FEASIBILITY STUDY REPORT

10th Street Bicycle / Pedestrian Crossing Feasibility Study

between Dickinson Ave. and Evans St. in Greenville, NC

PREPARED FOR

Greenville
NORTH CAROLINA

PREPARED BY

vhb

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Introduction

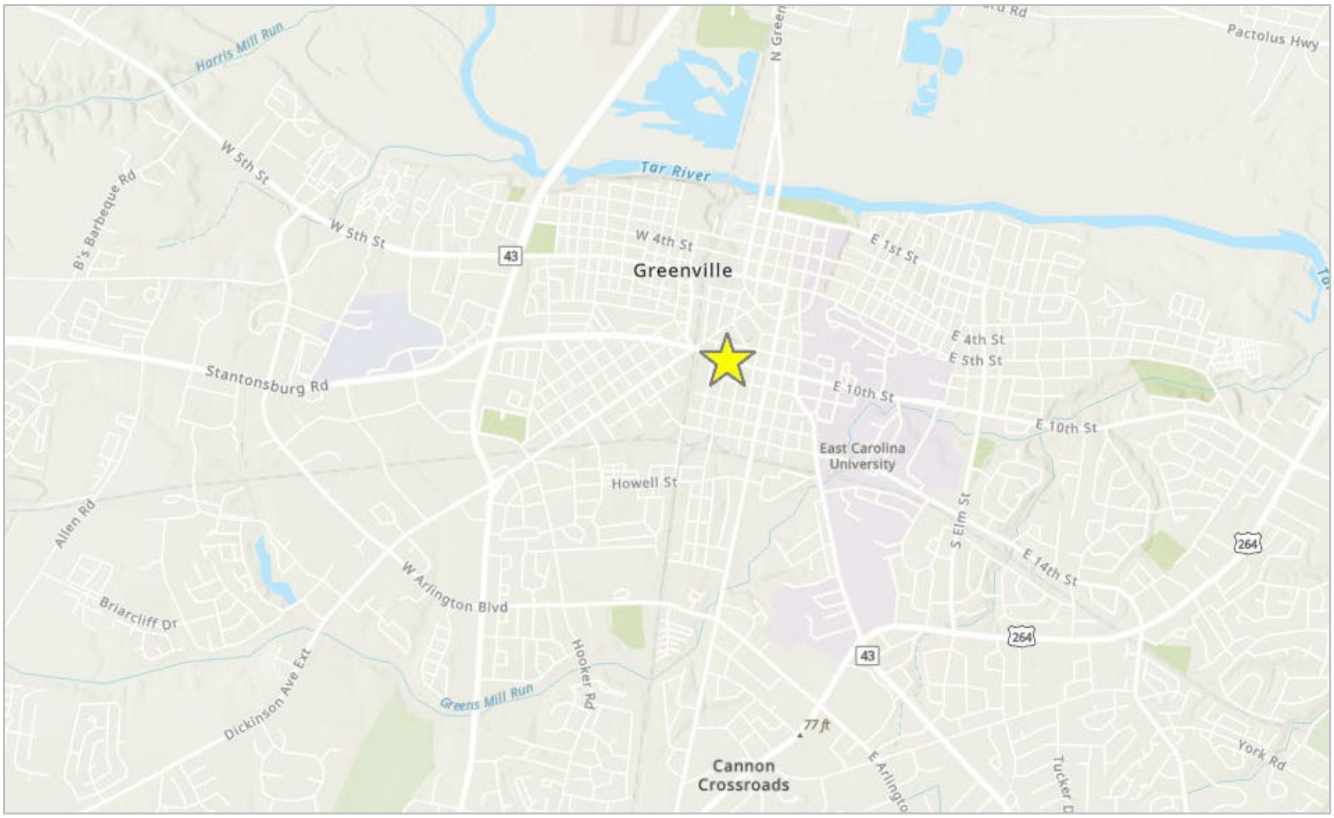
This Feasibility Study evaluated possible alternatives for establishing a north-south crossing of 10th Street in Greenville, NC near the planned Millennial Connector greenway and the feasibility for its implementation.

General Description

The City of Greenville is looking to deliver an effective solution to the challenges created by continued growth and development of the 10th Street corridor by providing a bicycle / pedestrian crossing of 10th Street between Dickinson Avenue and Evans Street.

The project area is located within Pitt County in the City of Greenville, NC, shown in **Figure 1**. The area is urban with primarily industrial and educational land uses and is in an area with a number of historic structures and districts.

Figure 1 - Project Location



Background

Greenville Urban Area MPO Active Transportation Plan
(adopted 2017, updated 2019)

The Greenville Urban Area Metropolitan Planning Organization's (MPO) Active Transportation Master Plan (ATP) identifies 10th Street as a "higher-volume and higher-speed barrier roadway" with approximately 10 crashes involving a bicyclist and / or pedestrians recorded from 2009-2013 NCDOT Bicycle and Pedestrian Crash data.

Priority Project AA (Downtown Rail Trail) calls for a crossing of 10th Street at or near Pitt Street with the recommendation that the "crossing should include a pedestrian hybrid beacon or a Rectangular Rapid Flash Beacon (RRFB) with thermoplastic rumble strips."

2030 Pitt County Comprehensive Transportation Plan
(approved 2006, 2045 CTP is in progress)

The 2030 Pitt County Comprehensive Transportation Plan (CTP) shows Pitt Street extended across 10th Street with proposed pedestrian use.

Future Transit Plans

A bus pull out was observed on the north side of 10th Street at the intersection of Evans Street. The Greenville Area Transit is currently developing the *Integrated Mobility and Enhancement Plan*, which is expected to include recommendations for this corridor. Increased transit in this area would also increase pedestrian traffic in and around the project area.

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Purpose and Need

There is a clear need for a safe crossing of non-motorized traffic across 10th Street, while balancing the mobility needs of the motorized vehicular users on the corridor.

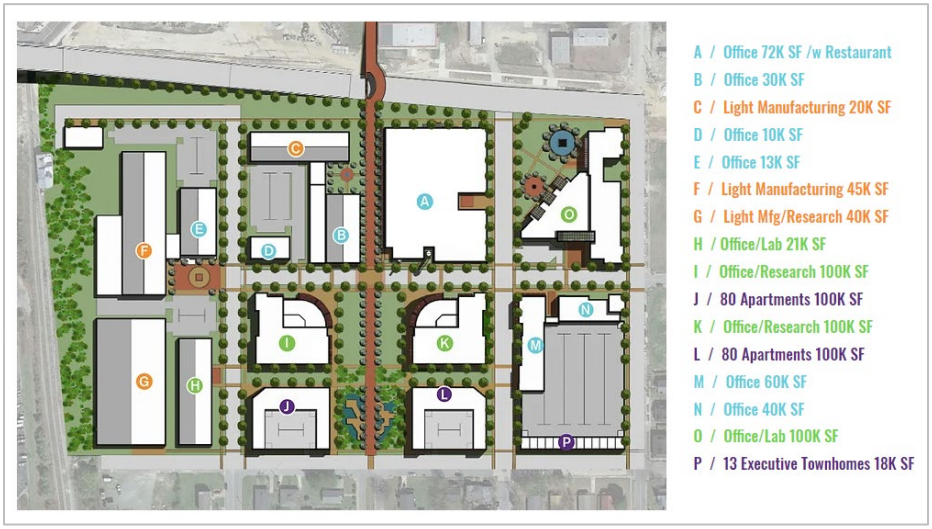
Adjacent Projects

There are numerous projects and planned developments on and around 10th Street that are anticipated to increase pedestrian traffic and would greatly benefit from pedestrian connectivity across or over 10th Street.

East Carolina University's Millennial Campus
(also known as Intersect East)

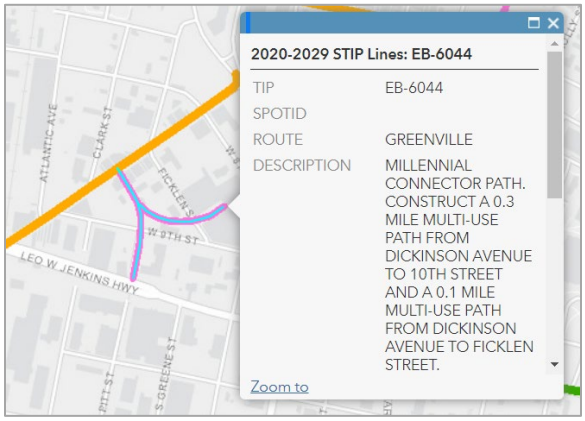
The East Carolina University (ECU) Millennial Campus, also known as Intersect East, is a development planned for the south side of 10th Street from the CSX Rail Line to S Washington Street. The development plans are made up of more than 869,000 square feet of renovated and new buildings for offices, light manufacturing, and research and development as well as apartment buildings, restaurants, and green spaces.

Intersect East Millennial Campus Plan



Millennial Connector (part of the Arts District Trail)
(NCDOT's STIP project No. EB-6042)

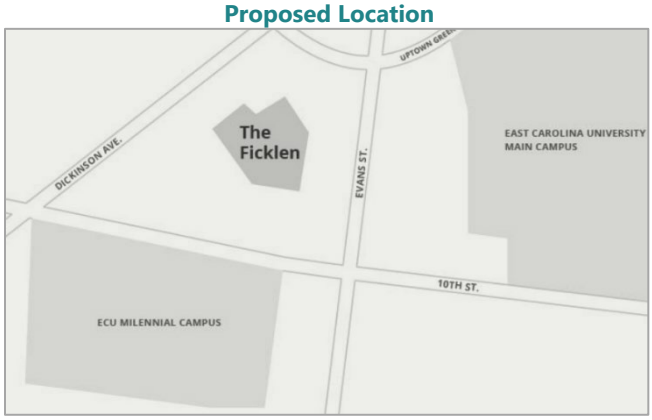
NCDOT's STIP Project No. EB-6042 (pr. EB-6044)
Millennial Connector Path



The ECU Millennial Campus Connector is one of the project components resulting from a BUILD grant award received by the City of Greenville. The BUILD grant is intended to improve non-vehicular safety and access between the planned Millennial Campus (also known as Intersect East) and Uptown. The Millennial Connector would convert an abandoned rail spur and railway into two new multi-use paths; however, the connector stops short of providing a crossing of 10th Street into the Millennial Campus. With numerous redevelopment projects in progress along with other planned projects, the City expects an increase in non-motorized traffic in this area, specifically those crossing 10th Street in the vicinity of the Millennial Connector. The Millennial Connector is scheduled for construction to begin in Spring 2023.

The Ficklen
(food hall and boutique hotel)

The Ficklen
Proposed Location



The Ficklen is a development planned for the Greenville Tobacco Warehouse Historic District adjacent to the revitalized Dickinson Avenue Art's district. The Ficklen Hotel will be a 70-room boutique hotel, nestled in Greenville's uptown district. In addition, the hotel will also operate an approximately 10,000-square feet event space. The Ficklen Development is planned to begin construction in 2022 and will be a pedestrian generator that would greatly benefit from pedestrian connectivity across/over 10th Street.

The Proximity at 10th Street
(a Taft of NC development)

The Proximity at 10th Street is a Taft of NC student housing development planned to be located south of 10th Street between Charles Boulevard / Cotanche Street and Charles Street, east of the project area. The Proximity is planned to open in 2023.

The Proximity Study Housing Rendering

Crash Analysis

Crash data was analyzed using NCDOT's Traffic Engineering Accident Analysis System (TEAAS) for 10th Street from Dickinson Avenue to Evans Street from July 1, 2012, to June 30, 2022. Note that this section of 10th Street was closed due to improvements at Dickinson Avenue and the 10th Street Connector construction.

Overall, the total crash rate on this corridor is 706.22 crashes per 100 million vehicle miles traveled (MVMT), which is higher than both the Pitt County total crash rate (447.61 crashes / 100 MVMT) and the state-wide total crash rate for secondary routes in urban areas (303.62 crashes / 100 MVMT), shown in **Table 1**.

Table 1 – Total Crash Rate Comparison

Location	Total Crash Rate (per 100 MVMT)
10th Street from Dickinson Ave. to Evans St.	706.22
Pitt County	447.61
North Carolina (secondary routes in urban areas)	303.62

A total of 108 crashes were reported along this segment of 10th Street. **Chart 1** shows crashes by collision type with the most common types being:

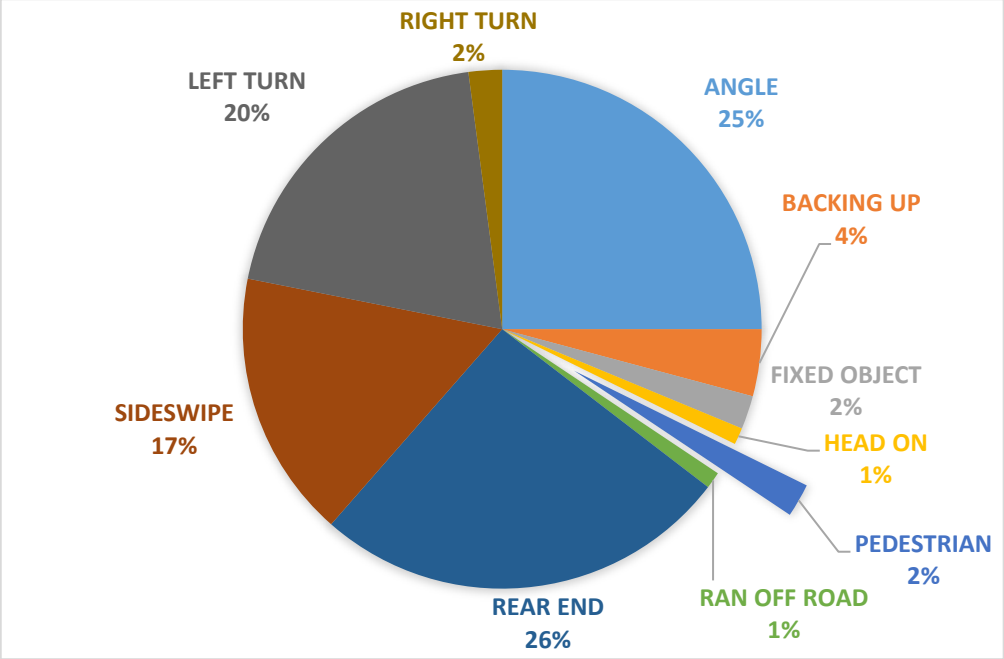
- Rear End (27%)
- Angle (25%)
- Fixed Object (20%)

No fatal collisions were reported; however, there were two collisions recorded where a pedestrian was struck. One collision occurred on a dry, clear day in a hit and run by a passenger car making a

left turn from Evans Street on to 10th Street and the other collision is recorded as an unusual circumstance. It is unknown if there were any contributing factors to the incident, such as driver impairment or vision obstruction.

It's important to note that the main drivers for pedestrian traffic and need for pedestrian connectivity across or over 10th Street has not yet been constructed; however pedestrian demand is anticipated to increase dramatically in the next 5 years due to adjacent developments.

Chart 1 – Collision Type Summary



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Existing Conditions

Within the project area, 10th Street is a 4-lane median-divided roadway with curb and gutter and sidewalks on the structure that transitions to a 4-lane undivided roadway with a two-way turn lane with curb and gutter, sidewalks, and bike lanes and a posted speed limit of 35 mph.

Land Use

Horizons 2026 Greenville's Community Plan
(adopted 2016)

Greenville's *Horizons 2026 Community Plan* classifies the existing land use of the project area as "Urban Center 2," which consists primarily of large footprint single-story industrial or warehouse buildings within the urban street grid, including the ECU warehouse district and future Millennial Campus area.

There are currently multiple vacant buildings and lots along both sides of 10th Street within the study area, generally zoned Downtown Commercial, Downtown Commercial Fringe, Mixed Use Institutional, and Industrial (unoffensive).

Vehicle and Pedestrian Traffic Volumes

NCDOT's Annual Average Daily Traffic (AADT) Mapping Application lists 12,000 vehicles per day (vpd) for 10th Street between Dickinson Avenue and Evans Street. Note that this AADT is for the year 2020, when university activities were primarily virtual, which could have impacted the typical vehicles traveling per day.

There was limited existing pedestrian data available for use in this study; however, the City of Greenville provided 2022 Eco-Visio pedestrian counts taken at Dickinson Avenue between Ficklin Street and 9th Street from January 1, 2022, to present day (data was last accessed on December 20, 2022). This is the closest City count location to the proposed project study area and generally reflects the expected pedestrians that would use the proposed Millennial Connector trail that links Dickinson Avenue to 10th Street near Pitt Street. There is an average of 146 pedestrians crossing this location during the week and 187 pedestrians crossing this location during the weekend, an increase of 12.3% and 4.5%, respectively, from 2021. The maximum pedestrian count recorded for 2022 occurred on Friday March 25, 2022, where 728 pedestrians were recorded.

Our team also evaluated several planned developments in the area that are likely to generate pedestrian traffic. These developments included Intersect East, The Ficklin and the planned Atlantic Avenue Parking lot.

During a recent site visit, free flow speeds of traffic along this corridor were recorded and ranged from 40-55 mph.

Community Resources

The land use in the project vicinity is varied with primarily commercial, industrial, and historic buildings on either side of the corridor. The south side of the corridor includes mostly state-owned land that is primarily made up of historic districts / structures and is the site of the future ECU Millennial Campus. To the north of the corridor, there are also historic districts as well as commercial buildings and vacant lots. Resources located along the corridor are shown in **Figure 2**.

Cultural Resources

Historic Resources

Records and maps of the North Carolina State Historic Preservation Office (NC SHPO) were reviewed for historic architectural resources that have been identified in previous surveys or that were listed on or had been determined eligible for the National Register (NR) of Historic Places. The project area is located between numerous historic sites either listed or determined to be eligible for the National Register, including:

- Dickinson Avenue Historic District (NR: PT2063)
- Greenville NC Tobacco Warehouse District (NR: PT0623)
- Greenville NC Tobacco Warehouse District Boundary Increase (NR: PT1728)
- Pure Oil Station (DOE: PT1574)

SHPO was contacted on November 30, 2022 with information regarding this project requesting preliminary feedback or expectation's of future coordination that may be expected. SHPO responded on January 9, 2023 noting that, given the information provided, there is the potential for historic above-ground resources to be affected, but, in SHPO's opinion, little reason to consider the potential for National Register-eligible archaeological resources.

SHPO has requested that, as the plans progress, alternatives under consideration including potential locations and treatments be shared with SHPO to provide more complete comments. In addition, SHPO recommends that no archaeological investigation be conducted in connection with this project.

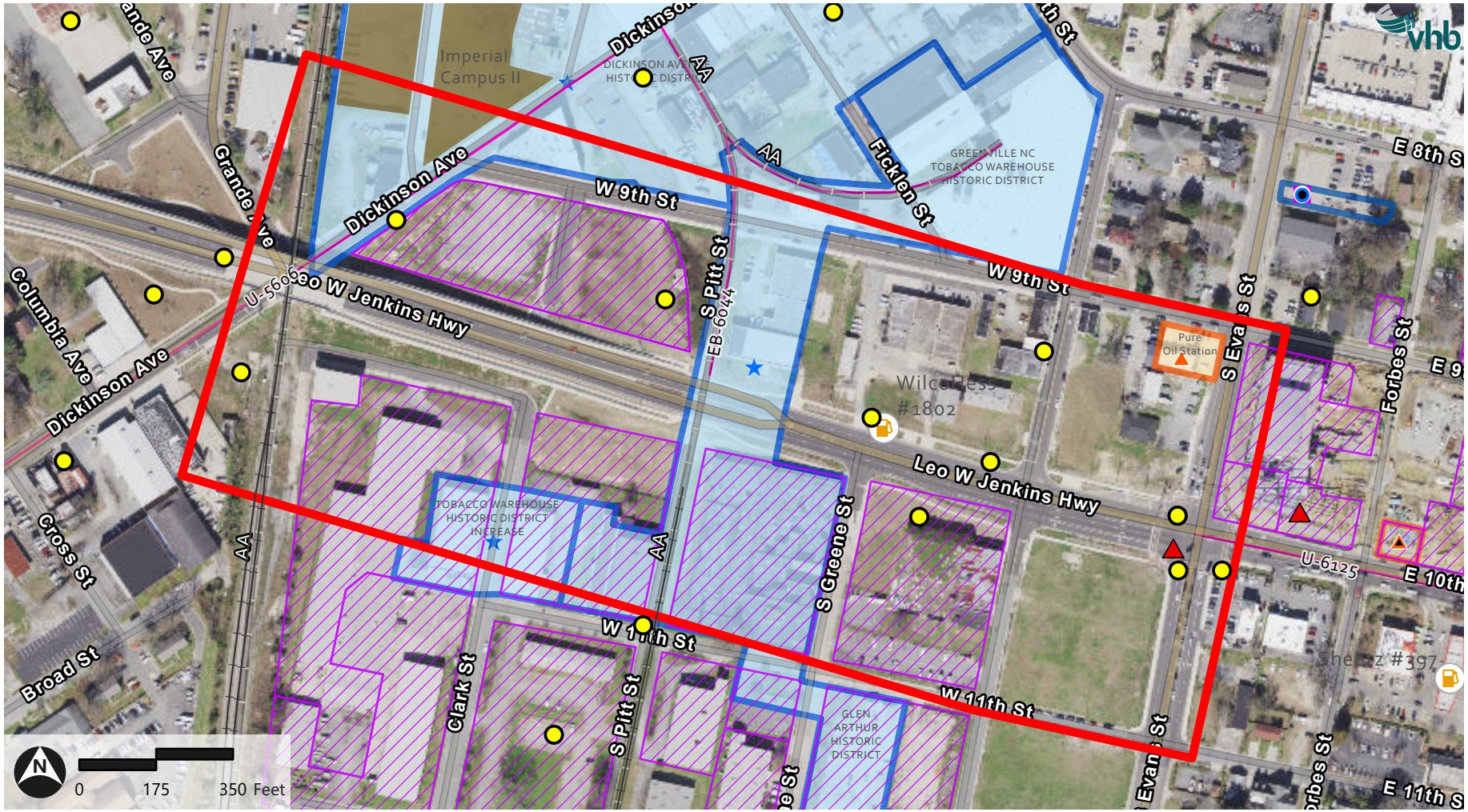
Section 4(f) of the US Department of Transportation Act of 1966 (49 USC § 303), as amended, regulates the use and taking of Section 4(f) resources for federally funded transportation projects. Section 4(f) resources include publicly owned parks, recreation areas, and wildlife and waterfowl refuges as well as significant historic sites under public or private ownership. Note that projects that receive only state or local funding are not typically subject to compliance with Section 4(f).

Archaeological Resources

Because this study is not the product of an exhaustive environmental or design effort, but rather an initial step to this process, the environmental impacts at this level are based on a screening of readily available GIS data. Currently, there are no known cemeteries or other archaeological resources in the project area. It is assumed that a more detailed impacts analysis would be performed during the NEPA / SEPA phase.

Figure 2 - Resource Map

10th Street Pedestrian Crossing Feasibility Study | Greenville, NC



Legend

- 10th Street Study Area
- Railroad Track
- UST
- Hazardous Waste Site
- Gas Station
- Brownfields Site
- State Owned Land
- NCDOT STIP Lines

Historic Resources

Status, LocalStat, HDstatus

- National Register individual listing
- NR and Local Landmark
- NR Listing, Gone
- NR and Landmark, Gone
- NR Historic District center point
- Determined Eligible - DOE
- DOE and Landmark
- DOE, Gone
- DOE, Landmark, Gone
- DOE Historic District center point

Historic District

STATUS

- NR
- NRD
- DOE
- DOED

Natural Environment

A Natural Resource Technical Report will be prepared during project development to fully identify and evaluate impacts to these resources. For the purposes of this report, a screening of readily available GIS data was performed.

The National Wetland Inventory (NWI) database shows no water resources or jurisdictional features in the project area. The North Carolina Department of Environmental Quality's (NCDEQ) Waste Management GIS Data and Maps show one brownfields site, which is a former Imperial Tobacco processing plant now owned by the City of Greenville located in the northwest side of the project area. Currently, there are no approved plans for the site, but the City did receive a grant from the NC Division of Rural Economic Development to clean up the property. The project's Environmental Management Plan must be approved by NCDEQ before soil disturbance on the site is allowed. NC DEQ's GIS data also shows one hazardous waste site, previously a dry cleaner (Scott's Cleaners), which is now a vacant lot located at the southwest corner of 10th Street and Evans Street.

Protected Species

Species with the federal status of endangered (E), threatened (T) are protected under provisions of the Endangered Species Act (ESA) of 1973 as amended (16 USC 1531 et. seq.). Any action likely to adversely affect a species classified as federally protected will be subject to review by the United States Fish and Wildlife Service (USFWS). It is not anticipated that there will be any protected species in the project area; however, as of December 20, 2022, the USFWS lists 16 federally protected species for Pitt County in the Information for Planning and Consulting (IPaC) tool (**Table 2**).

Table 2 – Pitt County Protected Species

Common Name	Scientific Name	Status
West Indian Manatee	*Trichechus manatus*	T
Eastern Black Rail	*Laterallus jamaicensis*	T
Red Knot	*Calidris canutus rufa*	T
Red-cockaded Woodpecker	*Picoides borealis*	E
American Alligator	*Alligator mississippiensis*	SAT
Green Sea Turtle	*Chelonia mydas*	T
Kemp's Ridley Sea Turtle	*Lepidochelys kempii*	E
Leatherback Sea Turtle	*Dermochelys coriacea*	E
Neuse River Waterdog	*Necturus lewisi*	T
Carolina Madtom	*Noturus furiosus*	E
Atlantic Pigtoe	*Fusconaia masoni*	T
Dwarf Wedgemussel	*Alasmidonta heterodon*	E
Tar River Spinymussel	*Parvaspina steinstansana*	E
Yellow Lance	*Elliptio lanceolata*	T
Rough-leaved Loosestrife	*Lysimachia asperulaefolia*	E
Sensitive Joint-vetch	*Aeschynomene virginica*	T

Source: Endangered and Threatened Species and Species of Concern by County for North Carolina (USFWS)
E=endangered; T=threatened; SAT=Similarity of Appearance (threatened)

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Future Conditions

Understanding future land use plans and drivers for pedestrian and bicycle trip generation is important to projecting future demand for the proposed crossing.

Horizons 2026 Greenville's Community Plan
(adopted 2016)

In Greenville's *Horizons 2026 Community Plan* the project area is referred to as a "preferred growth area" and is identified as an Uptown Edge future activity center. The plan recommends that Uptown Edge activity centers promote developments that include mixed use facilities with walkable patterns, as these areas offer opportunities for larger scale infill and redevelopment projects.

Vehicle and Pedestrian Traffic Volumes

In addition to reviewing exiting traffic numbers, our team also evaluated several planned developments in the area that are likely to generate pedestrian traffic. These developments include but are not limited to Intersect East, The Ficklin, and the planned Atlantic Avenue Parking lot. While finalized site plans and/or master plans are still in development, the minimum future pedestrian demand for the study area was estimated to determine if projected demand would meet the general guidelines for considering an at-grade or grade separated crossing for those users.

Table 3 summarizes the projected pedestrian demand based on the expected future land use for these planned developments.

Pedestrian traffic was estimated by using the ITE Trip Generation Manual (11th Edition) for planned land uses; a 10% walk reduction factor was applied to the vehicular trips. To remain conservative, a vehicle occupancy rate of one pedestrian per vehicle was assumed. Additionally, these estimates do not directly account for transit ridership that may bring additional pedestrians to this area.

Even with these caveats, there is an expectation that future development in the vicinity of the proposed crossing location would generate approximately 600 daily pedestrian trips within the general study area. 50-60 pedestrian trips are expected during the heavier travelled hours of the day (peak hours).

Table 3 – Future Pedestrian Demand

ITE Land Use Code	Land Use	Unit	ADT	AM Peak Hour			PM Peak Hour		
				Enter	Exit	Total	Enter	Exit	Total
110	Light Industrial	81,000 sf	36	5	1	**6**	1	3	**4**
221	Multifamily Housing (Mid-Rise)	180 du	78	2	5	**7**	4	3	**7**
310	Hotel	70 rooms	27	2	0	**2**	1	1	**2**
760	Research and Development Center	460,000 sf	464	35	8	**43**	7	34	**41**
Development Total			*605*	*44*	*14*	***58***	*13*	*41*	***54***

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Design Evaluation

Alternatives for the proposed crossing were developed using Environmental Screening mapping, understanding of the project background and goals, and existing/future traffic conditions—both vehicular and non-motorized.

At-Grade Options

Table 4 includes the FHWA recommended pedestrian safety countermeasures based on roadway configuration, posted speed limit, and AADT. These thresholds, as well as information gathered at the site visit, aided the determination regarding appropriate at-grade recommendations.

Table 4 – FHWA Recommended Pedestrian Safety Countermeasures

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)	● 2 4 5 6	● 5 6 7 9	○ 5 6 ● 9	● 4 5 6	● 6 7 9	○ 5 6 ● 9	4 5 6 7 9	○ 5 6 7 9	○ 5 6 ● 9
3 lanes with raised median (1 lane in each direction)	● 2 3 4 5	● ■ 5 7 9	○ ■ 5 ● 9	○ ■ 3 4 5 7 9	○ ■ 6 7 ● 9	○ ■ 5 ● 9	○ ■ 3 4 5 7 9	○ ■ 5 ● 9	○ ■ 5 ● 9
3 lanes w/o raised median (1 lane in each direction with a two-way left-turn lane)	● 2 3 4 5 6 7 9	● ■ 5 6 7 9	○ ■ 5 6 ● 9	○ ■ 3 4 5 6 7 9	○ ■ 6 7 ● 9	○ ■ 5 6 ● 9	○ ■ 3 4 5 6 7 9	○ ■ 5 6 ● 9	○ ■ 5 6 ● 9
4+ lanes with raised median (2 or more lanes in each direction)	● ■ 5 7 8 9	● ■ 5 7 8 9	○ ■ 5 8 ● 9	○ ■ 5 7 8 9	○ ■ 5 7 8 ● 9	○ ■ 5 8 ● 9	○ ■ 5 7 8 ● 9	○ ■ 5 8 ● 9	○ ■ 5 8 ● 9
4+ lanes w/o raised median (2 or more lanes in each direction)	● ■ 5 6 7 8 9	○ ■ 5 6 7 8 9	○ ■ 5 6 8 ● 9	○ ■ 5 6 7 8 9	○ ■ 5 6 7 8 ● 9	○ ■ 5 6 8 ● 9	○ ■ 5 6 7 8 ● 9	○ ■ 5 6 8 ● 9	○ ■ 5 6 8 ● 9

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)**

*Refer to Chapter 4, 'Using Table 1 and Table 2 to Select Countermeasures,' for more information about using multiple countermeasures.

**It should be noted that the PHB and RRFB are not both installed at the same crossing location.

This table was developed using information from: Zegeer, C.V., J.R. Stewart, H.H. Huang, P.A. Lagerway, J. Feaganes, and B.J. Campbell. (2005). Safety effects of marked versus unmarked crosswalks at uncontrolled locations: Final report and recommended guidelines. FHWA, No. FHWA-HRT-04-100, Washington, D.C.; FHWA. Manual on Uniform Traffic Control Devices, 2009 Edition. (revised 2012). Chapter 4F, Pedestrian Hybrid Beacons. FHWA, Washington, D.C.; FHWA. Crash Modification Factors (CMF) Clearinghouse. http://www.cmfclearinghouse.org/; FHWA. Pedestrian Safety Guide and Countermeasure Selection System (PEDSAFE). http://www.pedbikesafe.org/PEDSAFE/; Zegeer, C., R. Srinivasan, B. Lan, D. Carter, S. Smith, C. Sundstrom, N.J. Thirsk, J. Zegeer, C. Lyon, E. Ferguson, and R. Van Houten. (2017). NCHRP Report 841: Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments. Transportation Research Board, Washington, D.C.; Thomas, Thirsk, and Zegeer. (2016). NCHRP Synthesis 498: Application of Pedestrian Crossing Treatments for Streets and Highways. Transportation Research Board, Washington, D.C.; and personal interviews with selected pedestrian safety practitioners.

Corridor Improvements

Consideration should be given to corridor improvements made in the project area in addition to any at-grade or grade-separated pedestrian crossing. Corridor improvements include, but are not limited to:

- Implementing an LPI (leading pedestrian interval) at 10th Street and Evans Street to give pedestrians the opportunity to enter the crosswalk 3-7 seconds before vehicles are given a green indication.
- Adding median fencing or other channelization measures in the median where the proposed Millennial Connector ends at 10th Street to discourage mid-block crossings.
- Constructing an extension of the existing median eastward from the Dickinson Avenue Bridge, including median fencing, to approximately South Washington Street to further discourage mid-block crossings.
- Including additional lighting / signage under the Dickinson Avenue bridge to improve safety and give vehicles advanced warning of pedestrian crossings.
- Constructing additional sidewalk area or "small pedestrian plazas" at the corners of the Dickinson Street bridge abutments to soften the entrance to the under-bridge area.

Cost Estimates for Corridor Improvements

Planning level construction cost estimates were developed for the proposed corridor improvement options based on conceptual designs and recent bid documents for similar projects. Utility relocation costs are accounted for through a 15% contingency. For the corridor improvements, note that it is assumed that no right-of-way costs would be incurred. **Table 5** summarizes the probable construction costs for the above-mentioned improvements.

Table 5 – Cost Estimates for Corridor Improvements

Improvement	Cost	Utility Contingency (15%)	ROW Contingency	Overall Contingency (30%)	Total Cost
LPI Implementation	$1,500	$200	n/a	$500	**$2,200**
Median Fencing, existing median	$7,700	$1,200	n/a	$2,700	**$11,600**
Median Extension, including fencing	$60,200	$9,000	n/a	$20,800	**$90,000**
Improved lighting under Dickinson Street bridge	$30,000	$4,500	n/a	$10,400	**$44,900**
"Pedestrian Plazas" at Dickinson Street bridge (2 corners)	$30,000	$4,500	n/a	$10,400	**$44,900**

Pedestrian Hybrid Beacon

A Pedestrian Hybrid Beacon (PHB) is a traffic control device used to increase motorists' awareness of pedestrians crossing at uncontrolled marked crosswalk locations. A PHB is distinct from pre-timed traffic signals and constant flash warning beacons because it is only activated by pedestrians when needed, also known as being pedestrian actuated.

According to FHWA's Pedestrian Hybrid Beacon Guide, PHB's can reduce pedestrian crashes by 69% and total crashes by 29%. Because PHBs remain dark until activated, they can help increase driver attention to pedestrians crossing the roadway and can reduce rear-end collisions, which are also already prominent along this corridor.

As shown in Table 3, the characteristics of this corridor match those of a typical corridor that would see benefits from a PHB and, therefore, it should be considered at this location. For a PHB, the required stopping site distance for a 4-lane facility with a 9% downgrade is 355-feet for 40 mph vehicle speeds and 507-feet for 50 mph vehicle speeds. The current design provides 850-feet of stopping sight distance from the crest of the Dickinson Street Bridge and 790-feet to the next signalized intersection with Evans Street, which is sufficient.

Photo Rendering of Pedestrian Hybrid Beacon Option

According to *North Carolina Pedestrian Crossing Guidance* (adopted July 2015), developed by NCDOT's Research and Development Unit, a PHB crossing treatment should be considered on a corridor to accommodate pedestrians when the hourly volume reaches 20 pedestrians per hour (pph) regardless of vehicular free flow speed or volumes long the major street. As noted in the **Vehicle and Pedestrian Traffic Volumes** section of this report, approximately 50 pedestrians can be expected in this area during peak hours – well above the 20 pph threshold.

While the proposed PHB does meet design criteria to ensure pedestrian safety, the specific site of this proposed location presents a potential safety issue related to rear end crashes. If eastbound vehicles (coming over the bridge) queue back from the PHB location onto the bridge, the distance allowed for other westbound vehicles to stop before the end of the queue will shorten and could result in rear end crashes. With this in mind, advanced warning signs and/or caution lighting should be included as part of the PHB implementation as a safety enhancement if allowable. Coordination with SHPO should be included due to agreements in place related to additions to the bridge.

Perceived drawbacks often related to a PHB include increased congestion by adding another location to stop moving traffic through a corridor. For this specific location, the spacing between the proposed PHB location and the closest traffic signal (Evans Street) is approximately 1,000 feet, which meets NCDOT's signal spacing requirements. Additionally, it is possible – and recommended – to coordinate the traditional signal at Evans Street with the PHB and delay the pedestrian movement such that it occurs in sync with the downstream signal.

Cost Estimates for Pedestrian Hybrid Beacon

Planning level construction cost estimates were developed for the PHB based on conceptual designs and recent bid documents for similar projects. Utility relocation costs are accounted for through a 15% contingency. For the corridor improvements, note that it is assumed that no right-of-way costs would be incurred. **Table 6** summarizes the opinion of probable construction cost for a PHB.

Table 6 – Cost Estimate for Pedestrian Hybrid Beacon

Improvement	Cost	Utility Contingency (15%)	ROW Contingency	Overall Contingency (30%)	Total Cost
Pedestrian Hybrid Beacon	$118,400	$17,800	n/a	$40,900	**$177,100**

At-Grade Safety Measures

Of the FHWA pedestrian safety countermeasures recommended for this site, **Table 7** summarizes what safety issues are addressed by each countermeasure. It's important to note that the RRFB is not preferred even though it was identified in the *Greenville Urban Area MPO Active Transportation Plan* as discussed in the **Background** section of this report since it is identified as an unsatisfactory countermeasure for corridors with excessive vehicle speeds, which were observed along this corridor.

Table 7 – Safety Issues Addressed by FHWA Countermeasures

Pedestrian Crash Countermeasure for Uncontrolled Crossings	Safety Issue Addressed				
	Conflicts at crossing locations	Excessive vehicle speed	Inadequate conspicuity/ visibility	Drivers not yielding to pedestrians in crosswalks	Insufficient separation from traffic
Crosswalk visibility enhancement	✓	✓	✓	✓	✓
High-visibility crosswalk markings*	✓		✓	✓	
Parking restriction on crosswalk approach*	✓		✓	✓	
Improved nighttime lighting*	✓		✓		
Advance Yield Here To (Stop Here For) Pedestrians sign and yield (stop) line*	✓		✓	✓	✓
In-Street Pedestrian Crossing sign*	✓	✓	✓	✓	
Curb extension*	✓	✓	✓		✓
Raised crosswalk	✓	✓	✓	✓	
Pedestrian refuge island	✓	✓	✓		✓
Pedestrian Hybrid Beacon	✓	✓	✓	✓	
Road Diet	✓	✓	✓		✓
Rectangular Rapid-Flashing Beacon	✓		✓	✓	✓

*These countermeasures make up the STEP countermeasure "crosswalk visibility enhancements." Multiple countermeasures may be implemented at a location as part of crosswalk visibility enhancements.

Other At-Grade Options Considered

Median Refuge Island

A median is the area between opposing lanes of traffic, excluding turn lanes. Medians in urban and suburban areas can be defined by pavement markings, raised barriers, or monolithic concrete islands to separate motorized and non-motorized road users.

A median or pedestrian refuge island is a median with a protected area that is intended to help pedestrians safely cross a road.

Median or pedestrian refuge islands function best in curbed sections of urban and suburban multilane roadways, particularly in areas with a significant mix of pedestrian and vehicle traffic, traffic volumes over 9,000 vpd, and travel speeds of 35 mph or greater.

While these corridor characteristics match those of our project area, a median pedestrian refuge island was dropped early in the project discussion due to the known speeding and potential sight distance issues at this location presented by vehicles coming over the crest of the bridge over Dickinson Street.

Rectangular Rapid Flash Beacon

A Rectangular Rapid Flash Beacon (RRFB) is a is a traffic control device used to increase motorists' awareness of pedestrian crossings at uncontrolled marked crosswalk locations.

RRFBs consist of two, rectangular- shaped yellow indicators, each with a light-emitting diode (LED)-array-based light source, placed on both sides of a crosswalk. RRFBs flash with an alternating high frequency when activated to enhance conspicuity of pedestrians at the crossing to drivers. The flashing pattern can be activated with pushbuttons, also known as pedestrian actuated, or passive.

According to FHWA, the RRFB is applicable to many types of pedestrian crossings but is particularly effective at multilane crossings with speed limits less than 40 mph where it can reduce pedestrian crashes up to 47%.

Considering this, a PHB would be more effective than an RRFB for this roadway, which has speeds recorded between 40-55 mph.

Grade Separated Options

Grade separated pedestrian crossings could also be a good option at this location depending on available land, funding options, and the increase in pedestrian traffic seen due to continuing development in the direct adjacent areas, both in the part of Greenville in general and the Millennial Campus area. A grade separated crossing, or "pedestrian bridge" provides an option that completely removes all conflicts between pedestrians and vehicles. These options, however, come at a higher overall cost and may even be cost prohibitive based on the expected user demand. However, this specific location for a pedestrian bridge offers an opportunity beyond a solution for access and safe movement of pedestrians. It can also serve as a gateway into the ECU campus area, specifically the upcoming Millennial Campus, and it can be an aesthetic focal point that adds to the character and vibrancy of the area.

When considering the appropriateness of a pedestrian bridge as a crossing option solution, it should be noted that there is no standard, or "rule of thumb," related to pedestrian demand that would warrant a bridge option. Rather, the agency considering the grade separated option implementation must consider the ultimate benefit to the area realized by removing potential pedestrian/vehicle conflicts. As noted in the **Background** and **Crash Analysis** sections of this report, this corridor has been identified as a "higher-volume and higher-speed barrier roadway," and a high crash corridor. This is validated by recent NCDOT research that also classifies this corridor as being in the top 5% of high crash risk corridors across the state. The cost of a bridge would theoretically be offset by the fiscal benefit of fewer/no crashes involving pedestrians (injury and/or fatalities).

In developing the conceptual design of a pedestrian bridge, design criteria was assumed and maintained, including:

- 17.5' of vertical clearance under the bridge per NCDOT requirements of structures over state-maintained roadways
- For user comfort, maximum of 8% grade, with landings spaced along the ramps to the bridge, with preference given to a 5% grade if possible, which does not require landings
- 10' minimum curve radii on the structures when needed to gain horizontal ramp length
- 12' width of usable path on the structure, tying to the 10' on grade path as proposed for the Millennial Connector

10th Street Pedestrian Bridge Rendering by Elliott Sidewalk Communities/ Intersect East

Ramp Options

The project team studied various bridge concepts with options for landings and bike-friendly grades for ramps located on both the north and south side of 10th Street. The landing area on the north side of 10th Street is constrained by the presence of 9th Street, allowing only approximately 200 feet of straight-line distance. If an 8% grade with flat landings was used, it would need a run out length of approximately 275 feet. This presents a space issue, so switchback and curved ramp options were explored and are the only viable ramp options for the north side of 10th Street. When these are introduced, a new consideration of whether cyclists can use the bridge without dismounting comes into view. Options both requiring and not requiring bike dismounts were developed.

On the south side of 10th Street, there is no horizontal runout constraint; however, in discussions with the Intersect East developers, the area where this ramp would be constructed is intended to be the "front" of one of the mixed-use buildings, with multiple entry/exit points along the building length. With this in mind, a straight ramp concept was developed for comparison purposes; however, it is understood that a more compact ramp option is desired.

Three ramp options were developed that can be mixed and matched on either the north or south side of 10th Street, resulting in a coherent bridge design, keeping consistency on bike dismounting between the north and south sides.

Ramp Option A

- Requires bike dismount
- 5% grade with tight curves (less than 10' radii)

Ramp Option B

- Does not require bike dismount
- 5% grade with wide curves

Ramp Option C

(south ramp option only)

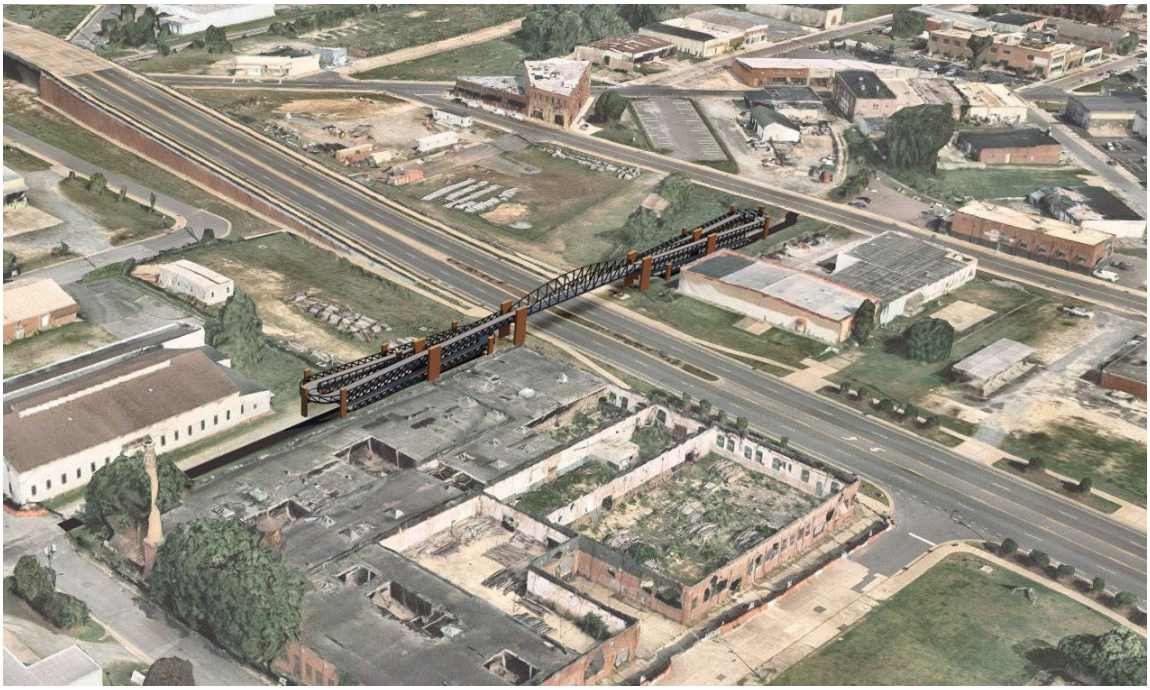
- Does not require bike dismount
- 8% grade with landings and a straight runout

Bridge Concepts

Bridge Concepts under study vary by ramp configuration and are defined by combining a north and south ramp option, resulting in "Bridge Concept XX." Each ramp assumes a 12-foot inner clear width on the structure to allow for a more comfortable experience for a mix of pedestrian and bicycle users but tie back to the planned 10-foot path planned for the Millennial Connector.

Bridge Concept AA

Bridge Concept AA includes a 5% grade and tight curves on both the north and south side of 10th Street. Due to the tight curves, Ramp A would require less right of way acquisition compared to Ramp B; however, this concept is not conducive to bike traffic and will likely require cyclists to dismount for the length of the bridge.



Bridge Concept BB

Bridge Concept BB includes a 5% grade and wide curves on both the north and south side of 10th Street. This concept is conducive to bike traffic and does not require dismount but would have right of way implications. Ramp B would require more right of way compared to Ramp A. The parcels that would require partial acquisition are either owned by the State of North Carolina or are expected to be acquired from Norfolk Southern by the City of Greenville prior to the implementation of a pedestrian bridge. While this removes the need to coordinate with private landowners, it introduces the potential need to coordinate with other public agencies to incorporate the pedestrian bridge design with any potential future land uses, such as a parking deck.

Bridge Concept BC

Bridge Concept BC includes a 5% grade with wide curves on the north side of 10th Street and an 8% grade with full run out on the south side of 10th Street. Ramp B (north side of 10th Street) would require more right of way compared to Ramp A, as previously mentioned, but the runout design on the south side of 10th Street (Ramp C) would require minimal, and potentially no, right of way acquisition. This option would allow for cyclists to cross the bridge without dismount. In focus group discussions with the developer associated with Intersect East (to the south), it was understood that the side of the historic building along the potential bridge ramp is expected to serve as the main entry/exit to this building, which is not supported by the presence of a ramp parallel to most of that frontage. A more compact design is likely to be preferred.

However, research does indicate that pedestrians are more likely to utilize a pedestrian bridge that does not have switchbacks and tight curves, but rather a bridge that provides a straight-line connection that integrates naturally with the greenway or path on either end. Upon selection of a

preferred bridge option, consideration must be given to the proper balance of user comfort and development exposure.

Cost Estimates for Grade Separated Options

Planning level construction cost estimates were developed for three pedestrian bridge concepts based on conceptual designs and recent bid documents for similar projects. Utility relocation costs are accounted for through a 15% contingency. For these crossing options, it is assumed that some right-of-way costs would be incurred; therefore, a percentage of the construction cost was applied to establish a right-of-way contingency based on the intensity of the projected impacts. **Table 8** summarizes the probable construction costs for these bridge concepts.

Table 8 – Cost Estimates for Bridge Options

Concept	Cost	Utility Contingency (15%)	ROW Contingency (varies)	Overall Contingency (30%)	Total Cost
Bridge AA	$7,117,500	$1,067,600	$355,900	$2,562,300	**$11,103,300**
Bridge BB	$6,364,800	$954,700	$636,500	$2,386,800	**$10,342,800**
Bridge BC	$5,499,800	$825,000	$412,500	$2,021,200	**$8,758,500**

Other Grade-Separated Options Considered

Tunnel

A tunnel is a grade separated option where the pedestrians are routed under the main roadway. This option was not carried forward for detailed study due to prominent concerns regarding safety and flooding.

Stakeholder Engagement

The project team worked with the City of Greenville early in the project process to develop a stakeholder engagement plan that would benefit the overall project process while providing valuable feedback at various points in time. Stakeholder engagement is a critical tool for developing vision, understanding constraints, and garnering the public buy in necessary for a project's ultimate success. "Stakeholders" is a broad term that identifies anyone with valuable input to the project, ranging from City staff to elected officials to local private development partners to the general public. The project team engaged stakeholders in meaningful ways as summarized below:

Stakeholder Charette and Site Visit

The first stakeholder outreach beyond the City's project team was comprised of a two-part charette, held on September 21, 2022. Invitees of this meeting included an expanded group of City staff, local emergency personnel, local activists, NCDOT Division 2 staff, and representatives from East Carolina University. There were approximately 15 individuals beyond the core project team that attended, with 10 joining the meeting in person. The intention of this meeting was to help frame the vision for the crossing from the perspective of those that were most likely to have direct input in its planning, design, funding and/or implementation. After a classroom style overview of the project background, purpose and generic conceptual solutions, the group visited the study area on foot to gain on-the-ground understanding of the information presented. After the site visit, the group reconvened inside for a focused discussion on vision for the project and to ask specific questions of the project team. From this meeting, the project team took away ideas about aesthetics that would frame the bridge as a gateway as well as input on specific areas of concern, such as designing for a width that would allow pedestrians and cyclists to use the facility concurrently.

Developer Focused Small Group Meeting

The project team identified five local private developers with recent, active, or planned projects near the project site. A virtual focus meeting was held on October 5, 2022 to present the project vision to these development partners to solicit feedback on their expectations of how people leaving from or bound for their developments may interact with a crossing or bridge at the proposed location. Those that could not attend were encouraged to provide any notable feedback to the project team. This meeting was focus on general idea and information sharing between the City and developers.

Project Website

The project team produced and maintained a project website, with content provided by VHB and website hosting from the City. The website included project background and concept design options, announcement of the public meeting, and an option for submitting digital public comments.

The website was hosted as part of the larger City website and could be accessed through the Greenville Urban Area MPO section of the site.

Public Meeting

The City of Greenville hosted a public meeting on October 10, 2022 at the ECU Life Sciences and Biotechnology Building to share the project with citizens, residents and students that may benefit

from or have input on this planned project. The project team was available to discuss the project background, need, design options and to receive any feedback the public may have to offer. The meeting was run as an open house with information boards and design concept renderings positioned at stations to visit and team members available for discussion and questions.

Public comments were collected via the project website, social media, at the public meeting and via direct mail. Comments received indicated that the project was generally well received, with a preference toward a pedestrian bridge over an at-grade crossing. All written public comments and the project responses are included as an appendix to this report and were also posted to the project website.

NCDOT Coordination

Following the public meeting, the core project team met specifically with representatives from NCDOT Division 2 to talk in more technical detail about the potential crossing options. In general, the Division is in support of the options as presented and is open to coordination with the City during future stages of planning and design.

Maintenance of Traffic / Constructability

Preliminary review of the project area reveals multiple complicating factors to be considered when developing alternatives for this north-south crossing in future stages of planning and design:

- Proximity to the newly constructed bridge over an active CSX rail line, complicating structural assumptions, sight distance, and potentially requiring coordination with CSX and the NCDOT Rail Division
- Multiple National Register and Study List historic districts and resources within the area, requiring consideration of potential impacts to these protected resources through coordination with NC State Historic Preservation Office
- Physical constraints of a potential structure requiring elevation change in a short span of length across the roadway

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Implementation and Funding

It is key to develop an implementation strategy that will ultimately deliver the best project solution in alignment with user demand and funding options.

Implementation Options

The implementation of this project should be split into three distinct phases, with each building upon the prior phase. Phase I is to implement recommended corridor improvements either as standalone projects or in coordination with other City or developer driven projects. As demand for the crossing increases, in line with progressing development of the surrounding area, Phase II would be to implement the at-grade pedestrian hybrid beacon, offset slightly to the east of the Millennial Connector endpoint. Phase III would ultimately deliver a grade separated bridge option. Depending on how the user demand for the crossing increases versus available funding mechanisms, it could be possible to skip Phase II. However, it is critical that regular re-evaluation for the crossing be conducted to ensure that the City's infrastructure is providing safe and accessible route options for all users, especially given the institutional nature of the corridor users.

Funding Sources

Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Grant 2023

The RAISE grant is federal funding allotted for planning and capital investments that support roads, bridges, transit, rail, ports, or other intermodal transportation. A total of $1.5 billon is available for the FY 2023 RAISE grant program for projects that will improve safety, environmental sustainability, quality of life, mobility and community connectivity, and economic competitiveness and opportunity. Additional considerations include demonstrated project readiness and cost effectiveness.

The minimum RAISE grant award is $5 million with a maximum of $25 million for projects located in urban areas. Complete program requirements and application information will be available on December 14, 2022. Applications must be submitted by February 28, 2023.

The 2023 RAISE Grant is a suitable funding source for the corridor improvements (lighting, leading pedestrian interval, median fencing) and Pedestrian Hybrid Beacon if bundled with other systemic projects within the downtown core to reach the minimum $5M grant award threshold. Approved pre-design tasks completed to support the grant application are reimbursable through this grant program.

Safe Streets for All (SS4A) Grant 2023

The SS4A implementation grant is federal funding allotted for applying system-wide low-cost roadway safety treatments, identifying and correcting comments risks across a network, or installing pedestrian safety enhancements, or speed management strategies. A total of $5 billion is available for the five year SS4A grant program for regional, local, and Tribal initiatives that prevent roadway deaths and serious injuries.

To qualify for an SS4A grant, the applicant must have an adopted comprehensive safety plan such as a Vision Zero plan or Safety Action Plan. At the time of this report, the City does not have an adopted plan, however, there are plans to formalize a prioritized list of safety projects to meet this requirement in Summer 2023.

Application information has not yet been released for 2023 SS4A grants but is anticipated to be available in the Fall of 2023.

The 2023 SS4A Implementation Grant is a suitable funding source for the corridor improvements (lighting, leading pedestrian interval, median fencing) and Pedestrian Hybrid Beacon if bundled with other systemic projects within the downtown core to reach the expected minimum $5M implementation grant award threshold.

Public Funding Options

Capital Improvement Project (CIP) Funding

Specific to the Corridor Improvements, the City's CIP could include local funding for these short term, low cost/high value improvements.

Bond Referendum

In coordination with the completion of a comprehensive safety plan, noted above as needed for and SS4A grant funding, the City could implement a bond referendum that would allow Greenville voters to weigh in on the funding of safety improvements, beyond those recommended in this study. A bond can be introduced to cover specific project types, and if passed, the City could use bond money to implement projects, such as this one, that are included in the comprehensive plan. Additionally, the dollars from the bond referendum can be leveraged to secure additional funding for complementary projects within the City.

NCDOT's State Transportation Improvement Program (STIP) Funding

NCDOT's State Transportation Improvement Program selects projects to be funded through the State Prioritization Process (SPOT). The process involves scoring all roadway, public transportation, bicycle, pedestrian, rail, and aviation projects on several criteria, which are all weighted differently, as follows:

- Local Input Points from the MPO and Division Engineers (50%)
- Safety (20%)
- Connectivity / Accessibility (15%)
- Demand / Density (10%)
- Cost Effectiveness (5%)

If seeking STIP funding, the Greenville Urban Area Metropolitan Planning Organization and the NCDOT Division 2 will be key in contributing to the final project score by assigning local priority points to this project. However, if there is buy in from the MPO and NCDOT Division to assign points to this project, then this is a viable option for getting funding for the pedestrian bridge. Increasing local match at this stage is unlikely to produce a noticeable priority increase for project scoring; rather, focusing on local input points and safety points are more important. Once the project has been programmed into the STIP, likely at a construction year well into the future, the City could pursue Federal grant options described above to help accelerate the project implementation timeline. This acceleration would occur because any secured grant funding or increased contribution from the City would lower the NCDOT project cost portion while maintaining all the benefits; thus, the project would score higher in subsequent rounds of prioritization.

It is not recommended that funding for the PHB be pursued through STIP funds, as it is not anticipated to score high enough in the SPOT process.

North Carolina Highway Safety Improvement Program (HSIP) Funding

Funding through the NCDOT HSIP program may be available for the corridor improvements (lighting, leading pedestrian interval, median fencing) and Pedestrian Hybrid Beacon, either submitted as a single project or as separate projects, however a combined project is recommended. This funding is meant to provide a continuous and systematic process that identifies, reviews, and addresses specific traffic safety concerns throughout the state. There are multiple submittal timeframes throughout the year when projects can be submitted for review, allowing for more frequent review than the SPOT cycle discussed above. This feasibility study establishes and supports the need for this project, which is needed for submittal. The City and MPO would next work with the Traffic Safety Unit and the Eastern and OBX Regional traffic safety engineer to have the project formally submitted for consideration. The project would then "compete" against other projects statewide for funding, also on a rolling cycle basis like the submittal process.

If a project does not score well within this process, the Traffic Safety Unit will return feedback that may help future considerations. No resubmittal is needed if the project is not selected; it remains on the list of projects for consideration. Unlike the SPOT process, increased local contributions could make a notable difference in the competitive scoring of HSIP projects.

Private Development Interests

Intersect East, or other surrounding developers, may be interested in contributing to the pedestrian improvements along 10th Street to support connectivity to that development. An option to cost share the implementation of a pedestrian bridge connection should be discussed as Intersect East and other developments continue to evolve in the study area. As part of this study, the project team had a specific outreach meeting with local developers with active projects in the vicinity to establish this common goal of connectivity and to initiate future coordination for joint support of a future pedestrian crossing at this location.

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Conclusions

A multi-phase methodology is key for leveraging funding opportunities and creating a safe and effective crossing environment.

Recommended Improvement Concepts and Study Conclusions

It is recommended that pedestrian and bicycle accommodations are implemented in a multi-phase approach to benefit the users of the corridor, both pedestrian and vehicular, as they adjust to development of the corridor. Options for a new pedestrian crossing of 10th Street should be determined based on a cyclical review of funding options and justification based on pedestrian volumes and the demand for a dedicated safe and effective pedestrian crossing of 10th Street increases. Balancing the timing of funding requests with actual demand for the crossing will be critical to securing the funding for implementation of this crossing.

This implementation plan includes the initial, short-term construction of corridor level improvements, such as leading pedestrian interval (LPI) timings at the Evans Street signal, a median extension and median fencing along 10th Street to help channelize locations where pedestrians attempt to cross the roadway, and improved lighting and small pedestrian plazas at the eastern abutments of the Dickinson Street bridge. These improvements should be implemented regardless of whether a formalized mid-block crossing of 10th Street is ever constructed. Overall, they will provide a safer and more user-friendly experience for the general study area.

However, as demand for a formalized crossing grows due to surrounding development, the need for a PHB or pedestrian bridge will also become more apparent. The City should continue to reevaluate the demand for a pedestrian/bicycle crossing with available funding. It is critical that the infrastructure for multimodal travel is prioritized in this area. The City should provide a safe crossing alternative as a proactive approach, rather than a reaction to a specific incident or increasing crash trend over time. If pedestrian demand for the crossing becomes evident before there is funding available for a pedestrian bridge, a PHB should be implemented. The PHB design included in this study sets the stage for a future pedestrian bridge by normalizing crossing at that general location but also being offset from the bridge location that the PHB could remain active during construction of the ped bridge.

Ultimately, the implementation of a grade separated crossing that follows the recommended design parameters from this study will provide increased connectivity between community spaces through a vibrant, multimodal option. However, as potential funding opportunities for such a large project are defined, the ongoing increase in pedestrian crossing demand should be evaluated against the actual (or calculated) pedestrian demand to determine when a PHB or bridge option should be considered

for implementation. There is not one solution or source in regard to funding, but rather how a combination of both grant and state funds can help to implement this improvement.