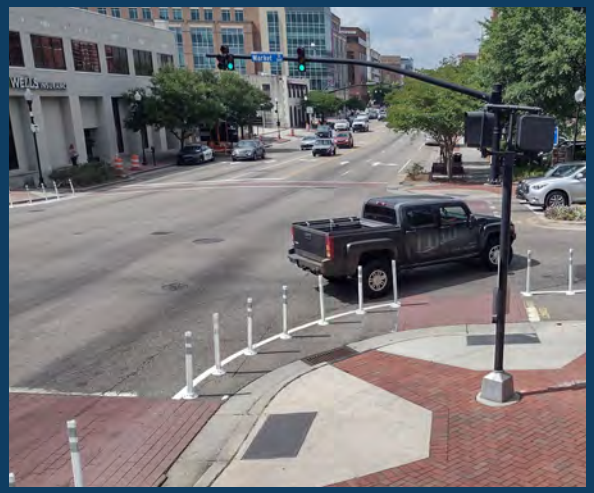
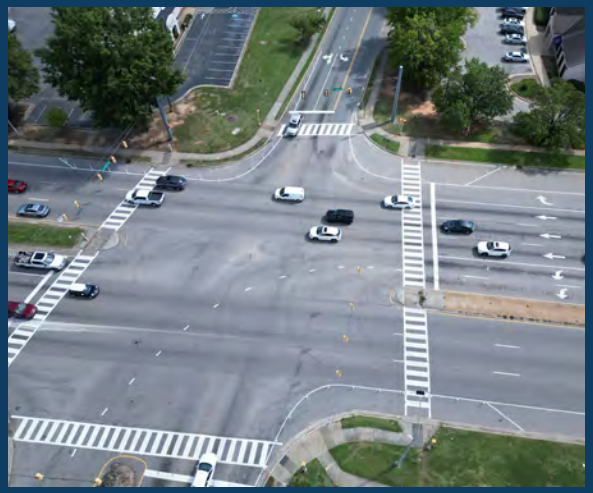
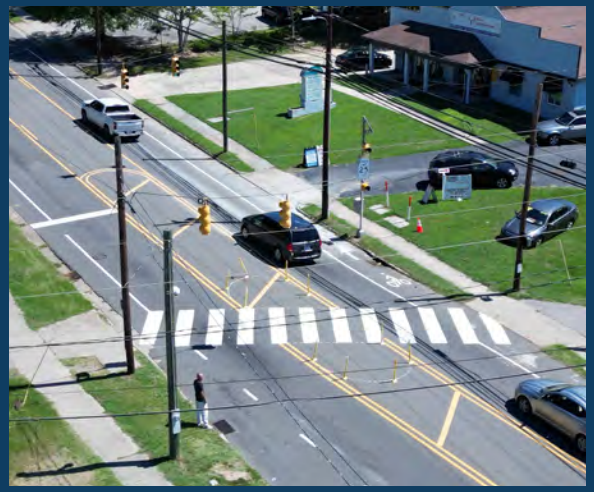


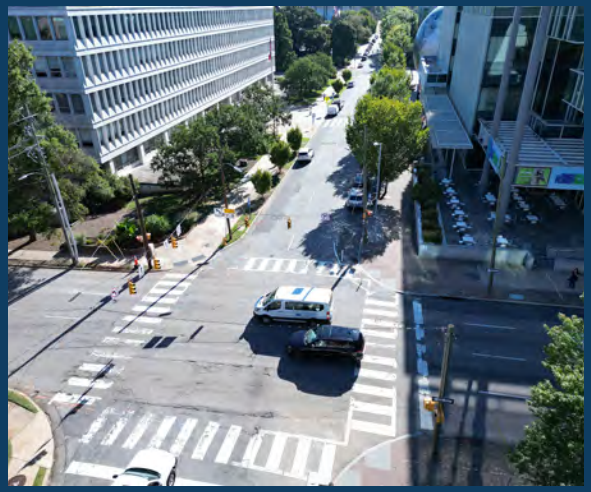


NCDOT INTERIM DESIGN SAFETY PILOT PROJECT

FINAL REPORT

SEPTEMBER 2023





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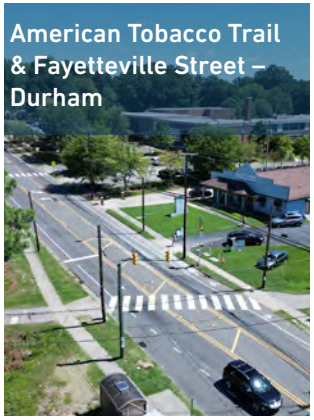
EXECUTIVE SUMMARY

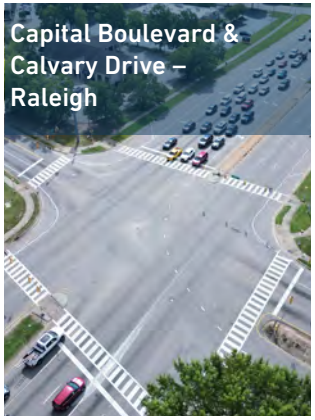
North Carolina Department of Transportation's (NCDOT) Integrated Mobility Division (IMD) developed a pilot project that would evaluate the process for deploying low-cost, interim design safety countermeasures on state owned and maintained roadways. These Federal Highways Administration's (FHWA) Proven Safety Countermeasures emphasized the safety of pedestrians and bicyclists—the most vulnerable roadway users—through risk and exposure reduction at intersections. This innovative approach to more rapidly deploy safety countermeasures was funded by the FHWA's State Transportation Innovation Council (STIC) Incentive program. Foundational to the approach of this project were the goals of the Technology and Innovation Deployment Program (TIDP) that emphasized innovative practices, improvements to safety, quick construction/deployment, new tools and techniques, and improvements to mobility.

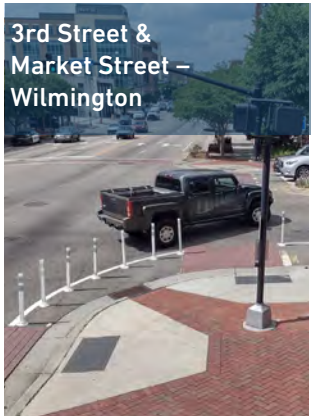
The term "interim design" was used throughout the life of the project to communicate that the deployment of the safety countermeasures is a step toward a more permanent solution. Although the materials used were low-cost and could be temporary, the design geometry and its impact on safety by reducing risk to pedestrians and bicyclists is important and potentially long-lasting.

Evaluation of the process for deployment was the purpose of the pilot project. As a statewide agency, NCDOT understands the value of safety countermeasures and includes them across the state as projects are designed and constructed. However, focusing on more rapid deployment and on risk rather than historical crash locations is not a common practice. The opportunity to test a new procedure for smaller spot safety projects was an important benefit of the interim design safety pilot project.

An overview of the key components of the project are included below and described in more detail in the final report.







Countermeasure Selection and Site Identification

Sites were identified using criteria that would minimize costly modifications to intersection approaches, reduce crossing distances, increase visibility, and would create physical separation for pedestrians and bicyclists. There were several countermeasures explored early on in the project. A narrow list of three countermeasures was confirmed for site identification and only two countermeasures were ultimately deployed—curb extension and median refuge. Potential deployment sites met criteria that included extra space near intersections, which could be a wide outside lane, on-street parking or a painted shoulder for curb extensions and a continuous two-way left turn lane for median refuges. Over 30 potential deployment sites were originally identified and the final list was narrowed down to ten with six sites completing deployment.

Interim Design Countermeasure Deployment

Once countermeasures, potential deployment sites, and communications were finalized, the process of deployment moved rapidly. Coordination meetings between NCDOT highway division staff and municipal staff proved valuable and successful, and Deployment was initiated within weeks and sites were completed in less than two months. Deployment sites are shown above.

Post-Deployment Interviews and Findings

After deployment, the Project Team (IMD and consultant Toole Design Group) conducted follow up interviews with municipal staff and NCDOT Regional Traffic Safety Engineers to collect feedback on the process for deployment and perceptions of the interim design safety solutions. Interview results highlighted that deployment was successful and the desire for a more rapid process for addressing safety concerns with a focus on reducing risk based on roadway characteristics. Feedback also noted the need for earlier coordination, the development of a clear process for keeping countermeasures in place, and discussions surrounding funding/reimbursement for deployment. Considerations for future iterations of the pilot project are described in the final report. A few noteworthy future considerations include:

- Evaluation of additional countermeasures
- Integrating interim design into larger safety projects
- Test an alternative site identification process

1

PURPOSE OF THE PROJECT

Intent

As a statewide agency, the North Carolina Department of Transportation (NCDOT) is responsible for how people move across a state with a variety of contexts. NCDOT's mission statement highlights the values of connectivity, safety, and efficiency that guide the organization. More specifically, the Integrated Mobility Division (IMD) is focused on multimodal transportation solutions. Their mission and core goals listed below created the opportunity for this pilot project:

The Division's mission is to provide leadership for safe, affordable, and innovative multimodal transportation throughout North Carolina.

Core goals include:

- **Increase Access**: Eliminate transportation barriers and ensure all North Carolinians have equal access to opportunities and services.
- **Enhance Quality of Life**: Offer a convenient network of multimodal choices to enhance the quality of life for all North Carolinian residents.
- **Ensure Safety**: Ensure all road users can travel safely by building streets fit for all and proactively correcting areas susceptible to crashes involving vulnerable road users.

With the mission in mind, IMD pursued funding to develop a first-of-its-kind pilot project that aligned core goals and when completed would provide information about future opportunities to increase safety for the state's more vulnerable roadway users. The specific purpose of the interim design safety pilot project is to evaluate the process for the following steps:

- Identifying low-cost safety countermeasures,
- Selecting sites on state-owned roadways, and
- Deploying countermeasures.

Foundational to this project was the use of FHWA approved safety countermeasures that reduce risk and exposure for pedestrians and bicyclists and that align with FHWA's Every Day Counts (EDC) and Safe Transportation for every Pedestrian initiative. The effectiveness of these countermeasures was not the purpose of this project due to the research and documentation that emphasizes the value of these interventions to increase safety. Using accepted and approved countermeasures that are effective allowed the pilot project to consider the process of selection, coordination, and deployment. While this report provides a more detailed overview of the process, the following notes the simplified steps that were accomplished:

As a pilot project, the evaluation of the process was critical to determine the appropriate steps for future opportunities and long-term sustainability. The feedback from highway division and municipal staff provides lessons learned that can be considered by IMD staff as they develop innovative safety solutions across the state.

2

PROCESS

Deploying pilot projects on NCDOT owned and maintained roadways does not follow the standard project development process. This section reviews the history of this project along with countermeasure selection criteria that resulted in potential project sites described later in this report.

Project History

The changes and adaptations that occurred throughout the pilot project's history provide additional insight into the purpose. Process changes from the original scope highlight the flexibility that is needed to test new ideas. The following section summarizes the initial scope of work for the project along with the specific changes that occurred prior to the project kickoff and throughout the project.

Original Scope of Work

In 2020, NCDOT applied and received funding from the Federal Highway Administration's (FHWA) State Transportation Innovation Council (STIC) Incentive program. This program was developed to provide financial resources that could be used to promote innovation and propel creative and innovative approaches toward standard statewide practices. As a recipient of funding, NCDOT's project must align with the Technology and Innovation Deployment Program's (TIDP) goals that include:

- Significantly accelerate the adoption of innovative technologies by the surface transportation community;
- Provide leadership and incentives to demonstrate and promote state-of-the-art technologies, elevated performance standards, and new business practices in highway construction processes that result in improved safety, faster construction, reduced congestion from construction, and improved quality and user satisfaction
- Construct longer-lasting highways through the use of innovative technologies and practices that lead to faster construction of efficient and

safe highways and bridges

- Improve highway efficiency, safety, mobility, reliability, service life, environmental protection, and sustainability
- Develop and deploy new tools, techniques, and practices to accelerate the adoption of innovation in all aspects of highway transportation

The original scope of work acknowledged that safety solutions for nonmotorized users did not have to wait for expensive roadway changes that could take years to implement. The following quote from the project abstract in the original scope of work sets the stage for all of the work completed to-date:

Several cost-effective countermeasures can be systematically applied to reduce crashes and save lives by using temporary materials. Temporary materials are valuable in broadening exposure to specific solutions and developing state data of their effectiveness in improving pedestrian safety.

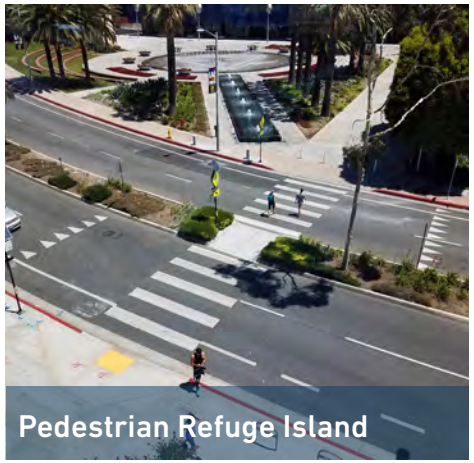
NCDOT's proposal was to create a tactical materials library that could be used by local municipalities across the state to deploy safety countermeasures that aligned with FHWA's Every Day Counts (EDC) Safe Transportation for Every Pedestrian (STEP) initiative that was approved in 2018. Using the STEP initiative as a foundation, the tactical materials library would become a resource for municipalities that desired to deploy promoted countermeasures that could increase pedestrian safety at crossings. The countermeasures identified by FHWA's STEP initiative include:

- **Road Diets** can reduce vehicle speeds, the number of lanes pedestrians cross, and can create space to add new bicycle and pedestrian facilities.
- **Pedestrian hybrid beacons (PHBs)** are a beneficial intermediate option between RRFBs and a full pedestrian signal. They provide positive stop control in areas without the high pedestrian traffic volumes that typically warrant signal installation.
- **Pedestrian refuge islands** allow pedestrians a safe place to stop at the midpoint of the roadway before crossing the remaining distance. This is particularly helpful for older pedestrians or others with limited mobility.
- **Raised crosswalks** can reduce vehicle speeds.
- **Crosswalk visibility enhancements**, such as crosswalk lighting and enhanced signing and marking, help drivers detect pedestrian–particularly at night.
- **Rectangular Rapid Flashing Beacons (RRFBs)** are active (user-actuated) or passive (automated detection) amber LEDs that use an irregular flash pattern at mid-block or uncontrolled crossing locations. They significantly increase driver yielding behavior.
- **Leading Pedestrian Intervals (LPIs)** at signalized intersections allow pedestrians to walk, usually 3 to 4 seconds, before vehicles get a green signal to turn left or right. The LPI increases visibility, reduces conflicts and improves yielding to pedestrians.

Initial project details noted that a deployment selection tool would be developed and used by local municipalities to evaluate specific locations where a pedestrian or bicyclist safety concern exists. The deployment selection tool would assist communities as they identified the most effective countermeasure for their site based on a variety of conditions and characteristics. After evaluation, a local request would be submitted to NCDOT for use of materials from the tactical materials library. If selected, a municipality would coordinate with NCDOT to check-out materials for deployment

Countermeasures included in the initial scope


Curb Bulb-Out


Pedestrian Refuge Island


Raised Crosswalk


Protected Bicycle Lane

of short-term projects. The specific countermeasures that were listed in the original scope included:

- Curb bulb-outs/extensions (intersection improvements)
- Pedestrian refuge island (mid-block crossing)
- Raised Crosswalk (intersection, mid-block crossing)
- Bike lane barriers (road diets, protected bike lanes)

As NCDOT reviewed the original scope of work with the selected consultant, there were concerns related to how the tactical materials library would function, the longevity of materials, and agreements that may be needed between NCDOT and municipalities. These concerns resulted in an updated scope of work that maintained the intent of the original scope of work—selecting and deploying low-cost countermeasures to increase safety through reducing risk for pedestrians and bicyclists. The next section describes the scope of work that was developed and used to initiate the project.

Interim Design Guidance and Pilot Projects

In early 2021, an updated scope of work was developed that maintained the intent of the original scope of work along with meeting the TIDP goals related to innovation, increasing safety, and accelerating deployment of countermeasures. There were several changes for the updated scope of work that focused on the process for deployment and emphasized evaluation of the process over the countermeasures. Of note, was the renaming of the project from Tactical Materials Library and Deployment Selection Tool to Interim Design Guidance and Pilot Projects. A task-by-task summary of the updated scope of work is to the right.

The Interim Design Guidance and Pilot Projects scope of work was finalized, and the project started with creating a list of countermeasures, developing a decision matrix, and preparing a web-based application tool. As advertisement of the web-based application tool was being prepared, changes to the process, described below, were occurring. These changes impacted the schedule of the project and the process for selecting deployment sites.

Task-by-task summary of the updated scope

A. **Interim Design Selection Tool and Application** – using local and national resources, an interim design safety countermeasure selection tool and application process would be developed. Key elements of this task included:
   a. **Review of Resources** – to provide background information and research related to safety countermeasures for pedestrians and bicyclists. Several documents were reviewed to identify a menu of countermeasures that could be applied. The list of resources included:
      i. FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations
      ii. FHWA Achieving Multimodal Networks: Applying Design Flexibility and Reducing Conflicts
      iii. FHWA Bikeway Selection Guide
      iv. FHWA Model Road Safety Audit Policy
      v. NCDOT's Pedestrian Crossing Guidance
      vi. NCDOT's Crash Reduction Factors
   b. **Interim Design Decision Matrix** – to identify effective interim design countermeasures that could be applied based upon specific roadway characteristics to increase safety and reduce risk for pedestrians and bicyclists. The decision matrix would be used to narrow the list of countermeasures used for the pilot projects. Three categories with corresponding countermeasures were developed for the decision-making matrix:
      i. Intersections
         1. High-visibility crosswalks
         2. Curb extensions/bulb-outs
         3. Pedestrian refuge islands
         4. Protected intersection elements including but not limited to:
            a. Corner refuge islands
            b. Hardened centerlines
            c. Turn wedges
      ii. Mid-block crossings
         1. High-visibility crosswalks
         2. Curb extensions/bulb-outs
         3. Pedestrian refuge islands
         4. Advance warning signage
         5. In-street pedestrian crossing signage
      iii. Corridors
         1. Designated bikeways (standard, buffered, or separated bike lanes)
   c. **Selection Tool and Deployment Application** – to locate deployment sites across the state, a web-based interactive application would be developed to allow local municipalities to provide information related to street characteristics and determine if the location was eligible for the pilot program. Applications would use logic-based questions to identify appropriate countermeasures based upon responses. Applications would address:
      i. Proposed project location
      ii. Interim design countermeasure(s) based upon selection tool results
      iii. Safety concern
      iv. Crash history
      v. Previous planning efforts/recommendations
      vi. Local support
      vii. Existing conditions related to speed, yielding, volumes, etc.
      viii. Proposed evaluation period

B. **Deployment and Evaluation** – reviewing the applications that were submitted, NCDOT IMD would determine the specific sites selected for deployment. This task included review of all applications, selecting deployment sites, and coordinating with municipalities to prepare for pilot project deployment. Specific goals identified for selecting deployment sites included:
   a. Deploying pilot projects across multiple NCDOT Divisions
   b. Varying the type of countermeasure deployed while ensuring each countermeasure type was deployed in at least two locations

C. **Summary Report** – evaluating the pilot project would include a summary report that described the outcomes and the process of deployment. This task included interviews with NCDOT Division and Municipal staff to understand feedback related to the process, communication, and impacts.

Pilot Project Modifications

Based on feedback from NCDOT IMD staff, a new approach to selecting deployment sites was developed. Specific criteria for pilot project sites were developed through a review of the interim design decision matrix and application creation. Instead of using the web-based application, the consultant team reviewed historical pedestrian and bicycle crash sites along with other locations near crash sites that may meet the criteria for pilot project deployment. Notable modifications to the scope of work for the pilot project selection and deployment included:

- Selecting potential deployment sites rather than issuing a call for applications
- Coordinating with IMD and highway division staff to narrow potential sites rather than a review of submitted applications
- Identifying specific countermeasures to be deployed on a site-by-site basis with input from NCDOT staff
- Finalizing a list of potential pilot project sites along with countermeasure design prior to coordination with municipal staff instead of engaging municipal staff prior to site selection through the application process

Modification to the selection and deployment process continued to align with the purpose of the project and with TIDP goals. The history of project development and process highlights the value in being flexible when moving toward innovative practices and solutions. The following sections provide more specific details related to countermeasure selection criteria based on the final modifications made to the scope of work.

- Grant from FHWA for Tactical Urbanism Library
- NCDOT would purchase and store materials
- Communities would "check-out" materials for short-term projects
- Refine scope to focus on Interim Design solutions for safety
- Initial direction – application process to determine site selection
- Refined approach – select sites that have:
- History of pedestrian and bicycle crashes
- Meet a set of criteria
- Discuss with divisions and then municipal staff

Early diagrams highlighting project goals at mid-block crossings and intersections:

SHORTENING CROSSING DISTANCES FOR PEDESTRIANS

SLOWING DOWN VEHICLES

Selecting Countermeasures for the Pilot

FHWA's list of proven safety countermeasures includes 28 strategies[1] which have been proven to reduce fatal and severe injury crashes on roadways. The countermeasures include infrastructure and engineering solutions such as bicycle lanes, walkways, and dedicated turn lanes, as well as program and policy strategies including setting appropriate speed limits and conducting road safety audits.

Proven safety countermeasures are designed to be applicable for all kinds of roads and all kinds of geographic contents. While opportunities exist to deploy all countermeasures across the state of North Carolina, this pilot project focused on a narrowed list of countermeasures that met the following criteria.

Low Cost

Large-scale roadway safety projects often require funding from multiple sources set aside years in advance. The selected countermeasures for this pilot, however, only required flex posts, paint, and minimal installation costs This emphasized the impact of proactively deploying countermeasures at multiple locations and gave highway divisions the ability to participate in the pilot even though it was outside the traditional NCDOT funding process.

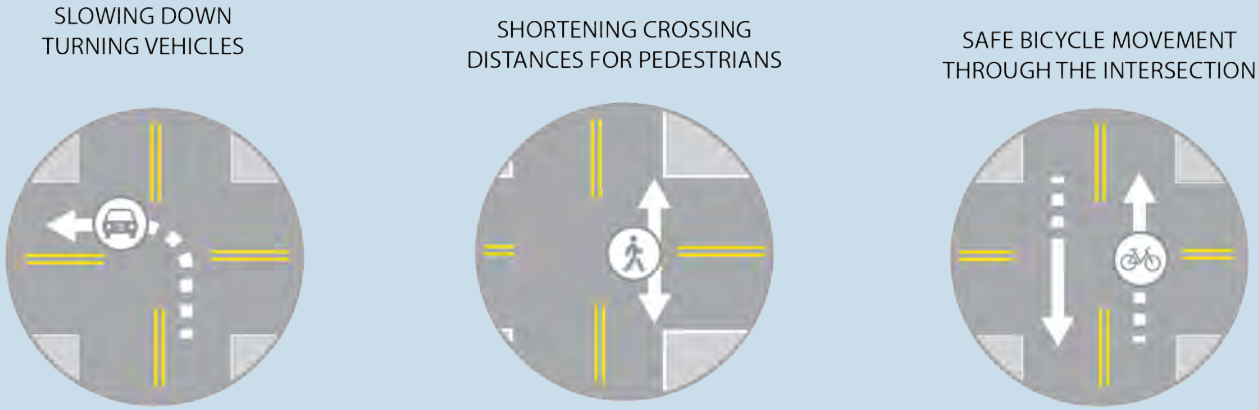
Simple to deploy

Part of ensuring low costs was focusing on countermeasures that were as easy to deploy as possible. Countermeasures were only considered if they could be installed within existing right-of-way, maintained the existing lane and signal configurations and did not require additional studies or policy changes.

Proven to reduce risk and exposure:

The safety benefits of countermeasures are quantified through crash modification factors (CMFs) which calculate the expected reduction in fatal and severe injury crashes after implementing a specific countermeasure. While all 28 strategies have been studied and proven to reduce risk, this project focused on those which have shown to have the biggest safety impact. Additionally, FHWA has provided a variety of resources through the EDC STEP initiative that highlights countermeasures that are effective for vulnerable road users.

1 https://highways.dot.gov/safety/proven-safety-countermeasures



FHWA Guide for Selecting Countermeasures at Uncontrolled Pedestrian Crossing Locations

Roadway Configuration	Posted Speed Limit and AADT								
	Vehicle AADT <9,000			Vehicle AADT 9,000–15,000			Vehicle AADT >15,000		
	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph
2 lanes (1 lane in each direction)	❶ 2 4 5 6	❶ 5 6 7 9	① 5 6 ❼ ❾	❶ 4 5 6	❶ 5 6 7 9	① 5 6 ❼ ❾	❶ 4 5 6 7 9	① 5 6 7 9	① 5 6 ❾
3 lanes with raised median (1 lane in each direction)	❶ 2 3 4 5	❶ ❸ 5 7 9	① ❸ 5 ❼ ❾	① 3 4 5 7 9	① ❸ 5 ❼ ❾	① ❸ 5 ❼ ❾	① ❸ 4 5 7 9	① ❸ 5 ❼ ❾	① ❸ 5 ❾
3 lanes w/o raised median (1 lane in each direction with a two-way left-turn lane)	❶ 2 3 4 5 6 7 9	❶ ❸ 5 6 7 9	① ❸ 5 6 ❾	① 3 4 5 6 7 9	① ❸ 5 6 ❼ ❾	① ❸ 5 6 ❾	① ❸ 4 5 6 7 9	① ❸ 5 6 ❾	① ❸ 5 6 ❾
4+ lanes with raised median (2 or more lanes in each direction)	❶ ❸ 5 7 8 9	❶ ❸ 5 7 8 9	① ❸ 5 8 ❾	① ❸ 5 7 8 9	① ❸ 5 ❼ 8 ❾	① ❸ 5 8 ❾	① ❸ 5 ❼ 8 ❾	① ❸ 5 8 ❾	① ❸ 5 8 ❾
4+ lanes w/o raised median (2 or more lanes in each direction)	❶ ❸ 5 6 7 8 9	① ❸ 5 ❻ 7 8 9	① ❸ 5 ❻ 8 ❾	① ❸ 5 ❻ 7 8 9	① ❸ 5 ❻ ❼ 8 ❾	① ❸ 5 ❻ 8 ❾	① ❸ 5 6 ❼ 8 ❾	① ❸ 5 ❻ 8 ❾	① ❸ 5 ❻ 8 ❾

Given the set of conditions in a cell,

- \# Signifies that the countermeasure is a candidate treatment at a marked uncontrolled crossing location.
- ● Signifies that the countermeasure should always be considered, but not mandated or required, based upon engineering judgment at a marked uncontrolled crossing location.
- ○ Signifies that crosswalk visibility enhancements should always occur in conjunction with other identified countermeasures.*

The absence of a number signifies that the countermeasure is generally not an appropriate treatment, but exceptions may be considered following engineering judgment.

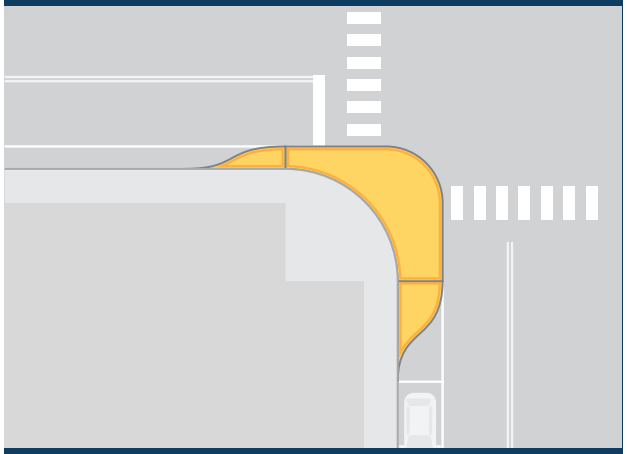
1 High-visibility crosswalk markings, parking restrictions on crosswalk approach, adequate nighttime lighting levels, and crossing warning signs
2 Raised crosswalk
3 Advance Yield Here To (Stop Here For) Pedestrians sign and yield (stop) line
4 In-Street Pedestrian Crossing sign
5 Curb extension
6 Pedestrian refuge island
7 Rectangular Rapid-Flashing Beacon (RRFB)**
8 Road Diet
9 Pedestrian Hybrid Beacon (PHB)**

https://safety.fhwa.dot.gov/ped_bike/step/resources/docs/fhwasa18018.pdf

Based on these criteria three countermeasures were selected to be included in the pilot project.

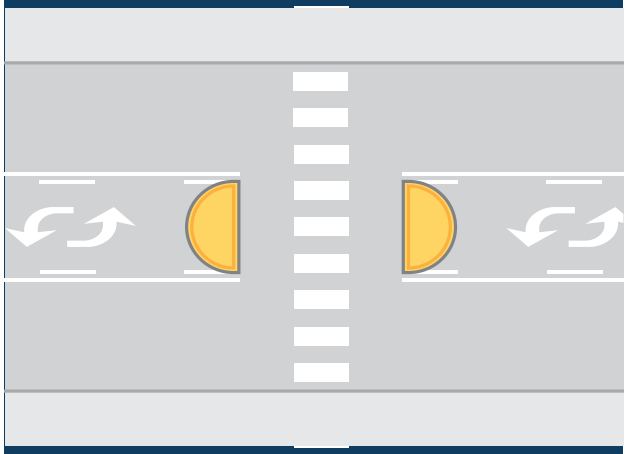
Curb Extensions

Curb extensions reduce vehicle turning speeds, shorten crossing distances for pedestrians, and increase space for those waiting to cross.



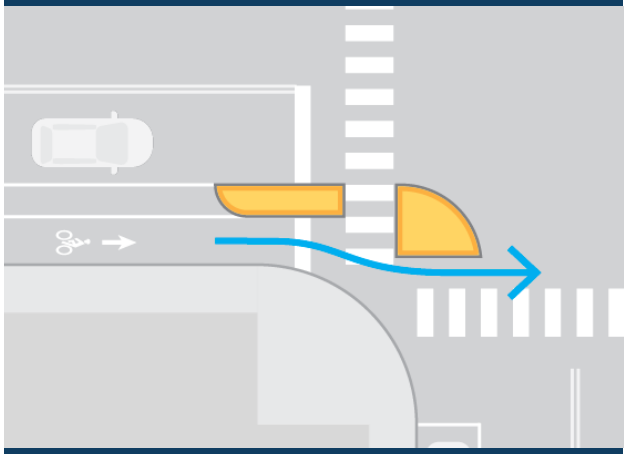
Median Refuges

Median refuge islands reduce crossing distances and provide protected space in the center of the roadway for pedestrians and bicyclists.



Protected Corners

Protected corners at intersections reduce vehicle turning speeds, improve sight lines, and provide people on bicycles advanced queuing to travel through an intersection.



Selection of deployment sites considered these specific countermeasures and developed criteria related to site characteristics to ensure deployment would be effective and meet the goals of the pilot project. Site identification and selection are described in the following section with supporting information related to potential site lists and factors that reduced the number of sites for countermeasure deployment.

3

SITE IDENTIFICATION & SELECTION

With curb extensions, median refuges, and protected corners as the selected safety countermeasures, the project team began the process of identifying candidate locations for these treatments to be deployed. This section outlines the methods and criteria used to identify potential locations, as well as how the list of locations was narrowed and refined by the project team, IMD, and highway division staff.

Site Identification

Site selection focused on identifying locations where proven safety countermeasures could be applied in a proactive and systemic way. Because of this proactive emphasis, crash histories and previously identified safety concerns were taken into consideration but were not the only factors considered. The project sought to also identify sites where the existing design of the street created unsafe conditions which could be addressed by slowing vehicles, shortening crossing distances, and reducing exposure. The process of site identification involved both an original concept where municipalities and local transportation staff could submit locations as well as the project's own desktop analysis.

Site Identification through a Web-Based Tool

Initially, a web-based tool was developed to give municipalities the opportunity to identify locations on NCDOT roadways in their community where these countermeasures could be applied. The tool allowed users to zoom into a map and drop a pin at a specific location with a safety concern. Users would then be prompted through a series of questions about the nature of the safety issues and the existing physical conditions of the site such as the number of lanes and approaches at the intersection and the presence of on-street parking. After the information was entered the tool would display which countermeasure (or countermeasures) were appropriate for the location and submit the response to the project team. The application tool was planned to be shared with municipalities

across the state and be open for responses from January-March 2022.

Site Identification through Project Team Analysis

When NCDOT decided to not move forward with the web-based tool, the Project Team began a state-wide analysis to identify locations where the selected safety countermeasures could be deployed. While there are numerous locations across the statewide network where these identified safety countermeasures could be deployed, this pilot project had specific criteria which narrowed the search. To ensure that low-cost, interim deployment of the countermeasures would be feasible, all initial sites met the following criteria:

- Intersection or mid-block crossings on NCDOT maintained roadways.
- Existing crosswalks where deployment would not require significant milling or re-striping.
- History of pedestrian and/or bicyclist crashes at or near the location or located in an area with high pedestrian activity.
- Existing compliant ADA curb ramps
- Existing right-of-way space where the countermeasure could be deployed.
    - » For intersection sites, this included existing on-street parking, striped shoulders, or wide outside lanes to qualify for curb extensions or protected intersection treatments.
    - » For mid-block crossing sites this included existing center-turn lane to accommodate a median refuge island, and/or on-street parking, striped shoulders, and/or wide outside lanes to qualify for a curb extension.

Using these criteria, the project team developed an initial list of 36 candidate locations.

Initial List of Candidate Locations

LOCATION	CITY	HIGHWAY DIVISION	TYPE	COUNTERMEASURE	CRASHES	ADDITIONAL SPACE USED
Water St and E Fearing St	Elizabeth City	1	Intersection	**Curb Extensions**	1 pedestrian injury	Shoulder
Founders Drive and E 10th St (SR-1598)	Greenville	2	Intersection	**Curb Extensions**	2 pedestrian injury crashes	On-street parking
Loon St and Emerald Drive (NS-97594)	Emerald Isle	2	Intersection	**Curb Extensions**	1 pedestrian injury, 2 total crashes	Shoulder
3rd Street (US-17 Bus) and Market Street (US-17 Bus)	Wilmington	3	Intersection	**Curb Extensions**	3 pedestrian injury, 5 total crashes	On-street parking
E Wilmington St (SR-1510) at Pecan Park	Burgaw	3	Mid-block	**Curb Extensions**	None	Wide outside lane
Tar River Trail at Leggett Road (SR-1243)	Rocky Mount	4	Mid-block	**Curb Extensions**	None	Wide outside lane
Goldsboro St (SR-1163) and Nash St	Wilson	4	Intersection	**Curb Extensions**	2 pedestrian injury crashes	On-street parking
Roanoke Ave (NC-48) and W 10th St (SR-1400)	Roanoke Rapids	4	Intersection	**Curb Extensions**	1 pedestrian injury crash	On-street parking
American Tobacco Trail at Fayetteville Street (SR-1118)	Durham	5	Mid-block	**Median Refuge**	2 pedestrian injury	Center turn lane
American Tobacco Trail at Scott King Road (SR-1103)	Durham	5	Mid-block	**Median Refuge**	None	Gored median
Capital Blvd (US-1) and Calvary Dr	Raleigh	5	Intersection	**Curb Extensions**	5 pedestrian injury, 20 total crashes	Shoulder
W Jones St and N McDowell St (US-70)	Raleigh	5	Intersection	**Curb Extensions**	8 pedestrian injury, 9 total crashes	On-street parking
Durham Chapel-Hill Boulevard (US-15-BUS) and James Street	Durham	5	Intersection	**Protected Corners**	1 pedestrian Crash	Bike Lane buffer/ shoulder
W Davie St and S McDowell St	Raleigh	5	Intersection	**Curb Extensions**	6 pedestrian injury crashes	On-street parking
W Main St (US-70 Bus) and Gregston St (SR-1327)	Durham	5	Intersection	**Curb Extensions**	6 pedestrian injury crashes	On-street parking
W Main St (US-70 Bus) and Duke St	Durham	5	Intersection	**Curb Extensions**	4 pedestrian injury crashes	On-street parking
E Martin St and S Blount St (SR-3670)	Raleigh	5	Intersection	**Curb Extensions**	6 pedestrian injury, 7 total crashes	On-street parking
W Hargett and S McDowell St (US-70)	Raleigh	5	Intersection	**Curb Extensions**	2 pedestrian injury crashes	On-street parking

Initial List of Candidate Locations - continued

LOCATION	CITY	HIGHWAY DIVISION	TYPE	COUNTERMEASURE	CRASHES	ADDITIONAL SPACE USED
W Martin and S McDowell St (US-70)	Raleigh	5	Intersection	**Curb Extensions**	5 pedestrian injury crashes	On-street parking
Edwards Mill Rd (SR-3009) and Reedy Creek Rd (SR-1775)	Raleigh	5	Intersection	**Protected Corners**	None	Wide outside lane
Anderson St and Erwin Road (SR-1320)	Durham	5	Intersection	**Protected Corners**	3 pedestrian injury, 5 total crashes	Wide outside lane
Bicentennial Greenway at Old Oakridge Road (SR-2137)	Greensboro	7	Mid-block	**Median Refuge**	1 pedestrian injury	Center turn lane
W Main Street (NC-100) at Town Hall	Gibsonville	7	Mid-block	**Curb Extensions**	None	On-street parking
Trollinger Ave and Williamson Ave (SR-1301)	Elon	7	Intersection	**Curb Extensions**	2 pedestrian injury crashes	Wide outside lane
Manning Dr (SR-1902) and Ridge Rd/Skipper Bowles Dr	Chapel Hill	7	Intersection	**Curb Extensions**	10 pedestrian injury, 11 total crashes	Wide outside lane
W Gate City Blvd (SR-4121) and W Florida Street	Greensboro	7	Intersection	**Protected Corners**	2 pedestrian injury, 5 total crashes	Wide outside lane
N Columbia St (NC-86) and W Franklin St (SR-1010)	Chapel Hill	7	Intersection	**Curb Extensions**	7 pedestrian injury crashes	On-street parking
N Columbia St (NC-86) and W Rosemary St	Chapel Hill	7	Intersection	**Curb Extensions**	6 pedestrian injury, 7 total crashes	On-street parking
Edgewood Ave and O'Neal St (SR-1452)	Burlington	7	Intersection	**Protected Corners**	None	Wide outside lane
S Main St (US-29) and W Innes St (SR-2200)	Salisbury	9	Intersection	**Curb Extensions**	3 pedestrian injury, 5 total crashes	On-street parking
S Church St and W Innes St (SR-2200)	Salisbury	9	Intersection	**Curb Extensions**	3 pedestrian injury crashes	On-street parking
Main St (US-29) and Fisher St	Salisbury	9	Intersection	**Curb Extensions**	3 pedestrian injury crashes	On-street parking
N Graham St (US-29) and W 5th St	Charlotte	10	Intersection	**Curb Extensions**	10 pedestrian injury, 11 total crashes	On-street parking
E 3rd St (NC-16) and S McDowell St (NC-27)	Charlotte	10	Intersection	**Curb Extensions**	8 pedestrian injury crashes	On-street parking
N State St (US-601) and Main St (SR-1605)	**Yadkinville**	11	Intersection	**Protected Corners**	1 pedestrian crash	Shoulder and on-street parking
Main Street (NC-7) at Belmont Capital Advisors	**Belmont**	12	Mid-block	**Curb Extensions**	None	On-street parking

Four additional sites were also identified by NCDOT highway division staff. While two of these locations were moved forward to the next stage of site selection refinement, Arboretum Drive at Military Cutoff Road and Ramsey Street at Facility Drive did not meet the selection criteria and could not be included as part of the Pilot project at this time.

Additional Sites Identified by Highway Division Staff

LOCATION	CITY	HIGHWAY DIVISION	TYPE	CRASHES	IDENTIFIED BY	NOTES
SR 2817 (17th Street) at Castle Street	Wilmington	3	Intersection	**None**	Jessi Leonard, PE	Proposed curb extension using existing on-street parking
Arboretum Drive at Military Cutoff Rd	Wilmington	3	Intersection	**1 pedestrian injury crash**	Jessi Leonard, PE	No existing cross walks or available right-of-way pavement for countermeasure
Ramsey Street at Facility Drive and/or at the VA Center Entrance	Fayetteville	6	Mid-block	**None**	Chuck Miller, PE	No existing crosswalks or ADA ramps **Location was removed**
NC 71 (3rd Avenue) at NC 211	Red Springs	6	Intersection	**None**	Chuck Miller, PE	Proposed curb extension using shoulder space

Site Selection Refinement

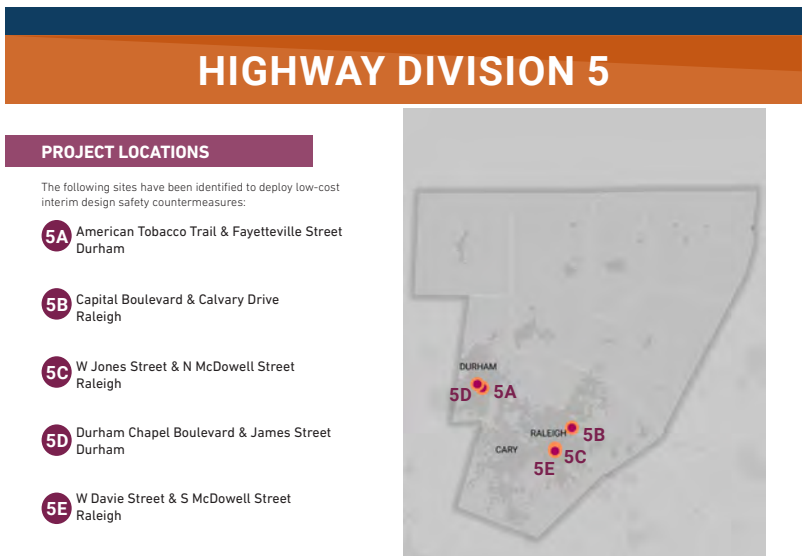
The above list represented 36 locations where curb extension, median refuge islands, and protected corners could significantly reduce exposure and increase safety for people walking and bicycling on state-maintained roads. Installing an interim countermeasure at any of these locations, however, relied on a number of other factors beyond the initial opportunity presented by the conditions at the site. Over the course of a year, the list of project locations was reviewed, modified, and presented to IMD, highway division, district, and municipal staff. Through this process the list narrowed considerably, based on the highway division's willingness to participate and the project's increasing desire to consolidate and prioritize efforts on a smaller number of locations where installation felt truly possible.

Narrowing Down Potential Sites

In the Spring of 2022, the full list of 36 sites was sent to NCDOT IMD for review. Based on this review a revised list of 23 projects was developed to be shared with the highway divisions. For each highway division, a project packet was developed with the following information.

- An overview of the goals of the project and the countermeasures being proposed
- Outlined responsibilities for the consultant team, IMD, and the NCDOT Highway division
- Timeline
- Map of project locations within the specific highway division
- Project cut sheets for each site with the following elements
  - » Brief explanation of the countermeasure being proposed
  - » Aerial map of the site
  - » Crash history at the site
  - » Estimated Cost
  - » Precedent photo of a site with the same countermeasure
  - » Simple construction detail

Sample Pages from Highway Division 5 Project Packet



HIGHWAY DIVISION 5

PROJECT LOCATIONS

The following sites have been identified to deploy low-cost interim design safety countermeasures:

- 5A American Tobacco Trail & Fayetteville Street, Durham
- 5B Capital Boulevard & Calvary Drive, Raleigh
- 5C W Jones Street & N McDowell Street, Raleigh
- 5D Durham Chapel Boulevard & James Street, Durham
- 5E W Davie Street & S McDowell Street, Raleigh

3A: S 17TH STREET & CASTLE STREET

WILMINGTON, NC

PROJECT OVERVIEW

Curb Extension

Curb extensions reduce vehicle turning speeds, shorten crossing distances for pedestrians, and increase space for those waiting to cross. A curb extension could be deployed on the northeast corner of S 17th Street and Castle Street, utilizing the parking area along S 17th Street.

Site Details

- One pedestrian related crash

Estimated Cost (Labor & Materials): $4,400

Project packets were sent to the highway divisions for their review. Highway division staff responded positively to the idea of improving pedestrian safety at these locations however the consensus among all highway divisions was that implementing these projects was not possible. Those who responded cited lack of funding, lack of staffing, and already stretched maintenance budgets as key barriers to moving any of the locations forward. The quick-build, interim nature of the projects also raised concerns. For many sites the highway divisions felt that flex posts would lead to on-going maintenance issues and that if there was a genuine safety concern, a more permanent solution should be pursued.

The following process was followed to further refine the list of Project Team Identified Locations. NCDOT IMD reviewed the initial list prior to setting up meetings with the associated NCDOT highway division offices.

- Typical concept treatment drawings were created along with concept drawings specific to the site
- Cost estimates were developed for each of the identified sites and played a part in further refining the list of sites
- For their review and comment, the highway division offices were provided cutsheets specific to sites located within their highway division
- Follow-up calls were scheduled with each highway division office and invitations were extended to the local municipalities
- Meeting discussions centered on the availability of local municipality staffing and funding to execute the deployment sites
  - » From the initial set of identified locations, there were only three municipalities that had the ability to perform the interim deployments – Raleigh, Durham, and Wilmington

Project Pairings

In the spring of 2023, the project team began refining the list of locations and setting up meetings with highway division staff to present a more targeted list of candidate sites. The team focused on pairs of projects that would provide a comparison for the same countermeasure being applied in at least two different places. The revised list shown in the table below consisted of five pairs of projects representing the three countermeasures applied in a variety of contexts.

Project Pairs Grouped By Countermeasure

COUNTERMEASURE	CONTEXT PAIR	LOCATION	CITY	HIGHWAY DIVISION
Curb Extensions	**Three-lane mid-block crossings**	Tar River Trail & Leggett Road	Rocky Mount, NC	4
		W Main Street at Town Hall Building	Gibsonville, NC	7
Median Refuge	**Three-lane greenway crossing**	American Tobacco Trail & Fayetteville Street	Durham, NC	5
		Bicentennial Greenway & Old Oak Ridge Road	Greensboro, NC	7
Protected Corner	**Existing bicycle lanes through a four-way intersection**	Durham-Chapel Hill Boulevard & James Street	Durham NC	5
		State Street & Main Street	Yadkinville, NC	11
Curb Extensions	**Multilane intersection with wide outside lanes**	3rd Street & Market Street	Wilmington, NC	3
		Trollinger Avenue & Williamson Avenue	Elon, NC	7
Curb Extensions	**Downtown intersection with on-street parking**	S 17th Street & Castle Street	Wilmington, NC	3
		W Jones Street & N McDowell Street	Raleigh, NC	5

Using the project pairings, NCDOT IMD staff and the consultant coordinated with highway division and municipal staff to prepare for deployment. Six of the ten pilot sites identified in the project pairs, shown in the table above, moved forward to deployment. The following sections provide details for each of the deployment sites.

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4

DEPLOYMENT SITES

After identifying pilot project pairings, coordination with NCDOT highway division staff was conducted. Highway division staff were provided with the site location, typical design treatment details, cost estimates, and safety benefit of deploying the countermeasure for each location. Highway divisions 3, 4, 5, 7, and 11 provided input on the pilot projects that refined the project list to six projects. Rationale for removing a pilot project from the list for deployment included:

- Staff capacity – not having the personnel available to deploy the project in the midst of staff shortages
- Financial resources – insufficient funding to purchase/ procure materials needed for countermeasures
- Time constraints – unable to dedicate staff based on the timeline needed for countermeasure deployment

Coordination meetings with municipal staff were scheduled for pilot project sites that were still being considered after highway division staff feedback. The purpose of each municipal meeting was to share the goal of the pilot project and determine if there was a path forward for deployment. In many cases, a partnership between highway division and municipal staff was formed to overcome challenges related to staff capacity, financial resources, or time constraints. Meetings with staff from the following municipalities were conducted:

- Durham
- Raleigh
- Rocky Mount
- Wilmington

In May 2023, a list of deployment sites was finalized. Due to constraints identified by highway division staff for some locations, alternate locations were added that were originally identified by the project team and met the criteria for the pilot project, preserving the project's integrity and thoroughness. The goal of the pilot project was to deploy each countermeasure for at least 90 days. The final deployment sites are listed in the table on the following page.

Deployment Sites

COUNTERMEASURE	CONTEXT PAIR	LOCATION	CITY	HIGHWAY DIVISION
Median Refuge	**Three-lane greenway crossing**	American Tobacco Trail & Fayetteville Street	Durham, NC	5
Curb Extensions	**Multilane intersection with wide outside lanes**	Capital Boulevard & Calvary Drive*	Raleigh, NC	5
		S 17th Street & Castle Street	Wilmington, NC	3
		3rd Street at Market Street	Wilmington, NC	3
Curb Extensions	**Downtown intersection with on-street parking**	W Davie Street & S McDowell Street*	Raleigh, NC	5
		W Jones Street & N McDowell Street	Raleigh, NC	5

* Indicates alternate location added for pilot project deployment

Deployment Site Details

The following sections provide summary details related to each deployment site. Information for sites have been categorized by municipality—Durham, Raleigh, and Wilmington. Each deployment site will include the following information to provide rationale, context, and deployment details:

- Site Details – information to highlight how this specific location met the criteria for the pilot project and any historical crash data
- Opportunities to Reduce Risk – a list of characteristics that increased risk for pedestrians and bicyclists at the site
- Typical Design Treatment – plan view graphic showing an example of low-cost and interim countermeasure design for each type—median refuge and curb extensions
- Site-specific Design Treatment – plan view design concept that includes details for each pilot project site
- Pre-deployment Photo(s) – imagery for the condition prior to the pilot project deployment
- Post-deployment Photo(s) – imagery showing the site after the countermeasure was deployed

The Project Team conducted interviews with municipal staff and NCDOT Regional Traffic Safety staff to collect feedback on the site selection, deployment process, and future low-cost countermeasure deployment. A summary of the interviews is provided at the end of each municipal subsection.

American Tobacco Trail at Fayetteville Street

Durham, NC

DURHAM

Site Details

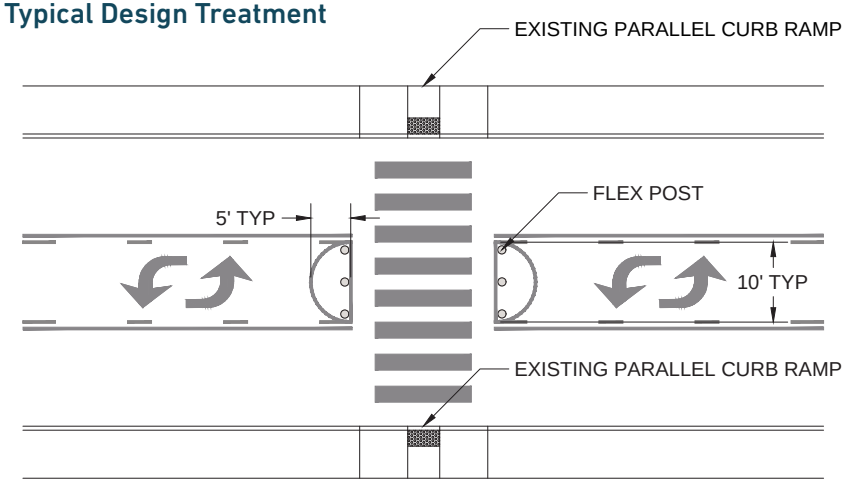
- Countermeasure: Mid-block median refuge
- Roadway space: Three lane street section provided space for refuge island
- Crash history: Two pedestrian crashes that resulted in injuries

Opportunities to Reduce Risk

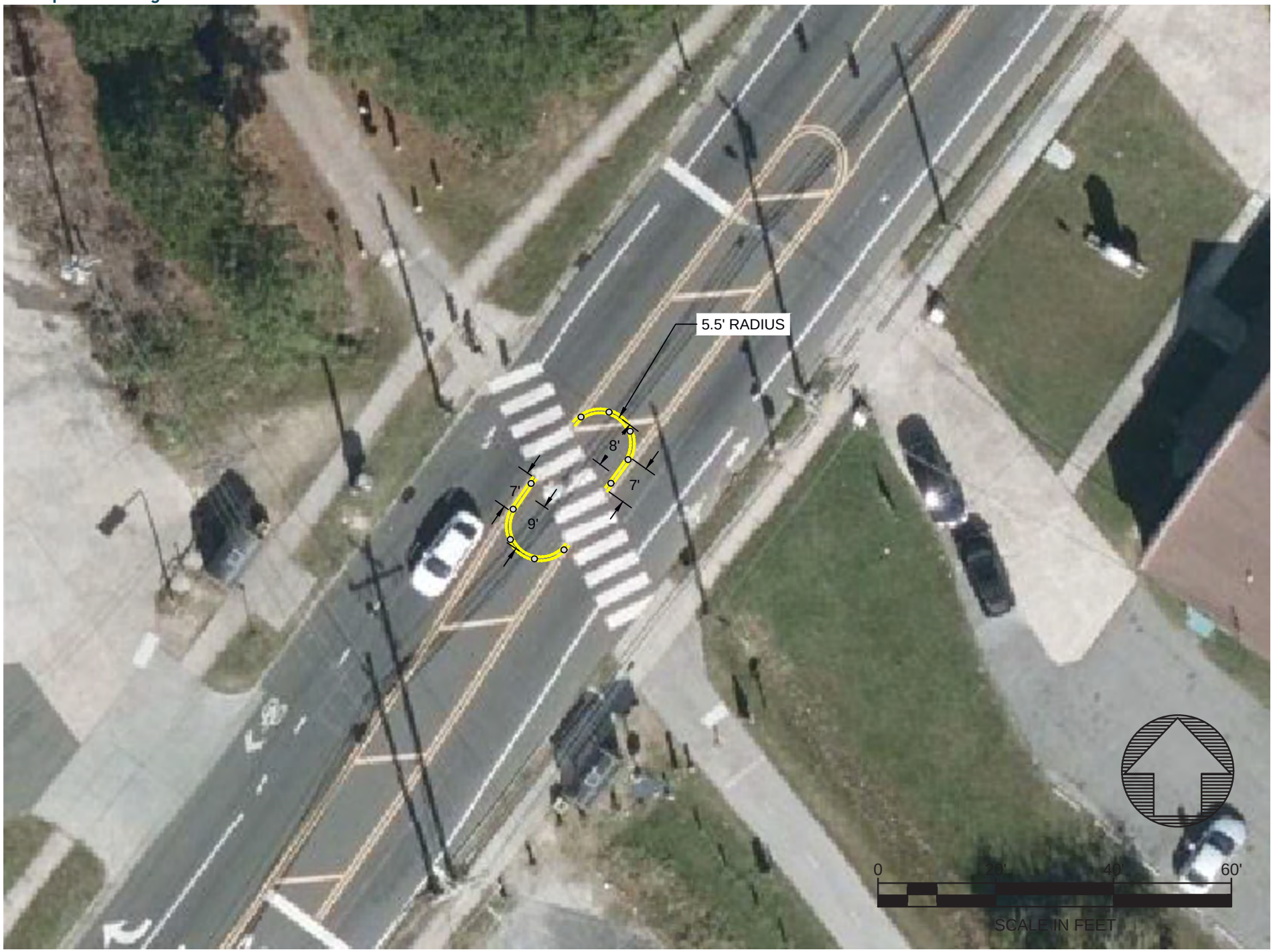
Median refuge islands reduce crossing distances and provide protected space in the center of the roadway for pedestrians and bicyclists. A median refuge could be deployed at the intersection of the American Tobacco Trail and Fayetteville Street, utilizing the striped median on Fayetteville Street.

Aerial Map

Typical Design Treatment



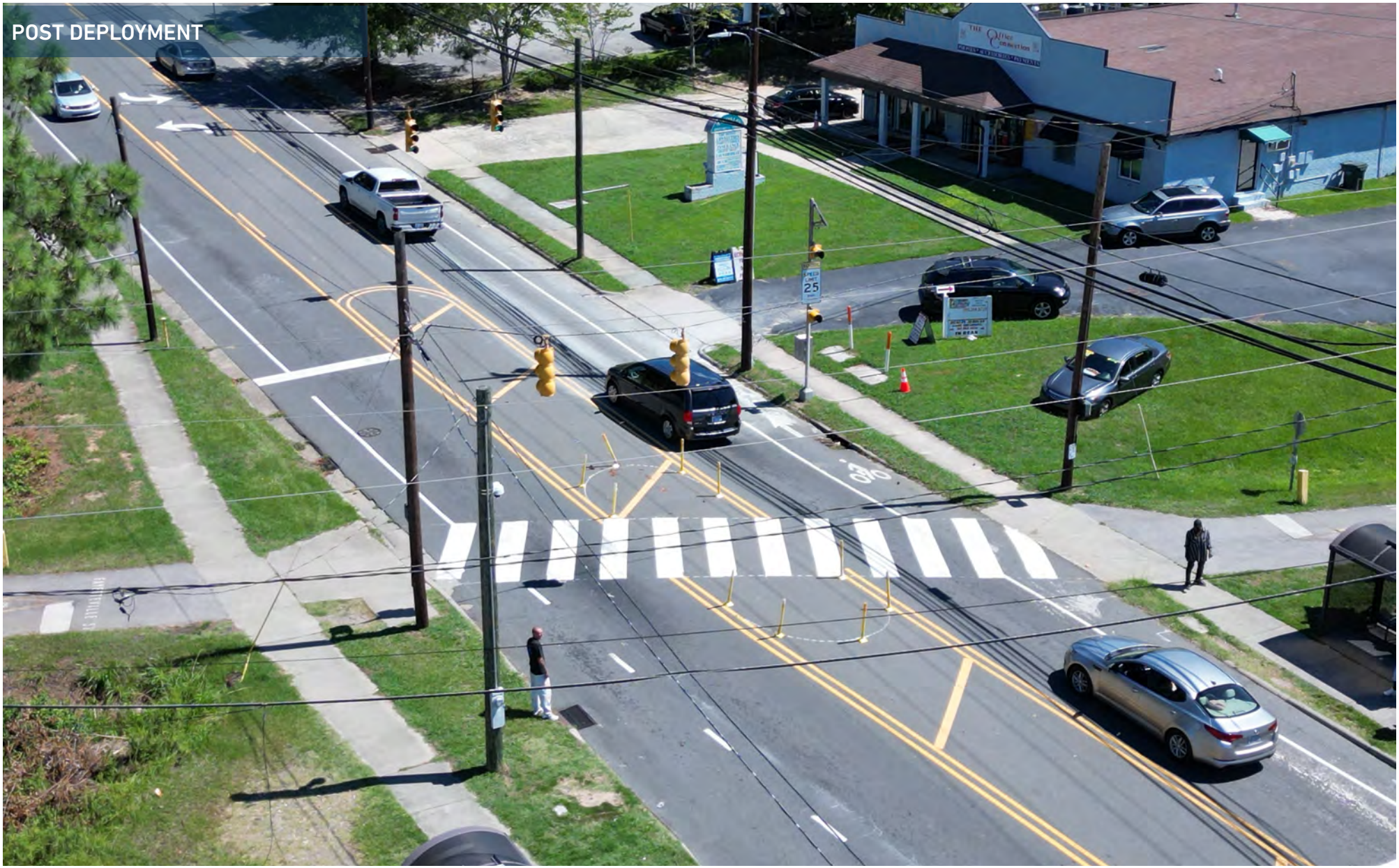
Site Specific Design Treatment



DEPLOYMENT PHOTOS

PRE-DEPLOYMENT

POST DEPLOYMENT


POST DEPLOYMENT

W. Davie Street at S. McDowell Street

Raleigh, NC

RALEIGH

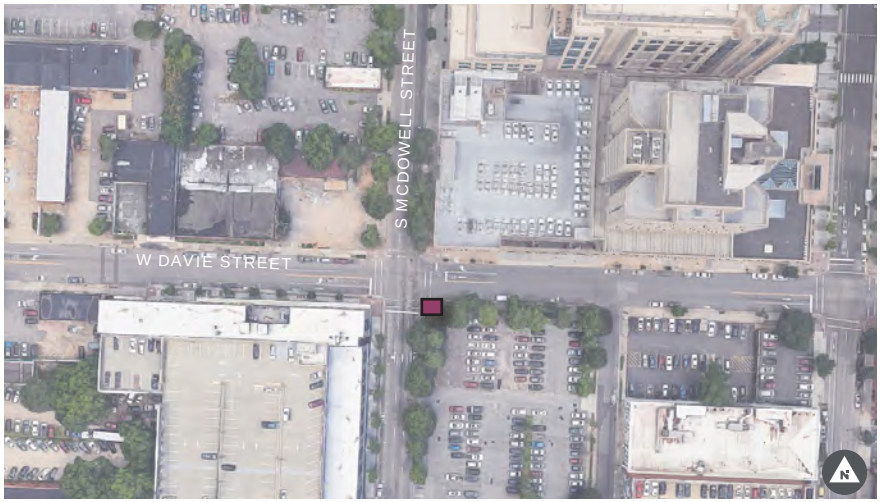
Site Details

- Countermeasure: Curb extensions
- Roadway space: On-Street Parking
- Crash history: 6 pedestrian injury crashes

Opportunities to Reduce Risk

Curb extensions reduce vehicle turning speeds, shorten crossing distances for pedestrians, and increase space for those waiting to cross. Curb extensions could be deployed on the southwest and southeast corners at the intersection of W Davie Street and S McDowell Street, utilizing the parking areas on both Davie Street and McDowell Street.

Aerial Map



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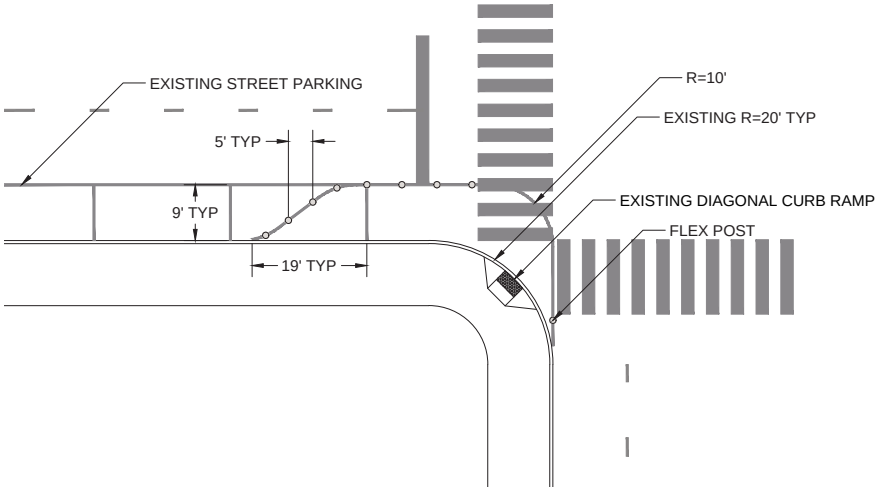
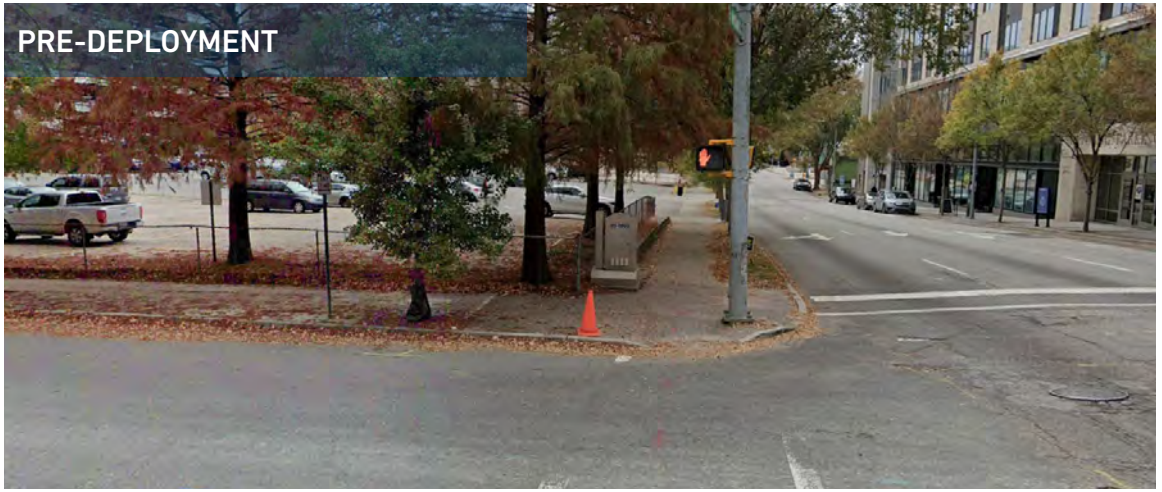
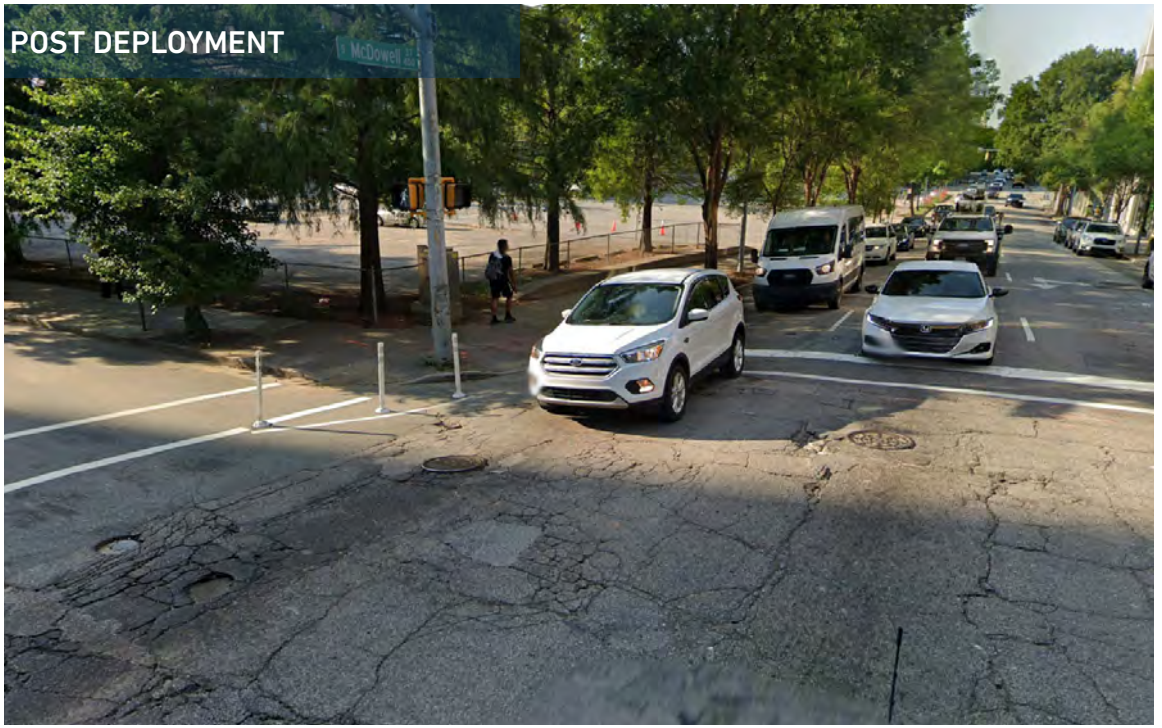


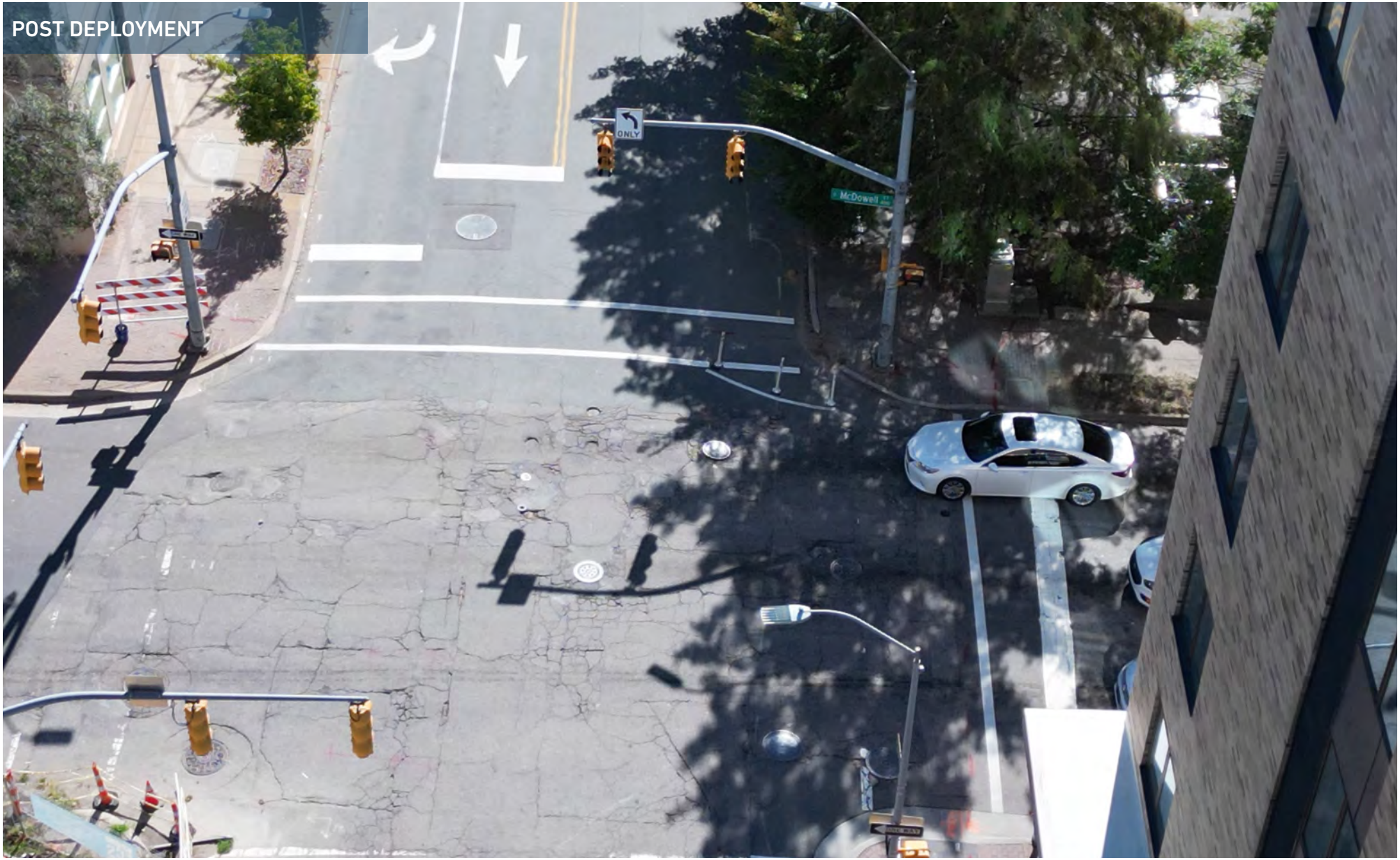
Site Specific Design Treatment

DEPLOYMENT PHOTOS





POST DEPLOYMENT



W. Jones Street at N. McDowell Street

Raleigh, NC

RALEIGH

Site Details

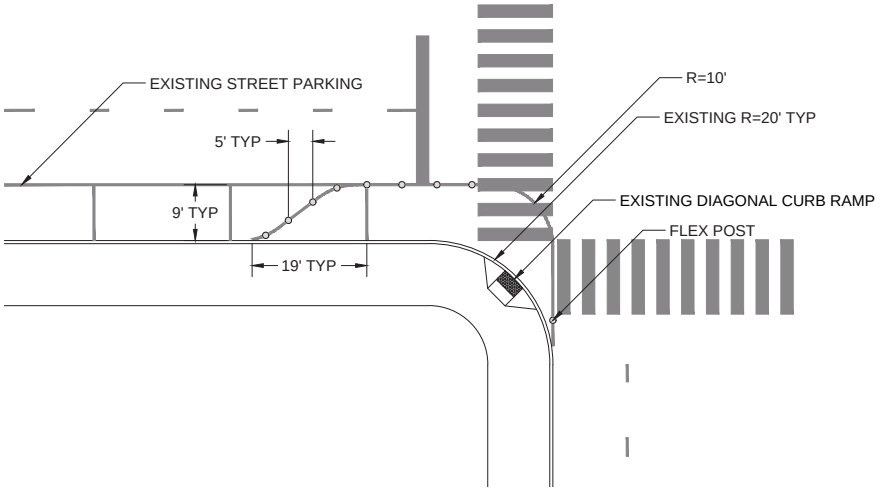
- Countermeasure: Curb extensions
- Roadway space: On-Street Parking
- Crash history: 8 pedestrian injury, 9 total crashes

Opportunities to Reduce Risk

Curb extensions reduce vehicle turning speeds, shorten crossing distances for pedestrians, and increase space for those waiting to cross. Curb extensions could be deployed on the northeast, southeast, and southwest corners at the intersection of W Jones Street and N McDowell Street, utilizing the parking areas along W Jones Street.

Aerial Map

Typical Design Treatment



Site Specific Design Treatment

DEPLOYMENT PHOTOS


POST DEPLOYMENT

Capital Boulevard at Calvary Drive

Raleigh, NC

RALEIGH

Site Details

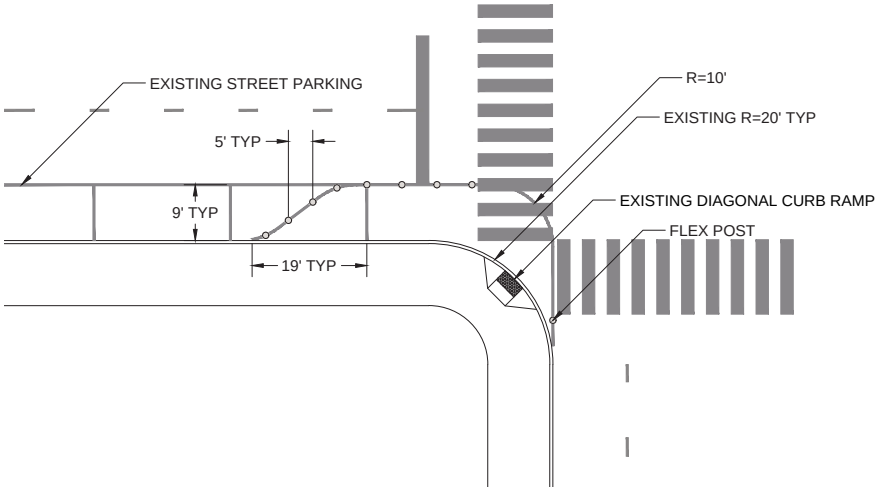
- Countermeasure: Curb extensions
- Roadway space: Wide outside lane
- Crash history: 5 pedestrian injury crashes, 20 total crashes

Opportunities to Reduce Risk

Curb extensions reduce vehicle turning speeds, shorten crossing distances for pedestrians, and increase space for those waiting to cross. Curb extensions could be deployed on the northeast, southeast, and southwest corners at the intersection of Capital Boulevard and Calvary Drive, utilizing the shoulder on both sides of Capital Boulevard.

Aerial Map

Typical Design Treatment



Site Specific Design Treatment

DEPLOYMENT PHOTOS

PRE-DEPLOYMENT

PRE-DEPLOYMMENT


POST DEPLOYMENT


POST DEPLOYMENT

3rd Street at Market Street

Wilmington, NC

WILMINGTON

Site Details

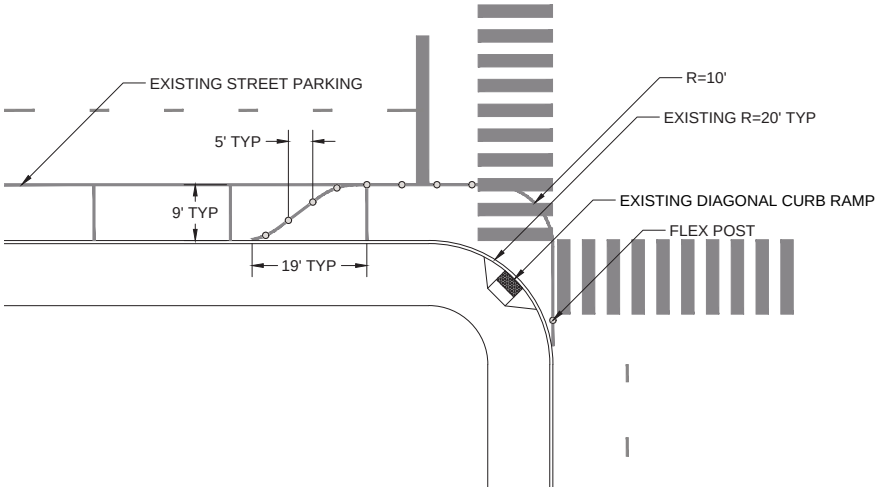
- Countermeasure: Curb extensions
- Roadway space: On-Street Parking
- Crash history: 3 pedestrian injury crashes, 5 total crashes

Opportunities to Reduce Risk

Curb extensions reduce vehicle turning speeds, shorten crossing distances for pedestrians, and increase space for those waiting to cross. Curb extensions could be deployed on the northwest corner and southwest corner of 3rd Street and Market Street, utilizing the parking areas along Market Street.

Aerial Map

Typical Design Treatment



Site Specific Design Treatment

DEPLOYMENT PHOTOS


POST DEPLOYMENT
Market
WELLS INSURANCE

S. 17th Street at Castle Street

Wilmington, NC

WILMINGTON

Site Details

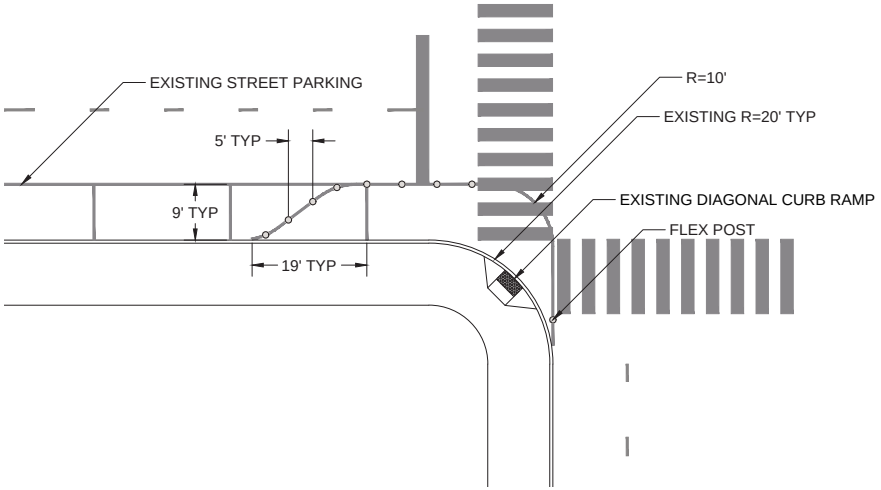
- Countermeasure: Curb extensions
- Roadway space: On-Street Parking
- Crash history: 8 pedestrian injury, 9 total crashes

Opportunities to Reduce Risk

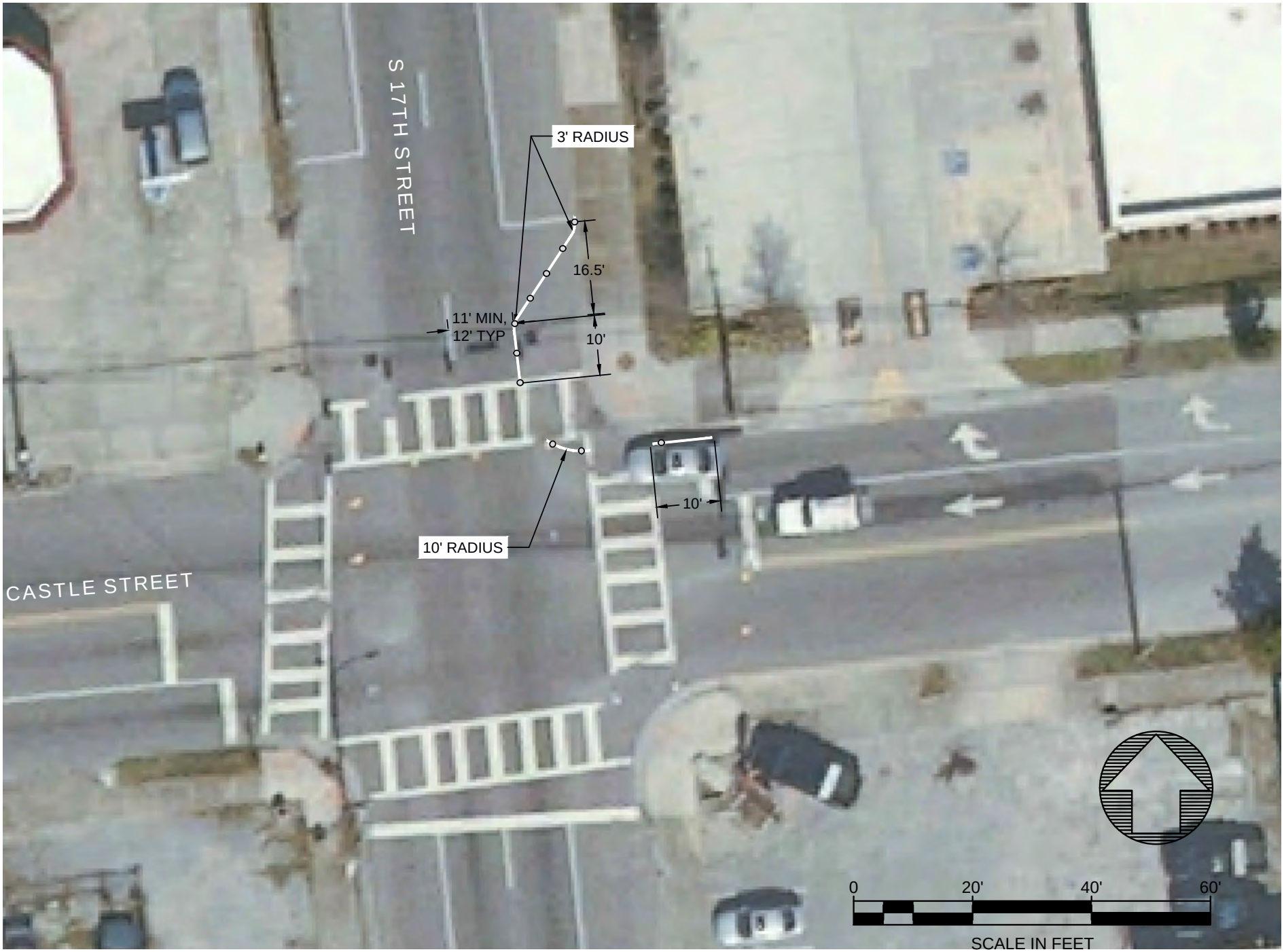
Curb extensions reduce vehicle turning speeds, shorten crossing distances for pedestrians, and increase space for those waiting to cross. A curb extension could be deployed on the northeast corner of S 17th Street and Castle Street, utilizing the parking area along S 17th Street.

Aerial Map

Typical Design Treatment



Site Specific Design Treatment



DEPLOYMENT PHOTOS

PRE-DEPLOYMENT

POST-DEPLOYMMENT


POST-DEPLOYMENT
FAST OIL CHANGE
CHECK ENGINE LIGHT
TUNE UP
BIG TIRE PROMOTION
TIRES - SUSPENSION - BRAKES
A/C SERVICE & REPAIR

5

FEEDBACK AND FINDINGS SUMMARY

The deployment of safety countermeasures at six locations was a critical step to evaluating the process for this pilot project. After deployment was complete, the Project Team coordinated with IMD staff to determine the most appropriate way to document the findings and feedback related to the pilot project. This section includes a summary of the responses from post-deployment interviews along with themes and lessons learned from the Project Team that may be valuable to consider for future iterations of the pilot project.

Post-Deployment Interviews

The Project Team conducted post-deployment interviews with both NCDOT Regional Traffic Safety and municipal staff, posing a series of questions to understand their perspectives and solicit feedback related to the pilot project process. Interviews were structured to encourage open dialogue and provide an opportunity for staff to share their experiences and insights. The feedback received was diverse, reflecting the range of roles and responsibilities of the interviewees. This report summarizes interview responses to each of the following questions, offering valuable insights into the process from those directly involved.

Interviewees included:

- Denys Vielkanowitz – City Traffic Engineer, City of Wilmington
- Randall Glazier – Signs and Markings Engineering Manager, City of Wilmington
- John Syme – Signs and Markings Supervisor, City of Wilmington
- Pete Nicholas – Traffic Operations, Engineering Manager Sr., City of Durham
- Steve Yetman – Interim Assistant City Engineer, City of Rocky Mount
- Jordan Reedy – Principal Transportation Planner, City of Rocky Mount
- Brad Kerr – Director of Public Works, City of Rocky Mount
- Ramon Muckle – Traffic Engineer, City of Rocky Mount

- Rebecca Duffy – Signs and Markings Manager, City of Raleigh
- Jed Niffenegger – City Traffic Engineer, City of Raleigh
- Coke Gray – Regional Traffic Engineer, NCDOT Traffic Safety Unit Highway Division 3
- John Grant – Central Regional Fields Operations Engineer, NCDOT Traffic Safety Unit Highway Division 5,7,8 & 9

Question: *What was your perception of the deployed countermeasure in your community?*

All respondents emphasized that pilot projects are valuable. They felt that while the process could be refined, this was an important exercise for both the municipalities and NCDOT. Staff from all participating municipalities would like to see these locations converted as permanent concrete features to cut down on staff time and maintenance issues. There was an understanding across the municipalities and NCDOT that smaller projects were easier to deploy with municipal staff and supplies. While Raleigh and Wilmington liked the ability to quickly deploy the interim measures, the City of Durham prefers to skip this step and go straight to the installation of a permanent solution.

Question: *What feedback did you receive from the public, elected officials, or others?*

There were minimal comments from the public in the City of Raleigh related to adjustments to delineators for specific turning movements. Durham experienced a positive buzz from trail users as they installed the delineators. Wilmington had some negative feedback regarding the aesthetics of the delineators within the Historic District as well as a general confusion by the public who initially complained that vehicles had to slow down to make the turns. Staff communicated that slower turning vehicles was the point of the pilot project.

Question: *Describe the process of deploying the countermeasure.*

The staff at the City of Wilmington had initial difficulty with installing the radii and recommended that future plans note the center of the radius, Auto Turn exhibits, and a radius template to allow them to install more quickly. Though the City of Raleigh felt the communication was disjointed, they felt the plans were easy to understand and they are moving to a similar city-wide pilot process in hopes to make a significant impact through quick deployment. The City of Durham agreed that the schematic plans were sufficient due to the nature of these proven countermeasures. Their only recommendation was that standard delineator spacing be included on the plans so there would be a consistent experience in each municipality.

Question: *If this pilot program was continued, what would your suggestion be for the future?*

The City of Wilmington would like for future pilot programs like this to include the steps necessary after a pilot project has ended. This could include preparing for public engagement, plans to make the treatment permanent, and follow-up communication with NCDOT highway division/district offices. For example, the NCDOT highway division office in Wilmington will require an encroachment agreement for the delineators to stay in place while the NCDOT district office in Durham recommends that these types of projects should be covered under a municipal maintenance agreement MOU that identifies the municipality's role in maintenance. The NCDOT Regional Traffic Safety staff recommended early initiation of project concept and purpose that includes involvement of the municipalities, provides framework, and gets buy-in for deployment. The participating municipalities consistently agreed that their involvement earlier in the process would help facilitate site selection, and kick-off the funding or reimbursement discussion. They also felt that highway divisions and the Integrated Mobility Division should have an initial conversation with State Traffic Engineer Brian Mayhew prior to launch of version 2.0 of the pilot to discuss funding sources, and a potential scenario where NCDOT purchases the materials, and the Municipality completes the installation.

Question: *Please provide any other feedback related to the purpose or process of this project.*

Most participants would like to see a hybrid collaboration where both NCDOT and the local municipalities bring potential sites to the table. The City of Wilmington thought this pilot project was a great opportunity for them to test out these proven countermeasures and get their community's feedback. They also noted the benefit of these countermeasures being easy to remove if needed. The City of Durham highlighted the importance of keeping all stakeholders engaged throughout and enforcing a 90-day timeline/deadline.

Success and Lessons Learned

As with any first-of-its-kind project, there were a variety of identified successes and challenges. Importantly, the charge of the pilot project —in alignment with STIC Incentive program and TIDP goals—to craft an innovative approach to addressing safety was accomplished. This project highlighted opportunities for interventions without relying on historic crash data, resulting in site selection that was based on reducing risk for pedestrians and bicyclists. Additionally, the pilot project established connections with municipal staff in deployment cities that will be beneficial to any future opportunity for this pilot program. These successes, however, also came with challenges. The following includes key challenges and lessons learned throughout the life of the project.

Challenges

- **COVID-19 Pandemic** – the impacts of the pandemic were felt throughout the project, including early delays due to shifting schedules and virtual work along with later in the project with limited staff capacity and funding needs.
- **Communication with Highway Divisions** – each highway division is unique, and the experiences related to safety countermeasure deployment are different. As the project was developed, feedback and support from highway division staff was variable and slowed down efforts for rapid deployment.
- **Clear Pilot Project Purpose** – as a new and innovative approach to safety on NCDOT streets, emphasizing the purpose of the project became crucial. Even with visual and written materials, communicating the intent of the pilot project was a consistent need and challenge as new staff were brought into the project from NCDOT IMD and highway divisions.
- **Project Authority and Momentum** – as the Project Team developed materials for review by IMD and highway division staff, project momentum was stalled due to internal reviews and hesitancy related to site selection and deployment strategies. Although modifications refined the approach, clear authority to move the pilot project forward with a clear purpose was a challenge that impacted early momentum.

Lessons Learned

- **Communicate with Highway Division Staff Early** – this step would have been valuable early in the process to gain buy-in and refine the selection process.
- **Communicate with Municipal Staff Early** – there are a variety of ideas about safety countermeasure deployment that local staff have and are willing to share. Bringing them into the process early may result in more cost effective and innovative deployment opportunities.
- **Start with Purpose** – a clear purpose can not be emphasized enough. Communication materials that could be distributed to NCDOT staff, municipal staff, and local elected officials would have been valuable in

understanding and addressing real and perceived impacts of pilot project deployment.

- **Emphasize "Pilot" in Pilot Project –** although the safety countermeasures that were deployed can be part of a more permanent strategy for safety, the purpose of this project was interim design—a shorter-term solution that does not have to be permanent. Emphasizing the short-term nature of these deployments during early communication may give perspective on what the project is and what it is not.
- **Create a Path Forward** – based on feedback from interviewees and anecdotal observations, the deployed safety countermeasures have reduced risk for vulnerable road users. This pilot project did not establish a formalized path forward for keeping countermeasures in place and each community is coordinating with highway division staff on next steps. Future iterations of the pilot project may consider a formal process for not only maintaining the interim design countermeasure solution but also steps to replace it with a more permanent design solution.

Construction to completed deployment at 3rd Street and Market Street

6

CONCLUSIONS AND FUTURE CONSIDERATIONS

The feedback and findings related to the deployment of the safety countermeasures provides a glimpse into the value of the pilot project along with the challenges that continue to exist. As a pilot project, it is expected that the organizing agency and the project team learns from the process to make adjustments that will make the process and outcomes more effective and efficient in the future. Based upon the evaluation of this pilot project that includes the post-deployment interviews and conversations with IMD staff, the following conclusions have been drawn:

A new approach can be effective

Making roadway changes along state-owned and maintained roadways is not a small task. In most cases, changes along these thoroughfares require substantial redesign that result in slower deployment and an increased need for funding. This interim design safety pilot project has proven that low-cost proven safety countermeasures can be deployed quickly along NCDOT roadways. Using a specific set of criteria that mitigated the need for a longer process and additional financial resources, pilot projects were able to be deployed in a matter of months and in some cases weeks after discussion with highway division and municipal staff. The interim design approach focused on space at intersections and mid-block crossings that could be reclaimed without warranting significant restriping, curb modifications, or signal changes. This conclusion is significant and is a building block for future iterations of the pilot project.

Interim design solutions are desirable

Countermeasures that were deployed in Raleigh, Durham, and Wilmington have introduced a new opportunity for safety projects that may not have seemed possible before. It has also highlighted that these low-cost, easy-to-install, and proven countermeasures are desirable as an interim solution. Municipalities provided feedback that indicated that deploying curb extensions, median refuges, and other elements for separation that benefit pedestrians and

bicyclists is an action they hope to do more often in the future.

Early coordination and effective communication are vital.

Comments received made it clear that municipality and highway division staff would like to be brought into the conversation earlier in the process. This early communication may assist with site selection, alternative designs for countermeasure deployment, and scheduling deployment logistics. In addition to early coordination, effective communication about the project, including what we are hoping to learn and the benefits of the countermeasures themselves is important to NCDOT staff, municipal staff, elected officials, and the general public.

The process for deploying quickly is difficult.

Although deployment occurred in only a few months after conversations with municipalities were conducted to discuss sites and design elements, site identification and selection required a substantial time and refinement. As described in the history of this project, there were multiple modifications to the scope of work—some formal and other informal. Creating a new and innovative process of project deployment—no matter how small the site or low the cost—requires significant oversight. This pilot project process moved through various reviews and may have set a valuable precedent that can be used in the future.

Systemic safety actions may require more explanation.

Many agencies continue to address safety with a focus on historical crashes to identify a need for change. While investment in locations with a high density of crashes and specifically those with higher volumes of killed or serious injury (KSI) crashes should be prioritized, there is an opportunity to reduce risk using systemic safety countermeasures at sites throughout North Carolina's statewide transportation network. Deploying countermeasure that reduce risk can result in significant safety benefits. This strategy, however, which aligns with the Safe System Approach[1] and Framework,[2] is somewhat new and may require additional explanation. It will be important at the local and statewide levels to provide training for staff to understand that an effective safety strategy is both reactive—addressing locations based on historic crash data—and proactive—deploying proven safety countermeasures at sites where roadway characteristics may increase risk for users.


17th Street and Castle Street

Davie Street & McDowell Street

1 https://www.transportation.gov/NRSS/SafeSystem
2 https://www.ite.org/technical-resources/topics/safesystems/

Future Considerations

Deploying low-cost safety countermeasures along NCDOT roadways provides insight into the process for interim design safety solutions that can reduce risk for pedestrians and bicyclists. This pilot project used an innovative approach to site selection and deployment strategy to test something new for NCDOT. Findings, feedback, and conclusions of the pilot project have highlighted future considerations for NCDOT IMD. These considerations may be valuable if another iteration of this pilot project is developed or if there is an opportunity to standardize deployment of interim design safety countermeasures.

Evaluate different countermeasures.

This pilot project identified a narrow set of countermeasures (curb extensions, median refuge, and protect corners) to use during site identification, selection, and deployment. Final deployments were only for curb extensions and a single median refuge. While a narrow set of countermeasures was useful for the initial pilot project, additional countermeasures could also be deployed as an interim solution.

Deploy the same countermeasures through a different site identification process.

Site identification was ultimately an exercise by the Project Team to find locations across the state that met the criteria for deployment. In the future, a different site identification process could be utilized. A different site identification and selection process may use the same narrow set of countermeasures and pursue deployment at more sites in regions across the entire state. NCDOT could consider using the online application process that was originally developed for this pilot project with modifications to meet the needs of a future pilot project.

Integrate interim design and deployment into larger safety projects.

Deployment of countermeasures during this pilot project shows that interim design safety solutions can be designed and installed quickly. Additionally, these installations provide an opportunity to learn about what works and what could be modified before a more permanent solution is designed and constructed. The materials used for deployment sites have the added benefit of being modified routinely without high cost. NCDOT could consider interim design solutions as a standard part of larger safety projects that are identified in the STIP. Budgeting for the interim solution could be included in the larger project and deployment could occur much sooner than the construction of the final solution. This approach may help refine the final design and address a safety concern more quickly, rather than waiting for design and construction to be completed.

Dedicate funding.

As deployment sites were identified and conversations with highway divisions began, funding became a key concern. Future pilot project iterations should consider the funding needed for deployment.

Formalize a clear process.

Each coordination meeting between municipal staff and highway division staff was unique and the expectations and assumptions varied. NCDOT should consider how to clarify and formalize the process for deploying interim design safety solutions that are the same across the state. Processes may include but are not limited to:

Agreements with municipalities to install countermeasures

- Encroachment agreements
- Maintenance of interim design countermeasure sites
- Removal process for interim design countermeasure sites

Pilot projects are intended to test ideas in a way that provides insight into what is being tested and the process involved. The NCDOT interim design safety pilot project was an innovative approach to deployment low-cost safety countermeasures on NCDOT owned and maintained roadways. The purpose of this project was to assess how the process was conducted and understand what could be changed in the future. Based on the deployment of six safety countermeasures that reduce risk for pedestrians and bicyclists, it is clear that a standardized process that can move quickly to address safety is valuable and desirable. Although the process was not as linear as originally intended, the lessons learned are important for future consideration of pilot projects like this one. The innovations of this project can impact how NCDOT deploys future safety projects that align with the Safe System Approach. Ultimately, deployment of interim design safety countermeasures will increase safety for vulnerable road users and help meet safety goals for NCDOT.

American Tobacco Trail Crossing