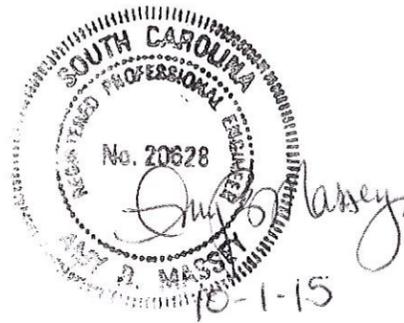


Traffic Impact Study for
Ansley Development
Lancaster County, South Carolina

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1.0 Executive Summary

The proposed Ansley development is located in Lancaster County, South Carolina along Henry Harris Road, south of Marvin Road and north of Collins Road. The proposed development will be accessed via two full-movement unsignalized access points on Henry Harris Road. The southern access point will align with Ravenwood Drive.

Two scenarios were considered regarding the ultimate build-out of the site:

1. 313 Single Family Homes
2. 313 Senior Adult Homes

The development is expected to be completed (built-out) in 2020.

This report presents trip generation, distribution, capacity analyses, and recommendations for transportation improvements required to meet anticipated traffic demands. The capacity analyses were performed under the following scenarios during the AM and PM peak hours:

- 2015 existing conditions
- 2020 background conditions (without the proposed development)
- 2020 build-out conditions

As directed by Lancaster County and South Carolina Department of Transportation (SCDOT) staff, the study area includes the following intersections:

1. US 521 at Marvin Road
2. Henry Harris Road at Marvin Road
3. Henry Harris Road at Ravenwood Drive/Access #1
4. Henry Harris Road at Collins Road
5. Henry Harris Road at Access #2

The study was performed in coordination with Lancaster County and SCDOT staff. Based on the study's results, the following improvements are recommended to accommodate **2020 background traffic conditions** (not due to the site's impact):

US 521 and Marvin Road

- Utilize existing median to construct an additional southbound left-turn lane to create dual left turn lanes, each with 325 feet of storage. This would require:
 1. Limiting the existing full movement access just to the north at S-29-801/QuikTrip drive to right-in/right-out operation so that this area and the median to the north could be used for southbound left-turn storage.
 2. An additional receiving lane on Marvin Road, for which an appropriate drop location would need to be determined.
- Construct a northbound right-turn lane with 50 feet of storage. This is limited by the existing Exxon drive just to the south.

- Construct a westbound approach that incorporates a 250-foot left-turn lane and 100-foot through lane, in addition to the existing single approach lane.
- Modify the eastbound approach to be an exclusive left-turn lane and a shared through-right. This improvement paired with the improvements on the westbound approach would allow for removing the split phasing of the signal, assuming geometric and sight distance requirements are met. Note that the eastbound queuing would significantly exceed the available Aldi throat length of approximately 85 feet.

It is also recommended that the access to the existing Exxon station be reviewed for potential driveway consolidation and/or narrowing opportunities to improve signal operations.

Henry Harris Road at Marvin Road

- Installation of a traffic signal, if/when warranted. A roundabout may be an alternative to signalization.

Based on the study's results, the following improvements are recommended to accommodate **2020 build-out traffic conditions** due to the impact of the proposed 313 single family homes:

US 521 at Marvin Road

- Channelization of the westbound right-turn lane out of the traffic signal, with yield control.
- Extend the southbound dual left-turn lanes (from 325 feet of storage in background) to 500 feet of storage each.

The recommended laneage is illustrated in Figure 8.1. Note that available sight distance should be verified at both access points.

2.0 Introduction

The proposed Ansley development is located in Lancaster County, South Carolina along Henry Harris Road, south of Marvin Road and north of Collins Road. The proposed development will be accessed via two full-movement unsignalized access points on Henry Harris Road. The access point will align with Ravenwood Drive.

Two scenarios were considered regarding the ultimate build-out of the site:

1. 313 Single Family Homes
2. 313 Senior Adult Homes

The development is expected to be completed (built-out) in 2020.

Kimley-Horn and Associates, Inc. was retained to study the potential traffic impacts of this development within the identified study area. This report presents trip generation, distribution, capacity analyses, and recommendations for transportation improvements required to meet anticipated traffic demands. Traffic analyses were performed under the following scenarios during the AM and PM peak hours:

- 2015 existing conditions
- 2020 background conditions (without the proposed development)
- 2020 build-out conditions

Lancaster County and South Carolina Department of Transportation (SCDOT) staff were contacted to obtain background information and to ascertain the elements to be covered in this traffic impact study (TIS). The study was prepared in accordance with the traffic study guidelines contained within SCDOT's *Access and Roadside Management Standards (ARMS) Manual* and performed in coordination with Lancaster County and SCDOT staff.

3.0 Inventory

3.1 Study Area

As directed by Lancaster County and SCDOT staff, the study area includes the following intersections:

1. US 521 at Marvin Road
2. Henry Harris Road at Marvin Road
3. Henry Harris Road at Ravenwood Drive/Access #2
4. Henry Harris Road at Collins Road
5. Henry Harris Road at Access #1

Figure 3.1 shows the site location and Figure 3.2 shows the proposed site plan for the project.

3.2 Existing Conditions

The major roadways in the project vicinity are US 521, Henry Harris Road, Marvin Road, and Collins Road. Existing roadway laneage is depicted on Figure 3.3. Table 3.1 shows facility type, SCDOT average daily traffic (ADT) volumes in vehicles per day (vpd), and posted speed limits for these study area roadways.

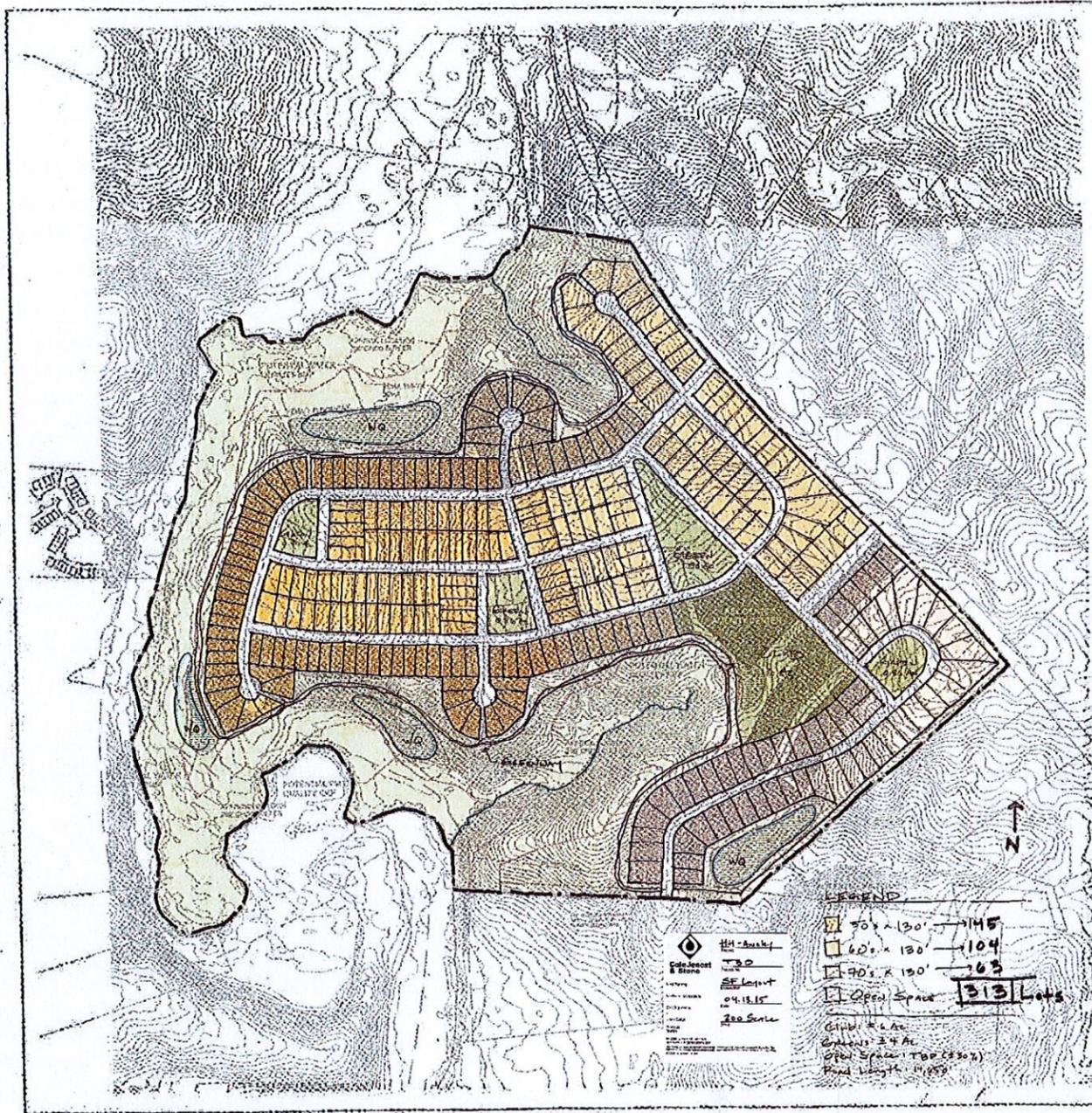
Table 3.1- Study Area Roadways

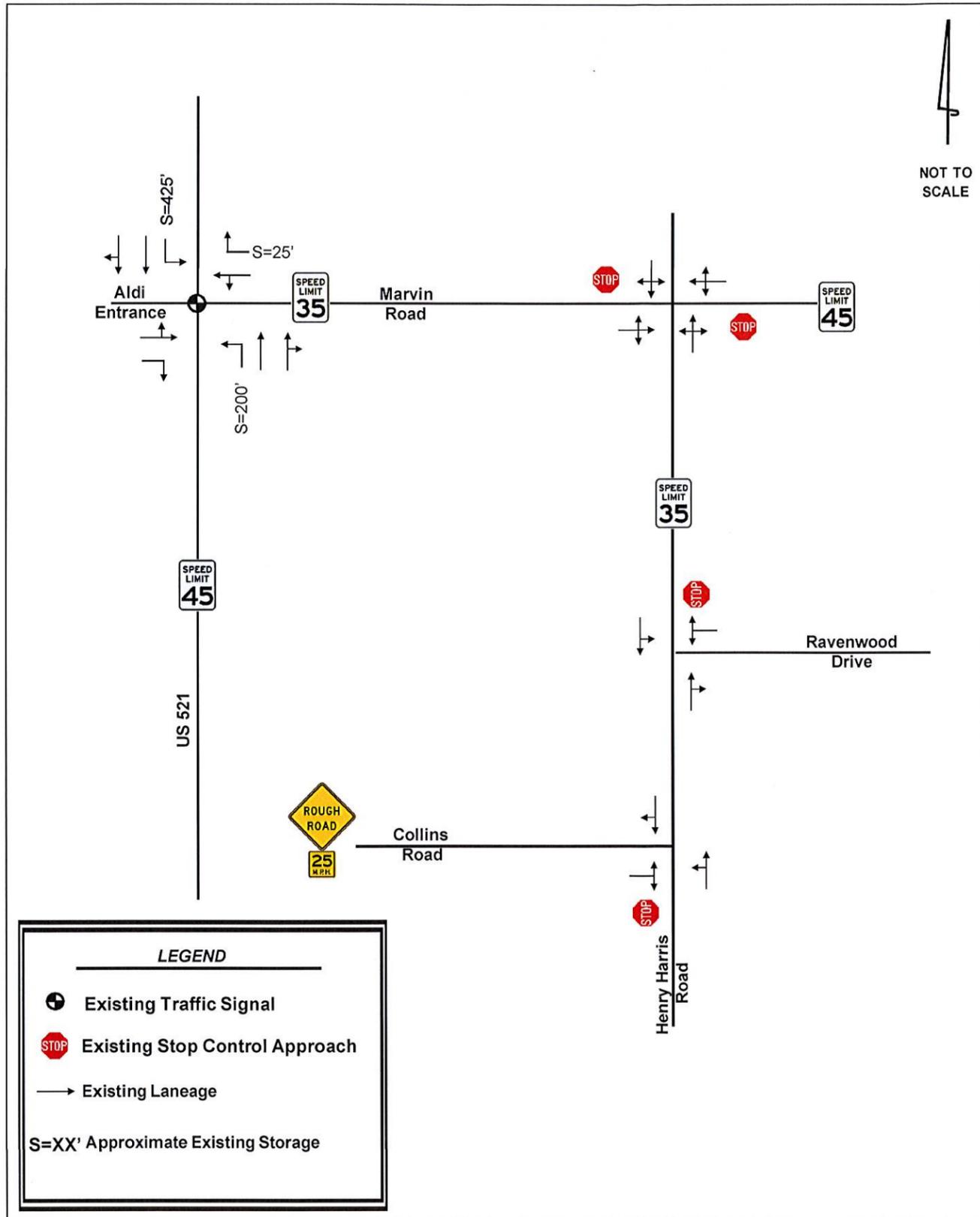
Roadway	Facility type	ADT (year)	Posted speed limit
US 521	5-lane, divided	35,300 (2013) north of Marvin Road	45 mph
Henry Harris Road	2-lane, undivided	Data not available	35 mph
Marvin Road	2-lane, undivided	9,100 (2013) east of US 521	35 mph at US 521 45 mph at Henry Harris
Collins Road	2-lane, undivided	Data not available	25 mph (advisory)

Poor pavement conditions along Collins Road were observed in the field, evidenced by a ‘rough road’ warning sign located near Henry Harris Road.

Based on field observation, Henry Harris Road was recently paved with 9.5-foot lanes.







4.0 Traffic Generation

The traffic generation potential of the proposed development was determined using the trip generation rates published in *ITE Trip Generation Handbook* (Institute of Transportation Engineers, Ninth Edition, 2012). The proposed development will ultimately consist of either 313 single family homes or 313 senior adult houses upon build-out in 2020.

Table 4.0A summarizes the expected traffic generation for the proposed development with single family homes.

Table 4.0A - Single Family Trip Generation								
Land Use	Intensity	Daily	AM Peak Hour			PM Peak Hour		
			Total	In	Out	Total	In	Out
Single-Family Homes	313 DU	3,000	229	57	172	293	185	108
Net New External Trips		3,000	229	57	172	293	185	108
Note: Trip generation was calculated using the following data: Daily Traffic Generation Single-Family Homes [ITE 210] = $\ln(T) = 0.92 \ln(X) + 2.72$; (50% in, 50% out) AM Peak-Hour Traffic Generation Single-Family Homes [ITE 210] = $T = 0.70 X + 9.74$; (25% in, 75% out) PM Peak-Hour Traffic Generation Single-Family Homes [ITE 210] = $\ln(T) = 0.90 \ln(X) + 0.51$; (63% in, 37% out)								

Table 4.0B summarizes the expected traffic generation for the proposed development with senior adult housing.

Table 4.0 B -Senior Adult Housing Detached Trip Generation								
Land Use	Intensity	Daily	AM Peak Hour			PM Peak Hour		
			Total	In	Out	Total	In	Out
Senior Adult Housing-Detached	313 DU	1,305	83	29	54	106	65	41
Net New External Trips		1,305	83	29	54	106	65	41
Note: Trip generation was calculated using the following data: Daily Traffic Generation Senior Adult Housing-Detached [ITE 251] = $\text{Ln}(T) = 0.89 \text{Ln}(X) + 2.06$; (50% in, 50% out) AM Peak-Hour Traffic Generation Senior Adult Housing-Detached [ITE 251] = $T = 0.17 X + 29.95$; (35% in, 65% out) PM Peak-Hour Traffic Generation Senior Adult Housing-Detached [ITE 251] = $\text{Ln}(T) = 0.75 \text{Ln}(X) + 0.35$; (61% in, 39% out)								

5.0 Traffic Volumes

5.1 2015 Existing Traffic

Peak-hour intersection turning-movement counts were performed by National Data and Surveying Services from 7:00 AM to 9:00 AM and from 4:00 PM to 6:00 PM on Wednesday, September 9, 2015. Turning movement counts were balanced along the study corridor. The turning-movement count data is included in the Appendix. Figure 5.1 shows the 2015 existing AM and PM peak-hour traffic volumes.

5.2 Historical Growth Traffic

Historical growth traffic is the increase in existing traffic volumes due to usage increases and non-specific growth throughout the area. As directed by SCDOT and Lancaster County staff, an annual growth rate of 5 percent was applied to the existing traffic counts over five years to calculate historical growth traffic volumes.

5.3 Approved Development Traffic

Approved development traffic is the traffic generated by approved but not yet constructed developments in the vicinity of the study area. Based on discussion with Lancaster County and SCDOT staff, no approved developments were considered in this study due to the relatively high annual growth rate used.

5.4 2020 Background Traffic

The 2020 background traffic volumes include existing and historical growth traffic. The 2020 AM and PM peak-hour background traffic volumes are shown in Figure 5.2.

5.5 Site Traffic

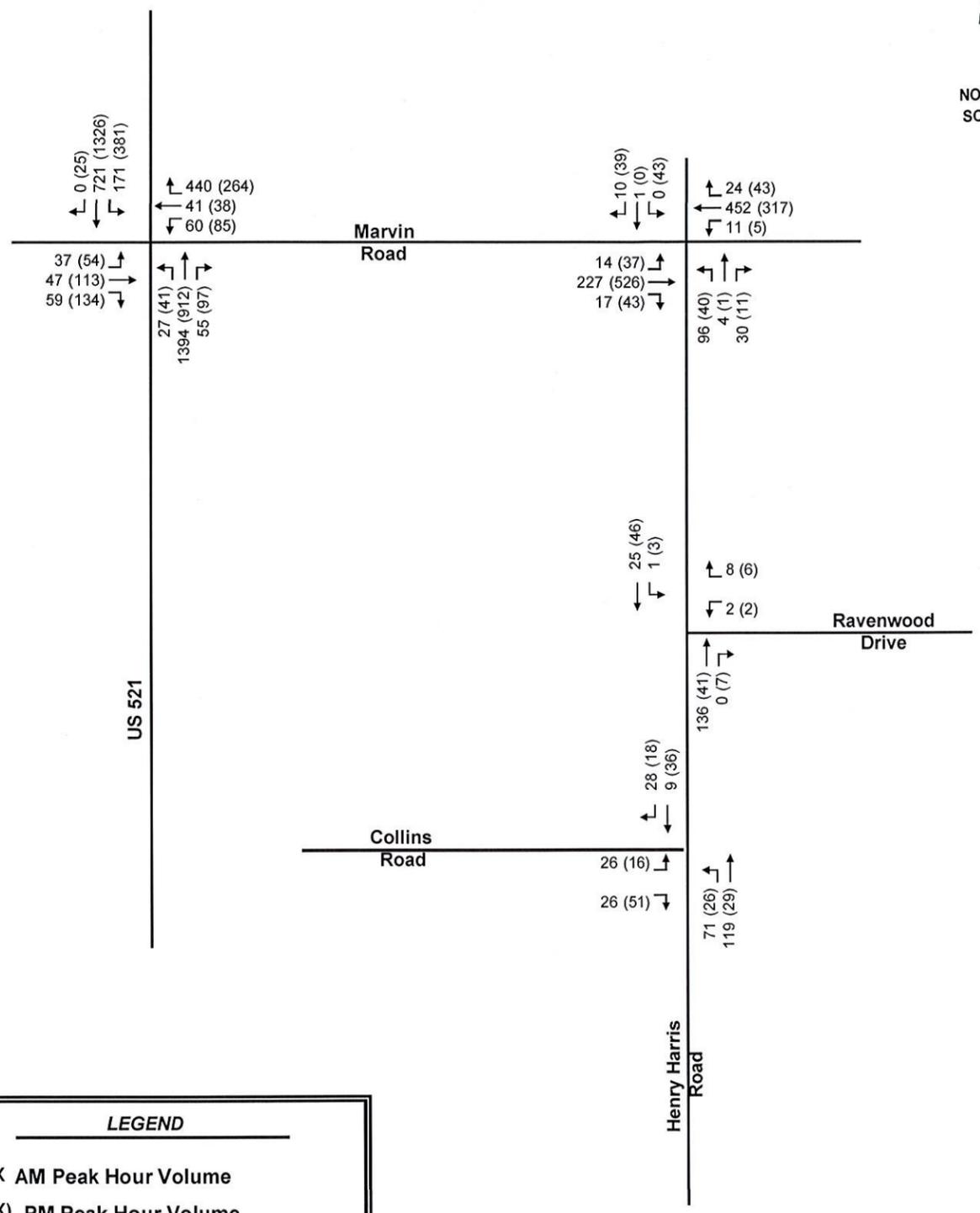
The proposed site traffic was generated as discussed previously in Section 4.0, distributed, and assigned to the adjacent roadway network. The directional distribution and assignment were generally based on existing travel patterns and discussion with Lancaster County and SCDOT, and are shown in Figure 5.3. The same distribution and assignment were assumed for the single family homes and senior adult homes.

5.6 2020 Build-out Traffic

Total 2020 AM and PM peak-hour build-out traffic volumes include the 2020 background traffic and the proposed site traffic. These volumes are shown in Figures 5.4 and 5.5 for single family housing and Figures 5.6 and 5.7 for senior adult housing for the AM and PM peak hours, respectively. Intersection volume development worksheets are included in the Appendix.

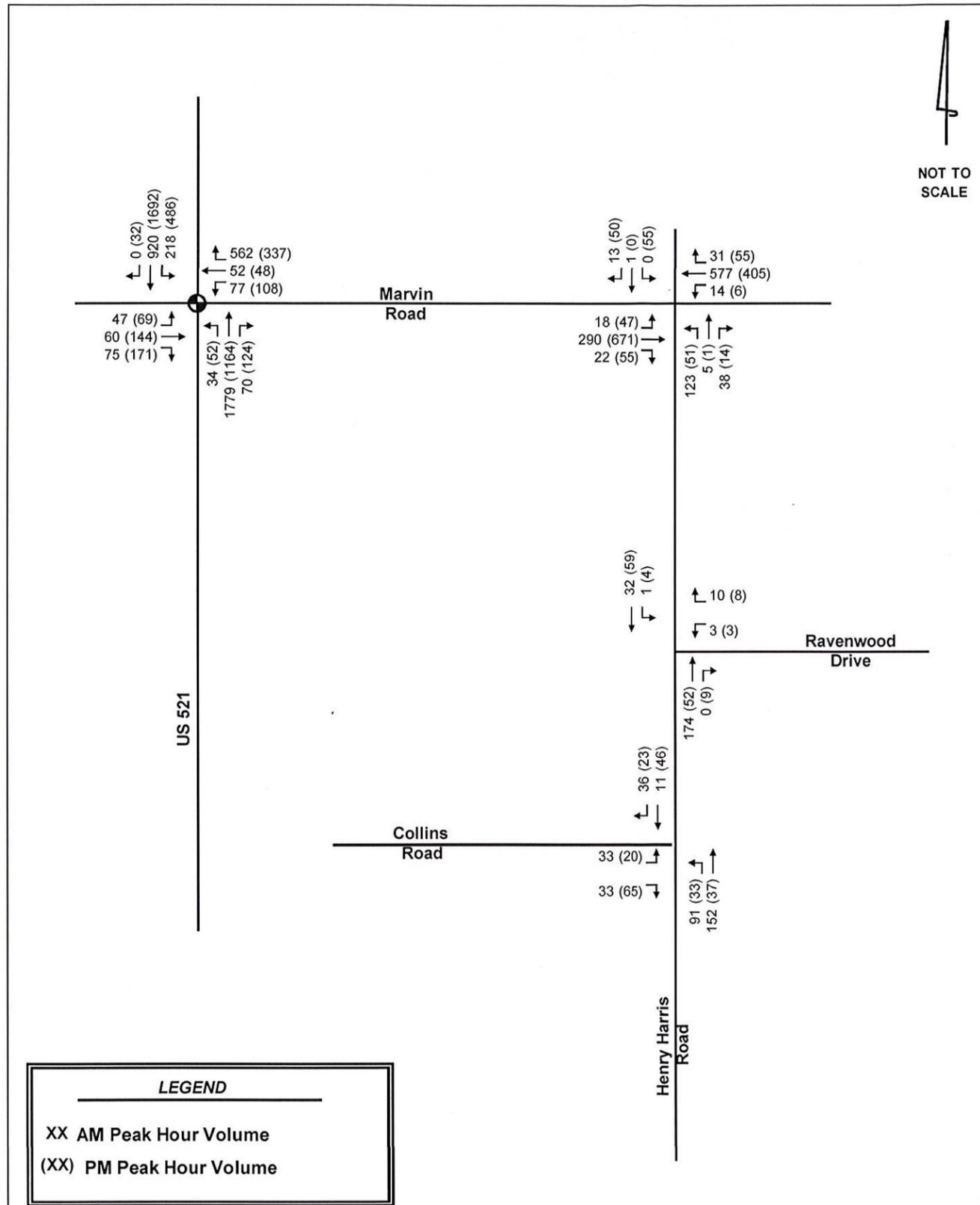


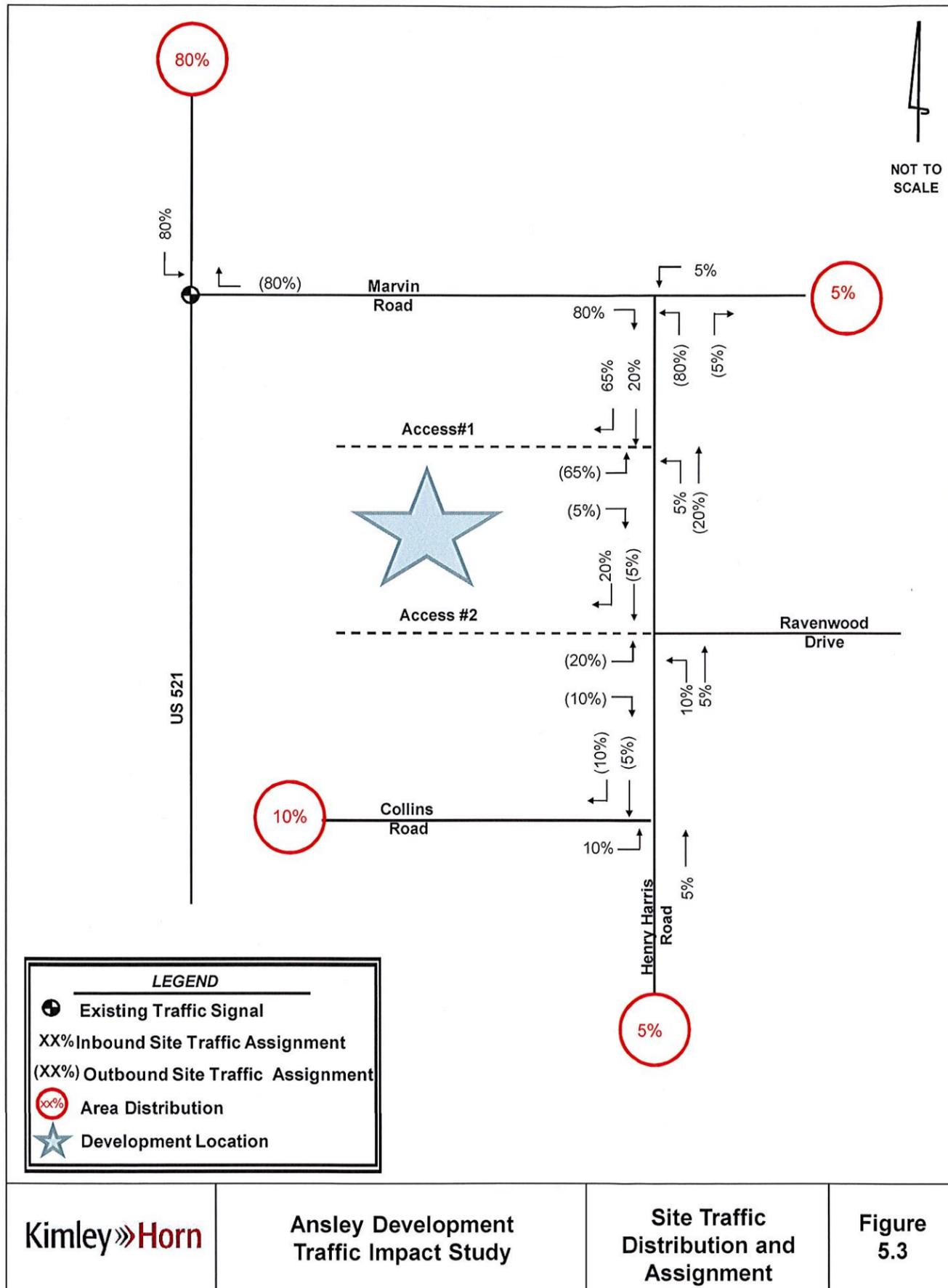
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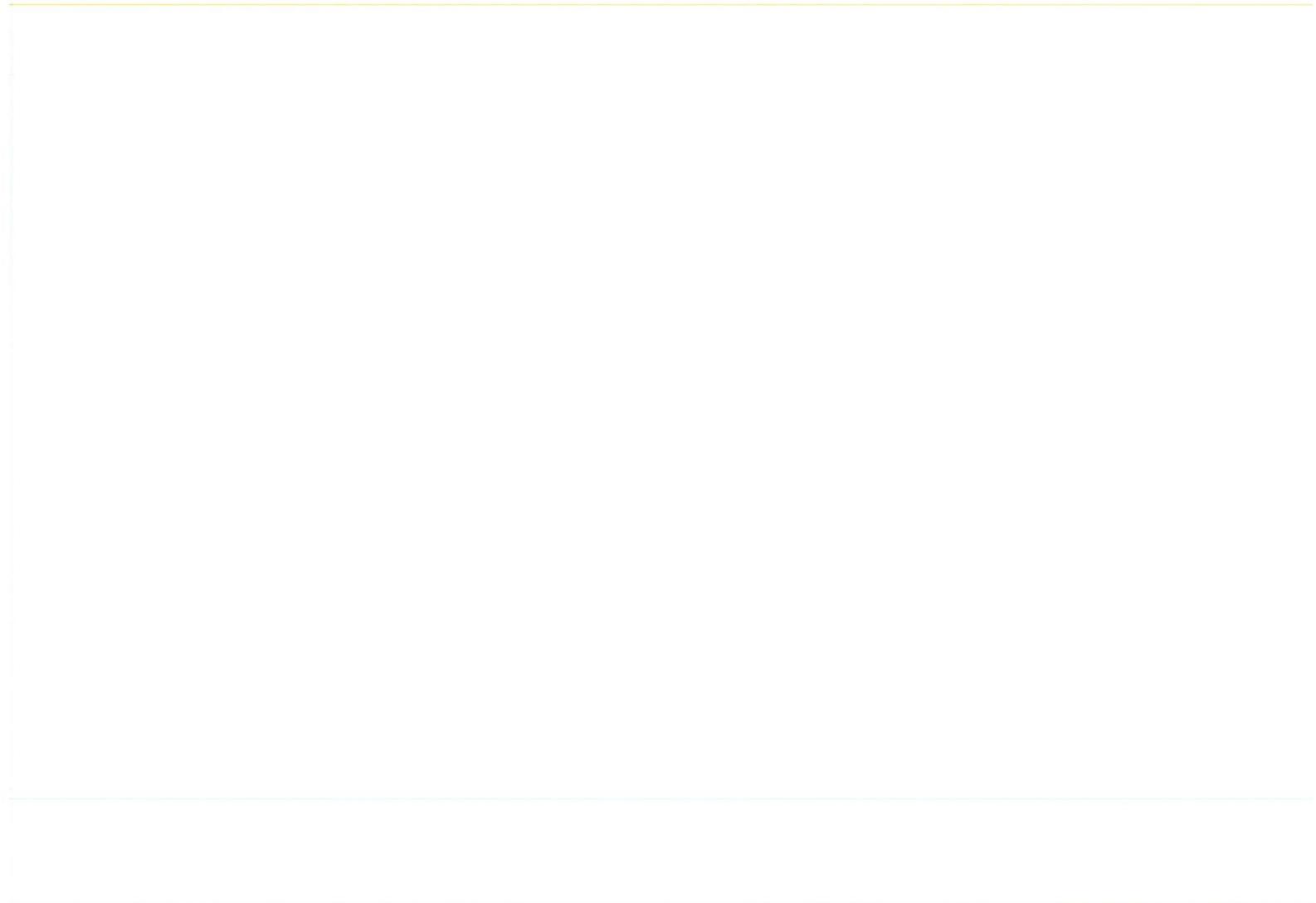
LEGEND

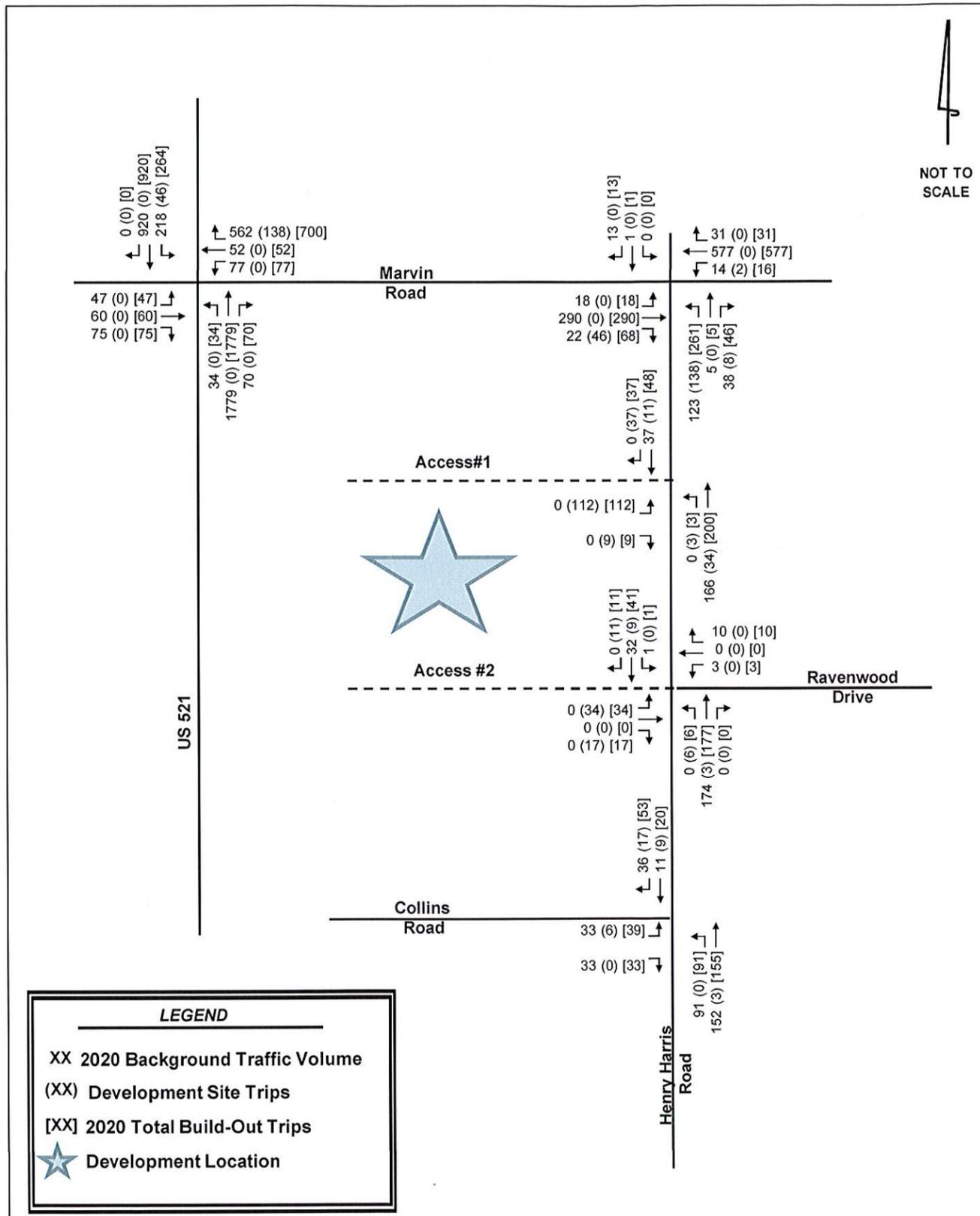
XX AM Peak Hour Volume
 (XX) PM Peak Hour Volume

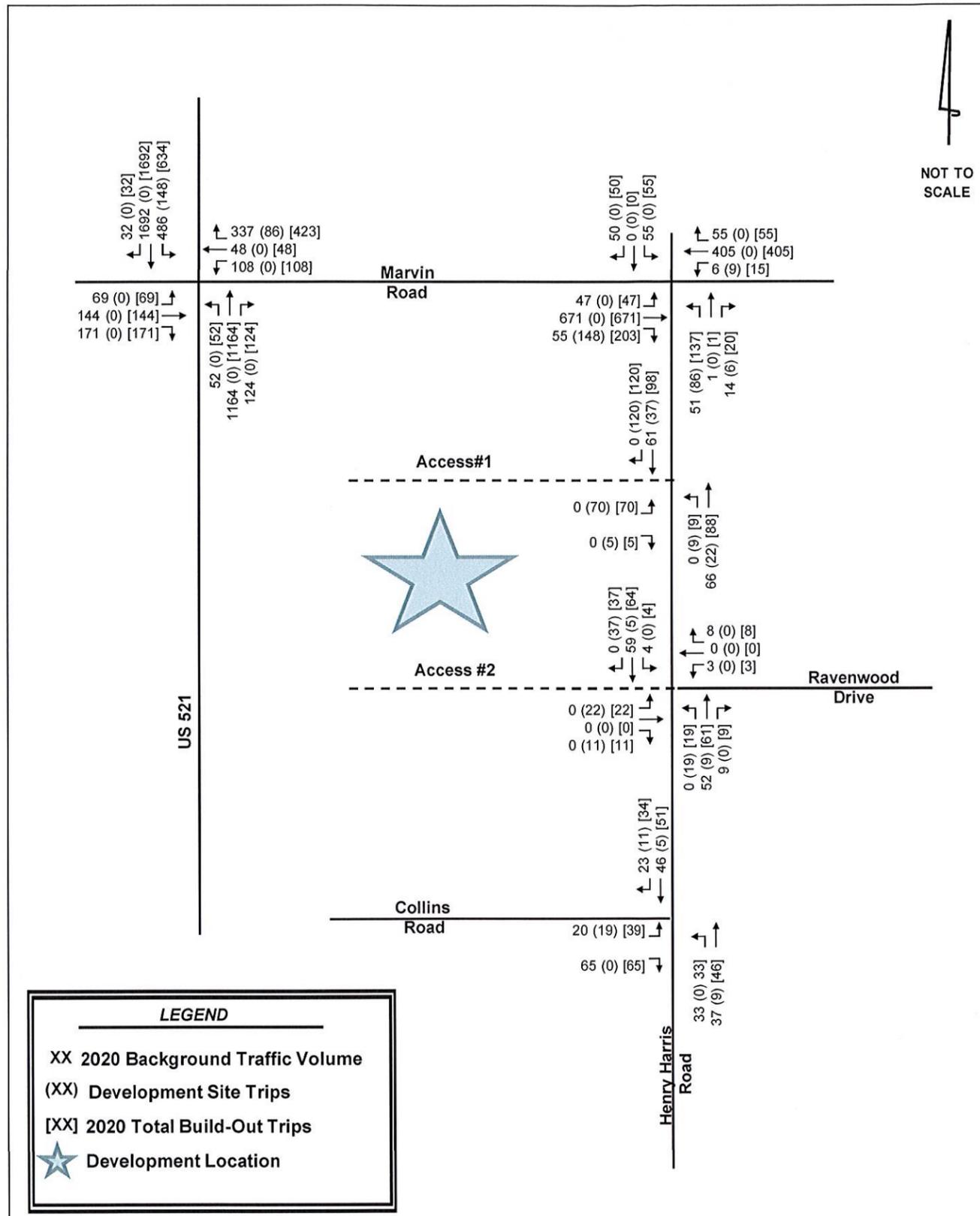


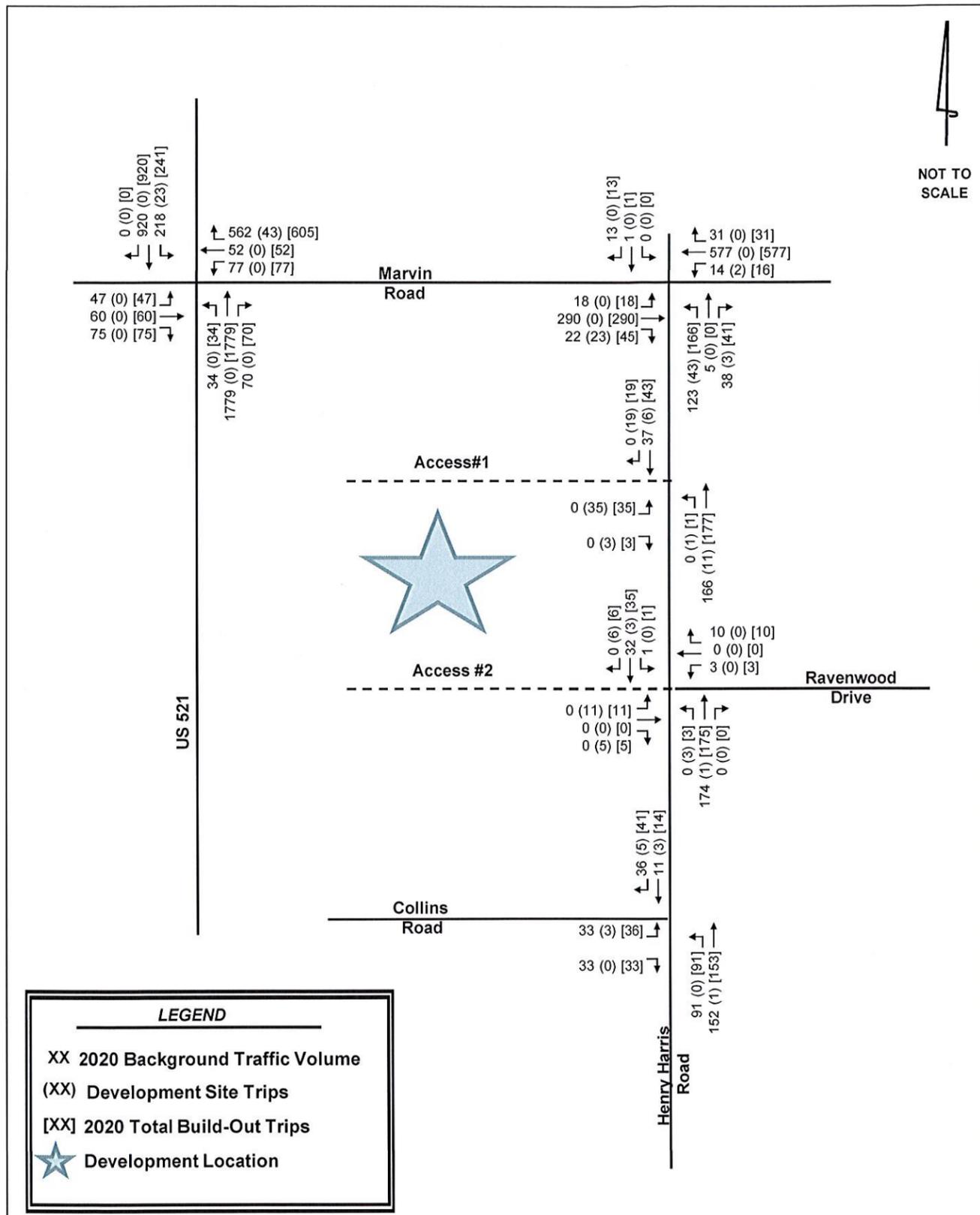


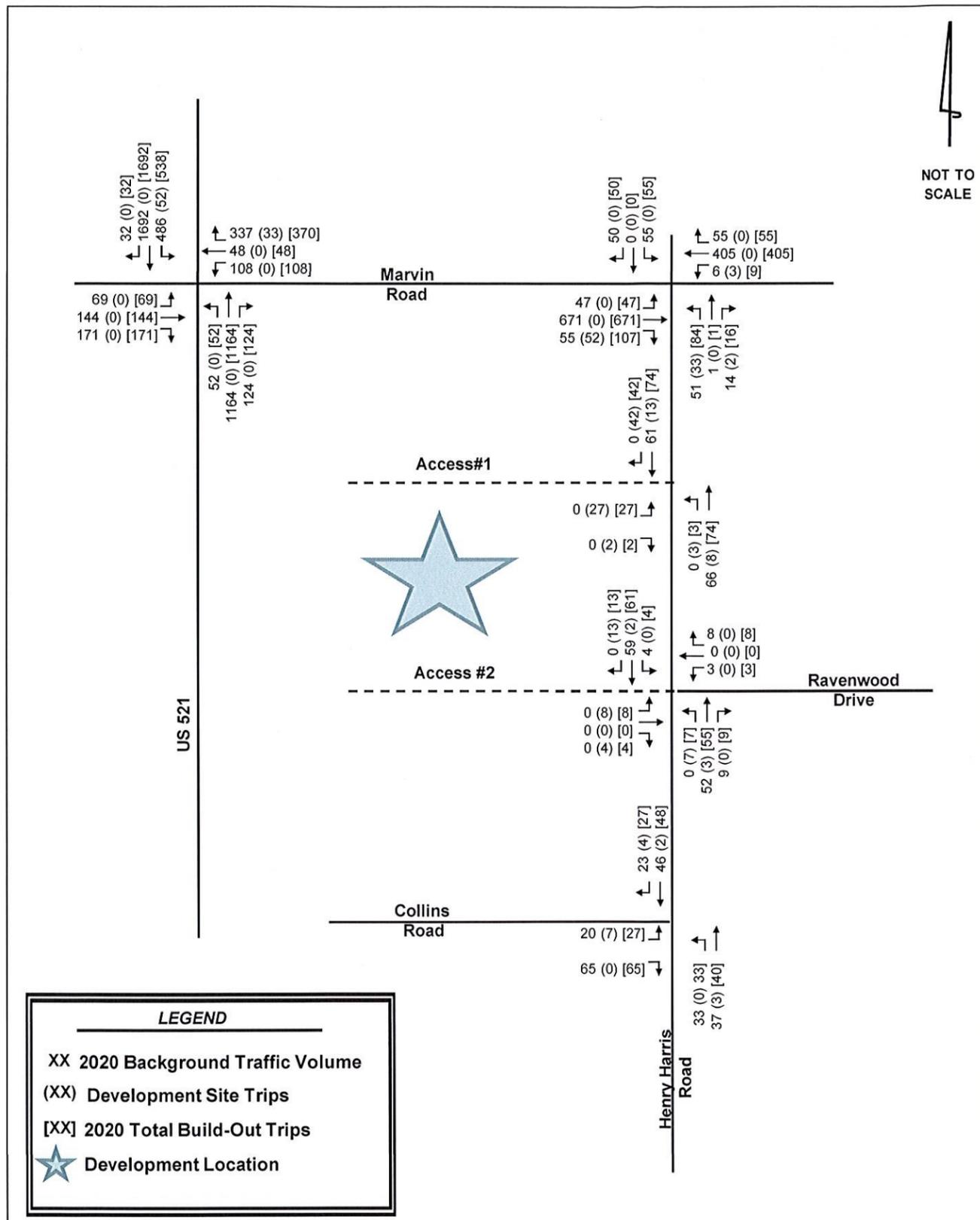
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6.0 Capacity Analysis

Capacity analyses were performed for the AM and PM peak hours using the Synchro Version 8 software to determine the operating characteristics of the adjacent road network and the impacts of the proposed project.

Capacity is defined as the maximum number of vehicles that can pass over a particular road segment or through a particular intersection within a set time duration. Capacity is described by Level-of-Service (LOS) for the operating characteristics of a road segment or intersection. LOS is defined as a qualitative measure that describes operational conditions and motorist perceptions within a traffic stream. The Highway Capacity Manual defines six levels of service, LOS A through LOS F, with A being the best and F being the worst. LOS D is the typically accepted standard for signalized intersections in urban and suburban areas. For signalized intersections, LOS is defined for the overall intersection operation.

LOS for a two-way stop-controlled (TWSC) intersection is determined by the control delay and is defined for the minor movements. Control delay includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay. With respect to field measurements, control delay is defined as the total elapsed time from the time a vehicle stops at the end of the queue to the time the vehicle departs from the stop line. LOS is not defined for a TWSC intersection as a whole. For descriptive purposes, results between LOS A and LOS C for the side street approach are assumed to represent short delays. Results between LOS D and LOS E for the side street approach are assumed to represent moderate delays, with LOS F representing long delays. It is typical for stop sign controlled side streets and driveways intersecting major streets to experience long delays during peak hours, particularly for left-turn movements. The majority of the traffic moving through the intersection on the major street typically experiences little or no delay.

Table 6.0 lists the LOS control delay thresholds published in the Highway Capacity Manual for signalized and unsignalized intersections, as well as the unsignalized operational descriptions assumed herein.

Table 6.0 Level-of-Service Control Delay Thresholds			
Level-of-Service	Signalized Intersections Control Delay Per Vehicle [sec/veh]	Unsignalized Intersections Average Control Delay [sec/veh]	
A	≤ 10	≤ 10	Short Delays
B	> 10 – 20	> 10 – 15	
C	> 20 – 35	> 15 – 25	
D	> 35 – 55	> 25 – 35	Moderate Delays
E	> 55 – 80	> 35 – 50	
F	> 80	> 50	Long Delays

Existing signal plans were obtained from SCDOT and used for the existing signalized intersection of US 521 at Marvin Road. The signal plans are included in the Appendix.

Capacity analysis reports generated by Synchro Version 8 software are included in the Appendix and are briefly summarized in the following subsections.

Note that all analyses assume the existing 140-second cycle length, with optimized splits in 2020 scenarios.

6.1 US 521 at Marvin Road

Table 6.1 summarizes the overall LOS and control delay (seconds per vehicle) at the signalized intersection under 2015 existing conditions, 2020 background conditions, and 2020 build-out conditions.

Condition	AM		PM	
	LOS	Delay	LOS	Delay
2015 Existing	D	40.6	D	46.1
2020 Background	F	99.8	F	87.3
2020 Background Improved	D	50.4	D	42.4
2020 Build Single Family	E	66.4	D	45.0
2020 Build Single Family Improved	C	24.0	D	42.5
2020 Build Senior Adult Housing	D	54.1	D	42.9

During both peak hours, the intersection of US 521 at Marvin Road is expected to drop from LOS D to LOS F between the 2015 existing conditions and 2020 background conditions. In order to maintain operation at LOS D, the following improvements are recommended for 2020 background conditions:

- Utilize existing median to construct an additional southbound left-turn lane to create dual left turn lanes, each with 325 feet of storage. This would require:
 1. Limiting the existing full movement access just to the north at S-29-801/QuikTrip drive to right-in/right-out operation.
 2. An additional receiving lane on Marvin Road, for which an appropriate drop location would need to be determined.
- Construct a northbound right-turn lane with 50 feet of storage. This is limited by the existing Exxon drive just to the south, which could possibly be narrowed in width to allow for additional northbound right-turn lane storage.
- Construct a westbound approach that incorporates a 250-foot left-turn lane and 100-foot through lane, in addition to the existing approach lane.
- Modify the eastbound approach to be an exclusive left-turn lane and a shared through-right. This improvement paired with the improvements on the westbound approach would allow for removing the split phasing of the signal, assuming geometric and sight distance requirements are met. Note that the eastbound queuing would significantly exceed the

available Aldi throat length of approximately 85 feet.

With these background improvements in place, the intersection is expected to drop to LOS E during the AM peak hour and continue to operate at LOS D during the PM peak hour if single family homes are constructed on the site. In order to mitigate the AM peak hour drop in LOS it is recommended to channelize the westbound right-turn lane out of the signal with yield operation. With these improvements in place the intersection is expected to operate at LOS C during the AM peak hour and continue to operate at LOS D during the PM peak hour. Note that the southbound dual left-turn queue would extend to 500 feet of storage each.

If senior adult homes are constructed the intersection is expected to operate at LOS D during the AM and PM peak hours without improvements beyond those called for in the background improved scenario.

6.2 Marvin Road at Henry Harris Road

Table 6.2 summarizes the LOS and control delay (seconds per vehicle) at the unsignalized intersection under 2015 existing conditions, 2020 background conditions, and 2020 build-out conditions. Note that 2015 and 2020 background unsignalized capacity analysis results are provided for the worst minor street lane group, while improved/signalized background and build-out scenarios are provided for the overall intersection.

Condition	AM		PM	
	LOS	Delay	LOS	Delay
2015 Existing	C	24.1	D	31.2
2020 Background	F	62.0	F	78.1
2020 Background Improved*	B	11.6	B	11.9
2020 Build Single Family*	C	25.4	C	21.6
2020 Build Senior Adult Housing*	B	15.3	B	14.6

*Signalized

Based on the capacity analysis results shown in Table 6.2, the stop-controlled approach is expected to operate with long delays under 2020 background conditions with a single/shared approach lane. In order to improve background conditions a northbound left-turn lane was

analyzed. With a northbound left-turn lane in place, the AM peak hour is expected to operate with moderate delays (E/47.5) but the PM peak hour is still expected to operate with long delays (F/68.7). Preliminary peak hour signal warrants were reviewed, and based on the AM and PM peak hour signal warrants a signal would be warranted for projected 2020 background conditions.

With a signal installed at this intersection the intersection is expected to operate at a LOS B during the AM and PM peak hours under 2020 background conditions.

Under the single family build-out scenario, the signalized intersection would be expected to operate at LOS C.

If senior adult homes are constructed, the signalized intersection is expected to operate at LOS B during the AM and PM peak hours.

Note that a roundabout may be considered as an alternative to signalization.

6.3 Henry Harris Road at Ravenwood Drive/Access #2 (southern access)

Table 6.3 summarizes the LOS and control delay (seconds per vehicle) at the unsignalized intersection under 2015 existing conditions, 2020 background conditions, and 2020 build-out conditions. Note that unsignalized capacity analysis results are provided for the worst minor street lane group, in this case westbound Ravenwood Drive during 2015 existing and 2020 background conditions and Access #2 during build-out conditions.

Condition	AM		PM	
	LOS	Delay	LOS	Delay
2015 Existing	A	9.2	A	8.7
2020 Background	A	9.4	A	8.8
2020 Build Single Family	B	10.2	A	9.8
2020 Build Senior Adult Housing	A	9.8	A	9.4

Based on the capacity analysis results shown in Table 6.3, the proposed stop-controlled approaches are expected to operate with short delays under 2020 build-out conditions for both single family and senior adult homes. Due to the expected short delays on the side streets and mainline during the peak hours, no capacity-related improvements are recommended.

6.4 Henry Harris Road at Collins Road

Table 6.4 summarizes the LOS and control delay (seconds per vehicle) at the unsignalized intersection under 2015 existing conditions, 2020 background conditions, and 2020 build-out conditions. Note that unsignalized capacity analysis results are provided for the worst minor street lane group, in this case eastbound Collins Road.

Table 6.4 – Henry Harris Road at Collins Road				
Condition	AM		PM	
	LOS	Delay	LOS	Delay
2015 Existing	A	9.9	A	9.0
2020 Background	B	10.5	A	9.2
2020 Build Single Family	B	10.9	A	9.6
2020 Build Senior Adult Housing	B	10.6	A	9.4

Based on the capacity analysis results shown in Table 6.4, the stop-controlled approach is expected to operate with short delays under 2020 build-out conditions for both single family and senior adult homes. Due to the expected short delays on the side streets and mainline during the peak hours, no capacity-related improvements are recommended.

6.5 Henry Harris Road at Access #1 (northern access)

Table 6.5 summarizes the LOS and control delay (seconds per vehicle) at the unsignalized intersection under 2020 build-out conditions.

Table 6.5 – Henry Harris Road at Access #1				
Condition	AM		PM	
	LOS	Delay	LOS	Delay
2020 Build Single Family	B	11.3	B	10.8
2020 Build Senior Housing	B	10.1	A	9.7

Based on the capacity analysis results shown in Table 6.5, the proposed stop-controlled approach is expected to operate with short delays under 2020 build-out conditions with a single/shared approach lane. Therefore, no capacity-related improvements are recommended.

7.0 Auxiliary Turn Lane Warrants and Sight Distance

Based on a review of Chapter 15 of the *SCDOT Highway Design Manual (2003)* for the proposed access points along Henry Harris Road, a southbound right-turn lane should be considered at Access #1 and Henry Harris Road due to projected PM peak hour volumes under single family build-out conditions. However, due to the posted 35 mph speed limit along this roadway, a southbound right-turn lane is not recommended. This assumes available sight distance meets standards at both access points.

The results of the warrant analysis for the proposed access points under 2020 build-out conditions are included in the Appendix

8.0 Recommendations

The study was performed in coordination with Lancaster County and SCDOT staff. Based on the study's results, the following improvements are recommended to accommodate **2020 background traffic conditions** (not due to the site's impact):

US 521 and Marvin Road

- Utilize existing median to construct an additional southbound left-turn lane to create dual left turn lanes, each with 325 feet of storage. This would require:
 3. Limiting the existing full movement access just to the north at S-29-801/QuikTrip drive to right-in/right-out operation so that this area and the median to the north could be used for southbound left-turn storage.
 4. An additional receiving lane on Marvin Road, for which an appropriate drop location would need to be determined.
- Construct a northbound right-turn lane with 50 feet of storage. This is limited by the existing Exxon drive just to the south.
- Construct a westbound approach that incorporates a 250-foot left-turn lane and 100-foot through lane, in addition to the existing single approach lane.
- Modify the eastbound approach to be an exclusive left-turn lane and a shared through-right. This improvement paired with the improvements on the westbound approach would allow for removing the split phasing of the signal, assuming geometric and sight distance requirements are met. Note that the eastbound queuing would significantly exceed the available Aldi throat length of approximately 85 feet.

It is also recommended that the access to the existing Exxon station be reviewed for potential driveway consolidation and/or narrowing opportunities to improve signal operations.

Henry Harris Road at Marvin Road

- Installation of a traffic signal, if/when warranted. A roundabout may be an alternative to signalization.

Based on the study's results, the following improvements are recommended to accommodate **2020 build-out traffic conditions** due to the impact of the proposed 313 single family homes:

US 521 at Marvin Road

- Channelization of the westbound right-turn lane out of the traffic signal, with yield control.
- Extend the southbound dual left-turn lanes (from 325 feet of storage in background) to 500 feet of storage each.

The recommended laneage is illustrated in Figure 8.1. Note that available sight distance should be verified at both access points.

