



STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

JAMES B. HUNT JR.
GOVERNOR

1534 MAIL SERVICE CENTER, RALEIGH, NC 27699-1534

DAVID MCCOY
SECRETARY

August 2, 2000

MEMORANDUM TO: Mr. Eric C. Michaux, Member, Board of Transportation
Ms Juanita D. Shearer-Swink, Member, Board of Transportation
Mr. J. G. Nance, P.E., Division Engineer, Division 5
Mr. David D. King
Mr. C. W. Leggett, P.E.
Mr. J. M. Lynch, P.E. (3) Attention: Jim Dunlop, P.E.
Mr. J. B. Williamson
Mr. Bill Gilmore, P.E. (2)
Ms. D. M. Barbour, P.E.
Mr. J. E. Alford, P.E.
Mr. Blake Norwood, P.E.
Mr. A. L. Avant (2)
Mr. J. D. Lane
Mr. T. A. Peoples, P.E.
Mr. David Smith, P.E.

FROM:

H. Franklin Vick, P.E.
Feasibility Studies Unit Head

A handwritten signature in black ink, appearing to read "H. F. Vick", written over the typed name and title.

SUBJECT:

Feasibility Study # FS-9905A, Monorail & Pedestrian
Accommodations, Western Boulevard (SR 1012) and Avent
Ferry Road (SR 1321), Wake County.

Our staff has completed a feasibility study for the subject proposed project. This brief analysis suggests improvements that would be logical if the project were to be funded. A copy of our report is attached for your information.

HFV/dl

Attachment

cc: Mr. R. L. Hill, P.E.
Mr. L. A. Sanderson, P.E.

FEASIBILITY STUDY

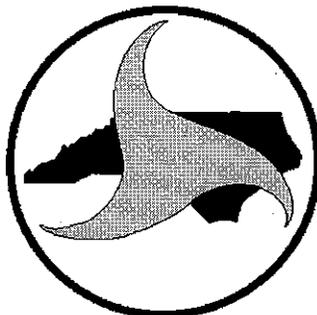
Raleigh

**Monorail & Pedestrian Accommodations
Western Boulevard (SR 1012) and
Avent Ferry Road (SR 1321)**

Wake County

Division 5

FS-9905A



Prepared by the
Program Development Branch
Division of Highways
N. C. Department of Transportation

Derrick W Lewis

Derrick W. Lewis, P.E.
Feasibility Studies Engineer

H. Franklin Vick

H. Franklin Vick, P.E.
Feasibility Studies Unit Head

8/2/00
Date

Monorail & Pedestrian Accommodations
Western Boulevard (SR 1012) and
Avent Ferry Road (SR 1321)
Wake County
FS-9905A

I. General Description

This feasibility study describes three alternates for accommodating a potential underground monorail and pedestrian crossing just west of the Western Boulevard (SR 1012) / Avent Ferry Road (SR 1321) intersection. The project location is shown on Figure 1.

The total cost for each of these alternates, including construction and right-of-way, is as follows:

<i>Alternate</i>	<i>Cost</i>
1. Construct a short bridge west of the existing Avent Ferry Road intersection for monorail and pedestrian access	\$ 8,300,000 (Recommended)
2. Construct two tunnels west of the existing Avent Ferry Road intersection for monorail and pedestrian access	\$ 6,800,000
3. Convert existing intersection into a partial-clover urban interchange with a long bridge for monorail and pedestrian access	\$ 33,800,000

This study is the initial step in the planning and design process for this project and is not the product of exhaustive environmental or design investigations. The purpose of this study is to describe the proposed project including costs, and to identify potential problems that may require consideration in the planning and design phases.

II. Need for Project

The purpose of this project is to accommodate a potential north-south monorail route that would connect the Central Campus and Centennial Campus of North Carolina State University (NCSU). A 1994 study by JKH Mobility Services, Inc., identified a preferred corridor for NCSU's proposed monorail system that would cross Western Boulevard just west of the intersection with Avent Ferry Road (see Figure 2). This project also provides a dedicated pedestrian facility under Western Boulevard that will enhance the traffic safety and operations of the area. This project was requested by the Institute for Transportation Research and Education (ITRE) at NCSU.

Western Boulevard and Avent Ferry Road are designated as major thoroughfares in the Raleigh Urban Area Thoroughfare Plan. Western Boulevard is designated as a principal urban arterial and Avent Ferry Road is designated as an urban collector in the North Carolina Statewide Functional Classification System.

Western Boulevard is currently a four-lane divided roadway with 12-foot (3.7 m) lanes and soil shoulders, and a median that is 32 feet (9.8 m) wide. The existing right-of-way along Western Boulevard is approximately 160 feet (48.8 m) wide. Avent Ferry Road is a six-lane undivided curb and gutter roadway, 76 feet (23.2 m) wide from face-to-face of curbs with 10-foot (3.0-m) berms on approximately 110 feet (33.5 m) of right-of-way. There is a 10-foot wide (3.0-m) asphalt path on the west side and a 5-foot (1.5-m) wide concrete sidewalk on the east side of Avent Ferry Road. Morrill Drive is a 44-foot (13.4-m) curb and gutter roadway on approximately 70 feet (21.3 m) of right-of-way and is one of three access points to NCSU's Central Campus from Western Boulevard. There is a 12-foot (3.7-m) wide brick sidewalk on the west side of Morrill Drive. Additionally, there is on-street parking along both sides of the roadway, as well as a bus stop near the project intersection. Faucette Drive, which intersects Morrill Drive just north of the project intersection, is a 24-foot (7.3-m) wide curb and gutter roadway on approximately 40 feet (12.2 m) of right-of-way. There is an existing traffic signal at the intersection of Western Boulevard and Avent Ferry Road.

NCSU property accounts for the majority of the development in the study area. Wood Hall, a residence hall, is located in the northeast quadrant. The university currently maintains a 77-space parking lot for Wood Hall residents on the north side of Western Boulevard, between Morrill Drive and the residence hall. Faucette Drive is located in the northwest quadrant of the intersection. This roadway allows access to Biltmore Hall, Robertson Hall, Jordan Hall, and an adjacent parking lot.

In the southwest quadrant of the intersection, there is a small gas station, which the University may purchase to accommodate a station for the proposed monorail. Behind this gas station and adjacent to Avent Ferry Road is the former Mission Valley Inn, which is now a University residence hall and meeting facility known as the Avent Ferry Complex. The Stroud Center, which is the University's student-athlete residence hall, is just west of this area. This property is surrounded on three sides by tall retaining walls and has one access via a driveway on Western Boulevard.

There is a substantial amount of development in the southeast quadrant of the intersection. There is a bank located on an outparcel immediately adjacent to the intersection. The Upper Level of the Mission Valley Shopping Center and its adjacent parking is located behind this bank. Just east of the Mission Valley Shopping Center, Capital City Broadcasting maintains studios, offices, and a transmission tower for two television stations, WRAL and WRAZ.

There is a substantial amount of pedestrian and bicycle activity within of the intersection because of the proximity to NCSU, which currently attracts 28,000 students and 6,000 faculty and staff. See Figure 3 for the current and design year vehicular and pedestrian volumes for this intersection. Truck traffic is estimated to make up five percent of daily traffic.

The Western Boulevard / Avent Ferry Road / Morrill Drive intersection currently operates at Level of Service (LOS) "F". If the proposed monorail / pedestrian facility (Alternate 1 or Alternate 2) is provided, we expect some traffic operation and safety benefits at this intersection because of the removal of pedestrians crossing Western Boulevard, but poor traffic operations are still expected during peak hour periods. Even if the intersection were reconstructed as an interchange (Alternate 3), additional improvements well beyond the scope of this project would be required before it would accommodate the peak hour traffic volumes in the 2025 design year.

During the five-year period from April 1993 to March 1998, there were 184 accidents reported at this intersection. There were 72 injuries, including no fatalities, reported as a result of these accidents. The accident rate at this intersection is 214.05 accidents per 100 million vehicle miles (acc/100mvm). This compares with the 1997 statewide rate of 277.54 acc/100mvm for four-lane divided urban primary routes with no access control.

III. Description of Alternates

The three alternates for accommodating the proposed monorail and pedestrian/bicycle movements beneath Western Boulevard as recommended by the JKH Mobility Services study are as follows:

Alternate 1 (Recommended)

This alternate proposes to construct a bridge (underpass) just west of this intersection to accommodate the proposed monorail and pedestrian facilities under Western Boulevard (See Figure 4). This bridge should be on abutments with a concrete median barrier. In addition, the bridge should be designed to accommodate future widening of Western Boulevard. Retaining walls along Avent Ferry Road and Morrill Drive would be required to accommodate the proposed monorail and pedestrian facilities.

It is anticipated that no residences and one business will be relocated due to this alternate. The total cost of this alternate, including right-of-way and construction, is \$ 8,300,000.

Construction.....	\$ 6,800,000
Right-of-way.....	\$ 1,500,000
<hr/>	
Total Cost	\$ 8,300,000

Alternate 2

This alternate is very similar to Alternate 1, but utilizes two reinforced concrete box culverts as tunnels instead of a single bridge structure in order to accommodate the proposed monorail and pedestrian facilities (See Figure 5). Under this alternate, the proposed tunnels would each be approximately 160 feet in length. Therefore, the pedestrian tunnel would require lighting throughout its length.

It is anticipated that no residences and one business will be relocated due to this alternate. The total cost of this alternate, including right-of-way and construction, is \$ 6,800,000.

Construction.....	\$ 5,300,000
Right-of-way.....	\$ 1,500,000
<hr/>	
Total Cost	\$ 6,800,000

While both Alternate 1 and 2 serve the same purpose with slightly different configurations, track maintenance for the proposed monorail maybe a problem for Alternate 2.

Alternate 3

As previously indicated, both Alternate 1 and 2 accommodate the proposed monorail as well as provide pedestrian accommodations but the adjacent intersection will continue to function poorly. Even if Western Boulevard is widened to a six lane divided facility and Morrill Drive is widened to multilanes, this intersection will still fail to operate acceptably. Therefore, Alternate 3 which provides an interchange at this location was considered because it would improve the traffic operations and safety problems of the subject intersection and still accommodate the monorail and pedestrian movements. However, this alternate would be significantly more expensive than the other two and requires extensive right of way acquisition.

This alternate would reconstruct the existing Western Boulevard / Avent Ferry Road / Morrill Drive intersection as a partial cloverleaf interchange with loops in the northeast and southeast quadrants (See Figure 6). Western Boulevard sits atop a ridgeline, and both Avent Ferry Road and Morrill Drive approaches have substantial uphill grades. To accomplish this interchange construction, both Avent Ferry Road and Morrill Drive would be lowered to pass beneath a structure carrying Western Boulevard. Retaining walls will be required to minimize the right of way impacts in the area. The existing cross-section of Western Boulevard would remain unchanged in this alternate. A five lane curb and gutter section, 64 feet wide face to face of curbs is proposed for Avent Ferry Road / Morrill Drive within the interchange area. Onsite detours for Western Boulevard traffic will be possible, but north-south traffic across Western Boulevard will not be possible for much of the construction.

This alternate will require the removal of the Wood Hall parking lot in the northeast quadrant of the proposed interchange. In addition, this alternate would result in major impacts to the available parking and access to the upper level of the Mission Valley Shopping Center. While this alternate will not directly affect the building structurally, it will remove the parking lot and will not allow any direct vehicular access from Avent Ferry Road to the upper level shops. It is anticipated that all stores in the upper level of the Mission Valley Shopping Center would be relocated due to this alternate. No impacts are anticipated to the movie theater or to the stores located in the lower level. Access to the Stroud Center may be maintained from Western Boulevard but the existing median opening at the Stroud Center drive should be removed under this alternate.

It is anticipated that no residences and ten businesses will be relocated due to this alternate. The total cost of this alternate, including right-of-way and construction, is \$ 33,800,000.

Construction.....	\$ 11,300,000
Right-of-way.....	\$ 22,500,000
<hr/>	
Total Cost	\$ 33,800,000

IV. Discussion of Alternates

While Alternate 1 uses a single bridge (underpass) to serve both the monorail facility and the pedestrian facility simultaneously, Alternate 2 uses a pair of tunnels to serve each facility separately. Under Alternate 2, the pedestrian tunnel will require lighting throughout its length and the proposed monorail tunnel may present future problems for monorail track maintenance within the tunnel. In either case, both Alternates 1 and 2 will accommodate the proposed monorail, pedestrian and bicycle movements while minimizing the project cost as well as the impacts to the surrounding properties. It should be noted that the removal of the pedestrian conflicts from the Western Blvd / Avent Ferry Road / Morrill Drive intersection will provide some traffic safety and operational benefits. However, it will not address all the traffic operational and safety needs of the intersection.

Alternate 3 proposes to provide a half-cloverleaf interchange at this location. It will improve the operations of the Western Boulevard / Avent Ferry Road / Morrill Drive intersection and accommodate the pedestrian and bicycle movements, but at a much higher cost and with extensive impacts to the area. These impacts include but are not limited to the loss of a parking lot at Wood Hall and the loss of the upper level of the Mission Valley Shopping Center.

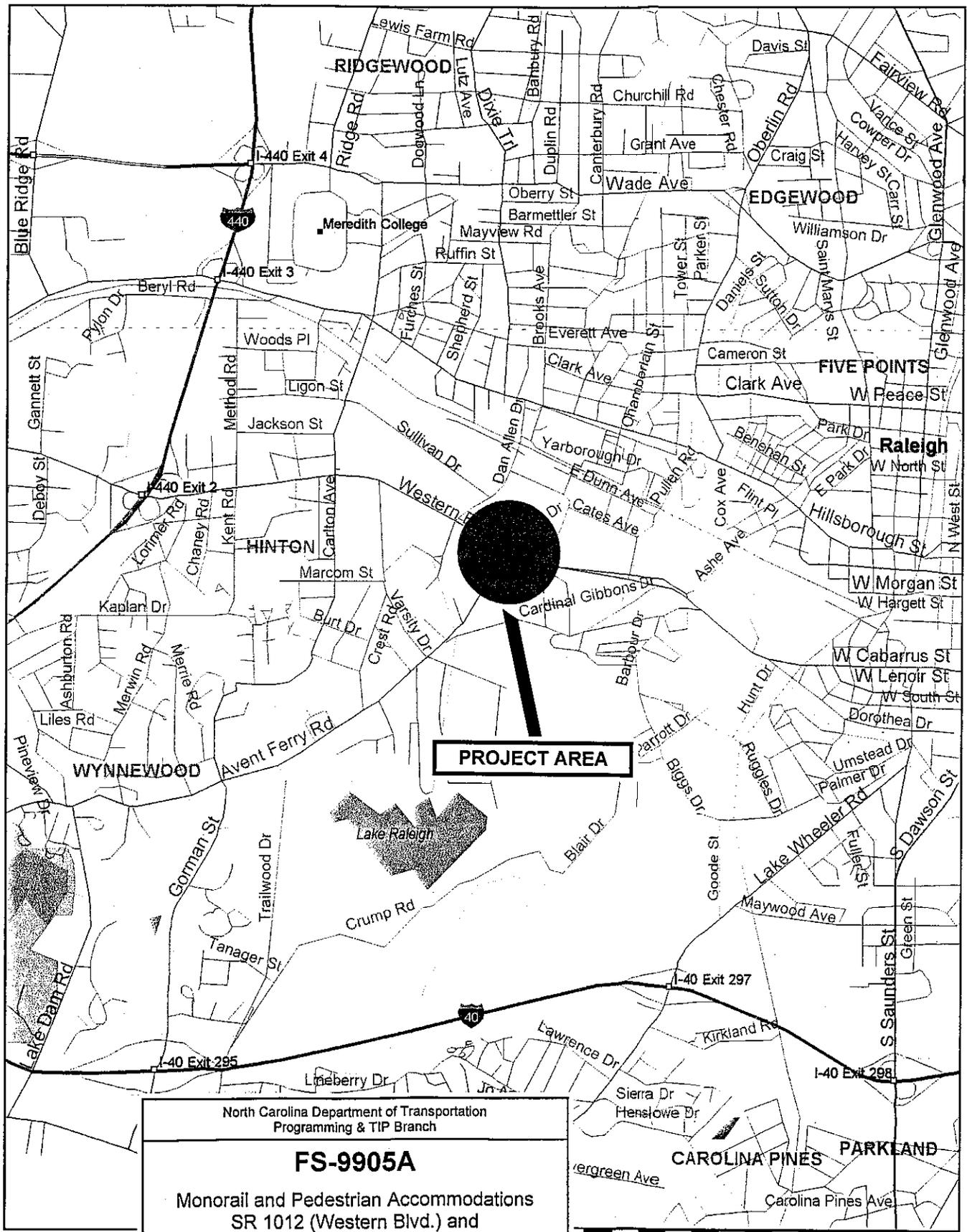
Considering these factors, it is our recommendation that Alternate 1, the proposed monorail / pedestrian bridge (underpass), be provided under this project.

V. Additional Comments

No transportation benefit analysis was conducted for this project because the recommended improvements are beyond the capabilities of the benefits analysis program developed by the Statewide Planning Branch.

An environmental screening was not conducted for this study. However, no impacts to historic properties or wetlands are anticipated. Based on maps at the Department of Environment, Health & Natural Resources - Natural Heritage Section, no threatened or endangered species were identified in the project area.

As of the writing of this study, NCSU and ITRE were considering the use of the Futrex System 21 fixed-guideway monorail for the University's monorail system. All estimates for the sizes of the bridges and the culverts are based on this design and are approximate. Construction of the structures in each of these alternates will require close coordination with the construction of the monorail segments.



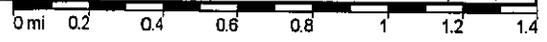
North Carolina Department of Transportation
 Programming & TIP Branch

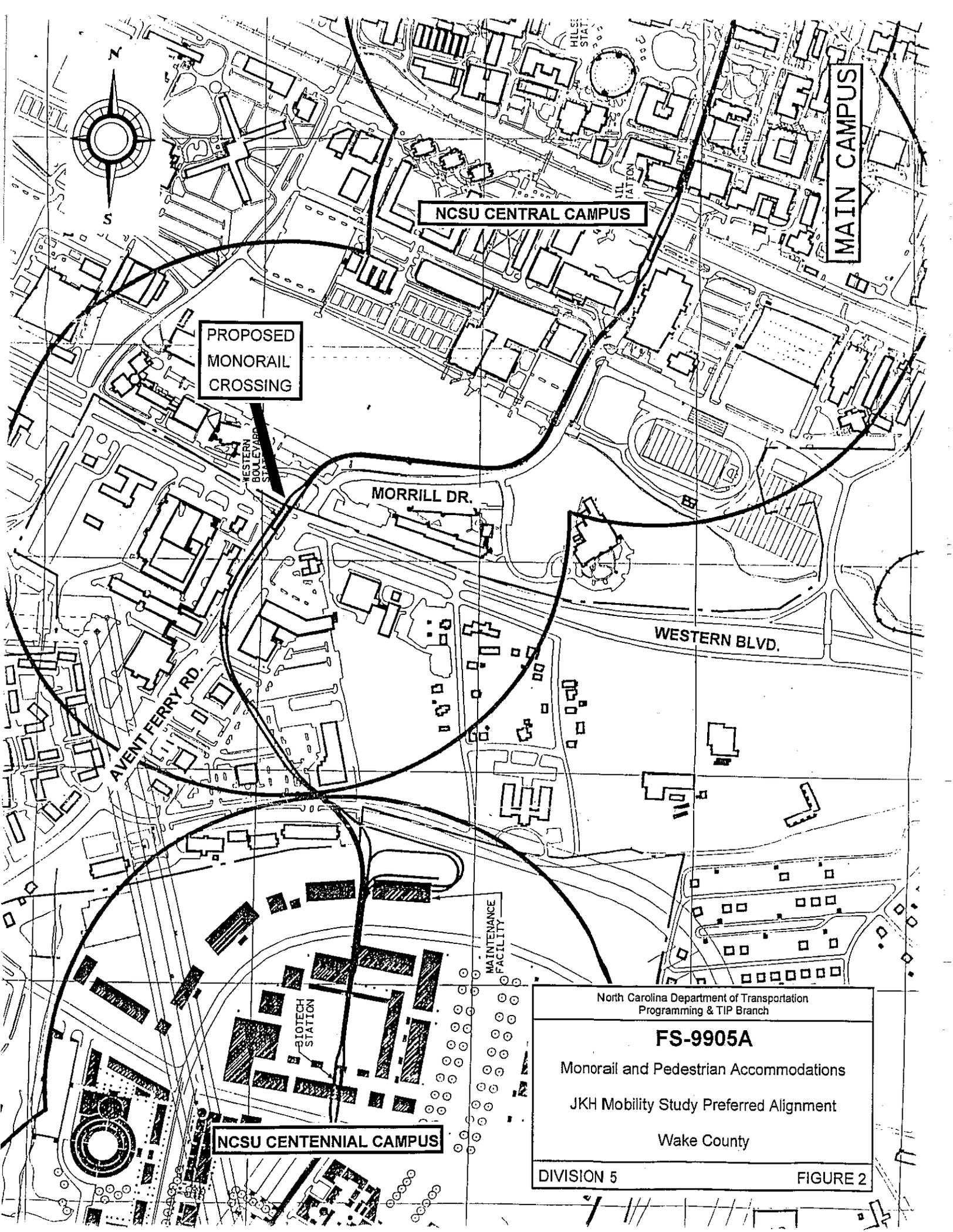
FS-9905A

Monorail and Pedestrian Accommodations
 SR 1012 (Western Blvd.) and
 SR 1321 (Avent Ferry Blvd.)

Wake County

DIVISION 5 FIGURE 1





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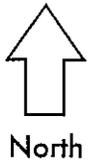
Monorail and Pedestrian Accommodations

JKH Mobility Study Preferred Alignment

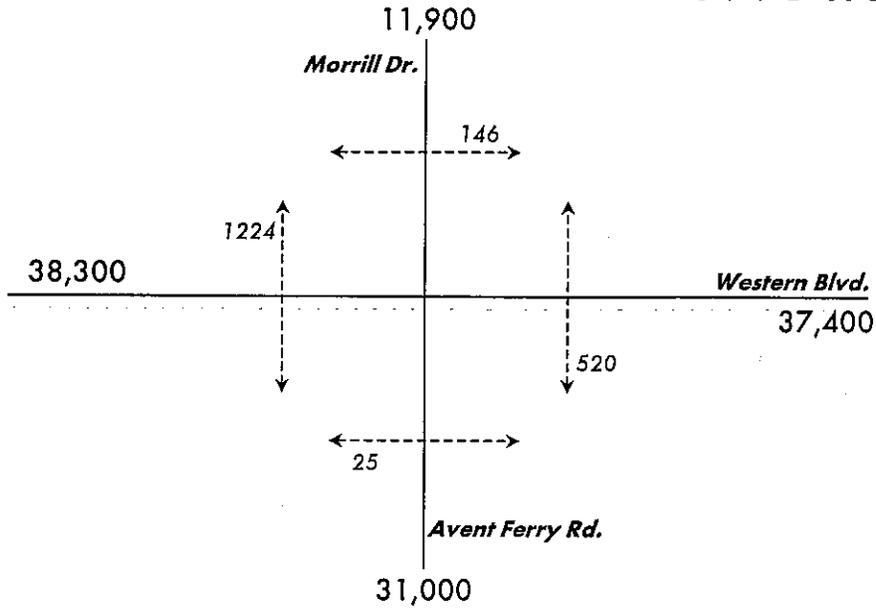
Wake County

DIVISION 5

FIGURE 2



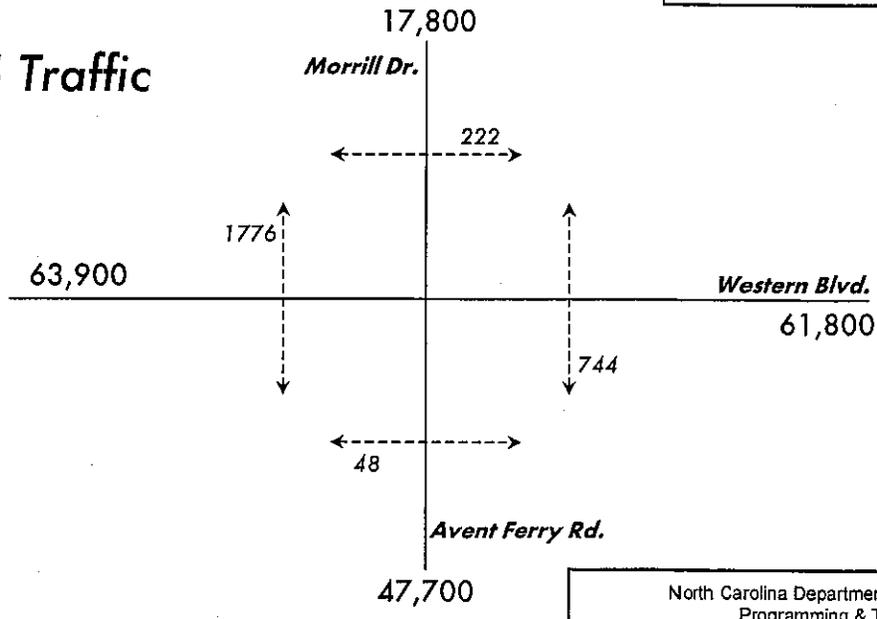
1998 Traffic



LEGEND

- ### Vehicles per day (vpd)
- ←###→ Pedestrians/Bicycles per day

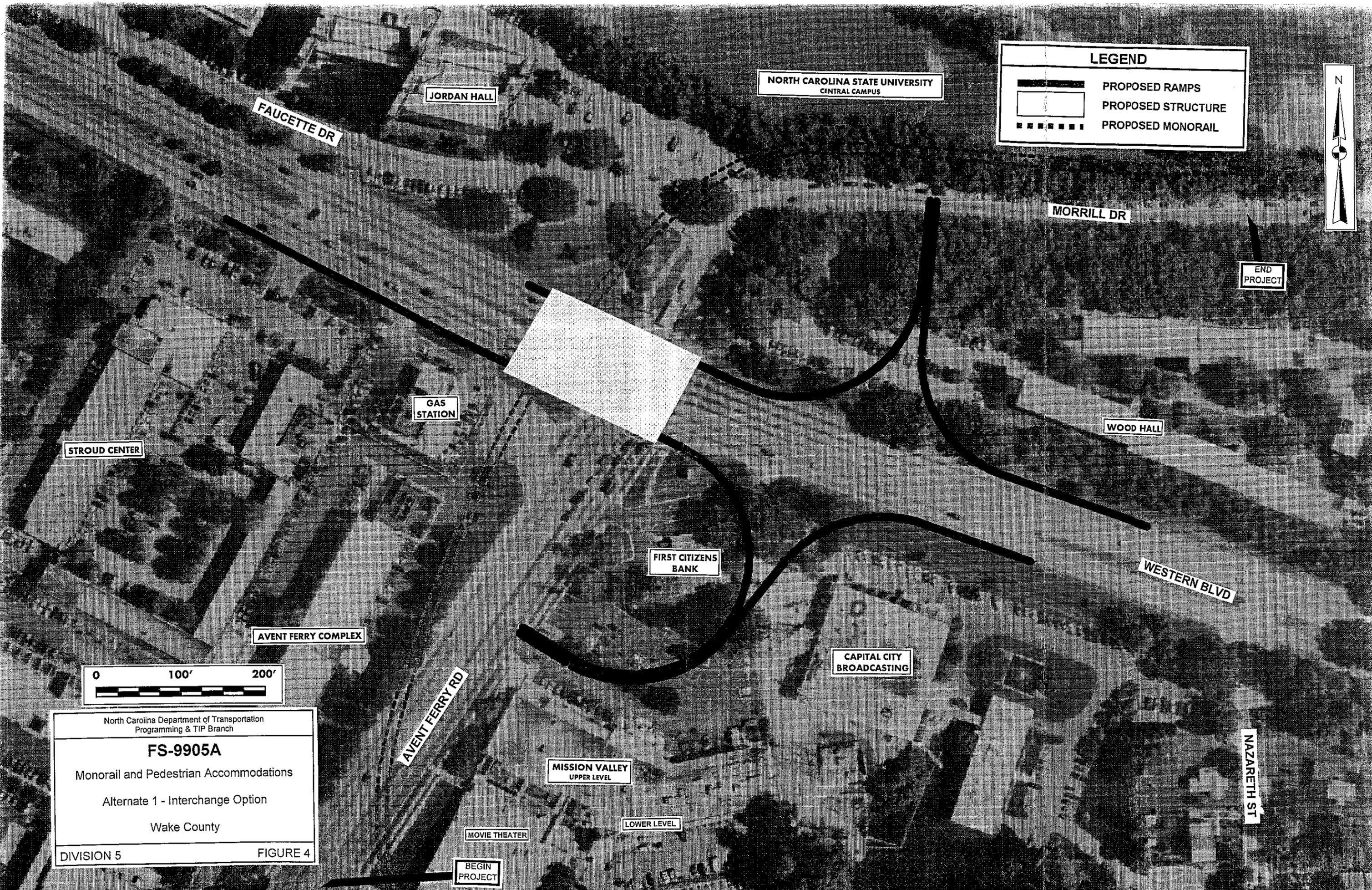
2025 Traffic



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FS-9905A

Monorail and Pedestrian Accommodations
Current and Future Traffic Demand
Wake County



LEGEND

-  PROPOSED RAMPS
-  PROPOSED STRUCTURE
-  PROPOSED MONORAIL



NORTH CAROLINA STATE UNIVERSITY
CENTRAL CAMPUS

JORDAN HALL

FAUCETTE DR

MORRILL DR

END PROJECT

GAS STATION

WOOD HALL

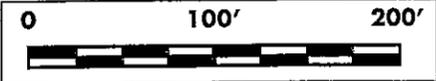
STROUD CENTER

FIRST CITIZENS BANK

WESTERN BLVD

AVENT FERRY COMPLEX

CAPITAL CITY BROADCASTING



AVENT FERRY RD

MISSION VALLEY
UPPER LEVEL

NAZARETH ST

LOWER LEVEL

MOVIE THEATER

BEGIN PROJECT

North Carolina Department of Transportation
Programming & TIP Branch

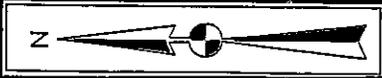
FS-9905A

Monorail and Pedestrian Accommodations

Alternate 1 - Interchange Option

Wake County

DIVISION 5 FIGURE 4



MORRILL DR

WESTERN BLVD

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FS-9905A

Monorail and Pedestrian Accommodations

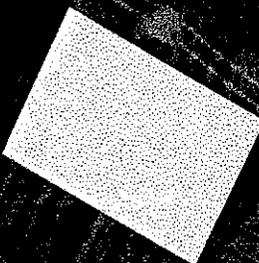
Alternate 2 - Bridge Option

Wake County

DIVISION 5

FIGURE 5

FIRST CITIZENS BANK



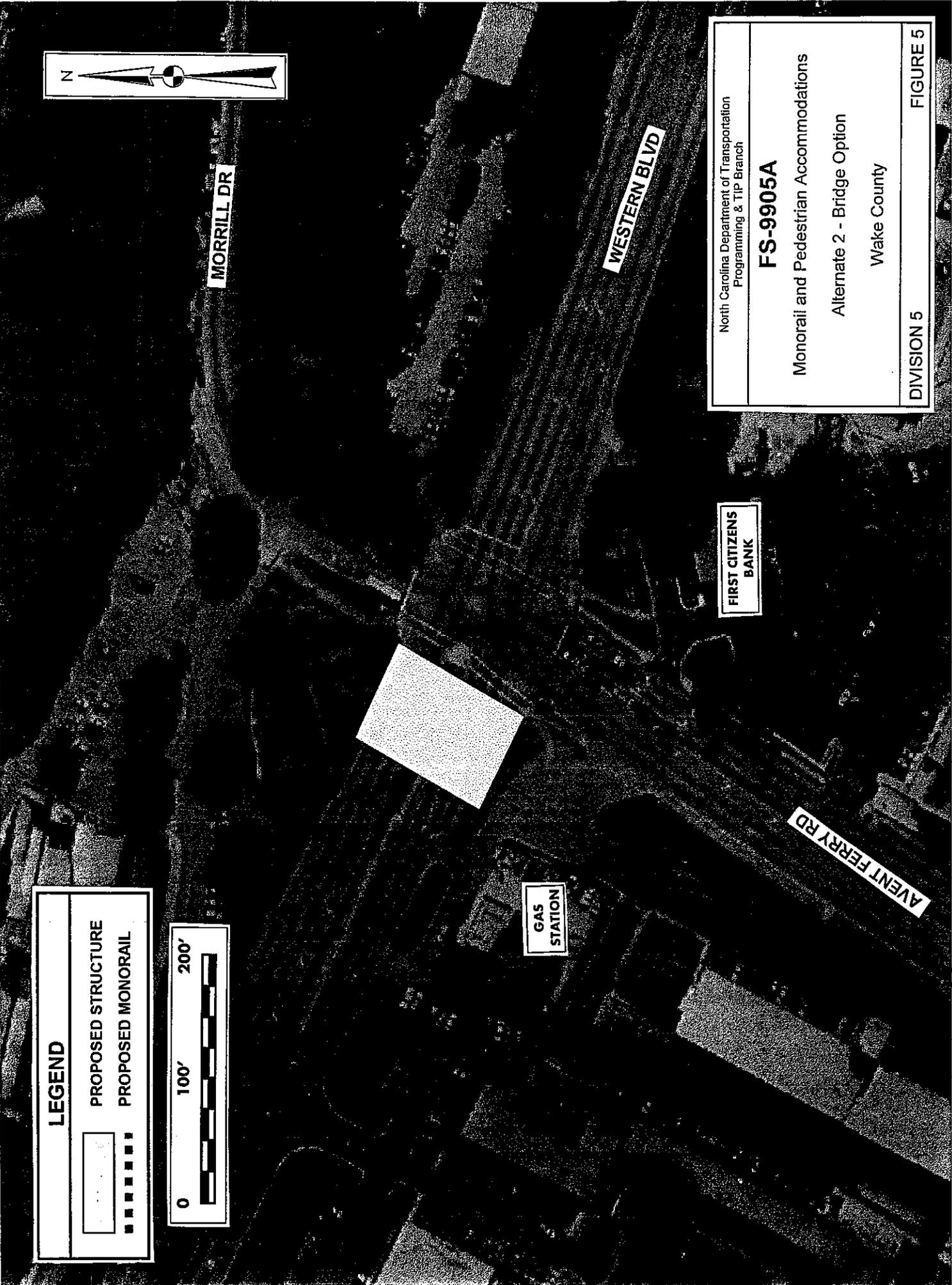
AVENT FERRY RD

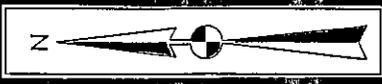
GAS STATION

LEGEND

PROPOSED STRUCTURE

PROPOSED MONORAIL





MORRILL DR

WESTERN BLVD

FIRST CITIZENS
BANK

GAS
STATION

AVENT FERRY RD

LEGEND

PROPOSED STRUCTURE

PROPOSED MONORAIL



North Carolina Department of Transportation
Programming & TIP Branch

FS-9905A

Monorail and Pedestrian Accommodations

Alternate 3 - Tunnel Option

Wake County

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FIGURE 6