MEMORANDUM

TO: Bill Harris, P.E., DR 4286 SC Group Force Leader, FEMA

FROM: David B. Cook, P.E., State Maintenance Engineer

DATE: May 25, 2017

RE: Code and Standard Documentation

This correspondence is in response to the questions raised regarding upgrades implemented during reconstruction of drainage facilities as a part of SCDOT's Hurricane Joaquin recovery. In Attachment A, Design References, you will find a complete listing of design references that must be considered during the design of a SCDOT bridge replacement project. Since SCDOT facilities which were reconstructed are open for public use, the project design must be performed by a licensed, professional engineer. This ensures that the designer has adequate knowledge and experience to understand and apply the design requirements as intended to protect the public.

All of the design requirements identified in this document meet the five FEMA criteria for eligibility. They all:

1. Apply to the type of restoration required;
    a. Restoration of the facilities damaged during the event included replacement of a bridge carrying highway vehicles with associated approach embankment and roadway work. Due to the magnitude of damage, repairs were not practical and replacement of the facilities was required. The replacement facilities will be designed and constructed to meet current adopted design and construction criteria.
2. Appropriate for the pre-disaster facility use;
    a. Restoration will allow the facility to serve the same function as pre-disaster original design. Design criteria for SCDOT highway and bridge projects are based on the functional classification of the highway. Highways are grouped by the character of service they provide. Once the function of the highway facility is defined, the designer selects an appropriate design speed, roadway width, roadside safety elements, bridge type and other design values.
3. Reasonable, in-writing, and were formally adopted by SCDOT prior to the disaster;
    a. The design criteria used were all established in conjunction with Federal Highway Administration review and formally approved, published and adopted for use by SCDOT prior to the disaster.
4. Apply uniformly;
    a. Established design criteria is uniformly applied to all SCDOT projects based on functional classification as noted above. Uniform application is routinely provided through SCDOT review of design plans and through inspection during construction. SCDOT criteria are not subject to discretionary enforcement by public officials as SCDOT has the following duties and powers provided by Title 57, Chapter 5 SC Code of Laws to "lay out, build, and maintain public highways and bridges, <u>including the exclusive authority to establish design criteria</u>, construction specifications, and standards required to construct and maintain

highways and bridges." Design criteria are not selectively applied as they are applied regardless of the cause for restoration, the source of funding and the availability of funding.

5. Have been enforced since adopted.
    a. Design criteria are continually enforced on all SCDOT projects after adoption. Enforcement of the criteria is typically accomplished through review and acceptance of compliant plans and construction work. Plans or construction work not compliant with criteria are not accepted or paid for by the Department.

Included herein are some of the design requirements that apply specifically to bridge structure depth, length and width. Additional elaboration on each of these specific items is included in Attachment B, Specific Reference Data.

I. Bridge thickness - the two primary design requirement documents that dictate this feature are:

1. SCDOT BDM = SCDOT Bridge Design Manual, 2006, and

2. AASHTO = AASHTO LRFD Bridge Design Specifications, 6th Edition, 2012 with 2013 Interims

Specific references are:

- SCDOT BDM Section 12.2.2 & AASHTO Article 2.5.2.6.2, Article 2.5.2.6.3, Table 2.5.2.6.3-1 - Provides criteria to limit live load deflections. This equates to minimum depth superstructures to limit the deflections.
- SCDOT BDM Section 15.5.5 - Specifies dimensions of cored slab sections.
- AASHTO Section 3 - Specifies required permanent and transient design loadings to apply to bridges, along with load factors and combinations of loadings that need to be evaluated. Specifically AASHTO Table 3.4.1-1 summarizes loadings, load combinations, and load factors to be applied in design. Depths of superstructures are affected by considering these criteria.
- AASHTO Article 3.6 - Specifies required live load design loadings and how they are applied, including HL-93 design truck. Depths of superstructures are affected by considering these criteria.
- AASHTO Section 5 - Provides required design criteria for reinforced concrete and pre-stressed concrete design. The design criteria determine the depth of the superstructure required.

II. Bridge length - the primary design requirement documents that dictate this feature are:

1. SCDOT HDS = SCDOT Requirements for Hydraulic Design Studies, 2009

2. SCDOT Standard Drawing for Bridge End Fill

Specific references are:

- SCDOT HDS Section 1.1.1 - Design frequencies for interstate, primary, and secondary routes
- SCDOT HDS Section 1.2.1 - the widened channel created by the flood may necessitate a longer replacement bridge than the old structure, in order to minimize encroachment of the abutment end fill into the channel.
- SCDOT HDS Section 1.3.1 - Level 2 Procedures for Riverine Bridges – Provides a description of how to establish bridge end slopes
- SCDOT HDS - Section 1.3.1 -Level 2 Procedures for Riverine Bridges – Provides guidance on establishing bridge end fills which directly affect the bridge length.

III. Bridge Width - the primary design requirement documents that dictate this feature are:

1. SCDOT HDM = SCDOT Highway Design Manual, 2003 and
2. SCDOT BDM = SCDOT Bridge Design Manual, 2006

Specific references are:

- SCDOT HDM Section 9.4.1.1 – Functional Classification – Relationship to Design
- SCDOT HDM Chapter 20 – Rural Highways
- SCDOT HDM Figure 20.1E – Geometric Design Criteria for Rural Two-lane Collectors
- SCDOT HDM Figure 20.1G – Alignment Criteria for Rural Collectors
- SCDOT BDM Section 12.6.1.4 - Bridge Roadway Widths
- SCDOT BDM Figure 12.6-1 – Guidelines for Bridge Roadway Widths

This documentation is intended to suffice as justification for all of the design upgrades that were implemented during the reconstruction of drainage facilities that were beyond mitigation limits and were therefore relegated to the design and replacement process. In addition to the information contained herein, please reference the following Attachments for additional information and justification:

- Attachment A – Design References
- Attachment B – Specific Reference Data
- Attachment C – Rural Collector Criteria
- Attachment D – Hydro Summary
- Attachment E - S-51 Final Hydro Reports and HECRAS Files
- Attachment F - S-51 OVER BLACK MINGO CREEK_BRIDGE CALCULATIONS
- Attachment G - S-51 Final Geotechnical Reports

Please advise if you have any questions regarding this information.

ec: Elizabeth Ryan, Chief of Recovery and Mitigation, SCEMD