FEASIBILITY STUDY

Spring Lake Loop

From Randolph Street to Odell Road

Cumberland County

Division 6

FS-1106A

Prepared for:
N.C. Department of Transportation
Program Development Branch
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1. INTRODUCTION

The proposed Spring Lake Loop is planned to connect Randolph Street and Odell Road in Spring Lake, North Carolina including improvements to existing roadways as well as roadway segments on new location to complete the proposed loop. The purpose of the project is to provide improved traffic operations through the Town of Spring Lake by providing an alternate route for traffic. This report provides an examination of the feasibility of this proposed project and provides conceptual designs for the improvements.

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

1.1 BACKGROUND

NC 24/87 and NC 210 are important facilities within the Town of Spring Lake and connect the City of Fayetteville and Fort Bragg Military Base with the Towns of Lillington (northeast) and Sanford (northwest). These roads are heavily travelled by local residents and daily commuters between the Triangle and Sandhills areas of North Carolina.

This proposed loop is included within the Fayetteville Area Metropolitan Planning Organization (FAMPO) Comprehensive Transportation Plan (CTP) as a needed project. A provision for the feasibility study for this proposed project is also included in the 2012-2020 STIP Plan as Project No. FS-1106A. At this time, designated funding for the right-of-way and construction phases of this project is not available, as the current priority is to assess the feasibility of such a connection and identify the potential benefits and problems associated with the proposed Spring Lake Loop.

The proposed Spring Lake Loop would include approximately 2.5 miles of existing roadway to be improved, including Odell Road, Chapel Hill Road, Hinkle Street and McCormick Road, as well as approximately 2 miles of roadway on new location that will serve to connect the existing parts of the loop.

1.2 STUDY AREA

The scope of the study area for this project includes the existing pieces of the proposed loop that would require upgrades, including Odell Road, Chapel Hill Road, Hinkle Street and McCormick Road. The study area also includes the land required to make connections between these existing facilities; specifically, new location roadway is being considered to link the future widened Odell Road to NC 24/87 (Bragg Boulevard), the area between the end of Chapel Hill Road and Hinkle Street (crossing NC 210), and an area of the Fort Bragg Military Reservation connecting McCormick Road to NC 210 (Murchison Road). The study focuses on an approximately 1,000-foot wide study corridor, although this width varies some along the project where there are known constraints or environmental concerns.

Furthermore, the study area includes existing intersections along NC 24/87 (Bragg Boulevard) and NC 210 (Lillington Highway). These intersections are included as part of the traffic capacity analysis to determine the impact that a loop facility may have on the existing infrastructure.

The following are the major intersections included in the study area, as shown in Figure 1-1:

- NC 24/87 (Bragg Boulevard) and Randolph Street
- NC 24/87 (Bragg Boulevard) and Butner Road
- NC 24/87 (Bragg Boulevard) and NC 210 (Murchison Road)
- NC 24/87/210 (Bragg Boulevard) and S Main Street (SR 1449)/Wilson Avenue
- NC 24/87/210 (Bragg Boulevard) and NC 210 (Lillington Highway)/Spring Avenue
- NC 24/87 (Bragg Boulevard) and N Main Street (SR 1449)
- NC 24/87 (Bragg Boulevard) and McKenzie Road
- NC 24/87 (Bragg Boulevard) and Odell Road
- NC 24/87 (Bragg Boulevard) and Chapel Hill Road (SR 1601)
- NC 210 (Lillington Highway) and Wal-Mart Entrance
- NC 210 (Lillington Highway) and Chapel Hill Road (SR 1601)
- McCormick Road (SR 1638) and Hinkle Street
- McCormick Road (SR 1638) and Spring Avenue/Grogg Street (SR 1635)
- Randolph Street and Butner Road (Future U-4444 Interchange)
- Butner Road and NC 210 (Murchison Road)

1.3 PROJECT ALTERNATIVES

This study analyzed various base year and future year scenarios. These scenarios present traffic projections for multiple base year and future conditions, as described below.

- *Base Year (2011) – No-Build:* This scenario represents existing roadway conditions and accounts for base year volumes.
- *Base Year (2011) – Build Alternative 1:* This scenario includes the proposed Spring Lake Loop as a four-lane facility but does not account for any other background improvements; it accounts for base year volumes.
- *Base Year (2011) – Build Alternative 2:* This scenario includes the proposed Spring Lake Loop as a six-lane facility but does not account for any other background improvements; it accounts for base year volumes.
- *Design Year (2035) – No-Build:* This scenario projects the traffic conditions along the study corridor with forecasted volumes; future roadway conditions excluding the proposed project are reflected including STIP Project #U-4444.
- *Design Year (2035) – Build Alternative 1:* This scenario includes the proposed Spring Lake Loop as a four-lane facility and accounts for future roadway volumes conditions including STIP Project #U-4444.
- *Design Year (2035) – Build Alternative 2:* This scenario includes the proposed Spring Lake Loop as a six-lane facility and accounts for future roadway volumes conditions including STIP Project #U-4444.

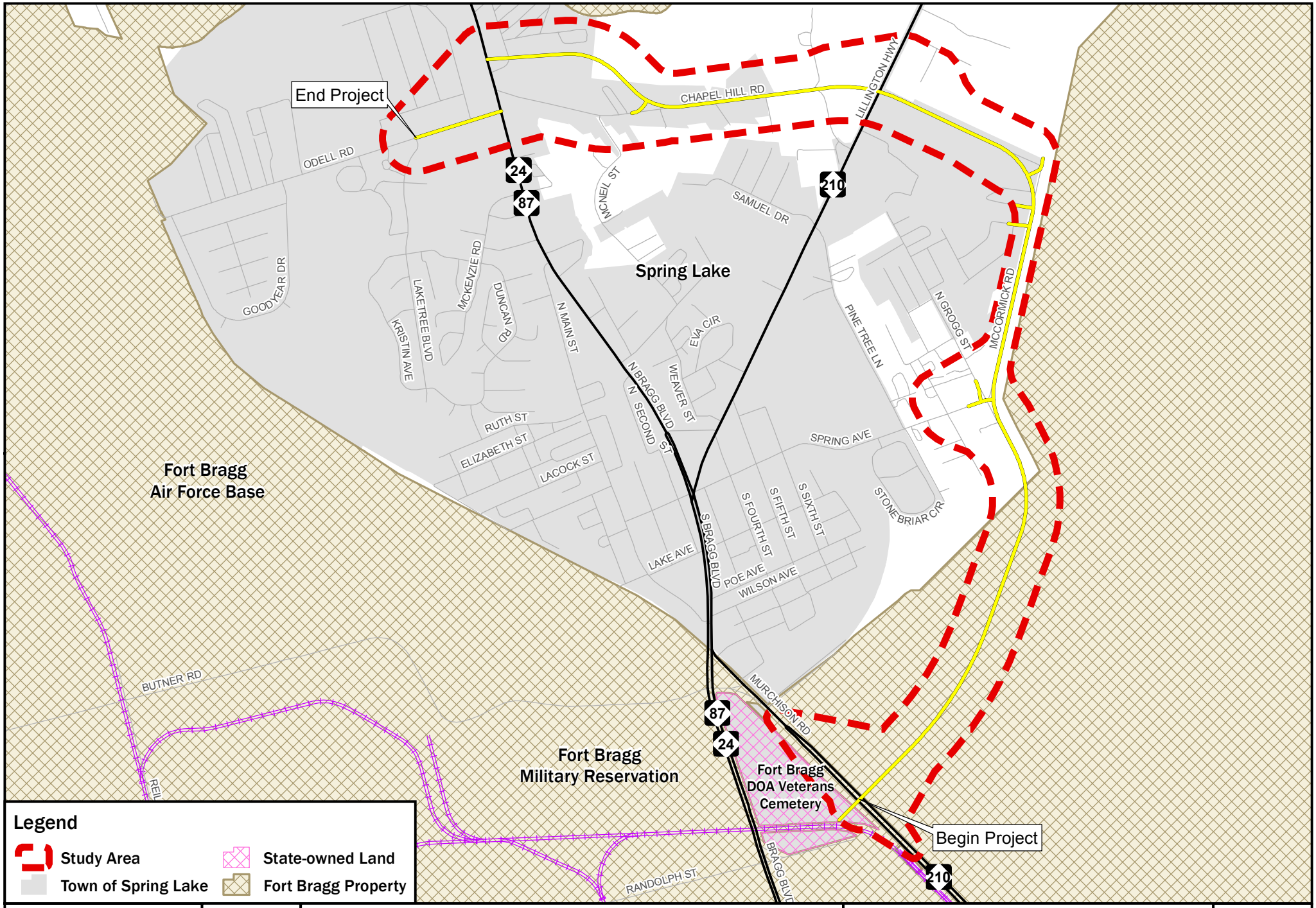


Figure 1-1
Project Study Area

Spring Lake Loop
Feasibility Study
(FS-1106A)
Randolph Street to Odell Road

VHB

2. EXISTING CONDITIONS

2.1 EXISTING ROADWAY AND TRAFFIC CONDITIONS

Existing Roadways

There are various segments of the proposed Spring Lake Loop that are existing roadways that would be improved. Some intersections along NC 24/87 (Bragg Boulevard) and NC 210 (Lillington Highway) are also included in the study area to analyze the impact of the proposed loop on traffic patterns. Descriptions of these existing facilities are included below.

NC 24/87 (Bragg Boulevard) is a north-south principal arterial that enters Spring Lake from the northwest and continues south, providing a direct route to Fayetteville. The section of NC 24/87 included in the study area stretches from Chapel Hill Road (SR 1601) south through the intersection with NC 210 and continues to Randolph Street. This roadway is primarily a four-lane facility with exclusive turn lanes present at major intersections. South of McKenzie Road/New Street, there is a concrete median present along the roadway. South of the intersection with NC 210, the typical section widens to a six-lane divided facility with a grassy median.

NC 210 (Lillington Highway/Murchison Road) is a north-south principal arterial that enters Spring Lake from the northeast, links with NC 24/87 (Bragg Boulevard) at Spring Avenue, and then separates from NC 24/87 near Olive Street as Murchison Road and continues in the southeast direction towards Fayetteville. The section of NC 210 included in the study area stretches from 300 feet north of the existing Chapel Hill Road intersection south through the intersection with NC 24/87 and continues to Butner Road.

Existing Traffic

The traffic volumes utilized in the traffic capacity analysis were taken from the forecasts completed by Martin/Alexiou/Bryson, P.C. in February 2012 for purpose and use in this project. The base year for these forecasts was 2011; thus, the existing conditions are based on the 2011 volume conditions.

The 2011 daily volumes vary within the study area; along the northern end of the NC 24/87 corridor, the daily volumes range between 33,000 – 39,000 vehicles per day (vpd) at the northern and southern extents of the study area to approximately 56,000 vpd south of the NC 210 intersection. Along NC 210, north of its intersection with NC 24/87, the base year daily volume is approximately 20,000 vpd. Once NC 210 branches from NC 24/87 again to the south, where it is called Murchison Road, the daily volume is approximately 20,200 vpd. Chapel Hill Road, which is an existing road that may be used for the proposed Spring Lake Loop, has a base year daily traffic volume of 2,800 vpd.

2.2 ENVIRONMENTAL FEATURES

An environmental screening was completed for the project study area. This screening indicated areas of potential environmental concern, including wetland areas, historic resources, and locations of hazardous material sites. The data were obtained through previous wetland delineations, new studies conducted for this report, and various GIS sources listed below:

- NC Center for Geographic Information and Analysis
- NC Department of Cultural Resources – State Historic Preservation Office (SHPO); including the GIS web service through this office

- NC DENR Division of Water Quality (DWQ)
- NC DOT GIS Unit
- NC One Map Geospatial Portal
- NC Wildlife Resources Commission (WRC)
- NC Natural Heritage Program (NHP)
- NC Green Growth Toolbox
- One NC Naturally
- Cumberland County GIS
- National Resource Conservation Service (NRCS)
- US Fish and Wildlife Services

Historic Resources

There are no identified national or state historical properties located within 0.5 miles of the project study area; thus, the project will have no direct impacts on historical resources.

Streams, Wetlands, and Flood Plains

The Town of Spring Lake lies within the sandhills region of North Carolina, approximately 90 miles from the ocean. The town and study area are between 200 and 300 feet above sea level and located within the Cross Creek and Little River watersheds of the Cape Fear River basin.

Based on the latest GIS information available from NCDENR – Department of Water Quality, there are eight potential stream crossings within the project study area (4 perennial, 4 intermittent). All of the streams that may be crossed are considered tributaries of Little River, which is classified by DWQ as a Class C water resource. The one stream that does not fit this description is the crossing at the southern end of the project, near the tie in to NC 210 (Murchison Road); this stream is named Cross Creek and is classified as a WS-IV water resource. According to the NCDOT Bridge Inventory, there are no existing bridges or major culvert crossings within the feasibility study area.

Based on US Fish & Wildlife Service wetland surveys, there is one wetland feature approximately 1.1 acres in size that is located along the project study area between the end of Hinkle Street and NC 210 (Lillington Highway). Additional wetland features are located greater than 500 feet from the study corridor, mostly along stream tributaries. Additionally, there is a wetland feature located east of NC 210/Murchison Road, near the location of the new U-4444 interchange where the proposed Spring Lake Loop would tie into NC 210. Delineations completed for U-4444 indicate that this wetland is approximately 11.8 acres in size.

There are at least three stream crossings along the corridor in which designated 100-year or 500-year floodplains are present. These locations are all tributaries of Little River that cross the study area in the following locations:

- Chapel Hill Road – between Mimosa Drive (SR 4406) and Kingstown Court
- NC-210/Lillington Highway – between Waterway Drive and Rosser Road (SR 2419)
- McCormick Road – near its intersection with Hollaway Street

Threatened or Endangered Species

A protected species and foraging habitat analysis (FHA) report was sent to NCDOT in September 2012. Following the initial report, the feasibility study area was narrowed to 140 feet (ft.) in width. Thus, three additional sections within the 0.5 mile radius of the feasibility study area (approximately

56 acres) were surveyed for red-cockaded woodpeckers (RCWs) and an additional 4 acre section of the study area was surveyed for other protected species in December 2012. In February 2013, NCDOT completed the final Protected Species Survey Report. According to that report, there are six protected species within the feasibility study area. These species and the biological conclusion of impacts are listed in Table 2-1.

Table 2-1
Endangered Species within Cumberland County

Group	Name	Comments	Biological Conclusion
Flowering Plant	Pondberry	Not currently present, no suitable habitat present	No impact
Flowering Plant	Rough-leaved loosestrife	None observed, but suitable habitat present	No impact
Flowering Plant	Michaux's sumac	None observed, but suitable habitat present	Unresolved; see additional information
Flowering Plant	American chaffseed	None observed, minimal habitat present on Fort Bragg	No impact
Bird	Red-cockaded woodpecker	6 RCW clusters affected; notable habitat present along east side of study area	No cavity trees are taken; see additional information
Insect	Saint Francis' satyr butterfly	None observed, marginal habitat present	No impact

Michaux's sumac

Potentially suitable habitat for Michaux's sumac occurred within the feasibility study area, however, none was encountered during field surveys in August 2012. Potentially suitable habitat was scattered throughout the additional 4 acres that were re-assessed in December 2012. Therefore, this project's "effect" on Michaux's sumac is unresolved until the additional 4 acres can be surveyed during the optimal flowering period of the growing season.

Red-cockaded woodpecker

Red-cockaded woodpecker (RCW) foraging and nesting habitat, as defined by the US Fish and Wildlife Service's (USFWS) RCW Recovery Plan (USFWS 2003), is located on Fort Bragg and private property within the project study area. In February 2013, NCDOT reported the results of a RCW survey and foraging habitat analyses (FHA) of 6 known active RCW clusters located on Fort Bragg that will be impacted by the Spring Lake Loop feasibility study corridor (Fort Bragg 132, 281, 372, 375, 442 and 443). The purpose of these analyses was to determine the likely impacts of the proposed project on known RCW clusters that may be impacted by the project.

The analyses concluded that no RCW cavity trees occur within the Spring Lake Loop feasibility corridor or within 200 feet of it. Therefore, no RCW cavity trees will be "incidentally taken" by the proposed project. Foraging habitat removals from the affected one-half mile radius RCW foraging habitat partitions were based on the 140 foot wide feasibility study corridor design. The feasibility study corridor impacts 6 RCW partitions located on Fort Bragg and would remove 24.83 acres of suitable, potentially suitable and future potential RCW habitat located on Fort Bragg and private properties. Post-project, the foraging habitat associated with Fort Bragg 372 and 443 would be below the minimum pine basal area (BA) and/or acreage required by the RCW Recovery Plan's Standard for Managed Stability (SMS) Guidelines (USFWS 2003) and these clusters would be

considered "incidentally taken." In addition, pre- and post-project, 5 RCW clusters (Fort Bragg 132, 372, 375, 442 and 443) would not meet the Recovery Standard Guidelines (RSG) (USFWS 2003).

The number of potential breeding groups (PBGs) of RCWs in the Primary Core Recovery Population currently exceeds the population recovery goal of 350 PBGs. This project's impacts will not reduce the RCW population below the Primary Core Population goal. However, Fort Bragg is required by the USFWS to manage RCW clusters to meet the RSG requirements in order to meet habitat recovery goals. Since 2 RCW clusters could be "taken" under the SMS guidelines and 5 clusters would not meet RSG requirements pre- or post-project, the proposed project may not allow Fort Bragg to meet its RCW habitat management goals in the Fort Bragg Integrated Natural Resources Management Plan (INRMP). Substantial coordination with Fort Bragg and the USFWS will be needed to resolve these issues. Ultimately, Fort Bragg and the USFWS will decide the magnitude of project impacts on the Fort Bragg INRMP.

The Protected Species Survey Report suggested adjusting the portion of the proposed feasibility corridor located on Fort Bragg in order to minimize and avoid impacts to RCW clusters on Fort Bragg. Specifically the corridor could be moved closer to Andrews Church Road and William T. Brown Elementary School and kept on private land west of the Fort Bragg boundary. However, if the proposed corridor was altered as suggested, it may not be feasible to align the Spring Lake Loop with the U-4444 interchange of NC 210 (Murchison Road) and Randolph Street that is currently under construction. At this level of analysis, no other alignments were examined other than ones that allow this connection; however, as the project progresses, it may be prudent to explore opportunities to change the alignment as suggested in the Protected Species Survey Report.

Hazardous Materials

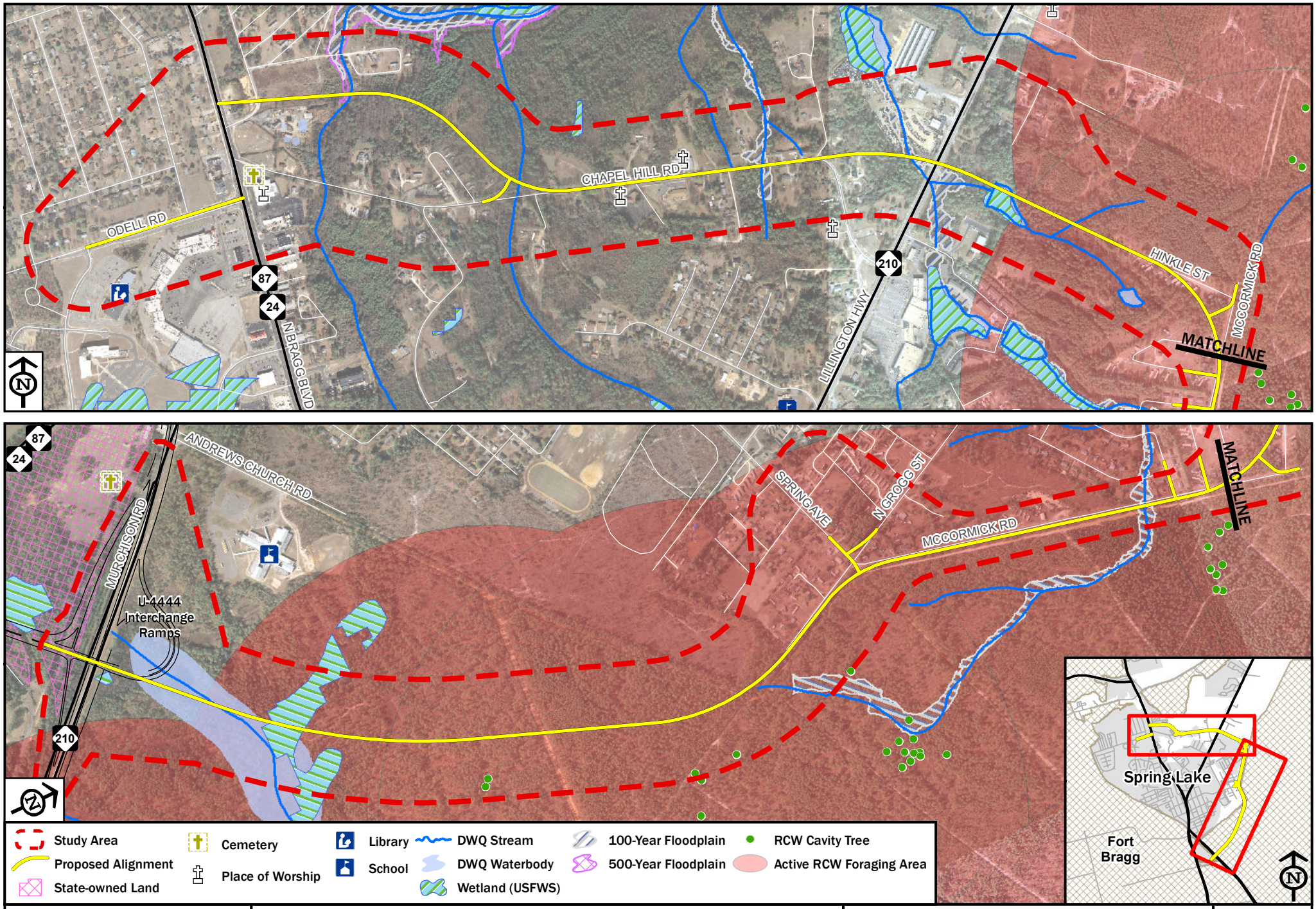
There are probable underground storage tank (UST) locations along the project corridor at existing gas stations. There are no other known hazardous material sites along the project corridor.

Figure 2-1 illustrates the environmental features along the study corridor.

2.3 ACCIDENT ANALYSIS

The accident analysis was derived from three years of available collision data obtained from NCDOT. The data covered the period from July 1, 2008 to June 31, 2011. The summary includes collisions that were reported along the existing segments of the proposed Spring Lake Loop, including Odell Road, Chapel Hill Road, and McCormick Road, and Randolph Street, as well as other major facilities in the area that are expected to have reduced levels of congestion and thus reduced levels of certain types of collisions due to the proposed project, including NC 210 (Murchison Road) from NC 24/87 (Bragg Boulevard) to Butner Road, NC 210 (Lillington Highway), from NC 24/87 (Bragg Boulevard) to Chapel Hill Road, and NC 24/87 (Bragg Boulevard) from Randolph Street to Chapel Hill Road.

The main type of collision in the study area was rear-end collisions, which constituted 47% of the overall collisions during the study period; left-turn, angle, and sideswipe collisions were also common, composing 13%, 12%, and 12% of the total collisions in the area, respectively. Rear-end collisions generally indicate overall congestion issues, as these type of collisions occur mainly in areas where there is frequent "stop and go" traffic or at traffic signals where vehicles may stop suddenly to avoid running a red light. Left-turn and angle collisions often indicate the need for more controlled access to side streets, thereby localizing the turning movements and making them more predictable to on-coming traffic. Table 2-2 summarizes the total number of crashes by type and segment; Table 2-3 summarizes the severity of accidents within the study area.



SCALE
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Figure 2-1
Environmental Features Map

Spring Lake Loop
Feasibility Study
(FS-1106A)
Randolph Street to Odell Road

VHB

Table 2-2
Crash Types and Totals by Segment

Segment Name	Rear End	Angle	Left Turn	Ran Off Road	Right Turn	Side-swipe	Other	Total
Bragg Boulevard (NC 24/87)	275	55	46	8	25	64	20	**493**
Murchison Road (NC 210)	20	11	4	0	10	6	2	**53**
Randolph Street	0	0	0	0	0	0	0	**0**
Lillington Highway/Spring Street (NC 210)	29	17	34	3	9	13	10	**115**
Odell Road (SR 4202)	3	1	5	2	1	1	3	**16**
McCormick Road (SR 1638)	0	0	0	1	0	0	0	**1**
Chapel Hill Road (SR 1601)	7	3	3	5	1	1	16	**36**
Total	**334**	**87**	**92**	**19**	**46**	**85**	**51**	**714**

Table 2-3
Crash Severity and Totals by Segment

Segment Name	Fatal	Injury	PDO	Total
Bragg Boulevard (NC 24/87)	0	108	385	**493**
Murchison Road (NC 210)	0	15	38	**53**
Randolph Street	0	0	0	**0**
Lillington Highway/Spring Street (NC 210)	1	32	82	**115**
Odell Road (SR 4202)	0	6	10	**16**
McCormick Road (SR 1638)	0	0	1	**1**
Chapel Hill Road (SR 1601)	0	12	24	**36**
Total	**1**	**173**	**540**	**714**

The NCDOT provides calculated rates for facility types based on data collected statewide. For comparison purposes, the analyzed corridors within the study area were split into four analysis segments based on their classification. The first roadway analyzed, NC 24/87 (Bragg Boulevard), is classified as an urban North Carolina route with four or more lanes, divided, and no access control. The second roadway analyzed, NC 210 (Murchison Road), is classified as an urban North Carolina route with four or more lanes and undivided. The third roadway analyzed was NC 210 (Lillington Highway), which is classified as an urban North Carolina route with four or more lanes and a continuous left-turn lane. The fourth category of roadways analyzed was urban secondary routes with two lanes and undivided, which included McCormick Road (SR 1638), Chapel Hill Road (SR 1601), and Odell Road (SR 4202). Finally, Randolph Street was not a classified roadway and did not have any collisions during the study period; thus, it is not included in the subsequent analysis. During the three years studied, there was one fatality along these roadways.

As shown in Table 2-4, the total crash rates for the facilities in the study area are generally higher than the statewide average for similar facilities, except for McCormick Road. The roads with total crash rates exceeding the statewide average exceed the critical collision rate, which is a statistically derived number greater than the average rate that serves as a screening measure to identify locations where the collision occurrence is higher than should be expected for a given facility type. The majority of the collisions occurring on the major roadways not included in the proposed Spring Lake Loop alignment, including NC 24/87 and NC 210, are rear-end and turning collisions, which may be reduced as the congestion levels along these corridors decrease in response to the proposed project.

Table 2-4
Crash Rate* Comparison of Study Area to Statewide Averages

Urban North Carolina Routes	Total Crash Rate	Fatal Crash Rate	Non-Fatal Injury Crash Rate	Night Crash Rate	Wet Crash Rate
NC 24 (Bragg Boulevard)	510.67	0.00	111.87	91.15	78.72
4+ Lanes (Divided, No Access Control)	330.56	0.81	110.02	68.97	62.37
NC 210 (Murchinson Road)	1833.40	0.00	518.89	103.78	172.96
4+ Lanes (Undivided)	377.39	0.93	136.12	76.05	62.43
NC 210 (Lillington Highway)	490.23	4.42	136.91	158.99	106.00
4+ Lanes (Continuous Left Turn Lane)	257.64	0.96	92.11	49.72	43.03

Urban Secondary Routes	Total Crash Rate	Fatal Crash Rate	Non-Fatal Injury Crash Rate	Night Crash Rate	Wet Crash Rate
McCormick Road (SR 1638)	107.28	0.00	0.00	0.00	0.00
Chapel Hill Road (SR 1601)	936.53	0.00	312.18	416.23	182.10
Odell Road (SR 4202)	402.12	0.00	150.80	25.13	50.27
2 Lanes (Undivided)	233.07	0.90	78.36	56.85	41.28

**All crash rates per 100 Million Vehicle Miles Traveled*
Shaded lines indicate statewide average values

Along the existing roadways that would be widened as part of the project, the main types of collisions include rear-end, angle, run-off-road and fixed-object collisions, which may be reduced as the existing infrastructure is upgraded.

3. BACKGROUND TRANSPORTATION AND LAND USE PLANS

3.1 LAND USE

Cumberland County Existing Zoning Map

According to the Cumberland County Zoning Map released in July 2011, developed land use along the study corridor is predominantly residential with some commercial and office or institutional uses. The NC 24/87 (Bragg Boulevard) corridor is composed of a mix of office and insitutional uses, medium-density residential, and commercial uses, with access to manufacturing uses, low-density residential housing, and the central business district (CBD). The land surrounding Odell Road is primarily residential uses, in addition to some commercial and institutional uses. Chapel Hill Road is also predominantly residential, with both medium- and low-density housing. The western portion of the study area, including Hinkle Street, McCormick Road, and the area through which the roadway segments on new locations are proposed, is currently residential, with access to commercial uses.

Cumberland County 2010 Land Use Plan

Land uses along the study corridor are likely to shift due to the Spring Lake Loop improvements, as the western portion will be more accessible for residents and experience a higher level of traffic. Similarly, the improvements to existing roadways will increase accessibility along the corridor. The Cumberland County 2010 Land Use Plan proposes a uniform commercial corridor along Bragg Boulevard, with access to residential uses, office and institutional uses, and the downtown area. Land uses around Odell Road will be mainly single-family and multi-family residential, with some office, institutional, and commercial uses near Bragg Boulevard. Land surrounding Chapel Hill Road will remain low- and medium-density residential, with some commercial uses near its intersection with Bragg Boulevard. The western portion of the study area, linking Chapel Hill Road to Randolph Street, will be low- and medium-density residential, with some commercial uses near Bragg Boulevard and access to government buildings and open space.

3.2 TRANSPORTATION

NCDOT State Transportation Improvement Plan (STIP)

Along with the proposed Spring Lake Loop Feasibility Study (Project #FS-1106A), the NCDOT STIP includes several roadway projects within or in proximity to the study area. Project #U-4444 proposes the widening of NC 210 (Murchison Road) from four to six lanes from the proposed Fayetteville Outer Loop and to north of NC 24/87 (Bragg Boulevard)/NC 210 (Lillington Highway); this widening is to occur in phases. Furthermore, Project #FS-0806B was a study to determine the feasibility of widening Odell Road to a median-divided four-lane facility from the Fort Bragg Boundary to NC 24/87 (Bragg Boulevard).

FAMPO Comprehensive Transportation Plan (CTP)

The Fayetteville Area Metropolitan Planning Organization (FAMPO) CTP was developed to ensure that the road system will be progressively developed to serve future travel demands. This plan classifies the proposed Spring Lake Loop corridor, including existing Odell Road and Chapel Hill Road, as a future expressway, noting the existing portions need improvement and the unconstructed portions as a proposed new road. The CTP also includes several recommended facilities within the study area. They include the Armistead Street extension, a proposed median-divided four-lane facility establishing a new access control point (ACP) for Fort Bragg at Odell Road; the Spring Lake

Expressway, which would connect McCormick Road to Murchison Road; a new connector road between McCormick Road and Chapel Hill Road; a proposed Cemetery Access Road connecting the proposed Spring Lake Expressway to Third Street; and extensions of Butner Road, Manchester Road, Lake Park Drive, Virginia Drive, Rainbow Court, McKenzie Road, Third Street, Fifth Street, and Pinetree Lane to improve connectivity.

FAMPO Multi-Modal Congestion Management Plan (CMP) for the Town of Spring Lake

The FAMPO Multi-Modal CMP for the Town of Spring Lake was developed to ensure that the community character of Spring Lake was protected through critical land use and transportation decisions. Along NC 24/87 (Bragg Boulevard), the Plan recommends the addition of a southbound left-turn lane, a southbound right-turn lane, and an eastbound right-turn lane at the intersection of NC 210 and Spring Avenue intersection, as well as access management improvements for that section of NC 24/87 (Bragg Boulevard), including driveway consolidation, back door access points, left-turn prohibitions, and cross parcel access. From Chapel Hill Road to McKenzie Road, the Plan recommends that the currently undivided facility be divided by a low four-foot concrete median to control left-turns in the heavily-developed section of the corridor. Additional median crossovers, turn lanes, and backside access alleys are also suggested throughout the corridor to allow access to properties while minimizing disruptions to traffic flow along the facility.

4. TRAFFIC FORECASTS

The traffic forecast for this project was completed by VHB Engineering, NC P.C., formerly Martin/Alexiou/Bryson P.C., in February 2012 for the NCDOT Transportation Planning Branch for use in this report. Previously completed forecasts for other projects within the area were reviewed during the development of this forecast. The forecast provided volumes for the following scenarios:

- 2011 Base Year No-Build
- 2011 Base Year Build 1 – 4 lane typical section
- 2011 Base Year Build 2 – 6 lane typical section
- 2035 Future Year No-Build
- 2035 Future Year Build 1 – 4 lane typical section
- 2035 Future Year Build 2 – 6 lane typical section

The future year forecasts were based on the latest adopted version of the Fayetteville Area Metropolitan Planning Organization (FAMPO) Model and accounted for the fiscally constrained projects detailed within the FAMPO Long Range Transportation Plan (LRTP) as well as projects listed in the STIP. The major background project that is accounted for within these forecasts is the Murchison Road Widening (U-4444), which is included in the current STIP and is to be funded by the Department of Defense. A portion of this project is currently under construction, while other parts are currently in the right-of-way stage.

The traffic forecasts included two Build alternatives. One alternative accounted for a four-lane typical section, while the other assumed a six-lane typical section.

The traffic forecasts for this project can be found in Appendix A. The developed forecasts were used to derive the AM and PM peak hour turning movement volumes using the NCDOT Intersection Analysis Utility (IAU) tool.

5. NO-BUILD ALTERNATIVES

A capacity analysis was performed for each of the alternative scenarios, examining operations at key intersections within the project area. Intersection capacity analyses were conducted for the AM and PM peak hours. 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). Table 5-1 provides a general description of the various levels of service categories and delay ranges for the intersection levels of service.

Table 5-1
Level of Service Descriptions for Intersections

Level of Service	Description	Signalized Intersection	Unsignalized Intersection
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.

Intersection capacity analysis was completed using the *Synchro, version 7* software package, within which signal timings were optimized. Analyzed intersections included those along the proposed project as well as key intersections along NC 24/87 (Bragg Boulevard) and NC 210 (Lillington Highway/Murchison Road) in order to quantify the impact the proposed project would have on the surrounding roadway network. The following intersections were analyzed for AM and PM peak hour operations, where applicable.

- NC 24/87 (Bragg Boulevard) and Randolph Street
- NC 24/87 (Bragg Boulevard) and Butner Road
- NC 24/87 (Bragg Boulevard) and NC 210 (Murchison Road)
- NC 24/87/210 (Bragg Boulevard) and S Main Street (SR 1449)/Wilson Avenue
- NC 24/87/210 (Bragg Boulevard) and NC 210 (Lillington Highway)/Spring Avenue
- NC 24/87 (Bragg Boulevard) and N Main Street (SR 1449)
- NC 24/87 (Bragg Boulevard) and McKenzie Road
- NC 24/87 (Bragg Boulevard) and Odell Road
- NC 24/87 (Bragg Boulevard) and Chapel Hill Road (SR 1601)
- NC 210 (Lillington Highway) and Wal-Mart Entrance
- NC 210 (Lillington Highway) and Chapel Hill Road (SR 1601)
- McCormick Road (SR 1638) and Hinkle Street
- McCormick Road (SR 1638) and Spring Avenue/Grogg Street (SR 1635)
- Randolph Street and Butner Road (Future U-4444 Interchange)
- Butner Road and NC 210 (Murchison Road)

5.1 BASE YEAR (2011) – NO-BUILD

This scenario takes into account the existing roadway conditions at the time of a field visit in fall 2011. The volumes used in this analysis scenario, and all analyses undertaken as part of this study, were derived from the forecasts discussed previously by using the NCDOT IAU tool. Figures 5-1 and 5-2 summarize the volumes and lane geometrics, respectively, used in this analysis scenario.

Based on the results of the intersection capacity analysis, all analyzed intersections operate acceptably under the Base Year (2011) No-Build conditions. The NC 24 at NC 210/Spring Avenue intersection operates at a LOS D during both peak hours, indicating that it may be approaching its capacity. At signalized intersections, the side street approaches generally experience longer delays than the major through movement, which is not uncommon. Table 5-2 summarizes the LOS results for this scenario.

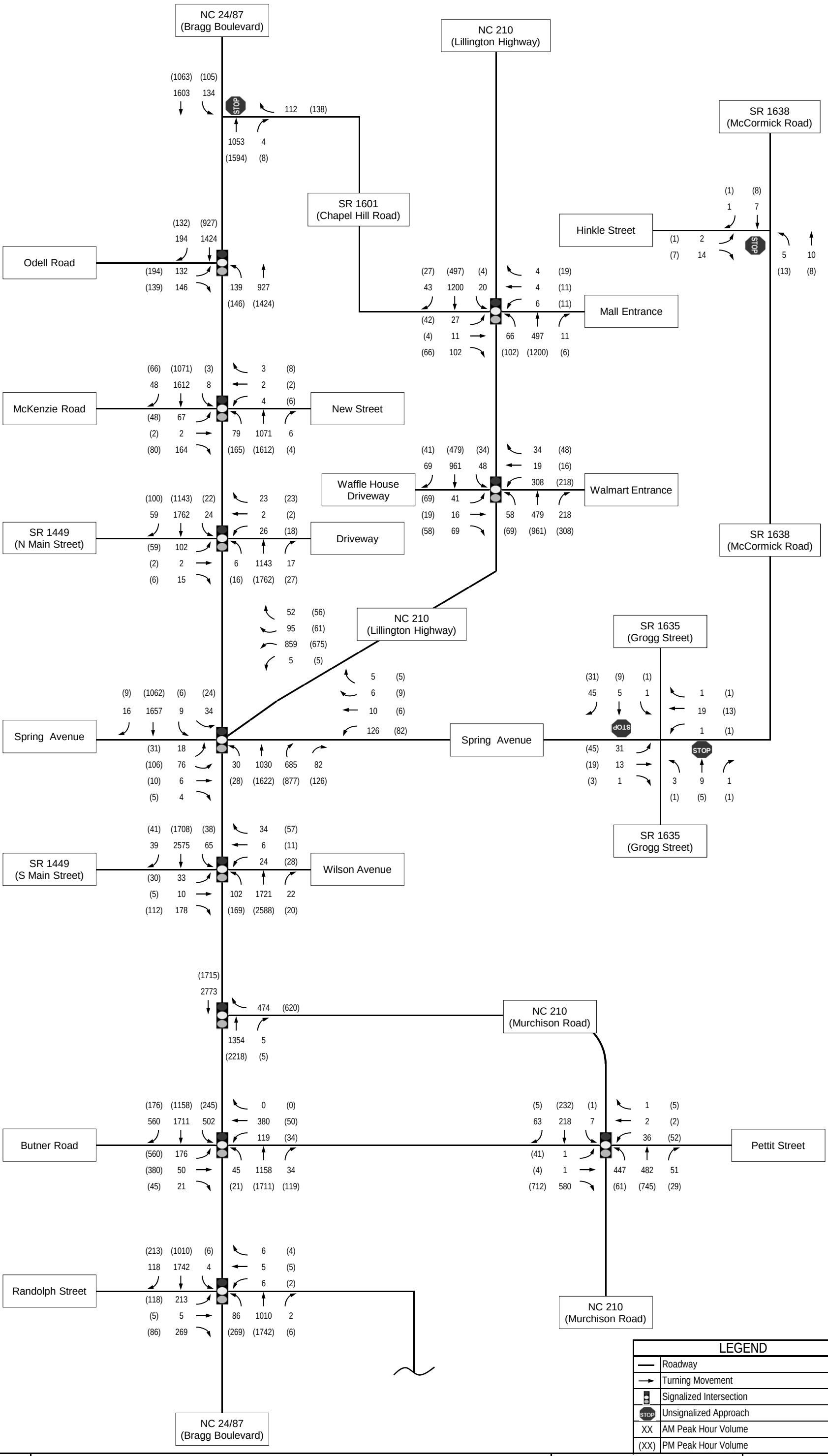
5.2 DESIGN YEAR (2035) – NO-BUILD

This scenario projects the traffic conditions along the study corridor with forecasted volumes along the roadway and the future year geometric and traffic control conditions without the proposed project in place. The geometric differences between the base year (2011) and the design year (2035) include the completion of STIP Project No. U-4444, which would result in geometric changes that affect traffic patterns as listed below:

- Randolph Street is extended to NC 210 (Murchison Road), creating a new interchange
- Bragg Boulevard north of Randolph is connected to Butner Road
- Bragg Boulevard between NC 210 (Murchison Road) and Butner Road is removed
- Butner Road between Bragg Boulevard and Murchison Road is removed
- The intersection of Bragg Boulevard at S. Main Street/Wilson Avenue is reconstructed as a Right-In/Right-Out (RIRO) intersection

Figures 5-3 and 5-4 summarize the volumes and lane geometrics, respectively, used in this analysis scenario.

Results of the intersection capacity analysis indicate that the study intersections are expected to experience significant degradation in the future as traffic volumes increase, despite the construction of U-4444. It is projected that many intersections in the study area will operate at LOS E or LOS F during at least one peak hour in the under Design Year (2035) scenario. The intersections not expected to operate poorly include Bragg Boulevard at McKenzie Street, Bragg Boulevard at Odell Road, McCormick Road at Hinkle Street, and Spring Avenue at Grogg Street. Also expected to operate acceptably are the intersections directly impacted by the new interchange: Bragg Boulevard at Randolph Street and the NC 210 at Randolph Street interchange ramps. Table 5-3 summarizes the LOS results for this scenario.



Not to Scale

Figure 5-1
Base Year (2011) No-Build Peak Hour Turning Movement Volumes

Spring Lake Loop Feasibility Study
(FS-1106A)
Randolph Street to Odell Road

VHB

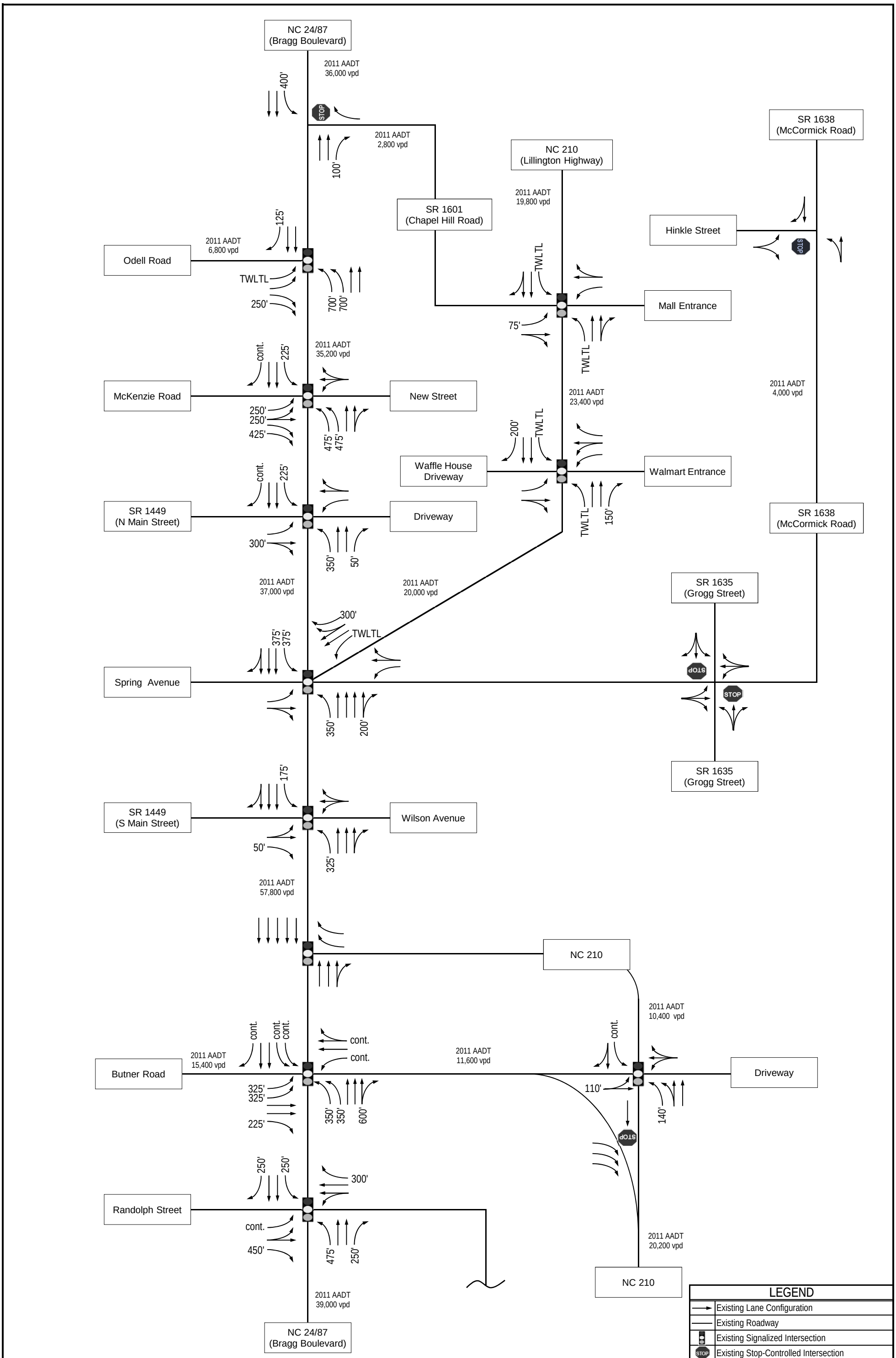


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Figure 5-2
Base Year (2011) No-Build Lane Configurations and Traffic Control

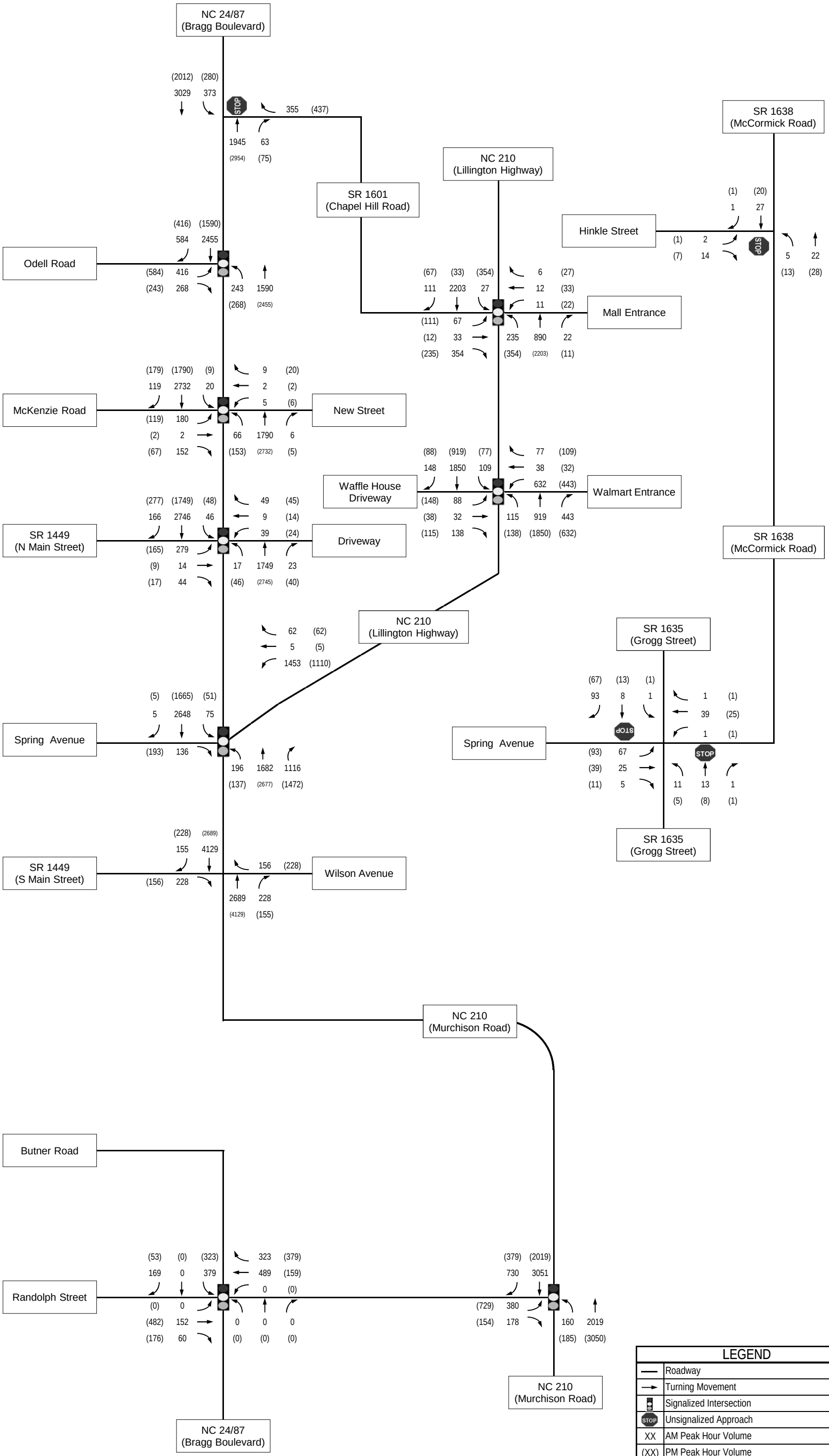
Spring Lake Loop Feasibility Study
(FS-1106A)
Randolph Street to Odell Road

VHB

Table 5-2
Base Year (2011) No-Build LOS Summary

Intersection	Traffic Control	Base Year (2011) No-Build	
		AM	PM
NC 24/87 (Bragg Blvd.) at Randolph St.	Signalized	C (EB-F) 28.9 sec	C (EB-E) 22.6 sec
NC 24/87 (Bragg Blvd.) at Butner Rd.	Signalized	C (EB-E) 31.7 sec	C (EB-E) 32.2 sec
NC 210 (Murchison Rd.) at Butner Rd.	Signalized	C (WB-E) 32.0 sec	D (WB-E) 38.6 sec
NC 24/87/210 (Bragg Blvd.) at NC 210 (Murchison Rd.)	Signalized; Median Divided	A (NB-A) 5.1 sec	A (NB-A) 9.2 sec
NC 24/87/210 (Bragg Blvd.) at South Main St. (SR 1449)	Signalized	B (WB-E) 17.3 sec	C (WB-E) 20.1 sec
NC 24/87/210 (Bragg Blvd.) at NC 210 (Lillington Hwy.) and Spring Ave.	Signalized	D (SW-F) 45.4 sec	D (EB-E) 47.3 sec
NC 24/87 (Bragg Blvd.) at North Main St. (SR 1449)	Signalized	A (EB-E) 7.6 sec	A (EB-E) 6.8 sec
NC 24/87 (Bragg Blvd.) at McKenzie Rd.	Signalized	A (WB-E) 9.3 sec	A (WB-E) 8.3 sec
NC 24/87 (Bragg Blvd.) at Odell Rd.	Signalized	B (EB-D) 14.2 sec	B (EB-E) 13.6 sec
NC 24/87 (Bragg Blvd.) at Chapel Hill Rd. (SR 1601)	Unsignalized	(WB-B)	(WB-C)
NC 210 (Lillington Hwy.) at Wal-Mart Shopping Center Entrance	Signalized	C (EB-E) 23.9 sec	C (EB-E) 24.3 sec
NC 210 (Lillington Hwy.) at Chapel Hill Rd. (SR 1601)	Signalized	B (EB-E) 14.0 sec	A (EB-E) 8.0 sec
McCormick Rd. (SR 1638) at Hinkle St.	Unsignalized	(EB-A)	(EB-A)
Spring Ave. at Grogg St. (SR 1635)	Unsignalized	(NB-A)	(NB-A)

LEGEND: X (XX-X), 00.0 sec – Overall LOS (Lowest operating approach – approach LOS), overall delay in seconds

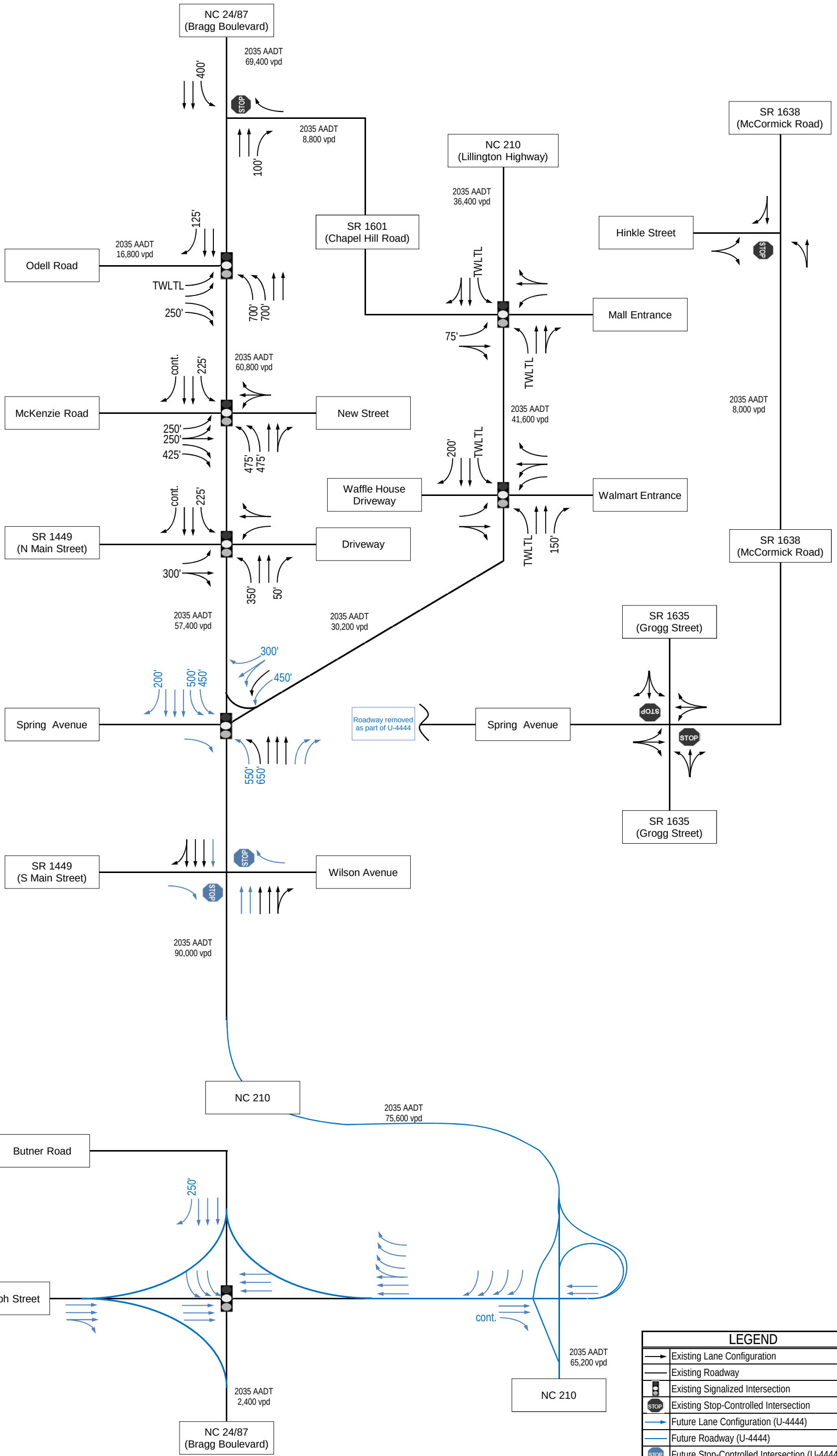


Not to Scale

Figure 5-3
Design Year (2035) No-Build Peak Hour Turning Movement Volumes

Spring Lake Loop Feasibility Study
(FS-1106A)
Randolph Street to Odell Road

VHB



Not to Scale

N

Figure 5-4
Design Year (2035) No-Build Lane Configurations and Traffic Control

Spring Lake Loop Feasibility Study

(FS-1106A)

Randolph Street to Odell Road

VHB

Table 5-3
Design Year (2035) No-Build LOS Summary

Intersection	Traffic Control	Design Year (2035) No-Build	
		AM	PM
NC 24-87 (Bragg Blvd.) at Randolph St.	Signalized	A (EB-A) 7.3 sec	A (SB-B) 6.4 sec
Randolph St. at Butner Rd.	Future Interchange	Free Flow Interchange	
NC 24-87-210 (Bragg Blvd.) at South Main St.	Signalized	(EB-F)	(WB-F)
NC 24-87-210 (Bragg Blvd.) at NC 210 (Lillington Hwy.) and Spring Ave.	Signalized	E (WB-F) 63.9 sec	D (WB-E) 45.8 sec
NC 24-87 (Bragg Blvd.) at North Main St.	Signalized	F (EB-F) 82.9 sec	D (EB-F) 37.8 sec
NC 24-87 (Bragg Blvd.) at McKenzie St.	Signalized	D (EB-F) 47.6 sec	C (EB-E) 23.4 sec
NC 24-87 (Bragg Blvd.) at Odell Rd.	Signalized	D (EB-F) 50.4 sec	D (EB-F) 41.7 sec
NC 24-87 (Bragg Blvd.) at Chapel Hill Rd. (Future Spring Lake Loop)	Unsignalized	(WB-F)	(WB-F)
NC 210 (Lillington Hwy.) at Wal-Mart Shopping Center Entrance	Signalized	E (EB-F) 56.0 sec	D (WB-F) 52.0 sec
NC 210 (Lillington Hwy.) at Chapel Hill Rd.	Signalized	F (EB-F) 110.9 sec	F (SB-F) 83.7 sec
McCormick Rd. at Hinkle St.	Unsignalized	(EB-A)	(EB-A)
Spring Ave. at Grogg St.	Unsignalized	(NB-B)	(NB-B)

LEGEND: X (XX-X), 00.0 sec – Overall LOS (Lowest operating approach – approach LOS), overall delay in seconds

6. BUILD ALTERNATIVES

This report examines two specific build alternatives. A capacity analysis for both Build Alternatives was completed using *Synchro, version 7* software package. Signal timings were optimized within this software. The Build Alternatives represent future conditions that can be compared and used in the process of deciding on the needed capacity of the proposed Spring Lake Loop.

Build Alternative 1 – Four-Lane Boulevard

This alternative includes the volumes forecasted for the Design Year (2035) Build 1 scenario which includes the proposed project. In addition to the projects and geometric changes included in the Design Year (2035) No-Build scenario, this alternative accommodates a four-lane boulevard typical section for the project.

Build Alternative 2 – Six-Lane Boulevard

This alternative includes the volumes forecasted for the Design Year (2035) Build 2 scenario which includes the proposed Spring Lake Loop project. In addition to the projects and geometric changes included in the Design Year (2035) No-Build scenario, this alternative accommodates a six-lane boulevard typical section for Spring Lake Loop. Volume forecasts for this scenario along the project were slightly elevated beyond those in the Build Alternative 1 scenario due to the model assuming a greater capacity, therefore allowing for a greater demand on the loop.

Preliminary traffic capacity analysis was completed for both alternatives, and it was clear that a four-lane capacity would be sufficient for the projected travel demand. Thus, conceptual designs were only completed for Build Alternative 1.

6.1 DESIGN CRITERIA

Conceptual designs were prepared for the Build Alternative 1, showing right-of-way estimations for each alterative along with proposed laneage and capacity improvements at each study intersection. These designs are included as Appendix B.

The criteria used in these conceptual designs are based on standards found in the *Geometric Design of Highways and Streets Manual* (AASHTO, 2004) as well as the *Roadway Design Manual* (NCDOT, 2002). The design criteria establish minimum values for various design parameters based on proposed characteristics of the facility, such as speed limit, median width, shoulder width, minimum and maximum grades and cross slope. Table 6-1 summarizes the design criteria used for each alternative.

6.2 TYPICAL SECTIONS

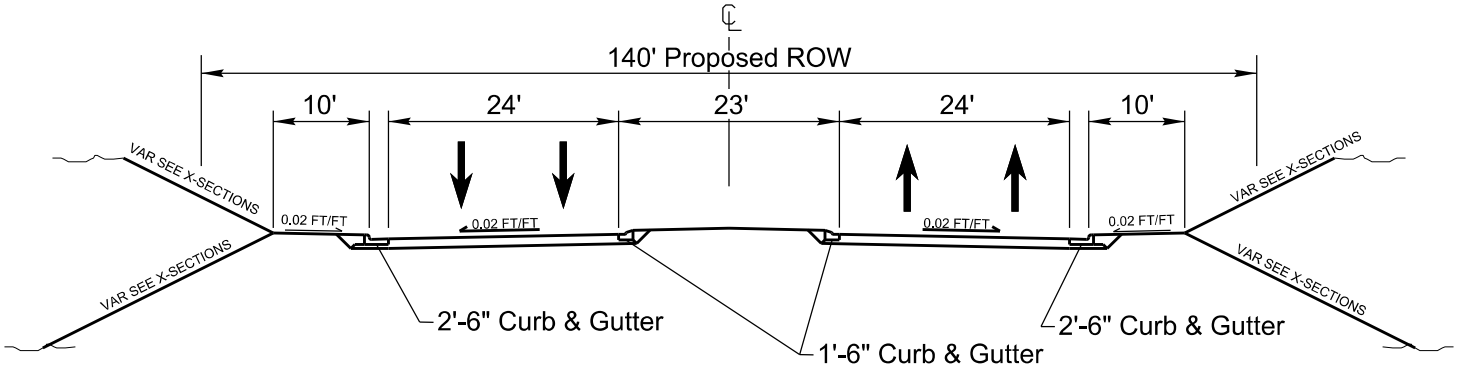
The typical sections along the project length vary, as some segments are shoulder sections and some are curb and gutter. Figures 6-1 and 6-2 show the proposed typical sections for both the four-lane and six-lane build alternatives, respectively.

Typical Section No. 1

Typical Section No. 1 includes two 12-foot travel lanes in each direction and curb and gutter treatment. The inner curb and gutter is 1'-6" and the outer curb and gutter is 2'-6." The median in this typical section is generally 23-foot. This typical section is present along the proposed Spring Lake Loop alignment in areas where the design would benefit from being narrower.

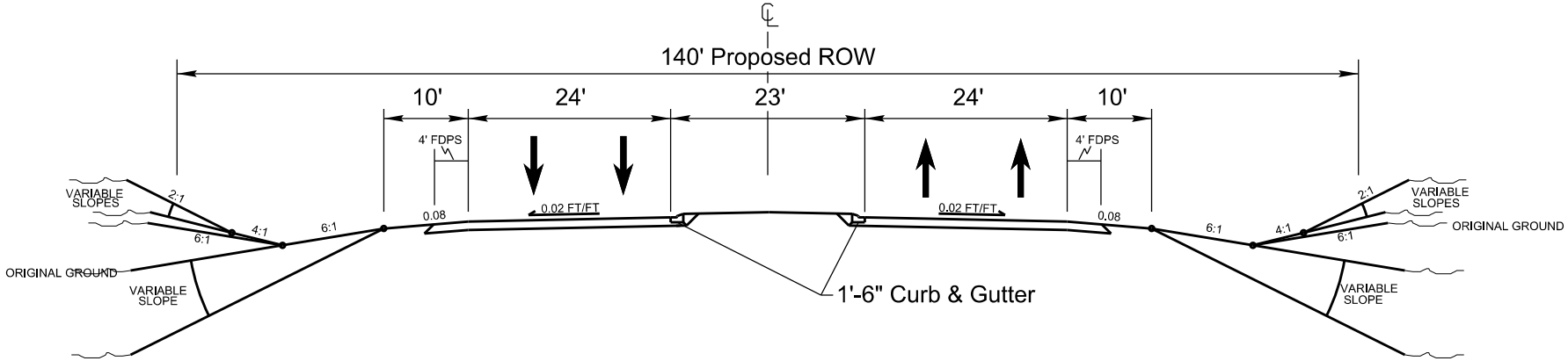
Table 6-1
Design Criteria

ROUTE	Proposed Spring Lake Loop				REFERENCE
LINE	-L-	-L-	-L-	-L-	OR REMARKS
TRAFFIC DATA	**4-Lane**	**4-Lane**	**6-Lane**	**6-Lane**	
ADT LET YR = 2011	N/A	N/A	N/A	N/A	
ADT DESIGN YR = 2035	228	228	284	284	
TTST	1%	1%	1%	1%	
DUALS	2%	2%	2%	2%	
DHV	9%	9%	9%	9%	
DIR	65%	65%	65%	65%	
CLASSIFICATION	**Arterial**	**Arterial**	**Arterial**	**Arterial**	
TERRAIN TYPE	**Level**	**Level**	**Level**	**Level**	
DESIGN SPEED	**50 mph**	**50 mph**	**50 mph**	**50 mph**	
POSTED SPEED	**45 mph**	**45 mph**	**45 mph**	**45 mph**	
PROP. R/W WIDTH	**140**	**140**	**160**	**160**	
CONTROL OF ACCESS	**N**	**N**	**N**	**N**	
RUMBLE STRIPS	**N**	**N**	**N**	**N**	
TYPICAL SECTION TYPE	**C&G**	**SHLD**	**C&G**	**SHLD**	
LANE WIDTH	**12'**	**12'**	**12'**	**12'**	
SIDEWALKS	**N**	**N**	**N**	**N**	
BICYCLE LANES	**N**	**N**	**N**	**N**	
MEDIAN WIDTH	**23'**	**23'**	**23'**	**23'**	1'-6" C&G
MED. PROTECT.	**N**	**N**	**N**	**N**	
SHOULDER WIDTH (total)					
MEDIAN	N/A	N/A	N/A	N/A	
OUTSIDE w/o GR	N/A	10'	N/A	10'	p. 1-4O Highway Design Manual
OUTSIDE w/ GR	N/A	13'	N/A	13'	
PAVED SHOULDER					
OUTSIDE TOTAL/FDPS	N/A	4	N/A	4	p. 1-4O Highway Design Manual
MEDIAN TOTAL/FDPS	N/A	N/A	N/A	N/A	
GRADE					
MAX.	6.0	6.0	6.0	6.0	AASHTO 7-29
MIN.	0.3	0.3	0.3	0.3	AASHTO 3-119
K VALUE					
SAG	96	96	96	96	
CREST	84	84	84	84	
HORIZ. ALIGN.					
MAX. SUPER.	6%	6%	6%	6%	
MIN. RADIUS	833	833	833	833	AASHTO 3-45
SPIRAL	N	N	N	N	
CROSS SLOPES					
PAVEMENT	0.02	0.02	0.02	0.02	Multilane Divided Non-Freeways - p. 1-4O
PAVED SHOULDER	N/A	0.04	N/A	0.04	Multilane Divided Non-Freeways - p. 1-4O
TURF SHOULDER	N/A	0.08	N/A	0.08	Multilane Divided Non-Freeways - p. 1-4O
MEDIAN DITCH	N/A	N/A	N/A	N/A	
DITCH TYPICAL					
CLEAR ZONE	**18'**	**18'**	**18'**	**18'**	**Design speed 45-50, 6:1 or flatter, 1,500-6,000 ADT**
TYPICAL SECTION NO.	**1**	**2**	**3**	**4**	



TYPICAL SECTION 1

4-Lane Section with 23' Median and Curb & Gutter



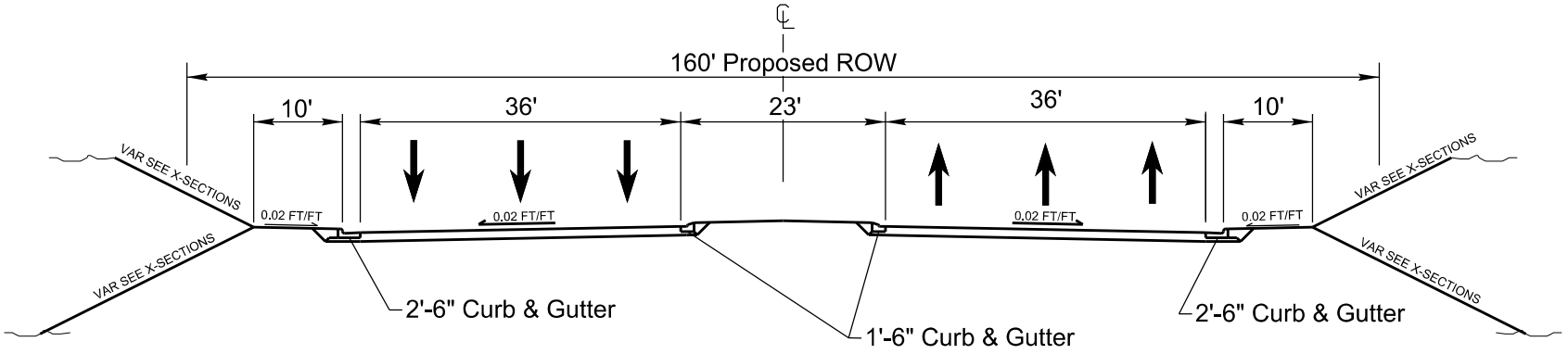
TYPICAL SECTION 2

4-Lane Section with 23' Median and 10' Shoulder Section

VHB

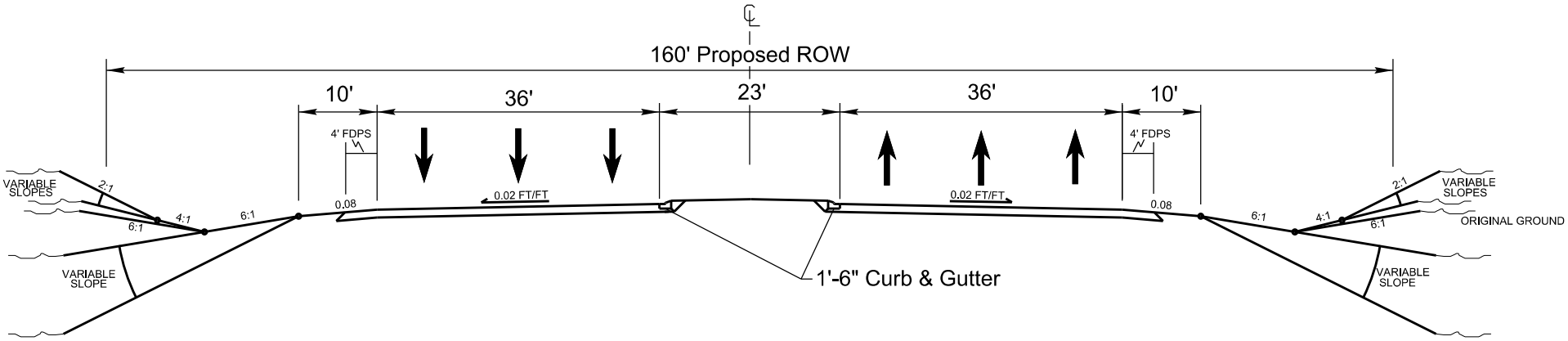
Figure 6-1
4-Lane Typical Sections

Spring Lake Loop
Feasibility Study
(FS-1106A)
Randolph Street to Odell Road



TYPICAL SECTION 3

6-Lane Section with 23' Median and Curb & Gutter



TYPICAL SECTION 4

6-Lane Section with 23' Median and 10' Shoulder Section

VHB

Figure 6-2
6-Lane Typical Sections

Spring Lake Loop
Feasibility Study
(FS-1106A)
Randolph Street to Odell Road

Specifically, along segments where existing pavement is being used there are typically residences present on at least one side of the roadway. These are areas where this typical section would be employed. The proposed ROW width for this typical section is 140-foot.

Typical Section No. 2

Typical Section No. 2 includes two 12-foot travel lanes in each direction and left-side curb and gutter adjacent to the median and 10-foot total right-side shoulders, with 4 feet paved. The median in this typical section is generally 23-foot. This typical section is along the proposed Spring Lake Loop alignment in areas where the design is not constrained by other development. Specifically, segments where the alignment is on completely new location are areas where this typical section would be employed. The proposed ROW width for this typical section is 140-foot.

Typical Section No. 3

Typical Section No. 3 has the same design elements as Typical Section No. 1 with three travel lanes in each direction and 160-foot ROW width.

Typical Section No. 4

Typical Section No. 4 has the same design elements as Typical Section No. 2 with three travel lanes in each direction and 160-foot ROW width.

6.3 BUILD ALTERNATIVE 1

Detailed traffic capacity analysis was completed for Build Alternative 1. This capacity analysis included the projected travel demands at all study area intersections as derived from the approved NCDOT forecast. This analysis provided results for the proposed loop as well as other intersections that may benefit from the proposed loop, specifically those along NC 24/87 (Bragg Boulevard).

6.3.1 Roadway Improvements

As part of this analysis, specific intersection improvements were assumed to accommodate the proposed volumes. The improvements recommended at the study intersections as part of this alternative are described below. Due to the shift of traffic from NC 24/87 (Bragg Boulevard) to the proposed Spring Lake Loop, capacity improvements beyond the changes included in the U-4444 project were not necessary at many of the study area intersections. Rather, the improvements were focused on the new or realigned intersections located along the proposed loop.

Proposed Spring Lake Loop

The proposed loop roadway would be constructed on a combination of existing and new location, utilizing existing pavement as feasible. Specifically, parts of Chapel Hill Road, McCormick Road and Grogg Street could be used. The remainder of the proposed roadway would be on new location.

NC 24/87 (Bragg Boulevard) and Proposed Spring Lake Loop

- Construct a signalized intersection on new location approximately 550 feet north of the existing Chapel Hill Road intersection.
- Construct an additional through lane along both directions of Bragg Blvd. From the north, the new through lane should extend at least 250 feet with an appropriate taper length.
- Construct dual southbound left-turn lanes with at least 350 feet of full storage and appropriate taper length.
- Construct and exclusive northbound right-turn lane with at least 150 feet of full storage and appropriate taper length.

- Construct westbound approach of Spring Lake Loop to accommodate dual left-turn lanes (inner lane should have at least 250 feet of full storage) and dual right-turn lanes (outer lane should have at least 350 feet of full storage).

NC 24/87 (Bragg Boulevard) and Chapel Hill Road (SR 1601)

- Cul-de-sac Chapel Hill Road at intersection.

NC 24/87 (Bragg Boulevard) and Odell Road

- Construct an additional through lane along both directions of Bragg Blvd. From the south, the new northbound through lane should have at least 500 feet of full storage with an appropriate taper length.
- Construct an additional southbound right-turn lane to form dual right-turn lanes with the inner lane accommodating continuous storage and the outer having at least 150 feet of full storage and appropriate taper length.
- Construct an additional northbound left-turn lane to form dual left-turn lanes with at least 250 feet of full storage and appropriate taper length.
- Reconstruct eastbound approach of Odell Road to accommodate triple left-turn lanes (inner lane should have at least 400 feet of full storage) and a single right-turn lane with at least 300 feet of full storage.

NC 210 (Lillington Highway) and Proposed Spring Lake Loop

- Construct signalized intersection on new location approximately 800 feet north of the existing Chapel Hill Road intersection.
- Construct the northbound approach to accommodate two through lanes, dual left-turn lanes with at least 150 feet of full storage and an exclusive right-turn lane with at least 100 feet of storage.
- Construct the southbound approach to accommodate two through lanes, dual left-turn lanes with at least 500 feet of full storage and an exclusive right-turn lane with at least 150 feet of storage.
- Construct the eastbound approach of Spring Lake Loop to accommodate two through lanes, dual left-turn lanes with at least 250 feet of full storage and an exclusive right-turn lane with at least 200 feet of storage.
- Construct the westbound approach of Spring Lake Loop to accommodate two through lanes, a single left-turn lane with at least 150 feet of full storage and an exclusive free flowing right-turn lane with at least 200 feet of storage.
- A third northbound lane should be constructed to receive the free-flowing westbound right-turn traffic for a minimum of 1000 feet along NC 210 north of the intersection.

Proposed Spring Lake Loop and Spring Avenue

- Construct a signalized T-intersection which slightly realigns the existing McCormick Road/Spring Avenue/Grogg Street intersection.
- Construct the northbound approach to accommodate two through lanes and a single left-turn lane with at least 150 feet of storage.
- Construct the southbound approach to accommodate two through lanes and a single right-turn lane with at least 150 feet of storage.
- Construct the eastbound approach of Spring Avenue to accommodate an exclusive left and right-turn lane. Allow at least 150 feet of full storage for the right-turn lane.

NC 210 (Murchison Road) and Proposed Spring Lake Loop Interchange

- Incorporate a fourth leg into the current U-4444 interchange design.
- Widen the bridge across NC 210 to accommodate six lanes, accommodating two westbound lanes, two eastbound lanes and two back-to-back left-turn lanes for the ramp intersections.
- Provide at least 300 feet of storage for the westbound left-turn lanes at the southbound ramps intersection.
- Provide at least 300 feet of storage for the eastbound left-turn lanes at the northbound ramps intersection.
- Reconstruct the southbound approach of the northbound ramps intersection to accommodate an exclusive right-turn lane and dual left-turn lanes with the outer lane providing at least 250 feet of storage on the off ramp.
- Construct the new westbound approach to accommodate two through lanes and an exclusive right-turn lane with at least 150 feet of full storage.
- Signalize the northbound ramps intersection.

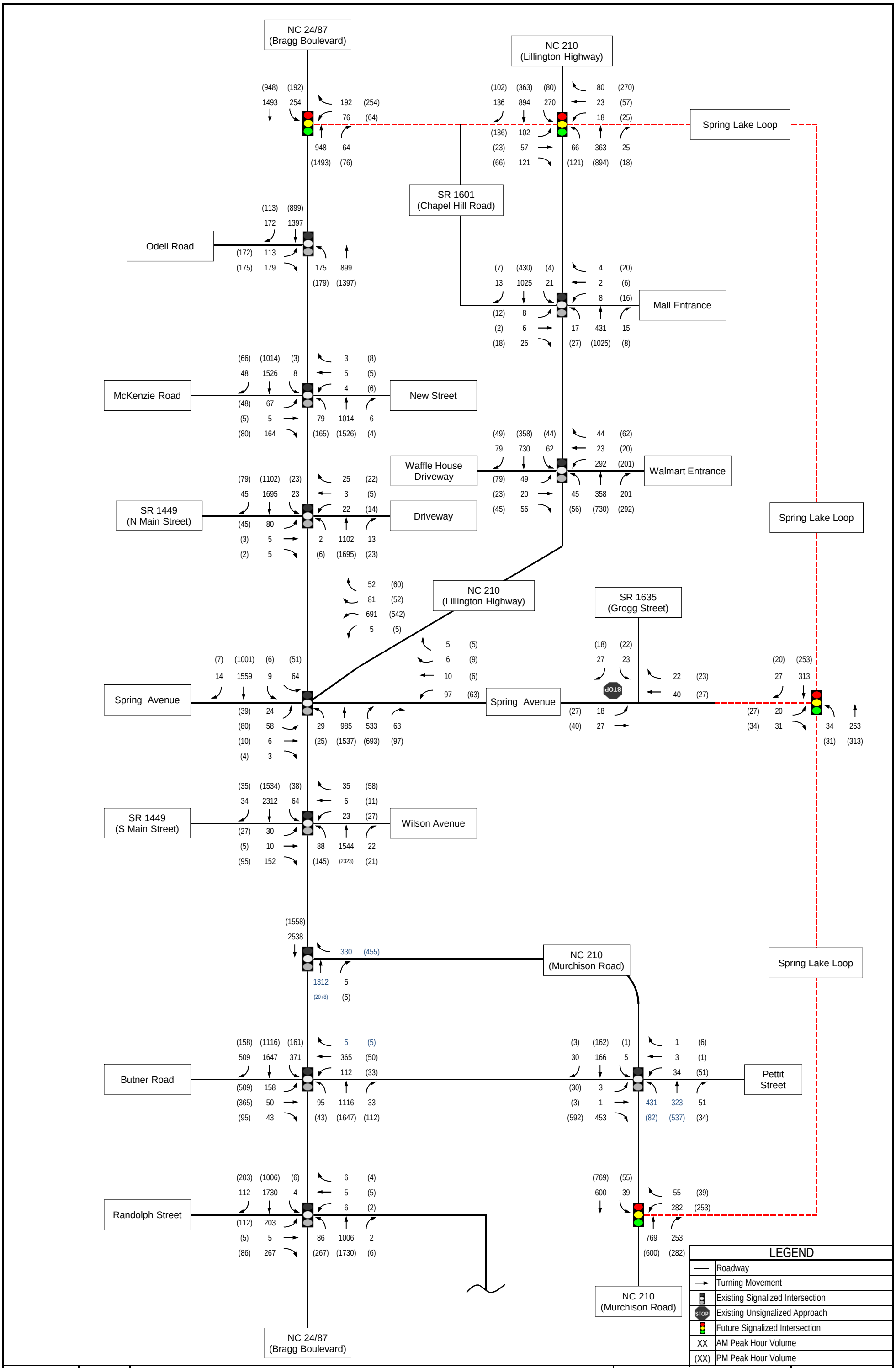
6.3.2 Base Year (2011) – Build Alt 1

This scenario represents operations given the base year volumes and accounting for the construction of the proposed Spring Lake Loop as a four-lane divided roadway; however, it does not include any of the fiscally constrained background projects such as U-4444. Because the future interchange of NC 210 (Murchison Road) is part of U-4444, the build configuration at the Spring Lake Loop and NC 210 (Murchison Road) intersection is scaled back to an at-grade, signalized intersection for this scenario. All other build improvements reflect those implemented in the Design Year (2035) Build recommendations detailed in Section 6.3.1. Figure 6-3 summarizes the volumes used in this analysis and Figure 6-4 illustrates the roadway geometrics.

Based on the results of the intersection capacity analysis, traffic operations under these conditions are similar to the Base Year (2011) No-Build results. Operations at some intersections along NC 24 (Bragg Boulevard) and NC 210 (Lillington Highway) improve slightly due to the diversion of through traffic to Spring Lake Loop. The intersections along the proposed Spring Lake Loop would all operate acceptably under these conditions. Table 6-2 summarizes the LOS results for this scenario.

6.3.3 Design Year (2035) – Build Alt 1

This scenario represents operations given the design year volumes and accounting for the construction of the proposed Spring Lake Loop as a four-lane divided roadway. It also includes any of the fiscally constrained background projects included in the Design Year (2035) No-Build scenario, such as U-4444. All build improvements detailed in Section 6.3.1 are included. Figure 6-5 summarizes the volumes used in this analysis and Figure 6-6 illustrates the roadway geometrics.



LEGEND	
—	Roadway
→	Turning Movement
	Existing Signalized Intersection
STOP	Existing Unsignalized Approach
	Future Signalized Intersection
XX	AM Peak Hour Volume
(XX)	PM Peak Hour Volume

Not to Scale

N

Figure 6-3
Base Year (2011) Build Alt 1 Peak Hour Turning Movement Volumes

Spring Lake Loop Feasibility Study
(FS-1106A)
Randolph Street to Odell Road

VHB

NC 24/87 (Bragg Boulevard)
NC 210 (Lillington Highway)
Spring Lake Loop
SR 1601 (Chapel Hill Road)
Odell Road
Mall Entrance
McKenzie Road
New Street
Waffle House Driveway
Walmart Entrance
SR 1449 (N Main Street)
Driveway
NC 210 (Lillington Highway)
SR 1635 (Grogg Street)
Spring Avenue
Spring Avenue
SR 1449 (S Main Street)
Wilson Avenue
NC 210 (Murchison Road)
Spring Lake Loop
Butner Road
Driveway
Randolph Street
NC 24/87 (Bragg Boulevard)
NC 210 (Murchison Road)

LEGEND
Existing Lane Configuration
Existing Roadway
Existing Signalized Intersection
Existing Stop Controlled Approach
Future Build Lane Configuration
Future Build Roadway
Future Signalized Intersection

Not to Scale

Figure 6-4
Base Year (2011) Build Alt 1 Lane Configurations and Traffic Control

Spring Lake Loop Feasibility Study (FS-1106A)

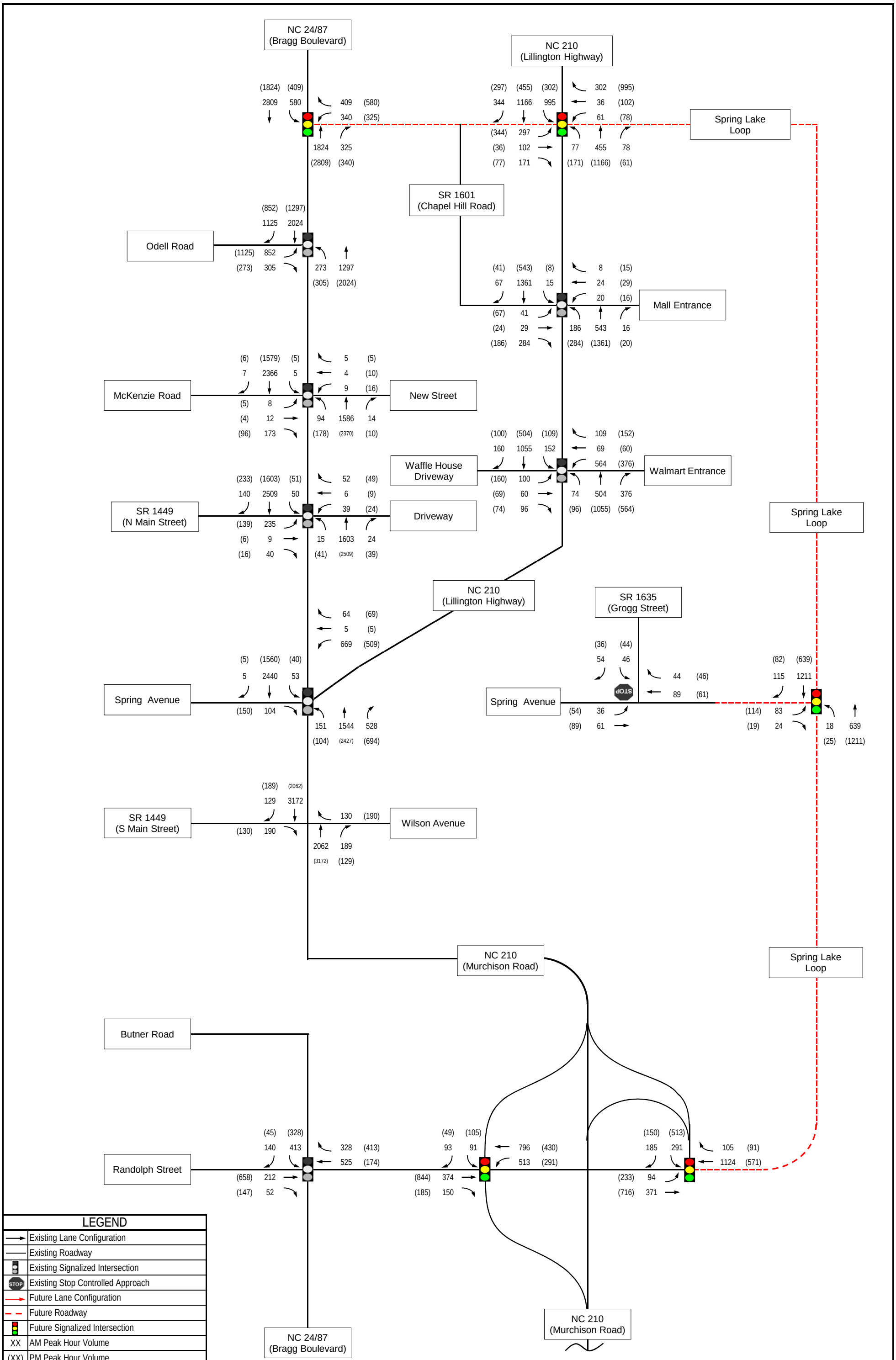
Randolph Street to Odell Road

VHB

Table 6-2
Base Year (2011) Build Alt 1 LOS Summary

Intersection	Traffic Control	Base Year (2011) Build 1	
		AM	PM
NC 24/87 (Bragg Blvd.) at Randolph St.	Signalized	C (EB-F) 27.8 sec	B (EB-E) 18.6 sec
NC 24/87 (Bragg Blvd.) at Butner Rd.	Signalized	D (EB-D) 36.8 sec	C (EB-D) 27.2 sec
NC 210 (Murchison Rd.) at Butner Rd.	Signalized	C (WB-E) 25.2 sec	C (WB-E) 30.0 sec
NC 24/87/210 (Bragg Blvd.) at NC 210 (Murchison Rd.)	Signalized; Median Divided	A (WB-D) 4.2 sec	A (WB-D) 6.8 sec
NC 24/87/210 (Bragg Blvd.) at South Main St. (SR 1449)	Signalized	B (WB-E) 14.8 sec	B (WB-E) 18.2 sec
NC 24/87/210 (Bragg Blvd.) at NC 210 (Lillington Hwy.) and Spring Ave.	Signalized	D (SW-F) 39.5 sec	D (SW-E) 40.1 sec
NC 24/87 (Bragg Blvd.) at North Main St. (SR 1449)	Signalized	A (EB-E) 5.4 sec	A (EB-E) 6.9 sec
NC 24/87 (Bragg Blvd.) at McKenzie Rd.	Signalized	B (WB-D) 10.2 sec	A (WB-E) 8.6 sec
NC 24/87 (Bragg Blvd.) at Odell Rd.	Signalized	B (EB-D) 13.4 sec	B (EB-D) 13.5 sec
NC 24/87 (Bragg Blvd.) at Future Spring Lake Loop	Future Signalized	A (WB-C) 9.5 sec	A (WB-C) 8.5 sec
NC 210 (Lillington Hwy.) at Wal-Mart Shopping Center Entrance	Signalized	C (EB-D) 22.1 sec	C (EB-E) 20.7 sec
NC 210 (Lillington Hwy.) at Chapel Hill Rd. (SR 1601)	Signalized	A (EB-D) 4.3 sec	A (WB-E) 4.5 sec
Spring Ave. at Grogg St. (SR 1635)	Unsignalized	(SB-A)	(SB-A)
NC 210 at Future Spring Lake Loop	Future Signalized	B (EB-B) 19.8 sec	B (EB-C) 18.6 sec
Spring Ave at Future Spring Lake Loop	Future Signalized	A (EB-C) 4.5 sec	A (EB-C) 5.0 sec
NC 210 (Murchison Road) at Future Spring Lake Loop	Future Signalized	B (WB-C) 14.0 sec	B (WB-C) 12.4 sec

LEGEND: X (XX-X), 00.0 sec – Overall LOS (Lowest operating approach – approach LOS), overall delay in seconds


NC 24/87
(Bragg Boulevard)
NC 210
(Lillington Highway)
Spring Lake
Loop
SR 1601
(Chapel Hill Road)
Odell Road
Mall Entrance
McKenzie Road
New Street
Waffle House
Driveway
Walmart Entrance
SR 1449
(N Main Street)
Driveway
Spring Lake
Loop
NC 210
(Lillington Highway)
SR 1635
(Grogg Street)
Spring Avenue
Spring Avenue
STOP
SR 1449
(S Main Street)
Wilson Avenue
NC 210
(Murchison Road)
Spring Lake
Loop
Butner Road
Randolph Street
NC 210
(Murchison Road)
NC 24/87
(Bragg Boulevard)
LEGEND
Existing Lane Configuration
Existing Roadway
Existing Signalized Intersection
Existing Stop Controlled Approach
Future Lane Configuration
Future Roadway
Future Signalized Intersection
XX AM Peak Hour Volume
(XX) PM Peak Hour Volume
Not
to
Scale
N
Figure 6-5
Design Year (2035) Build Alt 1 Peak Hour Turning Movement
Volumes
Spring Lake Loop
Feasibility Study
(FS-1106A)
Randolph Street to Odell Road
VHB

NC 24/87
(Bragg Boulevard)

NC 210
(Lillington Highway)

Spring Lake
Loop

SR 1601
(Chapel Hill Road)

Odell Road

Mall Entrance

McKenzie Road

New Street

Waffle House
Driveway

Walmart Entrance

SR 1449
(N Main Street)

Driveway

Spring Lake
Loop

NC 210
(Lillington Highway)

SR 1635
(Grogg Street)

Spring Avenue

Spring Avenue

SR 1449
(S Main Street)

Wilson Avenue

Spring Lake
Loop

NC 210
(Murchison Road)

Butner Road

Randolph Street

NC 24/87
(Bragg Boulevard)

NC 210
(Murchison Road)

LEGEND	
	No-Build Lane Configuration
	No-Build Roadway
	No-Build Signalized Intersection
STOP	No-Build Stop Controlled Approach
	Future Build Lane Configuration
	Future Build Roadway
	Future Signalized Intersection

Not
to
Scale

N

Figure 6-6
Design Year (2035) Build Alt 1 Lane Configurations and Traffic Control

Spring Lake Loop Feasibility Study
(FS-1106A)
Randolph Street to Odell Road

VHB

Based on the results of the intersection capacity analysis, all study area intersections are projected to maintain acceptable traffic operations under these conditions. The exception is The NC 24/87 (Bragg Boulevard) at N. Main Street intersection which is projected to operate at LOS E during the AM peak hour. However, operations at some intersections along NC 24/87 (Bragg Boulevard) and NC 210 (Lillington Highway) are projected to improve slightly over the No-Build conditions due to the diversion of through traffic to Spring Lake Loop. The intersections along the proposed Spring Lake Loop would all operate acceptably under these conditions. Table 6-3 summarizes the LOS results for this scenario.

Table 6-3
Design Year (2035) Build Alt 1 LOS Summary

Intersection	Traffic Control	Design Year (2035) Build 1	
		AM	PM
NC 24/87 (Bragg Blvd.) at Randolph St.	Signalized	A (SB-B) 7.5 sec	A (SB-B) 6.6 sec
NC 24/87/210 (Bragg Blvd.) at South Main St. (SR 1449)	Signalized	(EB-F)	(WB-D)
NC 24/87/210 (Bragg Blvd.) at NC 210 (Lillington Hwy.) and Spring Ave.	Signalized	C (EB-E) 23.4 sec	C (WB-E) 26.3 sec
NC 24/87 (Bragg Blvd.) at North Main St. (SR 1449)	Signalized	E (EB-F) 57.0 sec	C (EB-F) 25.3 sec
NC 24/87 (Bragg Blvd.) at McKenzie Rd.	Signalized	C (SB-D) 30.8 sec	B (WB-D) 12.9 sec
NC 24/87 (Bragg Blvd.) at Odell Rd.	Signalized	B (EB-D) 19.6 sec	B (EB-C) 19.9 sec
NC 24/87 (Bragg Blvd.) at Future Spring Lake Loop	Future Signalized	B (WB-D) 19.6 sec	C (WB-D) 32.8 sec
NC 210 (Lillington Hwy.) at Wal-Mart Shopping Center Entrance	Signalized	C (WB-E) 34.8 sec	D (EB-F) 36.5 sec
NC 210 (Lillington Hwy.) at Chapel Hill Rd. (SR 1601)	Signalized	C (EB-D) 21.9 sec	B (EB-D) 15.2 sec
Spring Ave. at Grogg St. (SR 1635)	Unsignalized	(SB-B)	(SB-B)
NC 210 at Future Spring Lake Loop	Future Signalized	C (EB-D) 27.9 sec	C (EB-D) 24.6 sec
Spring Ave at Future Spring Lake Loop	Future Signalized	A (EB-B) 6.2 sec	A (EB-B) 7.9 sec
NC 210 (Murchison Rd.) at Randolph Street/Future Spring Lake Loop (Southbound Ramps)	Future Interchange	B (SB-D) 12.7 sec	B (SB-D) 15.8 sec
NC 210 (Murchison Rd.) at Randolph Street/Future Spring Lake Loop (Northbound Ramps)	Future Interchange	B (SB-C) 18.3 sec	B (SB-C) 17.3 sec

LEGEND: X (XX-X), 00.0 sec – Overall LOS (Lowest operating approach – approach LOS), overall delay in seconds

6.4 BUILD ALTERNATIVE 2

Detailed traffic capacity analysis was not completed for Build Alternative 2. Based on preliminary traffic analysis of the projected travel demand derived from the forecasts and the capacity that a four-lane or six-lane typical section would provide, a four-lane design was determined to provide sufficient capacity. A facility such as Spring Lake Loop could be conservatively classified as an urban street, given its planned use and multiple signals along its length. Based on the traffic forecasts, this facility is expected to serve approximately 23,000 vehicles per day when modeled as a four-lane facility, and approximately 29,000 vehicles per day when modeled as a six-lane facility. Based on general guidance found in the Highway Capacity Manual, 2010, this type of facility can maintain an overall LOS D with only four lanes of travel for a volume of up to approximately 34,000 vehicles per day. Given this generalized service volume, a four-lane section was determined to be sufficient. Additionally, the forecasted volumes are similar between the four-lane and six-lane build alternatives and the recommended improvements combined with a four-lane typical section provide more than acceptable operations at all intersections along the proposed loop in the design year (2035). Therefore, a six-lane section (Build Alt. 2) was not carried further in the study process.

6.5 STRUCTURES AND HYDROLOGY

According to the NCDOT Bridge Inventory, there are no existing crossings within the feasibility study area that currently have a major structure (bridge or culvert of at least 72"); however, the proposed project would result in new stream crossings of Little River tributaries and Cross Creek that may require substantial culvert or bridge structures.

Existing stream crossing under Chapel Hill Road

Field work and GIS data indicate four stream crossings along existing portions of the project that would be extended or more likely replaced with the proposed project. Each crossing contains either concrete pipes or corrugated metal pipes.

There is potential for four new stream crossings; thus as part of the conceptual designs, an initial hydraulic analysis was conducted to estimate the size for the future stream crossings for costing purposes. These conceptual recommendations for the purpose of this level of study include the following structures:

- 10' x 10' RCBC; located approximately 1,000' east of NC 24/87 (Bragg Boulevard) along the proposed project alignment
- 9' x 8' Reinforced Concrete Box Culvert (RCBC); located approximately 2,700' east of NC 24/87 (Bragg Boulevard) along the proposed project alignment
- 4 @ 60" RCPs (Reinforced Concrete Pipe); under NC 210 (Lillington Highway) at new intersection with proposed project
- 4 @ 54" RCPs; located near NC 210 (Murchison Road) interchange (wetland fill– Build Alternative 1A); or, a dual structure bridge (700' length, 34' width) over wetland area, located near the NC 210 (Murchison Road) interchange (wetland bridge option – Build Alternative 1B)

During the environmental planning and design process, a preliminary hydraulic report should be completed which assesses the sufficiency of all existing crossings, recommending upgraded structures as needed, as well as makes more detailed recommendations on the hydrologic needs for any proposed stream crossings.

Along the southern end of the proposed project where there is a known wetland area, the conceptual design has considered two options, filling the wetland (Build Alternative 1A) and bridging over the wetland (Build Alternative 1B). As mentioned previously, the wetland fill option would include a series of RCPs at the crossing and the bridge option would include a dual structure, each with a length of approximately 700 feet and a width of 34 feet to span the wetland area. The overall cost and impacts of both alternatives will be evaluated in Sections 7 and 8.

7. OPINION OF PROBABLE COST

7.1 CONSTRUCTION AND RIGHT OF WAY ESTIMATES

Cost estimates were completed for the Build Alternatives including estimation of right-of-way costs, utility relocation costs, and construction costs. These estimates are based on the conceptual designs found in Appendix B. Table 7-1 summarizes the cost estimates for each component of each alternative and provides a total tally of estimated cost per alternative.

Table 7-1
Estimated Costs

	Build Alternative 1A (Wetland Fill)	Build Alternative 1B (Wetland Bridge)
Right of Way	$ 9,500,000	$ 9,500,000
Utility Relocation	$ 400,000	$ 400,000
Construction	$ 32,300,000	$ 36,800,000
Total	*$ 42,200,000*	*$ 46,700,000*

7.2 BENEFIT-COST ANALYSIS

A benefit-cost analysis was completed using the NCDOT Redbook Wizard tool, which is based on the *User Benefit Analysis for Highways* publication (AASHTO, 2003). Inputs for the benefit analysis include base year and projected future year traffic volumes, average travel speeds, and crash statistics and result in three types of benefits: user value of time, user operating cost, and user accident reduction benefits. The sum of these benefits constitutes the overall project benefit. Project costs are taken directly from cost estimates for right-of-way, utility relocation, and construction. The benefit and the cost of implementation are then weighed against one another to determine the "benefit-cost ratio" for a specific alternative. This tool also allows the user to compare this ratio among alternatives under review, providing a benefit-cost ranking for the alternatives. An additional use for this ratio is to allow for comparison between potential projects within a given vicinity and to aid in prioritizing funding for multiple projects in the same area.

The *User Benefit Analysis for Highways* publication does not directly account for new location projects, but rather evaluates new highway projects as analogous to the addition of new lane capacity on an existing facility. The procedure for analyzing additional lane capacity is applied to all corridors substantially affected by the new location project to determine the benefit of the new roadway. Thus, in the case of the proposed Spring Lake Loop, benefits associated with the project, such as accident reduction and increased average travel speed, were derived by determining the benefit that the new road would provide to NC 24/87 (Bragg Boulevard), the existing road that is currently the common route taken through the Town of Spring Lake. STIP Project #U-4444, of which parts are currently under construction, intends to improve this roadway significantly, accommodating additional through lanes in both directions. Additionally, NC 210 (Murchison Road) currently splits from Bragg Boulevard to the southeast for drivers bound for the Fayetteville area. Improvements associated with U-4444 also indicate changing the traffic flow south of Spring Lake such that Bragg Boulevard flows into Murchison Road only, removing a portion of Bragg Boulevard near Butner Road. It is important to account for these improvements when determining the benefit of the

proposed Spring Lake Loop, as the forecasted volumes used in the analysis assume U-4444 is completed.

With this in mind, a benefit was calculated for NC 24/87 (Bragg Boulevard) with only U-4444 in place and an additional benefit scenario was run that accounts for both U-4444 and the proposed Spring Lake Loop project. The difference between these scenarios can be assumed to be the benefit attributable only to the proposed Spring Lake Loop project. The benefit for Build Alternative 1A and 1B are identical as the treatment of the wetland crossing near the NC 210 (Murchison Road) interchange does not affect the overall project benefit. The proposed Spring Lake Loop project benefit was calculated to be approximately $83.1 million dollars. The benefit-cost ratio for Build Alternative 1A is calculated to be 2.0, while Build Alternative 1B is 1.8. This is due to the slightly less expensive option of filling the wetland area rather than bridging it.

8. ALTERNATIVES EVALUATION AND RECOMMENDATIONS

8.1 IMPACTS OF ALTERNATIVES

Although multiple alternatives concerning the treatment of the major loop intersections (NC 28/87 and NC 210) were studied, ultimately, only a single alternative for each intersection was carried forward to conceptual design. These intersection treatments helped determine the overall alignment of the proposed Spring Lake Loop and what parts were on new location versus existing pavement. The combination of these intersection treatments and alignment are collectively referred to as Build Alternative 1, which accounted for a four-lane typical section as determined by the traffic capacity analysis. There is some variance in the Build Alt. 1 design concerning the treatment of the wetland area near the NC 210 (Murchison Road) interchange. This area may either be filled (Build Alt. 1A) or bridged (Build Alt 1B). Table 8-1 provides a comparison of the quantitative impacts of each of these alternatives, with specific differences seen in the impacted wetland area and estimated project cost.

Additionally, the four existing stream crossings (Little River tributaries) along the study corridor would likely need to be replaced to accommodate increased drainage flow and the new roadway. Additionally, it is anticipated that three new stream crossings (Little River tributaries) would be required with at least two of them being major culvert structures, as well as the potential for a bridge crossing of a wetland and stream area (Cross Creek).

Table 8-1
Alternatives Major Impact Comparison

Impact	Build Alternative 1A (Wetland Fill)	Build Alternative 1B (Wetland Bridge)
Relocations - Business	2	2
Relocations - Residences	27	27
Relocations - Churches	2	2
Wetlands Impacted	4.84 acres	0.24 acres
Stream Crossings	8	8
Probable USTs	0	0
National Register of Historic Places Sites	0	0
ROW Cost	$ 9,500,000	$ 9,500,000
Construction Cost	$ 32,300,000	$ 36,800,000
Utility Relocation Cost	$ 400,000	$ 400,000
Total Cost	*$ 42,200,000*	*$ 46,700,000*

8.2 CONCLUSIONS

The presented alternative for the proposed Spring Lake Loop project includes both upgrading portions of existing roadways as well as constructing some parts on new location and includes multiple intersection upgrades and one interchange upgrade at locations where the loop would intersect existing roadways. The two build variations are very similar in design with the exception being the crossing of a wetland area at the southern end of the project. A bridge option and a fill option were both designed and estimated for cost, with the bridge being approximately $4.5 million more expensive. This leads to a slightly better benefit cost ratio for the wetland fill option, but that option impacts approximately 4.5 more acres of wetland area. The other major impact parameters are equal between the two build variations, including relocations, stream crossings and UST locations.

The presence of red-cockaded woodpecker habitat in the vicinity of the proposed project could result in additional costs associated with the project for mitigation and avoidance measures. Substantial coordination with Fort Bragg and USFWS will be required to resolve any concerns over potential impacts to the RCW habitat management goals in the Fort Bragg Integrated Natural Resources Management Plan. The Protected Species Survey Report does recommend exploring other alignment options as the project progresses to ensure that minimal impacts to the habitat are made.

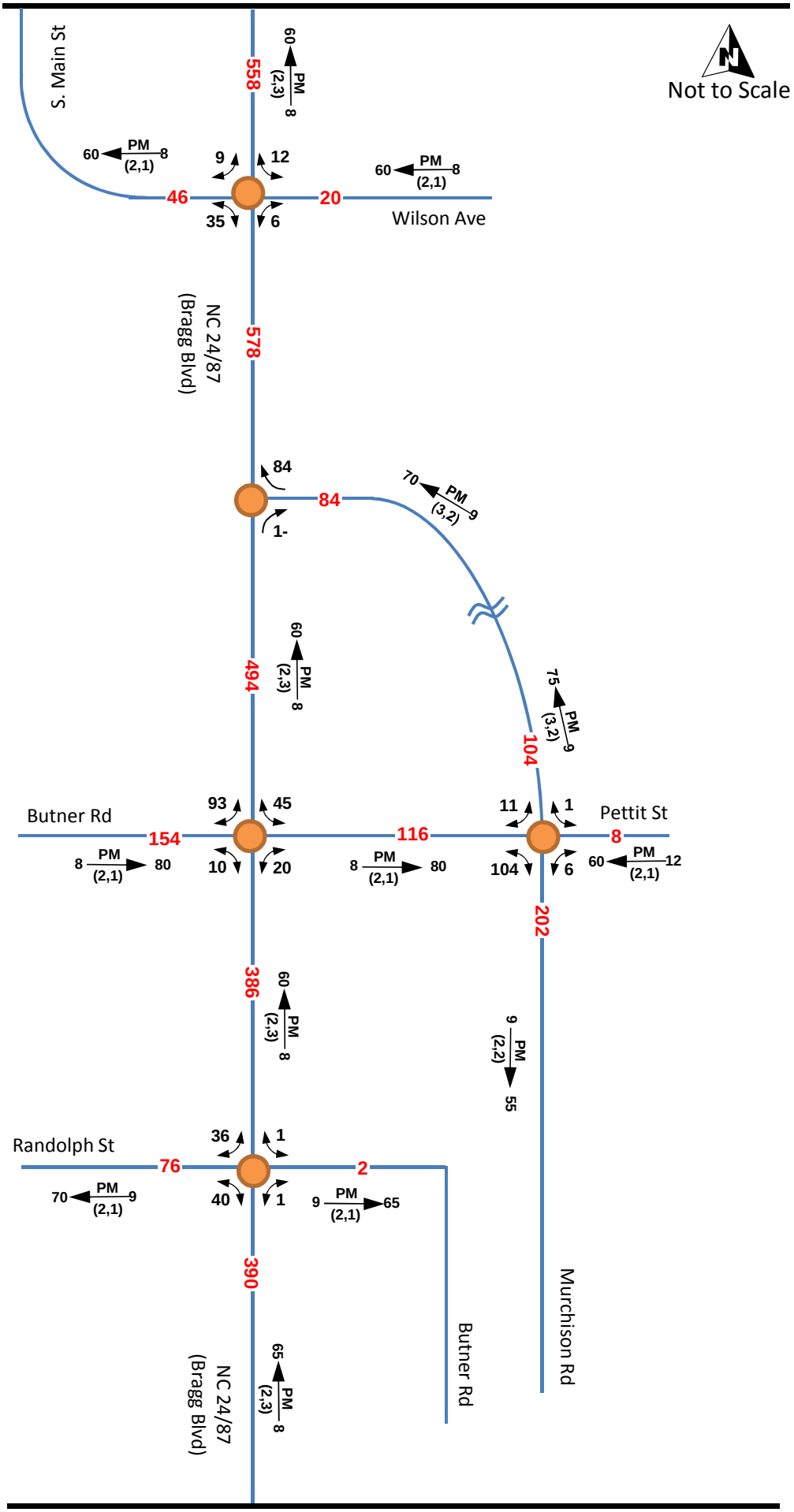
The benefit-cost ratio of this project indicates that there would be an overall positive benefit for the estimated investment. This ratio should be used to help prioritize this project against other potential projects in the area.

APPENDIX

APPENDIX A:

Traffic Forecasts

MATCHLINE



PROJECT START

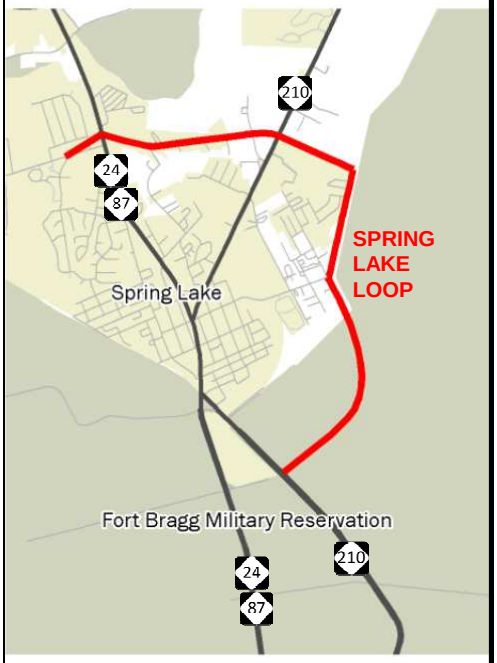


DIAGRAM 1

2011 ANNUAL AVERAGE DAILY TRAFFIC

NO-BUILD ALTERNATIVE
SHEET 1 OF 2

L E G E N D

K — PM (d, t) → D

###	No. of Vehicles per Day (VPD) in 100s
1-	Less than 50 VPD
X	Movement Prohibited
----	Roadway
K	Design Hour Factor (%)
PM	PM Peak Period
D	Peak Hour Directional Split (%)
→	Indicates Direction of D
(d,t)	Duals, TTSTs (%)

TIP: FS-1106A	**WBS:** 34263.1.1
COUNTY: Cumberland	**DIVISION:** 6
DATE: January 2012	
PREPARED BY: Martin/Alexiou/Bryson	
LOCATION: Spring Lake Loop, NC 210 to Odell Road	
PROJECT: Spring Lake Loop Upgrade	

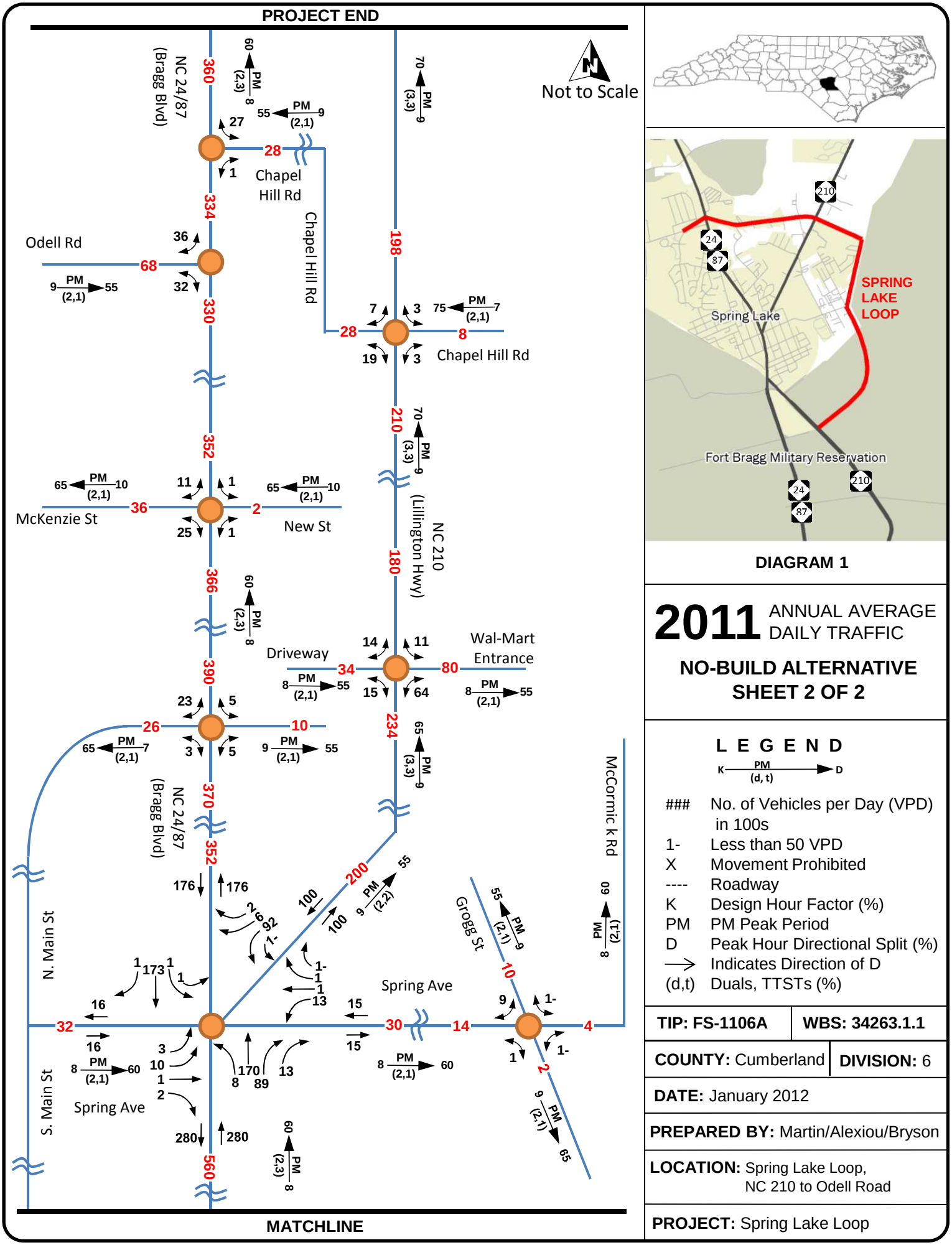


DIAGRAM 1

2011 ANNUAL AVERAGE DAILY TRAFFIC

NO-BUILD ALTERNATIVE
SHEET 2 OF 2

L E G E N D

K — PM (d, t) → D

###	No. of Vehicles per Day (VPD) in 100s
1-	Less than 50 VPD
X	Movement Prohibited
----	Roadway
K	Design Hour Factor (%)
PM	PM Peak Period
D	Peak Hour Directional Split (%)
→	Indicates Direction of D
(d,t)	Duals, TTSTs (%)

TIP: FS-1106A	**WBS:** 34263.1.1
COUNTY: Cumberland	**DIVISION:** 6
DATE: January 2012	
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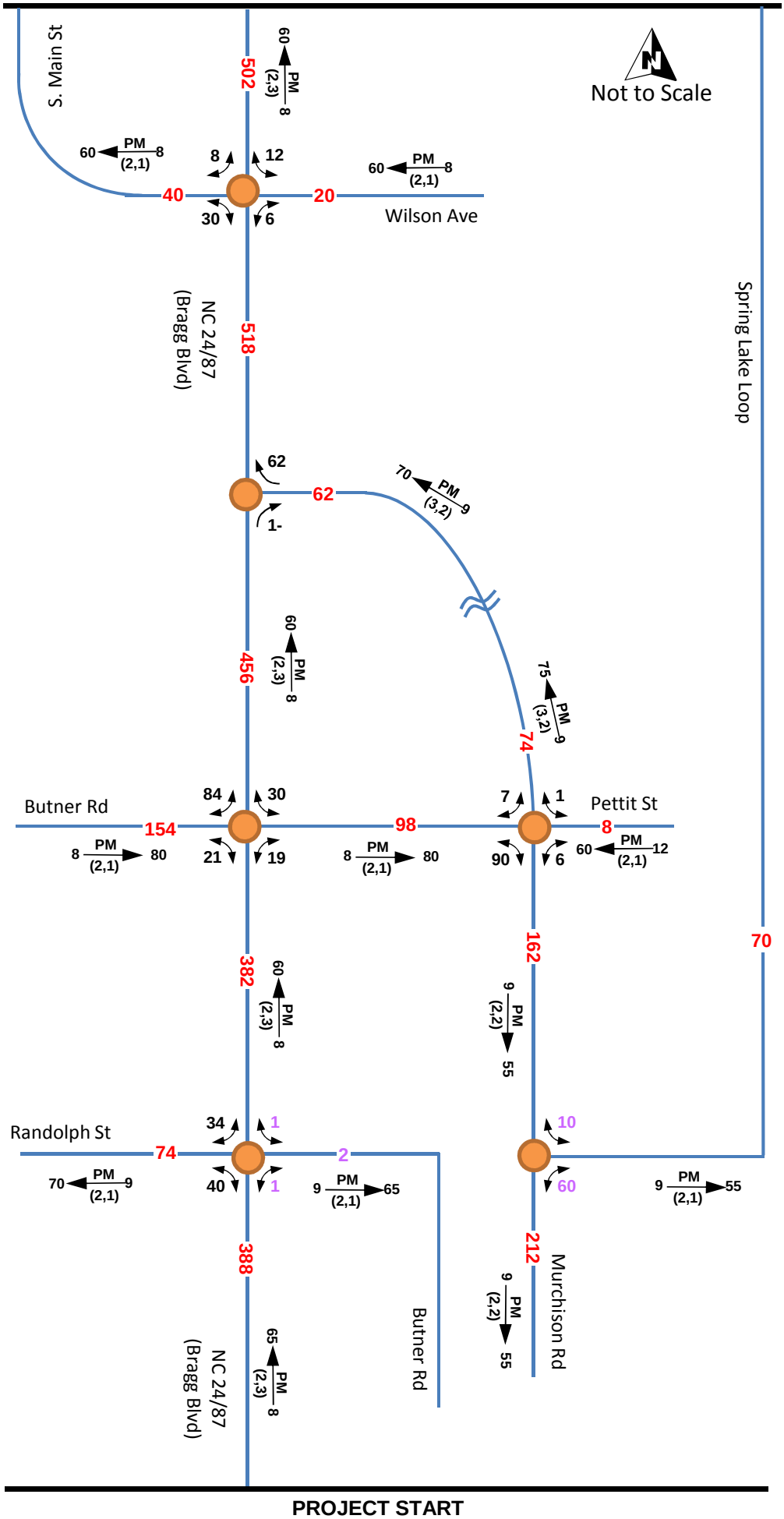
LOCATION: Spring Lake Loop, NC 210 to Odell Road	
PROJECT: Spring Lake Loop	



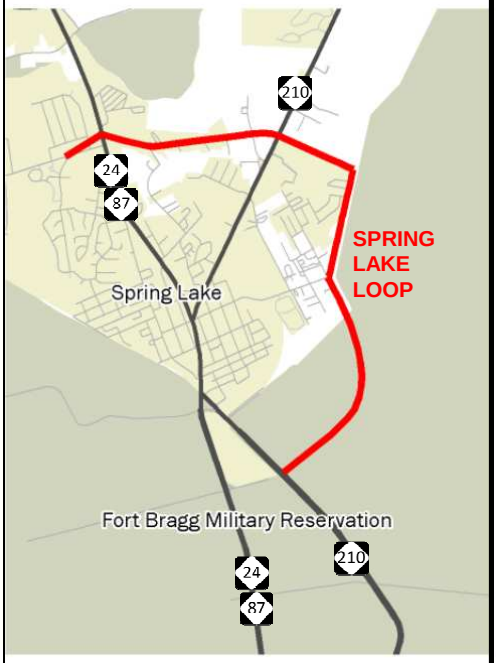


DIAGRAM 2

2011 ANNUAL AVERAGE DAILY TRAFFIC

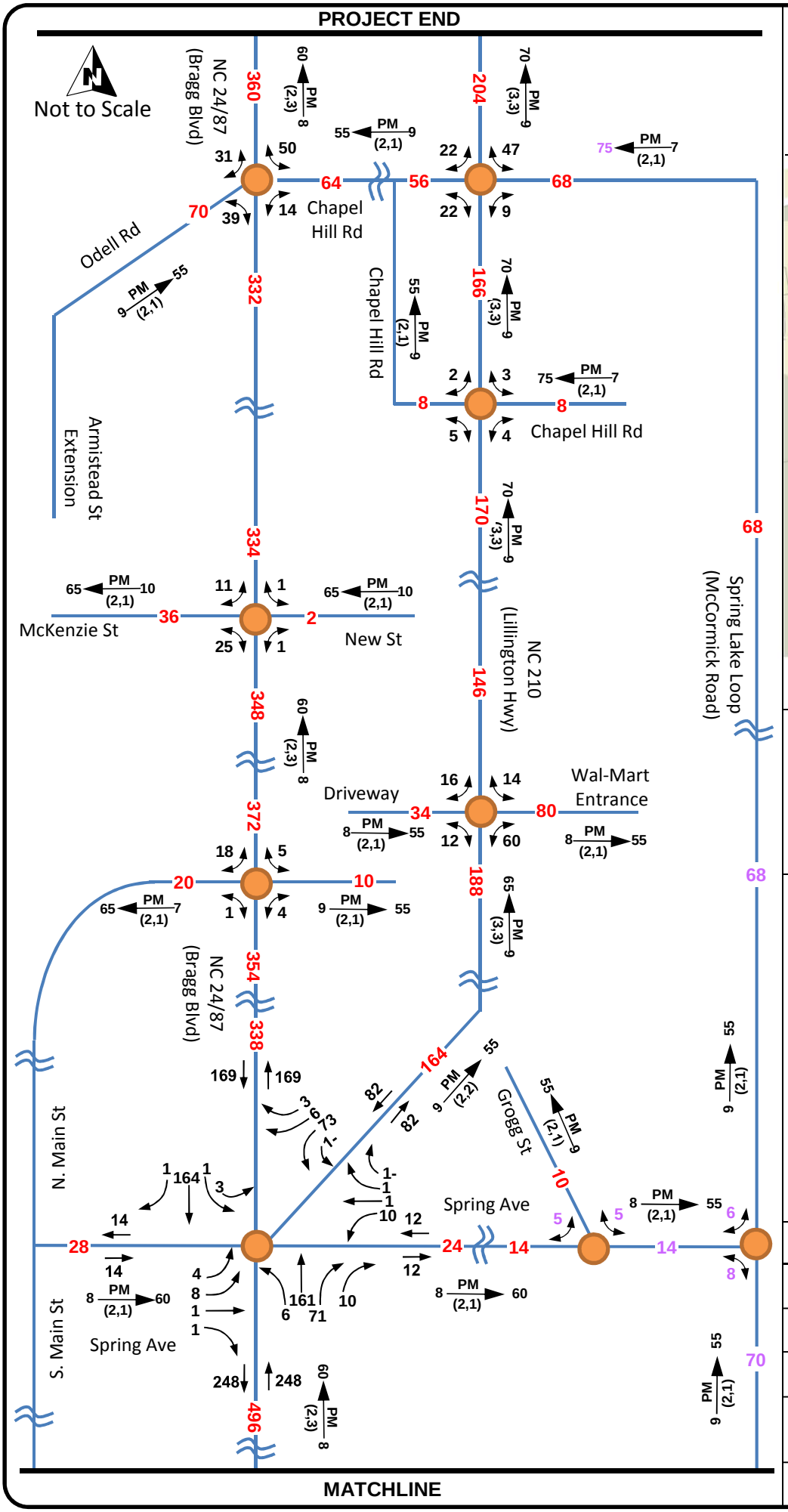
BUILD ALTERNATIVE 1
SHEET 1 OF 2

L E G E N D

K PM (d, t) D

###	No. of Vehicles per Day (VPD) in 100s
1-	Less than 50 VPD
X	Movement Prohibited
----	Roadway
K	Design Hour Factor (%)
PM	PM Peak Period
D	Peak Hour Directional Split (%)
→	Indicates Direction of D
(d,t)	Duals, TTSTs (%)

TIP: FS-1106A	**WBS:** 34263.1.1
COUNTY: Cumberland	**DIVISION:** 6
DATE: January 2012	
PREPARED BY: Martin/Alexiou/Bryson	
LOCATION: Spring Lake Loop, NC 210 to Odell Road	
PROJECT: Spring Lake Loop Upgrade	



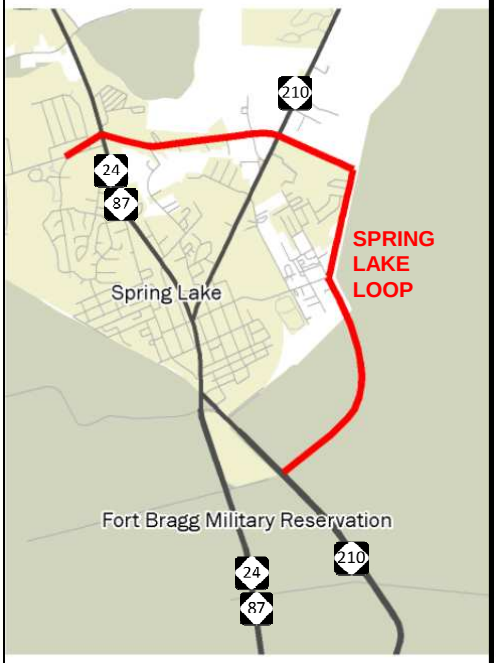


DIAGRAM 2

2011 ANNUAL AVERAGE DAILY TRAFFIC

BUILD ALTERNATIVE 1
SHEET 2 OF 2

L E G E N D

K PM (d, t) D

###	No. of Vehicles per Day (VPD) in 100s
1-	Less than 50 VPD
X	Movement Prohibited
----	Roadway
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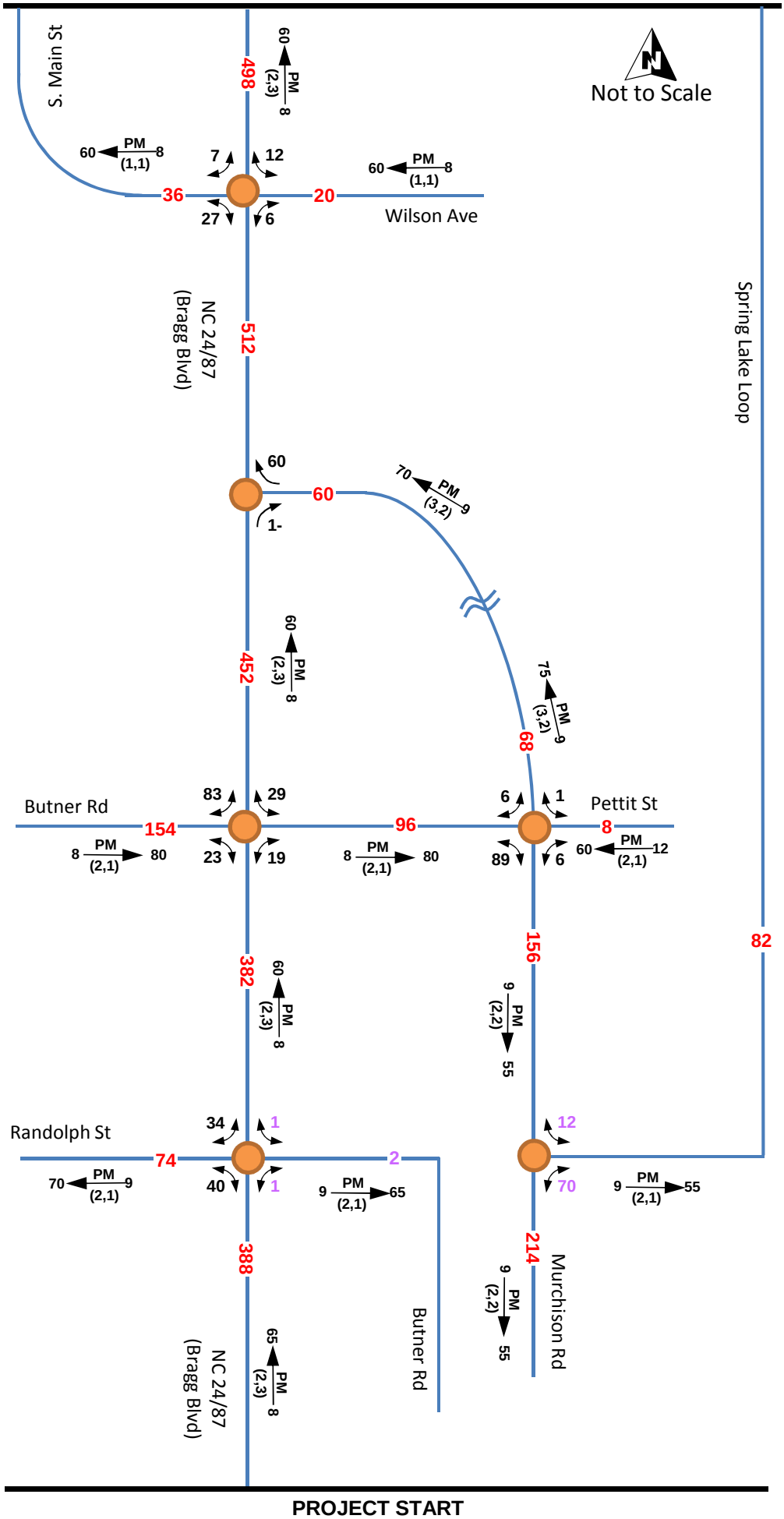
D	Peak Hour Directional Split (%)
→	Indicates Direction of D
(d,t)	Duals, TTSTs (%)

TIP: FS-1106A	**WBS:** 34263.1.1
COUNTY: Cumberland	**DIVISION:** 6
DATE: January 2012	
PREPARED BY: Martin/Alexiou/Bryson	
LOCATION: Spring Lake Loop, NC 210 to Odell Road	
PROJECT: Spring Lake Loop	



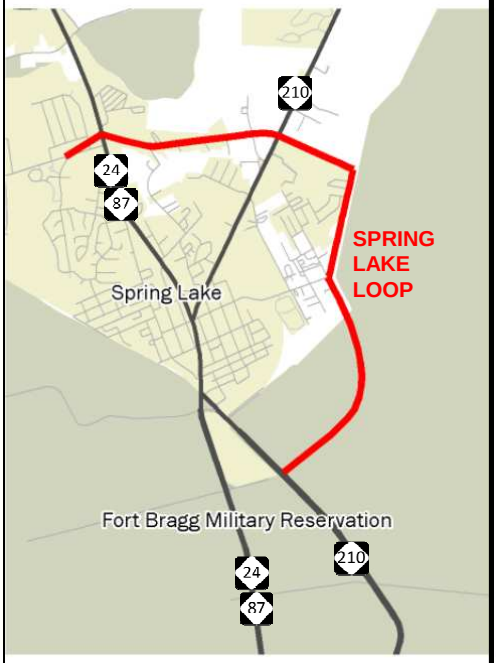


DIAGRAM 3

2011 ANNUAL AVERAGE DAILY TRAFFIC

BUILD ALTERNATIVE 2
SHEET 1 OF 2

L E G E N D

K PM (d, t) D

###	No. of Vehicles per Day (VPD) in 100s
1-	Less than 50 VPD
X	Movement Prohibited
----	Roadway
K	Design Hour Factor (%)
PM	PM Peak Period
D	Peak Hour Directional Split (%)
→	Indicates Direction of D
(d,t)	Duals, TTSTs (%)

TIP: FS-1106A	**WBS:** 34263.1.1
COUNTY: Cumberland	**DIVISION:** 6
DATE: January 2012	
PREPARED BY: Martin/Alexiou/Bryson	
LOCATION: Spring Lake Loop, NC 210 to Odell Road	
PROJECT: Spring Lake Loop Upgrade	

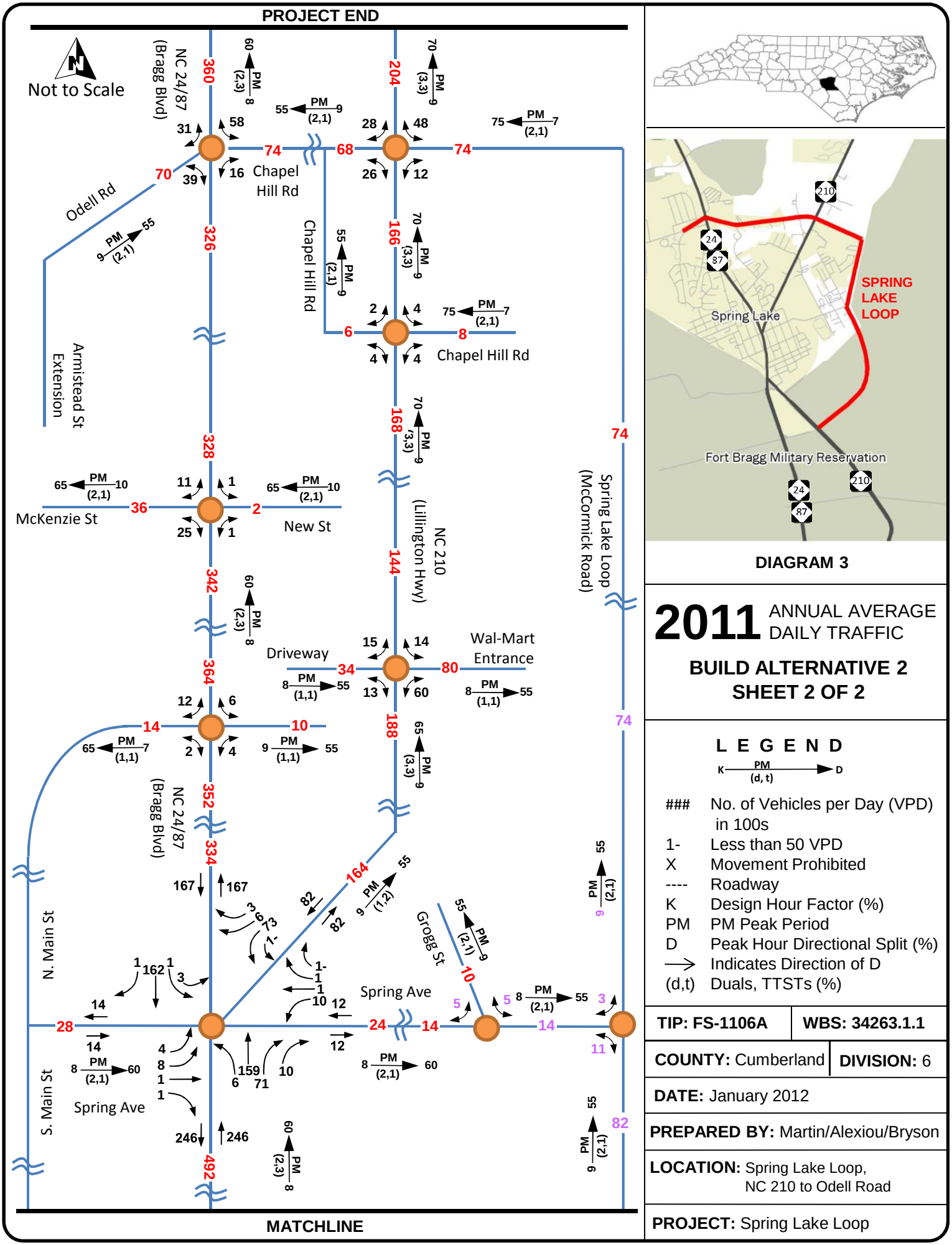


DIAGRAM 3

2011 ANNUAL AVERAGE DAILY TRAFFIC

BUILD ALTERNATIVE 2
SHEET 2 OF 2

L E G E N D

K PM (d, t) D

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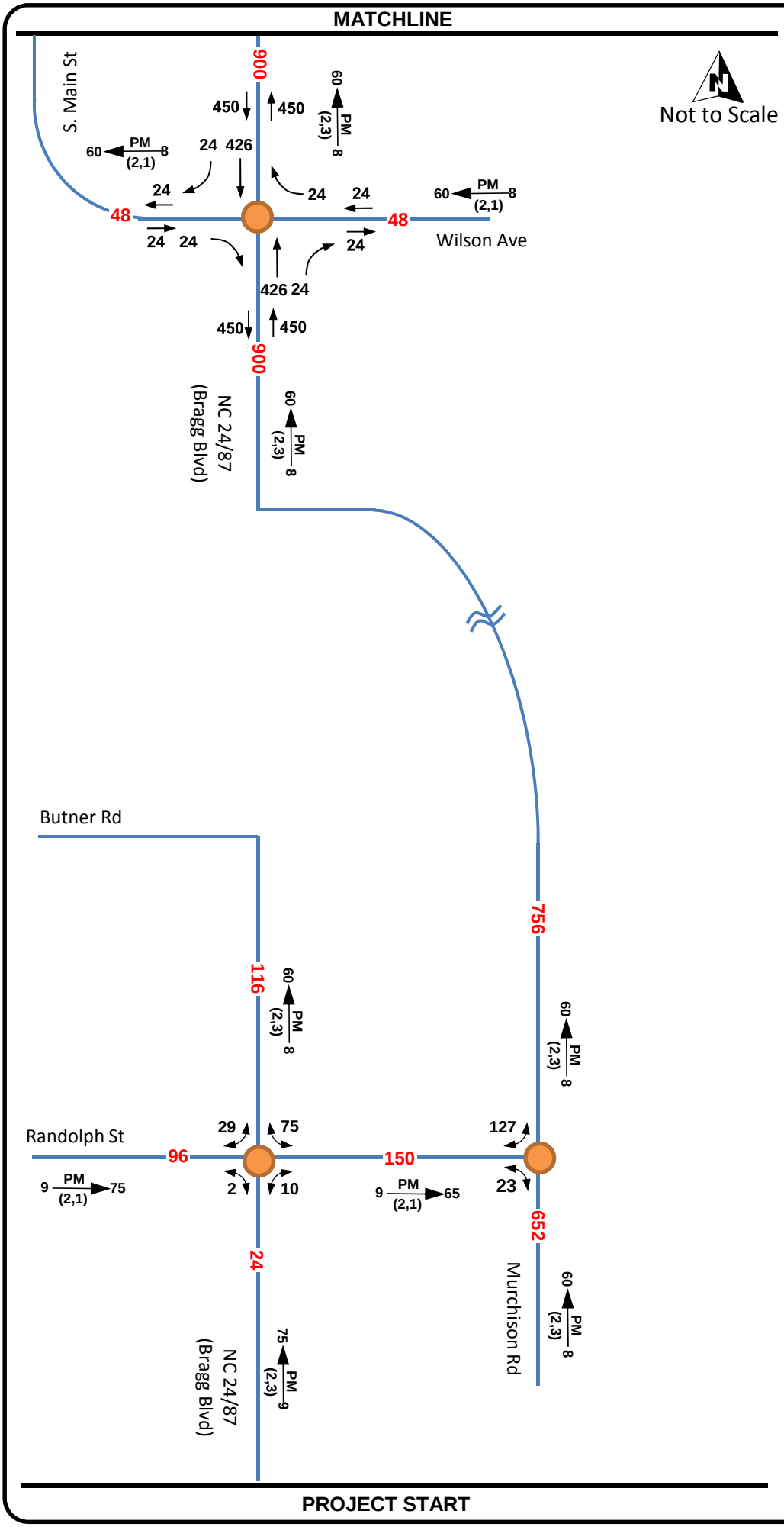
1-	Less than 50 VPD
X	Movement Prohibited
----	Roadway
K	Design Hour Factor (%)
PM	PM Peak Period
D	Peak Hour Directional Split (%)
→	Indicates Direction of D
(d,t)	Duals, TTSTs (%)

TIP: FS-1106A	**WBS:** 34263.1.1
COUNTY: Cumberland	**DIVISION:** 6
DATE: January 2012	
PREPARED BY: Martin/Alexiou/Bryson	
LOCATION: Spring Lake Loop, NC 210 to Odell Road	
PROJECT: Spring Lake Loop	



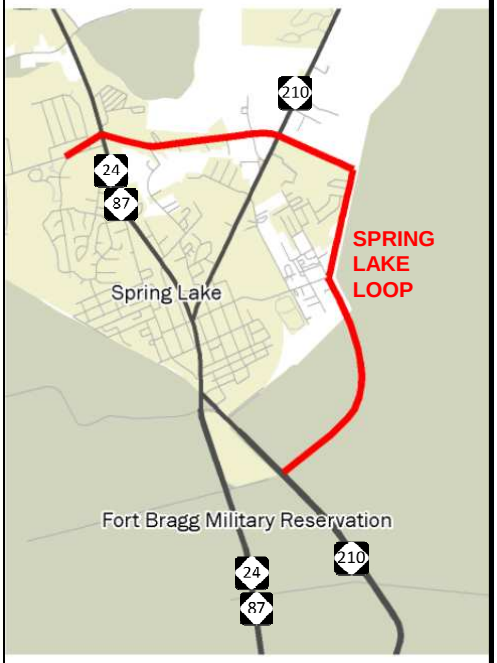


DIAGRAM 4

2035 ANNUAL AVERAGE DAILY TRAFFIC

NO-BUILD ALTERNATIVE
SHEET 1 OF 2

L E G E N D

K PM (d, t) D

###	No. of Vehicles per Day (VPD) in 100s
1-	Less than 50 VPD
X	Movement Prohibited
----	Roadway
K	Design Hour Factor (%)
PM	PM Peak Period
D	Peak Hour Directional Split (%)
→	Indicates Direction of D
(d,t)	Duals, TTSTs (%)

TIP: FS-1106A	**WBS:** 34263.1.1
COUNTY: Cumberland	**DIVISION:** 6
DATE: January 2012	
PREPARED BY: Martin/Alexiou/Bryson	
LOCATION: Spring Lake Loop, NC 210 to Odell Road	
PROJECT: Spring Lake Loop Upgrade	

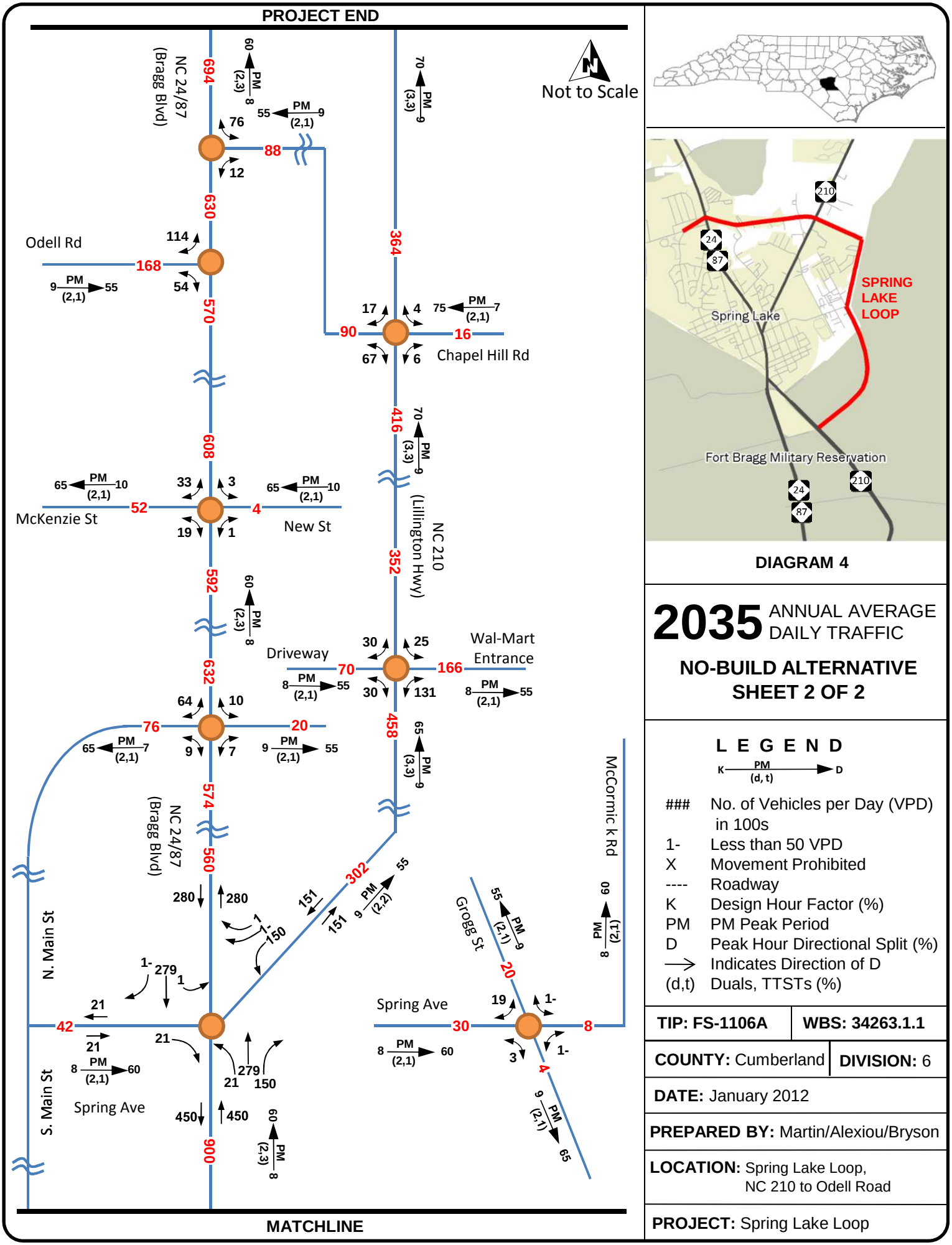


DIAGRAM 4

2035 ANNUAL AVERAGE DAILY TRAFFIC

NO-BUILD ALTERNATIVE
SHEET 2 OF 2

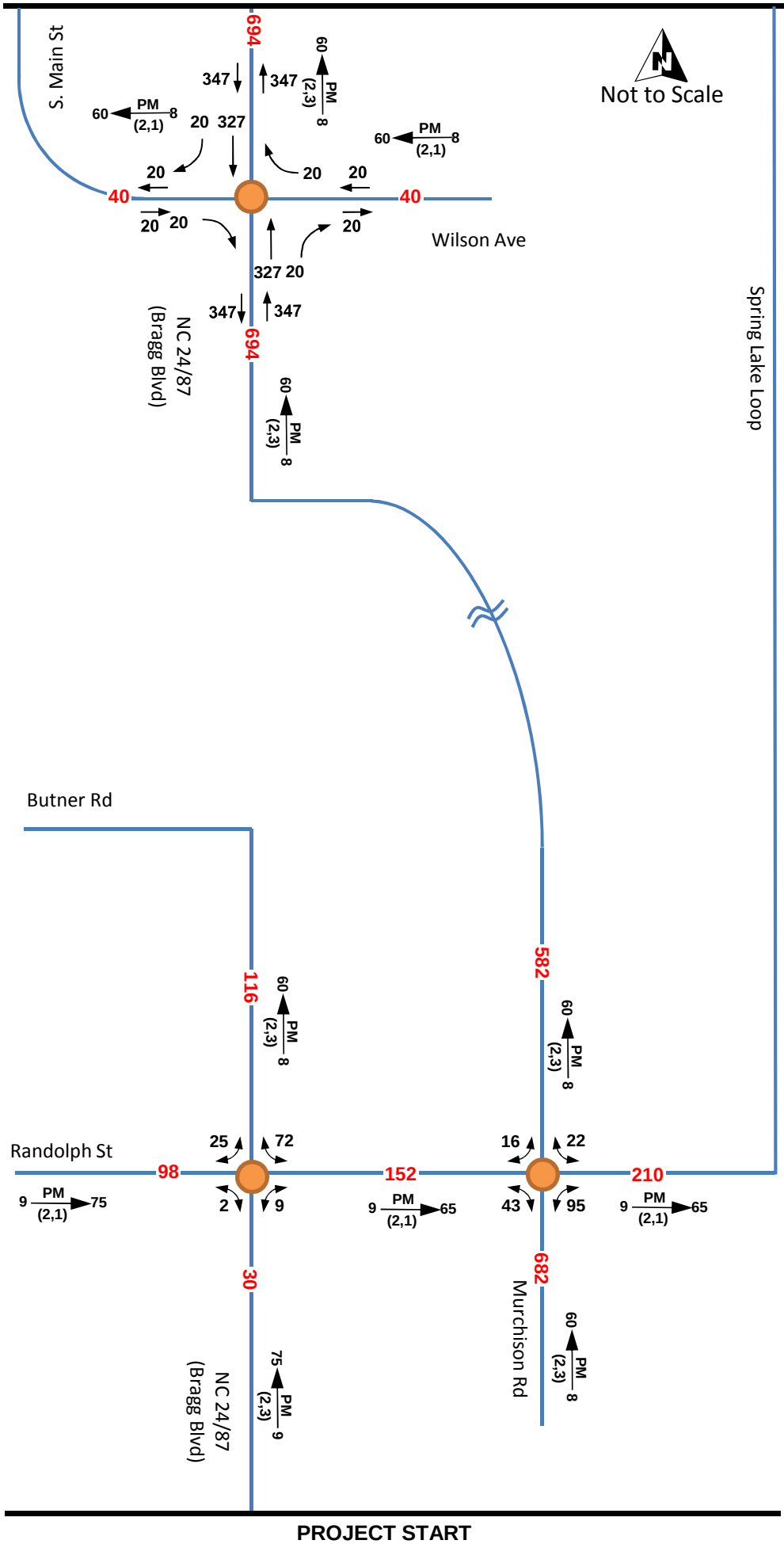
L E G E N D

K PM (d, t) D

###	No. of Vehicles per Day (VPD) in 100s
1-	Less than 50 VPD
X	Movement Prohibited
----	Roadway
K	Design Hour Factor (%)
PM	PM Peak Period
D	Peak Hour Directional Split (%)
→	Indicates Direction of D
(d,t)	Duals, TTSTs (%)

TIP: FS-1106A	**WBS:** 34263.1.1
COUNTY: Cumberland	**DIVISION:** 6
DATE: January 2012	
PREPARED BY: Martin/Alexiou/Bryson	
LOCATION: Spring Lake Loop, NC 210 to Odell Road	
PROJECT: Spring Lake Loop	

MATCHLINE



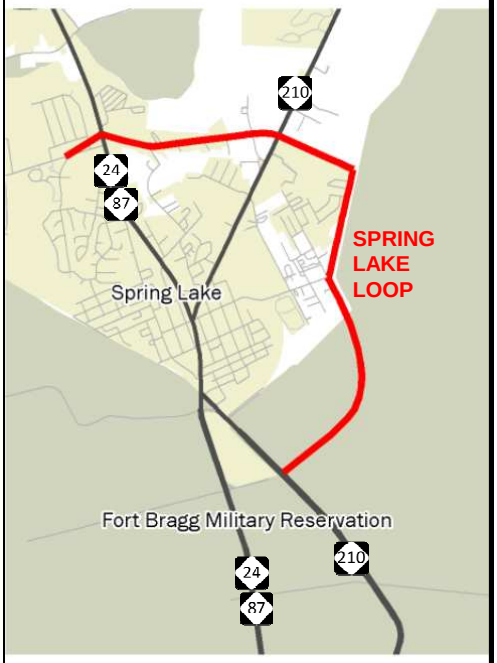


DIAGRAM 5

2035 ANNUAL AVERAGE DAILY TRAFFIC

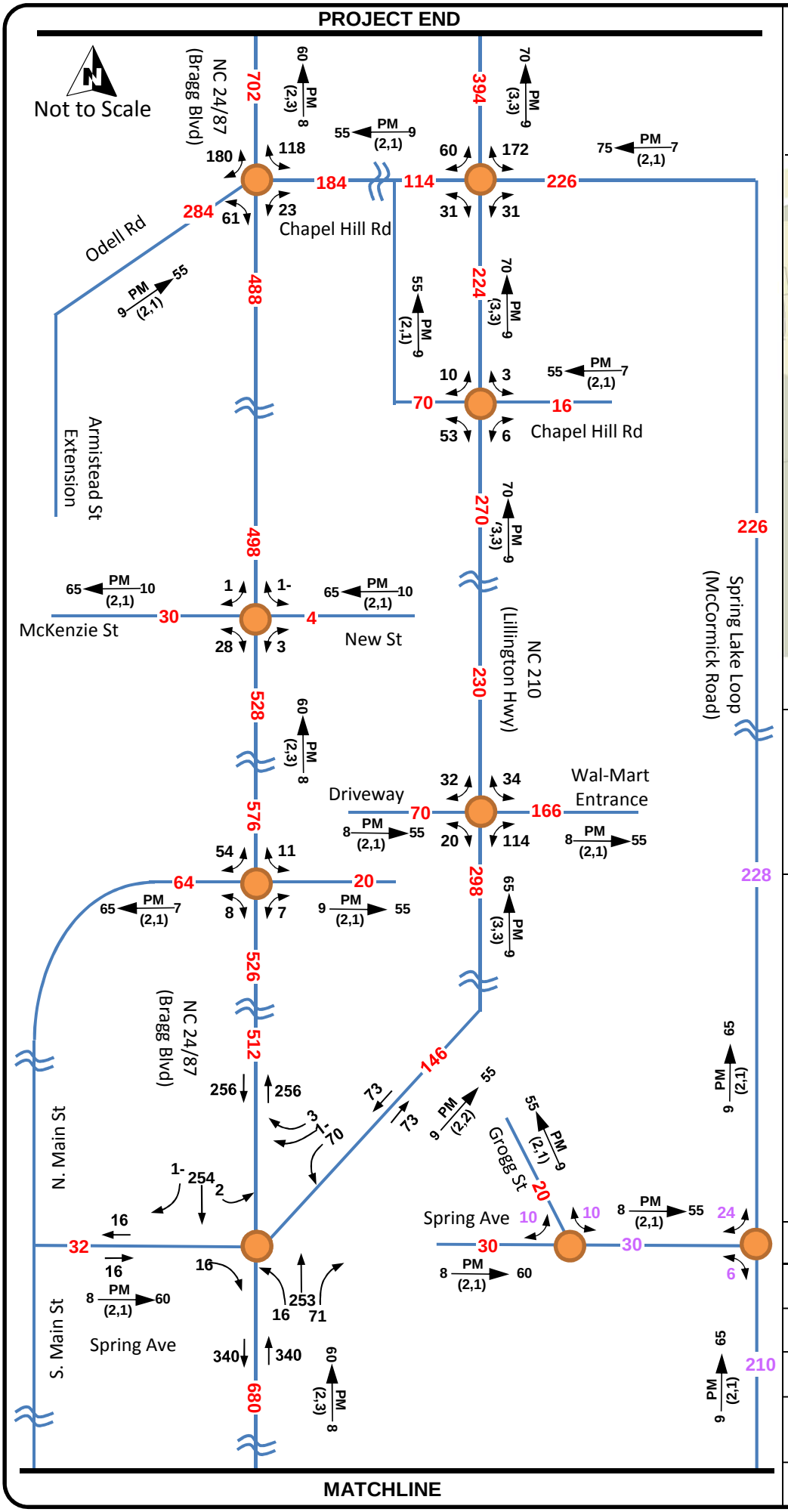
BUILD ALTERNATIVE 1
SHEET 1 OF 2

L E G E N D

K PM (d, t) D

###	No. of Vehicles per Day (VPD) in 100s
1-	Less than 50 VPD
X	Movement Prohibited
----	Roadway
K	Design Hour Factor (%)
PM	PM Peak Period
D	Peak Hour Directional Split (%)
→	Indicates Direction of D
(d,t)	Duals, TTSTs (%)

TIP: FS-1106A	**WBS:** 34263.1.1
COUNTY: Cumberland	**DIVISION:** 6
DATE: January 2012	
PREPARED BY: Martin/Alexiou/Bryson	
LOCATION: Spring Lake Loop, NC 210 to Odell Road	
PROJECT: Spring Lake Loop Upgrade	



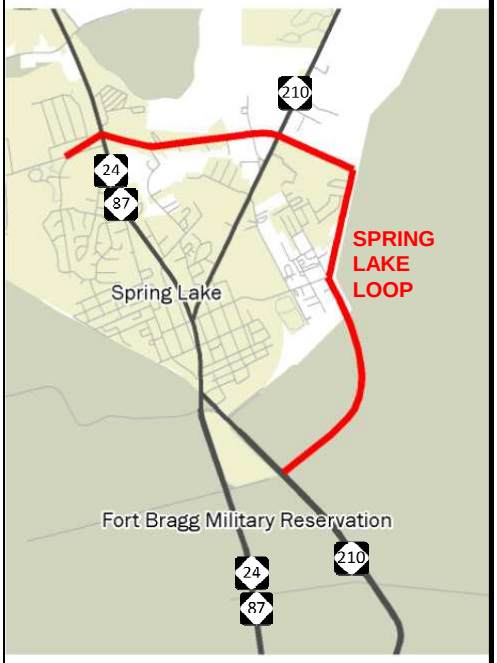


DIAGRAM 5

2035 ANNUAL AVERAGE DAILY TRAFFIC

BUILD ALTERNATIVE 1
SHEET 2 OF 2

L E G E N D

K PM (d, t) D

###	No. of Vehicles per Day (VPD) in 100s
1-	Less than 50 VPD
X	Movement Prohibited
----	Roadway
K	Design Hour Factor (%)
PM	PM Peak Period
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TIP: FS-1106A	**WBS:** 34263.1.1
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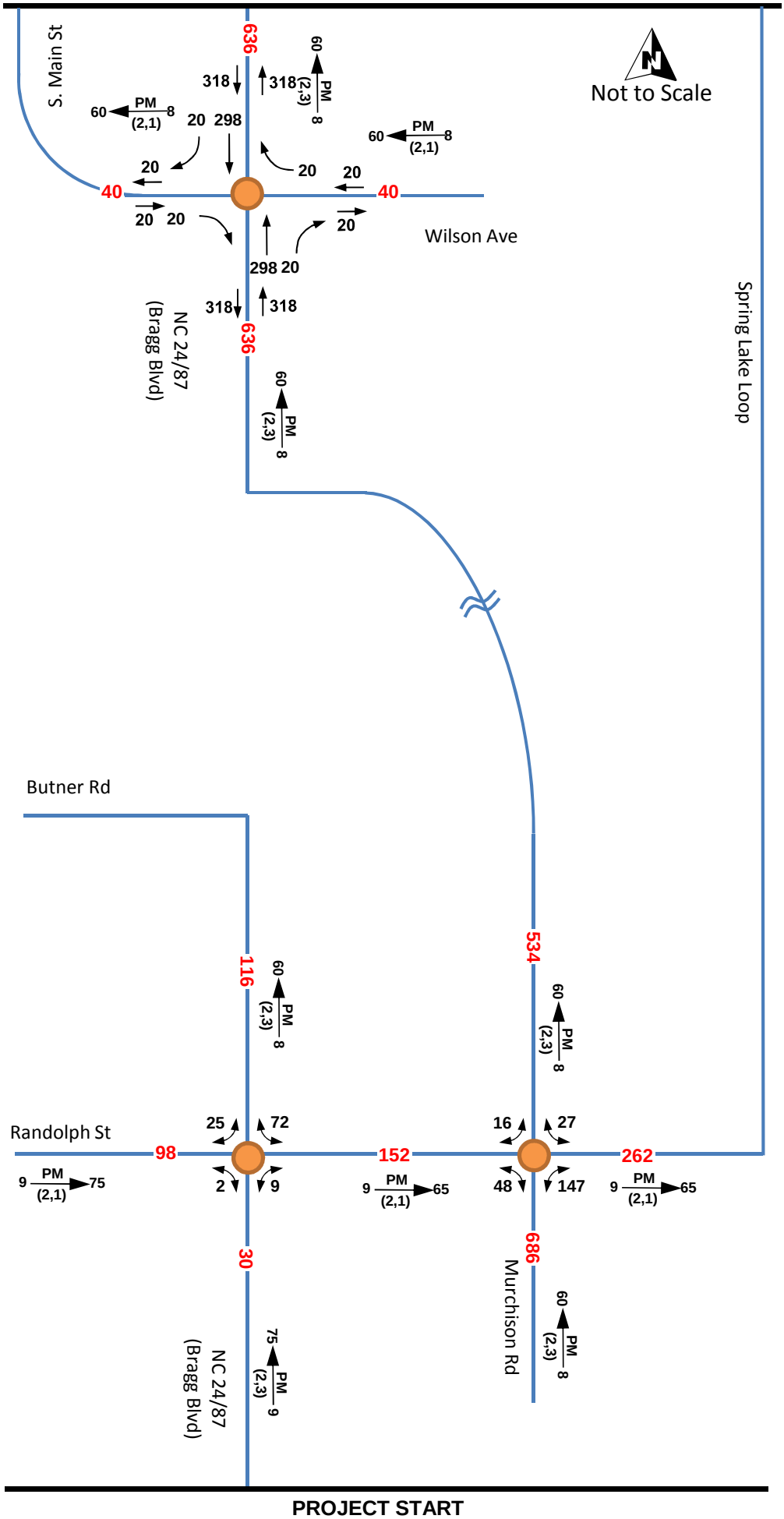


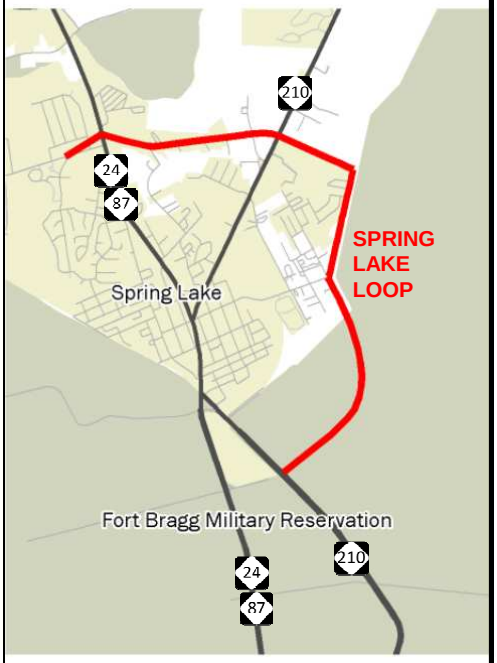


DIAGRAM 6

2035 ANNUAL AVERAGE DAILY TRAFFIC

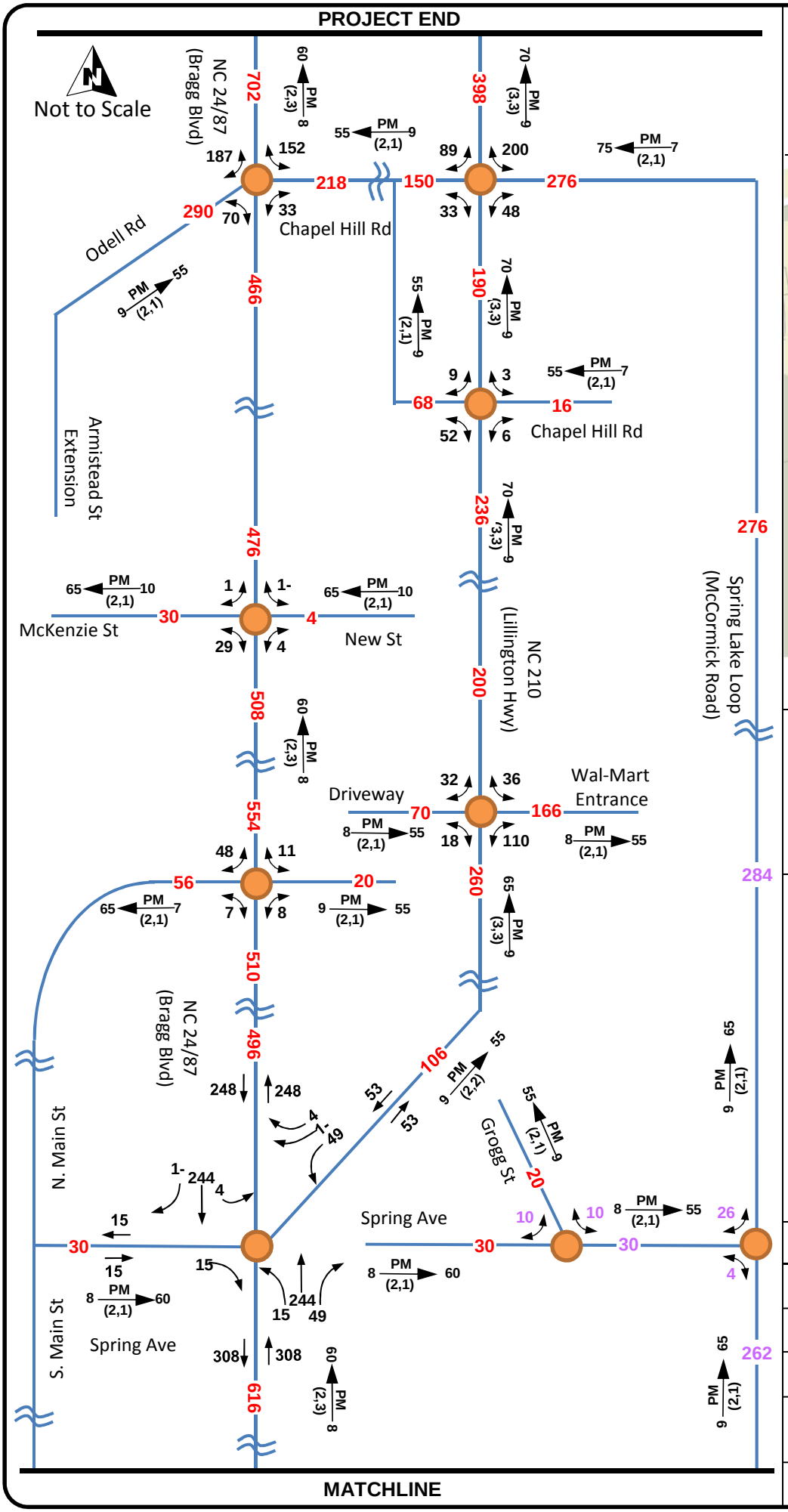
BUILD ALTERNATIVE 2
SHEET 1 OF 2

L E G E N D

K PM (d, t) D

###	No. of Vehicles per Day (VPD) in 100s
1-	Less than 50 VPD
X	Movement Prohibited
----	Roadway
K	Design Hour Factor (%)
PM	PM Peak Period
D	Peak Hour Directional Split (%)
→	Indicates Direction of D
(d,t)	Duals, TTSTs (%)

TIP: FS-1106A	**WBS:** 34263.1.1
COUNTY: Cumberland	**DIVISION:** 6
DATE: January 2012	
PREPARED BY: Martin/Alexiou/Bryson	
LOCATION: Spring Lake Loop, NC 210 to Odell Road	
PROJECT: Spring Lake Loop Upgrade	



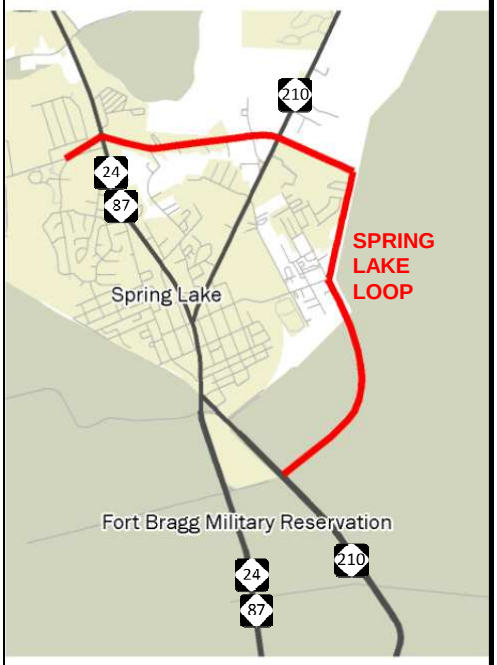


DIAGRAM 6

2035 ANNUAL AVERAGE DAILY TRAFFIC

BUILD ALTERNATIVE 2
SHEET 2 OF 2

L E G E N D

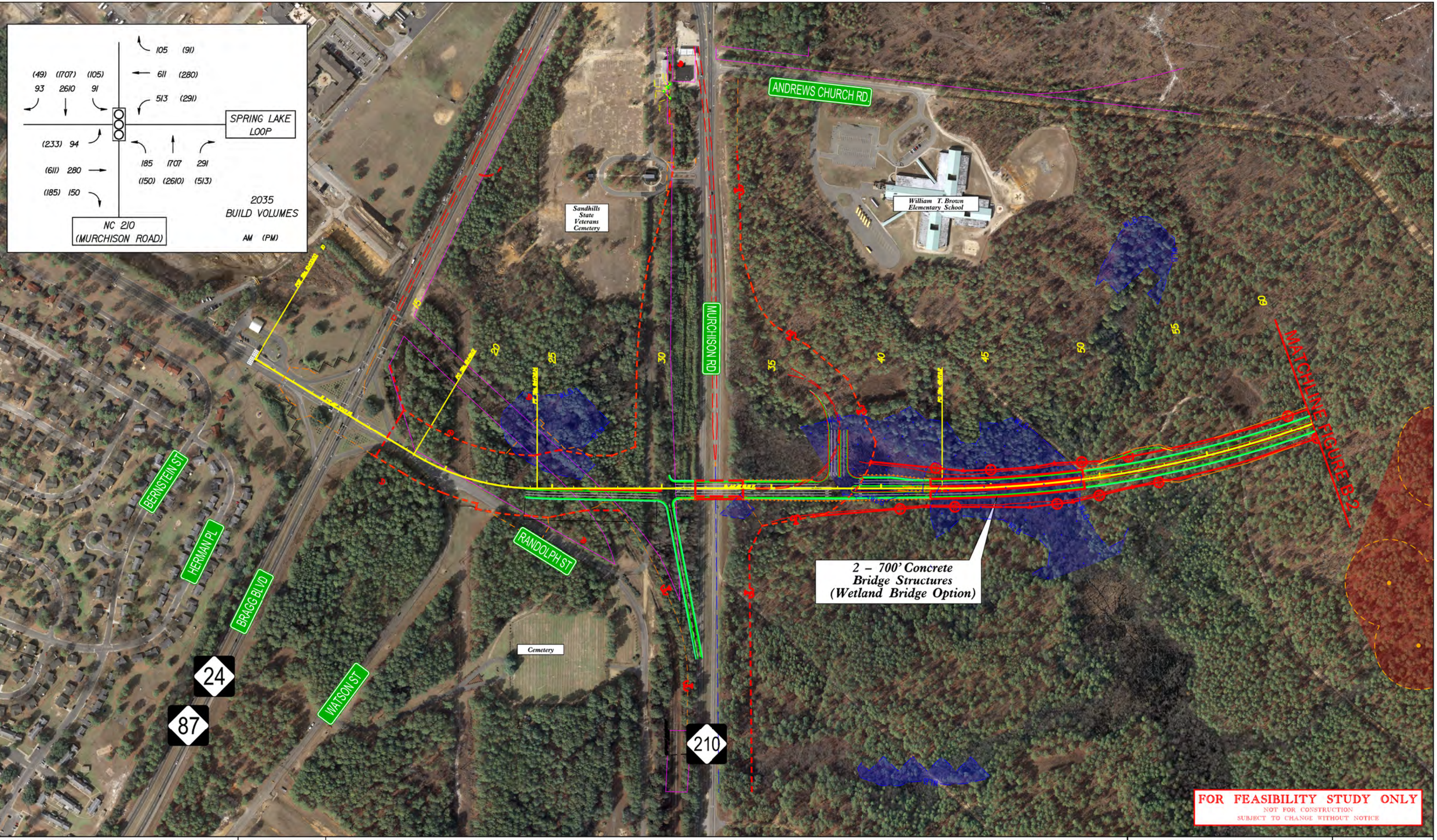
K — PM (d, t) → D

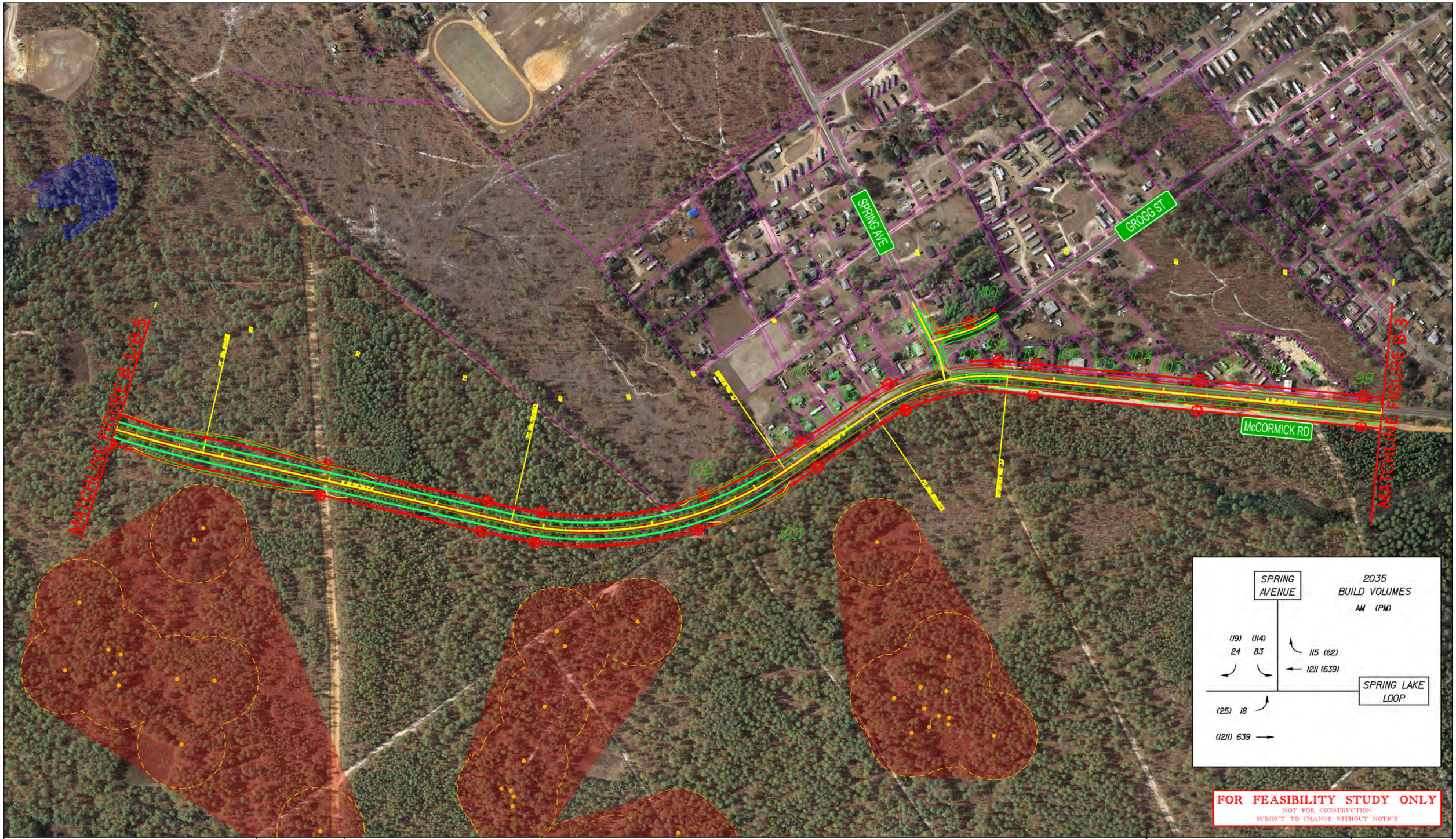
###	No. of Vehicles per Day (VPD) in 100s
1-	Less than 50 VPD
X	Movement Prohibited
----	Roadway
K	Design Hour Factor (%)
PM	PM Peak Period
D	Peak Hour Directional Split (%)
→	Indicates Direction of D
(d,t)	Duals, TTSTs (%)

TIP: FS-1106A	**WBS:** 34263.1.1
COUNTY: Cumberland	**DIVISION:** 6
DATE: January 2012	
PREPARED BY: Martin/Alexiou/Bryson	
LOCATION: Spring Lake Loop, NC 210 to Odell Road	
PROJECT: Spring Lake Loop	

APPENDIX B:

Conceptual Designs


105 (91)
(49) (1707) (105)
93 2610 91
611 (280)
513 (291)
SPRING LAKE LOOP
(233) 94
185 1707 291
(611) 280
(150) (2610) (513)
(185) 150
2035 BUILD VOLUMES
AM (PM)
NC 210 (MURCHISON ROAD)
ANDREWS CHURCH RD
Sandhills State Veterans Cemetery
William T. Brown Elementary School
MURCHISON RD
MATCHLINE FIGURE B-2
BERNSTEIN ST
HERMAN PL
BRAGG BLVD
RANDOLPH ST
WATSON ST
Cemetery
24
87
210
2 – 700' Concrete Bridge Structures (Wetland Bridge Option)
FOR FEASIBILITY STUDY ONLY
NOT FOR CONSTRUCTION
SUBJECT TO CHANGE WITHOUT NOTICE
400' 200' 0' 400'
SCALE: 1"=400'
RCW Cavity Tree 200' Buffer
Wetland
Figure B-1
Conceptual Roadway Plan
Spring Lake Loop Feasibility Study
(FS-1106A)
Randolph Street to Odell Road
VHB



400' 200' 0' 400'

SCALE: 1"=400'

RCW Cavity Tree
200' Buffer

Wetland

Figure B-2
Conceptual Roadway Plan

Spring Lake Loop
Feasibility Study
(FS-1106A)
Randolph Street to Odell Road

VHB

MATCHLINE FIGURE B-2

MATCHLINE FIGURE B-4

HOLLOWAY ST

McCORMICK RD

LAUREN CIR

WATERWAY DR

LILLINGTON HWY

MIMOSA DR

CHAPEL HILL RD

HINKLE ST

CREECH DR

4 – 60" RCP

Spring Lake Auto Center

210

FOR FEASIBILITY STUDY ONLY
NOT FOR CONSTRUCTION
SUBJECT TO CHANGE WITHOUT NOTICE

400' 200' 0' 400'

SCALE: 1"=400'

RCW Cavity Tree 200' Buffer

Wetland

Figure B-3
Conceptual Roadway Plan

Spring Lake Loop
Feasibility Study
(FS-1106A)
Randolph Street to Odell Road

VHB

400' 200' 0' 400'

SCALE: 1"=400'

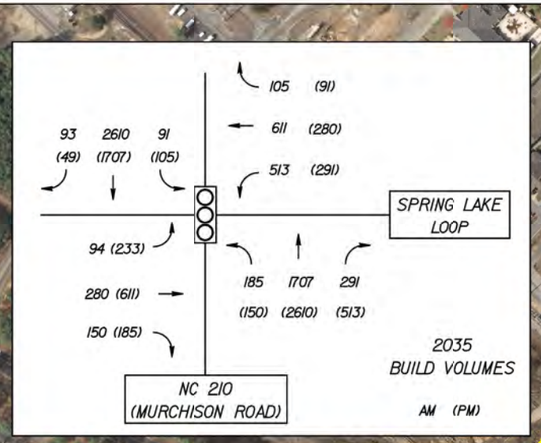
RCW Cavity Tree Partition

Wetland

Figure B-4
Conceptual Roadway Plan

Spring Lake Loop
Feasibility Study
(FS-1106A)
Randolph Street to Odell Road

VHB



400' 200' 0' 400'

SCALE: 1"=400'

RCW Cavity Tree 200' Buffer

Wetland

Figure B-5

Conceptual Roadway Plan

Spring Lake Loop Feasibility Study

(FS-1106A)

Randolph Street to Odell Road

VHB