

July 28, 2023

Mr. David Arning Vice President of Development Dominion Development Group, LLC 6305 Kingston Pike Knoxville, TN 37919

RE: Traffic Impact Letter

Northshore Drive Multi-Family Development

Knox County, Tennessee

Dear Mr. Arning:

This correspondence is intended as a summary report for the referenced evaluation that was performed at your request. The purpose of this study was to analyze operational conditions of a proposed residential development with access onto Northshore Drive. The project site is located north of the intersection of Northshore Drive and Choto Road, on the east side of Northshore Drive. Figure 1 is a location map showing the major roadways in the project site vicinity.

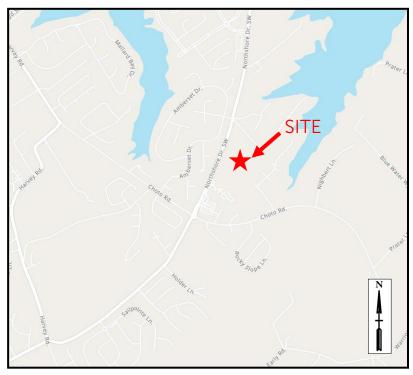


FIGURE 1 LOCATION MAP

The development plan for this site proposes a single-family attached residential development with 56 townhomes. The proposed development will have one full access onto Northshore Drive approximately 1,500 feet north of the intersection with Choto Road. Figure 2 in the Attachments is a Conceptual Site Plan detailing the proposed site.

The purpose of this study was the evaluation of the traffic operational and safety impacts of the proposed development upon roadways in the vicinity of the project site. Comments received from the Knox County Engineering Department resulted in the proposed access onto Northshore Drive being identified for detailed study. Sight distance was measured from the proposed site access looking left and right down Northshore Drive. Turn lane warrant evaluations were conducted at the proposed study intersection for future conditions with site generated traffic, in order to determine need for added turn-lanes entering the site.

EXISTING CONDITIONS

In the vicinity of the proposed development, Northshore Drive is classified as a Minor Arterial per the Knoxville-Knox County Major Road Plan. Within the study limits, Northshore Drive is an undivided two-lane roadway with one travel lane in each direction that generally runs south to north. In front of the proposed site, Northshore Drive has 11-foot lanes, a posted speed limit of 40 mph, and has no curb, gutter or sidewalk.

The area of the site is approximately 11.6 acres, and it is currently zoned Planned Residential. The site is relatively flat and covered with grass; there are some trees scattered around and a few single family homes currently exist on the site.

The Tennessee Department of Transportation (TDOT) collects annual average daily traffic (AADT) data on roadways in the study area. Two count stations, one located on Northshore Drive, and one located on Chto Road, were found near the project site that were felt to have particular relevance for this study. The most currently available data from these stations can be found in Table 1.

TABLE 1: ANNUA	L AVERAGE DAILY	TRAFFIC	COUNT SUMMARY

COUNT YEAR	TDOT COUNT STATION 47000297	TDOT COUNT STATION 47000362
COUNTIEAR	S NORTHSHORE DR, NEAR LOUDON CO LINE	CHOTO RD, SOUTH OF FARRAGUT
2017	14,522	4,265
2018	13,577	4,769
2019	12,716	4,615
2020	11,928	4,753
2021	17,552	5,917
2022	17,359	5,308

In addition to the available AADT data, a bi-directional traffic count was conducted at the proposed site access intersection with Northshore Drive to determine the current morning (AM) and evening (PM) peak hour operating volumes. These peak hour volumes are the traffic volumes with which the study's turn-lane warrant analyses are based. The the bi-directional count was collected on June 27, 2023. The 2023 existing peak hour traffic volumes are summarized in Figure 3 located in the Attachments, as is the raw 24-hour count data.

BACKGROUND CONDITIONS

The proposed development will be constructed in one general phase with completion anticipated by 2025. Therefore, Year 2025 was established as the appropriate design / analysis year for the study. In order to determine traffic volumes resulting solely from background traffic growth to Year 2025, it was necessary to establish an annual growth rate for existing traffic. The TDOT AADT values previously discussed, as well as knowledge of the area, were used to determine an approximate annual growth rate. Based on the available data, a background annual growth rate of 6% was assumed. Figure 4 in the Attachments contains the background traffic volumes that would result from this annual growth rate from Year 2023, when the counts were conducted, to Year 2025.

FUTURE CONDITIONS

In order to estimate the expected traffic volumes to be generated by the proposed development, the procedures recommended by the Institute of Transportation Engineers (ITE) were utilized. The proposed development will include 56 single-family attached housing units. Land Use Code (LUC) 215, "Single-Family Attached Housing" was utilized from ITE's *Trip Generation Manual*, 11th Edition to estimate development-generated traffic. The generated traffic volumes were determined based on the data for the peak hours of adjacent street traffic. See Table 2 for a summary of the traffic generated for this project. More detailed information is contained in the Attachments.

TABLE 2: TRIP GENERATION	SUMMARY
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LAND USE	ITE CODE	SIZE	WEEKDAY (TRIPS/DAY)	AM PEAK HOUR (TRIPS/HOUR)	PM PEAK HOUR (TRIPS/HOUR)
Single-Family Attached Housing	215	56 Units	376	23	30
Entering Trips Exiting Trips			188 (50%) 188 (50%)	6 (25%) 17 (75%)	18 (59%) 12 (41%)

A.M. Peak Hour trip generation is based on Peak Hour of Adjacent Street Traffic, One Hour Between 7 and 9 a.m. P.M. Peak Hour trip generation is based on Peak Hour of Adjacent Street Traffic, One Hour Between 4 and 6 p.m.

The proposed trip distribution for this development was determined through a review of existing travel patterns, local knowledge of the study area, proposed site location in relation to the surrounding roadway network, and engineering judgment. Figure 5 in the Attachments provides a summary of how the above site generated trips would be distributed to the study intersections. Figure 6 in the Attachments provides the proposed trip assignment volumes to the study intersections.

Future projected traffic volumes for the study intersections were developed by adding the generated and assigned trips shown in Figure 6 to the 2025 background traffic volumes developed in the previous section and shown in Figure 4. These combined 2025 volumes reflect the existing traffic, the background traffic growth, and the generated traffic from the proposed development. These future volumes are shown on Figure 7 in the Attachments and are the combined volumes used in the analyses of future conditions with the proposed development.

EVALUATIONS

Intersection sight distance was assessed via field measurements at the proposed intersection of Northshore Drive at the proposed site access. The measurements were taken looking right and left from the proposed site access approach. Based on Knox County sight distance requirements for 40 mph roadways, 400 feet of sight distance is required looking left and right from the proposed site access onto Northshore Drive. The field measurements indicated that sight distance looking right is approximately 650 feet, and sight distance looking left is approximately 900 feet. Sight distance looking both directions is more than required for the proposed site access.

Turn lane warrant evaluations were performed under combined conditions scenarios. For the proposed intersection of Northshore Drive at the site access, the methods employed for the turn lane warrant evaluations were those developed by M.D. Harmelink, as provided by in a series of tables from the Knox County publication, "Access Control and Driveway Design Policy". The results of these evaluations were that right and left turn lanes into the site driveway are not warranted under combined conditions. Additional information can be found on the turn lane evaluation worksheets contained in the Attachments.

CONCLUSIONS & RECOMMENDATIONS

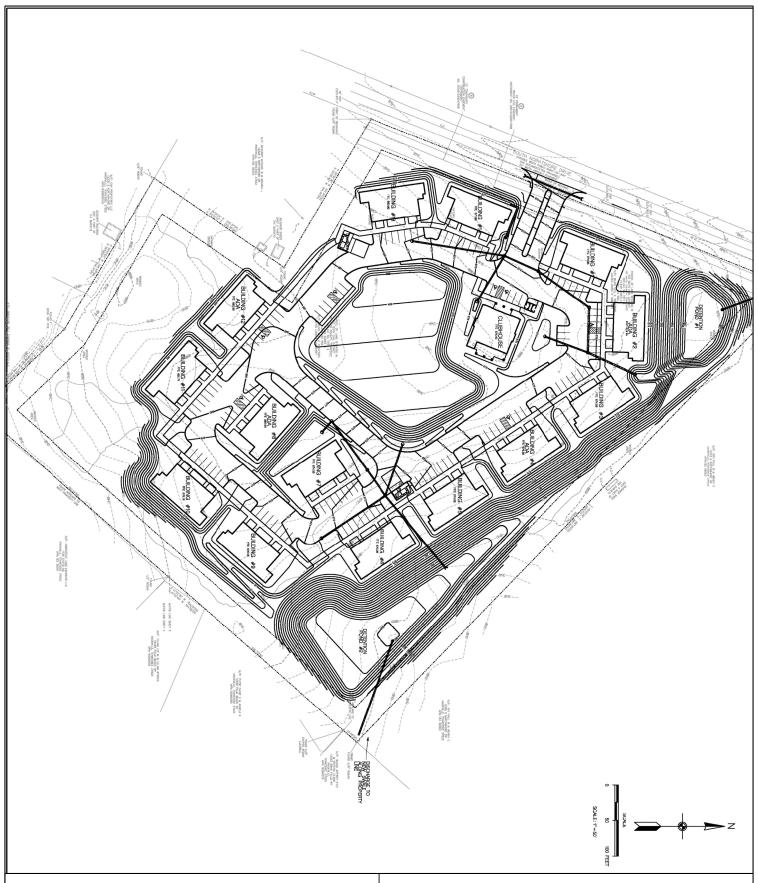
The primary conclusion of this study is that the traffic generated from the proposed development will have minimal impacts at the study intersections. Traffic volumes at this intersection would not warrant the construction of turn lanes on Northshore Drive, and sight distance is adequate. Based on the conclusions and other discussions throughout the report, the only recommendation developed with this traffic impact study is to maintain intersection sight distances at the proposed access point by ensuring that site grading, landscaping, signing, and other features do not restrict lines of sight.

Sincerely,

Brian J. Haas, P.E., PTOE Traffic Team Leader

Bring Man

Attachments

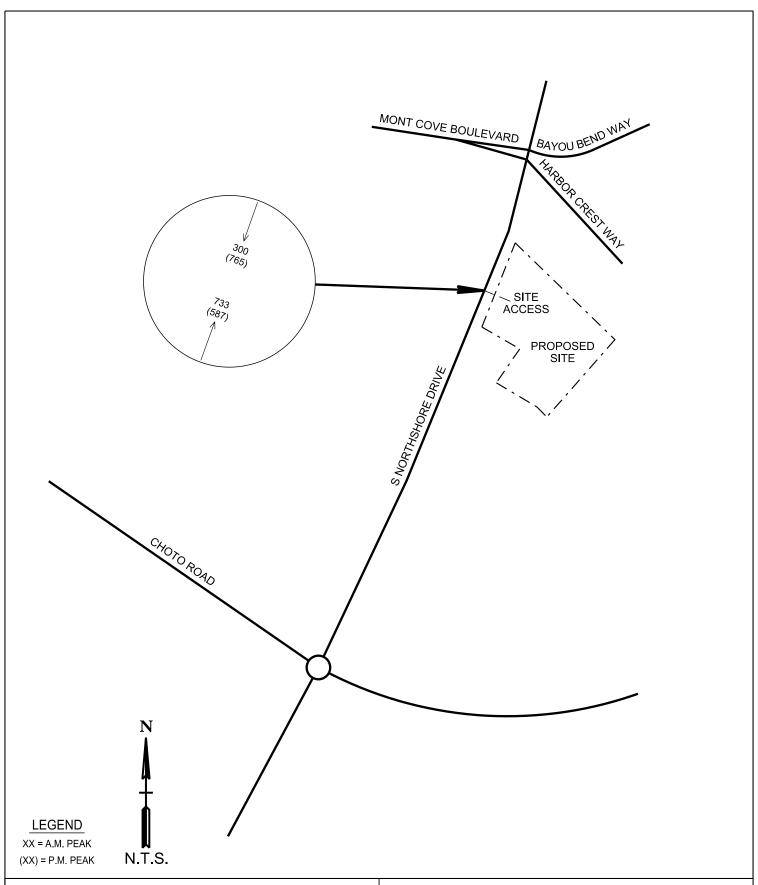




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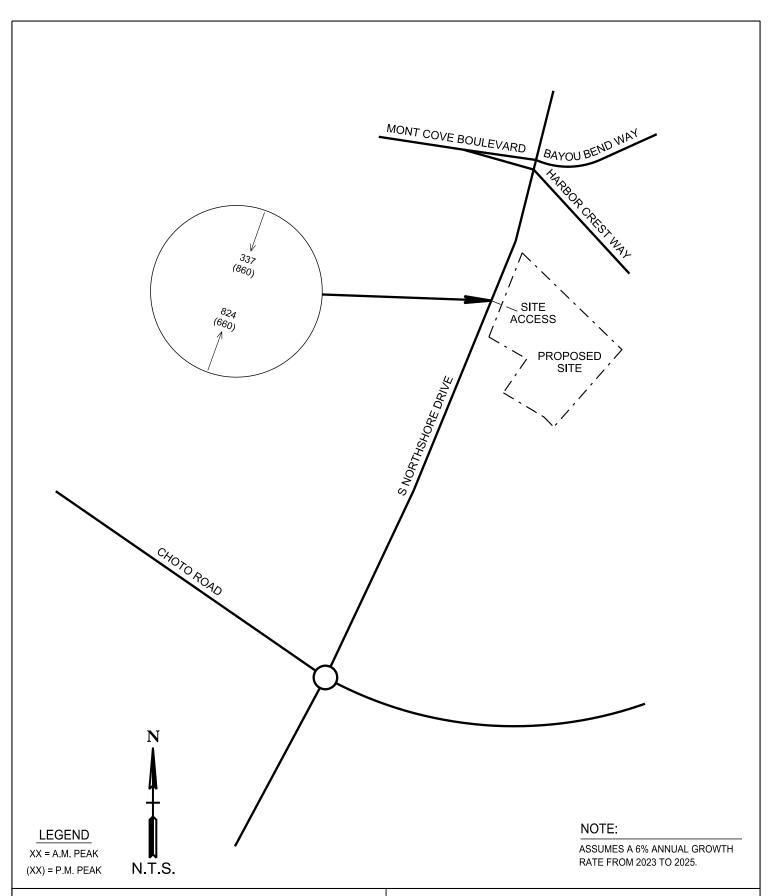
FIGURE 2 CONCEPTUAL SITE PLAN





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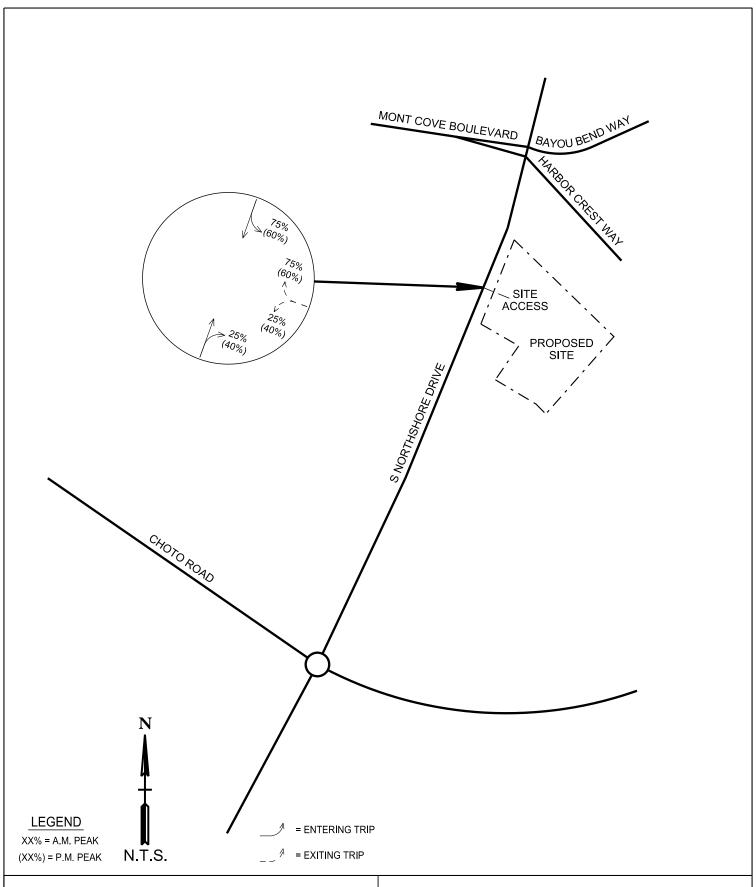
FIGURE 3 EXISTING TRAFFIC VOLUMES (2023)





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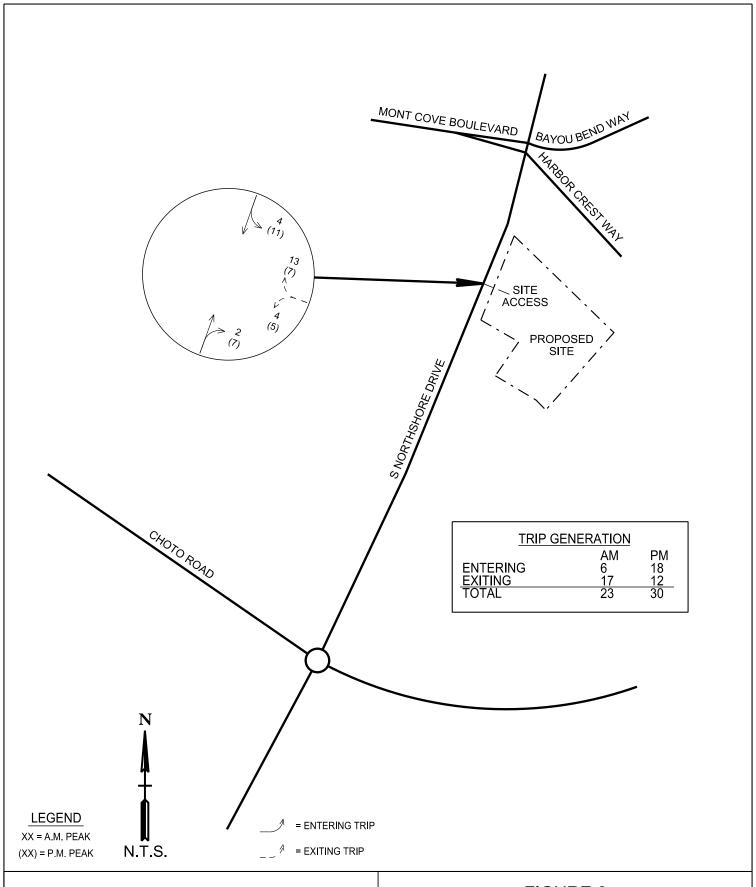
FIGURE 4 BACKGROUND TRAFFIC VOLUMES (2025)





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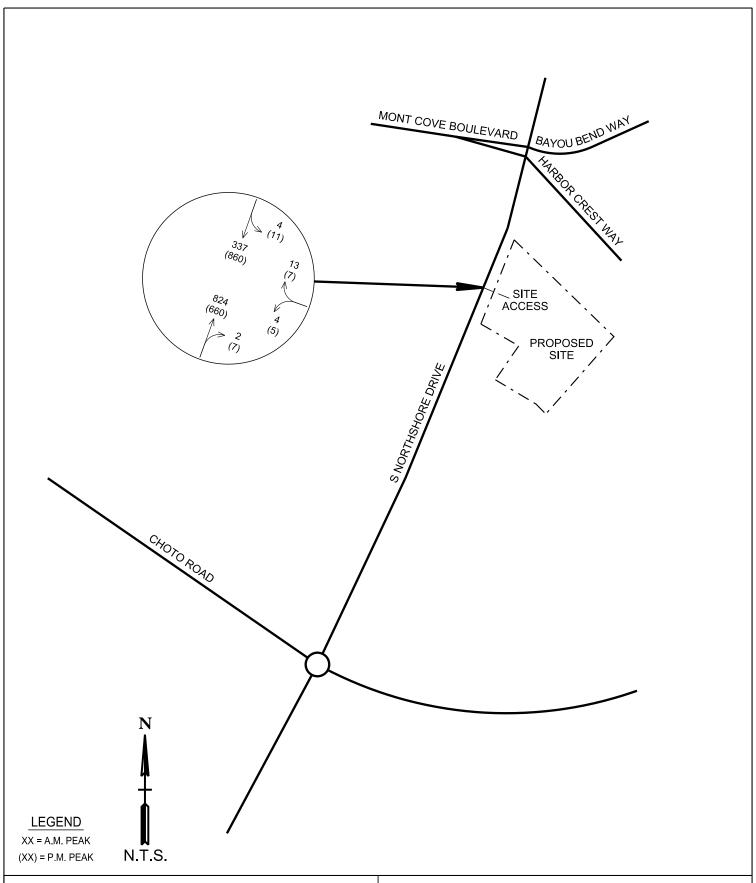
FIGURE 5 TRIP DISTRIBUTION





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FIGURE 6 TRIP ASSIGNMENT VOLUMES





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FIGURE 7 COMBINED TRAFFIC VOLUMES (2025)

VOLUME

S Northshore Dr Bet. Choto Rd & Harbor Crest Way/Mont Cove Blvd

 Day: Tuesday
 City: Knoxville

 Date: 6/27/2023
 Project #: TN23_190034_001

	D	AILY 1	TOT A	ıs		NB		SB		EB		WB							To	tal
		AILI	1017	ILJ		7,504		7,719		0		0							15,	223
AM Period	NB		SB		EB	WB		ТО	TAL	PM Period	NB		SB		ЕВ		WB		то	TAL
0:00	6		17					23		12:00	111		129						240	
0:15 0:30	3 6		4 6					7 12		12:15 12:30	144 106		116 140						260 246	
0:45	9	24	4	31				13	55	12:45	119	480	138	523					257	1003
1:00	2		5					7		13:00	109		141						250	
1:15 1:30	1 3		2 7					3 10		13:15 13:30	100 130		147 124						247 254	
1:45	1	7	2	16				3	23	13:45	97	436	157	569					254	1005
2:00	1		2					3		14:00	117		137						254	
2:15	2		3					5 5		14:15 14:30	119		153						272	
2:30 2:45	1 0	4	4 0	9				0	13	14:45	118 117	471	134 146	570					252 263	1041
3:00	3	•	1					4		15:00	102		149	3.0					251	10.11
3:15	10		2					12		15:15	97		171						268	
3:30 3:45	3 6	22	1	5				4 7	27	15:30 15:45	127 123	449	155 166	641					282 289	1090
4:00	6	22	<u>1</u> 4					10	21	16:00	161	449	170	041				-	331	1090
4:15	7		3					10		16:15	137		172						309	
4:30	17		1					18		16:30	131		200						331	
4:45	20	50	2	10				22	60	16:45	136	565	186	728					322	1293
5:00 5:15	24 22		4 7					28 29		17:00 17:15	151 148		185 205						336 353	
5:30	46		4					50		17:30	148		191						339	
5:45	44	136	8	23				52	159	17:45	140	587	184	765					324	1352
6:00	46		19					65		18:00	130		174						304	
6:15 6:30	76 83		22 26					98 109		18:15 18:30	122 113		169 135						291 248	
6:45	93	298	43	110				136	408	18:45	84	449	128	606					212	1055
7:00	157		44					201		19:00	77		116						193	
7:15	145		67					212		19:15	74		122						196	
7:30 7:45	204 202	708	68 67	246				272 269	954	19:30 19:45	78 67	296	98 86	422					176 153	718
8:00	154	700	69	240				223	554	20:00	65	230	131	722					196	710
8:15	173		96					269		20:15	61		108						169	
8:30	170	622	97	262				267	000	20:30 20:45	54	227	86	401					140	620
8:45 9:00	136 151	633	101	363				237 254	996	21:00	47 47	227	76 84	401					123 131	628
9:15	120		76					196		21:15	27		70						97	
9:30	133		104					237		21:30	29		73						102	
9:45	119	523	103	386				222	909	21:45	27	130	58	285					85	415
10:00 10:15	101 97		85 100					186 197		22:00 22:15	25 17		45 32						70 49	
10:30	123		100					232		22:30	17		42						59	
10:45	126	447	93	387				219	834	22:45	12	71	26	145					38	216
11:00	126		115					241		23:00	7		17						24	
11:15 11:30	110 114		95 118					205 232		23:15 23:30	8 6		16 9						24 15	
11:45	118	468	104	432				222	900	23:45	2	23	4	46					6	69
TOTALS		3320		2018					5338	TOTALS		4184		5701						9885
SPLIT %		62.2%		37.8%					35.1%	SPLIT %		42.3%		57.7%						64.9%
						NB		SB		EB		WB							Te	tal
	D	AILY 1	ΓΟΤΑ	LS								0 0								223
						7,504		7,719		0		U							13,	ZZS
AM Peak Hour		7:30		11:45					7:30	PM Peak Hour		17:00		16:30						17:00
AM Pk Volume		733		489					1033	PM Pk Volume		587		776						1352
Pk Hr Factor		0.898		0.873					0.949	Pk Hr Factor		0.972		0.946						0.958
7 - 9 Volume		1341		609					1950	4 - 6 Volume		1152		1493						2645
7 - 9 Peak Hour 7 - 9 Pk Volume		7:30 733		8:00 363					7:30 1033	4 - 6 Peak Hour 4 - 6 Pk Volume		17:00 587		16:30 776						17:00 1352
Pk Hr Factor		0.898		363 0.899					0.949	Pk Hr Factor		0.972		0.946						0.958
I K III Factor		0.030		0.033	U.U		0.000		0.343	7 K III Tactor		0.312		0.540		0.000		0.000		0.556

Land Use: 215 Single-Family Attached Housing

Description

Single-family attached housing includes any single-family housing unit that shares a wall with an adjoining dwelling unit, whether the walls are for living space, a vehicle garage, or storage space.

Additional Data

The database for this land use includes duplexes (defined as a single structure with two distinct dwelling units, typically joined side-by-side and each with at least one outside entrance) and townhouses/rowhouses (defined as a single structure with three or more distinct dwelling units, joined side-by-side in a row and each with an outside entrance).

The technical appendices provide supporting information on time-of-day distributions for this land use. The appendices can be accessed through either the ITETripGen web app or the trip generation resource page on the ITE website (https://www.ite.org/technical-resources/topics/trip-and-parking-generation/).

The sites were surveyed in the 1980s, the 1990s, the 2000s, and the 2010s in British Columbia (CAN), California, Georgia, Illinois, Maryland, Massachusetts, Minnesota, New Jersey, Ontario (CAN), Oregon, Pennsylvania, South Dakota, Utah, Virginia, and Wisconsin.

Source Numbers

168, 204, 211, 237, 305, 306, 319, 321, 357, 390, 418, 525, 571, 583, 638, 735, 868, 869, 870, 896, 912, 959, 1009, 1046, 1056, 1058, 1077



Single-Family Attached Housing (215)

Dwelling Units Vehicle Trip Ends vs: Weekday On a:

Setting/Location: General Urban/Suburban

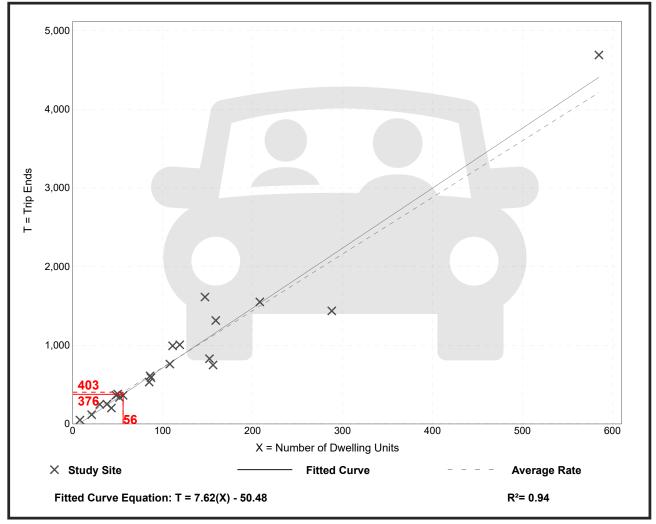
Number of Studies: 22 120 Avg. Num. of Dwelling Units:

Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
7.20	4.70 - 10.97	1.61

Data Plot and Equation



Trip Gen Manual, 11th Edition

• Institute of Transportation Engineers

1/1

https://itetripgen.org/printGraph 9

Single-Family Attached Housing

(215)

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

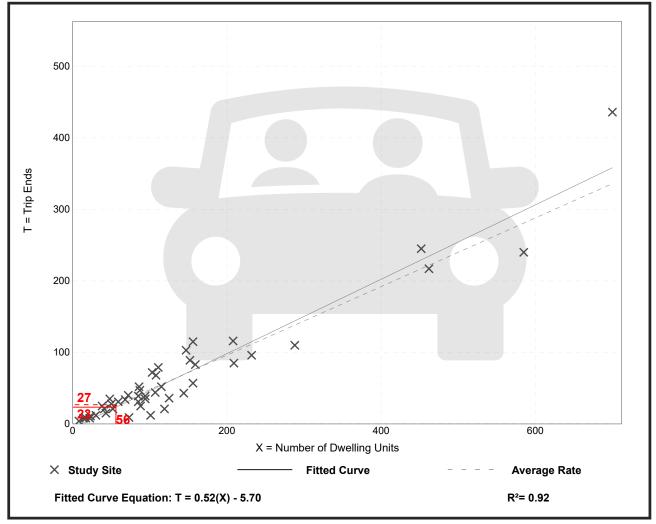
Number of Studies: 46 Avg. Num. of Dwelling Units: 135

> Directional Distribution: 25% entering, 75% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.48	0.12 - 0.74	0.14

Data Plot and Equation



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https://itetripgen.org/printGraph 10

Single-Family Attached Housing

(215)

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

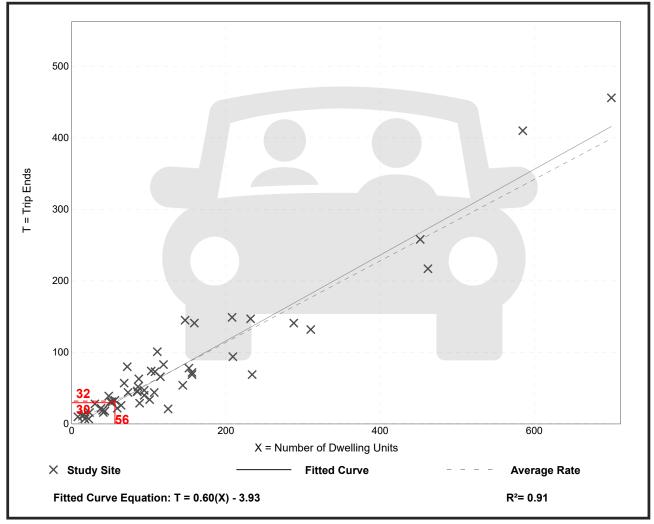
Number of Studies: 51 Avg. Num. of Dwelling Units: 136

Directional Distribution: 59% entering, 41% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.57	0.17 - 1.25	0.18

Data Plot and Equation



Trip Gen Manual, 11th Edition

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https://itetripgen.org/printGraph 11

TABLE 5A

LEFT-TURN LANE VOLUME THRESHOLDS FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 36 TO 45 MPH

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

OPPOSING	THROUG	H VOLUME I	PLUS RIGH	T-TURN V	OLUME	*
VOLUME	100 - 149	150 - 199	200 - 249	250-299	==300 ==349 ==	350 - 399
100 - 149	250	180	140	110	80	70
150 - 199	200	140	105	90	70	60
204) - 249	160	115	85	75	65	55
250) - 249	130	100	75	65	60	50
300 - 349	110	90	70	60	55	45
350 - 399		80	65	55	50	40
400 - 449	90	70	60	50	45	35
450 - 499	80	65	55	45	40	30
500 - 549	70	60	45	35	35	25
550 - 599		55	40	35	30	25
600 - 649	60	45 35	35 35	30 30	25 25	25 20
700- 749	50	35	30	25	20	20
750 or More	45	35	25	25		20

OPPOSING	THROU	GH VOLUME	PLUS RIGH	T-TURN	VOLUME	, *
VOLUME	350 - 399	400 - 449	450 - 499	500 - 549	550 - 599	=/ > 600
100 - 149	70	60	50	45	40	35
150 - 199	60	55	45	40	35	30
200 - 249	55	50	40	35	30	30
250 - 299	50	45	35	30	30	30
300 - 349	45	40	35	30	25	25
350 - 399	40 .	35	30	25	25	20
400 - 449	35	30	30	25	20	20
450 - 499	30	25	25	20	20	20
500 - 549	25	25	20	20	20	15
550 - 599	25	20	20	20	20	15
600 - 649	25	20	20	20	20	15
650 - 699	20	20	20	20	20	15
700 - 749	20	20	20	15	15	15
750 or More	20	20	20	15	15	15

^{*} Or through volume only if a right-turn lane exists

Left Turn Volume: 4

Through Plus Right Volume: 337

Opposing Volume: 826

TABLE 5A

LEFT-TURN LANE VOLUME THRESHOLDS FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 36 TO 45 MPH

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

OPPOSING	THROUG	H VOLUME	PLUS RIGH	T-TURN V	OLUME	*
VOLUME	100 - 149	150 - 199	200 - 249	250-299	300=349	350 - 399
100 - 149	250	180	140	110	80	70
150 - 199	200	140	105	90	70	60
209) - 249	160	115	85	75	65	55
280) - 299	130	100	75	65	60	50
300 - 349	110	90	70	60	55	45
350 - 399		80	65	55	50	40
400 - 449	90	70	60	50	45	35
450 - 499	80	65	55	45	40	30
500 - 549	70	60	45	35	35	25
550 - 599		55	40	35	30	25
600 - 649	60	45	35	30	25	25
	55	35	35	30	25	20
700]- 749	50	35	30	25	20	20
750 or More	45	35	25	25	20	20

OPPOSING	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *									
VOLUME	350 - 399	400 - 449	450 - 499	500 - 549	550 - 599	=/ >600				
100 - 149	70	60	50	45	40	35				
150 - 199	60	55	45	40	35	30				
200 - 249	55	50	40	35	30	30				
250 - 299	50	45	35	30	30	30				
300 - 349	45	40	35	30	25	25				
350 - 399	40 .	35	30	25	25	20				
400 - 449	35	30	30	25	20	20				
450 - 499	30	25	25	20	20	20				
500 - 549	25	25	20	20	20	15				
550 - 599	25	20	20	20	20	15				
600 - 649	25	20	20	20	20	15				
650 - 699	20	20	20	20	20	15				
700 - 749	20	20	20	15	15	15				
750 or More	20	20	20	15	15	15				

^{*} Or through volume only if a right-turn lane exists

Left Turn Volume: 11

Through Plus Right Volume: 860

Opposing Volume: 667

TABLE 5B

RIGHT-TURN LANE VOLUME THRESHOLDS FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 36 TO 45 MPH

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						
100 - 149 150 - 199						
200 - 249 250 - 299					Yes	Yes Yes
300 - 349 350 - 399			Yes	Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499		Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
500 - 549 550 - 599	Yes	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	No Yes Yes
100 - 149 150 - 199		Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
200 - 249 250 - 299	Yes 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.

Right Turn Volume: 2

Through Plus Left Volume: 824

TABLE 5B

RIGHT-TURN LANE VOLUME THRESHOLDS FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 36 TO 45 MPH

RIGHT-TURN	THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
VOLUME	< 100	100 - 199	200 - 249	250 - 299	300 - 349	350 - 399
Fewer Than 25 25 - 49 50 - 99						
100 - 149 150 - 199						
200 - 249 250 - 299					Yes	Yes Yes
300 - 349 350 - 399			Yes	Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499		Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
500 - 549 550 - 599	Yes	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	No Yes Yes	
100 - 149 150 - 199		Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	
200 - 249 250 - 299	Yes 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.

Right Turn Volume: 7

Through Plus Left Volume: 660