

ANDES ROAD SUBDIVISION

Transportation Impact Analysis

Andes Road
Knoxville, TN

A Transportation Impact Analysis for the Andes Road Subdivision

Submitted to

Knoxville – Knox County Planning Commission

Revised August 10, 2020
June 22, 2020
FMA Project No. 592.007

8-SD-20-C

8-F-20-UR

Submitted By:



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Executive Summary

Ball Homes, LLC is proposing a residential development (i.e. Andes Road Subdivision) with single-family housing located in Knox County. The project is located at the intersection of Andes Road at Old Andes Road north of Middlebrook Pike. The full buildout of the development will consist of 170 single family lots. Construction is proposed to take place this year and this study assumes full build out for the development will occur in 2023.

The driveway connection will be located at the existing intersection of Andes Road at Old Andes Road approximately 365 feet north of the intersection of Ivywood Lane and approximately 1,280 feet north of the intersection with Middlebrook Pike. As a part of the construction of the Andes Road Subdivision an existing portion of Old Andes Road will be widened and renamed Road "A". Road "A" will begin at the intersection of Andes Road and will intersect at Road "Old Andes" at Station 6+14.70. Road "Old Andes" will begin at the intersection of Road "A" and will continue to Station 4+66.37 at which point it will intersect with the existing Old Andes Road.

In order to maintain or provide an acceptable level-of-service for each of the intersections studied, some recommendations are presented.

Andes Road at Driveway Connection

The full buildout conditions at the unsignalized intersection of Andes Road at the driveway connection were analyzed using the Highway Capacity Software (HCS7). Both the eastbound approach and northbound left turn lane operate at a LOS A during both the AM and PM peak hours.

After the completion of the Andes Road Subdivision neither a northbound left turn lane nor a southbound right turn lane are warranted at the intersection of Andes Road at the driveway connection.

Subdivision Roads

Road "A" starting at Station 6+14.70 as well the internal subdivision Road "B", Road "C", Road "E" and Road "F" will have a width of 26 feet in accordance with the "Knoxville-Knox County Subdivision Regulations" amended through February 13, 2020.

Sight distance easements for the internal subdivision intersections of Road "A", Road "B", Road "C", Road "D", Road "E" and Road "F" should be coordinated with Knox County Engineering and Public Works and included on the final design drawings prior to construction of the subdivision.

1 Introduction

1.1 Project Description

This report provides a summary of a traffic impact study that was performed for the Andes Road Subdivision. The project is located at the intersection of Andes Road at Old Andes Road north of Middlebrook Pike in Knox County, Tennessee. The location of the site is shown in Figure 1.

The full build out of the development will consist of 170 single family lots. Construction is proposed to take place this year, and this study assumes full build out for the development will occur in 2023.

The driveway connection will be located at the existing intersection of Andes Road at Old Andes Road approximately 365 feet north of the intersection of Ivywood Lane and approximately 1,280 feet north of the intersection with Middlebrook Pike. As a part of the construction of the Andes Road Subdivision an existing portion of Old Andes Road will be widened and renamed Road "A". Road "A" will begin at the intersection of Andes Road and will intersect at Road "Old Andes" at Station 6+14.70. Road "Old Andes" will begin at the intersection of Road "A" and will continue to Station 4+66.37 at which point it will intersect with the existing Old Andes Road. The proposed site layout is shown in Figure 2.

The purpose of this study is to evaluate the impacts to the traffic conditions caused by the proposed development.

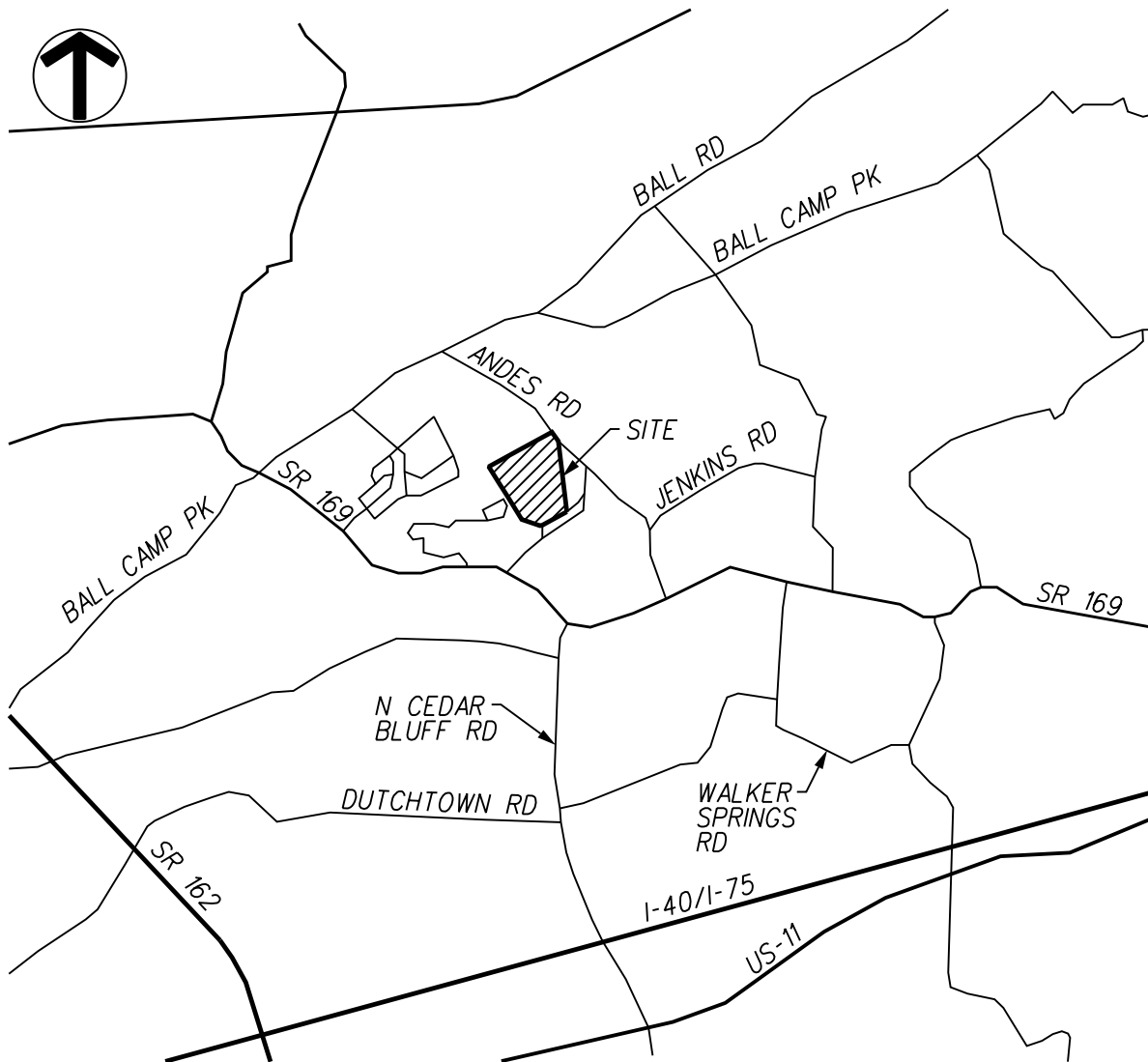


Figure 1: Location Map

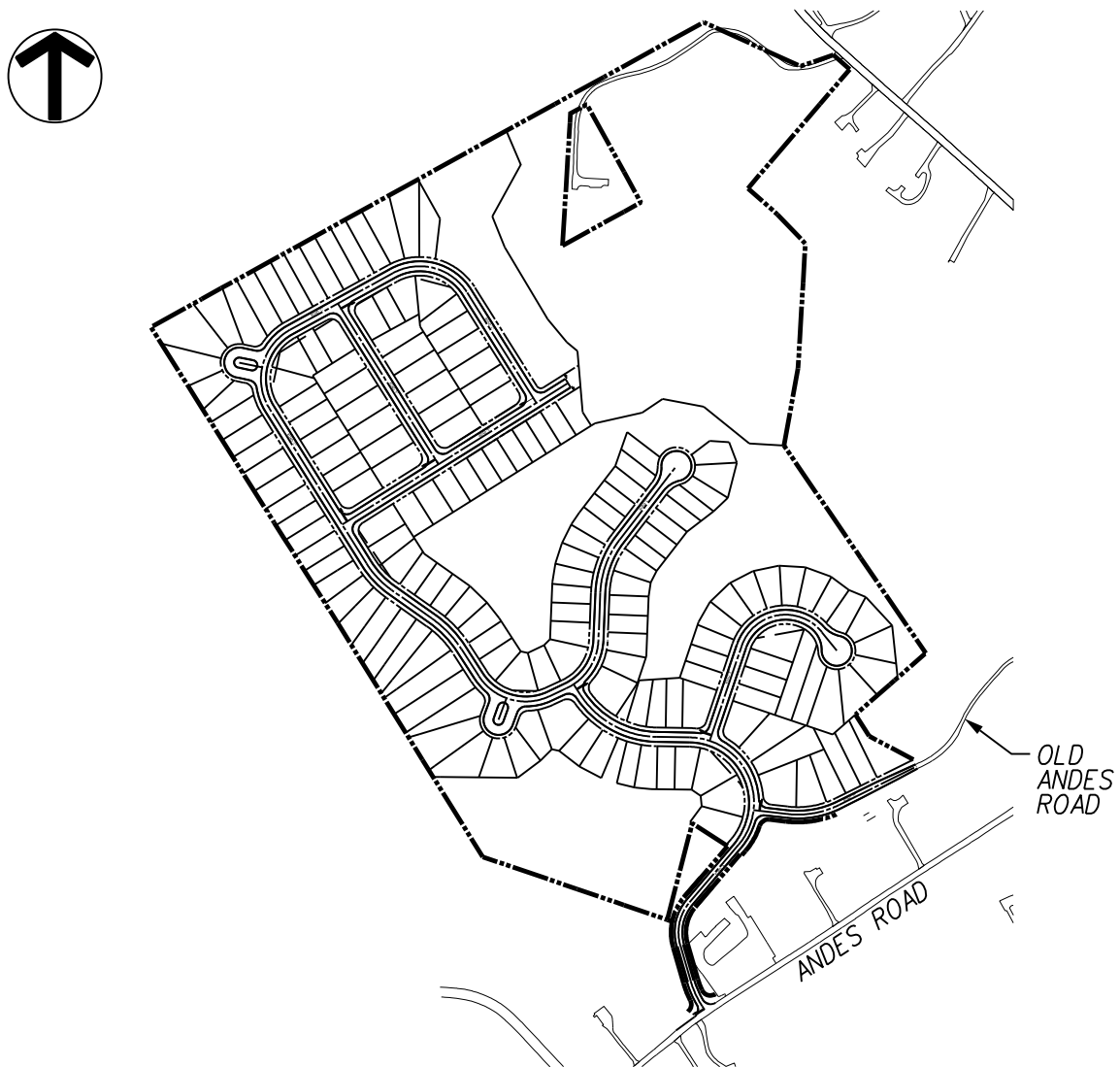


Figure 2: Site Plan

1.2 Existing Site Conditions

Old Andes Road is a narrow two-lane road with an average width of 12 feet. Knoxville-Knox County Planning does not classify Old Andes Road; therefore it is considered a local street. The posted speed limit on Old Andes Road is 20 mph.

Andes Road is a two-lane road at the intersection with Old Andes Road. Knoxville-Knox County Planning does not classify Andes Road south of the intersection with Chert Pit Road; therefore it is considered a local street. The posted speed limit on Andes Road is 30 mph.

There are no existing sidewalks or designated bike lanes along Andes Road or Old Andes Road in the vicinity of the proposed development.

An aerial photo of the existing intersection is included in Attachment 1.

2 Existing Traffic Volumes

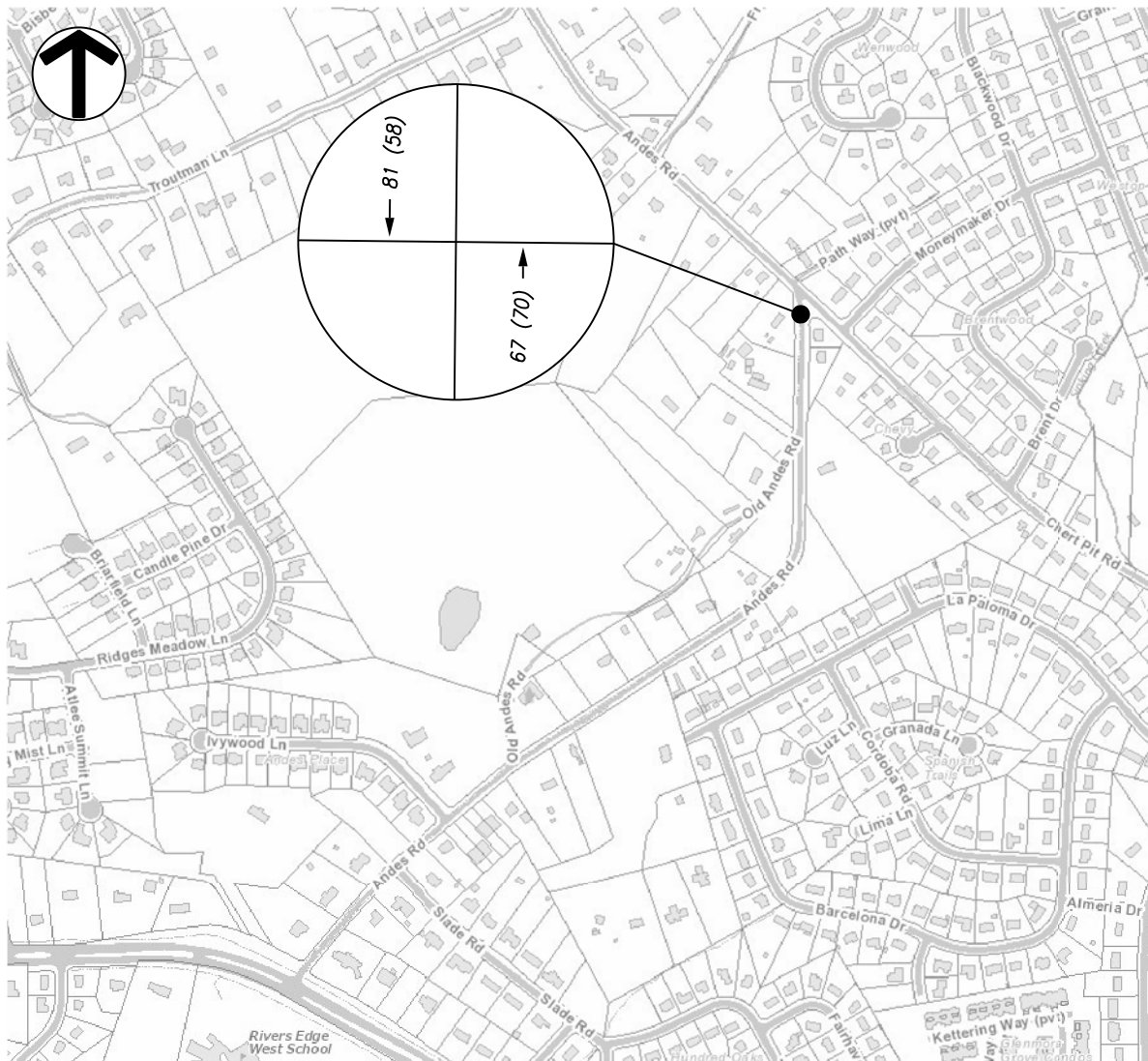
Due to the altered traffic patterns from COVID-19 FMA did not collect any new traffic volumes for the Andes Road Subdivision transportation impact analysis. A worksheet was included in Attachment 2 outlining the step-by-step calculations and assumptions that were used in determining the existing traffic counts along Andes Road.

The only available traffic count in the vicinity of the proposed development is a tube count that was collected at the intersection of Andes Road at Chert Pit Road. The tube count was conducted by Knox County Engineering starting on Thursday September 23, 1999 at 10:00 a.m. and ending Friday September 24, 1999 at 10:00 a.m. The AM peak hour occurred between 8:00 a.m. and 9:00 a.m. and the northbound peak hour volume was 54 vehicles. The PM peak hour occurred between 5:00 p.m. and 6:00 p.m. and the northbound peak hour volume was 57 vehicles. The Knox County Engineering tube count is included in Attachment 2.

The existing PM peak hour trip distribution was determined using a turning movement count that FMA conducted on June 18, 2020 at the intersection of Andes Road at Old Andes Road. The PM peak hour distribution was 55% northbound and 45% southbound and FMA assumed that the AM peak hour distribution would be 45% northbound and 55% southbound.

In order to calculate existing traffic conditions FMA estimated the growth rate from the 1999 tube count to the projected existing 2020 traffic conditions. The growth rate was determined by analyzing nearby traffic counts provided by the Knoxville Regional Transportation Planning Organization (TPO) in the vicinity of the proposed development. Traffic counts located on Andes Road and Chert Pit Road had an average growth rate of approximately 1.0%. The ADT trend line growth charts are included in Attachment 3. Figure 3 shows the projected 2020 traffic volumes including both the AM and PM peak hour traffic.

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LEGEND:

← 5 (16)

TURNING MOVEMENT VOLUME AM (PM)

Figure 3: 2020 Existing Peak Hour Traffic

3 Background Growth

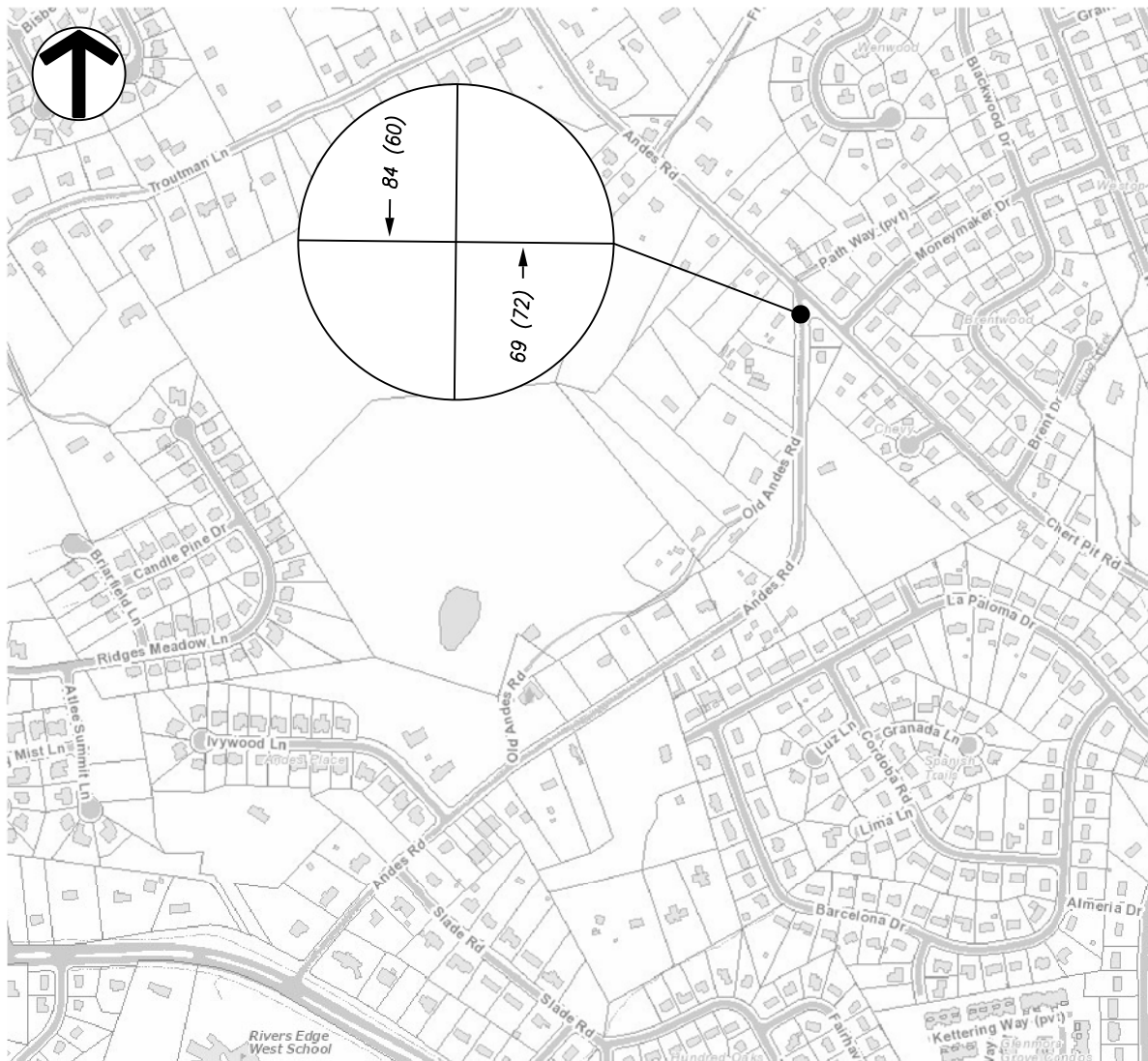
The Tennessee Department of Transportation (TDOT) and Knoxville Regional Transportation Planning Organization (TPO) maintain count stations in the vicinity of the proposed development.

TDOT count station ID: 000465 is located on Andes Road between Ball Camp Pike and Cureton Road. The annual growth rate for this station over the last nine years is approximately 0.19% and the 2019 ADT was 4,053 vehicles per day.

Knoxville TPO count station ID 093M285 is located on Chert Pit Road north of Middlebrook Pike. The annual growth rate for this station over the last fourteen years is approximately -.42% and the 2015 ADT was 7520 vehicles per day.

For the purpose of this study, an annual growth rate of 1.0% was assumed for the thru traffic along Andes Road until full occupancy is reached in 2023. Attachment 3 shows the trend line growth charts for the TDOT and TPO count stations.

Figure 4 demonstrates the projected background peak hour volumes on Andes Road at after applying the background growth rate to the existing conditions.



LEGEND:

← 5 (16)

TURNING MOVEMENT VOLUME AM (PM)

Figure 4: 2023 Background Peak Hour Traffic

4 Trip Generation and Trip Distribution

The Andes Road Subdivision proposes 170 single family lots. Single-Family Detached Housing or Land Use 210 was used to calculate site trips for the subdivision using the fitted curve equations from the *Trip Generation, 10th Edition*, published by the Institute of Transportation Engineers. The land use worksheets are included in Attachment 5.

The total trips generated by the full buildout of the Andes Road Subdivision was estimated to be 1,694 daily trips. The estimated trips are 126 trips during the AM peak hour and 169 trips during the PM peak hour. A trip generation summary is shown in Table 4-1.

**Table 4-1
Andes Road Subdivision
Trip Generation Summary**

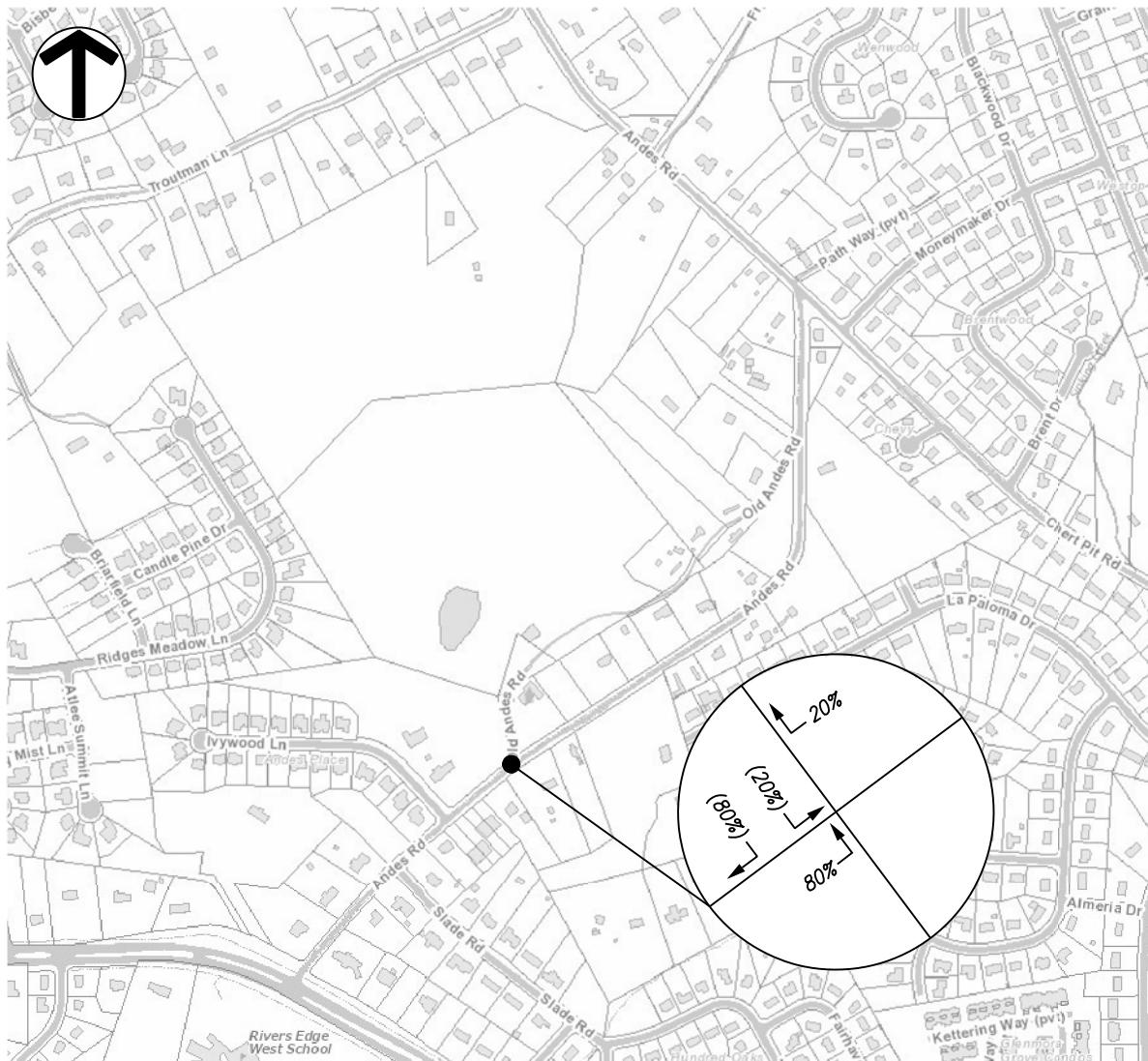
Land Use	Density	Daily Trips	AM Peak Hour		PM Peak Hour	
			Enter	Exit	Enter	Exit
Single-Family Detached Housing (Land Use 210)	170 lots	1694	32	95	106	63

FMA calculated the existing PM peak hour trip distribution on Andes Road in the vicinity of the proposed development. The PM peak hour distribution was 55% northbound and 45% southbound and FMA assumed that the AM peak hour distribution would be 45% northbound and 55% southbound.

The directional distribution of the traffic generated by the Andes Road Subdivision was estimated based on the proximity of the subdivision to Middlebrook Pike. The entering trip distribution is 80% northbound and 20% southbound and the exiting trip distribution is 20% northbound and 80% southbound during both the AM and PM peak hours. Figure 5 shows the peak hour trip distribution for the Andes Road Subdivision.

Figure 6 shows the peak hour site trips generated by the Andes Road Subdivision and Figure 7 shows the projected full buildout peak hour traffic after the completion of the Andes Road Subdivision.

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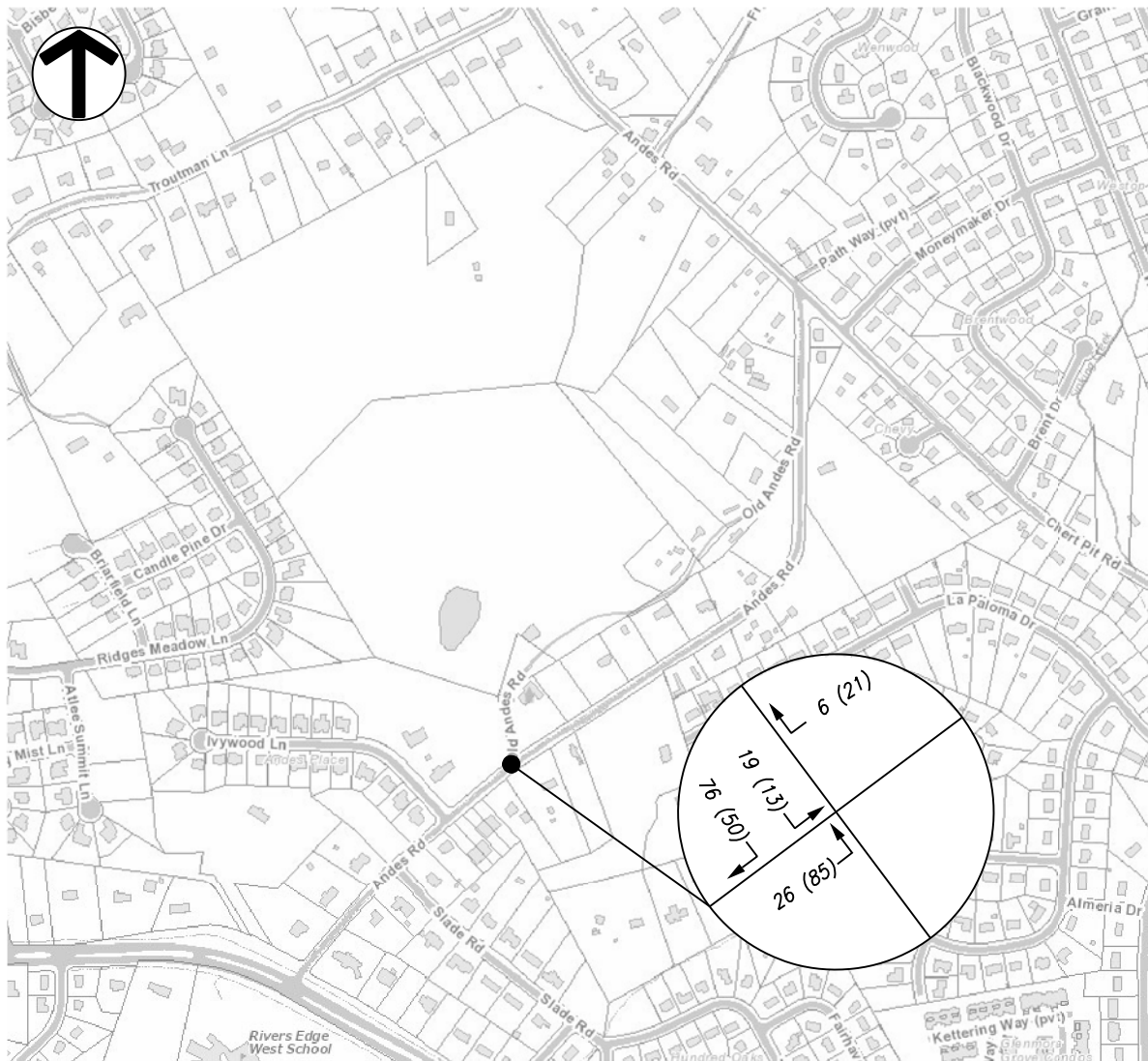


LEGEND:

← 50% (50%) TRIP DISTRIBUTION ENTERING (EXITING)

Figure 5: Peak Hour Trip Distribution

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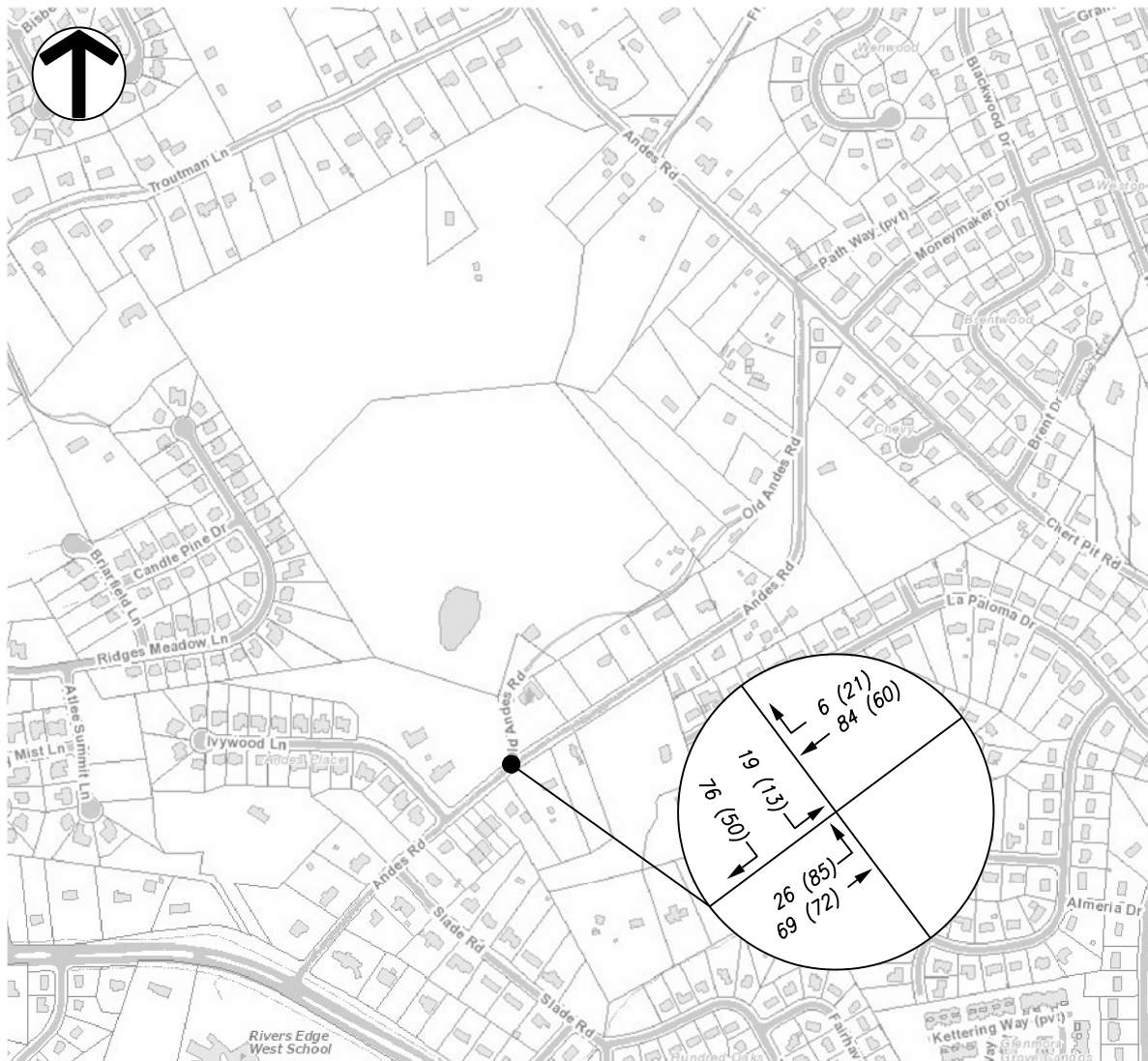
LEGEND:

← 5 (16)

TURNING MOVEMENT VOLUME AM (PM)

Figure 6: Andes Subdivision Peak Hour Site Trips

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LEGEND:

← 5 (16)

TURNING MOVEMENT VOLUME AM (PM)

Figure 7: 2023 Full Buildout Peak Hour Traffic

5 Projected Capacity and Level of Service

The proposed intersection of Andes Road at the driveway connection (Road "A") is a two-way stop controlled intersection.

Unsignalized intersection capacity analyses were performed using the Highway Capacity Software (HCS7) for the AM and PM peak hours to evaluate the traffic existing and background conditions at the intersection of Andes Road at the driveway connection and the full buildout conditions at the intersection of Andes Road at the driveway connection.

The results from the analyses are expressed with a term "level of service" (LOS), which is based on the amount of delay experienced at the intersection. The LOS index ranges from LOS A, indicating excellent traffic conditions with minimal delay, to LOS F indicating very congested conditions with excessive delay. LOS D generally is considered the minimum acceptable condition in urban areas. The full buildout HCS7 worksheets are included in Attachment 5.

Table 5-1 shows the results of the capacity analyses.

**Table 5-1
Intersection Analysis
Level of Service (LOS) Summary**

Delay (sec)/LOS		
Andes Road @ Driveway Connection (Full Buildout 2023)		
AM Peak	EB Approach	9.5 / A
	NB Left Turn	7.5 / A
PM Peak	EB Approach	9.4 / A
	NB Left Turn	7.5 / A

6 Turn Lane Warrant Analysis

The intersection of Andes Road at the driveway connection was evaluated to determine if a right turn lane or a left turn lane are warranted. The Knox County Department of Engineering and Public Works handbook, "Access Control and Driveway Design Policy," was used to analyze the information. Neither a southbound right turn lane nor a northbound left turn lane on Andes Road is warranted. The turn lane warrant worksheets and analysis are included in Attachment 6.

7 Conclusions and Recommendations

7.1 Andes Road @ Driveway Connection

The full buildout conditions at the unsignalized intersection of Andes Road at the driveway connection were analyzed using the Highway Capacity Software (HCS7). Both the eastbound approach and northbound left turn lane operate at a LOS A during both the AM and PM peak hours.

After the completion of the Andes Road Subdivision neither a northbound left turn lane nor a southbound right turn lane are warranted at the intersection of Andes Road at the driveway connection.

The minimum required sight distance for a road with a posted speed limit of 30 mph is 300 feet in each direction in accordance with the "Knoxville-Knox County Subdivision Regulations" amended through February 13, 2020. FMA measured the sight distance at the existing intersection of Andes Road at Old Andes Road in June 2020. At 15 feet from the edge of pavement the sight distance is greater than 500 feet northbound and 415 feet southbound.

The proposed driveway connection (Road "A") will be located approximately 30 feet north of the existing intersection of Andes Road at Old Andes Road. This realignment of Road "A" will continue to comply with the minimum intersection sight distance requirements.

Andes Road is not classified per the Major Road Plan; therefore it is considered a local street. The minimum intersection spacing required on a local street is 125 feet per the "Knoxville-Knox County Subdivision Regulations" amended through February 13, 2020. The existing intersection of Andes Road at Old Andes Road is located approximately 365 feet north of the intersection with Ivywood Lane. This driveway

connection exceeds the typical minimum separation on a local street; therefore, no change is necessary.

7.2 Subdivision Roads

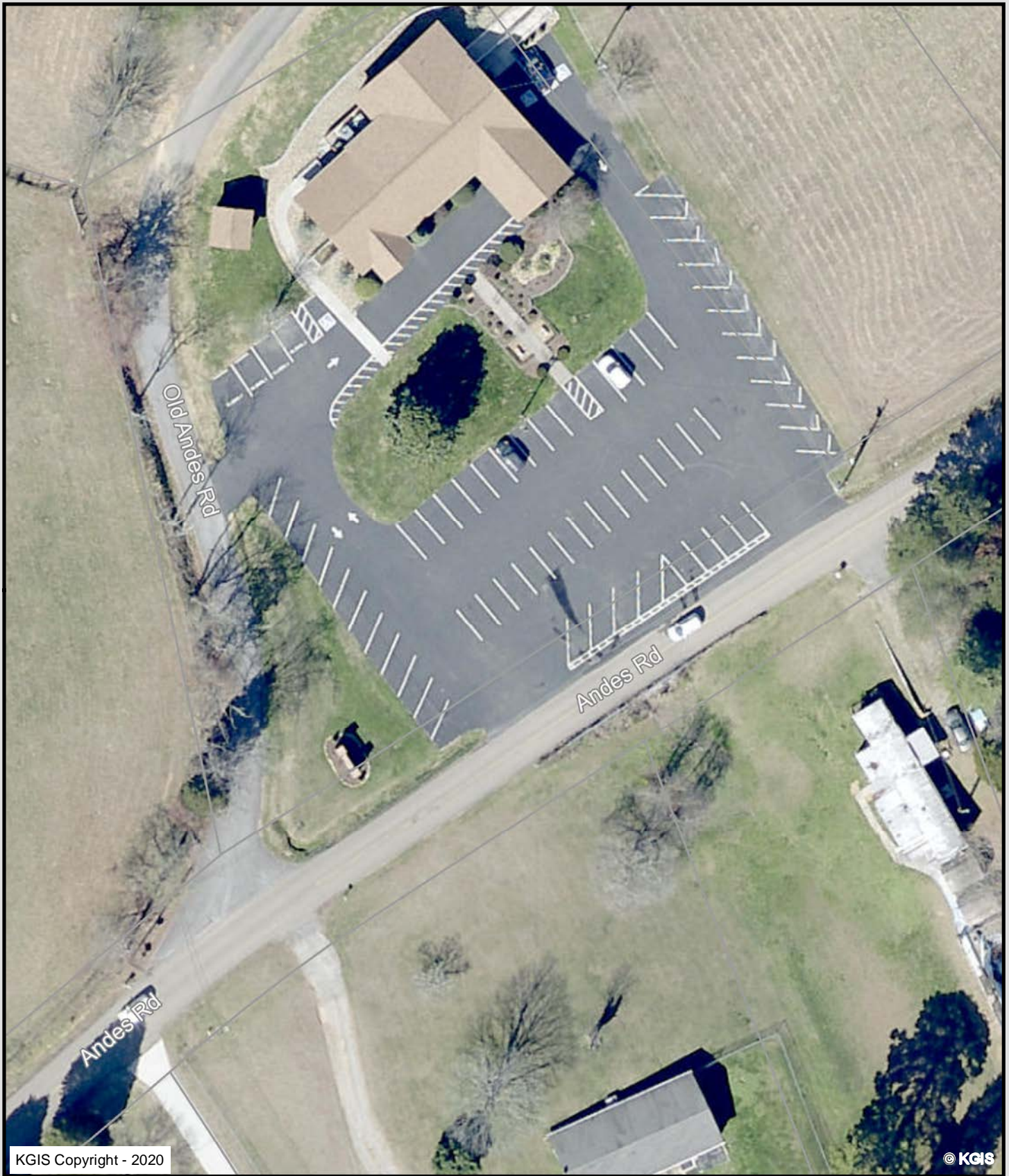
Old Andes Road at the existing intersection of Andes Road has an average width of 12 feet. As a part of the construction of the Andes Road Subdivision an existing portion of Old Andes Road will be widened and renamed Road "A". Road "A" will begin at the intersection of Andes Road and will intersect at Road "Old Andes" at Station 6+14.70. Road "Old Andes" will begin at the intersection of Road "A" and will continue to Station 4+66.37 at which point it will intersect with the existing Old Andes Road.

Road "A" starting at Station 6+14.70 as well the internal subdivision Road "B", Road "C", Road "E" and Road "F" will have a width of 26 feet in accordance with the "Knoxville-Knox County Subdivision Regulations" amended through February 13, 2020.

The minimum required sight distance for the internal subdivision Road "A", Road "B", Road "C" and Road "E", Road "F" and Old Andes Road will be 250 feet in each direction in accordance with the "Knoxville-Knox County Subdivision Regulations" as amended through February 13, 2020.

Sight distance easements for the internal subdivision intersections of Road "A", Road "B", Road "C", Road "D", Road "E" and Road "F" should be coordinated with Knox County Engineering and Public Works and included on the final design drawings prior to construction of the subdivision.

Attachment 1
Aerial Photo

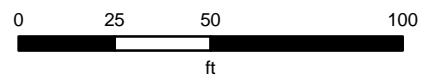


Andes Road

Knoxville - Knox County - KUB Geographic Information System



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Attachment 2

Traffic Counts

Chert Pit/Andes

Time	Andes north leg	Andes west leg	Chert Pit south leg	TOTAL	
0	15	0	43	58	
1	7	3	13	23	
2	5	2	10	17	
3	6	4	11	21	
4	10	4	4	18	
5	35	1	17	53	
6	94	10	50	154	
7	301	53	158	512	>500
8	301	54	134	489	close
9	176	34	118	328	
10	153	25	107	285	
11	130	23	118	271	
12	135	28	170	333	
13	178	42	159	379	
14	194	25	218	437	close
15	215	29	204	448	close
16	249	38	267	554	>500
17	297	57	396	750	>500
18	273	42	310	625	>500
19	215	50	235	500	>500
20	147	31	165	343	
21	98	40	167	305	
22	68	15	101	184	
23	39	2	66	107	
TOTAL	3341	612	3241	7194	

09/27/99
07:48:08

KNOX COUNTY ENGINEERING
205 WEST BAXTER AVENUE
KNOXVILLE, TN 37917
423/215/5800

Page: 1

*** Hourly Multi-Channel Horizontal ***

Site ID : CHERT PIT #2
Info 1 : S/ANDES RD
Info 2 :
Factor : 1.000%

Lane #1 Info : NB
Lane Mode : Directional

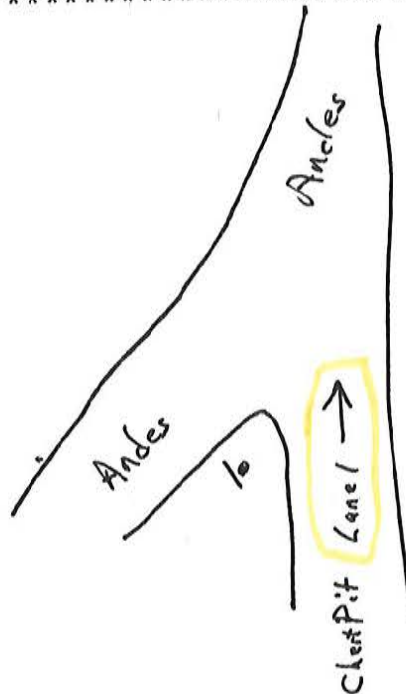
Start Time : 10:00
Start Date : Sep 23, 1999 Thu
End Time : 09:45
End Date : Sep 24, 1999 Fri
Sensor Used : Axle
Divide By 2 : Yes

Date	Day	Time	Lane #1
09/23/99	Thu	10:00	107
		11:00	118
		12:00	170
		13:00	159
		14:00	218
		15:00	204
		16:00	267
		17:00	396
		18:00	310
		19:00	235
		20:00	165
		21:00	167
		22:00	101
		23:00	66

14 HOUR TOTAL
PERCENTS

2683
100%

Lane	AM Total	AM Avg.	PM Total	PM Avg.	Peak AM	Peak Total	Peak Percent	Peak PM	Peak Total	Peak Percent
#1	225	112.5	2458	204.8	11:00	118	4.4%	17:00	396	14.8%



09/27/99
07:48:08

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Page: 2

*** Hourly Multi-Channel Horizontal ***

Site ID : CHERT PIT #2 Date of Data : Sep 24, 1999 Fri
Info 1 : S/ANDES RD Adj. Factor : 1.00
Info 2 : # Of Lanes : 1

Date	Day	Time	Lane #1
09/24/99	Fri	00:00	43
		01:00	13
		02:00	10
		03:00	11
		04:00	4
		05:00	17
		06:00	50
		07:00	158
		08:00	134
		09:00	118
10 HOUR TOTAL			558
PERCENTS			100%

Lane	AM Total	AM Avg.	PM Total	PM Avg.	Peak AM	Peak Total	Peak Percent	Peak PM	Peak Total	Peak Percent
#1	558	55.8			07:00	158	28.3%			

09/27/99
07:48:08

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KNOXVILLE, TN 37917
423/215/5800

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GRAND TOTALS FOR HOURLY MULTI-CHANNEL HORIZONTAL

=====

Site ID : CHERT PIT #2	Start Time : 10:00
Info 1 : S/ANDES RD	Start Date : Sep 23, 1999 Thu
Info 2 :	End Time : 09:45
Factor : 1.000%	End Date : Sep 24, 1999 Fri

Date	Day	Time	Lane #1
09/23/99	Thu	00:00	43
		01:00	13
		02:00	10
		03:00	11
		04:00	4
		05:00	17
		06:00	50
		07:00	158
		08:00	134
		09:00	118
		10:00	107
		11:00	118
		12:00	170
		13:00	159
		14:00	218
		15:00	204
		16:00	267
		17:00	396
		18:00	310
		19:00	235
		20:00	165
		21:00	167
		22:00	101
09/24/99	Fri	23:00	66
24 HOUR TOTAL			3241
PERCENTS			100%

Lane	AM Total	AM Avg.	PM Total	PM Avg.	Peak AM	Peak Total	Peak Percent	Peak PM	Peak Total	Peak Percent	ADT
#1	783	65.3	2458	204.8	07:00	158	4.9%	17:00	396	12.2%	3241

09/27/99
07:41:58

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*** Hourly Multi-Channel Horizontal ***

Site ID : ANDES #1
Info 1 : 1/2 N/CHERTPIT
Info 2 : 3/4 W/CHERTPIT
Factor : 1.000%

Lane #1 Info : SB ANDES
Lane Mode : Directional

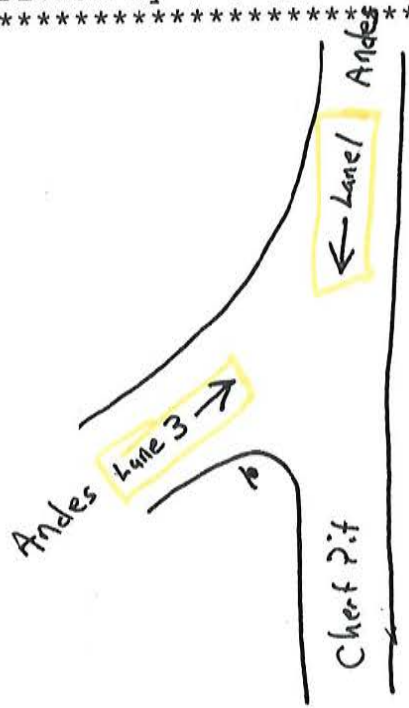
Lane #3 Info : EB ANDES
Lane Mode : Directional

Start Time : 10:00
Start Date : Sep 23, 1999 Thu
End Time : 09:45
End Date : Sep 24, 1999 Fri

Sensor Used : Axle
Divide By 2 : Yes

Sensor Used : Axle
Divide By 2 : Yes

Date	Day	Time	Lane #1	Lane #3	Avg.	Total
09/23/99	Thu	10:00	153	25	89	178
		11:00	130	23	76	153
		12:00	135	28	81	163
		13:00	178	42	110	220
		14:00	194	25	109	219
		15:00	215	29	122	244
		16:00	249	38	143	287
		17:00	297	57	177	354
		18:00	273	42	157	315
		19:00	215	50	132	265
		20:00	147	31	89	178
		21:00	98	40	69	138
		22:00	68	15	41	83
		23:00	39	2	20	41
14 HOUR TOTAL			2391	447	1419	2838
PERCENTS			84%	16%		



Lane	AM Total	AM Avg.	PM Total	PM Avg.	Peak AM	Peak Total	Peak Percent	Peak PM	Peak Total	Peak Percent
#1	283	141.5	2108	175.7	10:00	153	6.4%	17:00	297	12.4%
#3	48	24.0	399	33.3	10:00	25	5.6%	17:00	57	12.8%
COMB.	331	82.8	2507	104.5	10:00	178	6.3%	17:00	354	12.5%

09/27/99
07:41:58

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205 WEST BAXTER AVENUE
KNOXVILLE, TN 37917
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*** Hourly Multi-Channel Horizontal ***

Site ID : ANDES #1
Info 1 : 1/2 N/CHERTPIT
Info 2 : 3/4 W/CHERTPIT

Date of Data : Sep 24, 1999 Fri
Adj. Factor : 1.00
Of Lanes : 2

Date	Day	Time	Lane #1	Lane #3	Avg.	Total
09/24/99	Fri	00:00	15	0	7	15
		01:00	7	3	5	10
		02:00	5	2	3	7
		03:00	6	4	5	10
		04:00	10	4	7	14
		05:00	35	1	18	36
		06:00	94	10	52	104
		07:00	301	53	177	354
		08:00	301	54	177	355
		09:00	176	34	105	210

10 HOUR TOTAL	950	165	557	1115
PERCENTS	85%	15%		

Lane	AM Total	AM Avg.	PM Total	PM Avg.	Peak AM	Peak Total	Peak Percent	Peak PM	Peak Total	Peak Percent
#1	950	95.0			07:00	301	31.7%			
#3	165	16.5			08:00	54	32.7%			
COMB.	1115	55.8			08:00	355	31.8%			

09/27/99
07:41:58

KNOX COUNTY ENGINEERING
205 WEST BAXTER AVENUE
KNOXVILLE, TN 37917
423/215/5800

Page: 3

=====

GRAND TOTALS FOR HOURLY MULTI-CHANNEL HORIZONTAL

=====

Site ID : ANDES #1	Start Time : 10:00
Info 1 : 1/2 N/CHERTPIT	Start Date : Sep 23, 1999 Thu
Info 2 : 3/4 W/CHERTPIT	End Time : 09:45
Factor : 1.000%	End Date : Sep 24, 1999 Fri

Date	Day	Time	Lane #1	Lane #3	Avg.	Total
09/23/99	Thu	00:00	15	0	7	15
		01:00	7	3	5	10
		02:00	5	2	3	7
		03:00	6	4	5	10
		04:00	10	4	7	14
		05:00	35	1	18	36
		06:00	94	10	52	104
		07:00	301	53	177	354
		08:00	301	54	177	355
		09:00	176	34	105	210
		10:00	153	25	89	178
		11:00	130	23	76	153
		12:00	135	28	81	163
		13:00	178	42	110	220
		14:00	194	25	109	219
		15:00	215	29	122	244
		16:00	249	38	143	287
		17:00	297	57	177	354
		18:00	273	42	157	315
		19:00	215	50	132	265
		20:00	147	31	89	178
		21:00	98	40	69	138
		22:00	68	15	41	83
09/24/99	Fri	23:00	39	2	20	41
24 HOUR TOTAL			3341	612	1976	3953
PERCENTS			85%	15%		

Lane	AM Total	AM Avg.	PM Total	PM Avg.	Peak AM	Peak Total	Peak Percent	Peak PM	Peak Total	Peak Percent	ADT
#1	1233	102.8	2108	175.7	07:00	301	9.0%	17:00	297	8.9%	3341
#3	213	17.8	399	33.3	08:00	54	8.8%	17:00	57	9.3%	612
COMB.	1446	60.3	2507	104.5	08:00	355	9.0%	17:00	354	9.0%	3953

Detailed Calculations for Determining Count Data due to COVID-19

Project: Andes Road Subdivision

Date Conducted: 07/24/2020

Intersection: Andes Road at Chert Pit Road

Original Tube Count Date: September 23, 1999 - September 24, 1999

Per the tube count conducted in September, 1999 it was established that the existing northbound traffic on Andes Road was:

AM Peak Hour (8:00 a.m. - 9:00 a.m.) - 54 vehicles - NB on Andes Road

PM Peak Hour (5:00 p.m. - 6:00 p.m.) - 57 vehicles NB on Andes Road

(reference Attachment 2 for the Knox County Engineering tube count)

In order to estimate the existing southbound traffic on Andes Road FMA performed a PM peak hour turning movement count

Intersection: Andes Road at Old Andes Road

Turning Movement Count Date: June 18, 2020

The results of the PM peak hour turning movement count were:

PM Peak Hour (5:00 p.m. - 6:00 p.m.) - 43 vehicles - NB on Andes Road

55% NB on Andes Road

PM Peak Hour (5:00 p.m. - 6:00 p.m.) - 35 vehicles - SB on Andes Road

45% SB on Andes Road

FMA assumed the AM peak hour trip distribution would be 45% NB on Andes Road and 55% SB on Andes Road

Calculated the Existing 1999 SB thru traffic on Andes Road using the results of the trip distribution analysis

AM Peak Hour

54 vehicles / 45% = 120 vehicles total traffic on Andes Road

120 vehicles - 54 vehicles = **66 vehicles - SB on Andes Road**

PM Peak Hour

57 vehicles / 55% = 104 vehicles total traffic on Andes Road

104 vehicles - 57 vehicles = **47 vehicles - SB on Andes Road**

Assumed a 1% Growth Rate for Thru Traffic on Andes Road

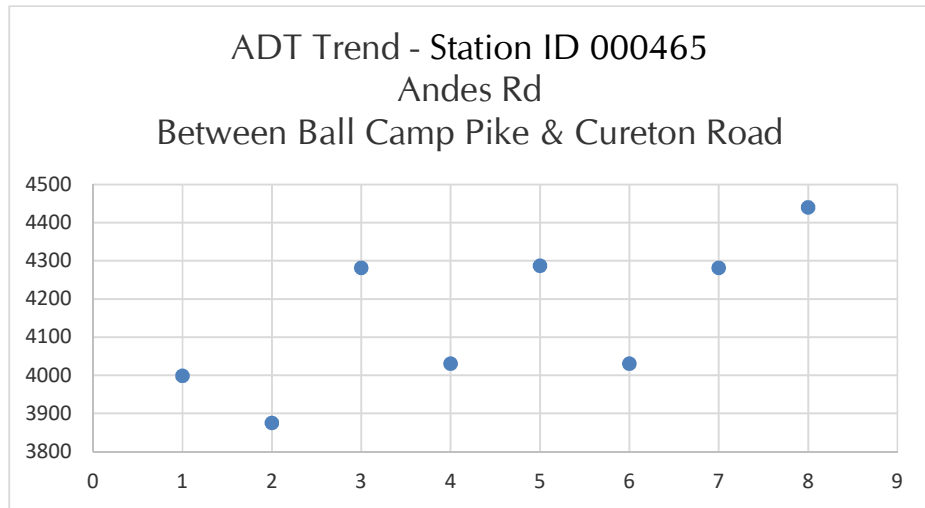
(reference Attachment 3 ADT trend line growth charts)

	Old Andes Road Eastbound		Andes Road Northbound		Andes Road Southbound	
Start	Left	Right	Thru	Right	Left	Thru
AM Peak Hour						
Existing AM Peak - September 1999	-	-	54	-	-	66
Existing AM Peak - 2020 (1% over 21 yrs)	-	-	67	-	-	81
Background AM Peak - 2023 (1% over 24 yrs)	-	-	69	-	-	84
PM Peak Hour						
Existing PM Peak - September 1999	-	-	57	-	-	47
Existing PM Peak - 2020 (1% over 21 yrs)	-	-	70	-	-	58
Background PM Peak - 2023 (1% over 24 yrs)	-	-	72	-	-	60

Figure 3: 2020 Existing Peak Hour Traffic - Includes the NB and SB Thru Traffic on Andes Road at the existing tube count location south of the intersection of Andes Road at Chert Pit Road

Attachment 3 ADT Trends

Year	Adjusted Average Daily Traffic
2010	3999
2011	3875
2012	4282
2013	4031
2014	4287
2015	4031
2016	4282
2017	4440
2018	3684
2019	4053

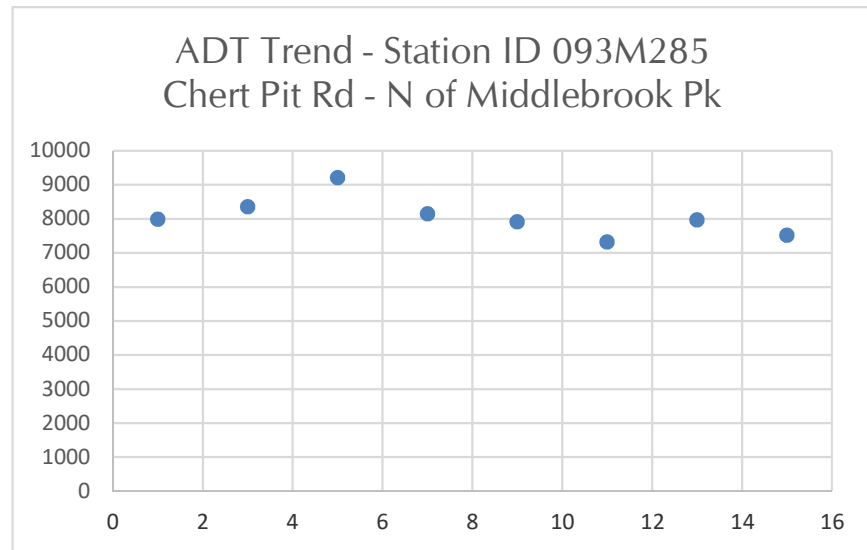


Most Recent Trend Line Growth

Year	ADT
2010	3999
2019	4053

Annual Percent Growth	0.19%
------------------------------	--------------

Year	Adjusted Average Daily Traffic
2001	7990
2002	
2003	8360
2004	
2005	9210
2006	
2007	8150
2008	
2009	7910
2010	
2011	7320
2012	
2013	7970
2014	
2015	7520



Most Recent Trend Line Growth

Year	ADT
2001	7990
2015	7520

Annual Percent Growth	-0.42%
------------------------------	---------------

Attachment 4

Trip Generation

Project: Andes Road Subdivision

Date Conducted: 7/24/2020

Single-Family Detached Housing (LUC 210)

170 Single Family Lots

Average Daily Traffic

$$\ln(T) = 0.92\ln(X) + 2.71$$

$$\ln(T) = 0.92\ln(170) + 2.71$$

$$T = 1694$$

Peak Hour of Adjacent Street Traffic

One Hour Between 7 and 9 a.m.

$$T = 0.71(X) + 4.80$$

$$T = 0.71(170) + 4.80$$

$$T = 126$$

Peak Hour of Adjacent Street Traffic

One Hour Between 4 and 6 p.m.

$$\ln(T) = 0.96\ln(X) + 0.20$$

$$\ln(T) = 0.96\ln(170) + 0.20$$

$$T = 169$$

Time Period	Total Trips	Percent		Number	
		Enter	Exit	Enter	Exit
Weekday (24 hours)	1694	50%	50%	847	847
AM Peak Hour	126	25%	75%	32	95
PM Peak Hour	169	63%	37%	106	63

Single-Family Detached Housing (210)

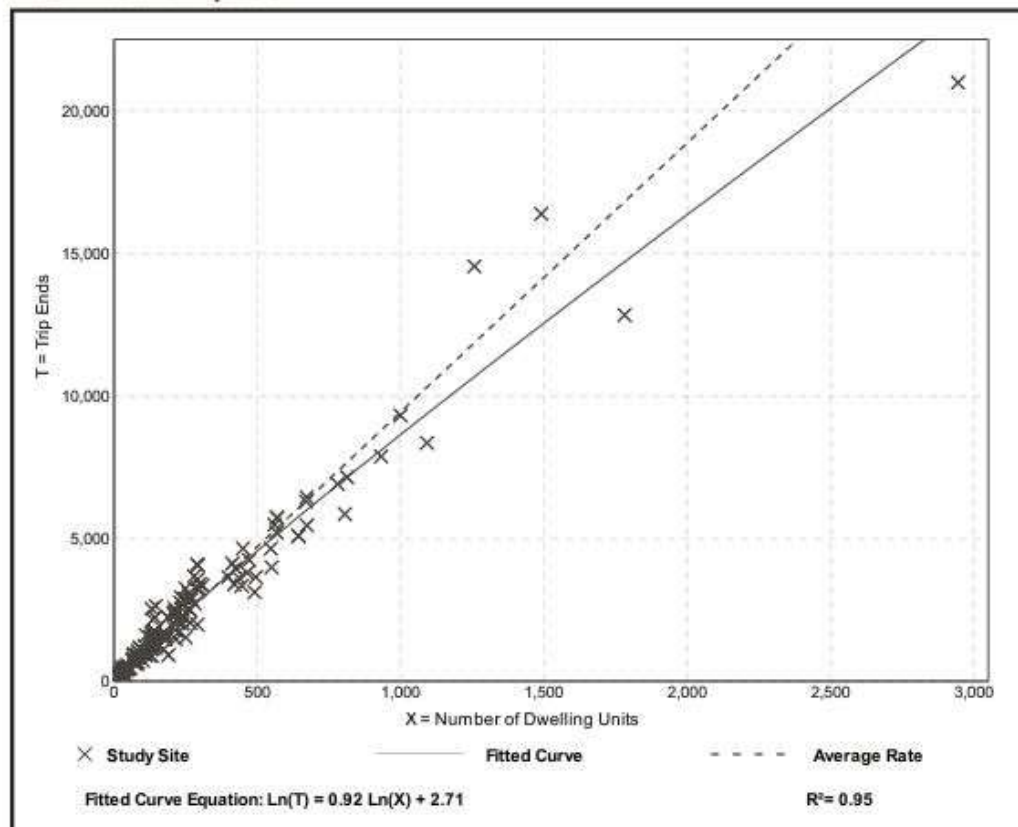
Vehicle Trip Ends vs: Dwelling Units
On a: Weekday

Setting/Location: General Urban/Suburban
Number of Studies: 159
Avg. Num. of Dwelling Units: 264
Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
9.44	4.81 - 19.39	2.10

Data Plot and Equation



Single-Family Detached Housing (210)

Vehicle Trip Ends vs: Dwelling Units

On a: Weekday,

Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.

Setting/Location: General Urban/Suburban

Number of Studies: 173

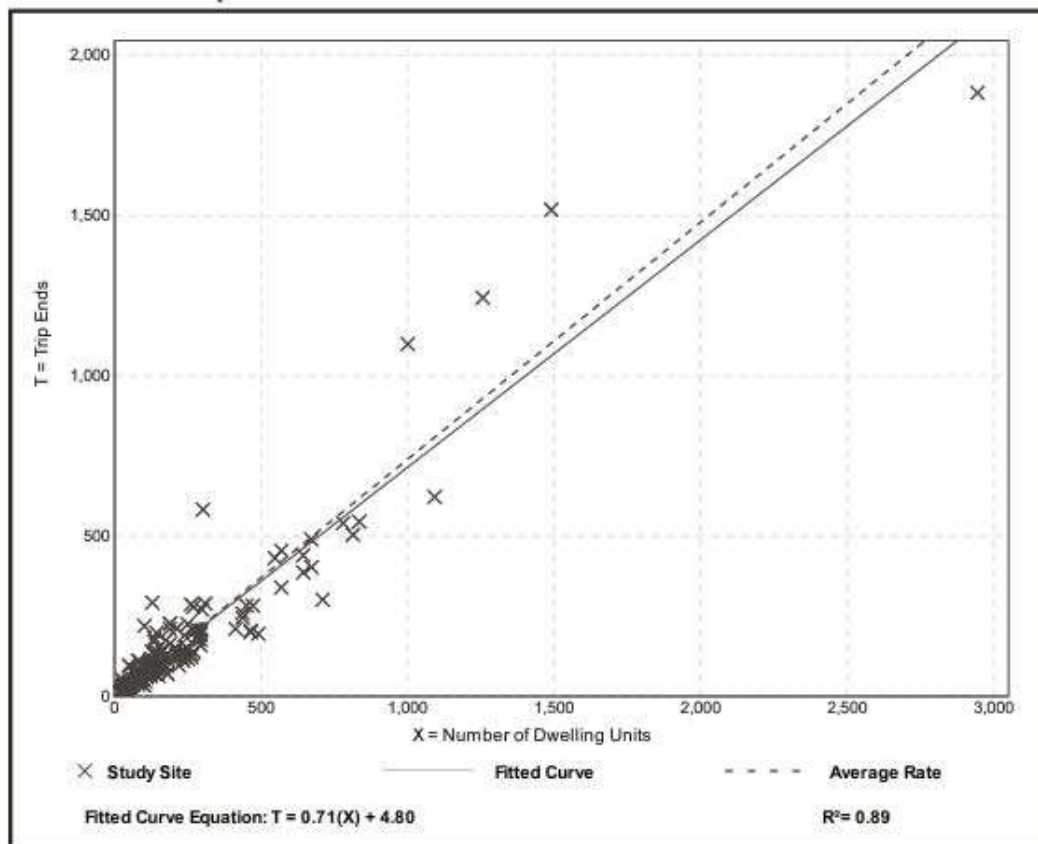
Avg. Num. of Dwelling Units: 219

Directional Distribution: 25% entering, 75% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.74	0.33 - 2.27	0.27

Data Plot and Equation



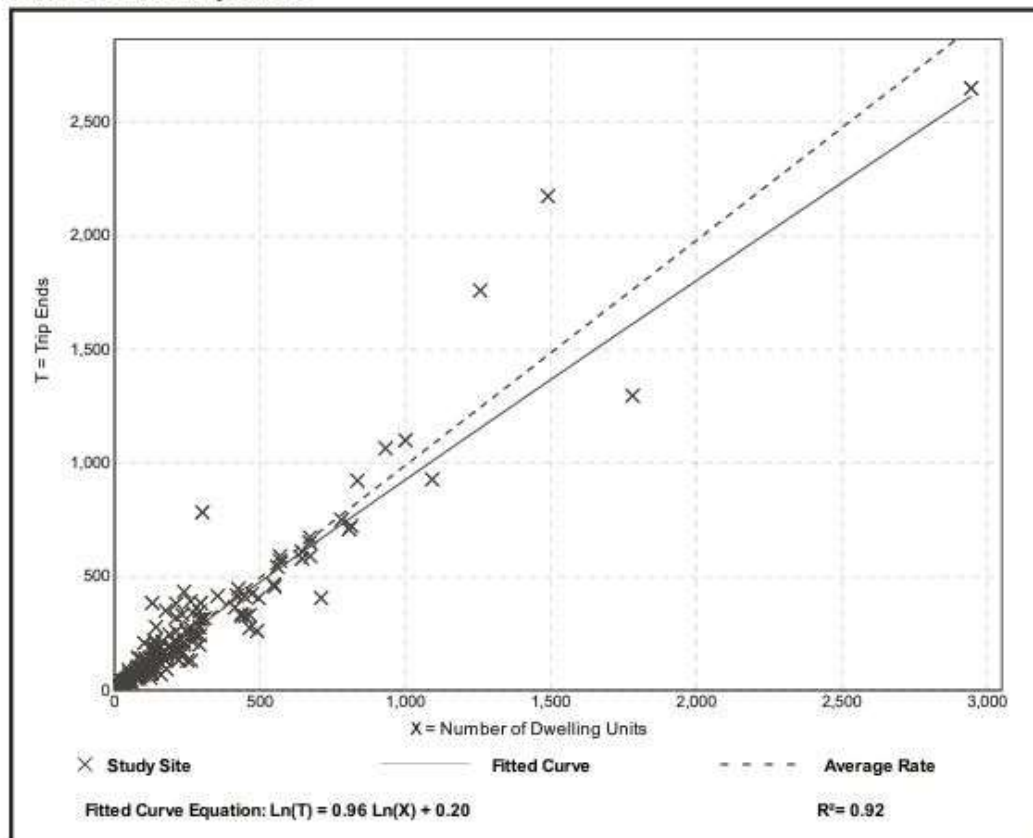
Single-Family Detached Housing (210)

Vehicle Trip Ends vs: Dwelling Units
 On a: Weekday,
 Peak Hour of Adjacent Street Traffic,
 One Hour Between 4 and 6 p.m.
 Setting/Location: General Urban/Suburban
 Number of Studies: 190
 Avg. Num. of Dwelling Units: 242
 Directional Distribution: 63% entering, 37% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.99	0.44 - 2.98	0.31

Data Plot and Equation



Attachment 5
Intersection Worksheets – Full Buildout AM/PM Peaks

HCS7 Two-Way Stop-Control Report

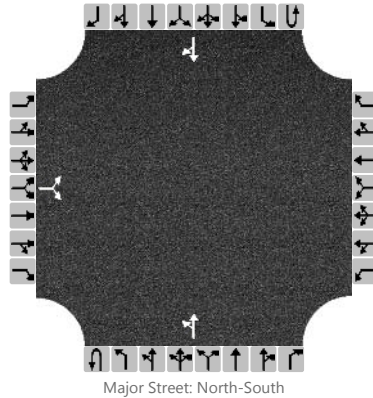
General Information

Analyst	Addie Kirkham
Agency/Co.	FMA
Date Performed	7/27/2020
Analysis Year	2023
Time Analyzed	Full Buildout AM Peak
Intersection Orientation	North-South
Project Description	592.007 Andes Rd Subdivision

Site Information

Intersection	Andes Road at Driveway
Jurisdiction	Knox County
East/West Street	Driveway
North/South Street	Andes Road
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume, V (veh/h)		19		76						26	69				84	6
Percent Heavy Vehicles (%)		2		2						2						
Proportion Time Blocked																
Percent Grade (%)	0															
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		7.1		6.2						4.1						
Critical Headway (sec)		6.42		6.22						4.12						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.52		3.32						2.22						

Delay, Queue Length, and Level of Service

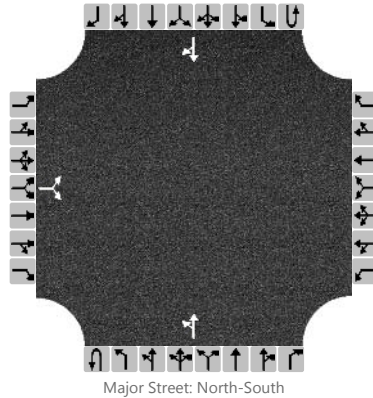
Flow Rate, v (veh/h)			104							28						
Capacity, c (veh/h)			910							1494						
v/c Ratio			0.11							0.02						
95% Queue Length, Q ₉₅ (veh)			0.4							0.1						
Control Delay (s/veh)			9.5							7.5						
Level of Service, LOS			A							A						
Approach Delay (s/veh)	9.5								2.1							
Approach LOS	A															

HCS7 Two-Way Stop-Control Report

General Information

Analyst	Addie Kirkham	Intersection	Andes Road at Driveway
Agency/Co.	FMA	Jurisdiction	Knox County
Date Performed	7/27/2020	East/West Street	Driveway
Analysis Year	2023	North/South Street	Andes Road
Time Analyzed	Full Buildout PM Peak	Peak Hour Factor	0.92
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	592.007 Andes Rd Subdivision		

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	0	0	0	0	1	0	0	0	1	0
Configuration			LR							LT						TR
Volume, V (veh/h)		13		50						85	72				60	21
Percent Heavy Vehicles (%)		2		2						2						
Proportion Time Blocked																
Percent Grade (%)	0															
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		7.1		6.2						4.1						
Critical Headway (sec)		6.42		6.22						4.12						
Base Follow-Up Headway (sec)		3.5		3.3						2.2						
Follow-Up Headway (sec)		3.52		3.32						2.22						

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			68							92						
Capacity, c (veh/h)			877							1507						
v/c Ratio			0.08							0.06						
95% Queue Length, Q ₉₅ (veh)			0.3							0.2						
Control Delay (s/veh)			9.4							7.5						
Level of Service, LOS			A							A						
Approach Delay (s/veh)	9.4								4.3							
Approach LOS	A															

Attachment 6

Turn Lane Warrant Analysis

Project: Andes Road Subdivision

Andes Road at Driveway Connection

Andes Road VOLUMES

at Driveway Connection

LEFT TURN

	Opposing	Thru	LT	LT MAX	Warrant Met
AM	90	69	26	300	NO
PM	81	72	85	300	NO

Andes Road

VOLUMES

at Driveway Connection

RIGHT TURN

	Thru	RT	RT MAX	Warrant Met
AM	84	6	599	NO
PM	60	21	599	NO

TABLE 4A

LEFT-TURN LANE VOLUME THRESHOLDS
FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 35 MPH OR LESS


(If the left-turn volume exceeds the table value a left -turn lane is needed)

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	100 - 149	150 - 199	200 - 249	250 - 299	300 - 349	350 - 399
100 - 149	300	235	185	145	120	100
150 - 199	245	160	130	110	90	80
200 - 249	205	140	115	100	80	70
250 - 299	175	125	105	90	70	65
300 - 349	155	135	110	95	80	60
350 - 399	135	120	100	85	70	55
400 - 449	120	105	90	75	65	50
450 - 499	105	90	80	70	60	50
500 - 549	95	80	70	65	55	45
550 - 599	85	70	65	60	50	40
600 - 649	75	65	60	55	45	35
650 - 699	70	60	55	50	40	30
700 - 749	65	55	50	45	35	30
750 or More	60	50	45	40	35	30

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 599	= / > 600
100 - 149	100	80	70	60	55	50
150 - 199	90	75	65	55	50	45
200 - 249	80	72	60	55	50	45
250 - 299	70	65	55	50	45	40
300 - 349	65	60	50	50	45	40
350 - 399	60	55	50	45	40	40
400 - 449	55	50	45	45	40	35
450 - 499	50	45	45	40	35	35
500 - 549	50	45	40	40	35	35
550 - 599	45	40	40	35	35	35
600 - 649	40	35	35	35	35	30
650 - 699	35	35	35	30	30	30
700 - 749	30	30	30	30	30	30
750 or More	30	30	30	30	30	30

* Or through volume only if a right-turn lane exists.

TABLE 4B
RIGHT-TURN LANE VOLUME THRESHOLDS
FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 35 MPH OR LESS

RIGHT-TURN VOLUME	THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
	<100	100 - 199	200 - 249	250 - 299	300 - 349	350 - 399
Fewer Than 25 25 - 49 50 - 99	 6 RT AM Peak 21 RT PM Peak					
100 - 149 150 - 199						
200 - 249 250 - 299						Yes
300 - 349 350 - 399				Yes	Yes Yes	Yes Yes
400 - 449 450 - 499			Yes Yes	Yes Yes	Yes Yes	Yes Yes
500 - 549 550 - 599		Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

RIGHT-TURN VOLUME	THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 600	+ / > 600
Fewer Than 25 25 - 49 50 - 99					Yes	Yes Yes
100 - 149 150 - 199			Yes	Yes Yes	Yes Yes	Yes Yes
200 - 249 250 - 299	Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
300 - 349 350 - 399	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
500 - 549 550 - 599	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

* Or through volume only if a left-turn lane exists.



Date: July 27, 2020

Project Name: Andes Road Subdivision

To: Knoxville-Knox County Planning

Subject: TIS Review for Andes Road Subdivision (8-SD-20-C / 8-F-20-UR)

Dear Knoxville-Knox County Planning staff,

The following comment response document is submitted to address comments dated July 21, 2020:

1. **Reviewer Comment:** In several parts of the TIS it mentions the full build-out of the development will consist of 134 single family lots, but the actual site plan submitted to Knoxville-Knox County Planning shows 180 single family lots. Please modify these areas and according analysis.

Response: Revised TIS to show an updated 170 single family lots.

2. **Reviewer Comment:** Page 6, update the site plan. This site plan should show the stub-out connection and 180 total lots.

Response: Updated Figure 2: Site Plan to show revised lot layout.

3. **Reviewer Comment:** Page 8, please provide a worksheet outlining the step-by-step calculations and assumptions that were employed for the existing traffic volumes. The Planning review team needs to be able to follow how the existing counts were configured due to the pandemic. Please add such a worksheet to the Appendix.

Response: Added a sheet to Attachment 2 to show the detailed step-by-step calculations and assumptions for the existing traffic volumes.

4. **Reviewer Comment:** Are the bubbles in the figure pointing to the intersection of Chert Pit Road and Andes Road, or just to Andes Road?

Response: The bubble is pointing to the tube count location on Andes Road just south of the intersection of Andes Road at Chert Pit Road.

5. **Reviewer Comment:** Page 17, include a discussion on sight distance for the realignment of Road A to Andes Road.

Response: Added the following to Page 17. "The proposed driveway connection (Road "A") will be located approximately 30 feet north of the existing intersection of Andes Road at Old Andes Road. This realignment of Road "A" will continue to comply with the minimum intersection sight distance requirements."

6. **Reviewer Comment:** Page 18, include a discussion on sight distance easements for internal roads. Also remove the last paragraph since this pavement reduction was not on the site plans and has not been approved by Knox County EPW.

Response: Removed the last paragraph and added the following to page 18. "Sight distance easements for the internal subdivision intersections of Road "A", Road "B", Road "C", Road "D", Road "E and Road "F" should be coordinated with Knox County Engineering and Public Works and included on the final design drawings prior to construction of the subdivision."

Sincerely,



Addie Kirkham, P.E.