

APPENDICES

“...Perceived time for pedestrians, especially under adverse (e.g., inclement weather) conditions, is often valued more highly than automobile traveler times.”

- Technical Memorandum, “Benefit-Cost Assessment,” Stantec Consulting



Appendix A. Existing Conditions Report

Introduction

This report documents the public involvement, existing conditions, and previous studies that collaboratively shape and provide context to the development of alternatives and recommendations for the Western Boulevard Crossing Study. One aspect of the overall planning process is to work towards developing a bicycle, transit and pedestrian grade-separated alternative to safely and efficiently cross Western Boulevard between Varsity Drive and Pullen Road. Today’s needs, tomorrow’s vision, and understanding past decisions are key tools for the development of innovative recommendations and feasible implementation. This report provides a concise overview of our initial steps taken toward understanding the tapestry of the project study area and the goals and needs of key decision makers.

Project Background

Western Boulevard is a major arterial facility that bisects the southern and northern campuses of North Carolina State University (NCSU). The corridor is a crossroads linking NC State campus activity centers south of Western Boulevard (Avent Ferry Complex, Greek Village, Centennial Campus, and College Inn apartments) to the Central and North campuses and includes several major pedestrian, bicycle, and transit crossings. It experiences congested conditions during traditional peak hour periods with off-peak congestion coinciding with NCSU course schedules.

Safety in the corridor is also a concern. Traffic volumes and congestion levels are increasing, as are the number of pedestrian and bicycle trips crossing Western Boulevard. The University is committed to creating a pedestrian-friendly campus as one of its guiding principles, and in anticipation of additional non-motorized trip growth as Centennial Campus matures, seeks to create a safe and effective way to redirect the majority of pedestrian-bike movements across Western Boulevard onto facilities that would separate pedestrians from general vehicular traffic, and become the most desirable way for pedestrians to cross Western Boulevard.

Project Objectives

The objectives for this project as defined by the project advisory committees are:

- Develop alternative designs that intercept existing pedestrian and bike desire lines, and seamlessly redirect them to segregated crossing locations across Western Boulevard;
- Evaluate the feasibility of incorporating transit vehicles in the conceptual designs; and
- Provide a safe multi-modal connector between the South and Central campuses for North Carolina State University.

Study Area

The defined study area for this project consists of the section of Western Boulevard from Pullen Road to Varsity Drive and the surrounding quarter-mile buffer area adjacent to the corridor (Figure 1).



FIGURE 1: WESTERN BOULEVARD PROJECT STUDY AREA

Future Growth

Projected future growth is an existing force that is driving the current need for this project. This section briefly documents the “perceived future needs” by presenting the projections for the state, region, and campus growth.

The State of North Carolina is projected to be the 7th largest state with 12.2M people in 2030.¹ This growth will occur throughout the state as a whole with majority of the growth occurring in the larger Cities including the research triangle (Raleigh, Durham, and Chapel Hill). The City of Raleigh is anticipated to grow by 270,000 people between 2010 and 2030. That correlates to approximately 120,000 new dwelling units and 170,000 new jobs. The City of Raleigh is working collaboratively with the surrounding areas to develop a Growth Framework as part of the 2030 *Raleigh Comprehensive Plan*. [Figure 2](#) captures the vision and how our project fits into the larger plan for the city and regional growth.

The study area, shown in the close up circle ([Figure 2](#)), illustrates that Avent Ferry and Hillsborough Street are designated as multi-modal corridors and Western Boulevard is noted as a Parkway Corridor. The large orange circle denotes a Transit Oriented Development (TOD) Area for growth and land use planning with a future rail station at the intersection north of Western Boulevard and Avent Ferry Road along the rail line. This provides context for the development of alternatives as it fits into the larger growth plan of the area and region.

The campus of NC State University is projected to increase 20% in student, faculty, staff, and corporate partners from 2011-2022² These projections are due to development occurring throughout

NC State’s six campuses: (1) Centennial campus, (2) South, (3) North, (4) Central, (5) College of Veterinary Medicine, and (6) Stadium/Arena. The study area is highlighted below (yellow box) in context of the NC State University Campus Regions.

The Centennial Campus is where the majority of the planned construction and development is located. The population of this region is projected to

more than double in population by 2025, which equates to nearly 12,000 more people.

The alternatives developed in this study are developed through working meetings with the campus planners, City of Raleigh, and professional staff to ensure that the small and large recommendations are effective today and essential for the future growth and needs. Western Boulevard will remain a high volume crossing for the years to come, but how it successfully balances the needs of pedestrians, transit patrons, cyclists, and automobile users, as well as meet the aesthetic demands of a premier gateway into the Region’s most populous city and a world-class learning and research institution, are the premier challenges of the Project.

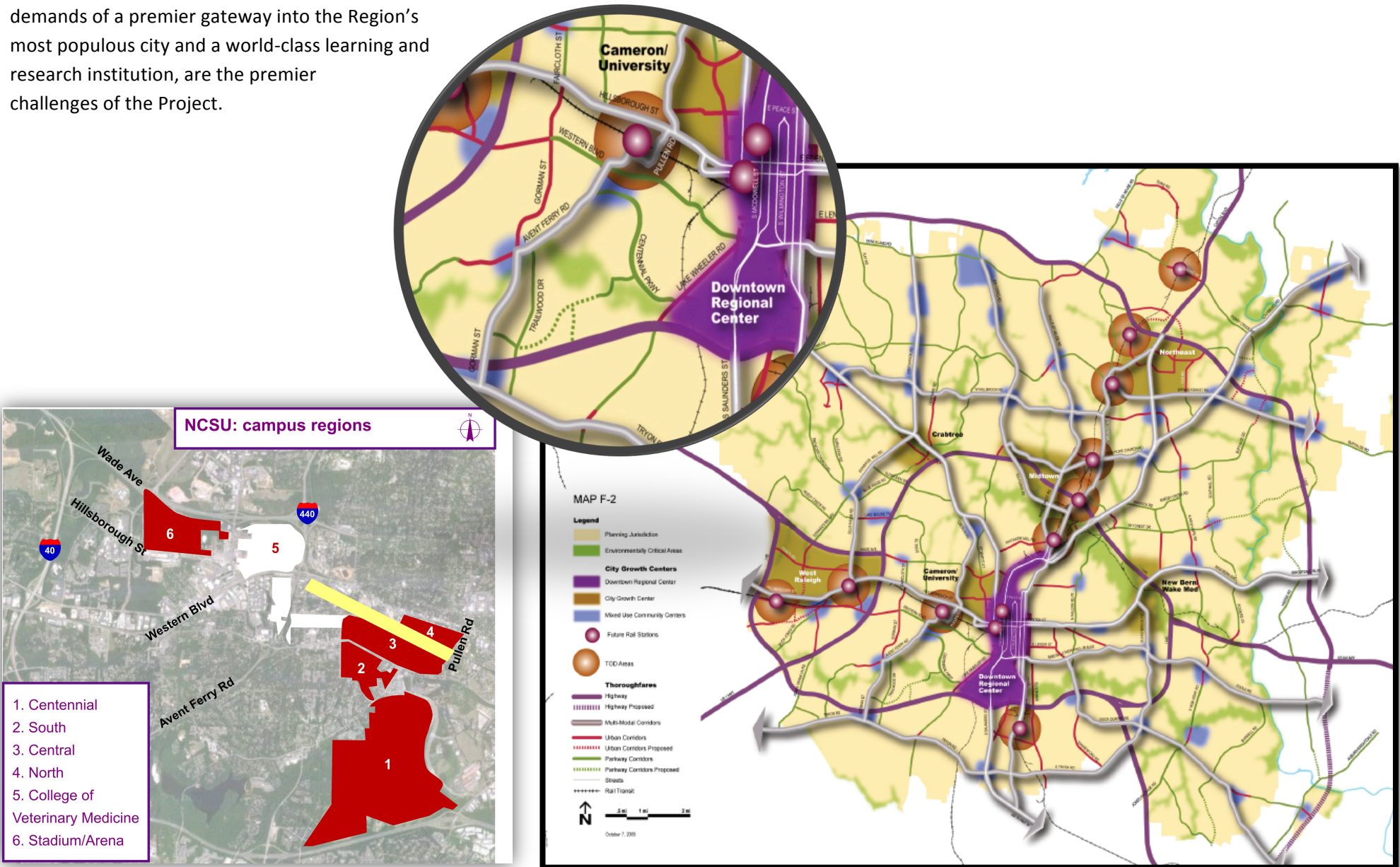


FIGURE 2. RALEIGH COMPREHENSIVE GROWTH FRAMEWORK, CITY OF RALEIGH

¹ The Changing Faces of America Presentation, October 2011, Mitch Silver.
² Campus Mobility Plan, HDR, June 2012

I. Committee & Public Involvement

Collaboration of modes, generations, and authorities is our approach to public and community engagement. The composition of our team included representatives from the City of Raleigh, North Carolina State University, NCDOT, Wake County, transit operators, neighborhoods, landowners,

Core Technical Team (CTT)
Aaron Hair, Capital Area Transit
Sarah E Lee, NCDOT TPB
Gerald Daniel, Capital Area MPO
Shelby Powell, Capital Area MPO
Chris Lukasina, Capital Area MPO
Fleming El-Amin, City of Raleigh
Eric Lamb, City of Raleigh
Jennifer Baldwin, City of Raleigh
Jed Niffenegger, City of Raleigh
Brian O' Sullivan, NCSU Transportation
Kristy Jackson, NCSU/ ITRE

Study Oversight Committee (SOC)
John Vine-Hodge, NCDOT Bike/Ped
Helen M. Chaney, NCDOT Bike/Ped
Bastian Schroeder, NCSU
David Eatman, Capital Area Transit
Joey Hopkins, NCDOT Division 5
John Hodges-Copple, Triangle J COG
Ed Johnson, Capital Area MPO
Scott Walston, NCDOT TPB
Mike Kennon, City of Raleigh
John Stone, NCSU Faculty
Erik Landfried, Triangle Transit
Tom Kendig, NCSU Transportation Staff
Tom Skolnicki, NCSU Landscape Architecture
Andy Walsh, NCSU Student President
Joshua Privette, NCSU Student Body

Friends of the Committee
Cha'ssem Anderson, Triangle Transit Authority
Christine Klein, NCSU Transportation Staff
Michael Ousdahl, NCSU Transportation Staff
Rupal Desai, NCDOT

interest groups, decision makers, and the traveling public. Working relationships were built through collaborative on-site days in the field, drop-in workshops, and working meetings. Project meetings were held on Avent Ferry to engage attendees and continually keep the focus and their eyes on the behaviors and needs of this corridor.

Committees

Two formal committees provided expert review and guidance in the development and review of the alternatives and final recommendations.

The **Core Technical Team (CTT)** comprised of professional staff met on a periodic basis to review details and assist in technical decisions and guidance of the Project. The members of this team dedicated many hours of review and guidance to the development of alternatives and met with the design engineers and planners to consider facets such as: utilities, alternative roadway treatments, constructability, intelligent transportation systems (ITS), and the efficient use of technology to reduce conflict, delay, and improve overall mobility for all modes.

The **Study Oversight Committee (SOC)** comprised of members of the public, elected/appointed officials, and higher-level policy makers that met collectively to assist in policy and general guidance of the project. Implementation and collaboration were the key elements discussed and collectively achieved through working together to determine how to best serve all needs for today and the goals of future development and growth.

Friends of the Committee

Official **“friends of the committee”** members are those people who are very interested in the project yet not formally on one of the two committees. The project vision is to have all users involved in the discussions, the alternatives, and the solution for the future. This committee provided additional insight and served as conduits to distribute project information and seek involvement from a greater population.

Public Engagement

In addition to the formal committees and friends of the committee our outreach involved engagement in four key areas. The engagement of these groups was purposeful and innovative to reach specific audiences that were not easily represented through formal committee meetings. The key

areas of public engagement provided great momentum at the ground level of planning and are noted and described in the following sections:

- Media (Print, Radio, Internet)
- Intercept Survey/CycleTracks
- Focus Groups: In Person
- Video Stream
- Media

Communication through local and student papers provided base information

Communication Team
Student Government President
Sustainability Chair
Green Life Director
Avent Ferry Complex Resident Hall Director
Inter-Residency Council President
WKNC 88.1 General Manager
NCSU Web Communications Technician Editor-in-Chief
College Inn
Cycling and Mountain Biking Club
NCSU Pedestrian/Bike Department
NCSU Transit
Design College



with messaging focused on health and safety to appeal to individuals traveling the corridor and encouraging involvement in the planning process. Students have been targeted to participate and learn about the

project as our communication team volunteers. Printed posters with QR codes were placed at the following locations: on all Wolfline buses, in university housing, at the design college, and popular gathering places around campus including the Carmichael Gym and Athletic Center. Project posters like the one on the next page were selected from one of three options by the CTT, and were provided to the communication team volunteers for distribution to their representative groups.

The radio airwaves assisted in advertising and reaching the community through the partnership with the staff at WKNC 88.1 FM. Project information and milestones were distributed throughout the duration of the project to provide key dates of project workshops to encourage participation from those traveling through the corridor commuting to non-campus locations.

With every university student required to own or at least have access to a computer, and with students using the Internet for school and social purposes, our project partnered with the Student Body President to use web-based communication extensively to engage students. The Internet methods were optimal for distributing information and driving students to the project website. The student body president partnered with the project team to distribute student-wide email blasts to inform and engage students. In addition, he ensured all meeting dates were posted on the centralized calendar; information was on the NCSU student body president’s Facebook page, and was intimately aware of the vision, goals, and schedule of the project prior to the project kick-off.



The project website provided up-to-date information, involvement opportunities, and documents/image resources developed throughout the planning process.



Figure 3: PROJECT POSTER

Intercept Survey

The purpose of conducting intercept surveys was to understand behavior and preference by engaging users within the study area. Casual conversations initiated while users were actively within the corridor allowed for more accurate information to be collected by reducing recall factors and capturing real time responses to the environment – including perception and stated opinions. Activating user reactions on-site increases the ability of the surveyor to obtain accurate feedback on potential scenarios by avoiding some respondents' inability to correctly visualize existing conditions when they are removed from the corridor. Intercept surveys also enable clarification of questions and create opportunities for open discussions that may lead to further discoveries.

Method

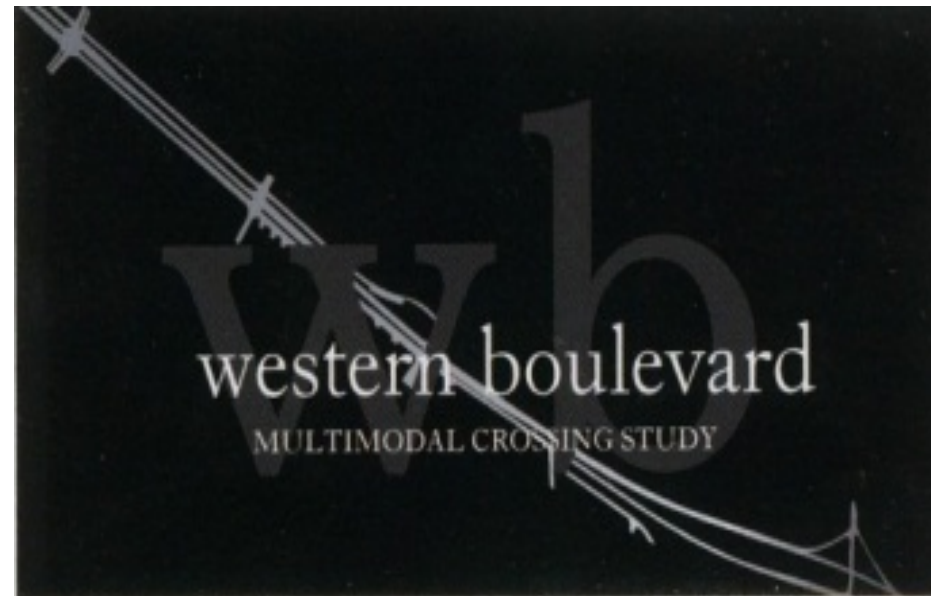
Survey Team: The survey team consisted of three members from the project team. Each surveyor was trained on how to appropriately approach subjects and facilitate the survey process.

Data Collection Time: Intercept surveys were conducted during morning, afternoon, and evening commute periods on Tuesday, October 9, 2012. The weather was cloudy and mild with a temperature in the mid to upper 50's.

Data Collection Locations:

1. Western Blvd. at Varsity Dr.
2. Western Blvd. at Dan Allen Dr.
3. Western Blvd. at mid-block crossing location between Avent Ferry Rd. and Dan Allen Dr.
4. Western Blvd. at Avent Ferry Rd.
5. Western Blvd. at Pullen Rd.

Data Collection Subjects: Surveyors targeted those walking and cycling throughout the data collection areas. All measures were taken to position pedestrians and cyclists off the road during survey interaction. The goal was to collect at least 40 complete surveys. During the study period, a total of 68 surveys were completed. Each survey was equipped with the following supplies: Safety vest, clipboard, surveys, pens, graphic of tunnel crossing, and project information card (*shown at right*). The survey is shown on the following page.



Front



Rear

"Hello, my name is _____. The University is partnering with a regional planning organization to redesign pedestrian and bicycle circulation across Western Blvd to increase safety. Would you mind chatting with me for a couple minutes?"

1. What is the purpose of your trip? (CIRCLE)

CLASS WORK EAT EXERCISE

OTHER _____

2. On this trip, where did you begin? _____

3. Did you stop anywhere? Where? _____

4. Where are you headed next? _____

5. Where do you typically cross: VARSITY DAN ALLEN AVENT FERRY PULLEN MIDBLOCK

6. On a scale of 1-5, 1 being very safe, how safe do you feel when you cross Western Blvd?

VERY SAFE 1 2 3 4 5 NOT SAFE

What would make you feel safer? _____

7. If you could cross using a tunnel, bridge, or other separated facility, what location would work best for you? MARK SELECTION ON MAP BELOW



8. Would you be likely to use an underpass like the one shown here by yourself or with others?

YES, BY MYSELF YES, WITH OTHERS YES, BUT NOT AT NIGHT

NO, UNCOMFORTABLE NO, INCONVENIENT NOT SURE

Please indicate any notes from subject here:



"Thank you for taking the time to chat with me. This card has the project website if you would like to learn more about the project or follow our progress. There is also information about downloading a free app if you would like to help us further by tracking your biking and walking routes. Thank you for participating today."

Weather _____ Time _____ Surveyor Name _____

Location of Interception (CIRCLE ONE):

VARSITY DAN ALLEN MID BLOCK AVENT FERRY PULLEN

Data Collection

The survey was used to gain a better understanding of the following:

- The level of safety when crossing Western Boulevard;
- Where people are coming from and going to;
- Where people typically cross;
- The ideal location of a potential grade-separated crossing;
- How safe people would feel using a tunnel crossing under Western Boulevard; and
- What would make people feel safer?

Three surveyors were stationed along the Western Boulevard study area to capture a representation of people crossing in each location. One surveyor covered the mid-block/Avent Ferry Road intersection area, one covered the Dan Allen Drive and Varsity Drive intersection areas, and one covered the Pullen Road intersection area. Surveyors asked questions listed in the survey and recorded the respondents' answers. The graphic showing a hypothetical tunnel crossing under Western Boulevard was used to aid the respondents' visualization of such a scenario and their comfort level in using this type of crossing. When the survey was complete, the surveyor gave the information card to the respondent. The respondent was asked to follow the link on the website to Cycle Tracks where they would be able to download the application to trace their respective route across Western Boulevard.

Results

It was clear to the survey takers by observing activity throughout the day that the Avent Ferry intersection experiences the highest use of those intersections included in the study. Pullen Drive foot and bicycle traffic were quite low, with most respondents indicating they were making a connection to Centennial Campus.

A total of 68 surveys were collected throughout the day. Of the group surveyed, 90% (61 respondents) said they were traveling to or from campus and their apartment/home.

Perception of Safety Crossing Western Boulevard

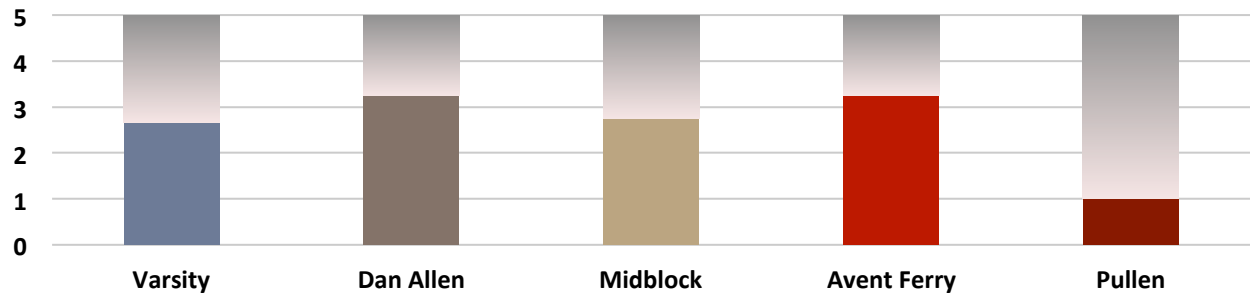


Figure 4: AVERAGE COMFORT LEVEL WHEN CROSSING WESTERN BLVD BY LOCATION

When asked how safe subjects felt on a scale of 1-5 (1 feeling safe and 5 feeling not safe), 2.9 was the overall average response regarding comfort level felt when crossing Western Boulevard. In addition to this cumulative average, the scale below shows the average comfort levels for crossing Western Boulevard at each individual intersection/location within the study area. The closer to mid-block/Avent Ferry Rd, the less safe people felt when crossing Western Boulevard. Overwhelmingly, there were comments made about the traffic volume and speed at Avent Ferry, and some respondents intercepted at other locations indicated Avent Ferry was the least safe intersection along Western Blvd. Also noted were comments about motorists ignoring the regulatory signage prohibiting right turns on red from Avent Ferry to Western Blvd.

The typical crossing location was skewed by the number of people intercepted in this location. Although the surveyors intended to distribute

the collection of data evenly across all five locations, the low pedestrian and cyclists activity at Pullen and Varsity prevented even distribution. The graph below may be a combination of traveler preference and convenience as well as the greater sample of respondents intercepted at Avent Ferry.

Typical Crossing Location

Preference of location for a grade separated crossing may also be influenced by the current path of the individual participate, but even those traveling along Pullen Road indicated the crossing would serve the community best by being located at the busiest intersection – which they determined to be Avent Ferry.

Suggested Location for Crossing Improvement

When considering the tunnel crossing scenario, more than half of the participants (59% - 40 respondents) said they would feel comfortable walking through a tunnel crossing at all times, and 28% (19 respondents)

said they would be hesitant to cross alone and/or at night (seven respondents were unsure/had no comment and two said they would not use a tunnel crossing at all because of safety concerns).

When asked for free response to: In crossing Western Boulevard, what would make you feel safer – many respondents were at a loss to suggest improvements. Some of the most common responses to this question are listed as follows.

- Bridge/tunnel or any kind of general improvement would be welcomed
- Improve crosswalk timing and length
- Enforce no turn on red
- Slow traffic speed and limit traffic volume
- A tunnel crossing would be great if well lit
- Raise driver awareness of pedestrians/bicyclists who are crossing

Intercept surveys are not intended to be statistically significant; however, they do provide a glimpse into the behavior patterns and opinions of users. From this sample of users, it can be generalized that people believe Western Boulevard is a challenging road to cross, with Avent Ferry being the busiest and most dangerous of the selected sites. While users do not indicate severe discomfort or danger, they do have concerns about motorist behavior, traffic volume, and speed. The outlier of safety, interestingly, was Pullen Road. While travelers did not feel safe walking on Pullen (no sidewalk), or crossing the Western on-ramp (bad sightlines and

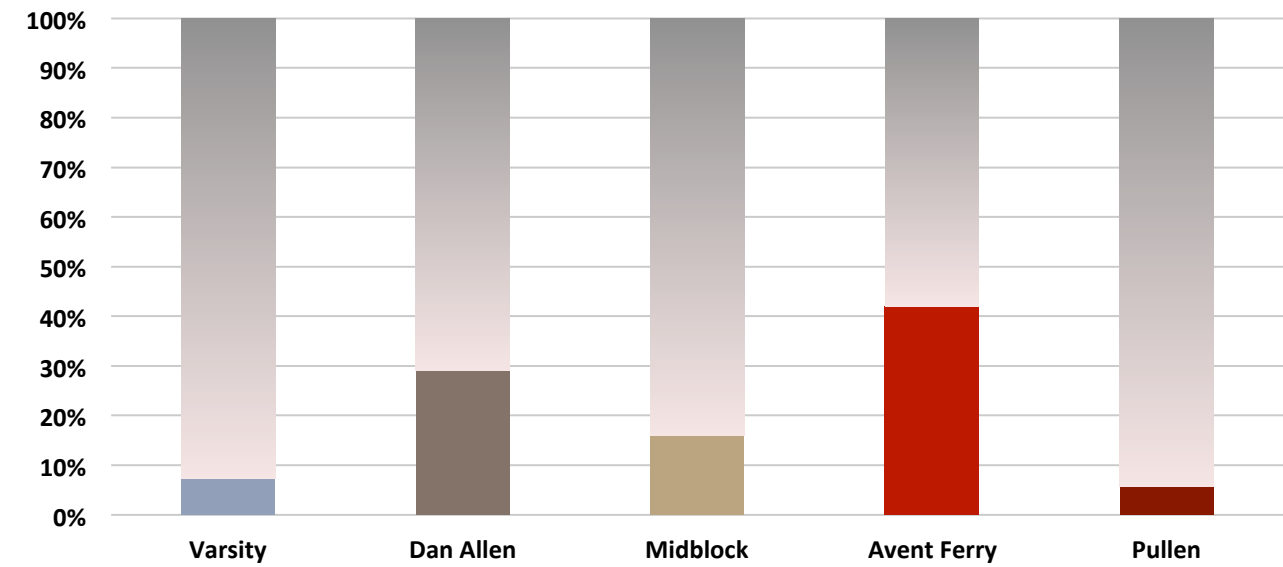


Figure 5: TYPICAL CROSSING LOCATION USAGE

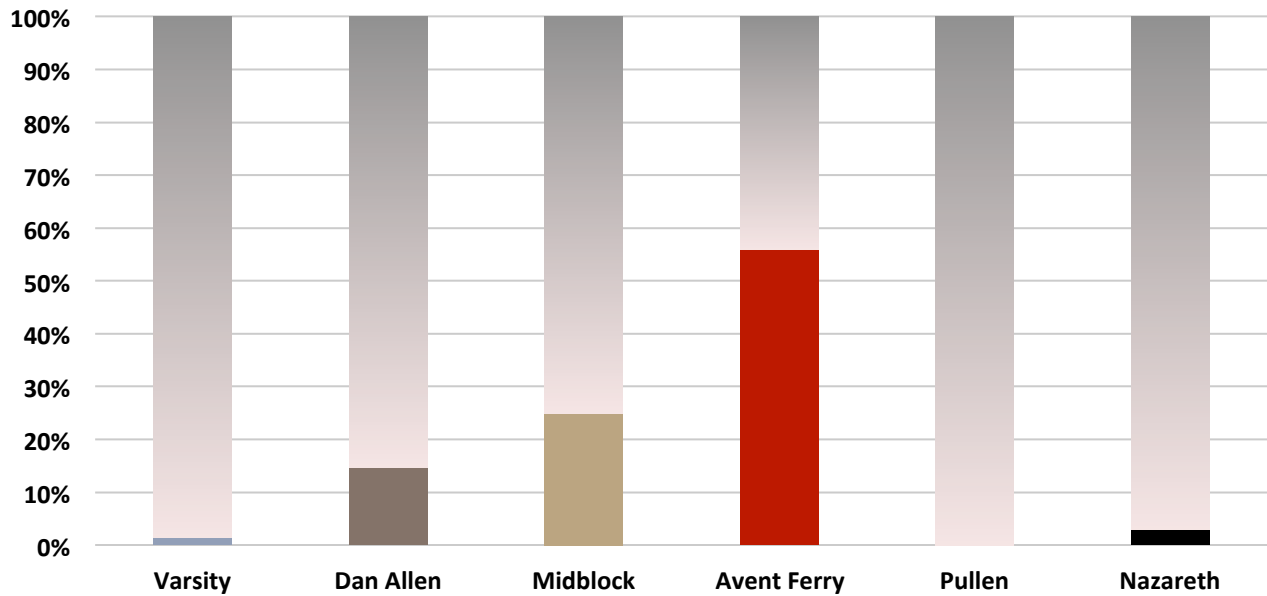


Figure 6. SUGGESTED LOCATION FOR CROSSING IMPROVEMENT

motorists failing to use a turn signal), they did feel safe using the pedestrian countdown signal and only needing to check for one-way vehicular traffic.

Convenience and travel efficiency is also important to pedestrians as their comments, as well as destinations and departure locations, indicated their crossing was most often a direct route. While over half of the respondents indicated they would be open to a tunnel or other grade-separated crossing, most also firmly indicated the location would have to be very near to their existing travel path. Vehicular conflict seemed less of a concern to those surveyed than the perceived safety after dark. Several quick comments following the tunnel visualization presentation indicated the importance of any facility selected being well lit.

It can be inferred from the results of the study that users will be open to a new method for crossing Western Boulevard, as long as it is convenient and safe. Most respondents would agree the best location would be at or near the Avent Ferry intersection. This response is likely a result of the high volume of pedestrian and bicycle usage as well as the behavior of motorists.

Origin/Destination – CycleTracks Results

CycleTracks uses the iPhone and Android's GPS support to track users’ movement. The app is free and simple to use: tap Start to start recording your ride, Save at the end, and specify a purpose (commuting, shopping, exercise, etc.). Data representing the purpose, route, date and time are stored on a server. Latitude and Longitude points can be uploaded to ArcGIS to create route lines. All personally identifiable data will be kept confidential. Users can cancel a trip at any time for any reason and no data will be sent unless explicitly directed by the user.

The purpose of using the CycleTracks application is to record and make assumptions about human behavior. These behaviors (biking and walking) will be cross-referenced with known conditions such as topography, facilities (or lack thereof), departure location, arrival points, and participant comments to deduce why cyclists and pedestrians choose specific routes. Logical conclusions will lead to an understanding of design elements lacking in the study area that could improve trip experience by decreasing travel time, decreasing distance, providing a more comfortable commute, increasing legibility, and improving safety.

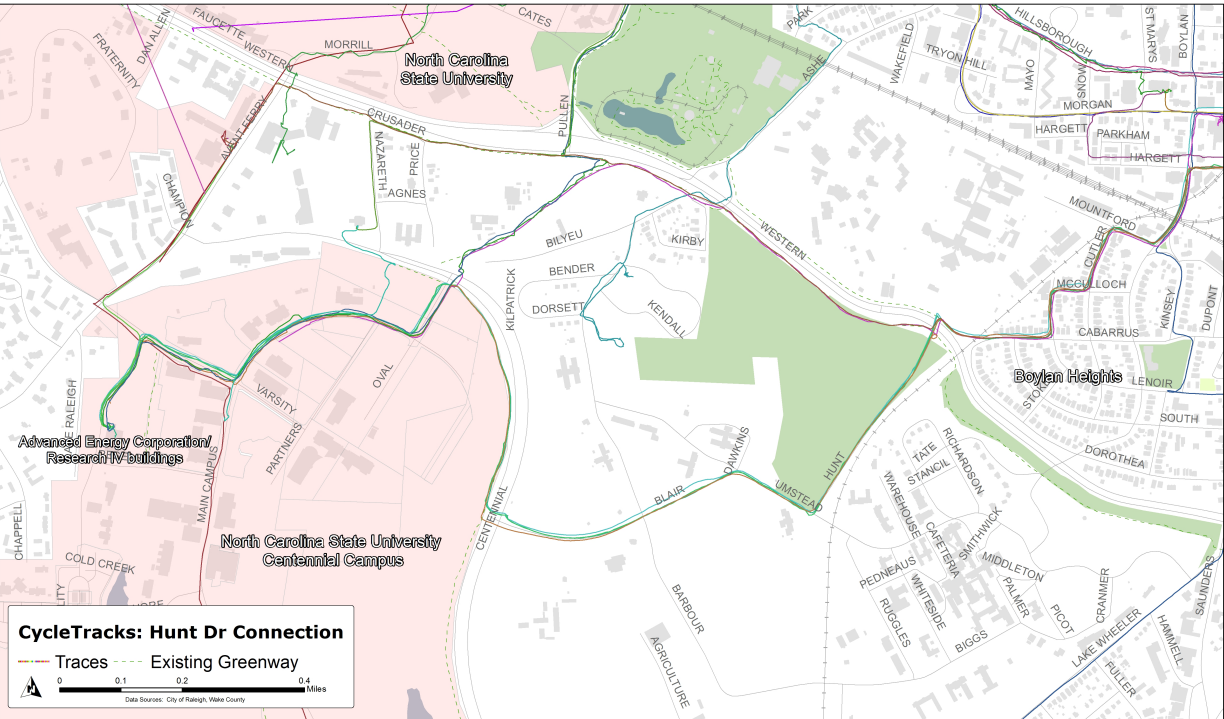
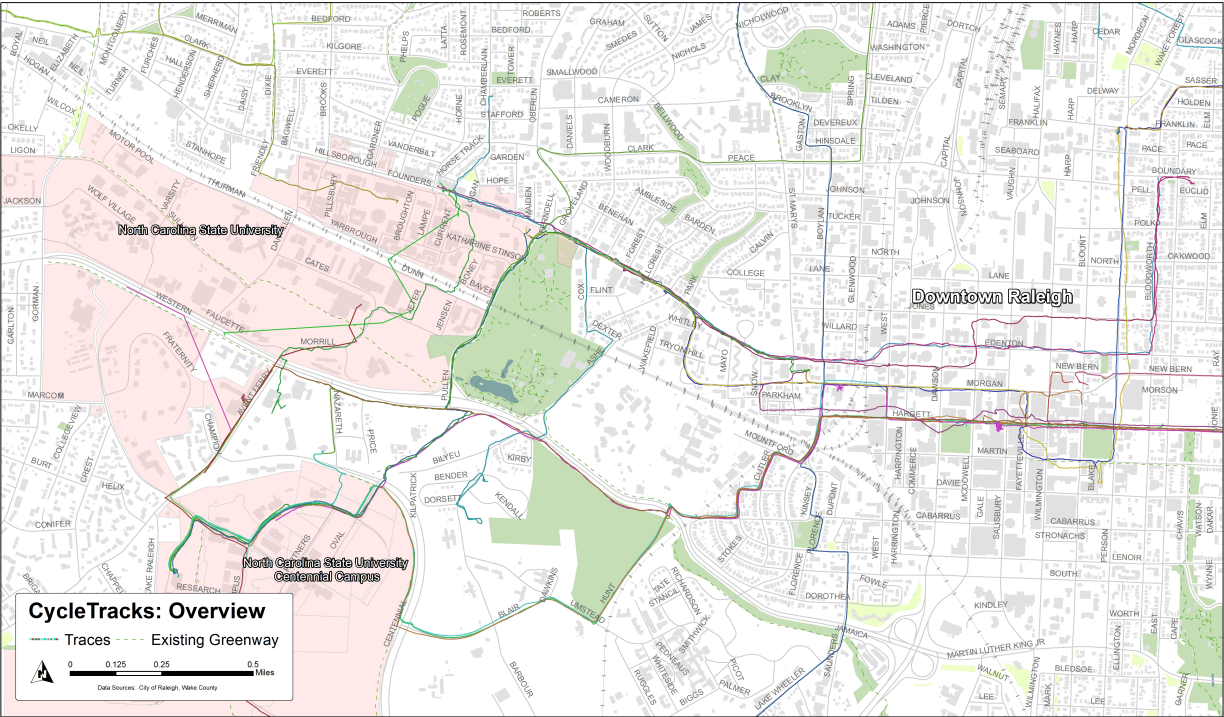
Some limitations do exist with this method of study. App users know they are being recorded and in some cases will change their behavior. Also, recruiting subjects to use the app will be limited to those interested in the study, who also are comfortable using an app on their smart phone. While this is not a representative sample of all people traveling through the area, conclusions can be made from analyzing this data in concert with field observations, comments recorded at workshops, and intercept survey results.

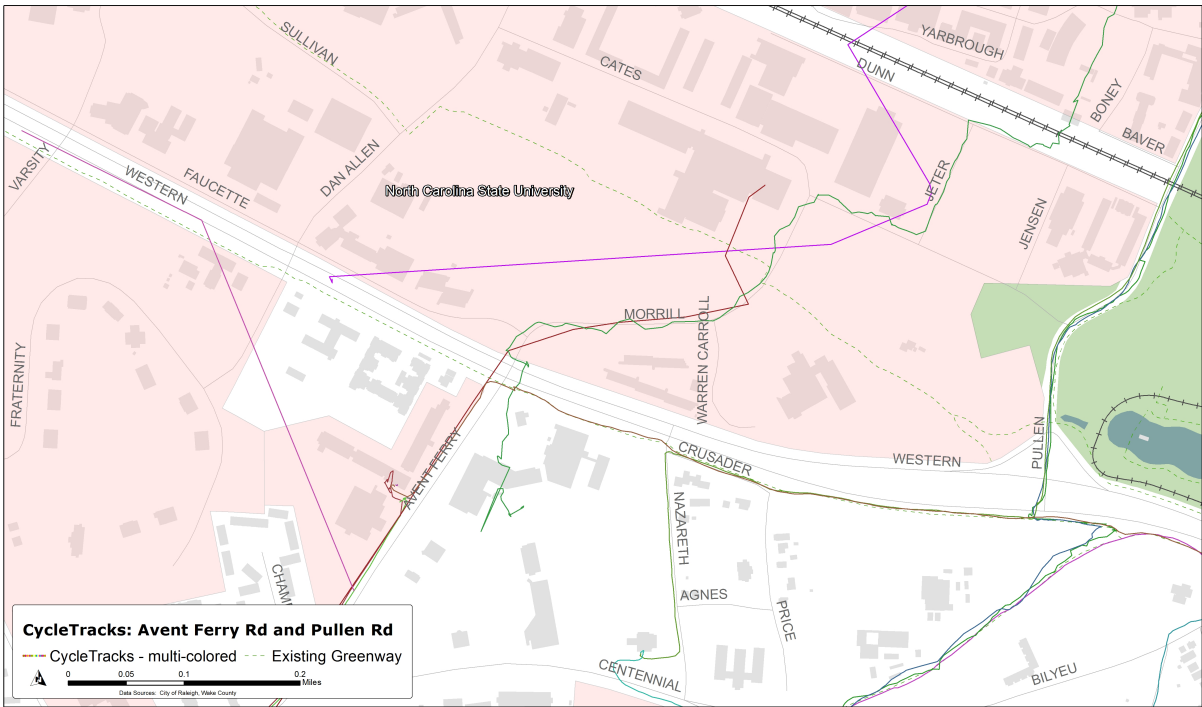
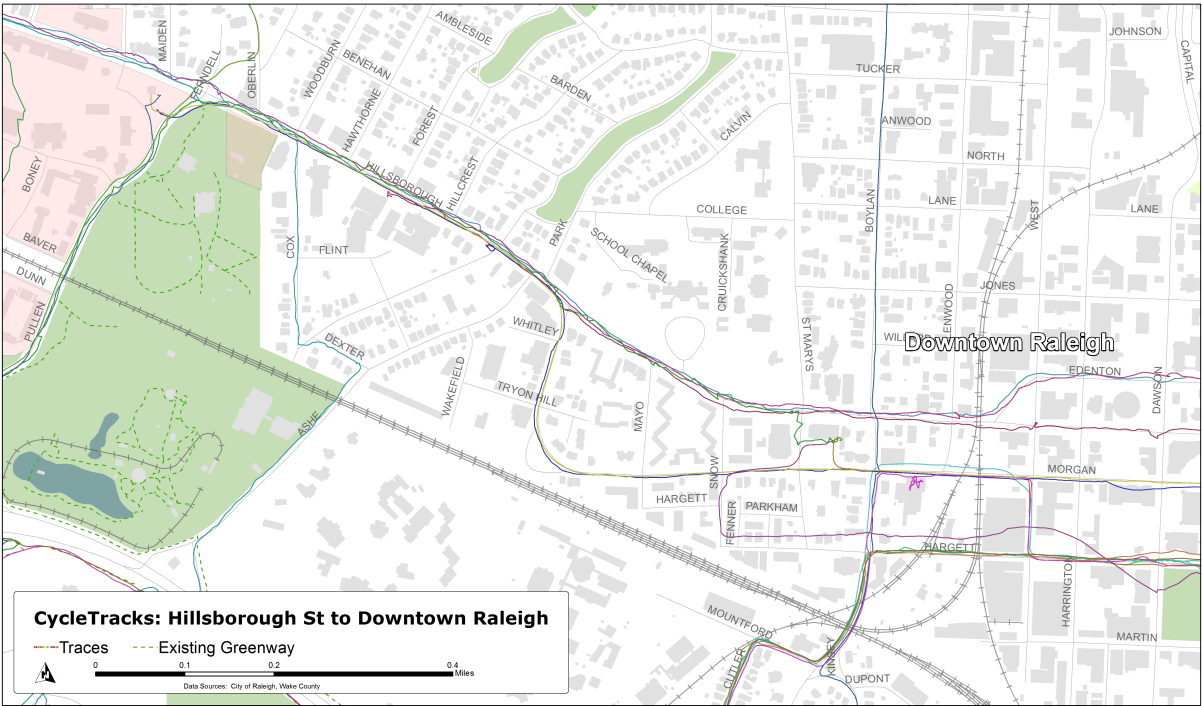
Method

Recruiting Participants: Several methods were used to recruit subjects to participate in the CycleTracks survey tool. Information about the app and download instructions were available on the project website. To drive traffic to the website, a Communications Team was formed to spread the word around campus. This team included the University Student Body President, representatives from housing, representatives from transportation, and the president of the mountain biking club at NC State. Posters were distributed to the group for display in dormitories around the study area and also displayed in Wolfline Buses. The Student Body President also released project information via “e-blast” and Facebook.

Project information cards were created and distributed at housing locations in the study area. These cards were also given to all subjects who participated in the intercept survey. During both the intercept survey and workshop, groups traveled throughout campus speaking with students about the project and encouraging them to download the app. In addition to these on-campus efforts, the app was introduced in press releases distributed to all local media and announced to the group of riders who depart from the Bell Tower on First Friday.

Data Collection Period: CycleTracks information collection began with the launch of the approved project communications plan. While participants can continue to use this application *ad infinitum* this report includes data collected from launch to November 26,2012.





with existing bicycle facilities - as seen along Hillsborough Street and Pullen Road. This alludes to a user preference of traveling with separation from vehicles, or visual indications to motorists that bikes are intended to share the road (sharrows). Other paths depict a clear desire for efficiency. The shortest distance between two points is often selected instead of greenways, bike lanes, and shared roads. Routes along Hunt Drive indicate

Results

Over 40 different users recorded unique trips using CycleTracks in and around the study area. While not all trips are through the study area, some patterns do emerge.

Many participants travel from downtown to Centennial Campus by using Hunt Drive through Dorthea Dix. Most of the observed trips departed from or arrived at the Research IV building. This behavior may change with the future Pullen Extension Plan, particularly if bike facilities are comfortable and convenient.

Traces also appear along Hillsborough en route to downtown, which can indicate a preference for using bike lanes (as they have recently been added along this corridor).

Concentrations of activity along Pullen support the use of sharrows, and also the need for safe facilities for pedestrians and cyclists along this road. Travelers crossing Western Blvd. at Avent Ferry Road were recorded using the east and west crosswalks. Those crossing on the east as pedestrians arrive where no sidewalks are present, and must cross traffic again to remain on a sidewalk, or continue along Morrill in a mulched area.

Conclusion

Avoidance and preference are two main themes occurring in the analysis of the CycleTracks study. Many of the routes recorded, including those not circulating through the study area, are along roads

efficiency and potentially a desire for safety, as the volume of traffic is low through Dorthea Dix Campus.

From the traces, it is clear people are traveling along Pullen Road. Currently no pedestrian facilities exist from the bridge over Western, north to Cates Avenue. Since this appears to be a well-traveled route from the east side of Main Campus to Centennial Campus, pedestrian and bicycle facilities and crossing treatments should be vetted in this area. Coupling this exercise with field observations, the stretch of greenway along the north side of Western Blvd. from Pullen west to Avent Ferry Road is not frequently traveled. While this route may not be the most efficient connection in the study area, it is also a narrow, uncomfortable path in need of resurfacing and may be avoided for the aforementioned reasons.

While field observations confirm the importance of treatments at Avent Ferry and Western Blvd, the CycleTracks traces add emphasis to the importance of Pullen Drive as a connection from Main Campus to Centennial Campus. Also important to acknowledge is the connection from downtown to points within both campuses. Overall, key destinations were revealed in the recorded routes and recommendations should be made to create safe, efficient routes for pedestrians and cyclists to connect Hillsborough Street, Main Campus, Centennial Campus, and downtown Raleigh.

Campus Drop-in Sessions

Three focus groups were identified to provide specific feedback, perspective, and insight into the project. Each focus group was engaged in a 90-minute meeting focused at engaging their experience and perspectives on the pedestrian, bicycle, and safety issues within the project corridor. The focus groups are:

- Students;
- Law Enforcement; and
- Property Owners.

The student Focus Group was formatted as a drop-in workshop focused on existing conditions and understanding the spectrum of treatments that will be developed, assessed, and recommended to improve the multi-modal safety and mobility along Western Boulevard. The focus groups was attended by over 150 students and interested citizens on November 8, 2012 at the Witherspoon building on campus; over 50 attendees were present at the second workshop held on April 18 at the DH Hill Library.

The Consultant team and committee members shared the vision, goals, and concerns along Western Boulevard between Varsity Drive and Pullen Road with attendees and how they can assist in shaping the future recommendations to improve the safety of crossing Western Boulevard. Attendees were engaged at four stations where they provided feedback interactively with staff and over 80 written surveys were completed.

Public comment and written survey added key information directly from those who cross the study corridor daily. Below are a few highlights of the focus group survey responses.

- Over half of our respondents stated that they cross Western Boulevard at Avent Ferry/ Morrill Drive. The second most heavily crossed location is Dan Allen Drive.
- Forty-percent (40%) of respondents answered that they feel unsafe or very unsafe when crossing Western Boulevard.
- Over half of the respondents stated that they would cross in an underpass alone. Only 4% stated that they would not use an underpass.
- Almost half of the recommendations to improve Western Boulevard were related to a new grade separation. One-third was related to signal-related improvements, and the remainder included recommendations related to signage and facility improvements.

On April 18th at the D H Hill Library on the campus of NC State University, three (3) options for separated-grade treatments at the Avent Ferry intersection were presented as part of the Western Boulevard Multi-Modal Crossing Feasibility Study. The Consultant Team and committee members shared the vision, options, and operations of each option. Attendees were asked to vote for the option they liked the best (green dot) and the option they would rank as the worst option (red dot). Facilitated discussions provided valuable insight and directly lead attendees into participating in the survey to rank evaluation criteria for the options.

The three options are briefly described below with the accompanying presentation boards. The presentation included a VISSIM model simulation showing the 2040 traffic conditions with and without Option 3. The score noted represents the total vote (best/ worst) awarded to each option.



Western Boulevard

FREE PIZZA & SODA

5 minutes

WITHERSPOON 11AM-1PM

share ideas

JOIN US!!

lunch on us!

<http://www.westernblvd.net/>

Option 1 is a pedestrian and two-way bicycle tunnel underneath Western Boulevard on the west side (opposite Mission Valley Shopping Center) of Avent Ferry Road/Morrill Drive. The estimate of probable cost is \$5million. The tunnel will be well-lit including "daylighting" in the middle (through the median), and have security call boxes and cameras. The tunnel is assumed to be about 300 feet long, longer than any tunnel on campus now. Automobile traffic and transit traffic will benefit only slightly, if at all, from minor changes to signal timing.

SCORE: 18 (best) /6 (worst)

Option 2 also features a bicycle and pedestrian tunnel in the same location as Option 1, but is wider to accommodate bus traffic. While the first phase may have smaller vehicles ("people-movers'), the subsequent phase would

be able to accommodate full-size bus traffic in the southbound direction (Morrill Drive to Avent Ferry) only. Buses and bus patrons would not have to wait for the signal to change to cross Western Boulevard. As with Option 1, only very minor improvements to automobile traffic and flow would result from minor changes to signal timing. The estimated probable cost for Option 2 is approximately \$9million.

SCORE: 22 (best) /4 (worst)

Option 3 would actually redesign the entire intersection of Avent Ferry and Morrill so that traffic on Western Boulevard would "fly over" the Avent Ferry and Morrill Drive traffic. A separate walkway/bikeway would accommodate pedestrians and cyclists underneath Western Boulevard; they would have to stop for traffic at least twice to allow for turning vehicles, however. Unlike Options 1 and 2, significant benefits to automobile traffic are realized with this Option, with traffic delay substantially reduced. Properties on the south side of Western Boulevard are likely to be impacted or taken to make room for this Option, and Western Boulevard itself would need to be closed for as long as eight months due to allow for construction of the two new bridges required. The estimate of probable cost for Option 3 is \$18million, which includes a completely new compressed diamond interchange.

SCORE: 7(best) / 31 (worst)

Survey Cards were presented to each participant where they ranked the criteria in level of importance. The summary below represents the responses of most to least importance based on 48 total responses:

| | |
|----------------------------|-----|
| Pedestrian Benefit | 2.1 |
| Transit Benefit | 3.5 |
| Cyclist Benefit | 4.5 |
| Vehicular Level-of-Service | 4.7 |
| Construction | 5.1 |
| Construction / Delay | 5.3 |
| Right-of-Way Impacts | 5.4 |
| Aesthetics | 5.5 |

Over 50 attendees completed the survey and approximately 80 interested visitors came to the Open House. Project cards were presented to those passing by so they could engage in the project via the website. Attendees were also encouraged to let others know that they could take the survey on-line and view all of the presentation material if they were unable to attend the Open House.

II. Existing Conditions, Data Collection, Review & Analysis

Existing conditions represent years of previous decisions as based in part on the dominance of motorized forms of travel, even in areas where there are many pedestrians, cyclists, and transit users sharing the same space. This section provides key information to guide the development of alternatives, ensures that vision and need for the surrounding area is

- Sight Distance
- Ramps
- Sidewalk Conditions
- Pedestrian Push Buttons
- Crosswalks

A corridor map of the following comments is located in [Appendix A](#).

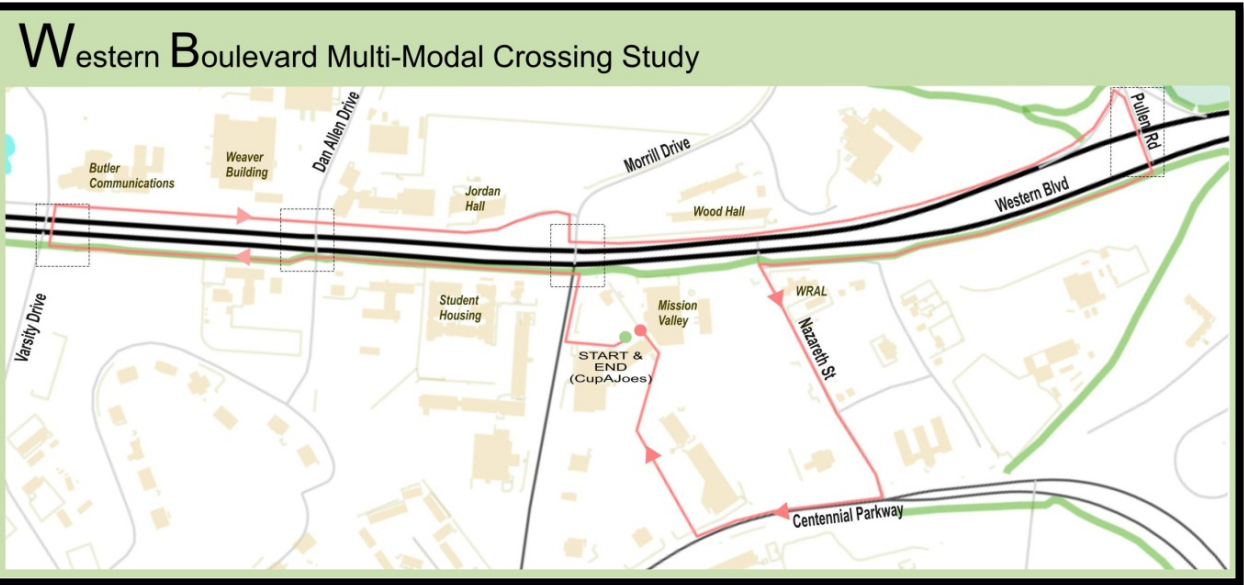


FIGURE 7: FIELD RECONNAISSANCE WALKING MAP

Pedestrian Safety Comments

Lighting study is key due to large tree canopies and safety concerns in some sections of the study corridor screened by heavy foliage and buildings.

Gateway and pedestrian/cyclist signage is needed within corridor to alert motorists of the heavy crossing traffic by pedestrians.

understood, and seeks a collaborative vision for improved safety and mobility. The following provides essential information to understand the infrastructure, users, and purpose of the existing conditions.

Field Reconnaissance

A half-day in-field inventory of the corridor was conducted that documented existing conditions, operations, and issues. This initial

- Signage
- Land Uses
- Crossing Timing
- Origins and Destinations
- Transit Stops and Accessibility

Signals should not require pedestrian buttons to be pushed to active pedestrian countdown phase, as many students don’t bother to push the buttons.

Fence in the median of Western Boulevard may be needed to prevent mid-block crossings, although some students may still “leap” the fence.

If a mid-block crossing option is chosen, consider safety of pedestrians within environment of student drivers and new drivers that come to the campus annually. The safest crossing needs to be made the crossing that is the most attractive, easy, and logical choice.

A bicycle/pedestrian underpass solution should be considered without the inclusion of transit due to the difficulties of achieving sufficient turning radii in physically constrained areas.

An overpass is not a solution for the campus culture and expectations of student mobility due to the perceived and real time differentials between crossing at-grade as opposed to climbing stairs and crossing on a structure. An underpass option would not encounter the same degree of time difference, and the campus population is generally more accepting of underpasses due to the existing underpasses already on the campus.

No audible pedestrian signal present.

collaboration of the team members in earnest at the kick-off of the project provided a rich context and understanding of the public perception of the problems, issues, needs and limitations of construction within the corridor. The team walked the corridor (see map on following page), made extensive notes on what they observed, and identified the following existing conditions. Each participant was provided detailed intersection aerial maps and the following list of issues to consider and discuss:

- Barriers to Walking
- Lighting Features
- Location of Automobile Parking
- Conflict Points

Growth and Development Comments

Future student numbers growth on Centennial campus (20% increase, approximately 10,000 students), as well as up to one million square feet of potential new research and office space, will change the travel demands and patterns for all modes of travel.

The Pullen Road Extension roadway project will directly change travel patterns and transit routing in the vicinity.

Western is planned to expand to a third lane in each direction of travel (total of six through lanes). The segment of the corridor from Avent Ferry/Morrill westward to Gorman Street is considered the more urgent priority.

Avent Ferry is the main pedestrian/bicycle connection within the University.

Transit Comments

Bus turning radii and integrating them into the rest of the transportation system is a key element in design/planning.

Priority at-grade transit opportunities should be explored, and improvements to bus stop furniture and signing.

Dan Allen northbound is the priority bus corridor for Wofline.

Location-Specific Comments

Intersection: Varsity Drive

Missing sidewalk along eastern side of Varsity Drive (SE side of intersection).

Wolfline pole and sign down on NE corner, needs replacement.

Long pedestrian wait time crossing Western at Varsity Drive.

Corridor: Varsity to Dan Allen

Tree gap on north side of Western Blvd.

Lighting on both sides of Western Boulevard need to be investigated due to heavy foliage screening the existing lighting sources.

Landscape opportunity along Western Boulevard on the southern side could be the subject of a student study.

No ADA landing pad for night route bus stop near student housing on south side of Western Boulevard.

Structures and old oak trees on the northern side of Western Boulevard make this stretch of corridor a poor candidate location for an underpass.

Along Faucette consider adding sharrows and/or multi-use path on north side of Faucette (note worn path in this location as well).

Intersection: Dan Allen Drive

Cracks in path (North side of intersection of Dan Allen with Faucette Blvd).

Move utility poles in NW corner of Dan Allen and Faucette Blvd.

Crosswalk deteriorated at driveway on north side of Faucette Blvd just NE of the intersection of Dan Allen with Faucette Blvd.

Driveways should be striped at the Han Dee Hugo on the SW side of the intersection.

Pedestrians cut through in this corridor.

Consider a median fence to discourage mid-block crossings.

Lighting is an issue in this section as well.

Water ponding and drainage issues (northeast corner of Faucette Blvd and Dan Allen Drive).

Asphalt path in poor condition along the north side of Western just east of the intersection.

No ADA-compliant tactile domes on ramps for all corners.

Gateway, linear park, signage noting pedestrian activity needs to be present in this section to raise awareness of the numerous pedestrians using the facility.

Corridor: Dan Allen to Morrill Drive/Avent Ferry

Consider mid-block fence to discourage mid-block crossings.

Remove parking bays on Faucette Blvd in this corridor near Jordan Hall; this would likely be a controversial action.

Striped crossing on Faucette Drive near Jordan Hall leads to no pedestrian infrastructure.

Poor bus stop sign placement in front of Jordan Hall on northern side of Western Blvd.

Worn path along the northern side of Western from Morrill Drive to bus stop needs to be replaced with sidewalk and/or pathway.

Poor sense of place; gateway and aesthetic improvements needed to raise awareness of pedestrian space.

Intersection: Morrill Drive/Avent Ferry

NW and SW pedestrian ramp should be split not to direct pedestrians into intersection.

Sidewalk in poor condition beginning on northeast corner of intersection.

No sidewalk along Morrill Drive on the east side north of the Faucette Blvd intersection.

Channelization and or radii change for the SE corner recommended for the geometry of a right and a through-right lane at this intersection with no bicycle lane or marking.

No turn on red within this intersection for pedestrian safety.

Pedestrian crossing on east is easier.

Sight distance sag headed southbound.

Gas utility consideration on southwest corner.

Corridor: Morrill Drive/ Avent Ferry to Pullen Road

Sightlines along the pedestrian path on the northern side of Western Blvd need to be improved.

Buffer between sidewalk and road becomes narrow or non-existent as westbound lane “drops” on northern side of Western Boulevard

Intersection: Pullen Road

Major pedestrian visibility issue at Pullen WB On-Ramp to Western Boulevard; tree trimming and re-design of radii of WB on/off ramps and lines-of-sight could be substantially improved. Note restrictions on incursion of Pullen Park would limit the degree to which the City could acquire any additional right-of-way.

Increased demand to 18-20k vehicles per day (vpd) planned.

Pullen Road extension planned to connect to Oval Drive to be a two-lane, median-divided roadway with on-street bicycle lanes and sidewalks.

Potential construction of monolithic median at WB on-ramp and WB off-ramp to prohibit left turn movements.

Pedestrian crossing time on Pullen Road crossing of the eastbound lanes of Western Boulevard is currently at the minimum (approximately 10 seconds) of what is needed.

These field observations, combined with public involvement work and data collection, allow the characterization of the Western Boulevard corridor: the “Corridor DNA” presented in the following section.

Corridor DNA: The Character of Western Boulevard

Baseline information including topography, lighting, crash analysis, vehicular travel (AADT, travel speeds and behavior), intercept survey and origin/destination/path tracing (CycleTracks) information provided a foundation of the conditions and perceptions that comprise the character of Western Boulevard. The following topics are represented in graphical format in [Appendix A](#) and are described below.

Topography

Western Boulevard is generally a level ride (or walk), descending only by 100 feet over its approximately 4,800-foot length traveling from west to east. However, the road follows a ridgeline, with the steep grades occurring at either end of the corridor “falling away” from the roadway. This topography actually presents some moderate ascents towards Western Boulevard and poses some challenges to designers seeking to widen Western Boulevard. For example, as Avent Ferry climbs towards the Western Boulevard ridge, it is ranked a category 5 climb by the MapMyRide.org climbing algorithm.

The topography is essential in the consideration of grade-separated alternatives. The slope of Avent Ferry Road is of significant importance and consideration regarding tunnel and overhead structure options to cross Western Boulevard.

Lighting

Lighting conditions vary greatly along the length of Western Boulevard, and the nature of lighting measurements creates substantial variation within even a few feet. Lighting conditions were measured between 9:15pm and 10:15pm on a cloudy, moonless weekday evening in August prior to school being in full session. Lighting is provided by buildings and car headlamps, but primarily by high-level, pole-mounted fixtures in the medians and at roadway edges. Lighting conditions are notably poor between Nazareth Street and Pullen Road on the south side of Western Boulevard, particularly where trees on both sides of the greenway trail shield the pedestrian from high-level street lighting as well as automobile headlights. However, the lighting conditions are also poor even at several intersections, particularly at Dan Allen Drive. Few locations on the south side of Western Boulevard achieve the desired 1.8fc illumination levels recommended for pedestrians by FHWA for mid-block crossings.

Crash Analysis

Accident data from 05/01/2007 - 04/30/2012 is illustrated in [Figure 8](#) showing the majority of bicycle, pedestrian, and auto accidents within this corridor happen at intersections - primarily at the intersection of Western Boulevard and Avent Ferry/Morrill Boulevard. This result is not surprising since, although crossing at intersections is generally the safest point for pedestrians, it is also the place where the most crossing occurs and hence presents the highest rate of exposure for conflicts between pedestrians, cyclists and automobiles. Ten (10) pedestrian and four (4) bicycle accidents were recorded during this period within the study area, none of which were fatal.

Three-fourths of reported cycling accidents (three out of four) occurred within the crosswalks at intersections where auto drivers did not yield to cyclists in the crosswalk. The other accident occurred along Faucette as a cyclist was traveling in the opposite direction of the one-way traffic in the travel lane. All of these accidents are infrastructure related occurrences. Proper bicycle lanes and signage would increase the visibility, safety, and travel of cyclists and assist motorists in identifying cyclists as a key part of the corridor mobility.

The pedestrian accidents are very different than the cyclist accidents reported. Of the ten (10) reported only one (1) was due to a driver not yielding to a pedestrian crossing in the designated crosswalk. That is reflective of the extensive infrastructure that has been planned and constructed at the intersections within the corridor: pavement markings, pedestrian-actuated signals, and mid-block pedestrian actuators are present at each major intersection. The majority of crashes did occur at crosswalks (5/10); however, they were due to pedestrians crossing outside of the pedestrian crossing signal phase. This statistics confirms the behaviors observed in the field where students were not paying strict attention to automobile behaviors. Mid-block crossings accounted for two (2/10) of the accidents, as many students desire to navigate their desired route through the wide landscaped median between east and westbound Western Boulevard. Infrastructure and behavior issues are potential causes for the last crash that occurred due to a pedestrian walking on the shoulder of the roadway between Nazareth and Pullen instead of using the adjacent greenway facility.

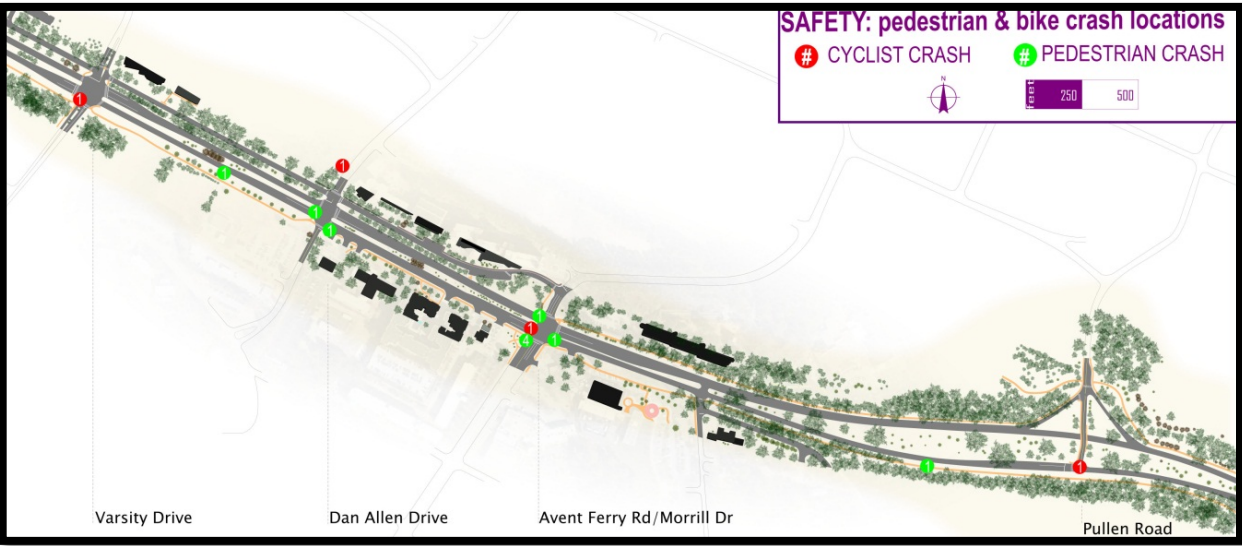


FIGURE 8: 2007-2012 PEDESTRIAN & CYCLIST ACCIDENT DATA

Transit Ridership

Transit riders traveling through this corridor are riding either a Wolfline or Capital Area Transit (CAT) bus. Wolfline is a fare-free public system on and around the NC State Campus that carried in excess of 14,000 average weekday boardings in spring semester of 2011.³ In the academic year 2011-2012 the network operated: 12 peak-hour weekday routes, three late-night routes, and two weekend routes. Existing campus stop locations are shown below.

³ Campus Mobility Plan, HDR, June 2012

Transit stops are currently located along the intersection corridor beginning at Varsity Drive to Avent Ferry Rd – Morrill Drive. Many transit riders wait for buses and exit buses along Western Boulevard and the frontage road Faucette Drive. For the university, these stops are well populated as students and staff are travelling to and from housing along Western Blvd and then between Centennial campus and main campus. Avent Ferry Rd at Western Boulevard has the highest amount of transit travelers with over three- fourths of the riders exiting at this intersection. A summary of ridership obtained from Wolfline data and TTA route data are displayed in the graphs below.

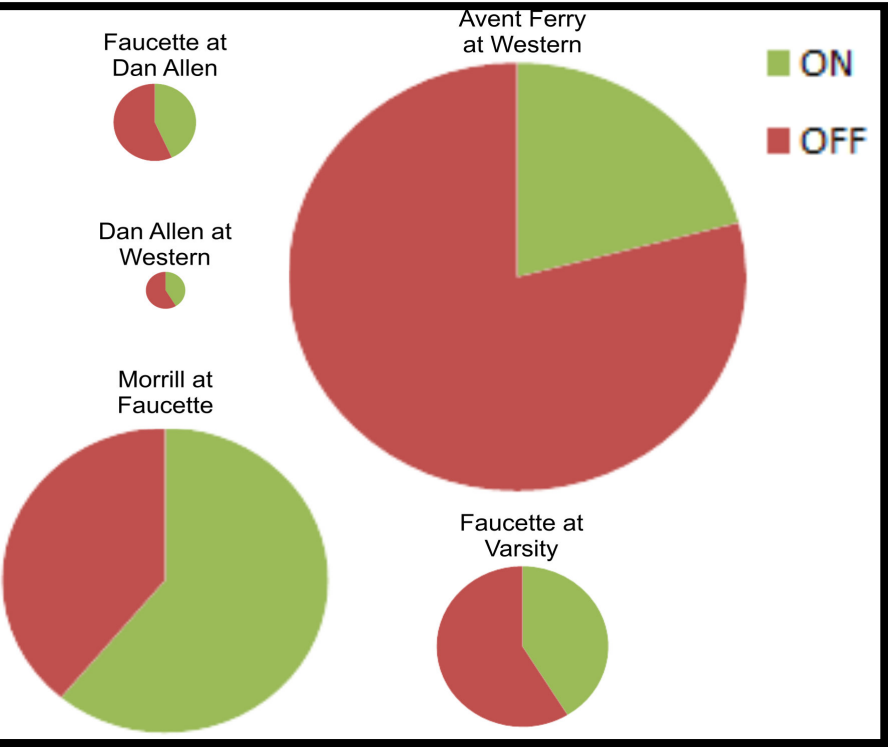


FIGURE 10: Transit Ridership Along Western Boulevard

The projected growth of the Centennial Campus drive the recommendations contained in the 2012 *Campus Mobility Plan* developed by HDR Engineer, Inc. The mobility study documented a variety of phased recommendations that may occur in response to the change in traffic congestion, infrastructure improvements, and transportation demand improvements. The vision of Wolfline is to provide the best service for each year as development and populations increase and shift in location due to growth. A few recommendations are noted below that provided

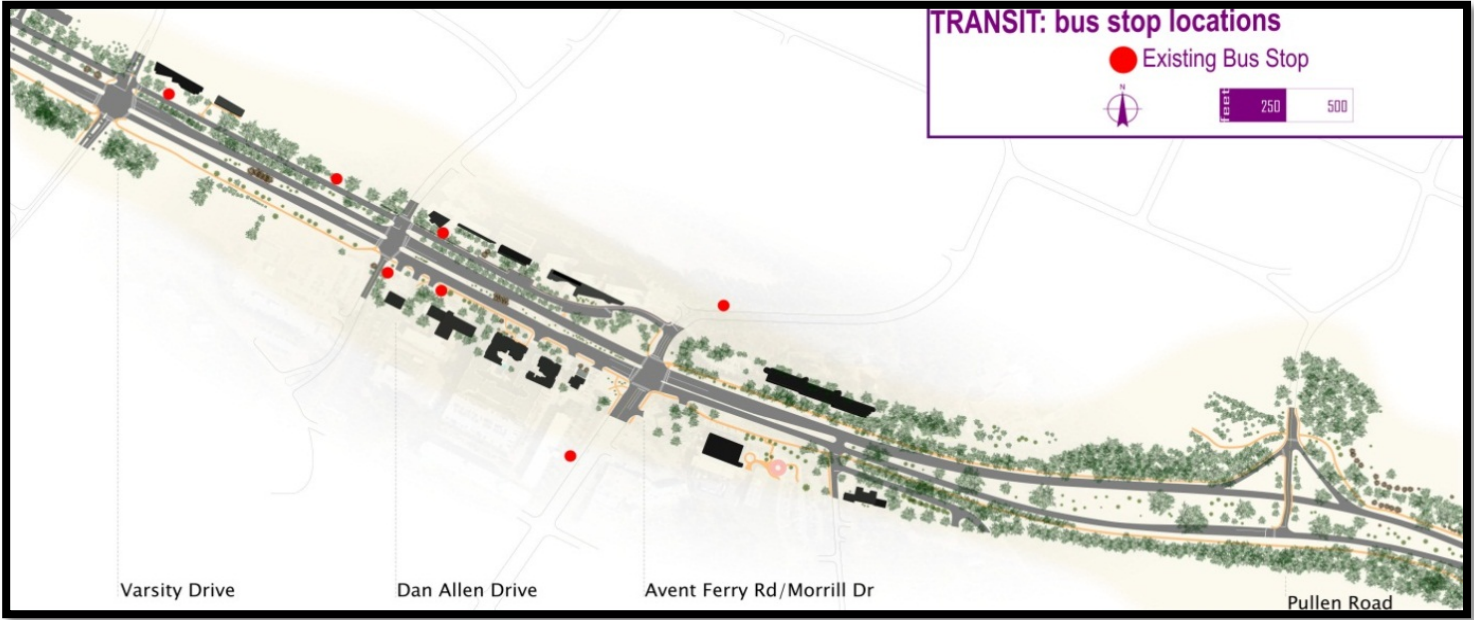


Figure 9: Existing 2012 Bus Stop Locations

insight and talking points for understanding the potential and need for a grade separation for the transit component of mobility with in the corridor:

- Close Dan Allen Drive at railroad from 9am-5pm to all traffic except busses & authorized traffic. (short term 1-2 years)
- New Centennial Circulator providing internal mobility for the Centennial Campus. (mid-term 3-5 years)
- Route using new Ligon St Tunnel under I-440
- New Commuter Rail shuttle during peak times between Dan Allen commuter rail station and centennial (long range 6-10 years)
- Centennial Transit Center near Hunt Library
- New Western Blvd/Avent Ferry underpass and transfer point. (long range 6-10 years)

Vehicular Travel (AADT, Speeds & Behavior)

Western Boulevard serves approximately 36,000 annual average daily trips (AADT). Western Boulevard is a major arterial facility serving the commuters to downtown Raleigh and those attending class and working on the NCSU campus, a major urban activity center with approximately 8,000 university employees and 31,000 students.

Speed studies were completed over two weekday periods: Monday, 8/20/2012 from 2-3pm and Tuesday, 8/21/2012 from 11am until noon. The corridor travel speeds shown in Figure 12 represent the free-flow conditions when traffic lights are green and the platoon is not impeded by waiting traffic. Data was collected by dynamic flow-speed observations (traveling with traffic through the corridor multiple times) and static observations (a radar speed gun was used at intersections and mid-block locations both east and west to observe speeds). The recorded speeds throughout the corridor were within the posted speed limit and controlled significantly by the signal progression and spacing that requires most all motorists to stop at multiple signals throughout the corridor.

The character of driving observed is the most critical element of data observed. The “race car” mentality of drivers and the “un-expected pedestrian crossings” within this corridor make mobility unpredictable and dangerous. Lane shifts between Dan Allen Drive and Avent Ferry for eastbound vehicles is consistent and dangerous as weaving is occurring at a very high volume in this short roadway segment.

Traffic analyses for intersection operation and corridor conditions for 2010 traffic volumes for the AM and PM peak hours along Western Boulevard from Avent Ferry Road to Varsity Drive were provided to further detail information on the vehicle delay and operation. The data confirmed the field observations of our team that congestion and delay are lengthy at the intersection of Western Boulevard and Avent Ferry Road. The long delays and queues at this intersection for the west and eastbound traffic is complicated by the mid-block crossing of pedestrians who weave through the queued cars to cross into the median and then dash across traffic.

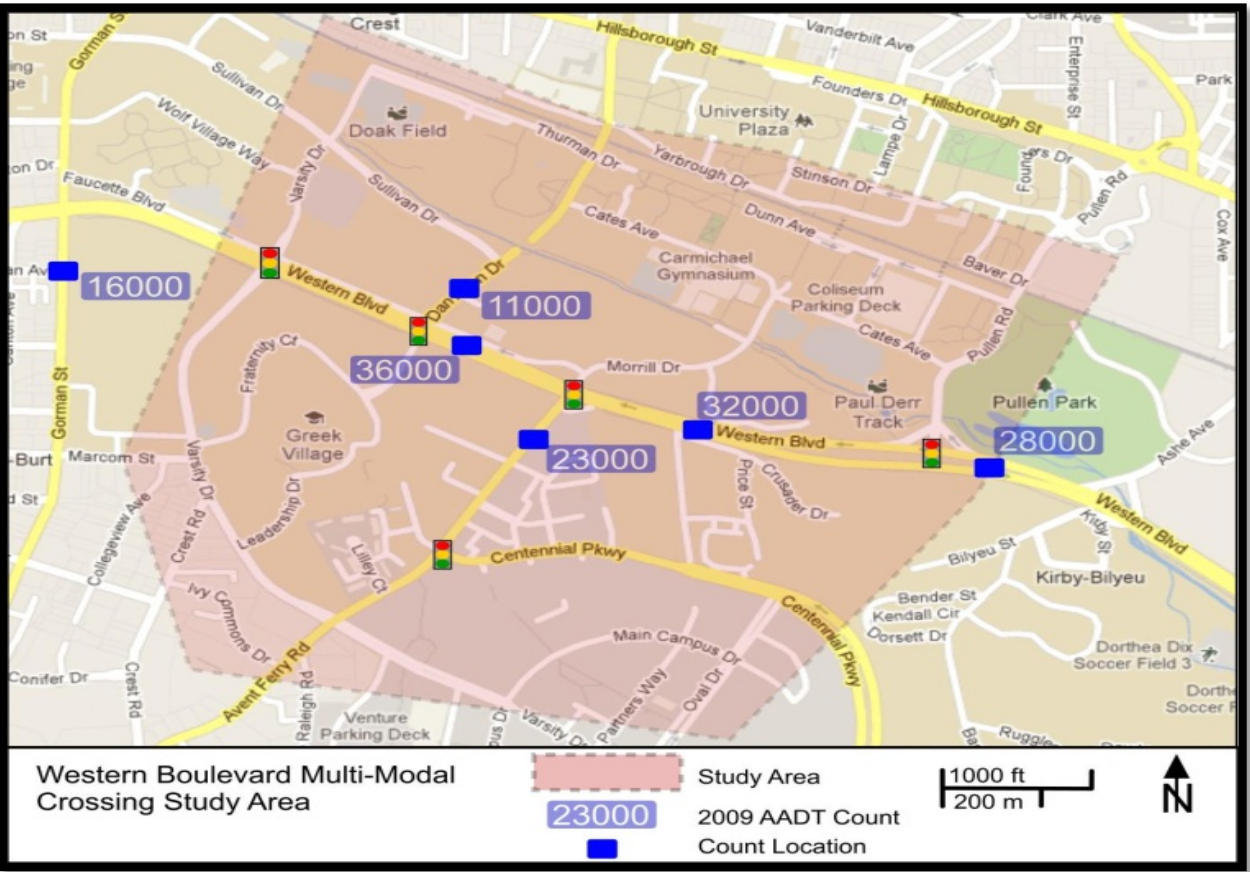


Figure 11: 2009 AVERAGE ANNUAL TRAFFIC VOLUMES

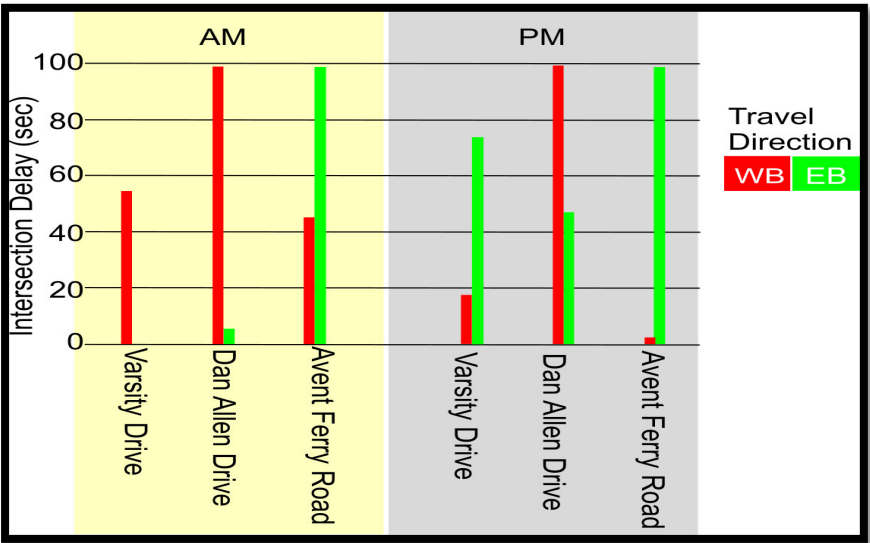


Figure 12: INTERSECTION DELAY & BOTTLENECK ANALYSIS

Specific travel behaviors of each intersection were recorded in October 2012. The vehicle, pedestrian, cyclist, and transit records were recorded to identify the volumes at each intersection and the desired travel patterns along Western. The data gathered and analyzed is shown below by intersection by peak hour volume.

The final section, as well as [Appendix B](#), discusses the ideas and observations of previous studies.

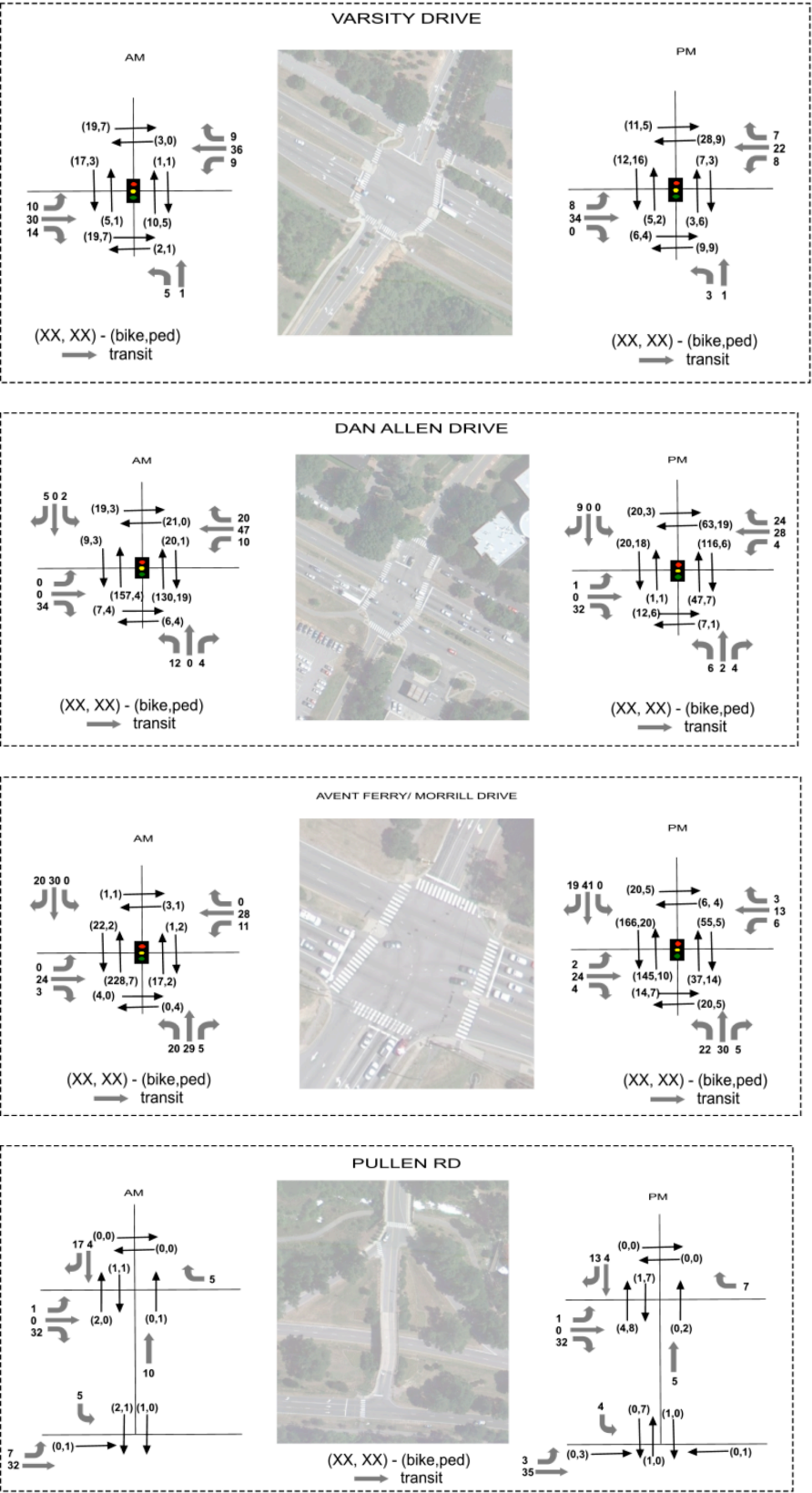


Figure 13: INTERSECTION TURNING MOVEMENT DATA

III. Summary of Previous Studies

This section of the report provides a matrix of previous study recommendations and summaries of all related studies that have been completed along the corridor. Each study was reviewed with the intent to “learn from the past” and identify and validate current issues and problems associated with safe and efficient movement of all modes along the corridor and across Western Boulevard. Over twenty (20) previous studies and technical data sets were reviewed related to the corridor and bicycle, pedestrian, transit, and auto mobility and safety along Western Boulevard. The previous planning efforts and data collection assist in framing the vision of the future mobility of this area as well as direct the vision and alternative development for the future needs and goals of the City and University.

Previous Report Matrix

The matrix below provides a quick snapshot of recommendations and the correlating plans. The recommendations listed below showcase those recommendations that directly tie to this scope of work. The key recommendations include:

- A fixed guideway;
- Median fence;
- Prohibit right turn on red;
- Lower speed limit;
- Education campaign,
- Pedestrian signal phase;
- Bicycle lanes and greenway trail connection;
- Bicycle connection between campuses; and
- Ribbon Greenway on Western Boulevard.

It is noteworthy that five of the six plans reviewed included a pedestrian / multi-modal tunnel in their recommendations between the study years of 1991-2012.

The above studies are described in more detail below in the plan summaries in [Appendix B](#). Full document versions of the plans and documents reviewed are available at the offices of the Capital Area Metropolitan Planning Organization or on the project website.

| Date | Report Name/ Author | Recommendations | | | | | | | | | | |
|------|---|-----------------|--------------------------------|-------------------------|--------------|---------------------------|-------------------|--------------------|-------------------------|--|-------------------------------------|----------------------------|
| | | | Pedestrian/ Multi-modal Tunnel | Fixed Transit Guide way | Median Fence | Prohibit Left-turn on Red | Lower speed limit | Education Campaign | Pedestrian Signal Phase | Bicycle lanes & greenway trail connections | Bicycle Connection Between Campuses | Ribbon Greenway on Western |
| 1991 | North Carolina State University People Mover Feasibility Study, Douglas & Douglas, Inc. | | X | | | | | | | | | |
| 1995 | Intermodal Concept for North Carolina State University Monorail, Catherine Reeve and James Green | X | X | | | | | | | | | |
| 2007 | A Campus of Neighborhoods and Paths: NC State University Physical Master Plan, NC State University Commission | X | | | | | | | X | X | X | |
| 2009 | Pedestrian/Traffic Safety Study for North Carolina State University, Wetherill Engineering, Inc. | X | | X | X | X | X | X | | | | |
| 2011 | NCSU Campus Bicycle and Pedestrian Plan, Martin, Alexiou, Bryson | X | | X | | X | X | | X | | | |
| 2012 | Campus Mobility Plan 2012-2022, HDR | X | | | | | | | | | | |

IV. Summary of Western Boulevard Corridor

The approximately one-mile-long corridor has characteristics today that will last for many years to come, and others that are in a perpetual state of change. Most significant of these proposed changes are continued expansions of the Centennial Campus, with hundreds of thousands of square feet of office, research and housing (both student and general) still to come. Additionally, Raleigh has planned for an extension of Pullen Road to Centennial Parkway, and an expansion of the number of lanes and automobile capacity of Western Boulevard itself in this study corridor as well as to the east. The expansion of demand for automobile travel, and the related expansion of the roadway network may bring some relief to traffic conditions but if done without consideration of the other modes of travel – which are very popular and well-used in this corridor – may do long-term damage to the viability and safety of pedestrian, transit, and cyclist travel. These considerations must be in the forefront of the recommendations as they are developed in the next phase of the Project.

However, the current conditions of the corridor – the DNA of the Western Boulevard Corridor – suggest that existing safety concerns as well as aesthetic and general mobility are already not ideal. With over 30,000 vehicles per day (vpd) riding on Western Boulevard now, and hundreds of students crossing at various locations throughout the corridor, the potential for dangerous conflicts is quite high. Many students cross mid-block now west of Avent Ferry Road in order to avoid that intersection’s longer delay (here, we acknowledge the efforts of the City of Raleigh to make this crossing more convenient and safer through the installation of two-phase actuators and signal re-timing). This crossing method, while not the safest option, eliminates multi-way traffic conflicts found at intersections – and it is at the intersections, particularly Avent Ferry/Morrill, where the majority of reported pedestrian accidents have been concentrated. A number of students were observed using cell phones or otherwise paying little attention to the traffic conditions around them regardless of where they crossed the street. Students have a tendency on campus to be willing to take bigger risks with automobile traffic than would otherwise be the case; Western Boulevard’s physical location in the campus does not translate into motorist’s altering their behavior because of a heightened awareness of student activity around them.

In fact, there is very little visual signal provided to drivers in either direction of travel that they are entering into the NCSU campus area. The Western Boulevard Corridor is a relatively high-speed, aggressive driving environment, with many people starting at the I-440 Beltline to the west of the corridor and finishing their trip to the west of the corridor. Drivers often make these “through trips” with a destination outside of the campus, and a number of the comments received from pedestrian students underscored the lack of driver awareness and courtesy. While the fault may lie with both types of users – pedestrian/cyclist inattention and motorist lack of respect or awareness of change in conditions not well-signaled by the context of their surroundings, the consequences for pedestrians and cyclists are much more severe.

Within the Steering Committee (Core Technical Team) a strong interest has been noted to ensure that the corridor fits in with the campus atmosphere. NCSU is already a “tunnel campus” to an extent, with three existing tunnels already in popular use. However, a tunnel or bridge crossing near Avent Ferry Road (where most of the foot traffic exists now and where most of the survey participants thought that a grade-separated structure should be constructed) would be much different than any existing crossing on the campus, perhaps as long as 300 feet to accommodate existing and any future expansions of the roadway. There is some indication that a fraction of students would avoid the additional time, inconvenience and, in a few instances, perception of personal insecurity, that a grade-separated crossing would present unless they were channeled to the structure. Additionally, many students use transit on Avent Ferry to “climb the hill” towards campus; discussion is needed about the ability of transit to be accommodated, or at least associated with, a grade-separated facility. Time and inconvenience penalties, particularly in severe weather, tend to be less for transit patrons than for non-motorized travelers but the need still exists to ensure that transit vehicles, stop accessibility, and other features of the Wolfline, CAT, and Triangle Transit systems are considered during the recommendations phase of the project.

Discussion of a longer-term, capital-intensive prospect like a grade-separated structure over or under Western Boulevard should not preclude or reduce in importance the more available shorter-term objectives of improving greenways, bikeways, pedestrians crossings, transit stop locations, and sidewalks that knit the corridor together. These types of improvements will make a cumulative difference in the quality of the travel experience, and may including improvements to lighting, further changes in signal timing,

pavement markings, signage, extensions of the sidewalk/greenway networks, drainage improvements, and landscaping/streetscaping modifications.



Appendix B. Comments Received and Responses Offered on Draft Report Dated 7-15-2013

An open public comment period of thirty (30) days conducted during the month of August, 2013. The following are the verbatim comments received, followed by two sets of responses: general public (although these were mainly Pullen Road Extension commentaries provided by email and at the August 28 meeting, provided as a separate meeting summary) and NCSU comments received by email transmittal.

Comments Received Generally (through project website or email)

Name: Mike Davidson

Comment:
Currently there is too much vehicular and bike/pedstrian interaction on Western Blvd between Gorman and Ashe. A bike/pedestrian tunnel under Western Blvd at the Avent Ferry intersection would certainly be helpful. Bike/pedestrian paths on each side of Western Blvd between Gorman and Ashe would also be helpful.

Name: John Lambert

Comment:
1. Reopen Dan Allen as a through street.
2. Put a light at the intersection of Pullen and Western.

Name: David Iversen

Comment:
As a resident and property owner of Pullen Park Terrace (Kirby-Bilyeu St) I feel that this plan should directly address the impact it would have on traffic from Bilyeu St. into Western Blvd. Should this plan be implemented I feel that it would put an undo amount of strain on an already unsafe intersection. Accidents happen here on a monthly basis already. An integral part of this plan should include a redesign or outright closure of the Bilyeu/Western Blvd intersection for the safety of the residents that have to use this intersection on a daily basis.

Name: Barrett Jenkins

Comment:
I live on Kirby Street in the Pullen Terrace neighborhood and am concerned about how the proposed changes will impact traffic at the

intersection of Bilyeau Street and Western Blvd, as it is a rather dangerous intersection currently. This intersection may not handle increased traffic well, but as development with the Catholic Church and Centennial Campus continues, traffic may increase. Our neighborhood is concerned about safety on Bilyeau Street in particular and how it is being addressed and considered as you move forward. Thank you for your consideration.

Name: Will Hooker

Comment:
I will comment further when I'm able, but just to give you feedback immediately, your process for obtaining feedback is ridiculous. Your maps are too small, too detailed and too convoluted. And the documentation is far too involved for people who are not assigned to work directly on this to be able to comprehend and integrate all of the information in order to substantive feedback. It almost seems like the intent of all of the maps and documents was to overwhelm the public just so that you could do whatever you want while rationalizing that you sought public feedback. I tell you all of this and want you to know that I'm a registered landscape architect, so am used to dealing with this kind of data - so feel comfortable telling you that you've done a very poor job.

Comment:
Scott, Gerald,

Thank you both (and please pass on my thanks to Alex as well) for meeting with us last night and giving us all a much clearer understanding of the proposals for the Western Blvd. Corridor. It was a good discussion, and we all seemed to be clearer on what is being proposed. I will say, however, that given the 'ifs' and the vagueness of the timing of the changes, it all left us not really knowing what or when anything is going to happen. But at least I understand what is being studied now, and have a better handle on the possible sticking points. So, again, thanks so much.

Take care,
Will
Will Hooker
Permaculture Designer, Landscape Architect

Name: Tonia

Comment:
The underpath option is good for both NC State transportation (bus), foot and bike traffic only which would reduce the number of accidents and keep traffic moving but that only satisfies one side of the street. My

recommendation would be to create overpath walk ways (U-shape) with exit ramps on all four corners except on the Western Blvd cross walk on the NC State side. Again free flowing traffic and keeping residents safe 100%.
(See Vegas Strip Walkway for picture reference)

Name: Kate Pattison & Jacob Osten

Comment:
Mr. Rickard and members of the Project Development Team,

As residents of the Pullen Park Terrace neighborhood, we would like to submit this public comment towards the Western Boulevard Corridor Study.
We have a number of concerns regarding the Western Boulevard Corridor Study for our community, which comprises Kirby and Bilyeu streets. Our primary concern is the plan to close the intersection of Bilyeu Street and Western Boulevard if Pullen Road is extended. After attending a meeting on August 28th, 2013 with representatives from the Project Development Team, we have seen that there are a number of possibilities for the Bilyeu/Western/Pullen road traffic patterns. We understand these plans probably will change, and could take as long as 15 years to implement. The residents of Pullen Park Terrace need to remain informed and see fully documented how and when Pullen Road will be extended, how and when Bilyeu and Western intersection will be closed, and how traffic from Bilyeu and Kirby Streets will be able to exit the neighborhood traveling east and west as plans are modified.

The current plans show a new roundabout proposed for the intersection of Bilyeu Street with the extension of Pullen Road. We feel that a roundabout will continue to direct fast moving through-traffic into the Pullen Park neighborhood. Committee representatives verbally ensured us at the August 28th meeting that the proposed roundabout will slow traffic considerably in this area. Whatever traffic control measure is used for this new intersection must be designed in such a way to slow traffic through and near our residential neighborhood. We also strongly suggest that new signage be installed immediately upon closing the intersection of Bilyeu Street and Western Boulevard to indicate that Bilyeu is no longer a through-street with permanent signs as well as temporary signs and flagging to emphasize that change.

We are also concerned about traffic and parking for nearby Pullen Park, which is already far beyond capacity and will certainly be impacted by the project. Park visitors have been parking along the sides of Western Boulevard since the park’s reopening last year, which creates visibility hazards. Also, a CAT bus stop is located on Western Boulevard near the intersection with Bilyeu Street, which happens to be a blind curve on a

down slope in a 45-mph zone. This stop presumably services Pullen Park, yet drops passengers off on the opposite side of Western from the park, forcing bus riders to cross four lanes of traffic with no crosswalk, traffic signals or other safety measures. While the closure of the Bilyeu and Western intersection will make Bilyeu a much safer road for our community, the bus stop and access to Pullen Park, Ashe Avenue and points directly north for pedestrians remains very dangerous.

Pullen Park Terrace is a small neighborhood with citizens who are very active in the community. We are also a neighborhood with many small children, active people, and beloved pets. We have worked recently with the Raleigh Police Department to monitor traffic and speeding vehicles on Bilyeu Street, but this continues to be a huge concern for our neighborhood’s safety. We support the safety measures for students and pedestrians in the Western Boulevard Corridor Study, and we hope that you will also take our comments into serious consideration.

Many thanks,

Kate Pattison & Jacob Osten

Name: Andy Grieshop & Margaret Rush

Comment:
As residents of the Pullen Park Terrace neighborhood, we would like to submit this public comment towards the Western Boulevard Corridor Study.
We have a number of concerns regarding the Western Boulevard Corridor Study for our community, which comprises Kirby and Bilyeu streets. Our primary concern is the plan to close the intersection of Bilyeu Street and Western Boulevard if Pullen Road is extended. We in general are highly supportive of the closing of this intersection to vehicular traffic, as this is a dangerous and awkward intersections. However, we are concerned that this change be carefully considered and attempts made to mitigate any negative impacts (e.g. increased through-traffic on Bilyeu). After attending a meeting on August 28th, 2013 with representatives from the Project Development Team, we have seen that there are a number of possibilities for the Bilyeu/Western/Pullen road traffic patterns. We understand these plans probably will change, and could take as long as 15 years to implement. The residents of Pullen Park Terrace would like to remain fully informed of how and when Pullen Road will be extended, how and when the Bilyeu and Western intersection will be closed, and how traffic from Bilyeu and Kirby Streets will be able to exit the neighborhood traveling east and west as plans are modified.

As cyclist commuters (both to NCSU and other locations) we would like to see bicycle access across and along Western remain an emphasis of the

improvement, as this has the potential to provide a vital bike/ped link between the main and Centennial NCSU campuses, which is currently completely lacking. We are both happy to serve in an 'daily biker' advisory capacity if this is needed as one of us (Andrew) rides from Pullen Park Terrace to NCSU on a daily basis and the other (Margaret) rides towards downtown and the Hillsborough corridor frequently.

We are also concerned about traffic and parking for nearby Pullen Park, which is already far beyond capacity and will certainly be impacted by the project. Park visitors have been parking along the sides of Western Boulevard since the park’s reopening last year, which creates visibility hazards. Also, a CAT bus stop is located on Western Boulevard near the intersection with Bilyeu Street, which happens to be a blind curve on a down slope in a 45-mph zone. This stop presumably services Pullen Park, yet drops passengers off on the opposite side of Western from the park, forcing bus riders to cross four lanes of traffic with no crosswalk, traffic signals or other safety measures. While the closure of the Bilyeu and Western intersection will make Bilyeu a much safer road for our community, the bus stop and access to Pullen Park, Ashe Avenue and points directly north for pedestrians remains very dangerous.

Pullen Park Terrace is a small neighborhood with citizens who are very active in the community. We are also a neighborhood with many small children, active people, and beloved pets. We have worked recently with the Raleigh Police Department to monitor traffic and speeding vehicles on Bilyeu Street, but this continues to be a huge concern for our neighborhood’s safety. We support the safety measures for students and pedestrians in the Western Boulevard Corridor Study, and we hope that you will also take our comments into serious consideration.

Thank you,

Andrew Grieshop & Margaret Rush

Name: David J. McDonald

Comment:
I strongly favor the roundabout proposed at the intersection of the Pullen Rd. extension and Bilyeu St.

I believe that additional study needs to be done exploring the possibility of a pedestrian/bicycle overpass perhaps near the west side of the existing left-turn lane off Western heading north on Ashe Ave. The entrance to Pullen Park is near here, and this would allow both the people getting off at a bus stop in this area, as well as future pedestrians/cyclists from Spring Hill Precinct, Centennial Campus, and the future Dix Park, to cross Western (with it's increased traffic count) in a safe manner.

Name: Denny Murphy

Comment:
Western Blvd currently has functioning rain gardens in the medians and areas where there is no curb and gutter. These have worked well over the years and help to limit erosion while keeping some of the automobile related pollution out of the streams. This plan is a great one but does add a lot of paving that could negatively impact Rocky Branch, Pullen Park, and the Walnut Creek / (Swift Creek?) watersheds.

The mountable curbs and area next to parking are perfect places for permeable paving with continuous perforated pipes to keep runoff out of the bike paths, eliminate traditional catch basins, and allow deeply excavated sub-surface absorption of the first inch of rain to protect our waterways.

An advantage of pervious paving is that it has greater traction in wet/ ice/ snow conditions and would be very useful in the ramps and walks associated with the tunnel / bridge areas needing elevation changes. It would also keep the water away from the travel surface during high rain events and prevent the accumulation of trash that is associated with catch basin in low areas.

Traffic bearing permeable Verges would also be of use in these designs to prevent the accumulation of drained clogging debris and keep the pedestrian and bike paths from dangerous water flow during heavy rain events.

Please do not design the storm water system in the new design to channel water at high rates to the adjacent waterways, campus green areas and Pullen Park. The use of various low impact techniques can prevent this without impacting Right of way widths or traffic lanes.

thank you.

Name: Kim Gillespie

Comment:
Looks good...glad to see a corridor study being done for this road section.

Name: Aly Khalifa & Beth Khalifa

Comment:

As residents at 617 Kirby St, my wife and I are very concerned about changes to Western Boulevard and how it will affect transportation and property value.

1. Bilyeu street presents a challenge to the neighborhood due to Dix workers speeding through blind corners on a street with no sidewalks. I would propose to serious traffic calming or removing access to Dix.
2. Bilyeu's entrance to Western is dangerous. For years the city has not maintained tree and shrub growth on the shoulder, making for a blind entrance to Western.
3. The traffic on Western moves too fast. Cars are frequently moving at 60 miles an hour or more. Some type of traffic calming would help us entering and exiting Bilyeu. However, I did not see traffic calming as any part of the current Western plan.
4. Any potential change to vehicular access of Bilyeu St should be done as an improvement and not a reduction in access to our fair city. The current plans show Bilyeu St being cut off and our only realistic access via Pullen Road after crossing Western. This would surely be a nightmare in rush hour at current traffic levels. With a 2000 person Cathedral and blooming Centennial Campus population coming, I fear we will be severely limited in our travel.
5. Since it's renovation, Pullen Park has developed a significant traffic and parking issue. Cars are doing U-turns, backing up ad parking in medians. And draping police tape across signs is not having a meaningful effect. I did not see this addressed in any way on these plans, but surely it has created a very dangerous and prevalent problem.
6. Pedestrian access to the bus station across Western is dangerous. It is disingenuous to plan for these riders to be crossing at Pullen. This needs to be planned better.
7. It is increasingly dangerous for our neighborhood to cross western by bicycle or by pedestrian means. If the city is trying to increase pedestrian and cycling activity, then it must service those that live close enough to downtown to do so as commuters.
8. The current plan shows a massive investment in a pedestrian tunnel at Avent Ferry. However this road used to be signified as one of the most dangerous roads for cyclists in Raleigh. Why would you want to increase this risk? Such a project should be matched with cycling safety on Avent Ferry itself. Certainly crossing Avent Ferry on your bike once through the tunnel is a significantly dangerous activity.
9. As a cyclist (and former employe for NCDOT and NCSU Cycling programs), I know that cyclists avoid big roads like the plague. With the Pullen Road bridge open to cyclists, I predict this would be much more heavily traveled. It would also be more direct for many main campus- centennial campus trips. Additionally - the "center of gravity"

- is shifting over time to Centennial. As a result it would make more sense to put a serious cycling/pedestrian crossing investment here than at Avent Ferry.
10. Regardless of what happens to the Dix property, we expect for some type of access to be increased. We saw no evidence of this exploration in this study
 11. Finally I think the issues between Hunt Drive, Bilyeu St, Pullen Road, Dix Property, Catholic Property, NCSU and Pullen park are all interrelated. I propose that we form a charrette/ creative session that includes these and other significant stakeholders to drive to a solution that addresses needs for all parties, and all types of travel modes. We have done this work before with the City for the Dix Dirt Project and would love to see this collaborative spirit continue.

Best Regards,
Aly & Beth Khalifa

Name: Travis Hamrick

Comment:

I appreciate that the Western Blvd. Corridor is being studied with an eye towards improving public safety for everyone regardless of mode of transportation. As a resident of the Pullen Terrace neighborhood who accesses Western via Bilyeu Sts., I know from first hand experience the how challenging this section of road can be. Although I applaud the overall approach of the study and its content, it fails to address the intersection of Bilyeu and Western should Pullen Rd. be extended. Should the extension of Pullen Rd occur, I have no doubt that the increased traffic flow will create a situation at the intersection of Bilyeu and Western that quite possibly would make it one of the most dangerous in the area. I would like to see the study address Bilyeu St. in its final form. My personal preference is that it be closed to Western Blvd and that all traffic exiting our neighborhood for Western do so via the Pullen Rd. extension.

There should also be sidewalks on both sides of Pullen Rd. north of Western. Not just on one side as the report suggests.

Name: MM Taylor

I would like to see tunnels put in at Western & Avent, Dan Allen, and Varsity. Then put fencing along the road to prevent any pedestrian access. It is worth the expense to prevent pedestrian casualties. It is getting worse as Centennial Campus and Frat Court get bigger.

Comments Received at Pullen Road Community Workshop (Meeting Summary included)

Pullen Road Community Outreach Meeting (August 28, 2013 at DesignBox)

Attendees:

- Mike Carpenter, Resident
Phil Dickerson, Resident
Steve Duncan, Resident
Andy Grieshop, Resident
Travis Hamrick, Resident
Will Hooker, Resident
Ollie Inglis, Resident
Aly Khalifa, Resident
Jacob Oster, Resident
Kate Pattison, Resident
Margaret Rush, Resident

Gerald Daniel, City of Raleigh
Alex Rickard, CAMPO
Scott Lane, Stantec Consulting Services Inc./J S Lane Company, LLC

Meeting Summary:

Eleven people (not including staff or consultant) signed in to this meeting conducted at the request of the Pullen Road Neighborhood Association. Mr. Lane reviewed the purposes of the project and the overall corridor and major crossing recommendations with the audience. He then fielded questions (with Gerald Daniel, City of Raleigh and Alex Rickard, Capital Area Metropolitan Planning Organization) from the audience, including questions about safety at the corners of Avent Ferry Road/Western Boulevard; provisions for cyclists in the study area; and questions pertaining to the details and status of the separated grade road crossing.

Mr. Lane then asked the attendees to step over to a wall map of the corridor recommendations. He guided them through a discussion of the major recommendations in the vicinity of Pullen Road, with the following comments being received:

1.

There is too much traffic cutting through the neighborhood at high speeds, including construction-related traffic. Traffic calming measures were discussed as an option to bring to the City’s attention.
2.

The intersection of Bilyeu Street and Western Boulevard is very dangerous due to poor sight lines and high speeds on Western

Boulevard. The group discussed alternatives to shutting off access onto Western Boulevard, with some people expressing concerns about the circuitous routing that would result, although closure was generally agreed to by most of those attending and commenting. Alternative access (e.g., “leftovers” and directional turning) was also discussed, although no option received a lot of additional approval or comment.

3.

The left-turn from Pullen Road across the bridge to the westbound on-ramp for Western Boulevard was thought to have a lot of potential for backing up traffic in both directions. Mr. Lane discussed the limitations of right-of-way in that vicinity, but also said that he would take the comments back to the staff. Some of the concerns were lessened when the group identified that continuous, dedicated left-turns were to be provided in both directions across the new bridge.
4.

The existing bus stop on Western Boulevard encourages people to cross mid-block on Western Boulevard to reach Pullen Park. Mr. Lane noted that in the proposed recommendations a better location for a bus stop would be on the access ramps leading to a new intersection on the new Pullen Road extension. This would afford people a dedicated walkway to reach the Park as well as the Centennial Campus.
5.

Concerns about the arrangement of intersections and convenience for residents to travel in and out of the neighborhood were expressed, particularly when/if the recommendation to close Bilyeu Street commences.
6.

A request for additional crash information at Ashe Avenue / Western Boulevard was requested.

RESPONSES

Note: See also item #10 in revised (9-9-2013) Western Boulevard Multi-Modal Crossing Feasibility Study Report, page 14.

1.

The residents are encouraged to consider speaking with the City of Raleigh concerning traffic management measures that could be employed as an interim measure to reduce speeding of through traffic (see: www.raleighnc.gov/neighbors/content/PWksTrafficEng/Articles/NeighborhoodTrafficMan.html).
2.

The report maintains its recommendation to close Bilyeu Street concurrent with or shortly after the Pullen Road Extension project.
3.

As noted, the recommended structure has concurrent left-turn lanes provided for both directions of travel. Right-of-Way limitations, particularly on the east side of the structure, would hamper the implementation of many roadway improvements,

including a roundabout of sufficient size to manage the turning and through movements at this location.

4.

Text has been added (refer to page 14 in the revised report) noting the desirability of relocating the bus stop to a safer location that doesn’t encourage mid-block crossings of Western Boulevard to access Pullen Park.
5.

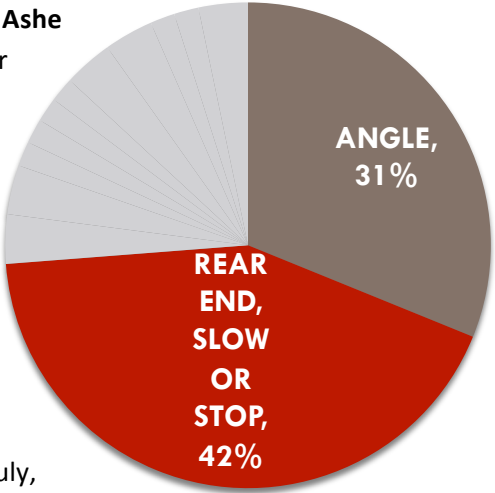
The design diagram presented to residents at the Outreach Meeting (August 28) was slightly different than that assumed for the draft report, which was operating on the latest information available at the time. Future revisions to this design are probable; residents are encouraged to stay in contact with the City of Raleigh staff to ensure that they are kept abreast of changes. Names and email contact information have also been recorded and provided to the City for any announcements or other public engagement opportunities (e.g., charrette, open house) regarding this project.
6.

Traffic count data has been provided through the NC Department of Motor Vehicles for reported crashes at

Western Boulevard between Ashe Avenue and Bilyeu Street, per

the request of one person in this meeting. The following summarizes the crash report by type (see also chart at right). The most common accidents were angle (31%) and rear-end (42%) of the total of 61 crashes that have occurred in the five-year period prior to July, 2013. No other crash type had more than

two accidents, while these two accident types had a total of 45 reported crashes. Alcohol was a factor in only one incident. Generally, the accidents were of a low level of seriousness in terms of injury, with 80% of the accidents resulting in property-damage only, and the remainder involving minor injuries. The typical accident happened during a weekday in peak traffic hours (particularly evening between 5pm and 6pm). The complete accident report is available upon request.



Comments and Responses (NCSU Transportation)

Table of Contents (Pg. 1):

- What about Table of Figures? Would be useful to list out with titles/corresponding page numbers for reference.
- The graphic is blurry -- looks nice, but you can't read any of the results so is this even useful to include? Why not insert the entire graphic somewhere else in the report where you could actually read it.

RESPONSE: (1) A table of figures has been inserted. (2) The graphic was not blurry when printed out, although some of the text is unavoidably small given the page limitations. Inserting the graphic elsewhere in the report would not have a different result since the image size is already at the maximum allowable dictated by header and footer margins.

Introduction (Pg. 3):

- Under problem statement --> classifies connections between "the South and Central campuses of NCSU". I think the origins/destinations are really driven between Main Campus and Centennial Campus. Seems like classifying in that manner would be stronger.
- Seems like briefly acknowledging/brief overview of the prior studies looking at the corridor would be useful.
- What about a discussion of the study team?

RESPONOSE: (1) Problem statement terminology for Main and Centennial campuses were changed, as suggested. (2) Acknowledgement of past studies added to introductory text. (3) The composition generally of the two steering committees has been defined under "Outreach."

Outreach (Pg. 5):

- Reword --> "The outreach began with a half-day field reconnaissance with the Core Technical Team (CTT) and members of the Study Oversight Committee (SOC)

RESPONSE: Re-worded.

Media (Pg. 5):

- "on-campus" (typo)

RESPONSE: Re-worded to "on the campus."

Cycletracks (Pg. 6):

- The summary of the Cycletracks effort all seems very vague for such a time consuming effort --> more detail would be useful here in detailing desire lines and trip ends. At the very least it would be useful to know the magnitude of the O-D pairs. Some type of graphical map of the trip lines would probably provide the necessary insight as opposed to simply saying the major trip generators are Main Campus, Centennial Campus, etc.
- "Main Campus" (typo)

RESPONSE: (1) This information in more detail is presented in the Appendix. (2) "Main Campus" is the terminology used for the traditional (not Centennial Campus) and was what was intended in this reference (see also second set of comments, above).

Workshops (Pg. 6):

- "Main Campus (capitalized)
- Need to also include NCSU staff (distinct population from faculty)
- To say that the input from Workshop #1 simply provided confirmation to prior themes seems too vague --> I think the report should be more deliberate and specifically identify what those themes were and exactly how that feedback connects to the field review, intercept survey, etc.
- No discussion of the results of Workshop #2 -- what were the findings from the evaluation of crossing alternatives? How did this help inform the project? What are the ramifications? etc.

RESPONSE: The suggestions from this set of comments have been implemented, as suggested. Additional discussion of Workshop #2 has been included in the Appendix A.

Vision/Objectives (Pg. 6):

- Shouldn't this section come before the outreach summary? Seems like it would be more logical to lead off with the broad vision/objectives for the study possibly moving this as a subsection to the introduction may be more useful.

RESPONSE: In many reports/studies an early presentation of goals, objectives and/or vision statement would be appropriate. However, in this study the vision and objectives were not presented back to the CTT/SOC for verification until after the field data and first public workshop had been conducted. This practice was intentional, since formulating the objectives and vision would have been done without the benefit of a fuller array of input otherwise. The position of the vision/objectives in the report therefore corresponds more closely to how the actual study process transpired.

Recommendations (Pg. 10):

- Reword --> "The ultimate design goal, however, was to include recommendations for a grade-separated crossing of Western Boulevard."
- The bullets that outline the NCDOT Complete Streets Planning and Design Gudelines are confusing --> I think they need to be grouped by category (land use, ped/bike, etc.) in order to show how they are relevant to this project. As it reads now, the list is difficult to follow and doesn't really seem to add much substance to the report.
- For each recommendation segment number --> I think a cross section would be useful for context purposes.
- The cross sections on Figure 3 are blurry and difficult to read --> see note above, could help with clarity.
- Segment #1: Where are the gaps in the sidewalk? There is now existing sidewalk on both sides of Gorman St. both North and South of Western Blvd.
- Segment #2: There are multiple transit stops along Faucette --> the report cites only a single transit stop for improvements. Need to be more specific on which stops would be candidates for improvements.

RESPONSE: (1) Re-wording and bullets have been modified. (2) Cross-sections have been added to the report. (3) One gap apparently remains on the northeast corner, and there may have been some newer construction completing the sidewalk after the initial findings were posted. (4) Transit stop at west end of Faucette (north side) is specified in the text now.

Option 2 (Pg. 18):

- Is phase 1 relevant? I thought we had expressed that small, golf cart style vehicles are not pertinent to NC State's future campus transit demand.

RESPONSE: Ultimately, Phase I (of Option 2) was not deemed relevant. However, the report is citing what was actually presented to the steering committees and public during this phase of the report. Recommend leaving this information as-is, but adding a note that these vehicles were not compatible with future transit services.

Option 3 (Pg. 18):

- The graphic of the full interchange is very difficult to understand --> seems blurry and difficult to understand the configuration/impacts. I don't see it adding any sort of value other than making it more confusing. It would be more useful if it could be redone to better show the lane configurations and contextual implications for the Avent Ferry/Western intersection.

RESPONSE: Agreed; however, additional funding for conducting this scale of visualization was not a part of the original or modified scopes of work.

Evaluation of Grade-Separated Options (Pg. 19):

- The Benefit/Cost Assessment Figure is mislabeled --> should be Figure 7.
- Again, I think in this section it would be beneficial to discuss the survey results from the 2nd public involvement workshop where participants rated the alternative crossing scenarios.
- Related to the above point -- I see that in the evaluation write-up that Option 3 benefits/tradeoffs are discussed primarily from a value standpoint. Whats missing is the feedback expressed by the City of Raleigh and NC State -- detailing the drawbacks of the interchange configuration from a property impact (large footprint), aesthetic (large interchange in NC State's backyard), and safety (concerns over ped/bike movements traversing the interchange).
- One of the objectives of the study was to identify environmental constraints and impacts to structures -- how was this incorporated in the evaluation of grade-separated options? I think more specific detail is needed in how this was evaluated.
- Is there any value to discussing that the pedestrian/bike tunnel was the preferred option? Again, I think discussing the survey results of the 2nd public involvement workshop and feedback from the study team would be useful in drawing this conclusion at the end of the report.

RESPONSE: (1) Label corrected. (2) Additional text comparing the results of the second public workshop have been added to the text. (3) An additional

sentence has been added here to represent the concerns of some members of the CTT regarding Option 3.

Project Costs and Priorities (Pg. 20):
- Tha graphic on the last page doesn't have a Figure #.
RESPONSE: This figure has a number now (Figure 9), and has also been revised to provide some details on the closure of Bilyeu Street and redesign of Ashe Avenue.

Comments and Responses (NCSU Office of the University Architect)

The introduction is confusing since figure 1 doesn't show entire study area. Show project limits on the map in the introduction.
RESPONSE: The limits of the study as specified in the project scope of services was from Varsity Drive to Pullen Road; additional recommendations made beyond either end of the study are provided in other graphics.

Clarify who has responsibility for the recommended improvements (City or University) Page 14, number (3). Add note "in concurrence with projects identified in NC State Bike and Pedestrian Master Plan."
RESPONSE: The responsibility for many of these projects would likely, although not concretely, be determined to be in the best interest of both NCSU and the City of Raleigh, as well as in some cases the NC Department of Transportation. No discussions were held about levels of cost-sharing at this stage of planning, however, making final allocations of cost impossible.

Number (2) Faucette Drive: Clarify how the parking is impacted in the text. How many parking spaces will be lost with this recommendation?
RESPONSE: The report has been revised slightly to indicate the loss of on-street parking. Although some of the parking could be salvaged by locating the cycle track on the north side of the existing roadway, east of Dan Allen this option becomes unviable. Note that representatives from NCSU Transportation and Office of the Architect agreed to showing the cycle track and were willing to consider the loss of parking that would result.

Number (4) – All recommendations from the NC State Bicycle and Pedestrian Master plan should be noted.
RESPONSE: As the Transportation and Office of Architecture were both represented on technical and steering committees, we had assumed that these recommendations were viewed favorably by NCSU, either because they complied with earlier reports or because they improved upon them. Changing a slate of recommendations at this point would roll back the process considerably.

Number (5) - Dan Allen is not closed, but has restricted access between 9am and 5pm when classes are in session.
RESPONSE: This distinction has been made in the report.

Number (5) – Provide an intersection design diagram for the intersection where this will be implemented. We would prefer striping verses a solid red lane to direct cyclist across intersections.
RESPONSE: The additional graphic requested here is out-of-scope. We would, however, encourage a continuous striping treatment to provide consistency in this area and to further reinforce the pedestrian and cyclist crossing spaces.

Number (6) – The right of way width for Varsity Drive may not allow for bicycle lanes. Please verify.
RESPONSE: Measurements were conducted in the field for these recommendations; aerial photography seems to confirm that the 22' needed for the cross-section rendered is available south of Western Boulevard.

Number (10) – Please note in study that NC State University's top priority is to promote the safest and quickest way to move both pedestrian and bicycle traffic through the intersection – we should be on record that option (1) meets the Universities' goal. Also it should be noted that the University is not in favor for option (3) due to the increased pedestrian crossing in this design and the impacts to the campus.

Need to provide recommendations to resolve mid-block crossing issues for entire study corridor.
RESPONSE: (1) The safety goal statement has been introduced in the Evaluation section (page 19 of the revised report). (2) A number of improvements have already been installed in this corridor to improve pedestrian safety at multiple crossing locations. Provisions for separated-grade crossings are further recognized in the project study at Avent Ferry/Morrill and Pullen Road. Shorter-term recommendations at Avent Ferry (pork chop plus lane channelization), bike boxes, etc. are also identified. A median fence to encourage more crossings under Western Boulevard when the tunnel recommendation is constructed has also been recommended, as has wider medians for pedestrian refuge (refer to page 10 as well as individual intersection recommendations).

Appendix C. Technical Memorandum (Cost-Benefit Assessment)

Cost-Benefit Analysis | Western Boulevard Multi-Modal Crossing Study

This technical memo briefly describes the three (3) Options and the cost/benefit criteria, assumptions, and methodology to assist in the evaluation of the Options. All figures are estimated and based on local and nation precedent, as noted in the descriptions that follow

Please contact the Project Manager for additional information.

J. Scott Lane, Project Manager
919-601-9098 | jslanempo@gmail.com

Options

Three Options have been developed and deemed worthy of final analysis:

- Option 1: Bicycle and Pedestrian Tunnel
- Option 2: Bicycle/ Pedestrian / Transit Tunnel
- Option 3: Compressed Diamond Interchange

Each of these Options is depicted in the following figures.



Figure 1. Pedestrian/Bicycle Tunnel



Figure 2. Pedestrian/Bicycle/Transit Tunnel



Figure 3. Compressed Diamond Interchange

Evaluation Criteria

Evaluation criteria and assumptions have been developed to provide high-level information to help the selection process for the preferred option(s). The MS-Excel™ spreadsheet that accompanies this document uses the following sets of assumptions to calculate the benefits and costs for each of the three Options described previously.

Estimate of Probable Construction Cost – Planning-level estimates of probable construction costs were provided using engineering judgment and reflect comparative values between options.

Traffic Control (Ease of Construction) – This variable describes the monetary impact of construction on the total daily users in 2040 due to the difference in vehicular delay compared between the preferred option and the at-grade-only intersection as it would likely be described in 2040. In all cases it was assumed that there are 30 days in a calendar month for the purpose of producing annualized benefit-cost estimates.

Key Assumptions:

Option 1: Bike/Pedestrian Tunnel

- Water main will be relocated in three months
- Tunnel will be constructed in two phases and construction will shift to maintain traffic
- Tunnel will take 10 months to finish (partial night construction)
- Capacity on Western Boulevard will be reduced by half during the construction period
- 80% of the 58,410 vehicles will travel through the Avent Ferry/Western Boulevard intersection/day in 2040 with an increased average delay of three minutes.
- 20% of the 58,410 vehicles will detour and require an additional five minutes/day in 2040.
- Average wage/vehicle/hour is \$22.06/hour¹

Option 2: Bike/Pedestrian/Transit Tunnel

- Water main will be relocated in 3 months
- Tunnel will be constructed in two-phases and traffic will shift
- Tunnel will take 14 months to finish (partial night construction)
- Capacity on Western and Morrill will be reduced by half
- 70% of the 58,410 vehicles will travel through the Avent Ferry/ Western Boulevard intersection/day in 2040 with an increased average delay of three minutes.
- 30% of the 58,410 vehicles will detour and require an additional five minutes/day in 2040.
- Average wage/vehicle/hour is \$22.06/hour¹

Option 3: Compressed Diamond Interchange

- Water main will be relocated in 3 months
- The intersection will be completely closed off for 8 months
- 100% of the 58,410 vehicles will detour with an increased travel time of five minutes/day/vehicle in 2040
- Average wage/vehicle/hour is \$22.06/hour¹

Right-of- way Impacts/Cost – The costs represent commercial property relocation/access closure.

Key Assumptions:

Option 1: Bike/Pedestrian Tunnel

- No Impact

Option 2: Bike/Pedestrian/Transit Tunnel

- NCSU property north of Morrill Drive and on the north side of Western Boulevard in the northeast quadrant of the intersection will have 0.8 acres taken at an estimated value of \$260,000 (based on nearby assessed land values)

Option 3: Compressed Diamond Interchange

- The Gas Station on the southwest quadrant will be relocated for an estimated property value of \$350,000²

Person Level of Service - Monetary impact of delay saved compared to the base situation of the likely intersection configuration in 2040. Vehicular levels-of-service were converted to person LOS by using 1.3 occupancy factor, so that pedestrian, cyclist, and automotive modes could be readily compared. Note that transit user (delay) benefits and accident reduction benefits are calculated separately.

Key Assumptions:

Option 1: Bike/Pedestrian Tunnel

- The average delay of vehicular traffic will be reduced due to shorter pedestrian phases on the existing signals, and smaller delays realized by using the proposed tunnel
- An estimate of 1200 pedestrian crossings was assumed

Option 2: Bike/Pedestrian/Transit Tunnel

- The average delay of vehicular traffic will be reduced due to shorter pedestrian phases on the existing signals, and smaller delays realized by using the proposed tunnel
- An estimate of 1200 pedestrian crossings was assumed

Option 3: Compressed Diamond Interchange

- The average delay of vehicular traffic will decrease by 42 seconds in 2040 between the existing signal design and the compressed diamond interchange according to the VISSIM analysis
- Average wage/vehicle/hour is \$22.06/hour¹
- 100% of the 58,410 vehicles will experience reduced delay

Transit Benefit (Operations) Monetary impact of delay saved compared to the base situation of the likely intersection configuration in 2040.

Key Assumptions:

Option 1: Bike/Pedestrian Tunnel

- No change to transit operations

Option 2: Bike/Pedestrian/Transit Tunnel

- Assume 20 buses traverse Western Boulevard on Avent Ferry/ Morrill daily in 2040 in the southbound through direction of travel (e.g., Morrill Drive to Avent Ferry Road) in one peak hour; multiply this by a factor of eight (8) to estimate daily traffic for a 10-month school calendar year
- 80% is the daily occupancy per bus based on seated capacity; 40 students per bus
 - The average rider has a wage of \$9 dollars/hour (based on estimated student wages)
 - The delay/bus through the intersection will be reduced by one minute

Option 3: Compressed Diamond Interchange

- Assume 20 buses traverse Western Boulevard on Avent Ferry/ Morrill daily in 2040 in the southbound through direction (e.g., Morrill Drive to Avent Ferry Road) in one peak hour
- A multiplier of a factor of eight (8) was used to estimate daily traffic for a 10-month school calendar year
- 80% is the daily occupancy per bus based on seated capacity; 40 students per bus
 - The average rider has a wage of \$9 dollars/hour (based on estimated student wages)
 - The delay/bus through the intersection will be reduced by 60 seconds

Pedestrian Benefit (Safety & Mobility) – Monetary benefit to pedestrians in crash reductions by eliminating the need to cross at grade.

Key Assumptions:

Option 1: Bike/Pedestrian Tunnel

- Six (6) pedestrian crashes will be mitigated in five-year period (based on historical crash information for most recent five-year period) for an annual crash rate of 1.2/year
- Average medical cost for pedestrian crash: \$70,200³
- 70% reduction in crashes

Option 2: Bike/Pedestrian/Transit Tunnel

- Six pedestrian crashes will be mitigated/ 5 year period (crash rate of 1.2/year)
- Average medical cost for pedestrian crash \$70,200³
- 70% reduction in crashes

Option 3: Compressed Diamond Interchange

- Six pedestrian crashes will be mitigated/ 5 year period (crash rate of 1.2/year)
- Average medical cost for pedestrian crash \$70,200³
- Since pedestrians and cyclists will be expected to cross in front of at least two lines of stopped traffic (pedestrians) or mingle with existing traffic through the interchange (cyclists), a lower estimated benefit of a 30% reduction in crashes was assumed for this option.

Cyclist Benefit (Safety & Mobility) – Monetary benefit to cyclists in crash reductions by eliminating the need to cross at grade.

Key Assumptions:

Option 1: Bike/Pedestrian Tunnel

- One cyclist crash will be mitigated/ five-year period
- Average medical and repair cost for cyclist crash \$70,200³
- 60% reduction in crashes

Option 2: Bike/Pedestrian/Transit Tunnel

- One cyclist crash will be mitigated/ five-year period
- Average medical and repair cost for cyclist crash \$70,200³
- 60% reduction in crashes

Option 3: Compressed Diamond Interchange

- One cyclist crash will be mitigated/ five-year period
- Average medical and repair cost for cyclist crash \$70,200³
- Since pedestrians and cyclists will be expected to cross in front of at least two lines of stopped traffic (pedestrians) or mingle with existing traffic through the interchange (cyclists), a lower estimated benefit of a 30% reduction in crashes was assumed for this option.

Benefit-Cost Summary and Use of Spreadsheet

The chart below illustrates the cost/ benefit summary of the three (3) Options based on the criteria and assumptions noted above. The resulting Benefit/Cost Ratio (Benefits divided by estimate of probable construction cost, assuming a 20-year project lifespan), and payback period for estimating the time (years) it takes to “pay back” the construction costs *only* are also presented. Generally, a b/c ratio of greater than 1.0 is desirable, although there are circumstances (such as when monetization of impacts is difficult or impossible) when this rule of thumb is not the case.

In this assessment, the major factors contributing to the substantially higher B/C performance are the traffic control (measured in terms of the product of delay and prevailing wage rates) and the relatively large person LOS/year value for Option 3. Other factors, even the construction cost, are relatively minor and are dwarfed by these two variables. Note that Option 3 assumes significant night-time construction; if this assumption were to hold for all three options and their period of construction was reduced to eight months

| | Cost or Benefit Element | Option 1 | Option 2 | Option 3 |
|---------|---|--------------|--------------|--------------|
| COST | Estimate of Probable Construction Cost | \$5,000,000 | \$9,000,000 | \$18,000,000 |
| | Traffic Control (Ease of Construction) | \$21,904,918 | \$32,470,820 | \$25,770,492 |
| | Right-of-way Impacts(1) | \$0 | \$260,000 | \$350,000 |
| BENEFIT | Person Level of Service Benefit/Year | \$158,832 | \$158,832 | \$7,035,344 |
| | Transit Rider Benefit/Year | \$0 | \$201,600 | \$302,400 |
| | Pedestrian Crash Benefit/Year | \$58,968 | \$58,968 | \$25,272 |
| | Cyclist Crash Benefit/Year | \$9,828 | \$9,828 | \$4,212 |
| | 20-Year B/C Ratio | 0.17 | 0.21 | 3.34 |
| | Payback Period (Construction ONLY; Years) | 22.0 | 21.0 | 2.4 |

Figure 4. Benefit-Cost Analysis

as it is assumed for Option 3, then the B/C ratio gets slightly more favorable towards Options 1 and 2 (e.g., Option 2 goes from a 0.21 B/C to 0.31, an improvement of approximately 50%). Because all three Options have relatively similar values for Traffic Control/Ease of Construction, changing construction durations have little effect in the overall comparisons/contrasts of the three Options.

However, the major difference between Option 3 and Options 1 and 2 is primarily the Person Level-of-Service Benefit/Year, since Option 3 is working on all of the 58,410 vehicles and their occupants. This value produces a difference that is an order of magnitude higher for Option 3 compared to Options 1 and 2. Options 1 and 2 improve (reduce) the delay for only a subset of users that are crossing Western Boulevard on the west side of the Avent Ferry/Morrill Drive intersection (assumed to number 1,200 in the design year of 2040). When the Person LOS value for Option 3 is reduced to the same as that shown for Options 1 and 2, the overall B/C and payback period metrics indicate a comparable or even lower level of performance for Option 3 compared to the other two Options. The payback period is particularly hard-hit for Option 3 when the Person LOS is set to levels associated with Options 1 and 2 due to the higher anticipated construction costs for this Option. It should also be pointed out that perceived time for pedestrians, especially under adverse (e.g., inclement weather) conditions, is often valued more highly than automobile traveler times.⁴ If, for example, the pedestrian delay assumption of 60 seconds was multiplied by a factor of three (180 seconds) to try and reflect this increased perceived value of travel time to pedestrians, the payback periods for Options 1 and 2 are approximately halved, although the B/C ratio is still not comparable to Option 3. (The same impact could be obtained by dividing by three the 42 seconds of delay of each auto occupant in Option 3 to 17 seconds). However, there is no reliable evidence obtained during this study for making disparate assumptions for the value of travel times for pedestrians as opposed to automobile occupants and, in the interest of comparing values as closely as possible across all three Options, the actual and not perceived travel time values were chosen for this analysis.

The MS-Excel™ spreadsheet contains three features that enhance its utility for examining how the performance of these three options changes under different assumptions. To use these features, the “Enable Macros” selection will have to be chosen when opening this workbook.

1. The major assumptions outlined in the previous section are explicitly stated in the workbook. This allows the user to review the formulas more easily (press F2 key to see how the formulas are linked to the assumptions; or use the Trace Precedents command)
2. The slider bars to the right of each assumption listed can be used to see how fast or slow the performance for each Option changes when the inputs are changed. Benefit-Cost assessments are particularly vulnerable to their assumptions and how each variable interacts with others. By creating an easier interface for changing the assumptions quickly the rate of change of the two performance measures can be quickly reviewed to see which variables are the most important to the outcomes. Note that the slider bars do not have to be used to change the assumption values; the user can type directly into the appropriate cell to make a change to any assumption.
3. To the right of the assumptions table is a click box (“Reset All”) that, when used, resets all of the assumptions to their base (2040) state.

Sources

1 Bureau of Labor Statistics, *Occupational Employment Statistics, “May 2012 Metropolitan and Nonmetropolitan Area Occupational Employment and Wage Estimates for the Raleigh-Cary, NC Metropolitan Statistical Area.* Website: http://www.bls.gov/oes/current/oes_39580.htm#00-0000.

2 Wake County Tax Assessment, *IMAPS for T&B Enterprises property at 2709 Western Boulevard.* Website: <http://maps.raleighnc.gov/iMAPS/index.html>. Note: includes additional 15% contingency in addition to assessed value; figure does not include tank removal or remediation costs.

3 National Safety Council, *Estimating the costs of unintentional injuries, 2010.* Website: http://www.nsc.org/news_resources/injury_and_death_statistics/Pages/EstimatingtheCostsofUnintentionalInjuries.aspx.

4 Goodman, Rachel, “A traveller in time: Understanding deterrents to walking to work,” *World Transport Policy & Practice*, Volume 7, Number 4, (2001). Pages 50-54. Website: <http://www.eco-logica.co.uk/pdf/wtp07.4.pdf>.