Submitted By: Chris Lacy Date: 6 / 15 / 20 Recommended: Chris Lacy Date: 7 / 1 / 20

Engineer of Record

To: Brian Klauk

Program / Project Manager

BASIS OF DESIGN EXCEPTION

- [x] Request for Approval of Design Exceptions to AASHTO Guidelines
- [x] Request for Approval of Design Exceptions from Standard SCDOT Procedures

PROJECT CHARACTERISTICS

County: Richland Rd./Route: I-20 Const. Pin: P039719

From: MM 64.2 To: 66.3

Length: 2 miles MPO / COG: COATS

Work Type: Additional lane being added to I-20

Functional Classification: Interstate

Group Designation: (1 ☐ / 2 ☐ / 3 ☐ / 4 ☐) (if applicable)

Type of Terrain: (Level ☐ / Rolling ☒ / Mountainous ☐)

Design Speed: 60 (mph)

2020 ADT 112,200

2040 ADT 129,000

TRUCKS 5 %

CRASH ANALYSIS

(Attach additional sheets with accident history data)

TOTAL PROJECT ESTIMATE ($) 95M

CHECK APPROPRIATE BOX(ES) FOR DESIGN EXCEPTION(S)

- ☐ Design Speed
- ☐ Horizontal Alignment
  - ☐ Minimum Radii
- ☐ Vertical Alignment
  - ☐ Level SSD K-Values
- ☐ Maximum Grade
- ☐ Vertical Clearance
- ☐ Bridge Width
- ☐ Structural Capacity
- ☐ Superelevation Rate
- ☐ Cross Slope
  - ☐ Travel Lanes
  - ☐ Shoulders
- ☐ Travel Lane Width
- ☒ Shoulder Width
- ☐ Horizontal Clearance
- ☐ Stopping Sight Distance

DESCRIBE ELEMENT(S) FOR DESIGN EXCEPTION(S)

(Attach additional sheets as needed)

See Attachment A

JUSTIFICATION FOR DESIGN EXCEPTION(S)

(Attach additional sheets as needed)

See Attachment A

DESCRIBE STEPS TO ELEMINATE DESIGN EXCEPTION(S), INCLUDE COST

(Attach additional sheets as needed)

See Attachment A

HOW WILL FUTURE CONSTRUCTION IMPACT DESIGN EXCEPTION(S)?

(Attach additional sheets as needed)

See Attachment A

RECORD OF DECISION

- [x] For
- [ ] Against

(Regional Design Manager / Program Manager / DEA) 8/5/20 Date

- [x] For
- [ ] Against

~~(Regional Production Engineer)~~ PROJECT MANAGER 09/30/2020 Date

- [x] Approved
- [ ] Denied

(~~Director of Preconstruction~~) ACTING DIRECTOR FOR MEGA PROJECTS 9/30/2020 Date

X Concur

Thaddeus Kitowicz December 8, 2020

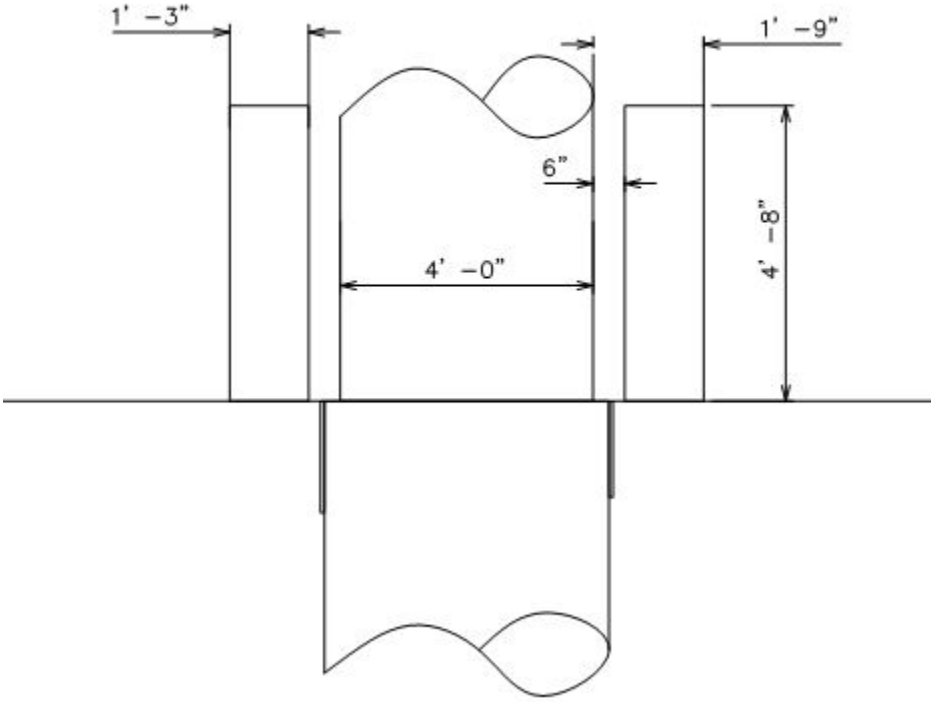
FHWA (NHS > $50 million & All Interstate)

cc:
Director of Preconstruction
FHWA
Preconstruction Support Engineer
Regional Production Group Engineer
District Engineering Administrator
Director of Traffic Engineering

Attachment A – Design Exception

Describe Elements for Design Exception:

Bridges along I-20 within the project limits of Carolina Crossroads would be reconstructed as part of the Carolina Crossroads project. The existing inside shoulder width along I-20 is approximately 4.75'. The proposed inside shoulder width is 12'. The minimum inside shoulder width for interstates with 3 or more lanes is 10’. For overpassing bridges constructed with assumed 4’ diameter columns the inside shoulder width would be reduced from 12’ to 9.25’.



Justification for Design Exception:

The design exception is requested to allow spot locations where the inside shoulder would be less than 10' (approximately 9.25’) but greater than the existing 4.75'. Stopping sight distance would still be provided per the contract documents for the design-build project.

A predictive crash analysis was performed by the Traffic Safety office and found no substantial increase in crash volumes between a 10’ shoulder and 9’ shoulder in either a 5-lane or a 4-lane section.

Describe Steps to Eliminate Design Exception (include Costs):

To provide a 10' inside shoulder, the crown point of I-20 in both directions would need to be shifted approximately 0.75’. This would then result in deflections of the horizontal alignment and introduce curves or tapers into the mainline geometry which is undesirable. The span length would also increase in order to provide the necessary clear width. As part of I-20 improvements, the additional lanes entering from and exiting to I-26 will require longer bridge spans potentially increasing the vertical grade on US 176 (Broad River Road). Any increase to the vertical alignment of Broad River Road may create additional impacts for roadside access. Broad River Road is a very urbanized corridor and providing access along the route is an important consideration so minimizing impacts is a goal of the project.

A strategy to eliminate the exception could be to construct the Broad River Road bridge over I-20 and the additional ramp lanes with a single span. A single span bridge would require the grade of Broad River Road to be raised due to the depth of the bridge structure. As mentioned above, the grade change may cause additional impacts along the crossing route. The estimated cost of a single span bridge including the roadway approach work is $13.6M. This does not include costs for purchasing additional right of way or total parcels due to change in access to accommodate the vertical alignment that would result by using longer span bridges. Based on the cost schedule risk assessment (CSRA), the estimated cost of the multi span bridges proposed is $11.6M. Due to the urban location of the interchange and the desire to minimize impacts, a design exception is warranted at this location.

Other strategies such as reduction in lane width to provide shoulder width was ruled out due to the functional classification of the route and the percentage of trucks. Providing 12’ lanes on the interstate is more desirable in this location.

How will future Construction Impact Design Exception?

This project is being built in advance of reconstructing the system interchange of I-20 at I-26. The bridge constructed as part of this project accommodates requirements of future construction. Future construction of the system interchange will not impact this design exception.

October 14, 2019

TRAFFIC ENGINEERING SAFETY REVIEW

FROM: **State Traffic Safety Engineer Smith**

TO: **Christopher Lacy**

SUBJECT: Carolina Crossroads Project
Project ID P027662

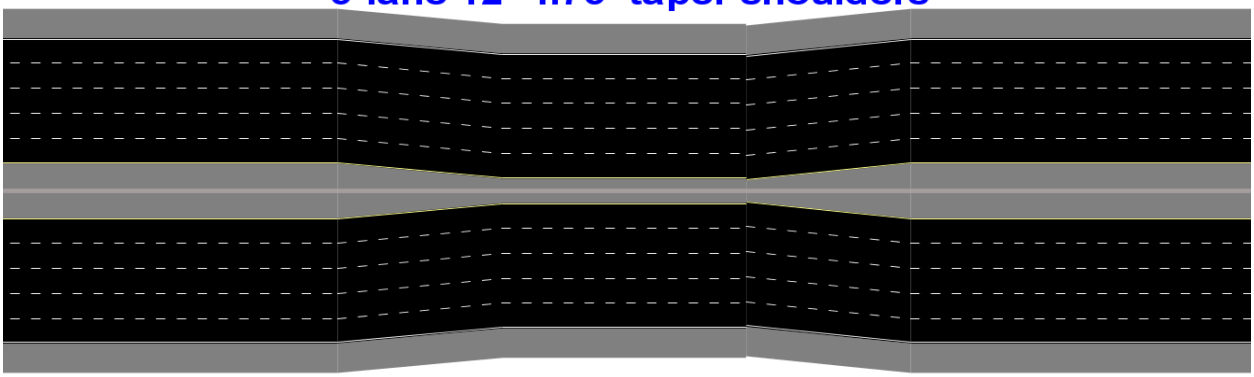
Safety Comments

The Traffic Safety Office has completed an analysis of predicted crashes in regards to reduced shoulder widths at point locations along the interstate corridors that comprise the Carolina Crossroads project. The analysis was conducted to provide data driven decisions regarding the safety impacts for various inside shoulder widths at interchanges and overpasses where guidance may be needed to save or replace existing structures.

As Carolina Crossroads is proceeding as a design build project, exact design elements and geometrics are not currently known, but a high level alternatives analysis using the IHSDM software could be conducted to determine impacts. A reduced inside shoulder width at a bridge was considered to be a 'point' along the corridor. It is understood that trying to determine the exact predicted crash rate at a single point along a corridor will not yield accurate results, and should only be used as a guide to review the trends as variables are changed. The results are not considered a full predicted analysis and lack the full input of data to complete a project specific HSM analysis. Additionally, results are for internal SCDOT use only in relation to this project and analysis only. These results should not be used to solely justify decisions on this project, or any project, without full review of all contextual elements involved within.

In order to complete the requested review, a sample interstate corridor similar to the proposed cross sections provided with the request was modeled. This sample model consisted of a 0.25 mile section of 4-lane interstate and 5-lane interstate. Projected AADT's were input as 90,000 and 100,000 VPD in the years 2020 and 2040 for the 4-lane section; along with 120,000 and 130,000 VPD for the 5-lane section. In order to get a baseline prediction of crashes for comparison, a maximum straight shoulder width of 12' was used to estimate a total number of crashes over a ten year period for the given conditions of each theoretical corridor. Subsequent crash totals were modeled by reducing the inside shoulder width for a section of the corridor to estimate the effects of a narrower inside shoulder at a point on the interstate due to interchange bridge piers and or barriers. The reduced shoulder widths were modeled for a length of approximately 225', of which 95' was the length of the fully reduced width, along with variable widths before and after this reduced width due to the leading and trailing tapers. These taper lengths started from a full 12' width shoulder, and tapered for a length of approximately 65'. The reduced shoulder widths that were sampled are as follows; 4.75', 6', 7', 8', 9', 9.75', 10', & 11' and are shown in the table below. Also shown is a sample plan view produced from the IHSDM software.

5-lane 12'-4.75' taper shoulders



Results from the Crash Prediction Module* of the IHSDM are as follows**:

5-Lane Interstate Corridor									
Reduced Shoulder Width at Bridge	**4.75' (Existing)**	**6.0'**	**7.0'**	**8.0'**	**9.0'**	**9.75' (Proposed)**	**10.0' (Required)**	**11'**	**12' No reduction in shoulder width**
Total Crashes (10 years)	70.9	70.7	70.6	70.5	70.4	70.3	70.2	70.1	69.9

4-Lane Interstate Corridor									
Reduced Shoulder Width at Bridge	**4.75' (Existing)**	**6.0'**	**7.0'**	**8.0'**	**9.0'**	**9.75' (Proposed)**	**10.0' (Required)**	**11'**	**12' (No change)**
Total Crashes (10 years)	55.8	55.6	55.5	55.4	55.3	55.2	55.2	55.1	55.0

*Complete Crash Prediction Module Reports showing further details and additional results are provided with this summary document for further review. **Based on SCDOT calibration and crash distributions

Summary

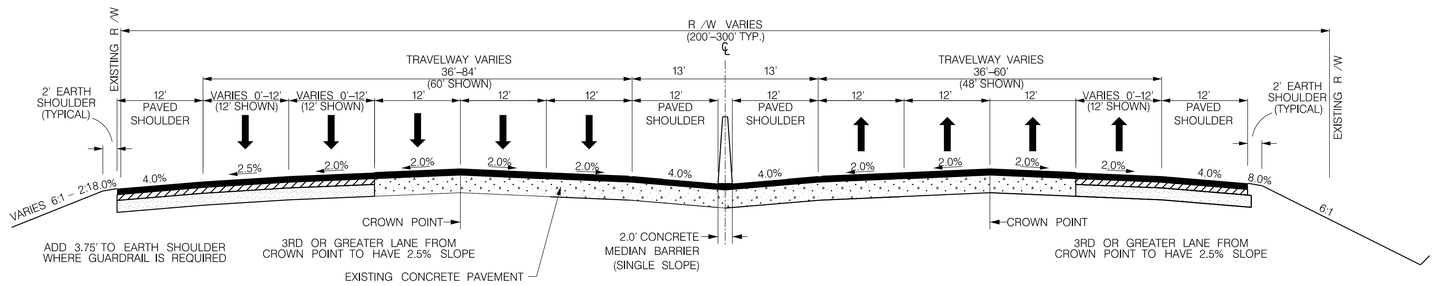
For the conditions outlined above and used in the IHSDM, results predict that there would be approximately 1 additional crash every 10 years in the worst case scenario of reducing the inside shoulder width from 12' to 4.75' for approximately 225'. There was practically no additional crash experience between the proposed 9.75' and minimum required width of 10.0'

Based upon these results with the provided input values, there does not appear to be any adverse safety effects at these point locations due to a reduction in shoulder widths.

Duncan Smith

FOR INFORMATION ONLY

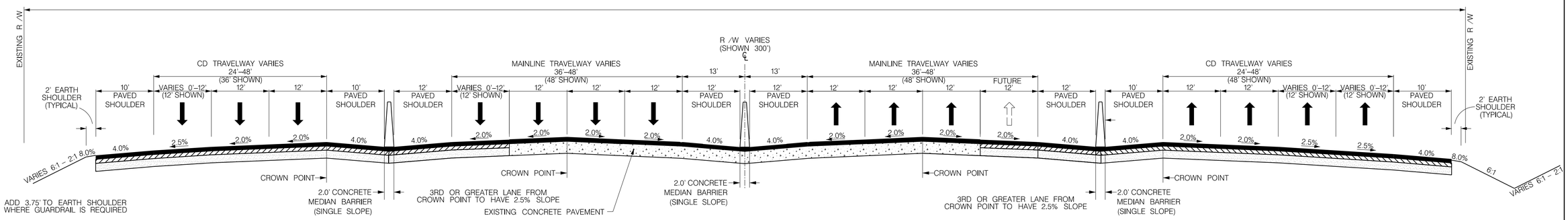
FED. ROAD DIV. NO.	STATE	COUNTY	PROJECT ID	RTE. NO.	SHEET NO.
3	S.C.	LEXINGTON RICHLAND	XX.XXXX		



INTERSTATE MAINLINE WITH MEDIAN BARRIER WALL

INTERSTATE I–20 FC= URBAN INTERSTATE DS= 60 MPH

STA. XXX+XX.XX – XXX+XX.XX



INTERSTATE MAINLINE WITH COLLECTOR–DISTRIBUTOR LANES

INTERSTATE I–20 FC= URBAN INTERSTATE DS= 60 MPH

STA. XXX+XX.XX – XXX+XX.XX

RTE.	DESIGN SPEED	
MPH	FROM STA.	TO STA.

PAVEMENT DESIGN

APPROVED BY

DATE

SOUTH CAROLINA
DEPARTMENT OF TRANSPORTATION
ROAD DESIGN COLUMBIA, S.C.

CAROLINA CROSSROADS
I–26/I–126/I–20

TYPICAL SECTIONS

SCALE: NTS RTE. DWG. NO.

7/8/2020
HDR Engineering, Inc. of the Carolinas
Carolina Crossroads_Typical Sections_PREFERRED_ALT.dgn

FOR INFORMATION ONLY

FED. ROAD DIV. NO.	STATE	COUNTY	PROJECT ID	RTE. NO.	SHEET NO.
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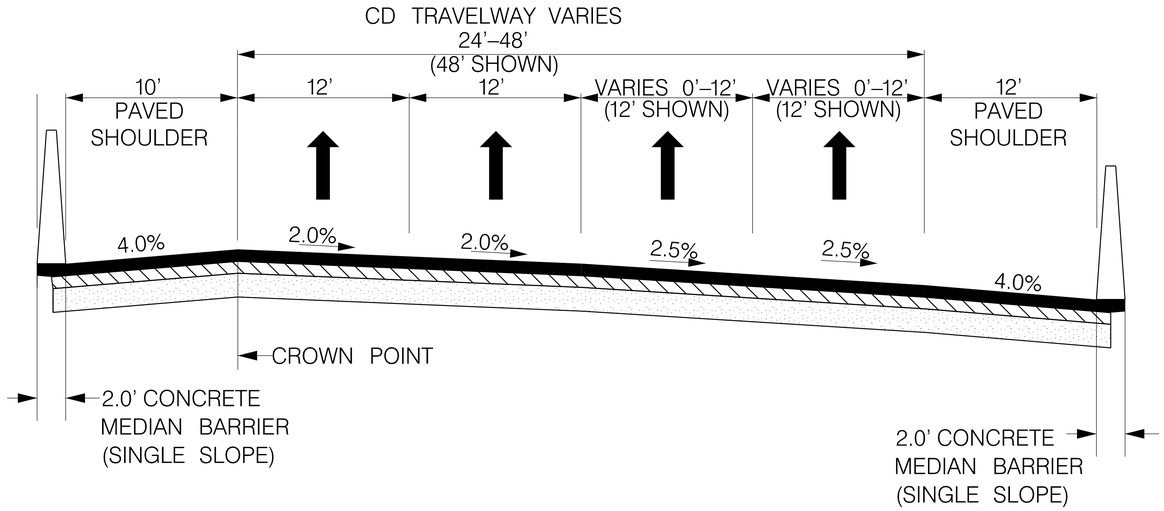
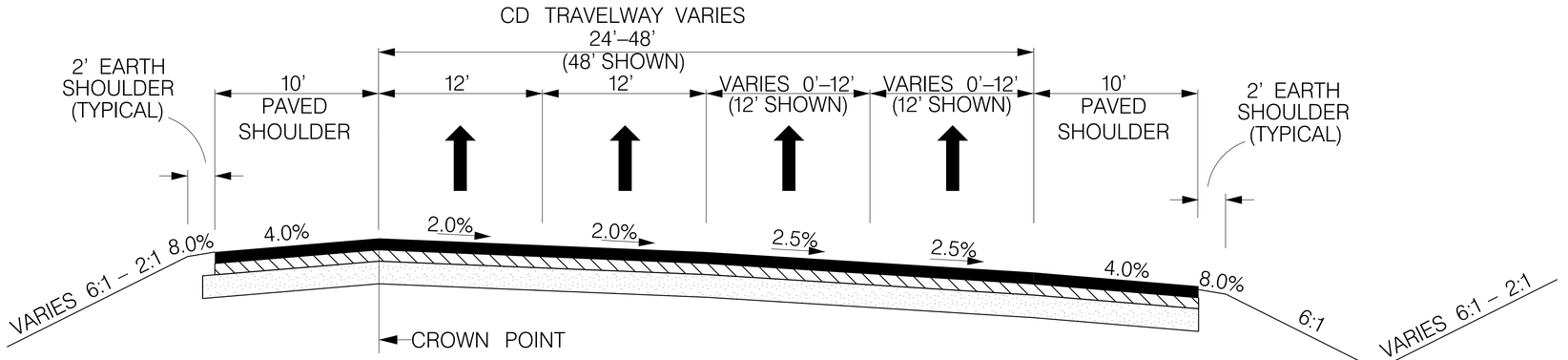


C–D ROADWAY – MULTILANE WITH BARRIER WALL
FC = URBAN INTERSTATE DS = 50 MPH



ADD 3.75' TO EARTH SHOULDER
WHERE GUARDRAIL IS REQUIRED

C–D ROADWAY – MULTILANE
FILL/DITCH SECTION
FC = URBAN INTERSTATE DS = 50 MPH

RTE.	DESIGN SPEED	
MPH	FROM STA.	TO STA.

PAVEMENT DESIGN

APPROVED BY

DATE

SOUTH CAROLINA
DEPARTMENT OF TRANSPORTATION
ROAD DESIGN COLUMBIA, S.C.

CAROLINA CROSSROADS
I–26/I–126/I–20

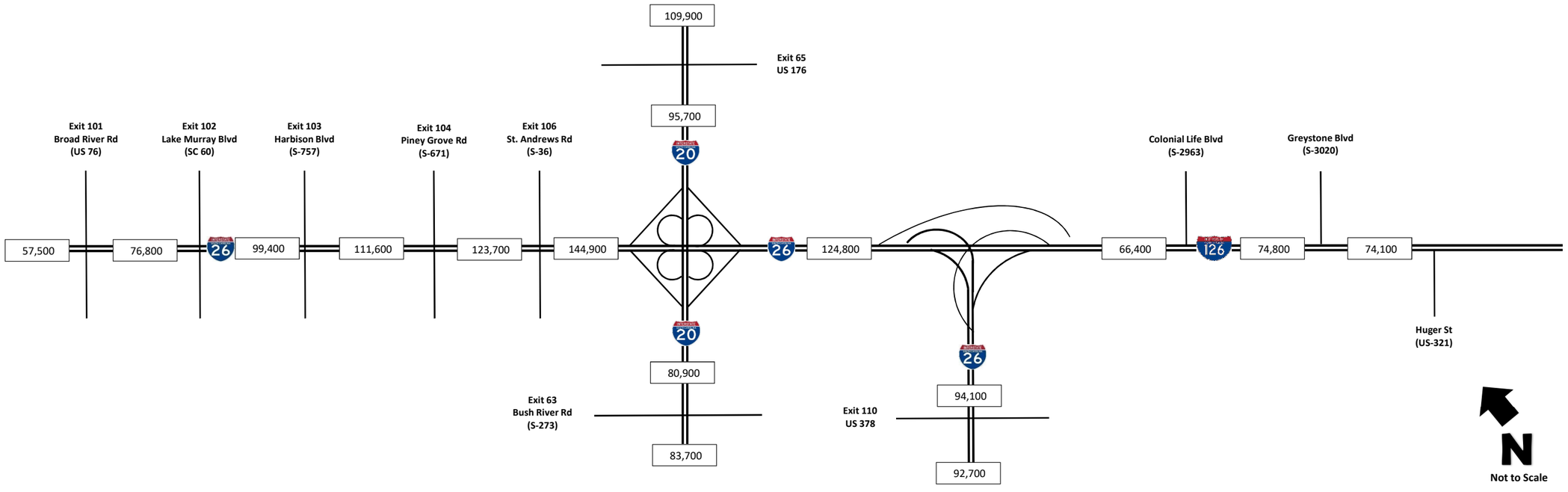
TYPICAL SECTIONS

SCALE: NTS RTE. DWG. NO.

7/8/2020
HDR Engineering, Inc. of the Carolinas
Carolina Crossroads_Typical Sections_PREFERRED_ALT.dgn

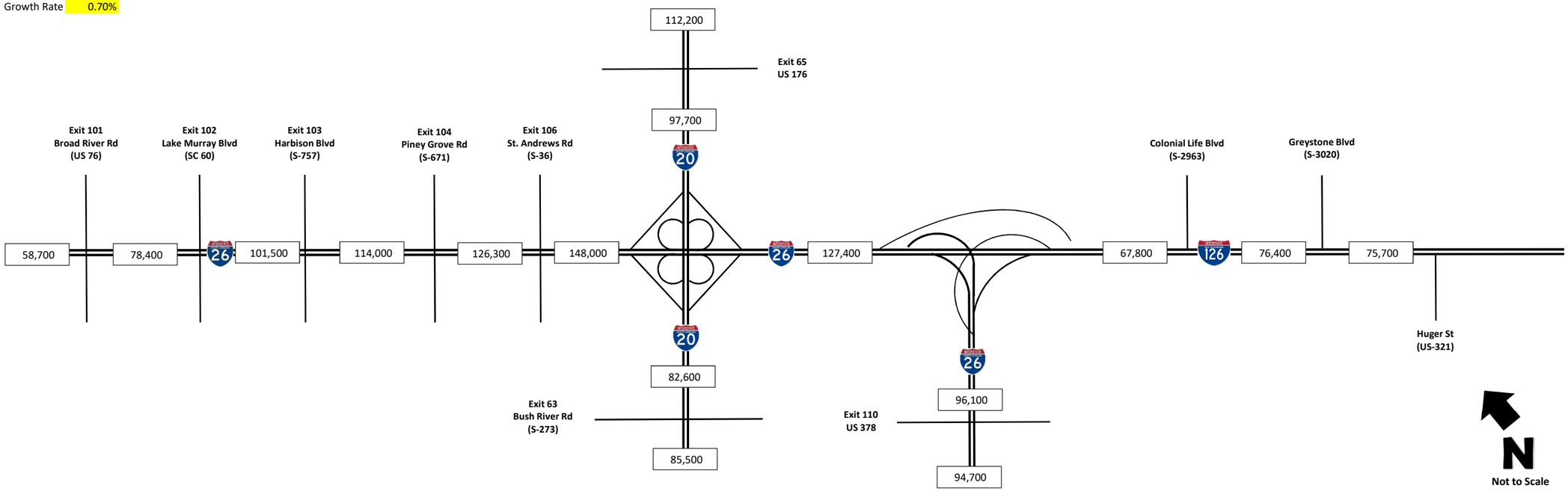
2017 FREEWAY SEGMENT AADT

Year 2017



2020 ESTIMATED FREEWAY SEGMENT AADT

Design Year 2020
Growth Rate 0.70%



2040 ESTIMATED FREEWAY SEGMENT AADT

Design Year 2040
Growth Rate 0.70%