Draft Final Report

Submitted to DCHC MPO October 2018

NC54
WEST CORRIDOR STUDY

Executive Summary

Study Purpose

The NC 54 West Corridor Study is an in-depth review of the 20.4 mile stretch of NC 54 between Old Fayetteville Road in Carrboro and the I-85/I-40 interchange in Graham. The City of Graham, NCDOT Division 7, and the Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (DCHCMPO) recognized the need to evaluate this vital roadway. The two-lane roadway is a regionally significant east-west corridor that carries an average of 6,000 to 15,000 vehicles per day. Traffic congestion on the corridor, which is higher than would be expected from the daily level of traffic, is amplified by inadequate access management, heavy turning conflicts, and substantial truck volumes. The roadway also traverses urban, suburban, industrial and agricultural land uses, which makes designing a roadway that accommodates the needs of all users an important challenge.

This study clarifies the long-term vision for the corridor through the year 2045, including the NC 54 roadway itself and the surrounding communities. This vision is comprehensive, addressing preservation of the area's character, economic opportunity and vitality, environmental sensitivity, and transportation improvements for all users (e.g., drivers, freight, pedestrians, bicyclists). The project's Study Team represents the broad interests of the corridor, including members from the City of Graham, Town of Carrboro, DCHC MPO, the Burlington-Graham MPO, Triangle Area Rural Planning Organization, Alamance and Orange Counties, VHB, and Rose & Associates. The project Study Team considered numerous issues, improvements, and their trade-offs, such as:

- Safety
- Access to goods, services, and residences
- Multimodal network facilities and amenities
- Economic vitality/opportunity
- Environmental/community preservation
- Consideration of all travel modes, including bicycle, pedestrian, and freight
- Funding constraints

Study Context

NC 54 is federally classified as a Minor Arterial roadway. Historically, this route was the primary link between Burlington/Graham and Chapel Hill/Carrboro. Completion of I-40 has somewhat diminished the importance of this function, although it is still an important commuter route, and plays an important role during UNC football games and other major events. A growing share of trips using this part of NC 54 begin or end at homes and businesses along the corridor itself. Outside either end of the corridor (especially west of NC 119), most of the adjacent land remains rural in character, although new subdivisions and other development are appearing.

According to the North Carolina Department of Transportation's (NCDOT) ongoing traffic count program, Average Annual Daily Traffic volumes (AADTs) on NC 54 ranged from 6,000 to 18,000 vehicles per day (vpd) in 2015-2016, depending on location. The highest volumes are near I-40/I-85, followed by the eastern end of the corridor (15,000 vpd). Volumes steadily decrease towards the middle of the study corridor, reaching a minimum near the County Line. Additional 2017 counts collected as part of this study suggest a recent increase in volumes. AADTs at the three locations cited above grew as follows:

- East of I-40/I-85: 21,100 vpd (+3,100 vpd)
- Near the County Line: 6,900 vpd (+900 vpd)
- West of Old Fayetteville Road; 16,000 vpd (+1,000 vpd)

Traffic volumes over the next 25 years are forecasted to increase annually by 1%-1.5% along the corridor. The estimated effects of such pressures on the existing corridor's roadway cross sections are the basis for multimodal improvements identified throughout the study.

ES1 – NC 54 Study Corridor and Planning Jurisdictions

The corridor cuts across numerous municipal, county, and planning jurisdictions with different right-of-way (ROW) dimensions, lane configurations, and improvement priorities (Figure ES1). Most of the westernmost 1.4 miles of the corridor (between I-40/I85 and the Haw River) falls within the city limits of Graham; the most recent Burlington-Graham MPO Comprehensive Transportation Plan (CTP) identifies most of this segment as "Boulevard, Needs Improvement." Most of this segment has 100' ROW, as opposed to a 120' width east of Haw River. The remainder of the Alamance County portion of NC 54 is classified as a Major Thoroughfare, with about 0.75 miles or roadway immediately east of NC 119 designated as "Needs Improvement." Nearly 0.3 miles of NC 54 in this vicinity is in Swepsonville. The prevailing cross-section west of NC 119 is five lanes, with curb-and-gutter and a continuous two-way left-turn (TWLT) lane. The cross-section then transitions to two lanes with paved shoulders between 2' and 4' wide. There are limited opportunities for passing throughout the 2-lane portion of NC 54.

Just under 7.5 miles east of the Alamance/Orange County, NC 54 is in the Triangle Area Rural Planning Organization (TARPO). The Orange County CTP classifies the first 4.0 miles (to Orange Grove Road) as a Major Thoroughfare; the next 3.4 miles (to Bethel Hickory Grove Church Road) is identified as "Boulevard, Needs Improvement." East of this point, NC 54 enters the Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (DCHC-MPO) boundary. The latest DCHC-MPO CTP classifies the easternmost 2.6 miles of NC 54 as "Major Thoroughfare, Needs Improvement."

Intersections with public streets and private roads and driveways are frequent. Apart from the intersection at Mt Willen Rd/Salem Church Rd, all traffic signals are located on the multi-lane segments at either end of the study corridor (five in Alamance County, one in Carrboro). No on-street parking is permitted along NC 54, and there are no sidewalks or bicycle facilities (except for a few hundred feet of bike lanes just west of Old Fayetteville Road and sidewalk near a commercial development in Graham). Between I-40/I-85 and about a mile east of NC 119, the speed limit is 55 MPH, except for a 35 MPH school zone at Alexander-Wilson Elementary. East of this point, the prevailing speed limit is 55 MPH.

Study Process

The study was conducted over a twelve-month period beginning in September 2017 and concluding one year later in September 2018. The study was overseen by a Study Team composed of staff from the City of Graham, Town of Carrboro, DCHC MPO, the Burlington-Graham MPO, Triangle Area Rural Planning Organization, Alamance and Orange Counties, VHB, and Rose & Associates. The Study Team held twelve meetings. Two rounds of community workshops were held at locations across the corridor (three locations during the first round, and four locations in the second round) after major project milestones to share project updates and solicit feedback on findings and recommendations.

The study included extensive data collection and analysis, including previous plans and studies as well as capturing existing conditions through traffic counts, interviews, and broad public engagement.

Critical Issues

Safety and Access Management

Historical data, engineering analysis, and community feedback confirm the importance of reducing crashes throughout this corridor. Given the anticipated trends in traffic growth, the number of conflicts will increase, and without intervention, the number of crashes will, as well. The locations and spacing of numerous driveways and intersections along the corridor reduce both safety and capacity.

Congestion

Combined estimates from the corridor's planning jurisdictions anticipate a 1%-1.5% annual increase in vehicle volumes along the corridor through the year 2045. For the two-lane corridor segment between NC 119 and Mebane Oaks Road, Level of Service (LOS) is D or worse during peak hours and deteriorates further in 2045. The portion of the NC 54 corridor from Mebane Oaks Road to Dodsons Crossroads operates at LOS E or F in 2045, while the remaining segment eastward to Old Fayetteville Road experiences LOS F in both directions, during both peak periods. As traffic volumes on both NC 54 and side roads increase, conflicts and delay at major intersections also grow, creating capacity deficiencies at several locations.

Bicycle and Pedestrian Use

The lack of bicycle and pedestrian connectivity throughout the corridor was frequently cited by community workshop attendees and Study Team members as a major source of concern and frustration. There is consensus that the lack of safe and convenient facilities is suppressing walking and bicycle trips. Even in the absence of improved facilities, increases in pedestrian and bicyclist activity combined with substantial growth in vehicular traffic could increase both crash frequency and severity. There are opportunities for on-street and off-street bicycle and pedestrian paths along the corridor, though there are noted tradeoffs of ROW impacts, cost (construction and maintenance), and phasing of improvements, among others. The needs identified from the Study Team, interviews, and community workshops can be effectively addressed only by a parallel and complementary approach that coordinates roadway and bicycle and pedestrian improvement programs. Awareness of constraints and opportunities associated with roadway improvements when developing bicycle projects must be combined with sensitivity to bicycle and pedestrians needs in the planning and design of roadway projects.

Transit

While demand for transit within the NC 54 West corridor is anticipated, it is difficult to reliably determine due to lack of potential ridership and service data. This portion of the NC 54 corridor is not well-suited to the traditional urban transit paradigm of larger vehicles operating on fixed routes and schedules, due to high operator costs and poor user convenience. The convergence of smart phones, transportation network companies (or TNCs, such as Uber and Lyft), and autonomous vehicles is poised to transform transit service, creating a wider range of more dynamic options better tailored to individual needs. Park-and-ride lots (possibly incorporating drop-and-ride and bike-and-ride options) are another missing piece of a potentially successful transit system in this corridor that have been explored in plans from neighboring planning jurisdictions.

Alexander Wilson Elementary School

Overlapping peaks of school and manufacturing plant traffic generate congestion at the intersection of NC 54 and NC 119/East Main. Future development of intersection-adjacent parcels and anticipated traffic increases posed may pose significant access and safety issues for vehicles and pedestrians. Spillover of school pick-up and drop-off traffic onto NC 119 and NC 54 appears to be a major contributor to delays and long queues.

Market Assessment

The NC 54 West corridor exhibits demand for land use and real estate products at specific nodal and zonal locations, promotion of tourism as an economic development strategy, and transportation improvement coordination with a focus on multimodal and Complete Streets investments. The Economic Nodes include the intersections of Woody Drive, NC 119, and Old Fayetteville, and the Heritage Zones include the areas near Mt Willen Road, Orange Grove Road, Mebane Oaks Road, and Bethel-Hickory Grove Church Road.

Study Recommendations

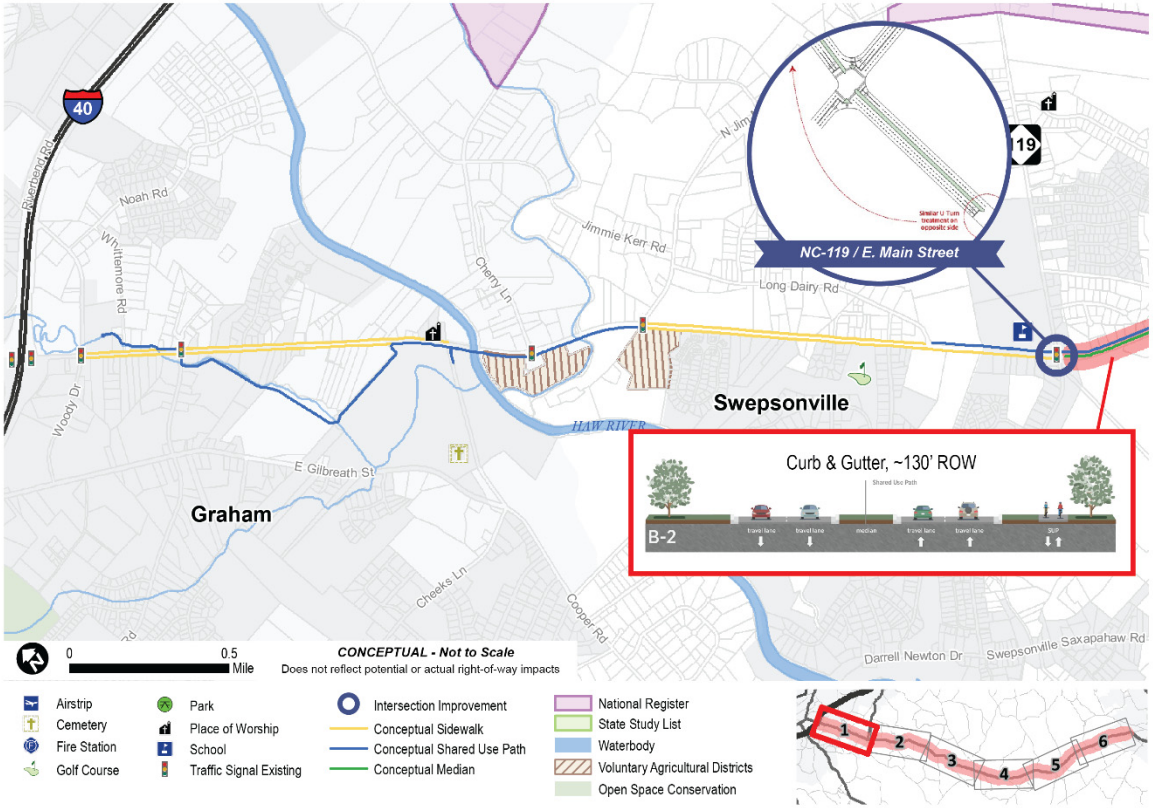
The NC 54 West Corridor Study recommends a phased package of conceptual improvements summarized below. Widening and related improvements are recommended for completion when the practical capacity of the roadway is forecasted to be exceeded. The implementation schedule consists of four overlapping ten-year phases. The widening

schedule is preliminary, and it reflects reasonable assumptions about overall conditions within each corridor segment. The probable cost of the entire package of widening improvements described totals just under $180 million (in 2018 dollars).

Corridor Level

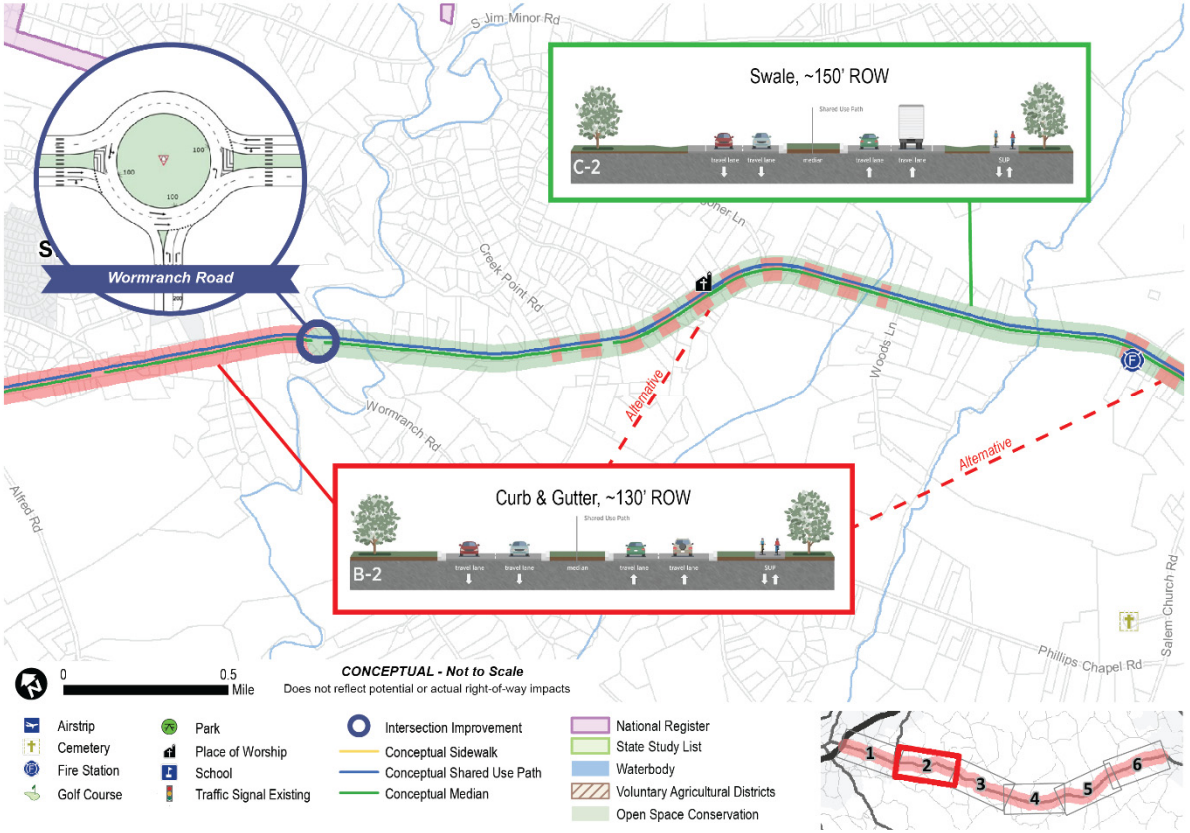
Given the length of the corridor, recommendations are described according to six segments (see Figures ES2 through ES7 below). Recommended roadway cross sections consist of two variations of a 4-lane median divided roadway from NCDOT's *Complete Streets Guidelines*. The C-2 cross section is a ditch and swale design with paved shoulders and shallow, vegetated, open-channel drainage, rather than concrete curb-&-gutter with piped runoff. The B-2 cross section is a curb-and-gutter version; the median and inner travel lane have the same dimensions as the ditch and swale version, but the outer lane is 14 feet wide with a 2-foot curb and gutter pan. Both cross sections allocate space for a shared-use-path.

ES2 - Segment 1 Corridor Recommendations



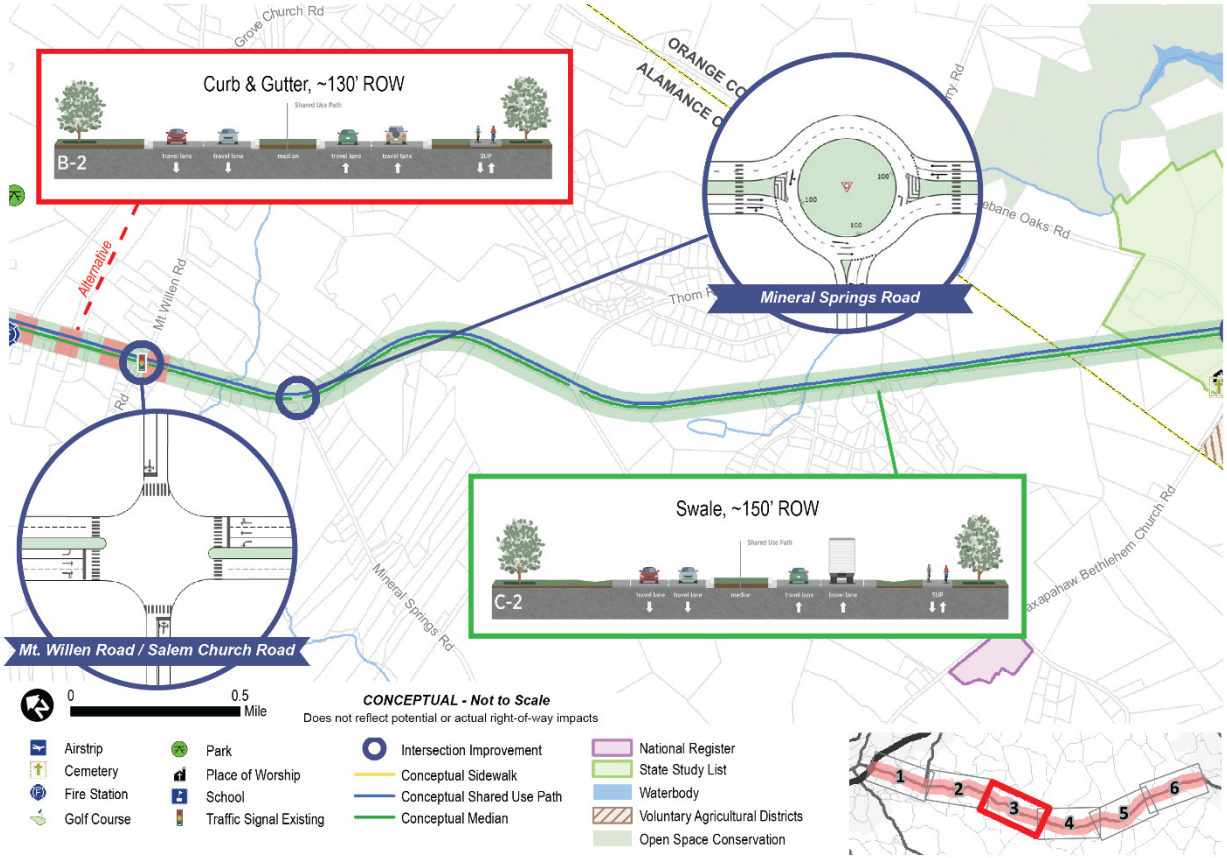
- Potential addition and lengthening of turn lanes
- Access management for driveways
- Implement sidewalk and shared-use-path facilities
- Four-lane curb and gutter cross section beginning at NC 119 eastward to Wormranch Road

ES3 - Segment 2 Corridor Recommendations



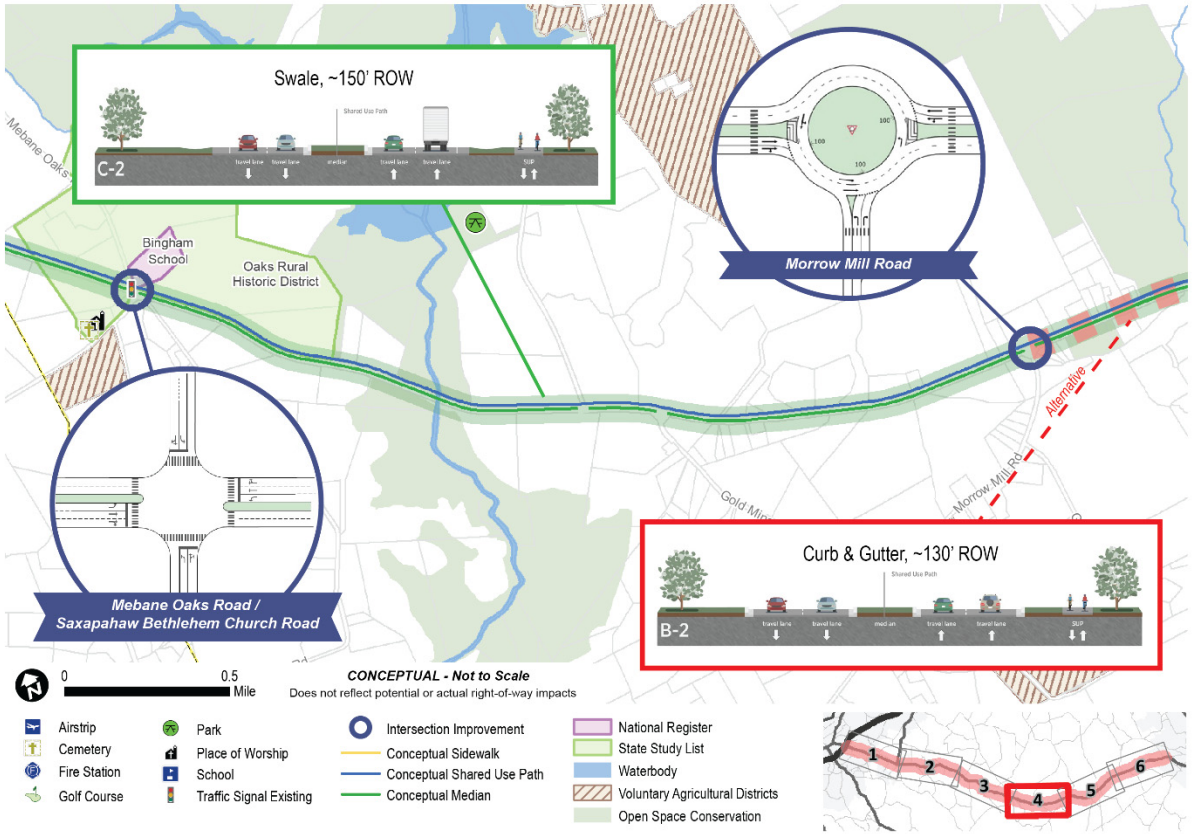
- Four-lane swale cross section beginning from Wormranch Road to Mt Willen Road with alternative for curb and gutter in key locations
- Implement shared-use-path
- Intersection improvements at Wormranch Road

ES4 - Segment 3 Corridor Recommendations



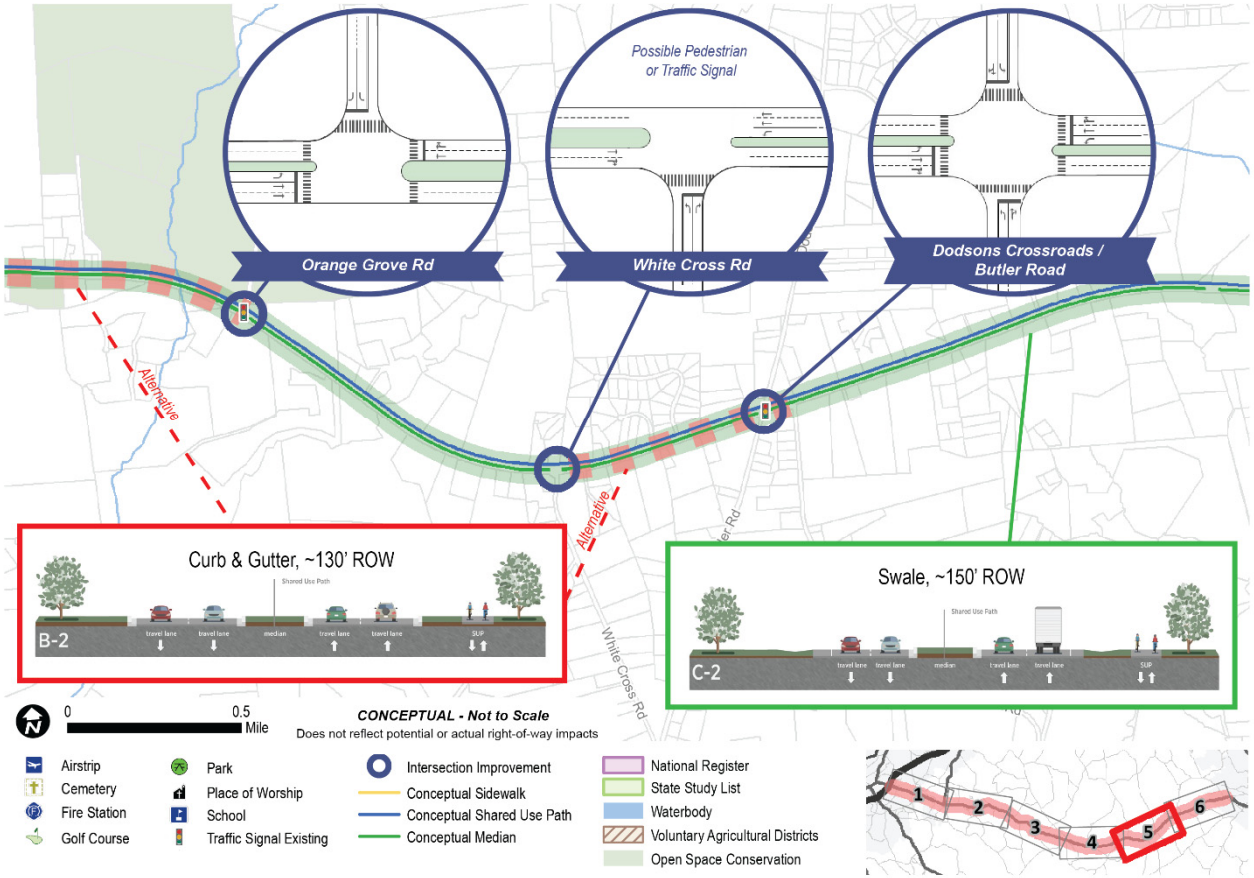
- Four-lane swale cross section beginning from Mt Willen Road to the Alamance/Orange County Line with alternative for curb and gutter in key locations
- Implement shared-use-path
- Intersection improvements at Mt Willen Road and Mineral Springs

ES5 - Segment 4 Corridor Recommendations



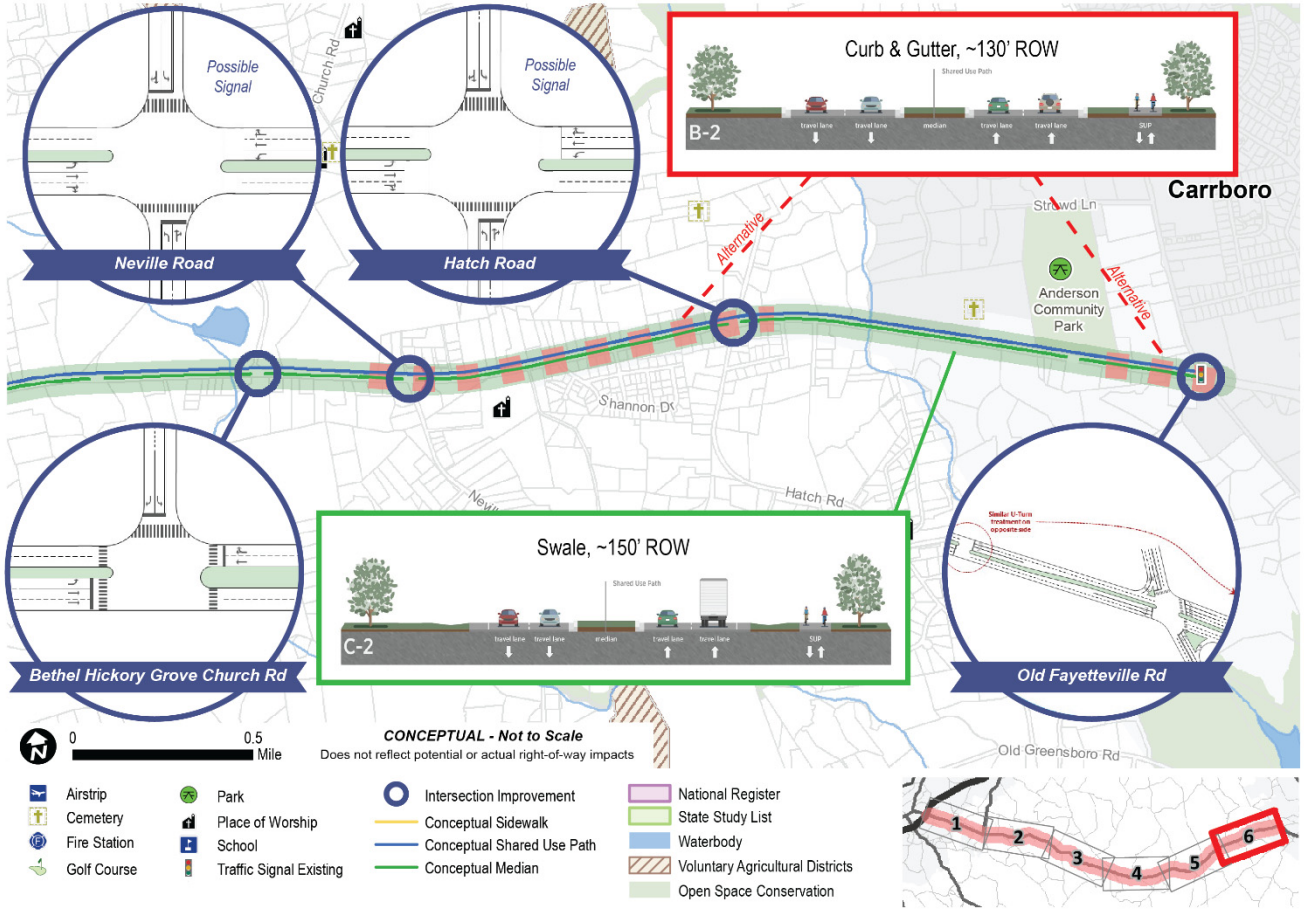
- Four-lane swale cross section beginning from the Alamance/Orange County Line to Orange Grove Road with alternative for curb and gutter in key locations
- Implement shared-use-path
- Intersection improvements at Mebane Oaks Road and Morrow Mill Road

ES6 - Segment 5 Corridor Recommendations



- Four-lane swale cross section beginning from Orange Grove Road to west of Bethel Hickory Road with alternative for curb and gutter in key locations
- Implement shared-use-path
- Intersection improvements at Orange Grove Road, White Cross Road, and Dodsons Crossroads/Butler Road

ES7 - Segment 6 Corridor Recommendations



- Four-lane swale cross section beginning from Bethel Hickory Road to Old Fayetteville with alternative for curb and gutter in key locations
- Implement shared-use-path
- Intersection improvements at Bethel Hickory Road, Neville Road, Hatch Road, and Old Fayetteville Road

Intersections

Details of individual intersection improvements are addressed in the main body of this report. All such improvements are associated with the overall corridor widening, although some may be implemented in advance of the ultimate widening.

Pedestrian and Bicycle Improvements

The shared-use-path (SUP) depicted in the cross-sections and segment illustrations represents a configuration that is more desirable from the perspective of the typical SUP walker or cyclist, as it provides greater separation from traffic lanes, reduces noise, and increases both actual and perceived safety. Due to cost and ROW considerations, as well as anticipated demand, a SUP is recommended along only one side of NC 54. Wide paved shoulders are recommended in the C-2 cross section variation to support cyclists who wish to remain on-road. Pedestrian and bicyclist crossing treatments are integrated into recommended intersection improvements.

Short Range Improvements

The study recommendations relate to longer-term improvements representing the "ultimate" condition of the NC 54 study corridor. There are a number of smaller, cost-effective improvements that should be considered in the meantime, and they can be implemented without contravening longer-range plans. These include centerline and shoulder rumble strips, SafetyEdge technology, high friction surface treatments, retroreflective markings, left turn lanes, acceleration and deceleration lanes, access management, intersection lighting, and wayfinding. Although intersection projects and other improvements (such as turn lanes and wider shoulders) can provide localized interim benefits, they do not address the growing capacity and safety deficiencies of the existing two-lane cross-section

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1.1 Study Purpose

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The goal of this study is to develop a long-term vision for this corridor, including the NC 54 roadway itself and the surrounding communities. This vision is comprehensive, addressing preservation of the area's character, economic opportunity and vitality, environmental sensitivity, and transportation improvements for all users (e.g., drivers, freight, pedestrians, bicyclists). While this vision cannot determine ultimate design details, its analysis and recommendations will help guide those decisions by documenting transportation needs, community priorities, and environmental constraints.

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opportunity and vitality, environmental sensitivity, and transportation improvements for all users (e.g., drivers, freight, pedestrians, bicyclists). The project's Study Team represents the broad interests of the corridor, including members from the City of Graham, Town of Carrboro, DCHC MPO, the Burlington-Graham MPO, Triangle Area Rural Planning Organization, Alamance and Orange Counties, VHB, and Rose & Associates. The Study Team will review previous roadway plans, examine economic and land use trends, and consider both short-term and long-range improvements that will preserve and enhance environmental resources and the economic vitality of the corridor and the surrounding communities it supports.

1.2 Study Context

The study corridor spans 20.4 miles between the I-40/I-85 interchange in Graham and Old Fayetteville Road in Carrboro (Although it runs somewhat northwest-southeast, for clarity and simplicity it will generally be referred to as an east-west facility for the purposes of this study.) Its current federal functional classification is Minor Arterial. Historically, this route was the primary link between Burlington/Graham and Chapel Hill/Carrboro. Completion of I-40 has somewhat diminished the importance of this function, although it is still an important commuter route, and plays an important role during UNC football games and other major events. A growing share of trips using this part of NC 54 begin or end at homes and businesses along the corridor itself. Outside either end of the corridor (especially west of NC 119), most of the adjacent land remains rural in character, although new subdivisions and other development are appearing.

The Alamance County Orange County line falls near the midpoint of the corridor (see Figure 1 below). Most of the westernmost 1.4 miles of the corridor (between I-40/I85 and the Haw River) falls within the city limits of Graham; the most recent Burlington-Graham MPO Comprehensive Transportation Plan (CTP) identifies most of this segment as "Boulevard, Needs Improvement." Most of this segment has 100' of right-of-way (ROW), as opposed to a 120' width east of Haw River.

The remainder of the Alamance County portion of NC 54 is classified as a Major Thoroughfare, with about 0.75 miles or roadway immediately east of NC 119 designated as "Needs Improvement." Nearly 0.3 miles of NC 54 in this vicinity is in Swepsonville. The prevailing cross-section west of NC 119 is five lanes, with curb-and-gutter and a continuous two-way left-turn (TWLT) lane. The cross-section then transitions to two lanes with paved shoulders between 2' and 4' wide. There are limited opportunities for passing throughout the 2-lane portion of NC 54.

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According to NCDOT's ongoing traffic count program, Average Annual Daily Traffic volumes (AADTs) on NC 54 ranged from 6,000 to 18,000 vehicles per day (vpd) in 2015-2016, depending on location. The highest volumes are near I-40/I-85, followed by the eastern end of the corridor (15,000 vpd). Volumes steadily decrease towards the middle of the study corridor, reaching a minimum near the County Line. Additional 2017 counts collected as part of this study suggest a recent increase in volumes. AADTs at the three locations cited above grew as follows:

- East of I-40/I-85: 21,100 vpd (+3,100 vpd)
- Near the County Line: 6,900 vpd (+900 vpd)
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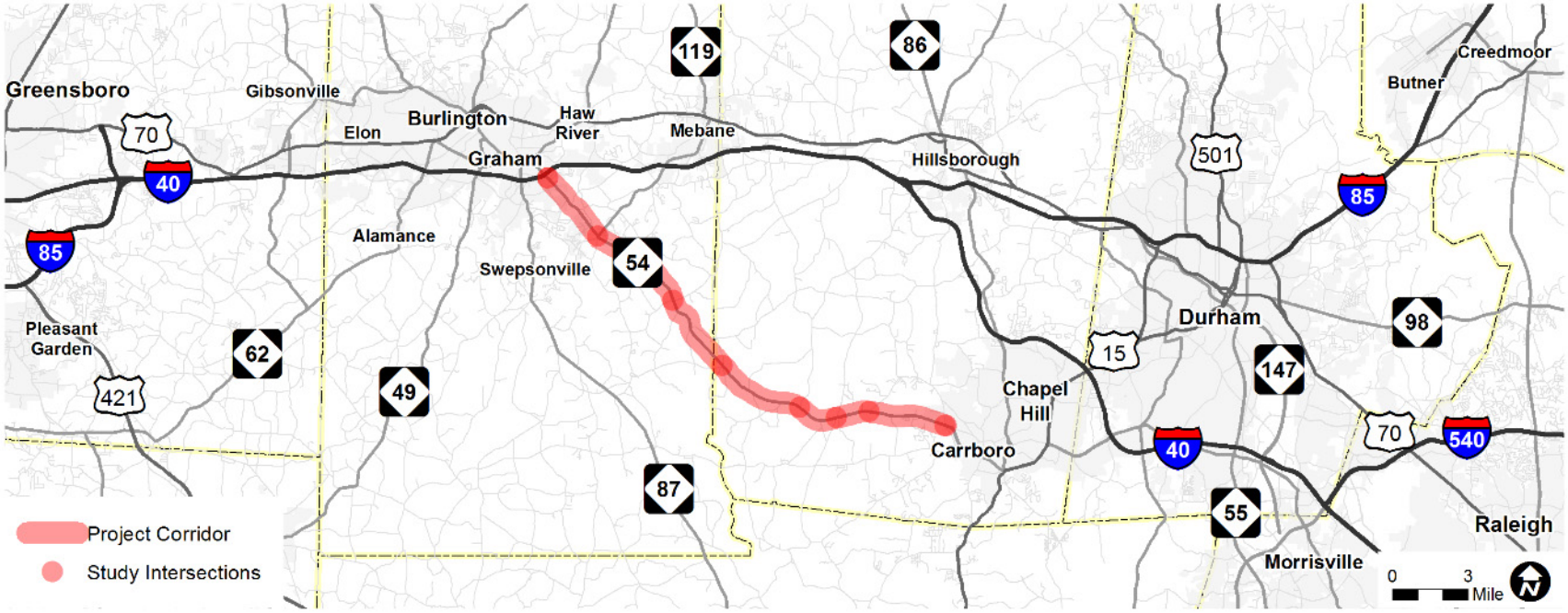
Figure 1: Project Vicinity and Study Intersections



Existing Conditions

2.1 Transportation Infrastructure

2.1.1 NC 54 Roadway Design Elements

The 3.2-mile segment of NC 54 between I-40/I-85 and NC 119 consists of a standard curb-and-gutter 5-lane cross-section (with continuous two-way center turn lane), 64 feet wide, on 100 feet of right-of-way. Driveways and intersections are frequent, but visibility is adequate for the 50-MPH posted speed limit. The alignment is generally unremarkable; the only significant horizontal and vertical curvature is found on the approaches to the Haw River Bridge. There are no bicycle or pedestrian facilities.

Except for the final 500 feet at the eastern end of the study corridor, the remainder of NC 54 is a basic 2-lane highway, most of which has 4' paved shoulders and 120' ROW. Driveways and intersections are intermittent, often grouped in clusters. The terrain is mildly-to-moderately rolling, with some significant vertical and horizontal curvature, though not excessive for the 55-MPH speed limit. There are no bicycle or pedestrian facilities west of Carrboro to the City of Graham's municipal boundary.

2.1.2 NC 54 Intersections

Within the study area, NC 54 intersects approximately 75 public streets, and numerous private roads and driveways. Not counting the I-40/I-85 interchange, eight intersections were signalized:

Signalized Intersections

- Woody Dr (SR 2105)*
- Ivey Rd/Sunset Dr (SR 2108)
- Cherry Ln (SR 2123)
- Jim Minor Rd (SR 2135)/Reatkin Rd
- NC 119/E Main St (SR 2159)*
- Mt Willen Rd/Salem Church Rd (SR 2142)*
- Dodsons Crossroads (SR 1102)/Butler Rd (SR 1951)*
- Old Fayetteville Rd (SR 1107/SR 1937)*

As part of traffic analysis, peak-period turning-movement counts were collected at four of these signalized intersections, indicated with asterisks (*). These intersections were determined to be most critical, and most likely to undergo significant change. Peak-period turning-movement counts were also collected at these major unsignalized intersections:

Unsignalized Intersections

- Mebane Oaks Rd (SR 1007)/Saxapahaw Rd (SR 1961)*
- Orange Grove Rd (SR 1006)*
- Bethel Hickory Grove Church Rd (SR 1104)*

A traffic signal was installed at the Mebane Oaks Rd/Saxapahaw Rd intersection (STIP W-5707B) in summer 2018 after turning-movement count collection. Signalization is being investigated for Orange Grove Road as part of improvements associated with STIP project R-5821-B.

A number of signalized and unsignalized intersections have been upgraded beyond their original cross-sections to reduce crash potential and/or increase capacity. Such improvements--typically involving additional turn-lanes, acceleration/deceleration lanes, or channelization--are summarized below:

Woody Drive

- Left-turn lanes on Woody Drive

Ivey Road/Sunset Drive

- Eastbound right-turn lane on NC 54

- Left-turn lanes on Ivey Road and Sunset Drive

Cooper Road

- Separate right -turn and left-turn lanes on Cooper Road

Cherry Lane

- Westbound right-turn lane on NC 54
- Separate right-turn and left-turn lanes on Cherry Lane

Jim Minor Road

- Separate right-turn and left-turn lanes on Jim Minor Road

George Bason Road

- Separate right-turn and left-turn lanes on George Bason Road

NC 119/East Main Street

- NC 54 transition between 5-lane and 2-lane cross-sections
- Separate right-turn, through, and left-turn lanes on NC 54 approaches
- Eastbound acceleration/merge lane on NC 54
- Separate right-turn, through, and left-turn lanes on East Main Street and NC 119

Freshwater Road

- Westbound right-turn lane on NC 54

Wormranch Road

- Eastbound right-turn lane on NC 54
- Eastbound right-turn lane on NC 54

Mt Willen/Salem Church Roads

- Separate right-turn, through, and left-turn lanes on NC 54 approaches

Anderson Products Driveway

- Eastbound left-turn lane on NC 54

Mebane Oaks/Saxapahaw Roads

- Eastbound and westbound right-turn lanes on NC 54

Stanford Road

- Westbound right-turn lane on NC 54

Gold Mine Road

- Eastbound right-turn lane on NC 54

Morrow Mill Road

- Eastbound right-turn lane on NC 54

Orange Grove Road

- Westbound right-turn lane on NC 54

White Cross Road

- Westbound left-turn lane on NC 54
- Eastbound right-turn deceleration taper on NC 54

Fiesta Grill Driveway

- Westbound right-turn lane on NC 54

Dodsons Crossroads/Butler Road

- Separate through and left-turn lanes on NC 54 approaches
- Right-turn/deceleration-lanes with raised "porkchop" islands on NC 54 approaches

Carl Durham Road

- Eastbound right-turn/deceleration lane on NC 54

Martin Marietta – American Stone Quarry Driveway

- Westbound right-turn/deceleration lane on NC 54

Bethel Hickory Grove Church Road

- Westbound right-turn lane on NC 54
- Eastbound left-turn lane on NC 54

Neville Road

- Eastbound right-turn lane on NC 54
- Westbound left-turn lane on NC 54

Southern Drive

- Westbound left-turn lane on NC 54

Hatch Road

- Westbound right-turn/deceleration lane on NC 54
- Eastbound right-turn lane on NC 54
- Eastbound right-turn lane on NC 54

Bethel Hickory Grove Church Road

Henry Anderson III Community Park Drive

- Westbound right-turn/deceleration lane on NC 54

Old Fayetteville Road

- Separate left-turn lanes on NC 54 approaches

- One through and one shared through/right-turn lane on NC 54 approaches
- Separate through and left-turn lanes on Old Fayetteville Road approaches
- Separate right-turn lane with raised "porkchop" islands on Old Fayetteville Road approaches
- Pedestrian signal and crosswalk on east side of intersection

Monolithic channelization islands (also referred to as a "porkchop" or raised concrete island) are used on many side roads intersecting NC 54. These help guide vehicles turning off NC 54 into the proper lane, avoiding sideswipe or head-on collisions. This is especially relevant for left-turns, at skewed intersections, and where large turning radii (used to accommodate higher-speed turns and large vehicles) create wide intersection throats. The following intersections incorporate this treatment:

- Clifford-Ray Road
- Freshwater Road
- Wormranch Road
- Mt Willen Road and Salem Church Road
- Mebane Oaks Road and Saxapahaw Road
- Stanford Road
- Gold Mine Road
- Morrow Mill Road
- Orange Grove Road
- White Cross Road
- Dodsons Crossroads and Butler Road
- Carl Durham Road
- Martin Marietta – American Stone Quarry Driveway
- Neville Road
- Hatch Road
- Brookfield Drive

Clifford Ray Road

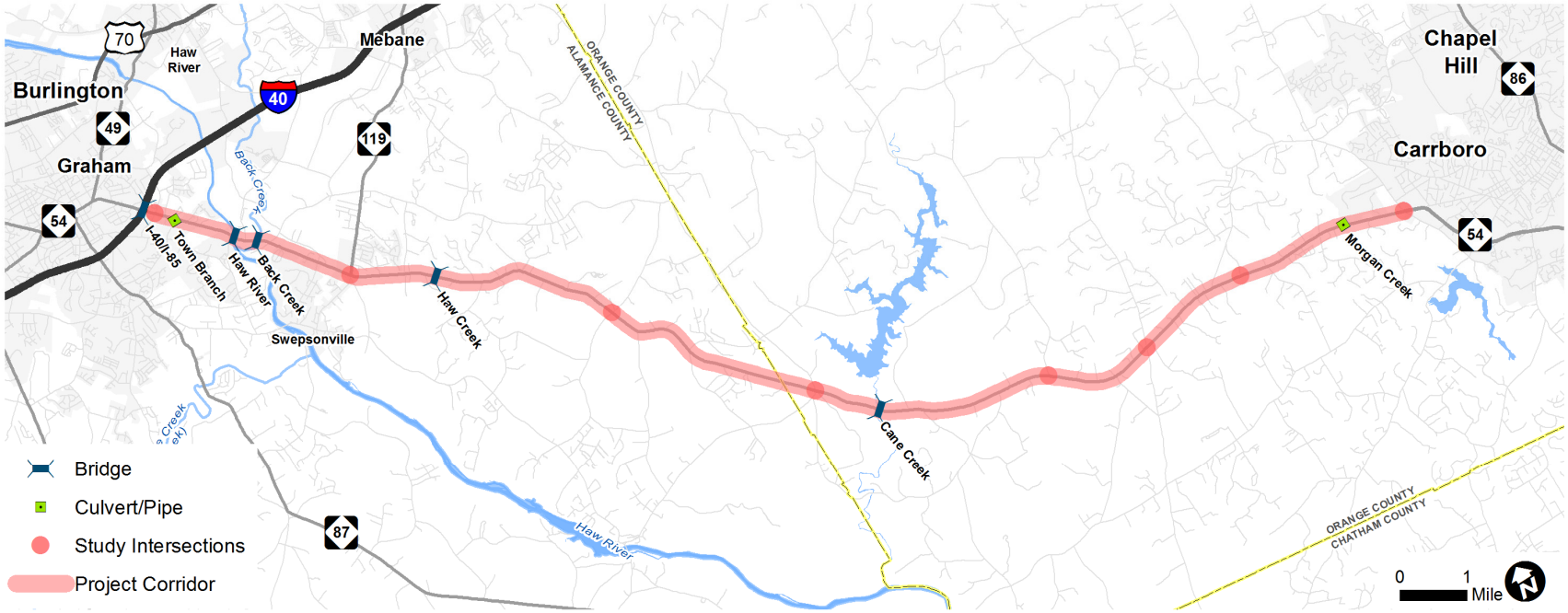
2.1.3 Bridges

NC 54 crosses four bridges and two major culverts in the study corridor. These are described in west-to-east order and are identified in Figure 2 below.

Town Branch Culvert

This structure consists of two 8' by 7' concrete box culverts flanking a 9' by 8' culvert, just under 90' long. It has a Sufficiency Rating of 87.79, with no weight restrictions.

Figure 2: Bridge and Culvert Locations in Corridor



Haw River Bridge

At 365 feet, this is the longest bridge in the study corridor. It has a 64-foot wide, 5-lane cross-section with a center TWLT lane. Although there are no sidewalks on either bridge approach, a 4' sidewalk runs along the bridge deck's western edge. Narrow sidewalk on only one side, low guardrails, high traffic speeds, and lack of delineation or separation (other than the single raised sidewalk) render the current configuration of this bridge less than desirable for pedestrian or bicycle use. Since there is no room to move away from the travel lane on a bridge, these factors are more critical than on the ground. This bridge has a Sufficiency Rating of 92.61, with no weight restrictions.

Looking east across Haw River Bridge

Back Creek Bridge

This bridge is 175' long, with a 5-lane cross-section similar to the Haw River Bridge above. Although there are no sidewalks on either bridge approach, a 4' sidewalk runs along the bridge deck's western edge. Although of relatively short length, proximity to travel lanes and high traffic speeds make this bridge less than desirable for pedestrian or bicycle use in its current state. This bridge has a Sufficiency Rating of 81.69, with no weight restrictions.

Looking east at Back Creek Bridge

Haw Creek Bridge

This 2-lane bridge is 150′ long, with a 42′ wide travelway including 8′ shoulders. Railings are very low, and there is no sidewalk. Lack of separation from traffic lanes, low guardrails, and relatively high traffic speeds make this bridge less than desirable for pedestrian or bicycle use, as currently configured. It has a Sufficiency Rating of 99.25, with no weight restrictions.

Looking east at Haw Creek Bridge

Cane Creek Bridge

Very similar to the Haw Creek Bridge, this Orange County bridge is 150′ long, with a 42′ wide travelway including 8′ shoulders. Railings are very low, and there is no sidewalk. Proximity to traffic, low guardrails, and relatively high traffic speeds make this bridge less than desirable for pedestrian or bicycle use in its current configuration. It has a Sufficiency Rating of 97.27, with no weight restrictions.

Morgan Creek Culvert

This structure consists of a pair of 13′ by 13′ concrete box culverts just over 120′ long. It has a Sufficiency Rating of 85.12, with no weight restrictions.

2.1.4 Pedestrian Facilities

Sidewalks are largely absent from this rural NC Highway corridor. The lone exception is a retail strip development located at 1264 NC Hwy 54, Graham, NC. This 4-foot wide, 320-foot long sidewalk that runs along the road frontage of this property was a local development requirement. Curb and gutter is present along this portion of the corridor, which is typically installed in conjunction with sidewalks.

Sidewalks are absent near Alexander Wilson Elementary School (2518 NC Hwy 54, Haw River, NC). Marked pedestrian crosswalks at the signalized intersection of NC Hwy 54 and NC Hwy 119 are also absent. One school administrator noted that no children have been observed walking along NC Hwy 54, although some parents have inquired about whether walking to school along NC Hwy 119 (nearby Autumn Trace neighborhood) would be possible.

Worn paths along the roadside shoulders of the corridor were not observed, suggesting that pedestrians are rarely or infrequently walking along the roadside. Lawn mower or all-terrain vehicle paths (two paths) were observed along portions of the roadside shoulder.

2.1.5 Bicycle Facilities

Striped bicycle lanes are present for a 500-foot-long portion of the corridor, at the very eastern end and within the Carrboro Town limits.

Paved shoulders are present along the two-lane section of roadway, which represents the largest portion of the corridor. The width of these paved shoulders is less than three feet. Roadside debris, gravel, and grass was observed within the paved shoulder, which poses a potential safety concern by encouraging a cyclist to ride closer to the travel lane.

Paved shoulders are not present within the five-lane section of roadway, west of NC Hwy 119 (Alamance County). Share the Road signs were not observed. Such signage would not be considered a bicycle facility unless accompanied by shared lane markings. Bicycle facilities along the corridor are depicted in the photos below.

End of bicycle facilities west of Carrboro

Bicycle lane near Old Fayetteville Road in Carrboro

Bicycle crossing warning sign near Mt Willen Road

Bicycle crossing warning sign near Mt Willen Road

Bicycle crossing warning sign near Salem Church Road

Roadway shoulder west of Carrboro

2.1.6 System Connectivity

I-40 has supplanted much of NC 54's role in connecting the Burlington urban area and parts west with Chapel Hill/Carrboro, and even RTP. While the proportion of traffic traveling the entire length of the corridor has declined, new development--especially along the western portion of the corridor--generates trips that use part of the corridor in travelling to jobs, residences, schools, stores, and other services or activities. Roadway volumes continue to increase along the entire corridor.

There are few alternate routes for such trips. NC 87 parallels about half the corridor, but it is 2-4 miles to the west, and separated by the Haw River, which limits connectivity. Old Greensboro Road (SR 1005) roughly parallels the other half of the NC 54 corridor at a similar distance to the south, connecting NC 87 with Carrboro. Neither of these facilities are competitive with NC 54 in terms of capacity or travel time.

Orange Grove Road (SR 1006) links NC 54 with Hillsborough, and serves intervening destinations. Mebane Oaks Road (SR 1007) serves a similar function for Mebane, while Saxapahaw/Saxapahaw-Bethlehem Church/Church Roads connects with Saxapahaw and NC 87. Cherry Lane and NC 119 provide access to I-40/I-85 (east), as well as adjacent commercial development and downtown Mebane.

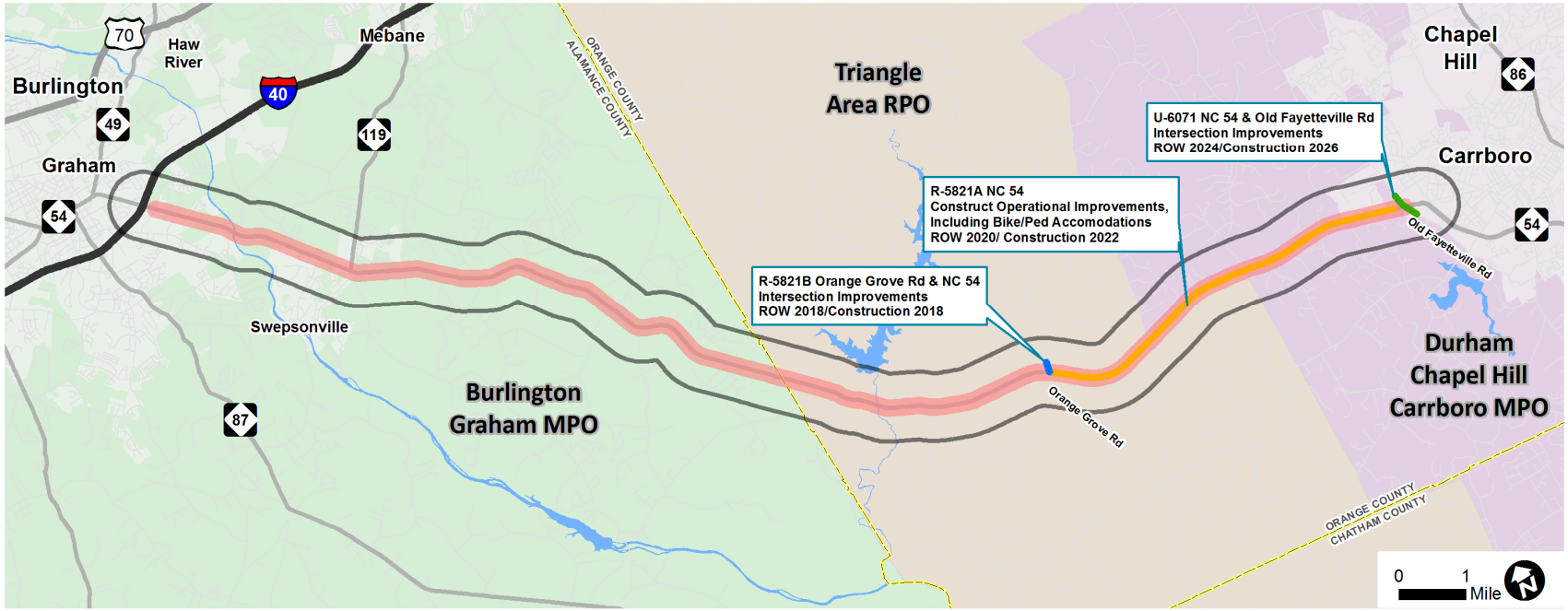
2.1.7 Planned & Committed Improvements

The following sections describe many projects that directly or indirectly affect –or are affected by– travel in the NC 54 corridor.

2.1.7.1.1. STIP Projects

The 2018-2027 State Transportation Improvement Program (STIP) recently released by the NCDOT includes three projects of critical relevance to the NC 54 Corridor Study (see Figure 3). The nature, purpose, and schedule of each project is summarized below. The State had indicated that these three projects are coordinated. Note: project schedules are subject to change.

Figure 3: 2018-2027 STIP Projects in Corridor



STIP # U-6071 – NC 54

U-6071 is a Regional intersection improvement project at Old Fayetteville Road and NC 54 in Carrboro, NC. Right of way acquisition is scheduled for 2024 with construction in 2026.

STIP # R-5821A – NC 54

R-5821A is also a Regional operational improvement project with bicycle and pedestrian accommodations along NC 54 from Orange Grove Road in Orange County to Old Fayetteville Road in Carrboro. Right of way acquisition is scheduled for 2020 with construction in 2022. VHB is coordinating the project's National Environmental Policy Act (NEPA) study process.

STIP # R-5821B – NC 54

R-5821B is a Division intersection improvement project at NC 54 and Orange Grove Road in Orange County. Right of way acquisition is scheduled for 2018 with construction in anticipated in 2019.

2.2 Corridor Travel Demand Characteristics

This section summarizes characteristics of travel in the study corridor, including historic and current average annual daily traffic volumes (AADTs) and associated trends; truck/heavy vehicle volumes; traffic speeds; time-of-day characteristics; peak-period turning movements at signalized intersections; and relevant attributes of pedestrian, bicycle, transit, and rail modes.

2.2.1 Historic Traffic Volumes (AADTs)

NCDOT's count program provides a consistent source of data for assessing traffic volume trends over time. There are 16 count stations on NC 54 within the study limits, ten in Alamance County and six in Orange County. In most cases these counts yield at least semi-annual data points between 2002 and 2016. Counts are summarized in Table 1 and Figure 4.

Average Annual Daily Traffic volumes (AADTs) on NC 54 are highest near I-40/I-85 (18,000), and at the eastern end of the corridor (15,000 vpd). Volumes steadily decrease towards the middle of the study corridor, reaching a low of 6,000 vpd near the County Line. These data indicate that over the preceding decade, traffic growth has been modest, averaging just over 1.2% annually. This translates to a typical annual increase of between 70 vpd and 300 vpd, depending on the location. By comparison, I-40/I-85 traffic at the NC 54 interchange grew by more than 2.2% annually during the same period, with a 15% increase (8,000 vpd) between 2015 and 2016 alone. NCDOT conducted counts in 2016 at five locations within the study area, and Table 1 and Figure 4 illustrate that those increases surpass 2015 levels. These new counts—while a portion of the corridor—indicate support for projected growth in traffic volumes.

Additional counts collected by VHB in September of 2017 also suggest a recent acceleration in growth rates along NC 54, especially towards the western limits of the study. AADTs at the three locations cited above increased as follows:

- East of I-40/I-85: 21,100 vpd (+3,100 vpd, or 17.2%)
- Near the County Line: 6,900 vpd (+900 vpd, or 15.0%)
- West of Old Fayetteville Road: 16,000 vpd (+1,000 vpd, or 6.67%)

Further analysis of NCDOT count data reveals no sustained growth trends on NC 54 immediately beyond the study limits; in fact, some minor decreases were observed. The NCDOT count program also includes AADT records for approximately two dozen intersecting roads along the corridor. In general, traffic trends at these locations are consistent with NC 54 observations.

Table 1: NC 54 Historic AADT (by location)

	Location	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1	E of I-40/I-85	16,000	--	17,000	--	14,000	--	16,000	--	16,000	--	16,000	--	18,000	--
2	E of SR 2183	13,000	--	13,000	--	13,000	--	13,000	--	14,000	--	13,000	--	14,000	--
3	E of SR 2123	13,000	--	12,000	--	13,000	--	13,000	--	14,000	--	14,000	--	15,000	--
4	E of NC 119	10,000	--	9,400	--	9,900	--	11,000	--	11,000	--	10,000	--	11,000	--
5	E of SR 2138	10,000	--	10,000	--	10,000	--	11,000	--	--	--	10,000	--	10,000	--
6	W of SR 2142	9,000	8,000	8,100	7,600	7,500	7,600	7,100	8,400	7,500	7,500	8,400	8,500	8,000	8,600
7	E of SR 2145	6,500	5,900	5,800	5,300	5,700	5,900	5,400	6,400	5,800	5,700	6,500	--	6,200	6,300
8	W of SR 1007	5,700	5,800	5,600	5,300	5,400	5,500	5,300	5,800	5,700	4,900	--	5,300	5,700	6,000
9	E of SR 1006	8,800	9,200	8,900	8,500	8,700	8,900	8,400	9,300	9,200	10,000	10,000	--	9,000	10,000
10	E of SR 1207	11,000	11,000	12,000	11,000	12,000	11,000	11,000	12,000	12,000	13,000	--	11,000	11,000	13,000
11	W of SR 1945	12,000	--	11,000	--	12,000	--	13,000	--	12,000	--	13,000	--	12,000	--
12	W of SR 1107	14,000	--	14,000	--	15,000	--	14,000	--	15,000	--	15,000	--	15,000	--

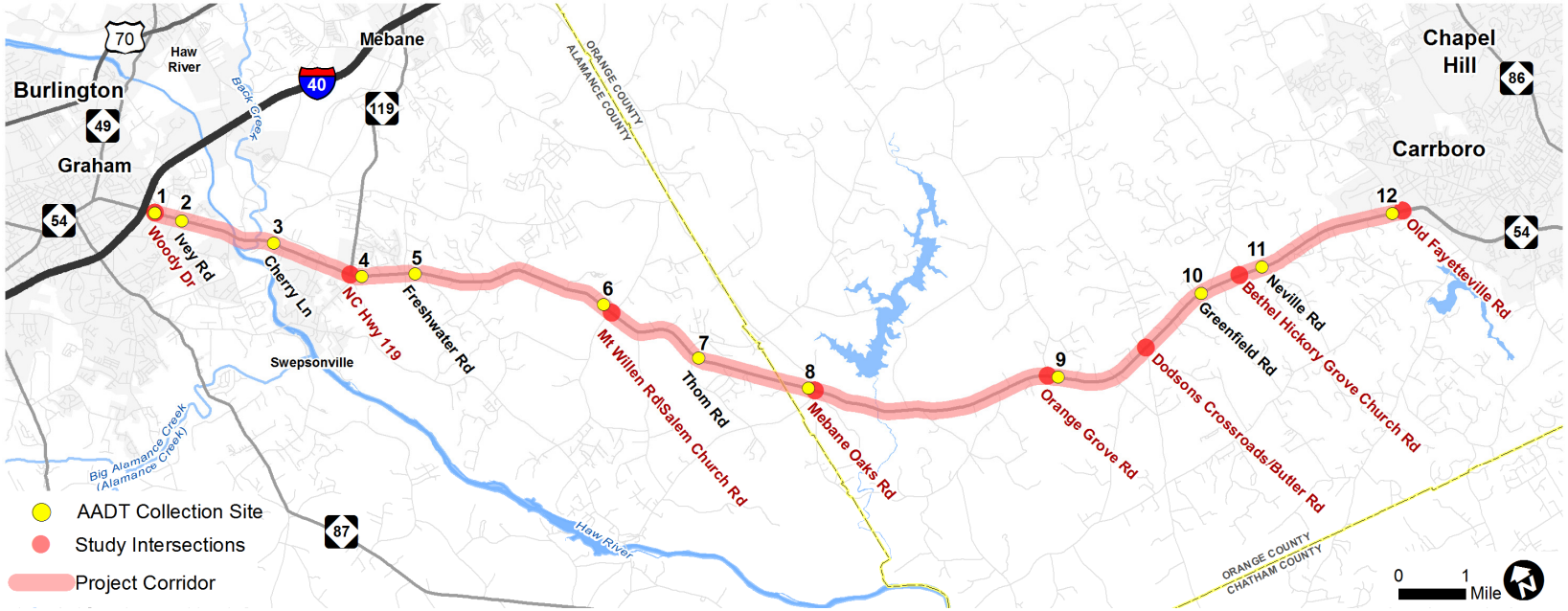
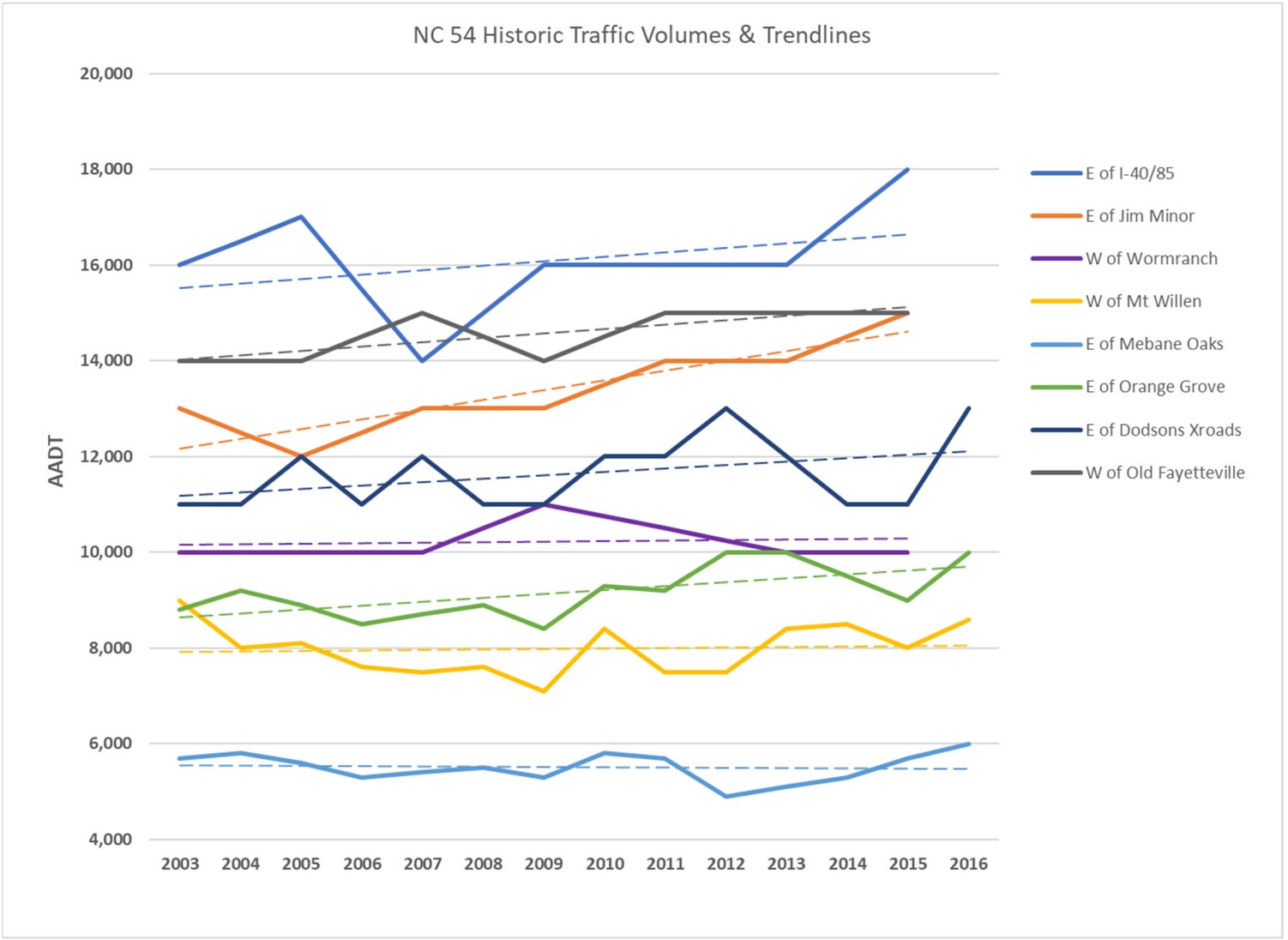


Figure 4: Selected NC 54 Traffic Trends (by location)



2.2.2 Traffic Data

VHB collected traffic data at locations along the corridor in September of 2017. These data are discussed below.

2.2.2.1.1. Traffic Characteristics

2017 Average Annual Daily Traffic (AADT) Volumes

MioVision cameras were used to collect 48-hour traffic counts at eight locations on September 12th and 13th, 2017 (see Figure 5). Due to heavy rains on Tuesday, the Wednesday counts were used for calculating AADTs, directional splits, peaking characteristics, and vehicle classifications. Locations counted were:

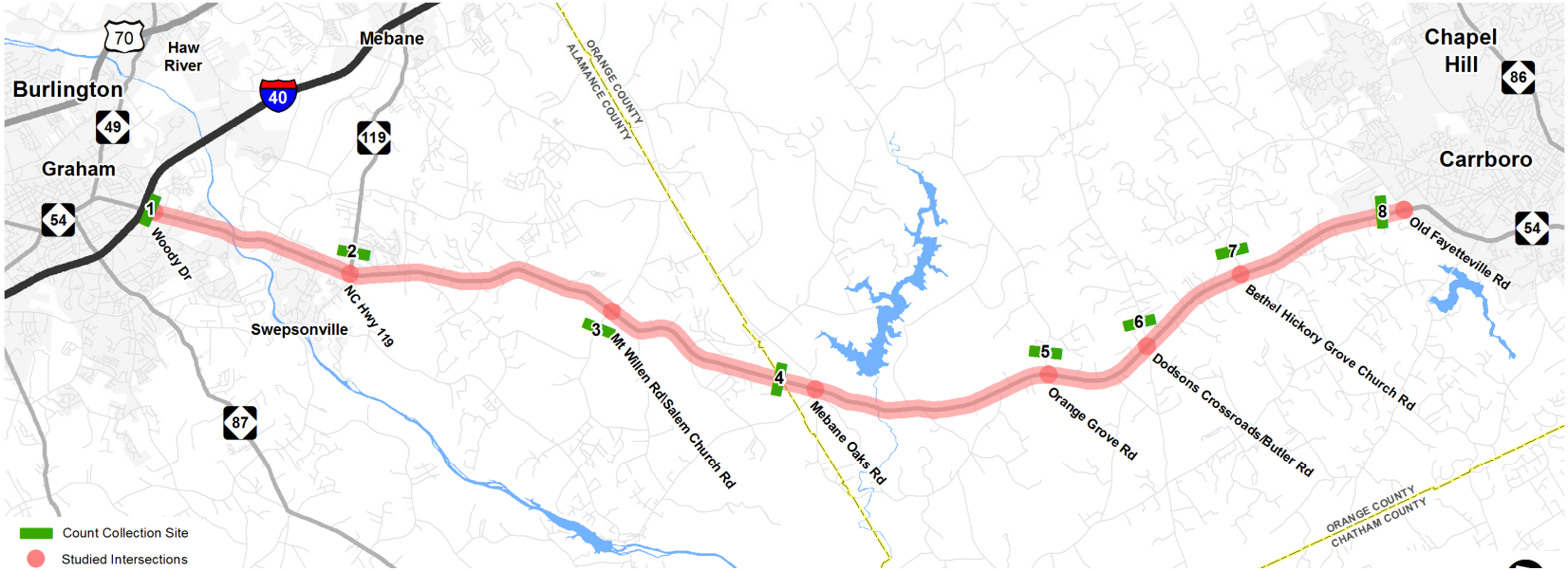
1. NC 54, east of I-40/I-85
2. NC 54, near the Alamance-Orange County Line
3. NC 119, north of NC 54
4. Salem Church Road (SR 2142), south of NC 54
5. Orange Grove Road (SR 1006), north of NC 54
6. Dodsons Crossroads (SR 1102), north of NC 54
7. Bethel Hickory Grove Church Rd (SR 1104), north of NC 54
8. NC 54, west of Old Fayetteville Road (SR 1107/SR 1937)

The resulting traffic counts were adjusted using the appropriate NCDOT seasonal and day-of-week factors to obtain annul daily traffic volumes (AADTs). summarizes the results, and compares them against 2015-16 NCDOT counts at nearby locations. Collection sites are identified in Figure 5. Overall, the NC 54 counts at these locations grew between 3% and 15% annually between 2015-16 and 2017. Annual traffic growth on the intersecting roads ranged from 0% to 16.7%, but given the low volumes involved relative to roadway capacities, these increases are not that impactful. The exception is the 9% annual growth over two years for NC 119, from 6,900 vpd to 8,200 vpd.

Table 2: 2017 AADTs

Location	2015 NCDOT	2016 NCDOT	2017
1. NC 54 east of I-40/I-85	18,000	---	21,100
2. NC 119 north of NC 54	6,900	---	8,200
3. Salem Church Road south of NC 54	---	1,500	1,500
4. NC 54 near the Alamance-Orange County Line	5,700	6,000	6,900
5. Orange Grove Road north of NC 54	---	1,400	1,500
6. Dodsons Crossroads north of NC 54	---	1,800	2,100
7. Bethel Hickory Grove Church Rd north of NC 54	---	---	2,300
8. NC 54 west of Old Fayetteville Road	15,000	---	16,000

Figure 5: VHB Traffic Count Collection Sites, 2017



Peaking Characteristics

The 48-hour counts obtained at the above locations also yield valuable information about the hourly distribution of traffic (its peaking characteristics), as well as directional variations in demand. Figure 6 depicts the variations in total (two-way) traffic volumes throughout the day at three locations, as well as a corridor-wide composite or average hourly distribution.

The westernmost count exhibits a "bump" in the midday "saddle" attributable to lunch trips using the interchange. The smaller 8 PM peak is a consistent artifact, possibly caused by shift work at a nearby industrial plant. The higher AM and PM peaks exhibited in the middle location are typical of lower-volume rural roads with high proportions of commute trips. Throughout the corridor, volumes during the AM peak period (7 AM – 8 AM) are slightly higher than during the PM peak (usually 5 PM – 6 PM).

Total traffic volumes do not tell the entire story, however. Directional variations can also have significant impacts on traffic congestion. Figure 7, Figure 8, and Figure 9 depict traffic volumes in opposing directions throughout the day at three locations. At the corridor's western end, there is little difference between volumes in either direction during peak periods, although westbound traffic appears slightly higher in both periods, a mildly unusual condition. The heavier eastbound flow later in the evening westbound is also atypical. Moving eastward, the directional imbalances shift, and become more pronounced. In the morning, the proportion of traffic heading east becomes greater, with flows reversing in the evening, reflecting the substantial regional commuting influence of the University and the Medical Center in Chapel Hill. This extreme directionality places greater demands on available roadway capacity than does a more balanced distribution of traffic, increasing delay and creating longer queues at signalized intersections.

Figure 6: NC 54 Traffic Peaking Characteristics

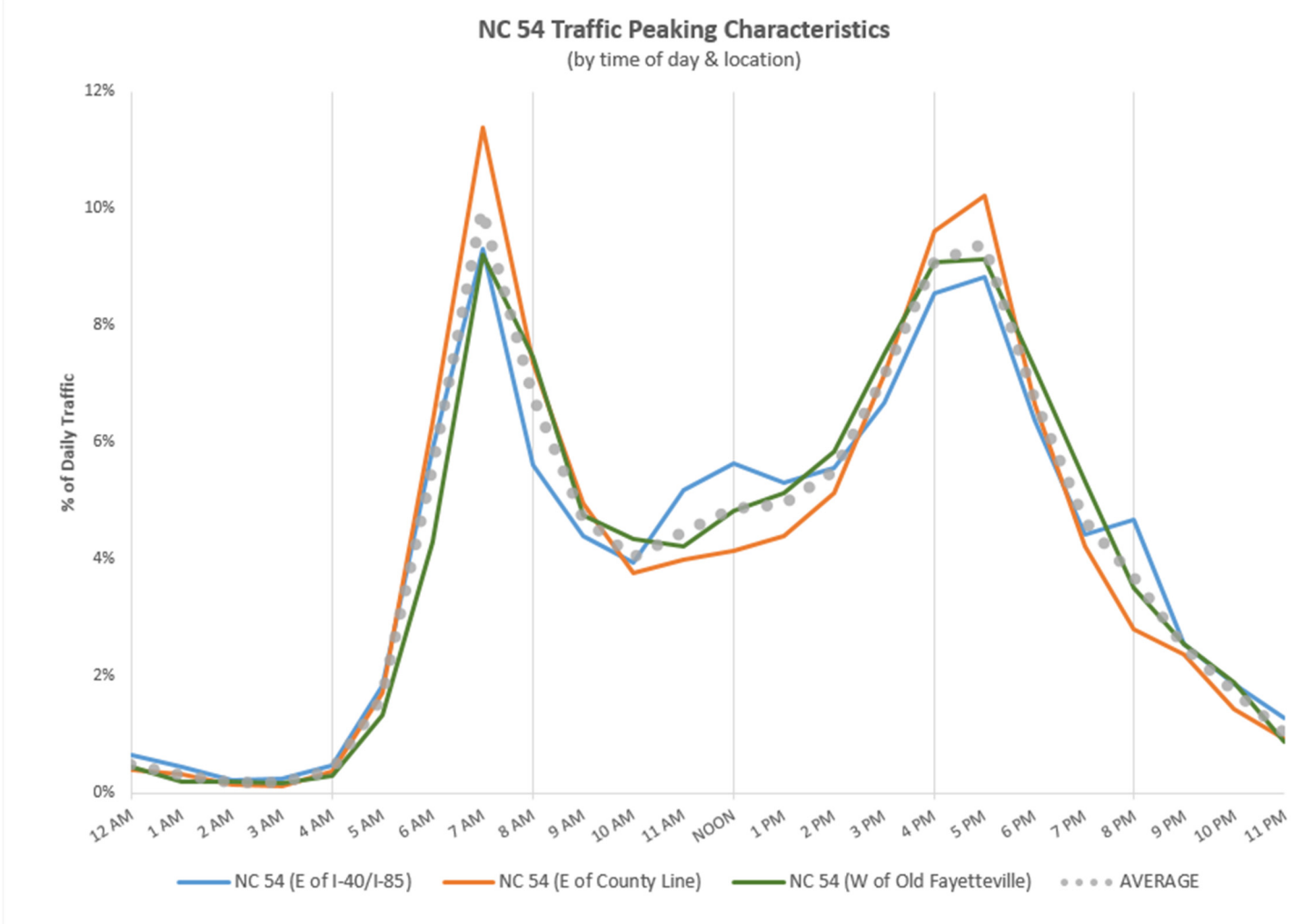


Figure 7: NC 54 Traffic Peaking by Direction (western end of corridor)

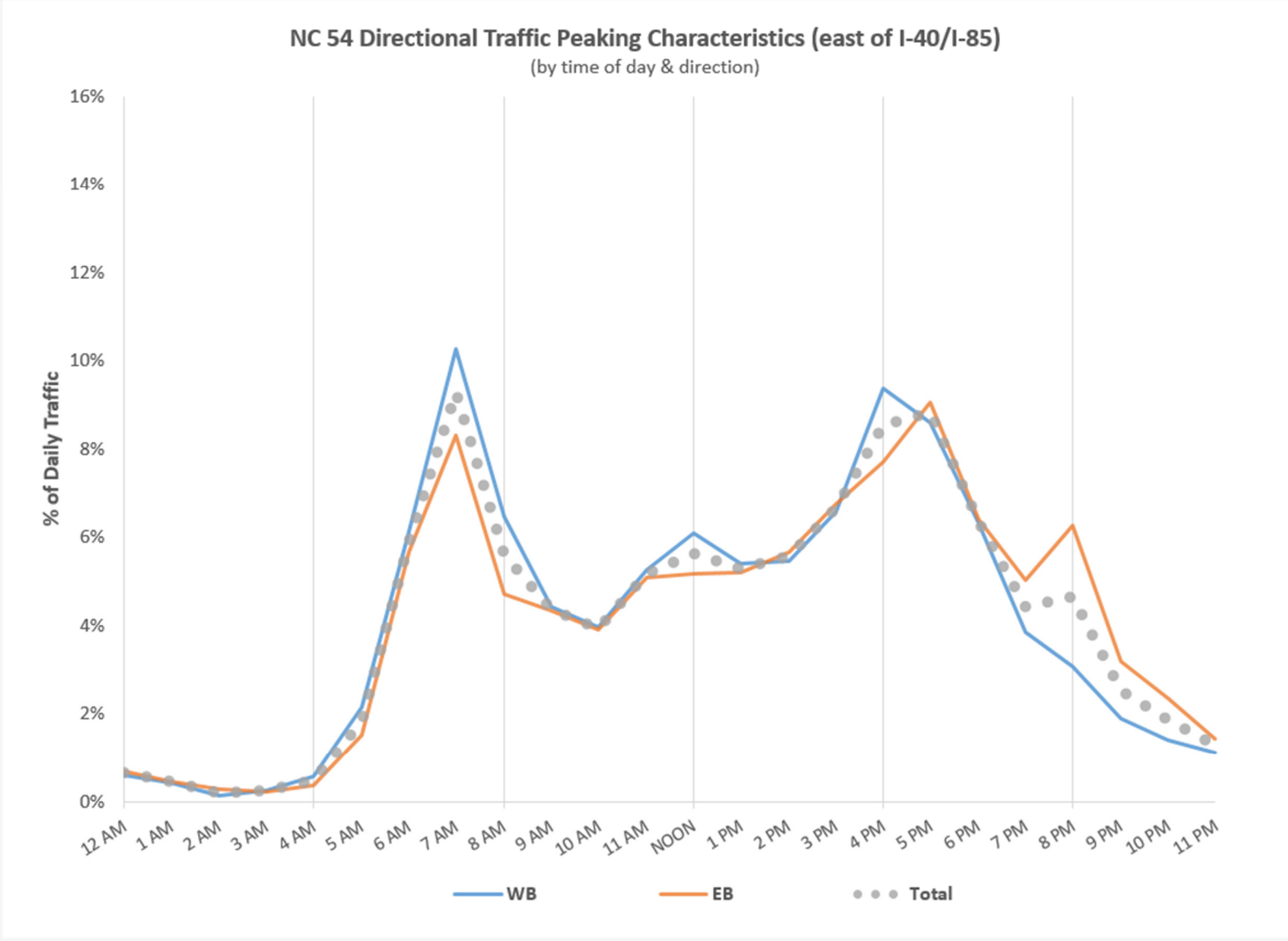


Figure 8: NC 54 Traffic Peaking by Direction (middle of corridor)

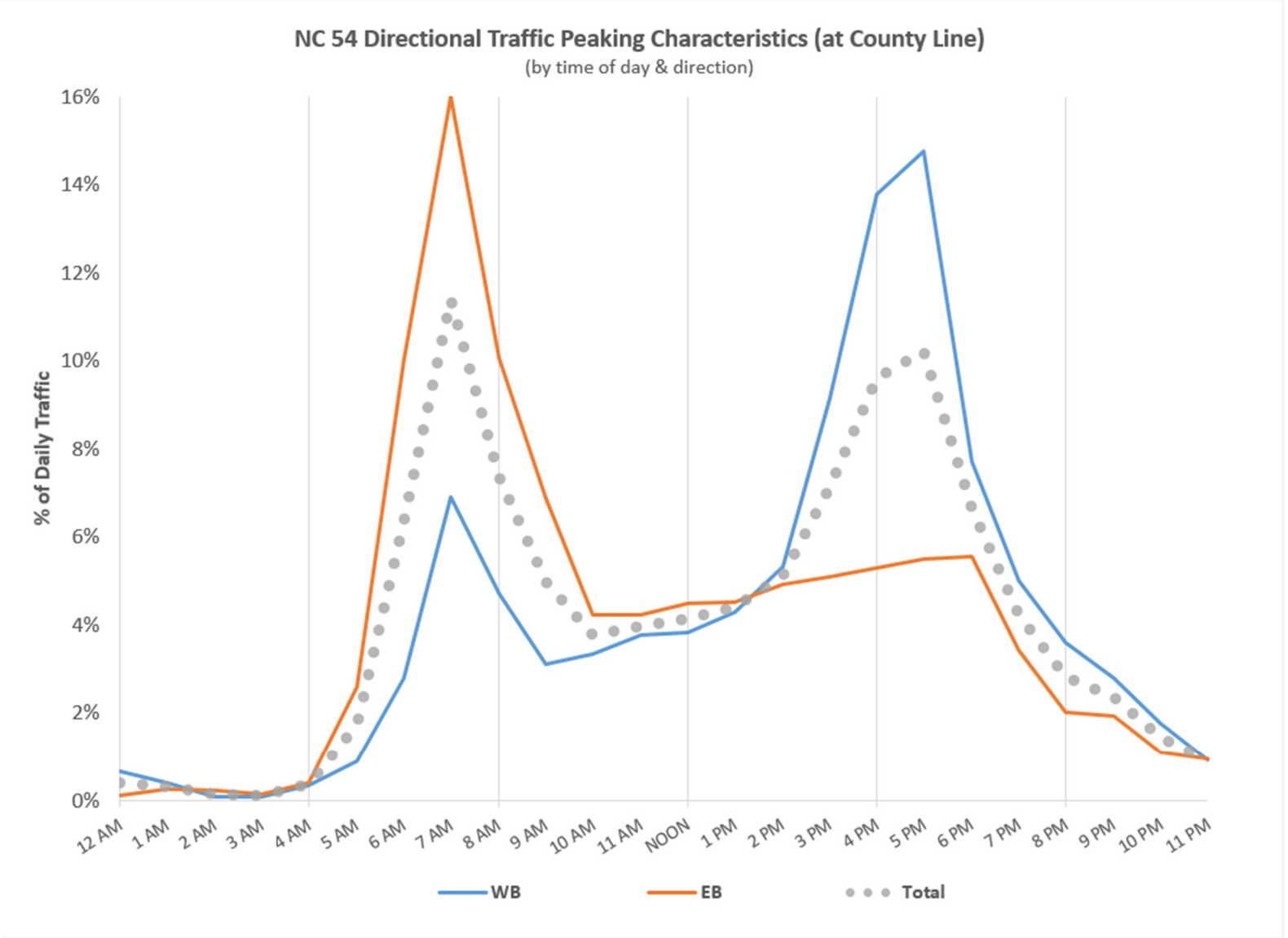
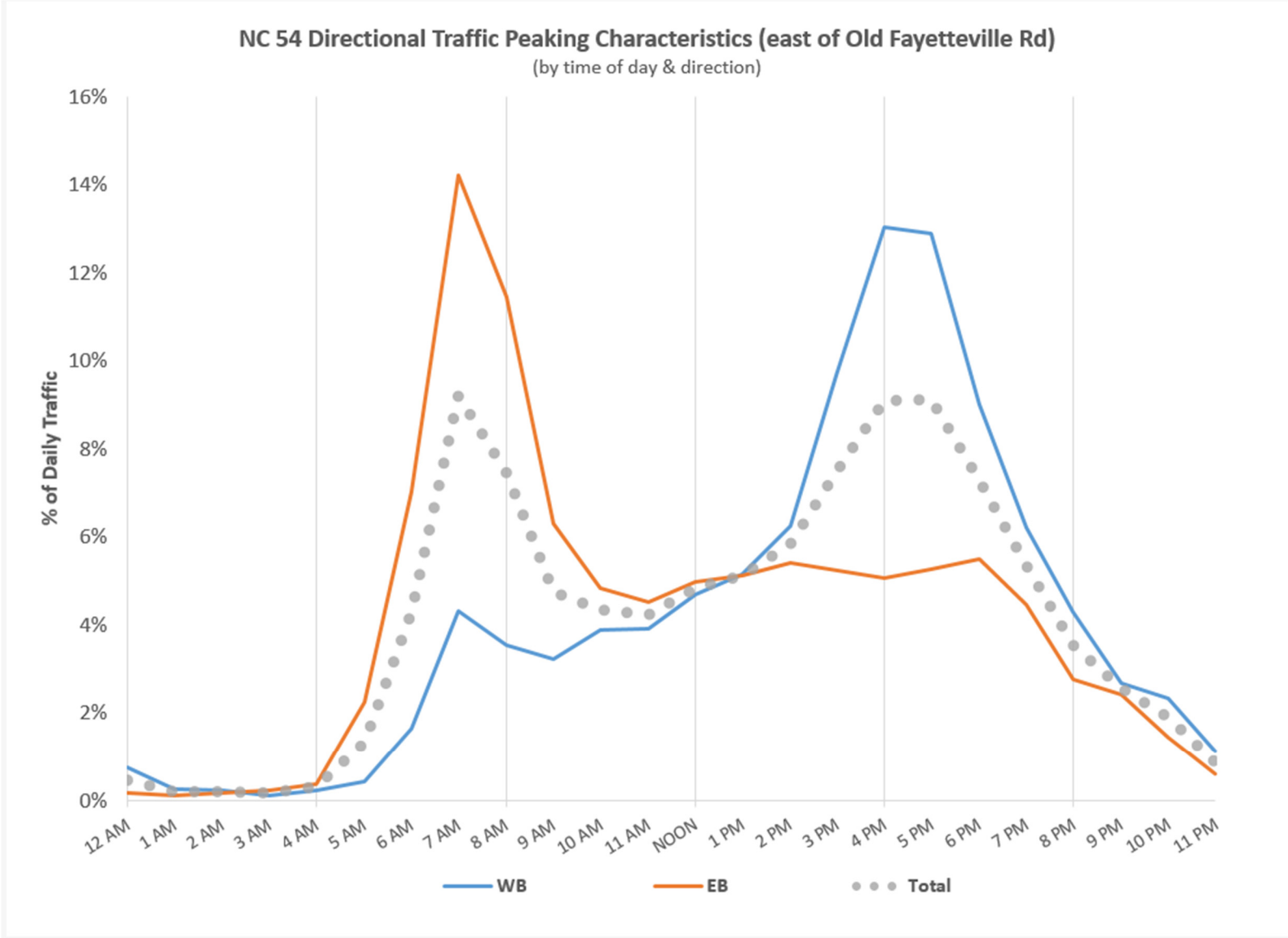


Figure 9: NC 54 Traffic Peaking by Direction (eastern end of corridor)



These variations in traffic demand patterns affect the design of potential solutions. The degree to which this characteristic persists into the future depends largely on land use changes, both inside and outside the corridor. Assumptions regarding the location, nature, and magnitude of development must be carefully considered in forecasting design year traffic volumes.

Vehicle Speeds

Given the length of the corridor, comprehensive speed studies were not feasible. However, vehicle speeds are considered in the analysis of crash statistics later in this report.

Truck Volumes / Freight Movement

Data is divided into single unit trucks, which have two or more axles but no towed trailer, and truck tractor semitrailers (TTST), which are trucks towing separate trailer units.

Table 3 summarizes the results of this data collection effort.

Table 3: Truck Percentages (from 48-hour counts)

Location	Single Unit	TTST	All Trucks
1. NC 54 east of I-40/I-85	2.3%	1.3%	3.3%
2. NC 54 near Alamance-Orange Co Line	1.5%	1.0%	2.5%
3. NC 54 west of Old Fayetteville Road	1.7%	0.8%	2.4%

These truck percentages are slightly lower than would be expected for a Minor Arterial like NC 54. This may be due to the presence of I-40 as a more direct thru route across Alamance and Orange counties.

Intersection turning movement counts conducted for this study also include truck data, used in calculating intersection levels-of-service during peak periods, when trucks typically comprise a smaller share of total traffic.

2.2.2.2 Intersection Turning Movement Counts

MioVision cameras were used to collect intersection turning movement counts at eight locations on Tuesday and Wednesday, September 12th and 13th, 2017. Due to heavy rains, the Tuesday counts were not used. Passenger vehicles, motorcycles, light goods vehicles, single-unit trucks, articulated trucks, bicycles, pedestrians, and buses were counted over a 16-hour period (6:00 AM to 10:00 PM) and summarized. AM and PM peak hours were also identified and summarized. Detailed summaries of the traffic counts can be found in the Appendix. Counts were conducted at the following locations:

Signalized Intersections

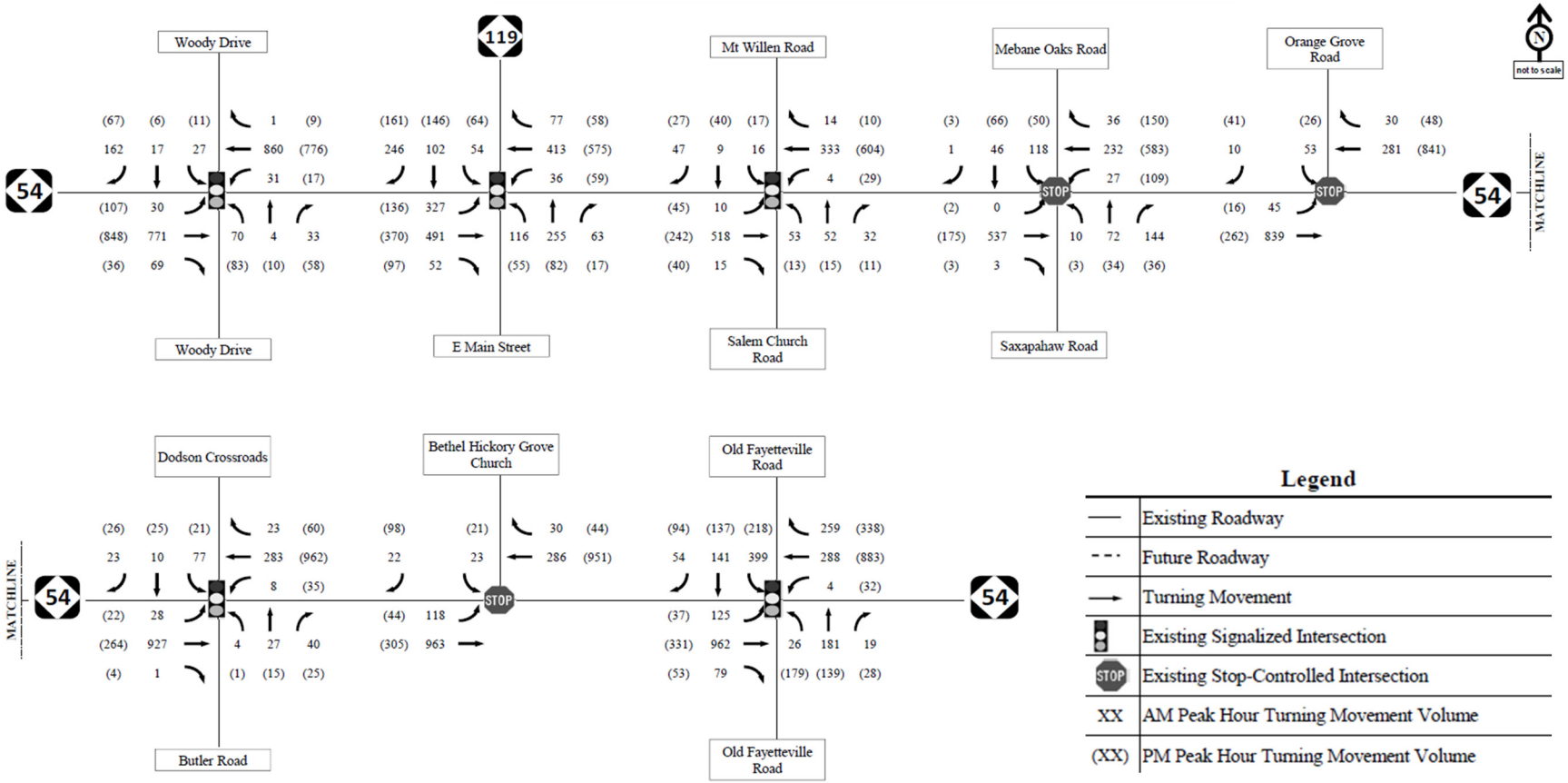
- Woody Dr (SR 2105)
- NC 119/E Main St (SR 2159)
- Mt Willen Rd/Salem Church Rd (SR 2142)
- Dodsons Crossroads (SR 1102)/Butler Rd (SR 1951)
- Old Fayetteville Rd (SR 1107/SR 1937)

Unsignalized Intersections

- Mebane Oaks Rd (SR 1007)/Saxapahaw Rd (SR 1961)
- Orange Grove Rd (SR 1006)
- Bethel Hickory Grove Church Rd (SR 1104)*

Figure 10 depicts peak hour turning movements at each intersection.

Figure 10: Peak Hour Turning Movements



2.2.3 Pedestrian and Bicycle Trips

Pedestrian counts collected for this study revealed a total of 57 pedestrians crossing the corridor during the 16-hour count period (6 Am – 10 PM Wednesday, September 13, 2017). Eight pedestrians were observed at three studies intersections on the western end (Alamance County), and 49 pedestrians were observed at two intersections within Orange County.

The intersection of Old Fayetteville Road observed 48 of the 57 pedestrians (84%). Sidewalks are present along one side of Old Fayetteville Road, as are Chapel Hill Transit bus stops. This roadway connects commercial/retail development to the south of NC Hwy 54 with residential and McDougle Elementary/Middle School to the north.

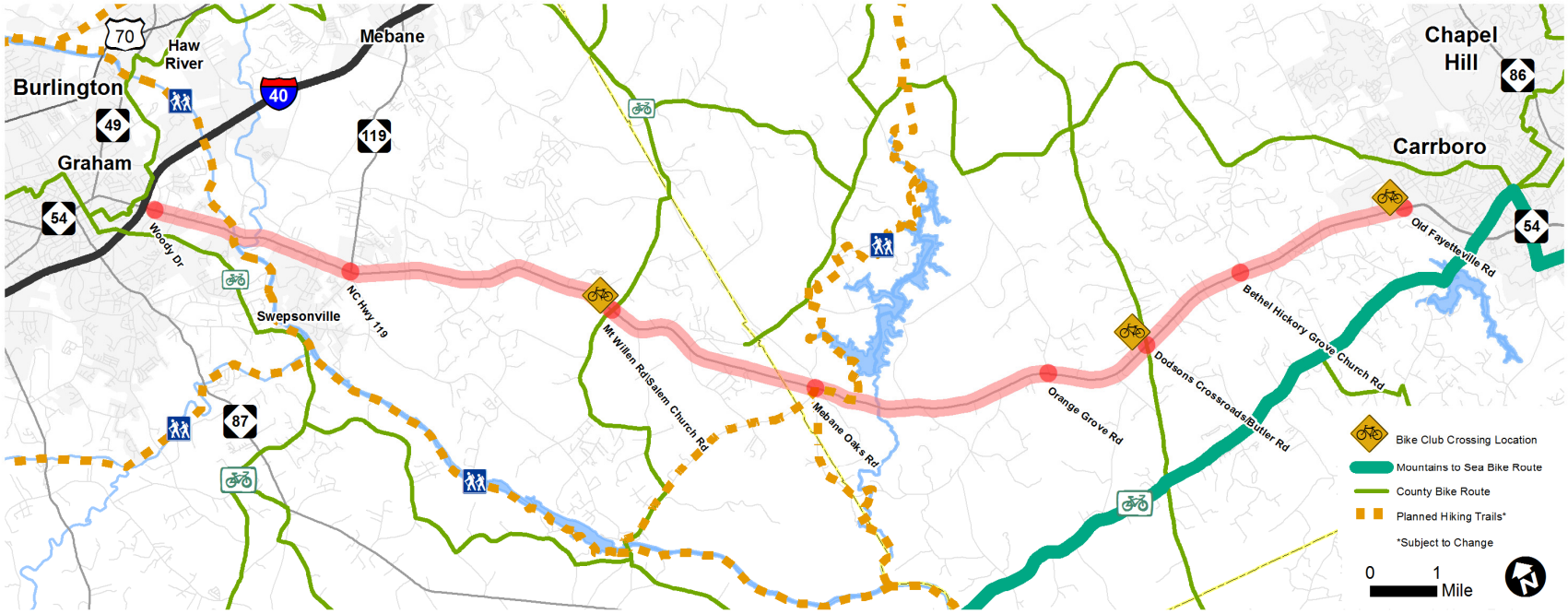
Bicycle counts collected for this study revealed a total of 77 cyclists among seven intersection count locations. More than 60 cyclists (84%) were observed east of the Orange Grove Road intersection in Orange County.

Most cyclists within the corridor are crossing NC 54 rather than riding along it. There are a variety of formal and informal cycling clubs and groups rides throughout the week in the corridor's vicinity. Higher levels of group bicycle rides are reported during the weekend. Cycle club members who choose to ride along the corridor are experienced, and comfortable operating a relatively high speed with vehicular traffic. A majority of cyclists are less experienced, and therefore do not choose to ride along this corridor (see Figure 11).

Strava is an online exercise community where users contribute GPS data from their watch or smart phone to map their route and calculate distances, speed (pace), and/or calories burned. Strava data suggests that cyclists are crossing the corridor at several intersections, associated with regional bicycle routes. Some of the more significant intersections include (from west to east):

- Jim Minor Road,
- Salem Church Road – Mt Willen Road (Alamance County Regional Bicycle Route),
- Thorn Road,
- Saxapahaw Road – Mebane Oaks Road,
- Butler Road – Dodsons Crossroads,
- Bethel Hickory Grove Church Road, and
- Old Fayetteville Rd.

Figure 11: Bicycle Routes and Hiking Trails in Corridor



2.2.4 Transit Service

There are five transit service providers in the NC 54 corridor, and the provision of service ranges from an on-demand service to an express regional service. All routes are served by shuttle vans or transit buses.

- Alamance County Transportation Authority operates an on-demand reservation-based shuttle van service across the county Monday-Friday, 5:00 AM - 5:30 PM.
- Chapel Hill Transit operates the weekday peak-hour CPX route that connects the Carrboro Plaza Park and Ride on NC 54 and Old Fayetteville Road to the Chapel Hill downtown and UNC Chapel Hill Campus.

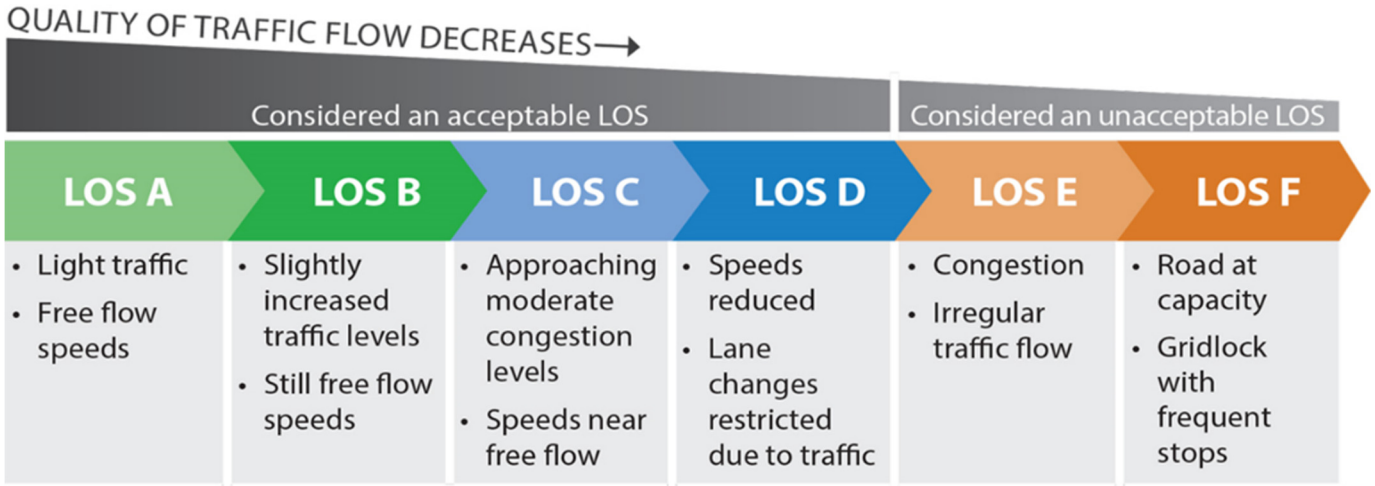
- The Piedmont Authority for Regional Transportation operates the Route 4: Alamance Burlington Express. Route 4 is a fixed route and schedule service that departs from the Greensboro Depot three times in the morning and two times in the evening and terminates at the Ambulatory Care center at the University of North Carolina Hospital in Chapel Hill. The route travels along I-85 and I-40, and it stops at the Alamance Park & Ride on Kirkpatrick Road in the study corridor's north-west proximity.
- Link Transit operates light transit service vehicles on fixed routes and schedules for the communities of Burlington and Gibsonville and Alamance Community College. The Orange Route crosses the north-western portion of the corridor on I-85. The two stops in the corridor's vicinity are a Park & Ride Lot (located at Hwy 87 and Crescent Square Drive) and Alamance Community College. The Orange Route service maintains 90-minute headways beginning in 6:35AM and concludes shortly before 8PM.
- Orange County Public Transportation (OPT) operates demand response services across Orange County, including the study corridor. OPT also operates a commuter connector route to the north of the corridor between Hillsborough and Mebane, Monday through Friday, from 10AM-3PM along I/40 I/85 and US 70.

2.3 Traffic Operations and Quality of Service

There are a variety of ways to measure the performance of a transportation facility. Transportation professionals typically rely on guidance from the Highway Capacity Manual, which describes performance from the traveler point of view that is designed to be useful to roadway operators, decisions makers and member of the community. Individuals may travel along NC 54 via personal vehicle, walking, bicycling, or via transit, each of which can be quantitatively measured using standard criteria such as delay, average speed, percent time spent following or other measures. The dominant form of transportation currently along NC 54 is by automobile. As a result, this section covers traffic operations along the corridor on a corridor basis (i.e. distinguishable segments with common roadway characteristics), as well as by individual intersections. Given the low volume of pedestrian and bicycle trips, and the lack of dedicated facilities, providing a meaningful assessment of bicycle level-of-service is difficult; however, deficiencies and opportunities can be identified.

The conventional concept of traffic, level-of-service (LOS) can be summarized—at least qualitatively—in Figure 12 below. More detailed, qualitative tables are presented in subsequent sections. Generally, LOS D is acceptable in most rural and suburban situations. In some highly urbanized settings, or where there are unacceptable environmental/community impacts, excessive costs, or other policy or planning objectives, LOS E can be appropriate.

Figure 12: Level of Service Illustration



2.3.1 Corridor-Level

For corridor-level capacity analysis using Highway Capacity Software Plus (HCS+), NC 54 was divided into seven segments, each assessed for level-of-service (LOS) in the AM and PM peak hours. The 5-lane segment between I-40/I-85 and NC 119 was treated as a multilane highway (its predominant character). The remaining segments were classified as Class I two-lane highway. This classification applies to intercity routes connecting major traffic generators and serving commuters who expect to travel at relatively high speeds. For these segments, directional analysis was required to capture the effects of opposing traffic and passing restrictions.

Segmental corridor analyses were conducted using the Highway Capacity Software Plus (HCS+) software package. Segmental corridor LOS results reflect daily operations; however, peak-hour parameters are considered. To analyze segments, various parameters are accounted for, including daily volume, lane width, shoulder width, peak hour directional split, terrain type, access point density and truck percentages. The LOS analysis integrated data from the

traffic count VHB conducted in fall 2017. Figure 13 graphically represents the worst case (AM or PM peak) directional LOS for the corridor.

Figure 13: Peak Period Corridor Level of Service Summary for NC 54

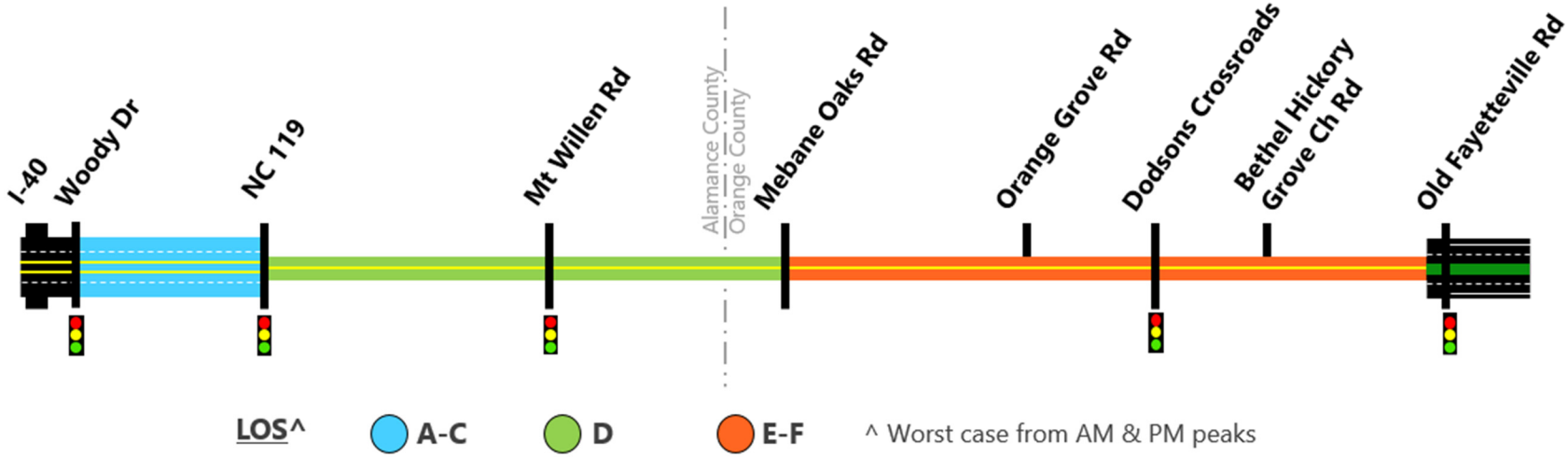


Table 4 summarizes results for the 5-lane segment between I-40/I-85 and NC 119. LOS for this type of facility is determined by traffic density (passenger-cars per mile per lane, or pc/mi/ln). Conditions are very good, with both directions operating at LOS B or better during both peak hours. Intersection LOS appears to be the more critical capacity consideration in this portion of the corridor.

Table 5 describes level of service criteria relating to average travel speed (ATS) and percent time-spent following (PTSF) for Class I facilities. PTSF can have a significant impact on LOS when there are

What is Percent Time-Spent Following (PTSF)?

PTSF is a traffic performance measure for two-lane highways that describes the average percent of travel time that vehicles spend in platoons (i.e. groups) behind a slower moving vehicle due to the inability to pass. Higher PTSF percentages indicate decreasing levels of service (e.g. travel speed relative to posted speed).

Source: Highway Capacity Manual, 6th Edition: A Guide for Multimodal Mobility Analysis (2010)

few opportunities to pass slower-moving vehicles, typically because of sight-distance limitations.

Table 6 summarizes the results of HCS capacity analysis by segment and direction for the AM and PM peak periods. In general, LOS is slightly lower in the AM peak due to a combination of higher volumes and more pronounced directionality.

Table 4: Corridor Level of Service Summary for NC 54: 5-Lane w/ Two-Way Left Turn Lane

Segment Location	Segment Length (miles)	AM Peak			PM Peak		
		Segment LOS	Avg. Speed (mph)	Density (pc/mi/ln)	Segment LOS	Avg. Speed (mph)	Density (pc/mi/ln)
Woody Dr – Mebane Oaks Rd (EB / WB)	3.2	A / B	45 / 45	11 / 11	B / B	45 / 45	12 / 11

Table 5: Level of Service Description for Two-Lane Highways

Level of Service	Class I Highways	
	ATS (mph)	PTSF (%)
A	>55	<=35%
B	>50 - 55	35% - 50%
C	>45 - 50	50% - 65%
D	>40 - 45	65% - 80%
E	<= 40	>80%
F	Flow rate exceeds segment capacity	Flow rate exceeds segment capacity

The segments between NC 119 and Mebane Oaks Road operate at acceptable levels of service at all times. East of Mebane Oaks Road, all four segments operate at LOS E in one direction during peak periods. During the AM peak, the eastbound

direction is deficient; the westbound direction fails during the PM peak. This is attributable not only to increasing traffic volumes to the east, but to the highly imbalanced directional flows discussed in Section 1.3.2.1. This characteristic is especially problematic given the limited passing opportunities within these segments. For example, the 2.6-mile segment between Bethel Hickory Grove Church and Old Fayetteville Roads is over 80% "no-passing," and averages 12 access points per mile, the highest density in the entire study corridor.

Example of no-passing and passing zone transition in corridor, near Thom Road

Table 6: Corridor Level of Service Summary for NC 54: 2-Lane Highway

Segment Location	Segment Length (miles)	AM Peak			PM Peak		
		Segment LOS	Avg. Speed (mph)	PTSF (%)	Segment LOS	Avg. Speed (mph)	PFFS (%)
NC 119 – Mt Willen Rd (EB / WB)	4.1	D / D	45 / 45	76 / 74	C / D	45 / 44	68 / 83
Mt Willen Rd – Mebane Oaks Rd (EB / WB)	3.3	D / C	46 / 47	77 / 62	B / D	47 / 46	53 / 79
Mebane Oaks Rd – Orange Grove Rd (EB / WB)	3.6	**E** / B	44 / 46	86 / 54	B / **E**	46 / 44	53 / 86
Orange Grove Rd – Dodsons Crossroads (EB / WB)	1.6	**E** / C	42 / 44	87 / 57	B / **E**	44 / 42	54 / 88
Dodsons Crossroads – Bethel Hickory Grove Church Rd (EB / WB)	1.8	**E** / C	41 / 43	92 / 57	C / **E**	42 / 41	61 / 90
Bethel Hickory Grove Church Rd – Old Fayetteville Rd (EB / WB)	2.6	**E** / C	40 / 41	92 / 62	C / **E**	40 / 40	65 / 93

The HCS methodology for estimating LOS for travel by bicycle (BLOS) is an empirically-derived procedure that assesses a facility's suitability for bicycle travel using a specified set of roadway characteristics, including traffic volume and speed; heavy vehicle percentage; pavement condition; access points on right side; presence of bicycle lane; and bicycle lane, shoulder, and outside travel lane widths. Table 7 summarizes the BLOS for each segment by direction and peak period. Note that BLOS for individual intersections has not been calculated.

In its current state, this corridor is generally not well-suited for bicycle travel. The segments at each end of the corridor operate at LOS E in at least one direction during at least one peak period. The most important contributing factors appear to be traffic volumes and speeds; lack of bicycle lanes; limited width of shoulders and outside travel lanes; and density of access points.

Table 7: Corridor Segment Bicycle LOS Summary for NC 54

Segment Location	Segment Length (miles)	AM Peak		PM Peak	
		Segment BLOS	BLOS Score	Segment BLOS	BLOS Score
Woody Dr – Mebane Oaks Rd (EB / WB)	3.2	B / B	2.3 / 2.3	B / B	2.4 / 2.5
NC 119 – Mt Willen Rd (EB / WB)	4.1	D / D	4.3 / 4.19	D / D	4.2 / 4.1
Mt Willen Rd – Mebane Oaks Rd (EB / WB)	3.3	D / D	4.2 / 4.0	D / D	3.9 / 4.3
Mebane Oaks Rd – Orange Grove Rd (EB / WB)	3.6	D / D	4.4 / 3.9	D / D	3.9 / 4.5
Orange Grove Rd – Dodsons Crossroads (EB / WB)	1.6	D / D	4.5 / 3.9	D / **E**	3.9 / 4.5
Dodsons Crossroads – Bethel Hickory Grove Church Rd (EB / WB)	1.8	**E** / D	4.6 / 3.9	D / **E**	4.0 / 4.5
Bethel Hickory Grove Church Rd – Old Fayetteville Rd (EB / WB)	2.6	**E** / D	4.6 / 4.0	D / **E**	4.1 / 4.6

2.3.2 Intersections

Peak hour LOS measures the adequacy of the intersection geometrics and traffic controls of a particular intersection or approach for the given turning volumes. Levels of service range from A through F, based on the average control delay experienced by vehicles traveling through the intersection during the peak hour. Control delay represents the portion of total delay attributed to traffic control devices (e.g., signals or stop signs). The engineering profession generally accepts LOS D as an acceptable operating condition for signalized intersections in urban areas LOS C for rural areas.

At unsignalized intersections, LOS E is generally considered acceptable only if the side street encounters delay. Nevertheless, side streets sometimes function at LOS F during peak traffic periods; however, the traffic volumes often do

not warrant a traffic signal to assist side street traffic. Table 8 provides a general description of various levels of service categories and delay ranges.

Table 8: Level of Service Description for Intersections

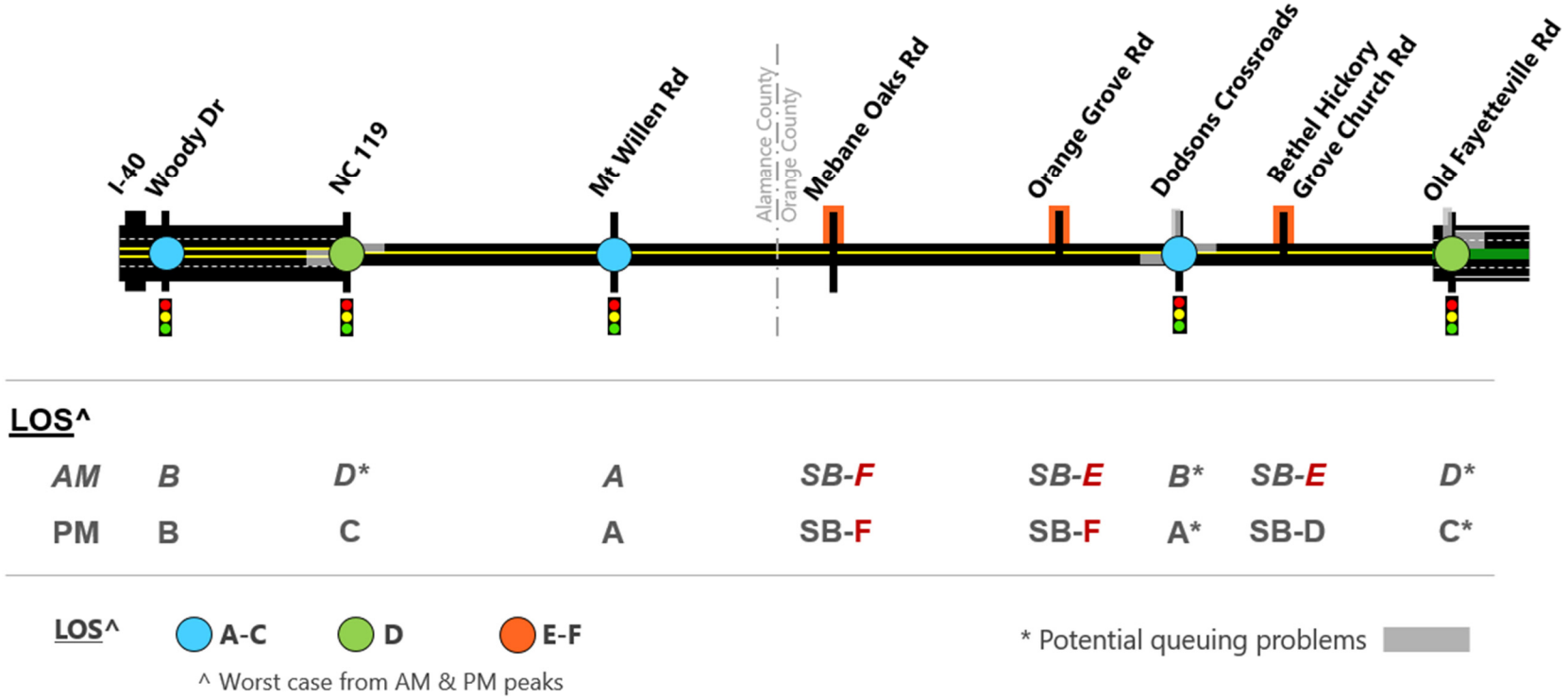
Level of Service	Description	Signalized	Unsignalized
A	Little or no delay	<= 10 sec.	<= 10 sec.
B	Short traffic delay	10-20 sec.	10-15 sec.
C	Average traffic delay	20-35 sec.	15-25 sec.
D	Long traffic delay	35-55 sec.	25-35 sec.
E	Very long traffic delay	55-80 sec.	35-50 sec.
F	Unacceptable delay	> 80 sec.	> 50 sec.

Level of Service Analysis

Intersection LOS analyses were performed for the typical weekday AM and PM peak hours using *Synchro/SimTraffic Professional Version 9.* The Existing (2017) scenario analysis utilized the existing signal plans from the NCDOT. The intersection cycle lengths were optimized, and in some cases, where the optimized cycle length fell below the recommended minimum, the cycle length was set manually at the NCDOT minimum cycle length. A summary of the findings for the Existing (2017) scenario level of service analysis can be found in Table 9, and the full *Synchro/HCS* output can be found in Appendix II. Figure 14 graphically depicts the worst case (AM or PM peak) LOS for signalized intersections and unsignalized approaches, as well as identifying locations with potential for queuing problems.

All five signalized intersections analyzed are operating at acceptable overall LOS during peak hours, and in every case, conditions are worse during the AM peak. In terms of individual approaches, except for the NC 119/East Main Street intersection, NC 54 generally experiences a better LOS than do cross streets. The only approach with a failing LOS is southbound Old Fayetteville Road, which operates at LOS E during the AM peak.

Figure 14: Intersection LOS



Long vehicle queues have the potential to create problems (typically by exceeding available storage length) at several signalized intersections:

- NC 54 westbound through and left-turn lanes at East Main Street (City of Graham) (AM peak only)
- NC 54 westbound through turn lane at Dodsons Crossroads (PM peak only)
- NC 54 westbound through lane at Old Fayetteville Road (PM peak only)
- Old Fayetteville Road southbound left-turn lane at NC 54 (AM peak only)

All three 2-way STOP-controlled intersections analyzed have a cross street approach operating at LOS E or F during at least one peak period. However, only the Mebane Oaks Road/Saxapahaw Road intersection fails overall, operating at LOS E during the AM peak. The Mebane Oaks Road approach experiences LOS F during both peak hours.

These LOS deficiencies are due mainly to vehicles waiting to turn left onto NC 54, although crossing and right-turning vehicles contribute. Combined with heavy peak-hour traffic, high speeds and some visibility constraints create long delays as drivers wait for adequate gaps in traffic. In many cases, a single left-turning vehicle can block several other vehicles that could otherwise have safely executed a right turn onto NC 54. The location with the greatest potential for long vehicle queues is southbound Mebane Oaks Road (95th percentile queues of >12 cars in the AM, and nearly 6 cars in the PM).

As delays build, impatient drivers sometimes make unsafe maneuvers, leading to higher crash rates. These delays—as well as left-turn delays *from* NC 54—can also encourage traffic to take alternate routes, such as Stanford Road instead of Orange Grove Road.

Table 9: Intersection LOS and Delay

Intersection and Approach	Traffic Control	2017 LOS & Avg Delay/Veh (sec) AM	PM
NC 54 & Woody Drive	Signalized	**B (15.9)**	**A (11.7)**
Eastbound		B-10.4	A-6.6
Westbound		B-10.6	A-8.8
Northbound		D-41.5	D-45.0
Southbound		D-49.0	D-40.8
NC 54 & NC 119 / East Main Street	Signalized	**D (42.0)**	**C (20.8)**
Eastbound		D-41.7	B-14.5
Westbound		D-48.1	C-23.8
Northbound		C-26.7	C-20.7
Southbound		D-47.6	C-27.8
NC 54 & Mt Willen Road / Salem Church Road	Signalized	**A (9.2)**	**A (7.6)**
Eastbound		A-6.9	A-4.3
Westbound		A-5.5	A-6.5
Northbound		C-22.9	C-20.5
Southbound		B-19.4	C-22.9
NC 54 & Mebane Oaks Road / Saxapahaw Road	2-Way STOP	**E (12.3)**	**B (26.4)**
Eastbound		---	---
Westbound		---	---
Northbound		D-33.6	C-22.9
Southbound		**F-306.8**	**F-96.8**
NC 54 & Orange Grove Road	2-Way STOP	**A (2.2)**	**A (1.5)**
Eastbound		---	---
Westbound		---	---
Southbound		**E-38.7**	D-25.5
NC 54 & Dodsons Crossroads / Butler Road	Signalized	**B (12.2)**	**A (9.0)**
Eastbound		B-10.7	A-3.2
Westbound		A-3.7	A-8.7
Northbound		C-26.6	C-24.6
Southbound		D-40.0	C-27.7
NC 54 & Bethel Hickory Church Rd	2-Way STOP	**A (1.7)**	**A (3.7)**
Eastbound		---	---
Westbound		---	---
Southbound		D-33.4	**E-41.2**
NC 54 & Old Fayetteville Road	Signalized	**D (39.4)**	**C (34.6)**
Eastbound		C-23.5	B-18.0
Westbound		C-27.4	C-31.6
Northbound		D-53.5	D-43.4
Southbound		**E-76.3**	D-51.9

2.4 Safety

Given the changes in the corridor segments to the west and east of NC 119, some differentiation is warranted in performing crash analysis. The cross-sections are the most significant difference, although traffic volumes and speeds, development/access density, signalized intersection spacing, and vertical and horizontal alignments also contribute. For this reason, the portion of the corridor west of NC 119 is compared against a typical NC route in an urban area with a 5-lane cross section. While the corridor's context is qualitatively and narratively described as rural in nature, the two-lane highway segment to the east of NC 119 is also compared to urban routes for the safety analysis. This comparison is supported by a conservative analytical approach and because most of it the section lies within an MPO-designated urbanized area.

Analysis of crashes reported along the study corridor from November 2012 through October 2017 reveals that total crash rates for the NC 54 study area are slightly higher overall than the Critical Crash Rates determined by comparing NC 54 with similar facilities in North Carolina (see Tables 10 and 11). However, rates for fatal crashes are lower on NC 54. NC 54 exceeds the respective Critical Crash Rates for non-fatal injuries and for wet conditions, but not for nighttime crashes.

There were 714 recorded crashes in the study corridor during the analysis period. The 3.2 miles west of NC 119 (16% of the corridor length) accounted for 29% of the crashes. Rear-end collisions accounted for 227 crashes, or nearly one-third of the total. These crashes were distributed the most evenly between the two corridor segments. The frequency of this crash type is not surprising, given the combination of frequent driveways and intersections, relatively high travel speeds, and rolling terrain.

The second most common crash type involved animal strikes. These 136 crashes represented 19% of the total, and were distributed very unevenly through the corridor: only 9 occurred in the western segment. The 126 animal strikes in the eastern portion of the corridor represented 25% of all crashes there. This disparity is not surprising given its more wooded and rural character. Thirty of these crashes were concentrated within a ½-mile of two locations: Freshwater Drive and Hatch Road.

Left turns accounted for 14% of all crashes, and angle collisions 9%. These crash types were heavily concentrated in the western portion of the corridor, together comprising 43% of all crashes west of NC 119 (compared with only 14% to the east). This difference can be attributed to the 5-lane cross-section and higher traffic volumes, which greatly increase the number of potential conflict points for any turning movement.

Sideswipes represent 6% of the crash total, running-off-the-road 3%, and right turns 1%. All other types of crashes combine to make up 17% of the total.

Table 10: Crash Rate Comparison for Western 5-Lane Segment (2013-2015 NC Data, per 100M veh-miles)

Rate	NC 54 Crashes	**Crashes per 100 MVM**	Statewide Rate [1]	**Critical Rate [2]**
Total	208	282.5	196.6	222.5
Fatal	2	1.0	1.7	4.7
Non-Fatal	76	82.5	60.7	75.4
Night	60	55.7	54.1	68.0
Wet	35	50.4	23.9	33.3

[1] 2013-2015 statewide crash rate for Total, All North Carolina (NC) Routes in North Carolina
[2] Based on the statewide crash rate (95% level of confidence).

Looking west towards I-40/I-85

Looking west towards Long Dairy Rd

Looking east towards Bethel Hickory Grove Church Road

Looking west at Wormranch Road

Table 11: Crash Rate Comparison Eastern 2-Lane Segment (2013-2015 NC Data, per 100M veh-miles)

Rate	NC 54 Crashes	**Crashes per 100 MVM**	Statewide Rate [1]	**Critical Rate [2]**
Total	507	241.4	196.6	209.8
Fatal	2	1.3	1.7	3.1
Non-Fatal	182	75.6	60.7	68.1
Night	165	57.6	54.1	61.1
Wet	57	41.5	23.9	28.6

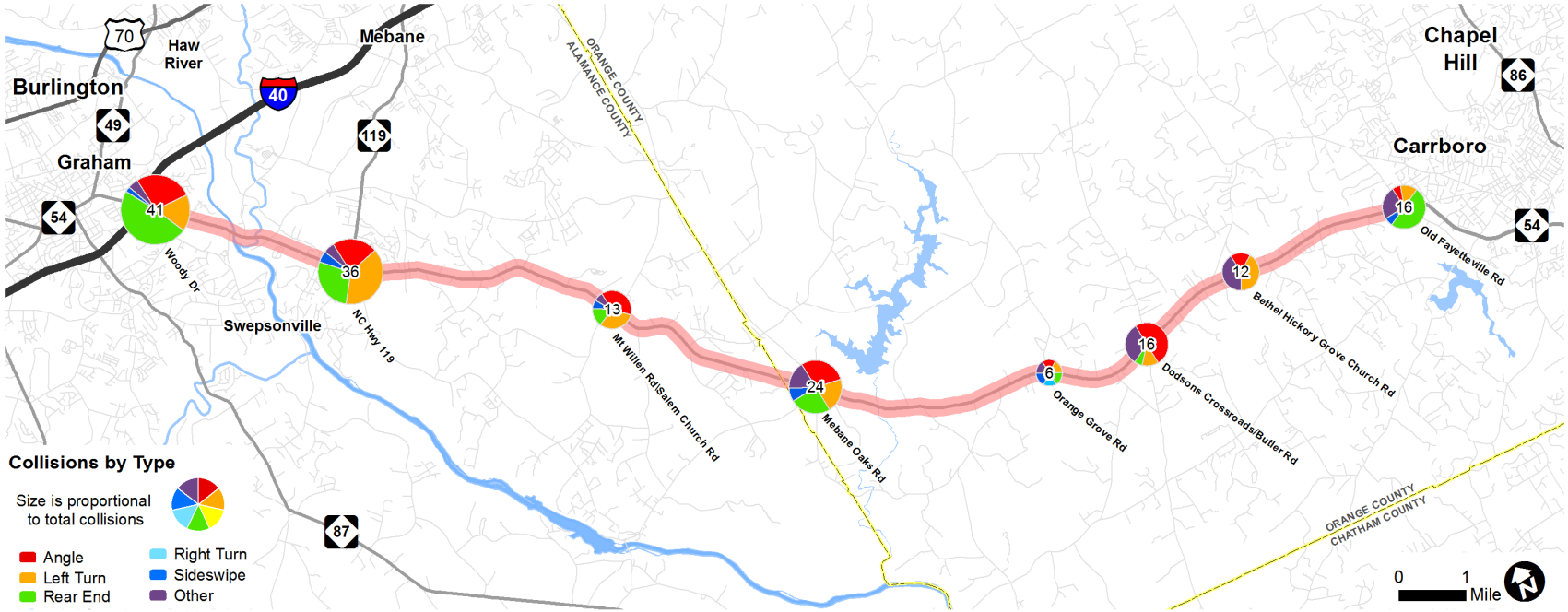
[1] 2013-2015 statewide crash rate for Total, All North Carolina (NC) Routes in North Carolina
[2] Based on the statewide crash rate (95% level of confidence).

Figure 15 depicts the number and types of crashes at the major intersections analyzed in this study. The number of crashes is generally proportional to the total volume of traffic passing through the intersection; the higher the volume, the greater the exposure to potential conflicts. The relatively high number of crashes relative to volumes at the Mebane

Oaks/Saxapahaw Road intersection indicates a problem, possibly due to intersection skew, curving approaches, and nearby intersections on Saxapahaw Road.

As would be expected, Rear End, Angle, and Left Turn crashes are the most common. The fact that Rear End collisions make up about half of the crashes at either end of the corridor suggests that drivers may not be anticipating the transitions occurring there between more rural and more urban conditions. The high proportion of Angle and Left Turn collisions at the Mebane Oaks/Saxapahaw Road and Mt Willen/Same Church Road intersections points to turning traffic as a contributing factor. Most of the large share of "Other" crashes at Bethel Hickory Grove Church Road and Dodsons Crossroads/Butler Road consist of Animal and Fixed Object strikes, as well as Ran Off Road, implying that speed and/or roadway alignment may be a major factor.

Figure 15: Intersection Crash Locations and Analysis



Six pedestrian crashes and three bicycle crashes **reported** along the corridor between 2007 and 2014 are summarized in Table 12 below from west to east. Many bicycle or pedestrian "near-misses" are not reported, and therefore unsubstantiated. Both travelling along NC 54 and crossing NC 54 are potentially hazardous, given the lack of appropriate accommodations for pedestrians and bicyclists. Traffic speeds, rolling terrain, driver expectations, and access locations all contribute to crash potential, and suggest that pedestrian and bicycle demand is suppressed due to discomfort and risk.

Although the number of bicycle and pedestrian crashes may not appear substantial for a corridor of this length, the severity of the results is a matter of concern. Due primarily to high vehicle speeds, one-third of these crashes resulted in a fatality, and over half caused either death or disabling injury. Whether for discretionary trips or because the traveler has no other options, this level of risk is difficult to accept, both in terms of personal costs and costs to society.

Table 12: Bicycle and Pedestrian Crashes (2007-14)

Type	Date	Day	Time	Location	Nearest Intersection	Severity
Pedestrian	Dec 2012	Monday	5:57 AM	Graham, Alamance County	Whittemore Rd	**K: Killed**
Pedestrian	Mar 2008	Sunday	2:27 AM	Graham, Alamance County	Ivey Road	**A: Disabling Injury**
Bicyclist	Jul 2007	Monday	5:45 PM	Alamance County	Clifford Ray Rd	B: Evident Injury
Pedestrian	Jun 2012	Sunday	4:56 PM	Alamance County	Brucewood Rd	B: Evident Injury
Pedestrian	Sep 2014	Wednesday	8:57 PM	Alamance County	Brucewood Rd	B: Evident Injury
Pedestrian	Nov 2010	Thursday	10:37 PM	Alamance County	Mt Willen Rd	**K: Killed**
Bicycle	Jun 2012	Sunday	12:42 AM	Orange County	Brookfield Dr	**K: Killed**
Bicycle	Jun 2009	Tuesday	9:13 AM	Orange County	Lavenia Ln	C: Possible Injury
Pedestrian	Oct 2010	Friday	3:00 PM	Carrboro, Orange County	Old Fayetteville Rd	**A: Disabling Injury**

Source: NCDOT Division of Bicycle and Pedestrian Transportation, https://www.ncdot.gov/divisions/bike-ped/Pages/research-data.aspx

2.5 Environmental Context

An environmental screening was completed for the project study area utilizing existing GIS resources. This screening analysis indicated areas of possible environmental concern, including streams and wetland areas, community resources, and locations of hazardous waste sites. These data were obtained from a variety of sources including those listed below:

- Local Government GIS Departments - Alamance County, Orange County, Burlington, Carrboro
- NC Center for Geographic Information and Analysis (NC One Map)
- NCDENR Division of Water Quality (DWQ)
- NC Department of Cultural Resources – State Historic Preservation Office (NC SHPO)
- NC Department of Environmental Quality – Waste Management (DEQ-WM)
- NC Department of Transportation GIS Unit
- NC Natural Heritage Program (NHP)
- NC Wildlife Resources Commission (WRC)
- US Fish and Wildlife Services (FWS)

Figures 16 through 18 illustrate the known environmental features present within the project study area as indicated by the environmental screening process.

This summary references environmental features that are located within the:

- Project corridor
- Project study area
- Vicinity of the project study area

The project corridor refers to the right-of-way, which varies between 100-124 feet wide along the corridor. The project study area refers to a quarter-mile buffer (2,640 feet total width) of the exiting roadway centerline, displayed as a red line in Figure 16. Features within the vicinity of the project study area are located beyond the quarter-mile buffer, however still relevant because they are nearby or downstream of the roadway.

2.5.1 Built Environment

The built environment in the study area is primarily rural residential, with agricultural farms scattered in between. There are commercial, highway retail, retail, and industrial developments at the eastern and western ends of the study area. Overall, the study area is low density.

A review of places of worship in the vicinity of the study area identified eight churches and three cemeteries. The full list is included as an Appendix item. One school (Alexander Wilson Elementary School) is located along the corridor at the NC 119 intersection, and there are two additional child care facilities in the corridor vicinity: Creative Child Care in Graham, and Our Playhouse Preschool near White Cross Road. One additional school (McDougle Elementary/Middle) is located more than 0.5 miles from the corridor, at its eastern end.

Other notable points of interest include a private airstrip (The Duchy Airstrip) adjacent to the corridor, off of Thorn Road in Alamance County and near the Alamance-Orange county border. This airstrip serves residents of The Duchy neighborhood. The Swepsonville Volunteer Fire Station 10 is located on the corridor's western end, near Salem Church Road – Mt Willen Road. The White Cross Volunteer Fire Station 2 is located on Neville Road, nearly 0.5 miles off of the corridor.

2.5.2 Land Use

Historic Properties

The North Carolina State Historic Properties Office (SHPO) is responsible for surveying and designating structures and districts of historical significance, and maintains an online webviewer with more information http://gis.ncdcr.gov/hpoweb/. The highest level of preservation is the National Register. The second highest is the State Study List. The third level is Determined Eligible, meaning that the properties are in the process of becoming placed on the Study List. All properties and districts listed in or eligible for listing in the National Register are considered in the planning of federal undertakings such as highway construction and Community Development Block Grant projects. The following historic properties were identified within the project study area:

National Register

- Bingham School (1978) – 1845 Greek Revival School – NE Corner of NC 54 & Mebane Oaks Rd.

State Study List

- Oaks Rural Historic District (1993) – contains Bingham School property – Mebane-Oaks Rd./Saxapahaw Bethlehem Church Rd intersection with NC Hwy 54 corridor.
- White Cross School (1993) – 3501 NC 54 Chapel Hill, NC 27516
- Hickory Grove School (1999) – 1101 NC 54 Chapel Hill, NC 27516

Determined Eligible for Study List

- Bethlehem Presbyterian Church (1998) – within Oaks Rural Historic District – 3624 Saxapahaw Bethlehem Church Rd. Mebane, NC 27302

Hazardous Materials

Ten gas stations were identified, each with underground storage tanks that may pose a potential challenge for redevelopment of these parcels.

- Kangaroo Express - 801 E. Harden St. Graham, NC 27253
- Shell Gas Station - 901 E. Harden St. Graham, NC 27253
- BP Gas Station - 924 E. Harden St. Graham, NC 27253
- Talbert's Grocery - 4848 NC 54 Graham, NC 27253
- PSM Food Mart - 4908 NC 54 Graham, NC 27253
- White Cross Citgo - 3322 NC 54 Chapel Hill, NC 27516
- White Cross Shell Gas Station - 3233 NC 54 Chapel Hill, NC 27516
- Exxon Gas Station - 601 NC 54 Chapel Hill, NC 27514
- Kangaroo Express Gas Station - 102 B Hwy 54W Carrboro, NC 27510
- Han-Dee Hugo Gas Station - 1401 W. Main St. Carrboro, NC 27510

A former landfill (Graham Disposal facility) previously operated along Cooper Road, approximately 0.25 miles off of the NC 54 Hwy corridor near the western end.

This GIS-level screening included the following hazardous waste categories, however, no features were identified within the study area: Active landfills, Brownfield sites, Dry-cleaning sites, Hazardous substance disposal sites.

Conservation

The Cane Creek Reservoir (8705 Stanford Road) near Mebane Oaks Road along the eastern end of the corridor, serves as a drinking water supply for 70,000 people and is operated by the Orange Water and Sewer Authority (OWASA). This reservoir includes recreational opportunities, including boat rental, fishing, nature trail and picnic areas. OWASA has acquired more than 1,600 acres of land within the Cane Creek watershed to protect the quality of this resource.

For additional background visit https://deq.nc.gov/about/divisions/water-resources/drinking-water/drinking-water-protection-program/success-stories/orange-county

2.5.2.1 Natural Environment

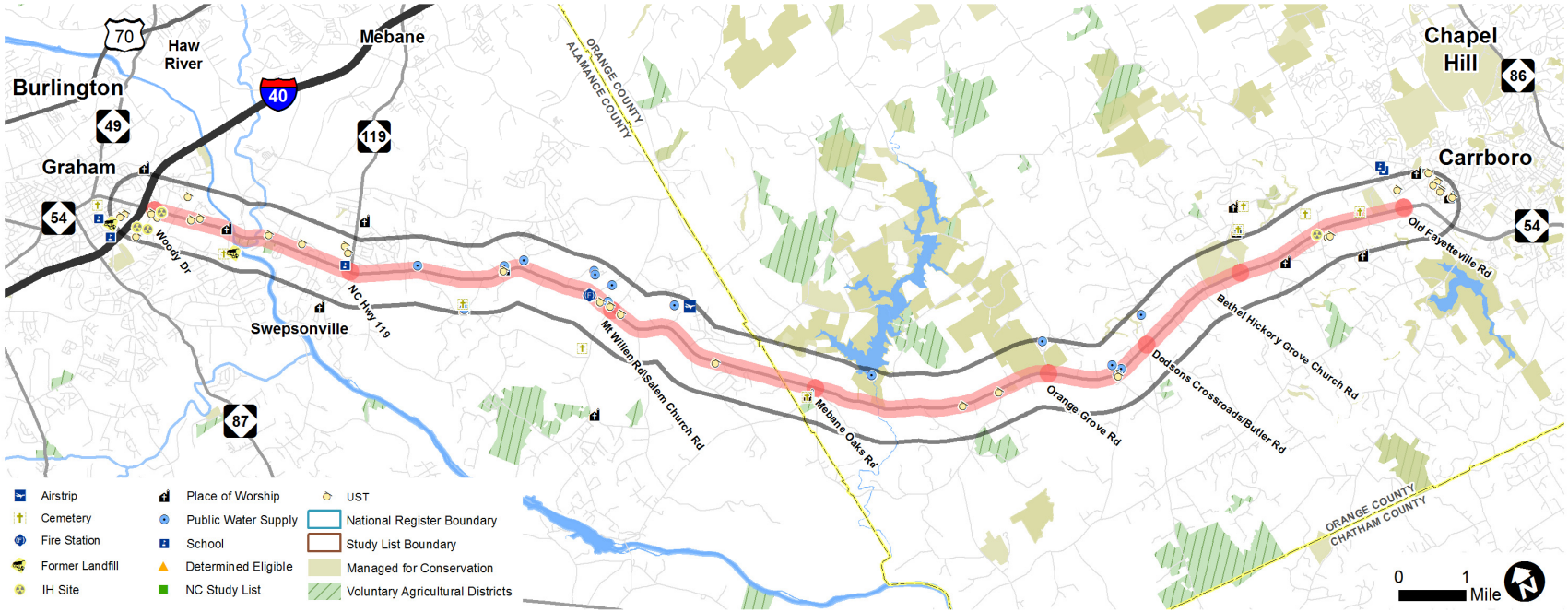
The NC Natural Heritage Program (NHP) is responsible for identifying occurrences of rare plants and animals, exemplary or unique natural communities, and important animal assemblages (see Figure 16). Collectively, these plants, animals, natural communities, and animal assemblages are referred to as elements of natural diversity, or simply as elements.

Some of the NHP resources that have been identified include:

- Easements of land managed by several agencies:
  - NC Clean Water Management Trust Fund (State)
  - NC Division of Mitigation Services (State)
  - Triangle Land Conservation Easement (Private)
- Orange County Water and Sewer Authority (OWASA) Property (Local)
- Orange County Open Space (Local)
- Natural Heritage Areas
  - Lower Cane Creek Slopes and Bottom – NAID #2160
  - Calvander Laurel Bluff and Bottom – NAID #30
- Natural Heritage Elements (Name – Significance level – Category ID – Year)
  - Unnamed Animal – Medium – Animal EOID# 8723 – 1988
  - Eastern Creekshell – Medium – Aquatic Community EOID# 29628 – 1996
  - Notched Rainbow – Medium – Aquatic Community EOID# 29488 – 1996

- Piedmont Alluvial Forest – Medium – Natural Community EOID# 13426 – 2010
- Piedmont Alluvial Forest – High – Natural Community EOID# 29368 – 1988
- Mesic Mixed Hardwood Forest – Low – Natural Community EOID# 29388 – 1988

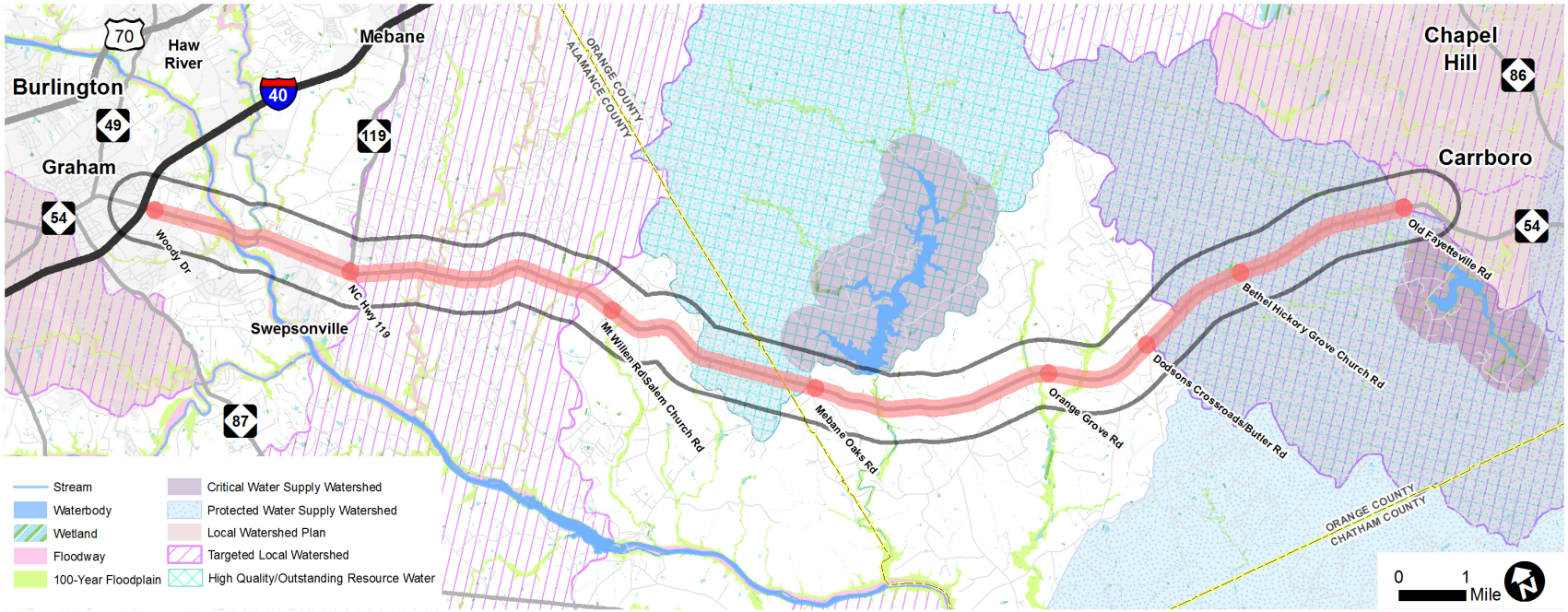
Figure 16: Places of Interest and Natural Features in Corridor



2.5.2.2 Water Quality

The Division of Water Resources (DWR), a subset of the NC Department of Environmental Quality, is responsible for the protection, classification and enhancement of all streams and water bodies within North Carolina. The project study area is located within the Cape Fear River Basin of North Carolina (see Figure 17).

Figure 17: Water Quality, Sources, and Watersheds in Corridor



There are no fewer than 12 named stream crossings along the corridor, with designated floodplains along 10 of them. The Haw River is the most regionally-significant stream crossed by the NC 54 Hwy corridor, which flows southeast into Jordan Lake and becomes the Cape Fear River below its US Army Corps of Engineer-controlled dam. The full list of streams along the corridor included in Table 13 below. Local watershed plans and floodplain presence is also included.

The local watershed plan for Morgan and Little Creek protects 74.5 square miles of land within Orange, Durham, and Chatham counties. More information on this Local Watershed Plan (LWP) is available here: https://files.nc.gov/ncdeq/Mitigation%20Services/Watershed_Planning/Cape_Fear_River_Basin/Morgan_Little_CK/Morgan%20and%20Little%20LWP%20Fact%20Sheet%20.pdf

Table 13: Identified Streams Along NC Hwy 54 Corridor

Number	Stream Name	Classification	Local Watershed Plan / Targeted Watershed Plan	Designated Floodplain
1	Town Branch	WS-V; NSW	-	Yes
2	Haw River	WS-V; NSW	-	Yes
3	Back Creek	WS-V; NSW	-	Yes
4	Haw Creek	WS-V; NSW	Targeted – Cape Fear CPF2	Yes
5	McAdams Creek	WS-V; NSW	Targeted – Cape Fear CPF2	No
6	Meadow Creek	WS-V; NSW	Targeted – Cape Fear CPF2	Yes
7	Motes Creek (Newland Creek)	WS-V; NSW	-	Yes
8	Caterpillar Creek	WS-II; HQW; NSW	-	No
9	Cane Creek	WS-V; NSW	Cane Creek Reservoir (OWASA)	Yes
10	Collins Creek	WS-V; NSW	-	Yes
11	Phils Creek	WS-II; HQW; NSW	Local (Morgan & Little Creeks), Targeted (Cape Fear CFP6)	Yes
12	Morgan Creek	WS-II; HQW; NSW	Local (Morgan & Little Creeks), Targeted (Cape Fear CFP6)	Yes

Water supply watersheds (WSW) are portions of land that drain into a reservoir that serves as a municipal drinking water supply. The portion of land that is immediately adjacent to the water intake is designated as 'critical', and the land that is upstream of this area is designated as a 'protected' water supply watershed.

Two water supply watersheds are present within the study area, Cane Creek and Morgan Creek. The Cane Creek WSW is class II, and protected as a nutrient-sensitive water (NSW). This WSW begins at the reservoir on Stanford Road and protects 20,200 acres of land upstream within Cane Creek. There are portions of critical and protected WSW along the corridor. The Morgan Creek protected WSW includes portions of the corridor, near the eastern end, however the critical portion surrounds University Lake further south of the study area. The Morgan Creek WSW protects 19,200 acres of land upstream.

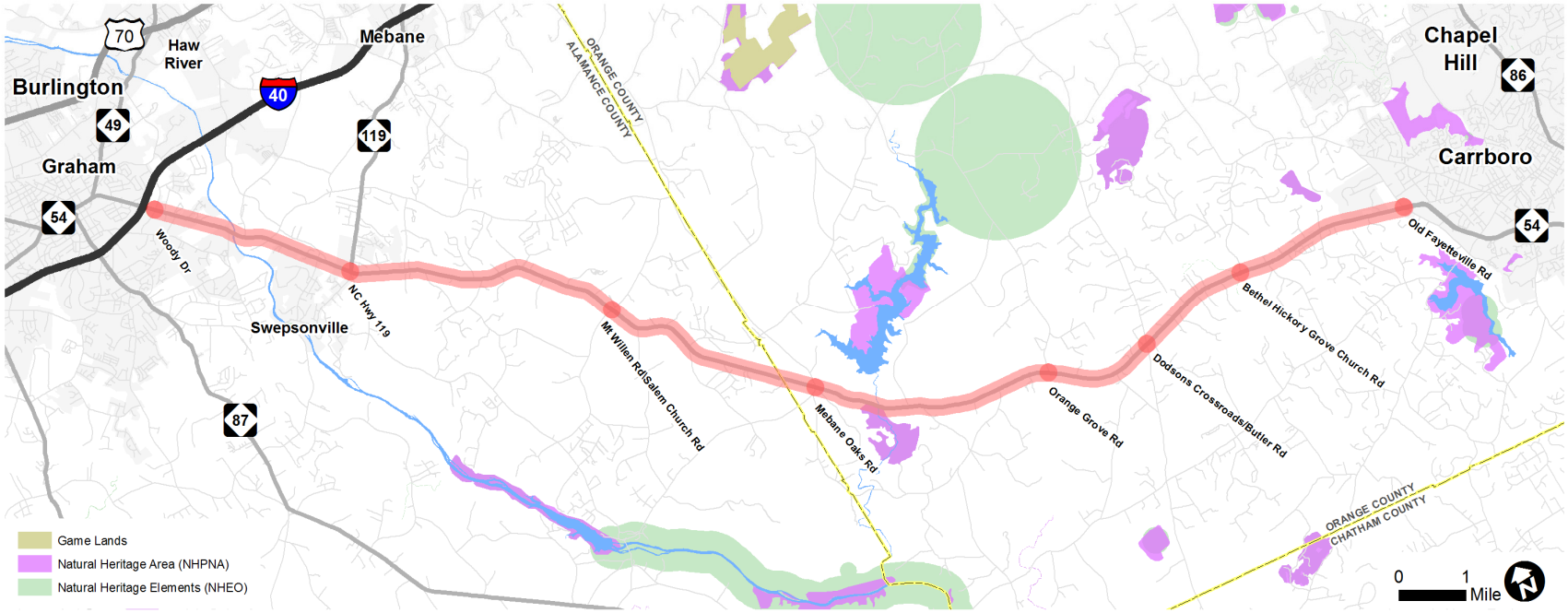
More information on water supply planning is available at https://deq.nc.gov/about/divisions/water-resources/planning/water-supply-planning.

2.5.2.3 Wildlife Resources

While it is not expected that this corridor study project would directly impact plant or animal species, best management strategies during construction must be implemented protect aquatic habitats within and downstream of the project study area.

This GIS-level screening included the following wildlife resource categories, however, no features were identified within the study area: Game lands, Dedicated nature preserves, Conservation for tax credit purposes (see Figure 18).

Figure 18: Wildlife Resources in Corridor



2.6 Relevant Plans

This section summarizes relevant planning and policy efforts, focusing on the most recent transportation-related plans, and on those specific elements that affect the NC 54 Corridor Study, or which could be affected by it.

2.6.1 Pedestrian and Bicycle Plans

Alamance County Trails Plan (2015)

The plan details the existing inventory of recreational trails in Alamance County and identifies goals to improve and extend trails through 2025. Two proposed recreation trail segments cross the study corridor. The Haw Creek Trail is a second priority proposed 9-mile trail that would follow Little Haw Creek, cross the corridor at Wormranch Road, and terminate at the Haw River. The other proposed trail is the extension of the high priority Haw River Trail north from Red Slide Park to along the Haw River to Swepsonville River Park to the south. The extension is noted as a 0-4-year Short Term goal. The proposed trail extension crosses the study corridor near Cherry Lane north of Swepsonville.

NCDOT Pedestrian and Bicycle Plan, "WalkBike NC" (2013)

The State Division of Bicycle and Pedestrian Transportation convened stakeholders and community members statewide to review and update the State's bicycling routes (among other objectives). The plan adopted an alternate alignment of the NC 2 – Mountains to Sea Route that crosses the study corridor at Bethlehem Saxapahaw Church Road in Orange County. Funding has not been programmed to implement wayfinding for this alternate route.

Orange County Bicycling Routes (2010)

Orange County's bicycling plan consists of existing signed routes, greenway trails, and unsigned connector routes. Two routes parallel the eastern portion of the NC 54 corridor, the Perimeter Route to the north and a segment of the Mountains-to-Sea Bicycle Route to the south. The North-South Route crosses NC 54 at Dodsons Crossroads Road, and this intersection is noted for higher traffic volumes. The County's plan lists NC 54 as a primary road.

Burlington-Graham MPO Bicycling Routes (2009)

The BGMPO's bicycling plan displays the area's primary and alternative routes. The Western Loop Route crosses NC 54 at Salem Church Road, and a segment of an unnamed alternative connector runs parallel to the corridor south of the Haw River.

TARPO Regional Bicycle and Pedestrian Planning Framework (2015)

The plan from the corridor's rural planning organization recommended paved shoulders for bicycles on both NC 54 and Orange Grove Road, and identifies other unspecified on-road bike accommodations on Mebane Oaks/Saxapahaw Bethlehem Church Road and on Dodsons Crossroad/Butler road. The plan also recommended pedestrian trails in the NC 54 corridor from White Cross eastward connecting to the Carrboro area and the development of the Mountains-to-Sea Trail from the Hillsborough area to the Alamance County line.

Burlington Greenways and Bikeways Plan (2017)

The purpose of the plan is to create a connected and comprehensive system of greenways and bikeways that enhance the quality of life throughout Burlington. The plan includes proposed shared use paths, separated bike lanes, neighborhood bikeways, and sidepaths. None of the plan elements intersect with the NC 54 West study corridor.

Town of Carrboro Comprehensive Bicycle Transportation Plan (2009)

The Town's bicycle plan recommended improvements for roadways and intersections to create a robust non-motorized network and establish viable alternative transportation routes. Among the plan's Top 10 Prioritized Projects is improvement at the Old Fayetteville and NC 54 intersection to include bicycle signal loop indicators and bicycle crossing signage to facilitate crossing NC 54 (this project's associated sidewalks and bicycle lanes along Old Fayetteville have been constructed). Non-priority projects along the NC 54 corridor include general bicycle improvements from Old Fayetteville Road along NC 54 west to the Town Limits and a sidepath along NC 54 from W Main St to Henry Anderson III Community Park

2.6.2 Regional/Long Range Transportation Plans

2013 Orange County Comprehensive Transportation Plan (CTP)

This plan addresses the aspirational transportation improvements within the TARPO jurisdiction of Orange County through the year 2035. It identifies several roadway, transit, bicycle, and pedestrian improvements within the NC 54 corridor area.

- Widen NC 54 from a two-lane road to a four-lane divided roadway between Orange Grove Road and Neville Road. This segment is anticipated to exceed acceptable Level of Service levels by the year 2035, and the widening and addition of a median is anticipated to alleviate congestion and allow for better access control.
- Increase cross section of Mebane Oaks Road to 24 feet wide between NC 54 to the Alamance County line. This widening would permit turn lanes and wider shoulders for other vehicular needs.
- Establish an express bus service on NC 54 from the Alamance County border to Neville Road (SR 1945).
- Provide a park-and-ride lot at the intersection of NC 54 and White Cross Road (SR 1951) to support transit and non-motorized users.
- Add 4-foot shoulders to Orange Grove Road (SR 1006) from NC 54 to Arthur Minnis Road (SR 1115) to support bicycle use.
- Recommend an off-road pedestrian facility from White Cross along NC 54 eastward to the DCHC MPO line.

2017 Burlington Graham Metropolitan Planning Organization Comprehensive Transportation Plan (CTP)

This plan addresses the aspirational transportation improvements in the Burlington-Graham Metropolitan Planning Organization (BGMPO) area through the year 2030. The noted recommendations along the NC 54 corridor include roadway and bicycle improvements:

- Widen NC 54 from two-lanes to an undivided four-lane facility from Swepsonville Road (SR 2116) to the BGMPO boundary and include a shoulder section for 0.8 miles.
- Widen NC 54 from a two-lane to a five-lane facility from Swepsonville Road to Freshwater Road
- Widen Jimmy Kerr Road from a two-lane to a five-lane facility from Trollingwood Road to Cherry Lane Road.
- Widen Swepsonville Road from a two-lane to a three-lane facility from NC 87 to Swepsonville Methodist Church Road.
- Widen Swepsonville Methodist Church Road from a two-lane to three-lane facility from Swepsonville Road to NC 54.

- General on-road bicycle network improvements.

An update in fall 2017 removed the Southern Alamance Loop project from the CTP. The project had included a new four-lane roadway that intersected NC 54 north of Swepsonville.

2017 Durham-Chapel Hill-Carrboro Metropolitan Planning Organization Metropolitan Transportation Plan (MTP)

This plan identifies the planned transportation improvements in the Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (DCHC MPO) area through the year 2045. The notable recommendation along the NC 54 corridor addresses roadway and bicycle improvements.

- Modernization of NC 54 from Old Fayetteville Road to the DCHC MPO boundary (Butler Road). Improvements included in modernization may include widened shoulders to accommodate bicycling and the addition of a median for vehicle turning movements. The project is categorized as Regional and is scheduled for completion in 2023.

2015 Burlington-Graham Metropolitan Planning Organization Metropolitan Transportation Plan (MTP)

This plan identifies the planned transportation improvements in the Burlington-Graham area through the year 2040. There are two projects within the NC 54 corridor. The first is the Southern Alamance Loop, a combination of a new four-lane modernized four-lane roadway that intersected NC 54 north of Swepsonville. However, an update in fall 2017 removed the Southern Alamance Loop project from the BGMPO's CTP. The second project is a 2040 widening of Jimmy Kerr Road from two to four-lanes between Trollingwood Road and Alamance Community College.

The 2040 MTP also references short-term through long-term pedestrian improvements from the City of Graham's 2006 Pedestrian Transportation Plan. Improvements along the project corridor include parallel five-foot sidewalks along NC 54 from E Pine Street to Cooper Road (short-term).

2.6.3 Corridor and Intersection Studies

US 15-501 Corridor Study Traffic Analysis Report (2014)

The US 15-501 study assesses level of service (LOS) changes from interchange improvements and roadway widenings on the portion of the corridor from NC 54 in Orange County to US 64 in Chatham County. Traffic volumes, vehicle delays, and LOS are compared across a 2013, 2040 no build, 2040 partial build (interchange improvements only) and 2040 full build (widenings and interchange improvements). The report predicts that without improvements at the NC 54/US 15-501 interchange, there will be an unacceptable LOS and vehicle delay in the AM and PM peak periods.

2.6.4 Other Plans, Studies, Policies, and Documents

Alamance County Zoning

Unincorporated areas within Alamance County are not regulated by zoning.

Orange County Unified Development Ordinance (Updated 2015)

Orange County has adopted zoning classifications and subdivision regulations to protect the natural environment and to promote compatible development of land. The Unified Development Ordinance was originally adopted in 2011, and has been updated as recently as 2015.

Properties along the corridor and within the Orange County jurisdiction fall into one of eight zoning classifications. Agricultural Service (AS) and Agricultural Residential (AR) relate to preserving land suitable for farming activities. Rural Buffer (RB) and Rural Residential (R1) relate to low density development without water or sewer utilities. Four commercial zones (Existing Commercial (EC5), Local Commercial (LC1), Neighborhood Commercial (NC2), and General Commercial (GC4) all relate to businesses that serve the needs of nearby residents, with a varying degree of proximity and density. More specific zoning definitions are available at http://www.orangecountync.gov/departments/planning_and_inspections/ordinances.php

Orange County Future Land Use (2016)

The future land use plan balances environmental constraints and community needs by accommodating a particular combination of compatible land uses and relating them to current zoning classifications. There are three basic land use categories (Developed, Transition, and Rural) and several overlays (watershed protection).

The project corridor is predominantly within the rural land use category. There are resource protection areas along streams and flood-prone areas, one rural industrial area (American Stone Quarry), and one public interest area (Phils Creek and dam) adjacent to the quarry.

Traveling eastward along the corridor from the Orange County line, the following future land uses are represented:

- Agricultural Residential (4 miles), until Orange Grove Road intersection
- Rural Residential (1 mile), between Orange Grove Road and Carl Durham Road intersections
- Rural Buffer (3 miles), between Carl Durham Road and Carrboro Town Limits/ETJ near Shannon Road intersection

The future land use map features two activity nodes at specific roadway intersections along the corridor:

- Rural Neighborhood activity node (1,000-foot radius) at the Morrow Mill Road intersection, which is appropriate for small-scale commercial uses, such as convenience stores and gas stations.
- Rural Community activity node (half-mile radius) at the White Cross Road intersection, which is appropriate for church, fire station, post office, school, or similar institutional uses and one or more commercial uses.

The Cane Creek Watershed and University Lake Watersheds encompass a large portion of the corridor. These water supply watersheds exist to protect the water quality upstream of two drinking water supply reservoirs in the area.

- Cane Creek Watershed (Critical and Protected portions) - north and east of the reservoir, located on the north side of the NC Hwy 54 corridor near Stanford Road.
- University Lake Watershed (Protected portion) - land upstream of the reservoir, which includes both sides of the NC Hwy 54 corridor east of Carl Durham Road towards Carrboro.

For more information on the location(s) of Orange County zoning, future land uses, and water supply watershed boundaries visit https://gis.orangecountync.gov:8443/orangeNCGIS/zoning.htm.

City of Graham Zoning (1999)

The City of Graham adopted zoning in 1950, and more recently updated in 1999 in accordance with their comprehensive plan to conserve the value of buildings and encourage the most appropriate use of land.

Properties along the corridor and within the City of Graham jurisdiction fall into one of 11 zoning classifications. Two business zones (B-2, B-3), one office and institutional (O-I), two industrial (I-1, I-2), and six residential (R-MF, R-12, R-15, R-18, R-G, and C-R) are present along the corridor.

The City of Graham also enforces an NC 54 (E. Harden Street) Overlay District along the corridor, west of Back Creek (near Cherry Lane). The Overlay District imposes additional development requirements for signage, lighting and access, however this does not affect the allowable type or intensity of use. Refer to Article XI Section 10.461 of the Graham Development Ordinance for more information http://www.cityofgraham.com/departments/planning/development-processes/.

Town of Carrboro Zoning (2017)

Properties along the corridor and within the Carrboro Town limits fall into one of four zoning classifications. All four are watershed zones, influenced by the University Lake Area: Watershed Commercial Uses (B5); Watershed Residential (WR); Watershed Light Industrial (WM3); and Conservation District (C).

All four zones are intended to conserve the overall quality of water resources within this watershed by limiting development intensity. More specific zoning definitions are available at http://gis.ci.carrboro.nc.us/ZoningQuery/pickzone.asp.

Voluntary Agricultural District(s) - Alamance and Orange Counties

Both Alamance and Orange Counties participate in a program for Voluntary Farmland Preservation. These programs aim to promote and encourage the preservation of farmland in the rural portions of the county, where agricultural uses predominate, by means which are voluntary, rather than regulatory. Designating land as a Voluntary Agricultural District (VAD) is the mechanism for this protection. The minimum acreage required for a VAD is 5 acres for horticulture use, 10

acres for agricultural use, and 20 acres for forestry use. Once designated as an agricultural district, the property is considered a conservation easement that prohibits non-farm use for a period of 10 years. Agricultural districts, once designated, are eligible for preservation grants from federal, state, and local funding sources.

More information may be found at:

- Alamance County https://alamance.ces.ncsu.edu/
- Orange County http://www.orangecountync.gov/departments/deapr/voluntary_agricultural_districts.php

Many VADs are located more than 1 mile off the corridor. There are two (2) Voluntary Agricultural Districts along the project corridor:

- 1183 Reatkin Lane, Graham – Alamance County (two properties, 35.8 acres)
- 5332 Teer Road, Chapel Hill – Orange County (three properties, 139.1 acres) Est. 2015

Alamance County Transportation Authority Community Connectivity Plan (2018)

The plan describes initiatives, projects, and milestones for the on-demand Alamance County Transportation Authority (ACTA) to meet the mobility needs of Alamance County residents over the upcoming five-year planning period. The plan includes several potential initiatives that may affect the western portion of the project corridor. These initiatives include improved service coordination between ACTA, PART, and Link Transit, updating regional transit plans, introducing Saturday service, increasing service in Graham, and increasing service to rural Alamance County communities. Noted disadvantages include cost of additional service and low population density.

Orange County Transit Plan through 2045 (2017)

The plan describes the operation and expansion of Orange County's existing and planned transit systems from 2017 through 2045. Orange Public Transportation (OPT) operates two fixed routes, the north-south Orange Chapel Hill Midday Connector and the Hillsborough Circulator; neither of these routes are within the study corridor. In 2018, the Orange County Commissioners will consider service improvements of approximately 1,700 hours that will support deviated fixed routes to three different parts of the county.

Piedmont Authority for Regional Transportation Vision 2025 (2014)

The transit plan proposed the improvement, realignment, and creation of new transit routes serving the communities of Alamance, Davidson, Davie, Randolph, Rockingham, Stokes, Surry, and Yadkin counties by the year 2025. One of the recommendations that has been implemented is creation of Route 4, the Alamance Burlington Express, as noted above.

Orange County Comprehensive Parks and Recreation Master Plan 2030 (2014)

The plan identifies facilities, parks, and trails for expansion, improvement, and creation across Orange County by 2030. A proposed segment of the Mountains-to-Sea Trail (MST) is planned to cross the study corridor at the confluence of Cane Creek and the Haw River. The Orange County trail segment is planned to parallel Cane Creek north from the Alamance County line to the Town of Hillsborough where the trail follows the Eno River westward. The plan recommends that the county and other stakeholders develop a master plan to facilitate the completion of the trail segment and consider the location of a node or way station on county or Orange Water and Sewer Authority land to provide basic hiking services.

In January 2018, the Orange County Commissioners approved a revised MST route—known as Section 11—that diverges from the Comprehensive Parks plan near the Alamance County boundary. In this revision, the MST has two route options that follow Saxapahaw Bethlehem Church Road and Morrow Mill Road from the Haw River north to the Alamance County line, where the trail turns southeast and runs adjacent to NC 54. The MST then jogs north to once upon OWASA property and rejoins the previously planned route. The planned route is subject to change depending on voluntary landowner easements.

2.7 Existing Conditions Conclusions

Although public and stakeholder input will add to the study's understudying of the function and adequacy of the NC 54 corridor, the analysis of existing conditions has revealed a number of issues to be addressed in developing a viable improvement plan:

- Although traffic growth over the last 10-15 years has not been dramatic, there are signs of a recent increase.

- Pending and planned development along (or accessed by) NC 54 will be a major determinant of traffic growth.
- This facility serves a substantial volume of trips with one end outside the study area, so regional context is important.

- Challenges and opportunities vary along the corridor, requiring different solutions.
- The intersection at NC 119/East Main Street presents obvious safety and congestion problems. The overlapping schedules of Alexander-Wilson Elementary and the Honda plant result in concentrated congestion, especially in the afternoon. Long vehicle queues often spill back to NC 54 and beyond, creating gridlock conditions. Adding to the disruption, NC 54 transitions here between 5-lane and 2-lane sections. Conditions will worsen with inevitable development in the immediate vicinity of this intersection, as well as along East Main Street and NC 119. The lack of pedestrian and bicycle accommodations will become an even more critical deficiency over time.
- Any effective solution must carefully consider and address the highly directional peaking exhibited by traffic, especially towards the eastern end of the corridor.
- At unsignalized intersections, delay on crossroad approaches will become more problematic as volumes increase. Delay will also increase for traffic attempting left turns from NC 54. Either situation can also increase crash potential.
- Several unsignalized intersections are likely to warrant signalization, either in the near term or over a longer period.
    - More traffic signals will change the character of this roadway by adding turn lanes and tapers, interrupting free-flowing traffic, and facilitating crossings by vehicles, pedestrians, and bicyclists.
    - The number, type, and location of crashes will change.
    - Signalized intersections can increase attractiveness for adjacent commercial development.
- Access point density, combined with limited passing zones (due to roadway alignment and resulting sight distance constraints) contribute to low levels-of-service in the western portion of the corridor. These conditions will noticeably worsen and spread as traffic volumes increase.
- Spot safety improvements should be considered for various locations throughout the corridor.
- Environmental constraints are significant, especially in the eastern (Orange County) portion of the corridor. Any roadway design solutions must be sensitive to these constraints.

- Combined with traffic growth, increasing pedestrian and bicycle demand will multiply possibilities for conflicts and crashes.
- Existing bridges are not conducive to bicycle and pedestrian travel, and 2-lane bridges constrain traffic capacity expansion.
- No special accommodations are currently in place for transit service, changing conditions may warrant some improvements.
- Especially to the east of NC 119, adequate ROW is available for a range of enhancements.

Subsequent tasks in this study will identify specific criteria or performance measures that are sensitive to these and other concerns. Those measures will be applied in evaluating the effectiveness of various solution options and guiding their refinement.

Critical Issues

3.0 Critical Issues

This chapter describes the qualitative and quantitative impacts of growth on the corridor's operation and safety through the year 2045. There are numerous implications that arise from the forecasted 1%-1.5% annual growth in vehicle volumes along the corridor. These challenges include managing access to NC 54, increased collisions for all users, decreasing levels of service, providing access for non-motorized users, and providing transit access, among others. The estimated effects of such pressures on the existing corridor's roadway cross sections are the basis for multimodal improvements identified in Chapters 5 and 6.

3.1 Safety and Access Management

As summarized in Section 1.5, historical data, engineering analysis, and community feedback confirm the importance of reducing crashes throughout this corridor. Several anticipated trends suggest this issue will become even more critical in the future, as vehicular, pedestrian, and bicycle volumes grow, and additional development occurs. The number of conflicts will increase, and without intervention, the number of crashes will, as well. Of particular concern is the possibility that serious crashes involving pedestrians and bicycles are likely to become more frequent.

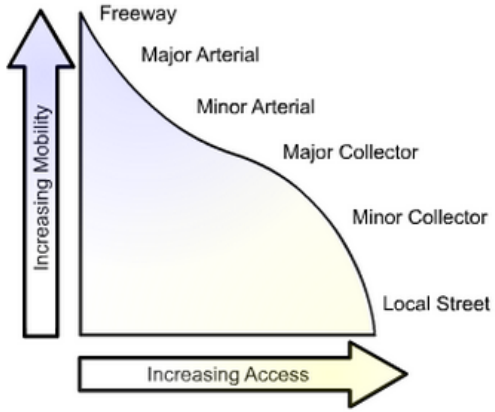
The locations and spacing of numerous driveways and intersections along the corridor reduce both safety and capacity.

- Vehicles attempting left turns from NC 54 can block following traffic, contributing to both rear-end collisions and significant delays. Less frequent—but more serious—collisions occur between left-turning vehicles and oncoming traffic.
- Cars attempting to turn onto or cross NC 54 must accurately judge speeds, distances, and acceleration rates to identify acceptable gaps in oncoming traffic. Long delays can generate impatience, leading to riskier decision-making, increasing the potential for more serious collisions.
- Vehicles turning in/out of side roads or driveways are especially hazardous to cyclists, as well as pedestrians.

All of these situations will become more pronounced as volumes increase over time. Conflicts will become more frequent, and acceptable gaps less frequent.

The primary strategy for addressing such challenges employs access management techniques to reduce conflicts, and to provide access that lessens risk while preserving reasonable capacity and convenience. These objectives can be accomplished by appropriate use of turning lanes and median treatments to separate conflicts, as well as managing the spacing and location of driveway access points to promote safer and more efficient traffic maneuvers. At a minimum, redundant driveways and those with constrained visibility or other hazards should be eliminated or avoided.

Conceptual Roadway Functional Hierarchy



NC 54 is a Minor Arterial under the Federal Functional Classification System, reflecting the fact that while this facility serves an important mobility function for longer trips between destinations in Orange and Alamance Counties, it also plays an essential role in accessing adjacent land uses. Roadway design decisions in this corridor must balance these competing—and sometimes conflicting—needs, recognizing that the precise equilibrium between mobility and access varies along the corridor, and can change over time. Furthermore, mobility and access roles also differ by mode. Planning for the NC 54 corridor must appreciate and incorporate these considerations. Promoting good access management encourages safe and efficient transportation network access. Managing access spacing, adding safe turning lanes, and employing median treatments helps preserve mobility by reducing crashes while increasing roadway capacity and yielding shorter, more consistent travel times.

3.2 Congestion

3.2.1 Traffic Forecasts

The NC 54 West Study Area spans multiple jurisdictions, requiring a combination of sources and techniques to develop consistent forecasts of future traffic volumes.

In the absence of substantial changes in land use or transportation systems, historic traffic count trends can provide reliable short-range forecasts, typically less than 5 years ahead. Data available from NCDOT traffic count stations (2002 through 2015 or 2016) were supplemented with some 2017 counts. This set of counts demonstrated considerable variability, both over time and among different locations. The most notable observation concerned locations where counts have been collected since 2015. These stations exhibited dramatic traffic growth, often the greatest increases experienced since 2003.

This study requires longer-range forecasts that account for anticipated changes in land use, employment, population, transportation system improvements. To estimate such a forecast, the following travel demand models were employed:

- **Piedmont Triad Regional Model (PTRMv4.2 – 2013 Base Year / 2040 Design Year).** The PTRMv4.2 is the travel demand model officially adopted by BGMPO and other agencies for long-range transportation planning. PTRMv4.2 includes the portion of the corridor west of Orange County.
- **Triangle Regional Model (TRMv5 – 2010 Base Year / 2040 Design Year).** The TRMv5 was the official travel demand model used by DCHC and other agencies at the start of this project. In this corridor, TRMv5 extends only as far west as the Alamance County Line. An interpolated 2016 interim year was used in this study.
- **Triangle Regional Model (TRMv6 – 2013 Base Year / 2045 Design Year).** As of February 2018, TRMv6 is the official travel demand model used by DCHC and other agencies. For the purposes of this study, the primary difference between TRMv5 and TRMv6 is updated socio-economic (land use) data and forecasts. Since TRMv6 was available, it was also employed in developing the NC 54 forecasts, since Version 6 would be adopted by the time the study was completed.
- **NC Statewide Travel Model (NCSTM – 2015 Base Year / 2040 Design Year).** The NC Statewide Travel Model covers the entire state of NC, although at a highly aggregated scale. Only major routes are represented, including the entire NC 54 West corridor used in this study.

As simplified regional representations, none of the above models include all roads or intersections in their networks.

The methodology for using model outputs in forecasting future traffic for this corridor consists of applying traffic growth from a pair of model runs (Base Year and Future Year) to a corresponding location with a recent traffic count. Both absolute (Future Year – Base Year) and relative or percentage growth (Base Year / Future Year) were considered. Since the Base Years and Future Years of the models are not consistent (with each other or with this study), an annual percentage growth rate was calculated from model outputs for any corresponding count locations. This growth rate was then applied to the traffic count to obtain a forecast for that location.

For the Alamance County portion of the corridor, PTRMv4.2 suggests substantial traffic increases (up to 4,900 vehicles/day) in the northwestern end of the corridor (especially I-40 and NC 119). Proceeding towards Orange County, however, growth gradually reduces. The NCSWM suggests a similar growth pattern in Alamance County.

In Orange County, however, the NCSWM generates sharp traffic reductions (on the order of 2,000 to 3,500 vehicles/day) at all locations. In contrast, TRMv5 indicates growth of between 2,700 and 5,300 vehicles/day, with volumes increasing towards the southeast. TRMv6 demonstrates a similar directional trend. However, the shift is much more dramatic in Version 6, with almost no growth at the Alamance County line, but a 9,400 vehicle/day increase at Old Fayetteville Rd.

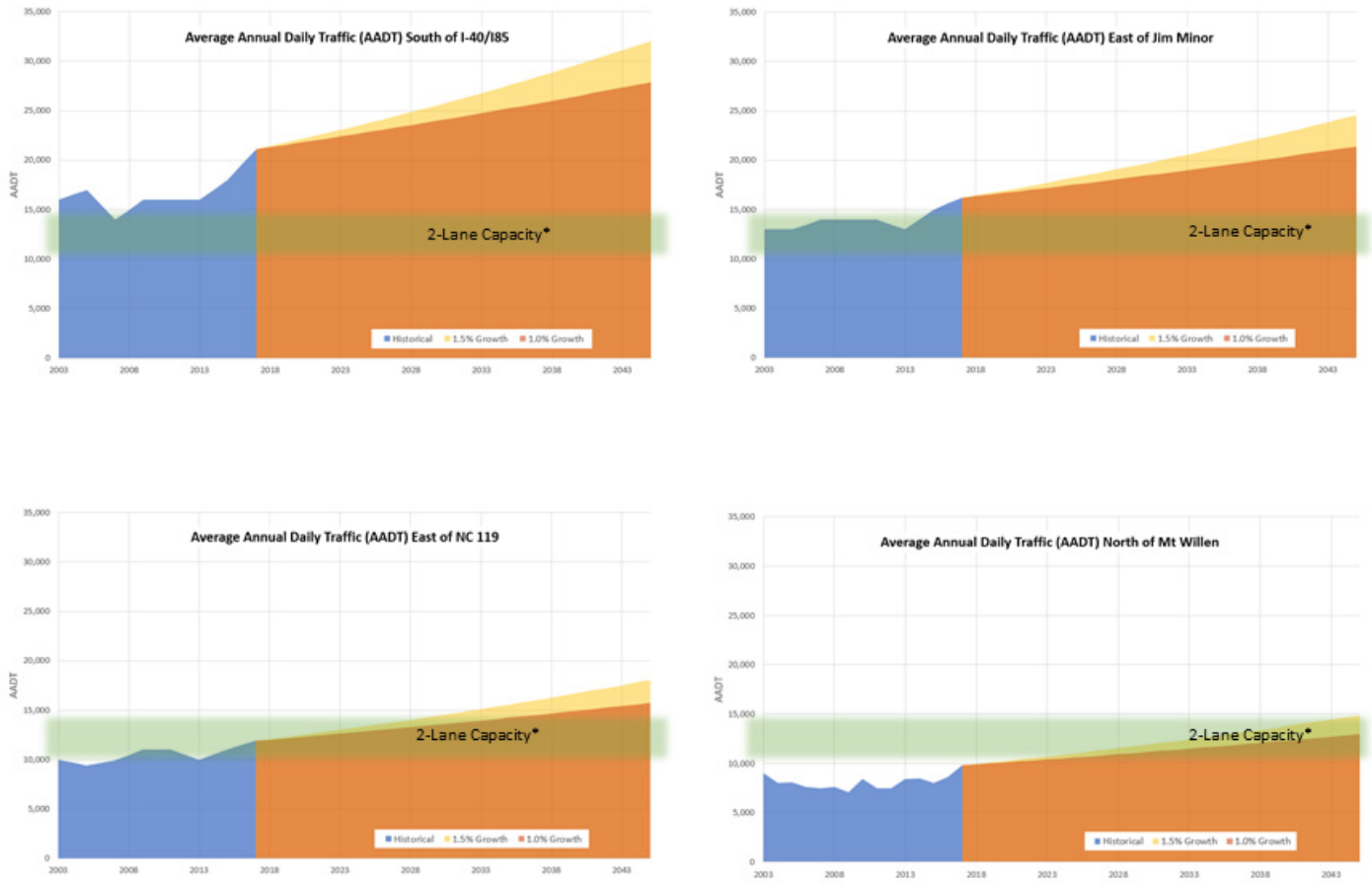
None of the models accurately reproduced actual traffic count volumes for specific locations and years, and their errors were generally inconsistent. (TRMv5 performed best in this respect; PTRMv4.2 was somewhat consistent between Jim Minor Road and I-40.) A variety of aggregation, normalization, and smoothing techniques were used in attempting to establish a consistent traffic forecast scenario. The most reliable data generated annual growth rates ranging from 0.7% to 1.8%. Ultimately, a 1.5% annual growth rate was used throughout the corridor, with 1.0% also tested as a lower limit. The 1.5% rate is most consistent with conditions near the Carrboro end of the corridor, and reflects new and anticipated development (beyond assumptions in the PTRM) near the Graham end. The relatively low volumes closer to the middle of the corridor are less sensitive to the difference between 1.0% and 1.5% growth; in either case, the existing 2-lane cross-section appears adequate for the immediate future, if level of traffic service (or the ratio of traffic volume to roadway capacity) is the only criteria used (as opposed to safety or multimodal considerations). On the other hand, a single unanticipated subdivision or industrial/commercial site of adequate size could substantially increase volumes in this vicinity.

Table 14 summarizes forecast traffic volumes for 5-year intervals at each NCDOT count location, for both 1.5% and 1.0% annual growth estimates. Figure 19 and Figure 20 graphically depict some of these forecasts at representative locations along the corridor, combined with historic AADTs and an indication of typical capacity for a 2-lane rural highway. These graphs help emphasize the presence of higher traffic volumes at either end of the corridor; variations in traffic volumes over time; how forecasts relate to past volumes; the timing and location of capacity deficiencies; and the relatively minor impacts of 1.0% versus 1.5% annual growth rate assumptions.

Table 14: NC 54 Traffic Forecasts for High and Low Growth Estimates (vehicles/day)

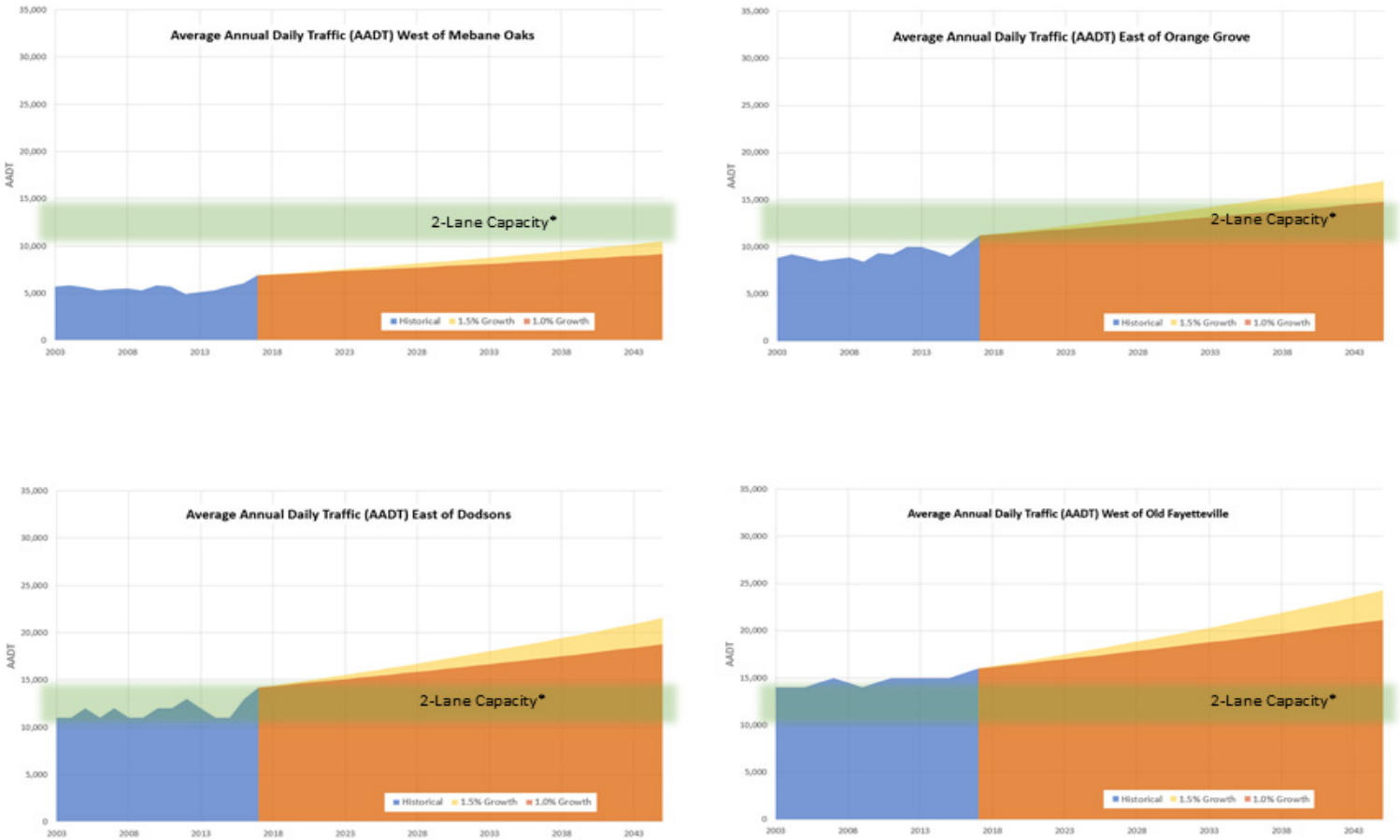
		Year								
		Estimated	1.0% Annual Growth				1.5% Annual Growth			
County	Location	2017	2030	2035	2040	2045	2030	2035	2040	2045
ALAMANCE	South of I-40/ I-85	21,100	24,000	25,200	26,500	27,900	25,600	27,600	29,700	32,000
	East of Ivey Road/ Sunset Drive	15,200	17,300	18,200	19,100	20,100	18,400	19,900	21,400	23,100
	East of Cooper Road	16,200	18,400	19,400	20,400	21,400	19,700	21,200	22,800	24,600
	East of Cherry Lane	16,200	18,400	19,400	20,400	21,400	19,700	21,200	22,800	24,600
	East of Reatkin Lane/ N Jim Minor Road	16,200	18,400	19,400	20,400	21,400	19,700	21,200	22,800	24,600
	West of NC 119/ E Main Street	16,200	18,400	19,400	20,400	21,400	19,700	21,200	22,800	24,600
	East of NC 119/ E Main Street	11,900	13,500	14,200	15,000	15,700	14,400	15,600	16,800	18,100
	East of Freshwater Road	10,800	12,300	12,900	13,600	14,300	13,100	14,100	15,200	16,400
	North of Mt. Willen Road/ Salem Church Road	9,800	11,200	11,700	12,300	12,900	11,900	12,800	13,800	14,900
	South of Thom Road	7,400	8,400	8,900	9,300	9,800	9,000	9,700	10,400	11,200
ORANGE	West of Mebane Oaks Road/ Saxapahaw Road	6,900	7,900	8,300	8,700	9,100	8,400	9,000	9,700	10,500
	West of Orange Grove Road	10,800	12,300	12,900	13,600	14,300	13,100	14,100	15,200	16,400
	East of Orange Grove Road	11,200	12,700	13,400	14,100	14,800	13,600	14,600	15,800	17,000
	East of Dodsons Crossroads/ Butler Road	14,200	16,200	17,000	17,900	18,800	17,200	18,600	20,000	21,500
	West of Neville Road	14,500	16,500	17,300	18,200	19,200	17,600	19,000	20,400	22,000
	West of Old Fayetteville Road	16,000	18,200	19,100	20,100	21,100	19,400	20,900	22,500	24,300

Figure 19: Traffic Trends & Forecasts at Key Locations



*Typical LOS E capacity range; actual values can be higher or lower depending on traffic and roadway characteristics.

Figure 20: Traffic Trends & Forecasts at Key Locations, Continued



*Typical LOS E capacity range; actual values can be higher or lower depending on traffic and roadway characteristics.

3.2.2 Corridor-Level

Consistent with the earlier analysis of exiting conditions, HCS capacity analysis was performed on seven segments of NC 54 between major intersections. Table 15 summarizes 2045 No-Build conditions for the 5-lane segment between I-40/I-85 and NC 119. Conditions remain good, with each direction operating at LOS B during both peak hours. Intersection LOS remains the more critical capacity consideration in this portion of the corridor.

Table 15: 2045 No-Build Corridor Level of Service Summary for NC 54: 5-Lane w/ Two-Way Left Turn Lane

Segment Location	Segment Length (miles)	AM Peak			PM Peak		
		Segment LOS	Ave. Speed (mph)	Density (pc/mi/ln)	Segment LOS	Ave. Speed (mph)	Density (pc/mi/ln)
Woody Dr – NC 119 (EB / WB)	3.2	B / B	45.0 / 45.0	16.0 / 17.2	B / B	45.0 / 45.0	17.7 / 15.5

Table 16 summarizes the results of HCS capacity analysis for the primarily two-lane highway between NC 119 and Old Fayetteville Road, by segment and direction for the AM and PM peak periods. Conditions are markedly worse than existing conditions. In 2017, the segment between NC 119 and Mebane Oaks Road experienced LOS D or worse in each direction during both peak hours; by 2045, at least one direction operates at LOS E. The portion of the NC 54 corridor from Mebane Oaks Road to Dodsons Crossroads operates at LOS E or F in 2045, while the remaining segment eastward to Old Fayetteville Road experiences LOS F in both directions, during both peak periods. East of Mebane Oaks Road, average travel speeds (in mph) drop from the mid/low 40s to the mid/low 30s, and the percent of travel time spend following a slower vehicle without being able to pass ranges from 96% to 100% during the worst-case peak hour. This deterioration in LOS results from higher traffic volumes, exacerbated by limited passing zones and extreme directionality of traffic flows.

Table 16: 2045 No-Build Corridor Level of Service Summary for NC 54: 2-Lane Highway

Segment Location	Segment Length (miles)	AM Peak			PM Peak		
		Segment LOS	Ave. Speed (mph)	PTSF (%)	Segment LOS	Ave. Speed (mph)	PTFS (%)
NC 119 – Mt Willen Rd (EB / WB)	4.1	E / E	38.7 / 38.9	87.7 / 83.9	E / E	38.7 / 38.3	78.9 / 91.0
Mt Willen Rd – Mebane Oaks Rd (EB / WB)	3.3	E / D	40.9 / 41.6	86.5 / 71.3	D / E	41.6 / 40.4	63.4 / 88.6
Mebane Oaks Rd – Orange Grove Rd (EB / WB)	3.6	E / F	35.9 / 35.9	96.0 / 68.2	E / E	37.0 / 35.5	66.8 / 96.9
Orange Grove Rd – Dodsons Crossroads (EB / WB)	1.6	E / F	35.9 / 35.9	96.0 / 68.2	E / E	37.0 / 35.5	66.8 / 96.9
Dodsons Crossroads – Bethel Hickory Grove Church Rd (EB / WB)	1.8	F / F	34.1 / 35.6	98.7 / 68.1	F / F	35.5 / 34.5	72.1 / 98.2
Bethel Hickory Grove Church Rd – Old Fayetteville Rd (EB / WB)	2.6	F / F	32.7 / 33.7	100 / 73.2	F / F	33.2 / 32.4	77.2 / 100

3.2.3 Intersections

As traffic volumes on both NC 54 and side roads increase, conflicts and delay at major intersections also grow, creating capacity deficiencies at several locations. It is assumed that the remaining STOP-controlled study intersections are signalized, with turn lanes added as warranted. Furthermore, additional through lanes and turn lanes were introduced at the NC 119 and Old Fayetteville Road intersections, reflecting anticipated reasonable attempts to improve intersection performance without major roadway reconstruction or widening. Typically, at least one separate left-turn lane is needed on each approach leg, and NC 54 requires two or more through lanes in each direction. Without signalization and intersection lane additions, most of the subject intersections fail.

As in the existing conditions analysis, intersection cycle lengths and phasings are optimized, and in cases where the optimized cycle length falls below the recommended minimum, the cycle length is set to the NCDOT minimum cycle length. A summary of the findings for the 2045 No Build scenario level of service analysis can be found in Table 17, and the full *Synchro/HCS* output can be found in the Appendix.

Table 17: Intersection LOS and Delay

Intersection and Approach	Traffic Control	2045 LOS & Avg Delay/Veh (sec) AM	PM
NC 54 & Woody Drive	Signalized	**C (24.8)**	**C (21.2)**
Eastbound		C-20.1	B-16.5
Westbound		C-20.7	C-22.4
Northbound		D-53.8	D-39.6
Southbound		D-47.0	C-30.7
NC 54 & NC 119 / East Main Street	Signalized	**D (53.7)**	**D (41.7)**
Eastbound		D-40.4	D-36.4
Westbound		E-67.7	D-38.3
Northbound		E-71.7	E-57.6
Southbound		E-61.2	D-50.1
NC 54 & Mt Willen Road / Salem Church Road	Signalized	**B (18.8)**	**B (11.5)**
Eastbound		C-20.5	A-6.3
Westbound		A-7.4	B-10.5
Northbound		D-37.9	C-25.6
Southbound		C-26.1	C-32.7
NC 54 & Mebane Oaks Road / Saxapahaw Road	Signalized	**C (34.5)**	**C (21.8)**
Eastbound		C-30.7	A-3.1
Westbound		D-35.9	B-19.8
Northbound		C-28.6	D-48.2
Southbound		D-52.4	D-48.0
NC 54 & Orange Grove Road	Signalized	**B (15.5)**	**B (16.2)**
Eastbound		B-17.7	A-3.5
Westbound		A-2.9	B-18.0
Southbound		D-47.3	D-45.1
NC 54 & Dodsons Crossroads / Butler Road	Signalized	**B (16.7)**	**B (15.4)**
Eastbound		B-12.4	A-9.4
Westbound		B-12.8	B-14.2
Northbound		C-29.2	D-37.7
Southbound		E-56.3	D-44.3
NC 54 & Bethel Hickory Church Rd	Signalized	**C (21.0)**	**B (10.6)**
Eastbound		C-24.6	A-8.3
Westbound		A-1.4	A-8.2
Southbound		E-72.3	D-36.9
NC 54 & Old Fayetteville Road	Signalized	**E (74.7)**	**F (124.4)**
Eastbound		E-58.5	C-34.4
Westbound		D-50.0	F-147.8
Northbound		E-79.6	F-133.4
Southbound		F-127.5	F-136.3

While these limited widenings improve calculated LOS at individual intersections, they do not address the deficiencies identified in the preceding corridor segment analysis. Nor do these calculations reflect the effects of the frequent adding

and dropping of lanes along the corridor. Each of these transitions introduces turbulence into the flow of traffic, and increases crash potential. However, isolated intersection improvements can provide cost-effective safety and capacity benefits (including for pedestrians) at specific locations, while incrementally building towards a long-range corridor vision.

With the assumed lane additions, most of the studied intersections operate at acceptable levels of service, at least for the intersection as a whole, if not for individual approaches. For example, while the NC 119/East Main Street intersection operates at LOS D (nearing LOS E in the AM), the westbound, southbound, and northbound approaches experience LOS E during at least during one peak period, frequently resulting in long vehicle queues. Dodsons Crossroads and Bethel Hickory Church Road also exhibit long side street delays. Even with additional lanes, however, the Old Fayetteville Road intersection operates at LOS E or F.

3.3 Bicycle and Pedestrian Issues

While future traffic deficiencies can be quantified through demand forecasts and capacity and crash analyses, the absence of substantial volumes and adequate facilities make it difficult to forecast and quantify pedestrian and bicycle deficiencies. As a result, anticipated pedestrian and bicycle problems tend to be defined more qualitatively, and identified in terms of inadequate infrastructure networks.

The lack of bicycle and pedestrian connectivity throughout the corridor was frequently cited by community workshop attendees and Study Team members as a major source of concern and frustration. Support for greater continuity, convenience, and safety for bicycle and pedestrian travel options has grown, a trend that appears likely to continue. There is consensus that the lack of safe and convenient facilities is suppressing walking and bicycle trips; in other words, support for a strategy of "build it and they will come." At the same time, there is a reasonable expectation that the number of bicyclists and pedestrians will increase even in the absence of improved facilities due to population growth and the corridor's recreational assets. While ongoing plans and projects are beginning to address this deficiency, concern remains that given the substantial growth in vehicular traffic, crashes involving pedestrians and bicycles could increase both in frequency and severity.

There is also recognition that adequate funding for both construction and maintenance of bicycle and pedestrian facilities—especially off-street multi-use paths—is a significant obstacle to implementing a continuous network across various jurisdictions, land uses, and environmental conditions. This is true with respect to travel both along and across the corridor. Although ultimate completion requires a long-term commitment, people want to see improvements in the near-term. However, there is also a strong desire to avoid investments that would be disrupted by subsequent widening or other improvements to NC 54.

While there is apparent consensus on most of the items described above, there is not universal agreement on the best types of pedestrian and bicycle facilities to build, or on prioritization. Positions diverge most notably regarding:

- On-street and off-street bicycle treatments, including multi-use paths, bike lanes, and wide shoulders
- Whether to locate sidewalks or multi-use paths on one side of the road or the other, or both
- How close to the road to locate sidewalks or multi-use paths

The primary concerns with off-street facilities relate to impacts of right-of-way and construction easements on private property, especially given the proximity of many wells and septic fields to the existing roadway. While greater separation from the road has benefits in terms of increased safety and comfort, and reduced risk of conflicts with future widening, trade-offs associated with additional earthwork, environmental impacts, and costs cannot be accurately quantified without more detailed design work.

Table 18 summarizes HCS Bicycle Level of Service (BLOS) for each segment by direction and peak period. Note that BLOS for individual intersections has not been calculated. The HCS BLOS methodology is generalized and not highly rigorous. It is not sensitive to several key factors that contribute to bicyclist comfort. Nevertheless, it indicates degradation in bicycle suitability along the corridor, especially during the PM peak period. This is due primarily to increased traffic volumes.

The needs identified above can be effectively addressed only by a parallel and complementary approach that coordinates roadway and bicycle improvement programs. Awareness of constraints and opportunities associated with roadway improvements when developing bicycle projects must be combined with sensitivity to bicycle needs in the planning and design of roadway projects.

Table 18: 2045 No-Build Corridor Segment Bicycle LOS Summary for NC 54

Segment Location	Segment Length (miles)	AM Peak		PM Peak	
		Segment BLOS	BLOS Score	Segment BLOS	BLOS Score
Woody Dr – NC 119 (EB / WB)	3.2	B / C	2.5 / 2.6	C / C	2.6 / 2.6
NC 119 – Mt Willen Rd (EB / WB)	4.1	D / D	4.5 / 4.4	D / **E**	4.3 / 4.5
Mt Willen Rd – Mebane Oaks Rd (EB / WB)	3.3	D / D	4.4 / 4.2	D / **E**	4.1 / 4.5
Mebane Oaks Rd – Orange Grove Rd (EB / WB)	3.6	**E** / D	4.7 / 4.1	D / **E**	4.1 / 4.7
Orange Grove Rd – Dodsons Crossroads (EB / WB)	1.6	**E** / D	4.7 / 4.1	D / **E**	4.1 / 4.7
Dodsons Crossroads – Bethel Hickory Grove Church Rd (EB / WB)	1.8	**E** / D	4.8 / 4.1	D / **E**	4.2 / 4.8
Bethel Hickory Grove Church Rd – Old Fayetteville Rd (EB / WB)	2.6	**E** / D	4.8 / 4.2	D / **E**	4.3 / 4.8

3.4 Transit Issues

Like the bicycle and pedestrian elements of this study, long-range planning for transit in NC 54 corridor lacks current demand and service data to provide a strong basis for reliable forecasting and analysis. While there is certainly latent transit demand, it is difficult to quantify, and to determine appropriate services in such a long, primarily low-density rural corridor. However, as growth continues, demand for transit (both among the transit-dependent and as an option to driving) should increase, especially given the overall aging of the population.

Adding to both uncertainty and opportunity in the NC 54 west corridor is the rapid evolution of transit service in response to innovative technologies. The convergence of smart phones, transportation network companies (or TNCs, such as Uber and Lyft), and autonomous vehicles is poised to transform transit service, creating a wider range of more dynamic options better tailored to individual needs. This portion of the NC 54 corridor is not well-suited to the traditional

urban transit paradigm of larger vehicles operating on fixed routes and schedules, due to high operator costs and poor user convenience. More viable services might employ real-time or instant ridesharing (also known as dynamic carpooling, or ride-sourcing when provided by a TNC) either as a feeder system for more traditional transit, or as its own single-ride mode. The precise nature of such services is unclear, as is the likely timeframe; however, enhancing pedestrian and bicycle connectivity and encouraging nodes of denser mixed-use development will support just about any alternative to the single-occupant vehicle. Park-and-ride lots (possibly incorporating drop-and-ride and bike-and-ride options) are another missing piece of a potentially successful transit system in this corridor. Several transportation plans, such as the Orange County CTP (2013) and the Draft Chapel Hill Transit Short Range Transit Plan (2018), have made fiscally unconstrained recommendations for a park-and-ride lot near White Cross with transit service along NC 54.

3.5 Alexander Wilson Elementary School / Honda Manufacturing Plant

Overlapping peaks of school and manufacturing plant traffic generate congestion at the intersection of NC 54 and NC 119/East Main. Pending development along NC 119 will combine with overall traffic growth to worsen conditions at this location. The likely development of the remaining three quadrants of this intersection will further complicate the situation, adding not only vehicular traffic but pedestrian, bicycle, and possibly even transit trips. Ongoing residential construction near Alexander Wilson Elementary School will further increase demand for safe and convenient walk and bicycle routes to school. Truck access to the Honda Manufacturing Plant could also become a more significant problem as traffic increases.

The spillover of school pick-up and drop-off traffic onto NC 119 and NC 54 appears to be a major contributor to delays and long queues. This problem stems from inadequate on-site storage and circulation space for buses and cars, and limited access options. Driveways are closely spaced to each other, and are less than 500 feet from the NC 54/NC 119 intersection, creating conflicts that can result in temporary gridlock due to turning-lane constraints. Moving even a portion of school and/or plant away from the signalized intersection would free up critical capacity, improving LOS and reducing (or at least delaying) the need for major widening.

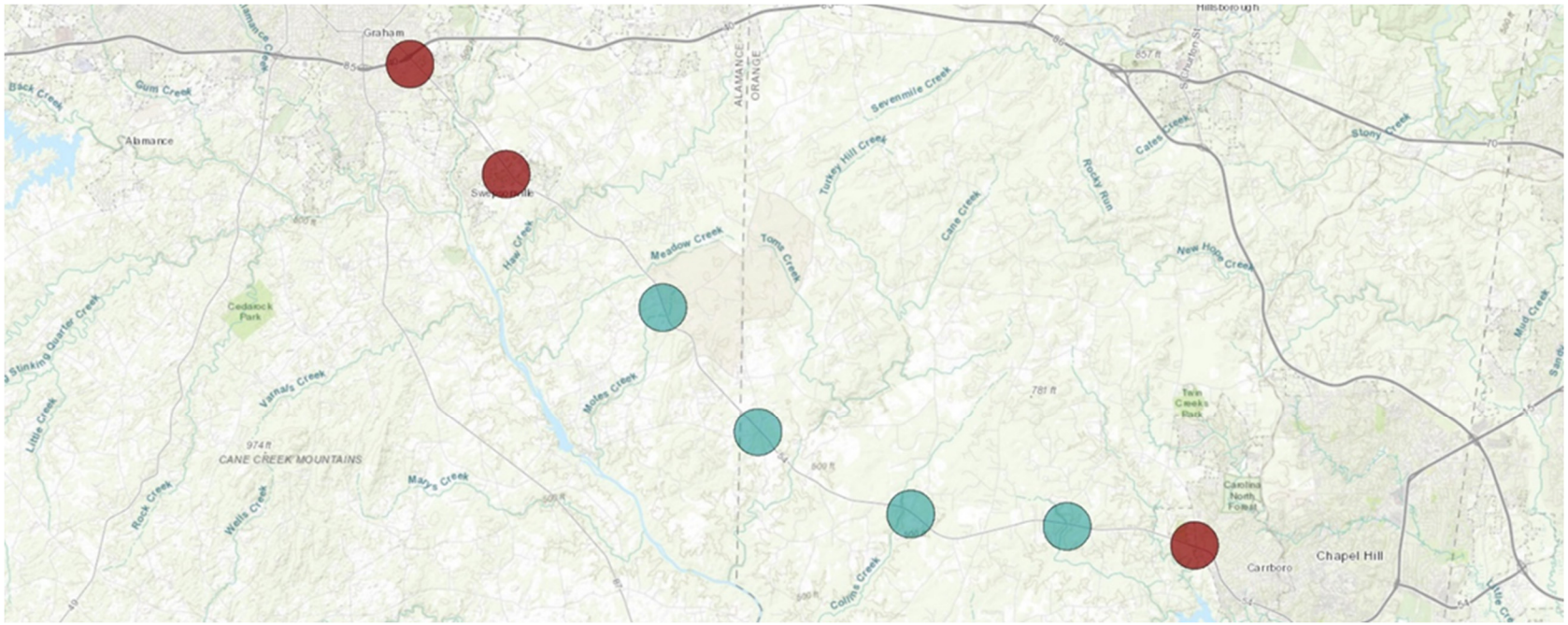
3.6 Market Assessment

Rose & Associates completed a market assessment and land use analysis for the counties composing the corridor (Alamance and Orange) and at major intersections along the corridor. The complete report is included in the Appendix. Key trends and findings from the report indicate demand for land use and real estate products at specific nodal and zonal locations, promotion of tourism as an economic development strategy, and transportation improvement coordination with a focus on multimodal and Complete Streets investments.

The corridor exhibits demand for additional commercial product development (i.e. office space, industrial, and retail) in the Economic Nodes at the intersections of Woody Drive, NC 119, and Old Fayetteville (see Figure 21 below, identified in red). However, physical limitations, topography, and zoning may limit development in one or more of these areas. Each economic node could benefit from additional office and/or light industrial product, where appropriate. Consumer trends and the preponderance of mixed-use and infill development throughout the region also suggest that in addition to retail, dining, and entertainment, additional housing may also be considered for integration and to support other product types. Options to guide land use development in accordance with the corridor's vision include:

- Provide small area planning in the Economic Nodes to further frame appropriate land uses, density and infrastructure;
- Provide opportunities in the Economic Nodes for mixed-use development, including additional multifamily housing, workplace space (office/light industrial), retail, and entertainment uses;
- Provide opportunities in the Heritage Nodes for additional recreational and rural housing development.

Figure 21: Market Assessment Economic Nodes & Heritage Zones



The existence of sensitive watersheds and significant historical, recreational, and agricultural assets along and adjacent to the corridor, together with the corridor's popularity for cyclists, suggests strategies for preservation over development, and tourism over traditional, employment-based economic development. While local workforce, students, commuters, and residents predominantly drive economic growth along the corridor, the current and potential economic impact of tourism for the corridor cannot be understated. There are four Heritage Zones along the corridor (identified in blue) that would benefit from targeted marketing, recreation, and tourism initiatives: Mt. Willen Rd, Orange Grove Rd, Mebane Oaks Rd, and Bethel-Hickory Grove Church Rd. Strategies for increasing economic activity to support the corridor's long-term vision include:

- Provide opportunities for "shovel ready" sites or mixed-use development in the Economic Nodes for expanded employment.
- Create a brand and marketing strategy to link recreational and tourism assets along the corridor, especially in relation to the Heritage Nodes

- Engage county and regional tourism agencies in further collaborating to promote cultural, recreational, and agricultural assets within or adjacent to the corridor.

Economic development and tourism promotion will increase congestion and exacerbate the corridor's poor vehicle performance during peak conditions. Also, tourists and those seeking the recreational assets along the corridor will seek safe non-motorized routes to access the area. Transportation improvements and land use development decisions based upon regional development pressures must consider the experience for all users. Strategies to support successful integration of transportation investments with corresponding development include:

- Coordinate transportation and land use strategies;
- Provide opportunities for Complete Streets sections in the Economic Nodes to enhance user experience and provide a safe biking/pedestrian amenity which supports existing uses (e.g. Alexander Wilson Elementary School) and encourages private investment;
- Provide for multimodal options along the Heritage Zone to link bicycle and pedestrian routes to recreational assets, including the Haw River and Mountains-to-Sea trails.

Public Input

4.0 Public Input

The Study Team solicited public input on this project through a diversity of channels. This included creating and recruiting a stakeholder group which was composed of community and business leaders and interested residents who provided feedback throughout the project. The project team also created a website, www.NC54West.com, that provided project updates and gathered public input through an interactive map. Finally, the project team scheduled two rounds of community workshops, the first of which began in January 2018. The project team also conducted interviews with several key stakeholders along the corridor.

4.1 Stakeholder Interviews

As part of the Public Involvement Plan, the project team solicited interviews from groups that possessed specialized knowledge of the NC 54 West corridor. Interviews were conducted over the phone during November-December 2017 timeframe. Interview subjects were selected based on their subject matter specialization and ability to complement the Study Team and existing data sources. These sources included public safety, education, and real estate and development perspectives. Major findings from these discussions are identified below.

- Public Safety – Three NC 54 intersections present vehicular safety concerns: Morrow Mill Road, Dodsons Road, and Mebane Oaks Road. Contributing factors of motor vehicle crashes at these locations include turning movements, passing, speed, and significant vehicular speed differentials. Congestion is noticeable during the AM and PM commuting periods that has been attributed to employees of the UNC Chapel Hill system and hospital. Recent and anticipated residential growth are perceived to also contribute to increasing collisions and congestion.

- Education – There is reported heavy congestion during morning and afternoon periods when school children are arriving/departing Alexander Wilson Elementary School, coinciding with shift changes at a nearby industrial site. These periods are at approximately 7:30AM and 3:00 PM. Vehicle backups are noticeable during these periods along NC 119 as well as on the elementary school's drop-off circle. School enrollment is anticipated to increase, and the number of students using school buses has also increased.
- Real Estate and Development – Rose and Associates conducted this series of discussions, and the associated findings are detailed in the Appendix.

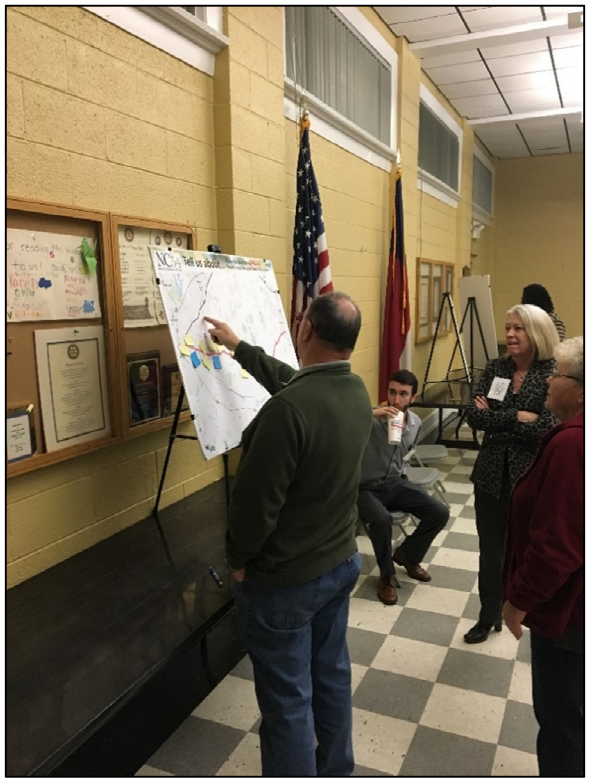
4.2 Community Workshops

Community workshops occurred in two rounds with three-to-four workshops per round. The sessions were scheduled for locations that balanced the geography of the corridor and were intended to engage—but not limited to—the general public and affected populations. The first round of community workshops occurred in January 2018 and the second round in May 2018 (the second round included an additional workshop to capture interest from the middle of the corridor). Workshop content was designed to inform stakeholders about identified deficiencies, and to confirm that the Study Team had captured the concerns, needs, and vision of the community as the project team proceeded with developing project alternatives and recommendations. Feedback and responses from the first round of workshops were incorporated into subsequent project exhibits, analysis, and deliverables. Summary memos from the two community workshop rounds are included in the Appendix. Attendance at the community workshops ranged from 12 to 44 attendees during the drop-in style sessions.

The first round of community workshops included the following locations, dates, and times:

- Mid Corridor – Rigmor House Event Center, January 23, 2018, 4:30 PM to 6:30 PM (to capture commuting residents)

- West Corridor – Graham Civic Center, January 24, 2018, 6:30 PM to 8:30 PM
- East Corridor – Carrboro City Hall, January 25, 2018, 6:30 PM to 8:30 PM



Comments in response to the initial project presentation and interaction with the displays focused primarily on preservation, roadway safety, and developing a vision for the corridor. Themes included:

- Preservation of the corridor's center from Mt Willen to Bethel Hickory Road for watershed protection and maintaining rural character;
- Safety concerns of high-speed vehicle passing in no-passing lanes, poor visibility due to trees or vegetation, curved roadway geometry, the sun's position, and turning vehicle conflicts;
- Competing visions of multimodal roadway design.

The second round of community workshops included the following locations, dates, and times:

- Orange County – Rigmor House Event Center, May 1, 2018, 4:30 PM to 6:30 PM (to capture commuting residents)
- East Corridor – Carrboro Century Center, May 2, 2018, 6:30 PM to 8:30 PM
- West Corridor – Graham Civic Center, May 3, 2018, 6:30 PM to 8:30 PM
- Alamance County – Swepsonville Fire Department, May 10, 2018, 4:30 PM to 6:30 PM (to capture commuting residents)

Public feedback during the second community workshop round consisted of reactions to VHB's proposed conceptual corridor improvements. These comments fell along the following themes:

- Skepticism of projected vehicle volume growth rates through the year 2045;
- Interaction of roadway widening and new development that would conflict with the corridor's rural character;
- Promoting safety improvements such as additional turn lanes, signals, lighting, and intersection treatments;

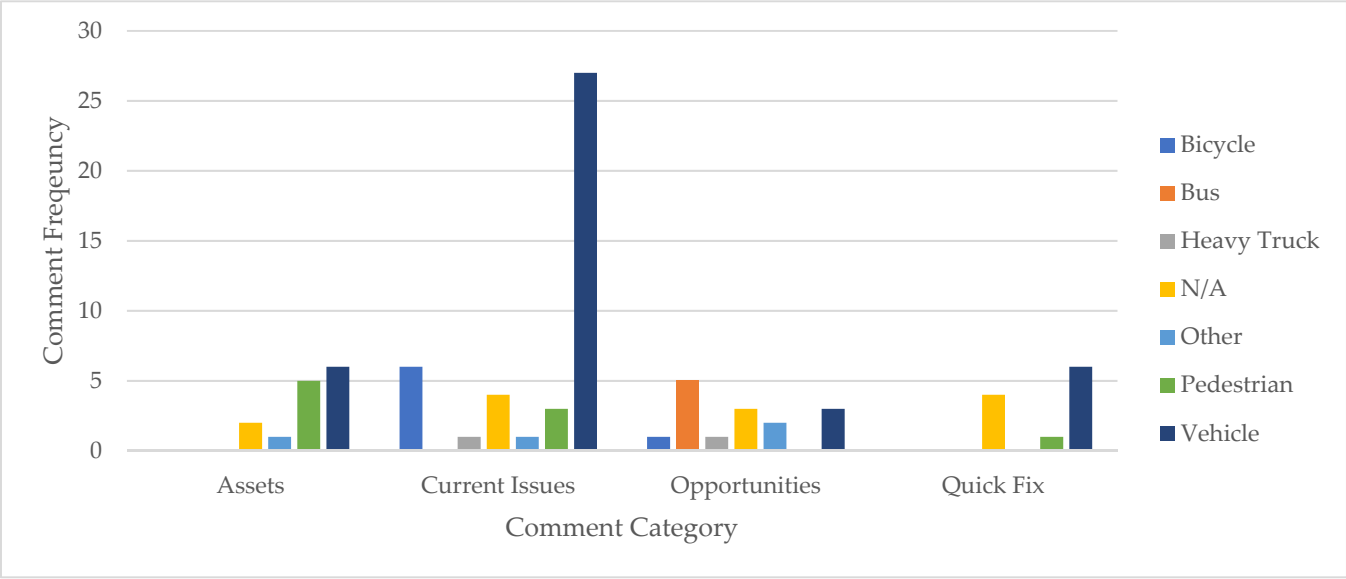
- Opposing preferences for five-lane and three-lane cross sections and maintaining the existing two-lane configuration throughout the corridor;
- Pedestrian and bicyclist difficulty in crossing larger improved intersections;
- Concern for farm and freight vehicle access and navigation of median divided four-lane roadways and roundabouts;
- Opposing preferences for on-road and off-road separated bicycle facilities;
- Identification of potential right-of-way constraints such as residential wells and property preservation.

The project team recorded community workshop comments and discussions and summarized in memo format. Meeting summary memos and workshop presentations were then posted to the project website after the respective community event.

4.3 Interactive Map

From fall 2017 through spring 2018, the project team welcomed corridor comments through an interactive map. The interactive map was prominently featured on the project website and promoted through the workshops, newsletters, and Study Team communications to the public. Residents, commuters, and other users of the NC 54 West corridor were encouraged to contribute to the Study Team's understanding of the corridor by placing "markers'" on assets, issues, opportunities, and quick fixes on locations of interest. Figure 22 below displays the distribution of the 82 interactive submissions by comment category and transportation mode. A plurality of submissions was vehicle-related current issues that addressed safety, visibility, speed, passing, and other operational problems.

Figure 22: Interactive Map Submissions by Category and Transportation Modes



4.4 Community Events

The community event component was eliminated to increase the level of public workshops from four to seven. The project team created a "Meeting in a Box" for the participating organizations and municipalities to communicate the project's status and purpose at community events of their choosing.

Corridor Vision

5.0 Corridor Vision

This chapter describes in detail the final roadway cross sections, intersection treatments, and bicycle and pedestrian features for the complete corridor buildout by the year 2045. It summarizes roadway levels of service for the recommended improvements, explores other critical issues, and discusses improvement alternatives that were considered, but not ultimately selected.

The recommendations described in this chapter are based on the best information currently available. As various projects in the corridor proceed through project development and construction, more detailed surveys, analysis, and design will be performed. Given the long-range nature of many of the recommendations, these efforts will incorporate changes in development, travel, and policy that may not have been anticipated. Refinements—and even major changes—to recommendations may result. It is not until the documentation of environmental impacts though the NEPA and SEPA (National and State Environmental Policy Acts) processes that critical design elements relating to cross-section and alignment will be determined.

5.1 Committed Improvements

There are a number of transportation improvements already planned along this corridor. The most significant are in the current 2018-2027 STIP. Some are associated with development projects, and others are already in the process of being implemented.

5.1.1 2018-2027 NC State Transportation Improvement Plan

The 2018-2027 State Transportation Improvement Program (STIP) released by NCDOT in July 2018 includes three projects of relevance to the NC 54 Corridor Study. See report Section 2.1.7 for the projects' locations and additional details.

STIP # U-6071 – NC 54

U-6071 is a Regional intersection improvement project at Old Fayetteville Road and NC 54 in Carrboro, NC. Right of way acquisition is scheduled for 2024 with construction in 2026. The Town of Carrboro is currently evaluating a Conditional Use Permit for a mixed-used development known as the Lloyd Farm Property at the northeast corner of NC 54 and Old Fayetteville Road.

STIP # R-5821A – NC 54

R-5821A is also a Regional operational improvement project with bicycle and pedestrian accommodations along NC 54 from Orange Grove Road in Orange County to Old Fayetteville Road in Carrboro. Right of way acquisition is scheduled for 2020 with construction in 2022. Findings from this corridor study will serve as baseline information and integrate into the purpose and need for the NEPA/Merger process of R-5821A.

STIP # R-5821B – NC 54

R-5821B is a Division intersection improvement project at NC 54 and Orange Grove Road in Orange County. The purpose of this near-term project is to address operational and visibility concerns without duplicating or conflicting with the efforts of this NC 54 corridor study. Right of way acquisition is scheduled for 2018 with construction anticipated in 2019.

5.2 Recommended Improvements

5.2.1 Corridor-Level

Typical Cross-Sections

Given the length of the corridor, this discussion is divided into recommendations by segment, as depicted in a series of six (west-to-east) maps depicted from Figure 25 through Figure 30. The primary focus is on the ultimate (2045) facility

cross-sections and general improvements; individual intersection recommendations will be described in more detail in the next section. Two cross-section variations are proposed, both versions of 4-lane median-divided roadways adapted from NCDOT's *Complete Streets Guidelines.*

One potential cross-section is a "ditch and swale" design (referred to as C-2, see Figure 23), with shoulders and shallow, vegetated, open-channel drainage, rather than concrete curb-&-gutter with piped runoff. The 23-foot grassed median has mountable concrete curbs (although medians as narrow as 10 feet are possible in limited circumstances). Travel lanes are 12 feet wide, with 8-foot shoulders, at least 6 feet of which are paved. This potential design includes a 10-12-foot-wide paved shared-use path (SUP) on one side of the road, ideally spaced 9'-6" or more from the edge of shoulder. This cross section requires approximately 150 feet of right-of-way (90 feet on the side of the SUP, 60 feet on the other side), but could be reduced by up to 10 feet in some cases.

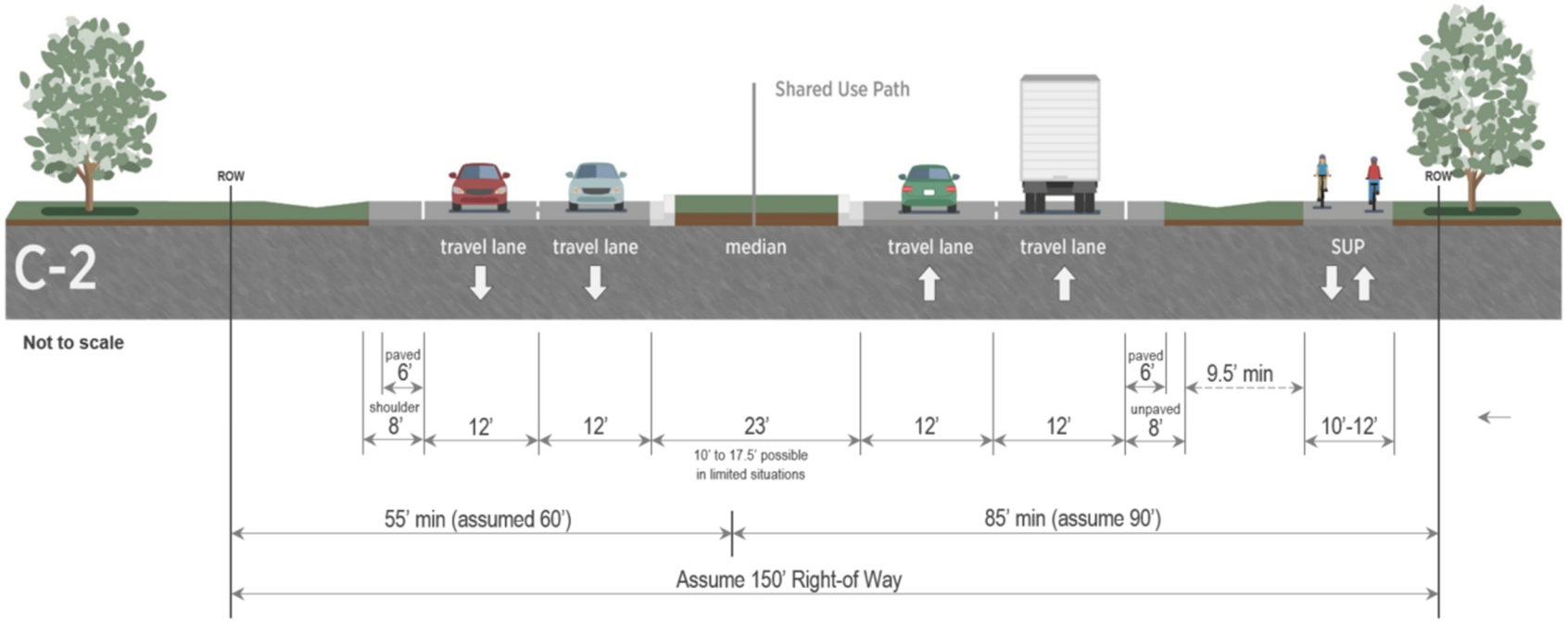
The second potential cross-section is a curb-and-gutter version (referred to as B-2, see Figure 24). The median and inner travel lane have the same dimensions as the ditch and swale version, but the outer lane is 14 feet wide, with a 2-foot curb and gutter pan. The shared-use path should ideally be at least spaced 9'-6" from the back of curb. This cross-section requires ROW width of about 130 feet (70 feet on the side of the SUP, 60 feet on the other side), but could in some situations fit within 120 feet. This cross-section is not suitable for posted speeds greater than 45 mph; however, this speed would be appropriate in locations where it is being considered, since these are more developed, with more frequent access/conflict points.

There are several trade-offs between the two cross-sections. Context determines the most appropriate solution, and the ultimate decision requires more detailed design and analysis beyond the scope of this corridor study. Future land use along the corridor will also affect this determination. Key considerations include:

- The narrower footprint of the curb-and-gutter version can reduce ROW costs and impacts on property and sensitive environmental areas.
- Curb-and-gutter cross-sections are limited to posted speeds of 45 mph or less.
- Ditch or swale versions typically costs less to construct and maintain.
- The wide shoulders on the swale section can accommodate bicycles for those who are comfortable riding along the shoulder; the curb-and-gutter does not, without additional width for traditional bike lanes.

- The swale section is more appropriate in a rural context, and can provide better access for farm equipment.
- Compared to traditional curb-and-gutter and storm sewer systems, properly-engineered swales will slow stormwater runoff, increasing infiltration and the removal of sediment and pollutants.

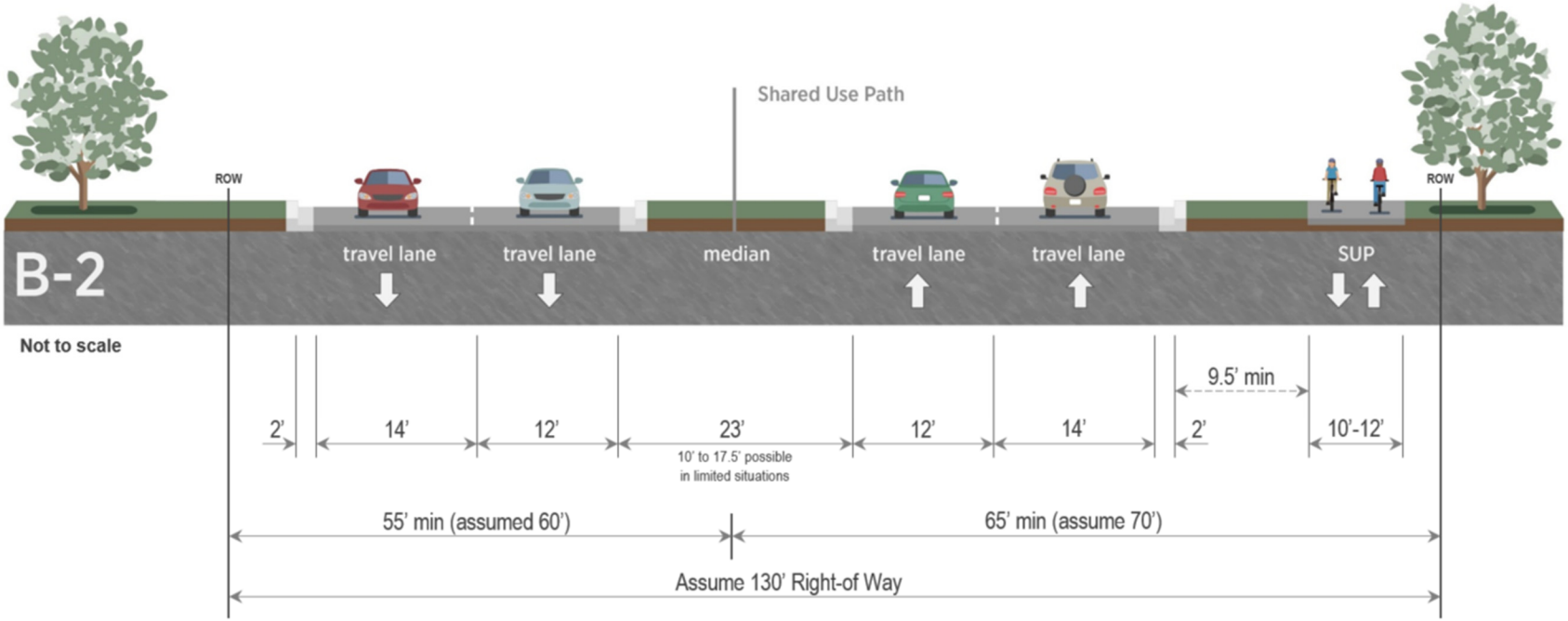
Figure 23: 4-Lane Divided Typical Swale Section



For the purposes of this study, widening is assumed to occur symmetrically from the existing NC 54 roadway centerline. More refined survey and design work to follow will determine whether that is the preferred solution or if the new centerline will shift to one side or the other. It is likely that widening will typically be symmetric, but could shift based on conditions at specific locations. Such conditions could include avoiding environmental hazards or

sensitive areas; minimizing ROW impacts or grading and construction costs; or improving roadway alignment (for example, straightening a tight curve to enhance visibility and safety).

Figure 24: 4-Lane Divided Typical Curb-&-Gutter Section



Median Breaks

Median breaks at major intersections are assumed, and likely locations for additional breaks are identified. Depending on design considerations and future traffic and development patterns, these breaks could be shifted or eliminated, and new breaks added at other locations. Median breaks can provide full access for all turning movements, or may permit only some movements. Examples include:

- U-turns only (for one or both directions). Not signalized.
- "Left-overs" in which left turns from NC 54 are allowed, but left turns onto NC 54 are not. No crossing through-movements are permitted. Not signalized.
- No left turns permitted onto (and usually from) NC 54; these are accommodated by median U-turns. Typically signalized.

Pedestrian and Bicycle Accommodations

The shared-use path (SUP) depicted in the cross-sections represents a configuration that is more desirable from the perspective of the typical SUP walker or cyclist. Greater separation from traffic lanes reduces noise and increases both actual and perceived safety. It also provides more alignment flexibility, increases landscaping options, and improves appearance. However, ROW, construction, and maintenance costs and other impacts increase. In addition, constructing a pedestrian facility on an alignment independent of the roadway can trigger more restrictive design standards, especially with respect to allowable grades. This can result in additional length, earthwork, and/or retaining walls. A shared-use path near or adjacent to the roadway would be able to more closely follow its alignment, taking advantage of grading associated with its construction. However, this is more difficult to achieve with a swale cross-section than with curb-and-gutter.

Due to cost and ROW considerations, as well as anticipated demand, a SUP is recommended along only one side of NC 54. An initial determination of the preferred side was made based on adjacent land uses, terrain, and desirable opportunities for crossing NC 54. Future development and information obtained from more detailed design will ultimately influence this decision.

Segment Descriptions/Discussions/Recommendations

Segment-specific recommendations are described below.

I-40 – NC 119/East Main Street

No major changes are suggested for the existing 5-lane cross-section with continuous two-way left-turn lane (TWLTL) extending from I-40 to NC 119. This cross-section is adequate for anticipated traffic growth. While no specific intersection

improvements are recommended for the analyzed intersections, signal timing and phasing (especially with respect to left-turns) should be regularly monitored and modified as needed. Turn lanes may also need to be added or lengthened, especially on side streets. It is also possible that some intersections will eventually warrant signalization.

A more critical concern, however, is the number and spacing of driveways, especially near I-40. Frequent driveways introduce conflicts that will both reduce capacity and increase crash rates as traffic volumes increase, especially if allowed to further proliferate. To maximize capacity and safety, a more rigorous access management plan should be implemented for both new and existing development. Potential measures include driveway consolidation, shared parking, primary access via side streets, frontage/backage roads, and increased driveway spacing, especially from intersections. At some locations, conditions may warrant replacing the center TWLTL with a median.

By reducing conflict points, improved access management would also provide a better starting point for enhancing bicycle and pedestrian travel options. The most notable transportation deficiencies in this part of the NC 54 corridor relate to pedestrian and bicycle travel.

Figure 25 indicates possible sidewalk locations, along with a possible route for a wider shared-use (or multi-use) path that combines roadside and off-street alignments. To the west, available ROW favors a sidewalk on the north side of NC 54, and in fact as part of recent commercial construction, a short segment has been built just east of Riverdale Drive. The northern side is also more feasible east of Jim Minor Road.

Between Cooper Road and Jim Minor Road, a SUP on the south side of NC 54 is most viable, due to ROW availability and the configuration of the two bridges that need to be traversed. Both the Haw River and Back Creek bridges maintain the 5-lane cross-section typical of this portion of NC 54. Since the center turn-lane is not needed on the bridges, it may be possible to eliminate or narrow it, and using the freed-up pavement for a bicycle/pedestrian facility. Such a treatment would require higher guardrails, and possibly a buffer or barrier to better separate the traffic lane.

Because of ROW availability and connectivity with Alexander-Wilson Elementary School, the sidewalk proposed east of Jim Minor Road could also be implemented as a SUP on the north side of NC 54, especially east of Long Dairy Road. Traveling the entire length of this sidewalk/shared-use path network between I-40 and NC 119 would require at least two

crossings of NC 54; one at Jim Minor Road, and another at either Cooper Road or Ivey Road/Sunset Drive. Since both the Jim Minor Road and Ivey Road/Sunset Drive intersections are signalized, crosswalks and pedestrian/bicycle signal accommodations can be readily added. Unless the Cooper Road intersection is eventually signalized, some other appropriate signage or activated signal would be desirable. Crosswalks (and signals, where appropriate) should also be considered on intersecting streets, and on all approaches at other signalized intersections.

NC 119/East Main Street – Wormranch Road

The recommended cross-section for this segment is a 4-lane divided curb-and-gutter, with a shared-use path along the north side (see Figure 25 and Figure 26). This decision is based on the existing cross-section west of NC 119/East Main Street, and on existing land use and anticipated changes near this intersection (identified as a development node). It is possible that sidewalks (and/or tighter SUP spacing) would be appropriate for at least part of this segment, depending on the nature of future development. In addition to the endpoints, median breaks are anticipated for intersection-related U-turns about 600 feet east of NC 119/East Main Street, at Clifford-Ray Road, and possibly Freshwater Road.

Wormranch Road – Mineral Springs Road

The ultimate cross-section recommended for this segment of NC 54 is the 4-lane median-divided swale, with a SUP along the north side (see Figure 26 and Figure 27). However, due to existing and possible future development, the curb-and-gutter version may be appropriate for at least some of the corridor, such as the segment between Cedar Point Road and Woods Lane, or the vicinity of Mt Willen/Salem Church Roads (which is a full-access intersection). Additional median breaks are likely at Brucewood Road and several other locations to be finalized in the design process. The existing bridge over Haw Creek will need to be widened or replaced, or a parallel bridge added.

Mineral Springs Road – Morrow Mill Road

A 4-lane median-divided swale cross-section is recommended for this portion of NC 54 (see Figure 27 and Figure 28). Mebane Oaks Road/Saxapahaw Bethlehem Church Road will be a full-movement intersection, and Thom Road is expected to have a median break, along with Gold Mine Road and/or Sanford Road. At least one other break is likely at a location to be determined.

The SUP is indicated on the north side of NC 54; however, there is not a major advantage over the south side. In fact, east of Mebane Oaks Road/ Saxapahaw Bethlehem Church Road, the south side may be preferable. An important unknown is the precise location of the Mountains-to-Sea Trail crossing of NC 54, and where trailhead access could be provided. Somewhere just east of the Mebane Oaks Road/Saxapahaw Bethlehem Church Road intersection appears most likely, so a major pedestrian/bicycle crossing at this intersection seems probable.

Morrow Mill Road – Dodson's Crossroad/Butler Road

Although a 4-lane median-divided swale cross-section is recommended, a curb-and-gutter treatment may be appropriate for segments between Morrow Mill and Orange Grove Roads, or from White Cross Road to Dodsons Crossroads/ Butler Road (see Figure 28 and Figure 29.) The Orange Grove Road and White Cross Road intersections will have median breaks.

Although a SUP on the north side of NC 54 is depicted, there may be advantages to an alignment on the south side. More detailed survey and design work will determine this outcome.

Dodson's Crossroad/Butler Road – Old Fayetteville Road

A 4-lane median-divided swale cross-section is recommended for most of this corridor segment. However, the current curb-and-gutter treatment at the eastern end of the corridor will probably be extended at least as far westward as the Henry Anderson III Park entrance. In addition, a cub-and-gutter cross-section may be more suitable for the segment between Newell and Hatch Roads (see Figure 29 and Figure 30). Median breaks are assumed at Bethel Hickory Grove Church Road, Neville Road, Hatch Road, the entrance to Henry Anderson III Park, and about 600 feet west of Old Fayetteville Road for intersection-related U-turns. Up to two other median breaks are likely.

Along this portion of NC 54, the north side is the preferred location for a SUP. The north side is less developed with more available room, and it is adjacent to existing and potential future recreational areas.

Segment Level-of-Service

Table 19 summarizes the 2045 HCS corridor level-of-service (LOS) for each segment, based on the recommended widening. Since there are no cross-section changes to the existing 5-lane segment west of NC 119, it remains at LOS B. All

segments between NC 119 and Bethel Hickory Grove Church Road operate at LOS A or B. The final segment east of Bethel Hickory Grove Church Road to Old Fayetteville Road operates at either LOS A or C, depending on the direction and time of day. These are significantly better than the corresponding 2045 No-Build LOS values, and are also better than existing conditions. It is notable that for all segments east of Mebane Oaks Road, LOS in the eastbound direction is worse during the AM peak, while the westbound direction is in the PM. This reflects the highly imbalanced directional flow experienced in the eastern portion of the corridor, attributable mainly to trips associated with UNC-CH and the UNC Medical Center.

Table 20 summarizes the 2045 HCS Bicycle Level of Service (BLOS) by each segment, direction, and peak period for bicycle trips using the shoulder or travel lane of the proposed 4-lane facility. This measure does not apply to the separate SUP, nor does it incorporate BLOS for intersections. All segments have LOS B or C; the corresponding values east of NC 119 were LOS D or E, both in the 2045 No Build scenario, and for existing conditions.

Figure 25: Corridor Recommendations – Segment 1

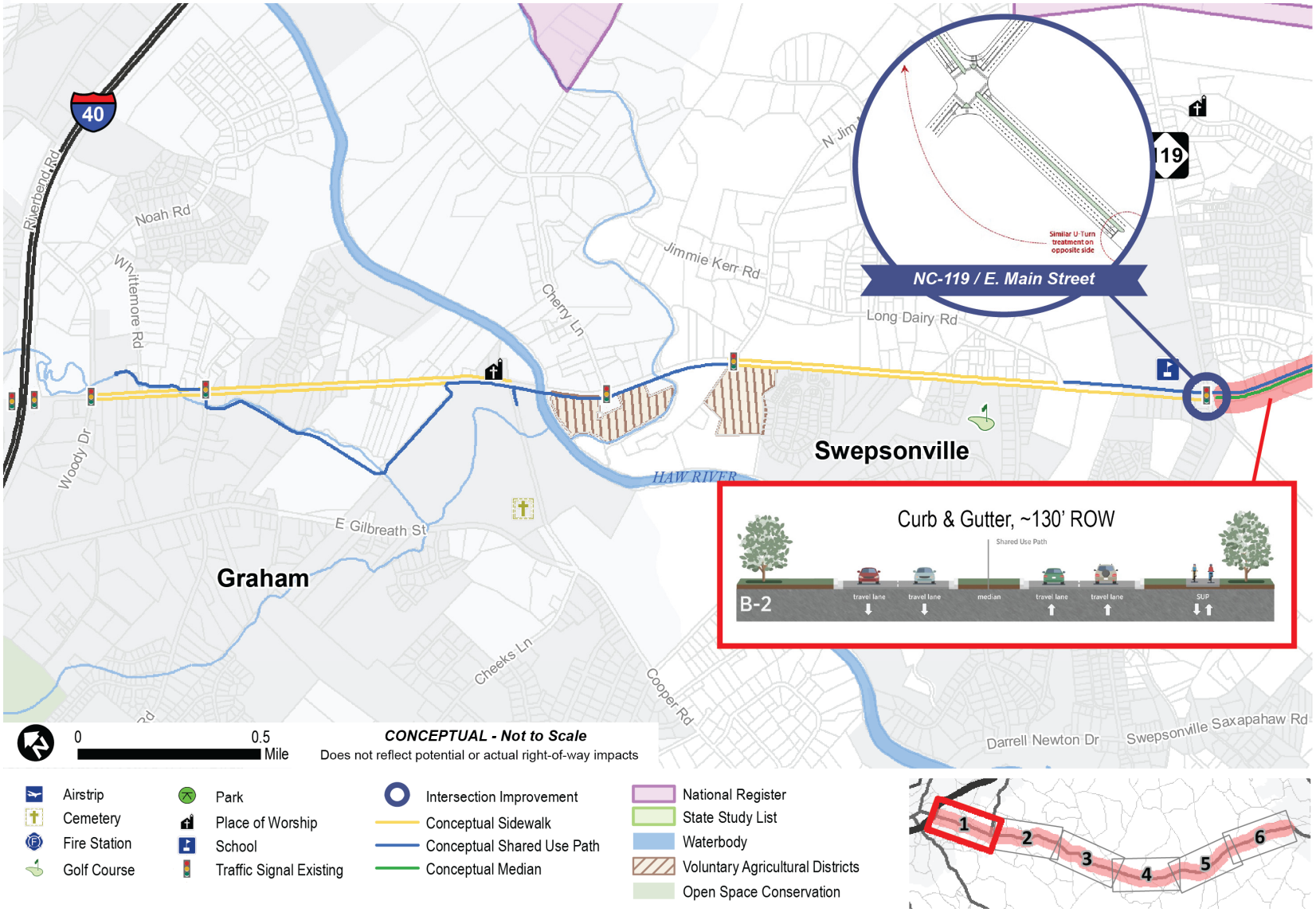


Figure 26: Corridor Recommendations – Segment 2

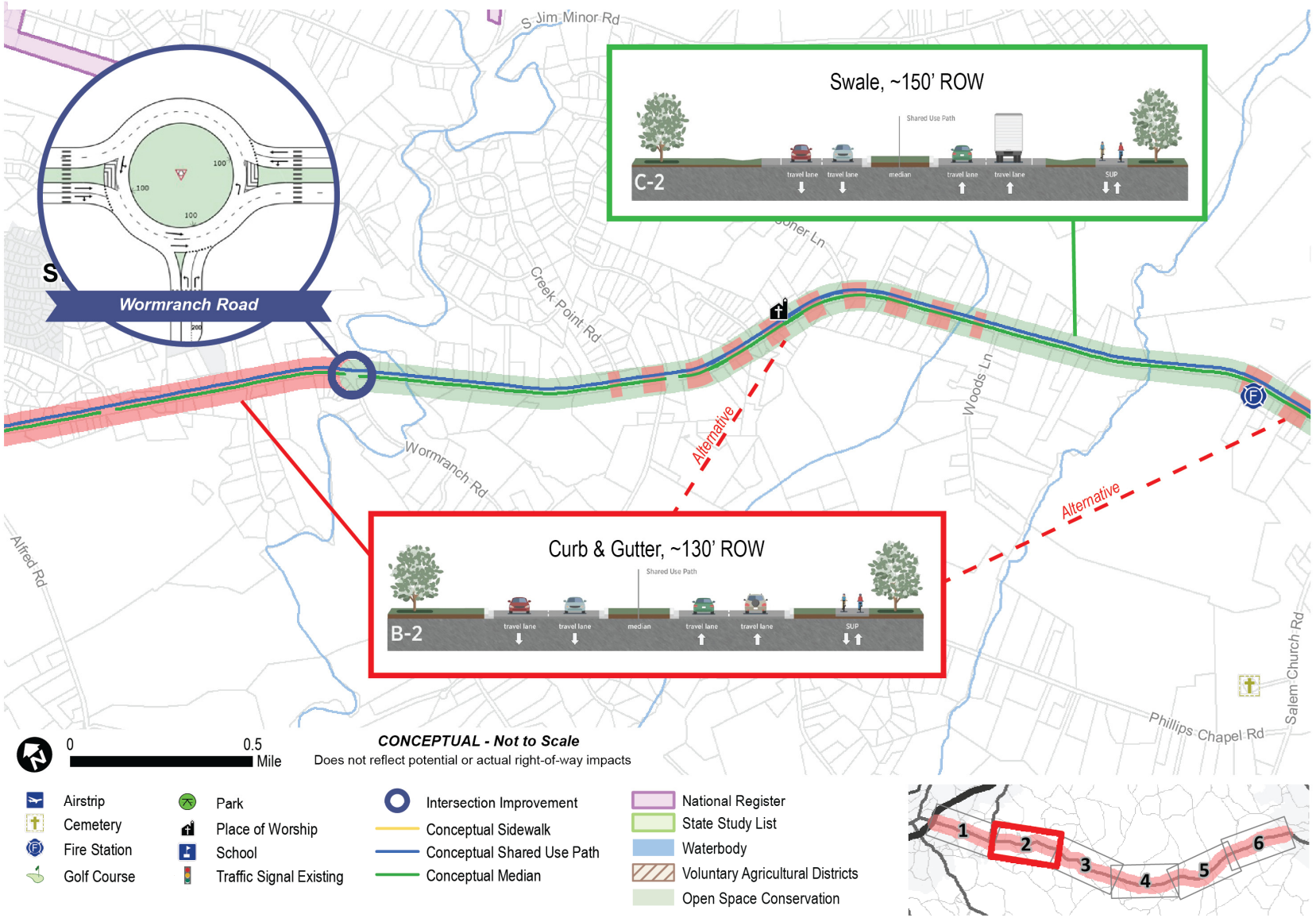


Figure 27: Corridor Recommendations – Segment 3

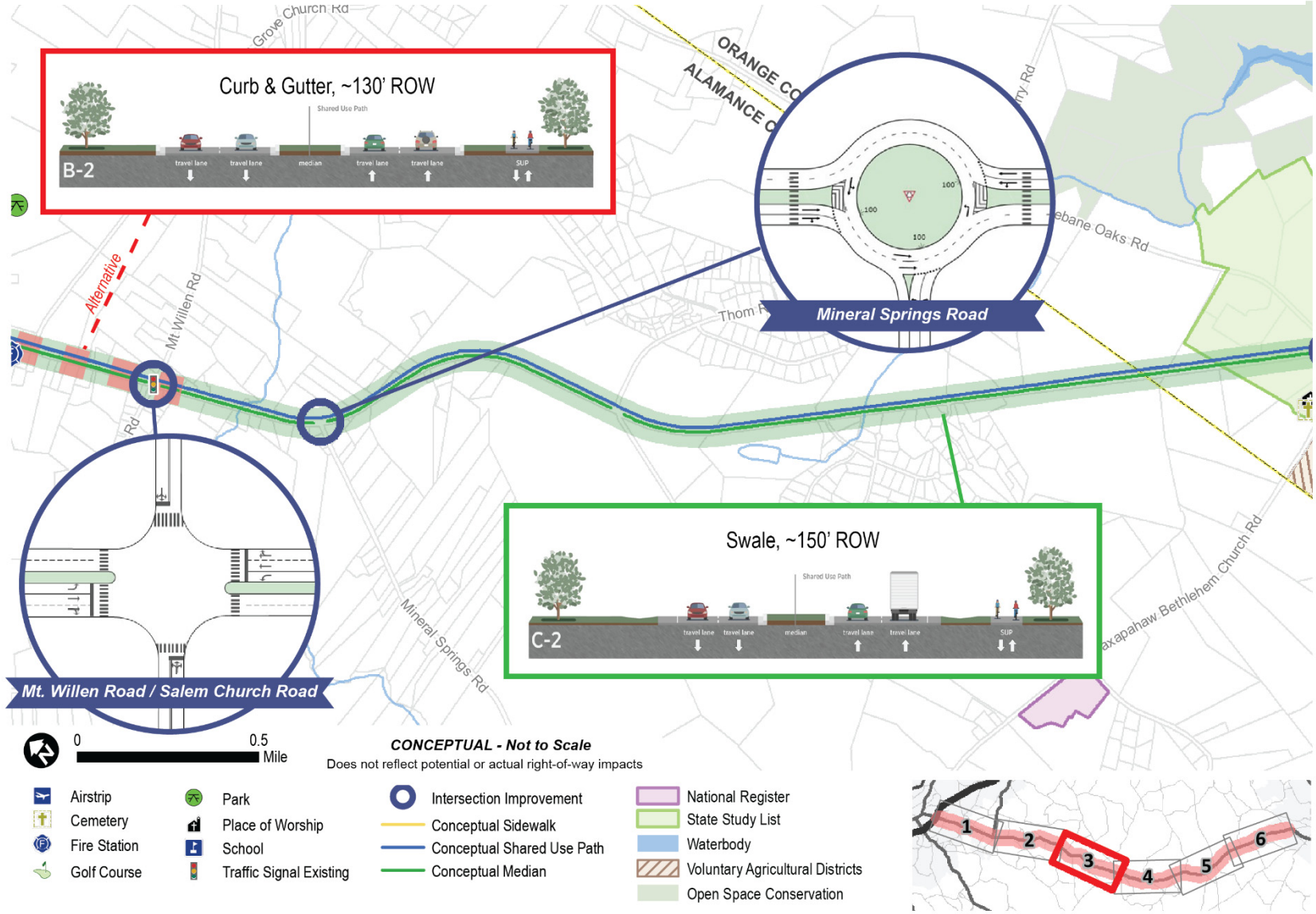


Figure 28: Corridor Recommendations – Segment 4

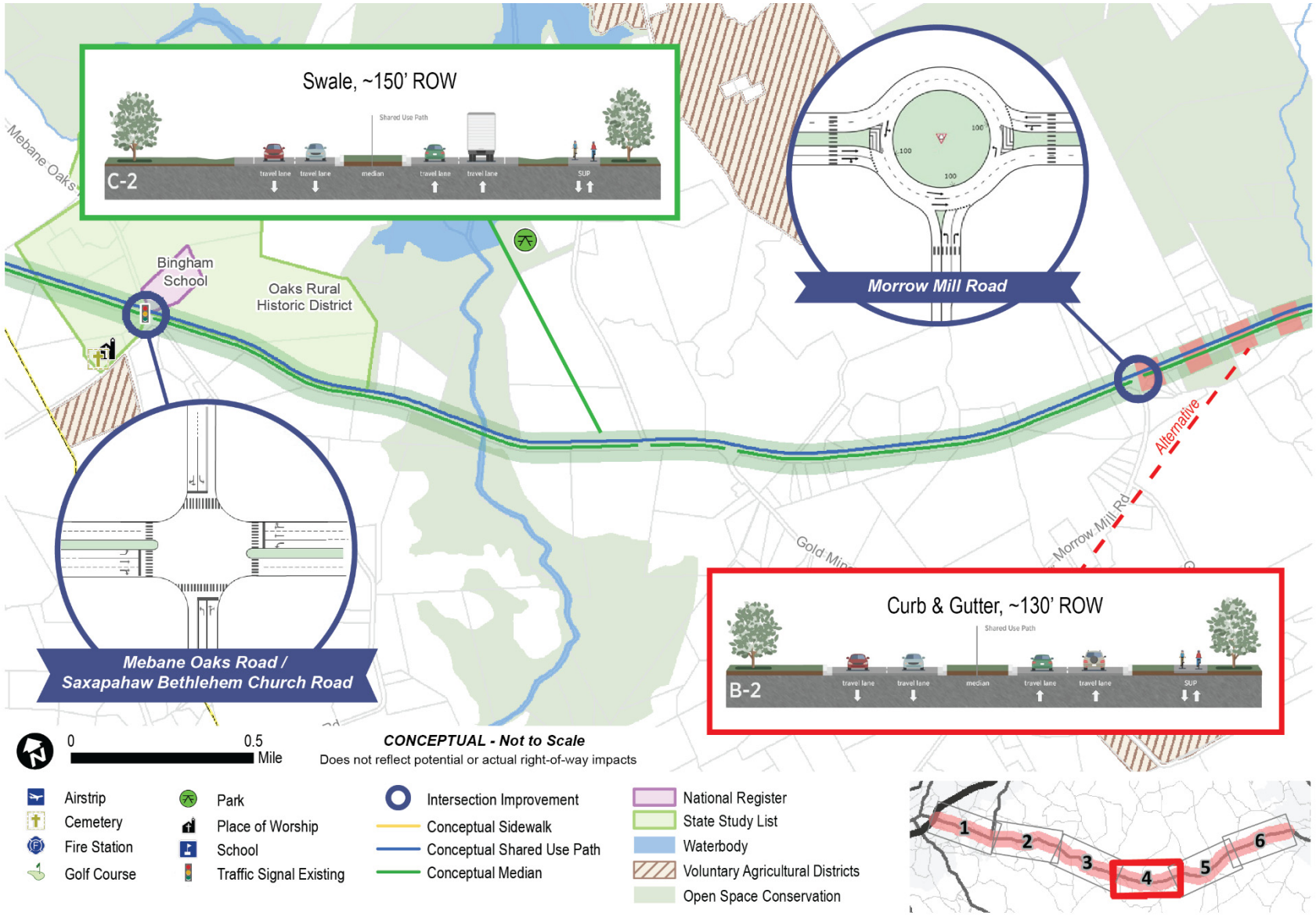


Figure 29: Corridor Recommendations – Segment 5

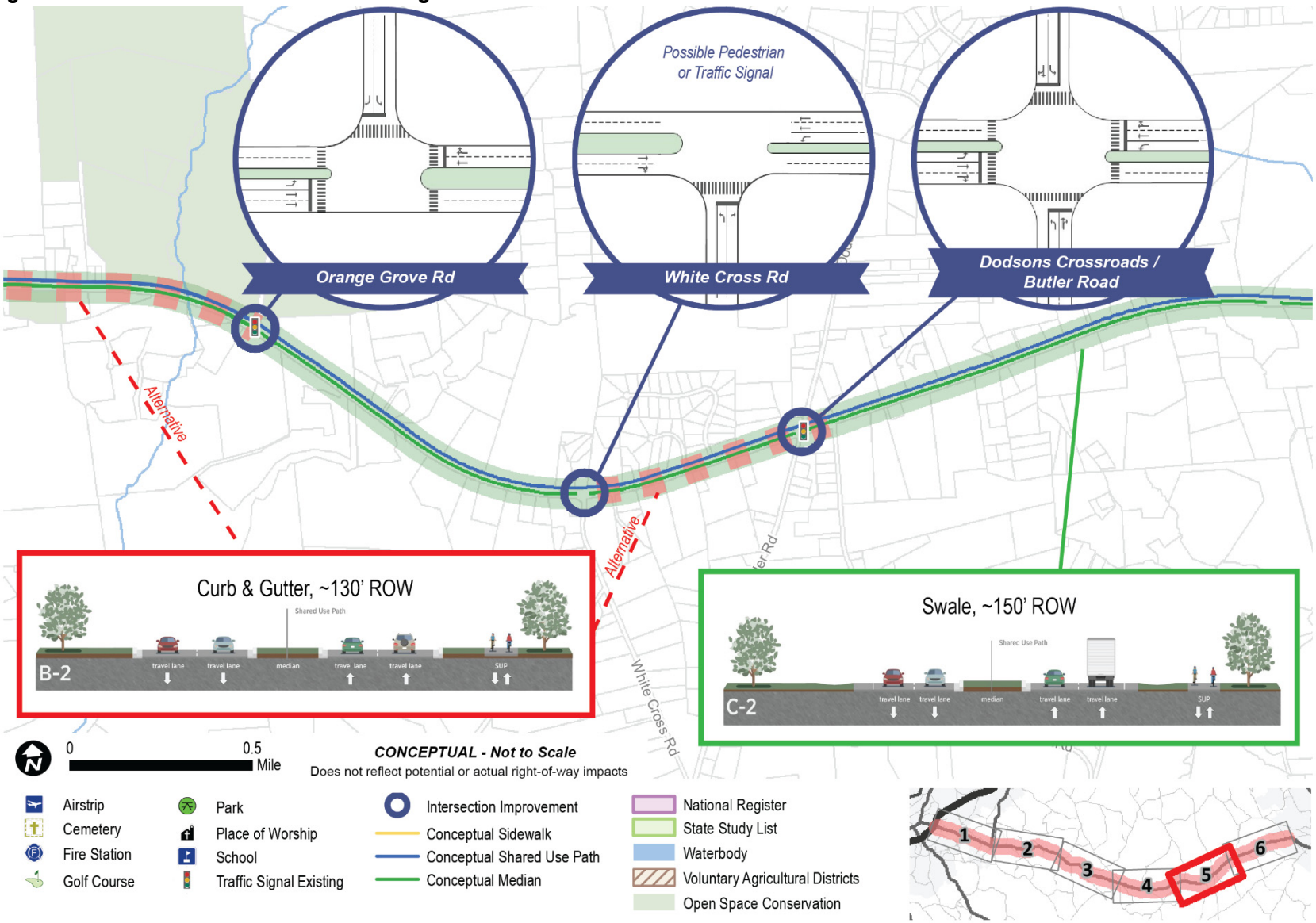


Figure 30: Corridor Recommendations - Segment 6

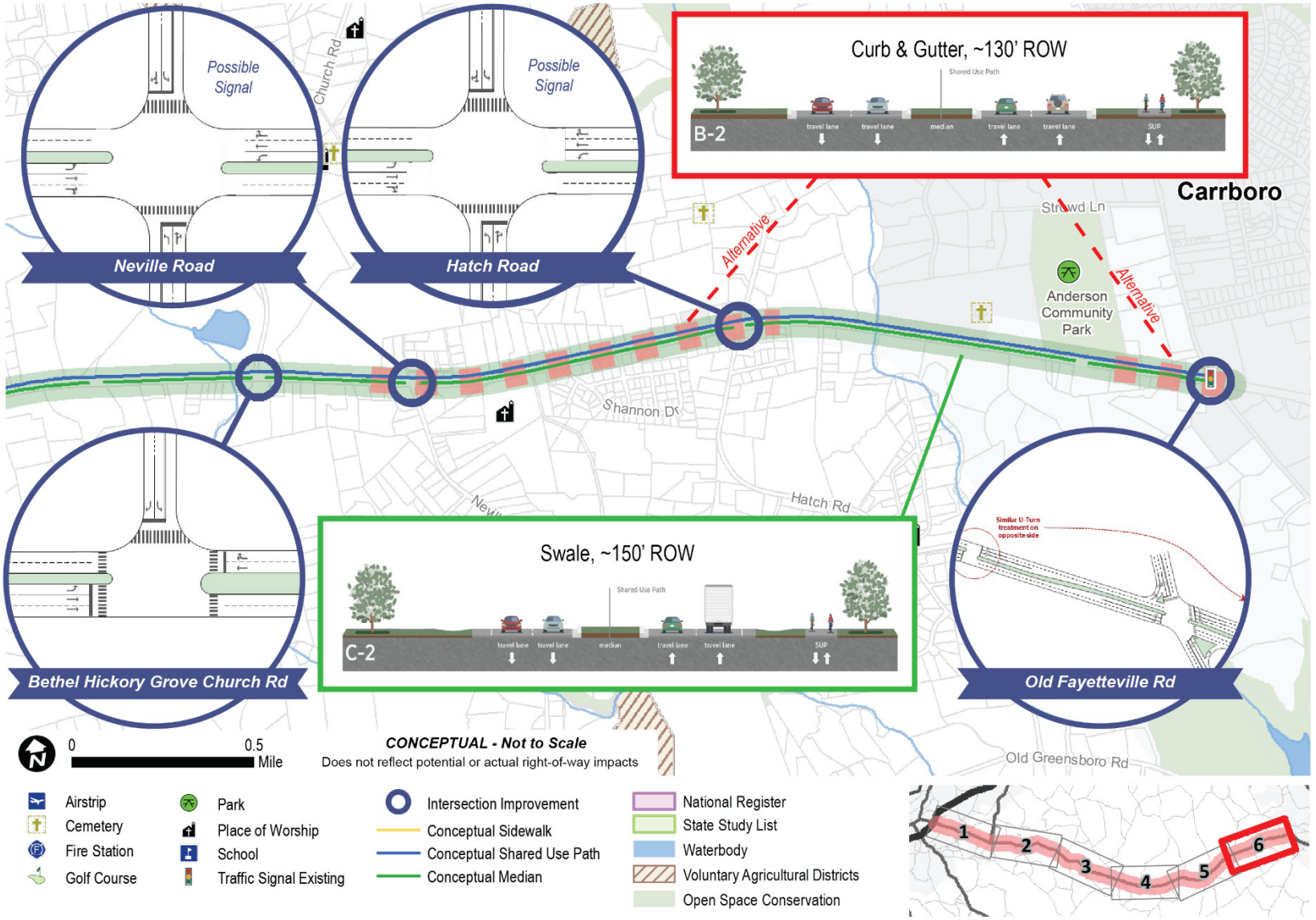


Table 19: 2045 Build Corridor Level of Service Summary for NC 54: 4-Lane Divided

Segment Location	Segment Length (miles)	AM Peak			PM Peak		
		Segment LOS	Ave. Speed (mph)	Density (pc/mi/ln)	Segment LOS	Ave. Speed (mph)	Density (pc/mi/ln)
Woody Dr – NC 119 (EB / WB)	3.2	B / B	45.0 / 45.0	16.0 / 17.2	B / B	45.0 / 45.0	17.7 / 15.5
NC 119 – Mt Willen Rd (EB / WB)	4.1	A / A	55.0 / 55.0	9.6 / 8.3	A / A	55.0 / 55.0	7.1 / 10.9
Mt Willen Rd – Mebane Oaks Rd (EB / WB)	3.3	A / A	55.0 / 55.0	8.9 / 5.5	A / A	55.0 / 55.0	4.3 / 10.1
Mebane Oaks Rd – Orange Grove Rd (EB / WB)	3.6	B / A	55.0 / 55.0	13.9 / 4.6	A / B	55.0 / 55.0	4.4 / 13.9
Orange Grove Rd – Dodsons Crossroads (EB / WB)	1.6	B / A	55.0 / 55.0	15.1 / 4.9	A / B	55.0 / 55.0	4.6 / 15.6
Dodsons Crossroads – Bethel Hickory Grove Church Rd (EB / WB)	1.8	B / A	55.0 / 55.0	17.1 / 4.9	A / B	55.0 / 55.0	5.5 / 16.5
Bethel Hickory Grove Church Rd – Old Fayetteville Rd (EB / WB)	2.6	C / A	55.0 / 55.0	18.4 / 5.8	A / C	55.0 / 55.0	6.6 / 18.2

Table 20: 2045 Build Corridor Segment Bicycle LOS Summary for NC 54: 4-Lane Divided

Segment Location	Segment Length (miles)	AM Peak		PM Peak	
		Segment BLOS	BLOS Score	Segment BLOS	BLOS Score
Woody Dr – NC 119 (EB / WB)	3.2	B / C	2.5 / 2.5	C / C	2.6 / 2.6
NC 119 – Mt Willen Rd (EB / WB)	4.1	C / B	2.5 / 2.5	B / C	2.4 / 2.6
Mt Willen Rd – Mebane Oaks Rd (EB / WB)	3.3	B / B	2.5 / 2.2	B / C	2.1 / 2.6
Mebane Oaks Rd – Orange Grove Rd (EB / WB)	3.6	C / B	2.7 / 2.2	B / C	2.1 / 2.7
Orange Grove Rd – Dodsons Crossroads (EB / WB)	1.6	C / B	2.8 / 2.2	B / C	2.2 / 2.8
Dodsons Crossroads – Bethel Hickory Grove Church Rd (EB / WB)	1.8	C / B	2.8 / 2.2	B / C	2.2 / 2.8
Bethel Hickory Grove Church Rd – Old Fayetteville Rd (EB / WB)	2.6	C / B	2.9 / 2.3	B / C	2.3 / 2.9

Other Cross-Section Options Considered

Several other cross-sections were suggested or considered in developing the recommended plan. Both three-lane and five-lane sections with center two-way left-turn lanes (TWLTL) were rejected due to NCDOT's policy to avoid new construction of these types of roadways, especially on NC and US routes, and in higher-speed rural settings. State and national research confirms that median cross-sections are significantly safer than corresponding TWLTL facilities, regardless of traffic volumes or driveway density. Converting from TWLTL to median-separated reduces sideswipe crashes by 21%, and head-on and fatal crashes by 47%, respectively. Even two-lane undivided roadways (such as existing NC 54) have lower crash rates for multi-vehicle non-driveway crashes.

Four-lane undivided facilities present similar head-on, rear-end, and sideswipe crash problems, due to left-turning vehicles slowing down or stopping in the inner lanes, which typically carry faster traffic. The resulting conflicts and lane changes also reduce the effective capacity of the inner lanes. In addition, drivers crossing or turning left from driveways or unsignalized intersections must simultaneously deal with multiple lanes of traffic from both directions. The same conditions present an even greater hazard for pedestrians and bicyclists. For this reason, NCDOT also avoids building 4-lane undivided roads in this type of situation.

A less common cross-section was also considered: an imbalanced or asymmetrical 3-lane roadway, in which an alternating third lane is constructed to facilitate passing. The hope was that for the lower-volume middle portion segments of NC 54 near the Alamance/Orange County Line, increasing opportunities to pass slower-moving vehicles would improve the level-of-service. These types of facilities are more common in mountainous areas, although an older portion of US 70 between Sedalia and McLeansville still retains this cross-section. However, crashes and congestion have become problems, and part of the corridor was converted to a 3-lane TWLTL some years ago, and planning has been underway to widen to a 4-lane divided facility. While this portion of US 70 has traffic volumes and driveway/intersection densities slightly higher than anticipated for relevant segments of NC 54, they share similar shortcomings. It is difficult to find a long enough stretch of roadway without (or with very few) driveways or intersection roads on one side, and then on the other. Otherwise, left-turning vehicles will be slowing/stopping in the passing lane, an unsafe condition that also undermines any capacity benefit. A median-divided version was also considered, but deemed impractical, especially since it required only about 12' less ROW than a 4-lane divided road. With the volume of highly-directional peak-period traffic in this part of the corridor, at least one-quarter mile in each direction is needed to allow enough passing to generate even a slight improvement; such segments are not available at suitable locations. Given these challenges, the potentially unexpected nature of this treatment, and need for other widening for turn lanes and transitions, this concept was eventually dropped from consideration.

Short-Range Improvements

The recommendations described to this point relate to longer-term improvements representing the "ultimate" condition of this NC 54 study corridor. There are a number of smaller, cost-effective improvements that should be considered in the meantime. Most of these short-range or interim improvements address safety concerns, and can be implemented without contravening longer-range plans.

- **Centerline and shoulder rumble strips** can reduce lane and roadway departure crashes, which have high injury and fatality potential. These relatively inexpensive treatments can be implemented along most of the corridor as part of regular repaving. Although rumble strips can have noise impacts on adjacent land uses, this should not be a problem in most of the corridor, given its low density and the fact that these types of rumble strips are rarely activated. Impacts on ride quality and safety for bicyclists can be a more significant concern. Rumble strip treatments should be located close to the outer lane marking to provide the widest usable shoulder possible; some designs even place the rumble strips just inside the traffic lane. There should also be frequent gaps, allowing bicyclists to cross without riding over rumble strips.
- **SafetyEdge** technology angles the edge of pavement to lessen vertical drop-off, allowing drifting vehicles to better maintain control when returning to the pavement, avoiding fixed-object crashes. As part of regular repaving in the absence of curbs, this treatment has minimal effect on asphalt paving costs, and can improve pavement life. This treatment can also benefit access for agricultural and maintenance equipment.
- **High-friction surface treatment** reduces crashes on wet roads and sharp curves, especially at higher speeds. This is a highly cost-effective countermeasure.
- **Retroreflective chevrons, post-mounted delineators, and enhanced pavement markings** are low-to-moderate cost treatments providing advance warning of changes in roadway curvature and operating speeds. Measures include larger, more reflective signs and markings, and dynamic or sequential warning signs.
- **Left-turn lanes** can reduce rear-end crashes.
- **Acceleration/deceleration and right-turn lanes** can cut down on rear-end and other crashes.
- **Access management** reduces conflicts, helping preserve capacity while reducing turning and rear-end crashes, as well as benefitting bicycle and pedestrian travel.
- **Intersection lighting** can help prevent nighttime left-turn crashes, especially at unsignalized intersections.
- **Enhanced wayfinding** and street signage can reduce driver uncertainty, especially at night, possibly diminishing the potential for some rear-end and turning crashes**.**

5.2.2 Intersections

Detailed intersection capacity analysis and improvement recommendations are limited to the eight major intersections discussed earlier in this report. However, qualitative assessments and recommendations are provided for a number of other intersections.

General recommendations for all intersections (some of which can be deployed as relatively low-cost, short-range improvements) include:

- Provide pedestrian crossing treatments, such as crosswalks, signage, and signals, where appropriate
- Where warranted, provide turn lanes (especially left-turns) of adequate length should to accommodate typical vehicle queues
- Monitor and update signal timing and phasing as necessary to optimize efficiency
- Periodically assess unsignalized intersections to determine if traffic volumes, delay, or crash history warrant signalization
- Enhance lighting, pavement marking, and signage as needed to maintain visibility

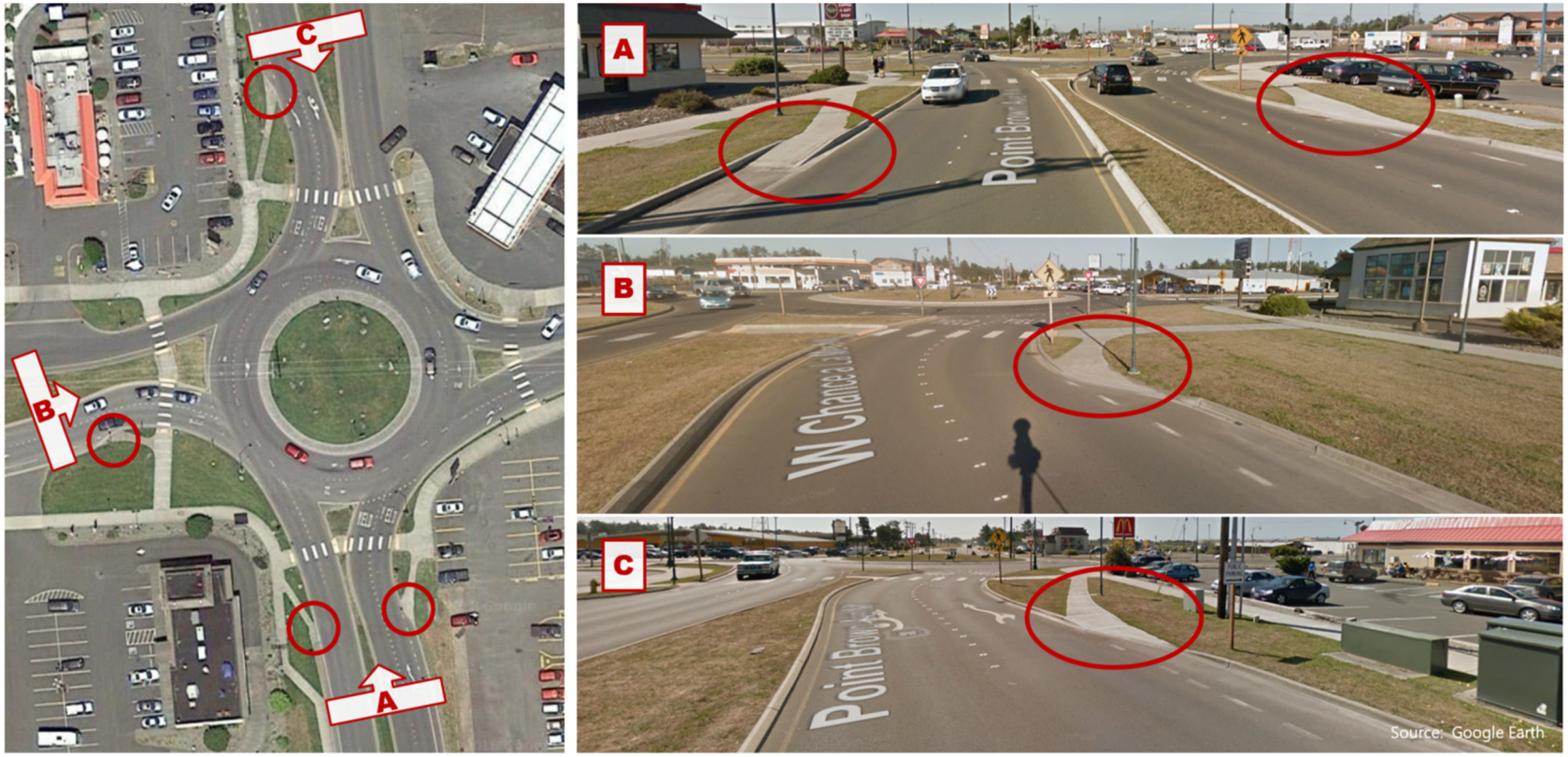
Roundabouts

Roundabouts are recommended as long-range solutions at three locations in the corridor (Wormranch Road, Mineral Springs Road, and Morrow Mill Road). Other locations evaluated for roundabout installation were better suited to STOP or signal control, typically due to topography, ROW impacts, or traffic volumes. All three of the proposed roundabouts would be constructed at T-intersections that are currently unsignalized. Given the volumes of through traffic forecast for NC 54, these roundabouts would eventually require two lanes, or possibly incorporate one or more bypass lanes. These roundabouts may require slightly more right-of-way than a typical intersection, but will not require signalization, and provide safety and operational advantages for both motorized and non-motorized travel. If needed, they can also better accommodate a low-volume driveway opposite the intersecting roadway.

It is not desirable or cost-effective to install a multilane roundabout on a two-lane road, nor to build a single-lane roundabout that would subsequently be enlarged. Anticipated traffic volumes suggest the best course of action would be

to maintain the existing STOP-controls, adding turn lanes or other interim improvements as warranted, until at least one leg of NC 54 is widened. The recommended roundabouts coincide with the ends of proposed construction phases for the NC 54 widening, providing effective transitions between 4-lane and 2-lane cross-sections.

Figure 31: Example Roundabout Treatment for On-Road Bicycles



Roundabouts help moderate traffic speeds and reduce crash severity comparted to STOP or signal control. Two-lane roundabouts accommodate most large vehicles and include a mountable apron for vehicles with challenging turning radii. Pedestrian crossings occur at crosswalks that incorporate splitter islands as pedestrian refuges, allowing separate crossing of each direction of slower-moving traffic. Bicycles can use the same crossing (as a shared-use path), or a parallel

path, or be dismounted and walked. Bicycles can also circulate with traffic, although this is not recommended for multi-lane rural roundabouts. To provide an alternative for cyclists using the road or shoulder, bicycle access "ramps" are proposed to connect the road with the shared-use path or crosswalk before and after a roundabout. Figure 31 depicts examples of this type of treatment.

Individual Intersection Descriptions/Discussions/Recommendations

Recommendations for key intersections are discussed in detail below.

NC 119/East Main Street

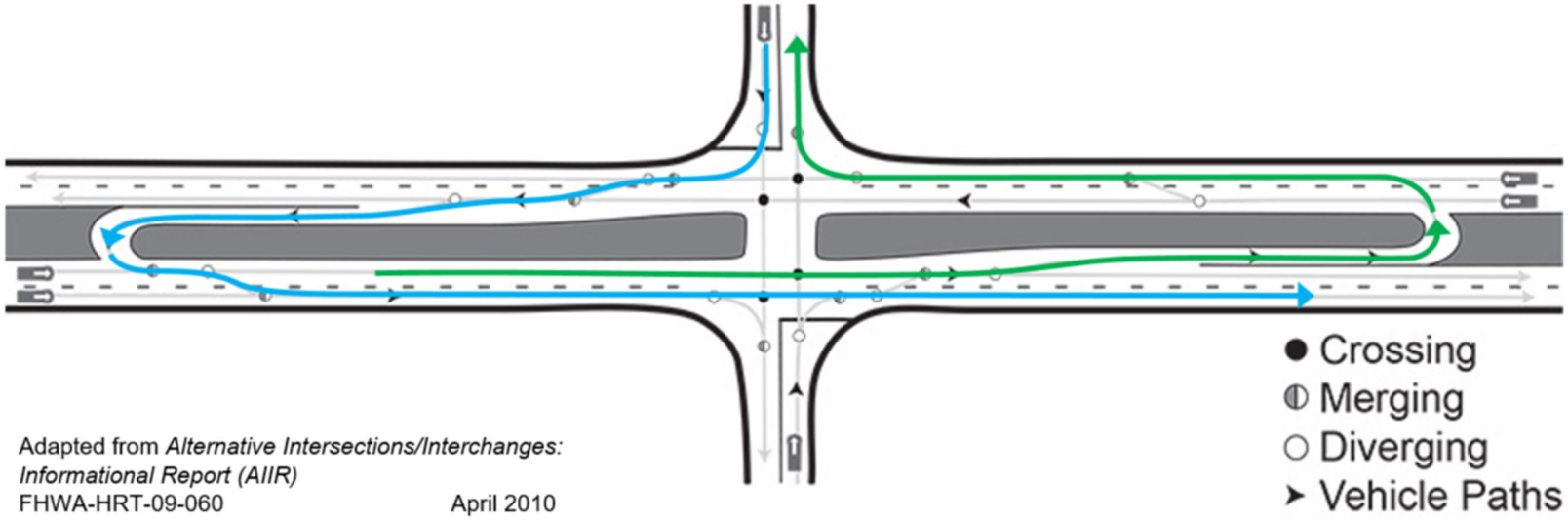
Delays and long queues at this intersection worsen as volumes increase. Turn-lanes and through-lanes can be added to improve LOS, but the resulting enlargement of the intersection footprint has significant impacts on adjacent properties. Some dual turn-lanes are required, along with increased storage lengths. The larger cross-section also reduces intersection efficiency, and impedes pedestrian crossings. Several alternate intersection designs were evaluated with respect to managing traffic delay and queue lengths, minimizing cost and ROW impacts, and promoting safe and convenient pedestrian and bicycle travel.

- A median U-turn (MUT) intersection (seen in Figure 30 and diagrammed in Figure 32) is recommended. The MUT allows through movements and right turns as in a typical intersection, but replaces direct left turns with indirect left turns via U-turns occurring on NC 54 at median cuts approximately 600 feet from the intersection. These U-turns can be signalized or unsignalized, and depending on median width and the number of lanes, additional widening in the form of bulb-outs may be required to accommodate large trucks.

  Traffic wishing to turn left from NC 54 first travels straight through the intersection, turns left through the median cut, then turns right onto NC 119/East Main Street. Left turns from the side street reverse this sequence, turning right onto NC 54, then making a U-turn before proceeding back through the intersection. Because left-turn conflicts and turn lanes are eliminated, the number of signal phases and conflict points at the primary intersection are reduced, enhancing operational efficiency and safety for all travel modes. Special consideration of school bus access and routing will be required, but this is the case for all options considered other than—to a degree—a roundabout or a traditional intersection.

- A quadrant intersection performs well overall, but requires construction of a new road in the southwest quadrant of the intersection, along with realignment of Alfred Road. The associated cost and impacts were deemed excessive.
- The size required for a roundabout, combined with pedestrian and bicycle impacts, eliminated a roundabout.
- The large footprint, ROW requirements, cost, access restrictions, and poor pedestrian and bicycle service disqualified a displaced left turn intersection.

Figure 32: Example of Median U-Turn Left-Turn Movements



Wormranch Road

Upon widening of NC 54 west of Wormranch Road, a two-lane roundabout (or one that employs bypass lanes) is recommended for this intersection (see Figure 26 for a schematic plan). This roundabout configuration is well-suited to

the traffic volumes forecast for this three-legged intersection. It also creates an effective transition between the widened 4-lane segment and the existing/improved 2-lane cross-section to the east.

Mt Willen Road/Salem Church Road

A standard intersection with dedicated left-turn lanes off NC 54 will be sufficient for this location (see Figure 27). Additional through lanes can be constructed in advance of widening, if warranted. Left-turn lanes on either cross-street approach are not needed, but are an option. Pedestrian and bicycle crossing treatments (crosswalks and signals) should be incorporated at this location, even prior to widening.

Mineral Springs Road

A roundabout with two lanes (or a bypass lane) is recommended for this intersection as part of any widening of NC 54 (see Figure 27 for a schematic plan). The traffic volumes forecast for this three-legged intersection are well-served by a roundabout of this type. Assuming NC 54 west of Mineral Springs Road is widened before the portion to the east, this roundabout will provide an effective transition.

Mebane Oaks Road/Saxapahaw Bethlehem Church Road

The ultimate design recommended for this recently-signalized intersection includes separate left-turn lanes on all approaches (see Figure 28). Additional through lanes may be needed in advance of widening. Lloydtown Road intersects Saxapahaw Bethlehem Church Road less than 100 feet from NC 54, and just over 500 feet from the Morrow Mill Road intersection. Some realignment of Lloydtown road away from NC 54 will be needed to accommodate increased traffic and improvements to the NC 54 intersection.

Pedestrian and bicycle crossing treatments (crosswalks and signals) should be incorporated at this location in the near term. This is especially important in light of the planned crossing of the Mountains-to-Sea Trail (MTS) at this location, which will increase existing bicycle and pedestrian trips already passing through this intersection. Unused NCDOT right-of-way between Lloydtown Road and NC 54 east of Saxapahaw Bethlehem Church Road could provide an opportunity for MTS trailhead parking, and possibly serve as a small park-and-ride lot for carpooling and transit service. The utility

easement to the south and any realignment of Lloydtown Road should also be considered in planning for this parking option.

This study identifies the Mebane Oaks Road/Saxapahaw Bethlehem Church Road intersection as an important node for recreational and heritage activity and related development (and protection). This context should be carefully considered in the planning and design of intersection improvements, including pedestrian and bicycle connectivity, parking availability, and even transit access.

Morrow Mill Road

A two-lane roundabout (or one incorporating bypass lanes) is recommended for this intersection in conjunction with widening of NC 54 (see Figure 28 for a conceptual diagram). A roundabout will function well at this three-legged intersection, and would provide an effective transition assuming NC 54 to the east of Morrow Mill Road is widened before the west.

Orange Grove Road

A typical signalized intersection with left-turn lanes on both approaches will provide adequate capacity at this location (see Figure 29). Additional through lanes may be needed in advance of widening. Pedestrian and bicycle crossing treatments (crosswalks and signals) should be incorporated at this location in the near term.

White Cross Road

This intersection may warrant signalization in the future, and left-turn lanes are anticipated for all approaches (see Figure 29). Appropriate pedestrian and bicycle crossing treatments should be installed in advance of eventual widening.

Dodson's Crossroad/Butler Road

A standard intersection with dedicated left-turn lanes on all approaches will be sufficient for this recently signalized location (see Figure 29). Additional through lanes may be required in advance of NC 54's widening. Pedestrian and bicycle crossing treatments (crosswalks and signals) should be incorporated at this location at the earliest opportunity.

Bethel Hickory Grove Church Road

A typical signalized intersection with left-turn lanes on both approaches will provide adequate capacity at this location (see Figure 30). Additional through lanes may be needed in advance of widening. Appropriate pedestrian and bicycle crossing treatments should be incorporated at this location in the near term.

Neville Road

This intersection may warrant signalization in the future, and left-turn lanes are anticipated (see Figure 30). Appropriate pedestrian and bicycle crossing treatments should be incorporated in advance of eventual widening.

Hatch Road

This intersection may warrant signalization in the future, and left-turn lanes are anticipated for all approaches (see Figure 30). Appropriate pedestrian and bicycle crossing treatments should be installed in advance of eventual widening.

Old Fayetteville Road

Improving operations (or even maintaining an acceptable level-of-service) in the face of traffic growth at this intersection can be achieved by adding turn-lanes and through-lanes. However, the resulting expansion of the intersection footprint will adversely impact adjoining land uses. Dual turn-lanes and increased storage lengths will be needed. The larger cross-section reduces intersection efficiency, and impedes pedestrian and bicycle crossings. Several alternate intersection designs were evaluated with respect to managing traffic delay and queue lengths, minimizing cost and ROW impacts, and promoting safe and convenient pedestrian and bicycle travel.

- A median U-turn (MUT) intersection (see Figure 30 and Figure 32) is recommended. The MUT allows through movements and right turns as in a typical intersection, but replaces direct left turns with indirect left turns via U-turns occurring on NC 54 at median cuts approximately 600 feet from the intersection. These U-turns can be signalized or unsignalized, and depending on median width and the number of lanes, additional widening in the form of bulb-outs may be required to accommodate large trucks.

  Traffic wishing to turn left from NC 54 continues straight through the intersection, turning left through the median cut, then right onto Old Fayetteville Road. Left turns from the side street reverse this sequence, turning right onto NC 54, then making a U-turn before proceeding back through the intersection. Because left-turn

conflicts and turn lanes are eliminated, the number of signal phases and conflict points at the primary intersection are reduced, enhancing operational efficiency and safety for all travel modes. It is also possible that median U-turns could instead be located on Old Fayetteville Road; however, this would require additional widening and bulb-outs, and could impact existing access to parcels along Old Fayetteville Road. Coordination with the pending Lloyd Farms development and additional traffic analysis and roadway design will be needed to determine the most appropriate design.

Special consideration of transit and school bus access and routing will be required, but this is the case for all options considered, other than—to a degree—a roundabout or a traditional intersection. It is possible that a bus-only lane and signal could be implemented at the main intersection, but it is not clear that this measure would be warranted.

- A quadrant intersection performs well overall, but requires construction of a new road in one of the northern quadrants of the intersection, resulting in excessive costs and impacts.
- The size required for a roundabout (up to three lanes in one quadrant), combined with pedestrian and bicycle impacts, eliminated a roundabout.
- The large footprint, ROW requirements, cost, access restrictions, and poor pedestrian and bicycle service disqualified a displaced left turn intersection.

Intersection Level-of-Service

Table 21 summarizes 2045 peak-hour levels-of-service by intersection and approach for each of the improved intersections. All primary intersections operate at LOS C or better; the only exception is the median U-turn east of Old Fayetteville Road during the morning peak period. This is due to the heavy eastbound flow of traffic.

Table 21: 2045 Build Intersection LOS and Delay

Intersection and Approach	Traffic Control	2045 LOS & Avg Delay/Veh (sec) AM	PM
NC 54 & Woody Drive	Signalized	**C (24.8)**	**C (21.6)**
Eastbound		C-20.1	B-18.2
Westbound		C-20.7	C-21.8
Northbound		D-53.8	D-37.0
Southbound		D-47.0	C-32.3
NC 54 & NC 119 / East Main Street	Signalized	**C (32.5)**	**B (16.7)**
Eastbound		C-31.6	B-13.6
Westbound		B-19.2	B-11.9
Northbound		C-30.8	B-15.3
Southbound		D-53.6	C-29.1
NC 54 & EB U–Turn (East of NC 119)	Signalized	**B (10.8)**	**A (8.1)**
Eastbound		A-4.2	A-4.6
Westbound		C-23.8	B-11.3
NC 54 & WB U–Turn (West of NC 119)	Signalized	**A (5.9)**	**A (4.8)**
Eastbound		A-8.7	A-8.8
Westbound		A-3.1	A-2.1
NC 54 & Mt Willen Road / Salem Church Road	Signalized	**B (18.8)**	**B (11.5)**
Eastbound		C-20.5	A-6.3
Westbound		A-7.4	B-10.5
Northbound		D-37.9	C-25.6
Southbound		C-26.1	C-32.7
NC 54 & Mebane Oaks Road / Saxapahaw Road	Signalized	**C (34.5)**	**C (21.8)**
Eastbound		C-30.7	A-3.1
Westbound		D-35.9	B-19.8
Northbound		C-28.6	D-48.2
Southbound		D-52.4	D-48.0
NC 54 & Orange Grove Road	Signalized	**B (15.5)**	**B (16.2)**
Eastbound		B-17.7	A-3.5
Westbound		A-2.9	B-18.0
Southbound		D-47.3	D-45.1
NC 54 & Dodsons Crossroads / Butler Road	Signalized	**B (16.7)**	**B (15.4)**
Eastbound		B-12.4	A-9.4
Westbound		B-12.8	B-14.2
Northbound		C-29.2	D-37.7
Southbound		E-56.3	D-44.3
NC 54 & Bethel Hickory Church Rd	Signalized	**C (21.0)**	**B (10.6)**
Eastbound		C-24.6	A-8.2
Westbound		A-1.4	A-7.9
Southbound		E-72.3	D-39.9
NC 54 & Old Fayetteville Road	Signalized	**B (17.0)**	**B (15.8)**
Eastbound		B-12.0	A-7.7
Westbound		B-12.5	B-15.4
Northbound		C-23.7	C-23.1
Southbound		C-34.2	C-23.4
NC 54 & EB U–Turn (East of Old Fayetteville Road)	Signalized	**D (47.8)**	**A (6.0)**
Eastbound		E-55.3	B-12.1
Westbound		D-36.4	A-4.2
NC 54 & WB U–Turn (West of Old Fayetteville Road)	Signalized	**A (7.8)**	**B (19.2)**
Eastbound		A-6.6	B-13.0
Westbound		B-10.4	C-23.1

5.3 Watershed and Environmental Protection Rules

The NC 54 West corridor sections in Alamance and Orange Counties fall within the Jordan Lake Watershed. To prevent pollution entering upstream and restore drinking water quality to the Jordan Reservoir, the Jordan Lake Nutrient Strategy was implemented in August 2009. The rules focus on reducing nutrient discharges from various sources, including stormwater from new and existing development. The Nutrient Strategy requires any new land development projects above a minimum size requirement to develop stormwater management plans that ensure best management practices (BMP) to handle stormwater and outflows of nitrogen and phosphorus. Buffer and stormwater permitting authority may involve a local government, county, or the NC Department of Water Resources depending on the affected site location. These plans must be approved before new development is allowed. Similarly, there are nutrient load reduction targets for existing developments as well. In addition to requirements for development activity, there are requirements for stormwater BMP for new or improved roadway sections to ensure that increased roadway surfaces do not increase nutrient loads. These rules and requirements are proven strategies to improve water quality downstream in Jordan Lake. They also impose new costs on development by adding costly stormwater management strategies. This can increase the time for approval of site plans as well as increasing development costs and reducing the amount of land on a parcel which can be developed. Further, it may lead to changes in roadway design to accommodate a stormwater BMP. The roadway improvements envisioned in this plan were not evaluated specifically in response to the Jordan Lake Strategy; this will need to be considered and implemented in the design phase for any roadway improvements and for the associated construction impacts.

Implementation

6.0 Implementation

This report chapter describes the recommended construction timeframes, phasing, estimated costs, and supporting initiatives and policies to achieve the NC 54 West corridor vision by the year 2045.

Implementation of any project recommendation entails a lengthy process of detailed studies identifying impacts and refining designs. This is especially true of a project of this magnitude, which will be implemented in a series of phases over many years. Adjustments will be needed to accommodate unanticipated variations in land use, travel demand, and policy and funding priorities. Estimates of probable costs are especially vulnerable to uncertainty, due both to variations in construction and right-of-way costs, and to design changes. Design decisions cannot be finalized until late in project development and construction, with the documentation of environmental impacts in the NEPA and SEPA (National and State Environmental Policy Acts) process being a critical point in this regard.

6.1 Potential construction phasing

Project recommendations are grouped in geographic segments for construction phasing (see Figure 33). Based on traffic forecasts, the range of years when practical capacity should be exceeded is identified along the entire corridor; this determines by when the recommended widening and related improvements should be complete. Since this implementation year varies by location, rational segments are defined and assigned to four, overlapping ten-year phases:

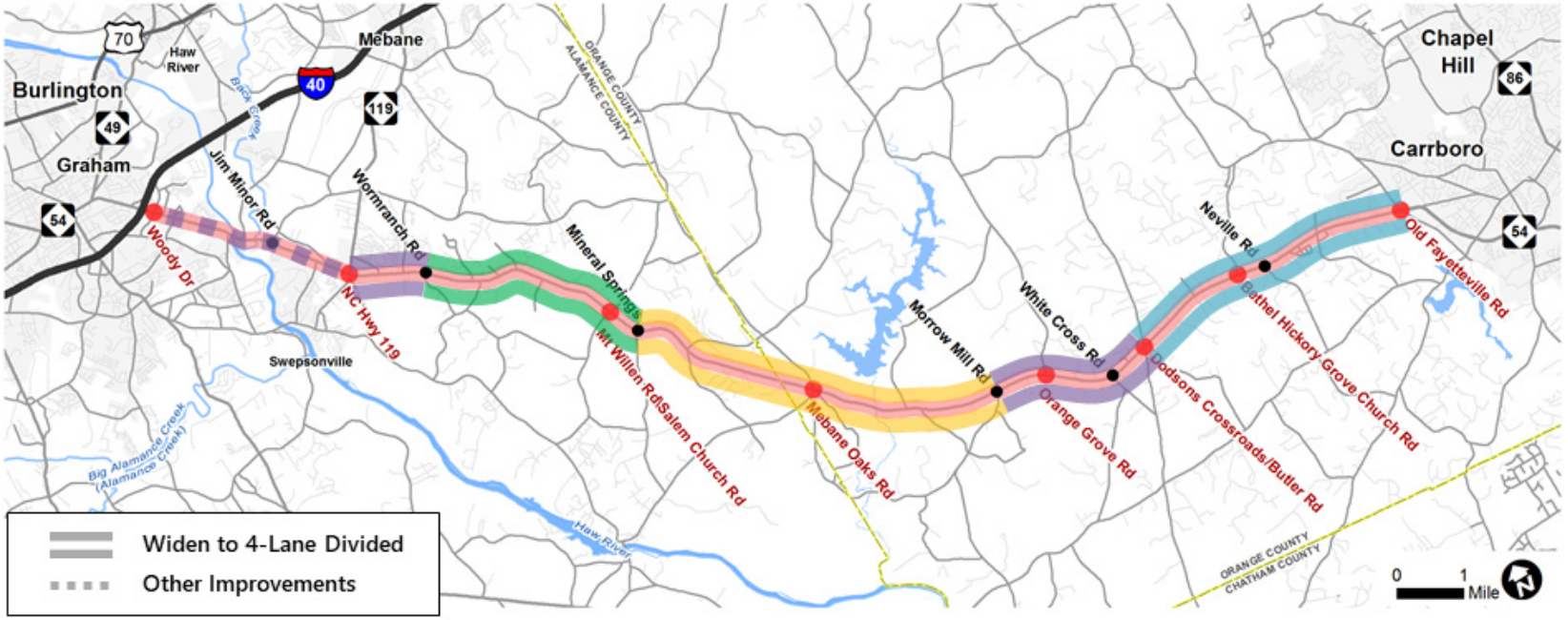
- Phase 1: 2020-2030
- Phase 2: 2025-2035
- Phase 3: 2035-2045
- Phase 4: 2040-2045+

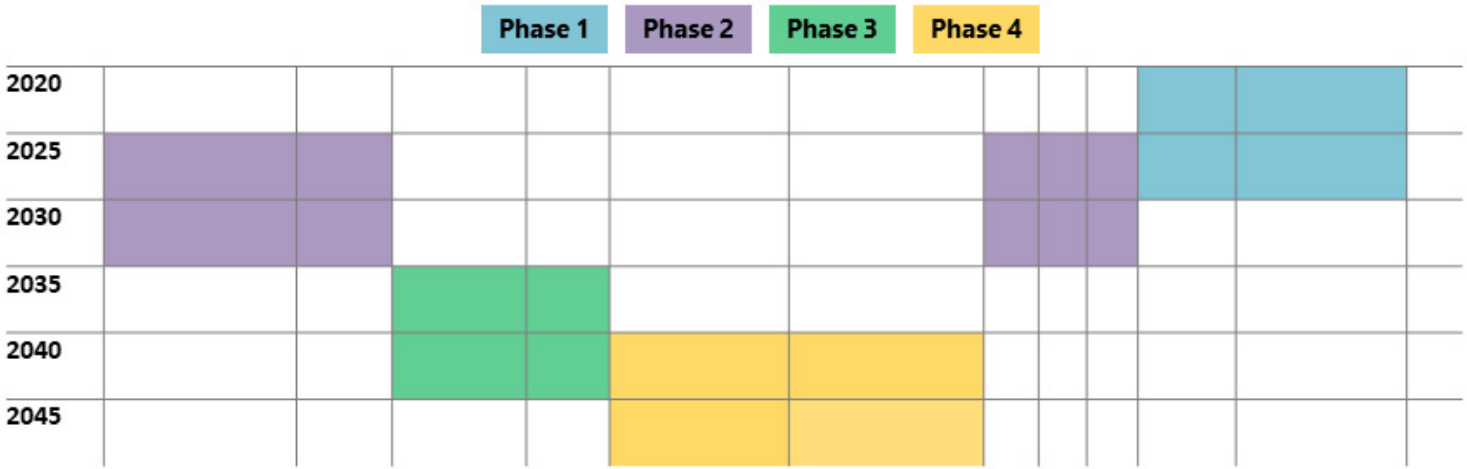
This widening schedule is preliminary, and reflects reasonable assumptions about overall conditions within each corridor segment; while capacity may be substantially exceeded in some locations, conditions may be acceptable or only marginally deficient in others. However, it is neither practical nor desirable to construct numerous small-scale widenings, since this is less cost-effective, more disruptive, and less safe and efficient due to numerous cross-section transitions. While there is some flexibility in defining segment limits, the proposed phasing attempts to align minimum feasible segments with anticipated traffic growth and capacity deficiencies, while considering safety issues and providing effective transition points.

The proposed phasing scheme does not explicitly consider funding availability, or constraints associated with prioritization and programming. There are currently no widening projects for this corridor in SPOT 5.0. Assuming a project is successfully submitted to SPOT 6.0 in 2019, completion is unlikely before 2030, or the end of Phase 1. Even completing significant "interim" improvements such as intersection widenings within Phase 1 will require an aggressive schedule. The potential cost-effectiveness of these projects could be jeopardized if they are not carefully coordinated with the subsequent widening, especially if that widening occurs only a few years later. Achieving such a "seamless" implementation will require more detailed design of the ultimate four-lane cross-section and alignment in advance of the interim improvements, so a sense of urgency is warranted.

Although intersection projects and other improvements (such as turn lanes and wider shoulders) can provide localized interim benefits, they do not address the growing capacity and safety deficiencies of the existing two-lane cross-section. Significant portions of NC 54 are already operating at LOS E or worse during at least one peak hour; these segments experienced a surge in traffic growth in the last two-to-three years, and continued growth is anticipated. Even with suggested interim improvements, conditions will deteriorate along the corridor, especially along lengthier segments between improved intersections.

Figure 33: Proposed Phasing for NC 54 Widening





6.2 Funding Pedestrian and Bicycle Facilities

The pedestrian and bicycle recommendations in Chapter 5 are based on design and cost considerations. However, current NCDOT policy does not treat all facilities the same in terms of funding. These differences in funding eligibility are substantial enough that they can determine the viability of a specific facility type or design in jurisdictions dependent on NCDOT participation to pay for construction, and even maintenance. In such cases, design compromises may be needed if the project is to have a realistic chance for implementation, especially within a given timeframe.
Bicycle and pedestrian facilities may be added along a roadway either incidental to a roadway improvement or as an independent project. The North Carolina Strategic Transportation Investments (STI) law requires NCDOT to rank highway improvement projects (such widening, upgrades, or a new alignment) separately from independent bicycle or pedestrian projects.

NCDOT may work with a local agency to determine and construct bicycle or pedestrian improvements as part of the roadway project. Otherwise, local agencies may apply for federal funding to add bicycle or pedestrian improvements separate from a roadway project.

NCDOT policy currently allows the Department to pay for and maintain all improvements within the curb or edge of pavement, including wide shoulders and bicycle lanes. When separated by a curb, swale, or vertical element, the Department may require the local jurisdiction to acquire additional right-of-way, share in the cost of construction, and maintain the separated bicycle or pedestrian facility (such as a sidewalk or shared use path). Despite these costs, incidental bicycle and pedestrian improvements are often less expensive than constructing the same improvements through an independent project.

However, there are several reasons why a local agency may choose to add bicycle and pedestrian improvements in advance of or separate from a roadway improvement. The roadway project may not be scheduled for design and construction for many years after a future need has been identified. This delay may not be acceptable to an agency whose interest is to provide a connected and safe network for cyclists and pedestrians as soon as possible.

Local agencies must also consider maintenance of separated facilities such as shared use paths, sidewalks, and separated bicycle lanes, regardless of funding options. Under current NCDOT policy, local governments sign an agreement to maintain separated facilities when constructed within NCDOT right-of-way. If the facility is outside an incorporated area, then either a County government or nearby city must assume maintenance responsibilities

6.3 Estimates of Probable Costs

Probable costs have been estimated for the entire set of recommendations for the NC 54 West Corridor Study. The basic cost consists of construction, design and engineering, contingency and other costs directly related to roadway widening, intersection improvements, signalization, bridge replacement, traffic control devices, shared-use paths, and pedestrian crossings. More details are provided in the project phase descriptions below, and in the Appendices. Not included in these estimates are costs associated with purchasing rights-of-way and residential or commercial structures, relocations, loss of use, landscaping, or extraordinary stormwater treatment costs.

Note that these recommendations and their timing are focused on the estimated years by which the entire package of improvements will be needed. Interim steps can be taken earlier, depending on the situation. It must also be emphasized that costs are based on planning-level analysis, and incorporate large contingency factors. Detailed design work is needed to refine cost estimates to be more precise and reliable.

Estimates are expressed in constant 2018 dollars, and various subtotals may not add up precisely due to rounding.

The probable cost of the entire package of widening improvements described totals just under **$180 million**. The costs are divided nearly equally between counties:

Alamance County:	**$ 79 million (say $ 80 million)**
Orange County:	**$ 99 million (say $100 million)**

Summing costs by planning organization yields the following subtotals:

BGMPO:	**$ 80 million**
TARPO:	**$ 56 million**
DCHC MPO:	**$ 44 million**

A more detailed breakdown by project segment (from west to east) and phase follows.

6.3.1 Segment Subtotals

Segment 1: Woody Drive to NC 119/East Main Street (Phase 2: 2025-2035)

This segment does not require roadway widening, but will need intersection improvements. These projects can be implemented incrementally, based on traffic conditions and future development. The major cost is associated with an admittedly aggressive level of sidewalk and SUP construction. This cost represents the high end of what might actually be implemented.

$ 2,800,000 – Intersection improvements, including pedestrian crossings
$ 500,000 – Sidewalks
$ 4,600,000 – Shared-Use Path, including bridge improvements
$ 7,900,000 – Segment 1 Total

Segment 2: NC 119/East Main Street to Wormranch Road (Phase 2: 2025-2035)

Recommendations for this portion of the corridor are likely to be implemented as a single project, rather than piecemeal, and could occur before many of the improvements to the east are realized. Adjacent development will play a major role in the timing and specific type of improvements, and may even result in participation in construction or ROW dedication.

$ 9,200,000 – Widening to 4-lane divided
$ 2,800,000 – MUT Intersection at NC 119/East Main Street
$ 2,600,000 – Roundabout at Wormranch Road
$ 1,800,000 – Shared-Use Path
$16,400,000 – Segment 2 Total

Segment 3: Wormranch Road to Mineral Springs Road (Phase 3: 2035-2045)

The greatest uncertainty in estimating improvement costs in this part of the corridor involves the necessary widening or replacement of the bridge over Haw Creek. In fact, avoiding this commitment played a major role in deciding to terminate Segment 2 improvements at Wormranch Road. The extent of intersection improvements at Mt Willen/Salem Church Roads is another source of uncertainty. These improvements could be implemented in advance of other

recommendations, and the shared-use path could be built before or after, depending on priorities and funding availability. The Mt Willen Rd/Salem Church Rd intersection could also serve as the eastern terminus of an initial stage of the recommended widening in this segment of NC 54.

$25,000,000 – Widening to 4-lane divided
$ 2,200,000 – Haw Creek bridge widening
$ 1,000,000 – Intersection improvements at Mt Willen Rd/Salem Church Rd
$ 2,600,000 – Roundabout at Mineral Springs Road
$ 4,600,000 – Shared-Use Path
$35,400,000 – Segment 3 Total

Segment 4: Mineral Springs Road to Morrow Mill Road (Phase 4: 2040-2045+)

Based on traffic forecasts and on the rural nature of this portion of the corridor, this set of recommendations should be the last requiring implementation. However, improvements at NC 54 and Mebane Oaks/Saxapahaw-Bethlehem Church Roads could happen sooner, especially in conjunction with a proposed MTS Trail crossing and trailhead/park-and-ride lot. The Mebane Oaks/Saxapahaw-Bethlehem Church Road intersection also provides a logical break point for subdividing this widening project into two stages.

Other key observations:

- Constructing a 4-lane divided NC 54 through this segment requires widening or replacement of the existing Cane Creek bridge, a source of uncertainty in estimating probable costs without more detailed analysis and design.
- A moderate increase in anticipated development along (or just off) this part of the corridor could accelerate the need for widening.

Since this segment crosses the county line, cost estimates are further subdivided to provide totals by county:

Alamance County:

$16,400,000 – Widening to 4-lane divided
$ 3,100,000 – Shared-Use Path
$19,500,000 – Segment 4: Alamance County Subtotal

Orange County:

$23,000,000 – Widening to 4-lane divided
$ 2,200,000 – Cane Creek bridge
$ 2,600,000 – Roundabout at Morrow Mill Road
$ 1,800,000 – Intersection improvements at Mebane Oaks/Saxapahaw-Bethlehem Church Roads (includes Lloydtown Road realignment and MTS trailhead improvements)
$ 3,100,000 – Shared-Use Path
$32,700,000 – Segment 4: Orange County Subtotal

$52,200,000 – Segment 4 Total

Segment 5: Morrow Mill Road to Dodsons Crossroads/Butler Road (Phase 2: 2025-2035)

Miscellaneous intersection improvements at Orange Grove Road, White Cross Road, and Dodsons Crossroads/Butler Road could be warranted in advance of the proposed widening to a 4-lane divided roadway. These or other improvements (such as additional/longer turn lanes or wider shoulders) could be implemented by 2022 under STIP project R-5821A, which is currently assessing operational improvements east of Orange Grove Road.

The suggested Phase 1 widening east of Dodsons Crossroads/Butler Road could be extended farther west, to White Cross Road or Orange Grove Road, if funding is available.

$18,100,000 – Widening to 4-lane divided
$ 600,000 – Intersection improvements at Orange Grove Road
$ 400,000 – Intersection improvements at White Cross Road
$ 1,000,000 – Intersection improvements at Dodsons Crossroads/Butler Road
$ 3,300,000 – Shared-Use Path
$23,400,000 – Segment 5 Total

Segment 6: Dodsons Crossroads/Butler Road to Old Fayetteville Road (Phase 1: 2020-2030)

The current DCHC 2045 MTP does not include any widening of NC 54 west of Old Fayetteville Road, so the improvement cannot be submitted for STIP consideration without an MTP amendment that meets fiscal constrained requirements. This

project could instead be added in the 2050 MTP update; however, this would preclude construction before 2030. Some interim improvements could be implemented as "operational improvements" included in the current MTP, although funding for these projects would be limited.

The most critical element of this segment is the Old Fayetteville Road intersection improvement. The recommended conversion to a median U-turn configuration interacts significantly with the anticipated mixed-use development in the northeast quadrant of the intersection, potentially affecting the timing, coordination, design and even funding of this project. Access management should be a priority, and any interim improvements should carefully consider long-range expansion needs. U-6071 is currently studying improvement options for the intersection of Old Fayetteville Road and NC 54. Construction is scheduled for 2026. However, the pending mixed-use Lloyds Farm development could result in improvements prior to 2026. Coordination between these two projects is ongoing, addressing vehicular access and circulation, bicycle and pedestrian accommodations, and intersection improvements.

It is recommended that any intersection improvements at Old Fayetteville Road also consider the entrance of Henry Anderson III Community Park, about 2,000 feet west, and address pedestrian and bicycle access at and between these two intersections. This segment of shared-use path is being considered for inclusion in the upcoming STIP, and appears very competitive for funding under SPOT 5.0.

Improvements to intersections at Hatch Road, Neville Road, and Bethel Hickory Road could be initiated in advance of the overall widening project. These or other improvements (such as additional/longer turn lanes or wider shoulders) could be implemented by 2022 under STIP project R-5821A, which is currently assessing operational improvements east of Orange Grove Road. Additional improvements may also be warranted at some point after the initial widening.

$32,500,000 – Widening to 4-lane divided
$ 700,000 – Signalization and intersection improvements at Bethel Hickory Church Road
$ 400,000 – Intersection improvements at Neville Road
$ 800,000 – Intersection improvements at Hatch Road
$ 3,000,000 – Intersection improvements at Old Fayetteville Road
$ 5,800,000 – Shared-Use Path
$43,200,000 – Segment 6 Total

6.3.2 Phase Subtotals

For financial programming purposes, total project costs associated with each proposed phase of the NC 54 widening are summarized below, broken down by county, as well. These costs represent the sum of all identified improvements, even though some may be implemented earlier than the defined phase.

$43,200,000 – Phase 1 Subtotal (Orange County)

$47,700,000 – Phase 2 Subtotal

$24,300,000 – Phase 2: Alamance County

$23,400,000 – Phase 2: Orange County

$35,400,000 – Phase 3 Subtotal (Alamance County)

$52,200,000 – Phase 4 Subtotal

$19,500,000 – Phase 4: Alamance County

$32,700,000 – Phase 4: Orange County

6.4 NC 54 West Council of Planning

The governing bodies with jurisdiction in or near the NC 54 West Corridor may elect to form a Council of Planning to help implement the ideas contained in this report and aid in the full implementation of the final corridor vision. The basic premise of a Council of Planning is a voluntary group (also referred to as a workgroup) comprised of staff from the local jurisdictions who work cooperatively with developers to ensure their developments are compatible with the planned roadway improvements. For a NC 54 West Council of Planning, staff from Graham, Carrboro, BGMPO, DCHC MPO, TARPO, NCDOT, Alamance and Orange Counties would meet on an as-needed basis to review new land development plans. The review would examine development site plans to ensure that they are compatible with the planned roadway cross-section for NC 54 at the site of the development, including examining building location, parking configuration, ingress/egress, site landscaping, stormwater management, and other site design elements. The Council of Planning makes any recommendations regarding the site plan and forwards these to the local government with jurisdiction for their

consideration. This review would not aim to be a regulatory hurdle and would not give Council of Planning members authority to approve or deny development applications in other jurisdictions. In no way would a Council of Planning restrict or remove development approval authority from the local jurisdiction. The US 1 Corridor in Wake and Franklin counties uses a Council of Planning, which has been successful.

6.5 Local Ordinances and Statutes

Successfully implementing the proposed set of recommendations for the NC 54 West Corridor requires, in part, coordinating land use and transportation together and managing project costs. Allowing development to occur uncoordinated with roadway improvements can lead to higher costs in the long run, project delays, and complications. Many counties and municipalities require developers to construct parts of roadways during rezoning or site plan approval processes, or at the very least to tailor site plans to accommodate future roadway plans. This can be accomplished without antagonizing developers or dampening development, and can even be positive for developers by ensuring their developments will be viable even when changes to the roadway occur.

There are several different policies, strategies, and local ordinance examples that have been successful at getting developer exactions and making sure new development is compatible with long-term roadway plans. The times when municipalities and counties have the most leverage to require developers to make concessions or accommodate future roadway plans are at the time of rezoning and during site plan review. An important note is that any concessions required should be rational and proportional to the size and scale of the development, so as not to discourage development. Table 22 includes several examples of these policies and ordinances, but the specifics of policies and the mix of policies will be up to local jurisdictions to find those that best fit their situation and goals.

These are only brief descriptions of several policies and ordinances that could help localities exact some roadway improvements from a developer to realize the NC 54 West Corridor vision. These are not meant to overburden the developer but rather to protect existing and future residents by making sure new development does not place an undue burden on shared public resources. The exact mix of policies and ordinances will need to be decided by each regulatory

entity, but the goal is to create collaborative processes that offer developers incentives in exchange for land, site configuration, or infrastructure.

Table 22: Planning and Land Use Policies

Planning and Land Use Tool	Description
Require traffic studies at rezoning	Rezoning is the time when municipalities have the most leverage to ask for concessions from developers. Requiring a traffic study allows municipalities to negotiate for transportation improvements before a site plan is even created. For a developer, traffic studies at this stage allow for greater transparency at the site plan review stage.
Require traffic management plans for large developments	New developments that meet certain unit, acreage, or square footage levels could be required to complete traffic management plans which may include constructing elements of roads in accordance with plans.
Require CTP improvements at time of site or subdivision plan	A developer may be required to tailor their development to construct CTP road improvements or at least to accommodate future CTP road improvements at the time of site plan review in order to have the site plan accepted.
Transportation development fees	The legality of some transportation development fees has been challenged recently, but there still may be instances when a developer could be asked to provide funds for transportation as part of development approval.
Create an Access Management Overlay District	A new zoning type that could be overlaid on a district could carry with it additional access management requirements that would trigger during development or redevelopment.
Driveway delineation, consolidation, or permitting	NCDOT has driveway guidance and the municipality could work to enforce driveways during zoning or site plan review by requiring permitting or negotiating for driveway consolidation.
Require stub out streets for developments	Aimed primarily at subdivisions, requiring stub out streets (incomplete and unconnected street ends) can improve future connectivity as more greenfield parcels develop and new roads connect to the stubs.
Site design guidelines	Guidelines could be set for a variety of site criteria that may affect future road improvements, but common requirements are for layout, building orientation, parking configuration, landscaping, screening, and lighting.
Shared stormwater management	Instead of requiring individual parcels and developments construct stormwater management systems for their own parcels, fees could be paid by several developments to construct joint stormwater systems, potentially saving money and creating better stormwater management.
Land swaps	Right of way or municipal land could be swapped with a developer in exchange for the development providing right of way for the planned roadway improvements.

Appendices

Rose and Associates Existing Economic Conditions Summary Brief

Traffic Count Data

Level-of-Service Analysis Reports

Crash Data & Analysis

Environmental Screening Summary

Community Workshop Summary Memos