Appendix 5 – Cross Sections and Safety Countermeasure Guidelines

Both the Capital Area MPO and Durham-Chapel Hill-Carrboro MPO promote street cross-section designs and safety counter measures with the objective to create roadways that are multi-modal, sensitive to the local context (e.g., land use, non-automotive trips), and safe.

Street Cross Sections and Guidelines

The street cross sections and guidelines in Chapter 4 of the North Carolina Department of Transportation's Complete Streets Planning and Design Guidelines are included in the 2040 MTP by reference. The illustrations show the intended spatial relationships of the various street components, and serve as a diagram of one or more possible street configurations. The guidelines provide ranges that allow the design team the flexibility to respond to particular conditions.

The cross-sections should not be used in isolation. Consideration of the context and other elements must be brought into the decision making process. The final cross-section and design of a road depends on many operational, planimetric, contour and land use factors, and thus design decisions must be made on a case-by-case basis. All pavement markings and placement of pavement markings should follow the guidelines specified in the current edition of the Manual on Uniform Traffic Control Devices (MUTCD).

Safety Countermeasures

Improving safety is a top priority for both the Capital Area MPO and Durham-Chapel Hill-Carrboro MPO, which are committed to reducing highway fatalities and serious injuries on our region's highways.

The FHWA Office of Safety Program is highly confident that certain processes, infrastructure design techniques, and highway features are effective and their use should be encouraged. In January 2012, FHWA issued a "Guidance Memorandum on Promoting the Implementation of Proven Safety Countermeasures." This guidance takes into consideration the latest safety research to advance a group of countermeasures that have shown great effectiveness in improving safety.

Safety practitioners are encouraged to consider this set of countermeasures that are research-proven, but not widely applied on a national basis. As both the Capital Area MPO and Durham-Chapel Hill-Carrboro MPO develop plans to address mobility and safety challenges, they are to consider the benefits and use of these proven roadway safety tools and techniques.

1. **Safety Edge –**The Safety Edge asphalt paving technique minimizes vertical drop-off safety hazards. A Safety Edge shape is created by fitting resurfacing equipment with a device that extrudes and compacts the shape of the pavement edge at a specific angle as the paver passes. This mitigates shoulder pavement edge drop-offs immediately during the construction process and over the life of the pavement. Because the

technique involves only a slight modification of paving equipment, it has a minimal impact on project cost. NCDOT has indicated that they are in the process of trying this technique on a few projects across the state and then monitor it to see if it has positive results. The Capital Area MPO and the Durham-Chapel Hill-Carrboro MPO will encourage NCDOT to inform them of the outcome and examine where the technique can best utilized along the roadway network.

2. **Roundabouts –**A roundabout is a circular intersection where entering traffic yields to vehicles on the circulatory roadway. Roundabouts are designed to channel traffic at the entrance and provide collision deflection around a center island. Modern roundabouts are geometrically designed to reduce speeds and deflect collision forces, which substantially improves safety, while providing excellent operational performance at the intersection. There are local governments in both MPOs that have ordinance provisions for roundabouts; and both MPOs will encourage their use as needed for transportation system measures.

3. **Corridor Access Management** -- Access management is a set of techniques that State and local governments use to control access to highways, major arterials, and other roadways. The benefits of access management include improved movement of traffic, reduced crashes, and fewer vehicle conflicts. Access management principles are applicable to roadways of all types, ranging from fully access-controlled facilities, such as freeways, to those with little or no access control, such as local streets. Successful access management, managed by change in access density, seeks to simultaneously enhance safety, preserve capacity, and provide for pedestrian and bicycle needs.

4. **Backplates with Retroreflective Borders.** Backplates are added to a traffic signal indication in order to improve the visibility of the illuminated face of the signal by introducing a controlled-contrast background. The improved visibility of a signal head with a backplate is then made more conspicuous by framing the backplate with a retroreflective border. Taken together, a signal head equipped with a backplate with retroreflective border is made more visible and conspicuous in both daytime and nighttime conditions, which is intended to reduce unintentional red-light running crashes.

5. **Longitudinal Rumble Strips and Stripes on 2-Lane Roads.** Longitudinal rumble strips are milled or raised elements on the pavement intended to alert inattentive drivers through vibration and sound that their vehicles have left the travel lane. Roadway departure crashes account for approximately 53% of fatal crashes each year on the Nation's highways. Rumble strips are designed primarily to address the subset of driver error crashes caused by distracted, drowsy, or otherwise inattentive drivers who unintentionally drift from their lane. Since driver error occurs on all roadway systems (including 2 lane roads), rumble strips are most effective when deployed in a systemic application. As discussed in Chapter 9 of the Chapter 4 of the North Carolina Department of Transportation's Complete Streets Planning and Design Guidelines, when rumble stripes are used, they should be designed to lessen the impacts on other users, specifically bicyclists. There are a number of possible applications that can be used:

    - Shoulder rumble strips are installed on a shoulder near the edge of the travel lane. They significantly reduce run-off-road (ROR) crashes.

- Edge line rumble strips are very similar to shoulder rumble strips, but placed at the edge of the travel lane, typically in line with the edge line pavement marking.
- Center line rumble strips are installed at or near the center line of an undivided roadway, and may be comprised of either a single or double line of rumbles. They reduce cross center line crashes such as head-on collisions and some run-off-road left crashes.
- Rumble stripes are either edge line or center line rumble strips where the pavement marking is placed over the rumble strip. This countermeasure increases nighttime visibility of the pavement marking.

6. **Enhanced Delineation and Friction for Horizontal Curves –** Low-cost safety treatments vary by the severity of the curvature and the operating speed. Low-cost treatments typically include methods for warning the driver in advance of the curve, but treatments will vary by intensity of the warning. Implementing the recently published curve treatments included in the Manual on Uniform Traffic Control Devices (MUTCD) should improve curve safety over past practices by providing consistency. However, additional enhancements can be made with post-mounted delineation in the curve or an enhanced signing treatment that may include larger chevron signs with enhanced retroreflectivity. For more challenging curves, dual indicated advanced signs with constant flashing beacons may be effective. Pavement markings are also an effective communication tool to indicate the alignment change. Pavement friction is critical for changing vehicle direction and ensuring the vehicle remains in its lane. Traditional friction courses or high friction surface treatments should be considered for curves with numerous wet weather crashes or severe curves with higher operating speeds.

7. **Medians and Pedestrian Crossing Islands in Urban and Suburban Areas –** Medians reduce traffic conflicts and increase safety by providing a buffer area between opposing lanes of traffic. Medians can be open (pavement markings only), or channelized (raised medians or islands) to separate various road users. Pedestrian Refuge Areas—also known as crossing islands, center islands, refuge islands, pedestrian islands, or median slow points—are raised islands placed in the street to separate crossing pedestrians from vehicles. Both the Capital Area MPO and Durham-Chapel Hill-Carrboro MPO will support the efforts to apply medians and pedestrian refuge areas where needed to support safety and reduce conflict between motor vehicles and pedestrians.

8. **Pedestrian Hybrid Beacon –** The pedestrian hybrid beacon (also known as the High intensity Activated crossWalK (or HAWK)) is a pedestrian-activated warning device located on the roadside or on mast arms over midblock pedestrian crossings. The beacon head consists of two red lenses above a single yellow lens. The beacon head is "dark" until the pedestrian desires to cross the street. At this point, the pedestrian will push an easy to reach button that activates the beacon. After displaying brief flashing and steady yellow intervals, the device displays a steady red indication to drivers and a "WALK" indication to pedestrians, allowing them to cross a major roadway while traffic is stopped. After the pedestrian phase ends, the "WALK" indication changes to a flashing orange hand to notify pedestrians that their clearance time is ending. The hybrid beacon displays alternating flashing red lights to drivers while pedestrians finish their crossings before once again going dark at the conclusion of the cycle.

9. **Road Diets (Roadway Reconfiguration) –** The classic roadway reconfiguration, commonly referred to as a "road diet," involves converting an undivided four lane roadway into three lanes made up of two through lanes and a center two-way left turn lane. The reduction of lanes allows the roadway to be reallocated for other uses such as bike lanes, pedestrian crossing islands, and/or parking. Road diets have multiple safety and operational benefits for vehicles as well as pedestrians, such as:

   - Decreasing vehicle travel lanes for pedestrians to cross, therefore reducing the multiple-threat crash (when one vehicle stops for a pedestrian in a travel lane on a multi-lane road, but the motorist in the next lane does not, resulting in a crash) for pedestrians,
   - Providing room for a pedestrian crossing island,
   - Improving safety for bicyclists when bike lanes are added (such lanes also create a buffer space between pedestrians and vehicles),
   - Providing the opportunity for on-street parking (also a buffer between pedestrians and vehicles),
   - Reducing rear-end and side-swipe crashes, and
   - Improving speed limit compliance and decreasing crash severity when crashes do occur.

   Several road diets have been implemented in the Durham-Chapel Hill-Carrboro MPO and Capital Area MPO areas, and the MPOs will continue to work with NCDOT and local government partners to review potential locations for road diets.