be made available to the geotechnical drilling Contractor. Include pedestal numbers in the boring label if they are available. If they are not available, ensure the boring labels can be cross-referenced to corresponding pedestal numbers or pedestal locations.

For each boring, submit a legible (hand written or typed) boring log signed and sealed 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, and a general description of the soil types encountered.

Borings that can't be easily related to their specific pedestal location will be returned to the contractor for clarification, or if approved by the Engineer, the foundation may be designed using the worst case soil condition obtained as part of this project.

23.3. MEASUREMENT AND PAYMENT

Soil test will be measured and paid as the actual number of Soil Tests with SPT borings drilled, furnished and accepted.

Payment will be made under:

Pay Item	Pay Unit
Soil Test	Each

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24. FOUNDATIONS AND ANCHOR ROD ASSEMBLIES FOR METAL POLES

24.1. DESCRIPTION

Foundations for metal poles include foundations for signals, cameras, overhead and dynamic message signs (DMS) and high mount and 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 foundations for signal pedestals; see Section 1743 of the *2018 Standard Specifications* and Standard Drawing No. 1743.01 of the *2018 Roadway Standard Drawings*.

24.2. MATERIAL

Refer to the *2018 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 *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:

connect.ncdot.gov/resources/Geological/Pages/Products.aspx

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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 nominal thickness of at least 1/4". Galvanize anchor rods and exposed nuts and washers in accordance with Article 1076-4 of the *2018 Standard Specifications*. It is not necessary to galvanize nuts, plates and washers embedded in concrete.

24.3. CONSTRUCTION METHODS

Install the required size and number of conduits in foundations in accordance with the Project Plans and accepted submittals. Construct top of piers, footings, pedestals, grade beams and wings flat, level and within 1" of elevations shown in the Project Plans or approved by the Engineer. Provide an Ordinary Surface finish in accordance with Subarticle 825-6(B) of the *2018 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 Project Plans. Install piers with tip elevations no higher than shown in the Project 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 *2018 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.

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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 the required slurry properties at all times 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 *2018 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 *2018 Standard Specifications*. A drilled pier will be considered defective in accordance with Subarticle 411-5(D) of the *2018 Standard Specifications* and drilled pier acceptance is based in part on the criteria in Article 411-6 of the *2018 Standard Specifications* except for the top of pier tolerances in Subarticle 411-6(C) of the *2018 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

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411-6 of the *2018 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 Project Plans, accepted submittals and Section 410 of the *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 Project Plans and in accordance with Section 825 of the *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 *Standard Specifications*. Proper compaction around footings and wings is critical for foundations to resist uplift and torsion forces.

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 Project 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 Project Plans. If leveling nuts and washers are not in full contact with the template, replace washers with galvanized beveled washers.

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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 checking top nuts for these structures. Check that top nuts meet the following torque requirements:

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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.

24.4. MEASUREMENT AND PAYMENT

Foundations 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 *Standard Specifications*. No payment will be made for remediation of unacceptable drilled piers or post repair testing

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25. DYNAMIC MESSAGE SIGN FOUNDATIONS

25.1. 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 *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals*, 6th Edition, 2013, including the latest interim specifications.

25.2. MATERIALS

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°F,
- 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 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.

C. Sign Foundation Designs

Design sign foundations for the wind zone and clearances shown in the foundation design 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 5th Edition of the *AASHTO Standard Specifications for Structural Supports for Highway*

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Signs, Luminaries and Traffic Signals, 6th Edition, 2013, including the latest interim specifications. 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, Luminaries and Traffic Signals*, 5th Edition, 2009, including the latest interim specifications.

Submit boring logs, if any, working drawings and design calculations for acceptance in accordance with Article 105-2 of the *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.

25.3. 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.

25.4. MEASUREMENT AND PAYMENT

DMS Foundation will be measured and paid in cubic yards of concrete for footings, pedestals, drilled piers, grade beams and wings shown on the accepted submittals. The contract unit price for *DMS Foundation* 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 *Standard Specifications*.

Payment will be made under:

Pay Item	Pay Unit
DMS Foundation	Cubic Yards

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26. ETHERNET SWITCHES

26.1. DESCRIPTION

Furnish and install managed Ethernet switches as specified below that are fully compatible, interoperable, and completely interchangeable and functional within the existing Division traffic signal system communications network as called for in the Project Plans and these Project Special Provisions.

26.2. MATERIALS

A. General

Furnish Ethernet switches that comply with the following electrical safety requirements: UL60950 or CSA C22.2 No. 60950 (safety requirements for IT equipment) and FCC Part15 Class A for EMI emissions.

B. Ethernet Edge Switch

Furnish and install a hardened, field Ethernet edge switch (hereafter "edge switch") for CCTV cameras and DMS in the field equipment cabinets as shown in the Project Plans and as described in these Project Special Provisions for the successful integration of the field devices into the Division 13 Traffic Services office . Ensure that the edge switch provides wire-speed, fast Ethernet connectivity at transmission rates of 100 megabits per second from each remote ITS device location to the routing switches.

Contact the Division to arrange for the programming of the new Edge Switches with the necessary network configuration data, including but not limited to, the Project IP Address, Default Gateway, Subnet Mask and VLAN ID information. Provide a minimum five (5) days working notice to allow the Division to program the new devices.

Ensure that the edge switch is fully compatible and interoperable with the trunk Ethernet network interface and that the edge switch supports half and full duplex Ethernet communications.

Furnish an edge switch 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 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.

Furnish Ethernet edge switches that are DIN rail mounted and come equipped with hardware to permit mounting in an EIA 19" equipment rack.

Furnish Ethernet edge switches that weigh no more than 15 lbs. and are no more than 250 cubic inches in volume.

1. Standards

Ensure that the edge switch complies 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 802.1Q standard for port-based virtual local area networks (VLANs);

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- IEEE 802.1P standard for Quality of Service (QoS);
- IEEE 802.1w standard for MAC bridges used with the Rapid Spanning Tree Protocol (RSTP);
- IEEE 802.1s standard for MAC bridges used with the Multiple Spanning Tree Protocol;
- 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;
- IFC 2236 regarding IGMP v2 compliance;
- IEEE 802.1AB Link Layer Discovery Protocol (LLDP);
- IEEE 802.3ad Ethernet Link Aggregation;
- IEEE 802.3i for 10BASE-T (10 Mbit/s over Fiber-Optic);
- IEEE 802.3ab for 1000BASE-T (1Gbit/s over Ethernet); and
- IEEE 802.3z for 1000BASE-X (1 Gbit/s Ethernet over Fiber-Optic).

2. Functional

Ensure that the edge 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.
- 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 & 3 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).

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- 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-1 & RMON-2) of the Ethernet agent.
- Support of the TFTP and SNTP. Ensure that the Ethernet edge switch supports port mirroring for troubleshooting purposes when combined with a network analyzer.

3. Physical Features

Ports: Provide 10/100/1000 Mbps auto-negotiating ports (RJ-45) copper Fast 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 Type LC connectors for the optical ports, as specified in the Project Plans or by the Engineer. Do not use mechanical transfer registered jack (MTRJ) type connectors.

Provide an edge switch having a minimum of two optical 100/1000 Base X ports capable of transmitting data at 100/1000 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. Ensure that the optical ports have an optical power budget of at least 15 dB.

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

*Port Security***:** Ensure that the edge switch supports/complies with the following (remotely) minimum requirements:

- Ability to configure static MAC addresses access;
- Ability to disable automatic address learning per ports; know 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 manually reset the port before communications are allowed.

4. Management Capabilities

Ensure that the edge 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 802.1 D standards;
- An RSTP healing/convergence rate that meets or exceeds specifications published in the IEEE 802.1w standard;

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- 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, 148,800 packets per second for 100 megabits per second and 1,488,000 packets per second for 1000 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 & 3 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; and
- Support of the Simple Network Management Protocol (SNMP). 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).

Network Capabilities: Provide an edge switch that supports/complies with the following minimum requirements:

- Provide full implementation of IGMPv2 snooping (RFC 2236);
- Provide full implementation of SNMPv1, SNMPv2c, and/or SNMPv3;
- Provide support for the following RMON–I groups, at a minimum:
  - Part 1: Statistics
  - Part 2: History
  - Part 3: Alarm
  - Part 9: Event
- Provide support for the following RMON–2 groups, at a minimum:
  - Part 13: Address Map
  - Part 16: Layer Host
  - Part 17: Layer Matrix
  - Part 18: User History
- 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;
- Password manageable;
- 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 an edge switch that supports/complies with the following (remotely) minimum network security requirements:

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- 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-1&2) 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.

5. Electrical Specifications

Ensure that the edge switch operates and power is supplied with 115 volts of alternating current (VAC). Ensure that the edge switch has 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 switch has diagnostic light emitting diodes (LEDs), including link, TX, RX, speed (for Category 5E ports only), and power LEDs.

6. Environmental Specifications

Ensure that the edge switch performs all of the required functions during and after being subjected to an ambient operating temperature range of -30 degrees to 165 degrees Fahrenheit as defined in the environmental requirements section of the NEMA TS 2 standard, with a noncondensing humidity of 0 to 95%.

Provide certification that the device has successfully completed environmental testing as defined in the environmental requirements section of the NEMA TS 2 standard. Provide certification that the device meets the vibration and shock resistance 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 switch shall meet or exceed the following environmental standards:

- IEEE 1613 (electric utility substations)
- IEC 61850-3 (electric utility substations)
- IEEE 61800-3 (variable speed drive systems)
- IEC 61000-6-2 (generic industrial)
- EMF – FCC Part 15 CISPR (EN5502) Class A

7. Ethernet Patch Cable

Furnish a factory pre-terminated/pre-connectorized Ethernet patch cable with each edge switch. Furnish Ethernet patch cables meeting the following physical requirements:

- Five (5)-foot length
- Category 5e or better
- Factory-installed RJ-45 connectors on both ends

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- Molded anti-snag hoods over connectors
- Gold plated connectors

Furnish Fast Ethernet patch cords meeting the following minimum performance requirements:

- TIA/EIA-568-B-5, Additional Transmission Performance Specifications for 4-pair 100 Ω Enhanced Category 5 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: 10dB
- Propagation Delay: 548 nsec

26.3. CONSTRUCTION METHODS

A. General

Furnish media access control (MAC) addresses for all equipment utilized as part of this project. Affix MAC Address label to each device utilized. Furnish IP addresses for all equipment utilized as part of this project. Affix final IP address each device utilized. Use labels that do not smear or fade.

B. Ethernet Edge Switch

Ensure that the edge switch is UL listed.

Install and integrate all Ethernet edge switches at field locations as called for in Project Plans.

In CCTV camera field equipment cabinets, fully integrate new Ethernet edge switches with CCTV cameras, and in DMS field equipment cabinets, fully integrate new Ethernet edge switches with DMS controllers.

Provide inline surge protection for all Ethernet connections in field cabinets.

Verify that network/field/data patch cords meet all ANSI/EIA/TIA requirements for Category 5E and Category 6 four-pair unshielded twisted pair cabling with stranded conductors and RJ45 connectors.

Contact the Signal Shop a minimum of 5 days prior to installation for the most current edge switch IP Address, VLAN, subnet mask, default gateway and configuration files.

Mount the edge switch inside each field cabinet by securely fastening the edge switch to the upper end of the right rear vertical rail of the equipment rack 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 has connectors on both ends, primarily used for interconnecting termination or patching facilities and/or equipment.

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26.4. MEASUREMENT AND PAYMENT

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

No separate measurement will be made for Ethernet patch cable, power cord, mounting hardware, nuts, bolts, brackets, or edge switch programming as these will be considered incidental to furnishing and installing the edge switch.

Payment will be made under:

Pay Item	Pay Unit
Ethernet Edge Switch	Each

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27. INTEGRATION AND CONFIGURATION

27.1. DESCRIPTION

Install and fully integrate new central equipment at the Division 13 Traffic Services Office. Fully configure existing central hardware and software at the Division 13 Traffic Services Office to establish communications with new CCTV and DMS devices.

Coordinate the working hours and building access for all central configuration activities with the Engineer.

27.2. CENTRAL INTEGRATION

Furnish media access control (MAC) addresses for all equipment utilized as part of this project. Affix MAC Address label to each device utilized. Furnish IP addresses for all equipment utilized as part of this project. Affix final IP address each device utilized. Use labels that do not smear or fade.

Configure the existing Ethernet switch and ports as required to establish communications to field Ethernet switches and CCTV cameras.

Configure the existing CCTV server to recognize the new CCTV units and process the video and control data for sharing with the Division 13 Traffic Services Office.

Configure the existing DMS server to recognize the new DMS units and process control data for sharing with the Division 13 Traffic Services Office.

27.3. CENTRAL CONFIGURATION

The existing DMS central software that controls the DMS units at the Division 13 Traffic Services Office is Daktronics Vanguard. Modify the existing DMS central software configuration at the Division 13 Traffic Services Office to display and map the new DMS units in the software GUI. Ensure that the software also allows for full communications and control of the DMS unit.

The existing CCTV central software that controls the existing video matrix switch at the Division 13 Traffic Services Office is Protronix's VideoPro. This software includes on-screen pan-tilt-zoom controls of each camera in the system. Modify the Protronix CCTV central software configuration at the Division 13 Traffic Services Office to display and map the new CCTV devices so that the CCTV video can be displayed on the existing monitors and display devices at the Division 13 Traffic Services Office.

27.4. MEASUREMENT AND PAYMENT

Integration and configuration will be measured and paid as a lump sum price. This item shall include the installation, testing, and all materials, equipment, labor, tools, storage, shipping, and incidentals necessary to complete the integration and configuration of CCTV and DMS devices with the existing systems at the Division 13 Traffic Services Office.

All cabling, labeling, sockets, or other accessories required to configure, integrate, and interconnect computer equipment shall be considered incidental and shall not be paid for separately.

All central equipment installed for communications to new CCTV and DMS units will be measured and paid for under the applicable Section of these Project Special Provisions.

Payment will be made under:

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Pay Item	**Pay Unit**
Integration and Configuration	Lump Sum

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28. TESTING & ACCEPTANCE

28.1. GENERAL TEST PROCEDURE

Test the CCTV camera and DMS systems in a series of design approval and functional tests. The results of each test must meet the specified requirements. These tests shall 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 Department, to incorporate all design changes necessary to pass the required tests.

Provide 4 copies of all test procedures and requirements to the Engineer for review and approval at least 30 days prior to the testing start date.

Use only 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, and
- 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 system functions properly even after the Engineer accepts the CCTV camera and DMS test results.

Provide 4 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.

28.2. DESIGN APPROVAL TESTS

A. DMS System

Design Approval Tests are applicable to DMS systems not currently on the Department's 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

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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.

B. CCTV Camera System

No design approval test is required.

28.3. COMPATIBILITY TESTS

A. DMS System

No compatibility test is required.

B. CCTV Camera System

Compatibility Tests are applicable to CCTV cameras and video encoders that the Contractor wishes to furnish but are of a different manufacturer or model series than the existing units in the field or existing units installed at the Division 13 Traffic Services Office. If required, the Compatibility Test shall be completed and accepted by the Engineer prior to approval of the material submittal.

The Compatibility Test shall be performed in a laboratory environment at a facility chosen by the Engineer based on the type of unit being tested. Provide notice to the Engineer with the material submitted that a Compatibility Test is requested. The notice shall include a detailed test plan that will show compatibility with existing equipment. The notice shall be given a minimum of 15 calendar days prior to the beginning of the Compatibility Test.

The Contractor shall provide, install, and integrate a full-functioning unit to be tested. The Department will provide access to existing equipment to facilitate these testing procedures. The Contractor is responsible for configuring proposed equipment at the Division 13 Traffic Operations Services Office and proving compatibility. The Engineer will determine if the Compatibility Test was acceptable for each proposed device.

28.4. OPERATIONAL FIELD TEST (ON-SITE COMMISSIONING)

A. DMS System

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:

1. 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:

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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, and

Verify that there are no exposed live terminals.

2. Continuity Tests

Check the wiring to assure it conforms to the requirements of these Project Special Provisions.

3. 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, and
- Verify detection of a power failure in the DMS enclosure and the report feature of the failure to the Control Software,
- Display IP address and web settings,
  - Verify that the IP address is not publicly accessible. Placing a display on a private network or VPN helps mitigate the lack of security,

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  - Disable the telnet, Web Interface, Web LCD, and ICMP (PING) interfaces,
  - Change the default password,
- Set the controller to enable a controller log file.

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.

B. CCTV Camera System

Perform the following local operational field tests at the camera assembly field site in accordance with the test plans. A laptop computer shall provide camera control and positioning. After installing the camera assembly, including the camera hardware, Ethernet edge switch, power supply, and connecting cables:

- 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,
- Verify installation of specified cables and connections between the camera, PTZ, Ethernet edge switch, and control cabinet,
- Perform the CCTV camera assembly manufacturer's initial power-on test in accordance with the manufacturer's recommendation,
- Set the VLAN, IP address, default gateway and subnet mask for the camera and Ethernet edge switch,
- Verify the presence and quality of the video image with a portable NTSC-approved monitor,
- 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,
- Interconnect the communication interface device with the communication network's assigned fiber-optic trunk cable and verify that there is a transmission LED illuminated, and
- Verify that the CCTV camera's built-in digital video Ethernet encoder is properly encoding its video signal.

Approval of Operational Field Test results does not relieve the Contractor to conform to the requirements in these Project Special Provisions. If the CCTV camera system does not pass these

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tests, document a correction or substitute a new unit as approved by the Engineer. Re-test the system until it passes all requirements.

28.5. 30-DAY OBSERVATION PERIOD

The 30-Day Observation Period shall not be considered part of work to be completed by the project completion date.

Upon successful completion of all project work, the component tests, the System Test, and the correction of all deficiencies, including minor construction items, the 30-day Observation Period may commence. This observation consists of a 30-day period of normal, day-to-day operations of the new field equipment in operation with the new central equipment without any failures. The purpose of this period is to ensure that all components of the system function in accordance with the Project Plans and these Project Special Provisions.

Respond to system or component failures (or reported failures) that occur during the 30-day Observation Period within twenty-four (24) hours. Correct said failures within forty-eight (48) hours. Any failure that affects a major system component as defined below for more than forty-eight (48) hours will suspend the timing of the 30-day Observation Period beginning at the time when the failure occurred. After the cause of such failures has been corrected, timing of the 30-day Observation Period will resume. System or component failures that necessitate a redesign of any component or failure in any of the major system components exceeding a total of three (3) occurrences will terminate the 30-day Observation Period and cause the 30-day Observation Period to be restarted from day zero when the redesigned components have been installed and/or the failures corrected. The major system components are:

- DMS Field Controller and Display Module,
- CCTV Camera, PTZ, and built-in digital video Ethernet encoder, and

28.6. FINAL ACCEPTANCE

Final system acceptance is defined as the time when all work and materials described in the Project 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 30-day observation period has been successfully completed.

The project will be ready for final acceptance upon the satisfactory completion of all tests detailed in this Section of the Project Special provisions; the rectification of all punch-list discrepancies; and the submittal of all project documentation.

28.7. MEASUREMENT AND PAYMENT

There will be no direct payment for the work covered in this section.

Payment for this work will be covered in the applicable sections of these Project Special Provisions at the contract unit price for other items furnished on this Project.

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ST-1

Project I-4700 Buncombe County

Project Special Provisions
Structure

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HNTB North Carolina, PC.
343 E. Six Forks Rd.
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5/29/2019

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PROJECT SPECIAL PROVISIONS STRUCTURE

MAINTENANCE AND PROTECTION OF TRAFFIC (SPECIAL) BENEATH PROPOSED STRUCTURE AT STATION 27+36.45 -Y13-

1.0 GENERAL

Maintain traffic on I-26 as shown in Traffic Control Plans and as directed by the Engineer.

Provide a minimum temporary vertical clearance of 17'-0" at all times during construction.

Submit plans and calculations for review and approval for protecting traffic, as described herein, at the above station before beginning work at this location. Have the drawings and design calculations prepared, signed, and sealed by a North Carolina Registered Professional Engineer. The approval of the Engineer will not relieve the Contractor of the responsibility for the safety of the method or equipment.

2.0 PROTECTION OF TRAFFIC

Protect traffic from any operation that affords the opportunity for construction materials, equipment, tools, etc. to be dropped into the path of traffic beneath the structure. Based on Contractor means and methods determine and clearly define all dead and live loads for this system, which, at a minimum, shall be installed between beams or girders over any travelway or shoulder area where traffic is maintained. Install the protective system before beginning any construction operations over traffic. In addition, for these same areas, keep the overhang falsework in place until after the rails have been poured.

3.0 BASIS OF PAYMENT

Payment at the contract unit prices for the various pay items will be full compensation for the above work.

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MAINTENANCE AND PROTECTION OF TRAFFIC (8-13-04)
BENEATH PROPOSED STRUCTURE AT STATION 912+89.86-EBL-

1.0 GENERAL

Maintain traffic on Glenn Bridge Road as shown in Traffic Control Plans and as directed by the Engineer.

Provide a minimum temporary vertical clearance of 13'-11" at all times during construction.

Submit plans and calculations for review and approval for protecting traffic and bracing girders, as described herein, at the above station before beginning work at this location. Have the drawings and design calculations prepared, signed, and sealed by a North Carolina Registered Professional Engineer. The approval of the Engineer will not relieve the Contractor of the responsibility for the safety of the method or equipment.

2.0 PROTECTION OF TRAFFIC

Protect traffic from any operation that affords the opportunity for construction materials, equipment, tools, etc. to be dropped into the path of traffic beneath the structure. Based on Contractor means and methods determine and clearly define all dead and live loads for this system, which, at a minimum, shall be installed between beams or girders over any travelway or shoulder area where traffic is maintained. Install the protective system before beginning any construction operations over traffic. In addition, for these same areas, keep the overhang falsework in place until after the rails have been poured.

3.0 BRACING GIRDERS

Brace girders to resist wind forces, weight of forms and other temporary loads, especially those eccentric to the vertical axis of the member during all stages of erection and construction. Before casting of intermediate diaphragms, decks, or connecting steel diaphragms do not allow the horizontal movement of girders to exceed ½ inch.

4.0 BASIS OF PAYMENT

Payment at the contract unit prices for the various pay items will be full compensation for the above work.

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MAINTENANCE AND PROTECTION OF TRAFFIC (8-13-04)
BENEATH PROPOSED STRUCTURE AT STATION 913+34.69-WBL-

1.0 GENERAL

Maintain traffic on Glenn Bridge Road as shown in Traffic Control Plans and as directed by the Engineer.

Provide a minimum temporary vertical clearance of 13'-9" at all times during construction.

Submit plans and calculations for review and approval for protecting traffic and bracing girders, as described herein, at the above station before beginning work at this location. Have the drawings and design calculations prepared, signed, and sealed by a North Carolina Registered Professional Engineer. The approval of the Engineer will not relieve the Contractor of the responsibility for the safety of the method or equipment.

2.0 PROTECTION OF TRAFFIC

Protect traffic from any operation that affords the opportunity for construction materials, equipment, tools, etc. to be dropped into the path of traffic beneath the structure. Based on Contractor means and methods determine and clearly define all dead and live loads for this system, which, at a minimum, shall be installed between beams or girders over any travelway or shoulder area where traffic is maintained. Install the protective system before beginning any construction operations over traffic. In addition, for these same areas, keep the overhang falsework in place until after the rails have been poured.

3.0 BRACING GIRDERS

Brace girders to resist wind forces, weight of forms and other temporary loads, especially those eccentric to the vertical axis of the member during all stages of erection and construction. Before casting of intermediate diaphragms, decks, or connecting steel diaphragms do not allow the horizontal movement of girders to exceed ½ inch.

4.0 BASIS OF PAYMENT

Payment at the contract unit prices for the various pay items will be full compensation for the above work.

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CONSTRUCTION, MAINTENANCE AND REMOVAL OF TEMPORARY ACCESS AT STATION 1163+08.56 **(SPECIAL)**

1.0 GENERAL

Construct, maintain, and remove the temporary access required to provide the working area necessary for construction of the new bridge, construction of the temporary detour structure, or for the removal of an existing bridge, as applicable. Temporary access may involve the use of a rock causeway [workpad], or other methods; however, all types of temporary access are required to meet the requirements of all permits, the Standard Specifications, and this Special Provision. Work bridges shall not be used. For additional requirements related to causeway construction, see the Biological Opinion, "I-26 Widening from US 25 Near Hendersonville to I-40/I-240 South of Asheville, Henderson and Buncombe Counties, North Carolina".

2.0 TEMPORARY ROCK CAUSEWAY [WORKPAD]

At the contractor's option, construction of a temporary rock causeway [workpad] within the limits shown in the contract documents is permitted. Build the causeway [workpad] with Class II riprap topped by a layer of Class B riprap or as otherwise designated on the plans or approved by the Engineer. If desired, recycle the Class II riprap used in the causeway [workpad] for placement in the final riprap slope protection as directed by the Engineer. No payment will be made for recycled riprap as this material is considered incidental to the causeway [workpad] placement and removal. If this option is exercised, no adjustment in contract bid price will be allowed due to an underrun in the quantity of "Rip Rap Class II (2'-0" Thick)".

Completely remove all causeway [workpad] material including pipes and return the entire causeway [workpad] footprint to the original contours and elevations within 90 days of the completion of the deck slab or as otherwise required by permits.

For sites affected by moratoriums or restrictions on in-stream work: Do not construct or remove causeway [workpad] during the moratorium period shown on the permit. If the completion of the deck slab falls within the prohibitive dates for causeway [workpad] construction or removal, begin causeway [workpad] removal immediately following the prohibitive dates.

3.0 BASIS OF PAYMENT

The lump sum price bid for "Construction, Maintenance and Removal of Temporary Access at Station 1163+08.56" will be full compensation for the above work, or other methods of access, including all material, pipes, work bridge components, equipment, tools, labor, disposal, and incidentals necessary to complete the work.

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APPLICATION OF BRIDGE COATING (SPECIAL)

GENERAL

This work consists of preparing and cleaning concrete and galvanized surfaces as well as furnishing and applying a colored base coating with a compatible anti-graffiti finish coating to the surfaces of the Airport Road Bridge (Henderson County #240) over I-26 described herein. The base coating and anti-graffiti coating shall be applied to all surfaces indicated on the plans or as directed by the Engineer and shall be applied only after the surface preparation specified herein has been completed, inspected and approved by the Engineer.

Alternate coating methods may be submitted for review and approval.

MATERIALS

The base coating shall be compatible with the anti-graffiti finish coating and must be designed specifically for coating galvanized surfaces or damp, uncured concrete. The coating material shall be delivered to the job site in sealed containers bearing the manufacturer's original labels. The brand, color, and type shall be clearly marked on each container. A copy of the manufacturer's Materials Safety Data Sheet and a copy of the manufacturer's printed instructions shall be presented to the Engineer at the time of delivery.

The coating material shall be stored in airtight, upright containers. The containers shall be stored in a dry location where the temperature remains above 40° F and less than 100° F.

The coating material shall have a shelf life of not less than 12 months. After application, the base coating shall be dry to the touch within 48 hours and shall achieve a final cure within 2 to 3 weeks under ideal conditions. After application, the anti-graffiti coating shall be dry to the touch within 1 hour and shall achieve a final cure within 3 hours.

The color of the base coating shall be in accordance with the Federal Standard 595. Colors and areas of application shall be as follows:

Superstructure

FS 26420 (Light Gray) or similar color approved by the Engineer shall be applied to the exterior face of the barrier rails, exterior vertical edges of deck and top edge of overhang from edge of deck to exterior face of barrier, and bottoms of exterior slab overhangs.

Substructure

FS 26420 (Light Gray) or similar color approved by the Engineer shall be applied to all exposed substructure elements including wingwalls, excluding top surfaces of bent and end bent caps. Backwalls at end bents need not be painted between girders.

The color of the anti-graffiti coating shall be clear after full cure.

Provide one gallon of graffiti remover, thinners, dryers and all necessary components recommended by the manufacturer to the North Carolina Department of Transportation Materials and Tests Unit, Chemical Testing Engineer.

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MATERIAL TESTING AND CERTIFICATION

Before coating material is applied, a Type 2 certification shall be supplied attesting that the product furnished is in accordance with the same formula as that previously subjected to the tests specified below and approved. Copies of the current tests reports shall be attached to the certification. Reports for tests made more than 4 years prior to shipment to the project site will not be accepted.

All testing shall be performed by a qualified commercial testing laboratory that has been approved by the North Carolina Department of Transportation Materials and Tests Unit.

The applied coating shall be subjected to and shall satisfy the requirements of the tests listed below, prior to use on the structure.

Freeze-Thaw

1. Three concrete specimens, not less than 4 inches by 6 inches by 6 inches, of the mix design for the structure shall be cast and cured. Fourteen days moist curing with a drying period at room temperature, 60° F to 80° F, for 24 hours will be required before applying the coating material to the specimens. Caution shall be taken that there be no excessive oil on specimen forms. The coating shall be applied to the sides of specimens at a spreading rate of 50 ± 10 square feet per gallon. Brush application will be permitted. Cementitious coatings shall be cured at room temperature and 30 percent relative humidity for 24 hours, at room temperature and 90 percent relative humidity for 48 hours, at room temperature and 50 percent relative humidity for 4 days for a total curing time of 7 days.

2. The specimens shall be immersed in water at room temperature for 3 hours, then removed.

3. The specimens shall be placed in cold storage at -15°F for 1 hour and then removed.

4. The specimens shall be thawed at room temperature for one hour.

5. Steps 3 and 4 shall be repeated for a total of 250 cycles. At the end of 250 cycles, the specimens shall show no visible defects.

Accelerated Weathering

Coating shall be subjected to a 7,500 hour exposure test in a Twin-Carbon-Arc-Weatherometer, ASTM G 23, Type D, at an opening temperature of 145° F. The test shall be made at 20-minute cycles consisting of 17 minutes of light and 3 minutes of water spray plus light. At the end of the exposure test, the exposed samples shall show no chipping, flaking, or peeling. The panels for this test shall be prepared by applying the coating at a spreading rate of 50 ± 10 square feet per gallon to both sides and edges of panels cut from asbestos cement shingles in accordance with Federal Specification SS-S-346, Type I. Curing time shall be in accordance with Freeze-Thaw Test curing time.

Fungus Growth Resistance

Coating shall pass a fungus resistance test in accordance with Federal Specification TT-P-29g. Fungus growth shall not be indicated after a minimum incubation period of 21 days.

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Abrasion Resistance

Coating shall pass the 2,000 litre sand abrasion test in accordance with Method 6191 Abrasion Resistance-Falling Sand, Federal Test Method Standard 141a, ASTM D968-81. The specimens for this test shall be prepared by applying the coating to a cleaned steel panel at a spreading rate of 50 ± 10 square feet per gallon. The specimens shall be cured at room temperature for 21 days.

Impact Resistance

Coating shall be applied to a concrete panel prepared according to Federal Test Method Standard 141a, Method 2051, at a spreading rate of 50 ± 10 square feet per gallon, and allowed to cure for 21 days at room temperature. The test shall then be run using the Gardner Mandrel Impact Tester in accordance with ASTM D 2794 using a one-half inch indenter with an impact load of 6 inch-pounds. The coating shall show no chipping under this impact load.

Salt-Spray Resistance

A concrete specimen shall be coated at the rate of 50 ± 10 square feet per gallon and cured for 21 days at room temperature. The coated specimen shall be exposed to a 5 percent salt solution in accordance with ASTM B 117 for 2,500 hours where the atmospheric temperature is maintained at 90° ± 2 °F. At the end of 2,500 hours of exposure, the coating shall show no ill effects, loss of adhesion, or deterioration.

Flexibility

A sheet metal specimen shall be coated at a rate of 50 ± 10 square feet per gallon and allowed to cure for 48 hours at room temperature. The coated specimen shall be bent 180 degrees over a one inch round mandrel. After bending, the coating shall show no breaking.

In addition to the certification and test reports required above, a service record shall be supplied showing that the coating material has a satisfactory service record on concrete and, when applicable, galvanized surfaces for a period of not less than 5 years prior to the date of submission of the service record. The coating shall also have shown satisfactory service characteristics without peeling, chipping, flaking, and non-uniform change in texture or color. The structure for the specific product shall be named in the service record.

In addition to the above requirements, each batch delivered to the project shall be sampled and tested for color and the following product analysis data submitted:

(a) Weight per gallon

(b) Viscosity in Kreb units

(c) Weight percent pigment

(d) Weight percent vehicle solids

(e) Infrared spectra of vehicle solution

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(f) Drying time

SURFACE PREPARATION

Prepare concrete surfaces and galvanized surfaces in accordance with Section 420-17(B) and Section 442-13 of the Standard Specifications, respectively, or the manufacturer's recommendations, whichever is more restrictive. All surfaces to be coated shall be free of efflorescence, flaking coatings, dirt, oil, curing compounds, release agents and other deleterious substances prior to the application of the coating.

Concrete curing compounds and release agents must be removed. Water blasting will be allowed; however, the blasting operation must not remove or damage the concrete.

Prior to application of the coating, all concrete surfaces to be coated shall be sprayed with water. If the water soaks into the concrete surfaces, the coating may be applied once all surfaces dry. If the water beads up and is repelled, the surfaces require further cleaning before application of the coating.

APPLICATION

The coating application, including equipment used, shall be in accordance with the manufacturer's recommendations. The coating shall be applied by qualified personnel with previous experience similar to the work outlined in the contract plans.

The material shall be thoroughly mixed in its original container and shall not be thinned. Containers with coatings that have formed skins shall not be permitted for use.

The base coating may be applied over damp, but not wet concrete surfaces and shall be applied at a rate of 50 ± 10 square feet per gallon. The application rate shall produce a uniform color texture. The base coating shall be applied only when the ambient temperature is between 40° F and rising, and 100° F. It shall not be applied over frozen surfaces or if rain is imminent. If a freshly applied surface is damaged by rain, re-coating may be necessary based on the Engineers assessment of the damage.

Schedule the application of the base coating as one of the final finishing operations or when construction-generated dust will be minimal. To prevent lap marks, a wet edge shall be maintained at all times. Stopping and starting in mid-sections will not be allowed. Start or end at natural breaks in the surface, i.e. at a panel edges, corners or joints. When applying the base coating with a roller, the material shall be applied in vertical strokes initially, cross rolled for even film and appearance, and then finished with vertical strikes.

Apply the anti-graffiti coating by brush, roller or airless spray when the ambient temperature is between 45° F and 90° F, and the surface temperature is between 50° F and 100° F. Ensure the surface is clean and dry before applying the anti-graffiti coating.

The coating shall be applied to the structure with due protection of the work and surroundings as required by Section 442-5 of the Standard Specifications.

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FINISHED PRODUCT

All coating material in the finished state shall be capable of accommodating the thermal and elastic expansion ranges of the concrete or, when applicable, galvanized surfaces without cracking.

The texture of the completed finish coat shall be similar to that of rubbed concrete. The completed finished coating shall be tightly bonded to the structure and present a uniform appearance and texture. Additional coats may be required by the Engineer in order to produce the desired surface texture and uniformity.

Coatings shall be entirely removed from the structure and reapplied if there is failure to positively adhere as evident by chipping, flaking, peeling, or the desired surface appearance is not achieved.

The average thickness of the completed finish coating shall not exceed 1/8 of an inch. The minimum dry film thickness of the anti-graffiti coating shall be 2.0 mils.

BASIS OF PAYMENT

The bridge coating will be paid for at the contract lump sum price bid for "Application of Bridge Coating." Price and payment shall be full compensation for surface preparation, furnishing and applying the materials, labor, equipment and any incidentals necessary to complete this work.

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STEEL REINFORCED ELASTOMERIC BEARINGS **(6-22-16)**

The 2018 Standard Specifications shall be revised as follows:

In **Section 1079-2(A) – Elastomeric Bearings** add the following after the second paragraph:

Internal holding pins are required for all shim plates when the contract plans indicate the structure contains the necessary corrosion protection for a corrosive site.

Repair laminated (reinforced) bearing pads utilizing external holding pins via vulcanization. Submit product data for repair material and a detailed application procedure to the Materials and Tests Unit for approval before use and annually thereafter.

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DISC BEARINGS (2-3-14)

1.0 GENERAL

This item consists of furnishing, fabrication and installation of disc bearings in accordance with AASHTO LRFD Bridge Design Specifications, the Standard Specifications, the recommendations of the manufacturer, the details shown on the plans and as specified herein. Disc Bearings consist of a polyether urethane structural element (elastomeric disc) confined by upper and lower steel bearing plates. Equip disc bearings with a shear restriction mechanism (shear pin) to prevent movement of the disc. Supply disc bearings as fixed bearings and guided expansion bearings as designated by the Contract Documents.

Fixed disc bearings allow rotation but no longitudinal or transverse movement in the bearing plane. Fixed bearings consist of a steel sole plate, an elastomeric disc, a shear pin, a steel upper bearing plate, a steel lower bearing plate, a steel masonry plate, a preformed bearing pad, anchor bolts, nuts and washers.

Guided expansion disc bearings allow rotation and only longitudinal movement in the bearing plane. Guided expansion disc bearings consist of a steel sole plate, a polished stainless steel sheet welded to the bottom of the sole plate within the sliding region, a steel upper bearing plate, a layer of virgin polytetrafluoroethylene (PTFE) material bonded to the top and sides of the upper plate within the sliding regions, guide bars welded to the bottom of the sole plate surrounding the sliding region to restrict transverse movement, polished stainless steel sheets welded to the sides of the guide bars within the sliding regions, an elastomeric disc, a shear pin, a steel lower bearing plate, a steel masonry plate, a preformed bearing pad, anchor bolts, nuts, washers, pipe sleeves, a closure plate, grout and various sizes of standard pipe, and any other necessary material as detailed on the plans. Align the stainless steel sheet on the bottom of the sole plate with the PTFE material on the top of the upper bearing plate. Align the PTFE material on the sides of the upper bearing plate with the stainless steel sheets on the sides of the guide bars.

2.0 MATERIALS

Use disc bearings produced by the same manufacturer.

Use AASHTO M270 Grade 50W (345W) or Grade 50 (345) for all steel plates except the stainless steel sheets in the disc bearings. Clean, coat, and seal the plates in the disc bearing assemblies except for the areas with special facings and the areas that come in contact with the elastomer disc, in accordance with the Special Provision for “Thermal Sprayed Coatings (Metallization)”. The surfaces shall be coated to a thickness of 8 mils minimum on all external parts. Repair surfaces that are abraded or damaged after the application of metallizing in accordance with the Special Provision for “Thermal Sprayed Coatings (Metallization)”.

Provide anchor bolts and nuts in accordance with the Standard Specifications.

When the maximum plan dimension of the sheet is 12" or less, provide a stainless steel sheet in expansion disc bearings that is at least 16 gage or 1/16". When the maximum plan dimension is greater than 12", provide a stainless steel sheet that is at least 11 gage or 1/8".

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Ensure that all stainless steel sheets are in conformance with ASTM A240/A167 Type 304 and polished to a minimum #8 mirror surface finish.

Blast clean the surfaces of the steel sole plate and the steel guide bars that will be attached to the stainless steel sheets to a near white condition in accordance with the Standard Specifications. Position and clamp the back of the stainless steel sheets in contact with the steel sole plate and the steel guide bars. Apply the stainless steel sheets to the blast cleaned surfaces of the steel sole plate and the steel guide bars as soon as possible after blasting and before any visible oxidation of the blast cleaned surfaces occurs. Weld the stainless steel sheets continuously around the perimeter using a tungsten inert gas, wire-fed welder.

For the PTFE sheets bonded to the top and side sliding surfaces of the steel upper bearing plate, used as mating surfaces for the stainless steel sheets attached to the steel sole plate and the guide bars, provide an unfilled virgin PTFE sheet (recessed) or a glass-fiber filled PTFE sheet, resulting from skiving billets formed under hydraulic pressure and heat. Provide resin that conforms to the requirements of ASTM D4894 or D4895.

To bond the PTFE sheets and the steel upper bearing plate, use heat cured high temperature epoxy capable of withstanding temperature of –320°F to 500°F.

Weld the guide bars in expansion bearings to the bottom of the sole plate. Alternatively, integrate the guide bars and sole plate from the same piece of steel, ensuring that the required dimensions are provided. Provide 1/16” clearances between the stainless steel sheets attached to the side sliding surfaces of the guide bars and the PTFE sheet attached to the side sliding surface of the steel upper bearing plate.

Mold the polyether urethane structural element (elastomeric disc) from a polyether urethane compound. The top and bottom surfaces of the disc shall be roughened. Ensure that the physical properties of the polyether urethane conform to the following requirements:

Physical Property	ASTM Test Method	Requirements Min.	Max.
Hardness, Type D Durometer	D2240	60	64
Tensile Stress psi At 100% elongation At 200% elongation	D412	 2000 3700	- - - -
Tensile Strength psi	D412	5000	- - - -
Ultimate Elongation %	D412	220	- - - -
Compression Set % 22 hrs. at 158°F	D395	- - - -	40

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3.0 DESIGN

Design the disc bearings for the loads and movements shown on the contract plans. However, use the anchor bolt size, length, spacing and masonry plate thickness as shown on the contract plans and provide an overall bearing height within ½ inch of the bearing assembly height shown on the contract plans. Either combine and cast the sole plate and upper bearing plate (for fixed bearings), the sole plate and guide bars (for expansion bearings), and the lower bearing plate and masonry plate (for fixed and expansion bearings) as a single unit or weld together prior to the installation of the disc.

Ensure access and removal of anchor bolt nut is not in conflict with the upper bearing plate, guide bars or sole plate.

When designing the bearings, use the following allowable bearing stresses:

- On polyether urethane structural element: 5000 psi
- On PTFE Sliding Surface, filled or unfilled PTFE (recessed): 3500 psi

Submit eight sets of shop drawings and one set of design calculations for review, comments and acceptance. Have a North Carolina Registered Professional Engineer check and seal the shop drawings and design calculations.

After the Engineer reviews the drawings and, if necessary, corrections are made, submit one 22" x 34" reproducible set of the working drawings.

4.0 SAMPLING AND TESTING

A. Sampling

The manufacturer is responsible for randomly selecting and testing sample bearings from completed lots of bearings. The manufacturer is also responsible for certifying that the completed bearings and their components have been tested and are in compliance with the requirements of this Special Provision. The manufacturer shall furnish the results of the tests to the Materials and Tests Engineer.

B. Testing

1. Proof Load Test

   Load a test bearing to 150% of the bearing's rated design capacity and simultaneously subject it to a rotational range of 0.02 radians (1.146°) for a period of 1 hour.

   Have the bearing visually examined both during the test and upon disassembly after the test. Any resultant visual defects, such as extruded or deformed elastomer or PTFE, damaged seals or rings, or cracked steel is cause for rejection.

   Keep continuous and uniform contact between the polyether urethane element and the bearing plates and between the stainless steel sheets and the PTFE sheets (for

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expansion bearings) for the duration of the test. Any observed lift-off or separation is cause for rejection.

2. Sliding Coefficient of Friction

   For all guided expansion bearings, measure the sliding coefficient of friction at the bearing's design capacity in accordance with the test method described below, and on the fifth and fiftieth cycles, at a sliding speed of 1 in/min.

   Calculate the sliding coefficient of friction as the horizontal load required to maintain continuous sliding of one bearing, divided by the bearing's vertical design capacity.

   The test results are evaluated as follows:

   - A maximum measured sliding coefficient of friction of 3%.
   - A visual examination both during and after the test. Any resultant visual defects, such as bond failure, physical destruction, cold flow of PTFE to the point of debonding, or damaged components is cause for rejection of the lot.

   Using undamaged test bearings in the work is permitted.

3. Test Method

   The test method and equipment shall meet the following requirements:

   a. Arrange the test to determine the coefficient of friction on the first movement of the manufactured bearing.

   b. Clean the bearing surface prior to testing.

   c. Conduct the test at maximum working stress for the PTFE surface with the test load applied continuously for 12 hours prior to measuring friction.

   d. Determine the first movement static and dynamic coefficient of friction of the test bearing at a sliding speed of less than 1 in/min, not to exceed:

      0.04 unfilled PTFE

      0.08 filled PTFE

   e. Subject the bearing specimen to 100 movements of at least 1 inch of relative movement and, if the test facility permits, the full design movement at a speed of less than 1 ft/min. Following this test determine the static and kinetic coefficient of friction again. The specimen is considered a failure if it exceeds the values measured in (d) above or if it shows any signs of bond failure or other defects.

   Bearings represented by test specimens passing the above requirements are approved for use in the structure subject to on-site inspection for visible defects.

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5.0 INSTALLATION

Store disc bearings delivered to the bridge site upright and under cover on a platform above the ground surface. Protect the bearings from injury at all times and, before placing the bearings, dry and clean all dirt, oil, grease or other foreign substances from the bearing. Do not disassemble the bearings during installation, except at the manufacturer's direction. Lift bearing assemblies by their bottom surfaces only, unless lifting brackets that have been designed and approved by the manufacturer are used. Ensure that the polyether urethane disc is not exposed to direct flame or sparks. Place the bearings in accordance with the recommendations of the manufacturer, Contract Drawings, and as directed by the Engineer. If there is any discrepancy between the recommendations of the manufacturer, Special Provisions, and Contract Drawings, the Engineer is the sole judge in reconciling any such discrepancy.

Provide preformed bearing pads under the masonry plates in accordance with Article 1079-1 of the Standard Specifications.

Do not install any bearing before the Engineer approves it.

6.0 BASIS OF PAYMENT

Payment for all disc bearings will be at the lump sum contract price bid for "Disc Bearings" which includes full compensation for furnishing all disc bearings, labor, materials, tools, equipment, testing and incidentals required to complete the work in accordance with the Standard Specifications, this Special Provision, the manufacturer's requirements and as directed by the Engineer.

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THERMAL SPRAYED COATINGS (METALLIZATION) (12-1-17)

1.0 DESCRIPTION

Apply a thermal sprayed coating (TSC) and sealer to metal surfaces in accordance with the Thermal Sprayed Coatings (Metallization) Program and as specified herein when called for on the plans or by other Special Provisions. Use only Arc Sprayed application methods to apply TSC. The Engineer must approve other methods of application.

The Thermal Sprayed Coatings (Metallization) Program is available on the Materials and Tests Unit website.

2.0 QUALIFICATIONS

Only use NCDOT approved TSC Contractors meeting the requirements outlined in the Thermal Sprayed Coatings (Metallization) Program.

3.0 MATERIALS

Use only materials meeting the requirements of Section 7 of the Thermal Sprayed Coatings (Metallization) Program.

4.0 SURFACE PREPARATION AND TSC APPLICATION

Surface preparation of TSC surfaces shall meet the requirements of Section 8 of the Thermal Sprayed Coatings (Metallization) Program. Apply TSC with the alloy to the thickness specified on the plans or as required by Thermal Sprayed Coatings (Metallization) Program.

5.0 INSPECTION AND TESTING

The TSC Contractor must conduct inspections and tests listed in the Thermal Sprayed Coatings (Metallization) Program.

6.0 REPAIRS

Perform all shop repairs in accordance with the procedures outlined in the Thermal Sprayed Coatings (Metallization) Program.

Repairs associated with field welding shall be made by removing the existing metallizing by blast or power tool cleaning. Affected areas shall be addressed as follows:

- For Marine Environments, incorporate a minimum surface preparation in accordance with SSPC SP-11 (Power Tool Cleaning to Bare Metal) and require an approved epoxy mastic coating applied in accordance with the manufacturer's recommendation. Apply a minimum of two (2) coats at a rate of 5-7 (WFT) per coat to the affected area.

- For Non-Marine Environments, incorporate a minimum surface preparation in accordance with SSPC SP-11 (Power Tool Cleaning to Bare Metal) and require an approved organic

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zinc-rich coating applied in accordance with the manufacturer's recommendation. Apply a minimum of two (2) coats at a rate of 5-7 (WFT) per coat to the affected area.

1. Minor localized areas less than or equal to 0.1 ft^2 with exposed substrate shall be repaired as outlined above for marine and non-marine environments.

2. Large localized areas greater than 0.1 ft^2 with exposed substrate shall require the Contractor to submit a detailed repair procedure to the Engineer for review and approval.

- Repair methods for areas where the substrate has not been exposed shall be mutually agreed upon between the Contractor and TSC Contractor as approved by the Engineer.

7.0 TWELVE MONTH OBSERVATION PERIOD

All TSC materials applied under the Thermal Sprayed Coatings (Metallization) Program shall be evaluated twelve (12) months after project acceptance for defective materials and workmanship.

8.0 BASIS OF PAYMENT

The contract price bid for the metal component to which the TSC is applied will be full compensation for the thermal sprayed coating.

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EXPANSION JOINT SEALS (9-30-11)

1.0 GENERAL

The work covered by this Special Provision consists of furnishing and installing the expansion joint seals as shown on the contract drawings. All materials, labor, equipment and incidentals necessary for the proper installation of the expansion joint seals are included.

2.0 MATERIAL

Provide expansion joint seals capable of accommodating a total movement measured parallel to the centerline of the roadway as shown on plans.

Provide an elastomeric component for each expansion joint seal that is a continuous unit for the entire length of the joint. Do not field splice the elastomeric component. Only vulcanized shop splicing of the elastomeric component is permitted. The minimum length of an elastomeric component before shop splicing is 20 feet. However, one piece shorter than 20 feet is permitted. Provide an elastomeric component that is clearly shop marked to indicate the top side and joint location of the elastomeric component. On skewed bridges, or under unsymmetrical conditions, clearly mark the left side of the elastomeric component. Left is defined as being on the left when facing in the direction of increasing station. Inspect the seals upon receipt to ensure that the marks are clearly visible upon installation.

Make sure the convolution of the gland does not project above the top of the hold-down plates when the joint opening is in the most compressed condition. Use either elastic polychloroprene (neoprene) or ethyl propylene diene monomer (EPDM) for the elastomer that meets the following minimum properties:

	ASTM TEST METHOD	REQUIREMENTS
Hardness, Durometer - Shore A	D2240	60 ± 5, Neoprene (upward corrugated shape - fabric reinforced) 75 ± 5, EPDM and Neoprene (upward non-corrugated shape) 80 ± 5, EPDM (upward corrugated shape-fabric reinforced)
Tensile Strength	D412	2000 psi (min.)
Elongation at Break	D412	250% (min.)
Width of Gland in Relaxed Condition	N/A	10" ± 0.25"

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Thickness of Upturned portion of gland	N/A	0.25" non-corrugated shape, -0.032" to +0.032"
Thickness of Upturned portion of gland	N/A	0.1875" corrugated shape, -0.032" to +0.032"
Thickness of Flat portion of gland	N/A	0.1563", -0.032" to +0.032"

For fabric reinforced glands, submit one unreinforced sample per lot number, up to 500 feet of Expansion Joint Seal, to the Engineer for testing.

Only field splice hold-down plates at crown points, at abrupt changes in the deck slab cross slope, and on lane lines. Splicing within travel lanes is not permitted and splicing on edge lines is not required. Field splice hold-down plates between the edge line and gutter upturn and where necessary for proper installation and alignment is permitted. Show all splice locations on the working drawings for approval. For the location of lane markings at the expansion joint seal, see the Structure plans. At the splice locations, locate the hold-down bolts 3 inches from the end of the hold-down plate. At splice locations where changes in deck slab cross slope occur, cut the ends of hold-down plates parallel to the bridge centerline for skews less than 80° and greater than 100°.

Do not use welded shop splices in hold-down plates.

3.0 SHOP DRAWINGS

Submit nine sets of working drawings to the Engineer for review, comments and acceptance. Show complete details drawn to scale and include:

- The proposed template details including the makeup of the template
- The proposed method of holding the base angle assembly in place while concrete is cast around it
- The proposed procedure to correct for the effects of beam movement and rotation when setting width of joint opening
- The proposed chronology of installation including the sequence and direction of the concrete casting
- The details of cross connectors between base angles, such as steel bars with slots bolted to angles, to maintain evenness between the adjacent base angles while accommodating movement that occurs when concrete is cast. Indicate when bolts are loosened to allow movement.
- The proposed method for removing the hold-down plate
- A section detail through the joint showing horizontal offset dimensions of the base angles from the centerline joint. This detail is required when the vertical face of the joint opening is not perpendicular to the roadway surface (e.g. when the roadway grade is significant).

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Have someone other than the one who prepares the drawing check all detailed drawings and include the signatures of both the drafter and checker on each sheet of the drawings. The Engineer returns unchecked drawings to the Contractor. Provide all completed drawings well in advance of the scheduled installation time for the expansion joint seal.

4.0 INSTALLATION

Provide supports for the base angle assembly at a maximum spacing of 9 feet. Place supports near field splices of base angles to ensure that field splices are straight and even. Provide base angles with ½" diameter weep holes at 12 inch centers to allow bleeding of trapped air and/or water. Do not obstruct the weep holes with falsework. Make the bottom of the trough parallel to grade and the sides parallel to the sides of the expansion joint seal.

For damaged areas, depressions, spalls, cracks, or irregularities of curbs or decks adjacent to the expansion joint, submit a proposed method of repair and repair material specifications for approval.

If the Engineer deems any aspects of the expansion joint seals unacceptable, make necessary corrections.

5.0 INSPECTION

When concrete is cast, use a non-aluminum, 10 foot, true to line straight edge to check and grade the top of the slab on each side of the joint to ensure smooth transition between spans.

Watertight Integrity Test

- Upon completion of an expansion joint seal, perform a water test on the top surface to detect any leakage. Cover the roadway section of the joint from curb to curb, or barrier rail to barrier rail, with water, either ponded or flowing, not less than 1 inch above the roadway surface at all points. Block sidewalk sections and secure an unnozzled water hose delivering approximately 1 gallon of water per minute to the inside face of the bridge railing, trained in a downward position about 6 inches above the sidewalks, such that there is continuous flow of water across the sidewalk and down the curb face of the joint.
- Maintain the ponding or flowing of water on the roadway and continuous flow across sidewalks and curbs for a period of 5 hours. At the conclusion of the test, the underside of the joint is closely examined for leakage. The expansion joint seal is considered watertight if no obvious wetness is visible on the Engineer's finger after touching a number of underdeck areas. Damp concrete that does not impart wetness to the finger is not a sign of leakage.
- If the joint system leaks, locate the place(s) of leakage and take any repair measures necessary to stop the leakage at no additional cost to the Department. Use repair measures recommended by the manufacturer and approved by the Engineer prior to beginning corrective work.
- If measures to eliminate leakage are taken, perform a subsequent water integrity test subject to the same conditions as the original test. Subsequent tests carry the same

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responsibility as the original test and are performed at no extra cost to the Department.

6.0 BASIS OF PAYMENT

Basis of payment for all expansion joint seals will be at the lump sum contract price for "Expansion Joint Seals" which price and payment will be full compensation for furnishing all material, including any steel accessory plates for sidewalks, medians and rails, labor, tools, and incidentals necessary for installing the expansion joint seal in place and including all materials, labor, tools and incidentals for performing the original watertight integrity test.

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SECURING OF VESSELS **(10-12-01)**

Secure vessels in accordance with Section 107 of the Standard Specifications and the following provision.

When utilizing barges, tugboats or other vessels, take all necessary precautions to ensure that such vessels are securely anchored or moored when not in active operation. Take all necessary measures to ensure that the vessels are operated in a manner that avoids damage to or unnecessary contact with bridges and other highway structures and attachments. If severe weather conditions are anticipated, or should be anticipated through reasonable monitoring of weather forecasts, take additional measures to protect bridges and other highway structures and attachments from extreme conditions. The Contractor is strictly liable for damages to any bridge or other highway structure or attachment caused by a vessel owned or controlled by the Contractor. The Contractor is also liable to third parties for property damages and loss of revenue caused by vessels under the Contractor's control.

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SOUND BARRIER WALL (5-17-18)

1.0 DESCRIPTION

This work consists of furnishing precast panels with an architectural surface treatment, structural steel, concrete, handling, transporting, fabricating, galvanizing, storing materials, furnishing erection drawings, pile excavation, backfilling, erecting and installing the sound barrier wall members and all other materials as required by the plans, Standard Specifications and this Special Provision.

Precast panels with an architectural surface treatment shall be constructed using form lining materials and patterns to match the appearance (size, shape, color, texture, pattern, and relief) of the textured finish as specified on the plans and approved by the Engineer.

The contractor is required to use the same form liner and coloration contractor to construct the precast panels with an architectural surface treatment.

The Standard Plans allow pile spacing of 10, 15 or 20 feet. Pile spacing greater than 15 feet will not be allowed for the precast concrete panels detailed in the standard plans. Provide consistent pile spacing for the entire length of the wall. Use odd pile spacing, if necessary, only at the ends of the wall and at turning points as approved by the Engineer. Architectural surface treatment shall not be applied to piles. Piles shall have a smooth, non-textured finish, and remain unstained in their natural color.

A maximum one foot drop or rise in elevation between wall sections is permitted. Elevation changes greater than one foot, if necessary, will be allowed only at the end of the wall. Top of wall elevation changes that result in a jagged appearance will not be allowed.

2.0 QUALIFICATIONS

Prior to beginning work the contractor shall submit the following qualifications to the Engineer for approval:

A. Architectural Surface Treatment Construction

The Contractor shall have a minimum of three years of experience in architectural concrete surface treatment construction on similar types of projects. The Contractor shall furnish to the Engineer 3 references who were responsible for supervision of similar projects. Include name, address, telephone number, and specific type of application.

B. Form Liners and Coloring System

The manufacturer of form liners for the standard textured finishes and coloring system shall have at least five years of experience making molds and color stains to create formed concrete surfaces to match the specified textured finish and colors. The Contractor shall schedule a pre-installation conference with a form liner manufacturer representative and the Engineer to assure understanding of simulated textured finish form liner use, color application, requirements for construction of sample panel(s), and to coordinate the work.

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The Contractor shall be required to disclose their source of form liner manufacturer and final coloration contractor prior to the Preconstruction Conference.

3.0 ALTERNATE PILE SPACING FOR STANDARD PRECAST PANELS

As an alternate, the Contractor may submit plans for pile spacings greater than 10 feet and less than 15 feet for review and approval. The pile excavation diameter, excavation depth and reinforcing steel shall be equal to the amount shown on the existing plans for the 15 feet pile spacing. A variance in the reinforcing steel will be allowed for the length of horizontal and number of vertical reinforcement bars in the precast panel for the alternate pile spacing.

Submit two sets of detailed plans for review. Include all details in the plans, including the size and spacing of required reinforcement necessary to fabricate the precast panels. Have a North Carolina registered Professional Engineer check, seal and date the plans. After the plans are reviewed and, if necessary, corrections made, submit one set of reproducible tracings on 22" x 34" sheets to become part of the contract plans.

4.0 ALTERNATE WALL TYPE

Walls that have been assigned "Approved" or "Approved for Provisional Use" status by the Product Evaluation Program will be considered for substitution to the detailed Standard Sound Barrier Wall only when noted on the plans. Alternate wall types, piles and pile spacing must meet the design and construction requirements of the project. Pile spacing greater than 20 feet will not be permitted. Alternate pile and wall structural stability and connection details shall conform to the current edition of the AASHTO LRFD Bridge Design Specifications.

Prior to submittal of Working Drawings, as described herein, submit a copy of the signed NCDOT Product Status Notification Letter and two sets of preliminary plans for review and approval. Include material specifications for all components. Once preliminary plans are approved, submit Working Drawings in accordance with all applicable portions of the requirements herein, including details necessary to fabricate and construct the proposed alternate.

Have a North Carolina registered Professional Engineer check, seal and date the plans and, when requested, provide calculations. After the plans are reviewed and, if necessary, corrections made, submit one set of reproducible tracings on 22" x 34" sheets to become part of the contract plans.

5.0 WORKING DRAWINGS

Submit precast panel casting drawings in accordance with Article 1077-2 of the Standard Specifications prior to casting. Show the inserts, method of handling, and support details used for transportation on the casting drawings. Submit fabrication drawings for approval prior to fabrication of wall components. Submit an erection plan and precast panel placing plan, including location of various heights of panels, for review and acceptance prior to fabrication of forms. Submit five sets of detail drawings on 22" x 34" sheets.

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Submit for review and acceptance, wall plan and elevation views and details showing overall simulated textured pattern, joint locations, and end, edge or other special conditions. The drawings should include typical cross sections of precast panels, joints, corners, texture relief, texture size, pitch/working line, mortar joint and bed depths. If necessary, the Contractor shall revise the working drawings until the proposed form liner patterns and arrangement have been accepted by the Engineer. Working drawings should be of sufficient scale to show the detail of all textured finishes and joint patterns. Shop drawings shall be reviewed and approved prior to fabrication of form liners.

6.0 MATERIALS AND FABRICATION OF STANDARD PRECAST PANELS

Provide materials and fabricate members in accordance with the requirements of Division 10 of the Standard Specifications for Roads and Structures. Provide precast panels 4 inches ± ¼ inch thick, excluding relief for a textured finish. Architectural surface treatment shall consist of a standard textured finish and a single color of stain applied to both faces of the precast panels as specified on the plans and approved by the Engineer. Relief of any texture is not to exceed an average depth of 1 inch. No textured finish or stain shall be applied on the uppermost foot of each wall segment and along the vertical edges of the panels. These areas shall have a smooth, non-textured finish, and remain in its natural concrete color.

Furnish three 12” x 12” samples for approval which establish the acceptable variations in color, texture, and uniformity. After the color, texture, and uniformity of the furnished samples are approved, produce a full scale panel unit meeting design requirements. This mock-up and the furnished samples establish the standard quality for determining acceptance of the panels. When producing the final installed panels, use fine and coarse aggregate, retarder, and cement from the same source as those used in the approved sample panels.

The standard textured finish shall be constructed using form lining materials. The form liner shall be a high quality, re-useable product manufactured of high strength urethane rubber or other approved material which attaches easily to the form work system, and shall not compress more than ¼ inch when concrete is poured at a rate of 10 vertical feet per hour. The form liners shall be removable without causing deterioration of the surface or underlying concrete.

The form liner shall be patterned such that long continuous horizontal or vertical lines do not occur on the finished exposed surface. The line pattern shall be random in nature and shall conceal construction joint lines.

Prior to each concrete pour, the form liners shall be clean and free of build-up. Each liner shall be visually inspected for blemishes and tears. Repairs shall be made in accordance with the manufacturer’s recommendations. Repairs shall be accepted by the Engineer before being used. Form liner panels that do not perform as intended or are no longer repairable shall be replaced.

Form liners shall be securely attached to forms in accordance with the manufacturer’s recommendations, with less than a ¼ inch seam. Blend form liner butt joints into the textured surface pattern and finish off the final concrete surface. Create no visible vertical or horizontal seams or conspicuous form liner butt joint marks. At locations where the form liners are joined, carefully blend to match the balance of the textured finish.

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Form liners shall be installed to withstand anticipated concrete placement pressures without leakage and without causing physical or visual defects.

When the approved textured finish requires simulated grout pattern joints, construct grout pattern joints to simulate the appearance of mortared joints produced in laid up masonry work. Grout pattern joints shall be produced in accordance with the form liner / concrete color system manufacturer.

The Contractor shall have a technical representative from the form liner manufacturer on site for technical supervision during the installation and removal of form liners. Unless directed by the Engineer, installation and removal of form liners shall not be permitted if the technical representative is not present.

Form release agent shall be a non-staining petroleum distillate free from water, asphaltic, and other insoluble residue, or an equivalent product and shall be applied in accordance with the manufacturer's recommendations. The form release agent shall be compatible with the form liner material, the concrete coloring system, any special surface finish and in accordance with this Special Provision. Form release agent should be worked into all areas, especially pattern recesses.

All form defects in finished uncolored surface shall be filled or repaired within 48 hours of form removal. Use patching materials and procedures in accordance with the manufacturer's recommendations.

Precast concrete shall be finished in accordance with the Standard Specifications, except that curing of concrete should been done to accommodate the application of coloring and surface finish treatment.

7.0 SURFACE COLORING

All surfaces that are to receive coloring agent application shall be free of all laitance, dirt, dust, grease, efflorescence, paint or any other foreign material prior to the application of coloring agent. Cleaning of surfaces to be accomplished by pressure washing with water set at 3,000 psi to remove laitance. The fan nozzle shall be held perpendicular to the surface at a distance of 1 to 2 feet. Sandblasting will not be permitted.

Surface coloring shall be achieved using an approved stain suitable for the purpose intended and applied in a manner consistent with the design intent of the project. Color system shall be a single color of stain in brown or gray tones as specified on the plans and approved by the Engineer. The approved sample panel shall be the basis for determining the appropriate stain application.

The coloring agent shall be a penetrating stain mix or other approved coloring system designed for exterior application on old or new concrete with field evidence of resistance to moisture, acid or alkali, mildew, mold or fungus discoloration or degradation. The coloring agent shall be breathable, allowing moisture and vapor transmission. Final coloring system and color of stain are subject to approval by the Engineer.

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Application of coloring/staining agent to finished precast concrete and patches shall occur at a minimum of 30 days after form liners are removed. Maintain the concrete temperature between 40°F and 85°F during color/stain application and for 48 hours after color/stain application. Consult the manufacturer's recommendations for preparation, application, curing, and storage of coloring agents/stains. The contractor shall provide a Color Application Artist who is experienced in producing realistic surface appearances. Treated surfaces located adjacent to exposed soil or pavement shall be temporarily covered to prevent dirt or soil splatter from rain.

Final surface shall be free of blemishes, discolorations, surface voids, and other irregularities. All patterns should be continuous without visual disruption. Linear butt joints shall be carefully blended into the approved pattern and finished off the final concrete surface. No visible vertical or horizontal seams or conspicuous form marks created by butt joining will be permitted.

Following the completion of all work, repairs of any damage made by other construction operations shall be made to the form lined and colored surfaces as directed by the Engineer.

8.0 CONSTRUCTION METHODS

Complete the final survey of existing ground profile after clearing the wall area but prior to submitting any working drawings. Submit the final groundline survey with the working drawings.

If the Department is responsible for the survey, the Engineer field verifies the existing ground profile along the sound barrier wall. Contact the Engineer to obtain the survey information. Otherwise, complete the existing ground survey prior to submittal of working drawings.

Excavate holes with the diameters shown on the plans. Perform pile excavation to the depths shown on the plans and install piles as shown on the plans or in the accepted submittals with a tolerance of ½ inch per foot from vertical. Backfill excavations with concrete after placing piles.

A. Pile Excavation

Use equipment of adequate capacity and capable of drilling through soil and non-soil including rock, boulders, debris, man-made objects and any other materials encountered. Blasting is not permitted to advance the excavation. Blasting for core removal is only permitted when approved by the Engineer. Dispose of drilling spoils in accordance with Section 802 of the Standard Specifications and as directed by the Engineer. Drilling spoils consist of all excavated material including water removed from the excavation either by pumping or drilling tools.

If unstable, caving or sloughing soils are anticipated or encountered, stabilize excavations with either slurry or steel casing. When using slurry, submit slurry details including product information, manufacturer's recommendations for use, slurry equipment information and written approval from the slurry supplier that the mixing water is acceptable before beginning drilling. When using steel casing, use either the sectional type or one continuous corrugated or non-corrugated piece. Steel casings should consist

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of clean watertight steel of ample strength to withstand handling and driving stresses and the pressures imposed by concrete, earth or backfill. Use steel casings with an outside diameter equal to the hole size and a minimum wall thickness of ¼ inch.

B. Concrete Placement

Before placing concrete, center and support the pile in the excavation and check the water inflow rate in the excavation after any pumps have been removed. If the inflow rate is less than 6 inches per half hour, remove any water and free fall the concrete into the excavation. Ensure that concrete flows completely around the pile. If the water inflow rate is greater than 6 inches per half hour, propose a concrete placement procedure to the Engineer. The Engineer shall approve the concrete placement procedure before placing concrete.

Fill the excavation with Class A concrete in accordance with Section 1000 of the Standard Specifications except as modified herein. Provide concrete with a slump of 6 to 8 inches. Use an approved high-range water reducer to achieve this slump. Place concrete in a continuous manner and remove all casings.

9.0 METHOD OF MEASUREMENT

The quantity of form liner textured finish and coloring stain to be paid for will be the actual square feet of architectural surface treatment that has been incorporated into the completed and accepted work. The area of architectural surface treatment will be measured by the area of treated panels. Do not include the uppermost foot of each wall segment, panel vertical edges without architectural surface treatment, or piles in the measurement. Area of sample panels shall not be included in the measurement of architectural surface treatment.

The quantity of sound barrier wall to be paid for will be the actual square feet of completed and accepted wall. In any individual section of sound barrier wall or in comparably dimensioned sections, the wall height is from the bottom of the bottom panel to the top of the top panel and the width is the distance between the centerline of the piles at the ends of the section. Include the full width of the piles at the ends of the wall.

10.0 BASIS OF PAYMENT

The quantity of sound barrier wall and architectural surface treatment, measured as provided above, will be paid for at the contract unit price bid per square foot.

The unit price bid per square foot for “Sound Barrier Wall” will be full compensation for work covered by this Special Provision including, but not limited to, furnishing precast panels, steel or concrete piles, miscellaneous structural steel, concrete, and all other materials; handling, transporting, fabricating, galvanizing, and storing materials; furnishing erection drawings, backfilling, pile excavation including any casing or slurry, and erecting and installing the sound barrier wall members.

The unit price bid per square foot for “Architectural Surface Treatment” will be full compensation for the architectural treatment covered by this Special Provision including, but not limited to, furnishing architectural detail drawings, sample panels; the construction,

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finishing, and removal of all equipment, materials, labor, and incidentals necessary for furnishing and use of all form liners to produce approved textured finish and application of approved surface coloring.

Payment will be made under:

Sound Barrier Wall..... Square Foot

Architectural Surface Treatment.…….Square Foot

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FALSEWORK AND FORMWORK (4-5-12)

11.0 DESCRIPTION

Use this Special Provision as a guide to develop temporary works submittals required by the Standard Specifications or other provisions; no additional submittals are required herein. Such temporary works include, but are not limited to, falsework and formwork.

Falsework is any temporary construction used to support the permanent structure until it becomes self-supporting. Formwork is the temporary structure or mold used to retain plastic or fluid concrete in its designated shape until it hardens. Access scaffolding is a temporary structure that functions as a work platform that supports construction personnel, materials, and tools, but is not intended to support the structure. Scaffolding systems that are used to temporarily support permanent structures (as opposed to functioning as work platforms) are considered to be falsework under the definitions given. Shoring is a component of falsework such as horizontal, vertical, or inclined support members. Where the term "temporary works" is used, it includes all of the temporary facilities used in bridge construction that do not become part of the permanent structure.

Design and construct safe and adequate temporary works that will support all loads imposed and provide the necessary rigidity to achieve the lines and grades shown on the plans in the final structure.

12.0 MATERIALS

Select materials suitable for temporary works; however, select materials that also ensure the safety and quality required by the design assumptions. The Engineer has authority to reject material on the basis of its condition, inappropriate use, safety, or nonconformance with the plans. Clearly identify allowable loads or stresses for all materials or manufactured devices on the plans. Revise the plan and notify the Engineer if any change to materials or material strengths is required.

13.0 DESIGN REQUIREMENTS

A. Working Drawings

Provide working drawings for items as specified in the contract, or as required by the Engineer, with design calculations and supporting data in sufficient detail to permit a structural and safety review of the proposed design of the temporary work.

On the drawings, show all information necessary to allow the design of any component to be checked independently as determined by the Engineer.

When concrete placement is involved, include data such as the drawings of proposed sequence, rate of placement, direction of placement, and location of all construction joints. Submit the number of copies as called for by the contract.

When required, have the drawings and calculations prepared under the guidance of, and sealed by, a North Carolina Registered Professional Engineer who is knowledgeable in temporary works design.

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If requested by the Engineer, submit with the working drawings manufacturer's catalog data listing the weight of all construction equipment that will be supported on the temporary work. Show anticipated total settlements and/or deflections of falsework and forms on the working drawings. Include falsework footing settlements, joint take-up, and deflection of beams or girders.

As an option for the Contractor, overhang falsework hangers may be uniformly spaced, at a maximum of 36 inches, provided the following conditions are met:

Member Type (PCG)	Member Depth, (inches)	Max. Overhang Width, (inches)	Max. Slab Edge Thickness, (inches)	Max. Screed Wheel Weight, (lbs.)	Bracket Min. Vertical Leg Extension, (inches)
II	36	39	14	2000	26
III	45	42	14	2000	35
IV	54	45	14	2000	44
MBT	63	51	12	2000	50
MBT	72	55	12	1700	48

Overhang width is measured from the centerline of the girder to the edge of the deck slab.

For Type II, III & IV prestressed concrete girders (PCG), 45-degree cast-in-place half hangers and rods must have a minimum safe working load of 6,000 lbs.

For MBT prestressed concrete girders, 45-degree angle holes for falsework hanger rods shall be cast through the girder top flange and located, measuring along the top of the member, 1'-2 ½" from the edge of the top flange. Hanger hardware and rods must have a minimum safe working load of 6,000 lbs.

The overhang bracket provided for the diagonal leg shall have a minimum safe working load of 3,750 lbs. The vertical leg of the bracket shall extend to the point that the heel bears on the girder bottom flange, no closer than 4 inches from the bottom of the member. However, for 72-inch members, the heel of the bracket shall bear on the web, near the bottom flange transition.

Provide adequate overhang falsework and determine the appropriate adjustments for deck geometry, equipment, casting procedures and casting conditions.

If the optional overhang falsework spacing is used, indicate this on the falsework submittal and advise the girder producer of the proposed details. Failure to notify the Engineer of hanger type and hanger spacing on prestressed concrete girder casting drawings may delay the approval of those drawings.

Falsework hangers that support concentrated loads and are installed at the edge of thin top flange concrete girders (such as bulb tee girders) shall be spaced so as not to exceed 75% of the manufacturer's stated safe working load. Use of dual leg hangers (such as Meadow Burke HF-42 and HF-43) are not allowed on concrete girders with thin top flanges. Design the falsework and forms supporting deck slabs and overhangs on girder

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bridges so that there will be no differential settlement between the girders and the deck forms during placement of deck concrete.

When staged construction of the bridge deck is required, detail falsework and forms for screed and fluid concrete loads to be independent of any previous deck pour components when the mid-span girder deflection due to deck weight is greater than ¾".

Note on the working drawings any anchorages, connectors, inserts, steel sleeves or other such devices used as part of the falsework or formwork that remains in the permanent structure. If the plan notes indicate that the structure contains the necessary corrosion protection required for a Corrosive Site, epoxy coat, galvanize or metalize these devices. Electroplating will not be allowed. Any coating required by the Engineer will be considered incidental to the various pay items requiring temporary works.

Design falsework and formwork requiring submittals in accordance with the 1995 AASHTO *Guide Design Specifications for Bridge Temporary Works* except as noted herein.

1. Wind Loads

   Table 2.2 of Article 2.2.5.1 is modified to include wind velocities up to 110 mph. In addition, Table 2.2A is included to provide the maximum wind speeds by county in North Carolina.

Table 2.2 - Wind Pressure Values

Height Zone feet above ground	Pressure, lb/ft^2 for Indicated Wind Velocity, mph				
	70	80	90	100	110
0 to 30	15	20	25	30	35
30 to 50	20	25	30	35	40
50 to 100	25	30	35	40	45
over 100	30	35	40	45	50

2. Time of Removal

   The following requirements replace those of Article 3.4.8.2.

   Do not remove forms until the concrete has attained strengths required in Article 420-16 of the Standard Specifications and these Special Provisions.

   Do not remove forms until the concrete has sufficient strength to prevent damage to the surface.

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Table 2.2A - Steady State Maximum Wind Speeds by Counties in North Carolina

COUNTY	25 YR (mph)	COUNTY	25 YR (mph)	COUNTY	25 YR (mph)
Alamance	70	Franklin	70	Pamlico	100
Alexander	70	Gaston	70	Pasquotank	100
Alleghany	70	Gates	90	Pender	100
Anson	70	Graham	80	Perquimans	100
Ashe	70	Granville	70	Person	70
Avery	70	Greene	80	Pitt	90
Beaufort	100	Guilford	70	Polk	80
Bertie	90	Halifax	80	Randolph	70
Bladen	90	Harnett	70	Richmond	70
Brunswick	100	Haywood	80	Robeson	80
Buncombe	80	Henderson	80	Rockingham	70
Burke	70	Hertford	90	Rowan	70
Cabarrus	70	Hoke	70	Rutherford	70
Caldwell	70	Hyde	110	Sampson	90
Camden	100	Iredell	70	Scotland	70
Carteret	110	Jackson	80	Stanley	70
Caswell	70	Johnston	80	Stokes	70
Catawba	70	Jones	100	Surry	70
Cherokee	80	Lee	70	Swain	80
Chatham	70	Lenoir	90	Transylvania	80
Chowan	90	Lincoln	70	Tyrell	100
Clay	80	Macon	80	Union	70
Cleveland	70	Madison	80	Vance	70
Columbus	90	Martin	90	Wake	70
Craven	100	McDowell	70	Warren	70
Cumberland	80	Mecklenburg	70	Washington	100
Currituck	100	Mitchell	70	Watauga	70
Dare	110	Montgomery	70	Wayne	80
Davidson	70	Moore	70	Wilkes	70
Davie	70	Nash	80	Wilson	80
Duplin	90	New Hanover	100	Yadkin	70
Durham	70	Northampton	80	Yancey	70
Edgecombe	80	Onslow	100		
Forsyth	70	Orange	70		

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B. Review and Approval

The Engineer is responsible for the review and approval of temporary works' drawings.

Submit the working drawings sufficiently in advance of proposed use to allow for their review, revision (if needed), and approval without delay to the work.

The time period for review of the working drawings does not begin until complete drawings and design calculations, when required, are received by the Engineer.

Do not start construction of any temporary work for which working drawings are required until the drawings have been approved. Such approval does not relieve the Contractor of the responsibility for the accuracy and adequacy of the working drawings.

14.0 CONSTRUCTION REQUIREMENTS

All requirements of Section 420 of the Standard Specifications apply.

Construct temporary works in conformance with the approved working drawings. Ensure that the quality of materials and workmanship employed is consistent with that assumed in the design of the temporary works. Do not weld falsework members to any portion of the permanent structure unless approved. Show any welding to the permanent structure on the approved construction drawings.

Provide tell-tales attached to the forms and extending to the ground, or other means, for accurate measurement of falsework settlement. Make sure that the anticipated compressive settlement and/or deflection of falsework does not exceed 1 inch. For cast-in-place concrete structures, make sure that the calculated deflection of falsework flexural members does not exceed 1/240 of their span regardless of whether or not the deflection is compensated by camber strips.

A. Maintenance and Inspection

Inspect and maintain the temporary work in an acceptable condition throughout the period of its use. Certify that the manufactured devices have been maintained in a condition to allow them to safely carry their rated loads. Clearly mark each piece so that its capacity can be readily determined at the job site.

Perform an in-depth inspection of an applicable portion(s) of the temporary works, in the presence of the Engineer, not more than 24 hours prior to the beginning of each concrete placement. Inspect other temporary works at least once a month to ensure that they are functioning properly. Have a North Carolina Registered Professional Engineer inspect the cofferdams, shoring, sheathing, support of excavation structures, and support systems for load tests prior to loading.

B. Foundations

Determine the safe bearing capacity of the foundation material on which the supports for temporary works rest. If required by the Engineer, conduct load tests to verify proposed bearing capacity values that are marginal or in other high-risk situations.

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The use of the foundation support values shown on the contract plans of the permanent structure is permitted if the foundations are on the same level and on the same soil as those of the permanent structure.

Allow for adequate site drainage or soil protection to prevent soil saturation and washout of the soil supporting the temporary works supports.

If piles are used, the estimation of capacities and later confirmation during construction using standard procedures based on the driving characteristics of the pile is permitted. If preferred, use load tests to confirm the estimated capacities; or, if required by the Engineer conduct load tests to verify bearing capacity values that are marginal or in other high risk situations.

The Engineer reviews and approves the proposed pile and soil bearing capacities.

15.0 REMOVAL

Unless otherwise permitted, remove and keep all temporary works upon completion of the work. Do not disturb or otherwise damage the finished work.

Remove temporary works in conformance with the contract documents. Remove them in such a manner as to permit the structure to uniformly and gradually take the stresses due to its own weight.

16.0 METHOD OF MEASUREMENT

Unless otherwise specified, temporary works will not be directly measured.

17.0 BASIS OF PAYMENT

Payment at the contract unit prices for the various pay items requiring temporary works will be full compensation for the above falsework and formwork.

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SUBMITTAL OF WORKING DRAWINGS (6-28-17)

1.0 GENERAL

Submit working drawings in accordance with Article 105-2 of the *Standard Specifications* and this provision. For this provision, "submittals" refers to only those listed in this provision. The list of submittals contained herein does not represent a list of required submittals for the project. Submittals are only necessary for those items as required by the contract. Make submittals that are not specifically noted in this provision directly to the Engineer. Either the Structures Management Unit or the Geotechnical Engineering Unit or both units will jointly review submittals.

If a submittal contains variations from plan details or specifications or significantly affects project cost, field construction or operations, discuss the submittal with and submit all copies to the Engineer. State the reason for the proposed variation in the submittal. To minimize review time, make sure all submittals are complete when initially submitted. Provide a contact name and information with each submittal. Direct any questions regarding submittal requirements to the Engineer, Structures Management Unit contacts or the Geotechnical Engineering Unit contacts noted below.

In order to facilitate in-plant inspection by NCDOT and approval of working drawings, provide the name, address and telephone number of the facility where fabrication will actually be done if different than shown on the title block of the submitted working drawings. This includes, but is not limited to, precast concrete items, prestressed concrete items and fabricated steel or aluminum items.

2.0 ADDRESSES AND CONTACTS

For submittals to the Structures Management Unit, use the following addresses:

Via US mail:

Mr. B. C. Hanks, P. E.
State Structures Engineer
North Carolina Department
of Transportation
Structures Management Unit
1581 Mail Service Center
Raleigh, NC 27699-1581

Attention: Mr. J. L. Bolden, P. E.

Via other delivery service:

Mr. B. C. Hanks, P. E.
State Structures Engineer
North Carolina Department
of Transportation
Structures Management Unit
1000 Birch Ridge Drive
Raleigh, NC 27610

Attention: Mr. J. L. Bolden, P. E.

Submittals may also be made via email.

Send submittals to:

jlbolden@ncdot.gov (James Bolden)

Send an additional e-copy of the submittal to the following address:

eomile@ncdot.gov (Emmanuel Omile)

mrorie@ncdot.gov (Madonna Rorie)

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For submittals to the Geotechnical Engineering Unit, use the following addresses:

For projects in Divisions 1-7, use the following Eastern Regional Office address:

Via US mail:

Mr. Chris Kreider, P. E.
Eastern Regional Geotechnical Manager
North Carolina Department of Transportation
Geotechnical Engineering Unit
Eastern Regional Office
1570 Mail Service Center
Raleigh, NC 27699-1570

Via other delivery service:

Mr. Chris Kreider, P. E.
Eastern Regional Geotechnical Manager
North Carolina Department of Transportation
Geotechnical Engineering Unit
Eastern Regional Office
3301 Jones Sausage Road, Suite 100
Garner, NC 27529

Via Email: EastGeotechnicalSubmittal@ncdot.gov

For projects in Divisions 8-14, use the following Western Regional Office address:

Via US mail or other delivery service:

Mr. Eric Williams, P. E.
Western Regional Geotechnical Manager
North Carolina Department of Transportation
Geotechnical Engineering Unit
Western Regional Office
5253 Z Max Boulevard
Harrisburg, NC 28075

Via Email: WestGeotechnicalSubmittal@ncdot.gov

The status of the review of structure-related submittals sent to the Structures Management Unit can be viewed from the Unit's website, via the "Drawing Submittal Status" link.

The status of the review of geotechnical-related submittals sent to the Geotechnical Engineering Unit can be viewed from the Unit's website, via the "Geotechnical Construction Submittals" link.

Direct any questions concerning submittal review status, review comments or drawing markups to the following contacts:

Primary Structures Contact:	James Bolden	(919) 707 – 6408
	(919) 250 – 4082 facsimile	
	jlbolden@ncdot.gov	
Secondary Structures Contacts:	Emmanuel Omile	(919) 707 – 6451
	Madonna Rorie	(919) 707 – 6508

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Eastern Regional Geotechnical Contact (Divisions 1-7):
Chris Kreider (919) 662 – 4710
ckreider@ncdot.gov

Western Regional Geotechnical Contact (Divisions 8-14):
Eric Williams (704) 455 – 8902
ewilliams3@ncdot.gov

3.0 SUBMITTAL COPIES

Furnish one complete copy of each submittal, including all attachments, to the Engineer. At the same time, submit the number of hard copies shown below of the same complete submittal directly to the Structures Management Unit and/or the Geotechnical Engineering Unit.

The first table below covers "Structure Submittals". The Engineer will receive review comments and drawing markups for these submittals from the Structures Management Unit. The second table in this section covers "Geotechnical Submittals". The Engineer will receive review comments and drawing markups for these submittals from the Geotechnical Engineering Unit.

Unless otherwise required, submit one set of supporting calculations to either the Structures Management Unit or the Geotechnical Engineering Unit unless both units require submittal copies in which case submit a set of supporting calculations to each unit. Provide additional copies of any submittal as directed.

STRUCTURE SUBMITTALS

Submittal	Copies Required by Structures Management Unit	Copies Required by Geotechnical Engineering Unit	Contract Reference Requiring Submittal [1]
Arch Culvert Falsework	5	0	Plan Note, SN Sheet & "Falsework and Formwork"
Box Culvert Falsework [7]	5	0	Plan Note, SN Sheet & "Falsework and Formwork"
Cofferdams	6	2	Article 410-4
Foam Joint Seals [6]	9	0	"Foam Joint Seals"
Expansion Joint Seals (hold down plate type with base angle)	9	0	"Expansion Joint Seals"

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Expansion Joint Seals (modular)	2, then 9	0	"Modular Expansion Joint Seals"
Expansion Joint Seals (strip seals)	9	0	"Strip Seals"
Falsework & Forms [2] (substructure)	8	0	Article 420-3 & "Falsework and Formwork"
Falsework & Forms (superstructure)	8	0	Article 420-3 & "Falsework and Formwork"
Girder Erection over Railroad	5	0	Railroad Provisions
Maintenance and Protection of Traffic Beneath Proposed Structure	8	0	"Maintenance and Protection of Traffic Beneath Proposed Structure at Station ___"
Metal Bridge Railing	8	0	Plan Note
Metal Stay-in-Place Forms	8	0	Article 420-3
Metalwork for Elastomeric Bearings [4,5]	7	0	Article 1072-8
Miscellaneous Metalwork [4,5]	7	0	Article 1072-8
Disc Bearings [4]	8	0	"Disc Bearings"
Overhead and Digital Message Signs (DMS) (metalwork and foundations)	13	0	Applicable Provisions
Placement of Equipment on Structures (cranes, etc.)	7	0	Article 420-20
Precast Concrete Box Culverts	2, then 1 reproducible	0	"Optional Precast Reinforced Concrete Box Culvert at Station ___"
Prestressed Concrete Cored Slab (detensioning sequences) [3]	6	0	Article 1078-11
Prestressed Concrete Deck Panels	6 and 1 reproducible	0	Article 420-3
Prestressed Concrete Girder (strand elongation and detensioning sequences)	6	0	Articles 1078-8 and 1078-11
Removal of Existing Structure over Railroad	5	0	Railroad Provisions

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Revised Bridge Deck Plans (adaptation to prestressed deck panels)	2, then 1 reproducible	0	Article 420-3
Revised Bridge Deck Plans (adaptation to modular expansion joint seals)	2, then 1 reproducible	0	"Modular Expansion Joint Seals"
Sound Barrier Wall (precast items)	10	0	Article 1077-2 & "Sound Barrier Wall"
Sound Barrier Wall Steel Fabrication Plans [5]	7	0	Article 1072-8 & "Sound Barrier Wall"
Structural Steel [4]	2, then 7	0	Article 1072-8
Temporary Detour Structures	10	2	Article 400-3 & "Construction, Maintenance and Removal of Temporary Structure at Station ____"
TFE Expansion Bearings [4]	8	0	Article 1072-8

FOOTNOTES

1. References are provided to help locate the part of the contract where the submittals are required. References in quotes refer to the provision by that name. Articles refer to the *Standard Specifications*.
2. Submittals for these items are necessary only when required by a note on plans.
3. Submittals for these items may not be required. A list of pre-approved sequences is available from the producer or the Materials & Tests Unit.
4. The fabricator may submit these items directly to the Structures Management Unit.
5. The two sets of preliminary submittals required by Article 1072-8 of the *Standard Specifications* are not required for these items.
6. Submittals for Fabrication Drawings are not required. Submittals for Catalogue Cuts of Proposed Material are required. See Section 5.A of the referenced provision.
7. Submittals are necessary only when the top slab thickness is 18" or greater.

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GEOTECHNICAL SUBMITTALS

Submittal	Copies Required by Geotechnical Engineering Unit	Copies Required by Structures Management Unit	Contract Reference Requiring Submittal [1]
Drilled Pier Construction Plans [2]	1	0	Subarticle 411-3(A)
Crosshole Sonic Logging (CSL) Reports [2]	1	0	Subarticle 411-5(A)(2)
Pile Driving Equipment Data Forms [2,3]	1	0	Subarticle 450-3(D)(2)
Pile Driving Analyzer (PDA) Reports [2]	1	0	Subarticle 450-3(F)(3)
Retaining Walls [4]	1 drawings, 1 calculations	2 drawings	Applicable Provisions
Temporary Shoring [4]	1 drawings, 1 calculations	2 drawings	"Temporary Shoring" & "Temporary Soil Nail Walls"

FOOTNOTES

1. References are provided to help locate the part of the contract where the submittals are required. References in quotes refer to the provision by that name. Subarticles refer to the *Standard Specifications*.

2. Submit one hard copy of submittal to the Engineer. Submit a second copy of submittal electronically (PDF via email), US mail or other delivery service to the appropriate Geotechnical Engineering Unit regional office. Electronic submission is preferred.

3. The Pile Driving Equipment Data Form is available from:
https://connect.ncdot.gov/resources/Geological/Pages/Geotech_Forms_Details.aspx
See second page of form for submittal instructions.

4. Electronic copy of submittal is required. See referenced provision.

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CRANE SAFETY **(8-15-05)**

Comply with the manufacturer specifications and limitations applicable to the operation of any and all cranes and derricks. Prime contractors, sub-contractors, and fully operated rental companies shall comply with the current Occupational Safety and Health Administration regulations (OSHA).

Submit all items listed below to the Engineer prior to beginning crane operations involving critical lifts. A critical lift is defined as any lift that exceeds 75 percent of the manufacturer's crane chart capacity for the radius at which the load will be lifted or requires the use of more than one crane. Changes in personnel or equipment must be reported to the Engineer and all applicable items listed below must be updated and submitted prior to continuing with crane operations.

Crane Safety Submittal List

A. **Competent Person:** Provide the name and qualifications of the "Competent Person" responsible for crane safety and lifting operations. The named competent person will have the responsibility and authority to stop any work activity due to safety concerns.

B. **Riggers:** Provide the qualifications and experience of the persons responsible for rigging operations. Qualifications and experience should include, but not be limited to, weight calculations, center of gravity determinations, selection and inspection of sling and rigging equipment, and safe rigging practices.

C. **Crane Inspections:** Inspection records for all cranes shall be current and readily accessible for review upon request.

D. **Certifications:** **By July 1, 2006**, crane operators performing critical lifts shall be certified by NC CCO (National Commission for the Certification of Crane Operators), or satisfactorily complete the Carolinas AGC's Professional Crane Operator's Proficiency Program. Other approved nationally accredited programs will be considered upon request. All crane operators shall also have a current CDL medical card. Submit a list of anticipated critical lifts and corresponding crane operator(s). Include current certification for the type of crane operated (small hydraulic, large hydraulic, small lattice, large lattice) and medical evaluations for each operator.

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GROUT FOR STRUCTURES (12-1-17)

1.0 DESCRIPTION

This special provision addresses grout for use in pile blockouts, grout pockets, shear keys, dowel holes and recesses for structures. This provision does not apply to grout placed in post-tensioning ducts for bridge beams, girders, decks, end bent caps, or bent caps. Mix and place grout in accordance with the manufacturer's recommendations, the applicable sections of the Standard Specifications and this provision.

2.0 MATERIAL REQUIREMENTS

Unless otherwise noted on the plans, use a Type 3 Grout in accordance with Section 1003 of the Standard Specifications.

Initial setting time shall not be less than 10 minutes when tested in accordance with ASTM C266.

Construction loading and traffic loading shall not be allowed until the 3 day compressive strength is achieved.

3.0 SAMPLING AND PLACEMENT

Place and maintain components in final position until grout placement is complete and accepted. Concrete surfaces to receive grout shall be free of defective concrete, laitance, oil, grease and other foreign matter. Saturate concrete surfaces with clean water and remove excess water prior to placing grout.

4.0 BASIS OF PAYMENT

No separate payment will be made for "Grout for Structures". The cost of the material, equipment, labor, placement, and any incidentals necessary to complete the work shall be considered incidental to the structure item requiring grout.

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ASBESTOS ASSESSMENT FOR BRIDGE DEMOLITION AND RENOVATION ACTIVITIES **(12-30-15)**

1.0 INSPECTION FOR ASBESTOS CONTAINING MATERIAL

Prior to conducting bridge demolition or renovation activities, the Contractor shall thoroughly inspect the bridge or affected components for the presence of asbestos containing material (ACM) using a firm prequalified by NCDOT to perform asbestos surveys. The inspection must be performed by a N.C. accredited asbestos inspector with experience inspecting bridges or other industrial structures. The N.C. accredited asbestos inspector must conduct a thorough inspection, identifying all asbestos-containing material as required by the Environmental Protection Agency National Emission Standards for Hazardous Air Pollutants (NESHAP) Code of Federal Regulations (CFR) 40 CFR, Part 61, Subpart M.

The Contractor shall submit an inspection report to the Engineer, which at a minimum must include information required in 40 CFR 763.85 (a)(4) vi)(A)-(E), as well as a project location map, photos of existing structure, the date of inspection and the name, N.C. accreditation number, and signature of the N.C. accredited asbestos inspector who performed the inspection and completed the report. The cover sheet of the report shall include project identification information. Place the following notes on the cover sheet of the report and check the appropriate box:

___ ACM was found
___ ACM was not found

2.0 REMOVAL AND DISPOSAL OF ASBESTOS CONTAINING MATERIAL

If ACM is found, notify the Engineer. Compensation for removal and disposal of ACM is considered extra work in accordance with Article 104-7 of the Standard Specifications.

An Asbestos Removal Permit must be obtained from the Health Hazards Control Unit (HHCU) of the N.C. Department of Health & Human Services, Division of Public Health, if more than 35 cubic feet, 160 square feet, or 260 linear feet of regulated ACM (RACM) is to be removed from a structure and this work must be completed by a contractor prequalified by NCDOT to perform asbestos abatement. RACM is defined in 40 CFR, Part 61, Subpart M. Note: 40 CFR 763.85 (a)(4) vi)(D) defines ACM as surfacing, TSI and Miscellaneous which does not meet the NESHAP RACM.

3.0 DEMOLITION NOTIFICATION

Even if no ACM is found (or if quantities are less than those required for a permit), a Demolition Notification (DHHS-3768) must be submitted to the HHCU. Notifications and Asbestos Permit applications require an original signature and must be submitted to the HHCU 10 working days prior to beginning demolition activities. The 10 working day period starts based on the post-marked date or date of hand delivery. Demolition that does not begin as originally notified requires submission of a separate revision form HHCU 3768-R to HHCU. Reference the North Carolina Administrative Code, Chapter 10A, Subchapter 41C, Article .0605 for directives on revision submissions.

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Contact Information
Health Hazards Control Unit (HHCU)
N.C. Department of Health and Human Services
1912 Mail Service Center
Raleigh, NC 27699-1912
Telephone: (919) 707-5950
Fax: (919) 870-4808

4.0 SPECIAL CONSIDERATIONS

Buncombe, Forsyth, and Mecklenburg counties also have asbestos permitting and NESHAP requirements must be followed. For projects involving permitted RACM removals, both the applicable county and the state (HHCU) must be notified.

For demolitions with no RACM, only the local environmental agencies must be notified. Contact information is as follows:

Buncombe County
WNC Regional Air Pollution Control Agency
49 Mt. Carmel Road
Asheville, NC 28806
(828) 250-6777

Forsyth County
Environmental Affairs Department
537 N. Spruce Street
Winston-Salem, NC 27101
(336) 703-2440

Mecklenburg County
Land Use and Environmental Services Agency
Mecklenburg Air Quality
700 N. Tryon Street
Charlotte, NC 28202
(704) 336-5430

5.0 ADDITIONAL INFORMATION

Additional information may be found on N.C. asbestos rules, regulations, procedures and N.C. accredited inspectors, as well as associated forms for demolition notifications and asbestos permit applications at the N.C. Asbestos Hazard Management Program website:

www.epi.state.nc.us/epi/asbestos/ahmp.html

6.0 BASIS OF PAYMENT

Payment for the work required in this provision will be at the lump sum contract unit price for "Asbestos Assessment". Such payment will be full compensation for all asbestos inspections, reports, permitting and notifications.

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SILANE DECK TREATMENT (SPECIAL)

DESCRIPTION

This work consists of preparation of concrete bridge deck surfaces and the furnishing and application of alkylalkoxysilane (silane) penetrant sealers, with 100% solids, to seal bridge deck surfaces and cracks. Prepare the surface of the concrete deck and apply the silane bridge deck sealer in accordance with this special provision and as indicated on the plans, or as approved by the Engineer.

Work includes: bridge deck surface preparation, placement of silane deck sealer, and any incidentals necessary to complete the project, as specified or as indicated on the plans.

SUBMITTALS

Submit for approval the following requested items and any other relevant documents:

(A) A safety data sheet (SDS) for each shipment of the silane materials.

(B) Silane material information and manufacturer's written preparation and application instructions.

(C) Certification from an independent testing laboratory that the materials meet the requirements of these provisions. Do not incorporate these materials into the project until the Engineer has accepted and approved the certification for the material.

(D) The dates of manufacture of the silane materials, their lot numbers and date of shelf-life expiration for each lot number.

(E) A table indicating the likely cure time, in minutes, to allow vehicular traffic on the silane-treated deck surface. Provide time for the allowable ambient temperature range, in increments of 10º F.

(F) A work plan for each structure that includes estimated times for surface preparation and silane application.

MATERIAL DELIVERY AND STORAGE

Store at the site sufficient quantities of silane materials to perform the entire application.

Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact. Ensure that each container is clearly marked by the manufacturer with the following information:

(A) Manufacturer's name and address.

(B) Product name.

(C) Date of manufacture.

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(D) Expiration date.

(E) LOT identification number.

(F) Container serial number.

Provide the Engineer a certification from the manufacturer, confirming that the silane materials meet the requirements of this special provision. Do not incorporate these materials into the project until the Engineer has accepted and approved the certification for the material. Submit such certification for each LOT of material delivered to the project. In each certification, identify the serial or LOT numbers of the containers certified.

The Engineer may require samples from each LOT or container of materials delivered to the project or from containers at the point of use. When samples are required, furnish samples in accordance with the Engineer's instructions.

Store silane materials in unopened containers in a clean, dry area between 40° F and 90° F. Store containers in a manner that prevents leakage or spillage.

MANUFACTURER'S REPRESENTATIVE

Provide a manufacturer's representative on site for the duration of the surface preparation and silane application work, to provide expert assistance on surface preparation, storage, mixing, application, clean-up, and disposal of materials.

MATERIALS

Provide silane from a single manufacturer, and provide silane that conforms to requirements indicated in Table 1, below.

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Table 1

SILANE PROPERTIES

Property	Test Method	Requirement
Silane Content		100%
VOC content	EPA method 24	Less than 350 g/l
Surface Appearance after Application		Unchanged
Flash Point	ASTM D3278	140° F, minimum
Resistance to Chloride Ion Penetration	AASHTO T259 and T260	Less than: 0.52 pounds/yd^3(criteria of 1.5) at 1/2 inch level; 0.00 pounds/yd^3(criteria of 0.75) at 1 inch level
Water absorption test	ASTM C 642	0.50% maximum/48 hours;
Scaling resistance	ASTM C 672	(non-air-entrained concrete) 0 rating "No Scaling" (100 cycles)
NCHRP 244		
Water weight gain	Series II - cube test	85% reduction, minimum
Absorbed chloride		87% reduction, minimum
Absorbed chloride	Series IV - Southern	95% reduction, minimum

SURFACE PREPARATION

Prepare the surface of the concrete deck for application of the silane by diamond grinding in order to remove all existing asphalt, grease, slurry, oils, paint, dirt, striping, curing compound, rust, membrane, weak surface mortar, or any other contaminants that could interfere with the proper adhesion, penetration, and the curing of the silane material.

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Prepare a final surface that adheres to the following requirements:

(A) For areas to receive deck seal treatment, clean by diamond grinding. Select the travel speed of the equipment to provide a uniformly clean surface with a uniform profile. Remove striping to the maximum extent determined to be practical by the Engineer using up to three passes with diamond grinding, or other approved equipment. Do not expose cleaned surfaces to vehicular traffic unless approved by the Engineer. If the deck becomes contaminated before placing the silane deck sealer, shotblast or abrasive sandblast the contaminated areas to the satisfaction of the Engineer, at no additional cost.

(1) DIAMOND GRINDING

Diamond grind the full width of all lanes and shoulders in the direction of travel to within 18" of the exterior gutterlines and 2" of expansion joints or elastomeric concrete in expansion joint blockouts.

Diamond grinding shall be performed using a Boart Longyear PC 5000, a Target 3804 or an approved equal. Submit grinding equipment specifications to the Engineer for approval before any grinding is performed. Use a grinding machine capable of removing a minimum of 3 feet of width with each pass. In addition, hand grinding may be required to remove vertical steps between passes.

The ground surface shall consist of between 50 and 60 grooves per foot of width. The grooves shall be between 0.09" and 0.15" in width and 0.0625" in depth. The area between the grooves shall be between 0.06" and 0.13" in width. The final concrete texture shall be uniform.

Construct and operate the grinding machine such that it will not cause strain or damage to the deck surface, excessive ravels, aggregate fractures, spalls, or disturbance of transverse joints. Longitudinally grind the deck parallel to the roadway centerline.

Continuously remove all slurry or other debris resulting from the grinding operations by vacuum pick-up or other approved methods. Prevent the slurry from flowing into floor drains, onto the ground or into the body of water under the bridge. Dispose of all residues off the project.

Limit grinding such that the final reinforcement cover is not less than the plan cover minus ½ inch. In cases where this cannot be achieved, other corrective work may be required as directed by the Engineer.

(B) Prior to silane application, protect cracks on the concrete bridge deck from materials that can interfere with the penetration and the curing of the silane material. Just prior to placement of the silane, remove, by magnets and oil-free compressed air and vacuuming, any loose particles, such that no excess particles remain. The concrete deck shall be completely dry. Power washing will not be allowed.

(C) The silane manufacturer may suggest cleaning and preparation methods other than those detailed by this special provision. The Engineer must approve such alternative methods prior to implementation.

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SILANE APPLICATION

Test Area

(A) Test a small area of the surface (minimum 5 ft. by 5 ft.) before general application to ensure desired performance results, aesthetics, and application rates and to verify application technique. Allow 5–7 days for the product to react fully before evaluating. Application rates may vary depending on field conditions.

(B) Conduct at least one absorption test in the test area, using a Rilem Tube Test. Acceptable results are no loss of water in the Rilem tube over a period of 20 minutes. Adjust application to achieve required repellent performance.

(C) The manufacturer's representative shall assist the Contractor in determining the application rates. Use test applications on actual surfaces to determine accurate application rates. Extremely porous surfaces may require two coats of silane.

(D) Do not begin production application of silane until Engineer has approved the test area, including approval of aesthetics, color, texture, and appearance.

Application

Immediately before placing silane, all exposed surfaces shall be completely dry and blown clean with oil-free compressed air to remove any loose dust and debris. Apply silane as soon as practical after the exposed surfaces have been properly prepared and conditions are satisfactory:

(A) Stir material thoroughly before and during application.

(B) Apply silane with low-pressure spray or by flooding, followed by brooming or squeegeeing for even distribution, in accordance with manufacturer's instructions.

(C) Maintain operating pressures in sprayers used for application of the silane sealer material sufficiently low so that atomization or misting of the material does not occur.

(D) Begin the application of the silane at the lowest elevation and proceed upward, toward higher elevations, unless otherwise approved by the Engineer.

(E) Apply even distribution of silane. Avoid ponding of silane; take care when applying the silane, so that running or puddling does not occur.

(F) Apply silane in a single application to the concrete deck surface with enough material to saturate the surface. Remove excess material with a broom or squeegee and dispose of excess material appropriately. If a second coat is required, it should be applied "wet on wet" before first coat dries.

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(G) Application of sealant by spray methods will not be permitted when wind speeds are 20 mph or more, or if in the opinion of the Engineer, unsatisfactory results will be obtained. Other application methods or rescheduling will be required.

(H) Avoid application with hand pump sprayers. For small areas of silane application, the use of hand pump sprayers must be approved by the Engineer.

(I) Contractor shall protect from overspray all pedestrians, vehicles, plants and vegetation, and other areas not receiving silane application.

(J) Allow product to penetrate the bridge deck and dry, as required by the manufacturer, prior to opening to traffic.

LIMITATIONS OF OPERATIONS

(A) Prior to application of any silane sealer, cure concrete or concrete repairs for a minimum of 21 days.

(B) Do not use silane material after the shelf life date.

(C) Do not return unused material in opened containers to storage for later use. Either apply such material to appropriate areas on concrete deck surfaces or remove and appropriately dispose of it at offsite locations provided by the Contractor.

(D) If expansion joints are not being replaced or have been replaced prior to diamond grinding, they shall be protected from damage from the diamond grinding operation. Deck drains and areas of curb or railing above the proposed surface shall be protected from the diamond grinding operation.

(E) If shotblasting is required after diamond grinding, thoroughly clean the deck. Pick up and store all blast media and contaminants in a vacuum unit. Do not create dust during the blasting operation that will obstruct the view of motorists in adjacent roadways. Store, handle, and dispose of blast media and contaminants in accordance with all applicable local, state, and federal requirements.

(F) Cover deck joint seal and elastomeric material, plug deck drain scuppers, seal cracks on underside of deck, and use other necessary protective measures to prevent leakage of silane below the concrete deck, to protect waterways, bridge components, pedestrians, vehicles, roadway, vegetation, and any other items or areas below or near the bridge.

(G) Application of sealant by spray methods will not be permitted during windy conditions, if in the opinion of the Engineer, unsatisfactory results will be obtained. Other application methods or rescheduling will be required.

(H) Avoid application with hand pump sprayers. For small areas of silane application, the use of hand pump sprayers might be allowed, but must be approved by the Engineer.

(I) Protect traffic from rebound, dust, overspray, and construction activities. Provide appropriate shielding, as required and/or directed by the Engineer.

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(J) The Contractor shall provide suitable coverings (e.g. heavy-duty drop cloths) as needed to protect all exposed areas not to receive silane treatment, such as asphalt pavement, curbs, sidewalks, parapets, etc.

(K) Clean and/or repair all damage or defacement resulting from Contractor's operations to the Engineer's satisfaction at no additional cost to the Department.

(L) The equipment used for silane application must be clean of foreign materials and approved by the Engineer before use.

(M) The surface to receive the treatment shall be dry for at least 48 hours before treatment and shall be free from sand, surface dust and dirt, oil, grease, chemical films, and other contaminants prior to application of the silane.

(N) The surface, air, and material temperatures shall be between 40°F and 90°F during application.

(O) Do not apply silane materials during cold, hot, or wet weather conditions or when adverse weather conditions are forecast within twelve (12) hours of the completion of the silane application. Correct any coating damaged by rain or moisture by an additional application or as required by the silane manufacturer.

(P) Protect prepared surfaces from precipitation and heavy dew during and after the application of the silane.

(Q) Conduct the work in a continuous operation, with the silane application as soon as practical following surface preparation.

(R) Apply silane during the lowest temperature period of the day, typically between 1:00 a.m. and 9:00 a.m., when the cracks are open to the greatest extent.

(S) Clean up, dispose of any surplus material, and restore any disturbed areas unless otherwise directed.

(T) 100% Silane is a combustible liquid; take appropriate precautions during handling, storage, and operations. KEEP AWAY FROM OPEN FLAME.

(U) Work crews should wear appropriate personal protection equipment and follow manufacturer's recommendations when applying silane. Refer to the SDS and all applicable local, state, and federal laws, and rules and regulations of authorities having jurisdiction over the project, for specific guidance for personal and environmental protection and safety requirements.

MEASUREMENT AND PAYMENT

Diamond Grinding will be measured and paid for at the contract unit price per square yard and will be full compensation for the diamond grinding and handwork to prepare the entire concrete bridge deck, and removal and disposal of all waste material generated.

Silane Deck Treatment will be measured and paid for at the contract unit price per square yard and will be full compensation for bridge deck surface and crack preparation; for furnishing and

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applying the silane deck treatment; for protection of waterways, bridge, and other nearby surfaces, vehicles, and pedestrians; and for all labor, tools, and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	**Pay Unit**
Diamond Grinding	Square Yard
Silane Deck Treatment	Square Yard

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SOUND BARRIER WALL (BRIDGE MOUNTED) (SPECIAL)

1.0 DESCRIPTION

This work consists of furnishing planks, structural steel, and all other materials; handling, transporting, fabricating, galvanizing, and storing materials; furnishing erection drawings, erecting and installing the sound barrier wall members and all other materials as required by the plans, Standard Specifications and this Special Provision on the bridge including the approach slabs and the panels to the first ground supported posts at ends of approach slabs.

The bridge plans allow for 9-foot maximum post spacing. Post spacing greater than 9 feet will not be permitted. Provide post spacing consistent with the plans. Post spacing varies in the plans due to geometrical constraints. The weight of the sound barrier in its entirety shall not exceed the value provided in the contract documents.

A maximum one foot drop or rise in elevation between wall sections is permitted. Elevation changes greater than one foot, if necessary, will be allowed only at the end of the wall. Top of wall elevation changes that result in a jagged appearance will not be allowed. Soil elevation at approach slabs shall be kept a minimum of 3" below bottom of wall panel.

2.0 ALTERNATE POST SPACING

As an alternate, the Contractor may submit plans for post spacing other than shown for review and approval. A submittal reducing the post spacing shall include the plank material and design specifications. The submittal shall also include an elevation view depicting the revised post spacing and proposed top of wall elevations. The proposed top of wall elevations shall be equal to or greater than the plan dimensions.

Submit two sets of detailed plans for review. Include all details in the plans, including the size, spacing and materials of required piles. Have a North Carolina Registered Professional Engineer check, seal and date the plans. After the plans are reviewed and, if necessary, the corrections made, submit one set of reproducible tracings on 22" x 34" sheets to become part of the contract plans.

3.0 WALL TYPE

Walls that have been assigned "Approved" or "Approved for Provisional Use" status by the Product Evaluation Program will be considered for use as the Sound Barrier Wall (Bridge Mounted) planks. Wall plank design details and materials must meet the design and construction requirements of the project and the applicable loadings except that the wall is not required to meet the traffic loading requirements. Wall structural stability and connection details shall conform to the current edition of the AASHTO LRFD Bridge Design Specifications, except that traffic loading shall not be applied to the sound barrier wall.

The wall shall meet the following aesthetic requirements in addition to those noted within the contract plans. The traffic and non-traffic faces of the wall planks shall be configured such that the only the post flanges extend beyond the face of the planks as shown in the plans such that a uniform surface is visible from the traffic and non-traffic sides of the wall. This

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uniform surface appearance is to extend from the top of wall to the bottom of the vertical post members as shown in the plans. The bottom of the wall shall be detailed for free and complete drainage of wall areas. Additionally, the plank configuration proposed shall allow for visual inspection of the post to concrete barrier rail bolts from the bottom of the wall without the need to remove any components.

Prior to submittal of Working Drawings, as described herein, submit a copy of the signed NCDOT Product Status Notification Letter and two sets of preliminary plans for review and approval. Include material specifications for all components. Once preliminary plans are approved, submit Working Drawings in accordance with all applicable portions of the requirements herein, including details necessary to fabricate and construct the proposed components.

Have a North Carolina Registered Professional Engineer check, seal and date the plans and, when requested, calculations. After the plans are reviewed and, if necessary, corrections made, submit one set of reproducible tracings on 22" x 34" sheets to become part of the contract plans.

4.0 MATERIALS AND FABRICATION

Provide materials and fabricate members in accordance with the requirements of Division 10 of the Standard Specifications for Roads and Structures. The structural planks for the Sound Barrier Wall (Bridge Mounted) are to have the following properties:

Flexural Strength	57,000 psi	ASTM D-790
Tensile Strength	60,000 psi	ASTM D-638
Compressive Strength	65,000 psi	ASTM D-695
Tensile Modulus	3,500,000 psi	ASTM D-638
Flexural Modulus	1,600,000 psi	ASTM D-790
Specific Gravity	1.88 (typ)	ASTM D-792

The structural planks are to be colored and shall be uniform throughout the pultruded composite. The color is to be approved by the Engineer before the planks are delivered to the jobsite.

The structural planks shall exhibit good workmanship and shall be free of burrs, cracks or other objectionable marks which would adversely affect the barrier's performance or serviceability. All cracked, discolored, burned or damaged structural planks will be rejected either at the fabrication shop or the construction site even after installation, but prior to acceptance of the project.

The structural steel is to meet the requirements of the Standard Specifications. The posts, backing angles, bolts, nuts and washers are to be painted to match the structural planks. The paint system as described in Section 442 of the Standard Specifications and the Structural Steel Shop Coatings shall by System 1, with the exception that the surfaces are not to be

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cleaned to an SSPC SP-10 finish after being galvanized and the top coat color is to be as noted on the contract plans and approved by the Engineer. After erection, the bolts, nuts, and washers are to be primed by brush, then the entire support system of posts, backing angles, bolts, nuts and washers are to be top-coated. The structural planks are to be masked so no overspray or spatters occur. The Contractor is to provide 3 samples of paint close to the color of the structural planks to the Engineer for his selection of the final color. The limits of the painting are from the top of the posts to the bottom of the lowest plank.

5.0 CONSTRUCTION METHODS

The erection of the sound barrier components shall not begin until the concrete in the bridge railing has reached a minimum compressive strength of 3,000 psi. Install posts as shown on the plans or in the accepted submittals with a tolerance of 1/2 inch per foot from vertical or as necessary to conform to the plank design if more restrictive.

6.0 WORKING DRAWINGS

Submit plank design calculations and specifications for approval prior to purchasing the plank materials. Submit metalwork fabrication drawings for approval prior to fabrication of steel wall components. This submittal shall clearly indicate access for visual inspection of the post attached bolts. Submit an erection plan and plank support components, for review and acceptance prior to fabrication of metalwork. Submit five sets of detail drawings.

7.0 METHOD OF MEASUREMENT

The quantity of Sound Barrier Wall (Bridge Mounted), to be paid for will be the completed and accepted wall, according to the limits shown on the plans.

8.0 BASIS OF PAYMENT

The quantity of Sound Barrier Wall (Bridge Mounted) measured as provided above, will be paid for at the contract unit price for “Sound Barrier Wall (Bridge Mounted)”.

The price bid will be full compensation for all work covered by this Special Provision including, but not limited to, furnishing panels, structural steel, and all other materials; handling, transporting, fabricating, galvanizing, and storing materials; furnishing erection drawings, and erecting and installing the sound barrier wall components.

Payment will be made under:

Item	Unit
Sound Barrier Wall (Bridge Mounted)	Lump Sum

PROJECT SPECIAL PROVISION

(10-18-95) (Rev. 3-21-17)) Z-1a

PERMITS

The Contractor's attention is directed to the following permits, which have been issued to the Department of Transportation by the authority granting the permit.

PERMIT	AUTHORITY GRANTING THE PERMIT
Dredge and Fill and/or Work in Navigable Waters (404)	U. S. Army Corps of Engineers
Water Quality (401)	Division of Environmental Management, DEQ State of North Carolina

The Contractor shall comply with all applicable permit conditions during construction of this project. Those conditions marked by * are the responsibility of the Department and the Contractor has no responsibility in accomplishing those conditions.

Agents of the permitting authority will periodically inspect the project for adherence to the permits.

The Contractor's attention is also directed to Articles 107-10 and 107-13 of the *2018 Standard Specifications* and the following:

Should the Contractor propose to utilize construction methods (such as temporary structures or fill in waters and/or wetlands for haul roads, work platforms, cofferdams, etc.) not specifically identified in the permit (individual, general, or nationwide) authorizing the project it shall be the Contractor's responsibility to coordinate with the Engineer to determine what, if any, additional permit action is required. The Contractor shall also be responsible for initiating the request for the authorization of such construction method by the permitting agency. The request shall be submitted through the Engineer. The Contractor shall not utilize the construction method until it is approved by the permitting agency. The request normally takes approximately 60 days to process; however, no extensions of time or additional compensation will be granted for delays resulting from the Contractor's request for approval of construction methods not specifically identified in the permit.

Where construction moratoriums are contained in a permit condition which restricts the Contractor's activities to certain times of the year, those moratoriums will apply only to the portions of the work taking place in the restricted waters, wetlands or buffer zones, provided that activities outside those areas is done in such a manner as to not affect the restricted waters, wetlands or buffer zones.

DEPARTMENT OF THE ARMY
WILMINGTON DISTRICT, CORPS OF ENGINEERS
69 DARLINGTON AVENUE
WILMINGTON, NORTH CAROLINA 28403-1343

June 21, 2019

Regulatory Division

Action ID: SAW-2013-01833, STIP I-4400/I-4700

North Carolina Department of Transportation
Division of Highways
Attn: Mr. Philip S. Harris III, P.E., C.P.M.
Natural Environment Section Head
1598 Mail Service Center
Raleigh, NC 27699-1598

Dear Mr. Harris:

In accordance with the written request of December 3, 2018, and the ensuing administrative record, enclosed is a Department of the Army (DA) Permit to authorize the discharge fill material into streams and wetlands to construct STIP I-4400/I-4700. Construction of STIP I-4400/I-4700 will permanently impact 14,831 linear feet of stream, 2.91 acres of wetland, and <0.01 acre of open water along the 22.2 mile project corridor in Henderson and Buncombe Counties, North Carolina.

This is a phased permit authorization: This permit only authorizes work on Sections I-4700 A & B (Phase 1 for permitting) of the STIP I-4400/I-4700 project. The permittee is authorized to impact regulated waters along I-4700 A & B as follows: permanent discharge of fill material into 2,956 lf of streams and 1.56 acres of wetlands. The permittee is also authorized to temporarily impact 1,601 lf of streams during construction. Construction on the remaining sections of STIP I-4400/I-4700 shall not commence until final designs have been completed for these sections; the permittee has minimized impacts to waters and wetlands to the maximum extent practicable, and; any modifications to the plans, and the compensatory mitigation plans, have been approved by the US Army Corps of Engineers (the Corps).

Any deviation in the authorized work will likely require modification of this permit. If a change in the authorized work is necessary, you should promptly submit revised plans to the Corps showing the proposed changes. You may not undertake the proposed changes until the Corps notified you that your permit has been modified.

Carefully read your permit. The general and special conditions are important. Your failure to comply with these conditions could result in a violation of Federal law. Certain significant general conditions require that:

a. You must complete construction before December 31, 2029.

b. You must notify this office in advance as to when you intend to commence and complete work.

c. You must allow representatives from this office to make periodic visits to your worksite as deemed necessary to assure compliance with permit plans and conditions.

You should address all questions regarding this authorization to Ms. Lori Beckwith in the Asheville Regulatory Field Office, telephone number (828) 271-7980, extension 4223.

Thank you in advance for completing our Customer Survey Form. This can be accomplished by visiting our web-site at http://corpsmapu.usace.army.mil/cm_apex/f?p=136:4:0 and completing the survey on-line. We value your comments and appreciate your taking the time to complete a survey each time you interact with our office.

FOR THE COMMANDER

Robert J. Clark
Colonel, U.S. Army
District Commander

Enclosures

Copy Furnished (with enclosures):

Chief, Source Data Unit
NOAA/National Ocean Service
Attn: Sharon Tear N/CS261
1315 East-West Hwy., Rm 7316
Silver Spring, Maryland 20910-3282

Copies Furnished with special conditions and plans:

Mr. Kenneth Riley, Ph.D.
Habitat Conservation Division
National Marine Fisheries Service Southeast Region
101 Pivers Island Road
Beaufort, North Carolina 28516

Mr. Pete Benjamin
U.S. Fish and Wildlife Service
Raleigh Ecological Service Field Office
Post Office Box 33726
Raleigh, North Carolina 27636-3726

Mr. Todd Bowers
Oceans, Wetlands and Streams Protection Branch
Wetlands and Streams Regulatory Section
U.S. Environmental Protection Agency – Region 4
Sam Nunn Atlanta Federal Center
61 Forsyth Street, SW
Atlanta, Georgia 30303-8931

Mr. Doug Huggett
Division Coastal Management
N.C. Department of Environment and Natural Resources
400Commerce Avenue
Morehead City, North Carolina 28557

Dr. Pace Wilber
Habitat Conservation Division – Atlantic Branch
NOAA Fisheries Service
219 Fort Johnston Road
Charleston, South Carolina 29412

DEPARTMENT OF THE ARMY PERMIT

Permittee **NORTH CAROLINA DEPARTMENT OF TRANSPORTATION**
ATTN: MR. PHILIP S. HARRIS III, P.E., C.P.M.

Permit No. **SAW-2013-01883**

Issuing Office **CESAW-RG-A**

NOTE: The term "you" and its derivatives, as used in this permit, means the permittee or any future transferee. The term "this office" refers to the appropriate district or division office of the Corps of Engineers having jurisdiction over the permitted activity or the appropriate official of that office acting under the authority of the commanding officer.

You are authorized to perform work in accordance with the terms and conditions specified below.

Project Description: **To construct STIP I-4400/I-4700, the project involves the permanent discharge of fill material into 14,831 linear feet (lf) of streams, 2.91 acres of wetlands, and <0.01 acre of open waters (a pond) along the 22.2-mile project corridor/this section of I-26 in Henderson and Buncombe Counties, North Carolina.**

Project Location: **STIP Project I-4400 is 13.6 miles in length and begins at US 25 (Exit 54) near Hendersonville, and extends along I-26 west to NC 280 (Exit 40). STIP Project I-4700 is 8.6 miles in length and extends along I-26 from NC 280 west to the I-40/I-240 interchange. For permitting purposes, STIP I-4400 and STIP I-4700 are considered to be one project (i.e., STIP I-4400/I-4700). Center coordinates for the project are N 35.432347 W 82.530633.**

THIS IS A PHASED PERMIT AUTHORIZATION: This permit only authorizes work on Sections I-4700 A & B (Phase 1 for permitting) of the STIP I-4400/I-4700 project. The permittee is authorized to impact regulated waters along I-4700 A & B as follows: permanent discharge of fill material into 2,956 lf of streams and 1.56 acres of wetlands. The permittee is also authorized to temporarily impact 1,601 lf of streams during construction. Construction on the remaining sections of STIP I-4400/I-4700 shall not commence until final designs have been completed for these sections; the permittee has minimized impacts to waters and wetlands to the maximum extent practicable, and; any modifications to the plans, and the compensatory mitigation plans, have been approved by the US Army Corps of Engineers (the Corps).

Permit Conditions:

General Conditions:

1. The time limit for completing the work authorized ends on **December 31, 2029.** If you find that you need more time to complete the authorized activity, submit your request for a time extension to this office for consideration at least one month before the above date is reached.

2. You must maintain the activity authorized by this permit in good condition and in conformance with the terms and conditions of this permit. You are not relieved of this requirement if you abandon the permitted activity, although you may make a good faith transfer to a third party in compliance with General Condition 4 below. Should you wish to cease to maintain the authorized activity or should you desire to abandon it without a good faith transfer, you must obtain a modification of this permit from this office, which may require restoration of the area.

3. If you discover any previously unknown historic or archeological remains while accomplishing the activity authorized by this permit, you must immediately notify this office of what you have found. We will initiate the Federal and state coordination

required to determine if the remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

4. If you sell the property associated with this permit, you must obtain the signature of the new owner in the space provided and forward a copy of the permit to this office to validate the transfer of this authorization.

5. If a conditioned water quality certification has been issued for your project, you must comply with the conditions specified in the certification as special conditions to this permit. For your convenience, a copy of the certification is attached if it contains such conditions.

6. You must allow representatives from this office to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished in accordance with the terms and conditions of your permit.

Special Conditions:

SEE ATTACHED SPECIAL CONDITIONS

Further Information:

1. Congressional Authorities: You have been authorized to undertake the activity described above pursuant to:

(X) Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403).

(X) Section 404 of the Clean Water Act (33 U.S.C. 1344).

( ) Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C. 1413).

2. Limits of this authorization.

a. This permit does not obviate the need to obtain other Federal, state, or local authorizations required by law.

b. This permit does not grant any property rights or exclusive privileges.

c. This permit does not authorize any injury to the property or rights of others.

d. This permit does not authorize interference with any existing or proposed Federal project.

3. Limits of Federal Liability. In issuing this permit, the Federal Government does not assume any liability for the following:

a. Damages to the permitted project or uses thereof as a result of other permitted or unpermitted activities or from natural causes.

b. Damages to the permitted project or uses thereof as a result of current or future activities undertaken by or on behalf of the United States in the public interest.

c. Damages to persons, property, or to other permitted or unpermitted activities or structures caused by the activity authorized by this permit.

d. Design or construction deficiencies associated with the permitted work.

e. Damage claims associated with any future modification, suspension, or revocation of this permit.

4. Reliance on Applicant's Data: The determination of this office that issuance of this permit is not contrary to the public interest was made in reliance on the information you provided.

5. Reevaluation of Permit Decision. This office may reevaluate its decision on this permit at any time the circumstances warrant. Circumstances that could require a reevaluation include, but are not limited to, the following:

a. You fail to comply with the terms and conditions of this permit.

b. The information provided by you in support of your permit application proves to have been false, incomplete, or inaccurate (See 4 above).

c. Significant new information surfaces which this office did not consider in reaching the original public interest decision.

Such a reevaluation may result in a determination that it is appropriate to use the suspension, modification, and revocation procedures contained in 33 CFR 325.7 or enforcement procedures such as those contained in 33 CFR 326.4 and 326.5. The referenced enforcement procedures provide for the issuance of an administrative order requiring you to comply with the terms and conditions of your permit and for the initiation of legal action where appropriate. You will be required to pay for any corrective measures ordered by this office, and if you fail to comply with such directive, this office may in certain situations (such as those specified in 33 CFR 209.170) accomplish the corrective measures by contract or otherwise and bill you for the cost.

6. Extensions. General condition 1 establishes a time limit for the completion of the activity authorized by this permit. Unless there are circumstances requiring either a prompt completion of the authorized activity or a reevaluation of the public interest decision, the Corps will normally give favorable consideration to a request for an extension of this time limit.

Your signature below, as permittee, indicates that you accept and agree to comply with the terms and conditions of this permit.

Carla Burnette for — 6/21/19

(PERMITTEE) **NC DEPARTMENT OF TRANSPORTATION**
ATTN: MR. PHILIP S. HARRIS III, P.E., C.P.M. — *(DATE)*

This permit becomes effective when the Federal official, designated to act for the Secretary of the Army, has signed below.

Mark M. Ahern for — 21 June 2019

(DISTRICT COMMANDER) **ROBERT J. CLARK, COLONEL** — *(DATE)*

When the structures or work authorized by this permit are still in existence at the time the property is transferred, the terms and conditions of this permit will continue to be binding on the new owner(s) of the property. To validate the transfer of this permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.

(TRANSFEREE) — *(DATE)*

*U.S. GOVERNMENT PRINTING OFFICE: 1986 - 717-425

SPECIAL CONDITIONS
ACTION ID. SAW-2013-01883
NC DEPARTMENT OF TRANSPORATION
I-26 WIDENING, HENDERSON AND BUNCOMBE COUNTIES
STIP NO. I-4400/I-4700

WORK LIMITS/NOTIFCATION

1) The entire 22.2 mile project is identified as STIP I-4400/I-4700. This permit only authorizes work on Sections I-4700 A and B ("I-4700") of STIP I-4400/I-4700; also known as "Phase 1" for permitting purposes. Construction on the remaining sections (i.e., Section I-4400C, I-4400BB, I-4400BA, and I-4400A) of I-4400/I-4700 project shall not commence until: (a) final design for those sections/phases has been completed and submitted to the U.S. Army Corps of Engineers (Corps); (b) the Permittee has minimized impacts to waters and wetlands to the maximum extent practicable for those sections/phases and the Corps concurs with this assessment through standard Merger 4B and 4C meetings; (c) any modification(s) to the plans for those sections/phases have been approved by the Corps in writing; and (d) a final compensatory mitigation plan for those sections/phases has been submitted by the Permittee and approved by the Corps.

2) All work authorized by this permit shall be performed in strict compliance with the attached permit plans titled, "Wetland and Surface Water Impacts Permit, I-4700", permit drawing sheets 1-97, which are now part of this permit. The Permittee shall ensure that the construction design plans for this project do not deviate from the permit plans attached to this authorization. Any modification to the attached permit plans must be approved by the US Army Corps of Engineers prior to any active construction in waters or wetlands.

3) The permittee shall ensure that the project is implemented in strict accordance with all commitments in the attached document titled, "I-26 Widening, STIP Project Nos. I-4400 & I-4700 Project Commitments", dated June 19, 2019 (Version 5). This document is 38 pages long and was created to compile project commitments that NCDOT has agreed to in a number of other documents, to include commitments from the following:

- Combined Final Environmental Impact Statement (EIS), Final Section 4(f) Evaluation, and Record of Decision (ROD) (March 2019);
- Biological Assessment (September 2018);
- Biological Opinion (BO) (February 2019);
- I-26 Bridge Over the French Broad River Construction and Demolition (November 2018);
- River Safety Plan (September 2018)

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STIP NO. I-4400/I-4700

- Strategic Communication Plan for the Construction of the I-26 Bridge over the French Broad River (September 2018)
- Section 106 Memorandum of Agreement (July 2018)

4) Unauthorized Dredge or Fill: Except as authorized by this permit or any U.S. Army Corps of Engineers approved modification to this permit, no excavation, fill, or mechanized land-clearing activities shall take place at any time in the construction or maintenance of this project, within waters or wetlands, or shall any activities take place that cause the degradation of waters or wetlands. There shall be no excavation from, waste disposal into, or degradation of, jurisdictional wetlands or waters associated with this permit without appropriate modification of this permit, including appropriate compensatory mitigation. This prohibition applies to all borrow and waste activities connected with this project.

5) Maintain Flows and Circulation Patterns of Waters: Except as specified in the plans attached to this permit, no excavation, fill or mechanized land-clearing activities shall take place at any time in the construction or maintenance of this project, in such a manner as to impair normal flows and circulation patterns within waters or wetlands or to reduce the reach of waters and/or wetlands

6) Permit Distribution: The Permittee shall require its contractors and/or agents to comply with the terms and conditions of this permit in the construction and maintenance of this project, and shall provide each of its contractors and/or agents associated with the construction or maintenance of this project with a copy of this permit. A copy of this permit, including all conditions, drawings and attachments shall be available at the project site during the construction and maintenance of this project.

7) Pre-Construction Meeting: The Permittee shall schedule and attend a preconstruction meeting between its representatives, the contractors representatives, and the U.S. Army Corps of Engineers, Asheville Regulatory Field Office, NCDOT Regulatory Project Manager, prior to any work within jurisdictional waters and wetlands to ensure that there is a mutual understanding of all the terms and conditions contained with this Department of Army Permit.

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I-26 WIDENING, HENDERSON AND BUNCOMBE COUNTIES
STIP NO. I-4400/I-4700

The Permittee shall provide the Corps, Asheville Regulatory Field Office, NCDOT Project Manager, with a copy of the final permit plans at least two weeks prior to the preconstruction meeting along with a description of any changes that have been made to the project's design, construction methodology or construction timeframe. The Permittee shall schedule the preconstruction meeting for a time frame when the Corps and NCDWR Project Managers can attend. The Permittee shall invite the Corps and NCDWR Project Managers a minimum of thirty (30) days in advance of the scheduled meeting in order to provide those individuals with ample opportunity to schedule and participate in the required meeting. The thirty (30) day requirement can be waived with the concurrence of the Corps.

8) Notification of Construction Commencement and Completion: The Permittee shall notify the U.S. Army Corps of Engineers in writing prior to beginning the work authorized by this permit and again upon completion of the work authorized by this permit.

9) Reporting Address: All reports, documentation, and correspondence required by the conditions of this permit shall be submitted to the following: U.S. Army Corps of Engineers, Wilmington District Asheville Regulatory Field Office, Attn: Lori Beckwith, 151 Patton Ave., Room 208, Asheville, NC 28801-5006, or loretta.a.beckwith@usace.army.mil . The Permittee shall reference the following permit number, SAW-2013-01883, on all submittals.

10) Reporting Violations: Violation of these permit conditions or violation of Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act shall be reported to the Corps in writing and by telephone at: 828-271-7980, ext. 4223, within 24 hours of the Permittee's discovery of the violation.

11) Permit Revocation: The Permittee, upon receipt of a notice of revocation of this permit or upon its expiration before completion of the work will, without expense to the United States and in such time and manner as the Secretary of the Army or his authorized representative may direct, restore the water or wetland to its pre-project condition.

SPECIAL CONDITIONS
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RELATED LAWS

12) Clean Fill: The Permittee shall use only clean fill material for this project. The fill material shall be free from items such as trash, construction debris, metal and plastic products, and concrete block with exposed reinforcement bars. Soils used for fill shall not be contaminated with any toxic substance in concentrations governed by Section 307 of the Clean Water Act. Unless otherwise authorized by this permit, all fill material placed in waters or wetlands shall be generated from an upland source.

13) Water Contamination: All mechanized equipment shall be regularly inspected and maintained to prevent contamination of waters and wetlands from fuels, lubricants, hydraulic fluids, or other toxic materials. In the event of a spill of petroleum products or any other hazardous waste, the Permittee shall immediately report it to the N.C. Division of Water Resources at (919) 733-3300 or (800) 858-0368 and provisions of the North Carolina Oil Pollution and Hazardous Substances Control Act shall be followed.

14) Federally Listed Species/Biological Opinion: This Department of the Army permit does not authorize you to take a federally listed species, in particular the Appalachian elktoe (*Alasmidonta raveneliana*) or the gray bat (*Myotis grisescens*). In order to legally take a federally listed species, you must have separate authorization under the Endangered Species Act (ESA) (e.g., an ESA Section 10 permit, or a Biological Opinion (BO) under ESA Section 7, with "incidental take" provisions with which you must comply). The U.S. Fish and Wildlife Service issued a BO for this project titled, "I-26 Widening from US 25 near Hendersonville to I-40/I-240 South of Asheville, Henderson and Buncombe Counties, North Carolina", on February 22, 2019. This BO contains mandatory terms and conditions to implement the reasonable and prudent measures that are associated with "incidental take" that is also specified in the BO. Your authorization under this permit is conditional upon your compliance with all of the mandatory terms and conditions associated with incidental take of the attached BO; the terms and conditions of the BO are incorporated by reference in this

SPECIAL CONDITIONS
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permit. Failure to comply with the terms and conditions associated with incidental take of this BO, where a take of the federally listed species occurs, would constitute an unauthorized take, and it would also constitute non-compliance with your permit. The U.S. Fish and Wildlife Service is the appropriate authority to determine compliance with the terms and conditions of its BO, and with the ESA.

15) Endangered Species Act: The Permittee shall implement all necessary measures to ensure the authorized activity does not kill, injure, capture, harass, or otherwise harm any federally listed threatened or endangered species. While accomplishing the authorized work, if the Permittee discovers or observes an injured or dead threatened or endangered species, the U.S. Army Corps of Engineers, Wilmington District, Asheville Regulatory Field Office, Attn: Lori Beckwith at 828-271-7980, ext. 4223, or loretta.a.beckwith@usace.army.mil will be immediately notified.

16) NCDOT shall abide by all stipulations identified in the attached Memorandum of Agreement titled, "MEMORANDUM OF AGREEMENT AMONG THE FEDERAL HIGHWAY ADMINISTRATION, the NATIONAL PARK SERVICE, the NORTH CAROLINA DEPARTMENT OF TRANSPORTATION, and the NORTH CAROLINA STATE HISTORIC PRESERVATION OFFICE PURSUANT TO 36 CFR 800.6 regarding the REPLACEMENT OF BRIDGE 205 CARRYING THE BLUE RIDGE PARKWAY OVER INTERSTATE 26 BUNCOMBE COUNTY, NORTH CAROLINA NCDOT TIP ID I-4700b", dated May 30, 2018 (last signature). This MOA is incorporated herein by reference.

AQUATIC LIFE/CULVERTS

17) Prohibitions on Concrete: The Permittee shall take measures necessary to prevent live or fresh concrete, including bags of uncured concrete, from coming into contact with any water in or entering into waters of the United States. Water inside coffer dams or casings that has been in contact with concrete shall only be returned to waters of the United States when it no longer poses a threat to aquatic organisms (concrete is set and cured).

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18) Unless otherwise requested in the application and depicted on the approved permit plans, culverts greater than 48 inches in diameter shall be buried at least one foot below the bed of the stream. Culverts 48 inches in diameter and less shall be buried or placed on the stream bed as practicable and appropriate to maintain aquatic passage, and every effort shall be made to maintain existing channel slope. The bottom of the culvert shall be placed at a depth below the natural stream bottom to provide for passage during drought or low flow conditions. Culverts shall be designed and constructed in a manner that minimizes destabilization and head cutting.

19) Measures shall be included in the construction/installation of culverts that will promote the safe passage of fish and other aquatic organisms. The dimension, pattern, and profile of the stream above and below a pipe or culvert shall not be modified by widening the stream channel or by reducing the depth of the stream in connection with the construction activity. The width, height, and gradient of a proposed opening shall be such as to pass the average historical low flow and spring flow without adversely altering flow velocity. Spring flow should be determined from gauge data, if available. In the absence of such data, bankfull flow can be used as a comparable level.

20) Aquatic Life Movement: Unless otherwise requested in the application and depicted on the approved permit plans, no activity may substantially disrupt the necessary life cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area. All discharges of dredged or fill material within waters of the United States shall be designed and constructed to maintain low flows to sustain the movement of aquatic species.

21) The Permittee shall implement all reasonable and practicable measures to ensure that equipment, structures, fill pads, work, and operations associated with this project do not adversely affect upstream and/or downstream reaches.

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Adverse effects include, but are not limited to, channel instability, flooding, and/or stream bank erosion. The Permittee shall routinely monitor for these effects, cease all work when detected, take initial corrective measures to correct actively eroding areas, and notify this office immediately. Permanent corrective measures may require additional authorization by the U.S. Army Corps of Engineers.

22) Culverts placed within wetlands must be installed in a manner that does not restrict the flows and circulation patterns of waters of the United States. Culverts placed across wetland fills purely for the purposes of equalizing surface water shall not be buried, but the culverts must be of adequate size and/or number to ensure unrestricted transmission of water.

SEDIMENT AND EROSION CONTROL

23) As noted on pages 34-38 of the attached document titled, "I-26 Widening, STIP Project Nos. I-4400 & I-4700 Project Commitments", dated June 19, 2019 (Version 5), the permittee shall ensure that (2) the site specific sediment and erosion control measures, and (2) sediment and control measures for all other portions of the 22.2 mile corridor, are strictly implemented and maintained. This document is 38 pages long and was created to compile project commitments that NCDOT has agreed to in a number of other documents, to include commitments from the following:

- Combined Final Environmental Impact Statement (EIS), Final Section 4(f) Evaluation, and Record of Decision (ROD) (March 2019);
- Biological Assessment (September 2018);
- Biological Opinion (BO) (February 2019);
- I-26 Bridge Over the French Broad River Construction and Demolition (November 2018);
- River Safety Plan (September 2018)
- Strategic Communication Plan for the Construction of the I-26 Bridge over the French Broad River (September 2018)
- Section 106 Memorandum of Agreement (July 2018)

SPECIAL CONDITIONS
ACTION ID. SAW-2013-01883
NC DEPARTMENT OF TRANSPORATION
I-26 WIDENING, HENDERSON AND BUNCOMBE COUNTIES
STIP NO. I-4400/I-4700

24) During the clearing phase of the project, heavy equipment shall not be operated in surface waters or stream channels. Temporary stream crossings will be used to access the opposite sides of stream channels. All temporary diversion channels and stream crossings will be constructed of non-erodible materials. Grubbing of riparian vegetation will not occur until immediately before construction begins on a given segment of stream channel.

25) No fill or excavation impacts for the purposes of sedimentation and erosion control shall occur within jurisdictional waters, including wetlands, unless the impacts are included on the plan drawings and specifically authorized by this permit. This includes, but is not limited to, sediment control fences and other barriers intended to catch sediment losses.

26) The Permittee shall remove all sediment and erosion control measures placed in waters and/or wetlands, and shall restore natural grades on those areas, prior to project completion.

BORROW AND WASTE

27) To ensure that all borrow and waste activities occur on high ground and do not result in the degradation of adjacent waters and wetlands, except as authorized by this permit, the Permittee shall require its contractors and/or agents to identify all areas to be used as a borrow and/or waste site(s) associated with this project and provide this information to the U.S. Army Corps of Engineers, along with the following:

a) Borrow Sites: When any portion of an aquatic resource(s) (i.e., a stream, river, wetland, pond, seep, and/or spring) is located within the boundaries of the proposed borrow site(s), or within a distance of 400 feet from the nearest boundary of the proposed borrow site(s), the Permittee shall provide the U.S. Army Corps of Engineers with

appropriate maps indicating: the locations of the proposed borrow site(s); boundaries of the proposed borrow site(s), and; delineation(s) of all aquatic resources (as described above) within the site, and out to 400 feet from the boundary of the site, as soon as such information is available.

b) Waste Sites: When any portion of an aquatic resource(s) (i.e., a stream, river, wetland, pond, seep, and/or spring) is located within the boundaries of the proposed waste site(s), the Permittee shall provide the U.S. Army Corps of Engineers with appropriate maps indicating: the locations of the proposed waste site(s); boundaries of the proposed waste site(s), and; delineation(s) of all aquatic resources (as described above) within the site, as soon as such information is available.

For those areas proposed as waste sites that have any aquatic resources within the boundaries, or borrow sites that have any aquatic resources within the boundary or out to 400 feet beyond the boundaries, the Permittee shall not approve those borrow and/or waste sites until the U.S. Army Corps of Engineers issues written confirmation that an area does or does not contain potentially jurisdictional resources. All delineations of aquatic sites on borrow and/or waste sites shall be verified by the U.S. Army Corps of Engineers and shown on the approved reclamation plans. The Permittee shall ensure that all borrow and/or waste sites comply with Special Condition #4 of this permit. Additionally, the Permittee shall produce and maintain documentation of all borrow and waste sites associated with this project. When aquatic resources are located within these designated areas, this documentation will include data regarding soils, vegetation, hydrology, delineation(s) of aquatic sites, and any jurisdictional determinations made by the Corps to clearly demonstrate compliance with Special Condition #4. All information will be available to the U.S. Army Corps of Engineers upon request. The Permittee shall require its contractors to complete and execute reclamation plans for each borrow and/or waste site and provide written documentation that the reclamation plans have been implemented and all

work is completed to the Permittee. For areas with aquatic resources that the Corps has determined are potentially jurisdictional (or jurisdictional), this documentation will be provided to the U.S. Army Corps of Engineers within 30 days of the completion of the reclamation work. The permittee shall ensure that (1) waste material placed in a project-related waste site(s) does not migrate into an aquatic resource, even if that resource is located outside the boundaries of the waste site, and (2) that any project-related activities in borrow sites does not adversely impact any off-site waters, to include dewatering (due to project-related excavation/borrow activities in the borrow site) of those off-site waters.

NAVIGATION/SECTION 10 WATERS (FRENCH BROAD RIVER)

28) This permit does not authorize the interference with any proposed Federal project, and the Permittee will not be entitled to compensation for damage or injury to the authorized structure or work which may be caused from future operations undertaken by the United States in the public interest. Except as authorized by this permit, or any approved modification to this permit, no attempt will be made by the Permittee to prevent the full and free use by the public of all navigable waters at or adjacent to the authorized work. Except as authorized by this permit, or any approved modification to this permit, the permitted activity must not interfere with the public's right to free navigation on all navigable waters of the United States.

29) The Permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the Permittee will be required, upon due notice from the U.S. Army Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal, relocation, or alteration.

SPECIAL CONDITIONS
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NC DEPARTMENT OF TRANSPORATION
I-26 WIDENING, HENDERSON AND BUNCOMBE COUNTIES
STIP NO. I-4400/I-4700

30) The Permittee, upon receipt of a notice of revocation of this permit or upon its expiration before completion of the work will, without expense to the United States and in such time and manner as the Secretary of the Army or his authorized representative may direct, restore the waterway to its former conditions. If the Permittee fails to comply with this direction, the Secretary or his representative may restore the waterway, by contract or otherwise, and recover the cost from the Permittee.

COMPENSATORY MITIGATION

31) In order to compensate for impacts associated with this permit, mitigation shall be provided in accordance with the provisions outlined on the most recent version of the attached Compensatory Mitigation Responsibility Transfer Form. The requirements of this form, including any special conditions listed on this form, are hereby incorporated as special conditions of this permit.

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ROY COOPER
Governor
MICHAEL S. REGAN
Secretary
LINDA CULPEPPER
Director

NORTH CAROLINA
Environmental Quality

June 19, 2019

Mr. Philip S. Harris, III, P.E., CPM
Natural Environment Section Head
Project Development and Environmental Analysis
North Carolina Department of Transportation
1598 Mail Service Center
Raleigh, North Carolina, 27699-1598

Subject: 401 Water Quality Certification Pursuant to Section 401 of the Federal Clean Water with ADDITIONAL CONDITIONS for Proposed improvements to Interstate 26 in Buncombe and Henderson Counties,
WBS No. 36030.1.2, TIP I4400 / I4700.
NCDWR Project No. 20181645 Modification 2

Dear Mr. Harris:

Attached hereto is a copy of Certification No. 20181645, modified to correct the proposed impacts and DWR required mitigation, issued to The North Carolina Department of Transportation (NCDOT) dated June 19, 2019. This modified Certification shall replace the Certification issued June 18, 2019.

If we can be of further assistance, do not hesitate to contact us.

Sincerely,

DocuSigned by:
Amy Chapman
9C9886312DCD474...

Linda Culpepper, Director
Division of Water Resources

Attachments

Electronic copy only distribution:
Lori Beckwith, US Army Corps of Engineers, Asheville Field Office
Roger D. Bryan, Division 13 Environmental Officer
David G. McHenry, Division 14 Environmental Officer
Colin Mellor, NC Department of Transportation
Carla Dagnino, NC Department of Transportation
Dr. Cynthia Van Der Wiele, US Environmental Protection Agency
Claire Ellwanger, US Fish and Wildlife Service
Marla Chambers, NC Wildlife Resources Commission
Beth Harmon, Division of Mitigation Services
Kevin Barnett, NC Division of Water Resources Asheville Regional Office
File Copy

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401 Water Quality Certification Pursuant to Section 401 of the Federal Clean Water Act) with ADDITIONAL CONDITIONS

THIS CERTIFICATION is issued in conformity with the requirements of Section 401 Public Laws 92-500 and 95-217 of the United States and subject to the North Carolina Division of Water Resources (NCDWR) Regulations in 15 NCAC 2H .0500 and 15A NCAC 2B. This certification authorizes the NCDOT to impact 2.91 acres of jurisdictional wetlands, 14,831 linear feet of jurisdictional in Buncombe and Henderson Counties. The project shall be constructed pursuant to the application dated received December 4, 2018. The authorized impacts for I-4700 A & B are as described below:

Stream Impacts in the French Broad River Basin

Site	Permanent Fill in Intermittant Streams (linear ft)	Temporary Fill in Intermittant Streams (linear ft)	Permanent Fill in Perennial Stream (linear ft)	Temporary Fill in Perennial Stream (linear ft)	Total Stream Impact (linear feet)	Stream Impacts Requiring Mitigation (linear ft)
I4700A			328	121	449	0
I4700B	911	40	1,717	1,480	3,197	401
TOTAL:	911	40	2,045	1,601	3,646	401

Total Stream Impact for Roadway Improvements: 4,557 linear feet

Riverine Wetland Impacts in the French Broad River Basin

Site	Fill (ac)	Total Wetland Impact (ac)	Impacts Requiring Mitigation (ac)
I4700A	0.74	0.74	0.74
I4700B	0.82	0.82	0.82
Total	**1.56**	**1.56**	**1.56**

Total Wetland Impact for Roadway Improvements: 1.56 acres.

Approximate Preliminary I-4400A Impacts (to be finalized in future certification version)
Wetlands: 0.54 acres
Streams: 5,068 linear feet
Open Waters (pond): <0.01 acres

Approximate Preliminary I-4400BA Impacts (to be finalized in future certification version)
Wetlands: 0.0 acres
Streams: 185 linear feet
Open Waters (pond): 0.0 acres

Approximate Preliminary I-4400BB Impacts (to be finalized in future certification version)
Wetlands: 0.04 acres
Streams: 2,354 linear feet
Open Waters (pond): 0.0 acres

Approximate Preliminary I-4400C Impacts (to be finalized in future certification version)
Wetlands: 0.77 acres
Streams: 4,268 linear feet
Open Waters (pond): 0.0 acres

The application provides adequate assurance that the discharge of fill material into the waters of the **French Broad River Basin** in conjunction with the proposed development will not result in a violation of applicable Water Quality Standards and discharge guidelines. Therefore, the State of North Carolina

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certifies that this activity will not violate the applicable portions of Sections 301, 302, 303, 306, 307 of PL 92-500 and PL 95-217 if conducted in accordance with the application and conditions hereinafter set forth.

This approval is only valid for the purpose and design that you submitted in your application dated received December 4, 2018, and phone comments provided in June, 2019. Should your project change, you are required to notify the NCDWR and submit a new application. If the property is sold, the new owner must be given a copy of this Certification and approval letter, and is thereby responsible for complying with all the conditions. If any additional wetland impacts, or stream impacts, for this project (now or in the future) exceed one acre or 150 linear feet, respectively, additional compensatory mitigation may be required as described in 15A NCAC 2H .0506 (h) (6) and (7). For this approval to remain valid, you are required to comply with all the conditions listed below. In addition, you should obtain all other federal, state or local permits before proceeding with your project including (but not limited to) Sediment and Erosion control, Coastal Stormwater, Non-discharge and Water Supply watershed regulations. This Certification shall expire on the same day as the expiration date of the corresponding Corps of Engineers Permit.

Condition(s) of Certification:

Additional Conditions:

1. This 401 Water Quality Certification is being issued with only the I-4700A and I-4700B phases having finalized design and impacts. When final design plans are completed for I-4400 Sections A, BA, BB, and C, a modification to the 401 Water Quality Certification shall be submitted with fees to the NC Division of Water Resources. Final designs shall reflect all appropriate avoidance, minimization, and mitigation for impacts to wetlands, streams, and other surface waters, and buffers. No construction activities that impact any wetlands, streams, surface waters, or buffers located in I-4400 Sections A, BA, BB, and C, shall begin until after the permittee applies for, and receives a written modification of the 401 Water Quality Certification from the NC Division of Water Resources.

2. The NCDOT Division Environmental Officer or Environmental Assistant will conduct a pre-construction meeting with all appropriate staff to ensure that the project supervisor and essential staff understand the potential issues with stream and pipe alignment at the permitted site. NCDWR staff shall be invited to the pre-construction meeting. [15A NCAC 02H.0506(b)(2) and (b)(3)

3. Compensatory mitigation for 401 linear feet of impact to streams and for 1.56 acres of wetlands is required. We understand that you have chosen to perform compensatory mitigation for impacts to streams through the North Carolina Division of Mitigation Service (DMS) (formerly NCEEP), and that the DMS has agreed to implement the mitigation for the project. The DMS has indicated in a letter dated December 3, 2018 that they will assume responsibility for satisfying the federal Clean Water Act compensatory mitigation requirements for the above-referenced project, in accordance with the DMS Mitigation Banking Instrument signed July 28, 2010.

General Conditions

1. Unless otherwise approved in this certification, placement of culverts and other structures in open waters and streams shall be placed below the elevation of the streambed by one foot for all culverts with a diameter greater than 48 inches, and 20 percent of the culvert diameter for culverts having a diameter less than 48 inches, to allow low flow passage of water and aquatic life. Design and placement of culverts and other structures including temporary erosion control measures shall not be conducted in a manner that may result in dis-equilibrium of wetlands or streambeds or banks, adjacent to or upstream and downstream of the above structures. The applicant is required to provide evidence that the equilibrium is being maintained if requested in writing by NCDWR. If this condition is unable to be met due to bedrock or other limiting features encountered during construction, please contact NCDWR for guidance on how to proceed and to determine whether or not a permit modification will be required. [15A NCAC 02H.0506(b)(2)]

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2. If concrete is used during construction, a dry work area shall be maintained to prevent direct contact between curing concrete and stream water. Water that inadvertently contacts uncured concrete shall not be discharged to surface waters due to the potential for elevated pH and possible aquatic life and fish kills. [15A NCAC 02B.0200]

3. During the construction of the project, no staging of equipment of any kind is permitted in waters of the U.S., or protected riparian buffers. [15A NCAC 02H.0506(b)(2)]

4. The dimension, pattern and profile of the stream above and below the crossing shall not be modified. Disturbed floodplains and streams shall be restored to natural geomorphic conditions. [15A NCAC 02H.0506(b)(2)]

5. The use of rip-rap above the Normal High Water Mark shall be minimized. Any rip-rap placed for stream stabilization shall be placed in stream channels in such a manner that it does not impede aquatic life passage. [15A NCAC 02H.0506(b)(2)]

* 6. The Permittee shall ensure that the final design drawings adhere to the permit and to the permit drawings submitted for approval. [15A NCAC 02H .0507 (c) and 15A NCAC 02H .0506 (b)(2) and (c)(2)]

7. All work in or adjacent to stream waters shall be conducted in a dry work area. Approved BMP measures from the most current version of NCDOT Construction and Maintenance Activities manual such as sandbags, rock berms, cofferdams and other diversion structures shall be used to prevent excavation in flowing water. [15A NCAC 02H.0506(b)(3) and (c)(3)]

8. Heavy equipment shall be operated from the banks rather than in the stream channel in order to minimize sedimentation and reduce the introduction of other pollutants into the stream. [15A NCAC 02H.0506(b)(3)]

9. All mechanized equipment operated near surface waters must be regularly inspected and maintained to prevent contamination of stream waters from fuels, lubricants, hydraulic fluids, or other toxic materials. [15A NCAC 02H.0506(b)(3)]

10. No rock, sand or other materials shall be dredged from the stream channel except where authorized by this certification. [15A NCAC 02H.0506(b)(3)]

11. Discharging hydroseed mixtures and washing out hydroseeders and other equipment in or adjacent to surface waters is prohibited. [15A NCAC 02H.0506(b)(3)]

12. When applicable, all construction activities shall be performed and maintained in full compliance with G.S. Chapter 113A Article 4 (Sediment and Pollution Control Act of 1973). Regardless of applicability of the Sediment and Pollution Control Act, all projects shall incorporate appropriate Best Management Practices for the control of sediment and erosion so that no violations of state water quality standards, statutes, or rules occur. [15A NCAC 02H .0506{b)(3) and (c)(3) and 15A NCAC 02B .0200]

13. Design, installation, operation, and maintenance of all sediment and erosion control measures shall be equal to or exceed the requirements specified in the most recent version of the *North Carolina Sediment and Erosion Control Manual,* or for linear transportation projects, the *NCDOT Sediment and Erosion Control Manual.*

14. All devices shall be maintained on all construction sites, borrow sites, and waste pile (spoil) sites, including contractor-owned or leased borrow pits associated with the project.

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Sufficient materials required for stabilization and/or repair of erosion control measures and stormwater routing and treatment shall be on site at all times.

15. For borrow pit sites, the erosion and sediment control measures shall be designed, installed, operated, and maintained in accordance with the most recent version of the *North Carolina Surface Mining Manual.* Reclamation measures and implementation shall comply with the reclamation in accordance with the requirements of the Sedimentation Pollution Control Act and the Mining Act of 1971.

16. If the project occurs in waters or watersheds classified as Primary Nursery Areas (PNAs), SA, WS-1, WS-11, High Quality Waters (HQW), or Outstanding Resource Waters (ORW), then the sedimentation and erosion control designs shall comply with the requirements set forth in 15A NCAC 04B .0124, *Design Standards in Sensitive Watershed.* [15A NCAC 02H.0506(b)(3) and (c)(3); GC 4135]

17. The permittee and its authorized agents shall conduct its activities in a manner consistent with State water quality standards (including any requirements resulting from compliance with §303(d) of the Clean Water Act) and any other appropriate requirements of State and Federal law. If the NCDWR determines that such standards or laws are not being met (including the failure to sustain a designated or achieved use) or that State or federal law is being violated, or that further conditions are necessary to assure compliance, the NCDWR may reevaluate and modify this certification. [15A NCAC 02B.0200]

18. All fill slopes located in jurisdictional wetlands shall be placed at slopes no flatter than 3:1, unless otherwise authorized by this certification. [15A NCAC 02H.0506(b)(2)]

19. A copy of this Water Quality Certification shall be maintained on the construction site at all times. In addition, the Water Quality Certification and all subsequent modifications, if any, shall be maintained with the Division Engineer and the on-site project manager. [15A NCAC 02H .0507(c) and 15A NCAC 02H .0506 (b)(2) and (c)(2)]

20. The outside buffer, wetland or water boundary located within the construction corridor approved by this authorization, including all non-commercial borrow and waste sites associated with the project, shall be clearly marked by highly visible fencing prior to any land disturbing activities. Impacts to areas within the fencing are prohibited unless otherwise authorized by this certification. [15A NCAC 02H.0501 and .0502]

21. The issuance of this certification does not exempt the Permittee from complying with any and all statutes, rules, regulations, or ordinances that may be imposed by other government agencies (i.e. local, state, and federal) having jurisdiction, including but not limited to applicable buffer rules, stormwater management rules, soil erosion and sedimentation control requirements, etc.

22. The Permittee shall report any violations of this certification to the Division of Water Resources within 24 hours of discovery. [15A NCAC 02B.0506(b)(2)]

* 23. Upon completion of the project (including any impacts at associated borrow or waste sites), the NCDOT Division Engineer shall complete and return the enclosed "Certification of Completion Form" to notify the NCDWR when all work included in the 401 Certification has been completed. [15A NCAC 02H.0502(f)]

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24. There shall be no excavation from, or waste disposal into, jurisdictional wetlands or waters associated with this permit without appropriate modification. Should waste or borrow sites, or access roads to waste or borrow sites, be located in wetlands or streams, compensatory mitigation will be required since that is a direct impact from road construction activities. [15A NCAC 02H.0506(b)(3) and (c)(3)

25. Erosion and sediment control practices must be in full compliance with all specifications governing the proper design, installation and operation and maintenance of such Best Management Practices in order to protect surface waters standards [15A NCAC 02H.0506(b)(3) and (c)(3):

26. The erosion and sediment control measures for the project must be designed, installed, operated, and maintained in accordance with the most recent version of the *North Carolina Sediment and Erosion Control Planning and Design Manual*.
    a. The design, installation, operation, and maintenance of the sediment and erosion control measures must be such that they equal, or exceed, the requirements specified in the most recent version of the *North Carolina Sediment and Erosion Control Manual*. The devices shall be maintained on all construction sites, borrow sites, and waste pile (spoil) projects, including contractor-owned or leased borrow pits associated with the project.
    b. For borrow pit sites, the erosion and sediment control measures must be designed, installed, operated, and maintained in accordance with the most recent version of the *North Carolina Surface Mining Manual*.
    c. The reclamation measures and implementation must comply with the reclamation in accordance with the requirements of the Sedimentation Pollution Control Act.

27. Sediment and erosion control measures shall not be placed in wetlands or surface waters, or within 5 feet of the top of bank, without prior approval from DWR. [15A NCAC 02H.0506(b)(3) and (c)(3)]

Violations of any condition herein set forth may result in revocation of this Certification and may result in criminal and/or civil penalties. This Certification shall become null and void unless the above conditions are made conditions of the Federal 404 and/or Coastal Area Management Act Permit. This Certification shall expire upon the expiration of the 404 or CAMA permit.

If you wish to contest any statement in the attached Certification you must file a petition for an administrative hearing. You may obtain the petition form from the office of Administrative hearings. You must file the petition with the office of Administrative Hearings within sixty (60) days of receipt of this notice. A petition is considered filed when it is received in the office of Administrative Hearings during normal office hours. The Office of Administrative Hearings accepts filings Monday through Friday between the hours of 8:00am and 5:00pm, except for official state holidays. The original and one (1) copy of the petition must be filed with the Office of Administrative Hearings.

The petition may be faxed-provided the original and one copy of the document is received by the Office of Administrative Hearings within five (5) business days following the faxed transmission.
The mailing address for the Office of Administrative Hearings is:

Office of Administrative Hearings
6714 Mail Service Center
Raleigh, NC 27699-6714
Telephone: (919)-431-3000, Facsimile: (919)-431-3100

A copy of the petition must also be served on DEQ as follows:

Mr. Bill F. Lane, General Counsel

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Department of Environmental Quality
1601 Mail Service Center

This the 19th day of June, 2019
DIVISION OF WATER RESOURCES

DocuSigned by:
Amy Chapman
9C9886312DCD474...

Linda Culpepper, Director

WQC No. 20180645

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Asheville Field Office
160 Zillicoa Street Suite #B
Asheville, North Carolina 28801

February 22, 2019

Mr. John F. Sullivan, III, P.E.
Division Administrator
Federal Highway Administration
310 New Bern Avenue, Suite 410
Raleigh, North Carolina 27601

Subject: Proposed Widening of I-26 From US 25 Near Hendersonville to I-40/I-240 South of Asheville, Henderson and Buncombe Counties, North Carolina. Federal Aid Project No. NHF-26-1(62)23/IMNHF-026-1(86)9/WBS No. 34232.1.1/36030.1.1/S.T.I.P. No. I-4400/I-4700

Dear Mr. Sullivan:

This document transmits the U.S. Fish and Wildlife Service's (USFWS) biological opinion (Opinion), based on our review of the proposed widening of I-26, and its effects on the federally endangered Appalachian elktoe (*Alasmidonta raveneliana*) and gray bat (*Myotis grisescens*), and is in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531-1543) (Act).

This Opinion is based on information provided in a Biological Assessment (BA) submitted to the Service and received on August 20, 2018, field investigations, personal communications with experts on the affected species, and other sources of information. A complete administrative record of this consultation is on file at this office.

In the BA, the North Carolina Department of Transportation (NCDOT), in association with the Federal Highway Administration (FHWA), determined that the following federally listed species were Not Likely to be Adversely Affected by the proposed action: Indiana bat (*Myotis sodalis*) and northern long-eared bat (*Myotis septentrionalis*). The USFWS concurs with this determination. Additionally, the NCDOT and FHWY's concluded that the following species would not be affected by the proposed bridge replacement project: bog turtle (*Glyptemys muhlenbergii*), Blue Ridge Goldenrod (*Solidago spithamaea*), Bunched Arrowhead (*Sagittaria fasciculata*), Carolina northern flying squirrel (*Glaucomys sabrinus coloratus*), mountain sweet pitcherplant (*Sarracenia rubra ssp. jonesii*), rock gnome lichen (*Gymnoderma lineare*), rusty patched bumblebee (*Bombus affinis*), small whorled pogonia (*Isotria medeoloides*), spotfin chub

(*Erimonax monachus*), spreading avens (*Geum radiatum*), Spruce-fir moss spider (*Microhexura monitvaga*), swamp pink (*Helonias bullata*), tan riffleshell (*Epioblasma florentina walkeri*), Virginia spiraea (*Spiraea virginiana*), white fringeless orchid (*Platanthera integrilabia*), and white irisette (*Sisyrinchium dichotomum*). After review of the information provided, we concur with your effects determinations for the above species.

This fulfills the requirements under section 7 of the Act have been fulfilled for these species. Requirements under section 7 of the Act must be reconsidered if: (1) new information reveals effects of this identified action that may affect listed species or critical habitat in a manner not previously considered, (2) this action is subsequently modified in a manner that was not considered in this review, or (3) a new species is listed or critical habitat is determined that may be affected by the identified action.

Sincerely,

Janet Mizzi
Field Supervisor

Biological Opinion
I-26 Widening from US 25 Near Hendersonville to I-40/I-240 South of Asheville
Henderson and Buncombe Counties, North Carolina

FWS Log # 01-206

Prepared by:
U.S. Fish and Wildlife Service
Asheville Ecological Services Field Office
160 Zillicoa St.
Asheville, NC 28801

Janet Mizzi, Field Supervisor

2-22-19
Date

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CONSULTATION HISTORY

- May 3, 2001 – United States Fish and Wildlife Services (USFWS) concurred with a "No Effect" determination for all listed species associated with project I-4400.
- May 18, 2006 – USFWS provided scoping comments for the newly combined I-4400/4700 project. USFWS recommended a reevaluation for all listed species since more than five years had passed since surveys were conducted and the project scope had changed.
- July 19, 2016 – Gray bat discovered by NCWRC and USFWS in a bridge roost near Action Area.
- October 5, 2016 – Letter from USFWS to NCDOT providing comments on the Draft Environmental Impact Statement (DEIS, NCDOT, 2016). USFWS recommended additional surveys for bats.
- October 20, 2016 – Letter from United States National Park Service (NPS) to NCDOT providing comments on the DEIS. NPS stated they did not agree with the "No Effect" finding for gray bat since the species had recently been discovered near the project. The letter also mentioned that results of recent acoustic surveys along the Blue Ridge Parkway recorded calls consistent with those of Indiana bat. The letter recommended additional surveys for gray bat and Indiana bat, as well as protection of known, occupied habitat for bog turtle, which occurs adjacent to the existing interstate.
- November 30, 2016 – Coordination meeting with NCDOT, USFWS, NPS, NCWRC, FHWA to discuss needed surveys for gray bat.
- December 20, 2016 – On-site coordination meeting with NCDOT, USFWS, NPS, NCWRC, and FHWA to visit areas of concern and discuss needed bat surveys.
- January 30, 2017 – Meeting in Asheville with NCDOT, USFWS, NCWRC, and NPS to discuss bat survey specifics.
- March 23, 2017 – USFWS and NCWRC provide comments on proposed scope of work for gray bat surveys.
- May -August 2017 – Updates on progress of ongoing gray bat surveys.
- September 12, 2017 – Draft acoustic survey report submitted to USFWS, NCWRC, and NCDOT for review.
- September 29, 2017 – Surveys conducted downstream of the I-26 crossing over the French Broad River found a previously undocumented occurrence of Appalachian elktoe.
- October 11, 2017 – Merger Team Concurrence Point 4A Meeting. Potential stormwater and sediment and erosion control measures specific to minimizing impacts to gray bat and Appalachian elktoe were discussed. USFWS suggested additional conservation measures including a revegetation plan, minimization of impacts to surface waters, and minimization of tree clearing, particularly around the bridge over the French Broad River.
- October - December 2017 – A series of conference calls regarding information and structure of the BA including Action Area, conservation measures for federally listed species - including gray bat research project and conservation for Appalachian elktoe - in the French Broad River basin, the use of Design Standards for Sensitive Watersheds

(DSSW), the use of (and commitment to, where feasible and practical) post-construction stormwater controls for any streams draining directly to the French Broad River.

- February 1, 2018 – Coordination call/meeting with USFWS, FHWA, and NCDOT to discuss USFWS and FHWA comments on draft version of BA.
- February 7, 2018 – Call/meeting between USFWS, FHWA, NCDOT, North Carolina Division of Water Resources (NCDWR), and USACE to discuss bridge replacement over the French Broad River. USFWS, NCDWR, and USACE expressed concern over safety of river users, size of causeways, length of time causeways will be in place, and size of river channel opening while causeways are in place.
- March 5, 2018 – Revised plan for replacement of bridges over the French Broad River.
- June-July 2018 – NCDOT submitted draft BA to USFWS, USACE, NPS, FHWA, and NCDWR for review and comment. A series of calls to discuss aspects of the BA and revisions.
- August 20, 2018 – Final BA submitted to USFWS
- August 29, 2018 – Initiation of Formal Consultation.
- November 20, 2018 – Section 404/NEPA Merger Meeting Concurrence Point 4C
- November 27, 2018 – USFWS notified FHWA and NCDOT of outstanding information requested for the BO.
- December 17, 2018 – USFWS received all information requested from FHWA and NCDOT.
- December 22, 2018 – January 25, 2019 - federal government shutdown, USFWS employees on furlough
- February 1, 2019 - Phone conversation between USFWS and Marissa Cox, NCDOT Biological Surveys Group Supervisor, where NCDOT committed to three years of post construction monitoring for gray bats.
- February 8, 2019 – Phone conversation with Division 13 Construction Engineer concerning lighted night operations on the I-26 bridge (BO Section 2.3.2.1). The Engineer agreed to include a two week period with no lighting to facilitate migration during a critical period.
- February 11, 2019 - USFWS submitted a Draft Biological Opinion to FHWA and NCDOT for review.

BIOLOGICAL OPINION

1. INTRODUCTION

The Federal Highway Administration (FHWA) and the North Carolina Department of Transportation (NCDOT) are proposing highway improvements to a 22.2-mile (mi.) segment of Interstate 26 (I-26) in Henderson and Buncombe Counties, NC. The current interstate is a four-lane median divided highway. The highway will be widened to six lanes for about 13.6 miles from US 25 (Exit 54) in Henderson County northward to the US 25 (Asheville Highway; Exit 44) interchange and to eight lanes for about 8.6 miles to the I-40/I-240 interchange in Buncombe County just west of Asheville. In addition to widening the roadway, the bridges that carry the Blue Ridge Parkway over I-26 and the existing bridge that crosses the French Broad River (FBR) will be replaced and the pair of existing rest areas in Henderson County, south of Fanning Bridge Road (SR 3539) will be reconstructed. Project construction is anticipated to begin approximately 2 months after the contract is let (finalized), and will continue for approximately 60 months (5 years). This Biological Opinion considers the effects of the Action on the Appalachian elktoe and the gray bat.

2. DESCRIPTION OF THE PROPOSED ACTION

2.1 Action Area

For purposes of consultation under Section 7 of the Act, the Action Area is defined as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action" (50 CFR §402.02). The I-4400/I-4700 Action Area (Figure 1) includes the I-4400/I-4700 study area (as defined in the DEIS; NCDOT 2016), which extends 22.2 mi. and consists generally of a 1,400 ft.-wide corridor that follows I-26 from US 25 in Henderson County north to I-40/I-240 in Buncombe County, with expanded areas at interchanges, rest areas, and the Blue Ridge Parkway bridge. In addition, the Action Area incorporates some tributaries and portions of the FBR including:

- Sections of the FBR within 0.5 mi. (downstream) of tributary impacts,
- FBR tributaries impacted within 0.5 mi. of occupied Appalachian elktoe habitat, and
- The FBR from the I-26 crossing downstream (north) to I-40, specifically to the I-26 Connector (I-2513) study area (Appendix I).

2.2 Proposed Action

The following describes the major activities involved in the proposed project that will have an impact on gray bats and Appalachian elktoe. Replacement of the existing bridges over the FBR, widening existing I-26 and ongoing operations of I-26 after the construction is completed are described in detail. In addition, NCDOT through project design and up-front implementation

planning, has committed to a number of conservation measures to avoid and minimize impacts to gray bats and Appalachian elktoe and these specific measures also are detailed.

2.2.1 Bridge Replacement over the French Broad River

The existing pair of two-lane bridges that carry I-26 over the FBR will be replaced with one new structure that will provide a total of eight travel lanes. Demolition of the existing bridges and construction of the new bridge is anticipated to take approximately three to four years.

The proposed new bridge structure will have three spans with lengths of approximately 151 ft., 170 ft., and 143 ft. from east to west, and will require two bents (foundation supports) in the river. Each bent will require ten drilled shafts. Assuming ten, 5-foot diameter shafts for each bent, the drilled shaft area is approximately 200 square feet (sq. ft.), per bent, for a total of 400 sq. ft. for both bents. Currently, drainage from the deck of the existing structure flows directly into the river. The new structures include shoulders sufficient to convey runoff into adjacent stormwater control devices and eliminate direct discharge into the river.

Bridge construction and demolition will require temporary access roads adjacent to existing I-26 to reach the river and temporary stone construction causeways in the FBR to construct the bridge. The access roads will be built parallel to I-26 in all four quadrants of the existing bridge. Vegetation clearing at the FBR will be minimized as much as practicable to build the access roads. Access roads will require approximately 3.75 ac. beyond the current slope stake limits for the project. However, these areas would need to be cleared as part of the typical construction process for this project.

Some work would likely need to be completed at night. The amount and type of lighting for all activities will be minimized to the maximum extent possible. Because the FBR is regularly used for recreation, it cannot be closed to navigation for the duration of construction. As part of providing a safe passage lane for river users, NCDOT will install steady-state, solar-powered red lighting on the construction causeways.

2.2.2 Highway Widening

Existing I-26 will be widened from four lanes to eight lanes for about 8.6 miles and to six lanes for about 13.6 miles. The highway will be widened primarily within the existing right-of-way and to the middle of the current roadway. Construction activities associated with the proposed widening project include clearing and grubbing vegetation, grading, paving, culvert extensions and replacements, bridge replacements, striping, signs, and lighting.

The project includes limited clearing of woody vegetation to accommodate additional travel lanes and interchange expansions. Clearing will likely begin almost immediately after the project is let for construction, and may continue for a period of up to two years. Clearing may occur at different locations along the length of the project, depending on construction timing/phasing. Clearing activities will take place during daylight hours, but may occur during any time of year, with the exception of the area on Blue Ridge Parkway property where tree clearing will occur between August 15 and May 15.

The 3.3-mi. long section of the project that extends from just north of the Blue Ridge Parkway to NC 191 (Brevard Road) is heavily wooded. For this reason, because of its proximity to the FBR, and because it is the largest contiguously forested area within the Action Area, clearing in this section will be minimized. Clearing will not extend beyond areas that will become part of the permanent project footprint. NCDOT developed a preliminary design that utilizes retaining walls whenever practicable for this section of the project. Based on the slope stake limits associated with preliminary design and the tree line presented in the final survey, approximately 3.8 ac. of trees will be cleared along this section of the project.

2.2.3 Highway Operation

Once the highway is widened and in operation, the additional capacity will increase the number of vehicles that travel the roadway in the Action Area. Increases in traffic will increase noise and nighttime lighting from headlights. The majority of the corridor will remain unlit except at existing interchanges. Two locations will require additional permanent lighting: the I-26 and US 25 (Asheville Highway) interchange and the reconstructed rest areas. The additional pavement will increase the amount of impervious surface and post-construction stormwater.

2.3 Conservation Measures

Conservation measures represent actions, pledged in the project description, that the action agency will implement to minimize the effects of the proposed action and further the recovery of the species under review. Such measures should be closely related to the action and should be achievable within the authority of the action agency. The beneficial effects of conservation measures are taken into consideration in the USFWS's determination of a jeopardy versus a non-jeopardy opinion and in the analysis of incidental take.

The NCDOT proposes to offset project related impacts by implementing a number of conservation measures. Included in the overall proposal are measures that will help aid recovery by conserving or restoring habitat and measures intended to minimize direct impacts through project design, construction practices, and monitoring and remediation. Some of these measures directly benefit gray bats or Appalachian elktoe, but many are beneficial to both species. Where appropriate, the measures are further categorized by the species that may derive the most benefit.

2.3.1 Highway Widening

Indiana, Northern long-eared and gray bats

2.3.1.1 Time of Year Restriction for Tree Clearing on the Blue Ridge Parkway:

- No tree clearing will occur on NPS land between May 15 and August 15.
- Emergence and/or acoustic surveys are required prior to any tree clearing that must occur between April 1 and May 1 or August 15 and November 15.
- No significant tree removal within 5 mi. of known hibernacula can occur between April 1 and November 15.

- In the event that any roost trees are documented within 0.25 mi. of the project area, regardless of the time of year, the NPS will seek consultation with the USFWS before work proceeds.

Gray bats

2.3.1.2 Minimization of Tree Clearing:

- In the area between the Blue Ridge Parkway and NC 191 (Brevard Road), trees will only be cleared to establish the permanent project footprint, temporary piping of streams SEE and SFG (as identified in Table 15 of the BA), establish associated SEC devices, and to create temporary construction access roads at the Blue Ridge Parkway.

2.3.1.3 Roadway Construction Lighting:

- Due to gray bat activity on the landscape between April 15 and October 15, NCDOT will limit all construction-related lighting to whatever is necessary to maintain safety in active work areas closest to the FBR during this time. Therefore, construction-related lighting will not project into adjacent wooded areas or over the water surface of the river. This restriction will apply to locations between Brevard Road (NC 191) and Glenn Bridge Road (SR 3495) with the exceptions of the construction area associated with the access roads at the Blue Ridge Parkway and the existing brightly lit area associated with the Long Shoals Road (NC 146) interchange.

- During construction, lighting will only be used in areas where active construction is occurring. Otherwise, no additional lighting is needed. For paving operations, specifically, which will more than likely be at night, the area typically lit is directly adjacent to the paving machine.

Gray Bats and Appalachian Elktoe

2.3.1.4 Erosion Control Measures:

When projects occur in watersheds that contain protected aquatic species, NCDOT implements erosion control measures that exceed the standard BMPs. For this project a combination of Design Standards in Sensitive Watersheds (DSSW, 15A NCAC 04B .0124), Environmentally Sensitive Areas and the NC Division of Water Quality (NCDWQ) Construction General Permit (NCG01) terms and conditions that allow for stormwater discharge under the National Pollutant Discharge Elimination System (NPDES) apply and NCDOT will default to the most-restrictive SEC measure requirement. A table comparing these methods can be found in Appendix II.

The sedimentation and erosion control plan (SECP) will be in place prior to any ground disturbance for all bridge replacements and construction. When needed, combinations of erosion control measures (such as silt bags in conjunction with a stilling basin) will be used to ensure that the most protective measures are being implemented.

- The sedimentation and erosion control plans shall adhere to the DSSW, where practicable, within the existing and proposed right of way for the following areas:
    - From the Blue Ridge Parkway bridge to the northern project terminus.
    - For portions of the project within 1 mi. and draining directly to streams that are identified as NCDEQ and/or NCWRC designated trout streams.
    - For portions of the project within 1 mi. and draining directly to streams where aquatic threatened or endangered species are present.

- Environmentally Sensitive Areas will be demarcated within the Action Area and will be defined by a 50-foot buffer zone on both sides of jurisdictional streams measured from top of streambank, in which the following shall apply:
    - The Contractor may perform clearing operations, but not grubbing operations until immediately prior to beginning grading operations.
    - Once grading operations begin, work shall progress in a continuous manner until complete.
    - Erosion control devices shall be installed immediately following the clearing operation.
    - Seeding and mulching shall be performed on the areas disturbed by construction immediately following final grade establishment.
    - Seeding and mulching shall be done in stages on cut and fill slopes that are greater than 20 ft. in height measured along the slope, or greater than 2 ac. in area, whichever is less.
    - All SEC measures, throughout the project limits, must be cleaned out when half full of sediment, when applicable, to ensure proper function of the measures.

2.3.1.4.1 Streams Designated as Environmentally Sensitive Areas

Stream Name	NRTR Map ID	Distance to French Broad River (mi.)	Stream Effects (ft.) (2:1 SS+25 ft.)*	Stream Effects (ft.) (2:1 SS)**
UT to Dellwood Lake^	SFG	0.00	2010.0	662.3
Powell Creek (Lake Julian)***	SDN	0.03	111.1	53.0
UT to French Broad***	SDU	0.05	86.9	34.4
UT to French Broad***	SDK	0.05	75.1	48.9
UT to French Broad ***	SDF	0.06	91.0	61.9
UT to French Broad***	SFX	0.06	72.6	47.3
UT to French Broad***	SEQ	0.07	74.5	24.2
UT to French Broad***	SDG	0.07	68.9	43.0
UT to French Broad***	SDX	0.08	1043.2	399.6
UT to French Broad***	SDW	0.09	60.0	25.3
UT to French Broad***	SFO	0.10	56.7	55.0
UT to French Broad***	SDE	0.10	99.1	47.6
UT to French Broad^	SEE	0.15	383.0	106.3
UT to French Broad***	SEF	0.15	505.3	368.1
UT to Dellwood Lake***	SFI	0.19	7.3	0.0

UT to French Broad***	SDY	0.41	22.5	2.3
UT to French Broad***	SED	0.43	66.7	9.4
UT to French Broad***	SEV	0.47	43.7	16.8
UT to French Broad***	SDC	0.50	102.5	44.2
UT to French Broad***	SEW	0.55	37.9	12.8
UT to French Broad***	SEU	0.55	18.3	10.6
UT to Dellwood Lake***	SFR	0.67	46.0	27.8
UT to Dellwood Lake***	SFQ	1.09	96.8	43.7
UT to Long Valley Branch***	SFM	1.86	382.0	29.0
UT to Long Valley Branch***	SFP	1.90	50.0	22.7
Long Valley Branch***	SFN	2.19	43.8	24.9

*Effects calculated based on current design proposed 2:1 slope stake (SS) limits plus 25 ft. (SS+25).
**Effects calculated based on current design proposed 2:1 slope stake (SS) limits. Effects for Streams SFG, SFO, and SEE calculated based on access road footprint.
***Streams subject to DSSW and designated as Environmentally Sensitive Areas.
^Stream to be temporarily piped for construction of access road (access road is too close to allow for 50-ft buffer).

- Contract language regarding erosion control will include the following, or similar language as appropriate:

    - "The Contractor will be required to prosecute the work in a continuous and uninterrupted manner from the time work begins until completion of each phase of structure construction, demolition, and completion. The Contractor will not be permitted to suspend operations except for reasons beyond their control or except where the Engineer has authorized a suspension of the Contractor's operations in writing."
    - "In the event that the Contractor's operations are suspended in violation of the above provisions or it is determined the Contractor is not deemed to be pursuing the work in a continuous manner in accordance with his submitted and approved schedule, the sum of $1000.00 per day will be charged to the Contractor for each and every calendar day that such suspension takes place. The said amount is hereby agreed upon as liquidated damages due to extra engineering and maintenance costs and due to increased public hazard resulting from a suspension of the work. Liquidated damages chargeable due to suspension of the work will be additional to any liquidated damages that may become chargeable due to failure to complete the work on time."

2.3.1.4.2 Monitoring of Effectiveness of SEC Devices:

- Two Construction Project Inspectors, one for I-4400 and one for I-4700, will monitor SEC devices for the life of the project.

- Inspections of erosion control devices will be done daily for construction associated with the FBR bridge replacement. For the remainder of the project, the standard inspection schedule (weekly, or after a rainfall event of one-half inch or greater) will apply.
- NCDOT will install a rainfall data logger at the river to continuously monitor and record rainfall events.
- NCDOT will self-report to USFWS any SEC device failures that result from excessive rainfall events (exceeding a 25-year storm event). The NCDOT inspector will report any failures to the Division Environmental Officer, who will contact the agency within 24 hours. If there are any failures in SEC measures, NCDOT will meet with resource agencies and work to adaptively manage SEC devices for further storm events while construction continues.

2.3.1.4.3 Agency Coordination:

- NCDOT will invite representatives from USFWS, USACE, and the NCWRC to the pre-construction meeting for the proposed project, as well as to all subsequent field inspections prior to construction, to insure compliance with all special project commitments.
- NCDOT shall provide USFWS with the SECP and allow 15 days for review.
- NCDOT shall provide USFWS with the FBR bridge demolition plan and allow 15 days for review.
- All resource agencies will be invited to review the demolition plan and will be notified prior to start of demolition so they may have a representative on site.
- NCDOT will invite USFWS and USACE to review the design of the SEC measures for streams SEE and SFG, as well as the revegetation and monitoring plan.
- NCDOT will contact USFWS if new information about gray bats is discovered, as it relates to the project.
- NCDOT will report any injured or dead bats found on the construction sites to USFWS.

2.3.2 Bridge Construction

Gray Bats

2.3.2.1 Night Time Construction Activities at FBR:

At the FBR bridge, the use of lights after sunset may be necessary to improve safety for work crews during construction. These are not operations that occur on a regular schedule.

- To minimize potential impacts to lactating females and their pups, between June 1 and June 14, NCDOT shall commit to restrict the construction contractor to no night work. During June 15 through August 1, NCDOT will also commit to restrict the construction contractor to no more than 28 total nights of work, with no more than four consecutive nights. Lighting used for construction will be limited to what is necessary to maintain safety standards, and will only be directed toward active work areas.

2.3.2.2 Red Safety Lighting:

- NCDOT shall place solar-powered, steady-state, red, safety lights on the causeways for river user safety. Generators will not be used to provide power, so as to avoid additional noise that may disturb bats flying through the work zone.

Gray Bats and Appalachian Elktoe

2.3.2.3 FBR Bridge Replacement:

- NCDOT may install temporary retaining walls on the outer edges of the access roads to reduce impacts to adjacent forested land and jurisdictional features.
- The footprint for the access roads will not extend beyond the permanent project footprint.
- Activities in the floodplain will be limited to those needed to construct the proposed bridge and remove the existing bridges.
- Streams SEE and SFG will be temporarily piped during bridge construction and demolition. A revegetation and stream monitoring plan shall be developed for Streams SEE and SFG. The revegetation and stream monitoring plan shall be approved by the USACE and USFWS and will commence once the bridge construction and demolition are complete and the pipe is removed. Monitoring, to observe vegetation success and stream stability and detect and control invasive exotic plants, will take place for a minimum of three years after construction.
- Causeways will be used instead of multiple work bridges which would require drilled piles and take longer to install. The use of causeways also means that work bridge support piers will not be present, thereby eliminating obstacles in the flight path of bats foraging and commuting through the work zone.
- Causeways will have 1:1 slopes to minimize their size.
- NCDOT will require the contractor to use clean rock (free of debris and pollutants) for the construction of the causeways to minimize unnecessary sediment input into the river.
- Causeway material will be removed to the extent practicable and either disposed of off-site or used in areas that require permanent stone protection after project completion. NCDOT will also require that concrete barriers (barrier rail) be placed along the downstream edge of each causeway to limit the downstream movement of causeway material during high flow events.
- Causeway material will be added/removed as needed for each stage to minimize the causeway footprint over the length of the project.
- The Stage 4 causeway extension will be sloped to allow water to flow over the top, reducing overall impact to channel flow (See NCDOT I-26 Bridge over the French Broad River Proposed Construction and Demolition document for details).
- To minimize disturbance to the riverbed, all readily detectable causeway material will be removed to the extent practicable, while removing as little of the original riverbed as possible.
- Construction fabric will not be used under the causeway material, as it has a tendency to tear into tiny pieces and float downstream during removal.
- Any equipment that is placed on the causeways will be removed any time throughout a work day when the water level rises, or is expected to rise overnight, to a point where the equipment could be flooded, or during periods of inactivity (two or more consecutive

days). The only exception to this measure is that the drill rig and crane may be left in place for periods of inactivity; however, they must also be removed if the water rises, or is expected to rise, to a point where the drill rig and crane could be flooded.

- NCDOT will require the contractor to use new or steam-cleaned equipment to access causeways that are under water if these causeways are utilized for removal of existing bents in underwater conditions.
- NCDOT will require the contractor to have clean, non-leaking equipment, diapers on-site for each causeway, and spill kits located at each causeway.
- With the exceptions noted below for the drill rig and crane, all construction equipment shall be refueled outside the 100-year floodplain or at least 200 ft. from all water bodies (whichever distance is greater) and be protected with secondary containment. During crucial periods of construction and demolition, when the drill rig and crane cannot be moved, the drill rig and crane can be refueled while inside the 100-year floodplain provided that spill response materials (such as spill blankets and fueling diapers) are used during the refueling. Hazardous materials, fuel, lubricating oils, or other chemicals will be stored outside the 100-year floodplain or at least 200 ft. from all water bodies (whichever distance is greater), and not in a Water of the U.S. Areas used for borrow or construction by-products will not be located within wetlands or the 100-year floodplain.
- When constructing drilled piers for the FBR bridge, a containment system will be developed so that material does not enter the river. Material by-product will be pumped out of the shaft to an upland disposal area to the extent practicable and treated through a proper stilling basin or silt bag.
- The erosion-control plan will be in place prior to any ground disturbance for the FBR bridge replacement. When needed, combinations of erosion-control measures (such as silt bags in conjunction with a stilling basin) will be used to ensure that the most protective measures are being implemented.
- Construction of the new bridge will be accomplished in a manner that prevents uncured concrete from coming into contact with water entering or flowing in the river.
- The causeway design has been refined to allow for a maximum free flow area of the FBR. The original design provided for only a 28 percent free flow area of the river at the causeway's largest size. The design was refined and now allows a 51 percent minimum free flow area when the causeway is at its greatest extent.
- Removal of the existing bridge shall be performed so as not to allow debris to fall into the water. If debris is dropped in the river, it will be immediately removed.
- The current barrier on the bridge is a one bar metal rail on concrete parapet with retrofitted guardrail. It will be replaced with concrete barrier rail, a 42-in. solid, concrete "Jersey barrier" style guard wall.

2.3.3 Roadway Operation

Gray Bat

2.3.3.1 Minimal Additional Roadway Lighting:

- NCDOT will add minimal additional permanent lighting. Lighting at interchanges may be relocated, to allow for reconfiguration or expansion of the interchanges, but new

lighting will only be required at the US 25 (Asheville Highway) interchange and the rest areas.

Gray Bat and Appalachian Elktoe

2.3.3.2 Stormwater Control Measures:

- NCDOT has developed stormwater commitment guidance, which will apply at crossings of the FBR and any portion of the NCDOT stormwater conveyance system draining to an outfall discharging to the river within the NCDOT right of way.
- NCDOT will prepare a stormwater management plan (SMP) that implements structural and non-structural post-construction stormwater best management practices (BMPs) to the maximum extent practical, which is consistent with the Department's National Pollutant Discharge Elimination System (NPDES) Post-Construction Stormwater Program.
- When preparing the SMP, NCDOT commits to using a hierarchical BMP selection process, which is optimized to treat silt, nutrients, and heavy metals.
- NCDOT will commit to evaluating the use of emerging BMP technologies that the Department has not yet published in its BMP Toolbox. These emerging BMP technologies are as follows:
    - Bioswales
    - Bioembankments
    - Biofiltration conveyances
    - Soil improvement to maximize infiltration

2.3.3.3 Reforestation and Monitoring Plan:

- Eastern Federal Lands Highway Division (EFLHD) of FHWA will develop a re-vegetation/landscaping plan to re-establish native vegetation and provide for a continuous visual experience for Blue Ridge Parkway and Mountains to Sea Trail users.
- For the portion of the project from the Blue Ridge Parkway overpass to the northern terminus of the project, NCDOT will develop a revegetation plan that incorporates native woody and/or shrubby vegetation, as appropriate, for areas outside of the final slope stake limits disturbed during construction. The monitoring shall be conducted annually for a minimum of three years after final planting. Photo documentation shall be utilized to document the success of the vegetation and a report shall be submitted to the USFWS within sixty (60 days) post monitoring.
- NCDOT will develop a revegetation and monitoring plan for Streams SEE and SFG to commence once the bridge construction and demolition are complete and the temporary pipes are removed, which will likely be similar to the revegetation plan presented above for the area between the Blue Ridge Parkway overpass and the northern project terminus.

2.3.4 Habitat Conservation Measures

2.3.4.1 Conservation Measures to Benefit Gray Bats

NCDOT-Sponsored gray bat Research Project:

- NCDOT, with the cooperation of the USFWS and NCWRC, committed to a three year study on gray bats within the FBR Basin. This study will serve as a conservation measure for NCDOT projects within the Divisions 13 and 14 for a limited time. NCDOT will provide $900,000 in funding to Indiana State University to conduct the research project, which will aid in the recovery and conservation of the gray bat. The end goal is to gather the information needed to allow NCDOT and USFWS to enter into a programmatic consultation to cover the gray bat for NCDOT Divisions 13 and 14, as well as help to develop species-specific avoidance and minimization measures.

2.3.4.2 Conservation Measures to Benefit Appalachian Elktoe

FBR Conservation Funding:

- NCDOT will provide $500,000 in funding to the North Carolina Nongame Aquatic Projects Fund for the FBR Conservation Plan (FBRCP) proposed by USFWS, which will aid in the recovery and conservation of Appalachian elktoe. The funding will be held by the NCWRC. A multi-agency/organization group of mussel species experts, including USFWS and NCDOT, will determine how to expend the funds, which may include the following: species reintroduction, early warning and emergency production capacity, genetic management program, and other appropriate activities as described in the FBRCP.

2.3.5. Monitoring

2.3.5.1 Erosion and Sediment Control Performance Monitoring

- NCDOT will implement a video surveillance system that will target critical areas identified along the project corridor for the purposes of monitoring the performance of erosion and sediment control practices. The surveillance equipment will be comprised of video equipment capable of monitoring target areas. The intent of the active surveillance will be to provide assurance that the necessary erosion and sediment control practices are being implemented and maintained as practical to protect the identified resource.

- NCDOT will document the performance through images extracted from the video surveillance system. Due to the complexity of utilizing sensitive video equipment in a construction area, the Department may experience technical difficulties which will have to be resolved or a supplemental monitoring system will need to be deployed.

- NCDOT will provide the monitoring images to USFWS at their request, and/or when there has been an event that resulted in a failed erosion and sediment control measure, and will also identify the actions taken to correct the situation.

- NCDOT will identify target areas that have significant risk to the resource due to failed erosion and sediment control devices while land disturbance would be occurring. Once the area is stabilized then the surveillance equipment can move to the next target area. Special attention will be given to those streams identified by the USFWS.

2.3.5.2 Monitoring for Gray Bat Return and Activity:

- NCDOT will conduct acoustic monitoring for gray bats immediately prior to and during construction at the FBR bridge. Acoustic data may provide valuable information on bat activity in general, and gray bat activity, in particular, as it relates to project construction.
- To determine whether gray bats avoid the active construction zone, NCDOT will investigate the use of night-vision video recordings, or other methods, in an attempt to monitor bat activity at the bridge while active night time construction is underway.

2.3.5.3 FBR Geomorphology Monitoring:

- To ensure bridge construction at the FBR crossing will not result in substantial changes to channel stability (scour, erosion, etc.), NCDOT will conduct river channel monitoring at the I-26 bridge construction site to document the morphological condition at the FBR bridge site and to evaluate the impacts of construction and temporary causeways on river habitat. Monitoring activities will consist of the following:

    - Surveying the FBR channel bathymetry and riverbanks before and during the construction of the I-26 crossing (approximately 3.5 years). Mapping will occur before construction and then every quarter during construction, with one final survey after the causeways are all removed, and will cover at least 100 ft. upstream and 250 ft. downstream of the causeway locations.
    - A complete digital terrain model (DTM) of the stream bed and banks from each survey conducted will be prepared. NCDOT will retain an experienced firm or staff members to analyze the DTM and compile a final report to be submitted to USFWS.
    - If monitoring at the FBR reveals excessive bank erosion, bank instability, or sedimentation associated with the bridge replacement, NCDOT will work to identify the cause and will make improvements to address the problems in a timely manner.

3. STATUS OF THE SPECIES

3.1 GRAY BAT

This section summarizes best available data about the biology and current condition of the gray bat (*Myotis grisescens* - gray bat) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list the gray bat as endangered on April 28, 1976. There is no designated critical habitat for this species.

3.1.1 Species Description and Life History

The gray bat is one of the largest species in the genus *Myotis* in eastern North America, with a forearm length of 40 to 46 millimeters, a weight of 7 to 16 grams (usually 8 to 11 grams), and a wingspan of 27.4 to 30 centimeters (Barbour and Davis 1969). Gray bats can most readily be distinguished from other *Myotis* by their wooly, unicolored dorsal fur, which may seem paler on

the bats' belly. The fur appears gray after the mid-summer molt, becoming chestnut brown or bright russet leading to the next molt (Gore 1992). Another important characteristic is the wing membrane, which is also gray, connects to the foot at the ankle rather than the base of the toes (Barbour and Davis 1969, Gore 1992). The nails on the feet are notched and the calcar is unkeeled (Harvey *et al.* 1981, Sealander 1979).

The primary range of the gray bat is concentrated in the cave regions of Alabama, Arkansas, Kentucky, Missouri and Tennessee, with smaller populations found in adjacent states, including a growing population in a quarry in Clark County, Indiana (Harvey *et al*. 1981, Brack *et al*. 1984, Harvey 1992, Harvey 1994, Mitchell 1998). Gray bats are one of the few species of bats in North America inhabiting caves year-round. The species occupies cold caves or mines in winter and warmer caves during summer (Tuttle 1976a, Harvey *et al*. 1981, Harvey 1994, Martin 2007). In winter, gray bats hibernate in deep vertical caves that trap large volumes of cold air and the species typically forms large clusters with some aggregations numbering in the hundreds of thousands of individuals (Harvey 1994, Tuttle and Kennedy 2005). The species chooses hibernation sites where there are often multiple entrances, good air flow (Martin 2007) and where temperatures are approximately 5°-9° C, though 1°-4° C appears to be preferred (Tuttle and Kennedy 2005). Tuttle (1979) noted that an estimated 95% of the range-wide population was confined to only nine caves.

There are a few exceptions to this cave-specific roosting strategy. Many bat species use bridges as roost sites (Keeley and Tuttle 1999) and the gray bat is no exception. Bridges provide a warm thermal refuge for individuals foraging far from their primary daytime roosts and have been documented as night roosts for gray bats in northwest Georgia (Johnson *et al*. 2002). Gray bat maternity colonies have been found in storm drains (i.e., culverts) in Arkansas (Harvey and McDaniel 1988, Timmerman and McDaniel 1992), Kentucky (Hays and Bingham 1964), and Kansas (Decher and Choate 1988). Culvert conditions can mimic those found in natural caves in terms of high levels of humidity and clear running water. Maternity colonies have also turned up in more unusual places, such as a barn in Missouri (Gunier and Elder 1971) and the gate room of a large dam in Tennessee (Lamb 2000).

Gray bats show strong philopatry to both summering and wintering sites (Tuttle 1976a, Tuttle 1979, Tuttle and Kennedy 2005, Martin 2007). Because of their highly specific roost and habitat requirements, only about 5% of available caves are suitable for occupancy by gray bats (Tuttle 1979, Harvey 1994). At all seasons, males and yearling females seem less restricted to specific cave and roost types (Tuttle 1976b). Bachelor males segregate in separate aggregations within a colony home range that usually includes several caves that may extend up to 70 kilometers along a particular river valley (Tuttle and Kennedy 2005).

Gray bat hibernacula are often comprised of individuals from large areas of summer range. Based on band recovery data, Hall and Wilson (1966) calculated that a gray bat hibernaculum in Edmonson, County Kentucky attracted individuals from an area encompassing 27,195 square kilometers in Kentucky, southern Illinois, and northern Tennessee (Hall and Wilson 1966). Gray bats are documented to regularly migrate from 17 to 437 kilometers between summer maternity sites and winter hibernacula (Tuttle 1976b, Hall and Wilson 1966), with some individuals moving as much as 689 to 775 kilometers (Tuttle 1976b, Tuttle and Kennedy 2005).

Gray bats are reproductively mature at two years of age (Miller 1939, Tuttle 1976a) and mate between September and October. Copulation occurs upon arrival at hibernating caves, whereupon females immediately enter hibernation. Mating males may take a few weeks to replenish fat stores, but are typically in hibernation by early November (Tuttle 1976b, Tuttle and Stevenson 1978). Adult females store sperm throughout hibernation, a strategy known as delayed fertilization, and pregnancy begins following their spring emergence (Krulin and Sealander 1972). After a gestation period of 60 to 70 days (Saugey 1978), females give birth to one pup between late May and early June. Newborn young weigh approximately one-third of their mother's weight and are volant within 21-33 days (Tuttle 1976b, Harvey 1994, Tuttle and Kennedy 2005).

In summer, female gray bats form maternity colonies of a few hundred to many thousands of individuals. Nursery colonies typically form on domed ceilings of caves that are capable of trapping the combined body heat from clustered individuals and where the temperature ranges between 14° and 25° C (Harvey 1992, Harvey 1994, Tuttle and Kennedy 2005, Martin 2007). All other individuals not actively mating, both male and female, occupy caves on the outlying edge of the home range (Tuttle 1976b).

Gray bats feed exclusively on insects, with flies (Diptera), beetles (Coleoptera), caddisflies (Trichoptera), moths (Lepidoptera), wasps (Hymenoptera), stoneflies (Plecoptera), leafhoppers (Homoptera), and mayflies (Ephemeroptera) being the most important orders of insect prey (Rabinowitz and Turtle 1982, Clawson 1984, Brack 1985, Lacki *et al*. 1995, Best *et al*. 1997). Diet has been found to coincide most directly with the predominantly available prey species in the foraging area (Clawson 1984, Barclay and Bingham 1994), including both terrestrial and aquatic species (Clawson 1984). A study examining fecal remains conducted by Brack and LaVal (2006) indicates that gray bat diets fluctuate to a minor degree depending upon varying factors such as age, sex, and location.

Gray bat summer foraging is strongly correlated with open water of rivers, streams, lakes or reservoirs, where insects are abundant (Tuttle 1976b, LeVal *et al*. 1977). Results of surveys conducted in Tennessee indicate that wetland depressions are also important foraging sites for gray bats (Lamb 2000). Although the species may travel up to 35 kilometers between prime feeding areas over lakes and rivers and occupied caves, (LaVal *et al*. 1977, Tuttle and Kennedy 2005, Moore *et al*. 2017), most maternity colonies are usually located between 1-4 kilometers from foraging locations (Tuttle 1976b). Newly volant gray bats travel 0.0 – 6.6 kilometers between roost caves and foraging areas (Tuttle 1976a, Tuttle 1976b). At foraging sites, Tuttle (1976b) estimated that gray bats forage within roughly three meters of the water's surface. Abbreviated instances of bad weather in early spring and late fall are generally the only times gray bats deviate from primarily feeding along local bodies of water, and then they are found foraging in forest canopies (LaVal *et al*. 1977, Stevenson and Tuttle 1981).

Gray bats are known to establish foraging territories as insect numbers drop after dusk. Territories are controlled by reproductive females, which annually return to preferred territories (Brady *et al*. 1982, Goebel 1996). Gray bats tend to have large home ranges. Thomas and Best (2000) reported non-reproductive gray bats (males and females) from one northern Alabama cave foraged over areas of approximately 97 square kilometers. Moore *et al.* (2017) found reproductive female gray bats in Arkansas had a larger home range than previously thought, with

an average of 159 square kilometers, and they depend on water for foraging and traveling. The home range for reproductive females may change depending on reproductive status, but could also change based on colony size, insect abundance, habitat continuity, land use, or a combination of these factors (Moore *et al.* 2017). During times of limited food resources, males and pre-reproductive females may be excluded from foraging territories (Stevenson and Tuttle 1981).

Forested areas along the banks of streams and lakes serve as corridors for travel and as protective feeding cover for newly volant young (Tuttle 1979, Brady *et al*. 1982, Moore *et al.* 2017). Whenever possible, gray bats of all ages fly in the protection of forest canopy between roosts and feeding areas (USFWS 1982). In addition, young often feed and take shelter in forest areas near the entrance to cave roosts (Tuttle 1979). Individuals may also fly overland from relatively land-locked roost sites to reach the main river channel or tributary systems that lead to open-water foraging sites (Thomas 1994, Best and Hudson 1996). Gray bats do not feed in areas along rivers or reservoirs where the forest has been cleared (LaVal *et al.* 1977).

Young, non-volant gray bats experience healthy growth rates because their energy expenditure for thermoregulation is reduced by the roosting colony (Herreid 1963, 1967). In undisturbed colonies, young may take flight within 20 to 25 days after birth. However, young may not become volant for 30 to 35 days if disturbed (Tuttle 1975). Hunting is primarily learned by young on their own after learning to fly (Stevenson and Tuttle 1981), though lactating females will continue to nurse their offspring for a short time after they become volant. Survival and growth of volant young is inversely proportional to the distance travelled for shelter and food (Tuttle 1976a). Roosts are cool during this period of lactation and females are often required to feed continuously to sustain the high body temperatures required to nurse (Tuttle and Stevenson 1977). Distance traveled to feeding areas may also be correlated with adult mortality (Martin 2007).

Gray bats have been recorded as living up to 17 years (Harvey 1992, Tuttle and Kennedy 2005), with a mean annual survival rate of 70 percent in males and 73 percent in females (Gunier and Elder 1971). While survivorship among juveniles is relatively high (Saugey 1978), only 50 percent of gray bats reach maturity (USFWS 1980). Therefore, approximately five years are required for a female gray bat to produce two surviving offspring. Mortality rates are higher during the spring migration when fat stores have been expended and food resources can be scarce (Tuttle and Stevenson 1977).

3.1.2. Status and Distribution

The gray bat largely occupies a limited geographic range in karst areas of the southeastern United States. They are mainly found in Alabama, northern Arkansas, Kentucky, Missouri, and Tennessee. A few can be found in northwestern Florida, western Georgia, southeastern Kansas, southern Indiana, southern and southwestern Illinois, northeastern Oklahoma, northeastern Mississippi, western Virginia, and western North Carolina.

In the late 1970s, Tuttle (1979) estimated the total population to be approximately 2.25 million. The population was estimated at only 1.6 million in the early 1980s (Brady *et al*. 1982) and fell to 1.5 million within the next 10 years (Harvey 1992). By 2001, the population increased to 2.3

million (Mitchell and Martin 2002), and again to 2.5 million in 2003 (Harvey *et al.* 2004). This is a net increase in population size of approximately 10 percent between the 1970's and 2003, and an increase of 40 percent from the smallest population estimate. The status of hibernating populations of gray bats was further reviewed in 2006 (Harvey and Currie 2007). At that time, the population was estimated at 3,377,100 – an estimated increase of 104 percent from 1982 (Harvey and Currie 2007).

As defined in the Gray Bat Recovery Plan, Priority 1(P1) hibernacula include caves occupied now or in the past by more than 50,000 gray bats in northern Alabama and Tennessee, and 25,000 elsewhere (USFWS 1982). Most of the 17 current P1 caves were designated in the recovery plan, but several additional caves have been identified as having significant winter populations in more recent times. From 2013 -2015 many of the 17 P1 hibernacula were surveyed, however not all caves were surveyed in the same winter. In 2017, winter surveys of all P1s were conducted, including the largest hibernaculum, Fern Cave in Alabama. This coordinated, rangewide effort provided the best opportunity in decades to estimate the gray bat population, now estimated at approximately 4,358,263 (Shauna Marquardt pers. comm.).

3.1.3 Threats

The primary cause of gray bat population decline is human disturbance of their natural habitat (Barbour and Davis 1969, Mohr 1972, Harvey 1975, Tuttle 1979, USFWS 1982, USFWS 2009b), with wintering sites and maternity roosts being especially susceptible to disruption. Commercialization of caves that allows for public access, spelunking, and looting for archaeological artifacts are activities that most commonly result in disturbance to roosting bats (USFWS 1982, USFWS 2009b). Disturbance in the hibernacula occurs when a human enters the cave and bats wake from hibernation, using vital energy stores that cannot be recovered before emerging in the spring (Tuttle 1976b). Approximately 20 to 30 days of stored energy is depleted with each arousal (Daan 1973). Losing these fat stores can cause bats to leave the roost prematurely in search of food during unsuitable circumstances, which may result in high mortality rates. During the first hour of arousal, individuals may lose up to 0.48 g of body weight; a significant amount when contrasted with the typical hibernation losses of 0.01 g per day (Brady *et al*. 1982). When this human interference occurs in maternity caves it is typically most devastating in late spring and early summer (May to July), as non-volant offspring are in the roost. Thousands of bats may die from a single disruption (USFWS 1982). In addition, Stevenson and Tuttle (1981) found that banded gray bats tended to avoid roosts where they had been handled by researchers.

Humans are also impacting the environment in other ways that can negatively impact bats. Deforestation close to cave entrances, at foraging sites, and along commuting routes is likely to have negative effects due to the removal of prey abundance and reduced cover from natural predators (Tuttle 1979). Recently-volant young are especially susceptible to the effects of deforestation, as they require the protection of forest cover while becoming proficient fliers.

Insecticide use historically had a detrimental impact on gray bat populations (Clark *et al.* 1978, Clark *et al.* 1988), though many of the toxic substances are now banned from the market. The longevity, high metabolic rate, and insectivorous diet of bats increases their likelihood of exposure to bioaccumulating chemicals in the environment. While modern pesticides (e.g.,

organophosphates, neonicotinoids, pyrethroids, carbonates) aren't expected to bioaccumulate in tissues, they are still a concern, are highly toxic, and may kill bats from direct exposure (Shapiro and Hohmann 2005). The presence of other contaminants of concern that can bioaccumulate (e.g., pharmaceuticals, flame retardants) has been documented in bats (Secord *et al.* 2015), though additional research is needed to understand impacts. Additionally, pesticides and other pollutants could indirectly impact bats by reducing insect populations.

Siltation and nutrient loading of waterways where bats forage and drink may negatively affect the species. As previously stated, a large portion of the gray bat diet is comprised of adult aquatic insects such as mayflies, stoneflies, and caddisflies. These groups of aquatic insects are especially susceptible to degraded water quality. Any substantial declines in the populations of these insects may have a detrimental effect on gray bat populations as well (USFWS 1982). Tuttle (1979) presented a correlation between a decline in gray bat numbers and an increase in sedimentation in several Alabama and Tennessee waterways.

Tied to increased waterway siltation is impoundment of streams and rivers to create reservoirs. While it was originally suspected that this practice would increase suitable foraging habitat for gray bats, it was ultimately found that the opposite is true (USFWS 1982). Disturbance to roosting bats using caves adjacent to these impoundments has also been observed. Noise from passing watercraft increased, as did access to cave roosts previously far from population centers and roads (USFWS 1982).

Gray bat populations could also be impacted by temperature and precipitation changes due to climate change. Climate change will likely affect the distribution of suitable hibernacula for bats (Humphries *et al.* 2002). Since gray bats are a cave-obligate species, requiring highly specific hibernacula and maternity caves, they are acutely at risk from fluctuating climate conditions. As temperatures rise, conditions within gray bat hibernacula and maternity caves could change, making them less suitable. In addition, the increase in overall temperatures may lead to earlier arousal from hibernation, resulting in higher energy expenditure and potentially premature parturition (Sherwin *et al.* 2013). Changes in precipitation is also of concern. Under drought conditions, bats have to travel further distances for food and more rainfall could inhibit insect flight and decrease prey availability. These changes could have particularly adverse effects on nursing females, as the energy costs associated with traveling longer distances for food and water result in longer lactation times, slowing overall juvenile development (Tuttle 1976b, Adams 2010). Furthermore, increased frequency of severe storms could lead to flooding of important roost sites.

Another potential threat to gray bat populations is the fungal disease white-nose syndrome (WNS). The disease is caused by the fungus *Pseudogymnoascus destructans*, which grows on the wings, ears, and muzzle of hibernating bats (Cryan *et al.* 2013). Since its discovery in New York in 2006, WNS has had an overwhelmingly negative effect on North American hibernating bats, eradicating millions of individuals. Mortality rates in afflicted bats often exceed 90 percent (Thogmartin *et al.* 2013). Bats that have been infected with WNS display erratic changes in behavior including day-time flying and increased frequency of arousal during hibernation (Cryan *et al.* 2013).

In 2012, USFWS confirmed the first instance of WNS in gray bats (USFWS 2012b). The full impact of WNS on overall gray bat populations is still being determined. It seems plausible that WNS would pose a serious threat to a species like the gray bat, where individuals overwinter in few high-density hibernacula, should it infect those colonies. However, some studies have found that *P. destructans* may not spread through gray bat colonies as quickly as once expected, nor be as substantial a threat to the species as initially suspected (Flock 2014, USFWS 2014b). As of spring 2017, the species has yet to experience any WNS-related declines and their populations appear to have remained stable within Tennessee (Bernard *et al.* 2017) and Virginia (Powers *et al.* 2016). Several behavioral traits, such as preferred microclimates within hibernacula and sustained activity and foraging throughout winter (Bernard and McCracken 2017) may enable this species to prevent or minimize the colonization of *P. destructans* during torpor.

3.2 APPALACHIAN ELKTOE

This section summarizes best available data about the biology and current condition of Appalachian elktoe (*Alasmidonta raveneliana*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list Appalachian elktoe as endangered on September 3, 1993. There is no designated critical habitat for this species in the Action Area.

3.2.1 Species Description and Life History

Lea (1834) described the Appalachian elktoe from the French Broad River system in North Carolina. Its shell is thin but not fragile, oblong, and somewhat kidney-shaped, with a sharply rounded anterior margin and a broadly rounded posterior margin. Parmalee and Bogan (1998) cite a maximum length of 8 cm. However, individuals from the Little River (French Broad River basin) in Transylvania County and West Fork Pigeon River (French Broad River Basin) in Haywood County measured more than 9.9 cm in length (USFWS 2009b). The periostracum (outer shell) of the Appalachian elktoe varies in color from dark brown to yellowish-brown in color. Rays may be prominent in some individuals, usually on the posterior slope, and nearly obscure in other specimens. The nacre (inside shell surface) is a shiny bluish white, changing to salmon color in the beak cavity portion of the shell. A detailed description of the shell characteristics is contained in Clarke (1981). Ortmann (1921) provides descriptions of the soft anatomy.

The reproductive cycle of the Appalachian elktoe is similar to that of other native freshwater mussels. Males release sperm into the water column, and the sperm are then taken in by the female through their siphons during feeding and respiration. The females retain the fertilized eggs in their gills until the larvae (glochidia) fully develop. The mussel glochidia are released into the water, and within a few days they must attach to the appropriate species of fish, which they parasitize for a short time while they develop into juvenile mussels. They then detach from their fish host and sink to the stream bottom where they continue to develop, provided they land in a suitable substrate with the correct water conditions (USFWS 2002). The Appalachian elktoe is a bradytictic (long-term) breeder, with the females retaining glochidia in their gills from late August to mid-June (USFWS 2009). Glochidia are released in mid-June, attaching to either the gills or fins of a suitable fish host species. Transformation time for the Appalachian elktoe occurs within 18 to 22 days at a mean temperature of l 8°C. The Appalachian elktoe can use a variety of

common fish hosts but appears to specialize on darters and sculpins, which are common in the action area

3.2.2 Status and Distribution

The Appalachian elktoe is known only from the mountain streams of western North Carolina and eastern Tennessee. It is found in gravelly substrates often mixed with cobble and boulders, in cracks of bedrock, and in relatively silt-free, coarse sandy substrates (USFWS 1996).

Although the complete historic range of the Appalachian elktoe is unknown, available information suggests that the species once lived in the majority of the rivers and larger creeks of the upper Tennessee River system in North Carolina, with the possible exception of the Hiwassee and Watauga River systems (the species has not been recorded from either of these river systems). In Tennessee, the species is known only from its present range in the main stem of the Nolichucky River. At the time of listing, two known populations of the Appalachian elktoe existed--the Nolichucky River, including its tributaries (the Cane River and the North Toe River), and the Little Tennessee River and its tributaries. The record in the Cane River was represented by one specimen found just above its confluence with the North Toe River (USFWS 1996). Since listing, the Appalachian elktoe has been found in additional areas. These occurrences include extensions of the known ranges in the Nolichucky River (North Toe River, South Toe River, and Cane River) and the Little Tennessee River (Tuckasegee River and Cheoah River) as well as a rediscovery in the French Broad River basin (Pigeon River, Little River, Mills River, and the main stem of the French Broad River). Many of these newly discovered populations are relatively small in size and range.

The Appalachian elktoe has experienced declines in two populations across its range. A sudden die-off in the Little Tennessee River, once considered the largest and most secure population, began in 2005 and continued through 2015, when periodic monitoring efforts failed to find any live individuals. In 2017 and 2018, several individual Appalachian elktoe were found in the Little Tennessee River, indicating a remnant population, but the population is limited and only a tiny fraction of its previous size. Appalachian elktoe also have declined in the lower portion of the South Toe River, a tributary of the Nolichucky River. Appalachian elktoe are still present in the South Toe River, but at reduced densities. The other populations of Appalachian elktoe appear to be stable (Tuckasegee, Cheoah, and Pigeon Rivers) or expanding (French Broad River). A remnant population known in the Cheoah River since the early 2000's is presently being augmented by the NCWRC with hatchery-propagated individuals sourced from the Tuckasegee River. This effort appears to be successful in bringing this population back to a viable state. Prior to 2004, the French Broad River population appeared to be confined to two tributary streams (Little River, Mills River), but over the last few years the known range of Appalachian elktoe in the main stem of the French Broad River has expanded and now appears to be well established, albeit at low density, over a broad area.

3.2.3 Threats

The decline of the Appalachian elktoe throughout its historic range has been attributed to a variety of factors, including sedimentation, point and nonpoint-source pollution, and habitat

modification (impoundments, channelization etc.). The low numbers of individuals and the restricted range of most of the surviving populations make them extremely vulnerable to extirpation from a single catastrophic event or activity. Catastrophic events may consist of natural events, such as flooding or drought, as well as human influenced events, such as toxic spills associated with highways or railroads.

Natural flooding events combined with alteration of watersheds can lead to large fluctuations in abundance observed in Appalachian elktoe populations. Portions of the French Broad River basin and most of western North Carolina experienced catastrophic flooding in late summer 2004 as a result of Tropical Storms Francis, Ivan, and Jeanne. Numerous dead mussels, including the Appalachian elktoe, were observed in over-wash areas along the Little Tennessee River after the flood events. Additionally, surveys conducted in the Little Tennessee River after the flooding yielded noticeably lower catch per unit effort of live mussels, including the Appalachian elktoe, compared to past survey efforts in this section of the river (USFWS 2009).

Siltation resulting from improper erosion control of various types of land usage, including agriculture, forestry, road construction, and development, has been recognized as a major contributing factor to the degradation of mussel populations (USFWS 1996). Siltation has been documented to be extremely detrimental to mussel populations by degrading substrate and water quality, increasing potential exposure to other pollutants, and direct smothering of mussels (Ellis 1936, Marking and Bills 1979). Sediment accumulations of less than an inch have been shown to cause high mortality in most mussel species (Ellis 1936). The abrasive action of sediment on mussel shells has been shown to cause erosion of the outer shell, which allows acids to reach and corrode underlying layers (Harman 1974).

Sewage treatment effluent has been documented to significantly affect the diversity and abundance of mussel fauna (Goudreau *et al*. 1988). Goudreau *et al*. (1988) found that recovery of mussel populations might not occur for up to 2 RM (3.22 km) below points of chlorinated sewage effluent. Most of the water bodies where Appalachian elktoe still exist have relatively few point source discharges within the watershed and are rated as having "good" to "excellent" water quality (NCDWR 2012**,** USFWS 1996).

The introduction of exotic species, such as the Asian clam and zebra mussel (*Dreissena polymorpha*), has also been shown to pose significant threats to native freshwater mussels. The Asian clam is now established in most of the major river systems in the United States (Fuller and Powell 1973). At the time the Appalachian elktoe was listed, the Asian clam was not known from the stretch of the Little Tennessee River that it occupies; however, it has been observed in the Little Tennessee River in recent years and, as mentioned earlier, may be a contributing factor to the decline of that population. Concern has been raised over competitive interactions for space, food, and oxygen between this species and native mussels, possibly at the juvenile stages (Neves and Widlak 1987). When the Appalachian elktoe was listed, it was speculated that, due to its restricted distribution, it "may not be able to withstand vigorous competition" (USFWS 1996).

Another exotic species that has the potential to adversely impact aquatic species, including Appalachian elktoe, is the Japanese knotweed (*Fallopia japonica*). The plant is considered to be an invasive species that can reproduce from its seed or from its long, stout rhizomes. It can tolerate a variety of conditions, such as full shade, high temperatures, high salinity, and drought.

It can be spread by wind, water, and soil movement to an area where it quickly forms dense thickets that exclude native vegetation and greatly alter the natural ecosystem. This species has become established in riparian habitats throughout western North Carolina. The species has a very shallow root system; because of this shallow root system and its preclusion of other vegetation, areas where this species has been established may be susceptible to erosion during flood events.

4. ENVIRONMENTAL BASELINE

Under section 7(a)(2) of the Act, when considering the effects of an action on federally listed species, we are required to take into consideration the environmental baseline. The environmental baseline includes past and ongoing natural factors and past and present impacts from all Federal, state, or private actions and other activities in the action area (50 CFR 402.02), including Federal actions in the area that have already undergone section 7 consultation and the impacts from state or private actions that are contemporaneous with the consultation in progress. The environmental baseline for this Opinion considers all projects approved prior to the initiation of formal consultation.

4.1 GRAY BAT

4.1.1 Species Status and Distribution in the Action Area

Acoustic data and bridge checks indicate gray bats are present in the Action Area between mid-March and late-October. Gray bats were also present in lower numbers into early November. Although no roosts were found in the Action Area, maternity, bachelor, and transient roosts were identified near the Action Area on or directly adjacent to the FBR. Gray bat calls detected in the Action Area and bats equipped with transmitters and tracked in and through the Action Area are from these nearby roost sites. The acoustic data indicate gray bats are primarily foraging and commuting along the FBR. Fewer gray bat calls were identified at the six detectors located in non-riparian areas and along smaller streams. Emergence count data from known roosts in 2018 suggest at least 1,300 gray bats in the area. Of the 488 gray bats captured in 2018 as part of the Indiana State University research project, approximately 82% were adult males, 13% were adult females, 4% were juveniles and 1% unknown age. The sex ratio of the juveniles was roughly 27% female and 73% male.

In order to determine the presence and distribution of gray bats in the Action Area, 13 acoustic detectors were located along the length of the project (Appendix I). Since gray bats are known to use large rivers for foraging and commuting, the detectors were deployed primarily along the FBR or its larger tributaries in the I-26 corridor. On the southern end of the project, Detectors 1-4 were located on larger tributaries to the FBR and adjacent to existing I-26. Detectors 5-13 were located at sites adjacent to the project and the FBR.

4.1.1.1 Acoustic Surveys

Acoustic detectors 1- 4 were located on large tributaries to the FBR that are crossed by I-26. These detectors recorded low numbers of gray bat calls, indicating gray bats are present to the

southern terminus of the project. Detector site 5, the southernmost detector site adjacent to the river, produced a substantial number of gray bat calls.

Detector site 8 at the Blue Ridge Parkway overpass recorded 11 calls attributable to gray bats during three weeks of deployment. The acoustic detector located between the French Broad River and the Blue Ridge Parkway (Site 9), recorded very few bat calls, and no *Myotis* calls. Although these sites are located in one of the most heavily wooded portions of the Action Area, no sizable water features are present here which is the likely explanation for low gray bat activity.

Detector site 11, the I-26 crossing of the French Broad River, had a particularly high level of gray bat activity throughout the survey season, and consistently recorded more gray bat calls than any other detectors deployed during the same time frame. Furthermore, gray bats were active throughout the night, with pulses of activity just after dusk and just before dawn, especially after pups became volant.

Gray bats are very active at the I-26 crossing relative to other detector locations along the FBR. Bats were observed flying under the bridges, rather than over them, likely to avoid the light from passing cars, avoid the possibility of predation by crossing open areas over the highway, and/or because bats were foraging on emerging aquatic insects associated with the highly oxygenated water created by the rocky riverbed in this area. The two detectors that bracket Site 11 upstream and downstream did not exhibit the high numbers of gray bat calls observed at detector site 11. Given the concentration of calls at Site 11, gray bats aren't just passing through but appear to be choosing to spend time there and making multiple passes in front of the detector.

The NPS conducted separate acoustic surveys for bats during 2016 and recorded what they believe to be Indiana bats on Blue Ridge Parkway property near I-26. In a letter to NCDOT dated November 2, 2017 USFWS states their position that acoustic surveys conducted by NPS in 2016 were not conclusive for Indiana bats. During the process of vetting matching *Myotis* calls for the acoustic survey report associated with this project, none of the high-quality calls examined had call characteristics consistent with Indiana bats.

4.1.1.2 Structure Surveys

Twenty-four (24) bridges and 18 culverts in the Action Area were inspected between April 26, 2017 and July 27, 2017 for the presence of bats or evidence of bat use (guano, staining, and/or urine). Minimal bat use was noted on the Long Shoals Road bridge over the FBR. It is likely that the structure is used infrequently for night roosting bats and while it is located in the Action Area, is not scheduled for any work as part of the subject project.

4.1.1.3 Telemetry Surveys

Limited telemetry data indicate gray bats are flying through and foraging in the Action Area. NCWRC staff attached transmitters to two gray bats from the nearby maternity roost during 2016 and 2017. In 2016, two bats were tracked for 12 days and the bats returned to the roost each night. Bat A foraged along Hominy Creek in the area near Pond Road. Bat B foraged along the French Broad River just north of the I-40 crossing.

In 2017, three individuals were captured at the maternity roost and tracked for 13 days. On most nights, the bats returned to the maternity roost, however, one bat traveled over 20 mi. to a roost in Madison County on three nights. On seven nights, bat roost locations could not be found. Unlike the bats tracked in 2016, bats tracked in 2017 did not consistently return to the same foraging areas. One bat travelled south to forage along the French Broad River just north of Long Shoals Road. The other bats flew north from the roost and foraged along Hominy Creek, Bent Creek, Long Valley Lake, and various locations on the French Broad River.

In 2018, transmitters were placed on 90 bats as part of the Indiana State University Research Project, in part to collect information on foraging and commuting areas. Six bats were tracked via car from two roosts near the project area and were found foraging in areas south and north of the primary roost. Three of these bats foraged south of the primary roost, mostly along the FBR, but also in the Sandy Bottom area. Three bats foraged north of the primary roost and the project area around Hominy Creek and along the river south of Amboy Rd. Bats appear to forage mainly over water, usually the French Broad River and associated tributaries. Towers were also set up throughout the French Broad watershed to collect additional data on transmittered bats. Three of these towers were located within or very close to the project area and tagged bats were detected at all three.

4.1.2 Factors Affecting the Species' Environment in the Action Area

Development directly adjacent to the FBR has fragmented gray bat habitat by removing vegetation and creating more artificially lighted areas that the bats must avoid as they commute from roost areas to forage areas. In contrast, improvements in water quality in the FBR have likely increased the prey base and improved the overall ability of bats to feed over the river.

4.2 APPALACHIAN ELKTOE

4.2.1 Species Status and Distribution in the Action Area

In 2017, mussel surveys were conducted at 20 sites in the mainstem FBR. The sites were selected by the consultants, Three Oaks Engineering, based on habitat characteristics and were surveyed by methods suited to water depth, including using view buckets, snorkel and scuba gear. Appalachian elktoe were located at four sites in the FBR in the Action Area. Given the size and variability of habitats in the FBR, Appalachian elktoe could occur in low numbers throughout the Action Area. Any adults or juveniles present will occur in the riverbed, while glochidia may be attached to host fish that reside in or move through the Action Area in the FBR.

4.2.2 Factors Affecting the Species' Environment in the Action Area

French Broad River water quality in the Action Area historically suffered from industrial and agricultural pollution. Beginning in the 1970's, efforts were begun to reduce pollution and sediment entering the River. While the FBR is much cleaner today than in the past century, there are still threats from ongoing development. Portions of the FBR and several of the larger

tributaries are on the 303d list of impaired waters. There have been no previous formal sec.7 consultations for Appalachian elktoe in the FBR in the Action Area.

5. EFFECTS OF THE ACTION

Under section 7(a)(2) of the Act, "effects of the action" refers to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action. Direct effects are actions that may result in immediate effects to the species, including lighting construction areas, increased noise, the placement of temporary causeways in the FBR, land-clearing, and changes in water quality. Indirect effects are those caused by the proposed action that occur later in time but that are still reasonably certain to occur.

5.1 GRAY BAT

5.1.1 Factors to Be Considered

5.1.1.1 Proximity of the Action

Based on acoustic and telemetry surveys within the Action Area, the gray bat occurs throughout the Action Area from mid-March through October. Although measures to avoid and minimize impacts to gray bats are included in the project plans, implementation of the project will result in unavoidable impacts to habitat and individual bats.

5.1.1.2 Nature of the Effect

Commuting and foraging habitat along the FBR in the Action Area will be affected for the duration of the construction project. At the bridge replacement on the FBR, additional lighting and noise from construction equipment located on causeways at the river level will repel some bats from the river, causing them to find other areas to forage or forcing them to fly over the highway making them more susceptible to being hit by cars or predation. Riparian vegetation at the FBR that is removed during construction will allow more light and noise from traffic to reach the river, potentially repelling foraging bats. Pregnant or lactating females repelled from their forage areas may experience lower fitness and be more likely to lose pups due to longer flight distances to forage. In-stream habitat for aquatic insects in the footprint of the bridge construction will be impacted by the construction, and for some time after the construction is completed. Additionally, water quality impacts from construction and increased impervious surface runoff may decrease the FBR food and drinking water source quality, potentially impacting gray bat fitness.

5.1.1.3 Disturbance Duration, Frequency and Intensity

Gray bats will be affected by the construction from mid-March through October when they are present in the action area. Disturbance from increases in nighttime lighting and noise will exist until construction is complete. After the construction causeways are removed from the FBR, the

substrate and its invertebrate population will continue to recover for some period of time as the river has bankfull flows that resort the riverbed and reestablish the riffle section. The widened highway is likely to result in more permanent impacts from increased noise and lighting from an increase in vehicles, which may impact foraging and commuting bats. The clearing will further fragment habitat and may act as a barrier in certain locations since *Myotis* are reluctant to cross wide, open areas and some species of bats avoid large roads (Berthinussen and Altringham 2012a).

5.1.2 Analysis of Effects of the Action

5.1.2.1 Potential Beneficial Effects

Reduction of direct stormwater runoff at bridge locations.

Storm water from the existing bridge over the FBR and at Cane and Clear Creeks currently enters the streams directly from the bridge decks. The new bridges will collect and direct storm water to the ends of the bridges and discharge the deck drainage into vegetated buffers before entering the river. Stormwater coming off the approaching roadways at the bridge locations will be managed in a similar manner. The elimination of direct roadway discharge should result in localized improvement of water quality and potentially a beneficial effect on gray bat forage.

Reduction in Permanent Fill at French Broad River Crossing

Permanent fill in the form of bridge bents will be reduced upon completion of the new bridge. The existing bridges have five interior bents each, arranged on spread footings, with only one of these bents situated on land. The proposed bridge will have two bents, both in the water. This means more of the river bed will be available for colonization of aquatic fauna, including aquatic insects, which are the main food source for gray bats. Furthermore, gray bats will have fewer vertical impediments to navigate as they fly near the water surface while foraging and commuting.

5.1.3.2 Direct and Indirect Effects

5.1.3.2.1 Bridge Construction at the French Broad River

The FBR in the location where I-26 crosses is relatively narrow and the riparian corridor is densely wooded. The bridge serves as an underpass for bats, funneling them under the existing roadway as they commute and forage along the surface of the river (uses of underpasses by bats is discussed by Berthinussen and Altringham 2012b). Night construction activities in this area will affect gray bat foraging and commuting along the FBR. In addition, this river reach is a long riffle section, providings high quality habitat for aquatic insects and an excellent forage area for the gray bats. The effects to gray bats are described in detail below.

5.1.3.2.1.1 Light and Noise

The use of lighting after sunset will be necessary to complete some aspects of construction. Bats currently use this area and are accustomed to traffic noise and some night lighting from car

headlights as cars pass over the bridge but there is little traffic noise or light that reaches the surface of the river.

In order to prepare the construction site, and for the duration of construction of the new bridges, the night work that must be done at the river level and from the causeways that are located roughly at river level will increase lighting and noise that will likely repel bats from this area while at the same time drawing insects from the adjacent areas to the light. Activities that may require night lighting during the active season include access road construction, causeway construction and phasing, drilling new shafts, concrete pours, and setting new bridge beams.

Myotis sp. are light averse (Voigt 2018) and the addition of night lighting and construction noise at the water level and in the riparian corridor will repel some bats from the river in this location. If gray bats avoid areas that are brighter and noisier than they are accustomed to, this could lead to increased travel time/distance between their roosts and foraging areas and result in diminished fitness of adults and/or reduced survivorship of pups at nearby maternity roosts. Furthermore, some bats could be lost to predation and/or vehicle strike if they attempt to cross over the highway rather than using the underpass.

5.1.3.2.1.2 Construction Causeways

Fill associated with the temporary causeways placed in the FBR will affect both the area available for forage and the quality of the river corridor for commuting bats. Construction activities in the river are expected to take at least three years, and causeways will be in place for the duration of the bridge construction. The fill material used for the causeways may temporarily reduce habitat for aquatic insects, narrow the river through this reach, and create changes in river flows at normal and flood flows. Although the causeways have been designed to cover as little of the river as possible and remain in place as short a duration as possible, they will alter flows for the duration of the construction. Bats may be deterred from commuting under the bridge while causeways are in place and construction is ongoing.

5.1.3.2.1.3 Removal of Vegetation

Limited tree clearing will be necessary for construction at the FBR. Four temporary access roads will be constructed to reach the construction area of the bridge. Although retaining walls will be used to minimize the amount of necessary clearing, the access roads will require about 3.75 acres of clearing. On the northwest bank of the river, there is currently a gap in the canopy that spans roughly 134 ft. Clearing necessary to widen the roadway will result in an additional 175 ft. of open space. On the southeast side of the river, the riparian vegetation is somewhat fragmented by the one-lane Old River Road. The current break in the canopy is 195 ft. and an additional 45 ft. of clearing will be necessary. Gray bats often avoid large open spaces and could be deterred from commuting and foraging in this area until the planted trees mature.

5.1.3.2.2 Highway Widening Construction

The project closely parallels the FBR for about 2.5 miles. Gray bat calls were recorded at all the detector sites adjacent to the river. Therefore, we assume gray bats are using the entire length of the river within the Action Area for foraging and commuting at night and may be affected by construction activities occurring after dark and temporary habitat changes occurring during construction. Construction activities associated with the proposed widening project include

clearing, grubbing, grading, installation of pavement, culvert extensions and replacements, bridge replacements, striping, signs, and lighting. The effects to gray bats are described in detail below.

5.1.3.2.2.1 Light and Noise

For construction work that must take place at night, the lighting likely will be brighter than ambient light generated by headlights or nearby overhead lighting around interchanges or near developed areas. Night construction could take place at any time throughout the life of the project. The portion of the roadway roughly located between the Long Shoals Road (NC 146) interchange and the Brevard Road (NC 191) interchange currently has no overhead lighting, so all ambient light is generated by automobile headlights. Additional construction lighting will elevate the amount of ambient light.

Within the Action Area, gray bat activity is highest along the French Broad River which may limit their exposure to construction lighting and noise for the highway widening, particularly in the sections south of the airport where the river shifts to the west away from the interstate. At the Blue Ridge Parkway, more nighttime construction activities may occur, but based on the results of acoustic surveys, as well as NCWRC telemetry studies, gray bats do not appear to be very active here. Construction lighting and noise may exacerbate the barrier effect of roads, causing gray bats to modify their preferred foraging and commuting areas due to increased light and noise associated with construction activities.

5.1.3.2.2.2 Removal of Woody Vegetation

Removal of trees and clearing will likely have the most impact in the project section from the northern terminus to about Long Shoals Road. From that point south, most of the project will widen to the already-cleared area between the existing lanes of I-26. Clearing will begin almost immediately after the project is let for construction and may continue for a period of up to two years. Clearing may occur at different locations and at different times along the length of the project, depending on construction timing/phasing. Clearing activities will take place during daylight hours, but may occur during any time of year, with the exception of Blue Ridge Parkway property where tree clearing will occur between August 15 and May 15.

To avoid flying through active construction areas, gray bats with foraging areas or travel corridors within the Action Area will have to expend an increased amount of energy to establish new foraging areas or travel corridors. Additionally, they may be subject to increased inter- and intra-specific competition. These impacts could extend beyond the widening project if some individuals continue to alter foraging and commuting routes because of permanent increased fragmentation from the project. Bats remaining loyal to certain foraging areas may continue crossing newly-cleared areas, potentially increasing their risk of mortality from predation and vehicle strikes. It is unclear whether gray bats that regularly forage in the Action Area will experience difficulty in establishing new foraging areas due to the availability of suitable foraging habitat in the surrounding landscape.

5.1.3.2.2.3 Changes in Water Quality

NCDOT has implemented design changes to minimize impacts to surface waters and wetlands. However, not all impacts could be eliminated, NCDOT activities may negatively affect water

quality within the Action Area. These effects are anticipated to be short term in nature, and may include:

- Temporary sedimentation from land-clearing and earth moving activities such as preparation, installation of drainage features, utility installation, culvert installation/extension, and grading activities;
- Temporary sedimentation from in-water work associated with bridge demolition and construction activities such as investigative drilling for bridge footings, installation and removal of temporary causeways, removal of existing bents, and shaft drilling.

Eighty-six streams, in addition to the French Broad River, will be impacted in some way by the project. Most of them are small streams, which gray bats do not typically use for foraging and commuting, but activities associated with these streams may contribute to diminished water quality within the Action Area. Insects associated with aquatic habitats make up a large portion of the diet of gray bats (Rabinowitz and Turtle 1982, Clawson 1984, Brack 1985, Lacki *et al.* 1995, Best *et al.* 1997), and many species of aquatic insects can be negatively affected by a decrease in water quality (Hilsenhoff 1982, Lenat 1993, and Ramezani *et al.* 2014). Therefore, a decrease in water quality may adversely affect a portion of the prey base of the species.

Although water quality impacts may result in a reduction in specific portions of the prey base and drinking water quality for gray bats, adverse effects are likely to be undetectable due to other inputs into the FBR watershed. Therefore, we do not anticipate any measurable effect on gray bats due to potentially diminished water quality.

5.1.3.2.3 Highway Operation

Traffic is projected to increase along I-26 because of the capacity expansion (NCDOT 2014b). With this increase in traffic will come associated increases in light and noise from more cars and the greater potential for bat-vehicle collisions, predation and for bats to abandon formerly used foraging and commuting areas. The removal of vegetation will further fragment habitat and the widened road could act as a travel barrier since *Myotis* are reluctant to cross wide, open areas. Gray bats may avoid flying over a road of this size, and have to fly longer distances along foraging or migration routes, thus resulting in lowered fitness.

5.1.3.2.3.1 Lighting

Once the proposed roadway is in operation and traffic volume increases, the amount of light generated by headlights will increase. Gray bats travelling across or adjacent to the roadway, particularly in areas near the river, would be most susceptible to increased light, and may avoid these areas in the future, potentially altering their migration routes and lowering their fitness. At the I-26 crossing of the FBR, the current guardrail is concrete parapet with a retrofitted metal rail on top, and a metal guardrail addition on the side facing traffic. These features allow automobile headlights to shine through the railing and over adjacent airspace above the French Broad River. The replacement bridge will have a solid concrete “Jersey barrier” guard wall. This guardrail/wall type will be more effective in controlling the amount of light generated by passing vehicles that reaches the surrounding airspace.

5.1.3.2.3.2 Noise

Noise will increase with increased traffic volume. Volume between Long Shoals Road and Brevard Road is projected to increase the peak hour bidirectional traffic from 4,952 vehicles to 9,904 vehicles after construction is completed. Per the 2016 NCDOT Traffic Noise Manual, a 3 dB(A) increase in traffic noise is expected whenever the traffic volume is doubled.

Given the amount of gray bat activity at the French Broad River crossing, noise levels were further analyzed at this location. Using FHWA's Traffic Noise Model (TNM), version 2.5, 2011 base year noise levels on I-26 at the French Broad River are estimated to be 78 decibels (dB(A)). The 2040 design year noise levels with the project in place are predicted to be 76 db(A), a decrease of 2 dB(A). The reasons for the decrease in noise levels of 2 dB(A) are: 1) the existing dual bridges are being replaced with a single bridge, eliminating the potential for noise to pass through the gap (and under) the two existing bridges; and 2) the new bridge will feature concrete Jersey barriers in the median and as guardrails on the bridge shoulders, which, based on the TNM model, reduce traffic noise levels at nearby human receptors.

Given that gray bat activity is high at the I-26 crossing over the French Broad River, bats are not noticeably deterred by the noise from the current traffic volume at this location. There are no studies focused specifically on gray bats and noise effects. However, some studies suggest that Indiana bats (a congener) may be able to tolerate disturbance from vehicular traffic noise at a roost near a large airport (Sparks *et al.* 2009). Therefore, at this time we do not anticipate noise levels will adversely affect bats.

5.1.3.2.3.3 Vehicle Collisions and Increased Predation

Bats attempting to cross the interstate in the heavily wooded area between the Blue Ridge Parkway and Brevard Road will encounter a wider opening in the forest. Gray bats that attempt to cross over the roadway could be struck and injured or killed by passing vehicles. Bat mortality caused by impacts with passing vehicles is widely documented (Kiefer *et al.* 1995, Lesiński 2007, Gaisler *et al.* 2009, Russell *et al.* 2009, Lesinski *et al.* 2010, Medinas *et al.* 2013). Bat injury and mortality from vehicle strikes may increase within the Action Area from increased traffic.

5.2 APPALACHIAN ELKTOE

Under section 7(a)(2) of the Act, "effects of the action" refers to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action. The federal agency is responsible for analyzing these effects. The effects of the proposed action are added to the environmental baseline to determine the future baseline, which serves as the basis for the determination in this Opinion. Should the effects of the federal action result in a situation that jeopardizes the continued existence of the species, we may propose reasonable and prudent alternatives the federal agency can take to avoid a violation of section 7(a)(2).

The discussion that follows is our evaluation of the anticipated direct, indirect, and cumulative effects of implementing the proposed action. Direct effects are actions that may result in immediate effects to the species, including the placement of temporary causeways in the FBR, permanent impacts of new bridge bents in the FBR, land-clearing, and changes in water quality.

Indirect effects are those caused by the proposed action that occur later in time but that are still reasonably certain to occur. Cumulative effects are those effects of future state or private activities, not involving Federal activities, which are reasonably certain to occur within the action area of the proposed Federal action (50 CFR 402.02).

5.2.1 Factors to Be Considered

5.2.1.1 Proximity of the Action

Based on surveys of the FBR in the Action Area, the Appalachian elktoe occurs in the very low numbers patchily distributed through the Action Area. Although measures to avoid and minimize impacts to Appalachian elktoe are included in the project plans, implementation of the project will result in unavoidable impacts to habitat and may result in impacts to individual mussels.

5.2.1.2 Nature of the Effect

In-stream habitat in the FBR will be permanently affected by new bents in the river. About 400 sq feet of riverbed will be permanently lost. Temporary construction causeways also will affect habitat in the immediate vicinity of the I-26 crossing of the FBR.

Highway widening will impact about 86 jurisdictional streams in the Action Area primarily through culvert extensions, including 26 FBR tributaries directly crossed by the project. Bridges over Clear Creek and Cane Creek will be replaced.

5.2.1.3 Disturbance Duration, Frequency, and Intensity

The highway widening will create disturbance to tributaries and downstream resources that will be ongoing in different segments of the project for years. With appropriate sediment and erosion control measures, large inputs of sediment should be avoided during construction. After the project is completed and the roadway opens to traffic, there will be increases in stormwater runoff volume and pollutants, some of which may reach areas occupied by the Appalachian elktoe.

Disturbance to the riverbed from bridge construction will occur over a relatively short period of time from the construction of the bridge piers at the FBR crossing. The causeways for construction and demolition will be in place for the length of time needed to construct and demolish the bridges. Although there will be direct impacts to the riverbed associated with the causeways, the construction of the causeways will be phased to limit the amount of causeway in the river at any one time, and only the causeways needed for an activity will be in place during that activity and will be removed when the action is completed. There will be temporary impacts to river hydrology both upstream and downstream of the causeways.

5.2.3 Analysis of Effects of the Action

5.2.3.1 Potential Beneficial Effects

Reduction of direct stormwater runoff at bridge locations. Storm water from the existing bridge over the FBR and at Cane and Clear Creeks enters the streams directly from the bridge decks. The new bridges will collect and direct storm water to the ends of the bridges and discharge the deck drainage into vegetated buffers before entering the river. Storm water coming off the approaching roadways at the bridge locations will be managed in a similar manner. The elimination of direct roadway discharge should result in localized improvement of water quality due to pollutant filtration and sequestration on the upland. Reduced pollutant load should have some beneficial effect on the Appalachian elktoe.

Elimination of bents in the main river channel. The existing crossing of the FBR has three sets of double piers in the river channel that will be eliminated with a new spanning structure. The elimination of these piers in the FBR is expected to reduce the bridge's effects on stream flow patterns at the bridge site and may result in less chance of catching woody debris which can cause bed instability.

5.2.3.2 Direct and Indirect Effects

5.2.3.2.1 Construction Effects

5.2.3.2.1.1 Investigative Drilling

Investigative drilling for the I-26 Bridge footings will be conducted from the existing bridge deck and will require three 4-in diameter borings within each of the two bent locations: one at each edge for a total of six. Each boring will reach a depth of 25 to 30 ft. This work will be completed before the causeways are put in the FBR. Investigative drilling will be conducted during nighttime hours, drilling four holes per day and take one week to complete the work. The borings will cover about 75 sq. in. in total.

5.2.3.2.1.2 Temporary Access Roads

Temporary access roads will be constructed to transport materials and construction equipment to the bridge worksite. The access roads will be built parallel to I-26, one in each quadrant. The access roads will require approximately 3.75 acres to be cleared of trees and other vegetation. The temporary access roads, if not maintained properly, could transport sediment into the river until disturbed slopes become stabilized with riprap, matting, or other measures. Since the roads slope down toward the river, they could channel sediment directly into Appalachian elktoe habitat. Special sediment and erosion control measures have been developed for the bridge construction site to minimize negative effects.

5.2.3.2.1.3 Causeway Construction and Use

To construct the new bridges that carry I-26 over the FBR and demolish the existing structures, it is necessary to build temporary stone causeways adjacent to and in the FBR. Causeway size will be minimized as much as possible during each stage of construction to maximize the free flow area of the river. Causeway area will vary with the stages of construction, but are projected to

temporarily affect a total area of 1.01-acres. The total time causeways will be in place is about 3.6 years (186 weeks). With the primary causeways in place, the river free flow will be constricted to a maximum 58 percent of the normal cross-sectional area.

The long duration of causeway operation needed to construct this project creates an opportunity for related effects to Appalachian elktoe and the habitat near the construction area. The BA acknowledges that it is possible the rock causeway material may be washed away during high flow events, where it could have a negative effect on the species by crushing individuals or fouling of habitat. Additionally, the disruption of approximately 1.0 acres of stream bottom affected by the installation and removal of the causeways may cause temporary negative effects to the habitat. The BA concludes that the probability of this causing direct mortality is low, due to the low density of Appalachian elktoe in the area downstream of the project crossing. Also, because the habitat is bedrock dominant, the USFWS believes this habitat will likely revert back to its present suitability within a few years post construction and the probability of direct mortality is low.

The operation of causeways can also increase stream bed and bank scour near the project area. The hydraulic effects of placing causeways in the river were modeled by NCDOT to determine the effect of high flows on the river. The causeways will restrict river flow and can result in upstream pooling with an increase in water level, depending on the size of the causeways in place at a given time and the magnitude of the increased flow. This is not expected to cause negative effects to the Appalachian elktoe. The area downstream of the causeway will experience higher velocities while causeways are in place, and may experience higher rates of scour as a result. Scouring could affect any mussels in the riverbed, washing them downstream and/or causing shell erosion. Most of the riverbed where the causeways will be placed and immediately downstream is bedrock, so adverse effects to mussels from channel instability or scour are not anticipated as a result of increased river velocity. NCDOT proposes to avoid disturbance to the area downstream of the causeways to the extent possible and to monitor the area for scour. Monitoring for channel stability during construction will extend 100 ft. upstream and 250 ft. downstream of the causeway locations (USGS Monitoring plan). Should significant scour be detected, NCDOT has committed to making improvements to the causeway to prevent scour. The USFWS believes that the area most likely to be affected, being largely dominated by bedrock, may be affected temporarily, but is likely to return to suitability within a few years post construction.

In addition to the potential changes in hydrology as a result of the causeways, there is the potential for the causeways to act as velocity barriers to fish movement. The disruption of fish movement could impact the Appalachian elktoe if fish hosts for the elktoe are unable to move freely in the river. These temporary disruptions to fish movement may cause some loss in recruitment to upstream or downstream areas for the period of time the causeways are in place. The USFWS believes the direction of disruption of fish host travel is primarily in the upstream direction. Downstream migration of fish is unlikely to be affected as strongly due to the nature of the causeways and associated flow disruptions. Since the distribution of the bulk of the Appalachian elktoe population is upstream of the project, and host fish directional movement downstream is the most important direction of movement in this case, the USFWS believes this effect will be minimal.

5.2.3.2.1.4 Spills and Pollutant Discharge

The inadvertent spill or discharge of toxic pollutants, such as diesel fuel and hydraulic oil, into the river could result in mortality of Appalachian elktoe. Spills of construction fluids are not uncommon, and the long duration of heavy equipment use adjacent to waterways increases the possibility that a spill or discharge could occur, adversely impacting the river water quality. However, NCDOT has committed to conservation measures to refuel the equipment away from the water and to have spill kits near the equipment on the causeways, reducing the likelihood of a spill or discharge reaching the river. Spills could also take place near any other waterway and subsequently have an effect further downstream, but we believe normal spill response is capable of avoiding effects from minor spills. Major spills resulting from negligent operation are still possible, but unlikely.

5.2.3.2.1.5 Bridge Demolition and Construction

The replacement of the existing I-26 bridge will be on similar alignment to the existing bridge. The new bridge will be slightly larger than the existing structure, but due to longer spans will only have two bents in the river where the existing bridge had three. Due to the near exact replacement of the existing structure we do not expect significant stream alteration due to the placement of the existing bridge itself. There will be minor changes in the permanent fill. The new bridge will require an additional 400 ft^2. of river bottom habitat that will be permanently affected by fill for bridge bents; however, removal of most of the existing bridge foundations will offset most of this change. The changes in bent number and construction of causeways will likely cause some localized scour during and after construction. Given the prevalence of bedrock at the bridge crossing, the degree of riverbed scouring due to presence of bridge bents is not expected to increase from the present conditions.

During demolition NCDOT will remove the existing bridge using methods that minimize the amount of construction debris in the river, and due to the unknown nature of the existing foundation construction and condition, many decisions about removal will have to be made on site. Small amounts of bridge debris may fall into the river. However, it will be removed and we do not believe that small amounts of construction debris temporarily in the river will have any effect on Appalachian elktoe.

The drilling of support shafts for the new bridge involves a drilling fluid of bentonite clay and water. This mixture is typically recycled. The loss of large amounts of clay into the river could have a negative effect to water quality; however, our understanding of this process is that leaks of drilling fluid, though possible, would be quickly detected and remedied. We do not believe that this activity will have a negative effect unless there is a negligent discharge of drilling fluid.

5.2.3.2.1.6 Erosion and Sedimentation from Construction

Highway construction projects require significant earth moving activity. This includes clearing and grubbing, cut and fill, grading operations, etc. This project will also require the replacement of a large number of culverts and two bridges over Clear and Cane creeks. All activities that expose soil create an opportunity for runoff from the project into the river. This type of runoff from construction can negatively impact aquatic species, including the Appalachain elktoe. With a duration of five years or more and effects to 86 streams draining to the FBR, this project has significant potential to cause long duration widespread negative effects to Appalachian

elktoe and its habitat. Two previous population declines in this species coincided with erosive events. In the Little Tennessee River, hurricanes Frances and Ivan in 2004 caused major flooding resulting in landslides and chronically unstable banks throughout the watershed. Over the next few years, the population of Appalachian elktoe declined precipitously and is now critically imperiled. On the South Toe River, starting in 2013 a major road widening project began affecting dozens of tributaries of the South Toe River. Subsequently, the Appalachian elktoe population immediately downstream of this disturbance declined. Investigations into the mechanism that caused the decline are ongoing, but the proximity to potential erosive sources begs caution that this species is particularly sensitive to elevated levels of fine sediment.

The distribution of Appalachian elktoe in the FBR is currently in the upper portions of the river. As previously described in the species baseline, the Appalachian elktoe appears to be currently expanding in the FBR and the known downstream extent of this species has expanded further every year since 2005. The known downstream range of the Appalachian elktoe is presently just upstream of the mouth of Hominy Creek, around 5 miles downstream of the I-26 crossing of the FBR. The presence of two other species of mussel downstream of this record and extending all the way into Tennessee gives us reason to believe that the downstream expansion of the Appalachian elktoe will continue unless external factors halt the population expansion. Due to the above mentioned losses in two other populations, the long term stability of the FBR population is a key factor in recovering this species.

The erosion control measures incorporated into the proposed action will reduce the levels of sedimentation into the FBR, but these measures have a design limit based on the amount of rainfall received at the project area. Rainfall events that are greater than the erosion control design limits will result in sediment loss into the river. The baseline levels of suspended sediment in the FBR are already elevated due to cumulative activity in the watershed. However, this baseline suspended sediment has allowed for recent population expansion. In 2018 the Asheville region experienced the highest level of rainfall on record. The previous record year was 2013. The five year duration of this project makes it possible that periods of significant rainfall will occur during the construction. In order to reduce the number and likelihood of sedimentation events from rainfall resulting in water quality impacts, the NCDOT has proposed several conservation measures to improve erosion control efficacy, monitor effectiveness and to fund resource agencies to plan for species recovery in case of unforeseen circumstances. However; if conditions are atypical or if effects to the species are greater than anticipated, NCDOT and USFWS have agreed to collaborate to seek solutions. Accordingly, we have included a Term and Condition that the USFWS can request an onsite meeting to discuss the project at any time. This will allow for adaptive improvements and ensure that problems are addressed early and impacts minimized.

5.2.3.2.2 Operation Effects

The construction of this project will lead to additional road surface drainage to the French Broad River indefinitely. The operation of roads is known to increase the rate of runoff into the river, causing potential destabilization of sensitive habitat within. Roadway runoff contains pollutants that may affect aquatic species at high concentration. Roadways are also a primary threat for toxic spills that could affect the river habitat.

5.2.3.2.2.1 *Impervious Surfaces*

Widening I-26 will increase impervious surface in the Action Area. There is an estimated increase of roadway pavement of 117.9 acres with additional increases associated with interchanges and rest areas. The increased impervious surfaces will cause an increase in stormwater runoff. NCDOT has committed to implementing stormwater control measures throughout the project where they are practical. We believe that proper stormwater controls will reduce the effects of stormwater on the receiving streams, but not entirely eliminate stormwater effects on the river, especially when rainfall rates are high. The increased stream velocities may have adverse erosive effects on tributary channels resulting in additional sedimentation in the river habitat. The NCDOT has committed to fixing erosion problems at culverts in tributary channels during construction. Proper outfall conditions should further reduce some erosion within the tributary channels. Therefore, based on the present conditions in the action area, as well as the conservation measures proposed we do not believe that the increase in impervious surface will significantly impact the suitability of the habitat in the future.

5.2.3.2.2.2 *Roadway Runoff*

NCDOT has committed to funneling runoff from the FBR bridge off the bridge to a vegetated buffer, thereby reducing runoff from the current baseline. However, there will be additional runoff due to the additional impervious surface. Numerous pollutants have been identified in highway runoff, including various metals (e.g., lead, zinc, iron), sediment, pesticides, de-icing salts, nutrients (nitrogen, phosphorus), and petroleum hydrocarbons and many of these.can be harmful to mussels. Mussels present in the Action Area may experience locally increased exposure to runoff from the I-4400/I-4700 widening project and the resulting increase in impervious surface from the highway. The effects from roadway runoff will be long-lasting, spanning the life of the highway but will likely be sporatic and site specific. The long term effects of chronic exposure to roadway pollutants to mussels are poorly understood. The conservation funding provided by the NCDOT for activities aiding in the conservation of Appalachian elktoe will be expended to further study the health of the watershed, as well as the elktoe to aid in recovery of the species.

5.2.3.2.2.3 *Toxic Spills*

Toxic spills on roadways are a concern for aquatic species. This will be true any time large quantities of material are transported near waterways. Due to the large amount of existing roadway and train transport in the FBR basin, the widening of I-26 will not appreciably increase the probability of a spill.

5.2.3.2.2.4 *Induced Land Development*

Qualitative analyses of the probable development patterns in the FLUSA suggested that Project I-4400/I-4700 would not have a notable indirect effect on land use in the FLUSA (NCDOT 2016), so land use effects within the smaller Action Area should not be notable either. Potential land use effects as a result of the I-26 widening are limited because the project does not provide any new access or opportunities for traffic exposure to properties and will generate marginal travel time savings (NCDOT 2016).

5.2.3.2.2.5 *Interrelated/Interdependent Effects*

Interrelated actions are those that are part of the larger action and depend on the larger action for their justification. Similarly, interdependent actions are those that have no independent utility apart from the action under consideration (50 CFR §402.02).

Highway projects can induce changes in surrounding land use when they shorten commuting times or provide access to areas previously poorly served. These changes can be interdependent if they would not occur without construction of the project. The NCDOT studied the potential for changes in land use surrounding the Action Area (NCDOT 2016) and found that the nature of this project, as an upgrade to an existing roadway, without additional access along its length, would not induce significant amounts of additional development.

Another source of interrelated effects common to roadway projects is the siting of waste and borrow areas necessary for the temporary holding of construction materials. On large projects, the area necessary for waste, borrow and staging operations can be large and under certain conditions could create additional negative effects for aquatic species. NCDOT allows the contractor to manage placement and operation of the waste and borrow sites after the contract is awarded and does not consider effects of the waste and borrow sites to be part of the authorized action, however, NCDOT does provide standard guidance for borrow/fill sites that are intended to regulate the environmental effects of these areas and requires consultation with the Division Engineer if their placement could affect a federally listed species. If not for the proposed action, the waste and borrow sites would not be necessary. Therefore, we consider them interdependent to the proposed action. However, if NCDOTs standard guidelines are followed, we believe they will effectively minimize additional effects associated with these sites.

6. CUMULATIVE EFFECTS

Gray bat and Appalachian elktoe

Cumulative effects are defined under the ESA as "those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the Action Area of the Federal action subject to consultation" (50 CFR 402.02). Future federal actions unrelated to the proposed action are not considered because they require separate consultation pursuant to Section 7 of the ESA.

The Indirect Screening Report (NCDOT 2013a), the associated update (NCDOT 2017a), and the Asheville Regional Cumulative Effects Study (NCDOT 2014c) indicate the I-26 widening project will result in few indirect impacts and minimal cumulative effects. The majority of activities identified in these reports will likely require federal authorization requiring their own ESA Section 7 consultation, and would not be considered a cumulative effect under the ESA. However, since publication of these reports, a large residential development within the action area has received approval from the Asheville City Council. The planned Riverwoods residential development, a mix of approximately 167 single family residences with additional commercial space, is planned for property adjacent to the French Broad River near the I-26 crossing of the river. We anticipate that this development will require Section 7 consultation due to impacts to waterways, but at this stage it is not certain.

Considering the existing level of development within the French Broad watershed, coupled with large areas of forested habitat nearby (Biltmore, Pisgah Forest, Bent Creek), these cumulative effects are unlikely to alter the species baselines in a manner easily distinguished from the background disturbance of other activities within the Action Area. We are not aware of additional state, local or private actions that are reasonably certain to occur within the Action Area that would not be subject to section 7 review. Therefore, cumulative effects to gray bat and Appalachian elktoe are not expected to reach a measurable level, and are not addressed further in the Opinion.

7. CONCLUSION

7.1 GRAY BAT

After reviewing the current status of the gray bat; the environmental baseline for the action area; the effects of bridge construction, demolition, and highway widening; conservation measures incorporated into the proposed action; any potential interrelated and interdependent actions associated with the proposed action; and any cumulative effects, it is the USFWS's opinion that implementing this project is not likely to jeopardize the continued existence of the gray bat. No critical habitat for gray bat exists within the Action Area, therefore, non will be affected.

7.2 APPALACHIAN ELKTOE

After reviewing the current status of the Appalachian elktoe; the environmental baseline for the action area; the effects of bridge construction, demolition, and highway widening; measures identified in the NCDOT's BA to help minimize the potential impacts of the proposed project and assist in the protection, management, and recovery of the species; any potential interrelated and interdependent actions associated with the proposed action; and any potential cumulative effects, it is the USFWS's opinion that implementing this project is not likely to jeopardize the continued existence of the Appalachian elktoe. No critical habitat for Appalachian elktoe exists within the Action Area, therefore, non will be affected.

8. INCIDENTAL TAKE STATEMENT

Section 9 of the Act and federal regulations pursuant to section 4(d) of the Act prohibit the taking of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct. Harm is further defined by the USFWS to include significant habitat modification or degradation resulting in death or injury to listed species by significantly impairing essential behavioral patterns, such as breeding, feeding, or sheltering. Harass is defined by the USFWS as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns that include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not for the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), incidental take is not prohibited under the Act, provided it is in compliance with the terms and conditions of this incidental take statement.

8.1 GRAY BAT

The USFWS anticipates incidental take of gray bats may occur as a result of the replacement of the I-26 bridge over the FBR and the widening of I-26. During construction, individual bats may be repelled from forage areas in the bridge footprint and along the river, reducing adult and juvenile fitness and affecting pup birth and health before they are able to fly and forage on their own. Additionally, more bats may be killed due to predation and car strikes if they are repelled from areas of active construction and forced to fly over the highway or more open areas.
No evidence of bat roosting was observed on any bridges or in any culverts to be included in project construction activities, therefore impacts to gray bats due to modification or elimination of summer roosts are not expected. The number of gray bats using the FBR within and near the action area is estimated at a minimum of 1300 individuals. An unknown number of these will be affected by the construction activities (including: temporary lighting, noise, causeways, decrease in water quality, and loss of woody vegetation). Most of the take associated with this project will be in the form of harm and harassment, but some mortality of adult bats, newly-volant juveniles, and non-volant pups is possible. Additionally, some loss of recruitment is expected due to stress on pregnant and lactating females and subsequent loss of pups. This harm is not expected to cause mortality of all individuals with in the Action Area, but could reduce fecundity and recruitment within the Action Area temporarily.

Data used to determine the number of gray bats in the Action Area is a conservative estimate, and gray bat populations are known to fluctuate seasonally and annually in a given area, therefore it is not possible to base the amount of incidental take on numbers of individual bats. Due to the difficulty of detecting take of gray bats resulting from the action, the amount of incidental take will be monitored using the duration of construction activities over and adjacent to the river, the most disruptive aspect of the project, as a surrogate measure of take. In order to limit the duration of this disruption, we believe that bridge construction activities extending beyond 5 years should be limited to work only during daylight hours so that the bats using the Action Area can resume normal behavior and return to the baseline condition. Therefore, the amount of incidental take will be exceeded if the night operations at the FBR bridge exceed five years.. If construction operations at the I-26 bridge cannot be completed in five years from the start of causeway construction without night operations, all work should stop, and the USFWS should be contacted immediately to reinitiate consultation.

In this Opinion, the USFWS has determined that this level of take is not likely to result in jeopardy to the gray bat. In addition to the subsequent measures listed in the Reasonable and Prudent Measures and Terms and Conditions sections of this Opinion, the measures listed in the Conservation Measures section of this opinion must be implemented for this determination to remain valid.

8.2 APPALACHIAN ELKTOE

The USFWS anticipates incidental take of the Appalachian elktoe may occur as a result of the construction of the bridge at the FBR. During construction, individual mussels may be crushed, harmed by siltation or other water quality degradation, or dislocated because of physical changes in their habitat. Appalachian elktoe were only found in the Action Area during 2017 surveys for this project.. Our knowledge of the density and distribution of Appalachian elktoe in the Action

Area is based on a small number of documented occurrences. Surveys for this project identified five individual Appalachian elktoe at four total sites.

The survey data is not sufficient to populate a robust population model, but in an effort to estimate potential take, the USFWS applied a simple model incorporating survey effort and catch rates to estimate a baseline density for Appalachian elktoe in the Action Area. We estimated an experienced surveyor could reasonably cover 400 square meters in an hour of surveying. The mussels are not always at the surface, and due to difficulty seeing the small aperatures in the substrate, surveyors are not likely to find every mussel. To compensate for this we estimated that a capture efficiency of 25% was reasonable based on previous experience with mussel survey techniques, i.e. the number of mussels found reflect 25% of the total mussels in a given area. Therefore, the model estimates an Appalachian elktoe density of of 0.0005 mussels per square meter in the Action Area.

This project proposes to directly affect around 1.04 acres of habitat that will be covered by rock causeways. Based on the estimated density, we expect around 2 Appalachian elktoe to be in the area buried by causeway installation. This area has been surveyed on at least two occasions and no Appalachian elktoe have been seen in the area to be affected by the causeway. Therefore we expect take from this activity to result in mortal take of two or fewer individuals.

Due to the large extent and duration of this project, it is possible Appalachian elktoe in the Action Area will be affected by indirect habitat degradation from sediment eroded from the project and from the degradation of channels receiving additional stormwater from the project. Applying the model density to the area of habitat in the Action Area returns an estimated population of 821 adult Appalachian elktoe in the Action Area. In order for the population to remain stable, recruitment in the action area needs to equal natural mortality in the population. Appalachian are estimated to live about 12 years with about 10 years of reproductive lifespan. That requires a recruitment rate of 0.10 annually, in this case 82 new recruits per year that could be affected by project related effects.

Conservation measures outlined in the BA are intended to minimize indirect effects due to sedimentation in the FBR. Even under standard construction conditions, we expect Appalachian elktoe within the Action Area may be harmed by the presence of turbidity or settling of sediment in depositional portions of its habitat. We expect this effect to be non-lethal harm to adults that could result in temporarily reduced recruitment throughout the duration of the project. The effects of sediment pollution within the Action Area should not reach a level prevents recolonization of the Action Area after construction. Prolonged increases in sediment transport in Appalachian elktoe habitat could cause habitat alteration that would prevent future population growth even after construction is finished. Due to the difficulty of measuring these effects directly, the NCDOT proposes monitoring project erosion control with a study conducted by the USGS. USGS proposes to use existing water quality data available from the NCDEQ and combine it with pre-construction data collected from USGS monitoring stations to measure a baseline turbidity. If the monitoring stations record an increase in turbidity greater than normal variation in the flow-corrected pre-construction monitoring data, the USFWS will reinitiate consultation with the FHWA to address the causes of the additional turbidity.

We believe the conservation measures and monitoring included in the BA are sufficient to reduce the effects of construction such that the population of Appalachian elktoe in the French Broad is likely to remain healthy and viable into the future. Therefore, in this Opinion, the USFWS has determined that this level of take is not likely to result in jeopardy to the Appalachian elktoe. In addition to the subsequent measures listed in the Reasonable and Prudent Measures and Terms and Conditions sections of this Opinion, the measures listed in the Conservation Measures section of this opinion must be implemented for this determination to remain valid.

9. REASONABLE AND PRUDENT MEASURES

The USFWS believes the following reasonable and prudent measures are necessary and appropriate to minimize take of the gray bat and Appalachian elktoe. These non-discretionary measures include, but are not limited to, the commitments in the BA and the terms and conditions outlined in this Opinion.

1. The USFWS must be notified of any project modifications.

10. TERMS AND CONDITIONS

In order for the exemption from the take prohibitions of section 9(a)(1) of the ESA, the NCDOT must comply with the following terms and conditions, which implement the reasonable and prudent measures described previously and outline required reporting and/or monitoring requirements. These terms and conditions are non-discretionary. As necessary and appropriate to fulfill this responsibility, the NCDOT must require any permittee, contractor, or grantee implement these Terms and Conditions through enforceable terms that are added to the permit, contract, or grant document.

1. NCDOT will adhere to all measures listed in the Conservation Measures section of this Opinion and in the BA.

2. NCDOT will simultaneously notify USACE and USFWS of any permit modification requests.

3. A USFWS biologist will be invited (at least seven days prior) to the preconstruction meeting(s) to review permit conditions and discuss any questions the contractor has regarding implementation of the project. After the contractor submits plans for various stages of the project, a USFWS biologist will review and provide comments on the plans and will be invited to attend any meetings to discuss implementation of the plans.

4. During construction, culvert inlets and outlets will be evaluated by the resident engineer with regard to stream stability immediately following installation and quarterly for a period of 1 year at each location. Indicators of instability, such as head cutting, scour, aggradation, or degradation, will be used to determine the need for corrective actions.

5. A final field inspection will be held with the contractor to evaluate culvert placement and stream stability before the project is considered complete. If instability is detected during any of these reviews, corrective actions will be performed when deemed necessary by the engineer or

by the conditions of any federal and state permits required by Section 404/401 of the Clean Water Act.

6. USFWS can call for a site meeting with NCDOT at any time to evaluate and discuss erosion control effectiveness.

7. To minimize impacts to gray bat, NCDOT will not install the causeway material at night in the French Broad River between April 15th and October 1st.

8. Modern bat modular roost panels or comparable structures will be installed on three bridges over the French Broad River and/or tributaries within or close to the Action Area. Panels should be constructed of fiber reinforced concrete with additives to mimic thermal mass and should be mounted using metal. Bridge selection and panel placement/design should be informed by work currently being conducted by Indiana State University. Panels should be checked for bat use once in early summer and once in late fall for three years following placement. The details of bat box location and installation will be decided by a committee to include USFWS, NCWRC, and NCDOT.

9. NCDOT will monitor bat activity post construction for up to three years.

NCDOT has committed to conduct acoustic monitoring for gray bats at the FBR bridge after construction of the bridge and after work ceases in the area surrounding the bridge (see consultation history). Monitoring should occur for a minimum of one season and maximum of three seasons. Monitoring can cease when activity levels resume to pre-construction levels (see 2017 and 2018 acoustic data) or after three seasons. NCDOT will also conduct three years of emergence counts at the BRP bridge, Marshall bridge, and the culvert roost using the same methods as counts conducted by Indiana State University so data can be compared. Partners including NCWRC and USFWS can assist with these counts. The details of post construction monitoring will be decided by a committee of USFWS, NCWRC, and NCDOT staff. Information gathered will help assess impacts from the project and will inform future consultation and conservation efforts. Information will also help establish a baseline for the connector project.

10. A special area will be designated from project Station 1078+00 to Station 1230+67 (Brevard Road to the Blue Ridge Parkway) where the following requirements will apply:

- The contractor will submit a comprehensive grading plan before starting any cut or fill work in this section for the approval of the division construction engineer. The plan shall include:

    a. The number and makeup of the crews working in this area;

    b. A narrative outlining a systematic approach to removing cut and placing fill including a proposed time for each operation.

- No more than 10 acres of cut and or fill open in this area without prior approval by the engineer.
- All access roads will be covered with railroad ballast or larger stone to prevent the loss of material.

- The contractor shall submit an access road construction plan for the Blue Ridge Parkway access road for review and approval by the division construction engineer.
- All cut and fill slopes are to be matted in this section of the project.

11. Energy dissipators will be installed at the following 18 sites to reduce post construction stormwater.

Location of Concrete Energy Dissipators

Station Location	Permit Drawing Site Number	Outfall Stream or Wetland ID
EBL between 940 and 941	Site 11	WBV
EBL between 951 and 952	Site 11	WBV
EBL approximately 1030		Near WCH
EBL between 1037 and 1038		Near WCH
EBL between 1044 and 1045		Near WCH
EBL approximately 1047		Near WCH
WBL between 1090 and 1091	Site 23	SDK
WBL approximately 1105	Site 28	SDY
WBL between 1115 and 1116 (in median)	Site 30	SDX
WBL between 1117 and 1118 (in median)	Site 30	SDX
WBL between 1118 and 1119 (in median)	Site 30	SDX
WBL between 1131 and 1132	Site 32	SEQ
WBL approximately 1135		Near WCW
WBL approximately 1138		Near WCW
WBL between 1148 and 1149	Site 37	SEF
WBL between 1155 and 1156	Site 38	SEE
WBL between 1157 and 1158	Site 38	SEE
WBL approximately 1173	Site 41	SFG

11. MONITORING AND REPORTING REQUIREMENTS

In order to monitor the impacts of incidental take, the NCDOT must report the progress of the Action and its impacts on the species to the USFWS as specified in the Incidental Take Statement. This section provides the specific instructions for such monitoring and reporting. As necessary and appropriate to fulfill this responsibility, the NCDOT must require any permittee, contractor, or grantee implement these Terms and Conditions through enforceable terms that are added to the permit, contract, or grant document. Such enforceable terms must include a requirement to immediately notify the NCDOT and USFWS if the amount or extent of incidental take specified in this Incidental Take Statement is exceeded during action implementation.

USGS geomorphology and surface water condition Erosion Control Monitoring

A final project report will be produced to describe the methodology and results from monitoring streamflow, precipitation, continuous and discrete water-quality, and geomorphology in Focus Areas 1 and 2. The report will summarize conditions before, during, and after NCDOT construction activities and will be provided to the Service.

Bat Activity Monitoring

NCDOT will provide a final report and yearly monitoring summaries starting at the end of the first monitoring season.

12. REINITIATION NOTICE

Formal consultation for the I-26 Widening project is concluded. Reinitiation of consultation is required by law if:

a. the amount or extent of incidental take is exceeded;
b. new information reveals that the Action may affect listed species or designated critical habitat in a manner or to an extend not considered in this BO;
c. the Action is modified in a manner that causes effects to listed species or designated critical habitat not considered in this BO; or
d. a new species is listed or critical habitat designated that the action may affect.

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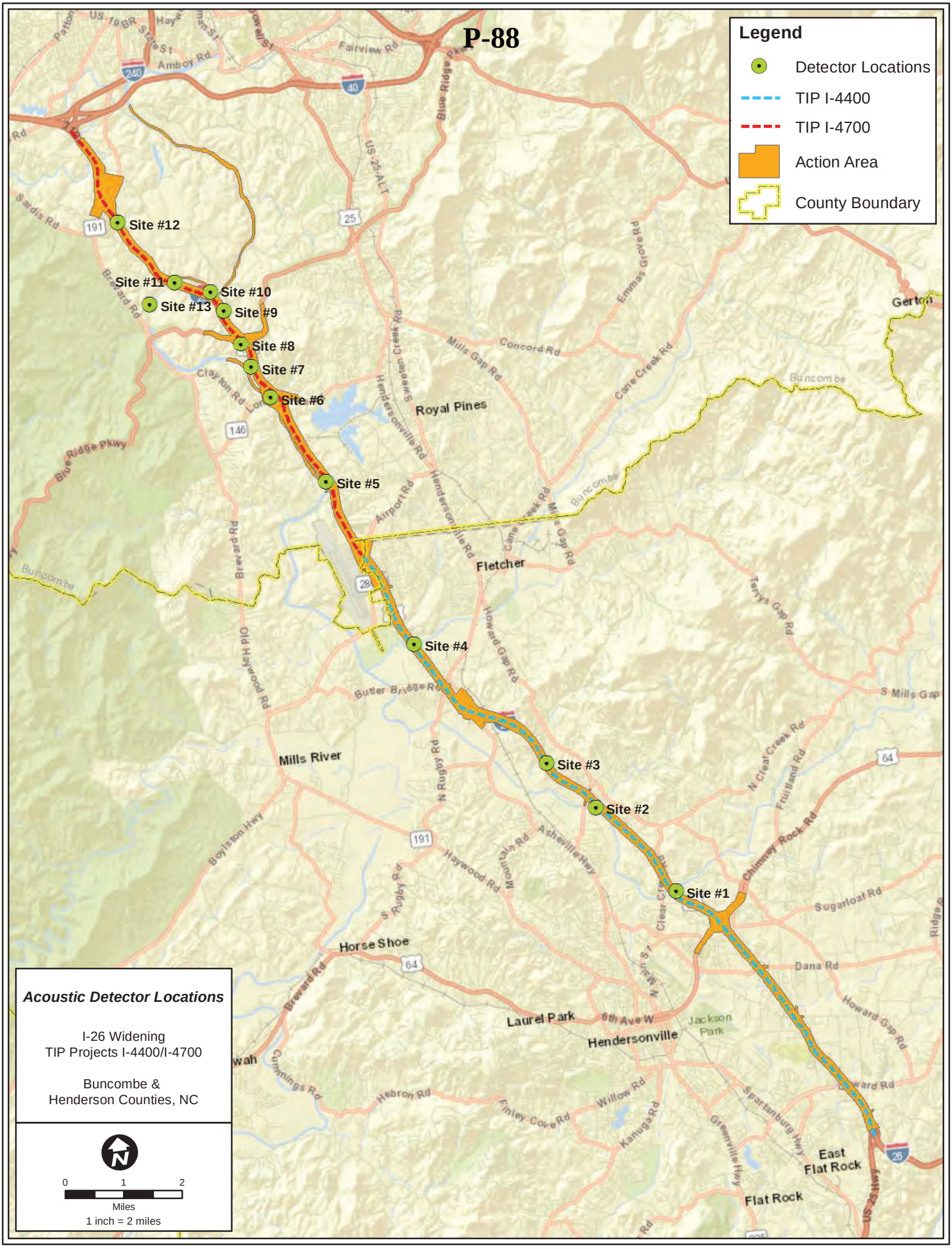
Appendix I – Action area and detector locations map


P-88
Legend
Detector Locations
TIP I-4400
TIP I-4700
Action Area
County Boundary
Site #12
Site #11
Site #10
Site #13
Site #9
Site #8
Site #7
Site #6
Site #5
Site #4
Site #3
Site #2
Site #1
Royal Pines
Fletcher
Mills River
Horse Shoe
Laurel Park
Hendersonville
East Flat Rock
Flat Rock
Gerton
Acoustic Detector Locations
I-26 Widening
TIP Projects I-4400/I-4700
Buncombe &
Henderson Counties, NC
0 1 2
Miles
1 inch = 2 miles

Appendix II – Erosion control standards comparison table

Guidelines & when they're applicable	**Environmentally Sensitive Areas** Effective area within 50' of T&E stream	**Design Standards in Sensitive Watersheds**	**NPDES - NCG01 (Must also follow DSSW in areas where project is w/in a mile of T&E aquatics)**	**NPDES - NCG01 II.B.2.b (for HQW)**	**I-4400/I-4700 CMs**
Limits on disturbance	No grubbing until just before grading. Grading work shall progress in continuous manner and permanently stabilized^ before starting next phase	20 ac limit for uncovered areas in HQW zones or w/in 1 mile of and draining to waters where T&E species are present (per NCG01)	20 ac limit for uncovered areas w/in a mile of T&E aquatic spp.		SEC plans shall adhere to the DSSW, where practicable, within the existing and proposed right of way for the following areas: For portions of the project within 1 mi. and draining directly to streams where aquatic threatened or endangered species are present.
S&EC design		S&EC designed for 25 yr. storm event within HQW zones or w/in 1 mile of and draining to waters where T&E species are present (per NCG01)	See DSSW		
S&EC structures	Sed & erosion control structures cleaned out when half full	Sed basins with 70% efficiency for 2 yr. storm within HQW zones or w/in 1 mile of and draining to waters where T&E species are present (per NCG01)	See DSSW (and bottom row, below)		Within ESA: Erosion control devices shall be installed immediately following the clearing operation. All SEC measures, throughout the project limits, must be cleaned out when half full of sediment, when applicable, to ensure proper function of the measures.
Slopes		2:1 max channel slope in HQW zones or w/in 1 mile of and draining to waters where T&E species are present (per NCG01)	See DSSW		

Guidelines & when they're applicable	**Environmentally Sensitive Areas** Effective area within 50' of T&E stream	**Design Standards in Sensitive Watersheds**	N**PDES - NCG01 (Must also follow DSSW in areas where project is w/in a mile of T&E aquatics)**	N**PDES - NCG01 II.B.2.b (for HQW)**	**I-4400/I-4700 CMs**
Ground stabilization	Seeding/mulching immediately after final grade Seeding/mulching done in stages on 20' high slopes or if >2 ac	Ground cover^^ sufficient to restrain erosion within 15 working days or 60 calendar days following completion of construction, whichever period is shorter in HQW zones or w/in 1 mile of and draining to waters where T&E species are present (per NCG01)	Permanent stabilization^ w/in 7 calendar days on >3:1 slope, ditches, swales, perimeter dikes & HQW. Stabilization w/in 14 calendar days on all other disturbed areas*	For portions of projects within the High Quality Water Zone**, stabilization shall be achieved as soon as practicable but in any event within 7 calendar days from last land-disturbing act.	Within ESA: Once grading operations begin, work shall progress in a continuous manner until complete. Seeding and mulching shall be performed on the areas disturbed by construction immediately following final grade establishment. Seeding and mulching shall be done in stages on cut and fill slopes that are greater than 20 ft. in height measured along the slope, or greater than 2 ac. in area, whichever is less.
Sediment reporting			The permittee shall report to DWQ any visible sediment being deposited in any stream or wetland w/in 24 hrs. Written submission w/in 5 days.		NCDOT will self-report to USFWS any SEC device failures that result from excessive rainfall events (exceeding a 25-year storm event). The NCDOT inspector will report any failures to the Division Environmental Officer, who will contact the agency within 24 hours. If there are any failures in SEC measures, NCDOT will meet with resource agencies and work to adaptively manage SEC devices for further storm events while construction continues.
S&EC inspections			All S&EC must be inspected at least once every 7 calendar days and must be inspected within 24 hours after storm event of > 0.50 inches of rain per 24-hour period.		Inspections of erosion control devices will be done daily for construction associated with the French Broad River bridge replacement. For the remainder of the project, the standard inspection schedule (weekly, or after a rainfall event of one-half in. or greater) will apply.

Guidelines & when they're applicable	**Environmentally Sensitive Areas** Effective area within 50' of T&E stream	**Design Standards in Sensitive Watersheds**	**NPDES - NCG01 (Must also follow DSSW in areas where project is w/in a mile of T&E aquatics)**	**NPDES - NCG01 II.B.2.b (for HQW)**	**I-4400/I-4700 CMs**
Piles of dirt			Earthen-material stockpiles must be located 50' from storm drains and streams		
Sediment basins			Sed. basin outlet structures must withdraw from surface unless drainage area < 1 acre. Discharges must meet the requirements of the Sediment Pollution Control Act and provisions of Section 6.74 of the Erosion and Sediment Control Planning and Design Manual to assure that buffers and vegetated areas will be used to reduce the potential for visible siltation outside of the 25% buffer zone nearest the land-disturbing activity.		

^ Permanent Stabilization - When all soil disturbing activity is completed, and exposed soils have been stabilized with a vegetative cover with a density of at least 80% or covered with a structural stabilization method. Permanent perennial vegetation may include the use of sod, shrubs and ground cover plants mixed with mulching, aggregate or other landscaping techniques. Structural methods include concrete, asphalt, retaining wall or other stabilization techniques.

^^ Ground cover is defined in15A NCAC 04A .0105 as "any natural vegetative growth or other material which renders the soil surface stable against accelerated erosion."

*conditions and exemptions apply
** areas that are within one mile of and drain to HQW's

ESAs are used for the following: streams, including HQWs and 303(d)s, wetlands, ORWs, critical areas, regulated riparian buffers, CAMA areas of environmental concern, T&E species habitat, and trout waters

TIP PROJECT: I-4700

CONTRACT:

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

BUNCOMBE & HENDERSON COUNTIES

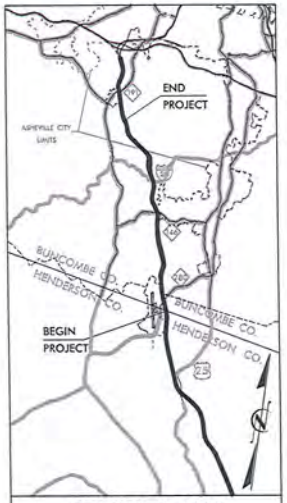
STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	I-4700	1	

STATE PROJ. NO.	F. A. PROJ. NO.	DESCRIPTION
WBS 36030.1.2	IMNHF-026-1(86)9	I-4700(P.E.)
TBD	TBD	I-4700A(R/W/UTIL)
TBD	TBD	I-4700B(R/W/UTIL)
WBS 36030.3.3	NHPP-026-1(198)3	I-4700A(CONST)
WBS 36030.3.4	NHPP-026-1(199)6	I-4700B(CONST)

PERMIT DRAWING
SHEET 1 OF 97

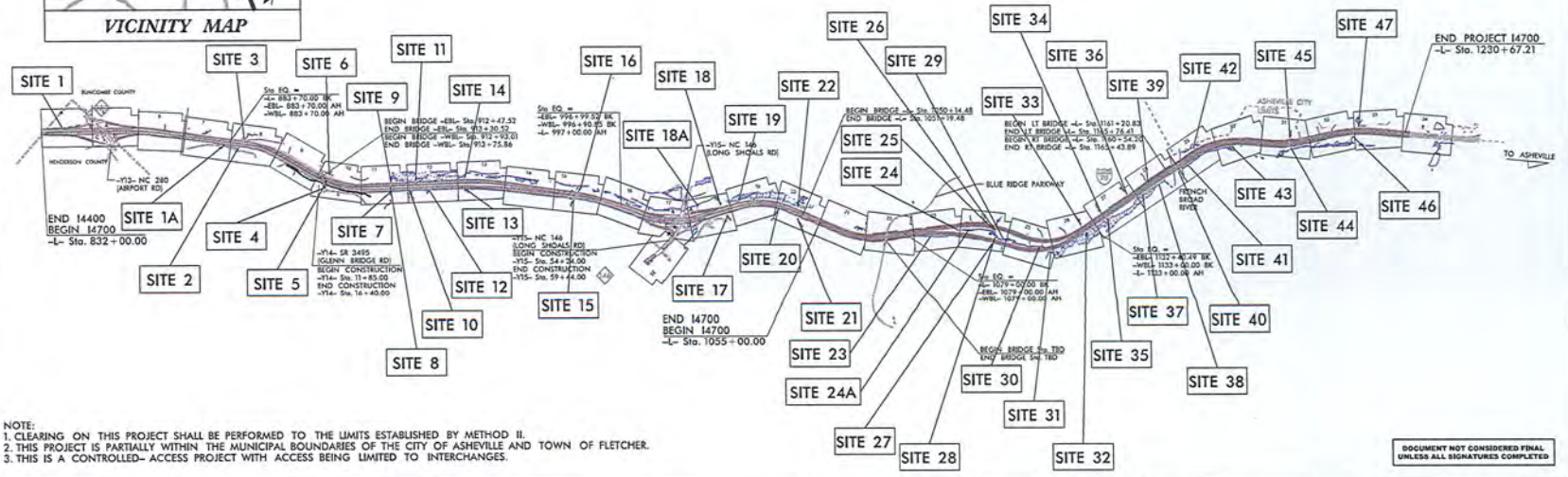
LOCATION: I-26 FROM 0.3 MI EAST OF NC 280 (AIRPORT ROAD) TO 0.5 MI EAST OF NC 191 (BREVARD ROAD)

TYPE OF WORK: GRADING, PAVING, DRAINAGE, RESURFACING, AND STRUCTURES



VICINITY MAP

WETLAND AND SURFACE WATER IMPACTS PERMIT



NOTE:
1. CLEARING ON THIS PROJECT SHALL BE PERFORMED TO THE LIMITS ESTABLISHED BY METHOD II.
2. THIS PROJECT IS PARTIALLY WITHIN THE MUNICIPAL BOUNDARIES OF THE CITY OF ASHEVILLE AND TOWN OF FLETCHER.
3. THIS IS A CONTROLLED- ACCESS PROJECT WITH ACCESS BEING LIMITED TO INTERCHANGES.

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

GRAPHIC SCALES

PLANS: 50 25 0 50 100
PROFILE (HORIZONTAL): 50 25 0 50 100
PROFILE (VERTICAL): 10 5 0 10 20

DESIGN DATA

ADT 2011 =72,000
ADT 2040 =117,900
DHV =11,790
D =55%
T =10% *
V =65 MPH
* TTST =4% DUAL 6%
FUNC CLASS =INTERSTATE
STATEWIDE TIER

PROJECT LENGTH

TOTAL LENGTH OF ROADWAY TIP PROJECT
I-4700A / I-4700B = 7.369 MI

TOTAL LENGTH OF STRUCTURES OF TIP PROJECT
I-4700A / I-4700B = 0.121 MI

TOTAL LENGTH OF TIP PROJECT
I-4700A / I-4700B = 7.490 MI

NOTE: LENGTHS WERE CALCULATED USING THE WBL ALIGNMENT

Prepared in the Office of:
HNTB
HNTB NORTH CAROLINA, P.C.
343 E. Six Forks Road, Suite 200
Raleigh, North Carolina 27609
NC License No: C-0554

2018 STANDARD SPECIFICATIONS

RIGHT OF WAY DATE: July 1, 2018

LETTING DATE: June 2019

JOSEPH OLSON, P.E.
PROJECT ENGINEER

JEFF HESS, P.E.
PROJECT DESIGN ENGINEER

WANDA AUSTIN, P.E.
NCDOT CONTACT

HYDRAULICS ENGINEER

SIGNATURE: P.E.

ROADWAY DESIGN ENGINEER

SIGNATURE: P.E.

STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

11/29/2018
...\Drawings\I4700A_HYD_PRM_TSH
HNTB

1/24/2017

P-93

DRAINAGE DITCH DETAILS

HNTB

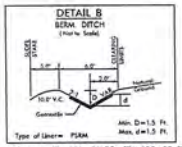
I-4700	2D-2
R/W SHEET NO.	

HYDRAULICS ENGINEER

PERMIT DRAWING
SHEET 2 OF 97

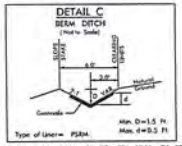
P-94

DETAIL B
BERM DITCH
(Not to Scale)



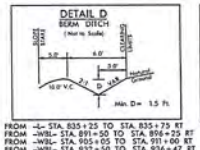
FROM -L- STA. 833+50 TO STA. 835+25 RT
FROM -L- STA. 835+75 TO STA. 837+83 RT
FROM -WBL- STA. 889+14 TO STA. 895+50 RT
FROM -WBL- STA. 896+25 TO STA. 901+50 RT.
FROM -WBL- STA. 924+50 TO STA. 931+25 RT
FROM -WBL- STA. 989+00 TO STA. 991+25 RT
FROM -WBL- STA. 994+25 TO STA. 994+95 RT
FROM -WBL- STA. 998+00 TO -Y15RPC- STA. 10+60 RT
FROM -L- STA. 997+00 TO STA. 1000+28 RT

DETAIL C
BERM DITCH
(Not to Scale)



FROM -L- STA. 1063+50 TO STA. 1066+75 RT.

DETAIL D
BERM DITCH
(Not to Scale)



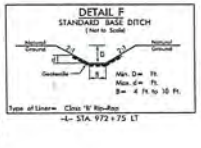
FROM -L- STA. 835+25 TO STA. 835+79 RT
FROM -WBL- STA. 891+50 TO STA. 896+25 RT
FROM -WBL- STA. 905+05 TO STA. 911+00 RT
FROM -WBL- STA. 932+50 TO STA. 936+47 RT
FROM -WBL- STA. 991+25 TO STA. 994+35 RT
FROM -WBL- STA. 994+95 TO STA. 996+00 RT
FROM -L- STA. 1031+50 TO 1042+25 STA. RT
FROM -WBL- STA. 1108+25 TO STA. 1110+50 RT
FROM -EBL- STA. 1114+51 TO STA. 1119+00 LT.
FROM -L- STA. 1217+75 TO STA. 1230+57.72 LT.

DETAIL E
SPECIAL LATERAL BASE DITCH
(Not to Scale)



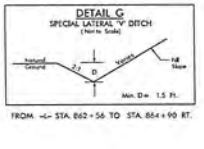
FROM -EBL- STA. 884+00 TO STA. 885+00 LT
FROM -WBL- STA. 902+00 TO STA. 903+25 RT

DETAIL F
STANDARD BASE DITCH
(Not to Scale)



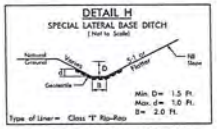
-L- STA. 972+75 LT

DETAIL G
SPECIAL LATERAL "V" DITCH
(Not to Scale)



FROM -L- STA. 862+56 TO STA. 864+90 RT.

DETAIL H
SPECIAL LATERAL BASE DITCH
(Not to Scale)



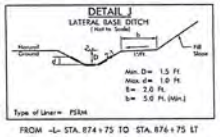
FROM -L- STA. 873+50 TO STA. 874+25 RT
FROM -Y15PRC- STA. 10+00 TO STA. 11+95 RT

DETAIL I
SPECIAL LATERAL "V" DITCH
(Not to Scale)



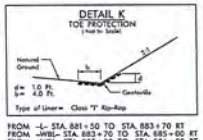
FROM -L- STA. 874+75 TO STA. 875+25 RT

DETAIL J
LATERAL BASE DITCH
(Not to Scale)



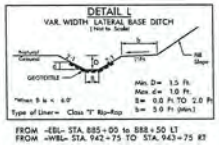
FROM -L- STA. 874+75 TO STA. 876+75 LT

DETAIL K
TOE PROTECTION
(Not to Scale)



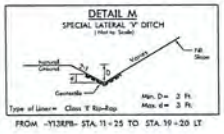
FROM -L- STA. 881+50 TO STA. 883+70 RT
FROM -WBL- STA. 883+70 TO STA. 885+00 RT
FROM -WBL- STA. 885+00 TO STA. 886+60 RT

DETAIL L
VAR. WIDTH LATERAL BASE DITCH
(Not to Scale)



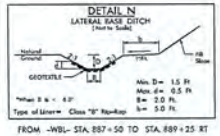
FROM -EBL- STA. 885+00 to 888+50 LT
FROM -WBL- STA. 942+75 TO STA. 943+75 RT

DETAIL M
SPECIAL LATERAL "V" DITCH
(Not to Scale)



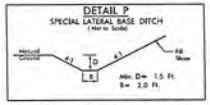
FROM -Y13RPB- STA. 11+25 TO STA. 19+20 LT

DETAIL N
LATERAL BASE DITCH
(Not to Scale)



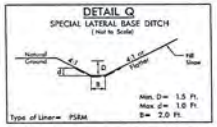
FROM -WBL- STA. 887+50 TO STA. 889+25 RT

DETAIL P
SPECIAL LATERAL BASE DITCH
(Not to Scale)



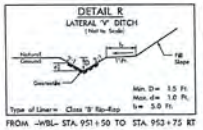
FROM -L- STA. 832+00 TO STA. 834+93 LT
FROM -WBL- STA. 902+00 TO STA. 905+25 RT

DETAIL Q
SPECIAL LATERAL BASE DITCH
(Not to Scale)



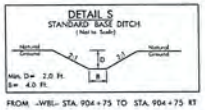
FROM -WBL- STA. 901+25 TO STA. 902+00 RT

DETAIL R
LATERAL "V" DITCH
(Not to Scale)



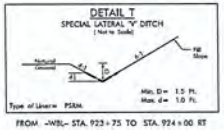
FROM -WBL- STA. 951+50 TO STA. 953+75 RT

DETAIL S
STANDARD BASE DITCH
(Not to Scale)



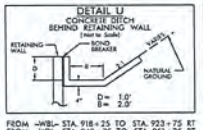
FROM -WBL- STA. 904+75 TO STA. 904+75 RT

DETAIL T
SPECIAL LATERAL "V" DITCH
(Not to Scale)



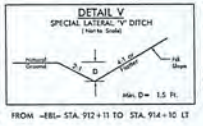
FROM -WBL- STA. 923+75 TO STA. 924+00 RT

DETAIL U
CONCRETE DITCH
BEHIND RETAINING WALL
(Not to Scale)



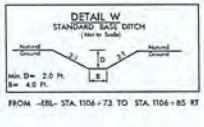
FROM -WBL- STA. 918+25 TO STA. 923+75 RT
FROM -WBL- STA. 948+75 TO STA. 951+25 RT
FROM -WBL- STA. 959+75 TO STA. 978+00 RT
FROM -L- STA. 1070+60 TO STA. 1078+00 LT.
FROM -L- STA. 1069+00 TO STA. 1079+00 RT.
FROM -EBL- STA. 1081+00 TO STA. 1084+50 LT.
FROM -EBL- STA. 1086+00 TO STA. 1093+00 LT.
FROM -WBL- STA. 1079+00 TO STA. 1081+00 RT.
FROM -WBL- STA. 1093+89 TO STA. 1100+50 RT.
FROM -L- STA. 1140+75 TO STA. 1148+58 LT.
FROM -L- STA. 1148+06 TO STA. 1161+65 LT.
FROM -L- STA. 1184+00 TO STA. 1194+92 LT.

DETAIL V
SPECIAL LATERAL "V" DITCH
(Not to Scale)



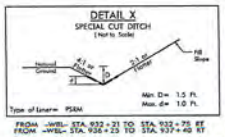
FROM -EBL- STA. 912+11 TO STA. 914+10 LT

DETAIL W
STANDARD BASE DITCH
(Not to Scale)



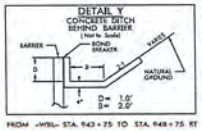
FROM -EBL- STA. 1106+73 TO STA. 1106+85 RT

DETAIL X
SPECIAL CUT DITCH
(Not to Scale)



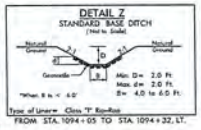
FROM -WBL- STA. 932+21 TO STA. 933+75 RT
FROM -WBL- STA. 936+25 TO STA. 937+40 RT

DETAIL Y
CONCRETE DITCH
BEHIND BARRIER
(Not to Scale)



FROM -WBL- STA. 943+75 TO STA. 948+75 RT

DETAIL Z
STANDARD BASE DITCH
(Not to Scale)



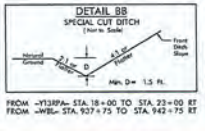
FROM STA. 1094+05 TO STA. 1094+32, LT.

DETAIL AA
SPECIAL LATERAL "V" DITCH
(Not to Scale)



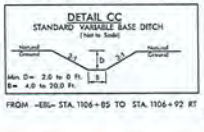
FROM -WBL- STA. 937+40 TO STA. 938+50 RT

DETAIL BB
SPECIAL CUT DITCH
(Not to Scale)



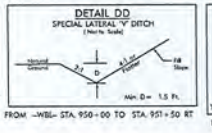
FROM -Y13RPA- STA. 18+00 TO STA. 23+00 RT
FROM -WBL- STA. 927+75 TO STA. 942+75 RT

DETAIL CC
STANDARD VARIABLE BASE DITCH
(Not to Scale)



FROM -EBL- STA. 1106+85 TO STA. 1106+92 RT

DETAIL DD
SPECIAL LATERAL "V" DITCH
(Not to Scale)



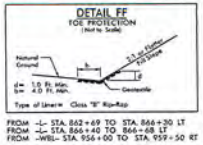
FROM -WBL- STA. 950+00 TO STA. 951+50 RT

DETAIL EE
SPECIAL LATERAL "V" DITCH
(Not to Scale)



FROM -WBL- STA. 1081+00 TO STA. 1083+50, RT.

DETAIL FF
TOE PROTECTION
(Not to Scale)



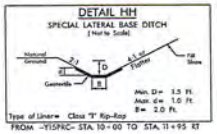
FROM -L- STA. 862+69 TO STA. 866+30 LT
FROM -L- STA. 866+40 TO 866+68 LT
FROM -WBL- STA. 956+00 TO STA. 959+50 RT

DETAIL GG
SPECIAL LATERAL "V" DITCH
(Not to Scale)



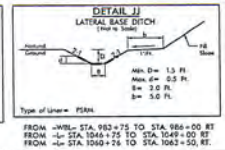
FROM -WBL- STA. 924+25 TO STA. 924+75 RT
FROM -WBL- STA. 988+00 TO STA. 992+00 RT

DETAIL HH
SPECIAL LATERAL BASE DITCH
(Not to Scale)



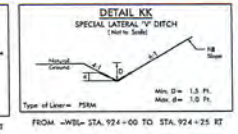
FROM -Y15PRC- STA. 10+00 TO STA. 11+95 RT

DETAIL JJ
LATERAL BASE DITCH
(Not to Scale)



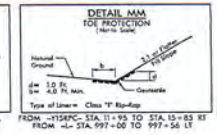
FROM -WBL- STA. 983+75 TO STA. 1046+00 RT
FROM -L- STA. 1046+75 TO STA. 1049+00 RT
FROM -L- STA. 1060+26 TO STA. 1062+50, RT.

DETAIL KK
SPECIAL LATERAL "V" DITCH
(Not to Scale)



FROM -WBL- STA. 924+00 TO STA. 924+25 RT

DETAIL MM
TOE PROTECTION
(Not to Scale)



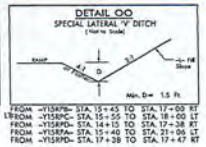
FROM -Y15KPC- STA. 11+95 TO STA. 15+85 RT
FROM -L- STA. 997+00 TO 997+56 LT

DETAIL NN
SPECIAL LATERAL "V" DITCH
(Not to Scale)



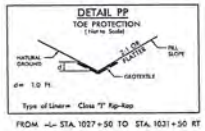
FROM -Y15RPB- STA. 1004+22 TO STA. 1005+65 LT

DETAIL OO
SPECIAL LATERAL "V" DITCH
(Not to Scale)



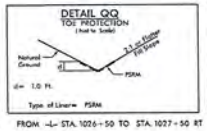
FROM -Y15RPB- STA. 15+45 TO STA. 17+00 RT
FROM -Y15RPC- STA. 15+55 TO STA. 18+00 LT
FROM -Y15RPD- STA. 14+15 TO STA. 17+38 RT
FROM -Y15RPA- STA. 15+40 TO STA. 21+06 LT
FROM -Y15RPD- STA. 17+38 TO STA. 17+47 RT

DETAIL PP
TOE PROTECTION
(Not to Scale)



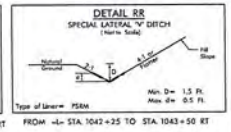
FROM -L- STA. 1027+50 TO STA. 1031+50 RT

DETAIL QQ
TOE PROTECTION
(Not to Scale)



FROM -L- STA. 1026+50 TO STA. 1027+50 RT

DETAIL RR
SPECIAL LATERAL "V" DITCH
(Not to Scale)



FROM -L- STA. 1042+25 TO STA. 1043+50 RT

DETAIL SS
BERM DITCH
(Not to Scale)

FROM -L- STA. 1043+10 TO STA. 1046+75 RT
FROM -L- STA. 1063+50 TO STA. 1066+75 RT.
FROM -EBL- STA. 1106+65 TO STA. 1109+13.21 LT.
FROM -EBL- STA. 1109+13.21 TO STA. 1114+50 LT.
FROM -EBL- STA. 1119+01 TO STA. 1125+75 LT.
FROM -WBL- STA. 1110+50 TO STA. 1114+25 RT.

DETAIL VV
LATERAL BASE DITCH
(Not to Scale)

FROM -L- STA. 1055+50 TO STA. 1058+50 LT.

DETAIL XX
LATERAL BASE DITCH
(Not to Scale)

FROM -L- STA. 1058+50 TO STA. 1061+50, LT.

11/29/2018
USER: HYD_PRM_D-drainageDetails.dgn

DRAINAGE DITCH DETAILS

HNTB

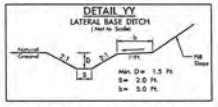
PROJECT REFERENCE NO.	SHEET NO.
I-4700	2D-2
R/W SHEET NO.	
	HYDRAULICS ENGINEER

PERMIT DRAWING SHEET 2A OF 97

P-95

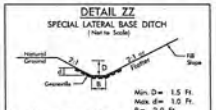
8/17/09

DETAIL YY
LATERAL BASE DITCH (Not to Scale)



FROM –WBL– STA. 911+00 TO STA. 913+75 RT
FROM –WBL– STA. 914+40 TO STA. 918+25 RT
FROM –L– STA. 1053+50 TO STA. 1060+25 RT.
FROM –WBL– STA. 1118+75 TO STA. 1120+00 LT.

DETAIL ZZ
SPECIAL LATERAL BASE DITCH (Not to Scale)



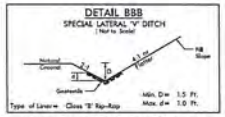
FROM –L– STA. 1066+76 TO STA. 1067+75, RT.

DETAIL AAA
SPECIAL LATERAL 'V' DITCH (Not to Scale)



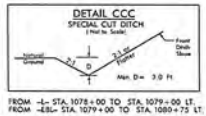
FROM –L– STA. 1066+00 TO STA. 1066+75 RT.
FROM –WBL– STA. 1081+00 TO STA. 1081+50 RT.

DETAIL BBB
SPECIAL LATERAL 'V' DITCH (Not to Scale)



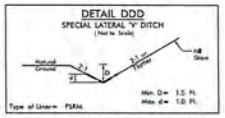
FROM –L– STA. 1067+75 TO STA. 1069+00 RT.

DETAIL CCC
SPECIAL CUT DITCH (Not to Scale)



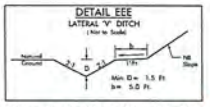
FROM –L– STA. 1078+00 TO STA. 1079+00 LT.
FROM –EBL– STA. 1079+00 TO STA. 1080+75 LT.

DETAIL DDD
SPECIAL LATERAL 'V' DITCH (Not to Scale)



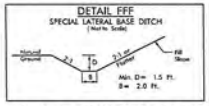
FROM –WBL– STA. 1118+00 TO STA. 1121+00 RT
FROM –L– STA. 1183+00 TO STA. 1183+50 RT.

DETAIL EEE
LATERAL 'V' DITCH (Not to Scale)



FROM –WBL– STA. 1081+50 TO STA. 1082+50 RT.

DETAIL FFF
SPECIAL LATERAL BASE DITCH (Not to Scale)



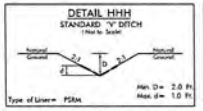
FROM –EBL– STA. 1084+50 TO STA. 1086+00 LT.
FROM –WBL– STA. 1119+00 TO STA. 1120+50 LT.
FROM –L– STA. 1159+02 TO STA. 1161+00 LT.
FROM –L– STA. 1176+00 TO STA. 1184+00 LT.

DETAIL GGG
SPECIAL CUT DITCH (Not to Scale)



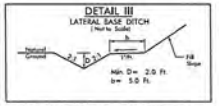
FROM –WBL– STA. 1085+50 TO STA. 1088+50, LT.

DETAIL HHH
STANDARD 'V' DITCH (Not to Scale)



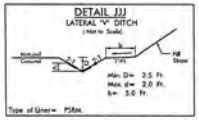
FROM –EBL– STA. 1093+75 TO STA. 1094+25 RT.
FROM –WBL– STA. 1102+75 TO STA. 1103+70 LT.
–EBL– STA. 1118+01 RT.

DETAIL III
LATERAL BASE DITCH (Not to Scale)



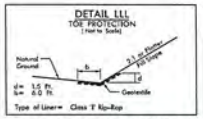
FROM STA. 1082+00 TO STA. 1085+00 RT.

DETAIL JJJ
LATERAL 'V' DITCH (Not to Scale)



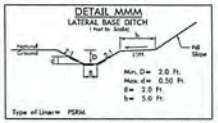
FROM –WBL– STA. 1082+50 TO STA. 1085+30 RT.

DETAIL LLL
TOE PROTECTION (Not to Scale)



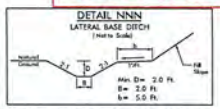
FROM –EBL– STA. 1093+00 TO STA. 1096+25 LT.
FROM –WBL– STA. 1091+50 TO STA. 1093+89 RT.
FROM –WBL– STA. 1102+50 TO STA. 1104+30 RT.
FROM –WBL– STA. 1118+00 STA. TO STA. 1121+00, RT.

DETAIL MMM
LATERAL BASE DITCH (Not to Scale)



FROM –EBL– STA. 1105+51 TO STA. 1106+65 LT.

DETAIL NNN
LATERAL BASE DITCH (Not to Scale)



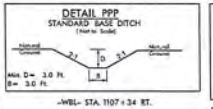
FROM –EBL– STA. 1103+80 TO STA. 1105+50 LT.
FROM –EBL– STA. 1127+50 TO STA. 1131+00 LT.

DETAIL OOO
SPECIAL LATERAL 'V' DITCH (Not to Scale)



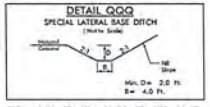
FROM –WBL– STA. 1107+25 TO STA. 1108+25 RT.
FROM –WBL– STA. 1115+50 TO STA. 1116+00 RT.
FROM –EBL– STA. 1122+00 TO STA. 1124+50 RT.
FROM –WBL– STA. 1125+00 TO STA. 1127+50 LT.

DETAIL PPP
STANDARD BASE DITCH (Not to Scale)



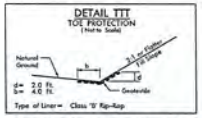
–WBL– STA. 1107+34 RT.

DETAIL QQQ
SPECIAL LATERAL BASE DITCH (Not to Scale)



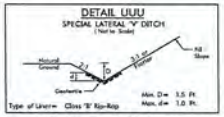
FROM –WBL– STA. 1114+00 TO STA. 1115+50 RT.

DETAIL TTT
TOE PROTECTION (Not to Scale)



FROM –EBL– STA. 1131+01 TO STA. 1132+40 LT.
FROM –L– STA. 1133+00 TO STA. 1140+00 LT.
FROM –L– STA. 1146+58 TO STA. 1148+06 LT.

DETAIL UUU
SPECIAL LATERAL 'V' DITCH (Not to Scale)



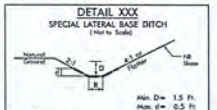
FROM –EBL– STA. 1124+50 TO STA. 1125+00 RT.

DETAIL WWW
STANDARD BASE DITCH (Not to Scale)



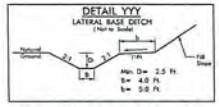
–EBL– STA. 1105+40 RT.
–L– STA. 1138+20 LT.
–L– STA. 1196+78 LT.

DETAIL XXX
SPECIAL LATERAL BASE DITCH (Not to Scale)



FROM –L– STA. 1161+00 TO STA. 1161+67 LT.

DETAIL YYY
LATERAL BASE DITCH (Not to Scale)



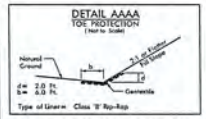
FROM –L– STA. 1149+50 TO STA. 1153+90 RT.

DETAIL ZZZ
SPECIAL LATERAL BASE DITCH (Not to Scale)



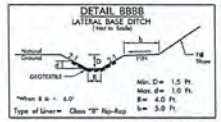
FROM –L– STA. 1175+00 TO STA. 1176+00 LT.

DETAIL AAAA
TOE PROTECTION (Not to Scale)



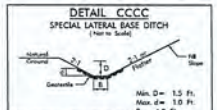
FROM –L– STA. 1198+00 TO STA. 1205+25 LT.
FROM –L– STA. 1213+50 TO STA. 1216+15 LT.

DETAIL BBBB
LATERAL BASE DITCH (Not to Scale)



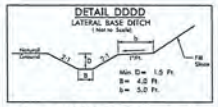
FROM –L– STA. 1205+30 TO STA. 1207+00 LT.

DETAIL CCCC
SPECIAL LATERAL BASE DITCH (Not to Scale)



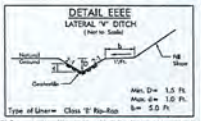
FROM –L– STA. 1207+00 TO STA. 1209+50 LT.

DETAIL DDDD
LATERAL BASE DITCH (Not to Scale)



FROM –L– STA. 1216+25 TO STA. 1217+75 LT.

DETAIL EEEE
LATERAL 'V' DITCH (Not to Scale)



FROM –WBL– STA. 1081+50 TO STA. 1082+50, RT.

BANK STABILIZATION

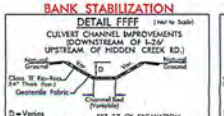
DETAIL IIII
CULVERT CHANNEL IMPROVEMENTS (UPSTREAM OF I-26) (Not to Scale)



D=Varies (To Top of Bank)
EST. 37 CY EXCAVATION
EST. 55 TONS CLASS B RIPRAP
EST. 36 SY GEOTEXTILE FABRIC

BANK STABILIZATION

DETAIL FFFF
CULVERT CHANNEL IMPROVEMENTS (DOWNSTREAM OF I-26/ UPSTREAM OF HIDDEN CREEK RD.) (Not to Scale)



D=Varies (To Top of Bank)
EST. 32 CY EXCAVATION
EST. 39 TONS CLASS B RIPRAP
EST. 40 SY GEOTEXTILE FABRIC

BANK STABILIZATION

DETAIL GGGG
CULVERT CHANNEL IMPROVEMENTS (DOWNSTREAM OF HIDDEN CREEK RD.) (Not to Scale)



D=Varies (To Top of Bank)
EST. 35 CY EXCAVATION
EST. 52 TONS CLASS B RIPRAP
EST. 53 SY GEOTEXTILE FABRIC

BANK STABILIZATION

DETAIL HHHH
BANK STABILIZATION IMPROVEMENTS (DOWNSTREAM OF HIDDEN CREEK RD.) (Not to Scale)



D=Varies (To Top of Bank)
EST. 26 CY EXCAVATION
EST. 39 TONS CLASS B RIPRAP
EST. 39 SY GEOTEXTILE FABRIC

BANK STABILIZATION

DETAIL JJJJ
CULVERT CHANNEL IMPROVEMENTS (UPSTREAM) (Not to Scale)



D=Varies (To Top of Bank)
EST. 98 CY EXCAVATION
EST. 146 TONS CLASS B RIPRAP
EST. 147 SY GEOTEXTILE FABRIC

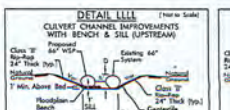
BANK STABILIZATION

DETAIL KKKK
CULVERT CHANNEL IMPROVEMENTS (DOWNSTREAM) (Not to Scale)



D=Varies (To Top of Bank)
EST. 208 CY EXCAVATION
EST. 290 TONS CLASS B RIPRAP
EST. 302 SY GEOTEXTILE FABRIC

DETAIL LLLL
CULVERT CHANNEL IMPROVEMENTS WITH BENCH & SILL (UPSTREAM) (Not to Scale)



D=Varies (To Top of Bank)
EST. 68 CY EXCAVATION
EST. 100 TONS CLASS B RIPRAP
EST. 101 SY GEOTEXTILE FABRIC

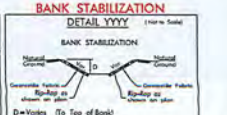
DETAIL MMMM
CULVERT CHANNEL IMPROVEMENTS (DOWNSTREAM) (Not to Scale)



D=Varies (To Top of Bank)
EST. 55 CY EXCAVATION
EST. 82 TONS CLASS B RIPRAP
EST. 83 SY GEOTEXTILE FABRIC

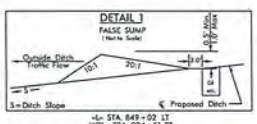
BANK STABILIZATION

DETAIL YYYY
BANK STABILIZATION (Not to Scale)



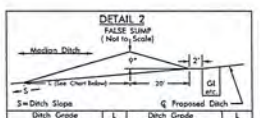
D=Varies (To Top of Bank)

DETAIL 1
FALSE SUMP (Not to Scale)



–L– STA. 849+02 LT
–WBL– STA. 594+51 RT.
–WBL– STA. 996+06 RT.
–Y138PD– STA. 18+61 LT.
–Y138PD– STA. 14+00 LT
–WBL– 1097+15 LT.

DETAIL 2
FALSE SUMP (Not to Scale)



Ditch Grade	L	Ditch Grade	L
0.0% To 2.0%	20'	Over 4.0% To 6.0%	40'
Over 2.0% To 4.0%	30'	Over 6.0%	50'

–EBL– STA. 902+53 RT
–EBL– STA. 905+32 RT
–EBL– STA. 907+54 RT
–EBL– STA. 909+71 RT
–EBL– STA. 911+56 RT
–EBL– STA. 912+68 RT
–EBL– STA. 916+83 RT
–EBL– STA. 923+67 RT
–EBL– STA. 931+86 RT
–EBL– STA. 934+32 RT
–EBL– STA. 940+30 RT
–EBL– STA. 947+30 RT
–EBL– STA. 952+57 RT
–EBL– STA. 955+03 RT
–EBL– STA. 958+07 RT
–EBL– STA. 963+10 RT
–EBL– STA. 964+00 RT
–EBL– STA. 972+90 RT
–EBL– STA. 976+83 RT

DETAIL 3
FALSE SUMP (Not to Scale)

–Y138PC– STA. 10+07 RT
–L– STA. 850+34 RT
–L– STA. 854+53 RT
–WBL– STA. 895+60 RT
–EBL– STA. 911+57 LT
–EBL– STA. 914+55 LT
–EBL– STA. 916+85 LT
–L– STA. 1037+28 RT
FROM STA. 1082+00 TO STA. 1085+00, RT.
–EBL– STA. 1109+15 LT.
–EBL– STA. 1113+15 LT.
–EBL– STA. 1114+70 LT.
–EBL– STA. 1119+32 LT.

BANK STABILIZATION

DETAIL ZZZZ
BANK STABILIZATION (Not to Scale)

D=Varies (To Top of Bank)

BANK STABILIZATION

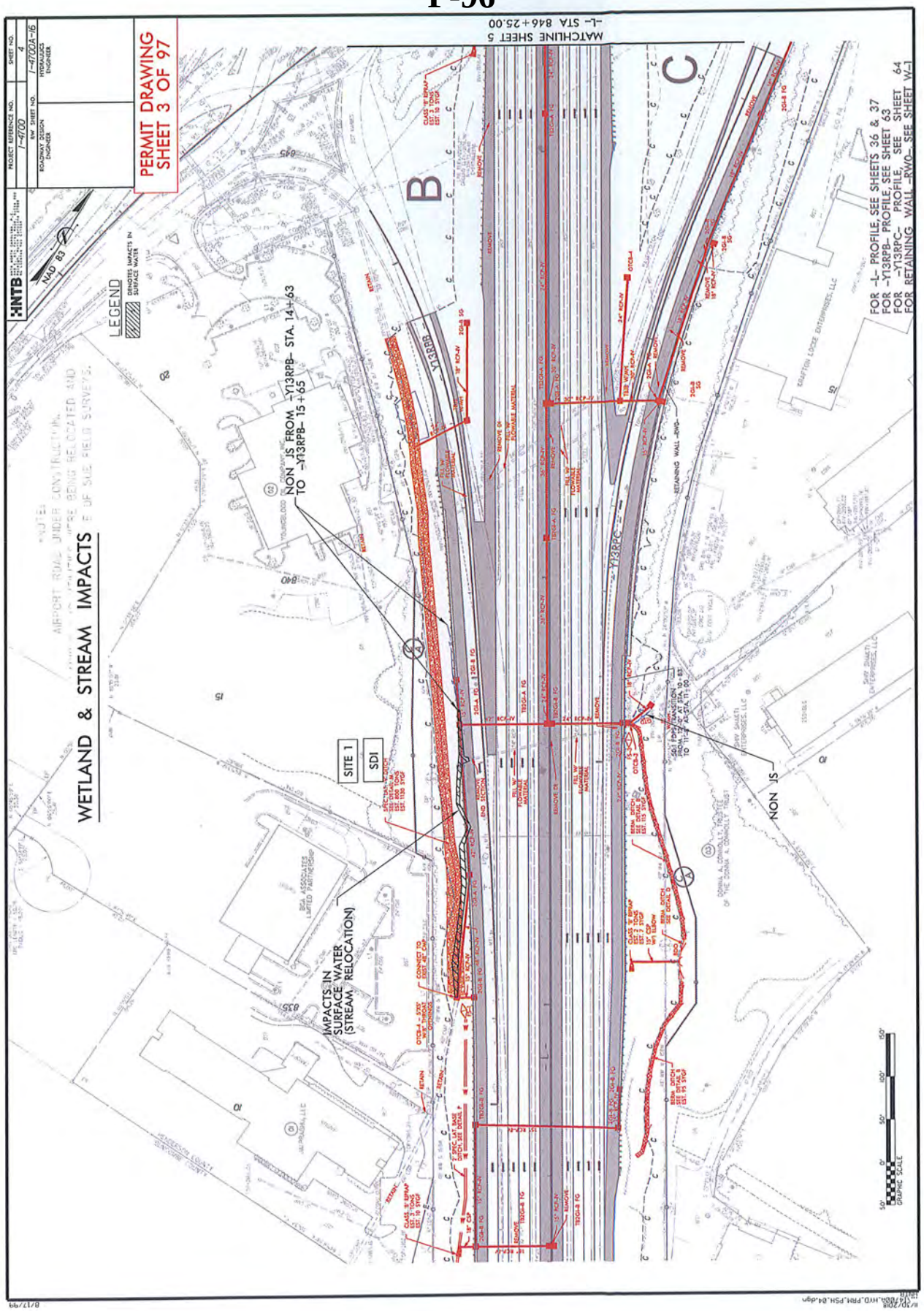
DETAIL RRRR
CULVERT CHANNEL IMPROVEMENTS (Not to Scale)

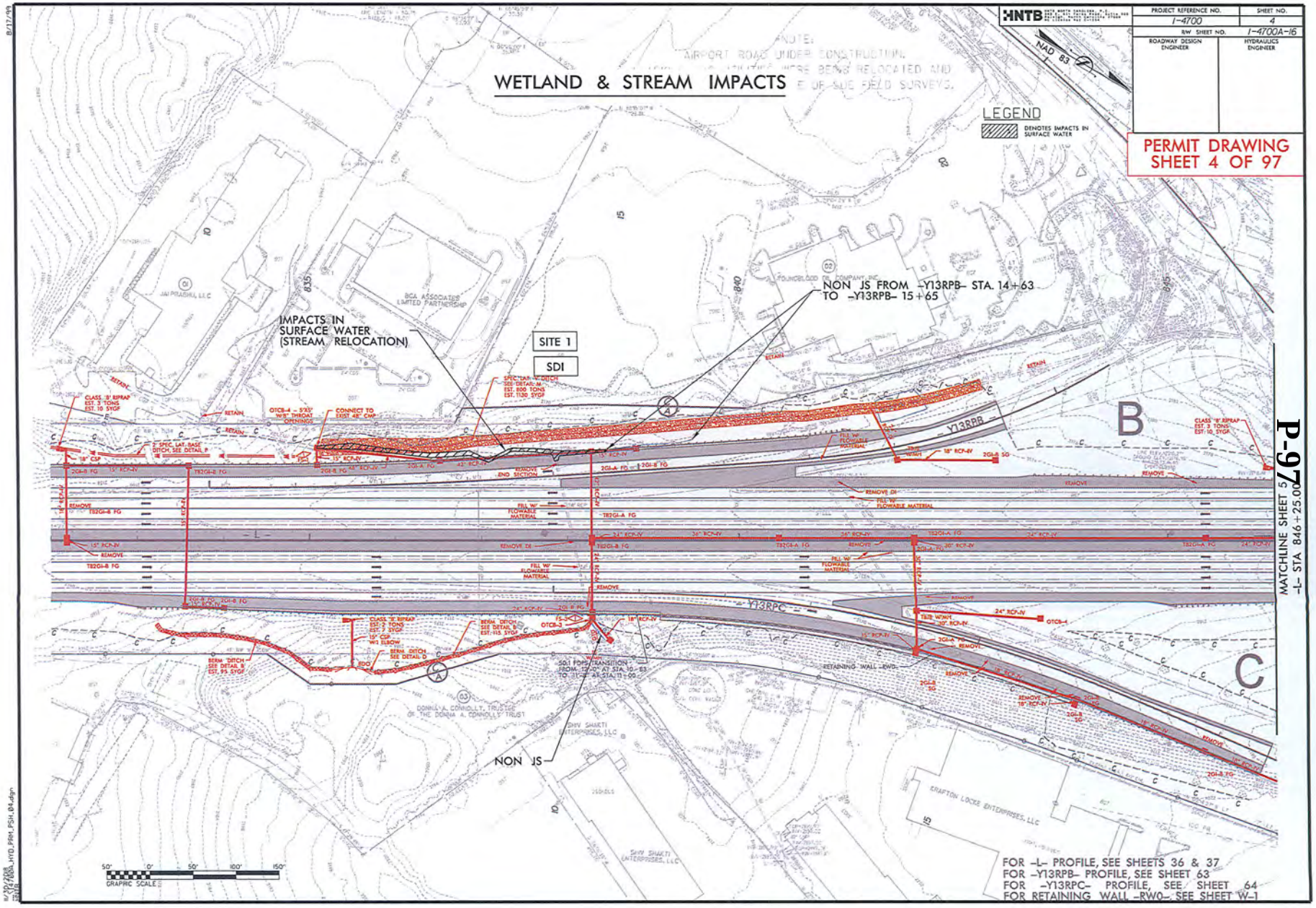
D=Varies (To Top of Bank)

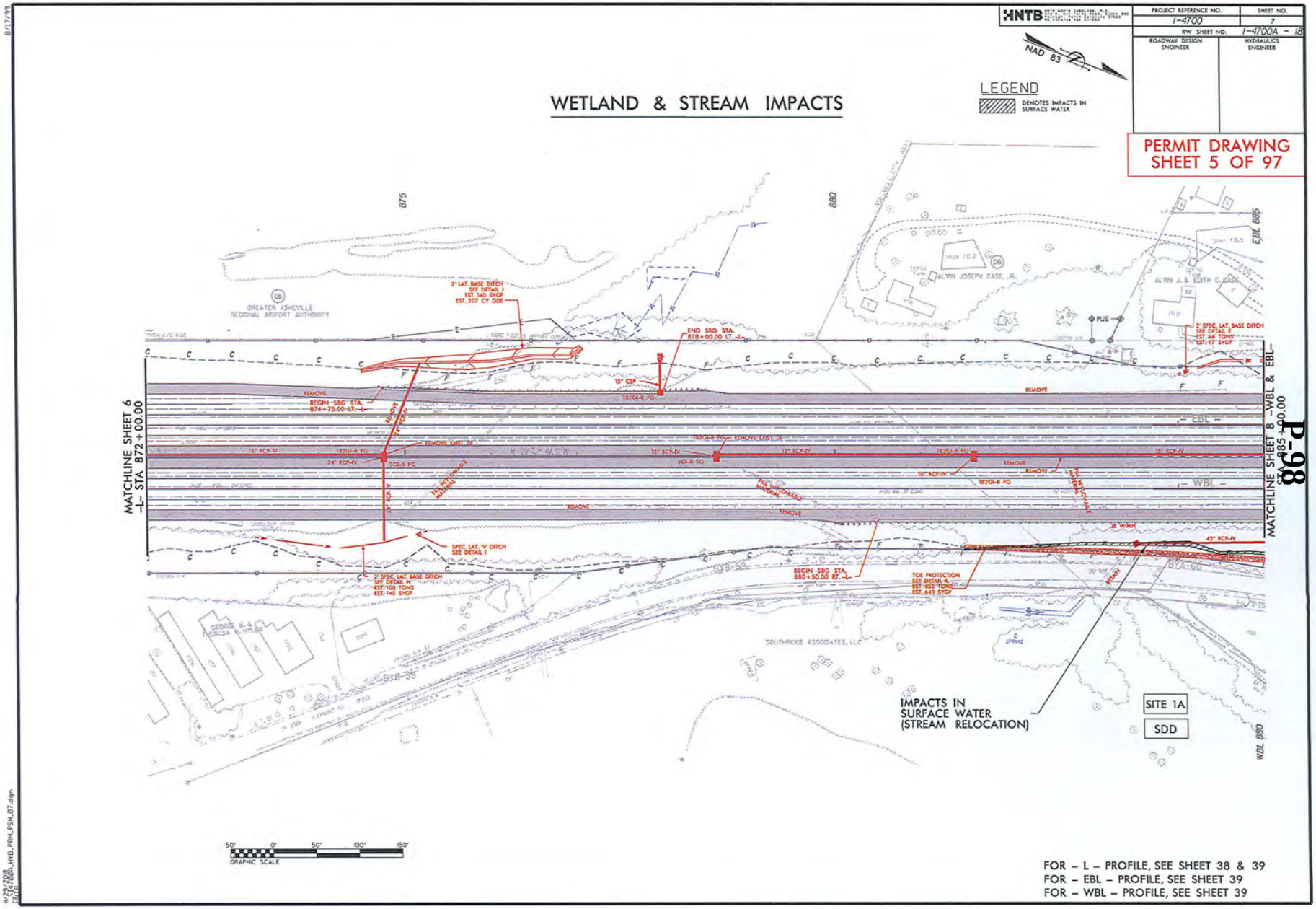
SPECIAL DETAIL
CONCRETE ENERGY DISSIPATOR

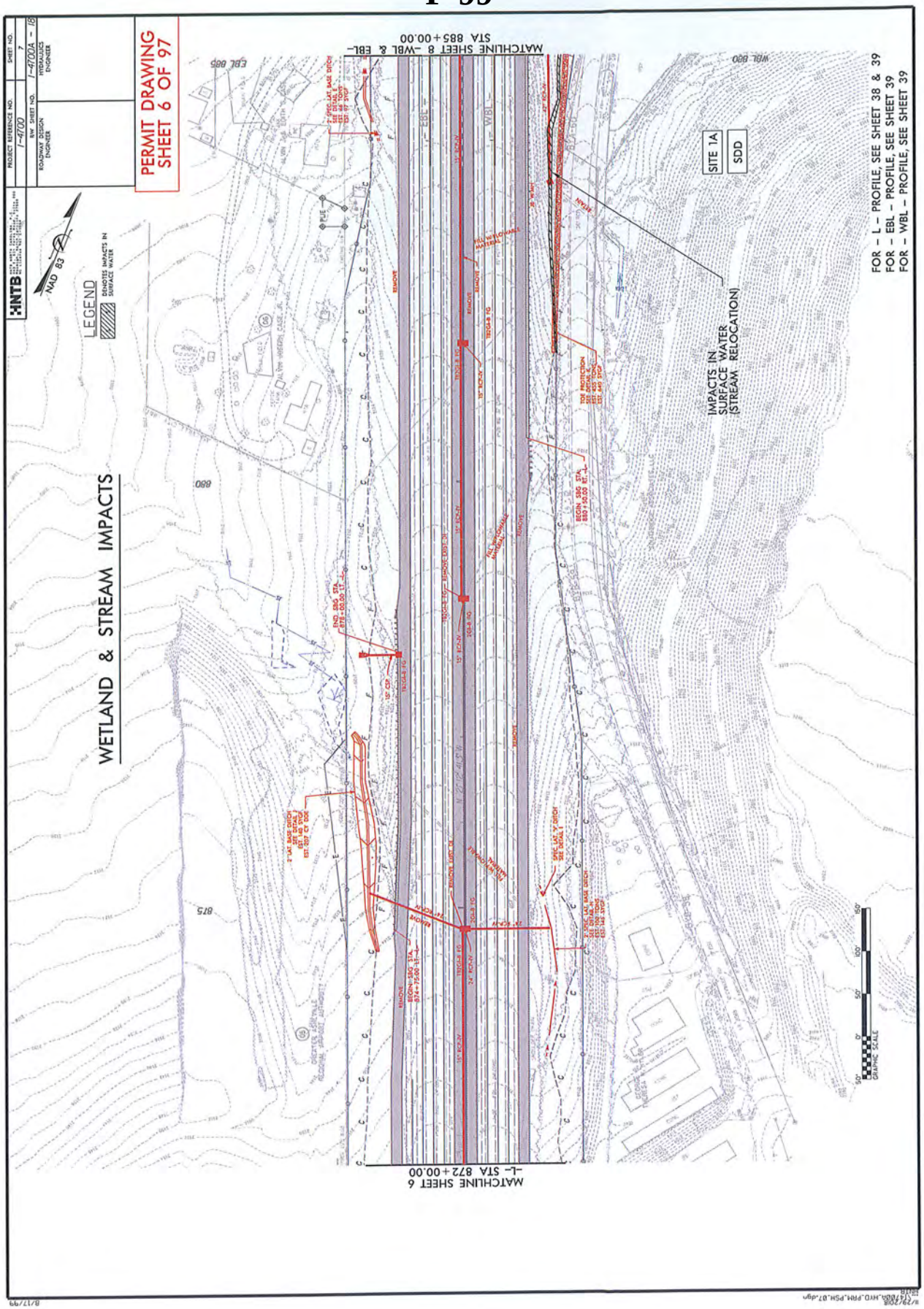
PLAN

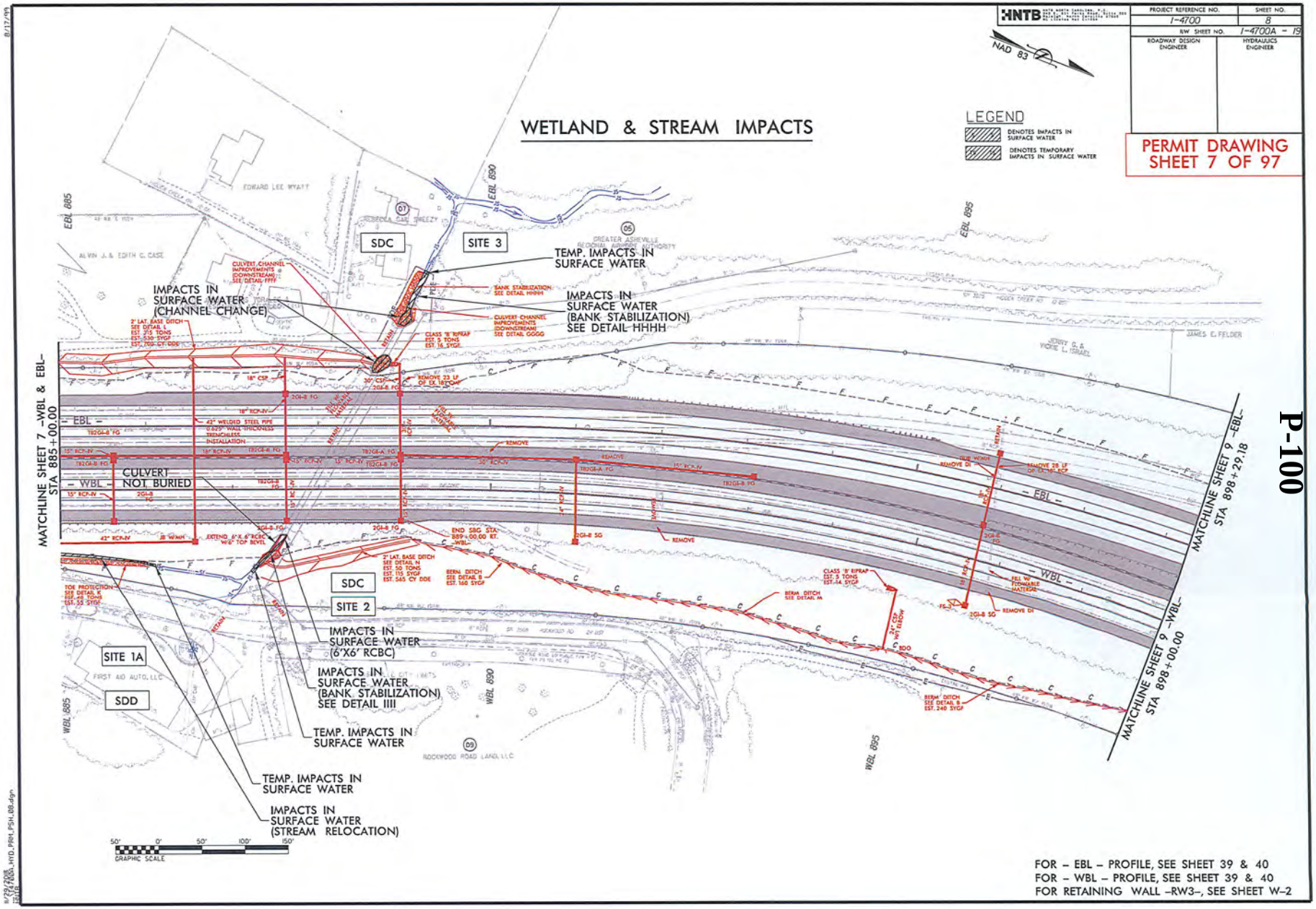
02/25/2008 10:16 M:\HYD_PHM\Drainage\Details.dgn

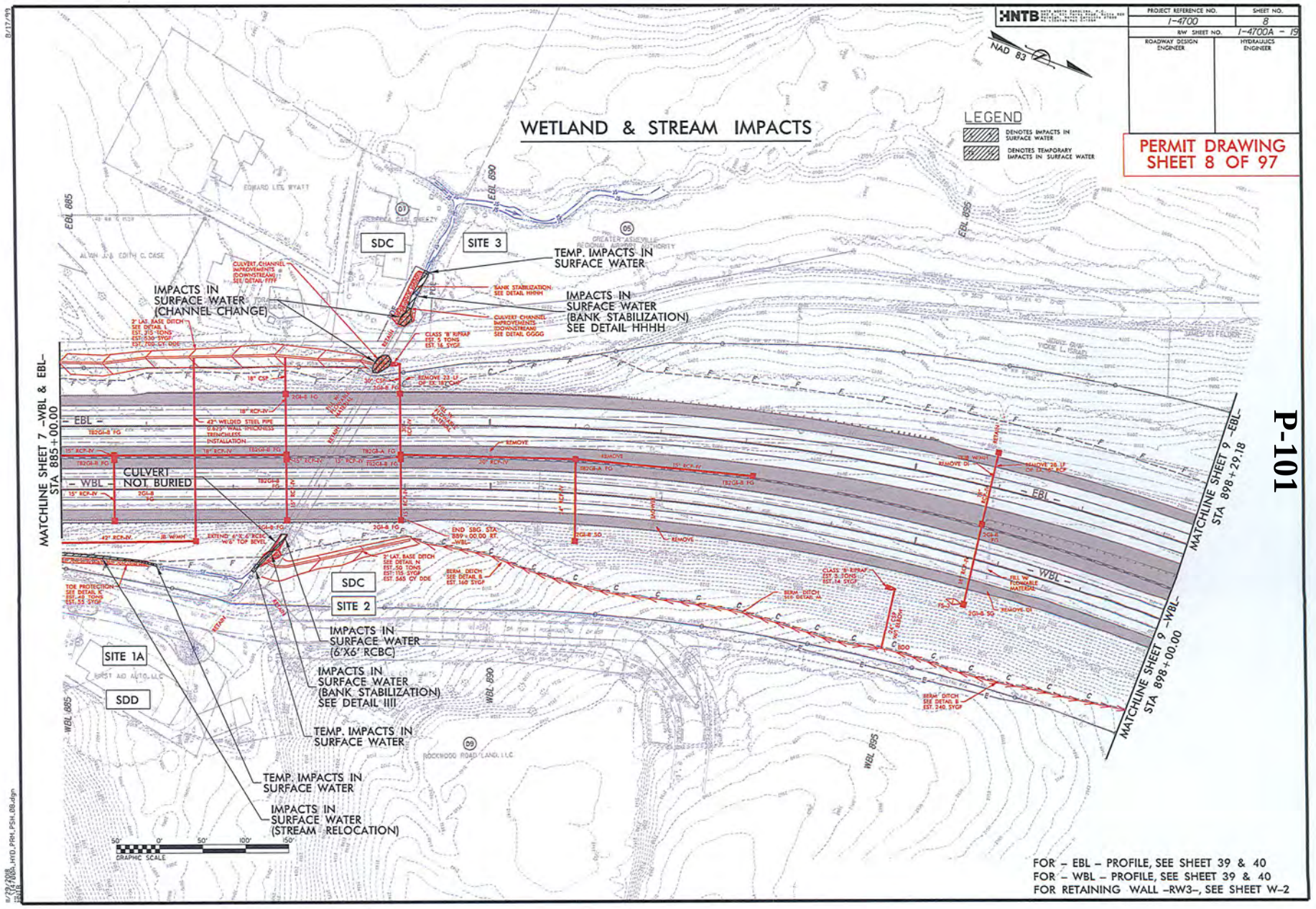

PERMIT DRAWING
SHEET 3 OF 97
WETLAND & STREAM IMPACTS
LEGEND
DENOTES IMPACTS IN SURFACE WATER
NAD 83
NON JS FROM -Y13RPB- STA. 14+63
TO -Y13RPB- 15+65
IMPACTS IN SURFACE WATER (STREAM) RELOCATION
SITE 1
SDI
NON JS
MATCHLINE SHEET 5
-L- STA 846+25.00
FOR -L- PROFILE, SEE SHEETS 36 & 37
FOR -Y13RPB- PROFILE, SEE SHEET 63
FOR -Y13RPC- PROFILE, SEE SHEET 64
FOR RETAINING WALL -RWC- SEE SHEET W-1
GRAPHIC SCALE


WETLAND & STREAM IMPACTS
HNTB
PROJECT REFERENCE NO. 1-4700
SHEET NO. 4
R/W SHEET NO. 1-4700A-16
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
LEGEND
DENOTES IMPACTS IN SURFACE WATER
PERMIT DRAWING SHEET 4 OF 97
NON JS FROM -Y13RPB- STA. 14+63 TO -Y13RPB- 15+65
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
SITE 1
SDI
Y13RPB
Y13RPC
B
C
NON JS
MATCHLINE SHEET 5 -L- STA 846+25.00
P-97
FOR -L- PROFILE, SEE SHEETS 36 & 37
FOR -Y13RPB- PROFILE, SEE SHEET 63
FOR -Y13RPC- PROFILE, SEE SHEET 64
FOR RETAINING WALL -RW0-, SEE SHEET W-1
GRAPHIC SCALE
8/17/99


HNTB
PROJECT REFERENCE NO. I-4700
SHEET NO. 7
R/W SHEET NO. I-4700A - 18
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
WETLAND & STREAM IMPACTS
LEGEND
DENOTES IMPACTS IN SURFACE WATER
PERMIT DRAWING SHEET 5 OF 97
MATCHLINE SHEET 6 –L– STA 872+00.00
MATCHLINE SHEET 8 –WBL & EBL– STA 885+00.00
GREATER ASHEVILLE REGIONAL AIRPORT AUTHORITY
ALVIN JOSEPH CASE, JR.
ALVIN J. & EDITH C. CASE
SOUTHRIDGE ASSOCIATES, LLC
GEORGE B. & THERESA W. HYLER
2' LAT. BASE DITCH SEE DETAIL J EST. 140 SYGF EST. 207 CY DDE
END SBG STA. 878+00.00 LT. –L–
BEGIN SBG STA. 874+75.00 LT. –L–
15" CSP
SPEC. LAT. 'V' DITCH SEE DETAIL I
2' SPEC. LAT. BASE DITCH SEE DETAIL M EST. 100 TONS EST. 145 SYGF
2' SPEC. LAT. BASE DITCH SEE DETAIL E EST. 66 TONS EST. 97 SYGF
BEGIN SBG STA. 880+50.00 RT. –L–
TOE PROTECTION SEE DETAIL K EST. 425 TONS EST. 640 SYGF
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
SITE 1A
SDD
–L–
–EBL–
–WBL–
EBL 885
WBL 880
GRAPHIC SCALE
50' 0' 50' 100' 150'
FOR – L – PROFILE, SEE SHEET 38 & 39
FOR – EBL – PROFILE, SEE SHEET 39
FOR – WBL – PROFILE, SEE SHEET 39
P-98

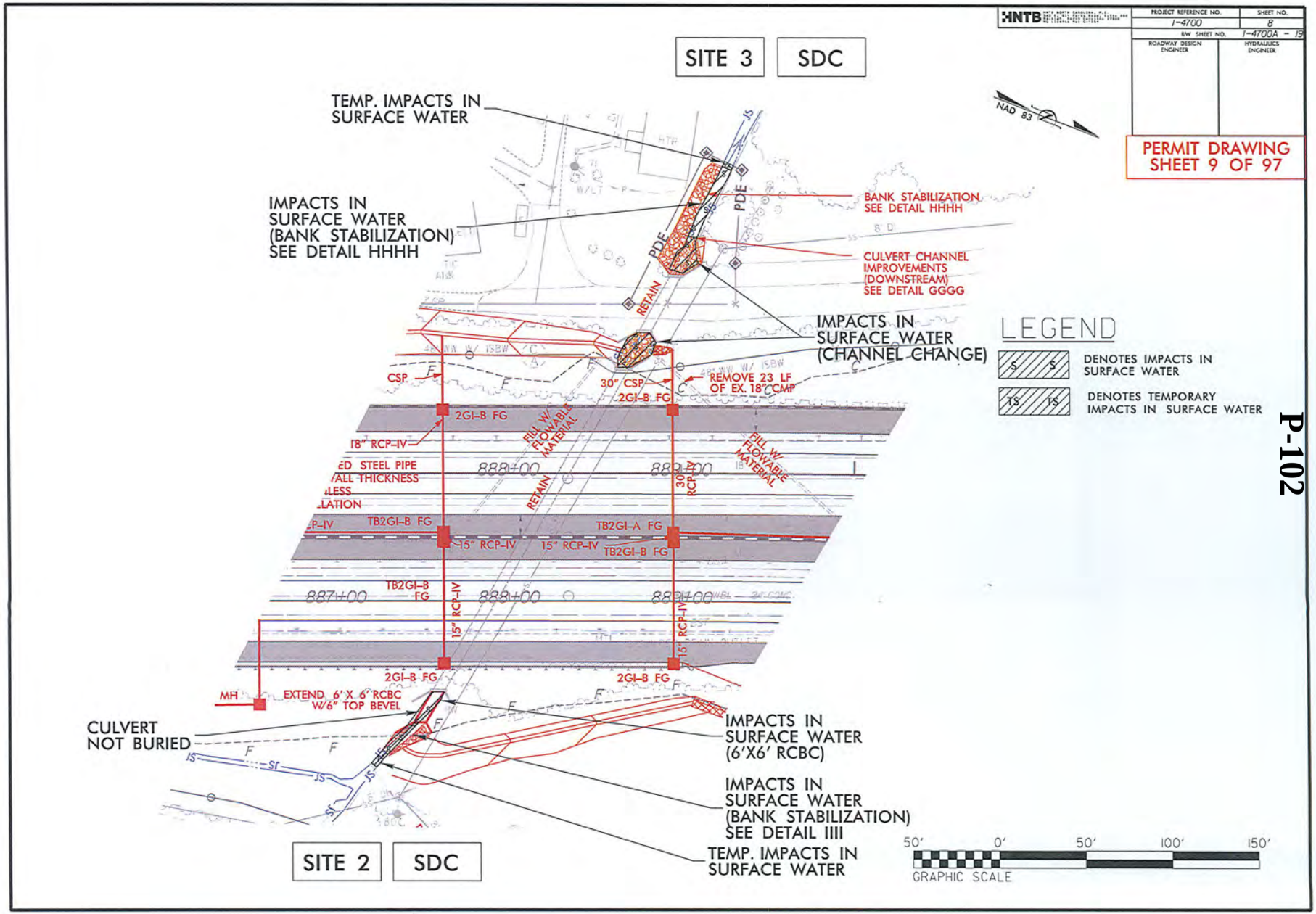

PERMIT DRAWING
SHEET 6 OF 97
WETLAND & STREAM IMPACTS
LEGEND
DENOTES IMPACTS IN SURFACE WATER
NAD 83
PROJECT REFERENCE NO.
I-4700
R/W SHEET NO.
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
SHEET NO.
7
I-4700A - 1B
MATCHLINE SHEET 8 -WBL & EBL- STA 885+00.00
MATCHLINE SHEET 6 -L- STA 872+00.00
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
SITE 1A
SDD
FOR - L - PROFILE, SEE SHEET 38 & 39
FOR - EBL - PROFILE, SEE SHEET 39
FOR - WBL - PROFILE, SEE SHEET 39
GRAPHIC SCALE
8/17/99

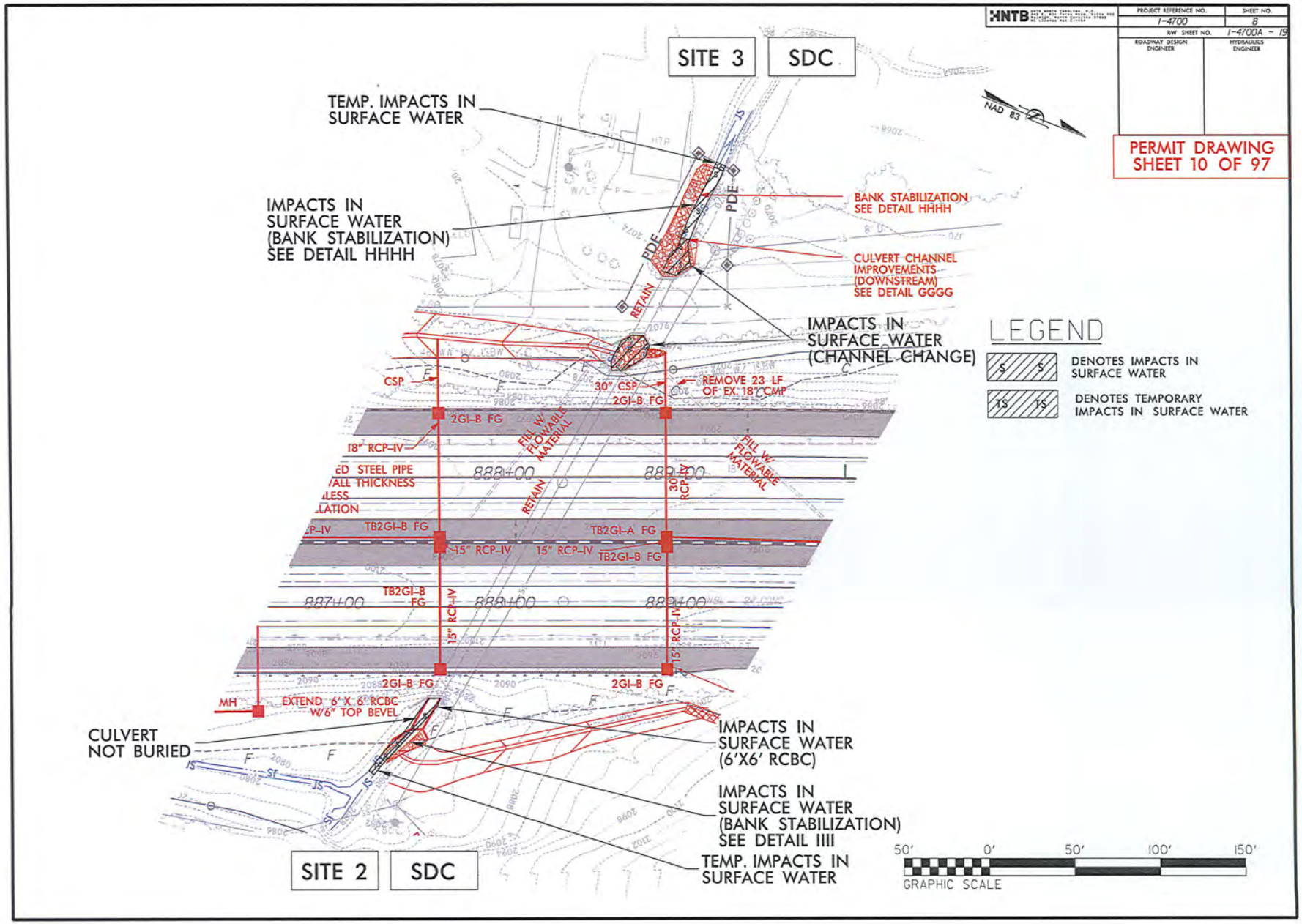

WETLAND & STREAM IMPACTS
HNTB
PROJECT REFERENCE NO. I-4700
SHEET NO. 8
R/W SHEET NO. I-4700A - 19
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
PERMIT DRAWING SHEET 7 OF 97
P-100
SDC
SITE 3
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL HHHH
CULVERT NOT BURIED
SDC
SITE 2
IMPACTS IN SURFACE WATER (6'X6' RCBC)
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL IIII
SITE 1A
SDD
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
MATCHLINE SHEET 7 -WBL & EBL- STA 865+00.00
MATCHLINE SHEET 9 -EBL- STA 898+29.18
MATCHLINE SHEET 9 -WBL- STA 898+00.00
EBL 885
EBL 890
EBL 895
WBL 885
WBL 890
WBL 895
EDWARD LEE WYATT
ALVIN J. & EDITH C. CASE
GREATER ASHEVILLE REGIONAL AIRPORT AUTHORITY
JAMES E. FELDER
JERRY G. & VICKIE L. ISRAEL
FIRST 40 AUTO, LLC
ROCKWOOD ROAD LAND, L.L.C.
GRAPHIC SCALE
50' 0' 50' 100' 150'
FOR – EBL – PROFILE, SEE SHEET 39 & 40
FOR – WBL – PROFILE, SEE SHEET 39 & 40
FOR RETAINING WALL –RW3–, SEE SHEET W–2



HNTB
PROJECT REFERENCE NO.
I-4700
SHEET NO.
8
RW SHEET NO.
I-4700A - 19
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
PERMIT DRAWING
SHEET 8 OF 97
NAD 83
WETLAND & STREAM IMPACTS
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
SDC
SITE 3
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL HHHH
CULVERT NOT BURIED
MATCHLINE SHEET 7 -WBL & EBL- STA 885+00.00
MATCHLINE SHEET 9 -EBL- STA 898+29.18
MATCHLINE SHEET 9 -WBL- STA 898+00.00
SDC
SITE 2
IMPACTS IN SURFACE WATER (6'X6' RCBC)
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL IIII
TEMP. IMPACTS IN SURFACE WATER
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
SITE 1A
SDD
GRAPHIC SCALE
FOR - EBL - PROFILE, SEE SHEET 39 & 40
FOR - WBL - PROFILE, SEE SHEET 39 & 40
FOR RETAINING WALL -RW3-, SEE SHEET W-2

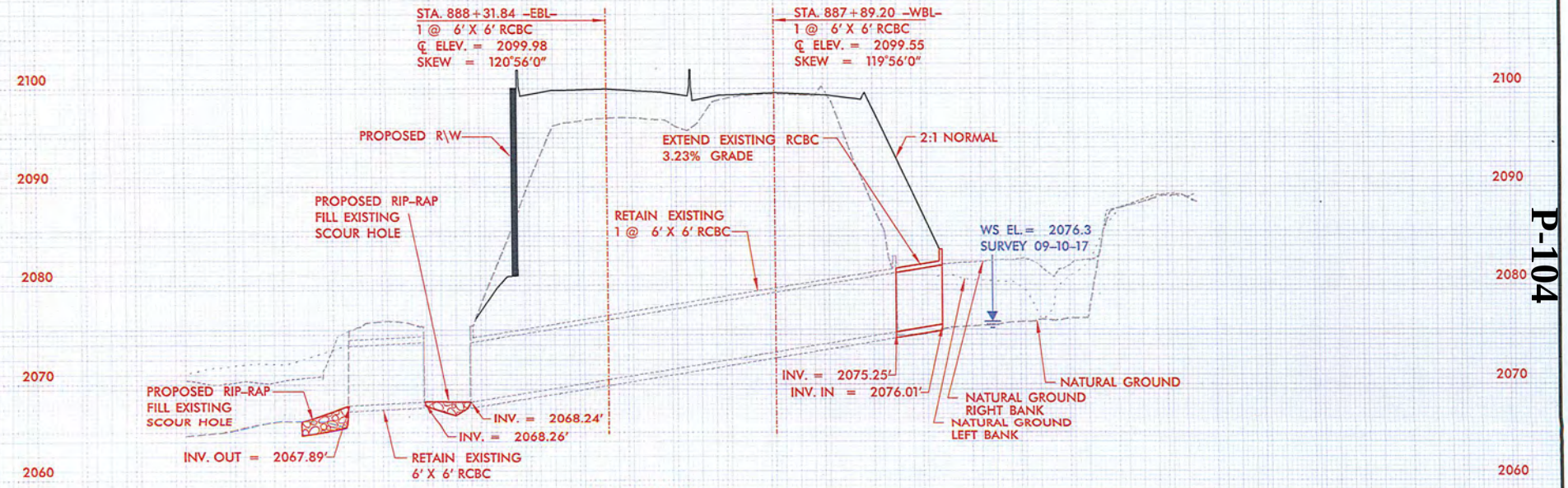
P-101


HNTB
PROJECT REFERENCE NO.
I-4700
SHEET NO.
8
RW SHEET NO.
I-4700A - 19
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
PERMIT DRAWING
SHEET 9 OF 97
SITE 3
SDC
NAD 83
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL HHHH
BANK STABILIZATION SEE DETAIL HHHH
CULVERT CHANNEL IMPROVEMENTS (DOWNSTREAM) SEE DETAIL GGGG
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
REMOVE 23 LF OF EX. 18"CMP
30" CSP
2GI-B FG
CSP
18" RCP-IV
FILL W/ FLOWABLE MATERIAL
RETAIN
TB2GI-B FG
TB2GI-A FG
15" RCP-IV
888+00
887+00
MH
EXTEND 6' X 6' RCBC W/6" TOP BEVEL
CULVERT NOT BURIED
IMPACTS IN SURFACE WATER (6'X6' RCBC)
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL IIII
TEMP. IMPACTS IN SURFACE WATER
SITE 2
SDC
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
50' 0' 50' 100' 150'
GRAPHIC SCALE
P-102


HNTB
PROJECT REFERENCE NO.
1-4700
SHEET NO.
8
R/W SHEET NO.
1-4700A - 19
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
PERMIT DRAWING
SHEET 10 OF 97
SITE 3
SDC
NAD 83
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL HHHH
BANK STABILIZATION SEE DETAIL HHHH
CULVERT CHANNEL IMPROVEMENTS (DOWNSTREAM) SEE DETAIL GGGG
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
CSP
30" CSP
REMOVE 23 LF OF EX. 18" CMP
2GI-B FG
18" RCP-IV
FILL W/ FLOWABLE MATERIAL
888+00
889+00
30" RCP-IV
TB2GI-B FG
TB2GI-A FG
15" RCP-IV
887+00
15" RCP-IV
MH
EXTEND 6' X 6' RCBC W/6" TOP BEVEL
CULVERT NOT BURIED
IMPACTS IN SURFACE WATER (6'X6' RCBC)
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL IIII
TEMP. IMPACTS IN SURFACE WATER
SITE 2
SDC
50' 0' 50' 100' 150'
GRAPHIC SCALE

PROJ. REFERENCE NO.	SHEET NO.
I-4700	

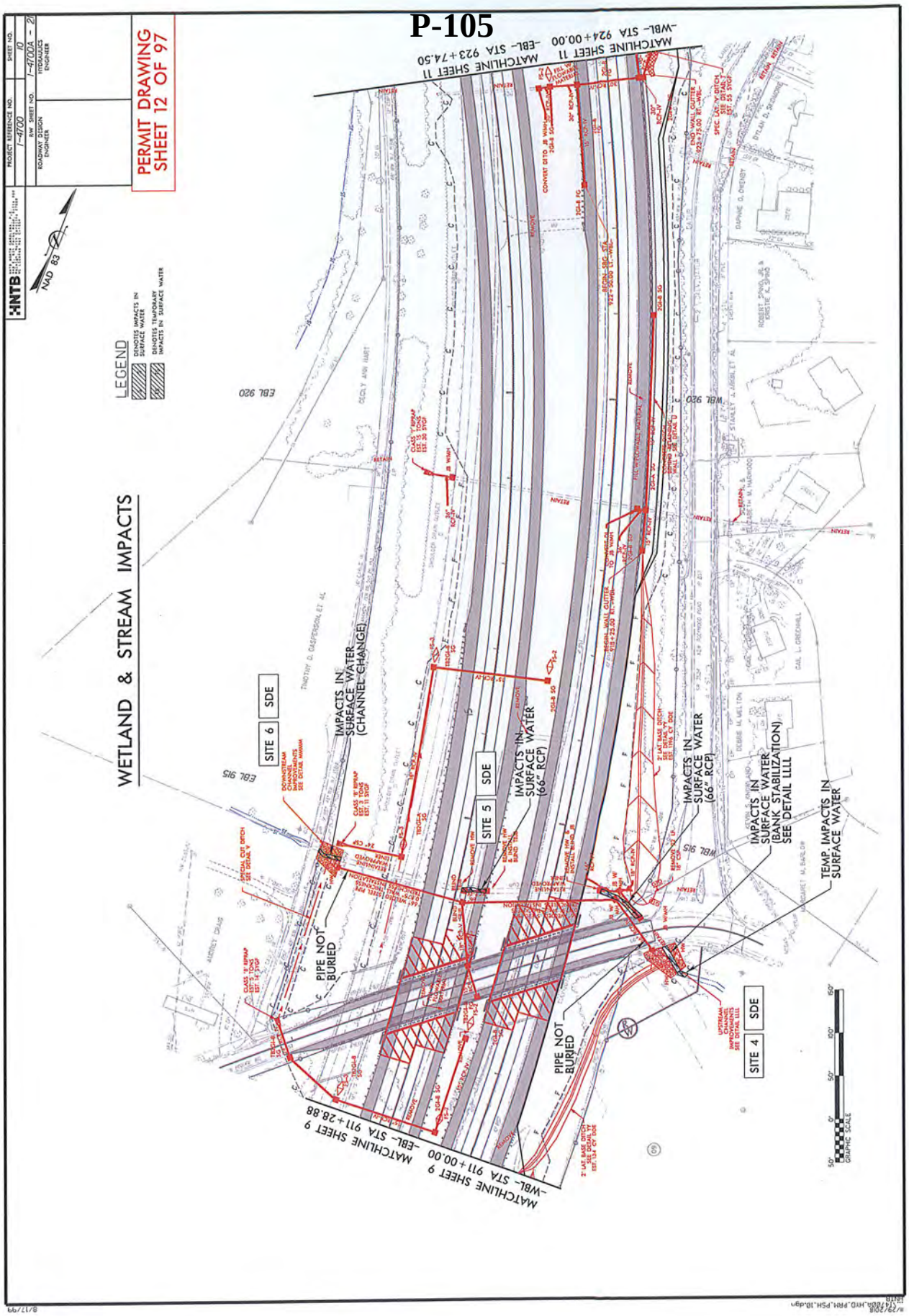
PERMIT DRAWING
SHEET 11 OF 97

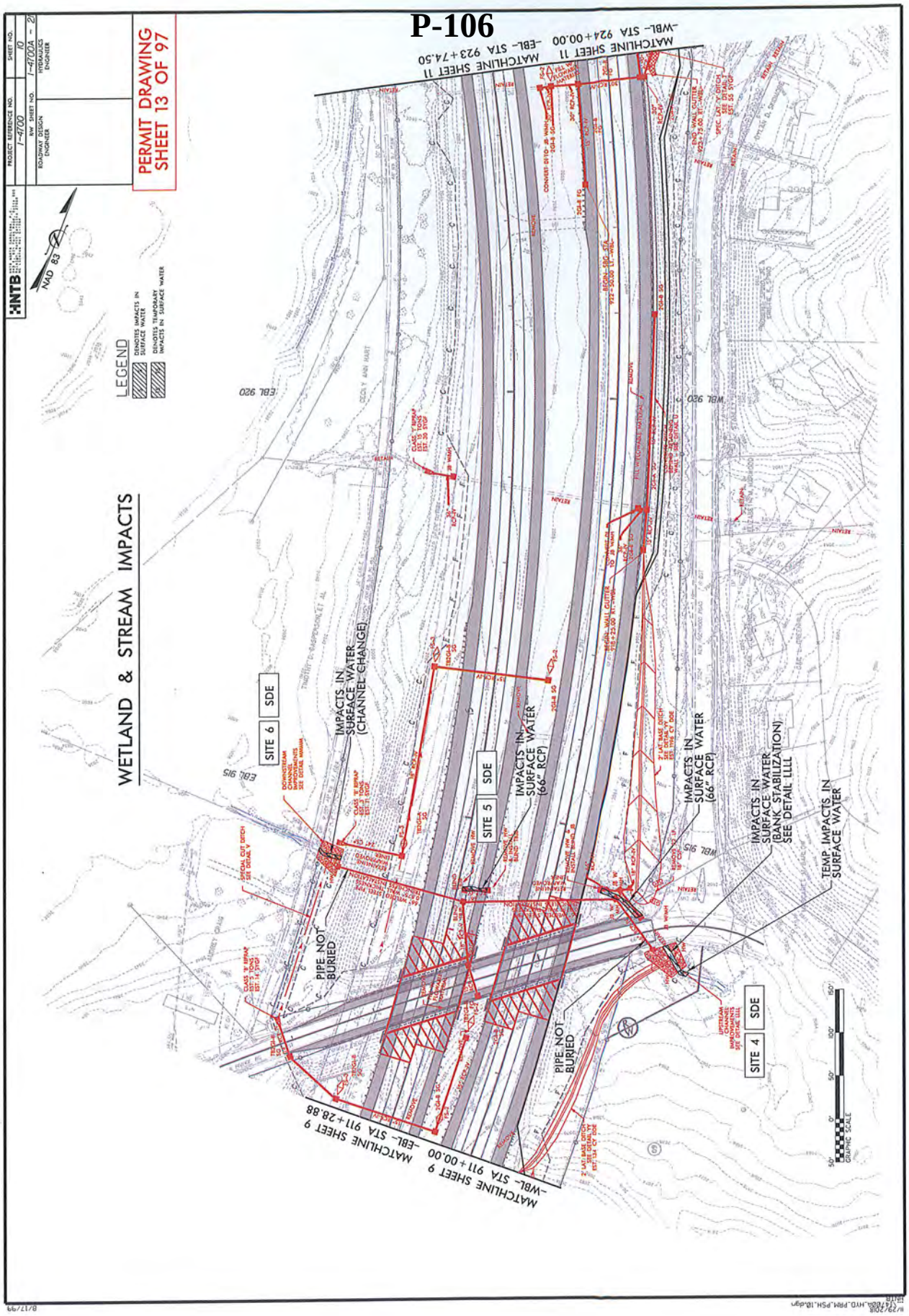


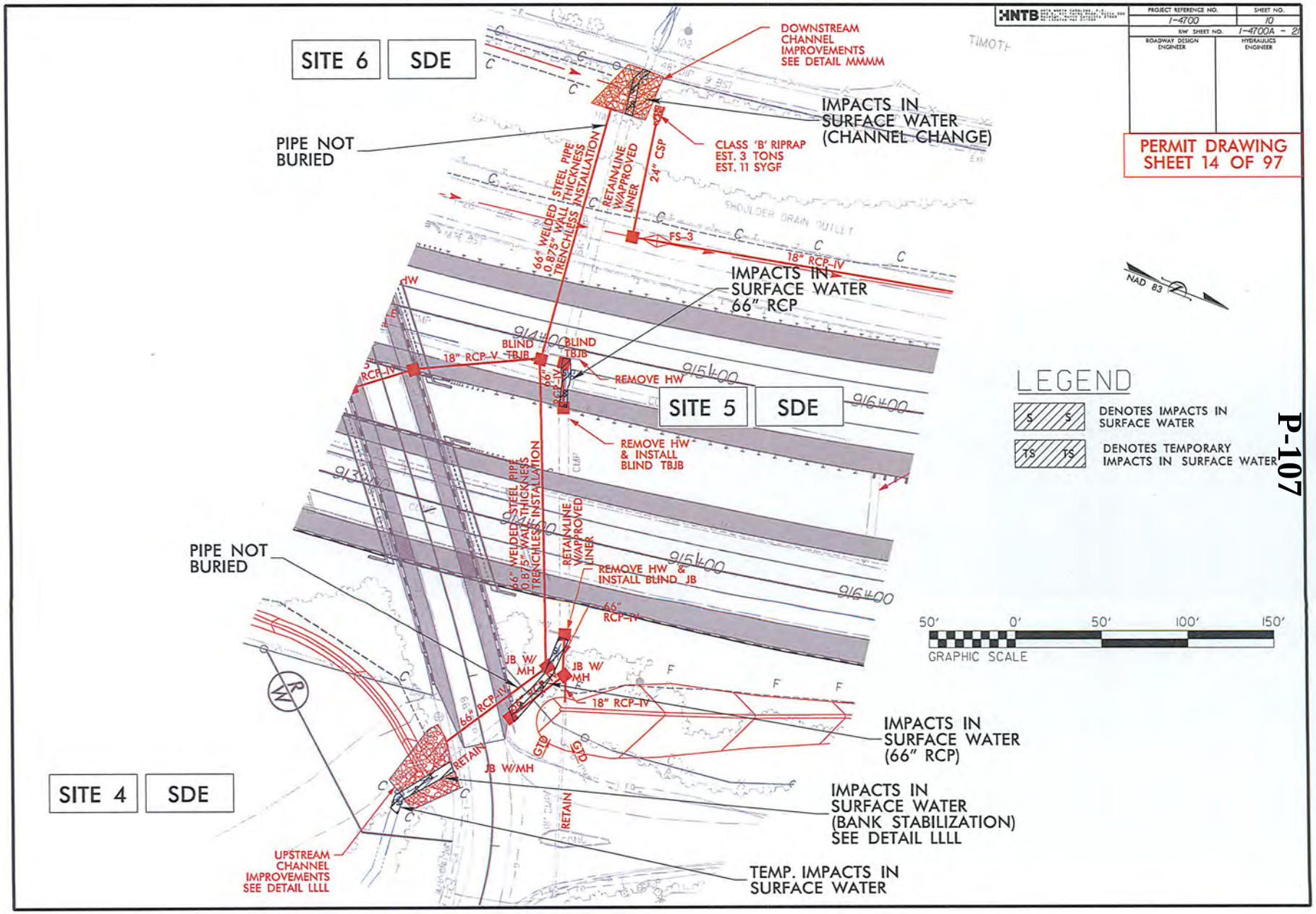
PROFILE

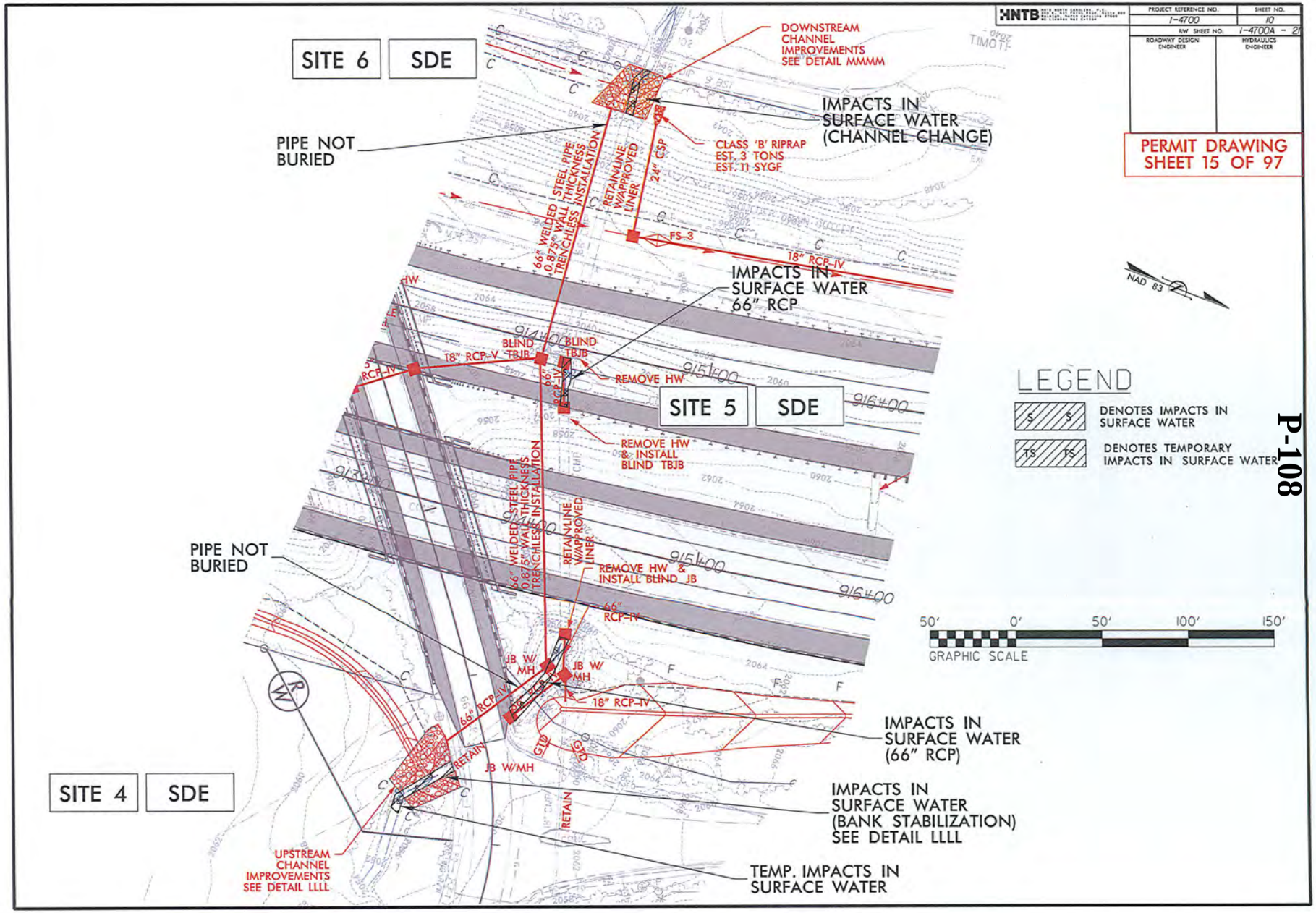
P-104

BUNCOMBE & HENDERSON COUNTY
PROJECT: I-4700
I-26
FROM 0.3 MI EAST OF NC 280 (AIRPORT RD.)
TO 0.5 MI EAST OF NC 191 (BREVARD RD.)


PERMIT DRAWING
SHEET 12 OF 97
PROJECT REFERENCE NO. I-4700
SHEET NO. 10
I-4700A - 2
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
WETLAND & STREAM IMPACTS
MATCHLINE SHEET 11 -WBL- STA 924+00.00 -EBL- STA 923+74.50
MATCHLINE SHEET 9 -WBL- STA 911+00.00 -EBL- STA 911+28.88
SITE 6 SDE
SITE 5 SDE
SITE 4 SDE
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
IMPACTS IN SURFACE WATER (66" RCP)
IMPACTS IN SURFACE WATER (66" RCP)
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL LLLL
TEMP. IMPACTS IN SURFACE WATER
PIPE NOT BURIED
PIPE NOT BURIED
GRAPHIC SCALE
8/17/99


PERMIT DRAWING
SHEET 13 OF 97
PROJECT REFERENCE NO. 7-4700
SHEET NO. 10
SW SHEET NO. 7-4700A - 2
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
WETLAND & STREAM IMPACTS
SITE 6 SDE
SITE 5 SDE
SITE 4 SDE
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
IMPACTS IN SURFACE WATER (66" RCP)
IMPACTS IN SURFACE WATER (66" RCP)
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL LLL
TEMP. IMPACTS IN SURFACE WATER
PIPE NOT BURIED
PIPE NOT BURIED
MATCHLINE SHEET 11 -EBL- STA 923+74.50
MATCHLINE SHEET 11 -WBL- STA 924+00.00
MATCHLINE SHEET 9 -EBL- STA 911+28.88
MATCHLINE SHEET 9 -WBL- STA 911+00.00
GRAPHIC SCALE

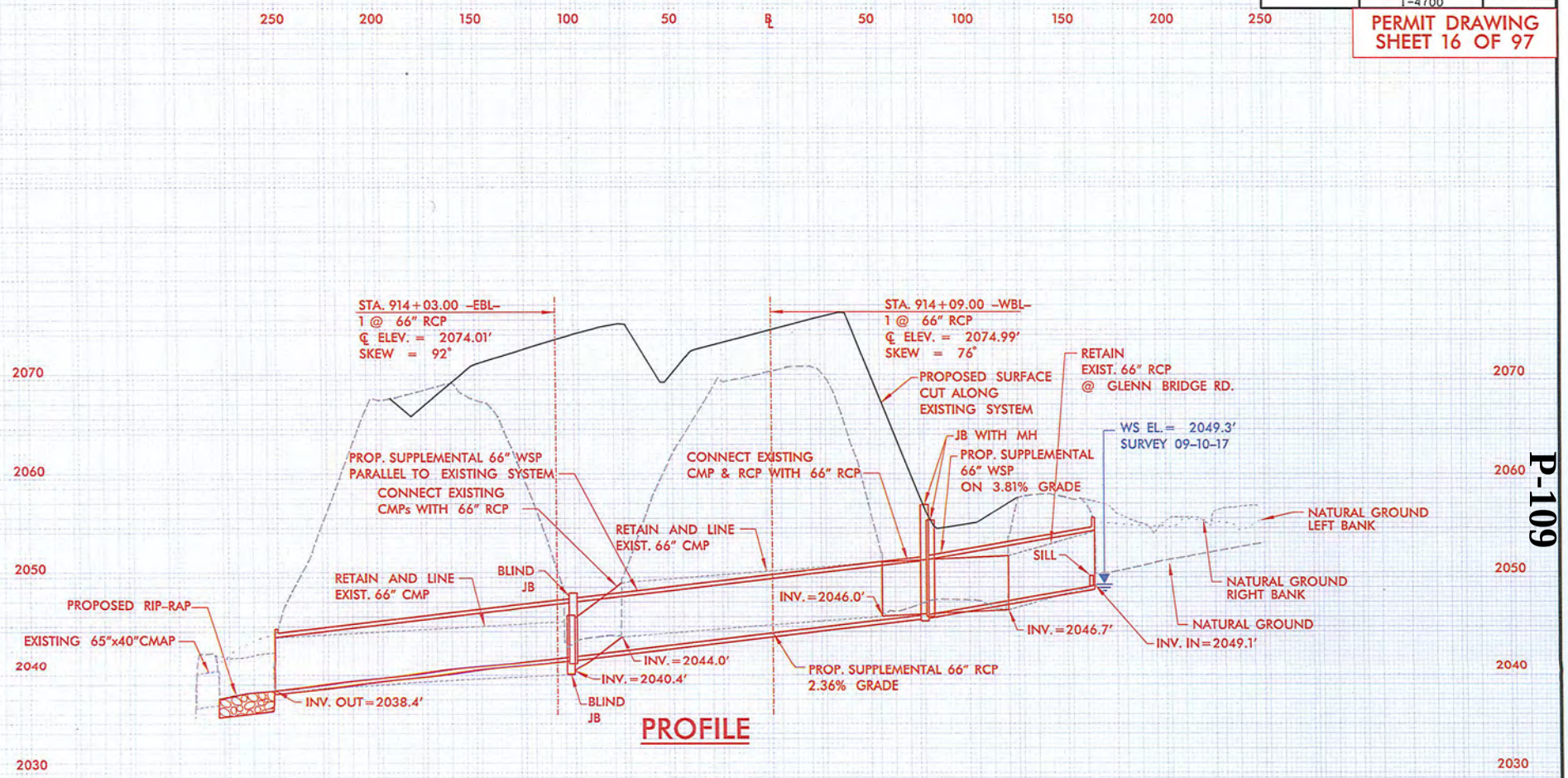

HNTB
PROJECT REFERENCE NO.
I-4700
SHEET NO.
10
RW SHEET NO.
I-4700A - 2
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
PERMIT DRAWING
SHEET 14 OF 97
P-107
SITE 6
SDE
SITE 5
SDE
SITE 4
SDE
DOWNSTREAM CHANNEL IMPROVEMENTS SEE DETAIL MMMM
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
CLASS 'B' RIPRAP EST. 3 TONS EST. 11 SYGF
PIPE NOT BURIED
66" WELDED STEEL PIPE 0.875" WALL THICKNESS TRENCHLESS INSTALLATION
RETAIN LINE W/APPROVED LINER
24" CSP
FS-3
18" RCP-IV
IMPACTS IN SURFACE WATER 66" RCP
NAD 83
BLIND TBJB
18" RCP-V
66" RCP-IV
REMOVE HW
REMOVE HW & INSTALL BLIND TBJB
REMOVE HW & INSTALL BLIND JB
JB W/ MH
18" RCP-IV
IMPACTS IN SURFACE WATER (66" RCP)
GTD
RETAIN
JB W/MH
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL LLLL
TEMP. IMPACTS IN SURFACE WATER
UPSTREAM CHANNEL IMPROVEMENTS SEE DETAIL LLLL
LEGEND
S S DENOTES IMPACTS IN SURFACE WATER
TS TS DENOTES TEMPORARY IMPACTS IN SURFACE WATER
50' 0' 50' 100' 150'
GRAPHIC SCALE


HNTB
PROJECT REFERENCE NO.
I-4700
SHEET NO.
10
RW SHEET NO.
I-4700A - 2
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
PERMIT DRAWING
SHEET 15 OF 97
SITE 6
SDE
SITE 5
SDE
SITE 4
SDE
DOWNSTREAM CHANNEL IMPROVEMENTS SEE DETAIL MMMM
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
PIPE NOT BURIED
CLASS 'B' RIPRAP
EST. 3 TONS
EST. 11 SYGF
66" WELDED STEEL PIPE 0.875" WALL THICKNESS TRENCHLESS INSTALLATION
RETAIN LINE W/APPROVED LINER
24" CSP
FS-3
18" RCP-IV
IMPACTS IN SURFACE WATER 66" RCP
NAD 83
BLIND TBJB
18" RCP-V
66" RCP-IV
REMOVE HW
REMOVE HW & INSTALL BLIND TBJB
REMOVE HW & INSTALL BLIND JB
66" RCP-IV
JB W/ MH
18" RCP-IV
66" RCP-IV
RETAIN
GTP
JB W/MH
IMPACTS IN SURFACE WATER (66" RCP)
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL LLLL
TEMP. IMPACTS IN SURFACE WATER
UPSTREAM CHANNEL IMPROVEMENTS SEE DETAIL LLLL
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
50' 0' 50' 100' 150'
GRAPHIC SCALE

P-108

PROJ. REFERENCE NO.	SHEET NO.
I-4700	

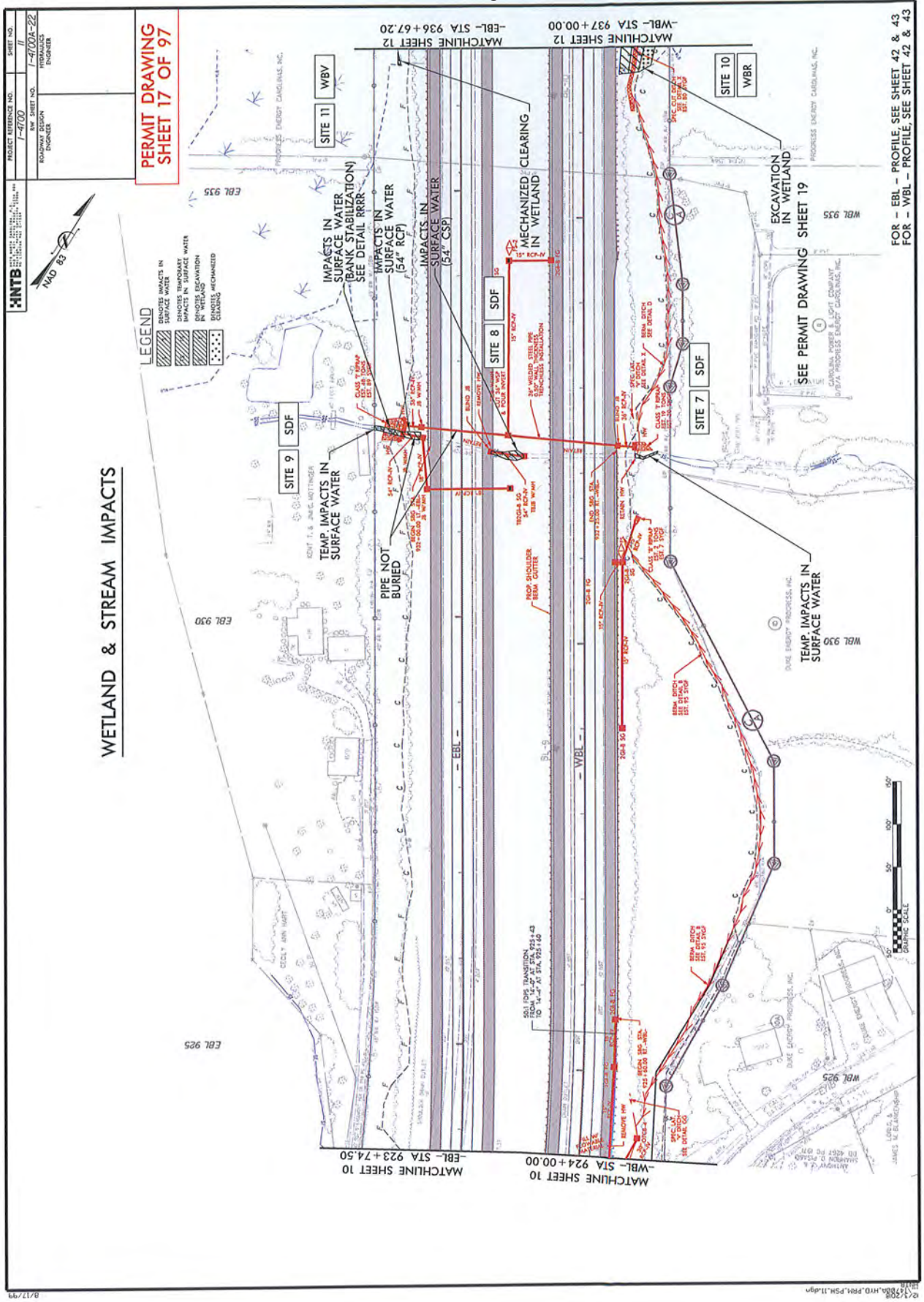
PERMIT DRAWING
SHEET 16 OF 97

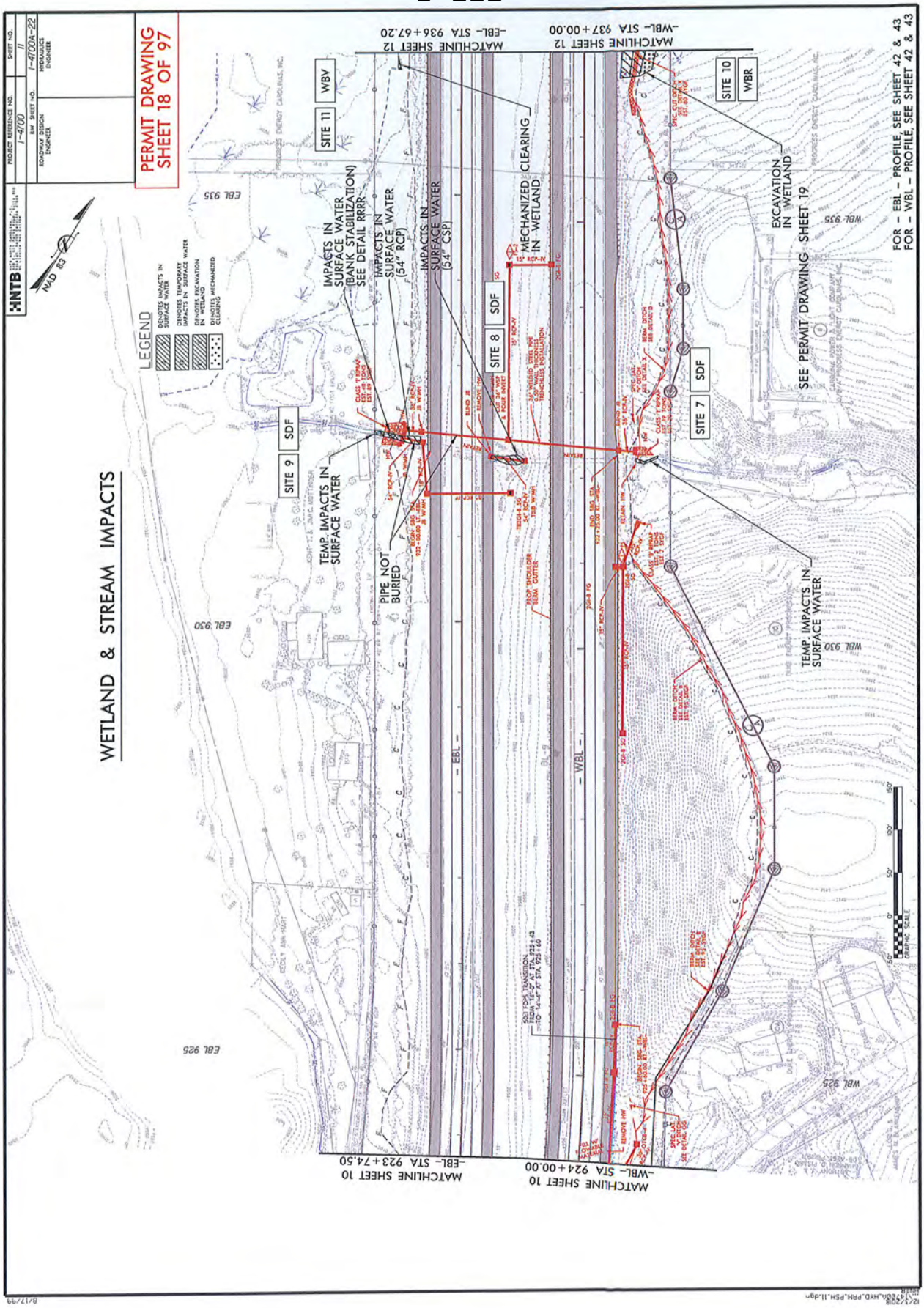


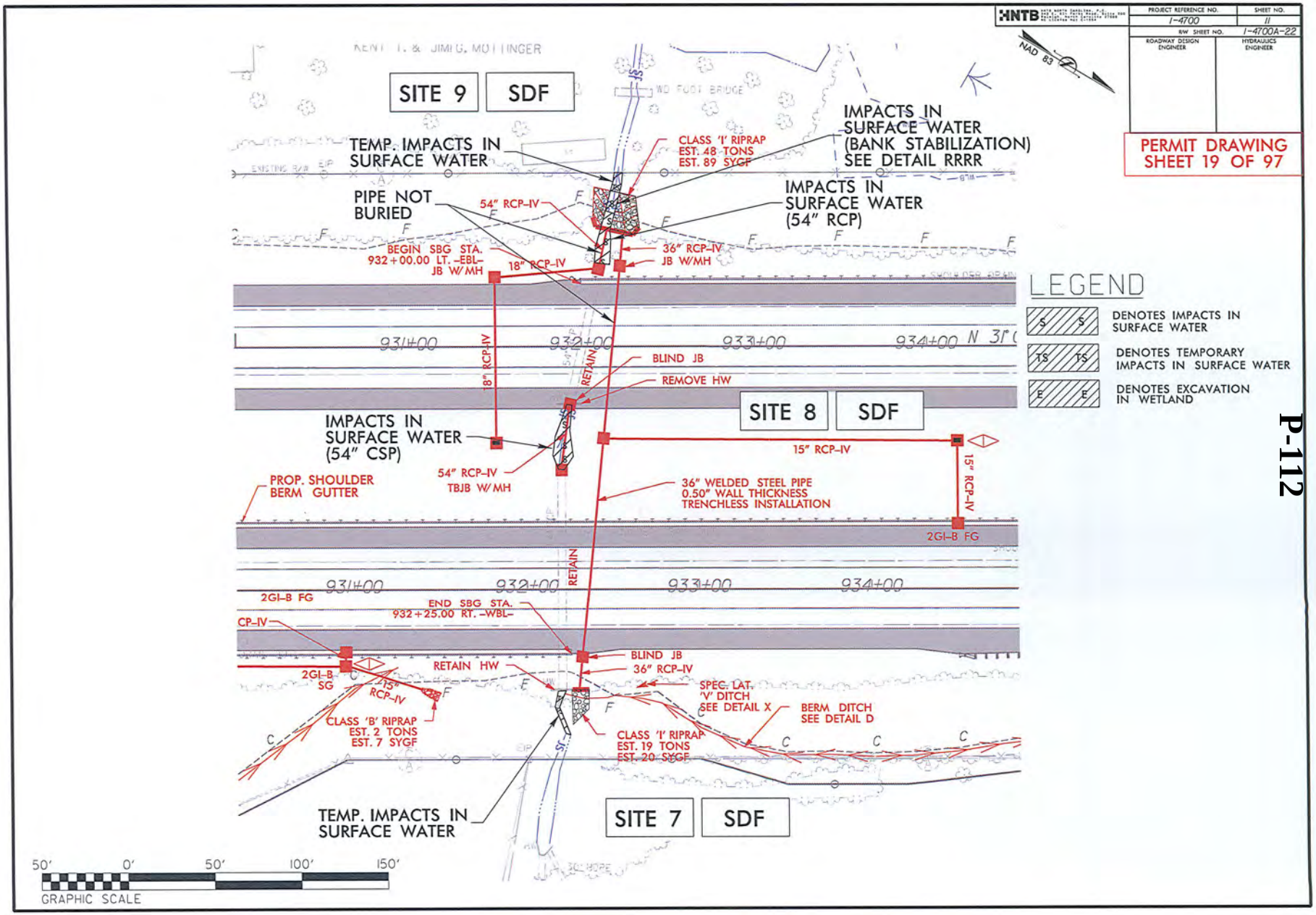
PROFILE

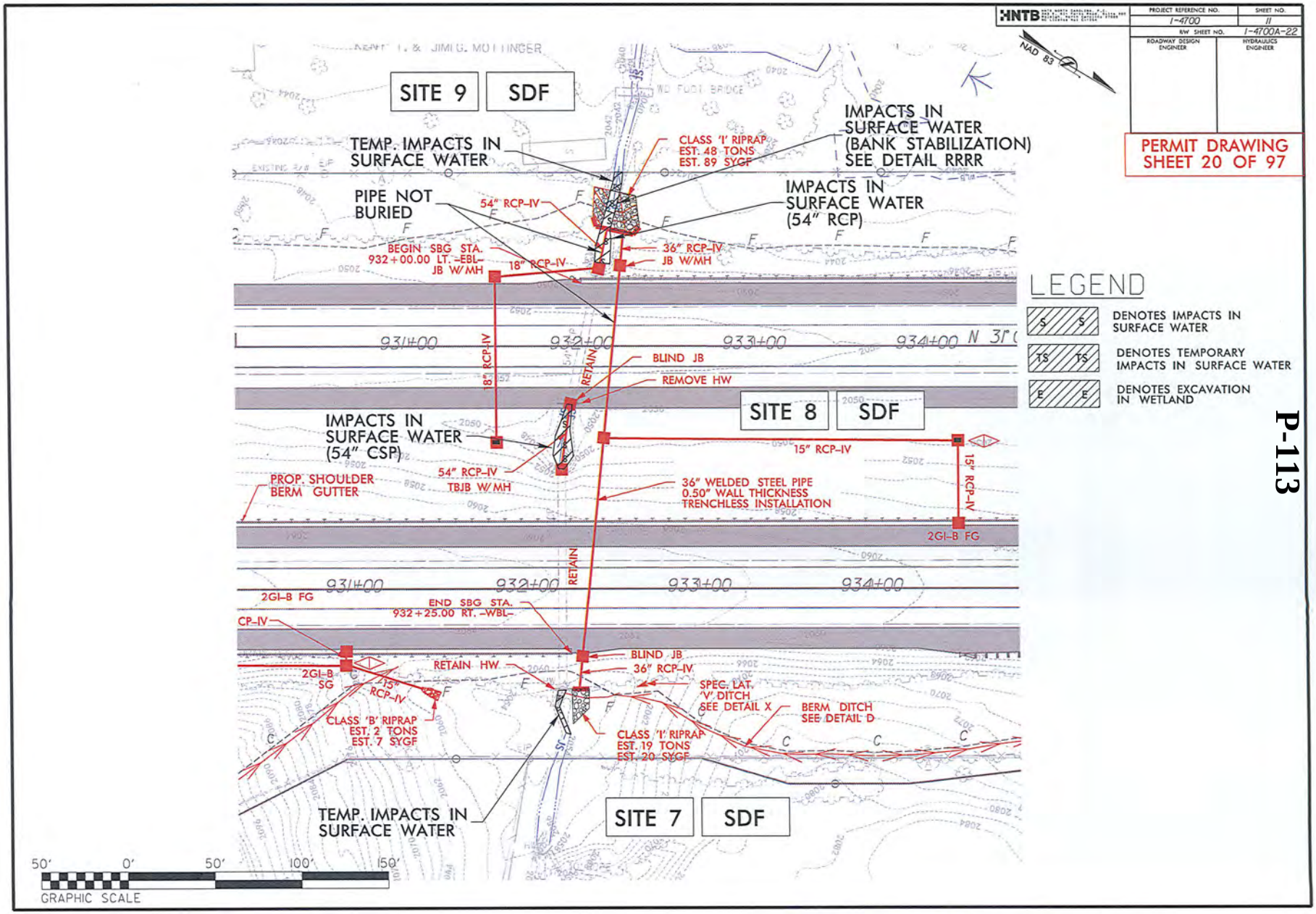
BUNCOMBE & HENDERSON COUNTY
PROJECT: I-4700
I-26
FROM 0.3 MI EAST OF NC 280 (AIRPORT RD.)
TO 0.5 MI EAST OF NC 191 (BREVARD RD.)

P-109

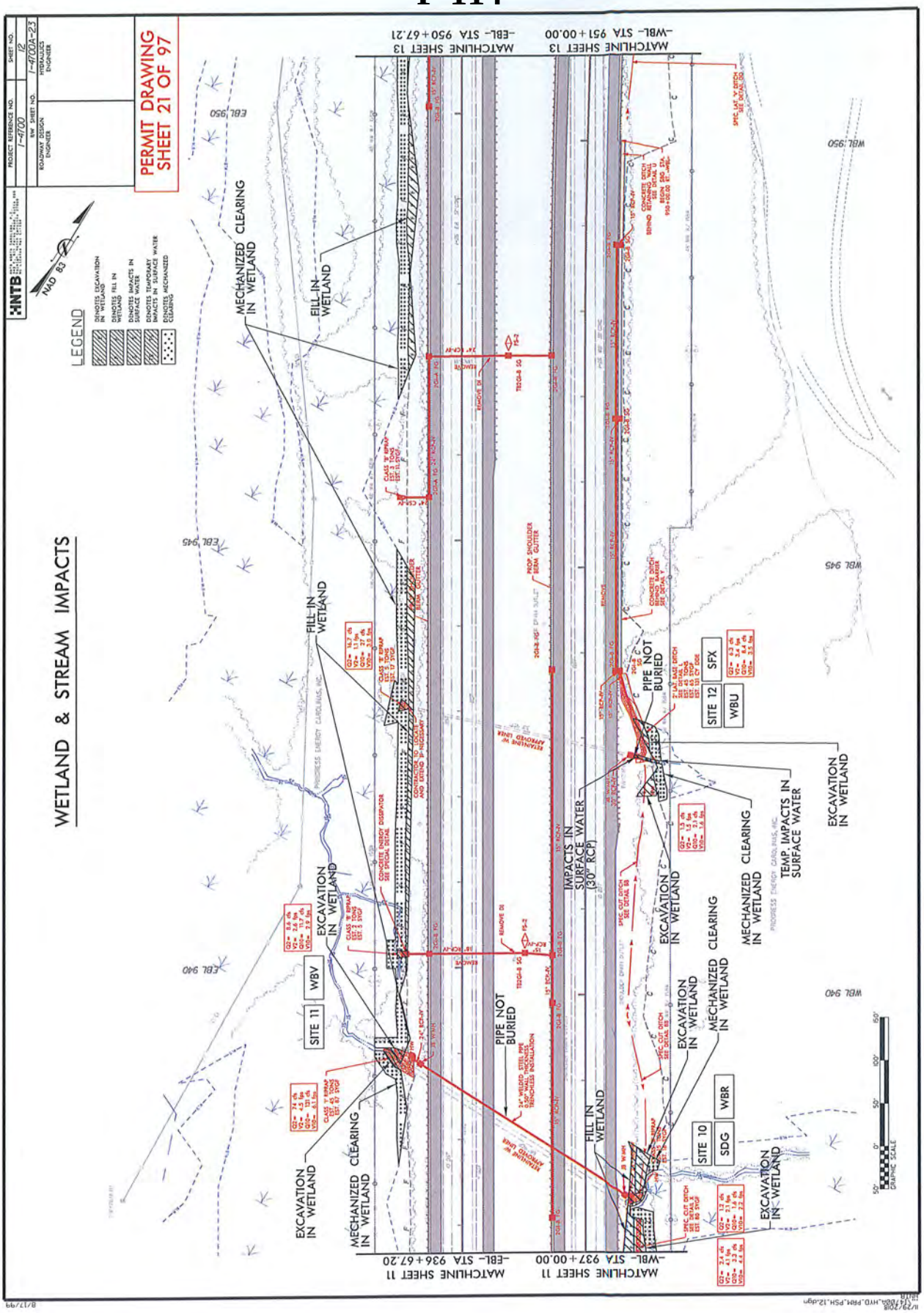

WETLAND & STREAM IMPACTS
PERMIT DRAWING
SHEET 17 OF 97
NTB
PROJECT REFERENCE NO.
1-4700
SHEET NO.
11
R/W SHEET NO.
1-4700A-22
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
DENOTES EXCAVATION IN WETLAND
DENOTES MECHANIZED CLEARING
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL RRRR
IMPACTS IN SURFACE WATER (54" RCP)
IMPACTS IN SURFACE WATER (54" CSP)
MECHANIZED CLEARING IN WETLAND
EXCAVATION IN WETLAND
SEE PERMIT DRAWING SHEET 19
TEMP. IMPACTS IN SURFACE WATER
PIPE NOT BURIED
SITE 7
SDF
SITE 8
SDF
SITE 9
SDF
SITE 10
WBR
SITE 11
WBV
MATCHLINE SHEET 12
-EBL- STA 936+67.20
MATCHLINE SHEET 12
-WBL- STA 937+00.00
MATCHLINE SHEET 10
-EBL- STA 923+74.50
MATCHLINE SHEET 10
-WBL- STA 924+00.00
FOR - EBL - PROFILE, SEE SHEET 42 & 43
FOR - WBL - PROFILE, SEE SHEET 42 & 43
EBL 935
EBL 930
EBL 925
WBL 935
WBL 930
WBL 925
- EBL -
- WBL -
8/17/99

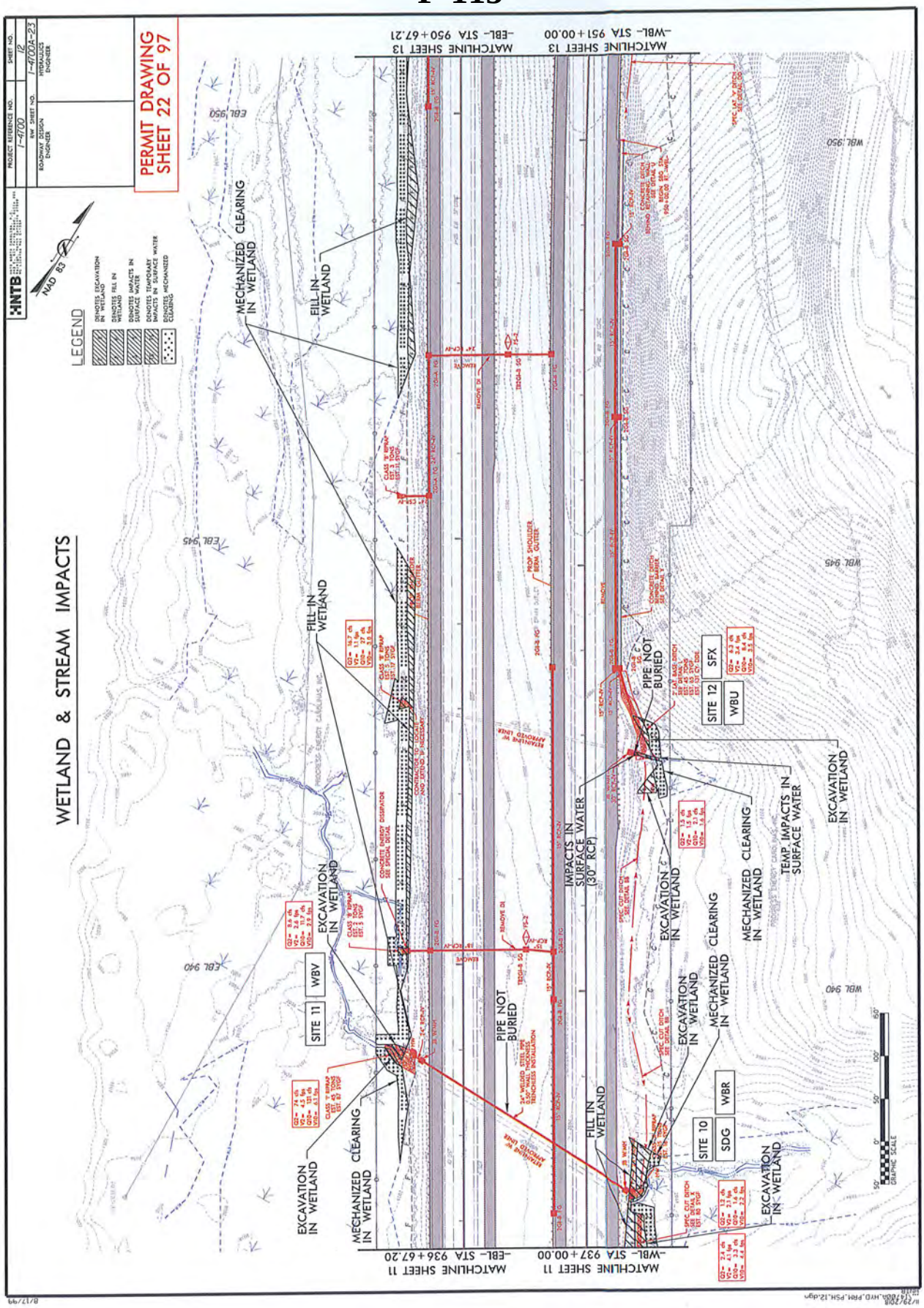

NTB
PROJECT REFERENCE NO. 7-4700
SHEET NO. 11
R/W SHEET NO. 7-4700A-22
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
PERMIT DRAWING SHEET 18 OF 97
NAD 83
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
DENOTES EXCAVATION IN WETLAND
DENOTES MECHANIZED CLEARING
WETLAND & STREAM IMPACTS
MATCHLINE SHEET 12 -EBL- STA 936+67.20
MATCHLINE SHEET 12 -WBL- STA 937+00.00
MATCHLINE SHEET 10 -EBL- STA 923+74.50
MATCHLINE SHEET 10 -WBL- STA 924+00.00
SITE 11 WBV
SITE 9 SDF
SITE 8 SDF
SITE 7 SDF
SITE 10 WBR
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL RRRR
IMPACTS IN SURFACE WATER (54" RCP)
IMPACTS IN SURFACE WATER (54" CSP)
MECHANIZED CLEARING IN WETLAND
EXCAVATION IN WETLAND
SEE PERMIT DRAWING SHEET 19
TEMP. IMPACTS IN SURFACE WATER
PIPE NOT BURIED
TEMP. IMPACTS IN SURFACE WATER
FOR – EBL – PROFILE, SEE SHEET 42 & 43
FOR – WBL – PROFILE, SEE SHEET 42 & 43
EBL 935
EBL 930
EBL 925
WBL 935
WBL 930
WBL 925
– EBL –
– WBL –
GRAPHIC SCALE

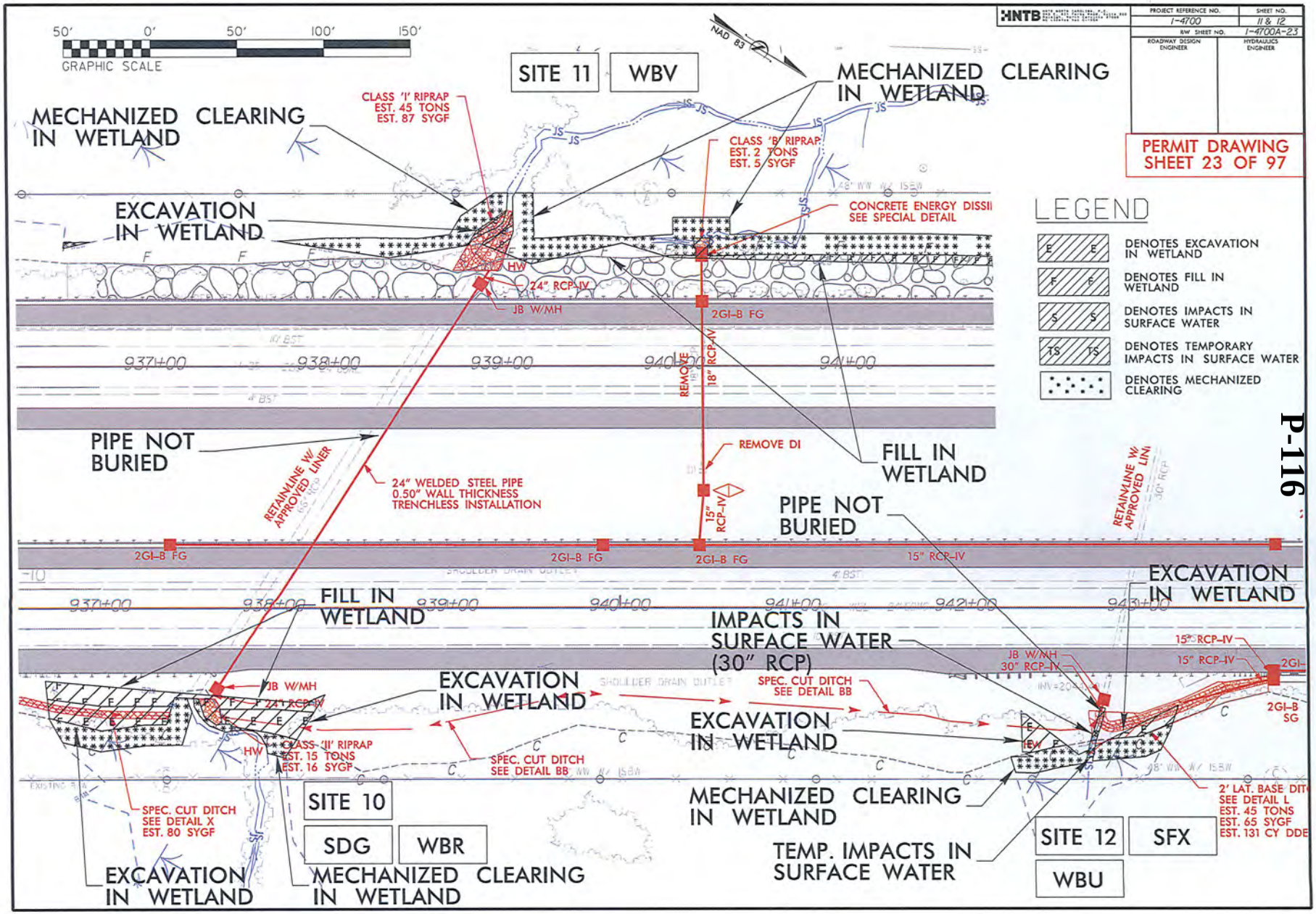

HNTB
PROJECT REFERENCE NO.
I-4700
SHEET NO.
11
RW SHEET NO.
I-4700A-22
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
PERMIT DRAWING
SHEET 19 OF 97
P-112
SITE 9
SDF
TEMP. IMPACTS IN SURFACE WATER
CLASS 'I' RIPRAP
EST. 48 TONS
EST. 89 SYGF
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL RRRR
PIPE NOT BURIED
54" RCP-IV
IMPACTS IN SURFACE WATER (54" RCP)
BEGIN SBG STA. 932+00.00 LT. -EBL- JB W/MH
18" RCP-IV
36" RCP-IV
JB W/MH
931+00
932+00
933+00
934+00
N 31°
8" RCP-IV
RETAIN
BLIND JB
REMOVE HW
SITE 8
SDF
IMPACTS IN SURFACE WATER (54" CSP)
15" RCP-IV
54" RCP-IV
TBJB W/MH
PROP. SHOULDER BERM GUTTER
36" WELDED STEEL PIPE
0.50" WALL THICKNESS
TRENCHLESS INSTALLATION
15" RCP-IV
2GI-B FG
931+00
932+00
RETAIN
933+00
934+00
2GI-B FG
END SBG STA. 932+25.00 RT. -WBL-
CP-IV
BLIND JB
36" RCP-IV
RETAIN HW
2GI-B SG
15" RCP-IV
SPEC. LAT. 'V' DITCH SEE DETAIL X
BERM DITCH SEE DETAIL D
CLASS 'B' RIPRAP
EST. 2 TONS
EST. 7 SYGF
CLASS 'I' RIPRAP
EST. 19 TONS
EST. 20 SYGF
TEMP. IMPACTS IN SURFACE WATER
SITE 7
SDF
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
DENOTES EXCAVATION IN WETLAND
50' 0' 50' 100' 150'
GRAPHIC SCALE


HNTB
PROJECT REFERENCE NO. I-4700
SHEET NO. 11
RW SHEET NO. I-4700A-22
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
PERMIT DRAWING
SHEET 20 OF 97
SITE 9
SDF
TEMP. IMPACTS IN SURFACE WATER
PIPE NOT BURIED
54" RCP-IV
CLASS 'I' RIPRAP EST. 48 TONS EST. 89 SYGF
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL RRRR
IMPACTS IN SURFACE WATER (54" RCP)
BEGIN SBG STA. 932+00.00 LT. -EBL- JB W/MH
18" RCP-IV
36" RCP-IV JB W/MH
931+00
932+00
933+00
934+00
18" RCP-IV
RETAIN
BLIND JB
REMOVE HW
SITE 8
SDF
IMPACTS IN SURFACE WATER (54" CSP)
54" RCP-IV TBJB W/MH
15" RCP-IV
15" RCP-IV
PROP. SHOULDER BERM GUTTER
36" WELDED STEEL PIPE 0.50" WALL THICKNESS TRENCHLESS INSTALLATION
2GI-B FG
2GI-B FG
END SBG STA. 932+25.00 RT. -WBL-
CP-IV
BLIND JB
36" RCP-IV
RETAIN HW
2GI-B SG
15" RCP-IV
SPEC. LAT. 'V' DITCH SEE DETAIL X
BERM DITCH SEE DETAIL D
CLASS 'B' RIPRAP EST. 2 TONS EST. 7 SYGF
CLASS 'I' RIPRAP EST. 19 TONS EST. 20 SYGF
TEMP. IMPACTS IN SURFACE WATER
SITE 7
SDF
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
DENOTES EXCAVATION IN WETLAND
50' 0' 50' 100' 150'
GRAPHIC SCALE

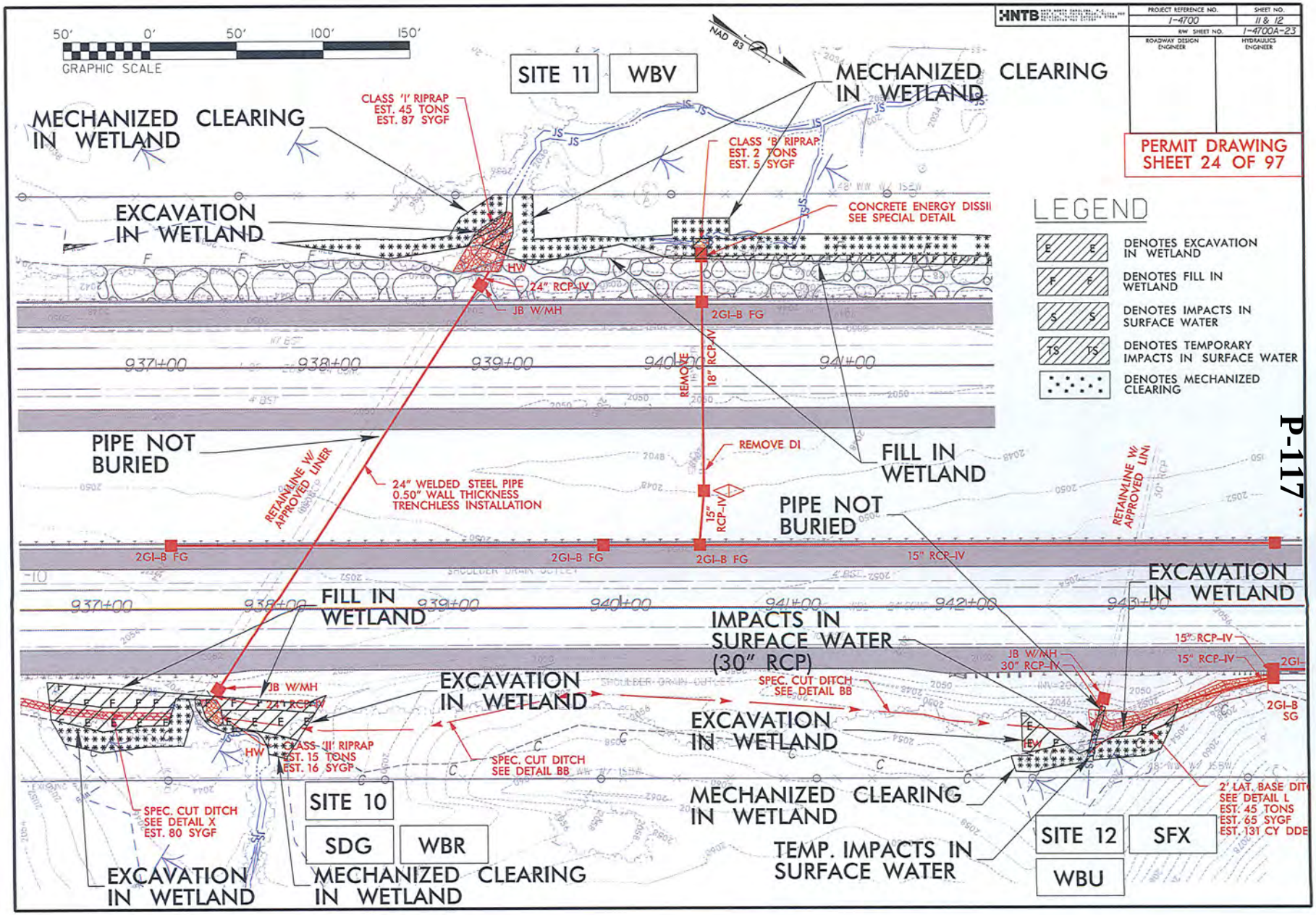
P-113


PERMIT DRAWING
SHEET 21 OF 97
WETLAND & STREAM IMPACTS
LEGEND
DENOTES EXCAVATION IN WETLAND
DENOTES FILL IN WETLAND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
DENOTES MECHANIZED CLEARING
NAD 83
MECHANIZED CLEARING IN WETLAND
FILL IN WETLAND
EXCAVATION IN WETLAND
PIPE NOT BURIED
IMPACTS IN SURFACE WATER (30" RCP)
TEMP. IMPACTS IN SURFACE WATER
SITE 11 WBV
SITE 10 SDG WBR
SITE 12 SFX WBU
MATCHLINE SHEET 11 -WBL- STA 937+00.00
MATCHLINE SHEET 11 -EBL- STA 936+67.20
MATCHLINE SHEET 13 -WBL- STA 951+00.00
MATCHLINE SHEET 13 -EBL- STA 950+67.21
EBL 940
EBL 945
EBL 950
WBL 940
WBL 945
WBL 950
GRAPHIC SCALE


PERMIT DRAWING
SHEET 22 OF 97
WETLAND & STREAM IMPACTS
LEGEND
DENOTES EXCAVATION IN WETLAND
DENOTES FILL IN WETLAND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
DENOTES MECHANIZED CLEARING
NAD 83
MECHANIZED CLEARING IN WETLAND
FILL IN WETLAND
EXCAVATION IN WETLAND
IMPACTS IN SURFACE WATER (30" RCP)
PIPE NOT BURIED
TEMP. IMPACTS IN SURFACE WATER
SITE 10
SDG
WBR
SITE 11
WBV
SITE 12
SFX
WBU
MATCHLINE SHEET 11 -WBL- STA 937+00.00
MATCHLINE SHEET 11 -EBL- STA 936+67.20
MATCHLINE SHEET 13 -WBL- STA 951+00.00
MATCHLINE SHEET 13 -EBL- STA 950+67.21
EBL 950
EBL 945
EBL 940
WBL 950
WBL 945
WBL 940
GRAPHIC SCALE


HNTB
PROJECT REFERENCE NO. I-4700
SHEET NO. 11 & 12
RW SHEET NO. I-4700A-23
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
PERMIT DRAWING SHEET 23 OF 97
50' 0' 50' 100' 150'
GRAPHIC SCALE
NAD 83
SITE 11
WBV
MECHANIZED CLEARING IN WETLAND
MECHANIZED CLEARING IN WETLAND
CLASS 'I' RIPRAP EST. 45 TONS EST. 87 SYGF
CLASS 'B' RIPRAP EST. 2 TONS EST. 5 SYGF
CONCRETE ENERGY DISSI SEE SPECIAL DETAIL
EXCAVATION IN WETLAND
HW
24" RCP-IV
JB W/MH
2GI-B FG
REMOVE 18" RCP-IV
REMOVE DI
PIPE NOT BURIED
RETAINLINE W/ APPROVED LINER
24" WELDED STEEL PIPE 0.50" WALL THICKNESS TRENCHLESS INSTALLATION
15" RCP-IV
FILL IN WETLAND
PIPE NOT BURIED
RETAINLINE W/ APPROVED LINER
2GI-B FG
2GI-B FG
2GI-B FG
15" RCP-IV
937+00
938+00
939+00
940+00
941+00
942+00
943+00
FILL IN WETLAND
EXCAVATION IN WETLAND
IMPACTS IN SURFACE WATER (30" RCP)
JB W/MH
24" RCP-IV
HW
CLASS 'II' RIPRAP EST. 15 TONS EST. 16 SYGF
EXCAVATION IN WETLAND
SPEC. CUT DITCH SEE DETAIL BB
SPEC. CUT DITCH SEE DETAIL BB
SPEC. CUT DITCH SEE DETAIL BB
EXCAVATION IN WETLAND
JB W/MH
30" RCP-IV
15" RCP-IV
15" RCP-IV
2GI-B SG
2' LAT. BASE DIT SEE DETAIL L EST. 45 TONS EST. 65 SYGF EST. 131 CY DDE
SPEC. CUT DITCH SEE DETAIL X EST. 80 SYGF
SITE 10
SDG
WBR
EXCAVATION IN WETLAND
MECHANIZED CLEARING IN WETLAND
MECHANIZED CLEARING IN WETLAND
TEMP. IMPACTS IN SURFACE WATER
SITE 12
SFX
WBU
LEGEND
DENOTES EXCAVATION IN WETLAND
DENOTES FILL IN WETLAND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
DENOTES MECHANIZED CLEARING

P-116

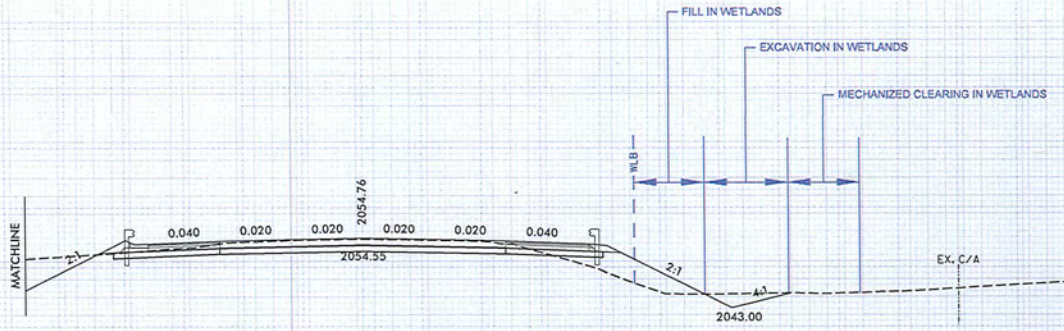

HNTB
PROJECT REFERENCE NO. 1-4700
SHEET NO. 11 & 12
R/W SHEET NO. 1-4700A-23
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
PERMIT DRAWING SHEET 24 OF 97
50' 0' 50' 100' 150'
GRAPHIC SCALE
NAD 83
SITE 11
WBV
MECHANIZED CLEARING IN WETLAND
MECHANIZED CLEARING IN WETLAND
CLASS 'I' RIPRAP EST. 45 TONS EST. 87 SYGF
CLASS 'B' RIPRAP EST. 2 TONS EST. 5 SYGF
CONCRETE ENERGY DISSI SEE SPECIAL DETAIL
EXCAVATION IN WETLAND
HW
24" RCP-IV
JB W/MH
2GI-B FG
REMOVE
18" RCP-IV
937+00
938+00
939+00
940+00
941+00
PIPE NOT BURIED
RETAINLINE W/ APPROVED LINER
24" WELDED STEEL PIPE 0.50" WALL THICKNESS TRENCHLESS INSTALLATION
REMOVE DI
15" RCP-IV
FILL IN WETLAND
PIPE NOT BURIED
RETAINLINE W/ APPROVED LINI
2GI-B FG
2GI-B FG
2GI-B FG
15" RCP-IV
EXCAVATION IN WETLAND
FILL IN WETLAND
938+00
939+00
940+00
941+00
942+00
943+00
IMPACTS IN SURFACE WATER (30" RCP)
15" RCP-IV
JB W/MH
30" RCP-IV
15" RCP-IV
2GI-
SPEC. CUT DITCH SEE DETAIL BB
JB W/MH
24" RCP-IV
EXCAVATION IN WETLAND
EXCAVATION IN WETLAND
2GI-B SG
CLASS 'II' RIPRAP EST. 15 TONS EST. 16 SYGF
HW
SPEC. CUT DITCH SEE DETAIL BB
SPEC. CUT DITCH SEE DETAIL X EST. 80 SYGF
SITE 10
SDG
WBR
MECHANIZED CLEARING IN WETLAND
TEMP. IMPACTS IN SURFACE WATER
2' LAT. BASE DIT SEE DETAIL L EST. 45 TONS EST. 65 SYGF EST. 131 CY DDE
SITE 12
SFX
WBU
EXCAVATION IN WETLAND
LEGEND
DENOTES EXCAVATION IN WETLAND
DENOTES FILL IN WETLAND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
DENOTES MECHANIZED CLEARING

P-117

PROJ. REFERENCE NO.	SHEET NO.
I-4700	

PERMIT DRAWING
SHEET 25 OF 97

WETLAND CROSS SECTIONS



P-118

SITE 10
-WBL- 937+00.00

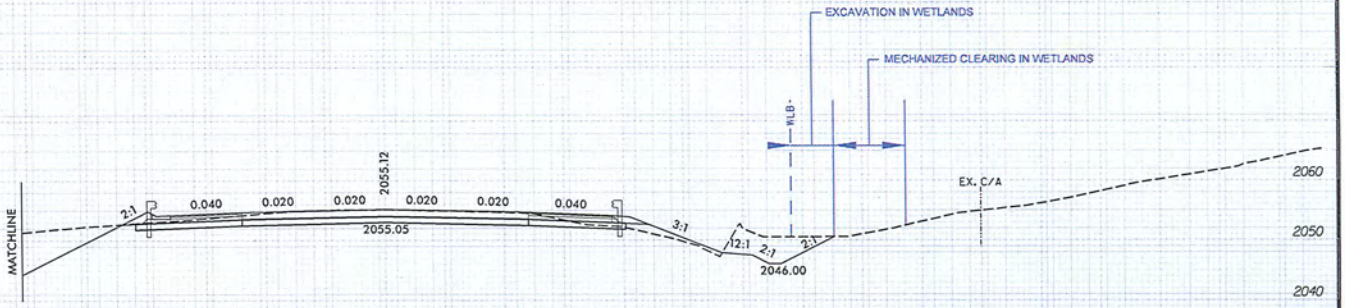
SCALE
1"=20' HORIZONTAL
1"=20' VERTICAL

BUNCOMBE & HENDERSON COUNTY
PROJECT: I-4700
I-26
FROM 0.3 MI EAST OF NC 280 (AIRPORT RD.)
TO 0.5 MI EAST OF NC 191 (BREVARD RD.)

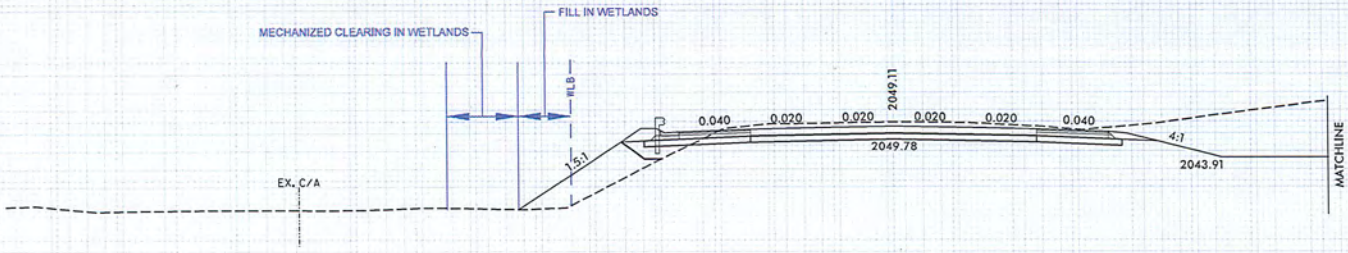
PROJ. REFERENCE NO.	SHEET NO.
I-4700	

PERMIT DRAWING
SHEET 26 OF 97

WETLAND CROSS SECTIONS



SITE 12
–WBL– 943+00.00



SITE 11
–EBL– 944+00.00

SCALE
1"=20' HORIZONTAL
1"=20' VERTICAL

BUNCOMBE & HENDERSON COUNTY
PROJECT: I-4700
I-26
FROM 0.3 MI EAST OF NC 280 (AIRPORT RD.)
TO 0.5 MI EAST OF NC 191 (BREVARD RD.)

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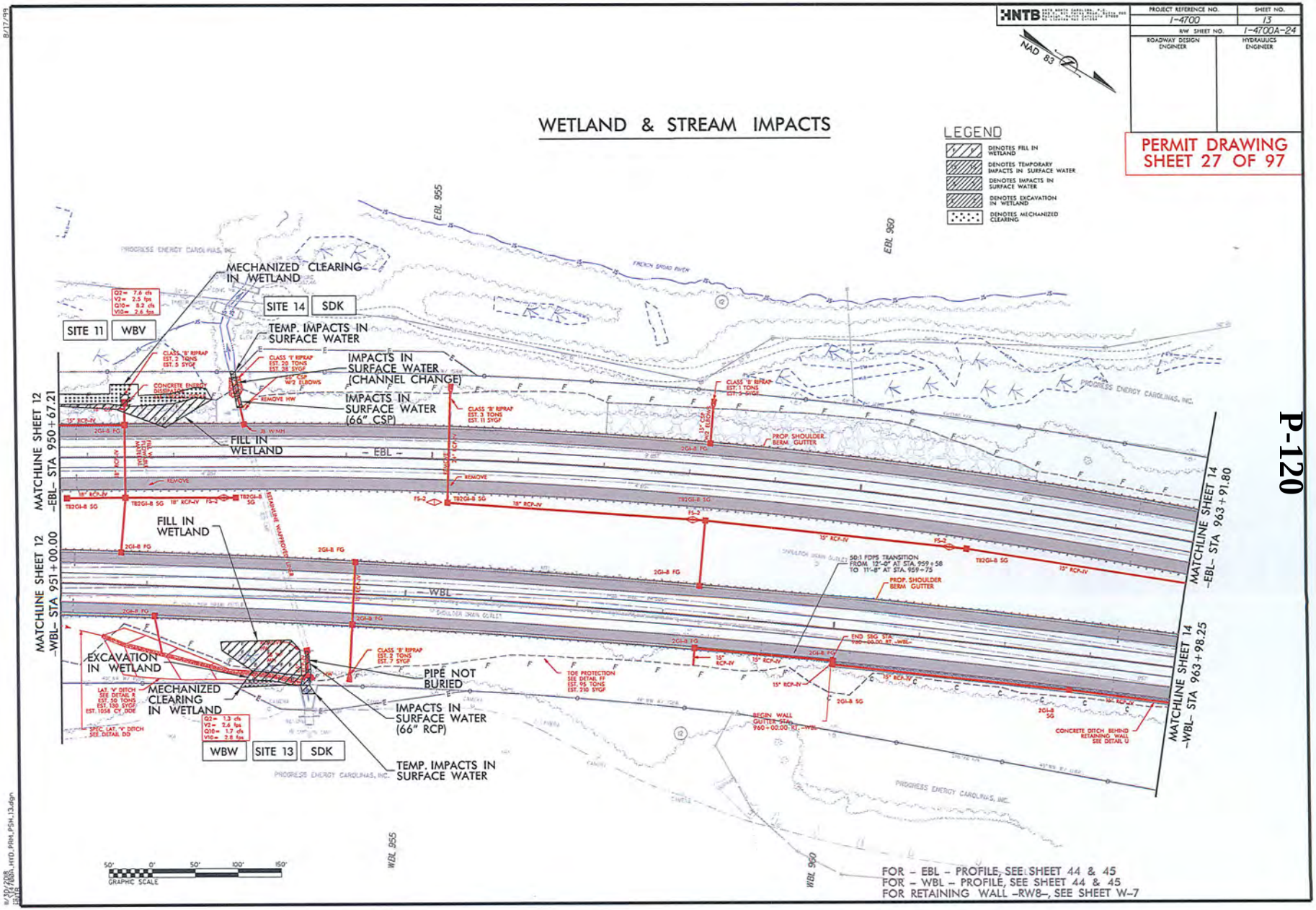
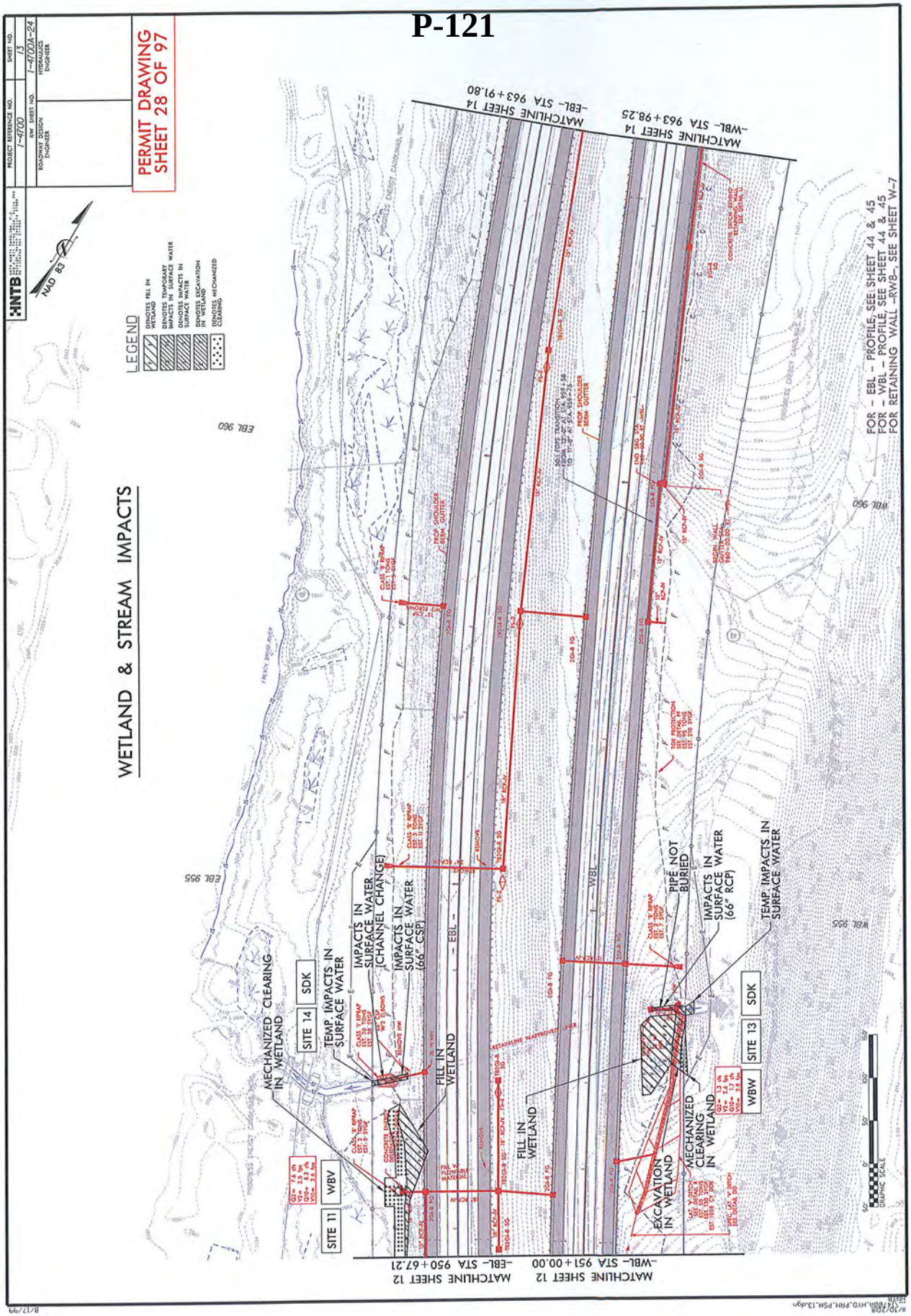
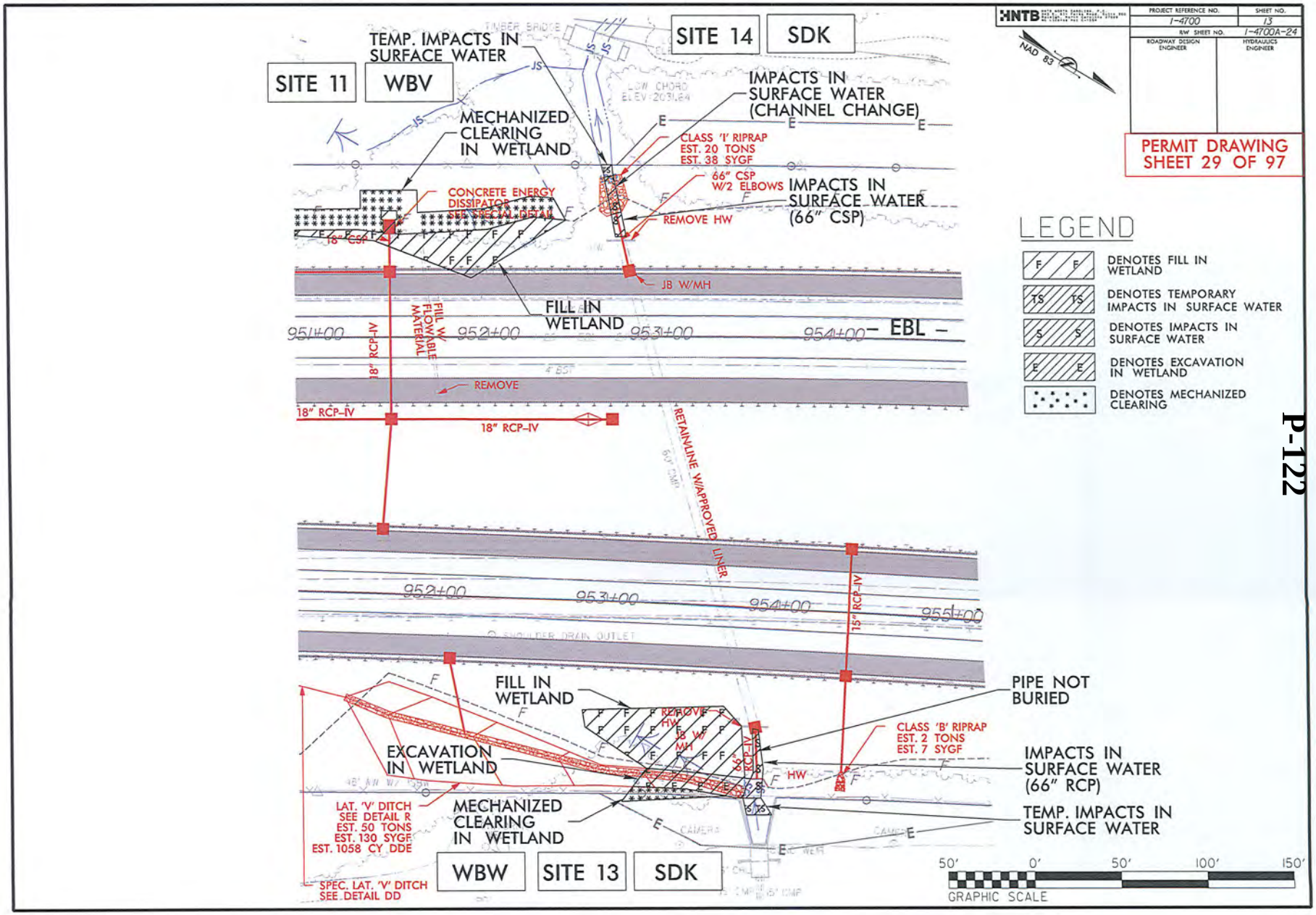
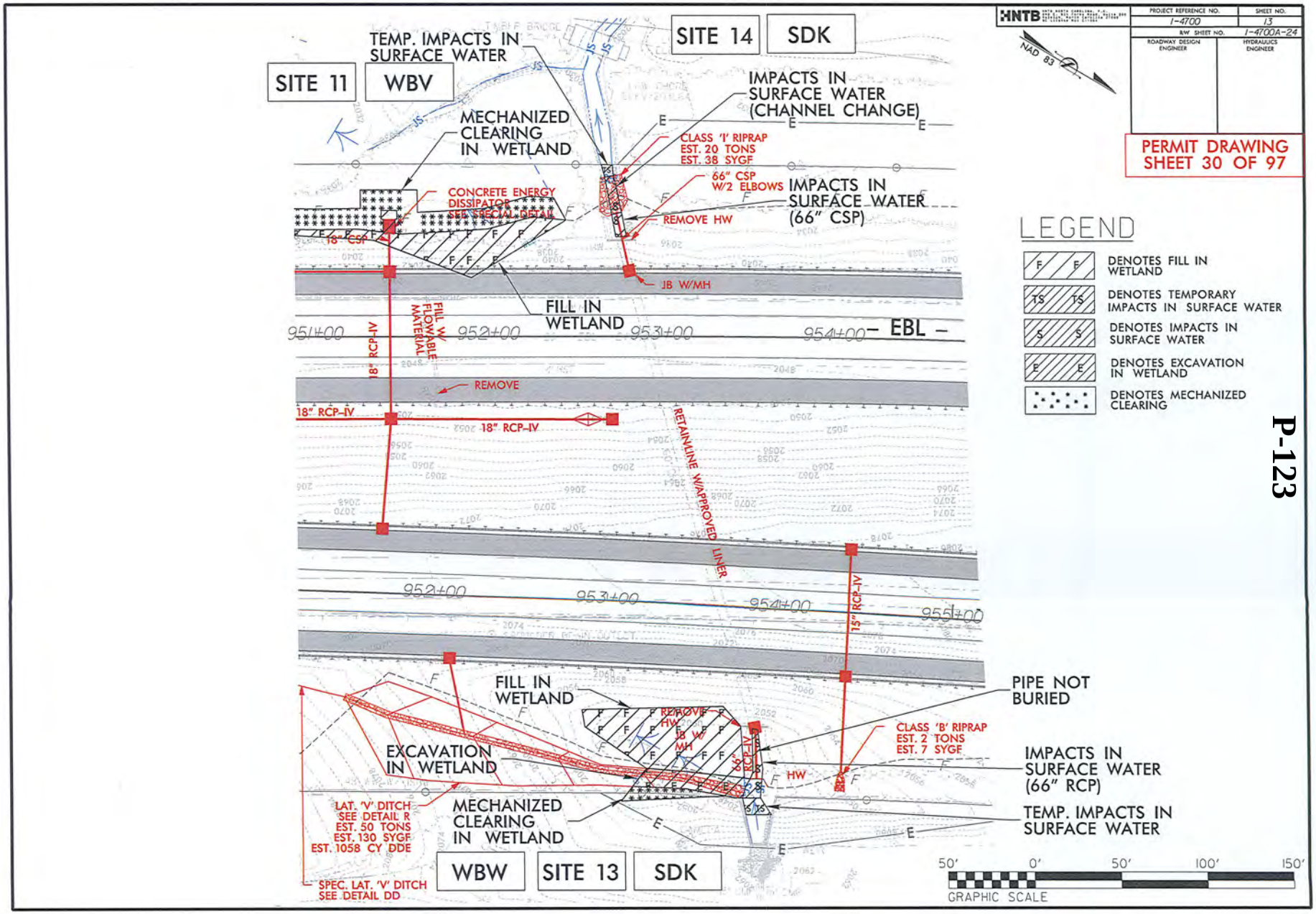

HNTB
PROJECT REFERENCE NO. 1-4700
SHEET NO. 13
R/W SHEET NO. 1-4700A-24
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
PERMIT DRAWING SHEET 27 OF 97
WETLAND & STREAM IMPACTS
LEGEND
DENOTES FILL IN WETLAND
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
DENOTES IMPACTS IN SURFACE WATER
DENOTES EXCAVATION IN WETLAND
DENOTES MECHANIZED CLEARING
MECHANIZED CLEARING IN WETLAND
SITE 14 SDK
SITE 11 WBV
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
IMPACTS IN SURFACE WATER (66" CSP)
FILL IN WETLAND
– EBL –
FILL IN WETLAND
– WBL –
EXCAVATION IN WETLAND
MECHANIZED CLEARING IN WETLAND
PIPE NOT BURIED
IMPACTS IN SURFACE WATER (66" RCP)
TEMP. IMPACTS IN SURFACE WATER
WBW SITE 13 SDK
MATCHLINE SHEET 12 –EBL– STA 950+67.21
MATCHLINE SHEET 12 –WBL– STA 951+00.00
MATCHLINE SHEET 14 –EBL– STA 963+91.80
MATCHLINE SHEET 14 –WBL– STA 963+98.25
EBL 955
EBL 960
WBL 955
WBL 960
PROGRESS ENERGY CAROLINAS, INC.
50' 0' 50' 100' 150'
GRAPHIC SCALE
FOR – EBL – PROFILE, SEE SHEET 44 & 45
FOR – WBL – PROFILE, SEE SHEET 44 & 45
FOR RETAINING WALL –RW8–, SEE SHEET W-7

P-120


PERMIT DRAWING
SHEET 28 OF 97
WETLAND & STREAM IMPACTS
LEGEND
DENOTES FILL IN WETLAND
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
DENOTES IMPACTS IN SURFACE WATER
DENOTES EXCAVATION IN WETLAND
DENOTES MECHANIZED CLEARING
NAD 83
MATCHLINE SHEET 12 -WBL- STA 951+00.00
MATCHLINE SHEET 12 -EBL- STA 950+67.21
MATCHLINE SHEET 14 -WBL- STA 963+98.25
MATCHLINE SHEET 14 -EBL- STA 963+91.80
FOR - EBL - PROFILE, SEE SHEET 44 & 45
FOR - WBL - PROFILE, SEE SHEET 44 & 45
FOR RETAINING WALL -RW8-, SEE SHEET W-7
SITE 11
WBV
SITE 14
SDK
SITE 13
SDK
WBW
MECHANIZED CLEARING IN WETLAND
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
IMPACTS IN SURFACE WATER (66" CSP)
FILL IN WETLAND
PIPE NOT BURIED
IMPACTS IN SURFACE WATER (66" RCP)
TEMP. IMPACTS IN SURFACE WATER
EXCAVATION IN WETLAND
MECHANIZED CLEARING IN WETLAND
EBL
WBL
EBL 960
EBL 955
WBL 960
WBL 955


HNTB
PROJECT REFERENCE NO. 1-4700
SHEET NO. 13
RW SHEET NO. 1-4700A-24
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
PERMIT DRAWING
SHEET 29 OF 97
SITE 14
SDK
SITE 11
WBV
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
MECHANIZED CLEARING IN WETLAND
CLASS 'I' RIPRAP
EST. 20 TONS
EST. 38 SYGF
66" CSP W/2 ELBOWS
CONCRETE ENERGY DISSIPATOR SEE SPECIAL DETAIL
IMPACTS IN SURFACE WATER (66" CSP)
REMOVE HW
18" CSP
JB W/MH
FILL IN WETLAND
FILL W/ FLOWABLE MATERIAL
18" RCP-IV
951+00
952+00
953+00
954+00
EBL
REMOVE
18" RCP-IV
18" RCP-IV
RETAINING LINE W/APPROVED LINER
952+00
953+00
954+00
955+00
15" RCP-IV
SHOULDER DRAIN OUTLET
FILL IN WETLAND
REMOVE HW
JB W/MH
66" RCP-IV
PIPE NOT BURIED
CLASS 'B' RIPRAP
EST. 2 TONS
EST. 7 SYGF
EXCAVATION IN WETLAND
IMPACTS IN SURFACE WATER (66" RCP)
HW
LAT. 'V' DITCH
SEE DETAIL R
EST. 50 TONS
EST. 130 SYGF
EST. 1058 CY DDE
MECHANIZED CLEARING IN WETLAND
TEMP. IMPACTS IN SURFACE WATER
SPEC. LAT. 'V' DITCH
SEE DETAIL DD
WBW
SITE 13
SDK
LEGEND
DENOTES FILL IN WETLAND
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
DENOTES IMPACTS IN SURFACE WATER
DENOTES EXCAVATION IN WETLAND
DENOTES MECHANIZED CLEARING
50' 0' 50' 100' 150'
GRAPHIC SCALE

P-122


HNTB
PROJECT REFERENCE NO. I-4700
SHEET NO. 13
R/W SHEET NO. I-4700A-24
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
PERMIT DRAWING SHEET 30 OF 97
SITE 14
SDK
SITE 11
WBV
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
MECHANIZED CLEARING IN WETLAND
CLASS 'I' RIPRAP EST. 20 TONS EST. 38 SYGF
66" CSP W/2 ELBOWS
IMPACTS IN SURFACE WATER (66" CSP)
CONCRETE ENERGY DISSIPATOR SPECIAL DETAIL
REMOVE HW
JB W/MH
FILL IN WETLAND
951+00
952+00
953+00
954+00
EBL
18" RCP-IV
FILL W/ FLOWABLE MATERIAL
REMOVE
18" RCP-IV
18" RCP-IV
RETAIN/LINE W/APPROVED LINER
952+00
953+00
954+00
955+00
15" RCP-IV
FILL IN WETLAND
REMOVE HW
JB W/ MH
EXCAVATION IN WETLAND
HW
PIPE NOT BURIED
CLASS 'B' RIPRAP EST. 2 TONS EST. 7 SYGF
IMPACTS IN SURFACE WATER (66" RCP)
TEMP. IMPACTS IN SURFACE WATER
LAT. 'V' DITCH SEE DETAIL R EST. 50 TONS EST. 130 SYGF EST. 1058 CY DDE
MECHANIZED CLEARING IN WETLAND
SPEC. LAT. 'V' DITCH SEE DETAIL DD
WBW
SITE 13
SDK
LEGEND
DENOTES FILL IN WETLAND
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
DENOTES IMPACTS IN SURFACE WATER
DENOTES EXCAVATION IN WETLAND
DENOTES MECHANIZED CLEARING
50' 0' 50' 100' 150'
GRAPHIC SCALE

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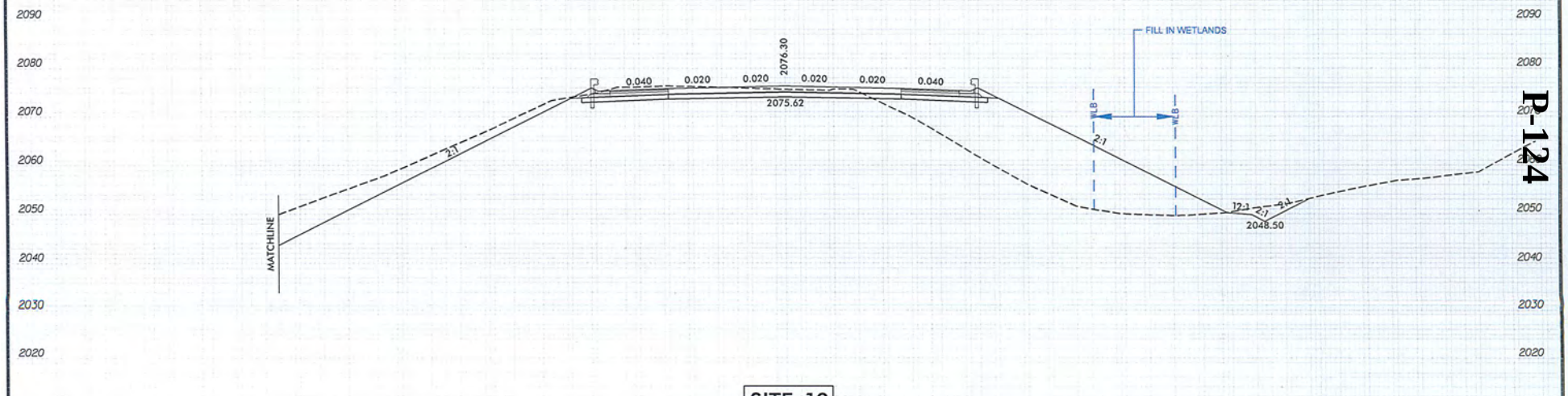
PROJ. REFERENCE NO.	SHEET NO.
I-4700	

PERMIT DRAWING
SHEET 31 OF 97

WETLAND CROSS SECTIONS



P-124

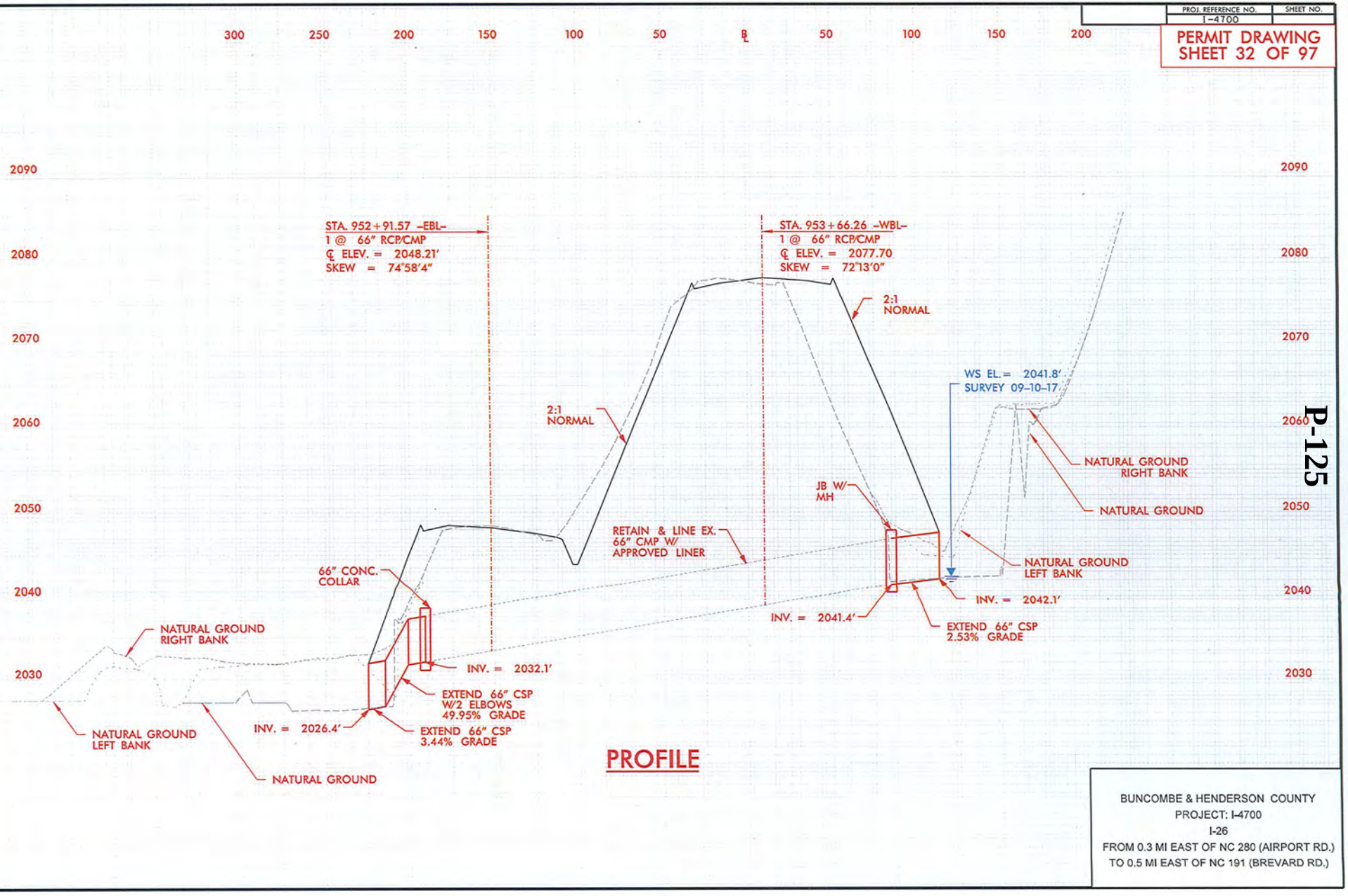
SITE 13
-WBL- 953+00.00

SCALE
1"=20' HORIZONTAL
1"=20' VERTICAL

BUNCOMBE & HENDERSON COUNTY
PROJECT: I-4700
I-26
FROM 0.3 MI EAST OF NC 280 (AIRPORT RD.)
TO 0.5 MI EAST OF NC 191 (BREVARD RD.)

PROJ. REFERENCE NO.	SHEET NO.
I-4700	

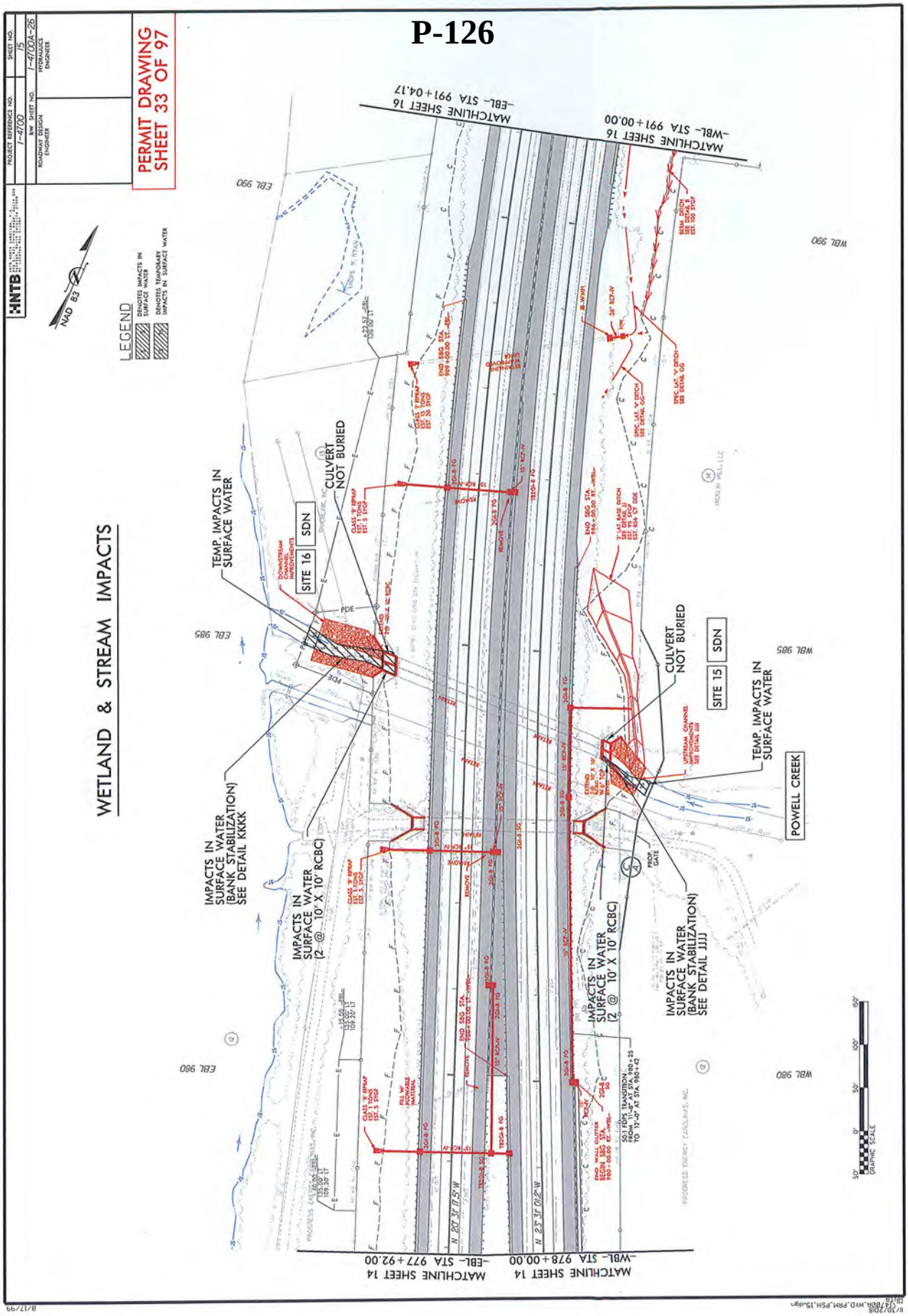
PERMIT DRAWING SHEET 32 OF 97

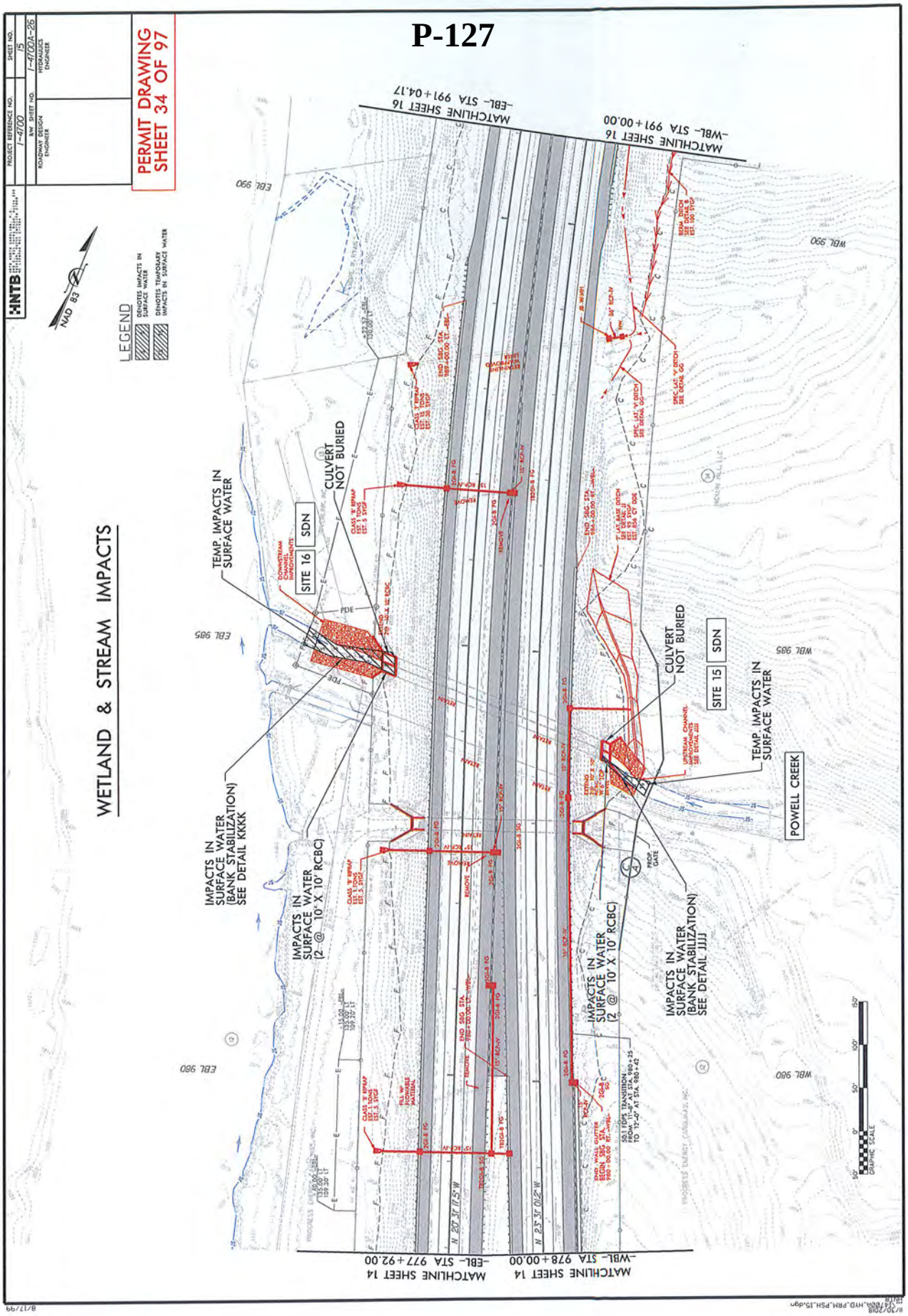


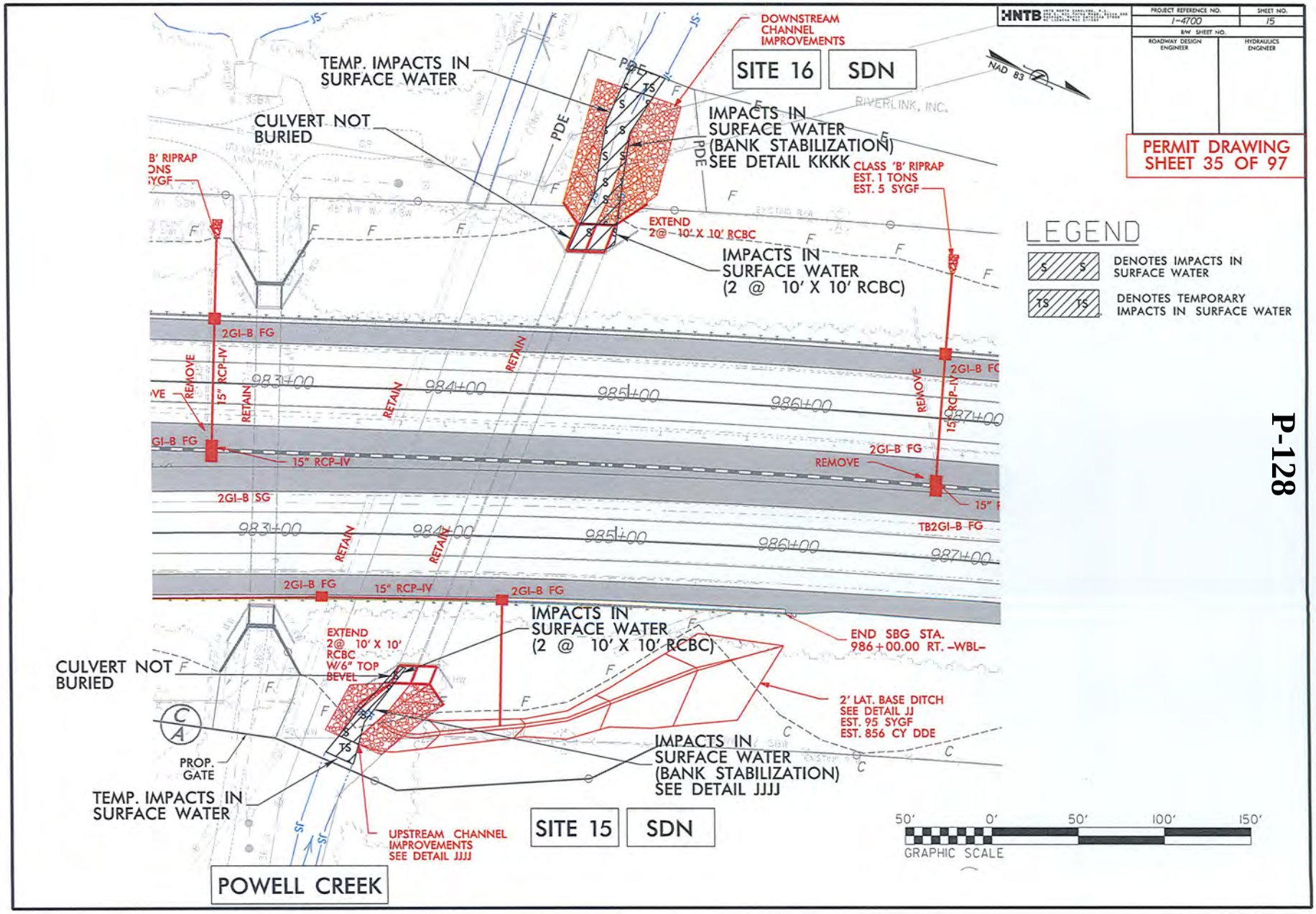
PROFILE

P-125

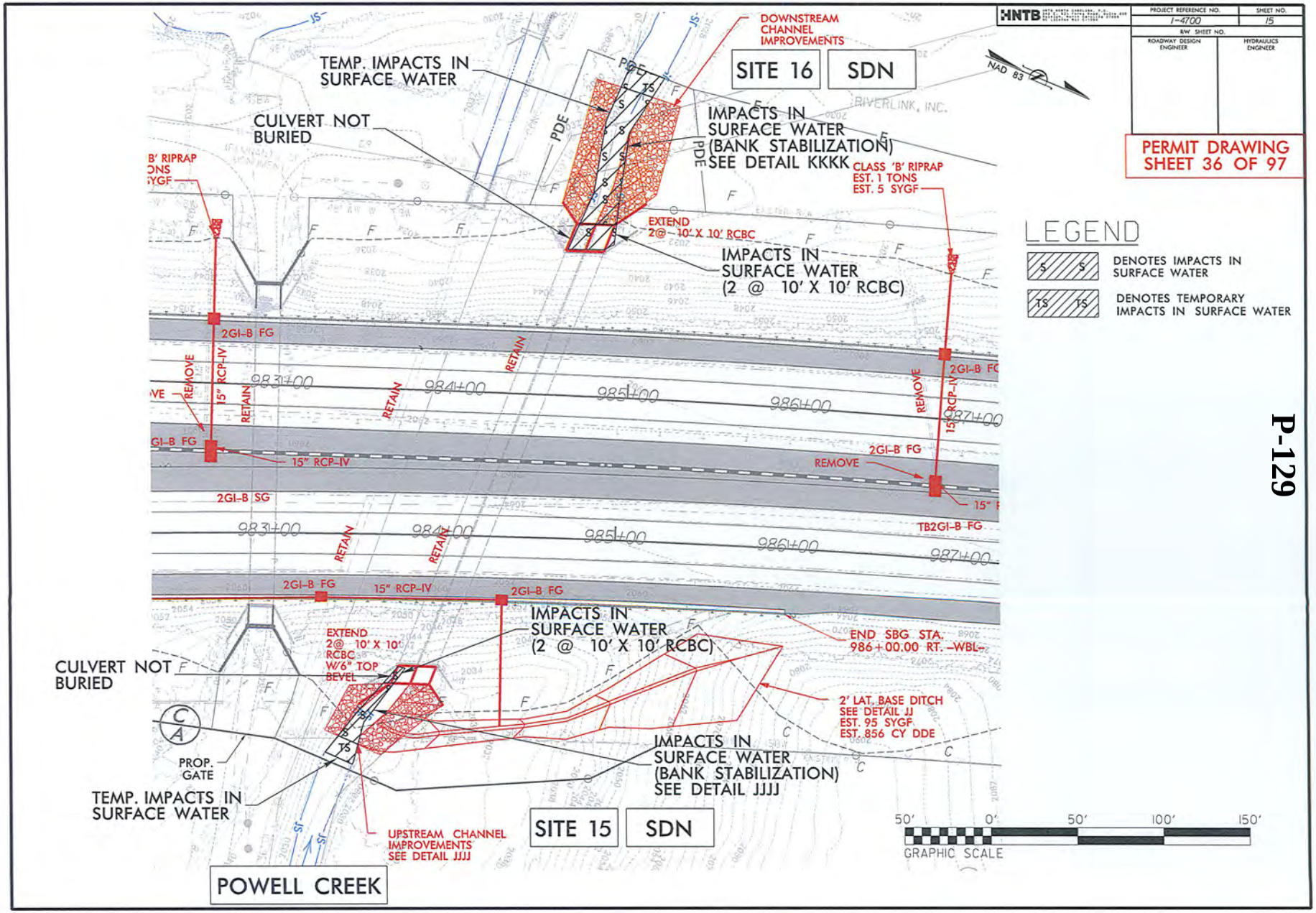
BUNCOMBE & HENDERSON COUNTY
PROJECT: I-4700
I-26
FROM 0.3 MI EAST OF NC 280 (AIRPORT RD.)
TO 0.5 MI EAST OF NC 191 (BREVARD RD.)


PERMIT DRAWING
SHEET 33 OF 97
WETLAND & STREAM IMPACTS
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
NAD 83
TEMP. IMPACTS IN SURFACE WATER
SITE 16
SDN
CULVERT NOT BURIED
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL KKKK
IMPACTS IN SURFACE WATER (2 @ 10' X 10' RCBC)
SITE 15
SDN
CULVERT NOT BURIED
TEMP. IMPACTS IN SURFACE WATER
POWELL CREEK
IMPACTS IN SURFACE WATER (2 @ 10' X 10' RCBC)
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL JJJJ
MATCHLINE SHEET 16 -EBL- STA 991+04.17
MATCHLINE SHEET 16 -WBL- STA 991+00.00
MATCHLINE SHEET 14 -EBL- STA 977+92.00
MATCHLINE SHEET 14 -WBL- STA 978+00.00
EBL 990
WBL 990
EBL 985
WBL 985
EBL 980
WBL 980
PROJECT REFERENCE NO. I-4700
SHEET NO. 15
R/W SHEET NO. I-4700A-26
ROADWAY DESIGN ENGINEER
PROJECTS ENGINEER
NTB
8/17/99


PERMIT DRAWING
SHEET 34 OF 97
PROJECT REFERENCE NO.
I-4700
SHEET NO.
15
I-4700A-26
NAD 83
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
WETLAND & STREAM IMPACTS
MATCHLINE SHEET 16 -EBL- STA 991+04.17
MATCHLINE SHEET 16 -WBL- STA 991+00.00
TEMP. IMPACTS IN SURFACE WATER
SITE 16
SDN
CULVERT NOT BURIED
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL KKKK
IMPACTS IN SURFACE WATER (2 @ 10' X 10' RCBC)
SITE 15
SDN
CULVERT NOT BURIED
TEMP. IMPACTS IN SURFACE WATER
POWELL CREEK
IMPACTS IN SURFACE WATER (2 @ 10' X 10' RCBC)
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL JJJJ
MATCHLINE SHEET 14 -EBL- STA 977+92.00
MATCHLINE SHEET 14 -WBL- STA 978+00.00
EBL 990
WBL 990
EBL 985
WBL 985
EBL 980
WBL 980
N 20° 31' 17.5" W
N 23° 31' 01.2" W
GRAPHIC SCALE


HNTB
PROJECT REFERENCE NO. I-4700
SHEET NO. 15
R/W SHEET NO.
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
PERMIT DRAWING SHEET 35 OF 97
DOWNSTREAM CHANNEL IMPROVEMENTS
SITE 16
SDN
NAD 83
TEMP. IMPACTS IN SURFACE WATER
CULVERT NOT BURIED
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL KKKK
CLASS 'B' RIPRAP EST. 1 TONS EST. 5 SYGF
EXTEND 2@ 10' X 10' RCBC
IMPACTS IN SURFACE WATER (2 @ 10' X 10' RCBC)
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
2GI-B FG
15" RCP-IV
REMOVE
RETAIN
2GI-B SG
TB2GI-B FG
983+00
984+00
985+00
986+00
987+00
IMPACTS IN SURFACE WATER (2 @ 10' X 10' RCBC)
EXTEND 2@ 10' X 10' RCBC W/6" TOP BEVEL
END SBG STA. 986+00.00 RT. -WBL-
CULVERT NOT BURIED
2' LAT. BASE DITCH SEE DETAIL JJ EST. 95 SYGF EST. 856 CY DDE
PROP. GATE
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL JJJJ
TEMP. IMPACTS IN SURFACE WATER
UPSTREAM CHANNEL IMPROVEMENTS SEE DETAIL JJJJ
SITE 15
SDN
POWELL CREEK
50' 0' 50' 100' 150'
GRAPHIC SCALE

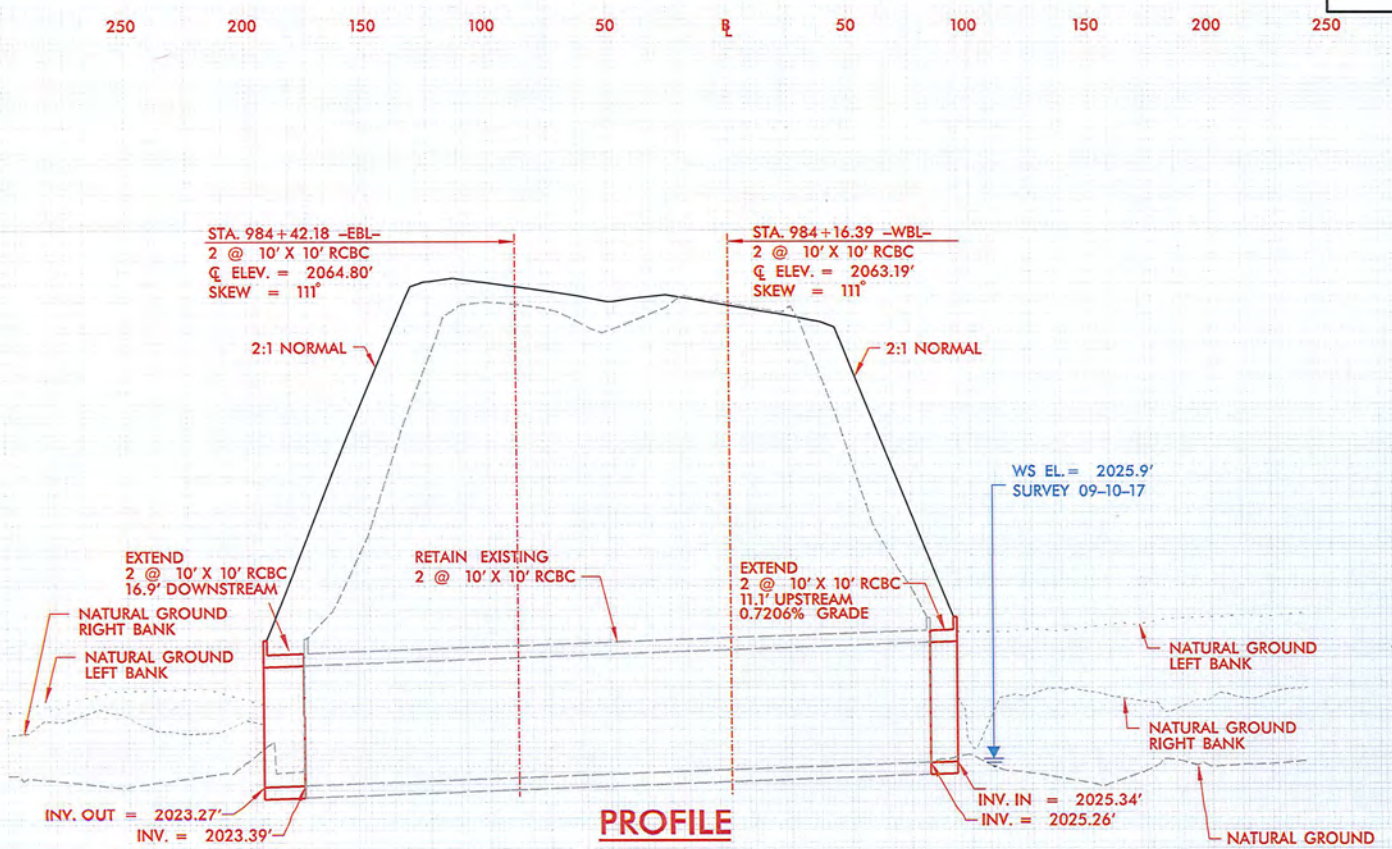
P-128


HNTB
PROJECT REFERENCE NO. I-4700
SHEET NO. 15
R/W SHEET NO.
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
PERMIT DRAWING SHEET 36 OF 97
NAD 83
RIVERLINK, INC.
DOWNSTREAM CHANNEL IMPROVEMENTS
SITE 16
SDN
TEMP. IMPACTS IN SURFACE WATER
CULVERT NOT BURIED
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL KKKK
CLASS 'B' RIPRAP EST. 1 TONS EST. 5 SYGF
EXTEND 2@ 10' X 10' RCBC
IMPACTS IN SURFACE WATER (2 @ 10' X 10' RCBC)
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
2GI-B FG
15" RCP-IV
REMOVE
RETAIN
2GI-B SG
TB2GI-B FG
983+00
984+00
985+00
986+00
987+00
EXTEND 2@ 10' X 10' RCBC W/6" TOP BEVEL
IMPACTS IN SURFACE WATER (2 @ 10' X 10' RCBC)
END SBG STA. 986+00.00 RT. -WBL-
2' LAT. BASE DITCH SEE DETAIL JJ EST. 95 SYGF EST. 856 CY DDE
CULVERT NOT BURIED
PROP. GATE
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL JJJJ
UPSTREAM CHANNEL IMPROVEMENTS SEE DETAIL JJJJ
SITE 15
SDN
POWELL CREEK
50' 0' 50' 100' 150'
GRAPHIC SCALE

P-129

PROJ. REFERENCE NO.	SHEET NO.
I-4700	

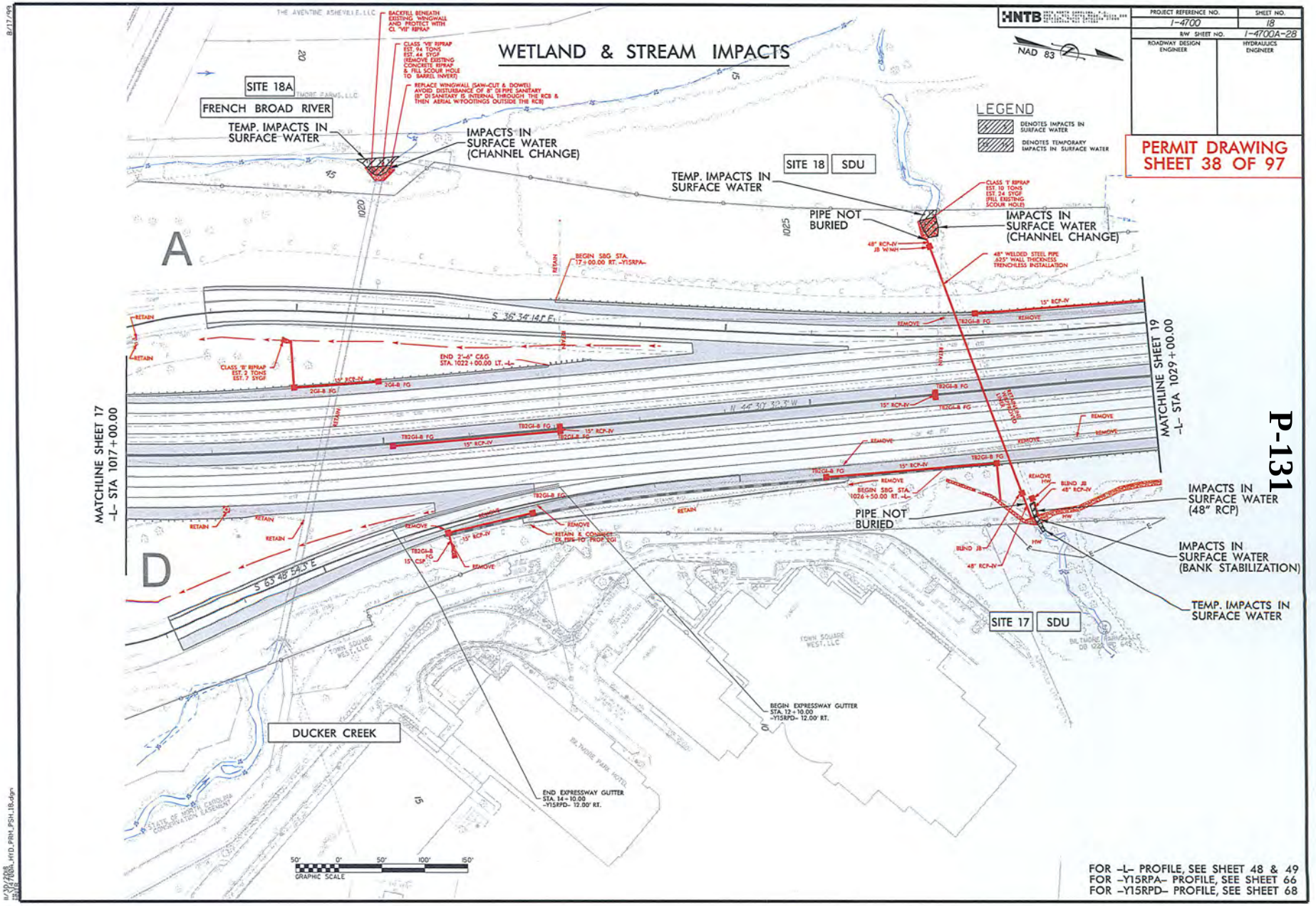
PERMIT DRAWING
SHEET 37 OF 97

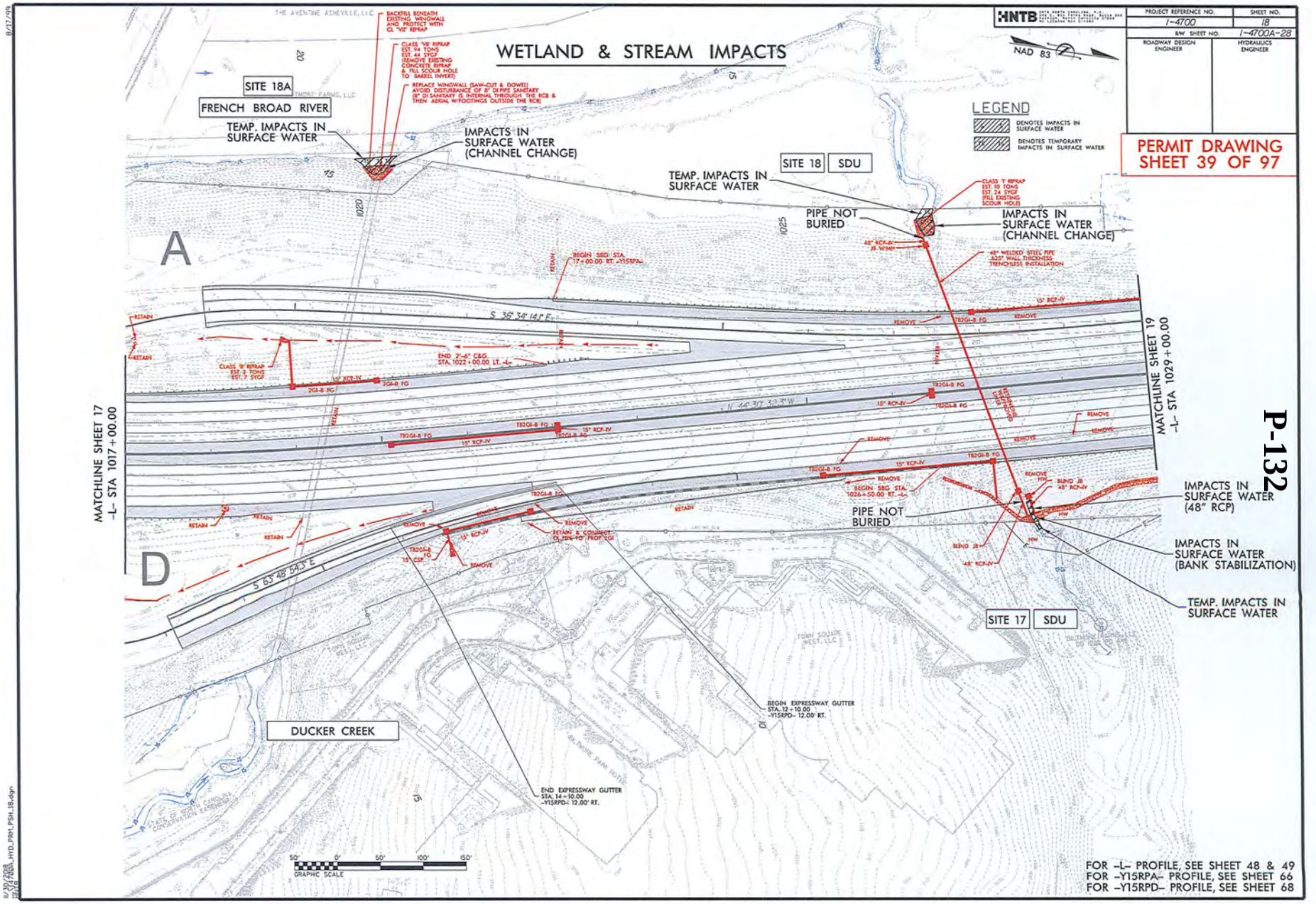


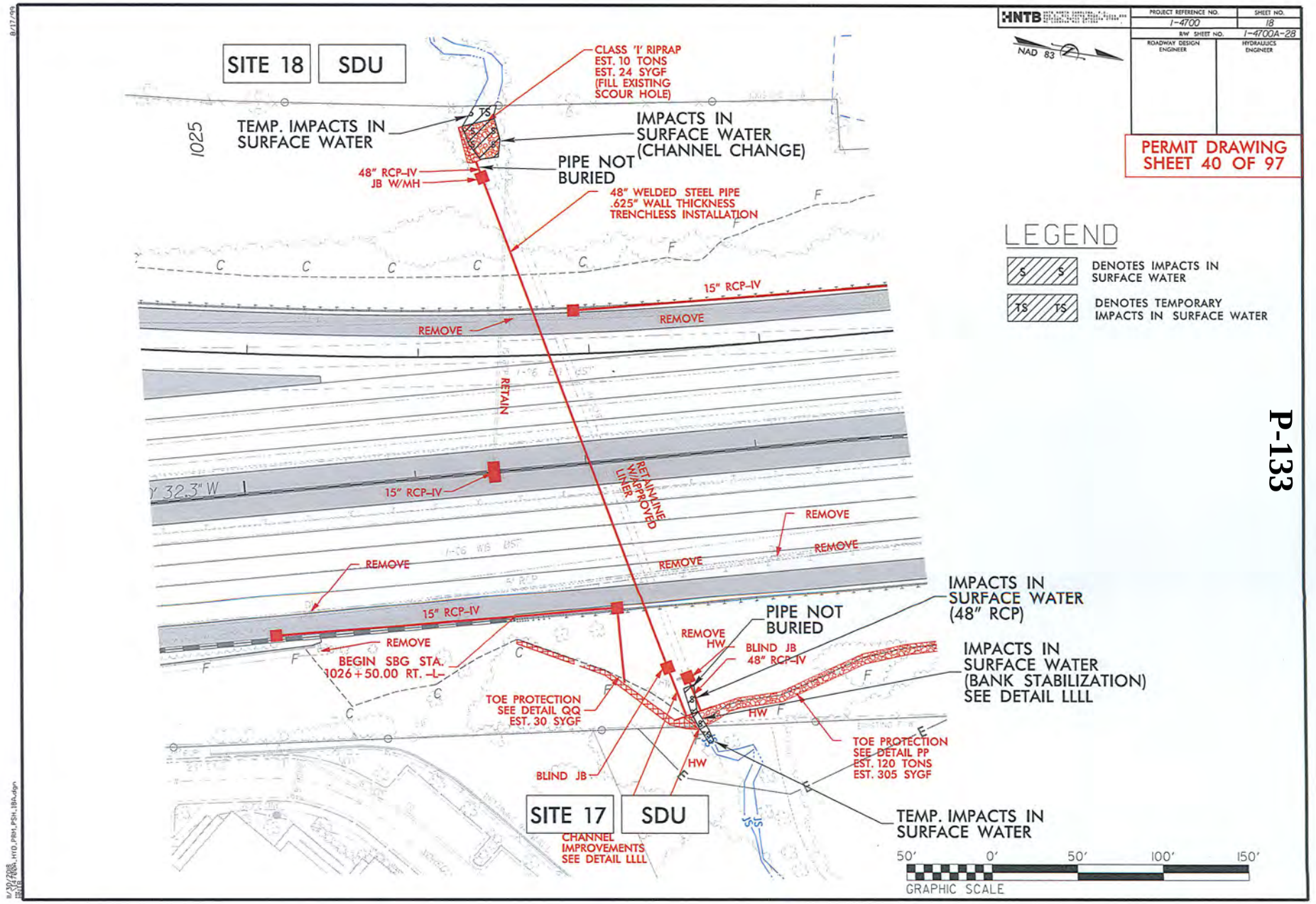
PROFILE

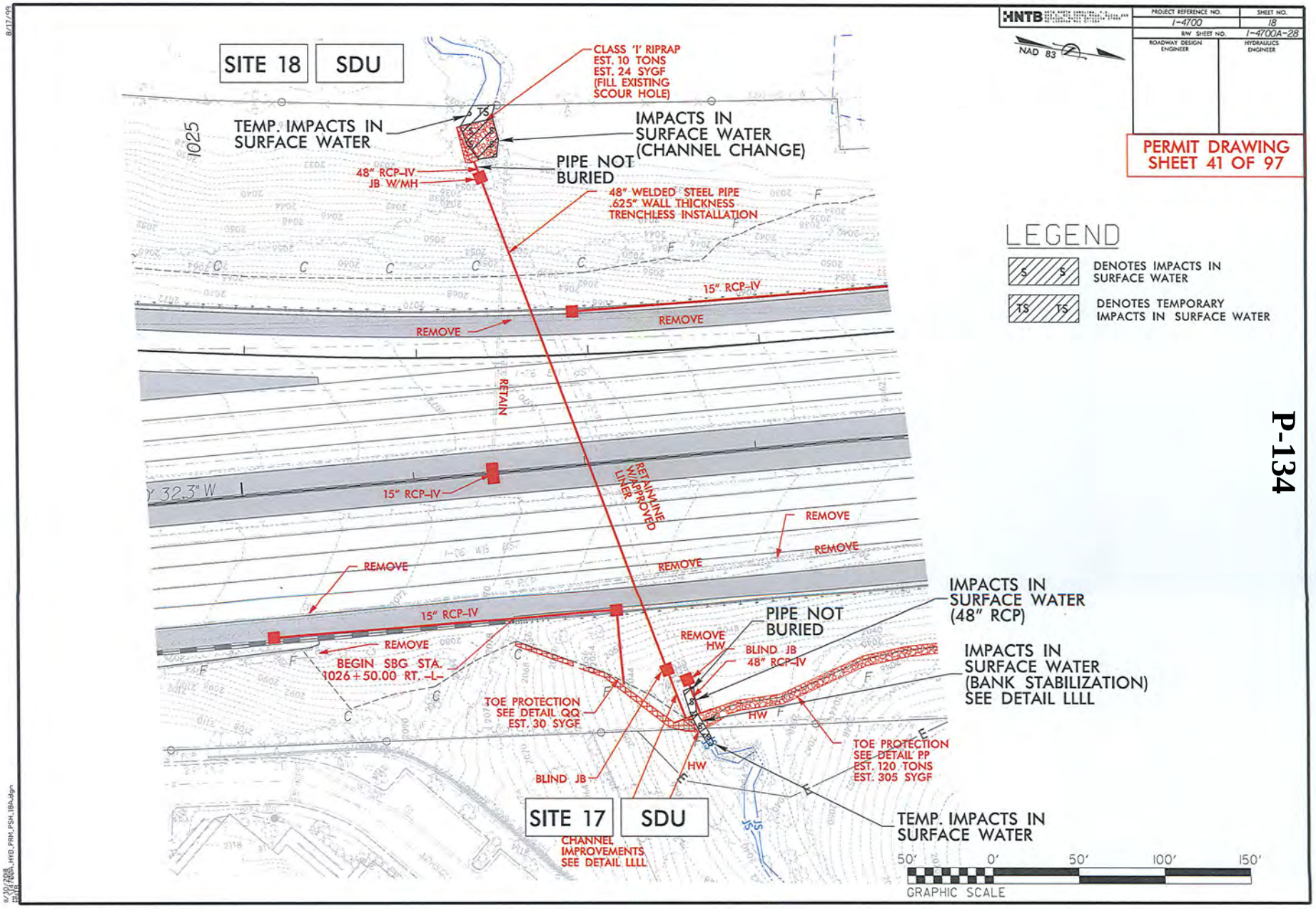
P-130

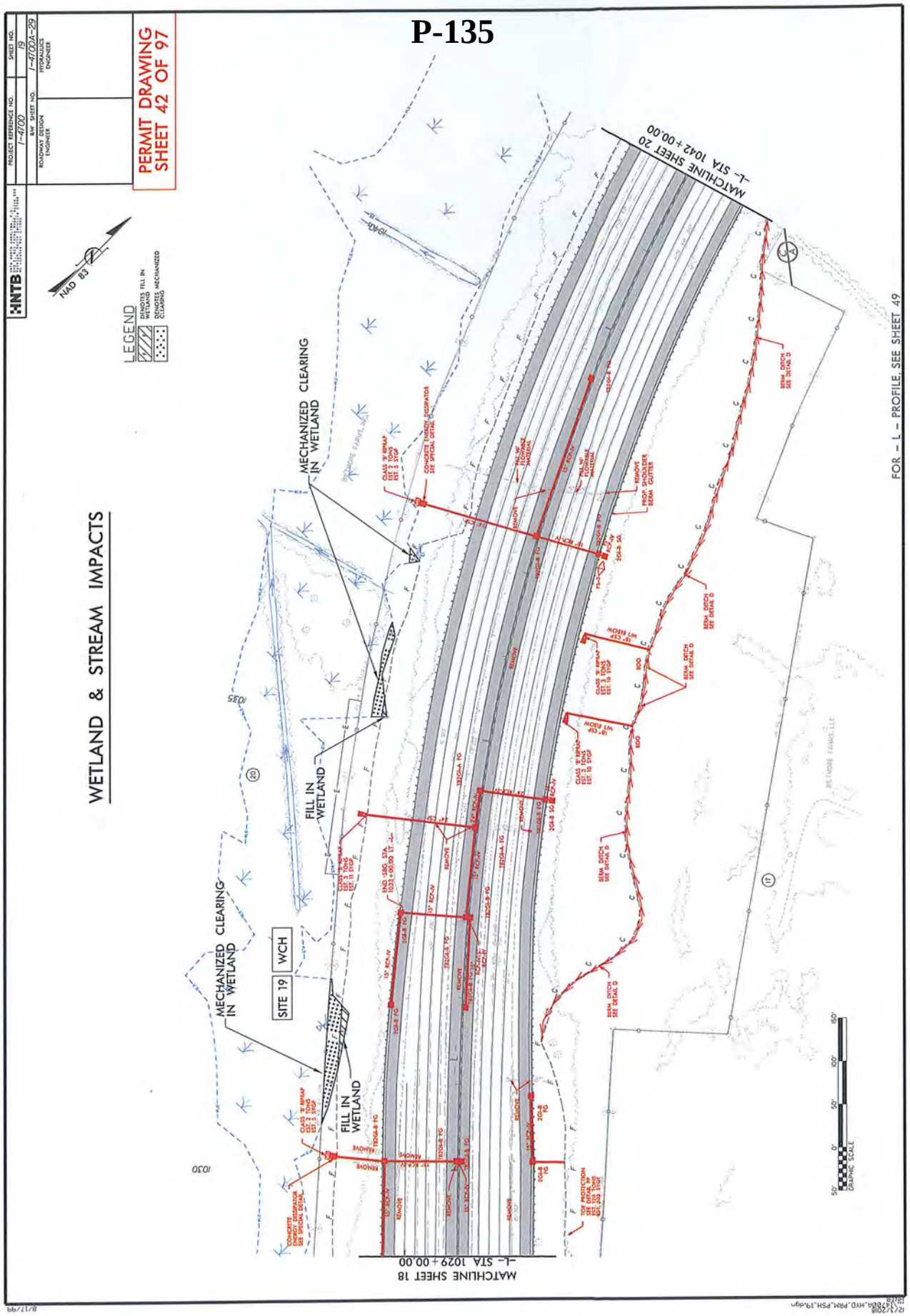
BUNCOMBE & HENDERSON COUNTY
PROJECT: I-4700
I-26
FROM 0.3 MI EAST OF NC 280 (AIRPORT RD.)
TO 0.5 MI EAST OF NC 191 (BREVARD RD.)

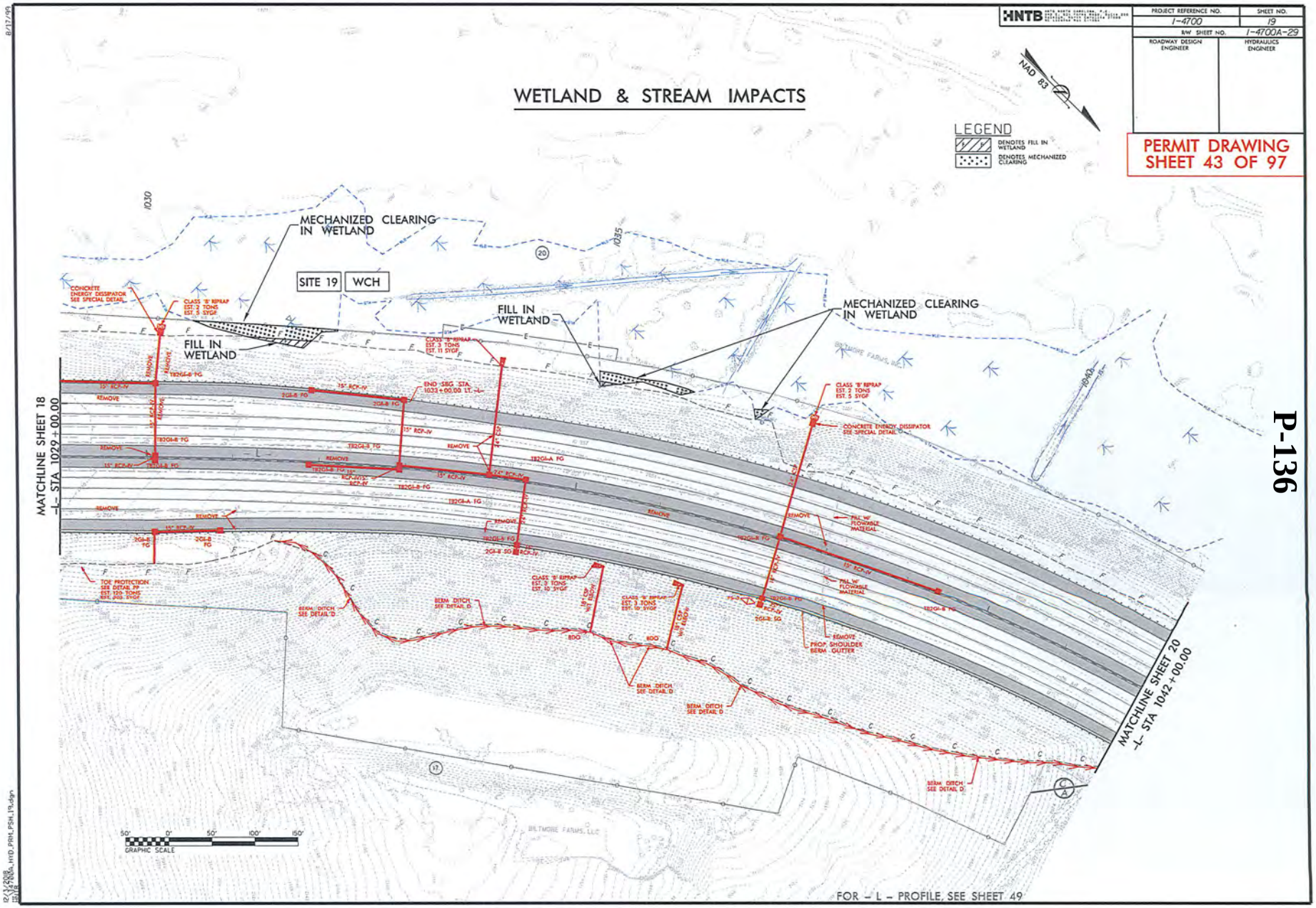

WETLAND & STREAM IMPACTS
HNTB
NAD 83
PROJECT REFERENCE NO. 1-4700
SHEET NO. 18
R/W SHEET NO. 1-4700A-28
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
PERMIT DRAWING SHEET 38 OF 97
P-131
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
SITE 18A
FRENCH BROAD RIVER
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
SITE 18
SDU
TEMP. IMPACTS IN SURFACE WATER
PIPE NOT BURIED
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
MATCHLINE SHEET 17 -L- STA 1017+00.00
MATCHLINE SHEET 19 -L- STA 1029+00.00
IMPACTS IN SURFACE WATER (48" RCP)
PIPE NOT BURIED
IMPACTS IN SURFACE WATER (BANK STABILIZATION)
TEMP. IMPACTS IN SURFACE WATER
SITE 17
SDU
DUCKER CREEK
BEGIN EXPRESSWAY GUTTER STA. 12+10.00 -Y15RPD- 12.00' RT.
END EXPRESSWAY GUTTER STA. 14+10.00 -Y15RPD- 12.00' RT.
GRAPHIC SCALE
FOR -L- PROFILE, SEE SHEET 48 & 49
FOR -Y15RPA- PROFILE, SEE SHEET 66
FOR -Y15RPD- PROFILE, SEE SHEET 68


WETLAND & STREAM IMPACTS
HNTB
NAD 83
PROJECT REFERENCE NO. 1-4700
SHEET NO. 18
R/W SHEET NO. 1-4700A-28
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
PERMIT DRAWING SHEET 39 OF 97
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
SITE 18A
FRENCH BROAD RIVER
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
SITE 18 SDU
TEMP. IMPACTS IN SURFACE WATER
PIPE NOT BURIED
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
MATCHLINE SHEET 17 -L- STA 1017+00.00
MATCHLINE SHEET 19 -L- STA 1029+00.00
IMPACTS IN SURFACE WATER (48" RCP)
PIPE NOT BURIED
IMPACTS IN SURFACE WATER (BANK STABILIZATION)
TEMP. IMPACTS IN SURFACE WATER
SITE 17 SDU
DUCKER CREEK
P-132
FOR -L- PROFILE, SEE SHEET 48 & 49
FOR -Y15RPA- PROFILE, SEE SHEET 66
FOR -Y15RPD- PROFILE, SEE SHEET 68


HNTB
PROJECT REFERENCE NO.
I-4700
SHEET NO.
18
R/W SHEET NO.
I-4700A-28
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
PERMIT DRAWING
SHEET 40 OF 97
SITE 18
SDU
CLASS 'I' RIPRAP
EST. 10 TONS
EST. 24 SYGF
(FILL EXISTING
SCOUR HOLE)
TEMP. IMPACTS IN
SURFACE WATER
IMPACTS IN
SURFACE WATER
(CHANNEL CHANGE)
PIPE NOT
BURIED
48" RCP-IV
JB W/MH
48" WELDED STEEL PIPE
.625" WALL THICKNESS
TRENCHLESS INSTALLATION
15" RCP-IV
REMOVE
RETAIN
RETAIN/LINE W/APPROVED LINER
BEGIN SBG STA.
1026+50.00 RT. -L-
TOE PROTECTION
SEE DETAIL QQ
EST. 30 SYGF
REMOVE HW
BLIND JB
48" RCP-IV
IMPACTS IN
SURFACE WATER
(48" RCP)
IMPACTS IN
SURFACE WATER
(BANK STABILIZATION)
SEE DETAIL LLLL
TOE PROTECTION
SEE DETAIL PP
EST. 120 TONS
EST. 305 SYGF
BLIND JB
HW
SITE 17
SDU
CHANNEL
IMPROVEMENTS
SEE DETAIL LLLL
TEMP. IMPACTS IN
SURFACE WATER
LEGEND
DENOTES IMPACTS IN
SURFACE WATER
DENOTES TEMPORARY
IMPACTS IN SURFACE WATER
50' 0' 50' 100' 150'
GRAPHIC SCALE
P-133


HNTB
PROJECT REFERENCE NO.
I-4700
SHEET NO.
18
R/W SHEET NO.
I-4700A-28
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
PERMIT DRAWING
SHEET 41 OF 97
SITE 18
SDU
CLASS 'I' RIPRAP
EST. 10 TONS
EST. 24 SYGF
(FILL EXISTING
SCOUR HOLE)
TEMP. IMPACTS IN
SURFACE WATER
IMPACTS IN
SURFACE WATER
(CHANNEL CHANGE)
PIPE NOT
BURIED
48" RCP-IV
JB W/MH
48" WELDED STEEL PIPE
.625" WALL THICKNESS
TRENCHLESS INSTALLATION
15" RCP-IV
REMOVE
RETAIN
RETAIN/LINE
W/APPROVED
LINER
15" RCP-IV
REMOVE
REMOVE
REMOVE
REMOVE
15" RCP-IV
REMOVE
BEGIN SBG STA.
1026+50.00 RT. -L-
PIPE NOT
BURIED
REMOVE
HW
BLIND JB
48" RCP-IV
IMPACTS IN
SURFACE WATER
(48" RCP)
IMPACTS IN
SURFACE WATER
(BANK STABILIZATION)
SEE DETAIL LLLL
TOE PROTECTION
SEE DETAIL QQ
EST. 30 SYGF
HW
TOE PROTECTION
SEE DETAIL PP
EST. 120 TONS
EST. 305 SYGF
BLIND JB
HW
SITE 17
SDU
CHANNEL
IMPROVEMENTS
SEE DETAIL LLLL
TEMP. IMPACTS IN
SURFACE WATER
LEGEND
DENOTES IMPACTS IN
SURFACE WATER
DENOTES TEMPORARY
IMPACTS IN SURFACE WATER
50' 0' 50' 100' 150'
GRAPHIC SCALE


PERMIT DRAWING
SHEET 42 OF 97
PROJECT REFERENCE NO. 1-4700
SHEET NO. 19
SW SHEET NO. 1-4700A-29
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NTB
NAD 83
LEGEND
DENOTES FILL IN WETLAND
DENOTES MECHANIZED CLEARING
WETLAND & STREAM IMPACTS
SITE 19
WCH
MECHANIZED CLEARING IN WETLAND
FILL IN WETLAND
MECHANIZED CLEARING IN WETLAND
FILL IN WETLAND
MATCHLINE SHEET 18
-L- STA 1029+00.00
MATCHLINE SHEET 20
-L- STA 1042+00.00
FOR -L- PROFILE, SEE SHEET 49
GRAPHIC SCALE
8/12/99

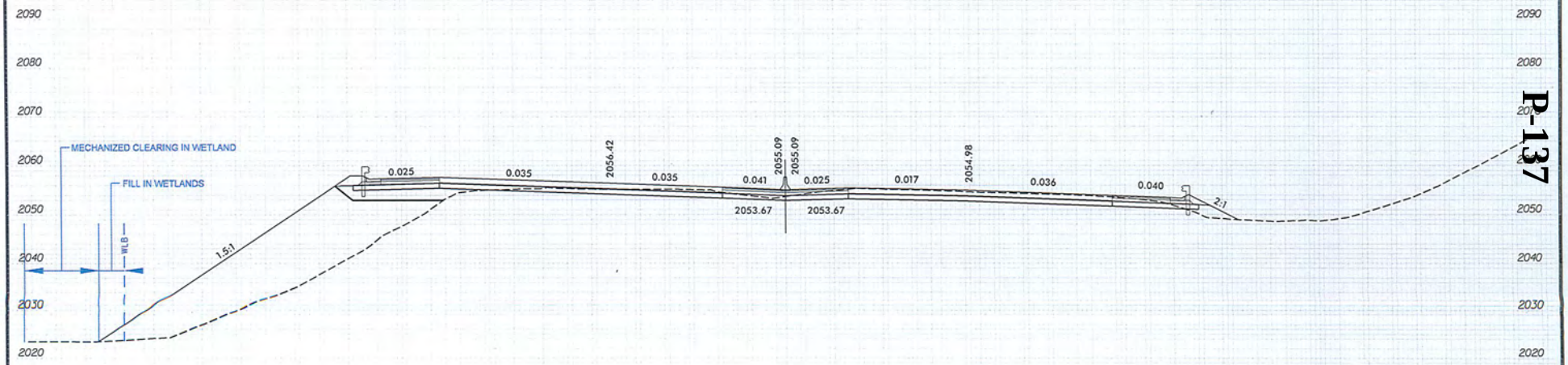


HNTB
PROJECT REFERENCE NO.
I-4700
SHEET NO.
19
R/W SHEET NO.
I-4700A-29
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
PERMIT DRAWING
SHEET 43 OF 97
WETLAND & STREAM IMPACTS
NAD 83
LEGEND
DENOTES FILL IN WETLAND
DENOTES MECHANIZED CLEARING
MECHANIZED CLEARING IN WETLAND
SITE 19
WCH
FILL IN WETLAND
FILL IN WETLAND
MECHANIZED CLEARING IN WETLAND
MATCHLINE SHEET 18 -L- STA 1029+00.00
MATCHLINE SHEET 20 -L- STA 1042+00.00
CONCRETE ENERGY DISSIPATOR SEE SPECIAL DETAIL
CLASS 'B' RIPRAP EST. 2 TONS EST. 5 SYGF
CLASS 'B' RIPRAP EST. 3 TONS EST. 11 SYGF
CLASS 'B' RIPRAP EST. 2 TONS EST. 5 SYGF
CONCRETE ENERGY DISSIPATOR SEE SPECIAL DETAIL
END SBG STA. 1033+00.00 LT. -L-
TOE PROTECTION SEE DETAIL PP EST. 120 TONS EST. 200 SYGF
BERM DITCH SEE DETAIL D
PROP. SHOULDER BERM GUTTER
FILL W/ FLOWABLE MATERIAL
REMOVE
GRAPHIC SCALE
FOR - L - PROFILE, SEE SHEET 49

PROJ. REFERENCE NO.	SHEET NO.
I-4700	

PERMIT DRAWING
SHEET 44 OF 97

WETLAND CROSS SECTIONS

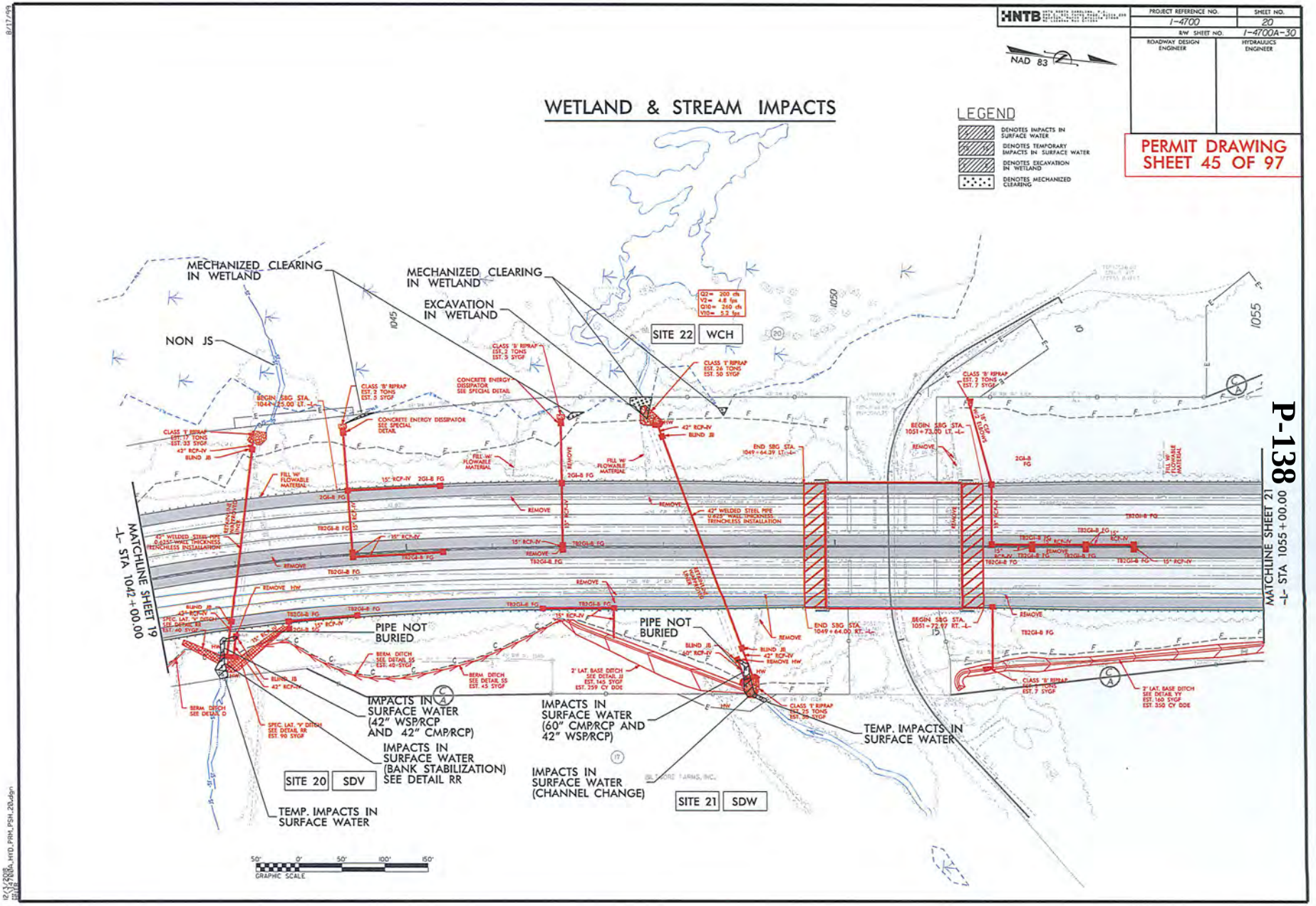


P-137

SITE 19
–L– 1031+50.00

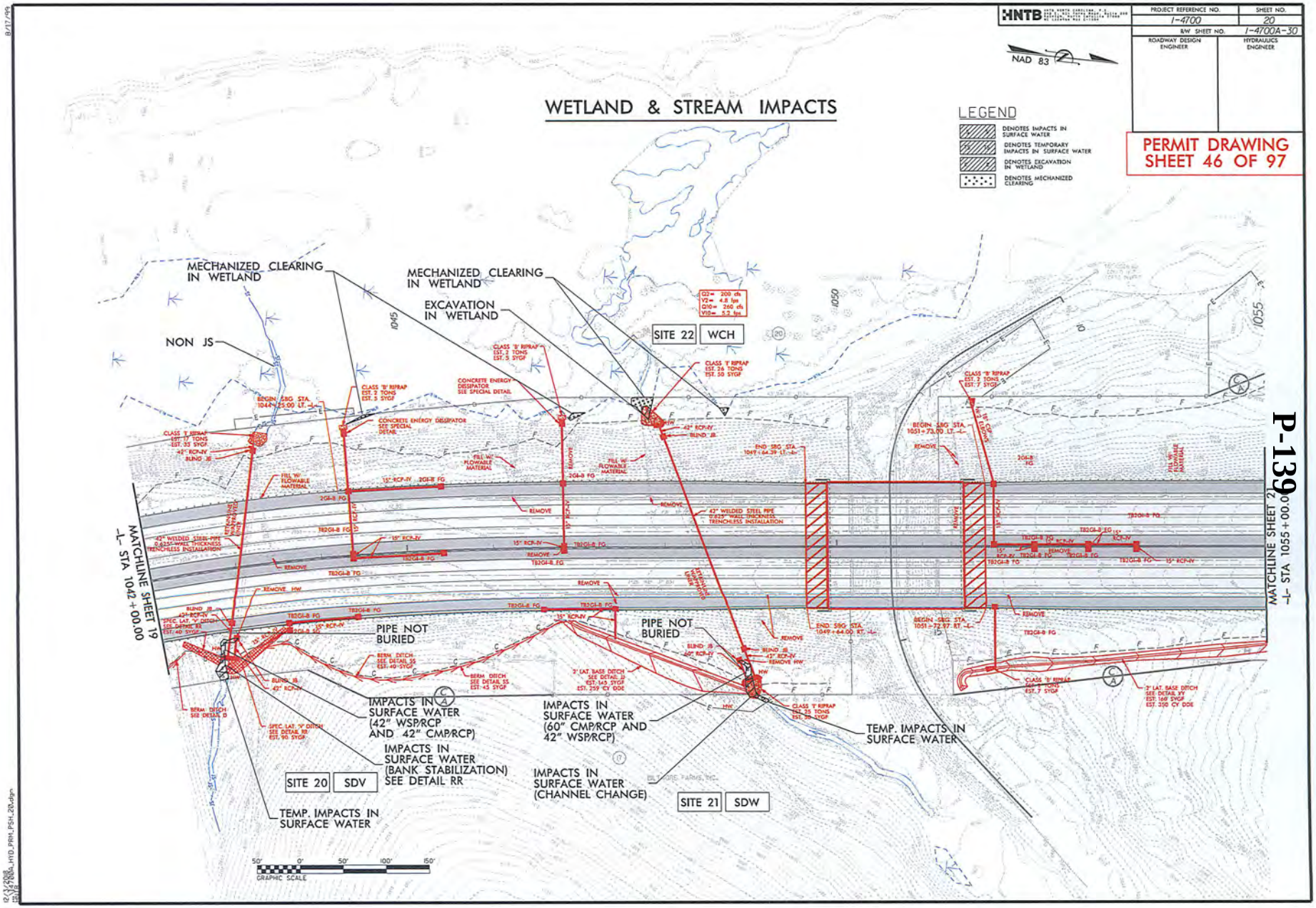
SCALE
1"=20' HORIZONTAL
1"=20' VERTICAL

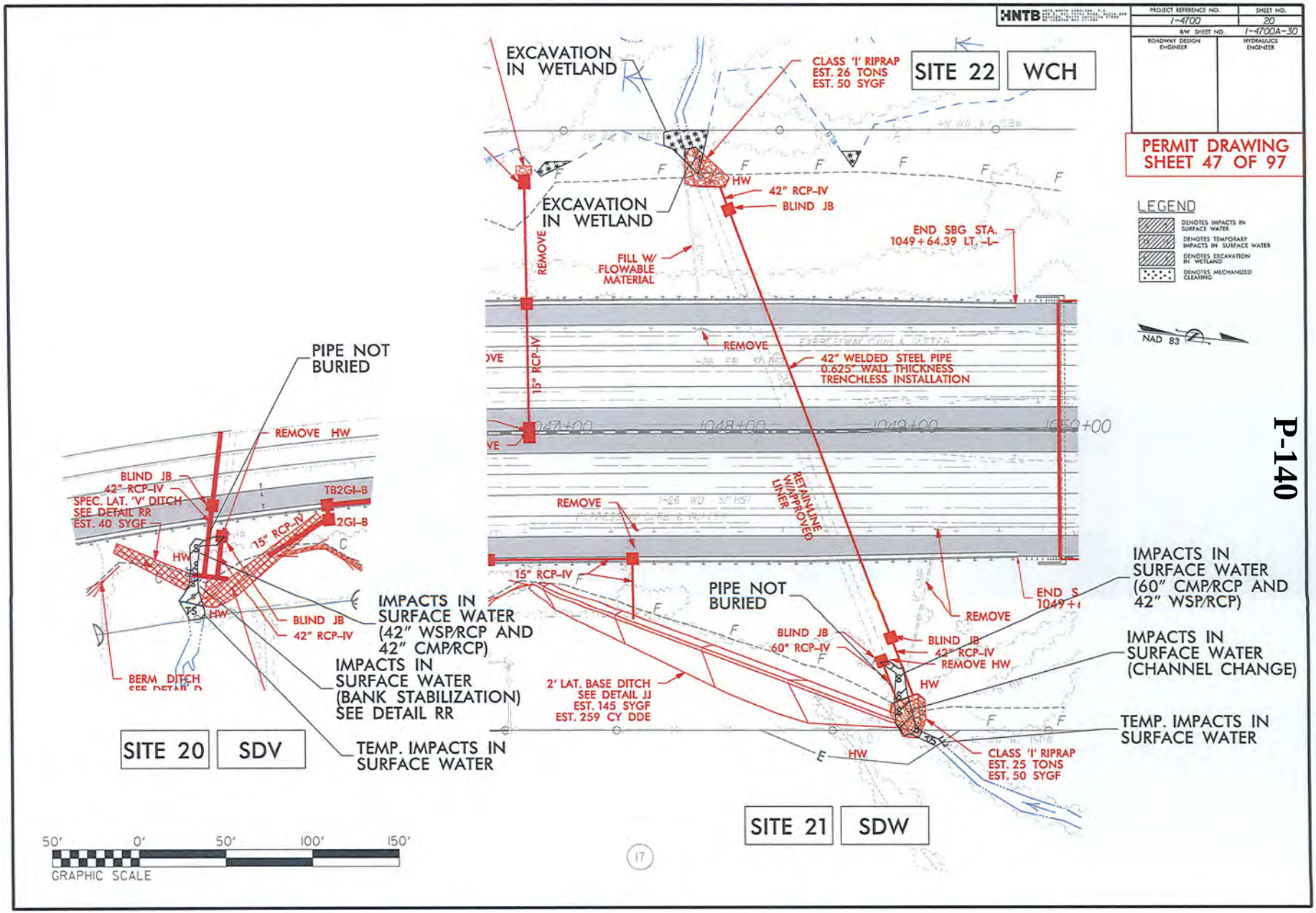
BUNCOMBE & HENDERSON COUNTY
PROJECT: I-4700
I-26
FROM 0.3 MI EAST OF NC 280 (AIRPORT RD.)
TO 0.5 MI EAST OF NC 191 (BREVARD RD.)

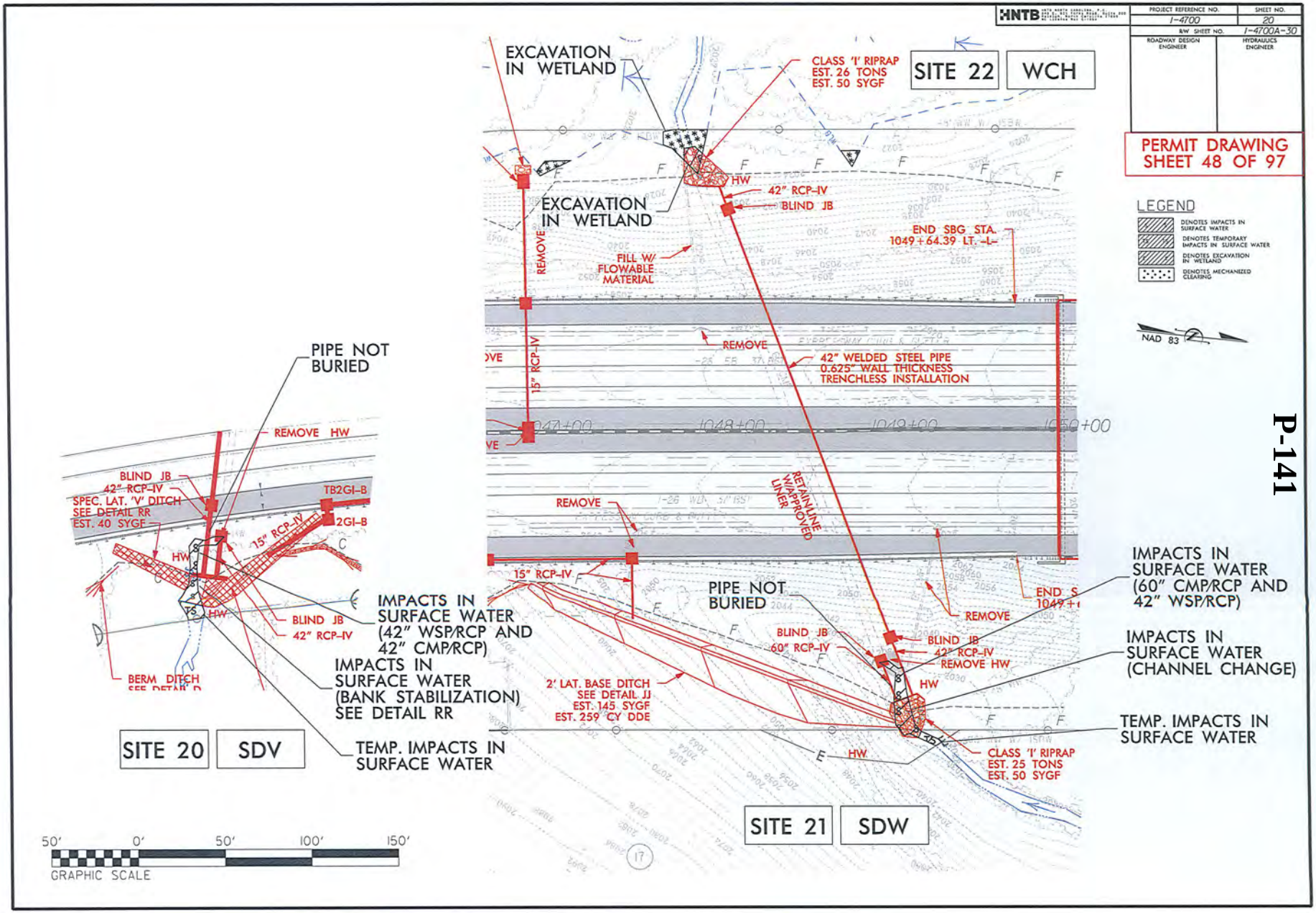


HNTB
PROJECT REFERENCE NO.
I-4700
SHEET NO.
20
R/W SHEET NO.
I-4700A-30
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
WETLAND & STREAM IMPACTS
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
DENOTES EXCAVATION IN WETLAND
DENOTES MECHANIZED CLEARING
PERMIT DRAWING
SHEET 45 OF 97
MECHANIZED CLEARING IN WETLAND
MECHANIZED CLEARING IN WETLAND
EXCAVATION IN WETLAND
NON JS
SITE 22
WCH
MATCHLINE SHEET 19
-L- STA 1042+00.00
MATCHLINE SHEET 21
-L- STA 1055+00.00
PIPE NOT BURIED
PIPE NOT BURIED
IMPACTS IN SURFACE WATER (42" WSP/RCP AND 42" CMP/RCP)
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL RR
IMPACTS IN SURFACE WATER (60" CMP/RCP AND 42" WSP/RCP)
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
TEMP. IMPACTS IN SURFACE WATER
TEMP. IMPACTS IN SURFACE WATER
SITE 20
SDV
SITE 21
SDW
GRAPHIC SCALE

P-138


WETLAND & STREAM IMPACTS
HNTB
NAD 83
PROJECT REFERENCE NO. I-4700
SHEET NO. 20
R/W SHEET NO. I-4700A-30
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
PERMIT DRAWING SHEET 46 OF 97
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
DENOTES EXCAVATION IN WETLAND
DENOTES MECHANIZED CLEARING
MECHANIZED CLEARING IN WETLAND
NON JS
EXCAVATION IN WETLAND
MECHANIZED CLEARING IN WETLAND
SITE 22 WCH
PIPE NOT BURIED
PIPE NOT BURIED
IMPACTS IN SURFACE WATER (42" WSP/RCP AND 42" CMP/RCP)
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL RR
SITE 20 SDV
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (60" CMP/RCP AND 42" WSP/RCP)
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
SITE 21 SDW
TEMP. IMPACTS IN SURFACE WATER
MATCHLINE SHEET 19 -L- STA 1042+00.00
MATCHLINE SHEET 21 -L- STA 1055+00.00
GRAPHIC SCALE
P-1399

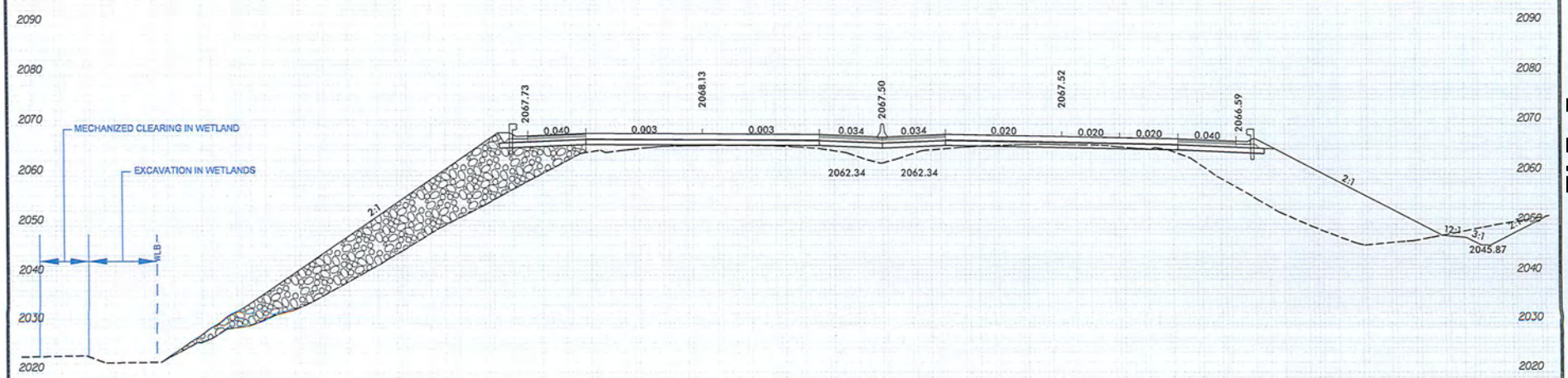

HNTB
PROJECT REFERENCE NO. 1-4700
SHEET NO. 20
R/W SHEET NO. 1-4700A-30
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
PERMIT DRAWING SHEET 47 OF 97
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
DENOTES EXCAVATION IN WETLAND
DENOTES MECHANIZED CLEARING
NAD 83
P-140
SITE 22
WCH
EXCAVATION IN WETLAND
CLASS 'I' RIPRAP
EST. 26 TONS
EST. 50 SYGF
HW
42" RCP-IV
BLIND JB
END SBG STA. 1049+64.39 LT. -L-
FILL W/ FLOWABLE MATERIAL
REMOVE
15" RCP-IV
42" WELDED STEEL PIPE
0.625" WALL THICKNESS
TRENCHLESS INSTALLATION
1047+00
1048+00
1049+00
1050+00
RETAINLINE WIA APPROVED LINER
PIPE NOT BURIED
60" RCP-IV
2' LAT. BASE DITCH
SEE DETAIL JJ
EST. 145 SYGF
EST. 259 CY DDE
CLASS 'I' RIPRAP
EST. 25 TONS
EST. 50 SYGF
IMPACTS IN SURFACE WATER (60" CMP/RCP AND 42" WSP/RCP)
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
TEMP. IMPACTS IN SURFACE WATER
SITE 21
SDW
PIPE NOT BURIED
REMOVE HW
BLIND JB
42" RCP-IV
SPEC. LAT. 'V' DITCH
SEE DETAIL RR
EST. 40 SYGF
TB2GI-B
2GI-B
15" RCP-IV
HW
BERM DITCH
IMPACTS IN SURFACE WATER (42" WSP/RCP AND 42" CMP/RCP)
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL RR
TEMP. IMPACTS IN SURFACE WATER
SITE 20
SDV
50' 0' 50' 100' 150'
GRAPHIC SCALE
17


HNTB
PROJECT REFERENCE NO. 1-4700
SHEET NO. 20
R/W SHEET NO. 1-4700A-30
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
PERMIT DRAWING SHEET 48 OF 97
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
DENOTES EXCAVATION IN WETLAND
DENOTES MECHANIZED CLEARING
NAD 83
P-141
EXCAVATION IN WETLAND
CLASS 'I' RIPRAP EST. 26 TONS EST. 50 SYGF
SITE 22
WCH
HW
42" RCP-IV
BLIND JB
EXCAVATION IN WETLAND
REMOVE
FILL W/ FLOWABLE MATERIAL
END SBG STA. 1049+64.39 LT. -L-
REMOVE
42" WELDED STEEL PIPE 0.625" WALL THICKNESS TRENCHLESS INSTALLATION
15" RCP-IV
1047+00
1048+00
1049+00
1050+00
REMOVE
RETAINLINE W/APPROVED LINER
15" RCP-IV
PIPE NOT BURIED
REMOVE
END S 1049+
BLIND JB
60" RCP-IV
BLIND JB
42" RCP-IV
REMOVE HW
HW
2' LAT. BASE DITCH SEE DETAIL JJ EST. 145 SYGF EST. 259 CY DDE
HW
CLASS 'I' RIPRAP EST. 25 TONS EST. 50 SYGF
SITE 21
SDW
IMPACTS IN SURFACE WATER (60" CMP/RCP AND 42" WSP/RCP)
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
TEMP. IMPACTS IN SURFACE WATER
PIPE NOT BURIED
REMOVE HW
BLIND JB
42" RCP-IV
SPEC. LAT. 'V' DITCH SEE DETAIL RR EST. 40 SYGF
TB2GI-B
2GI-B
15" RCP-IV
HW
HW
BLIND JB
42" RCP-IV
BERM DITCH
IMPACTS IN SURFACE WATER (42" WSP/RCP AND 42" CMP/RCP)
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL RR
TEMP. IMPACTS IN SURFACE WATER
SITE 20
SDV
50' 0' 50' 100' 150'
GRAPHIC SCALE

PROJ. REFERENCE NO.	SHEET NO.
I-4700	

PERMIT DRAWING
SHEET 49 OF 97

WETLAND CROSS SECTIONS

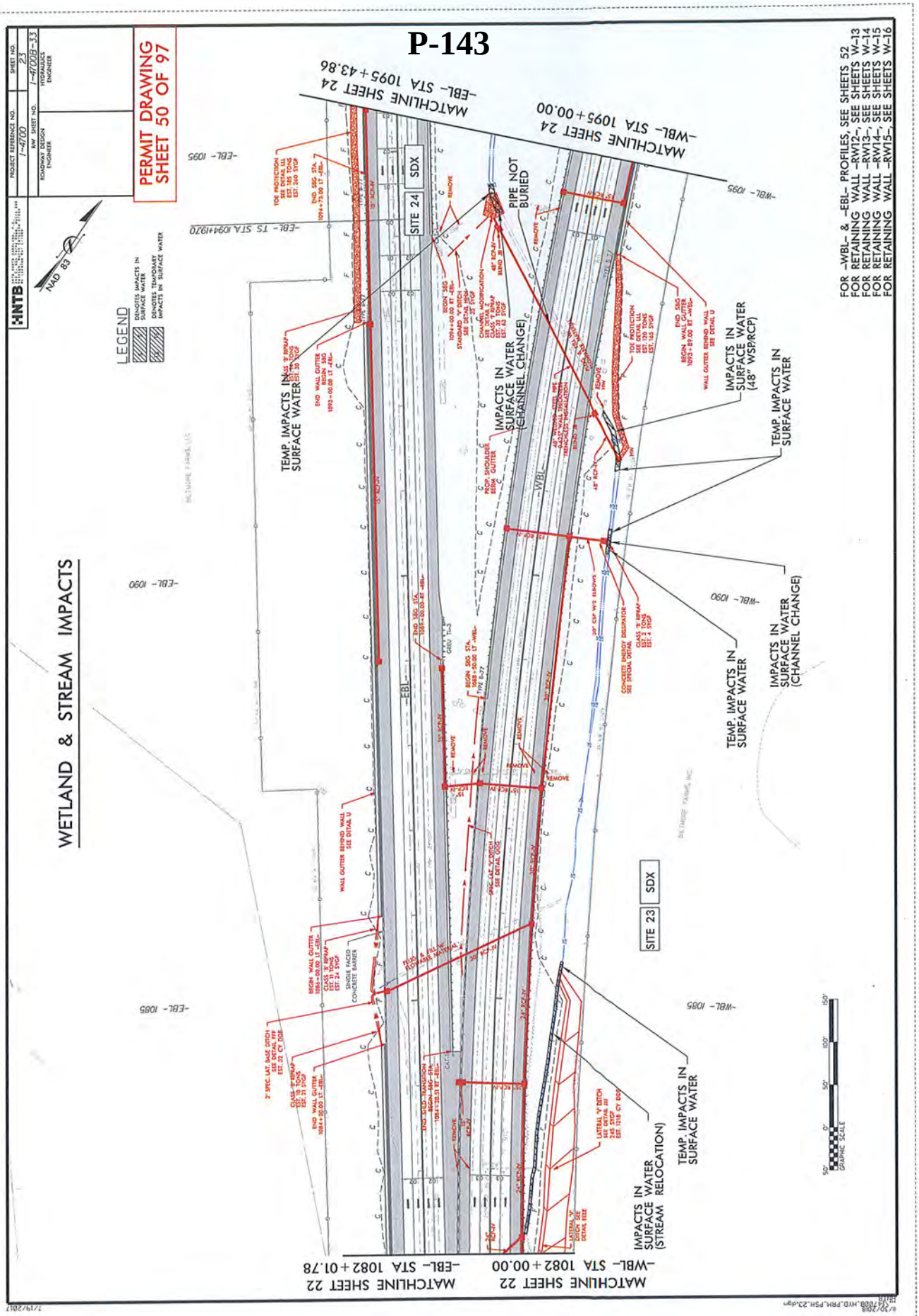


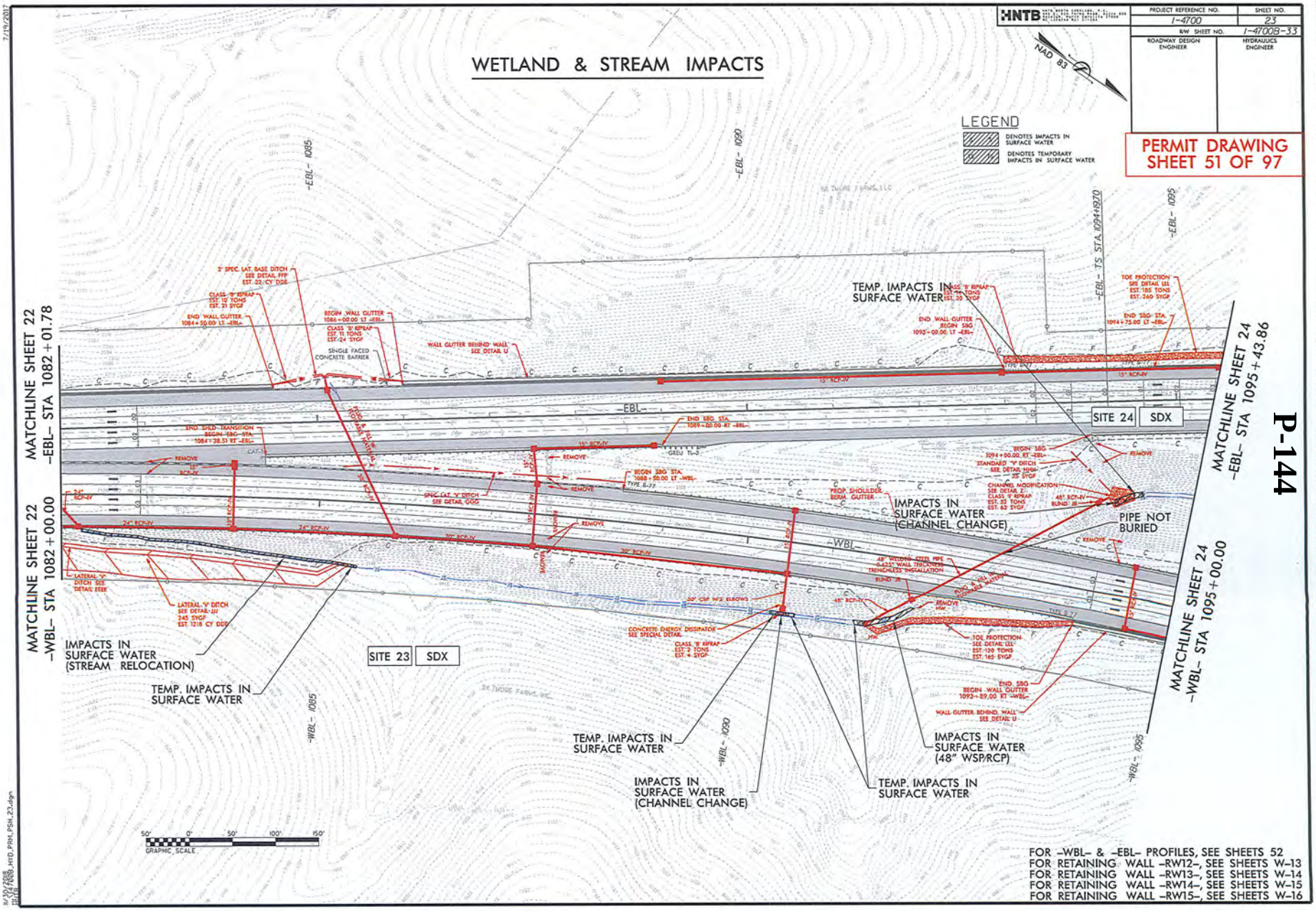
SITE 22
–L2– 1047+80.00

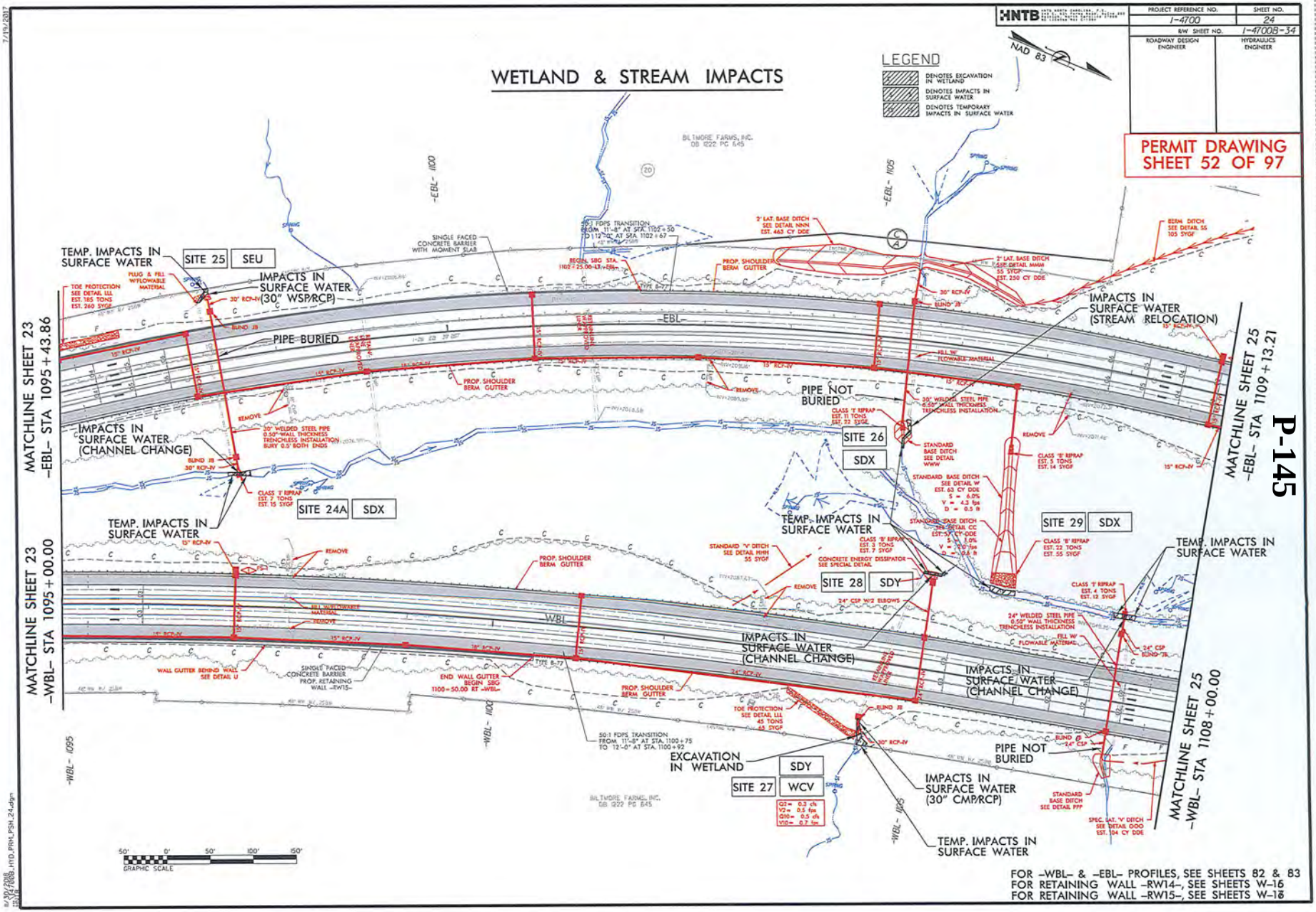
SCALE
1"=20' HORIZONTAL
1"=20' VERTICAL

BUNCOMBE & HENDERSON COUNTY
PROJECT: I-4700
I-26
FROM 0.3 MI EAST OF NC 280 (AIRPORT RD.)
TO 0.5 MI EAST OF NC 191 (BREVARD RD.)

P-142

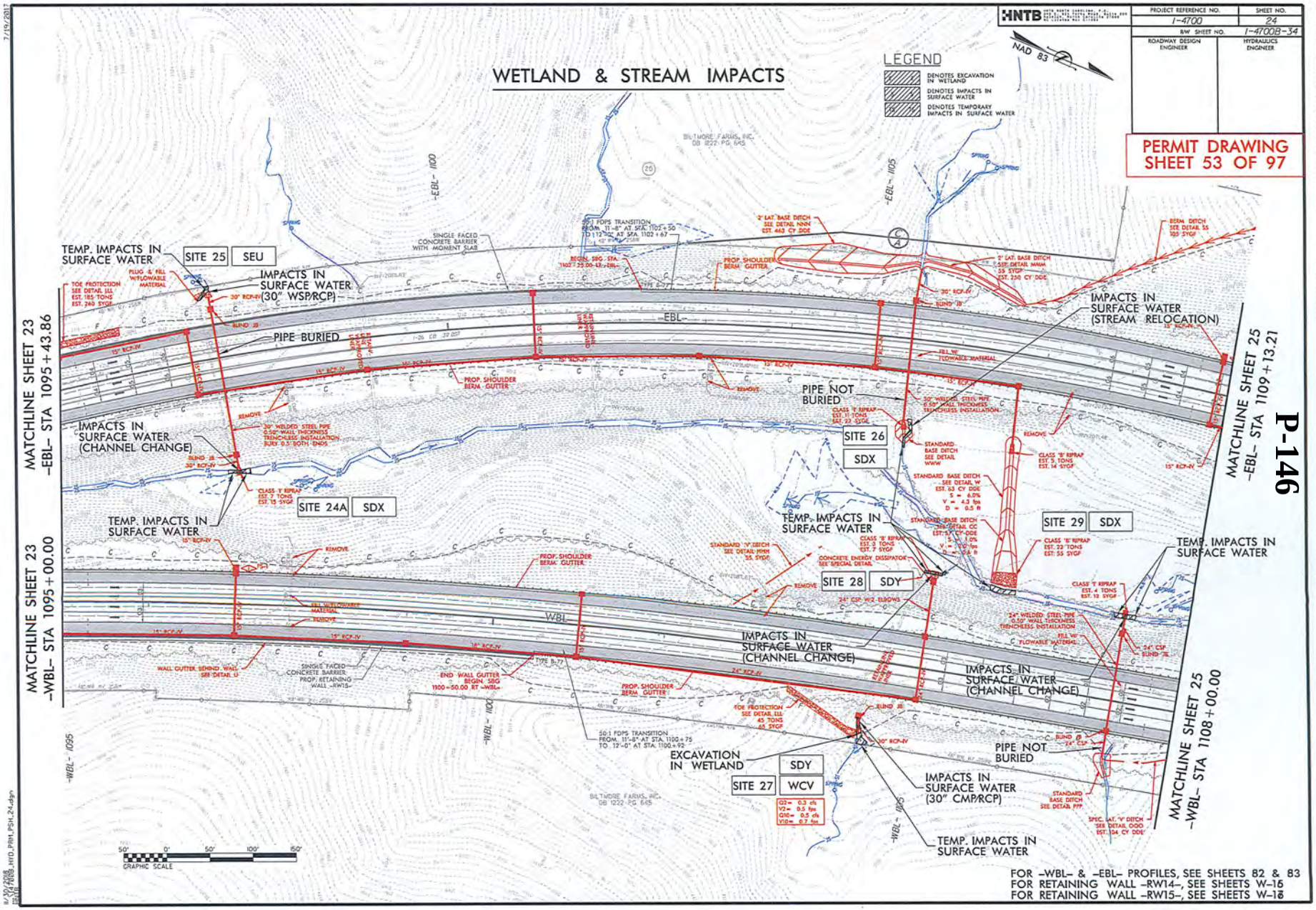

PERMIT DRAWING
SHEET 50 OF 97
PROJECT REFERENCE NO. I-4700
SHEET NO. 23
R/W SHEET NO. I-4700B-33
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NTB
NAD 83
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
WETLAND & STREAM IMPACTS
SITE 24
SITE 23
SDX
EBL
WBL
MATCHLINE SHEET 24 -EBL- STA 1095+43.86
MATCHLINE SHEET 24 -WBL- STA 1095+00.00
MATCHLINE SHEET 22 -EBL- STA 1082+01.78
MATCHLINE SHEET 22 -WBL- STA 1082+00.00
-EBL- TS STA 1094+19.70
PIPE NOT BURIED
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
IMPACTS IN SURFACE WATER (48" WSP/RCP)
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
FOR -WBL- & -EBL- PROFILES, SEE SHEETS 52
FOR RETAINING WALL -RW12-, SEE SHEETS W-13
FOR RETAINING WALL -RW13-, SEE SHEETS W-14
FOR RETAINING WALL -RW14-, SEE SHEETS W-15
FOR RETAINING WALL -RW15-, SEE SHEETS W-16
GRAPHIC SCALE


WETLAND & STREAM IMPACTS
NTB
PROJECT REFERENCE NO. I-4700
SHEET NO. 23
R/W SHEET NO. I-4700B-33
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
PERMIT DRAWING SHEET 51 OF 97
P-144
MATCHLINE SHEET 22 -EBL- STA 1082+01.78
MATCHLINE SHEET 22 -WBL- STA 1082+00.00
MATCHLINE SHEET 24 -EBL- STA 1095+43.86
MATCHLINE SHEET 24 -WBL- STA 1095+00.00
-EBL- 1085
-EBL- 1090
-EBL- 1095
-EBL- TS STA. 1094+19.70
-WBL- 1085
-WBL- 1090
-WBL- 1095
SITE 23 SDX
SITE 24 SDX
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
TEMP. IMPACTS IN SURFACE WATER
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
IMPACTS IN SURFACE WATER (48" WSP/RCP)
TEMP. IMPACTS IN SURFACE WATER
PIPE NOT BURIED
GRAPHIC SCALE
50' 0' 50' 100' 150'
FOR -WBL- & -EBL- PROFILES, SEE SHEETS 52
FOR RETAINING WALL -RW12-, SEE SHEETS W-13
FOR RETAINING WALL -RW13-, SEE SHEETS W-14
FOR RETAINING WALL -RW14-, SEE SHEETS W-15
FOR RETAINING WALL -RW15-, SEE SHEETS W-16



WETLAND & STREAM IMPACTS
LEGEND
DENOTES EXCAVATION IN WETLAND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
NAD 83
PROJECT REFERENCE NO. I-4700
SHEET NO. 24
R/W SHEET NO. I-4700B-34
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
PERMIT DRAWING SHEET 52 OF 97
TEMP. IMPACTS IN SURFACE WATER
SITE 25
SEU
IMPACTS IN SURFACE WATER (30" WSP/RCP)
PIPE BURIED
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
SITE 24A
SDX
TEMP. IMPACTS IN SURFACE WATER
PIPE NOT BURIED
SITE 26
SDX
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
SITE 29
SDX
TEMP. IMPACTS IN SURFACE WATER
SITE 28
SDY
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
EXCAVATION IN WETLAND
SITE 27
SDY
WCV
IMPACTS IN SURFACE WATER (30" CMP/RCP)
PIPE NOT BURIED
TEMP. IMPACTS IN SURFACE WATER
MATCHLINE SHEET 23 -EBL- STA 1095+43.86
MATCHLINE SHEET 23 -WBL- STA 1095+00.00
MATCHLINE SHEET 25 -EBL- STA 1109+13.21
MATCHLINE SHEET 25 -WBL- STA 1108+00.00
-EBL-
-WBL-
-EBL- 1100
-EBL- 1105
-WBL- 1095
-WBL- 1100
-WBL- 1105
BILTMORE FARMS, INC. DB 1222 PG 645
GRAPHIC SCALE
FOR -WBL- & -EBL- PROFILES, SEE SHEETS 82 & 83
FOR RETAINING WALL -RW14-, SEE SHEETS W-16
FOR RETAINING WALL -RW15-, SEE SHEETS W-18

P-145


WETLAND & STREAM IMPACTS
NTB
PROJECT REFERENCE NO. 1-4700
SHEET NO. P4
R/W SHEET NO. 1-4700B-34
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
LEGEND
DENOTES EXCAVATION IN WETLAND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
PERMIT DRAWING SHEET 53 OF 97
P-146
MATCHLINE SHEET 23 -EBL- STA 1095+43.86
MATCHLINE SHEET 23 -WBL- STA 1095+00.00
MATCHLINE SHEET 25 -EBL- STA 1109+13.21
MATCHLINE SHEET 25 -WBL- STA 1108+00.00
TEMP. IMPACTS IN SURFACE WATER
SITE 25 SEU
IMPACTS IN SURFACE WATER (30" WSP/RCP)
PIPE BURIED
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
SITE 24A SDX
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
PIPE NOT BURIED
SITE 26 SDX
SITE 29 SDX
SITE 28 SDY
EXCAVATION IN WETLAND
SITE 27 SDY WCV
IMPACTS IN SURFACE WATER (30" CMP/RCP)
EBL
WBL
FOR -WBL- & -EBL- PROFILES, SEE SHEETS 82 & 83
FOR RETAINING WALL -RW14-, SEE SHEETS W-16
FOR RETAINING WALL -RW15-, SEE SHEETS W-18
GRAPHIC SCALE

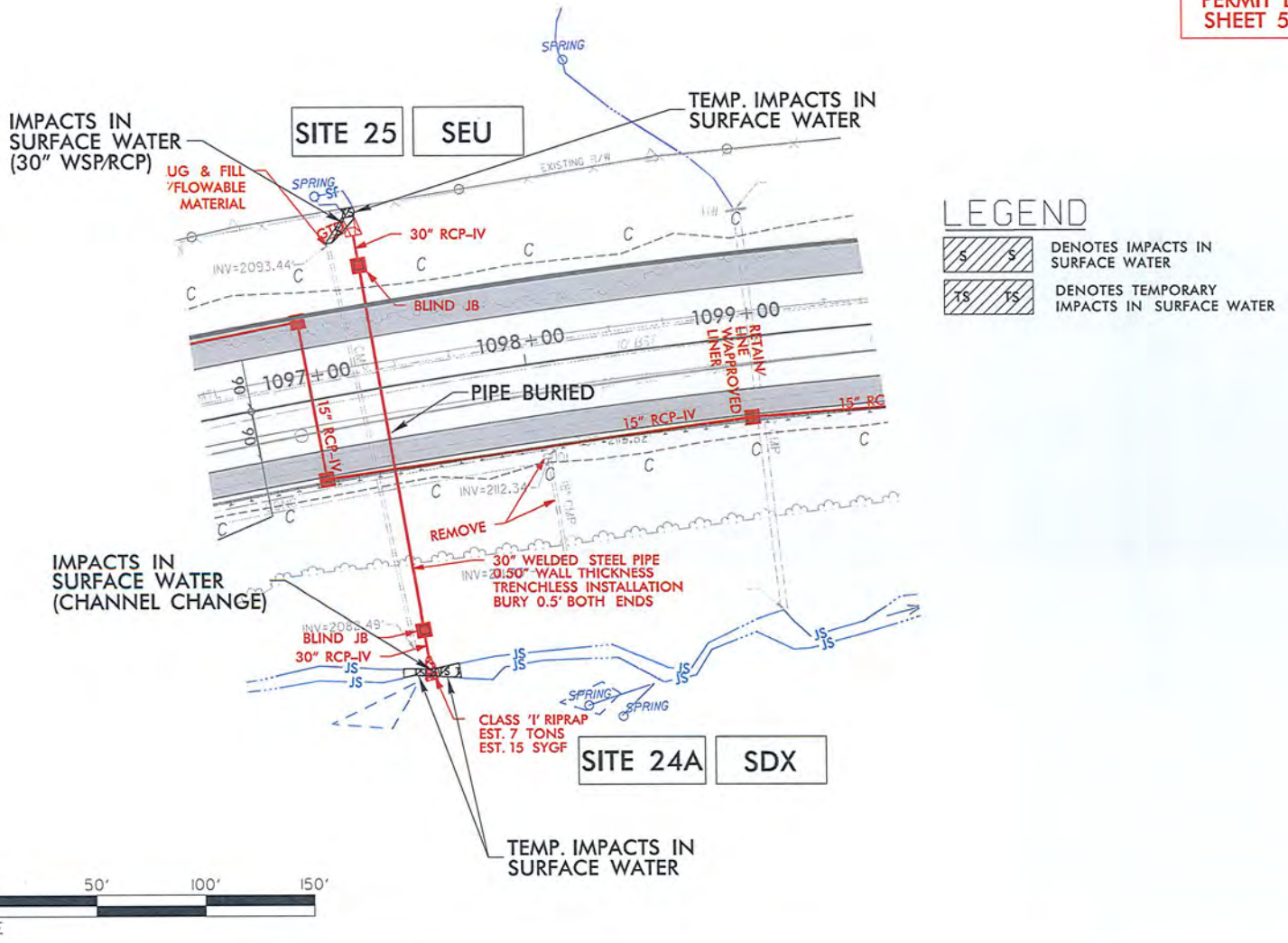
HNTB

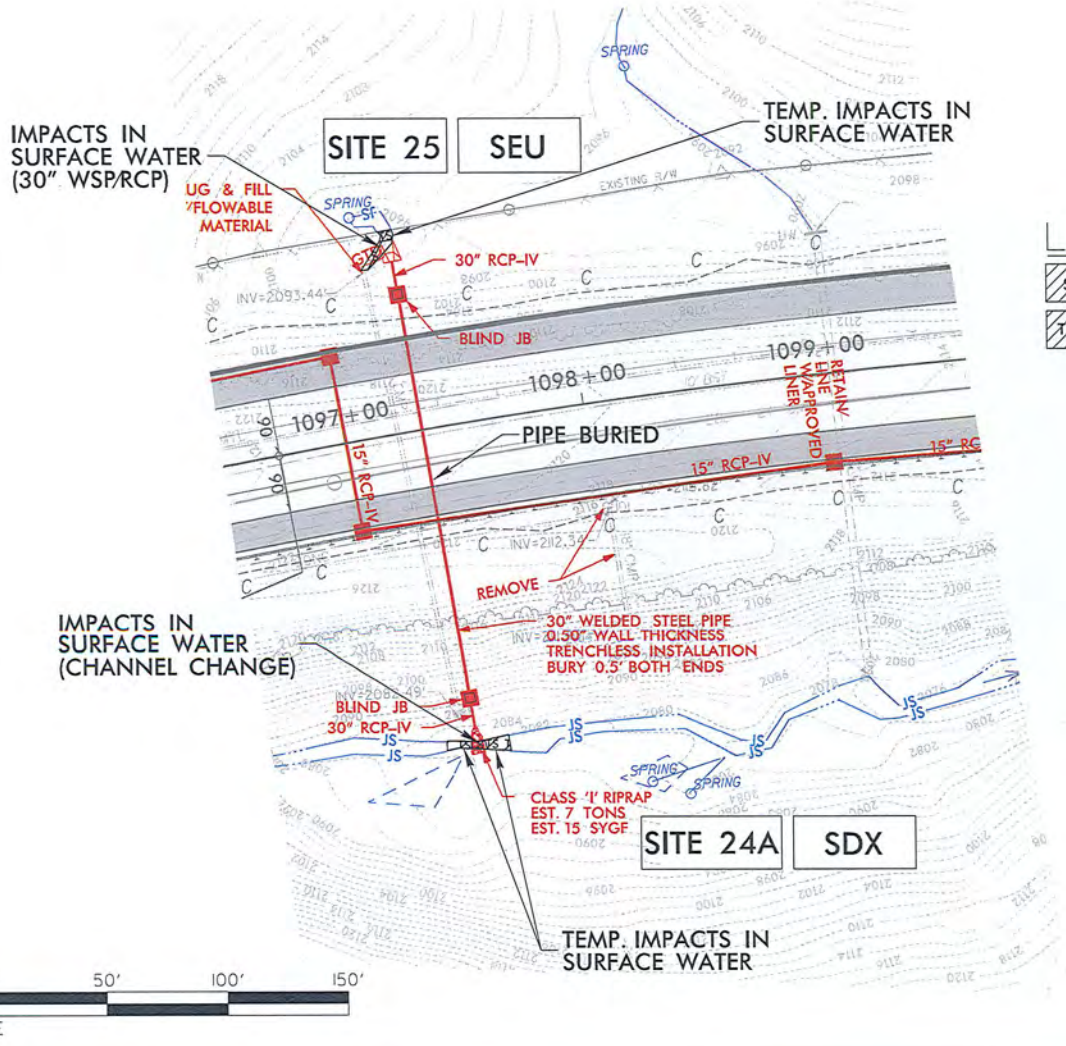
PROJECT REFERENCE NO.	SHEET NO.
I-4700	24
R/W SHEET NO.	I-4700B-34
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

NAD 83

PERMIT DRAWING
SHEET 54 OF 97

P-147

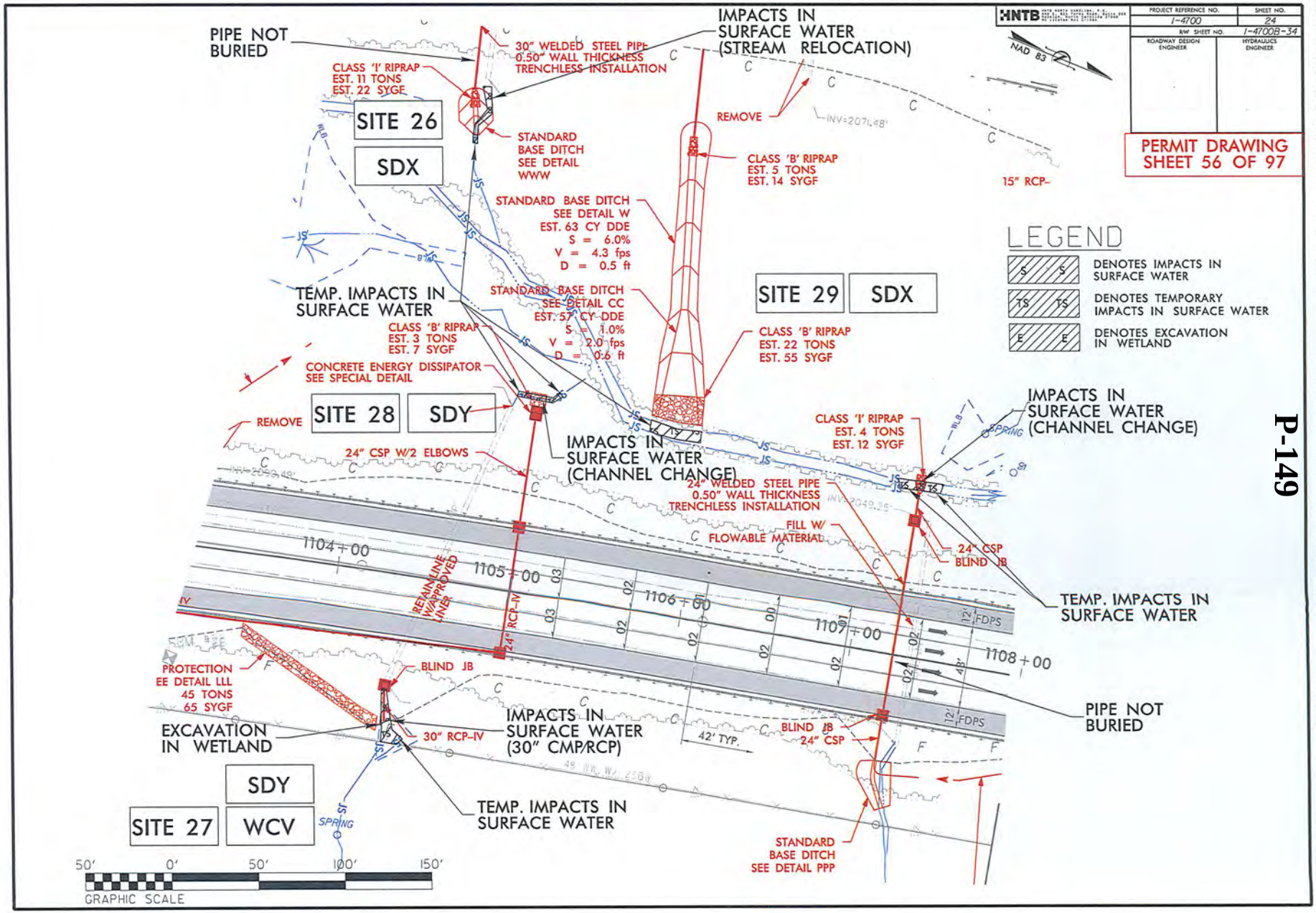


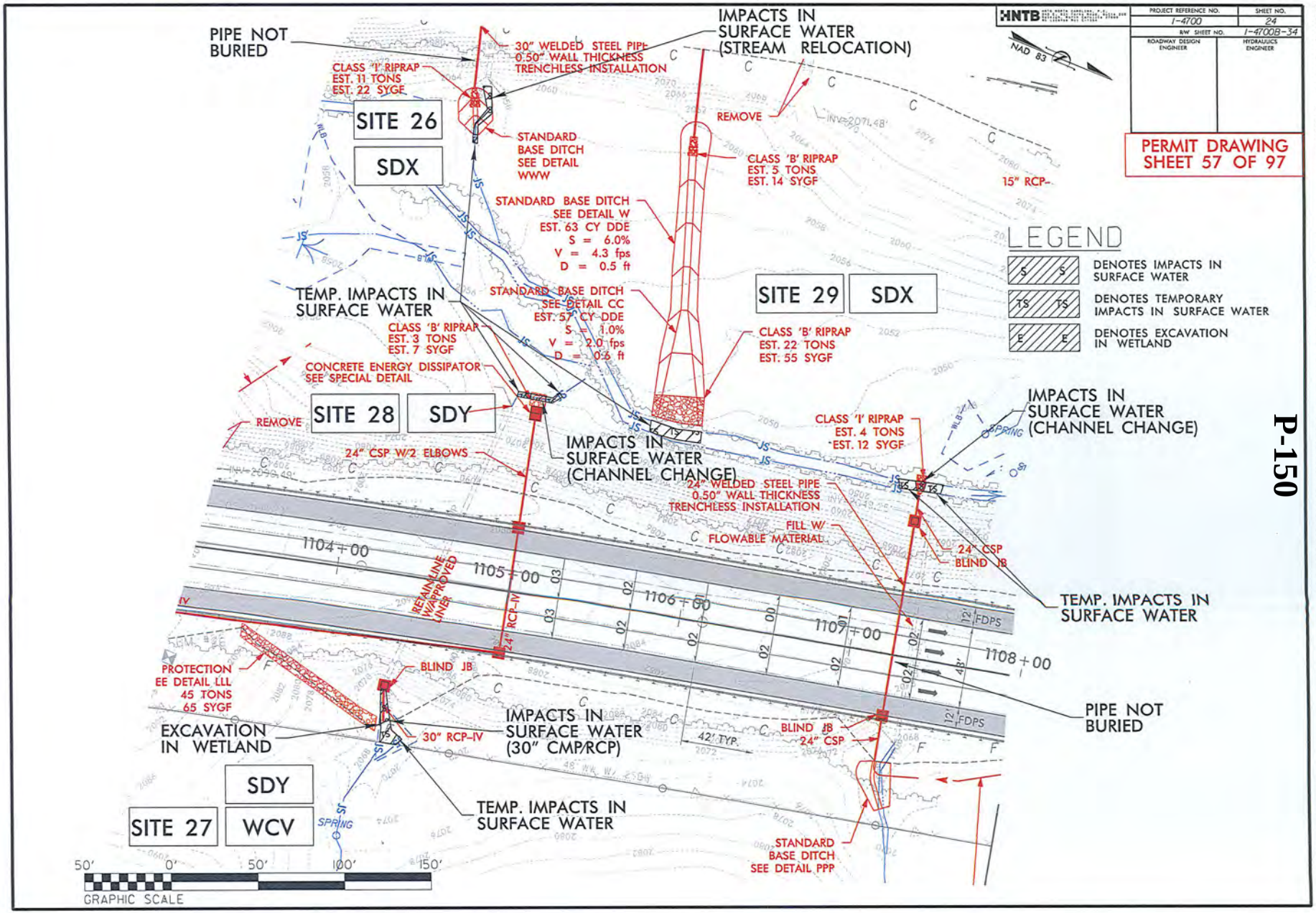


LEGEND

- S S — DENOTES IMPACTS IN SURFACE WATER
- TS TS — DENOTES TEMPORARY IMPACTS IN SURFACE WATER

P-148

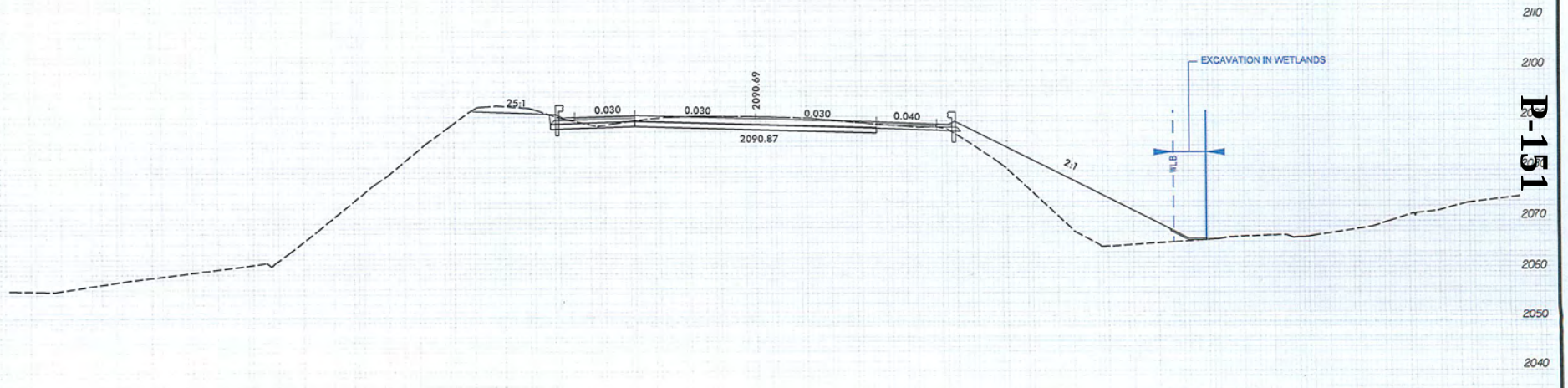

NTB
PROJECT REFERENCE NO. 1-4700
SHEET NO. 24
R/W SHEET NO. 1-4700B-34
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
PERMIT DRAWING SHEET 56 OF 97
P-149
PIPE NOT BURIED
CLASS 'I' RIPRAP EST. 11 TONS EST. 22 SYGF
30" WELDED STEEL PIPE 0.50" WALL THICKNESS TRENCHLESS INSTALLATION
SITE 26
SDX
STANDARD BASE DITCH SEE DETAIL WWW
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
REMOVE
CLASS 'B' RIPRAP EST. 5 TONS EST. 14 SYGF
15" RCP
STANDARD BASE DITCH SEE DETAIL W EST. 63 CY DDE S = 6.0% V = 4.3 fps D = 0.5 ft
TEMP. IMPACTS IN SURFACE WATER
STANDARD BASE DITCH SEE DETAIL CC EST. 57 CY DDE S = 1.0% V = 2.0 fps D = 0.6 ft
CLASS 'B' RIPRAP EST. 3 TONS EST. 7 SYGF
CONCRETE ENERGY DISSIPATOR SEE SPECIAL DETAIL
SITE 29
SDX
CLASS 'B' RIPRAP EST. 22 TONS EST. 55 SYGF
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
DENOTES EXCAVATION IN WETLAND
REMOVE
SITE 28
SDY
24" CSP W/2 ELBOWS
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
CLASS 'I' RIPRAP EST. 4 TONS EST. 12 SYGF
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
24" WELDED STEEL PIPE 0.50" WALL THICKNESS TRENCHLESS INSTALLATION
FILL W/ FLOWABLE MATERIAL
24" CSP BLIND JB
TEMP. IMPACTS IN SURFACE WATER
1104+00
1105+00
1106+00
1107+00
1108+00
RETAINING LINE W/APPROVED LINER
24" RCP-IV
PROTECTION EE DETAIL LLL 45 TONS 65 SYGF
BLIND JB
EXCAVATION IN WETLAND
IMPACTS IN SURFACE WATER (30" CMP/RCP)
30" RCP-IV
42' TYP.
PIPE NOT BURIED
BLIND JB 24" CSP
SDY
SITE 27
WCV
TEMP. IMPACTS IN SURFACE WATER
STANDARD BASE DITCH SEE DETAIL PPP
SPRING
50' 0' 50' 100' 150'
GRAPHIC SCALE


NTB
PROJECT REFERENCE NO. 1-4700
SHEET NO. 24
R/W SHEET NO. 1-4700B-34
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
PERMIT DRAWING SHEET 57 OF 97
P-150
PIPE NOT BURIED
CLASS 'I' RIPRAP EST. 11 TONS EST. 22 SYGF
30" WELDED STEEL PIPE 0.50" WALL THICKNESS TRENCHLESS INSTALLATION
SITE 26
SDX
STANDARD BASE DITCH SEE DETAIL WWW
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
REMOVE
CLASS 'B' RIPRAP EST. 5 TONS EST. 14 SYGF
15" RCP
STANDARD BASE DITCH SEE DETAIL W EST. 63 CY DDE S = 6.0% V = 4.3 fps D = 0.5 ft
TEMP. IMPACTS IN SURFACE WATER
CLASS 'B' RIPRAP EST. 3 TONS EST. 7 SYGF
STANDARD BASE DITCH SEE DETAIL CC EST. 57 CY DDE S = 1.0% V = 2.0 fps D = 0.6 ft
SITE 29
SDX
CLASS 'B' RIPRAP EST. 22 TONS EST. 55 SYGF
CONCRETE ENERGY DISSIPATOR SEE SPECIAL DETAIL
SITE 28
SDY
REMOVE
24" CSP W/2 ELBOWS
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
CLASS 'I' RIPRAP EST. 4 TONS EST. 12 SYGF
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
24" WELDED STEEL PIPE 0.50" WALL THICKNESS TRENCHLESS INSTALLATION
FILL W/ FLOWABLE MATERIAL
24" CSP BLIND JB
TEMP. IMPACTS IN SURFACE WATER
1104+00
1105+00
1106+00
1107+00
1108+00
RETAIN LINE W/APPROVED LINER
24" RCP-IV
FDPS
PROTECTION EE DETAIL LLL 45 TONS 65 SYGF
BLIND JB
EXCAVATION IN WETLAND
IMPACTS IN SURFACE WATER (30" CMP/RCP)
30" RCP-IV
42' TYP.
BLIND JB 24" CSP
PIPE NOT BURIED
SDY
SITE 27
WCV
SPRING
TEMP. IMPACTS IN SURFACE WATER
STANDARD BASE DITCH SEE DETAIL PPP
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
DENOTES EXCAVATION IN WETLAND
50' 0' 50' 100' 150'
GRAPHIC SCALE

PROJ. REFERENCE NO.	SHEET NO.
I-4700	

PERMIT DRAWING
SHEET 58 OF 97

WETLAND CROSS SECTIONS

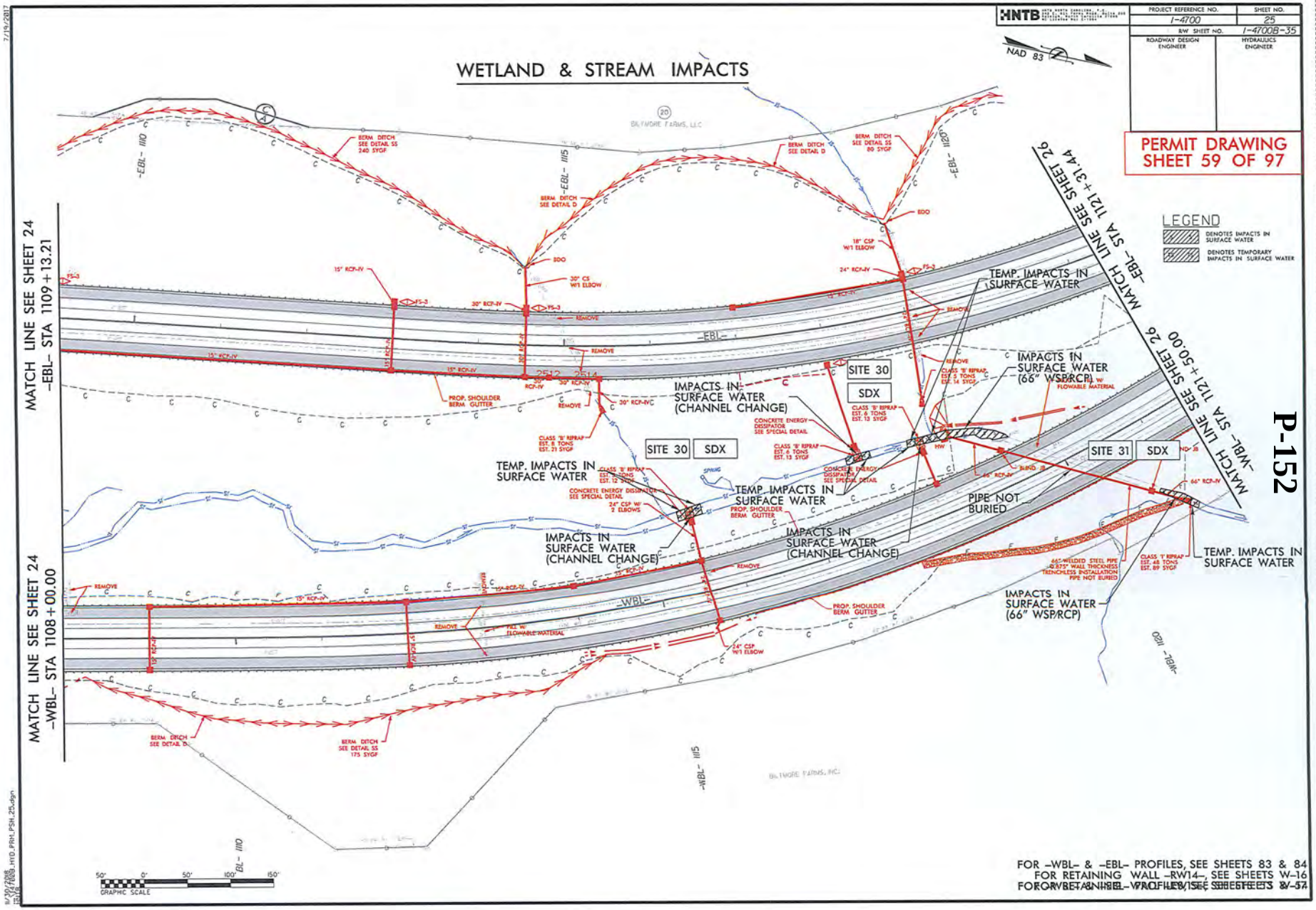


P-151

SITE 27
–WBL– 1104+37.00

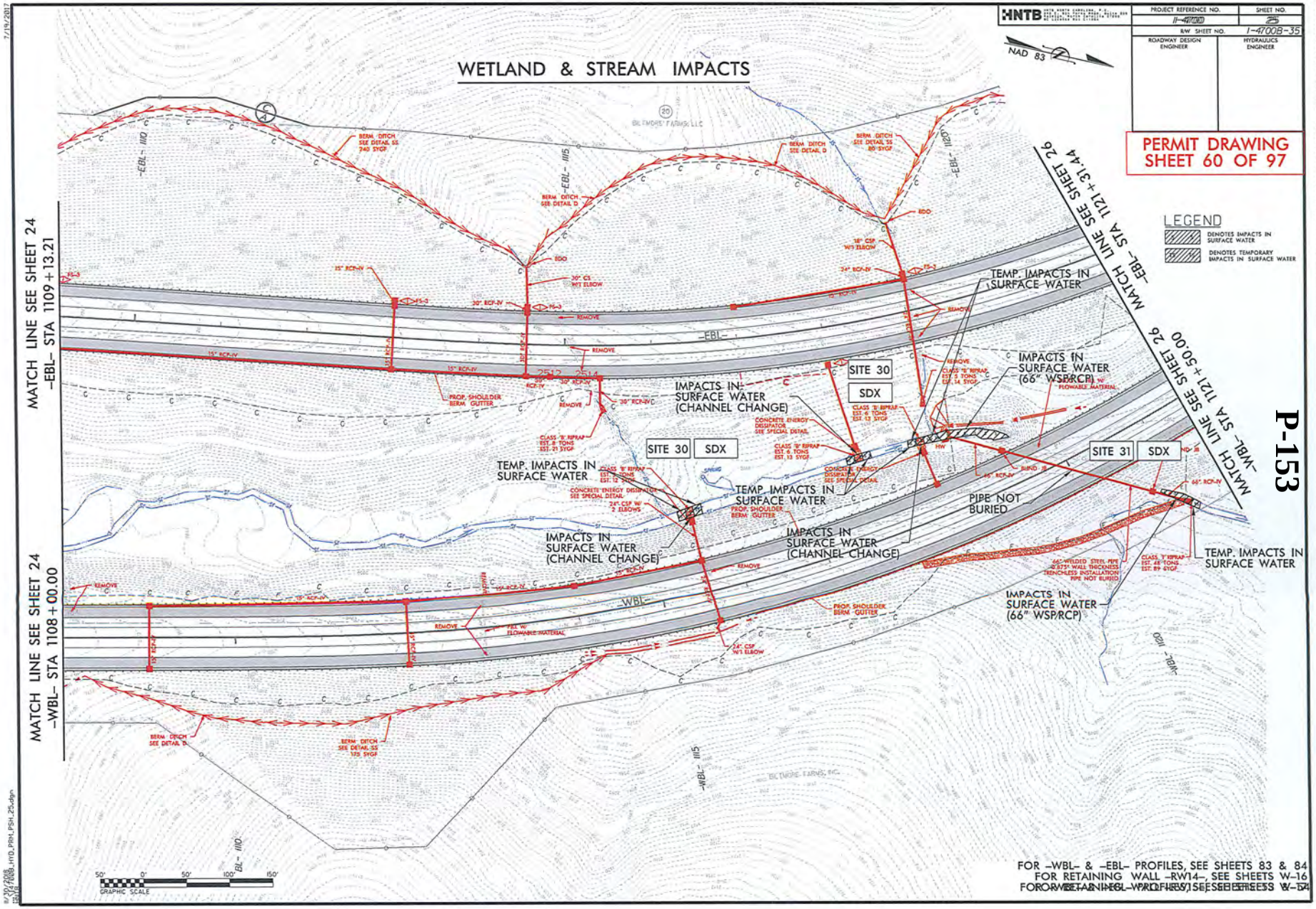
SCALE
1"=20' HORIZONTAL
1"=20' VERTICAL

BUNCOMBE & HENDERSON COUNTY
PROJECT: I-4700
I-26
FROM 0.3 MI EAST OF NC 280 (AIRPORT RD.)
TO 0.5 MI EAST OF NC 191 (BREVARD RD.)



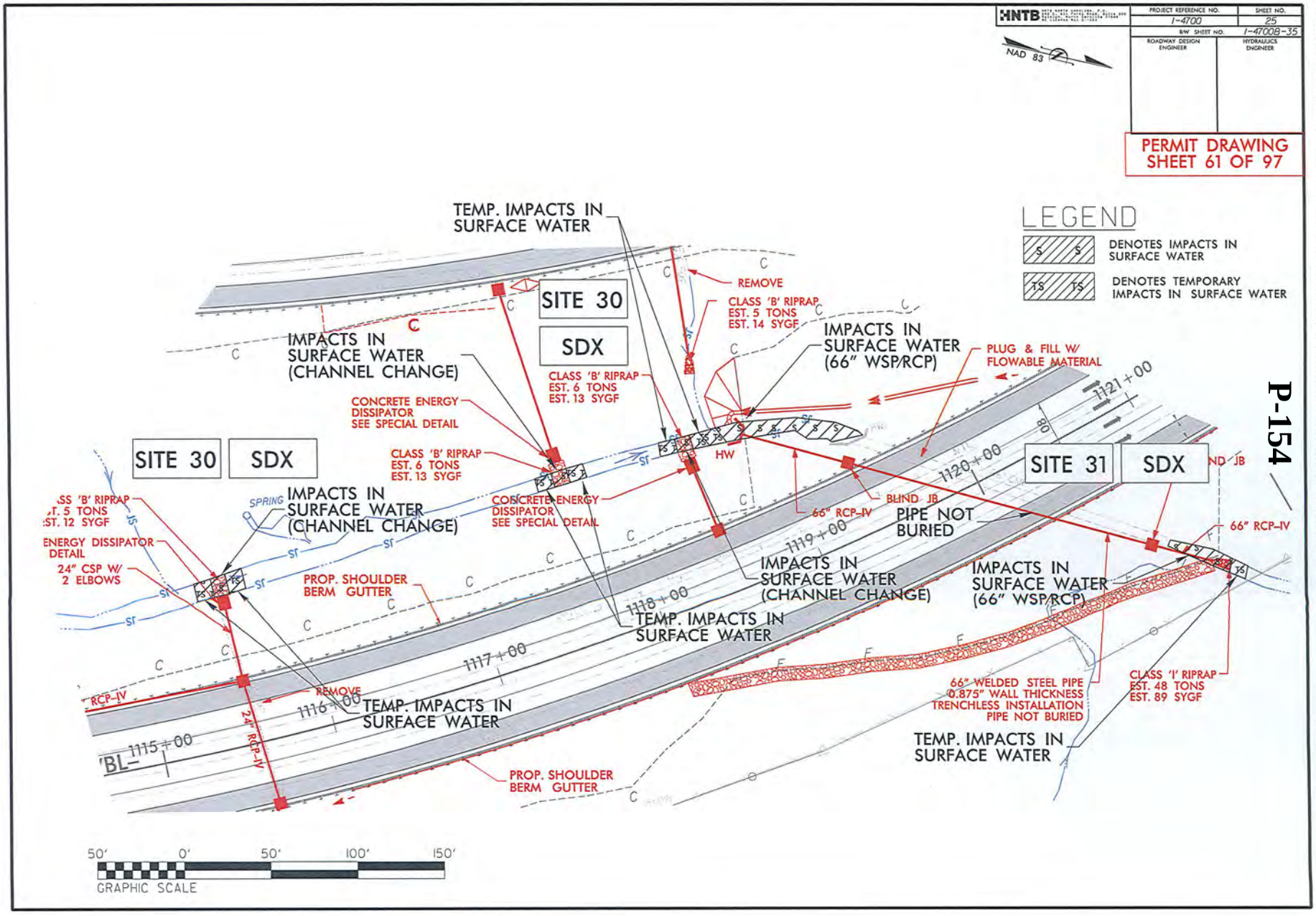
WETLAND & STREAM IMPACTS
HNTB
PROJECT REFERENCE NO. I-4700
SHEET NO. 25
R/W SHEET NO. I-4700B-35
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
PERMIT DRAWING SHEET 59 OF 97
NAD 83
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
MATCH LINE SEE SHEET 24 -EBL- STA 1109+13.21
MATCH LINE SEE SHEET 24 -WBL- STA 1108+00.00
MATCH LINE SEE SHEET 26 -EBL- STA 1121+31.44
MATCH LINE SEE SHEET 26 -WBL- STA 1121+50.00
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
IMPACTS IN SURFACE WATER (66" WSP/RCP)
SITE 30
SDX
SITE 31
PIPE NOT BURIED
-EBL-
-WBL-
-EBL- 1110
-EBL- 1115
-EBL- 1120
-WBL- 1115
-WBL- 1120
BERM DITCH SEE DETAIL SS 240 SYGF
BERM DITCH SEE DETAIL D
BERM DITCH SEE DETAIL SS 80 SYGF
BERM DITCH SEE DETAIL SS 175 SYGF
PROP. SHOULDER BERM GUTTER
CONCRETE ENERGY DISSIPATOR SEE SPECIAL DETAIL
24" CSP W/ 2 ELBOWS
24" CSP W/1 ELBOW
18" CSP W/1 ELBOW
30" CS W/1 ELBOW
15" RCP-IV
30" RCP-IV
24" RCP-IV
66" RCP-IV
66" WELDED STEEL PIPE 0.875" WALL THICKNESS TRENCHLESS INSTALLATION PIPE NOT BURIED
CLASS 'B' RIPRAP EST. 8 TONS EST. 21 SYGF
CLASS 'B' RIPRAP EST. 6 TONS EST. 13 SYGF
CLASS 'B' RIPRAP EST. 5 TONS EST. 14 SYGF
CLASS 'I' RIPRAP EST. 48 TONS EST. 89 SYGF
FILL W/ FLOWABLE MATERIAL
REMOVE
BDO
BLTMORE FARMS, LLC
BILTMORE FARMS, INC.
GRAPHIC SCALE
50' 0' 50' 100' 150'
FOR -WBL- & -EBL- PROFILES, SEE SHEETS 83 & 84
FOR RETAINING WALL -RW14-, SEE SHEETS W-16
FOR RETAINING WALL -RW15-, SEE SHEETS W-57

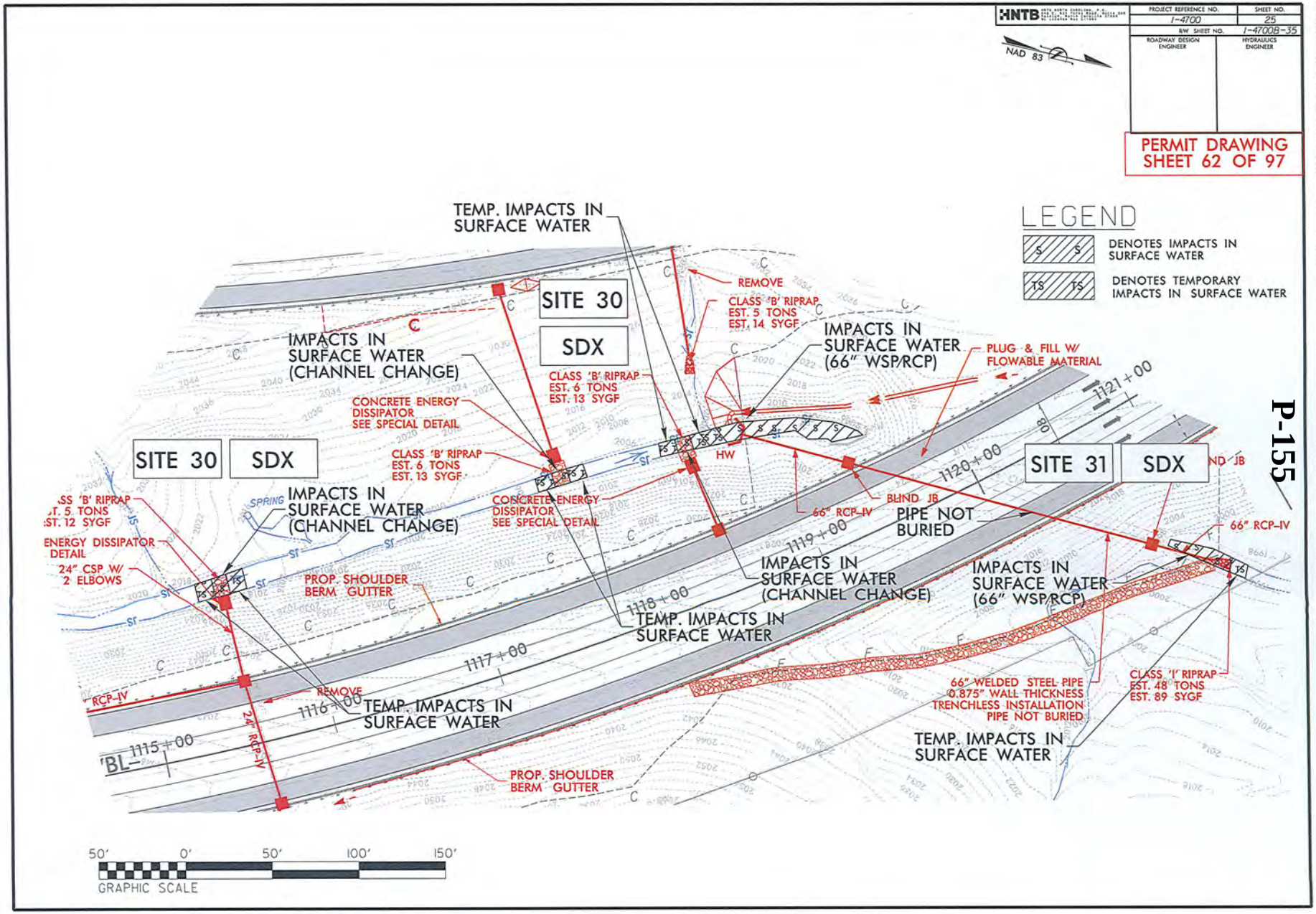
P-152



WETLAND & STREAM IMPACTS
HNTB
PROJECT REFERENCE NO.
I-4700
SHEET NO.
25
R/W SHEET NO.
I-4700B-35
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
PERMIT DRAWING
SHEET 60 OF 97
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
MATCH LINE SEE SHEET 24
-EBL- STA 1109+13.21
MATCH LINE SEE SHEET 24
-WBL- STA 1108+00.00
MATCH LINE SEE SHEET 26
-EBL- STA 1121+31.44
MATCH LINE SEE SHEET 26
-WBL- STA 1121+50.00
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (66" WSP/RCP)
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
SITE 30
SDX
SITE 31
PIPE NOT BURIED
-EBL-
-WBL-
GRAPHIC SCALE
FOR -WBL- & -EBL- PROFILES, SEE SHEETS 83 & 84
FOR RETAINING WALL -RW14-, SEE SHEETS W-16

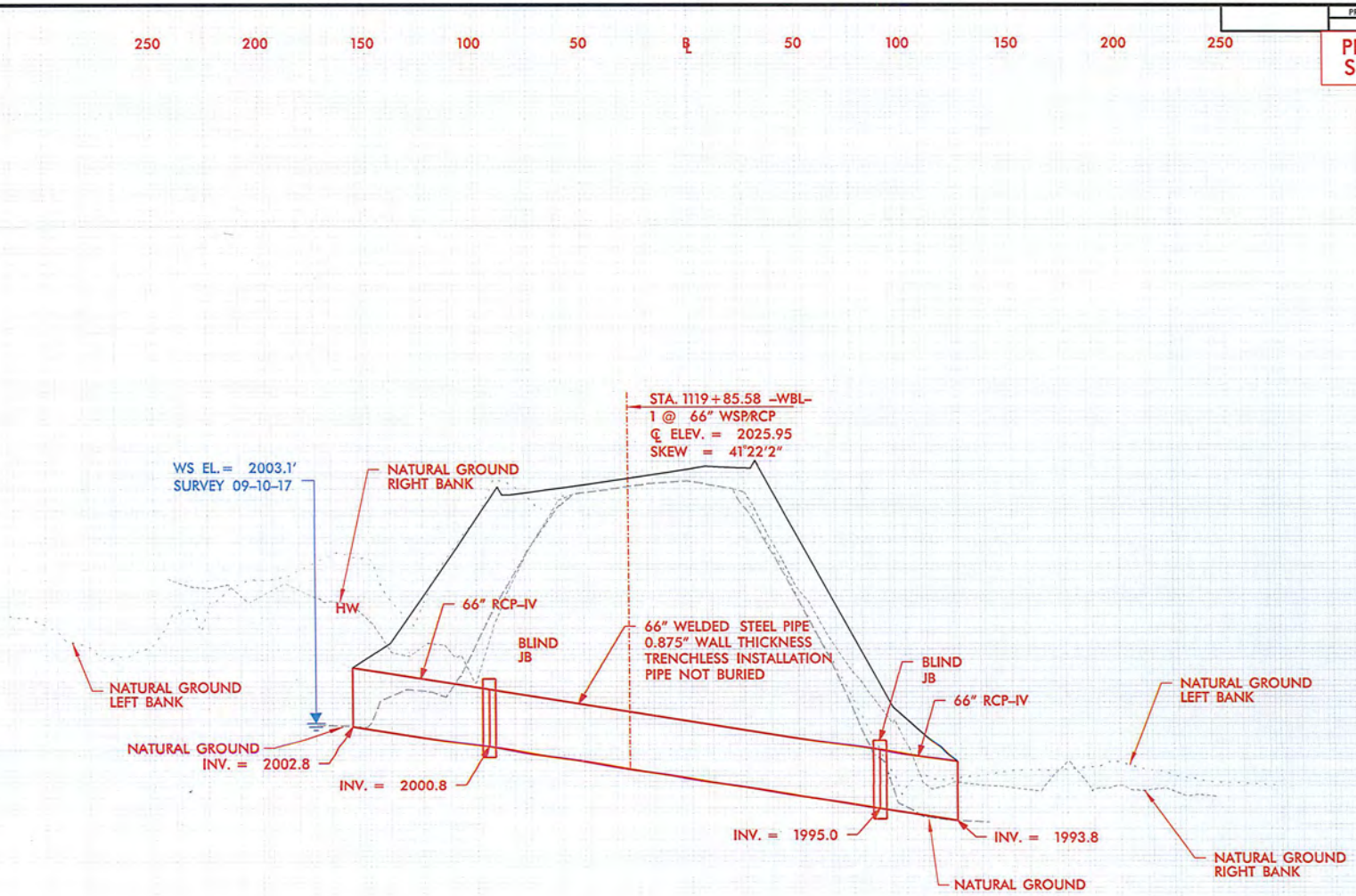
P-153


HNTB
NAD 83
PROJECT REFERENCE NO. I-4700
SHEET NO. 25
R/W SHEET NO. I-4700B-35
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
PERMIT DRAWING SHEET 61 OF 97
P-154
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
TEMP. IMPACTS IN SURFACE WATER
SITE 30
SDX
REMOVE
CLASS 'B' RIPRAP EST. 5 TONS EST. 14 SYGF
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
CLASS 'B' RIPRAP EST. 6 TONS EST. 13 SYGF
CONCRETE ENERGY DISSIPATOR SEE SPECIAL DETAIL
IMPACTS IN SURFACE WATER (66" WSP/RCP)
PLUG & FILL W/ FLOWABLE MATERIAL
1121+00
1120+00
SITE 31
SDX
HW
BLIND JB
66" RCP-IV
PIPE NOT BURIED
1119+00
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
IMPACTS IN SURFACE WATER (66" WSP/RCP)
1118+00
TEMP. IMPACTS IN SURFACE WATER
1117+00
PROP. SHOULDER BERM GUTTER
ENERGY DISSIPATOR DETAIL
24" CSP W/ 2 ELBOWS
SPRING
RCP-IV
REMOVE
1116+00
TEMP. IMPACTS IN SURFACE WATER
24" RCP-IV
BL 1115+00
66" WELDED STEEL PIPE 0.875" WALL THICKNESS TRENCHLESS INSTALLATION PIPE NOT BURIED
CLASS 'I' RIPRAP EST. 48 TONS EST. 89 SYGF
TEMP. IMPACTS IN SURFACE WATER
50' 0' 50' 100' 150'
GRAPHIC SCALE


HNTB
NAD 83
PROJECT REFERENCE NO.
I-4700
SHEET NO.
25
R/W SHEET NO.
I-4700B-35
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
PERMIT DRAWING
SHEET 62 OF 97
P-155
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
TEMP. IMPACTS IN SURFACE WATER
SITE 30
SDX
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
CONCRETE ENERGY DISSIPATOR SEE SPECIAL DETAIL
CLASS 'B' RIPRAP EST. 6 TONS EST. 13 SYGF
REMOVE
CLASS 'B' RIPRAP EST. 5 TONS EST. 14 SYGF
IMPACTS IN SURFACE WATER (66" WSP/RCP)
PLUG & FILL W/ FLOWABLE MATERIAL
1121+00
1120+00
SITE 31
SDX
HW
BLIND JB
66" RCP-IV
PIPE NOT BURIED
1119+00
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
1118+00
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (66" WSP/RCP)
66" WELDED STEEL PIPE 0.875" WALL THICKNESS TRENCHLESS INSTALLATION PIPE NOT BURIED
CLASS 'I' RIPRAP EST. 48 TONS EST. 89 SYGF
TEMP. IMPACTS IN SURFACE WATER
1117+00
1116+00
REMOVE
TEMP. IMPACTS IN SURFACE WATER
24" RCP-IV
RCP-IV
1115+00
BL
PROP. SHOULDER BERM GUTTER
PROP. SHOULDER BERM GUTTER
ENERGY DISSIPATOR DETAIL
24" CSP W/ 2 ELBOWS
SPRING
50' 0' 50' 100' 150'
GRAPHIC SCALE

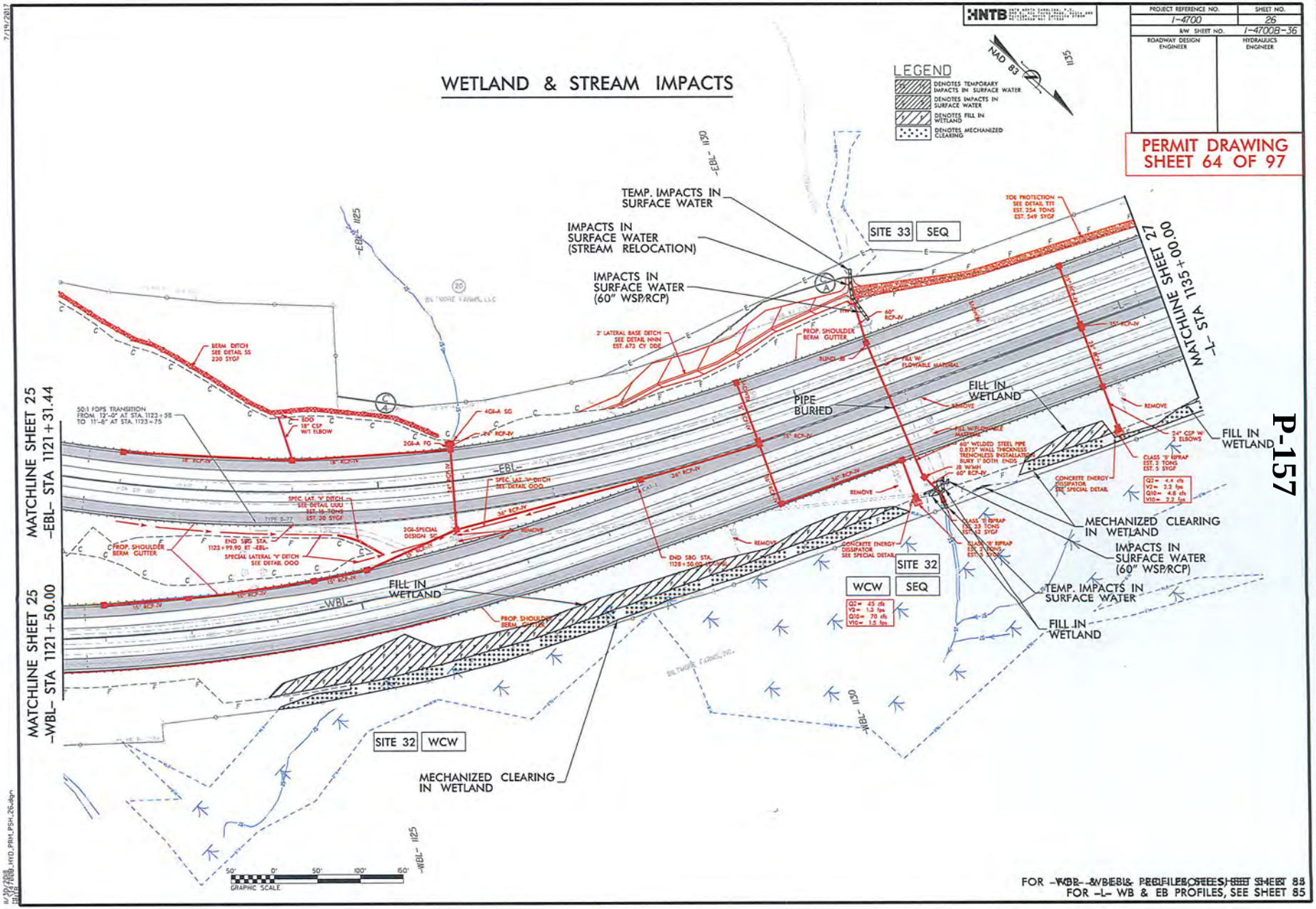
PROJ. REFERENCE NO.	SHEET NO.
I-4700	

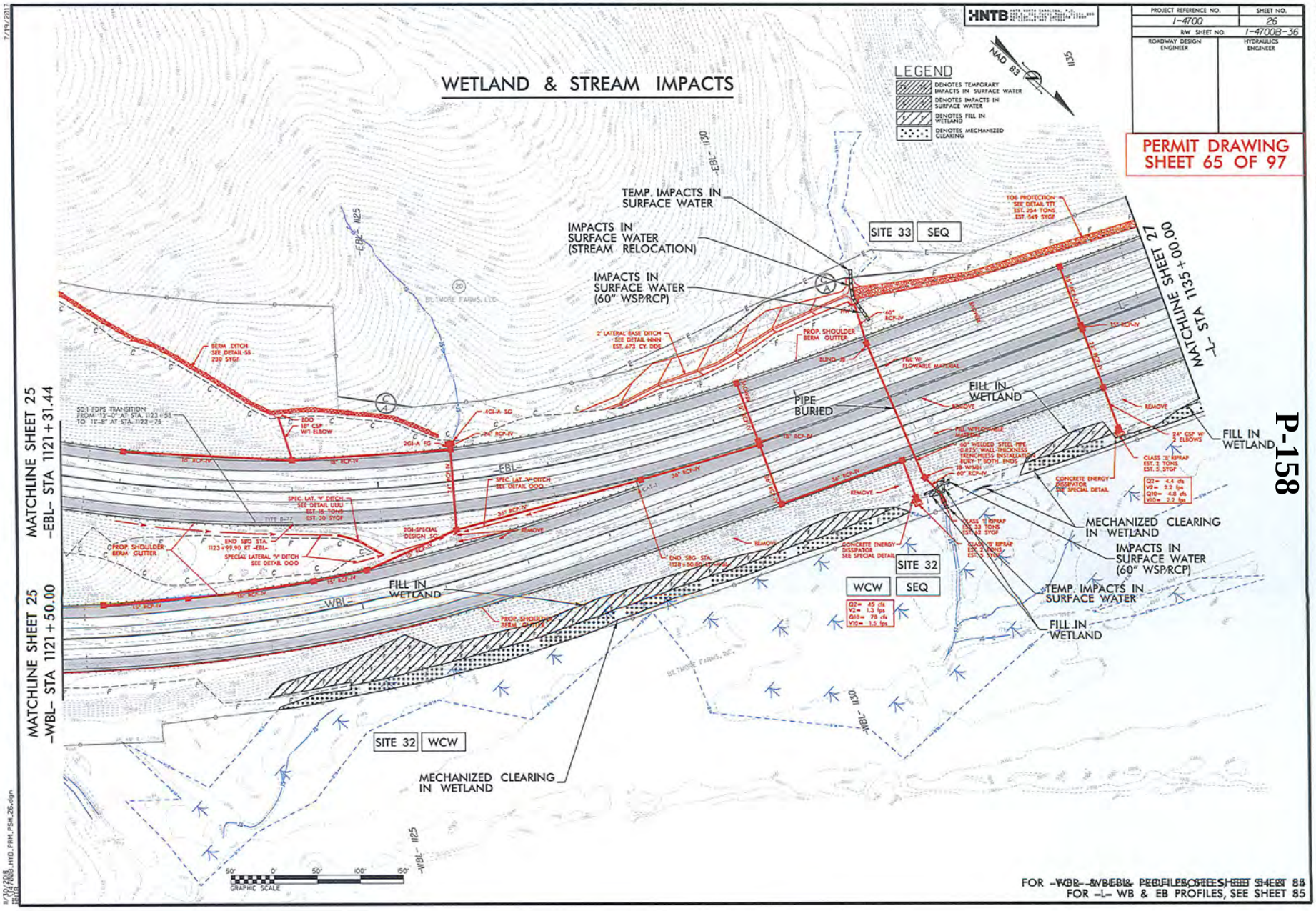
PERMIT DRAWING
SHEET 63 OF 97



P-156

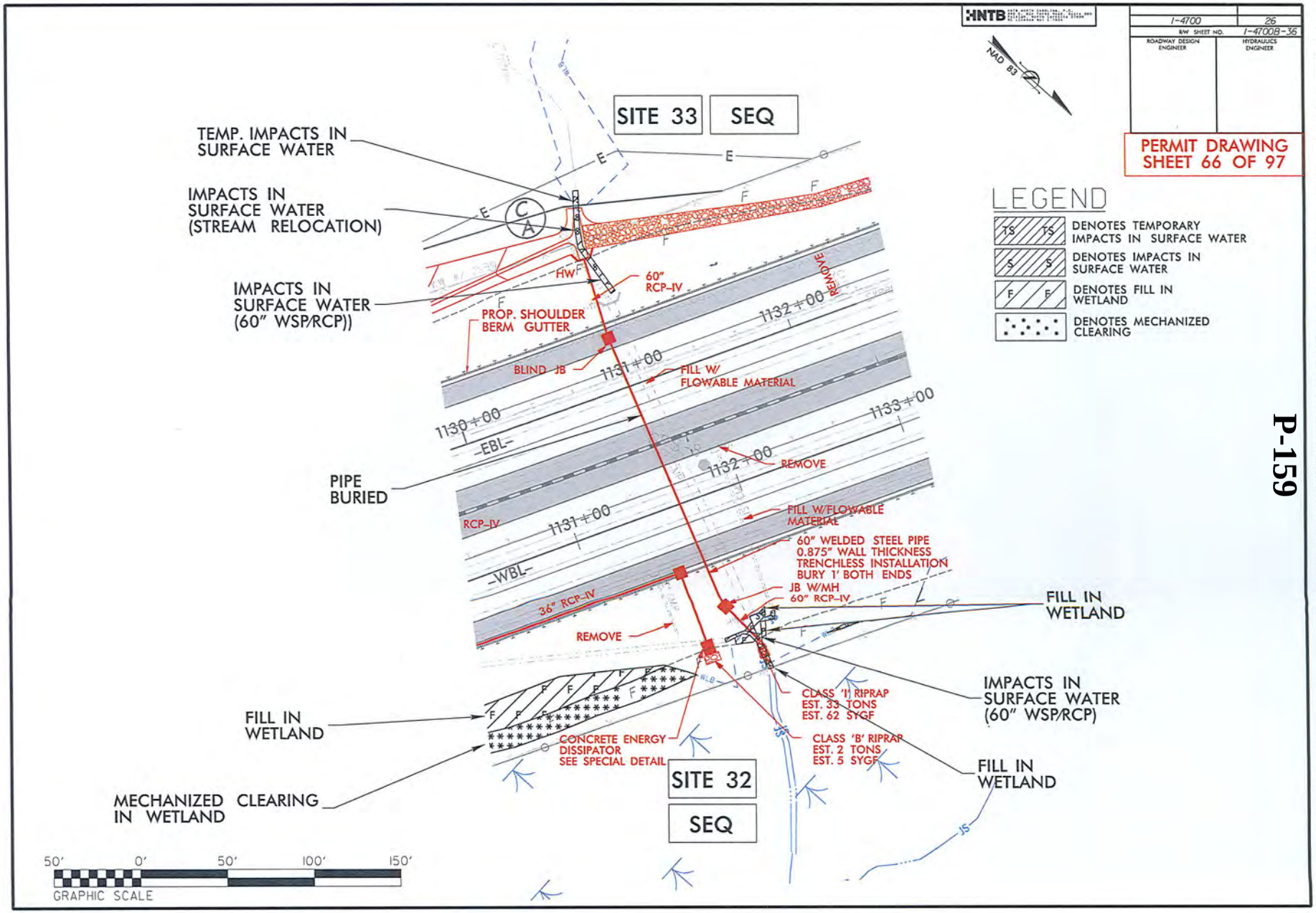
BUNCOMBE & HENDERSON COUNTY
PROJECT: I-4700
I-26
FROM 0.3 MI EAST OF NC 280 (AIRPORT RD.)
TO 0.5 MI EAST OF NC 191 (BREVARD RD.)


WETLAND & STREAM IMPACTS
HNTB
PROJECT REFERENCE NO. I-4700
SHEET NO. 26
R/W SHEET NO. I-4700B-36
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
PERMIT DRAWING SHEET 64 OF 97
LEGEND
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
DENOTES IMPACTS IN SURFACE WATER
DENOTES FILL IN WETLAND
DENOTES MECHANIZED CLEARING
NAD 83
MATCHLINE SHEET 25 -EBL- STA 1121+31.44
MATCHLINE SHEET 25 -WBL- STA 1121+50.00
MATCHLINE SHEET 27 -L- STA 1135+00.00
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
IMPACTS IN SURFACE WATER (60" WSP/RCP)
SITE 33 SEQ
SITE 32 WCW
SITE 32 SEQ
FILL IN WETLAND
PIPE BURIED
MECHANIZED CLEARING IN WETLAND
IMPACTS IN SURFACE WATER (60" WSP/RCP)
TEMP. IMPACTS IN SURFACE WATER
FILL IN WETLAND
FILL IN WETLAND
MECHANIZED CLEARING IN WETLAND
-EBL- 1130
-EBL- 1125
-WBL- 1130
-WBL- 1125
BERM DITCH SEE DETAIL SS 200 SYGF
2' LATERAL BASE DITCH SEE DETAIL NNN EST. 673 CY DDE
PROP. SHOULDER BERM GUTTER
TOE PROTECTION SEE DETAIL TTT EST. 254 TONS EST. 549 SYGF
50:1 FDPS TRANSITION FROM 12'-0" AT STA. 1123+58 TO 11'-8" AT STA. 1123+75
END SBG STA. 1123+99.90 RT -EBL-
SPECIAL LATERAL "Y" DITCH SEE DETAIL OOO
END SBG STA. 1128+50.00 -WBL-
CONCRETE ENERGY DISSIPATOR SEE SPECIAL DETAIL
CLASS "B" RIPRAP EST. 2 TONS EST. 5 SYGF
CLASS "B" RIPRAP EST. 33 TONS EST. 72 SYGF
Q2= 4.4 cfs V2= 2.2 fps Q10= 4.8 cfs V10= 2.2 fps
Q2= 45 cfs V2= 1.2 fps Q10= 70 cfs V10= 1.5 fps
GRAPHIC SCALE
FOR -L- WB & EB PROFILES, SEE SHEET 85
P-157

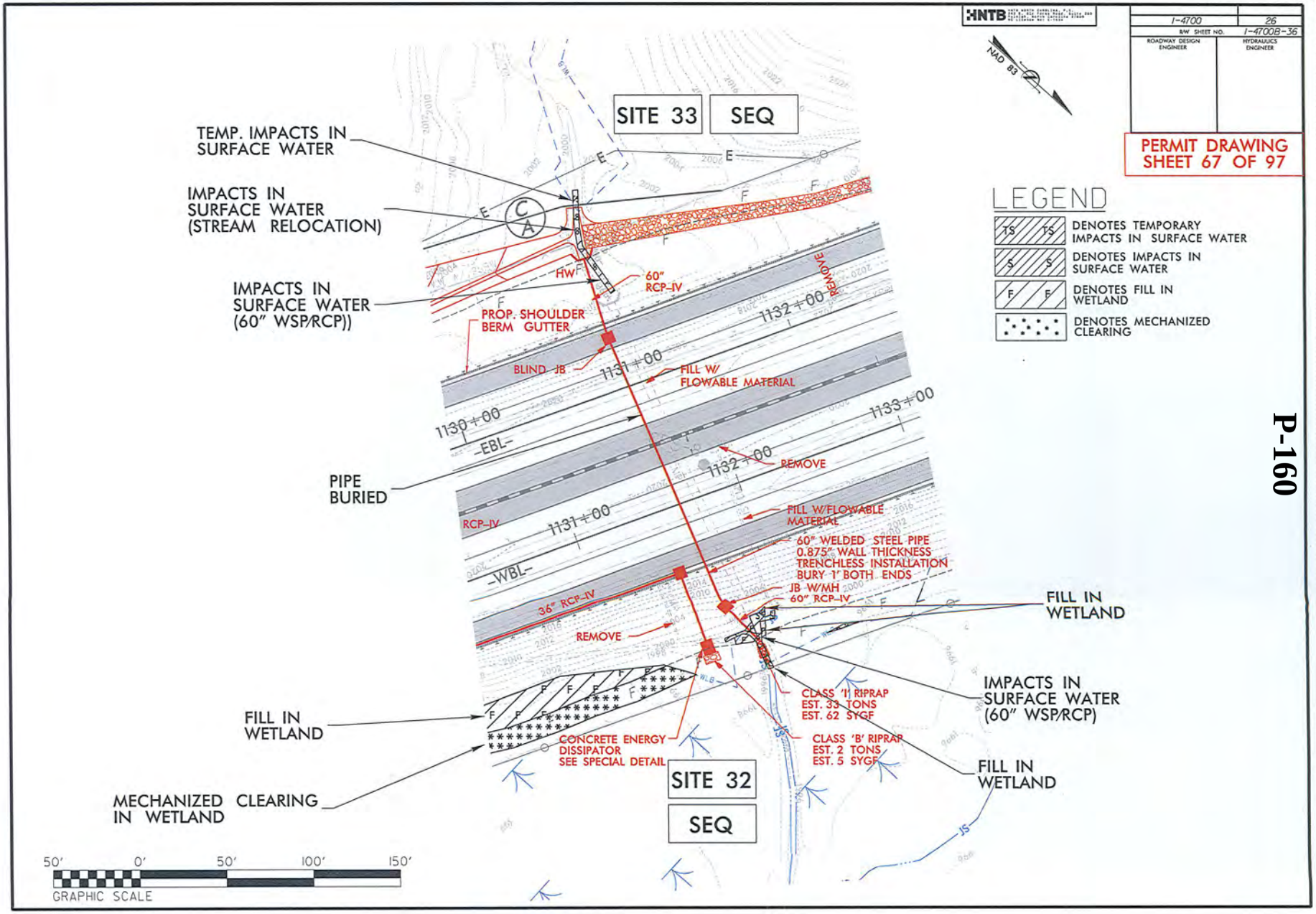


WETLAND & STREAM IMPACTS
LEGEND
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
DENOTES IMPACTS IN SURFACE WATER
DENOTES FILL IN WETLAND
DENOTES MECHANIZED CLEARING
PROJECT REFERENCE NO. I-4700
SHEET NO. 26
R/W SHEET NO. I-4700B-36
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
PERMIT DRAWING SHEET 65 OF 97
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
IMPACTS IN SURFACE WATER (60" WSP/RCP)
SITE 33
SEQ
MATCHLINE SHEET 27 -L- STA 1135+00.00
MATCHLINE SHEET 25 -EBL- STA 1121+31.44
MATCHLINE SHEET 25 -WBL- STA 1121+50.00
PIPE BURIED
FILL IN WETLAND
MECHANIZED CLEARING IN WETLAND
IMPACTS IN SURFACE WATER (60" WSP/RCP)
TEMP. IMPACTS IN SURFACE WATER
SITE 32
WCW
SEQ
SITE 32
WCW
MECHANIZED CLEARING IN WETLAND
GRAPHIC SCALE
FOR -WBL- & EBL PROFILES, SEE SHEET 85
FOR -L- WB & EB PROFILES, SEE SHEET 85

P-158


HNTB
I-4700
R/W SHEET NO.
26
I-4700B-36
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
PERMIT DRAWING SHEET 66 OF 97
SITE 33
SEQ
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
IMPACTS IN SURFACE WATER (60" WSP/RCP))
PIPE BURIED
FILL IN WETLAND
MECHANIZED CLEARING IN WETLAND
IMPACTS IN SURFACE WATER (60" WSP/RCP)
FILL IN WETLAND
FILL IN WETLAND
SITE 32
SEQ
LEGEND
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
DENOTES IMPACTS IN SURFACE WATER
DENOTES FILL IN WETLAND
DENOTES MECHANIZED CLEARING
60" RCP-IV
PROP. SHOULDER BERM GUTTER
BLIND JB
FILL W/ FLOWABLE MATERIAL
REMOVE
RCP-IV
36" RCP-IV
60" WELDED STEEL PIPE 0.875" WALL THICKNESS TRENCHLESS INSTALLATION BURY 1' BOTH ENDS
JB W/MH 60" RCP-IV
CLASS '1' RIPRAP EST. 33 TONS EST. 62 SYGF
CLASS 'B' RIPRAP EST. 2 TONS EST. 5 SYGF
CONCRETE ENERGY DISSIPATOR SEE SPECIAL DETAIL
1130+00
1131+00
1132+00
1133+00
-EBL-
-WBL-
50' 0' 50' 100' 150'
GRAPHIC SCALE

P-159

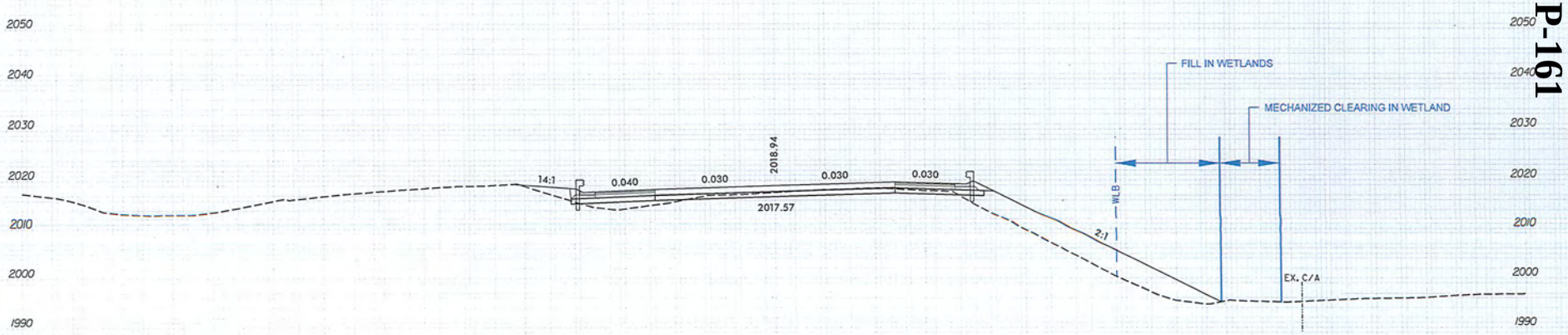

HNTB
I-4700
26
R/W SHEET NO.
I-4700B-36
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
PERMIT DRAWING
SHEET 67 OF 97
LEGEND
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
DENOTES IMPACTS IN SURFACE WATER
DENOTES FILL IN WETLAND
DENOTES MECHANIZED CLEARING
SITE 33
SEQ
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
IMPACTS IN SURFACE WATER (60" WSP/RCP))
PIPE BURIED
FILL IN WETLAND
MECHANIZED CLEARING IN WETLAND
FILL IN WETLAND
IMPACTS IN SURFACE WATER (60" WSP/RCP)
FILL IN WETLAND
60" RCP-IV
PROP. SHOULDER BERM GUTTER
BLIND JB
FILL W/ FLOWABLE MATERIAL
REMOVE
RCP-IV
FILL W/FLOWABLE MATERIAL
60" WELDED STEEL PIPE 0.875" WALL THICKNESS TRENCHLESS INSTALLATION BURY 1' BOTH ENDS
JB W/MH 60" RCP-IV
36" RCP-IV
CLASS '1' RIPRAP EST. 33 TONS EST. 62 SYGF
CONCRETE ENERGY DISSIPATOR SEE SPECIAL DETAIL
CLASS 'B' RIPRAP EST. 2 TONS EST. 5 SYGF
SITE 32
SEQ
1130+00
1131+00
1132+00
1133+00
-EBL-
-WBL-
50' 0' 50' 100' 150'
GRAPHIC SCALE

P-160

PROJ. REFERENCE NO.	SHEET NO.
I-4700	

PERMIT DRAWING
SHEET 68 OF 97

WETLAND CROSS SECTIONS



SITE 32
-WBL- 1128+00.00

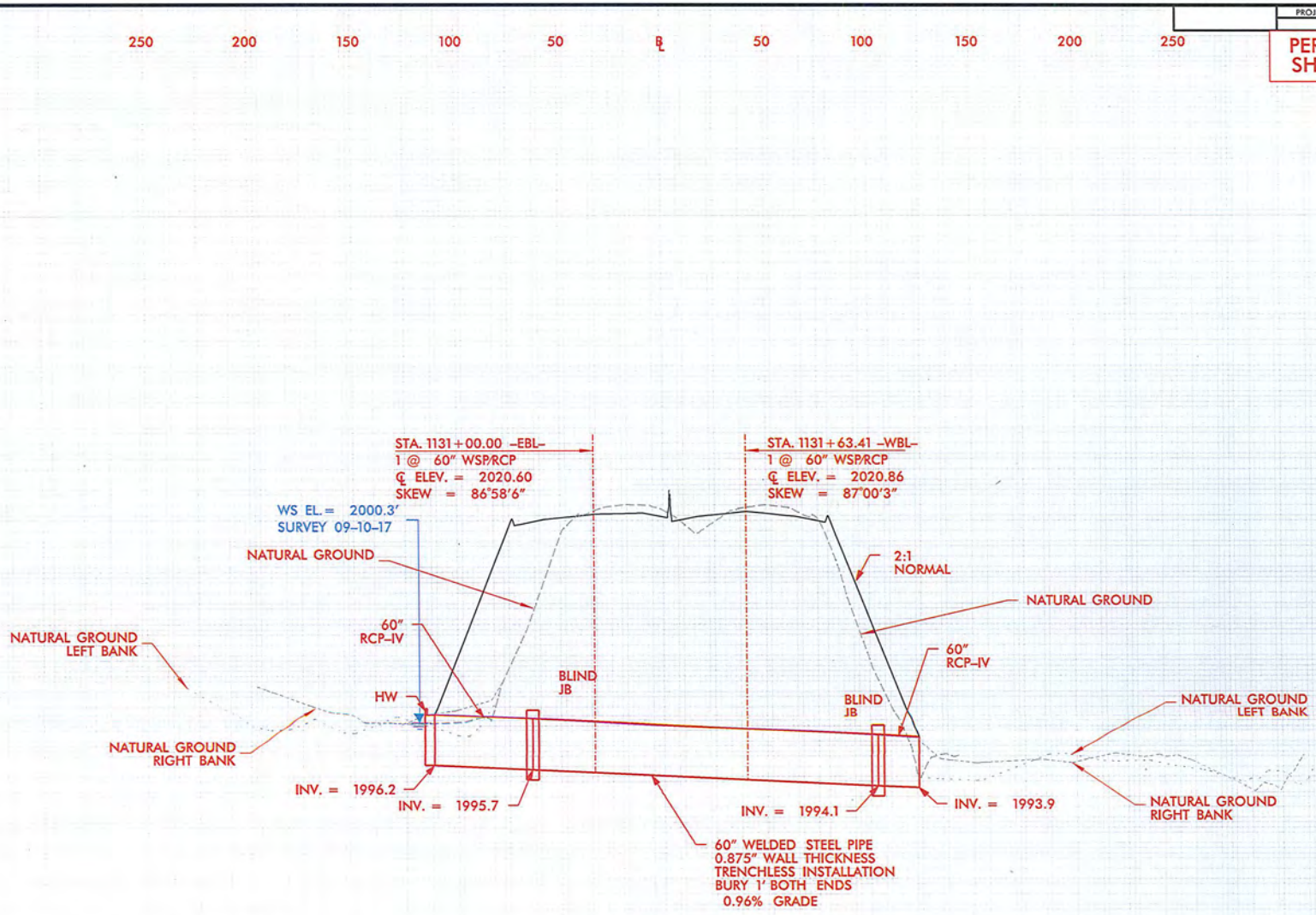
SCALE
1"=20' HORIZONTAL
1"=20' VERTICAL

BUNCOMBE & HENDERSON COUNTY
PROJECT: I-4700
I-26
FROM 0.3 MI EAST OF NC 280 (AIRPORT RD.)
TO 0.5 MI EAST OF NC 191 (BREVARD RD.)

P-161

PROJ. REFERENCE NO.	SHEET NO.
I-4700	

PERMIT DRAWING
SHEET 69 OF 97



PROFILE

BUNCOMBE & HENDERSON COUNTY
PROJECT: I-4700
I-26
FROM 0.3 MI EAST OF NC 280 (AIRPORT RD.)
TO 0.5 MI EAST OF NC 191 (BREVARD RD.)

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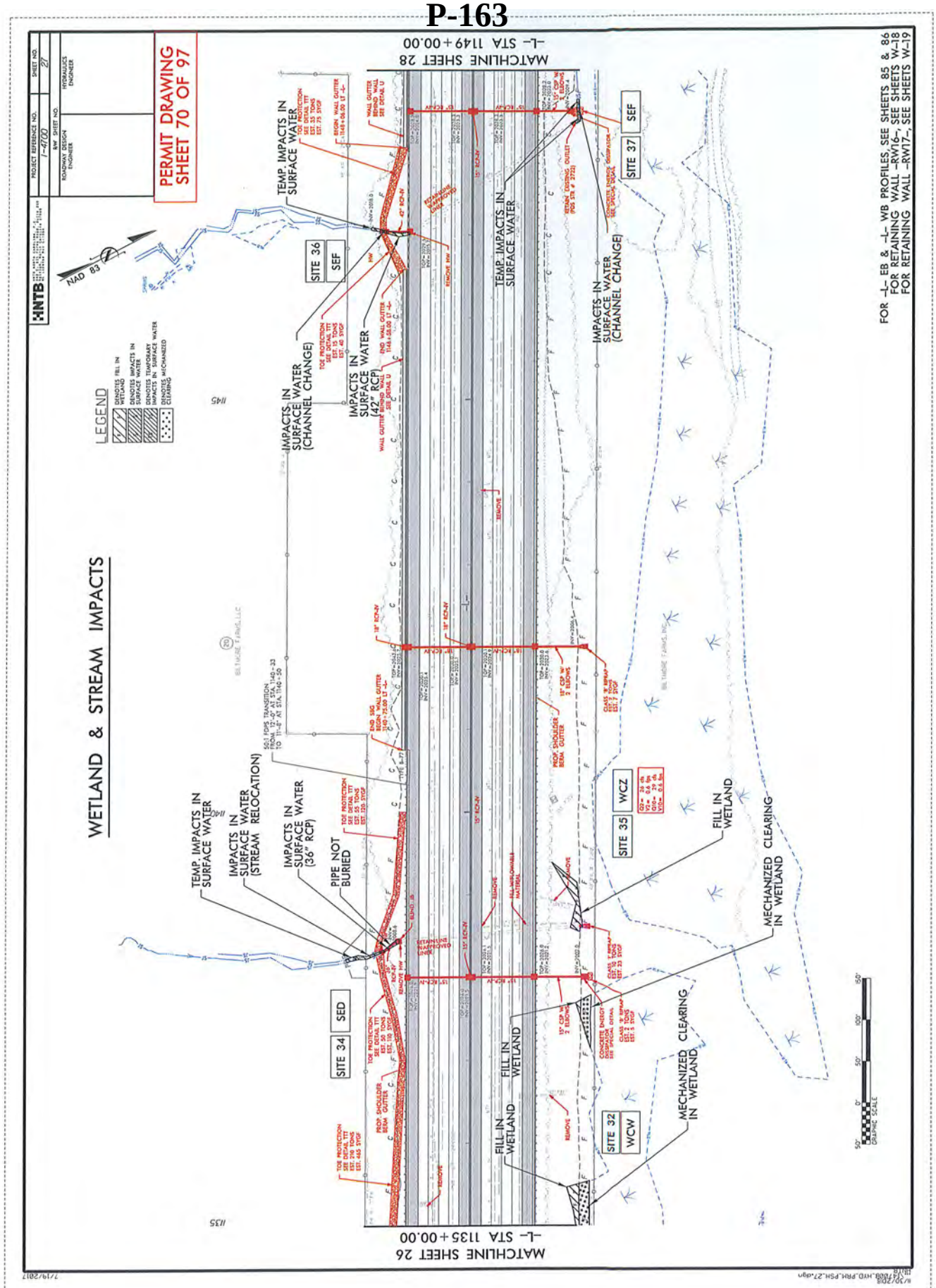
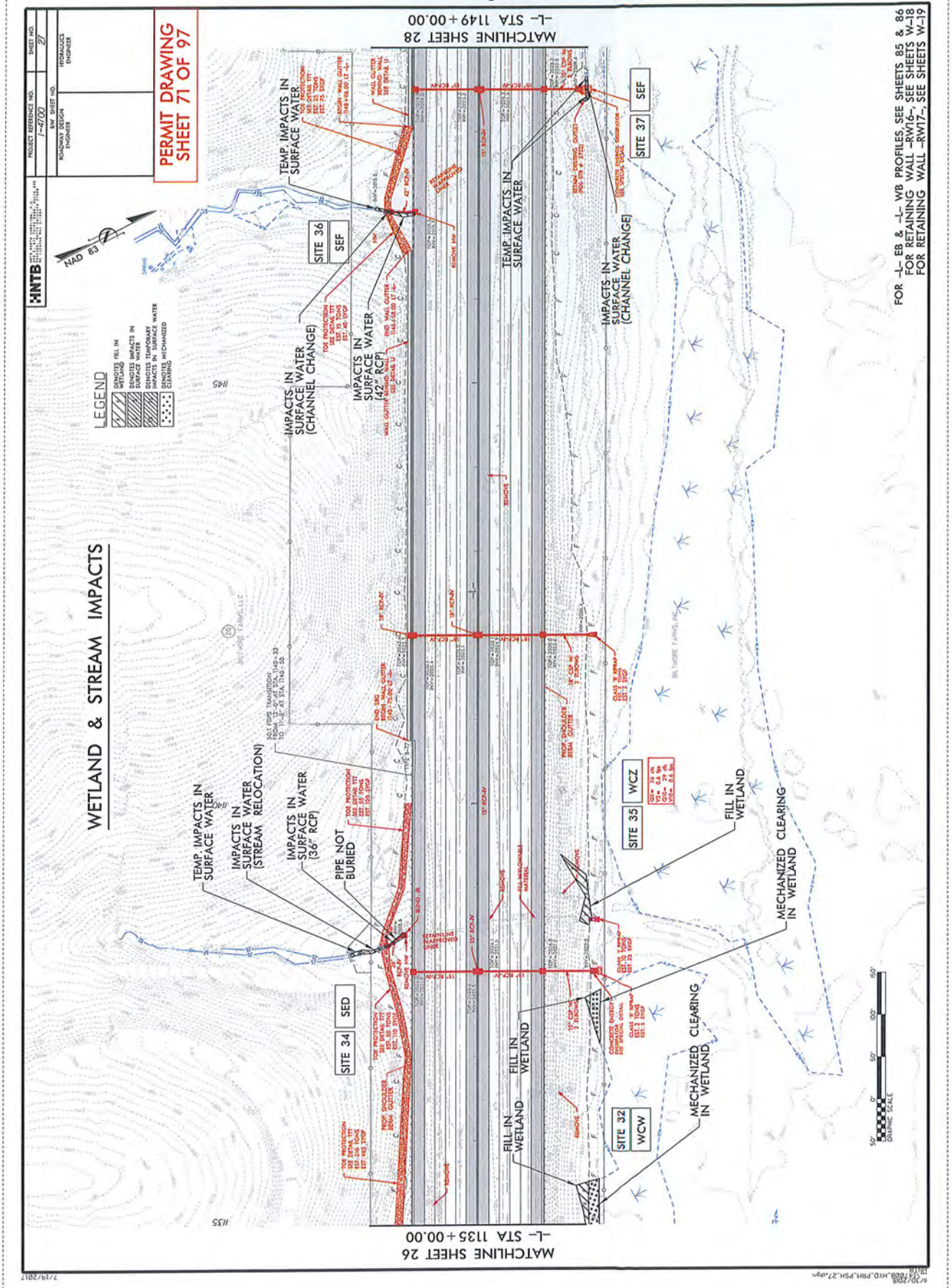
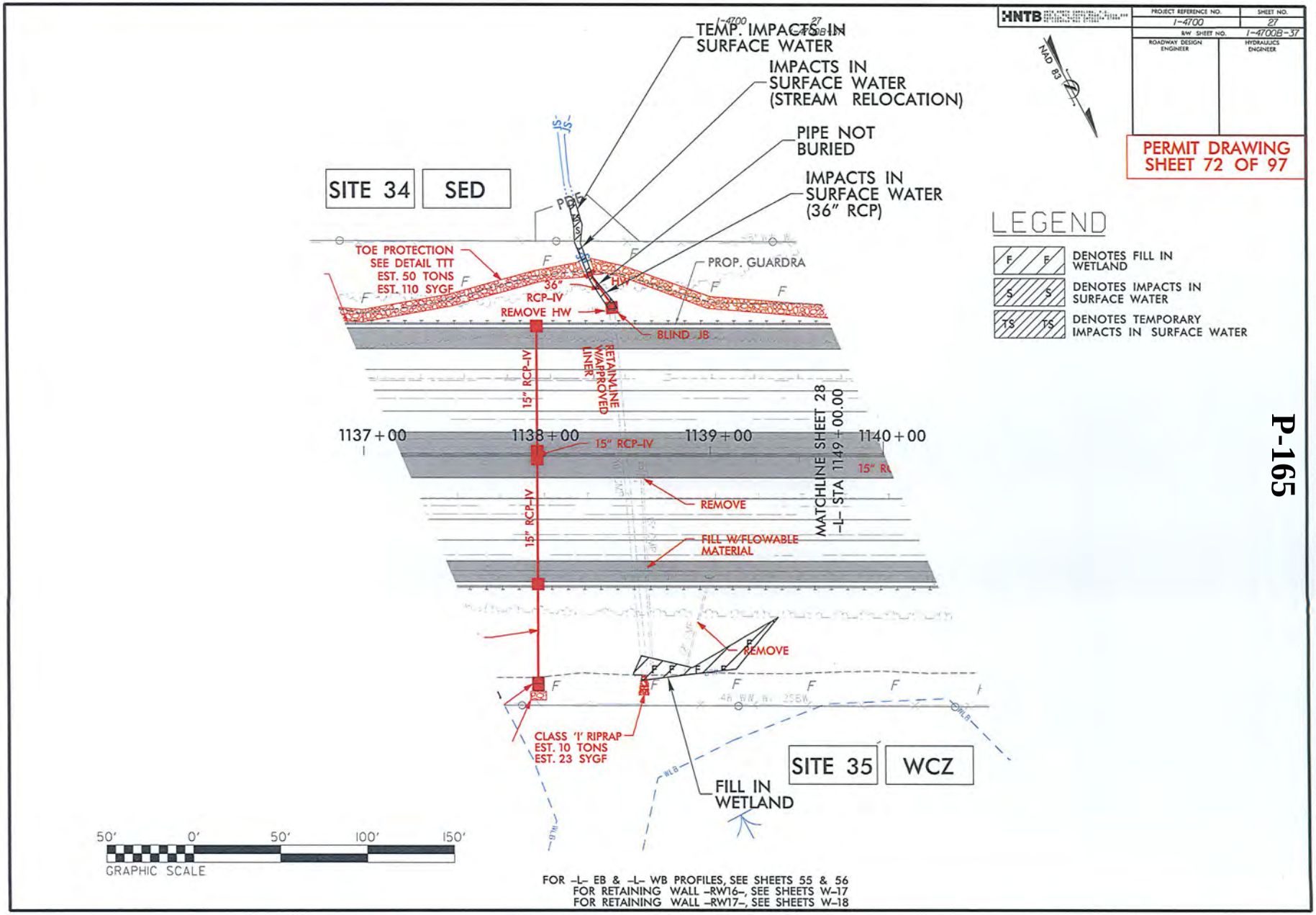
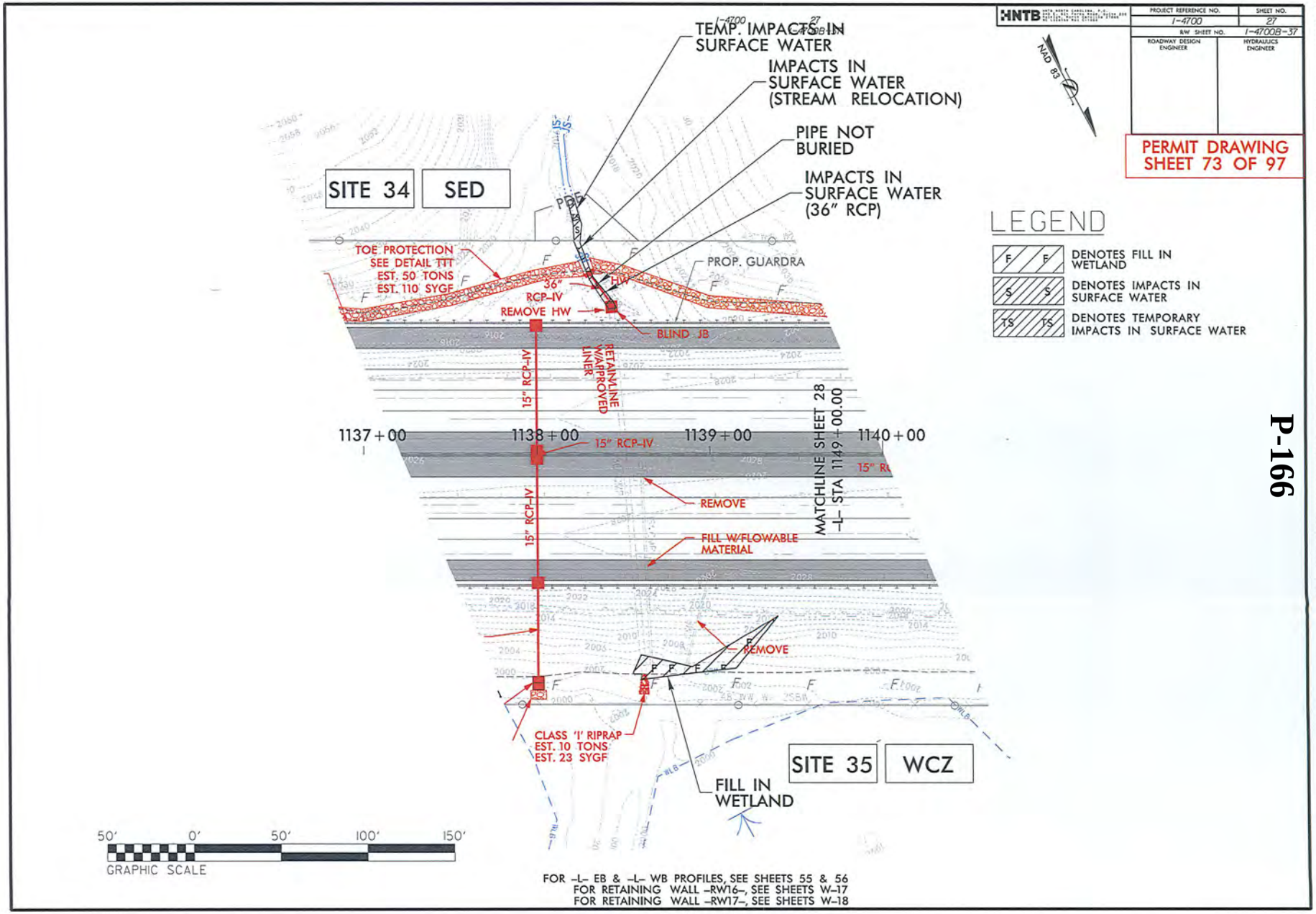

PERMIT DRAWING
SHEET 70 OF 97
NTB
PROJECT REFERENCE NO.
I-4700
SHEET NO.
27
RW SHEET NO.
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
WETLAND & STREAM IMPACTS
LEGEND
DENOTES FILL IN WETLAND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
DENOTES MECHANIZED CLEARING
NAD 83
MATCHLINE SHEET 28
-L- STA 1149+00.00
MATCHLINE SHEET 26
-L- STA 1135+00.00
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
IMPACTS IN SURFACE WATER (42" RCP)
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
IMPACTS IN SURFACE WATER (36" RCP)
PIPE NOT BURIED
FILL IN WETLAND
MECHANIZED CLEARING IN WETLAND
SITE 34 SED
SITE 35 WCZ
SITE 36 SEF
SITE 37 SEF
SITE 32 WCW
FOR -L- EB & -L- WB PROFILES, SEE SHEETS 85 & 86
FOR RETAINING WALL -RW16-, SEE SHEETS W-18
FOR RETAINING WALL -RW17-, SEE SHEETS W-19
GRAPHIC SCALE
7/19/2017


PERMIT DRAWING
SHEET 71 OF 97
WETLAND & STREAM IMPACTS
LEGEND
DENOTES FILL IN WETLAND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
DENOTES MECHANIZED CLEARING
NAD 83
MATCHLINE SHEET 28
-L- STA 1149+00.00
MATCHLINE SHEET 26
-L- STA 1135+00.00
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
IMPACTS IN SURFACE WATER (42" RCP)
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
IMPACTS IN SURFACE WATER (36" RCP)
PIPE NOT BURIED
FILL IN WETLAND
MECHANIZED CLEARING IN WETLAND
SITE 34 SED
SITE 35 WCZ
SITE 36 SEF
SITE 37 SEF
SITE 32 WCW
FOR -L- EB & -L- WB PROFILES, SEE SHEETS 85 & 86
FOR RETAINING WALL -RW16-, SEE SHEETS W-18
FOR RETAINING WALL -RW17-, SEE SHEETS W-19
NTB
PROJECT REFERENCE NO. I-4700
SHEET NO. 27
R/W SHEET NO.
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
GRAPHIC SCALE


HNTB
PROJECT REFERENCE NO. 1-4700
SHEET NO. 27
R/W SHEET NO. 1-4700B-37
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
PERMIT DRAWING SHEET 72 OF 97
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
PIPE NOT BURIED
IMPACTS IN SURFACE WATER (36" RCP)
SITE 34
SED
TOE PROTECTION SEE DETAIL TTT EST. 50 TONS EST. 110 SYGF
PROP. GUARDRA
36" RCP-IV
REMOVE HW
BLIND JB
15" RCP-IV
RETAINLINE W/APPROVED LINER
1137+00
1138+00
1139+00
1140+00
15" RCP-IV
REMOVE
FILL W/FLOWABLE MATERIAL
MATCHLINE SHEET 28 -L- STA 1149+00.00
REMOVE
CLASS 'I' RIPRAP EST. 10 TONS EST. 23 SYGF
FILL IN WETLAND
SITE 35
WCZ
LEGEND
F F DENOTES FILL IN WETLAND
S S DENOTES IMPACTS IN SURFACE WATER
TS TS DENOTES TEMPORARY IMPACTS IN SURFACE WATER
50' 0' 50' 100' 150'
GRAPHIC SCALE
FOR -L- EB & -L- WB PROFILES, SEE SHEETS 55 & 56
FOR RETAINING WALL -RW16-, SEE SHEETS W-17
FOR RETAINING WALL -RW17-, SEE SHEETS W-18

P-165

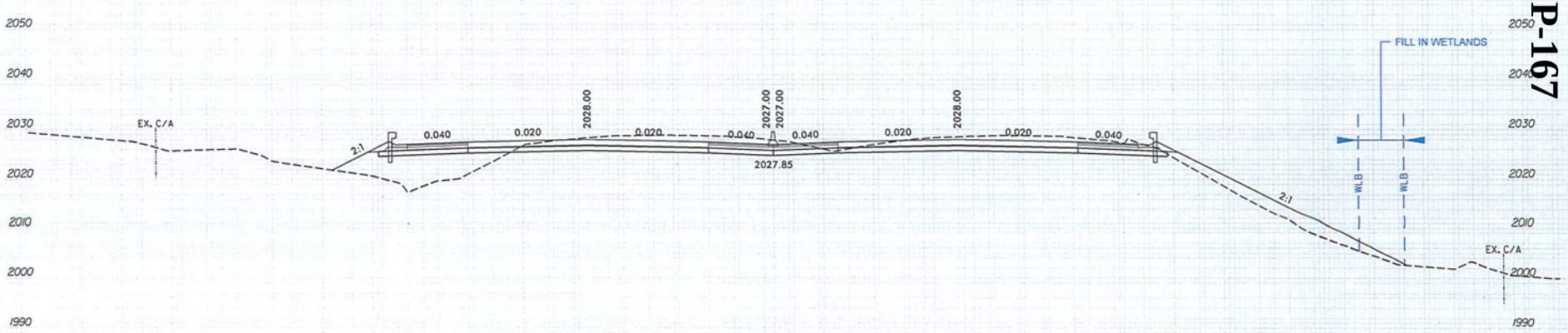

HNTB
PROJECT REFERENCE NO. 1-4700
SHEET NO. 27
R/W SHEET NO. 1-4700B-37
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
PERMIT DRAWING SHEET 73 OF 97
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
PIPE NOT BURIED
IMPACTS IN SURFACE WATER (36" RCP)
SITE 34
SED
TOE PROTECTION SEE DETAIL TTT EST. 50 TONS EST. 110 SYGF
36" RCP-IV REMOVE HW
HW
PROP. GUARDRA
BLIND JB
15" RCP-IV
RETAINLINE W/APPROVED LINER
1137+00
1138+00
1139+00
1140+00
15" RCP-IV
15" RCP-IV
REMOVE
FILL W/FLOWABLE MATERIAL
MATCHLINE SHEET 28 -L- STA 1149+00.00
REMOVE
CLASS 'I' RIPRAP EST. 10 TONS EST. 23 SYGF
FILL IN WETLAND
SITE 35
WCZ
LEGEND
F F DENOTES FILL IN WETLAND
S S DENOTES IMPACTS IN SURFACE WATER
TS TS DENOTES TEMPORARY IMPACTS IN SURFACE WATER
50' 0' 50' 100' 150'
GRAPHIC SCALE
FOR -L- EB & -L- WB PROFILES, SEE SHEETS 55 & 56
FOR RETAINING WALL -RW16-, SEE SHEETS W-17
FOR RETAINING WALL -RW17-, SEE SHEETS W-18

P-166

PROJ. REFERENCE NO.	SHEET NO.
I-4700	

PERMIT DRAWING
SHEET 74 OF 97

WETLAND CROSS SECTIONS

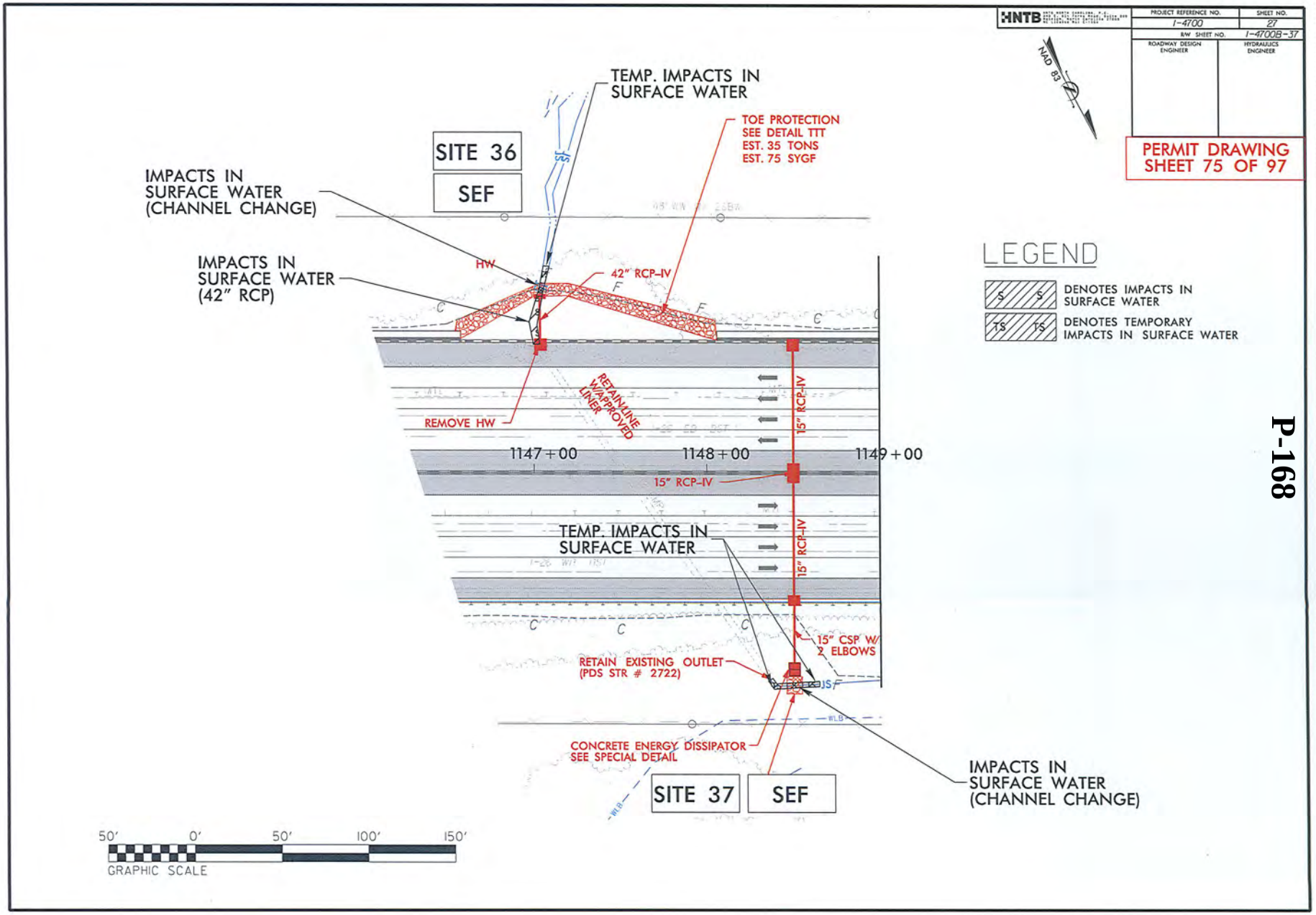


SITE 35
-L3- 1139+00.00

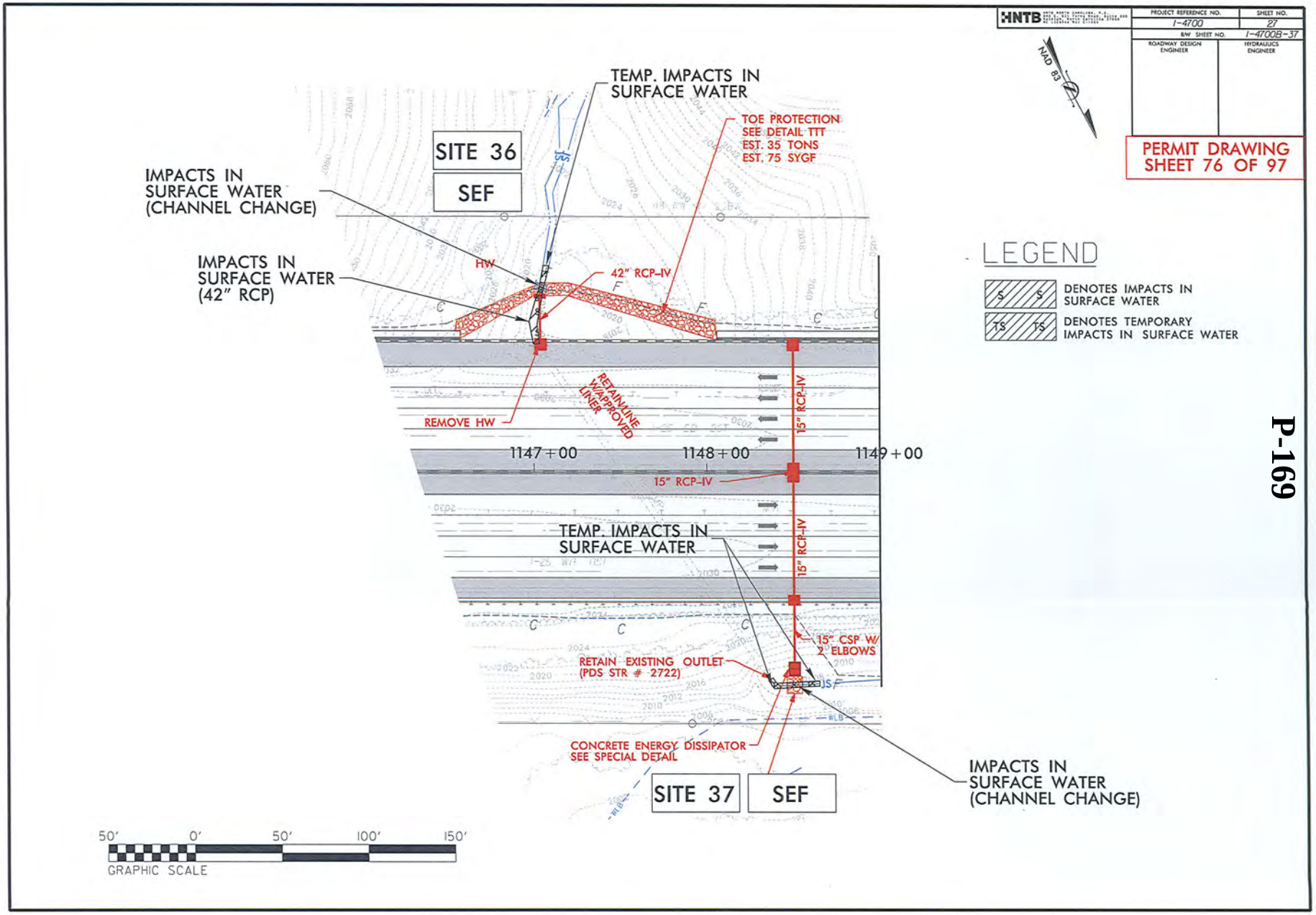
SCALE
1"=20' HORIZONTAL
1"=20' VERTICAL

BUNCOMBE & HENDERSON COUNTY
PROJECT: I-4700
I-26
FROM 0.3 MI EAST OF NC 280 (AIRPORT RD.)
TO 0.5 MI EAST OF NC 191 (BREVARD RD.)

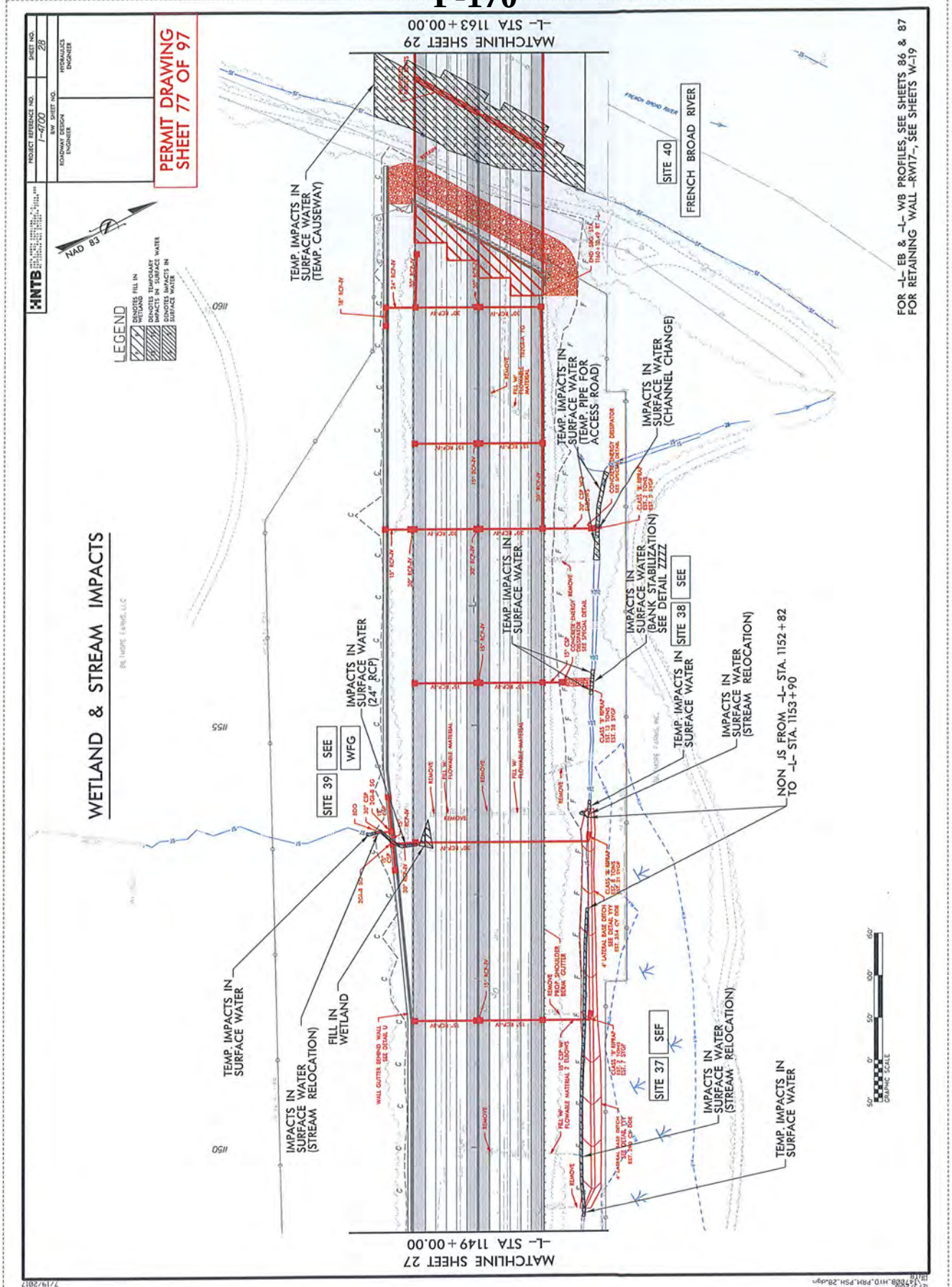
P-167

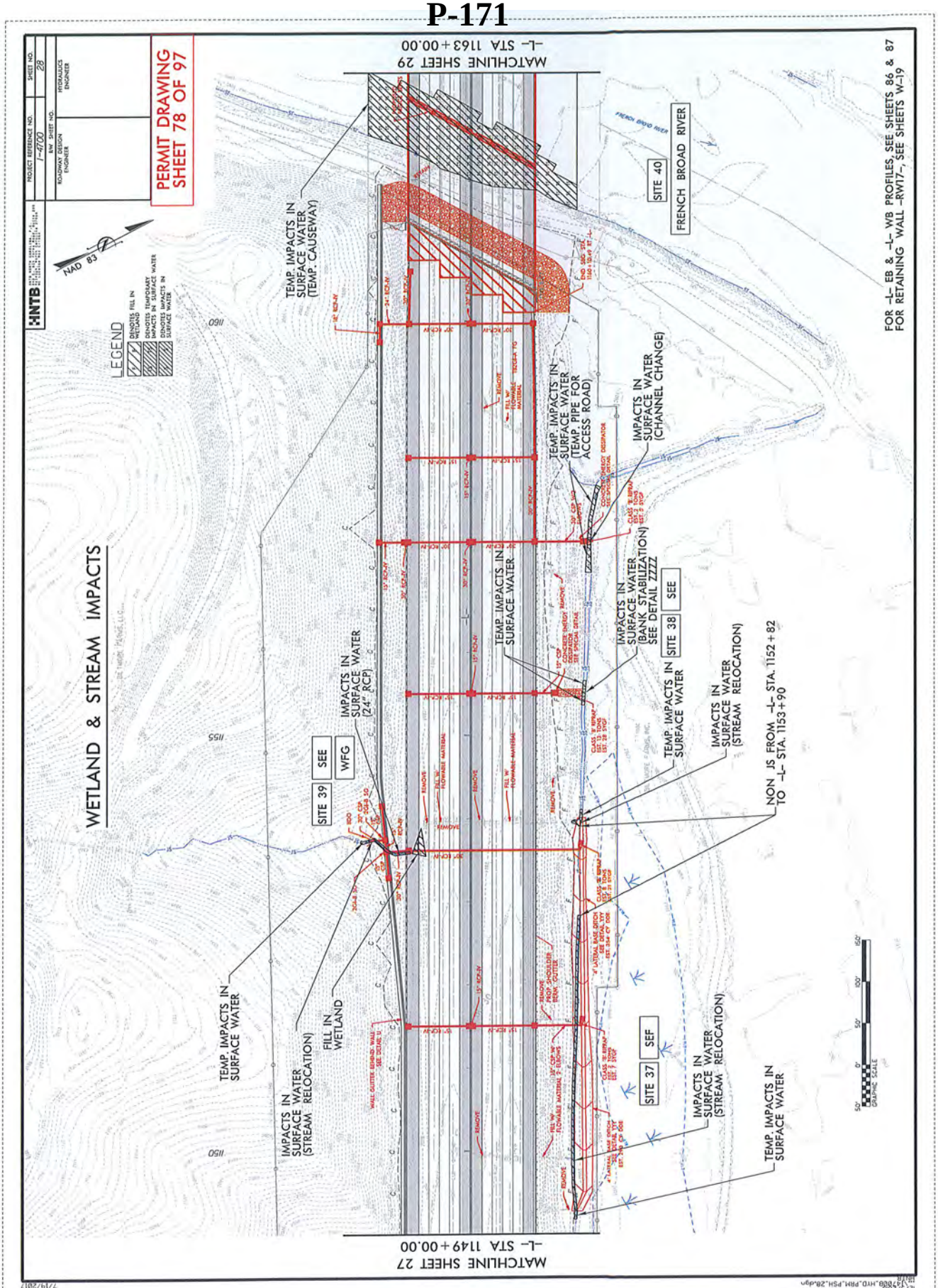

HNTB
PROJECT REFERENCE NO.
I-4700
SHEET NO.
27
R/W SHEET NO.
I-4700B-37
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
PERMIT DRAWING
SHEET 75 OF 97
TEMP. IMPACTS IN SURFACE WATER
TOE PROTECTION
SEE DETAIL TTT
EST. 35 TONS
EST. 75 SYGF
SITE 36
SEF
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
IMPACTS IN SURFACE WATER (42" RCP)
HW
42" RCP-IV
REMOVE HW
RETAIN/LINE W/APPROVED LINER
15" RCP-IV
1147+00
1148+00
1149+00
15" RCP-IV
TEMP. IMPACTS IN SURFACE WATER
15" RCP-IV
15" CSP W/ 2 ELBOWS
RETAIN EXISTING OUTLET (PDS STR # 2722)
CONCRETE ENERGY DISSIPATOR SEE SPECIAL DETAIL
SITE 37
SEF
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
50' 0' 50' 100' 150'
GRAPHIC SCALE

P-168


HNTB
PROJECT REFERENCE NO.
I-4700
SHEET NO.
27
R/W SHEET NO.
I-4700B-37
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
PERMIT DRAWING
SHEET 76 OF 97
TEMP. IMPACTS IN SURFACE WATER
TOE PROTECTION
SEE DETAIL TTT
EST. 35 TONS
EST. 75 SYGF
SITE 36
SEF
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
IMPACTS IN SURFACE WATER (42" RCP)
HW
42" RCP-IV
REMOVE HW
RETAIN/LINE W/APPROVED LINER
15" RCP-IV
1147+00
1148+00
1149+00
15" RCP-IV
TEMP. IMPACTS IN SURFACE WATER
15" RCP-IV
15" CSP W/ 2 ELBOWS
RETAIN EXISTING OUTLET (PDS STR # 2722)
CONCRETE ENERGY DISSIPATOR SEE SPECIAL DETAIL
SITE 37
SEF
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
50' 0' 50' 100' 150'
GRAPHIC SCALE

P-169

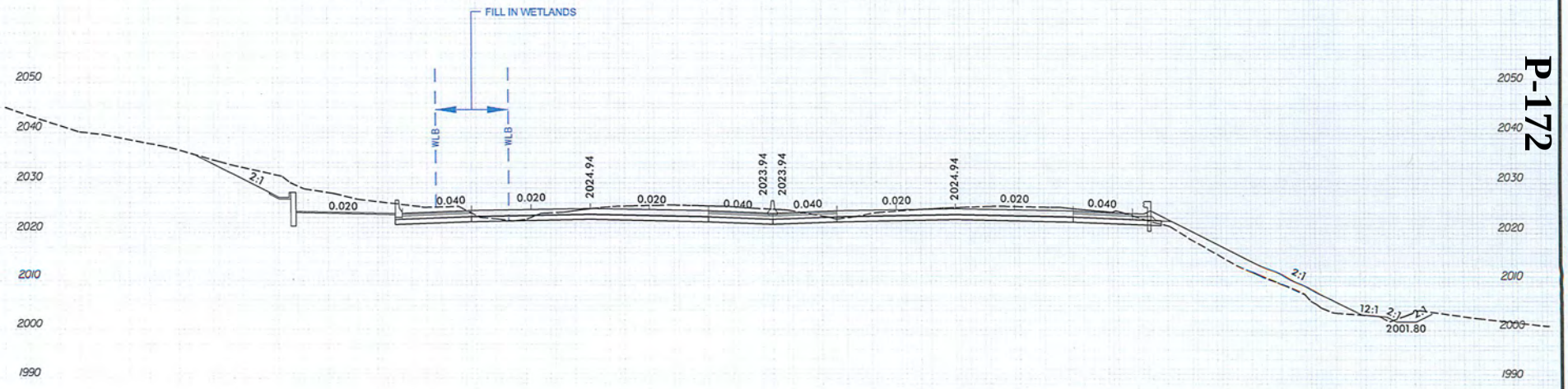

PERMIT DRAWING
SHEET 77 OF 97
WETLAND & STREAM IMPACTS
LEGEND
DENOTES FILL IN WETLAND
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
DENOTES IMPACTS IN SURFACE WATER
NAD 83
MATCHLINE SHEET 29
-L- STA 1163+00.00
MATCHLINE SHEET 27
-L- STA 1149+00.00
FRENCH BROAD RIVER
SITE 40
SITE 39
SEE
WFG
SITE 38
SEE
SITE 37
SEF
TEMP. IMPACTS IN SURFACE WATER (TEMP. CAUSEWAY)
IMPACTS IN SURFACE WATER (24" RCP)
TEMP. IMPACTS IN SURFACE WATER
TEMP. IMPACTS IN SURFACE WATER (TEMP. PIPE FOR ACCESS ROAD)
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL ZZZZ
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
NON JS FROM -L- STA. 1152+82 TO -L- STA. 1153+90
TEMP. IMPACTS IN SURFACE WATER
FILL IN WETLAND
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
TEMP. IMPACTS IN SURFACE WATER
FOR -L- EB & -L- WB PROFILES, SEE SHEETS 86 & 87
FOR RETAINING WALL -RW17-, SEE SHEETS W-19
GRAPHIC SCALE


WETLAND & STREAM IMPACTS
PERMIT DRAWING
SHEET 78 OF 97
NAD 83
LEGEND
DENOTES FILL IN WETLANDS
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
DENOTES IMPACTS IN SURFACE WATER
PROJECT REFERENCE NO. I-4700
SHEET NO. 28
R/W SHEET NO.
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
MATCHLINE SHEET 29 -L- STA 1163+00.00
MATCHLINE SHEET 27 -L- STA 1149+00.00
FOR -L- EB & -L- WB PROFILES, SEE SHEETS 86 & 87
FOR RETAINING WALL -RW17-, SEE SHEETS W-19
FRENCH BROAD RIVER
SITE 40
SITE 39
SEE WFG
SITE 38
SEE DETAIL ZZZZ
SITE 37
SEF
TEMP. IMPACTS IN SURFACE WATER (TEMP. CAUSEWAY)
IMPACTS IN SURFACE WATER (24" RCP)
TEMP. IMPACTS IN SURFACE WATER
TEMP. IMPACTS IN SURFACE WATER (TEMP. PIPE FOR ACCESS ROAD)
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
IMPACTS IN SURFACE WATER (BANK STABILIZATION)
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
NON JS FROM -L- STA. 1152+82 TO -L- STA. 1153+90
TEMP. IMPACTS IN SURFACE WATER
FILL IN WETLAND
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
TEMP. IMPACTS IN SURFACE WATER
GRAPHIC SCALE

PROJ. REFERENCE NO.	SHEET NO.
I-4700	

PERMIT DRAWING
SHEET 79 OF 97

WETLAND CROSS SECTIONS

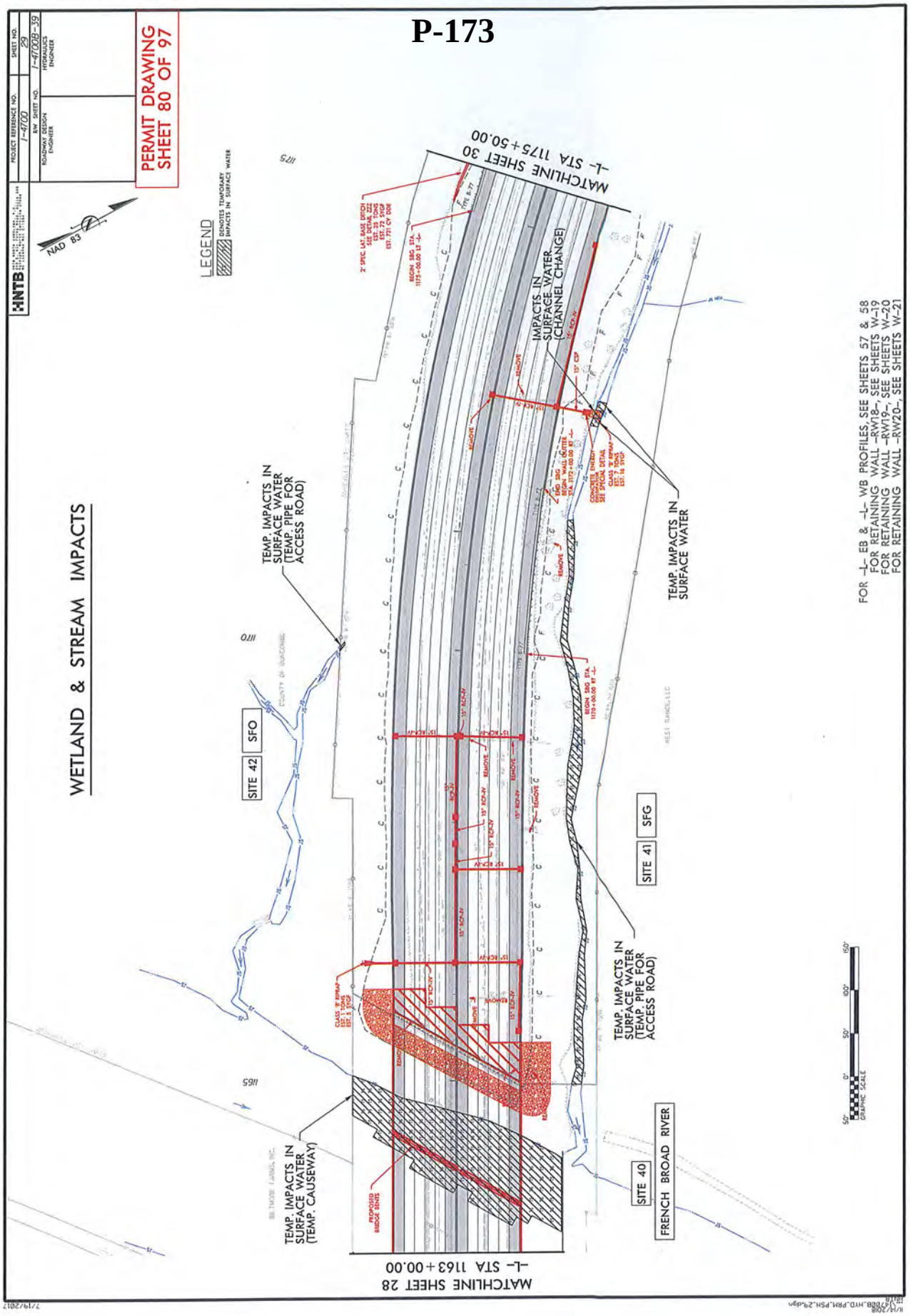


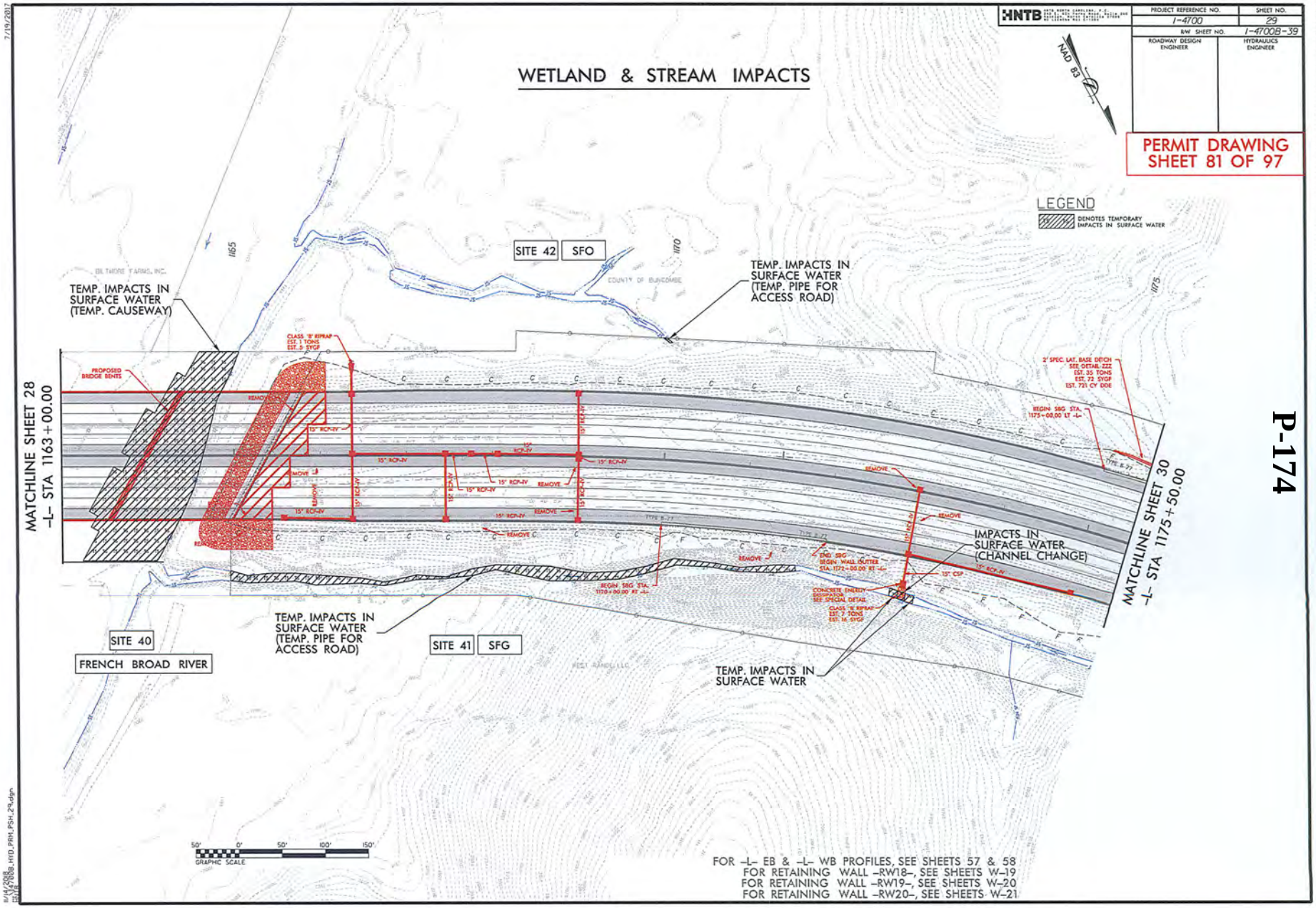
P-172

SITE 39
-L3- 1153+60.00

SCALE
1"=20' HORIZONTAL
1"=20' VERTICAL

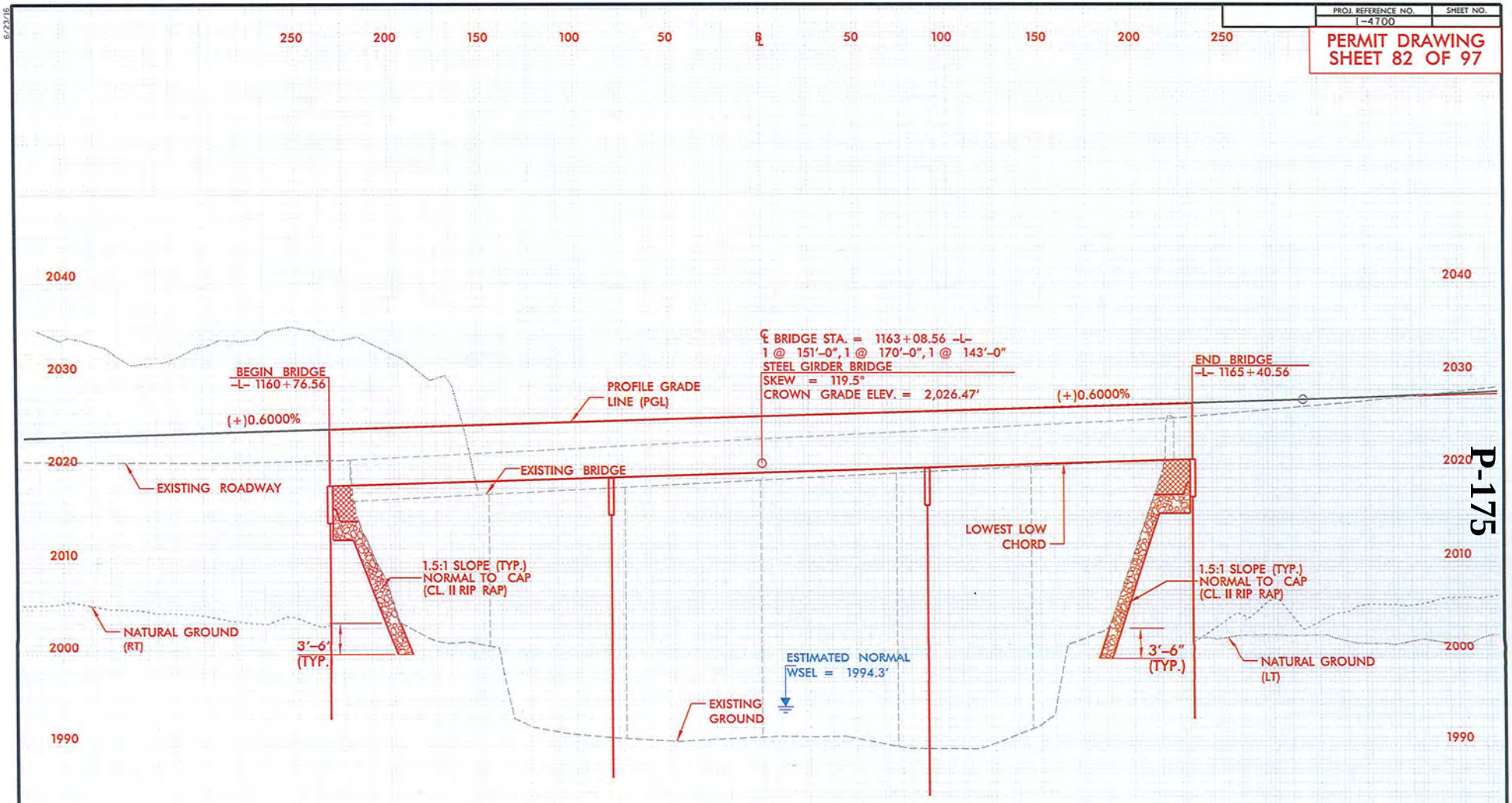
BUNCOMBE & HENDERSON COUNTY
PROJECT: I-4700
I-26
FROM 0.3 MI EAST OF NC 280 (AIRPORT RD.)
TO 0.5 MI EAST OF NC 191 (BREVARD RD.)


PERMIT DRAWING
SHEET 80 OF 97
PROJECT REFERENCE NO.
7-4700
SHEET NO.
29
RW SHEET NO.
7-47008-39
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NTB
NAD 83
LEGEND
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
WETLAND & STREAM IMPACTS
MATCHLINE SHEET 30
-L- STA 1175+50.00
MATCHLINE SHEET 28
-L- STA 1163+00.00
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
TEMP. IMPACTS IN SURFACE WATER (TEMP. PIPE FOR ACCESS ROAD)
TEMP. IMPACTS IN SURFACE WATER
TEMP. IMPACTS IN SURFACE WATER (TEMP. CAUSEWAY)
TEMP. IMPACTS IN SURFACE WATER (TEMP. PIPE FOR ACCESS ROAD)
SITE 42 SFO
SITE 41 SFG
SITE 40 FRENCH BROAD RIVER
FOR -L- EB & -L- WB PROFILES, SEE SHEETS 57 & 58
FOR RETAINING WALL -RW18-, SEE SHEETS W-19
FOR RETAINING WALL -RW19-, SEE SHEETS W-20
FOR RETAINING WALL -RW20-, SEE SHEETS W-21
GRAPHIC SCALE
7/19/2017


WETLAND & STREAM IMPACTS
HNTB
PROJECT REFERENCE NO.
I-4700
SHEET NO.
29
RW SHEET NO.
I-4700B-39
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
PERMIT DRAWING
SHEET 81 OF 97
LEGEND
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
SITE 42
SFO
TEMP. IMPACTS IN SURFACE WATER (TEMP. CAUSEWAY)
TEMP. IMPACTS IN SURFACE WATER (TEMP. PIPE FOR ACCESS ROAD)
MATCHLINE SHEET 28 -L- STA 1163+00.00
MATCHLINE SHEET 30 -L- STA 1175+50.00
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
TEMP. IMPACTS IN SURFACE WATER (TEMP. PIPE FOR ACCESS ROAD)
SITE 40
FRENCH BROAD RIVER
SITE 41
SFG
TEMP. IMPACTS IN SURFACE WATER
GRAPHIC SCALE
FOR -L- EB & -L- WB PROFILES, SEE SHEETS 57 & 58
FOR RETAINING WALL -RW18-, SEE SHEETS W-19
FOR RETAINING WALL -RW19-, SEE SHEETS W-20
FOR RETAINING WALL -RW20-, SEE SHEETS W-21
P-174

PROJ. REFERENCE NO.	SHEET NO.
I-4700	

PERMIT DRAWING SHEET 82 OF 97

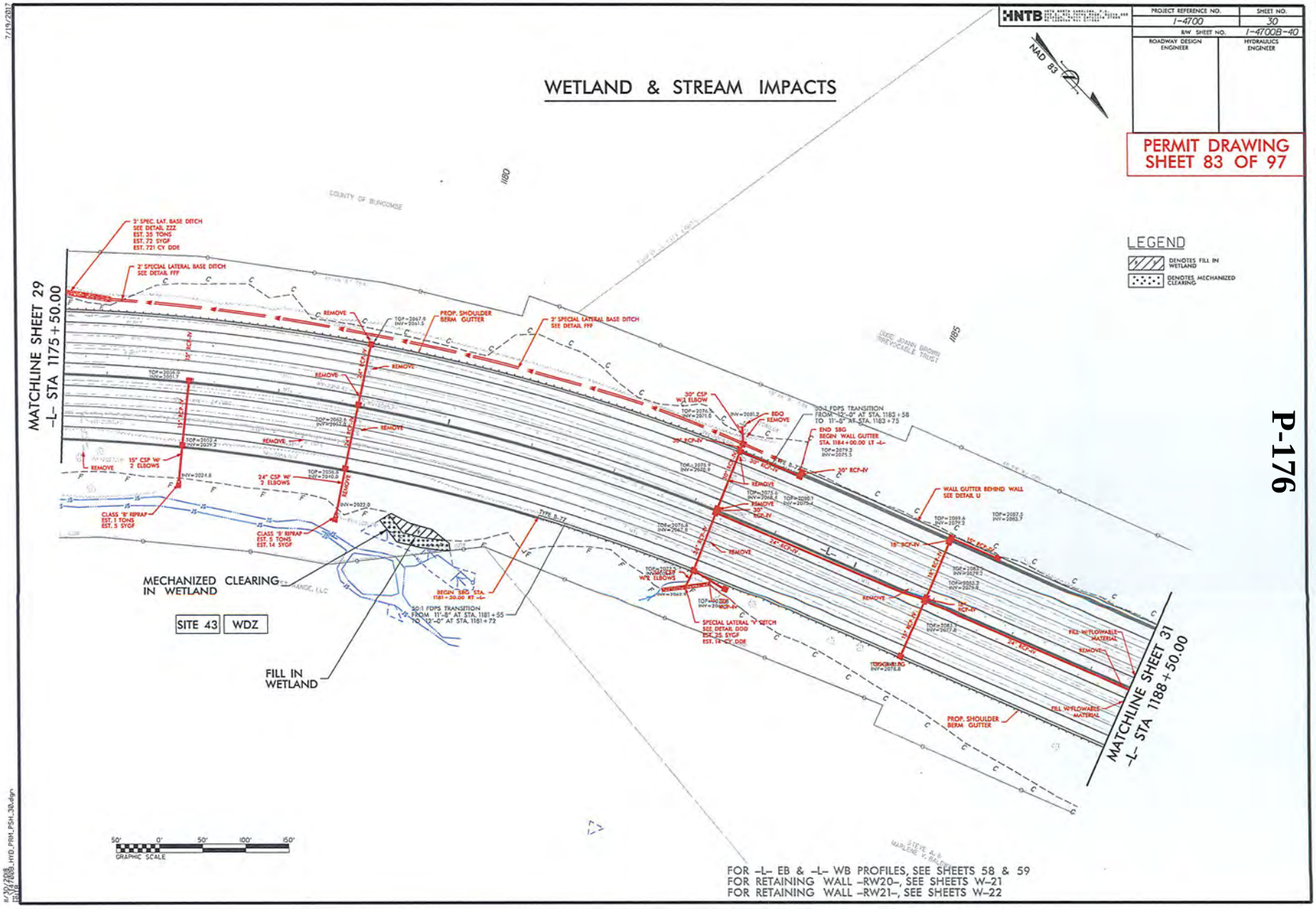


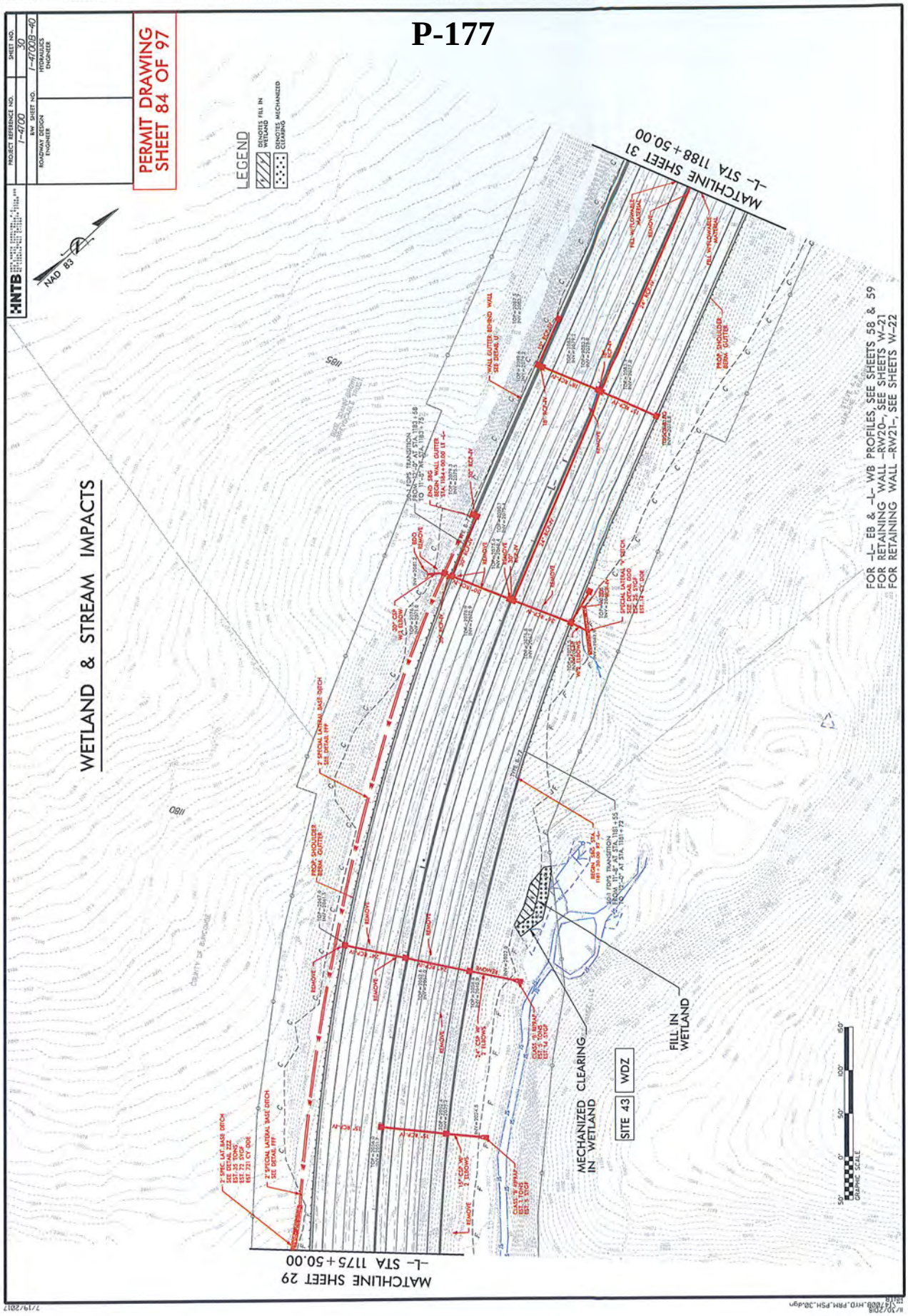
PROFILE

BUNCOMBE & HENDERSON COUNTY
PROJECT: I-4700
I-26
FROM 0.3 MI EAST OF NC 280 (AIRPORT RD.)
TO 0.5 MI EAST OF NC 191 (BREVARD RD.)

P-175

6/23/16

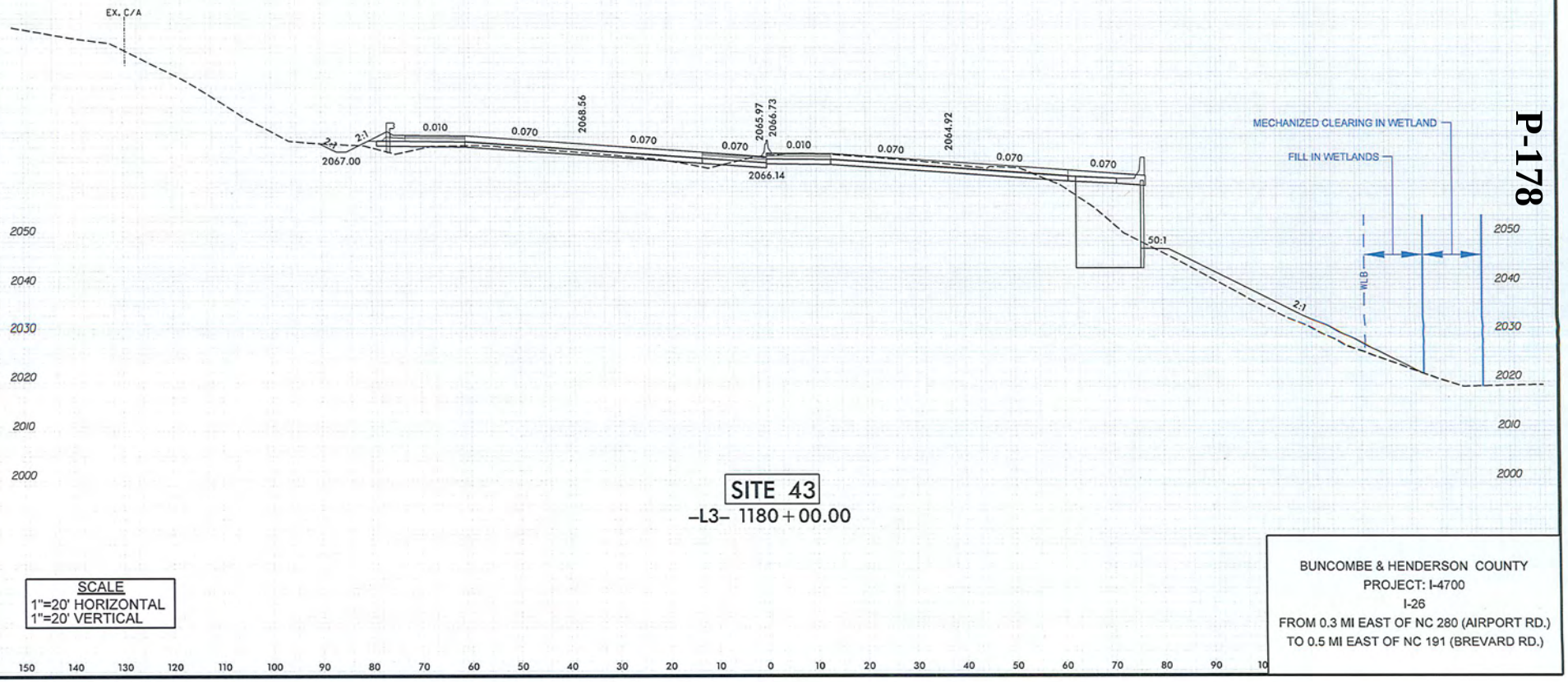

HNTB
PROJECT REFERENCE NO.
I-4700
SHEET NO.
30
R/W SHEET NO.
I-4700B-40
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
PERMIT DRAWING
SHEET 83 OF 97
WETLAND & STREAM IMPACTS
NAD 83
LEGEND
DENOTES FILL IN WETLAND
DENOTES MECHANIZED CLEARING
MATCHLINE SHEET 29
-L- STA 1175+50.00
MATCHLINE SHEET 31
-L- STA 1188+50.00
MECHANIZED CLEARING IN WETLAND
SITE 43
WDZ
FILL IN WETLAND
2' SPEC. LAT. BASE DITCH SEE DETAIL ZZZ EST. 35 TONS EST. 72 SYGF EST. 721 CY DDE
2' SPECIAL LATERAL BASE DITCH SEE DETAIL FFF
PROP. SHOULDER BERM GUTTER
REMOVE
15" CSP W/ 2 ELBOWS
24" CSP W/ 2 ELBOWS
CLASS 'B' RIPRAP EST. 1 TONS EST. 5 SYGF
CLASS 'B' RIPRAP EST. 5 TONS EST. 14 SYGF
30" CSP W/1 ELBOW
BDO REMOVE
30:1 FDPS TRANSITION FROM 12'-0" AT STA. 1183+58 TO 11'-8" AT STA. 1183+75
END SBG BEGIN WALL GUTTER STA. 1184+00.00 LT -L-
WALL GUTTER BEHIND WALL SEE DETAIL U
BEGIN SBG STA. 1181+30.00 RT -L-
30:1 FDPS TRANSITION FROM 11'-8" AT STA. 1181+55 TO 12'-0" AT STA. 1181+72
SPECIAL LATERAL 'Y' DITCH SEE DETAIL DDD EST. 25 SYGF EST. 14 CY DDE
FILL W/FLOWABLE MATERIAL
PROP. SHOULDER BERM GUTTER
GRAPHIC SCALE
FOR -L- EB & -L- WB PROFILES, SEE SHEETS 58 & 59
FOR RETAINING WALL -RW20-, SEE SHEETS W-21
FOR RETAINING WALL -RW21-, SEE SHEETS W-22


PERMIT DRAWING
SHEET 84 OF 97
PROJECT REFERENCE NO. I-4700
R/W SHEET NO.
SHEET NO. 30
I-4700B-60
ROADWAY DESIGN ENGINEER
STRUCTURES ENGINEER
NTB
NAD 83
LEGEND
DENOTES FILL IN WETLAND
DENOTES MECHANIZED CLEARING
WETLAND & STREAM IMPACTS
MATCHLINE SHEET 31
-L- STA 1188+50.00
MATCHLINE SHEET 29
-L- STA 1175+50.00
FOR -L- EB & -L- WB PROFILES, SEE SHEETS 58 & 59
FOR RETAINING WALL -RW20-, SEE SHEETS W-21
FOR RETAINING WALL -RW21-, SEE SHEETS W-22
MECHANIZED CLEARING IN WETLAND
FILL IN WETLAND
SITE 43
WDZ
GRAPHIC SCALE
7/19/2017

PROJ. REFERENCE NO.	SHEET NO.
I-4700	

PERMIT DRAWING
SHEET 85 OF 97

WETLAND CROSS SECTIONS

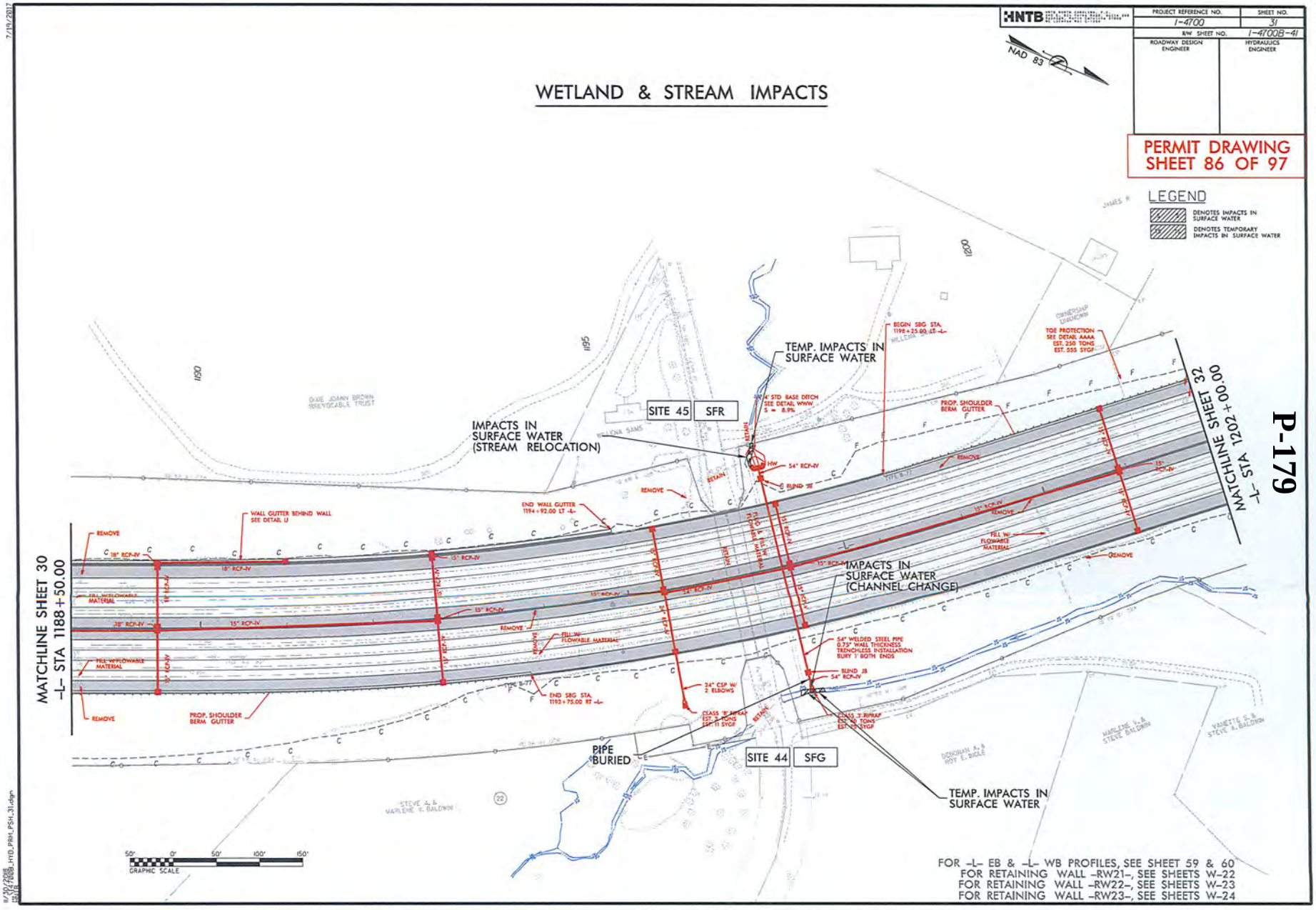


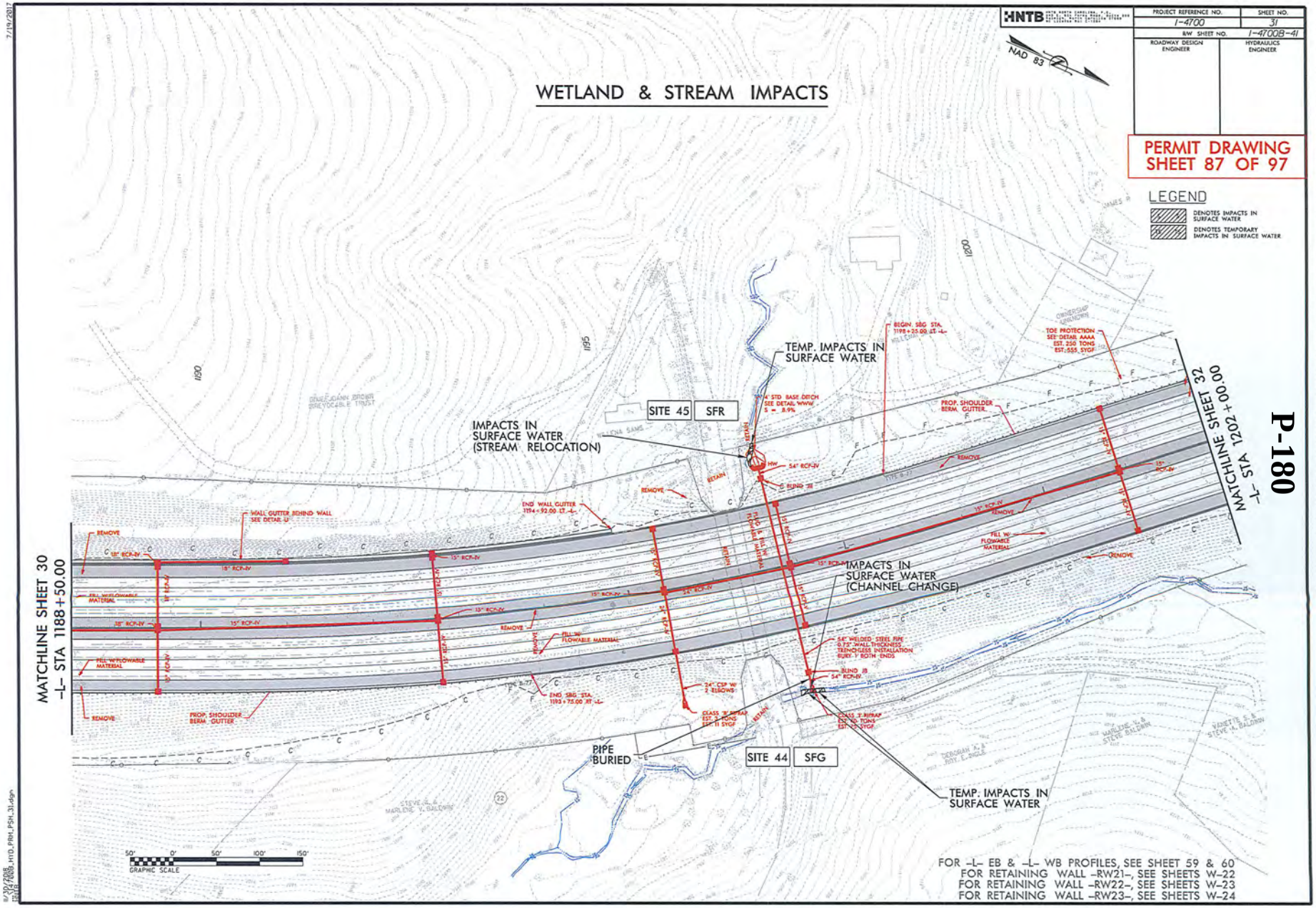
SITE 43
–L3– 1180+00.00

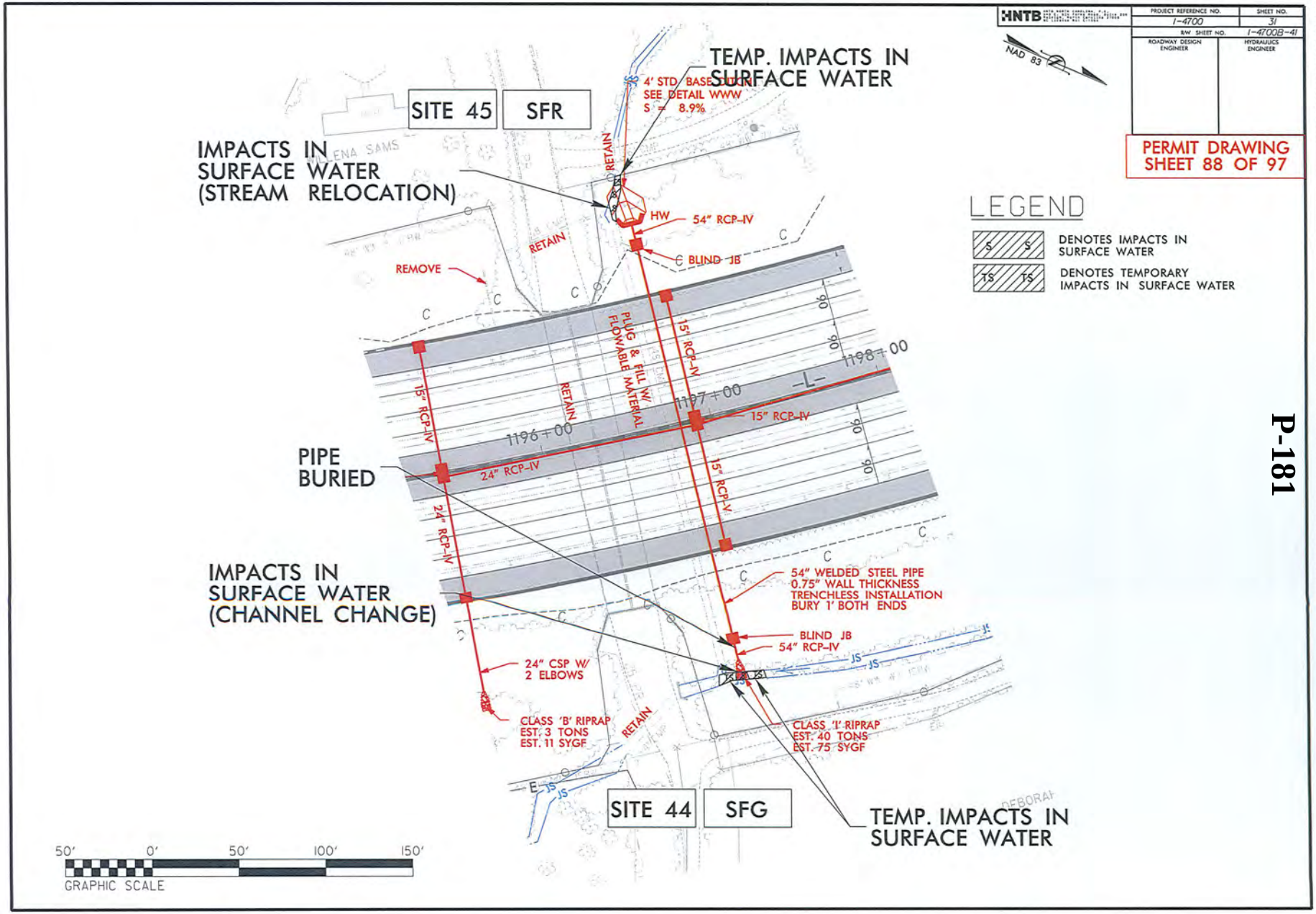
SCALE
1"=20' HORIZONTAL
1"=20' VERTICAL

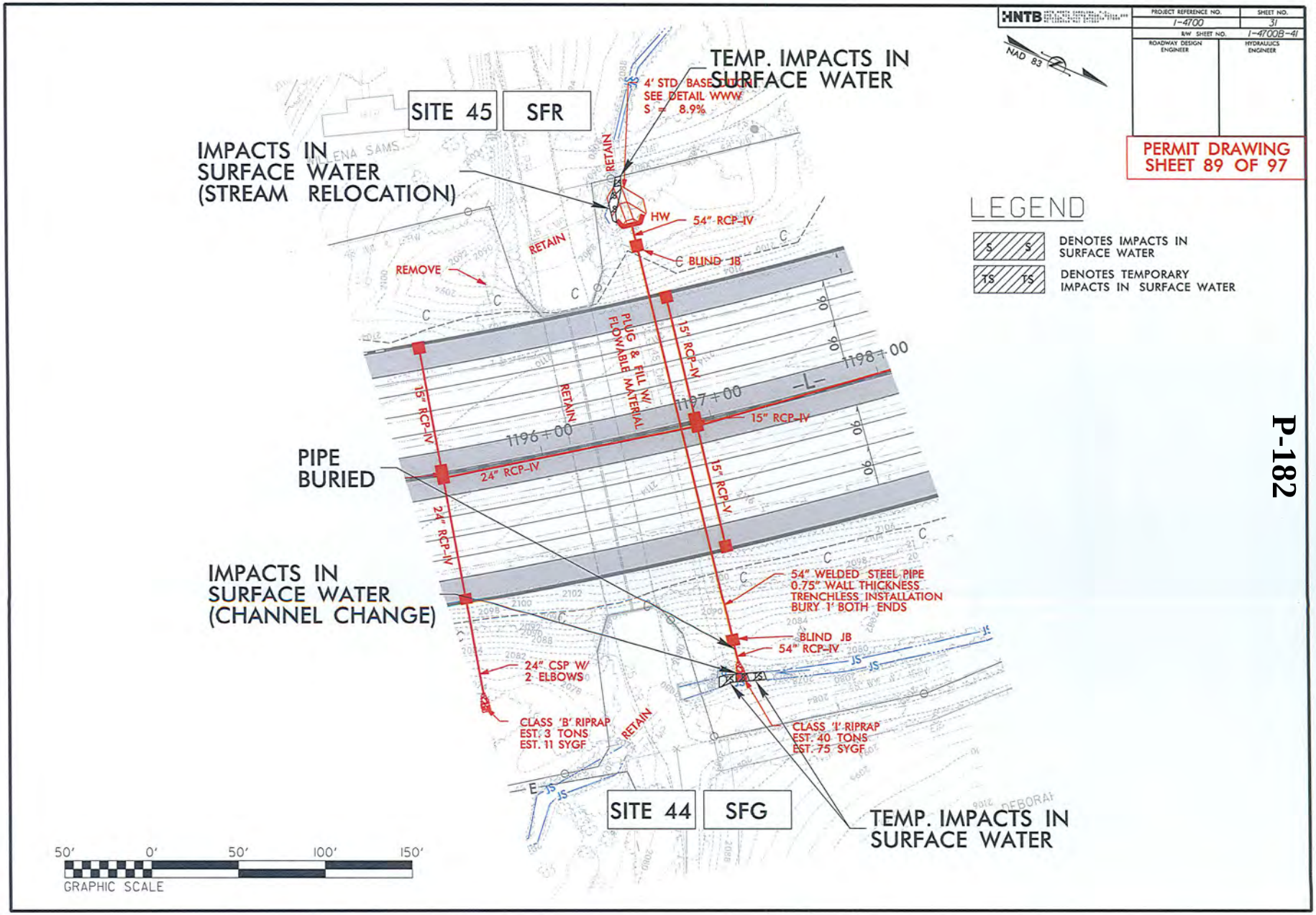
BUNCOMBE & HENDERSON COUNTY
PROJECT: I-4700
I-26
FROM 0.3 MI EAST OF NC 280 (AIRPORT RD.)
TO 0.5 MI EAST OF NC 191 (BREVARD RD.)

P-178

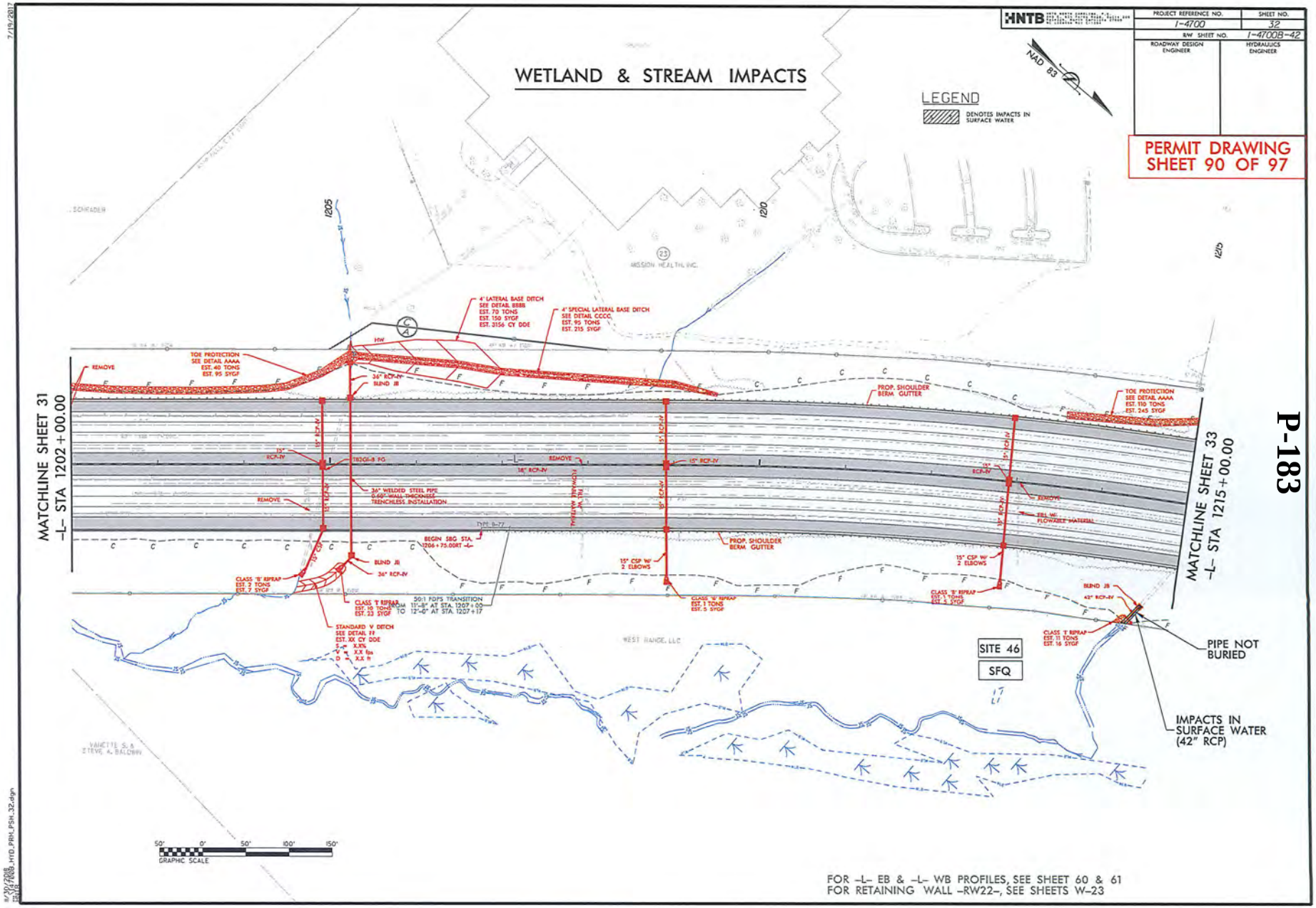

HNTB
PROJECT REFERENCE NO. I-4700
SHEET NO. 31
R/W SHEET NO. I-4700B-41
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
PERMIT DRAWING SHEET 86 OF 97
WETLAND & STREAM IMPACTS
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
SITE 45 SFR
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
SITE 44 SFG
PIPE BURIED
TEMP. IMPACTS IN SURFACE WATER
MATCHLINE SHEET 30 -L- STA 1188+50.00
MATCHLINE SHEET 32 -L- STA 1202+00.00
P-179
GRAPHIC SCALE
FOR -L- EB & -L- WB PROFILES, SEE SHEET 59 & 60
FOR RETAINING WALL -RW21-, SEE SHEETS W-22
FOR RETAINING WALL -RW22-, SEE SHEETS W-23
FOR RETAINING WALL -RW23-, SEE SHEETS W-24

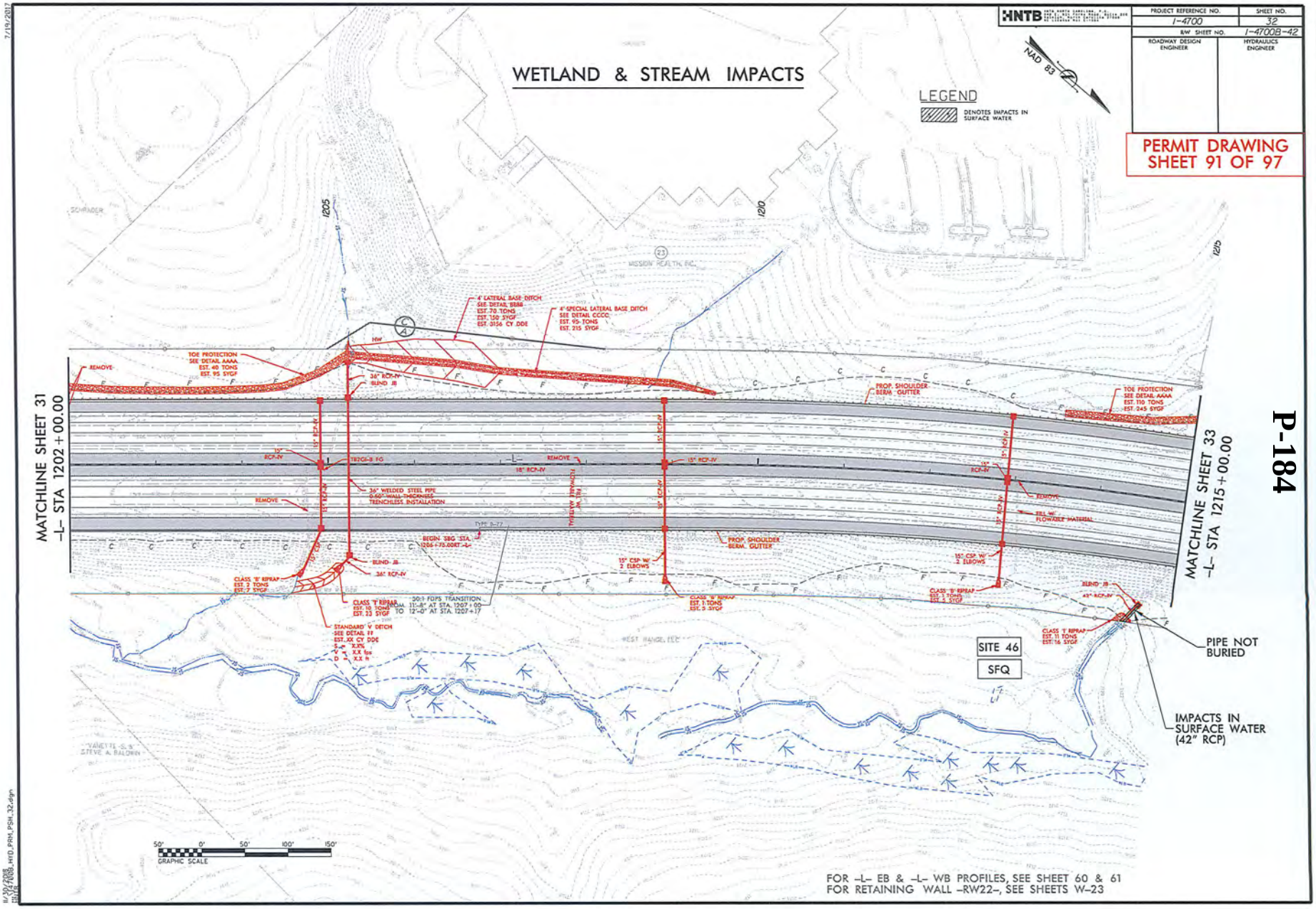

WETLAND & STREAM IMPACTS
HNTB
PROJECT REFERENCE NO. 1-4700
SHEET NO. 31
RW SHEET NO. 1-4700B-41
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
PERMIT DRAWING SHEET 87 OF 97
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
P-180
TEMP. IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
SITE 45 SFR
SITE 44 SFG
PIPE BURIED
MATCHLINE SHEET 30 -L- STA 1188+50.00
MATCHLINE SHEET 32 -L- STA 1202+00.00
FOR -L- EB & -L- WB PROFILES, SEE SHEET 59 & 60
FOR RETAINING WALL -RW21-, SEE SHEETS W-22
FOR RETAINING WALL -RW22-, SEE SHEETS W-23
FOR RETAINING WALL -RW23-, SEE SHEETS W-24
GRAPHIC SCALE
7/19/2017


HNTB
PROJECT REFERENCE NO.
1-4700
SHEET NO.
31
R/W SHEET NO.
1-47008-41
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
PERMIT DRAWING
SHEET 88 OF 97
P-181
TEMP. IMPACTS IN SURFACE WATER
SITE 45
SFR
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
4' STD BASE DITCH
SEE DETAIL WWW
S = 8.9%
RETAIN
HW
54" RCP-IV
BLIND JB
REMOVE
RETAIN
PLUG & FILL W/ FLOWABLE MATERIAL
15" RCP-IV
1198+00
1197+00
1196+00
-L-
15" RCP-IV
24" RCP-IV
PIPE BURIED
24" RCP-IV
15" RCP-IV
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
54" WELDED STEEL PIPE
0.75" WALL THICKNESS
TRENCHLESS INSTALLATION
BURY 1' BOTH ENDS
BLIND JB
54" RCP-IV
24" CSP W/ 2 ELBOWS
CLASS 'B' RIPRAP
EST. 3 TONS
EST. 11 SYGF
RETAIN
CLASS 'I' RIPRAP
EST. 40 TONS
EST. 75 SYGF
SITE 44
SFG
TEMP. IMPACTS IN SURFACE WATER
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
50' 0' 50' 100' 150'
GRAPHIC SCALE

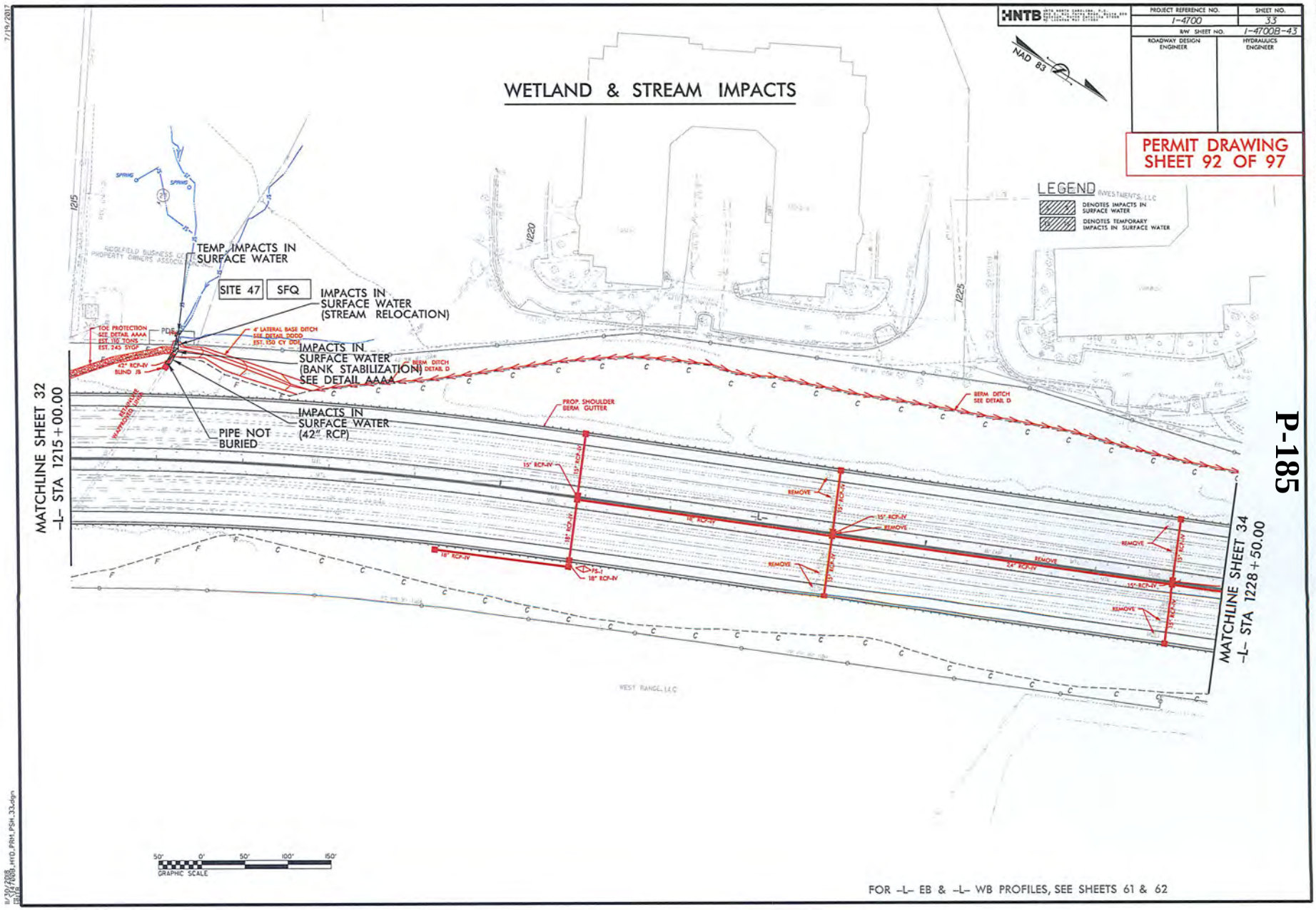

HNTB
PROJECT REFERENCE NO.
I-4700
SHEET NO.
31
R/W SHEET NO.
I-4700B-41
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
PERMIT DRAWING
SHEET 89 OF 97
TEMP. IMPACTS IN SURFACE WATER
SITE 45
SFR
4' STD BASE SUMP
SEE DETAIL WWW
S = 8.9%
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
RETAIN
HW
54" RCP-IV
C BLIND JB
REMOVE
RETAIN
PLUG & FILL W/ FLOWABLE MATERIAL
15" RCP-IV
1198+00
1197+00
-L-
15" RCP-IV
1196+00
24" RCP-IV
PIPE BURIED
15" RCP-IV
24" RCP-IV
IMPACTS IN SURFACE WATER (CHANNEL CHANGE)
54" WELDED STEEL PIPE
0.75" WALL THICKNESS
TRENCHLESS INSTALLATION
BURY 1' BOTH ENDS
BLIND JB
54" RCP-IV
24" CSP W/ 2 ELBOWS
CLASS 'B' RIPRAP
EST. 3 TONS
EST. 11 SYGF
RETAIN
CLASS 'I' RIPRAP
EST. 40 TONS
EST. 75 SYGF
SITE 44
SFG
TEMP. IMPACTS IN SURFACE WATER
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
50' 0' 50' 100' 150'
GRAPHIC SCALE

P-182


WETLAND & STREAM IMPACTS
HNTB
PROJECT REFERENCE NO. I-4700
SHEET NO. 32
R/W SHEET NO. I-4700B-42
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
PERMIT DRAWING SHEET 90 OF 97
NAD 83
LEGEND
DENOTES IMPACTS IN SURFACE WATER
MATCHLINE SHEET 31 -L- STA 1202+00.00
MATCHLINE SHEET 33 -L- STA 1215+00.00
4' LATERAL BASE DITCH SEE DETAIL BBBB EST. 70 TONS EST. 150 SYGF EST. 3156 CY DDE
4' SPECIAL LATERAL BASE DITCH SEE DETAIL CCCC EST. 95 TONS EST. 215 SYGF
TOE PROTECTION SEE DETAIL AAAA EST. 40 TONS EST. 95 SYGF
TOE PROTECTION SEE DETAIL AAAA EST. 110 TONS EST. 245 SYGF
REMOVE
HW
36" RCP-IV
BLIND JB
PROP. SHOULDER BERM GUTTER
15" RCP-IV
18" RCP-IV
24" RCP-IV
TRENCH B FG
36" WELDED STEEL PIPE 0.500"-WALL-THICKNESS TRENCHLESS INSTALLATION
BEGIN SBG STA. 1206+75.00RT -L-
CLASS 'B' RIPRAP EST. 2 TONS EST. 7 SYGF
CLASS 'I' RIPRAP EST. 10 TONS EST. 23 SYGF
50:1 FDPS TRANSITION 11'-8" AT STA. 1207+00 TO 12'-0" AT STA. 1207+17
STANDARD 'V' DITCH SEE DETAIL FF EST. XX CY DDE
15" CSP W/ 2 ELBOWS
CLASS 'B' RIPRAP EST. 1 TONS EST. 5 SYGF
FILL W/ FLOWABLE MATERIAL
42" RCP-IV
CLASS 'I' RIPRAP EST. 11 TONS EST. 16 SYGF
SITE 46
SFQ
PIPE NOT BURIED
IMPACTS IN SURFACE WATER (42" RCP)
WEST RANGE, LLC
VANETTE S. & STEVE A. BALDWIN
50' 0' 50' 100' 150'
GRAPHIC SCALE
FOR -L- EB & -L- WB PROFILES, SEE SHEET 60 & 61
FOR RETAINING WALL -RW22-, SEE SHEETS W-23
P-183
7/19/2017

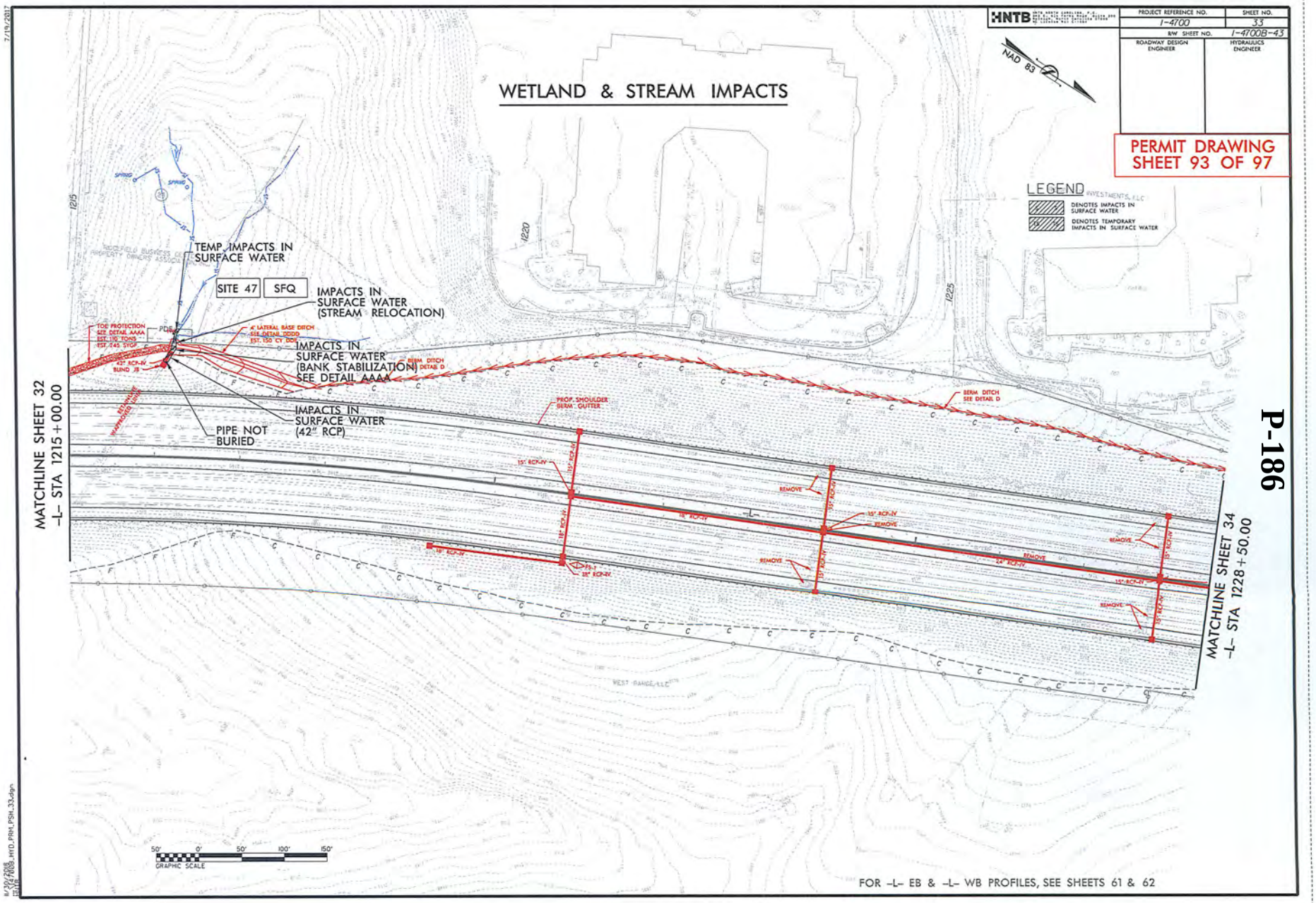


WETLAND & STREAM IMPACTS
HNTB
PROJECT REFERENCE NO.
I-4700
SHEET NO.
32
R/W SHEET NO.
I-4700B-42
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
PERMIT DRAWING
SHEET 91 OF 97
LEGEND
DENOTES IMPACTS IN SURFACE WATER
NAD 83
MATCHLINE SHEET 31
-L- STA 1202+00.00
MATCHLINE SHEET 33
-L- STA 1215+00.00
SITE 46
SFQ
PIPE NOT BURIED
IMPACTS IN SURFACE WATER (42" RCP)
GRAPHIC SCALE
FOR -L- EB & -L- WB PROFILES, SEE SHEET 60 & 61
FOR RETAINING WALL -RW22-, SEE SHEETS W-23



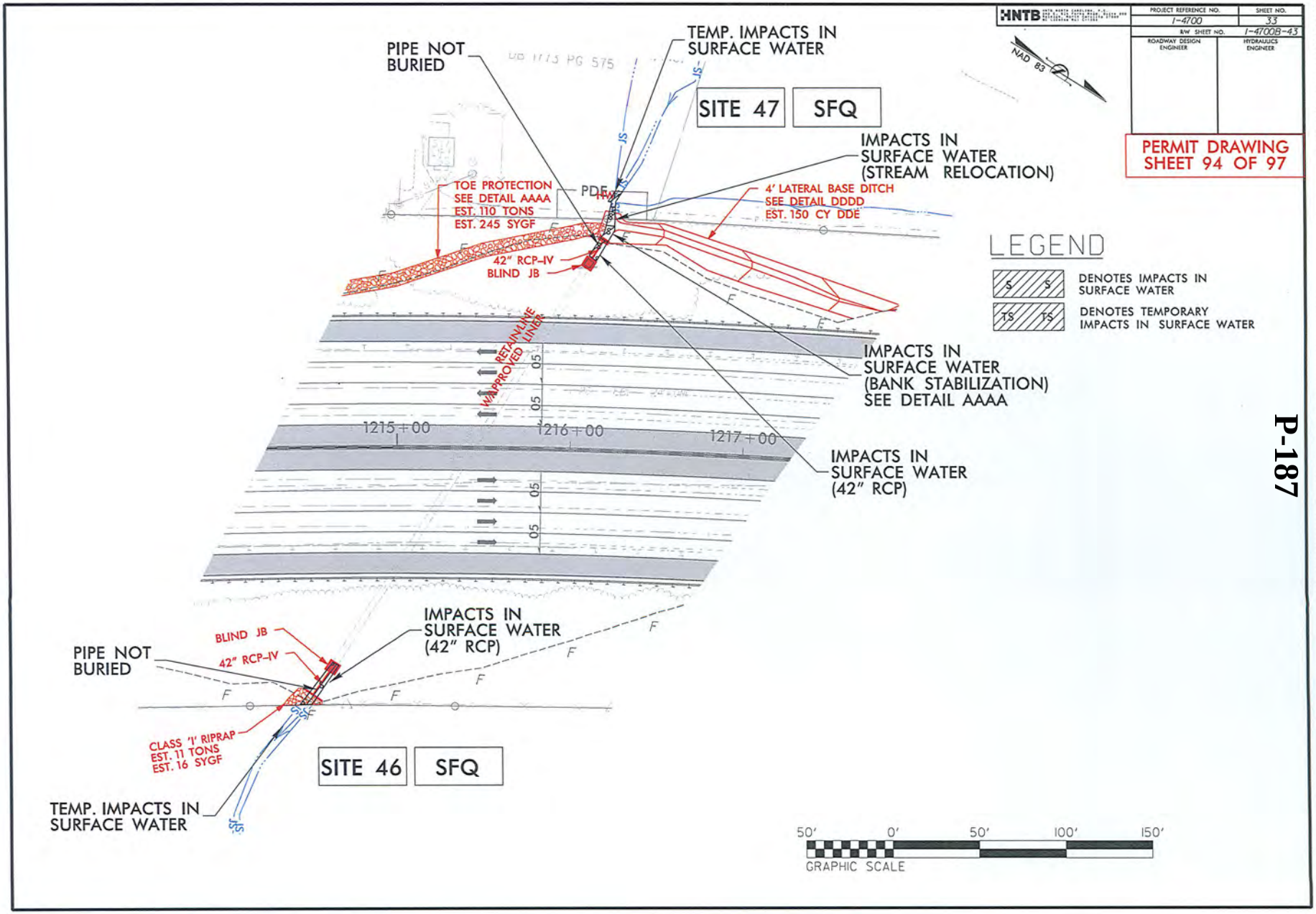
HNTB
PROJECT REFERENCE NO.
I-4700
SHEET NO.
33
R/W SHEET NO.
I-4700B-43
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
PERMIT DRAWING
SHEET 92 OF 97
NAD 83
WETLAND & STREAM IMPACTS
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
TEMP. IMPACTS IN SURFACE WATER
SITE 47
SFQ
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL AAAA
IMPACTS IN SURFACE WATER (42" RCP)
PIPE NOT BURIED
MATCHLINE SHEET 32 -L- STA 1215+00.00
MATCHLINE SHEET 34 -L- STA 1228+50.00
PROP. SHOULDER BERM GUTTER
BERM DITCH SEE DETAIL D
REMOVE
WEST RANGE, LLC
GRAPHIC SCALE
FOR -L- EB & -L- WB PROFILES, SEE SHEETS 61 & 62

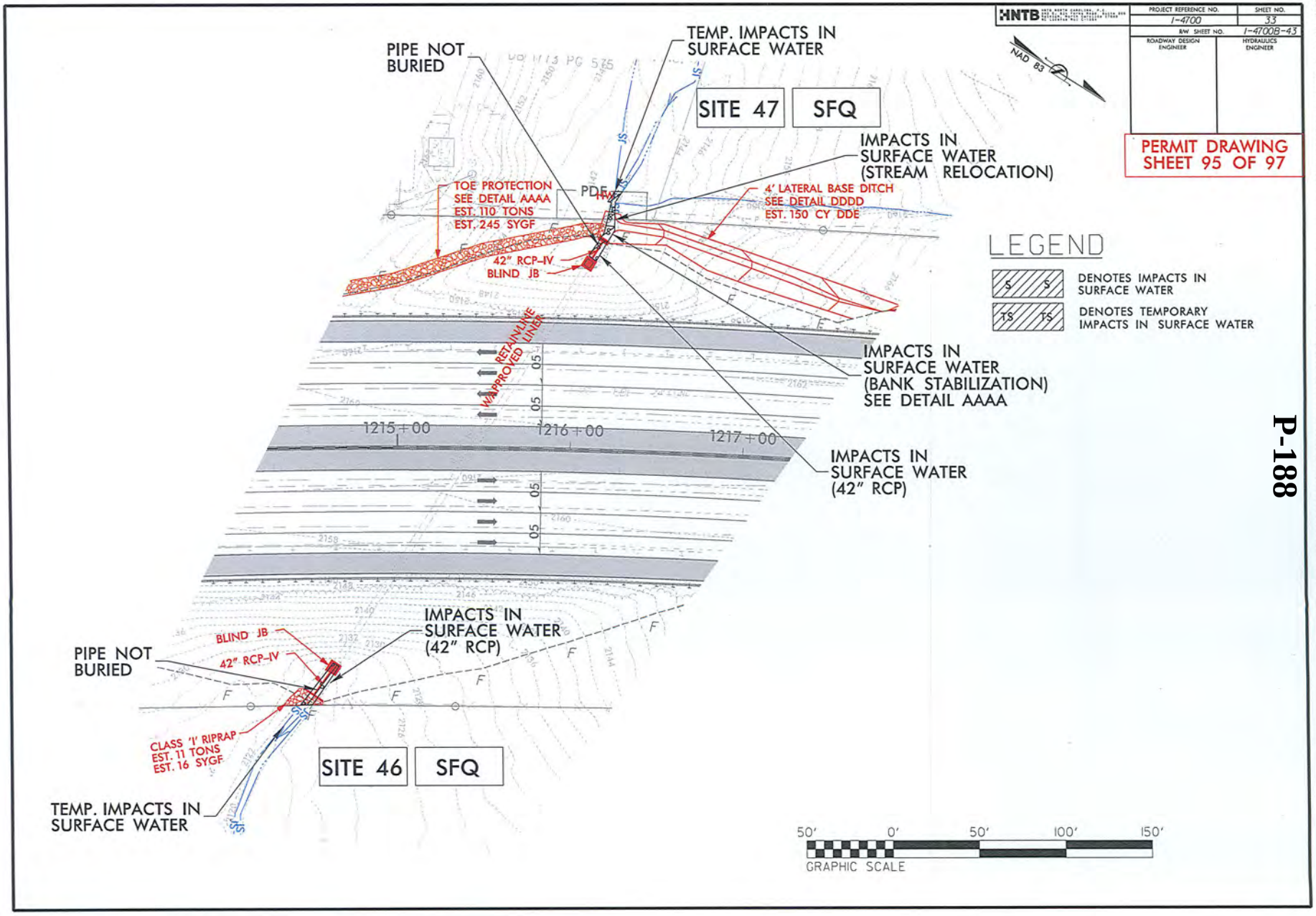
P-185



WETLAND & STREAM IMPACTS
HNTB
PROJECT REFERENCE NO.
I-4700
SHEET NO.
33
R/W SHEET NO.
I-4700B-43
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
PERMIT DRAWING
SHEET 93 OF 97
NAD 83
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
TEMP. IMPACTS IN SURFACE WATER
SITE 47
SFQ
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL AAAA
IMPACTS IN SURFACE WATER (42" RCP)
PIPE NOT BURIED
MATCHLINE SHEET 32 -L- STA 1215+00.00
MATCHLINE SHEET 34 -L- STA 1228+50.00
PROP. SHOULDER BERM GUTTER
BERM DITCH SEE DETAIL D
REMOVE
GRAPHIC SCALE
FOR -L- EB & -L- WB PROFILES, SEE SHEETS 61 & 62

P-186


HNTB
PROJECT REFERENCE NO.
1-4700
SHEET NO.
33
R/W SHEET NO.
1-4700B-43
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
PERMIT DRAWING
SHEET 94 OF 97
P-187
PIPE NOT BURIED
TEMP. IMPACTS IN SURFACE WATER
SITE 47
SFQ
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
TOE PROTECTION SEE DETAIL AAAA EST. 110 TONS EST. 245 SYGF
PDE
4' LATERAL BASE DITCH SEE DETAIL DDDD EST. 150 CY DDE
42" RCP-IV
BLIND JB
RETAINLINE WAPPROVED LINER
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL AAAA
1215+00
1216+00
1217+00
IMPACTS IN SURFACE WATER (42" RCP)
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
BLIND JB
42" RCP-IV
IMPACTS IN SURFACE WATER (42" RCP)
PIPE NOT BURIED
CLASS 'I' RIPRAP EST. 11 TONS EST. 16 SYGF
SITE 46
SFQ
TEMP. IMPACTS IN SURFACE WATER
50' 0' 50' 100' 150'
GRAPHIC SCALE


HNTB
PROJECT REFERENCE NO.
I-4700
SHEET NO.
33
R/W SHEET NO.
I-4700B-43
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
NAD 83
PERMIT DRAWING SHEET 95 OF 97
PIPE NOT BURIED
TEMP. IMPACTS IN SURFACE WATER
SITE 47
SFQ
IMPACTS IN SURFACE WATER (STREAM RELOCATION)
TOE PROTECTION SEE DETAIL AAAA EST. 110 TONS EST. 245 SYGF
PDE
4' LATERAL BASE DITCH SEE DETAIL DDDD EST. 150 CY DDE
42" RCP-IV
BLIND JB
RETAINING LINER (APPROVED)
IMPACTS IN SURFACE WATER (BANK STABILIZATION) SEE DETAIL AAAA
1215+00
1216+00
1217+00
IMPACTS IN SURFACE WATER (42" RCP)
LEGEND
DENOTES IMPACTS IN SURFACE WATER
DENOTES TEMPORARY IMPACTS IN SURFACE WATER
IMPACTS IN SURFACE WATER (42" RCP)
BLIND JB
42" RCP-IV
PIPE NOT BURIED
CLASS 'I' RIPRAP EST. 11 TONS EST. 16 SYGF
SITE 46
SFQ
TEMP. IMPACTS IN SURFACE WATER
50' 0' 50' 100' 150'
GRAPHIC SCALE

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WETLAND AND SURFACE WATER IMPACTS SUMMARY

Site No.	Stream Name Stream ID	Station (From/To)	Structure Size / Type	WETLAND IMPACTS					SURFACE WATER IMPACTS				
				Permanent Fill In Wetlands (ac)	Temp. Fill In Wetlands (ac)	Excavation in Wetlands (ac)	Mechanized Clearing in Wetlands (ac)	Hand Clearing in Wetlands (ac)	Permanent SW impacts (ac)	Temp. SW impacts (ac)	Existing Channel Impacts Permanent (ft)	Existing Channel Impacts Temp. (ft)	Natural Stream Design (ft)
1	UT to French Broad River / SDI	Y13RPB 11+26 to 15+64 LT	Stream relocated to Proposed Roadside ditch Due to Roadway Widening								342		
1A	UT to French Broad River / SDD	WBL 881+50 to 886+10 RT	Stream relocated to Toe Protection due to Roadway Widening								452	10	
2	UT to French Broad River / SDC	WBL 887+41 to 887+62 RT	6' x 6' RCBC Culvert Extension Due to Roadway Widening								25		
2	UT to French Broad River / SDC	WBL 887+20 to 887+45 RT	Bank Stabilization at inlet of 6' X 6' RCBC								22	10	
3	UT to French Broad River / SDC	EBL 888+63 to 889+10 LT	Channel change*1 at upstream and downstream of Existing Culvert								45		
3	UT to French Broad River / SDC	EBL 889+04 to 889+30 LT	Bank Stabilization at outlet of Existing Culvert								44	3	
4	UT to French Broad River / SDE	WBL 914+14 to 914+38 RT	66" RCP between Existing 66" RCP and 66" CMP in the WBL								55		
4	UT to French Broad River / SDE	WBL 913+64 to 913+93 RT	Bank Stabilization at inlet of 66" RCP								34	10	
5	UT to French Broad River / SDE	EBL 914+15 to 914+22 Median	66" RCP between Existing 66" CMP and 66" CMP in the Median								28		
6	UT to French Broad River / SDE	EBL 914+20 to 914+30 LT	Channel Change*1 between outlet of Existing 66" CMP and proposed 66" WSP and Existing 48" CMP								29		
7	UT to French Broad River / SDF	WBL 932+16 to 932+22 RT	54" RCP Extension due to Roadway Widening									27	
8	UT to French Broad River / SDF	EBL 931+83 to 931+95 Median	54" CSP between two Existing 54" RCP in the Median								38		
9	UT to French Broad River / SDF	EBL 932+08 to 932+20 LT	54" RCP Extension Due to Roadway Widening and Conc. Energy Dissipator								30		
9	UT to French Broad River / SDF	EBL 932+14 to 932+23 LT	Bank Stabilization at the outlet of Proposed 54" RCP Extension								12	11	
10	WBR	WBL 936+68 to 938+29 RT	Special Cut Ditches on both side of Inlet of Proposed 24" WSP and Existing 66" RCP	0.03		0.03	0.03						
11	WBV	EBL 938+81 to 952+45 LT	RipRap Outlet Protection of Proposed 24" CSP and Existing 66" RCP	0.15		< 0.01	0.37						
12	UT to French Broad River / SFX / WBU	WBL 942+31 to 943+22 RT	30" RCP Extension Due to Roadway Widening			0.01	0.02				20	10	
13	UT to French Broad River / SDK / WBW	WBL 952+88 to 954+00 RT	66" RCP Extension Due to Roadway Widening / Fill and Excavation in wetland Due to Roadway Widening	0.07		0.02	< 0.01				40	10	
14	UT to French Broad River / SDK	EBL 952+66 to 952+77 LT	66" CSP Extension Due to Roadway Widening								14		
14	UT to French Broad River / SDK	EBL 952+72 to 952+80 LT	Channel Change*1 at downstream of 66" CSP Extension								22	7	
15	Powell Creek / SDN	WBL 983+40 to 983+73 RT	Bank Stabilization at inlet of Proposed 2@ 10' X 10' RCBC								42	10	
15	Powell Creek / SDN	WBL 983+67 to 983+80 RT	Existing 10' X10' RCBC Extension Due to Roadway Widening								12		
16	Powell Creek / SDN	EBL 984+63 to 984+90 LT	Existing 10' X10' RCBC Extension Due to Roadway Widening								16		
16	Powell Creek / SDN	EBL 984+69 to 985+07 LT	Bank Stabilization at outlet of Proposed 2@ 10' X 10' RCBC								82	13	
17	UT to French Broad River / SDU	L 1027+43 to 1027+51 RT	Existing 48" RCP Extension Due to Roadway Widening								16		
17	UT to French Broad River / SDU	L 1027+47 to 1027+ 58 RT	Bank Stabilization at inlet of 2 @ 48" RCP								10	10	
18	UT to French Broad River / SDU	L 1026+47 to 1026+68 LT	Channel Change*1 at outlet of Existing and Proposed 48" CMP and WSP								22	10	
18 A	French Broad River	L 1019+98 to 1020+50 LT	Channel Change*1 at outlet of Existing 8' X 8' Conc. Box Culvert								10	10	
19	WCH	L 1031+14 to 1035+27 LT	Fill in Wetlands Due to Roadway Widening	< 0.01			0.06						
20	UT to French Broad River / SDV	L 1042+57 to 1042+72 RT	Bank Stabilization at outlet of proposed 42" RCP due to Existing 42" CMP Extension and Proposed 42" WSP								18	10	
20	UT to French Broad River / SDV	L 1042+69 to 1042+91 RT	Existing 42" CMP Extension Due to Roadway Widening and Proposed 42" WSP								33		
21	UT to French Broad River / SDW	L 1048+84 to 1049+00 RT	Existing 60" CMP Extension Due to Roadway Widening and Proposed 42" RCP								27		
21	UT to French Broad River / SDW	L 1048+93 to 1049+20 RT	Channel Change*1 at inlet of Proposed 60" CMP Extension and Proposed 42" RCP								24	12	
22	WCH	L 1047+74 to 1047+84	Excavation in Wetland Due to Roadway Widening			< 0.01	0.01						
TOTALS*:				0.26		0.07	0.50				1564	173	

*Rounded totals are sum of actual impacts

NOTES:
*1: Emedding Riprap

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WETLAND AND SURFACE WATER IMPACTS SUMMARY

Site No.	Stream Name Stream ID	Station (From/To)	Structure Size / Type	WETLAND IMPACTS					SURFACE WATER IMPACTS				
				Permanent Fill In Wetlands (ac)	Temp. Fill In Wetlands (ac)	Excavation in Wetlands (ac)	Mechanized Clearing in Wetlands (ac)	Hand Clearing in Wetlands (ac)	Permanent SW impacts (ac)	Temp. SW impacts (ac)	Existing Channel Impacts Permanent (ft)	Existing Channel Impacts Temp. (ft)	Natural Stream Design (ft)
23	UT to French Broad River / SDX	WBL 1082+23 to 1085+46 RT	Stream relocated to Proposed Lateral "V" ditch due to Roadway Widening								312	10	
23	UT to French Broad River / SDX	WBL 1090+35 to 1090+65 RT	Channel change*1 at the Outlet of Proposed 30" CSP and Conc. Energy Dissipator								9	20	
23	UT to French Broad River / SDX	WBL 1091+34 to 1092+04 RT	Proposed 48" WSP with 48" RCP Extension								62	10	
24	UT to French Broad River / SDX	WBL 1094+12 to 1094+42 median	Channel Change*1 at Outlet of Proposed 48" RCP								24	10	
24A	UT to French Broad River / SDX	EBL 1097+18 to 1097+46 median	Channel Change*1 at Outlet of Proposed 30" WSP with 30" RCP Extension								7	20	
25	UT to French Broad River / SEU	EBL 1097+19 to 1097+34 LT	Proposed 30" WSP with 30" RCP Extension								15	4	
26	UT to French Broad River / SDX	EBL 1105+42 to 1105+52 RT	Stream relocated to Proposed Standard Base Ditch								32	5	
27	UT to French Broad River / SDY / WCV	WBL 1104+37 to 1104+51 RT	Existing 30" CMP with 30" RCP Extension			< 0.01					19	13	
28	UT to French Broad River / SDY	WBL 1104+88 to 1105+14 LT	Channel Change*1 at Outlet of Proposed 24" CSP and Conc. Energy Dissipator								9	18	
29	UT to French Broad River / SDX	EBL 1106+74 to 1107+07 RT	Temp. Impact for Constructing Standard Base Ditch									30	
29	UT to French Broad River / SDX	WBL 1107+12 to 1107+38 LT	Channel Change*1 at Outlet of Proposed 24" WSP with 24" CSP Extension								7	20	
30	UT to French Broad River / SDX	WBL 1115+40 to 1115+70 LT	Channel Change*1 at Outlet of 24" CSP and Conc. Energy Dissipator								9	20	
30	UT to French Broad River / SDX	EBL 1118+02 to 1118+30 RT	Channel Change*1 at Outlet of Proposed 15" CSP and Conc. Energy Dissipator								9	20	
30	UT to French Broad River / SDX	WBL 1118+34 to 1118+65 LT	Channel Change*1 at Outlet of 15" CSP and Conc. Energy Dissipator								9	18	
30	UT to French Broad River / SDX	WBL 1118+62 to 1119+51 LT	Proposed 66" WSP with 66" RCP Extension								77	10	
31	UT to French Broad River / SDX	WBL 1120+78 to 1121+11 RT	Proposed 66" WSP with 66" RCP Extension								38	10	
32	WCW	WBL 1123+76 to L 1137+72 RT	Fill in Wetland Due to Roadway Widening	0.37			0.30						
32	UT to French Broad River / SEQ	WBL 1131+60 to 1131+94 RT	Proposed 60" WSP with 60" RCP Extension								57	7	
33	UT to French Broad River / SEQ	EBL 1131+02 to 1131+11 LT	Stream relocated to Proposed 60" WSP with 60" RCP Extension								24	10	
33	UT to French Broad River / SEQ	EBL 1131+00 to 1131+12 LT	Proposed 60" WSP with 60" RCP Extension								30		
34	UT to French Broad River / SED	L 1138+18 to 1138+32 LT	Stream relocated to Standard Base Ditch at the Outlet of Proposed 36" RCP								30	12	
34	UT to French Broad River / SED	L 1138+29 to 1138+47 LT	Existing 36" CMP Extension with a 36" RCP Due to Roadway Widening								25		
35	WCZ	L 1138+55 to 1139+39 RT	Fill in Wetland Due to Roadway Widening	0.02									
36	UT to French Broad River / SEF	L 1147+02 to 1147+09 LT	Channel Change*1 at Outlet of Proposed 42" RCP								8	10	
36	UT to French Broad River / SEF	L 1146+98 to 1147+07 LT	Existing 42" CMP Extension with a 42" RCP Due to Roadway Widening								28		
37	UT to French Broad River / SEF	L 1148+35 to 1148+64 RT	Channel Change*1 at the Outlet of Proposed 15" CSP and Conc. Energy Dissipator								9	20	
37	UT to French Broad River / SEF	L 1149+17 to 1151+55 RT	Stream relocated to Proposed 4' Lateral Base Ditch due to Roadway Widening								356	10	
38	UT to French Broad River / SEE	L 1153+90 to 1154+10 RT	Stream relocated to Proposed 4' Lateral Base Ditch due to Roadway Widening								18	10	
38	UT to French Broad River / SEE	L 1155+35 to 1155+64 RT	Bank Stabilization at outlet of Proposed 15" CSP and Conc. Energy Dissipator								9	20	
38	UT to French Broad River / SEE	L 1156+95 to 1158+01 RT	Temp. Pipe for Access Road									106	
38	UT to French Broad River / SEE	L 1157+29 to 1157+38 RT	Channel Change*1 at Outlet of Proposed 30" CSP and Conc. Energy Dissipator								9		
39	WFG	L 1153+55 to 1153+89 LT	Fill in Wetland Due to Roadway Widening	< 0.01		< 0.01							
39	UT to French Broad River / SEE	L 1153+56 to 1153+67 LT	Proposed 24" RCP								33		
39	UT to French Broad River / SEE	L 1153+63 to 1153+77 LT	Stream relocated to Retaining Wall Gutter								22	10	
40	French Broad River	L 1161+33 to 1165+06	Bridge									245	
41	UT to French Broad River / SFG	L 1164+95 to 1171+67 RT	Temporary Pipe Due to Acess Road									662	
41	UT to French Broad River / SFG	L 1172+85 to 1173+15 RT	Channel Change*1 at Outlet of Proposed 15" CSP and Conc. Energy Dissipator								9	20	
42	UT to French Broad River / SFO	L 1169+93 to 1170+02 LT	Temporary Pipe Due to Acess Road									9	
43	WDZ	L 1179+54 to 1180+29 RT	Fill in Wetland Due to Roadway Widening	0.02			0.02						
44	UT to French Broad River / SFG	L 1196+69 to 1196+95 RT	Channel Change*1 at Outlet of Proposed 54" WSP with 54" RCP Extension								8	20	
45	UT to French Broad River / SFR	L 1196+70 to 1196+81 LT	Stream relocated to Proposed 4' Standard Base Ditch at Outlet of Proposed 54" WSP with 54" RCP Extension								21	6	
46	UT to French Broad River / SFQ	L 1214+30 to 1214+64 RT	Existing 42" CMP Extension with a 42" RCP Due to Roadway Widening								29		
47	UT to French Broad River / SFQ	L 1216+09 to 1216+19 LT	Existing 42" CMP Extension with a 42" RCP Due to Roadway Widening								12		
47	UT to French Broad River / SFQ	L 1216+15 to 1216+22 LT	Bank Stabilization at end of Toe Protection								9		
47	UT to French Broad River / SFQ	L 1216+18 to 1216+26 LT	Stream relocated to Proposed 4' Lateral Base Ditch due to Roadway Widening								8	13	
TOTALS*:				0.41		< 0.01	0.32				1392	1428	
TOTALS FOR I-4700:				0.67		0.07	0.82				2956	1601	

*Rounded totals are sum of actual impacts

NOTES:
Site 40: Impacts of interior bents are 400 SF
*1: Emedding Riprap

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County : Buncombe, Henderson

Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
			ROADWAY ITEMS			
0001	0000100000-N	800	MOBILIZATION	Lump Sum	L.S.	
0002	0000400000-N	801	CONSTRUCTION SURVEYING	Lump Sum	L.S.	
0003	0000900000-N	SP	GENERIC MISCELLANEOUS ITEM UTILITY COORDINATOR	Lump Sum	L.S.	
0004	0000910000-N	SP	GENERIC MISCELLANEOUS ITEM EQUIPMENT OPERATING RATE FOR SNOW AND ICE REMOVAL	3,840 HR		
0005	0000915000-N	SP	GENERIC MISCELLANEOUS ITEM OUTFITTING FEE	4 EA		
0006	0000915000-N	SP	GENERIC MISCELLANEOUS ITEM RESPONSE FOR SNOW AND ICE REMOVAL	80 EA		
0007	0001000000-E	200	CLEARING & GRUBBING .. ACRE(S)	Lump Sum	L.S.	
0008	0008000000-E	200	SUPPLEMENTARY CLEARING & GRUB-BING	4 ACR		
0009	0022000000-E	225	UNCLASSIFIED EXCAVATION	717,100 CY		
0010	0028000000-N	SP	TYPE I STANDARD APPROACH FILL STATION ********** (1050+63.05 -L-)	Lump Sum	L.S.	
0011	0028000000-N	SP	TYPE I STANDARD APPROACH FILL STATION ********** (1163+08.56 -L-)	Lump Sum	L.S.	
0012	0029000000-N	SP	TYPE III REINFORCED APPROACH FILL, STATION ******* (912+89.86 -EBL-)	Lump Sum	L.S.	
0013	0029000000-N	SP	TYPE III REINFORCED APPROACH FILL, STATION ******* (913+34.69 -WBL-)	Lump Sum	L.S.	
0014	0036000000-E	225	UNDERCUT EXCAVATION	10,100 CY		
0015	0106000000-E	230	BORROW EXCAVATION	91,400 CY		
0016	0134000000-E	240	DRAINAGE DITCH EXCAVATION	18,000 CY		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0017	0141000000-E	240	BERM DITCH CONSTRUCTION	11,000 LF		
0018	0156000000-E	250	REMOVAL OF EXISTING ASPHALT PAVEMENT	360,000 SY		
0019	0163000000-E	250	REMOVAL OF EXISTING CONCRETE PAVEMENT	190,000 SY		
0020	0177000000-E	250	BREAKING OF EXISTING ASPHALT PAVEMENT	7,300 SY		
0021	0185000000-E	250	BREAKING OF EXISTING CONCRETE PAVEMENT	7,600 SY		
0022	0195000000-E	265	SELECT GRANULAR MATERIAL	8,000 CY		
0023	0196000000-E	270	GEOTEXTILE FOR SOIL STABILIZA-TION	728,300 SY		
0024	0199000000-E	SP	TEMPORARY SHORING	24,450 SF		
0025	0225000000-E	SP	REINFORCED SOIL SLOPES	1,900 SY		
0026	0241000000-E	SP	GENERIC GRADING ITEM GEOTEXTILE, TYPE 4	9,000 SY		
0027	0241000000-E	SP	GENERIC GRADING ITEM GEOTEXTILE, TYPE 5	4,250 SY		
0028	0241000000-E	SP	GENERIC GRADING ITEM OBLITERATION OF EXISTING MOUNTAIN TO SEA TRAIL	270 SY		
0029	0255000000-E	SP	GENERIC GRADING ITEM SELECT MATERIAL, CLASS IV	5,000 TON		
0030	0255000000-E	SP	GENERIC GRADING ITEM SELECT MATERIAL, CLASS VII	104,000 TON		
0031	0255000000-E	SP	GENERIC GRADING ITEM TOPSOIL	1,350 TON		
0032	0262000000-N	SP	GENERIC GRADING ITEM STONE HEADWALL REMOVAL	4 EA		
0033	0264000000-E	SP	GENERIC GRADING ITEM VACUUM SWEEPING	30 SMI		

County : Buncombe, Henderson

Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0034	0318000000-E	300	FOUNDATION CONDITIONING MATERIAL, MINOR STRUCTURES	4,880 TON		
0035	0320000000-E	300	FOUNDATION CONDITIONING GEOTEXTILE	15,330 SY		
0036	0335300000-E	305	18" DRAINAGE PIPE	110 LF		
0037	0372000000-E	310	18" RC PIPE CULVERTS, CLASS III	320 LF		
0038	0378000000-E	310	24" RC PIPE CULVERTS, CLASS III	405 LF		
0039	0448000000-E	310	****" RC PIPE CULVERTS, CLASS IV (48")	1,132 LF		
0040	0448000000-E	310	****" RC PIPE CULVERTS, CLASS IV (54")	158 LF		
0041	0448000000-E	310	****" RC PIPE CULVERTS, CLASS IV (60")	24 LF		
0042	0448000000-E	310	****" RC PIPE CULVERTS, CLASS IV (66")	284 LF		
0043	0448200000-E	310	15" RC PIPE CULVERTS, CLASS IV	20,350 LF		
0044	0448300000-E	310	18" RC PIPE CULVERTS, CLASS IV	8,008 LF		
0045	0448400000-E	310	24" RC PIPE CULVERTS, CLASS IV	5,500 LF		
0046	0448500000-E	310	30" RC PIPE CULVERTS, CLASS IV	3,064 LF		
0047	0448600000-E	310	36" RC PIPE CULVERTS, CLASS IV	1,320 LF		
0048	0448700000-E	310	42" RC PIPE CULVERTS, CLASS IV	808 LF		
0049	0576000000-E	310	**" CS PIPE CULVERTS, *****" THICK (66", 0.109")	32 LF		
0050	0582000000-E	310	15" CS PIPE CULVERTS, 0.064" THICK	3,064 LF		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0051	0588000000-E	310	18" CS PIPE CULVERTS, 0.064" THICK	1,138 LF		
0052	0594000000-E	310	24" CS PIPE CULVERTS, 0.064" THICK	684 LF		
0053	0600000000-E	310	30" CS PIPE CULVERTS, 0.079" THICK	164 LF		
0054	0636000000-E	310	**" CS PIPE ELBOWS, *****" THICK (15", 0.064")	86 EA		
0055	0636000000-E	310	**" CS PIPE ELBOWS, *****" THICK (18", 0.064")	27 EA		
0056	0636000000-E	310	**" CS PIPE ELBOWS, *****" THICK (24", 0.064")	21 EA		
0057	0636000000-E	310	**" CS PIPE ELBOWS, *****" THICK (30", 0.079")	7 EA		
0058	0636000000-E	310	**" CS PIPE ELBOWS, *****" THICK (66", 0.109")	2 EA		
0059	0973100000-E	330	**" WELDED STEEL PIPE, ****" THICK, GRADE B IN SOIL (36", 0.500")	332 LF		
0060	0973100000-E	330	**" WELDED STEEL PIPE, ****" THICK, GRADE B IN SOIL (42", 0.625")	100 LF		
0061	0973100000-E	330	**" WELDED STEEL PIPE, ****" THICK, GRADE B IN SOIL (48", 0.625")	152 LF		
0062	0973100000-E	330	**" WELDED STEEL PIPE, ****" THICK, GRADE B IN SOIL (66", 0.875")	162 LF		
0063	0973300000-E	330	**" WELDED STEEL PIPE, ****" THICK, GRADE B NOT IN SOIL (36", 0.500")	333 LF		
0064	0973300000-E	330	**" WELDED STEEL PIPE, ****" THICK, GRADE B NOT IN SOIL (42", 0.625")	100 LF		

County : Buncombe, Henderson

Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0065	0973300000-E	330	**" WELDED STEEL PIPE, ****" THICK, GRADE B NOT IN SOIL (48", 0.625")	152 LF		
0066	0973300000-E	330	**" WELDED STEEL PIPE, ****" THICK, GRADE B NOT IN SOIL (66", 0.875")	163 LF		
0067	0986000000-E	SP	GENERIC PIPE ITEM 15" CS SLOTTED DRAIN 0.064" THICK	1,768 LF		
0068	0995000000-E	340	PIPE REMOVAL	15,319 LF		
0069	0996000000-N	350	PIPE CLEAN OUT	3 EA		
0070	0999000000-E	462	4" SLOPE PROTECTION	130 SY		
0071	1011000000-N	500	FINE GRADING	Lump Sum	L.S.	
0072	1099500000-E	505	SHALLOW UNDERCUT	179,400 CY		
0073	1099700000-E	505	CLASS IV SUBGRADE STABILIZA-TION	460,000 TON		
0074	1110000000-E	510	STABILIZER AGGREGATE	1,000 TON		
0075	1115000000-E	SP	GEOTEXTILE FOR PAVEMENT STA-BILIZATION	63,807 SY		
0076	1121000000-E	520	AGGREGATE BASE COURSE	8,400 TON		
0077	1220000000-E	545	INCIDENTAL STONE BASE	5,000 TON		
0078	1275000000-E	600	PRIME COAT	3,900 GAL		
0079	1297000000-E	607	MILLING ASPHALT PAVEMENT, ***" DEPTH (1-1/2")	34,647 SY		
0081	1330000000-E	607	INCIDENTAL MILLING	70,000 SY		
0082	1491000000-E	610	ASPHALT CONC BASE COURSE, TYPE B25.0C	150,477 TON		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0083	1503000000-E	610	ASPHALT CONC INTERMEDIATE COURSE, TYPE I19.0C	85,576 TON		
0084	1519000000-E	610	ASPHALT CONC SURFACE COURSE, TYPE S9.5B	33,032 TON		
0085	1523000000-E	610	ASPHALT CONC SURFACE COURSE, TYPE S9.5C	40,000 TON		
0086	1524200000-E	610	ASPHALT CONC SURFACE COURSE, TYPE S9.5D	27,846 TON		
0087	1575000000-E	620	ASPHALT BINDER FOR PLANT MIX	15,500 TON		
0088	1577000000-E	620	POLYMER MODIFIED ASPHALT BIN-DER FOR PLANT MIX	1,600 TON		
0089	1693000000-E	654	ASPHALT PLANT MIX, PAVEMENT REPAIR	1,000 TON		
0090	1840000000-E	665	MILLED RUMBLE STRIPS (ASPHALT CONCRETE)	160,000 LF		
0091	1847000000-E	710	*****" PORT CEM CONC PAVEMENT, THROUGH LANES (WITH DOWELS) (13-1/2")	449,500 SY		
0092	1880000000-E	SP	GENERIC PAVING ITEM AGGREGATE TOPSOIL	425 TON		
0093	1891000000-E	SP	GENERIC PAVING ITEM DIAMOND GRINDING PORT CEM CONC PAVEMENT	449,500 SY		
0094	1891000000-E	SP	GENERIC PAVING ITEM STAMPED CONCRETE	250 SY		
0095	1920000000-E	724	NONWOVEN GEOTEXTILE INTERLAYER	460,000 SY		
0096	2000000000-N	806	RIGHT-OF-WAY MARKERS	3 EA		
0097	2022000000-E	815	SUBDRAIN EXCAVATION	1,008 CY		
0098	2026000000-E	815	GEOTEXTILE FOR SUBSURFACE DRAINS	4,500 SY		
0099	2036000000-E	815	SUBDRAIN COARSE AGGREGATE	756 CY		

County : Buncombe, Henderson

Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0100	2044000000-E	815	6" PERFORATED SUBDRAIN PIPE	4,500 LF		
0101	2070000000-N	815	SUBDRAIN PIPE OUTLET	67 EA		
0102	2077000000-E	815	6" OUTLET PIPE	402 LF		
0103	2099000000-E	816	SHOULDER DRAIN	112,000 LF		
0104	2110000000-E	816	4" SHOULDER DRAIN PIPE	112,000 LF		
0105	2121000000-E	816	4" OUTLET PIPE FOR SHOULDER DRAINS	5,200 LF		
0106	2132000000-N	816	CONCRETE PAD FOR SHOULDER DRAIN PIPE OUTLET	100 EA		
0107	2190000000-N	828	TEMPORARY STEEL PLATE COVERS FOR MASONRY DRAINAGE STRUCTURE	177 EA		
0108	2209000000-E	838	ENDWALLS	36 CY		
0109	2220000000-E	838	REINFORCED ENDWALLS	121 CY		
0110	2275000000-E	SP	FLOWABLE FILL	665 CY		
0111	2286000000-N	840	MASONRY DRAINAGE STRUCTURES	550 EA		
0112	2297000000-E	840	MASONRY DRAINAGE STRUCTURES	84 CY		
0113	2308000000-E	840	MASONRY DRAINAGE STRUCTURES	857 LF		
0114	2364200000-N	840	FRAME WITH TWO GRATES, STD 840.20	404 EA		
0115	2365000000-N	840	FRAME WITH TWO GRATES, STD 840.22	120 EA		
0116	2374000000-N	840	FRAME WITH GRATE & HOOD, STD 840.03, TYPE ** (F)	5 EA		
0117	2374000000-N	840	FRAME WITH GRATE & HOOD, STD 840.03, TYPE ** (G)	1 EA		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0118	2396000000-N	840	FRAME WITH COVER, STD 840.54	28 EA		
0119	2473000000-N	SP	GENERIC DRAINAGE ITEM ENERGY DISSIPATOR	20 EA		
0120	2473000000-N	SP	GENERIC DRAINAGE ITEM STONE MASONRY HEADWALL FOR 18" PIPE CULVERT	3 EA		
0121	2473000000-N	SP	GENERIC DRAINAGE ITEM STONE MASONRY HEADWALL FOR 24" PIPE CULVERT	7 EA		
0122	2476000000-E	SP	GENERIC DRAINAGE ITEM GROUTING	3,150 GAL		
0123	2484000000-E	SP	GENERIC DRAINAGE ITEM 24" PIPE REHABILITATION CIPP LINER	133 LF		
0124	2484000000-E	SP	GENERIC DRAINAGE ITEM 30" PIPE REHABILITATION CIPP LINER	810 LF		
0125	2484000000-E	SP	GENERIC DRAINAGE ITEM 36" OD PIPE REHABILITATION SOLID WALL THERMOPLASTIC SLIP LINER	1,433 LF		
0126	2484000000-E	SP	GENERIC DRAINAGE ITEM 36" PIPE REHABILITATION CIPP LINER	624 LF		
0127	2484000000-E	SP	GENERIC DRAINAGE ITEM 42" OD PIPE REHABILITATION SOLID WALL THERMOPLASTIC SLIP LINER	574 LF		
0128	2484000000-E	SP	GENERIC DRAINAGE ITEM 48" OD PIPE REHABILITATION SOLID WALL THERMOPLASTIC SLIP LINER	168 LF		
0129	2484000000-E	SP	GENERIC DRAINAGE ITEM 54" OD PIPE REHABILITATION SOLID WALL THERMOPLASTIC SLIP LINER	570 LF		
0130	2484000000-E	SP	GENERIC DRAINAGE ITEM 63" OD PIPE REHABILITATION SOLID WALL THERMOPLASTIC SLIP LINER	190 LF		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0131	2484000000-E	SP	GENERIC DRAINAGE ITEM PRE-INSTALLATION INSPECTION	4,502 LF		
0132	2484000000-E	SP	GENERIC DRAINAGE ITEM SEALANT	841 LF		
0133	2486000000-E	SP	GENERIC DRAINAGE ITEM TEMPORARY SHORING FOR DRAINAGE PIPE CONSTRUCTION	30,000 SF		
0134	2535000000-E	846	**"X **" CONCRETE CURB (6" X 18")	35 LF		
0135	2542000000-E	846	1'-6" CONCRETE CURB & GUTTER	70 LF		
0136	2549000000-E	846	2'-6" CONCRETE CURB & GUTTER	1,900 LF		
0137	2556000000-E	846	SHOULDER BERM GUTTER	58,000 LF		
0138	2577000000-E	846	CONCRETE EXPRESSWAY GUTTER	210 LF		
0139	2591000000-E	848	4" CONCRETE SIDEWALK	750 SY		
0140	2605000000-N	848	CONCRETE CURB RAMPS	14 EA		
0141	2619000000-E	850	4" CONCRETE PAVED DITCH	6,350 SY		
0142	2627000000-E	852	4" CONCRETE ISLAND COVER	400 SY		
0143	2647000000-E	852	5" MONOLITHIC CONCRETE ISLANDS (SURFACE MOUNTED)	280 SY		
0144	2703000000-E	854	CONCRETE BARRIER, TYPE ******* (I SINGLE SLOPE)	12,000 LF		
0145	2703000000-E	854	CONCRETE BARRIER, TYPE ******* (T1)	320 LF		
0146	2710000000-N	854	CONCRETE BARRIER TRANSITION SECTION	11 EA		
0147	2717000000-E	854	VARIABLE HEIGHT CONCRETE BARRIER, TYPE ********** (II SINGLE SLOPE)	14,300 LF		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0148	2724000000-E	857	PRECAST REINFORCED CONCRETE BARRIER, SINGLE FACED	13,000 LF		
0149	2738000000-E	SP	GENERIC PAVING ITEM PAVED WATERWAY, TYPE 5, AS-PHALT	1,400 SY		
0150	2752000000-E	SP	GENERIC PAVING ITEM CONCRETE CAP FOR SINGLE FACED BARRIER FILL	384 LF		
0151	2752000000-E	SP	GENERIC PAVING ITEM GRANITE CURB	380 LF		
0152	2752000000-E	SP	GENERIC PAVING ITEM MEDIAN HAZARD PROTECTION	119 LF		
0153	2845000000-N	858	ADJUSTMENT OF METER BOXES OR VALVE BOXES	5 EA		
0154	2850000000-N	858	GENERIC DRAINAGE ITEM ADJUSTMENT OF JUNCTION BOX	1 EA		
0155	2893000000-N	859	CONVERT EXISTING CATCH BASIN TO JUNCTION BOX WITH MANHOLE	3 EA		
0156	2938000000-N	859	CONVERT EXISTING DROP INLET TO JUNCTION BOX WITH MANHOLE	4 EA		
0157	3030000000-E	862	STEEL BEAM GUARDRAIL	70,000 LF		
0158	3150000000-N	862	ADDITIONAL GUARDRAIL POSTS	100 EA		
0159	3210000000-N	862	GUARDRAIL END UNITS, TYPE CAT-1	26 EA		
0160	3287000000-N	SP	GUARDRAIL END UNITS, TYPE TL-3	22 EA		
0161	3317000000-N	SP	GUARDRAIL ANCHOR UNITS, TYPE B-77	44 EA		
0162	3360000000-E	863	REMOVE EXISTING GUARDRAIL	95,030 LF		
0163	3380000000-E	862	TEMPORARY STEEL BEAM GUARDRAIL	500 LF		
0164	3387000000-N	SP	TEMPORARY GUARDRAIL ANCHOR UNITS, TYPE ********** (B-77)	18 EA		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0165	3387000000-N	SP	TEMPORARY GUARDRAIL ANCHOR UNITS, TYPE ********** (III)	8 EA		
0166	3420000000-E	SP	GENERIC GUARDRAIL ITEM GUARDRAIL SYSTEM, STEEL-BACKED TIMBER, TYPE A (SBTA)	1,200 LF		
0167	3420000000-E	SP	GENERIC GUARDRAIL ITEM STONE MASONRY GUARDWALL	655 LF		
0168	3435000000-N	SP	GENERIC GUARDRAIL ITEM GUARDRAIL TERMINAL SECTION, TYPE SBT TANGENT	4 EA		
0169	3435000000-N	SP	GENERIC GUARDRAIL ITEM RESPONSE FOR GUARDRAIL/ GUIDERAIL MAINTENANCE	200 EA		
0170	3503000000-E	866	WOVEN WIRE FENCE, 47" FABRIC	80,000 LF		
0171	3509000000-E	866	4" TIMBER FENCE POSTS, 7'-6" LONG	5,100 EA		
0172	3515000000-E	866	5" TIMBER FENCE POSTS, 8'-0" LONG	1,200 EA		
0173	3557000000-E	866	ADDITIONAL BARBED WIRE	1,000 LF		
0174	3559000000-E	866	** STRAND BARBED WIRE FENCE WITH POSTS (4)	1,000 LF		
0175	3563000000-E	SP	TEMP **" WOVEN WIRE FENCE, COMPLETE W/POSTS (47")	300 LF		
0176	3578000000-N	SP	GENERIC FENCING ITEM 16' STEEL PIPE GATE	1 EA		
0177	3628000000-E	876	RIP RAP, CLASS I	4,175 TON		
0178	3635000000-E	876	RIP RAP, CLASS II	790 TON		
0179	3649000000-E	876	RIP RAP, CLASS B	2,315 TON		
0180	3656000000-E	876	GEOTEXTILE FOR DRAINAGE	37,259 SY		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0181	4025000000-E	901	CONTRACTOR FURNISHED, TYPE *** SIGN (E)	30 SF		
0182	4048000000-E	902	REINFORCED CONCRETE SIGN FOUNDATIONS	36 CY		
0183	4054000000-E	902	PLAIN CONCRETE SIGN FOUNDATIONS	7 CY		
0184	4057000000-E	SP	OVERHEAD FOOTING	245 CY		
0185	4060000000-E	903	SUPPORTS, BREAKAWAY STEEL BEAM	30,539 LB		
0186	4066000000-E	903	SUPPORTS, SIMPLE STEEL BEAM	10,134 LB		
0187	4072000000-E	903	SUPPORTS, 3-LB STEEL U-CHANNEL	1,420 LF		
0188	4079000000-N	903	SUPPORTS, BARRIER (SMALL)	5 EA		
0189	4082100000-N	906	SUPPORTS, OVERHEAD SIGN STRUCTURE AT STA ****** (1001+50 -L-)	Lump Sum	L.S.	
0190	4082100000-N	906	SUPPORTS, OVERHEAD SIGN STRUCTURE AT STA ****** (1025+50 -L- LT)	Lump Sum	L.S.	
0191	4082100000-N	906	SUPPORTS, OVERHEAD SIGN STRUCTURE AT STA ****** (1068+00 -L- LT)	Lump Sum	L.S.	
0192	4082100000-N	906	SUPPORTS, OVERHEAD SIGN STRUCTURE AT STA ****** (1131+50 -EBL- LT)	Lump Sum	L.S.	
0193	4082100000-N	906	SUPPORTS, OVERHEAD SIGN STRUCTURE AT STA ****** (1171+00 -L-)	Lump Sum	L.S.	
0194	4082100000-N	906	SUPPORTS, OVERHEAD SIGN STRUCTURE AT STA ****** (1225+00 -L-)	Lump Sum	L.S.	
0195	4082100000-N	906	SUPPORTS, OVERHEAD SIGN STRUCTURE AT STA ****** (20+50 -Y15- RPA)	Lump Sum	L.S.	

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0196	4082100000-N	906	SUPPORTS, OVERHEAD SIGN STRUCTURE AT STA ****** (21+50 -Y15- RPC)	Lump Sum	L.S.	
0197	4082100000-N	906	SUPPORTS, OVERHEAD SIGN STRUCTURE AT STA ****** (838+75 -L-)	Lump Sum	L.S.	
0198	4082100000-N	906	SUPPORTS, OVERHEAD SIGN STRUCTURE AT STA ****** (860+50 -L-)	Lump Sum	L.S.	
0199	4082100000-N	906	SUPPORTS, OVERHEAD SIGN STRUCTURE AT STA ****** (911+00 -WBL-)	Lump Sum	L.S.	
0200	4082100000-N	906	SUPPORTS, OVERHEAD SIGN STRUCTURE AT STA ****** (916+00 -EBL)	Lump Sum	L.S.	
0201	4082100000-N	906	SUPPORTS, OVERHEAD SIGN STRUCTURE AT STA ****** (951+00 -WBL-)	Lump Sum	L.S.	
0202	4082100000-N	906	SUPPORTS, OVERHEAD SIGN STRUCTURE AT STA ****** (966+50 -EBL- LT)	Lump Sum	L.S.	
0203	4096000000-N	904	SIGN ERECTION, TYPE D	11 EA		
0204	4102000000-N	904	SIGN ERECTION, TYPE E	29 EA		
0205	4108000000-N	904	SIGN ERECTION, TYPE F	6 EA		
0206	4110000000-N	904	SIGN ERECTION, TYPE *** (GROUND MOUNTED) (A)	32 EA		
0207	4110000000-N	904	SIGN ERECTION, TYPE *** (GROUND MOUNTED) (B)	11 EA		
0208	4114000000-N	904	SIGN ERECTION, MILEMARKERS	30 EA		
0209	4116100000-N	904	SIGN ERECTION, RELOCATE TYPE **** (GROUND MOUNTED) (A)	28 EA		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0210	4116100000-N	904	SIGN ERECTION, RELOCATE TYPE **** (GROUND MOUNTED) (B)	4 EA		
0211	4116100000-N	904	SIGN ERECTION, RELOCATE TYPE **** (GROUND MOUNTED) (D)	4 EA		
0212	4116200000-N	904	SIGN ERECTION, REPOSITION OVERHEAD	1 EA		
0213	4138000000-N	907	DISPOSAL OF SUPPORT, STEEL BEAM	60 EA		
0214	4141000000-N	907	DISPOSAL OF SUPPORT, WOOD	4 EA		
0215	4149000000-N	907	DISPOSAL OF SIGN SYSTEM, OVER-HEAD	2 EA		
0216	4152000000-N	907	DISPOSAL OF SIGN SYSTEM, STEEL BEAM	24 EA		
0217	4155000000-N	907	DISPOSAL OF SIGN SYSTEM, U-CHANNEL	80 EA		
0218	4158000000-N	907	DISPOSAL OF SIGN SYSTEM, WOOD	7 EA		
0219	4192000000-N	907	DISPOSAL OF SUPPORT, U-CHANNEL	8 EA		
0220	4400000000-E	1110	WORK ZONE SIGNS (STATIONARY)	295 SF		
0221	4402000000-E	SP	HIGH VISIBILITY STATIONARY SIGNS	216 SF		
0222	4405000000-E	1110	WORK ZONE SIGNS (PORTABLE)	146 SF		
0223	4407000000-E	SP	HIGH VISIBILITY PORTABLE SIGNS	3,394 SF		
0224	4410000000-E	1110	WORK ZONE SIGNS (BARRICADE MOUNTED)	270 SF		
0225	4415000000-N	1115	FLASHING ARROW BOARD	25 EA		
0226	4420000000-N	1120	PORTABLE CHANGEABLE MESSAGE SIGN	18 EA		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0227	4422000000-N	1120	PORTABLE CHANGEABLE MESSAGE SIGN (SHORT TERM)	50 DAY		
0228	4424000000-N	SP	WORK ZONE PRESENCE LIGHTING	18 EA		
0229	4430000000-N	1130	DRUMS	148 EA		
0230	4432000000-N	SP	HIGH VISIBILITY DRUMS	2,000 EA		
0231	4434000000-N	SP	SEQUENTIAL FLASHING WARNING LIGHTS	36 EA		
0232	4435000000-N	1135	CONES	80 EA		
0233	4445000000-E	1145	BARRICADES (TYPE III)	384 LF		
0234	4447000000-E	SP	PEDESTRIAN CHANNELIZING DEVICES	48 LF		
0235	4455000000-N	1150	FLAGGER	117 DAY		
0236	4465000000-N	1160	TEMPORARY CRASH CUSHIONS	64 EA		
0237	4470000000-N	1160	REMOVE & RESET TEMPORARY CRASH CUSHION	12 EA		
0238	4480000000-N	1165	TMA	15 EA		
0239	4485000000-E	1170	PORTABLE CONCRETE BARRIER	148,394 LF		
0240	4490000000-E	1170	PORTABLE CONCRETE BARRIER (ANCHORED)	57,482 LF		
0241	4500000000-E	1170	REMOVE & RESET PORTABLE CONCRETE BARRIER	60,293 LF		
0242	4505000000-E	1170	REMOVE & RESET PORTABLE CONCRETE BARRIER (ANCHORED)	9,687 LF		
0243	4510000000-N	1190	LAW ENFORCEMENT	1,000 HR		
0244	4589000000-N	SP	GENERIC TRAFFIC CONTROL ITEM WATERCRAFT SAFETY	Lump Sum	L.S.	

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0245	4600000000-N	SP	GENERIC TRAFFIC CONTROL ITEM CONNECTED LANE CLOSURE DEVICE	8 EA		
0246	4600000000-N	SP	GENERIC TRAFFIC CONTROL ITEM FLASHING BEACONS AND DETECTION SYSTEM	16 EA		
0247	4600000000-N	SP	GENERIC TRAFFIC CONTROL ITEM RTMC/STOC MANAGED PCMS	20 EA		
0248	4600000000-N	SP	GENERIC TRAFFIC CONTROL ITEM TEMPORARY RIVER TRAFFIC WARN-ING SIGNS	16 EA		
0249	4650000000-N	1251	TEMPORARY RAISED PAVEMENT MARKERS	4,844 EA		
0250	4700000000-E	1205	THERMOPLASTIC PAVEMENT MARKING LINES (12", 90 MILS)	221 LF		
0251	4720000000-E	1205	THERMOPLASTIC PAVEMENT MARKING CHARACTER (90 MILS)	364 EA		
0252	4725000000-E	1205	THERMOPLASTIC PAVEMENT MARKING SYMBOL (90 MILS)	64 EA		
0253	4770000000-E	1205	COLD APPLIED PLASTIC PAVEMENT MARKING LINES, TYPE ** (4") (IV)	4,680 LF		
0254	4810000000-E	1205	PAINT PAVEMENT MARKING LINES (4")	11,450 LF		
0255	4815000000-E	1205	PAINT PAVEMENT MARKING LINES (6")	3,445 LF		
0256	4820000000-E	1205	PAINT PAVEMENT MARKING LINES (8")	125 LF		
0257	4835000000-E	1205	PAINT PAVEMENT MARKING LINES (24")	51 LF		
0258	4845000000-N	1205	PAINT PAVEMENT MARKING SYMBOL	51 EA		
0259	4847010000-E	1205	POLYUREA PAVEMENT MARKING LINES (4", 20 MILS)	10,445 LF		
0260	4847030000-E	1205	POLYUREA PAVEMENT MARKING LINES (6", 20 MILS)	245,426 LF		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0261	4847050000-E	1205	POLYUREA PAVEMENT MARKING LINES (8", 20 MILS)	533 LF		
0262	4847070000-E	1205	POLYUREA PAVEMENT MARKING LINES (12", 20 MILS)	6,800 LF		
0263	4847500000-E	SP	WORK ZONE PERFORMANCE PAVEMENT MARKING LINES, 6"	628,376 LF		
0264	4847600000-E	SP	WORK ZONE PERFORMANCE PAVEMENT MARKING LINES, 12"	16,900 LF		
0265	4855000000-E	1205	REMOVAL OF PAVEMENT MARKING LINES (6")	61,511 LF		
0266	4865000000-E	1205	REMOVAL OF PAVEMENT MARKING LINES (12")	4,113 LF		
0267	4875000000-N	1205	REMOVAL OF PAVEMENT MARKING SYMBOLS & CHARACTERS	7 EA		
0268	4891000000-E	1205	GENERIC PAVEMENT MARKING ITEM THERMOPLASTIC PAVEMENT MARKING LINES (24", 90 MILS)	400 LF		
0269	4895000000-N	SP	GENERIC PAVEMENT MARKING ITEM NON-CAST IRON SNOWPLOWABLE PAVEMENT MARKERS	3,827 EA		
0270	4900000000-N	1251	PERMANENT RAISED PAVEMENT MARKERS	135 EA		
0271	5070000000-N	SP	STANDARD FOUNDATION ********* (R1)	12 EA		
0272	5070000000-N	SP	STANDARD FOUNDATION ********* (R2)	3 EA		
0273	5155000000-E	1409	ELECTRICAL DUCT, TYPE BD, SIZE ***** (1.5")	180 LF		
0274	5170000000-E	1410	** #8 W/G FEEDER CIRCUIT (2)	300 LF		
0275	5175000000-E	1410	** #6 W/G FEEDER CIRCUIT (2)	220 LF		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0276	5185000000-E	1410	** #2 W/G FEEDER CIRCUIT (2)	100 LF		
0277	5205000000-E	1410	** #8 W/G FEEDER CIRCUIT IN *****" CONDUIT (2, 1.5")	4,660 LF		
0278	5210000000-E	1410	** #6 W/G FEEDER CIRCUIT IN *****" CONDUIT (2, 1.5")	250 LF		
0279	5240000000-N	1411	ELECTRICAL JUNCTION BOXES ********** (LS18)	5 EA		
0280	5255000000-N	1413	PORTABLE LIGHTING	Lump Sum	L.S.	
0281	5270000000-N	SP	GENERIC LIGHTING ITEM RELOCATE LIGHT STANDARD	15 EA		
0282	6000000000-E	1605	TEMPORARY SILT FENCE	126,325 LF		
0283	6006000000-E	1610	STONE FOR EROSION CONTROL, CLASS A	6,015 TON		
0284	6009000000-E	1610	STONE FOR EROSION CONTROL, CLASS B	42,960 TON		
0285	6012000000-E	1610	SEDIMENT CONTROL STONE	24,920 TON		
0286	6015000000-E	1615	TEMPORARY MULCHING	225 ACR		
0287	6018000000-E	1620	SEED FOR TEMPORARY SEEDING	10,500 LB		
0288	6021000000-E	1620	FERTILIZER FOR TEMPORARY SEEDING	55 TON		
0289	6024000000-E	1622	TEMPORARY SLOPE DRAINS	10,200 LF		
0290	6029000000-E	SP	SAFETY FENCE	37,000 LF		
0291	6030000000-E	1630	SILT EXCAVATION	95,155 CY		
0292	6036000000-E	1631	MATTING FOR EROSION CONTROL	500,000 SY		
0293	6037000000-E	SP	COIR FIBER MAT	14,025 SY		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0294	6042000000-E	1632	1/4" HARDWARE CLOTH	37,300 LF		
0295	6045000000-E	SP	**" TEMPORARY PIPE (18")	15 LF		
0296	6045000000-E	SP	**" TEMPORARY PIPE (36")	580 LF		
0297	6048000000-E	SP	FLOATING TURBIDITY CURTAIN	645 SY		
0298	6070000000-N	1639	SPECIAL STILLING BASINS	70 EA		
0299	6071010000-E	SP	WATTLE	1,000 LF		
0300	6071012000-E	SP	COIR FIBER WATTLE	9,000 LF		
0301	6071014000-E	SP	COIR FIBER WATTLE BARRIER	1,400 LF		
0302	6071020000-E	SP	POLYACRYLAMIDE (PAM)	14,100 LB		
0303	6071030000-E	1640	COIR FIBER BAFFLE	22,630 LF		
0304	6071050000-E	SP	**" SKIMMER (1-1/2")	48 EA		
0305	6071050000-E	SP	**" SKIMMER (2")	12 EA		
0306	6071050000-E	SP	**" SKIMMER (2-1/2")	3 EA		
0307	6084000000-E	1660	SEEDING & MULCHING	225 ACR		
0308	6087000000-E	1660	MOWING	135 ACR		
0309	6090000000-E	1661	SEED FOR REPAIR SEEDING	2,700 LB		
0310	6093000000-E	1661	FERTILIZER FOR REPAIR SEEDING	8.25 TON		
0311	6096000000-E	1662	SEED FOR SUPPLEMENTAL SEEDING	4,075 LB		
0312	6102000000-E	1664	SODDING	3,870 SY		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0313	6105000000-E	1664	WATER	109 M/G		
0314	6108000000-E	1665	FERTILIZER TOPDRESSING	122.25 TON		
0315	6111000000-E	SP	IMPERVIOUS DIKE	685 LF		
0316	6114500000-N	1667	SPECIALIZED HAND MOWING	350 MHR		
0317	6117000000-N	SP	RESPONSE FOR EROSION CONTROL	150 EA		
0318	6123000000-E	1670	REFORESTATION	2 ACR		
0319	6132000000-N	SP	GENERIC EROSION CONTROL ITEM CONCRETE WASHOUT	22 EA		
0320	6132000000-N	SP	GENERIC EROSION CONTROL ITEM RISER BASIN, 1170 CF VOLUME CAPACITY	1 EA		
0321	6132000000-N	SP	GENERIC EROSION CONTROL ITEM RISER BASIN, 2510 CF VOLUME CAPACITY	1 EA		
0322	6132000000-N	SP	GENERIC EROSION CONTROL ITEM TEMPORARY INLET PROTECTION, TYPE C	5 EA		
0323	6132000000-N	SP	GENERIC EROSION CONTROL ITEM TEMPORARY INLET PROTECTION, TYPE D	5 EA		
0324	6135000000-E	SP	GENERIC EROSION CONTROL ITEM BLRI REFORESTATION	9 ACR		
0325	6135000000-E	SP	GENERIC EROSION CONTROL ITEM BLRI SEEDING & MULCHING	9 ACR		
0326	6135000000-E	SP	GENERIC EROSION CONTROL ITEM BLRI TEMPORARY MULCHING	9 ACR		
0327	6141000000-E	SP	GENERIC EROSION CONTROL ITEM MATTING FOR EROSION CONTROL, RECP TYPE 2.A	2,900 SY		
0328	6141000000-E	SP	GENERIC EROSION CONTROL ITEM MATTING FOR EROSION CONTROL, RECP TYPE 2.B	950 SY		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0329	6141000000-E	SP	GENERIC EROSION CONTROL ITEM MATTING FOR EROSION CONTROL, RECP TYPE 2.C	4,300 SY		
0330	6141000000-E	SP	GENERIC EROSION CONTROL ITEM MATTING FOR EROSION CONTROL, RECP TYPE 2.D	15,600 SY		
0331	6141000000-E	SP	GENERIC EROSION CONTROL ITEM MATTING FOR EROSION CONTROL, RECP TYPE 3.B	130 SY		
0332	6141000000-E	SP	GENERIC EROSION CONTROL ITEM MATTING FOR EROSION CONTROL, RECP TYPE 4	2,050 SY		
0333	6144000000-E	SP	GENERIC EROSION CONTROL ITEM BLRI TEMPORARY SEEDING	220 LB		
0334	7048500000-E	1705	PEDESTRIAN SIGNAL HEAD (16", 1 SECTION W/COUNTDOWN)	8 EA		
0335	7060000000-E	1705	SIGNAL CABLE	6,880 LF		
0336	7120000000-E	1705	VEHICLE SIGNAL HEAD (12", 3 SECTION)	10 EA		
0337	7132000000-E	1705	VEHICLE SIGNAL HEAD (12", 4 SECTION)	1 EA		
0338	7144000000-E	1705	VEHICLE SIGNAL HEAD (12", 5 SECTION)	2 EA		
0339	7204000000-N	1705	LOUVER	2 EA		
0340	7252000000-E	1710	MESSENGER CABLE (1/4")	300 LF		
0341	7264000000-E	1710	MESSENGER CABLE (3/8")	155 LF		
0342	7279000000-E	1715	TRACER WIRE	50,860 LF		
0343	7288000000-E	1715	PAVED TRENCHING (**********) (2, 2")	150 LF		
0344	7300000000-E	1715	UNPAVED TRENCHING (**********) (1, 2")	4,110 LF		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0345	7300000000-E	1715	UNPAVED TRENCHING (**********) (1,1")	130 LF		
0346	7300000000-E	1715	UNPAVED TRENCHING (**********) (2, 2")	46,010 LF		
0347	7300100000-E	1715	UNPAVED TRENCHING FOR TEMP-ORARY LEAD-IN	40 LF		
0348	7301000000-E	1715	DIRECTIONAL DRILL (**********) (1, 2")	1,470 LF		
0349	7301000000-E	1715	DIRECTIONAL DRILL (**********) (2, 2")	5,590 LF		
0350	7312000000-N	1716	JUNCTION BOX (**********) (SPECIAL OVER-SIZED, HEAVY DUTY)	17 EA		
0351	7324000000-N	1716	JUNCTION BOX (STANDARD SIZE)	51 EA		
0352	7348000000-N	1716	JUNCTION BOX (OVER-SIZED, HEA-VY DUTY)	77 EA		
0353	7360000000-N	1720	WOOD POLE	4 EA		
0354	7372000000-N	1721	GUY ASSEMBLY	4 EA		
0355	7396000000-E	1722	1/2" RISER WITH WEATHERHEAD	1 EA		
0356	7408000000-E	1722	1" RISER WITH WEATHERHEAD	1 EA		
0357	7420000000-E	1722	2" RISER WITH WEATHERHEAD	2 EA		
0358	7432000000-E	1722	2" RISER WITH HEAT SHRINK TUBING	2 EA		
0359	7444000000-E	1725	INDUCTIVE LOOP SAWCUT	2,300 LF		
0360	7456000000-E	1726	LEAD-IN CABLE (**********) (14-2)	8,820 LF		
0361	7516000000-E	1730	COMMUNICATIONS CABLE (**FIBER) (144)	54,970 LF		
0362	7528000000-E	1730	DROP CABLE	6,520 LF		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0363	7540000000-N	1731	SPLICE ENCLOSURE	14 EA		
0364	7541000000-N	1731	MODIFY SPLICE ENCLOSURE	4 EA		
0365	7552000000-N	1731	INTERCONNECT CENTER	12 EA		
0366	7566000000-N	1733	DELINEATOR MARKER	90 EA		
0367	7575160000-E	1734	REMOVE EXISTING COMMUNICATIONS CABLE	5,110 LF		
0368	7588000000-N	SP	METAL POLE WITH SINGLE MAST ARM	2 EA		
0369	7613000000-N	SP	SOIL TEST	14 EA		
0370	7614100000-E	SP	DRILLED PIER FOUNDATION	60 CY		
0371	7631000000-N	SP	MAST ARM WITH METAL POLE DESIGN	2 EA		
0372	7636000000-N	1745	SIGN FOR SIGNALS	3 EA		
0373	7642200000-N	1743	TYPE II PEDESTAL WITH FOUNDATION	7 EA		
0374	7708000000-N	1751	DETECTOR CARD (**********) (2070-E)	5 EA		
0375	7960000000-N	SP	METAL POLE FOUNDATION REMOVAL	3 EA		
0376	7972000000-N	SP	METAL POLE REMOVAL	3 EA		
0377	7980000000-N	SP	GENERIC SIGNAL ITEM 5/8" X 10' GROUNDING ELECTRODE	77 EA		
0378	7980000000-N	SP	GENERIC SIGNAL ITEM CCTV CAMERA ASSEMBLY	8 EA		
0379	7980000000-N	SP	GENERIC SIGNAL ITEM CCTV CAMERA METAL POLE	8 EA		
0380	7980000000-N	SP	GENERIC SIGNAL ITEM DMS ACCESS LADDER	4 EA		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0381	7980000000-N	SP	GENERIC SIGNAL ITEM DMS PEDESTAL STRUCTURE	4 EA		
0382	7980000000-N	SP	GENERIC SIGNAL ITEM DYNAMIC MESSAGE SIGN	4 EA		
0383	7980000000-N	SP	GENERIC SIGNAL ITEM EQUIPMENT CABINET DISCONNECT	9 EA		
0384	7980000000-N	SP	GENERIC SIGNAL ITEM ETHERNET EDGE SWITCH	11 EA		
0385	7980000000-N	SP	GENERIC SIGNAL ITEM FIELD EQUIPMENT CABINET (WITH INVERTER)	2 EA		
0386	7980000000-N	SP	GENERIC SIGNAL ITEM FIELD EQUIPMENT CABINET (WITH UPS)	5 EA		
0387	7980000000-N	SP	GENERIC SIGNAL ITEM FIELD EQUIPMENT SHELL CABINET	1 EA		
0388	7980000000-N	SP	GENERIC SIGNAL ITEM ICM PORTABLE TRAILER MOUNTED CCTV CAMERA	4 EA		
0389	7980000000-N	SP	GENERIC SIGNAL ITEM METER BASE / DISCONNECT COMBI-NATION PANEL	6 EA		
0390	7980000000-N	SP	GENERIC SIGNAL ITEM MICROWAVE VEHICLE DETECTION SYSTEM - MULTIPLE ZONES	4 EA		
0391	7980000000-N	SP	GENERIC SIGNAL ITEM MODIFY ELECTRICAL SERVICE	3 EA		
0392	7980000000-N	SP	GENERIC SIGNAL ITEM PORTABLE CHANGEABLE MESSAGE SIGN	3 EA		
0393	7980000000-N	SP	GENERIC SIGNAL ITEM PORTABLE TRAILER MOUNTED CCTV CAMERA	4 EA		
0394	7980000000-N	SP	GENERIC SIGNAL ITEM PROTECTIVE COATING FOR SIGNAL PEDESTAL, TYPE II (BLACK)	7 EA		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0395	7980000000-N	SP	GENERIC SIGNAL ITEM PROTECTIVE COATING FOR SINGLE MAST ARM POLE (BLACK)	2 EA		
0396	7980000000-N	SP	GENERIC SIGNAL ITEM REMOVE EXISTING DMS AND STRUCTURE	3 EA		
0397	7980000000-N	SP	GENERIC SIGNAL ITEM REMOVE WOOD POLE	2 EA		
0398	7980000000-N	SP	GENERIC SIGNAL ITEM SOLAR POWER ASSEMBLY	2 EA		
0399	7980000000-N	SP	GENERIC SIGNAL ITEM STEP-UP STEP-DOWN TRANSFORMER	2 EA		
0400	7985000000-N	SP	GENERIC SIGNAL ITEM INTEGRATION AND CONFIGURATION	Lump Sum	L.S.	
0401	7990000000-E	SP	GENERIC SIGNAL ITEM #4 SOLID BARE GROUNDING CONDUCTOR	900 LF		
0402	7990000000-E	SP	GENERIC SIGNAL ITEM 3 WIRE COPPER FEEDER CONDUCTORS	2,000 LF		
0403	7990000000-E	SP	GENERIC SIGNAL ITEM 3 WIRE COPPER SERVICE ENTRANCE CONDUCTORS	180 LF		
0404	7990000000-E	SP	GENERIC SIGNAL ITEM 4 WIRE COPPER FEEDER CONDUCTORS	3,120 LF		
0405	7992000000-E	SP	GENERIC SIGNAL ITEM DMS FOUNDATION	24 CY		
0488	4848000000-E	SP	WORK ZONE TRAFFIC PATTERN MASKING	5,979,745 SF		
0490	3001500000-N	SP	IMPACT ATTENUATOR UNITS, TYPE TL-2	4 EA		
0491	3215000000-N	SP	GUARDRAIL ANCHOR UNITS, TYPE III	2 EA		
0494	0576000000-E	310	**" CS PIPE CULVERTS, *****" THICK (36", 0.079")	48 LF		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0495	0636000000-E	310	**" CS PIPE ELBOWS, *****" THICK (36", 0.079")	2 EA		
0496	0973100000-E	330	**" WELDED STEEL PIPE, ****" THICK, GRADE B IN SOIL (24", 0.5")	260 LF		
0497	0973100000-E	330	**" WELDED STEEL PIPE, ****" THICK, GRADE B IN SOIL (30", 0.5")	382 LF		
			CULVERT ITEMS			
0406	8035000000-N	402	REMOVAL OF EXISTING STRUCTURE AT STATION ********** (1019+28.18 -L-)	Lump Sum	L.S.	
0407	8126000000-N	414	CULVERT EXCAVATION, STA ****** (1019+28.18 -L-)	Lump Sum	L.S.	
0408	8126000000-N	414	CULVERT EXCAVATION, STA ****** (887+89.20 -WBL-)	Lump Sum	L.S.	
0409	8126000000-N	414	CULVERT EXCAVATION, STA ****** (982+96.44 -WBL-)	Lump Sum	L.S.	
0410	8126000000-N	414	CULVERT EXCAVATION, STA ****** (984+16.39 -WBL-)	Lump Sum	L.S.	
0411	8133000000-E	414	FOUNDATION CONDITIONING MATER-IAL, BOX CULVERT	130 TON		
0412	8196000000-E	420	CLASS A CONCRETE (CULVERT)	512.6 CY		
0413	8245000000-E	425	REINFORCING STEEL (CULVERT)	82,223 LB		
			WALL ITEMS			
0414	8801000000-E	SP	MSE RETAINING WALL NO **** (14)	14,640 SF		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0415	8801000000-E	SP	MSE RETAINING WALL NO **** (18)	3,340 SF		
0416	8801000000-E	SP	MSE RETAINING WALL NO **** (19)	17,670 SF		
0417	8801000000-E	SP	MSE RETAINING WALL NO **** (20)	13,880 SF		
0418	8801000000-E	SP	MSE RETAINING WALL NO **** (22)	23,270 SF		
0419	8801000000-E	SP	MSE RETAINING WALL NO **** (23)	3,060 SF		
0420	8801000000-E	SP	MSE RETAINING WALL NO **** (3)	7,360 SF		
0421	8801000000-E	SP	MSE RETAINING WALL NO **** (4)	5,620 SF		
0422	8801000000-E	SP	MSE RETAINING WALL NO **** (5)	4,820 SF		
0423	8801000000-E	SP	MSE RETAINING WALL NO **** (6)	4,990 SF		
0424	8802010000-E	SP	SOIL NAIL RETAINING WALLS	115,610 SF		
0425	8802015100-N	SP	SOIL NAIL VERIFICATION TESTS	32 EA		
0426	8802015110-N	SP	SOIL NAIL PROOF TESTS	282 EA		
0427	8847000000-E	SP	GENERIC RETAINING WALL ITEM ARCHITECTURAL SURFACE TREAT-MENT	53,482 SF		
0428	8847000000-E	SP	GENERIC RETAINING WALL ITEM SOUND BARRIER WALL NO -NW6.1-	30,058 SF		
0492	8847000000-E	SP	GENERIC RETAINING WALL ITEM ARCHITECTURAL CONCRETE SURFACE TREATMENT	214,260 SF		
0493	8504000000-E	460	CONCRETE BARRIER RAIL WITH MOMENT SLAB	5,260 LF		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
			STRUCTURE ITEMS			
0429	1308000000-E	607	MILLING ASPHALT PAVEMENT, ***" TO ******" (7-1/2" TO 1/4")	603 SY		
0430	8017000000-N	SP	CONSTRUCTION, MAINTENANCE, & REMOVAL OF TEMP ACCESS AT STA ********** (1163+08.56 -L-)	Lump Sum	L.S.	
0431	8035000000-N	402	REMOVAL OF EXISTING STRUCTURE AT STATION ********** (1050+63.05 -L-)	Lump Sum	L.S.	
0432	8035000000-N	402	REMOVAL OF EXISTING STRUCTURE AT STATION ********** (1163+08.56 -L-)	Lump Sum	L.S.	
0433	8035000000-N	402	REMOVAL OF EXISTING STRUCTURE AT STATION ********** (514+86.3)	Lump Sum	L.S.	
0434	8035000000-N	402	REMOVAL OF EXISTING STRUCTURE AT STATION ********** (912+89.86 -EBL-)	Lump Sum	L.S.	
0435	8035000000-N	402	REMOVAL OF EXISTING STRUCTURE AT STATION ********** (913+34.69 -WBL-)	Lump Sum	L.S.	
0436	8065000000-N	SP	ASBESTOS ASSESSMENT	Lump Sum	L.S.	
0437	8084000000-N	410	FOUNDATION EXCAVATION FOR END BENT ** AT STATION ********** (1, 514+86.3)	Lump Sum	L.S.	
0438	8084000000-N	410	FOUNDATION EXCAVATION FOR END BENT ** AT STATION ********** (2, 514+86.3)	Lump Sum	L.S.	
0439	8091000000-N	410	FOUNDATION EXCAVATION FOR BENT ** AT STATION ********** (1, 1050+65.05 -L-)	Lump Sum	L.S.	
0440	8091000000-N	410	FOUNDATION EXCAVATION FOR BENT ** AT STATION ********** (1, 514+86.3)	Lump Sum	L.S.	
0441	8091000000-N	410	FOUNDATION EXCAVATION FOR BENT ** AT STATION ********** (2, 514+86.3)	Lump Sum	L.S.	

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0442	8105500000-E	411	**'-**" DIA DRILLED PIERS IN SOIL (5'-0")	156.6 LF		
0443	8105600000-E	411	**'-**" DIA DRILLED PIERS NOT IN SOIL (5'-0")	300 LF		
0444	8111000000-E	411	PERMANENT STEEL CASING FOR **'-**" DIA DRILLED PIER (5'-0")	200.6 LF		
0445	8112730000-N	450	PDA TESTING	2 EA		
0446	8115000000-N	411	CSL TESTING	4 EA		
0447	8121000000-N	412	UNCLASSIFIED STRUCTURE EXCAVATION AT STATION ******** (1050+63.05 -L-)	Lump Sum	L.S.	
0448	8121000000-N	412	UNCLASSIFIED STRUCTURE EXCAVATION AT STATION ******** (1163+08.56 -L-)	Lump Sum	L.S.	
0449	8147000000-E	420	REINFORCED CONCRETE DECK SLAB	102,210 SF		
0450	8161000000-E	420	GROOVING BRIDGE FLOORS	114,643 SF		
0451	8175000000-E	420	CLASS AA CONCRETE (BRIDGE)	490 CY		
0452	8182000000-E	420	CLASS A CONCRETE (BRIDGE)	1,863.3 CY		
0453	8210000000-N	422	BRIDGE APPROACH SLABS, STATION ********** (1050+63.05 -L-)	Lump Sum	L.S.	
0454	8210000000-N	422	BRIDGE APPROACH SLABS, STATION ********** (1163+08.56 -L-)	Lump Sum	L.S.	
0455	8210000000-N	422	BRIDGE APPROACH SLABS, STATION ********** (514+86.3)	Lump Sum	L.S.	
0456	8210000000-N	422	BRIDGE APPROACH SLABS, STATION ********** (912+89.86 -EBL-)	Lump Sum	L.S.	

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0457	8210000000-N	422	BRIDGE APPROACH SLABS, STATION ********** (913+34.69 -WBL-)	Lump Sum	L.S.	
0458	8217000000-E	425	REINFORCING STEEL (BRIDGE)	533,185 LB		
0459	8238000000-E	425	SPIRAL COLUMN REINFORCING STEEL (BRIDGE)	32,327 LB		
0460	8262000000-E	430	45" PRESTRESSED CONCRETE GIR-DERS	1,156.5 LF		
0461	8265000000-E	430	54" PRESTRESSED CONCRETE GIR-DERS	2,986.5 LF		
0462	8280000000-E	440	APPROX ..... LBS STRUCTURAL STEEL	2,787,684 LS		
0463	8328200000-E	450	PILE DRIVING EQUIPMENT SETUP FOR *** STEEL PILES (HP 12 X 53)	178 EA		
0464	8328200000-E	450	PILE DRIVING EQUIPMENT SETUP FOR *** STEEL PILES (HP 14 X 73)	54 EA		
0465	8328200000-E	450	PILE DRIVING EQUIPMENT SETUP FOR *** STEEL PILES (HP 14 X 89)	52 EA		
0466	8355000000-E	450	HP ***X*** STEEL PILES (HP 14 X 89)	2,912 LF		
0467	8364000000-E	450	HP12X53 STEEL PILES	8,745 LF		
0468	8384000000-E	450	HP14X73 STEEL PILES	1,350 LF		
0469	8503000000-E	460	CONCRETE BARRIER RAIL	1,715.33 LF		
0470	8510000000-E	460	CONCRETE MEDIAN BARRIER	734.58 LF		
0471	8531000000-E	462	4" SLOPE PROTECTION	1,337.9 SY		
0472	8573000000-E	SP	LATEX MODIFIED CONC OVERLAY	110 CY		
0473	8580000000-E	SP	PLACING & FINISHING OF LATEX MODIFIED CONC OVERLAY	1,970 SY		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0474	8608000000-E	876	RIP RAP CLASS II (2'-0" THICK)	2,243.4 TON		
0475	8622000000-E	876	GEOTEXTILE FOR DRAINAGE	2,492.7 SY		
0476	8654000000-N	SP	DISC BEARINGS	Lump Sum	L.S.	
0477	8657000000-N	430	ELASTOMERIC BEARINGS	Lump Sum	L.S.	
0478	8706000000-N	SP	EXPANSION JOINT SEALS	Lump Sum	L.S.	
0479	8713000000-N	SP	MODULAR EXPANSION JOINT SEALS	Lump Sum	L.S.	
0480	8860000000-N	SP	GENERIC STRUCTURE ITEM SOUND BARRIER WALL (BRIDGE MOUNTED)	Lump Sum	L.S.	
0481	8867000000-E	SP	GENERIC STRUCTURE ITEM CALTRANS BARRIER RAIL	1,210 LF		
0482	8881000000-E	SP	GENERIC STRUCTURE ITEM HIGH STRENGTH CONCRETE	170 CY		
0483	8881000000-E	SP	GENERIC STRUCTURE ITEM PRECAST SEGMENTAL BRIDGE	2,225 CY		
0484	8881000000-E	SP	GENERIC STRUCTURE ITEM STONE MASONRY FOR WINGWALL, PARAPET, AND ABUTMENT	31 CY		
0485	8889000000-E	SP	GENERIC STRUCTURE ITEM POST-TENSIONING STEEL	147,300 LB		
0486	8893000000-E	SP	GENERIC STRUCTURE ITEM DIAMOND GRINDING	3,316 SY		
0487	8893000000-E	SP	GENERIC STRUCTURE ITEM SILANE DECK TREATMENT	3,340 SY		
0489	8860000000-N	SP	GENERIC STRUCTURE ITEM APPLICATION OF BRIDGE COATING	Lump Sum	L.S.	