South Kingstown, Rhode Island

The Village at Curtis Corner

February, 2020

TRAFFIC IMPACT STUDY

BETA
701 George Washington Hwy
Lincoln, Rhode Island 02865
401.333.2382
www.BETA-Inc.com

The Village at Curtis Corner

South Kingstown, Rhode Island

TRAFFIC IMPACT STUDY

Prepared by: BETA GROUP, INC.

Prepared for: Mr. Alex Petrucci
5A Builders, LLC
15 Robertson Road
Narragansett, Rhode Island 02882

February, 2020

February 17, 2020

Mr. Alex Petrucci
5A Builders, LLC
15 Robertson Road
Narragansett, Rhode Island 02882

Re: Proposed Land Development Project
The Village at Curtis Corner
Curtis Corner Road
South Kingstown, Rhode Island

Dear Mr. Petrucci:

BETA Group, Inc., in accordance with our scope of services, has completed a traffic impact study for a proposed residential development project in the Town of South Kingstown, Rhode Island. The site is located along the northerly side of Curtis Corner Road opposite Asa Pond, just west of Kingstown Road (Route 108). The parcel is defined by Assessor's Plat 40-4, Lot 55, which contains approximately 28.1 acres of undeveloped land.

Based upon information provided by the site engineer, *DiPrete Engineering*, and a review of the proposed development plan, it is our understanding that an existing wooded lot will be developed to accommodate 32 residential homes consisting of 16 single family and 16 multiunit residences. The main site access is proposed from a new subdivision roadway on Curtis Corner Road, approximately 700 feet west of Kingstown Road.

The study included herein was conducted to determine the adequacy of the existing serving roadways to accommodate anticipated traffic to be generated by the residential development project. An analysis of potential impacts to the roadway capacity and safety has been completed and is discussed in the following report.

Very truly yours,
BETA Group, Inc.

Richard A. Bernardo, P.E.
Vice President

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1.0 INTRODUCTION

The objective of the following study is to assess the potential traffic impacts associated with a proposed residential development project, *The Village at Curtis Corner*, in the Town of South Kingstown, Rhode Island. The project is located on a property along the northerly side of Curtis Corner Road between South Road and Kingstown Road (Route 108). The undeveloped 28.1 acre parcel will be subdivided into 24 residential lots consisting of 16 single family units, two of which front Curtis Corner Road, and 8 duplex units for a total of 32 homes. Access/egress to the new cul-de-sac neighborhood containing 30 homes will be provided from a proposed residential street intersecting with Curtis Corner Road. In addition, the two proposed single-family homes fronting Curtis Corner Road will have a shared access driveway, just west of the new residential street. Refer to the Figure 1, Project Vicinity Map, on the following page for the project location within the community.

The study summarized herein focused on both traffic flow efficiency and safety along Curtis Corner Road in the immediate area. The impacts associated with the site related traffic have been defined and evaluated in accordance with standard traffic engineering guidelines and procedures.

The traffic engineering study completed for this project included the following:

- A traffic counting program to define existing traffic patterns and operating characteristics along the immediate servicing roadways including Curtis Corner Road as part of design of future site access and circulation needs. Record data from the RIDOT and from a recent study completed by BETA along Curtis Corner Road was reviewed.

- An inventory of the physical roadway characteristics of the servicing roadways to determine the adequacy of the existing roadway geometric features in reference to access, safety, and operations.

- An estimate of future traffic volumes for the proposed residential development was calculated using data from the "Trip Generation" Manual, an informational report published by the Institute of Transportation Engineers (ITE).

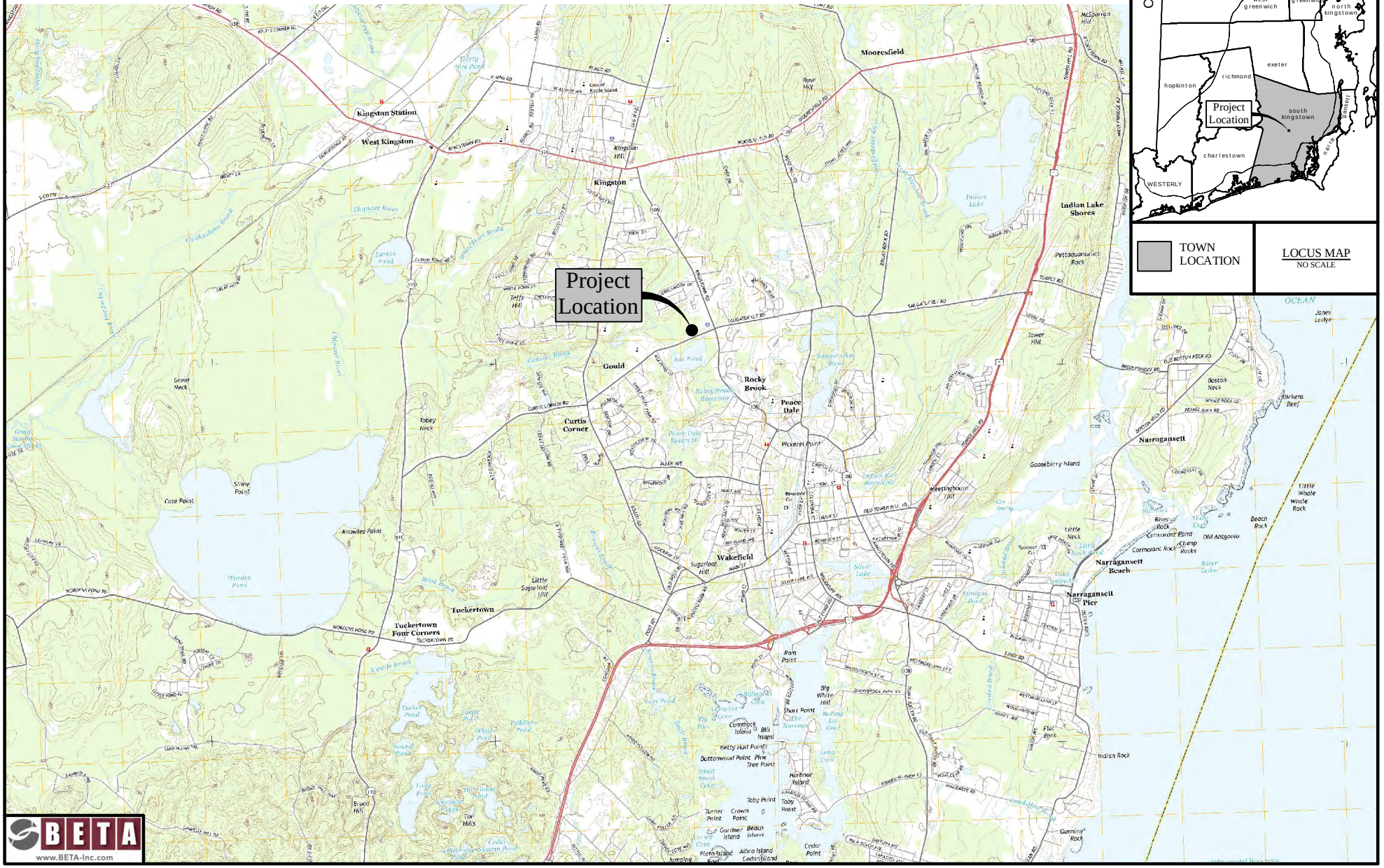
- Evaluation and analysis of the traffic safety and operational conditions for existing and future traffic periods.

- Development of recommendations for mitigation improvements where necessary, that would be required to maintain safe and efficient traffic flow in the project area.

The Village at Curtis Corner

SOUTH KINGSTOWN, RHODE ISLAND

Figure 1 - Project Vicinity Map



2.0 PROJECT AREA

As noted in the previous section, the subject property is situated along the northerly side of Curtis Corner Road, just west of Kingstown Road (Route 108). The lot is currently undeveloped and wooded. Access to the new *The Village at Curtis Corner* neighborhood will be provided from a new residential street intersecting with Curtis Corner Road. Figure 2 on the following page depicts the general project area, and the boundary lines of the subject property.

Land use in the immediate area can be described as a mixture of residential, commercial and government properties. Immediately abutting the subject property to the north is a wooded area, to the east is the South Kingstown Police Department, to the west are individual residential properties, and to the south across Curtis Corner Road is Asa Pond. Further to the west along Curtis Corner Road is the *Curtis Corner Middle School*, the *Champagne Heights* affordable senior apartment facility operated by the town, a vehicle repair and sales business and small residential neighborhoods off of intersecting side streets. Further to the south along Route 108 in the Peace Dale Village are commercial properties including restaurants, gas stations, auto part stores, and small commercial plazas. Further north along Route 138 is the *University of Rhode Island* Kingston campus.

Curtis Corner Road will serve as the primary access route to the proposed residential neighborhood, with the new cul-de-sac roadway providing immediate local access. Based upon the good operating characteristics of this roadway, and the relatively low amount of additional traffic anticipated with the new homes during peak daily traffic conditions, a study impact area was defined for this project. The limits of our analysis focused on Curtis Corner Road at the proposed site driveway.

3.0 EXISTING CONDITIONS

3.1 ROADWAYS

Curtis Corner Road

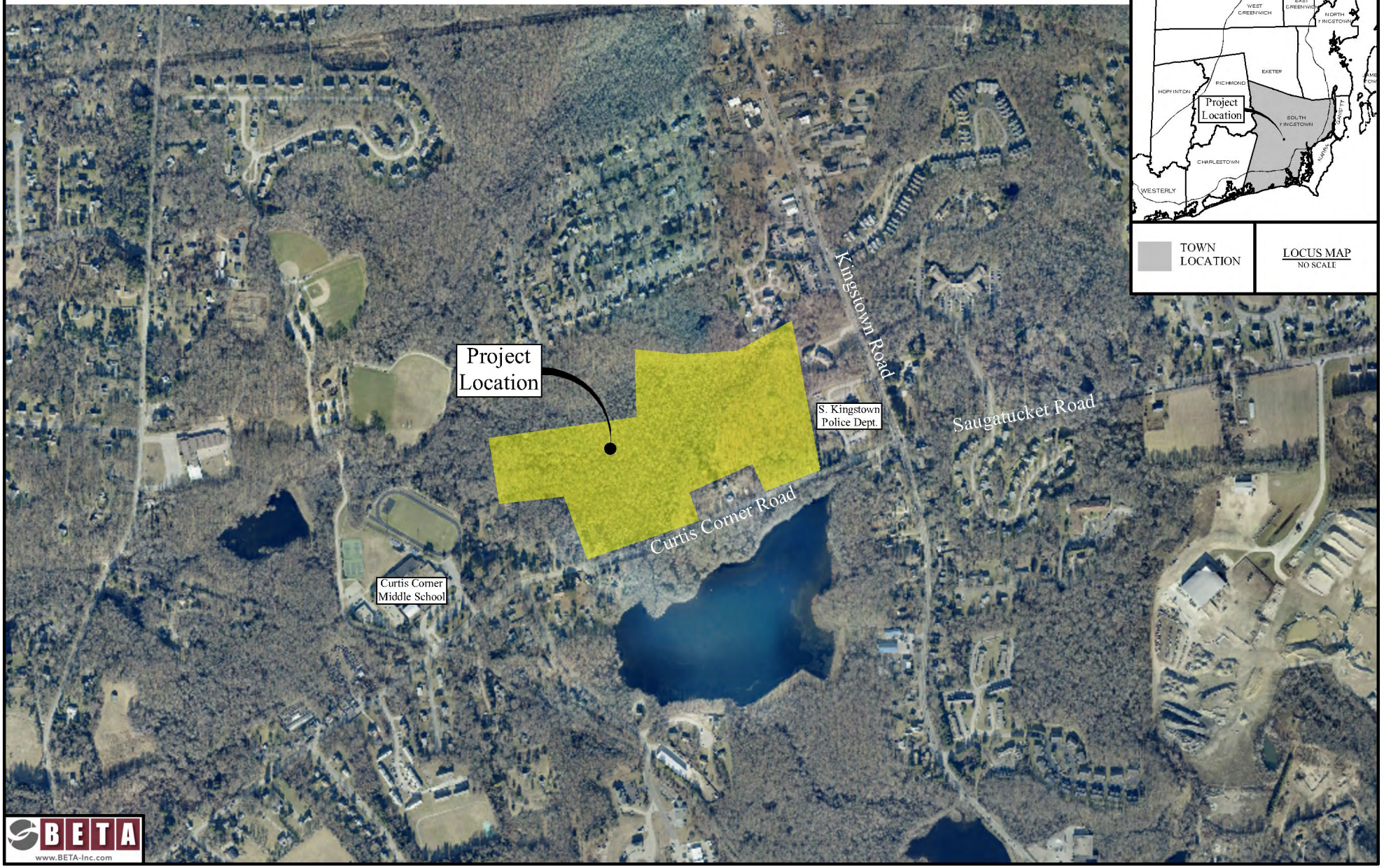
Curtis Corner Road is classified as a major collector road, running in an east/west direction extending from Route 108 to the east to Ministerial Road (Route 110) to the west. In the project area, Curtis Corner Road is approximately 26 feet wide with a 13-foot travel lane in each direction separated by double yellow centerline and no shoulder markings.

The speed limit is posted at 25 mph with school zone speed limit posted

The Village at Curtis Corner

SOUTH KINGSTOWN, RHODE ISLAND

Figure 2 - Project Area Map



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at 20 mph for the *Curtis Corner Middle School*. In addition, school zone signing for the middle school is posted. Cement concrete curbing and sidewalks are only provided along the northerly side of the road between the middle school and Route 108 to the east. The pavement can be classified as being in fair condition with visible minor block cracking. Sporadic cobra-head light fixtures on utility poles are provided along the southerly side of the roadway for nighttime illumination. The photograph on the previous page depicts the physical characteristics of Curtis Corner Road looking east.

3.2 Traffic Flow Data

Existing traffic flow characteristics for this area was determined from a data collection effort completed by BETA in the project area, and record data from the RIDOT. The data collected included Automatic Traffic Recorder (ATR) counts along Curtis Corner Road just west of the subject site.

Curtis Corner Road is heavily influenced by the *Curtis Corner Middle School* during the school year during the morning peak hour of traffic along the road, though it does not coincide with the afternoon commuter peak traffic condition. Based upon the ATR data obtained, Curtis Corner Road west of Route 108 was found to service an Average Daily Traffic (ADT) volume of approximately 4,800 vehicles per day. On a typical weekday along Curtis Corner Road, traffic volumes begin to increase at 5:00 AM, with the morning commuter/school peak hour occurring between 7:00 and 8:00 AM. During this hour, an average of approximately 550 vehicles was recorded. After 9:00 AM, volumes decreased substantially and remained consistent to between 200 and 300 vehicles per hour until the early afternoon peak of approximately 450 serviced between 2:00 and 3:00 PM during the school dismissal period. Volumes then decreased slightly until the afternoon commuter peak of 450 serviced between 4:00 and 5:00 PM. Complete count information can be found in the Appendix.

4.0 Safety Analysis

To determine if there are any limiting factors affecting safety relating to access to the new residential subdivision, the physical characteristics of Curtis Corner Road in the study area were investigated. These limiting factors would potentially include horizontal or vertical alignment changes or roadside obstructions that limit sight distances for vehicles traveling along the road or entering the road from a side street or driveway location. In this instance, the sight distance standard is necessary to permit turning vehicles to safely enter and exit the site access road.

The horizontal and vertical alignment of Curtis Corner Road in the project area can be described as generally straight and level with a gradual horizontal curve just west of Asa Pond Road in the vicinity of the middle school. Based upon the existing roadway geometry as described, the available sight distances at the site access road intersection were found to be greater than 500 feet to the east and west. These values are in excess of AASHTO's recommended minimum sight distance of 155 feet for the posted speed limit of 25 mph and 305 feet based on the measured 85th percentile speed of 40 mph.

It should be noted that there was roadside vegetation observed along the northerly side of Curtis Corner Road along the property frontage. This vegetation (small trees and brush), could potentially restrict sight lines for vehicles exiting the proposed site access road if allowed to mature further and become overgrown. To provide improved sight lines at the new intersection, appropriate trimming and clearing

of this vegetation along the property frontage should be reviewed during construction after required clearing for the driveway, and the appropriate treatment completed.

As a result of the preliminary evaluation of the existing roadway geometry and physical features, it does not appear that any significant physical roadway safety deficiencies exist within the defined study area that would warrant roadway or traffic related safety improvements, except for the previously mentioned sight line review recommended along the site frontage.

5.0 IMPACT ANALYSIS

5.1 TRIP GENERATION

To determine the traffic impact of a proposed development, estimates of anticipated traffic to be generated by a particular land use must be calculated. As previously discussed, this residential development proposal includes construction of 16 single family homes and 8 duplex units on an undeveloped 28.1-acre lot on the northerly side of Curtis Corner Road west of Kingstown Road (Route 108). Access to the new homes will be provided via a new cul-de-sac residential road containing 22 separate lots with the required frontage and size per current zoning regulations. In addition, two separate lots will have a shared access driveway along Curtis Corner Road just west of the new residential street. Figure 3 on the following page depicts the site layout and access plan, prepared by *DiPrete Engineering*.

For this development, estimated traffic volumes for the residential project were based on the use of trip generation factors. These factors are taken from the "Trip Generation" manual, an informational report published by the Institute of Transportation Engineers (ITE), a national professional organization for traffic and transportation engineers. The data provided in the ITE report are based on extensive traffic studies for various types of land uses (residential, commercial, industrial, etc.). This data has been found to be very reliable and provides a sound basis for estimating future trips to new development projects.

For the proposed residential neighborhood, Land Use Code 210 Single-Family Detached Housing and Land Use Code 220 Multifamily Housing (Low-Rise) were reviewed for applicability in developing an estimate of site related vehicle trips. The appropriate worksheets from the manual are included in the Appendix along with the trip estimate calculations. Table 1 summarizes the estimated trip volumes calculated for this project.

5.2 FUTURE TRAFFIC VOLUMES

In order to properly assess the impacts of a development, future traffic conditions of area roadways should be estimated for the period when the development is constructed and fully occupied. Typically, the expansion of base traffic is calculated when a project is to be constructed over an extended period (3 to 5 years). In all instances, area growth that may affect capacity results should be considered. For this project, a conservative annual growth rate of 1.0 percent was utilized for the future background traffic growth of the servicing roadways in addition to known site-specific developments that are being considered by the Town of South Kingstown.

The Village at Curtis Corner

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Figure 3 - Site Layout

Site Plan provided by DiPrete Engineering

TABLE 1 – Trip Generation Estimate

	Description		Enter	Exit	Total
AM PEAK HOUR					
ITE Land Use Code 210	Single-Family Detached Housing		3	9	12
ITE Land Use Code 220	Multifamily Housing (Low-Rise)		1	3	4
		Total	**4**	**12**	**16**
PM PEAK HOUR					
ITE Land Use Code 210	Single-Family Detached Housing		10	6	16
ITE Land Use Code 220	Multifamily Housing (Low-Rise)		3	2	5
		Total	**13**	**8**	**21**

One of the known future development potentials is the proposed relocation of the South Kingstown High School to the existing Curtis Corner Middle School site on Curtis Corner Road, to the west of the subject site. For the future conditions analysis, the estimated site-specific trips for the relocated high school were added to the design year base volumes, along with the proposed residential development, *The Village at Curtis Corner*, to establish the future 2023 Build traffic periods.

In developing the intersection volumes to be analyzed under the build condition, a directional distribution of the site traffic was estimated based upon the current traffic patterns in the project area. It is estimated that 60% of the site traffic will arrive from and depart to the east and 40% will arrive from and depart to the west during the AM and PM peak hours. Figure 4 on the following page depicts the future Build traffic conditions during the AM and PM peak hours studied for this project. Site distribution figures are provided in the Appendix.

5.3 Operation Analysis

The key to any traffic impact analysis is the evaluation of roadway operations during peak traffic periods on the servicing roadway system. This situation would occur when the site-generated traffic, combined with the traffic volumes on the main roadway, result in the highest one-hour volume serviced along a roadway segment, or through an intersection. Review of the record traffic data found that the weekday AM and PM peak hours would represent this worst-case combination of site-generated traffic with the servicing roadway peak traffic period.

The Village at Curtis Corner

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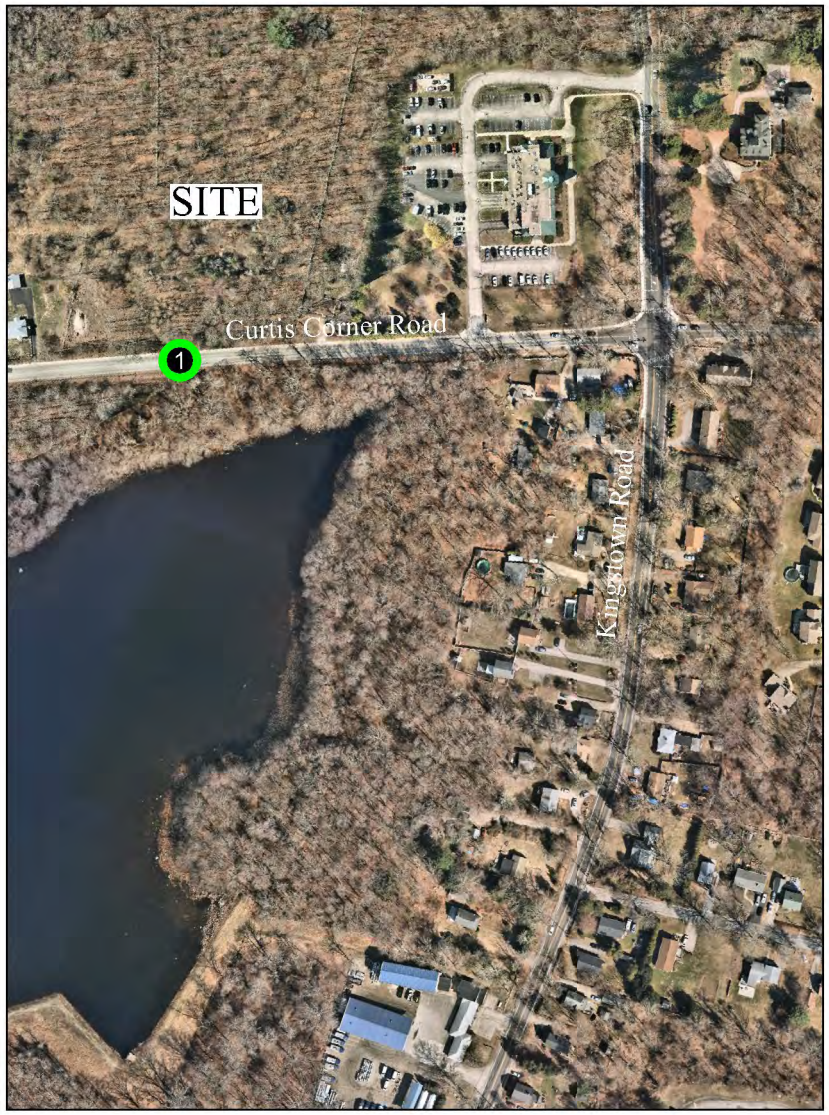
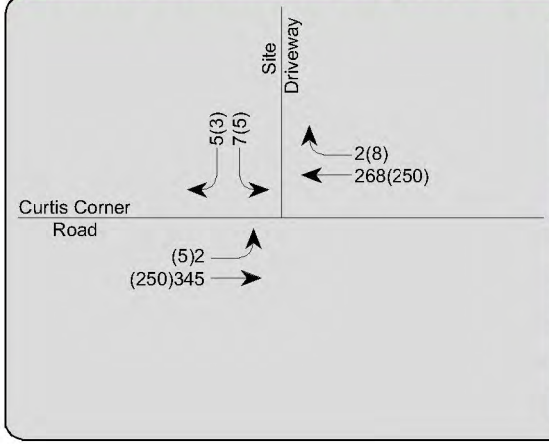
Figure 4 - Future Traffic Volumes



1 CURTIS CORNER ROAD/SITE ACCESS DRIVEWAY



LEGEND:

- TURN LANE
- XXX AM PEAK VOLUMES (7:00 TO 8:00)
- (XXX) PM PEAK VOLUMES (4:00 TO 5:00)
- 1 STUDY INTERSECTION
- TRAFFIC SIGNAL

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The Highway Capacity Manual methodology provides the most accurate means of evaluating traffic capacity and delays for roadways and intersections. The results of this procedure are expressed in terms of Level of Service (LOS). Level of Service is a qualitative measure of traffic flow efficiency based on anticipated vehicle delays. For example, LOS "A" represents the best condition with little or no delay, while LOS "F" indicates that the roadway/intersection is at full capacity resulting in extended vehicle delays and potential queuing. Table 2 on page 11 outlines the Level of Service delay criteria presented in the Highway Capacity Manual for signalized and unsignalized intersections.

TABLE 2 – Highway Capacity Manual Criteria

Level of Service	Unsignalized Delay Per Vehicle (sec)	Signalized Delay Per Vehicle (sec)
A	<10	<10
B	>10 and <15	>10 and <20
C	>15 and <25	>20 and <35
D	>25 and <35	>35 and <55
E	>35 and <50	>55 and <80
F	>50	>80

The proposed Curtis Corner Road intersection with the site access driveway was analyzed for the weekday morning and afternoon peak hour, which would represent the periods of greatest impact of site related traffic. The capacity analysis worksheets are included in the Appendix and Table 3 below summarizes the results of the analyses.

TABLE 3 – Level of Service Summary (Future Conditions)

Location / Movement	FUTURE CONDITIONS							
	AM Peak Hour				PM Peak Hour			
	LOS	Delay	95th % Queue Length (veh.)	v/c	LOS	Delay	95th % Queue Length (veh.)	v/c
Curtis Corner Road at Site Access Driveway (U)								
Curtis Corner Rd. EB Left	A	7.9	1	0.00	A	7.8	1	0.01
Site Access Road SB	B	12.1	1	0.03	B	11.4	1	0.02

(S) – Signalized
(U) – Unsignalized

As can be seen in the table the future build conditions analysis of the study intersection found that the proposed traffic condition during the daily peak periods resulting from new residential development project will have minimal impact on overall traffic operations along Curtis Corner Road, specifically at the defined study intersection reviewed for this project. The unsignalized intersection of Curtis Corner Road with the site access road will operate efficiently with critical movements experiencing minor delays of fewer than 12 seconds, representing Levels of Service (LOS) B or better during the daily peak hours of traffic.

6.0 CONCLUSIONS AND RECOMMENDATIONS

In summary, the study has shown that the proposed residential development project access and circulation plan has been designed to provide a level of traffic safety and efficiency on the servicing roadway system with the recommended improvements. As previously referenced, overgrown vegetation on the northerly side of Curtis Corner Road along the property frontage should be trimmed and selectively cleared to enhance both the sight lines for vehicles exiting the neighborhood and improve the visibility of the intersection for approaching motorist along Curtis Corner Road. The safety of the servicing roadways and specifically at the proposed study intersection were also reviewed for geometry and sight distances. The proposed intersection location was determined to provide sufficient sight distances in accordance with AASHTO criteria for visibility and decision making of drivers attempting to enter/exit main street traffic from a side street.

The results of the operational analysis determined that the estimated minor increase in traffic during the peak periods resulting from the proposed residential project will have a negligible effect on overall traffic operations along the servicing roadways, particularly during the daily morning and afternoon peak hours when the new residential neighborhood would generate its highest daily traffic volumes.

Therefore, based upon the data collected on the servicing roadways, the analysis completed as part of this study, it can be concluded that the future traffic conditions resulting from the proposed residential development, will provide for adequate and safe access to a public street, and will not have a detrimental effect on public safety and welfare in the study area.

APPENDIX

A. Traffic Volume Data

B. Trip Generation

C. Operational Analysis

APPENDIX A – Traffic Volume Data

Automatic Traffic Recorder Count

Curtis Corner Road

BETA Group, Inc.
701 George Washington Highway
Lincoln, Rhode Island 02865
401.333.2382

Project Name: School Development
Town/City: South Kingstown, RI
Roadway: Curtis Corner Road
Location: 1,400 Feet East of Middle School

Start Date: 11/15/2019
End Date: 11/22/2019

Time	11/11/19 Mon	11/12/19 Tue	11/13/19 Wed	11/14/19 Thu	11/15/19 Fri	Weekday Average	11/16/19 Sat	11/17/19 Sun
12:00 AM	*	*	*	*	*	*	20	10
01:00	*	*	*	*	*	*	19	11
02:00	*	*	*	*	*	*	8	9
03:00	*	*	*	*	*	*	1	3
04:00	*	*	*	*	*	*	4	3
05:00	*	*	*	*	*	*	24	17
06:00	*	*	*	*	*	*	50	39
07:00	*	*	*	*	*	*	126	52
08:00	*	*	*	*	*	*	187	132
09:00	*	*	*	*	*	*	274	176
10:00	*	*	*	*	*	*	277	209
11:00	*	*	*	*	*	*	330	247
12:00 PM	*	*	*	*	*	*	352	251
01:00	*	*	*	*	*	*	284	232
02:00	*	*	*	*	*	*	288	233
03:00	*	*	*	*	397	397	268	223
04:00	*	*	*	*	422	422	232	192
05:00	*	*	*	*	343	343	218	101
06:00	*	*	*	*	229	229	136	73
07:00	*	*	*	*	153	153	102	95
08:00	*	*	*	*	99	99	78	99
09:00	*	*	*	*	83	83	71	56
10:00	*	*	*	*	80	80	67	20
11:00	*	*	*	*	51	51	37	7
Total	0	0	0	0	1857	1857	3453	2490
Percent	0.0%	0.0%	0.0%	0.0%	100.0%		185.9%	134.1%
AM Peak							12:00 PM	12:00 PM
Volume	0	0	0	0	0	0	352	251
PM Peak					04:00	04:00	12:00 PM	12:00 PM
Volume	0	0	0	0	422	422	352	251

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Project Name: School Development
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Roadway: Curtis Corner Road
Location: 1,400 Feet East of Middle School

Start Date: 11/15/2019
End Date: 11/22/2019

Time	11/18/19 Mon	11/19/19 Tue	11/20/19 Wed	11/21/19 Thu	11/22/19 Fri	Weekday Average	11/23/19 Sat	11/24/19 Sun
12:00 AM	6	8	9	21	18	12	*	*
01:00	3	7	7	3	4	5	*	*
02:00	1	3	4	2	5	3	*	*
03:00	1	2	5	1	4	3	*	*
04:00	12	18	12	14	14	14	*	*
05:00	39	40	39	37	42	39	*	*
06:00	152	158	164	178	127	156	*	*
07:00	527	556	519	521	541	533	*	*
08:00	388	375	434	376	397	394	*	*
09:00	245	257	257	270	304	267	*	*
10:00	220	259	247	233	262	244	*	*
11:00	257	247	222	240	284	250	*	*
12:00 PM	244	298	283	274	*	275	*	*
01:00	298	325	244	333	*	300	*	*
02:00	452	449	470	428	*	450	*	*
03:00	372	423	394	365	*	388	*	*
04:00	409	484	447	433	*	443	*	*
05:00	293	384	312	329	*	330	*	*
06:00	227	344	253	237	*	265	*	*
07:00	141	150	162	179	*	158	*	*
08:00	91	128	109	129	*	114	*	*
09:00	54	88	78	73	*	73	*	*
10:00	39	49	51	44	*	46	*	*
11:00	22	28	15	27	*	23	*	*
Total	4493	5080	4737	4747	2002	4785	0	0
Percent	93.9%	106.2%	99.0%	99.2%	41.8%		0.0%	0.0%
AM Peak	07:00	07:00	07:00	07:00	07:00	07:00		
Volume	527	556	519	521	541	533	0	0
PM Peak	02:00	04:00	02:00	04:00		02:00		
Volume	452	484	470	433	0	450	0	0

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Start Date: 11/15/2019
End Date: 11/22/2019

11/11/2019	11/11/2019		11/12/2019		11/13/2019		11/14/2019		11/15/2019		Weekday Average		11/16/2019		11/17/2019	
Time	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
12:00 AM	*	*	*	*	*	*	*	*	*	*	*	*	8	12	3	7
1:00	*	*	*	*	*	*	*	*	*	*	*	*	5	14	3	8
2:00	*	*	*	*	*	*	*	*	*	*	*	*	4	4	5	4
3:00	*	*	*	*	*	*	*	*	*	*	*	*	0	1	0	3
4:00	*	*	*	*	*	*	*	*	*	*	*	*	2	2	3	0
5:00	*	*	*	*	*	*	*	*	*	*	*	*	19	5	8	9
6:00	*	*	*	*	*	*	*	*	*	*	*	*	34	16	24	15
7:00	*	*	*	*	*	*	*	*	*	*	*	*	78	48	31	21
8:00	*	*	*	*	*	*	*	*	*	*	*	*	114	73	65	67
9:00	*	*	*	*	*	*	*	*	*	*	*	*	169	105	97	79
10:00	*	*	*	*	*	*	*	*	*	*	*	*	146	131	105	104
11:00	*	*	*	*	*	*	*	*	*	*	*	*	179	151	123	124
12:00 PM	*	*	*	*	*	*	*	*	*	*	*	*	157	195	136	115
1:00	*	*	*	*	*	*	*	*	*	*	*	*	140	144	114	118
2:00	*	*	*	*	*	*	*	*	*	*	*	*	130	158	104	129
3:00	*	*	*	*	*	*	*	*	182	215	182	215	108	160	101	122
4:00	*	*	*	*	*	*	*	*	198	224	198	224	121	111	80	112
5:00	*	*	*	*	*	*	*	*	161	182	161	182	108	110	56	45
6:00	*	*	*	*	*	*	*	*	106	123	106	123	60	76	26	47
7:00	*	*	*	*	*	*	*	*	68	85	68	85	48	54	44	51
8:00	*	*	*	*	*	*	*	*	31	68	31	68	33	45	50	49
9:00	*	*	*	*	*	*	*	*	40	43	40	43	19	52	22	34
10:00	*	*	*	*	*	*	*	*	44	36	44	36	26	41	12	8
11:00	*	*	*	*	*	*	*	*	13	38	13	38	14	23	2	5
Total	0	0	0	0	0	0	0	0	843	1014	843	1014	1722	1731	1214	1276
Day	0		0		0		0		1857		1857		3453		2490	
AM Peak													11:00	12:00 PM	12:00 PM	11:00
Volume	0	0	0	0	0	0	0	0	0	0	0	0	179	195	136	124
PM Peak									4:00	4:00	4:00	4:00	12:00 PM	12:00 PM	12:00 PM	2:00
Volume	0	0	0	0	0	0	0	0	198	224	198	224	157	195	136	129

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11/18/2019	11/18/2019		11/19/2019		11/20/2019		11/21/2019		11/22/2019		Weekday Average		11/23/2019		11/24/2019	
Time	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
12:00 AM	4	2	3	5	1	8	4	17	4	14	3	9	*	*	*	*
1:00	1	2	4	3	3	4	1	2	3	1	2	2	*	*	*	*
2:00	0	1	1	2	3	1	1	1	1	4	1	2	*	*	*	*
3:00	1	0	2	0	4	1	1	0	3	1	2	0	*	*	*	*
4:00	9	3	12	6	10	2	10	4	9	5	10	4	*	*	*	*
5:00	30	9	33	7	31	8	30	7	36	6	32	7	*	*	*	*
6:00	96	56	97	61	95	69	102	76	72	55	92	63	*	*	*	*
7:00	281	246	303	253	289	230	276	245	276	265	285	248	*	*	*	*
8:00	215	173	204	171	231	203	193	183	211	186	211	183	*	*	*	*
9:00	129	116	148	109	145	112	159	111	181	123	152	114	*	*	*	*
10:00	119	101	131	128	128	119	129	104	138	124	129	115	*	*	*	*
11:00	132	125	115	132	112	110	117	123	138	146	123	127	*	*	*	*
12:00 PM	123	121	142	156	153	130	142	132	*	*	140	135	*	*	*	*
1:00	134	164	138	187	108	136	154	179	*	*	134	166	*	*	*	*
2:00	241	211	238	211	244	226	222	206	*	*	236	214	*	*	*	*
3:00	165	207	203	220	200	194	153	212	*	*	180	208	*	*	*	*
4:00	204	205	244	240	188	259	211	222	*	*	212	232	*	*	*	*
5:00	105	188	153	231	132	180	135	194	*	*	131	198	*	*	*	*
6:00	93	134	167	177	109	144	109	128	*	*	120	146	*	*	*	*
7:00	57	84	66	84	54	108	69	110	*	*	62	96	*	*	*	*
8:00	29	62	53	75	32	77	44	85	*	*	40	75	*	*	*	*
9:00	19	35	38	50	42	36	28	45	*	*	32	42	*	*	*	*
10:00	19	20	25	24	26	25	17	27	*	*	22	24	*	*	*	*
11:00	7	15	10	18	3	12	7	20	*	*	7	16	*	*	*	*
Total	2213	2280	2530	2550	2343	2394	2314	2433	1072	930	2358	2426	0	0	0	0
Day	4493		5080		4737		4747		2002		4784		0		0	
AM Peak	7:00	7:00	7:00	7:00	7:00	7:00	7:00	7:00	7:00	7:00	7:00	7:00				
Volume	281	246	303	253	289	230	276	245	276	265	285	248	0	0	0	0
PM Peak	2:00	2:00	4:00	4:00	2:00	4:00	2:00	4:00			2:00	4:00				
Volume	241	211	244	240	244	259	222	222	0	0	236	232	0	0	0	0
Comb Total	4493		5080		4737		4747		3859		6641		3453		2490	
ADT	N/A															

Page 2 of 2

APPENDIX B – Trip Generation

ITE Trip Generation Summary

Site Trip Distribution

ITE Land Use Code

ITE Land Use Code 210 – Single-Family Detached Housing

ITE Land Use Code 220 – Multifamily Housing (Low-Rise)

B

ITE Trip Generation Summary

Trip Generation Summary

Summary;

	Description		Enter	Exit	Total
AM Peak Hour					
ITE Land Use Code 210	Single-Family Detached Housing		3	9	12
ITE Land Use Code 220	Multifamily Housing (Low-Rise)		1	3	4
		TOTAL	**4**	**12**	**16**
PM Peak Hour					
ITE Land Use Code 210	Single-Family Detached Housing		10	6	16
ITE Land Use Code 220	Multifamily Housing (Low-Rise)		3	2	5
		TOTAL	**13**	**8**	**21**

Calculations;

ITE Land Use Code 210 Single-Family Detached Housing (16 Dwelling Units)

Independent Variable (X) = Dwelling Units X = 16

AM Peak *Directional Distribution: 25% Entering 75% Exiting*

T	=	0.74 (X)	Enter:	3
T	=	0.74 16	Exit:	9
T	=	12	Total:	12

PM Peak *Directional Distribution: 63% Entering 37% Exiting*

T	=	0.99 (X)	Enter:	10
T	=	0.99 16	Exit:	6
T	=	16	Total:	16

ITE Land Use Code 220 Multifamily Housing (Low-Rise) (8 Dwelling Units)

Independent Variable (X) = Dwelling Units X = 8

AM Peak *Directional Distribution: 23% Entering 77% Exiting*

T	=	0.46 (X)	Enter:	1
T	=	0.46 8	Exit:	3
T	=	4	Total:	4

PM Peak *Directional Distribution: 63% Entering 37% Exiting*

T	=	0.56 (X)	Enter:	3
T	=	0.56 8	Exit:	2
T	=	5	Total:	5

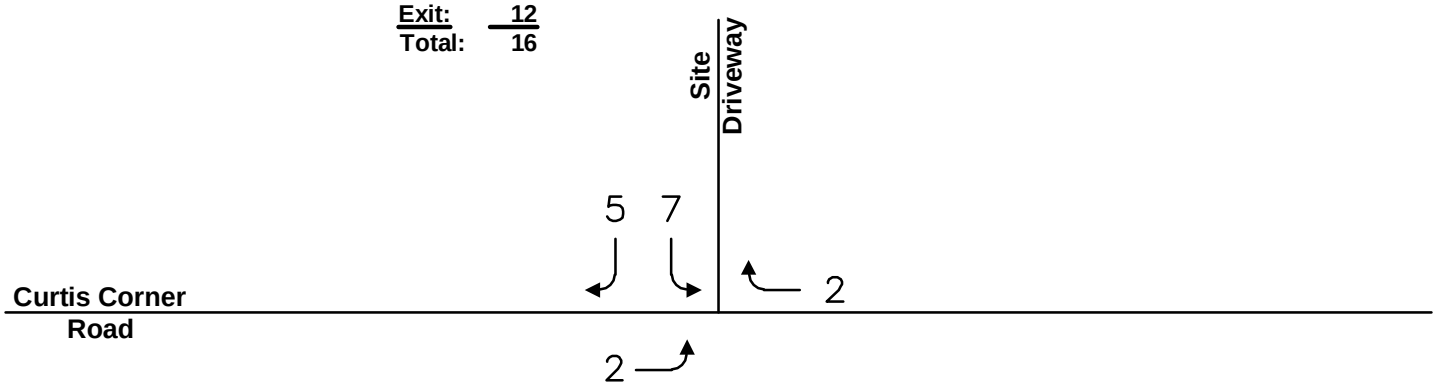
B

Site Trip Distribution

SITE

Site Trips:

Enter:	**4**
Exit:	**12**
Total:	**16**



WEEKDAY TRAFFIC DISTRIBUTION
AM PEAK HOUR BUILD

THE VILLAGE AT CURTIS CORNER
SOUTH KINGSTOWN, RHODE ISLAND

BETA
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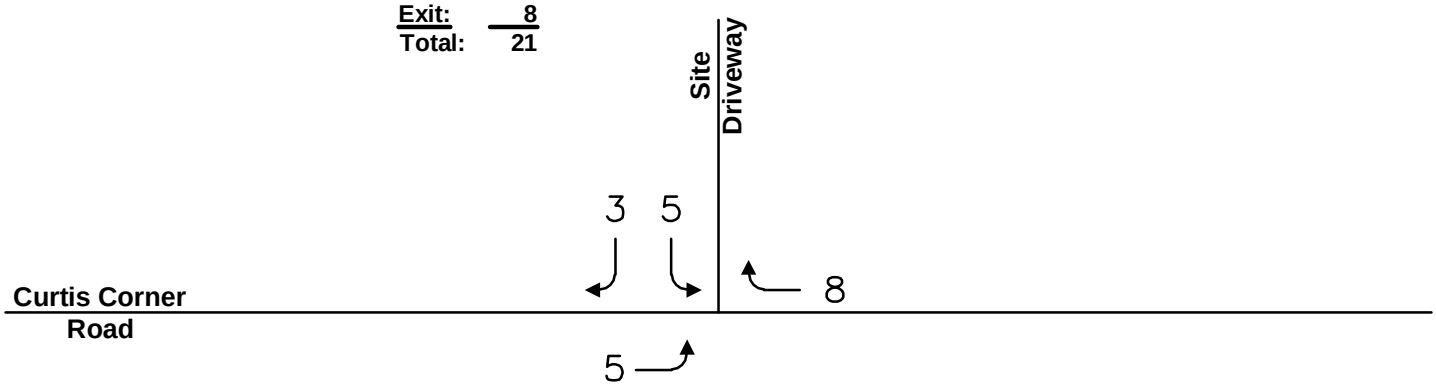
SITE

Site Trips:

Enter:	**13**
Exit:	**8**
Total:	**21**



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WEEKDAY TRAFFIC DISTRIBUTION
PM PEAK HOUR BUILD

THE VILLAGE AT CURTIS CORNER
SOUTH KINGSTOWN, RHODE ISLAND

B

ITE Land Use Code

ITE Land Use Code 210 – Single-Family Detached Housing

ITE Land Use Code 220 – Multifamily Housing (Low-Rise)

ITE Land Use Code 210 – Single-Family Detached Housing

Land Use: 210
Single-Family Detached Housing

Description

Single-family detached housing includes all single-family detached homes on individual lots. A typical site surveyed is a suburban subdivision.

Additional Data

The number of vehicles and residents had a high correlation with average weekday vehicle trip ends. The use of these variables was limited, however, because the number of vehicles and residents was often difficult to obtain or predict. The number of dwelling units was generally used as the independent variable of choice because it was usually readily available, easy to project, and had a high correlation with average weekday vehicle trip ends.

This land use included data from a wide variety of units with different sizes, price ranges, locations, and ages. Consequently, there was a wide variation in trips generated within this category. Other factors, such as geographic location and type of adjacent and nearby development, may also have had an effect on the site trip generation.

Single-family detached units had the highest trip generation rate per dwelling unit of all residential uses because they were the largest units in size and had more residents and more vehicles per unit than other residential land uses; they were generally located farther away from shopping centers, employment areas, and other trip attractors than other residential land uses; and they generally had fewer alternative modes of transportation available because they were typically not as concentrated as other residential land uses.

Time-of-day distribution data for this land use are presented in Appendix A. For the six general urban/suburban sites with data, the overall highest vehicle volumes during the AM and PM on a weekday were counted between 7:15 and 8:15 a.m. and 4:00 and 5:00 p.m., respectively. For the two sites with Saturday data, the overall highest vehicle volume was counted between 3:00 and 4:00 p.m. For the one site with Sunday data, the overall highest vehicle volume was counted between 10:15 and 11:15 a.m.

The sites were surveyed in the 1980s, the 1990s, the 2000s, and the 2010s in California, Connecticut, Delaware, Illinois, Indiana, Maryland, Minnesota, Montana, New Jersey, North Carolina, Ohio, Oregon, Pennsylvania, South Carolina, South Dakota, Tennessee, Vermont, and Virginia.

Source Numbers

100, 105, 114, 126, 157, 167, 177, 197, 207, 211, 217, 267, 275, 293, 300, 319, 320, 356, 357, 367, 384, 387, 407, 435, 522, 550, 552, 579, 598, 601, 603, 614, 637, 711, 716, 720, 728, 735, 868, 903, 925, 936

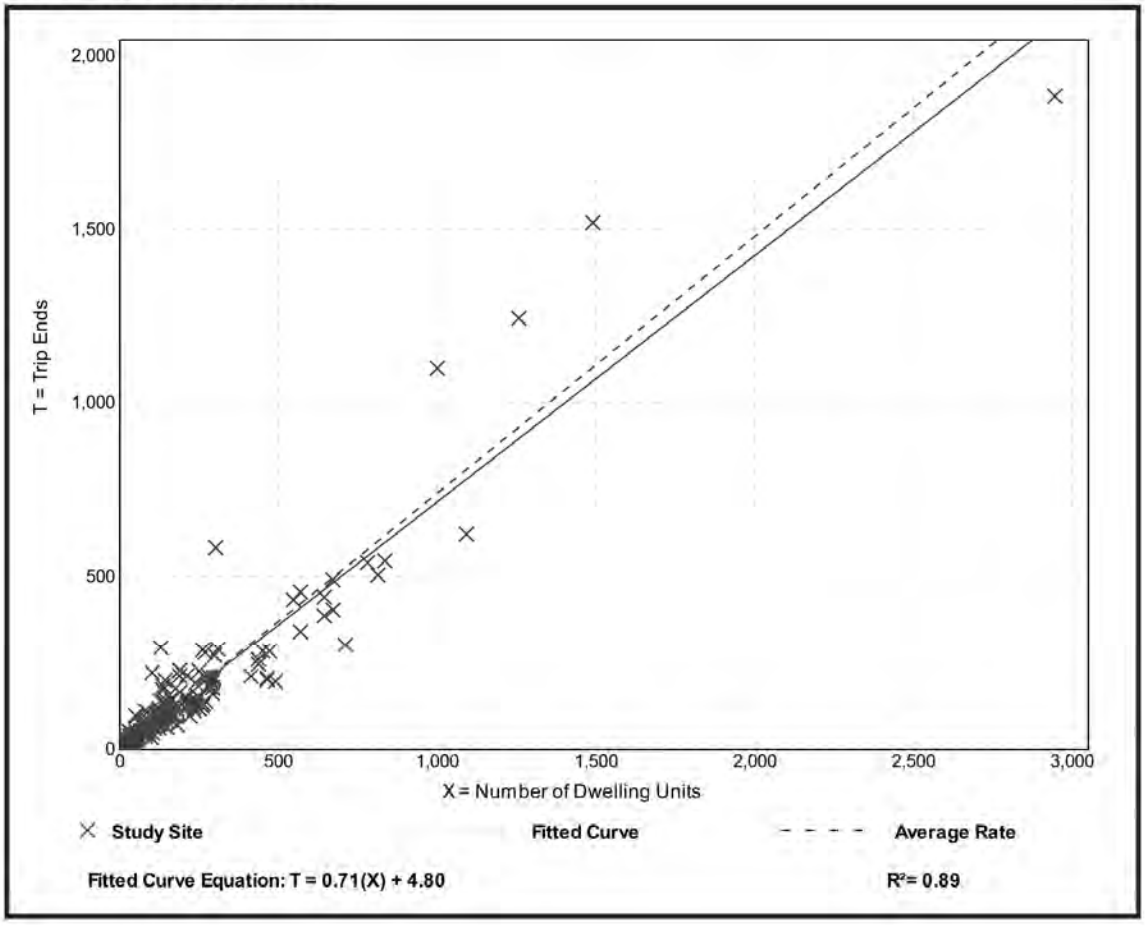
Single-Family Detached Housing
(210)

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



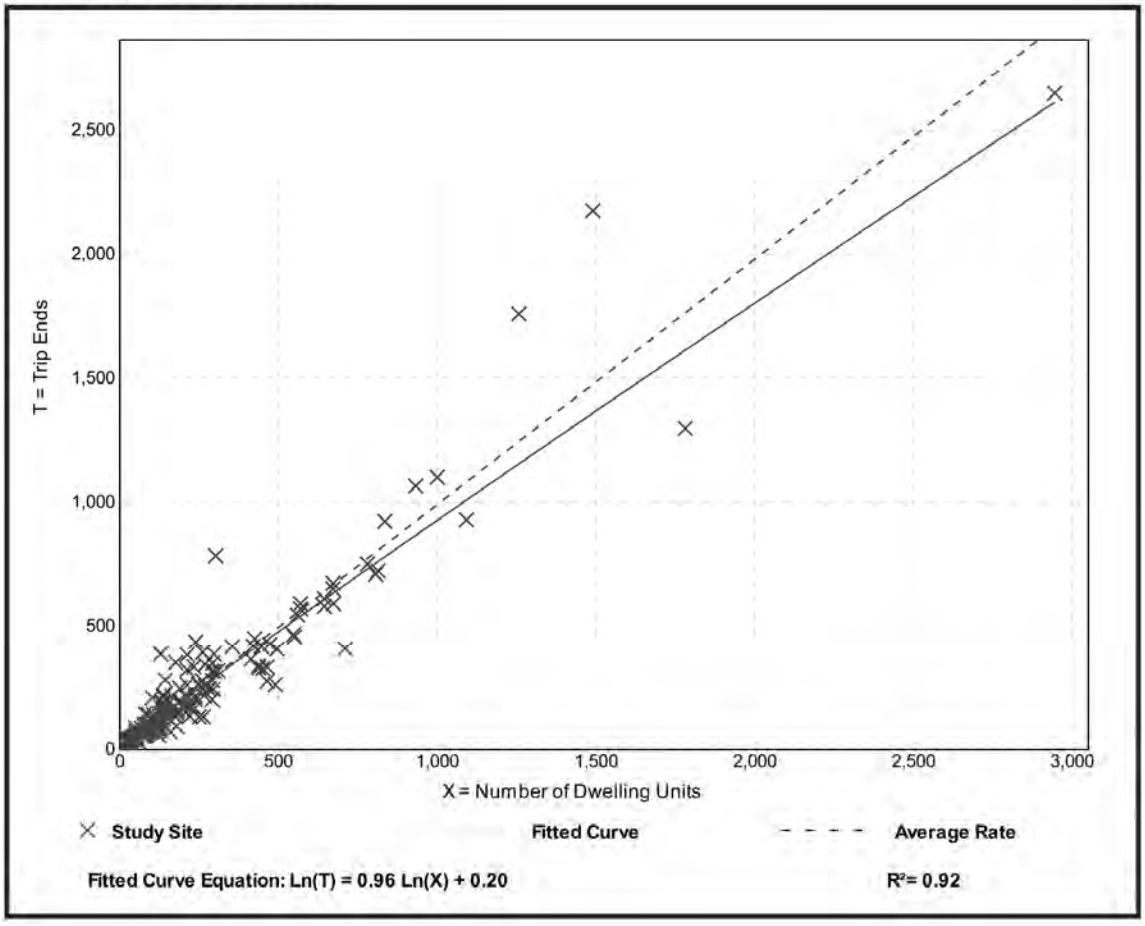
Single-Family Detached Housing
(210)

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



ITE Land Use Code 220 – Multifamily Housing (Low-Rise)

Land Use: 220
Multifamily Housing (Low-Rise)

Description

Low-rise multifamily housing includes apartments, townhouses, and condominiums located within the same building with at least three other dwelling units and that have one or two levels (floors). Multifamily housing (mid-rise) (Land Use 221), multifamily housing (high-rise) (Land Use 222), and off-campus student apartment (Land Use 225) are related land uses.

Additional Data

In prior editions of *Trip Generation Manual*, the low-rise multifamily housing sites were further divided into rental and condominium categories. An investigation of vehicle trip data found no clear differences in trip making patterns between the rental and condominium sites within the ITE database. As more data are compiled for future editions, this land use classification can be reinvestigated.

For the three sites for which both the number of residents and the number of occupied dwelling units were available, there were an average of 2.72 residents per occupied dwelling unit.

For the two sites for which the numbers of both total dwelling units and occupied dwelling units were available, an average of 96.2 percent of the total dwelling units were occupied.

This land use included data from a wide variety of units with different sizes, price ranges, locations, and ages. Consequently, there was a wide variation in trips generated within this category. Other factors, such as geographic location and type of adjacent and nearby development, may also have had an effect on the site trip generation.

Time-of-day distribution data for this land use are presented in Appendix A. For the 10 general urban/suburban sites with data, the overall highest vehicle volumes during the AM and PM on a weekday were counted between 7:15 and 8:15 a.m. and 4:45 and 5:45 p.m., respectively. For the one site with Saturday data, the overall highest vehicle volume was counted between 9:45 and 10:45 a.m. For the one site with Sunday data, the overall highest vehicle volume was counted between 11:45 a.m. and 12:45 p.m.

For the one dense multi-use urban site with 24-hour count data, the overall highest vehicle volumes during the AM and PM on a weekday were counted between 7:00 and 8:00 a.m. and 6:15 and 7:15 p.m., respectively.

For the three sites for which data were provided for both occupied dwelling units and residents, there was an average of 2.72 residents per occupied dwelling unit.

The average numbers of person trips per vehicle trip at the five general urban/suburban sites at which both person trip and vehicle trip data were collected were as follows:

- 1.13 during Weekday, Peak Hour of Adjacent Street Traffic, one hour between 7 and 9 a.m.
- 1.21 during Weekday, Peak Hour of Adjacent Street Traffic, one hour between 4 and 6 p.m.

The sites were surveyed in the 1980s, the 1990s, the 2000s, and the 2010s in British Columbia (CAN), California, District of Columbia, Florida, Georgia, Illinois, Indiana, Maine, Maryland, Minnesota, New Jersey, New York, Ontario, Oregon, Pennsylvania, South Dakota, Tennessee, Texas, Utah, Virginia, and Washington.

It is expected that the number of bedrooms and number of residents are likely correlated to the number of trips generated by a residential site. Many of the studies included in this land use did not indicate the total number of bedrooms. To assist in the future analysis of this land use, it is important that this information be collected and included in trip generation data submissions.

Source Numbers

168, 187, 188, 204, 211, 300, 305, 306, 319, 320, 321, 357, 390, 412, 418, 525, 530, 571, 579, 583, 864, 868, 869, 870, 896, 903, 918, 946, 947, 948, 951

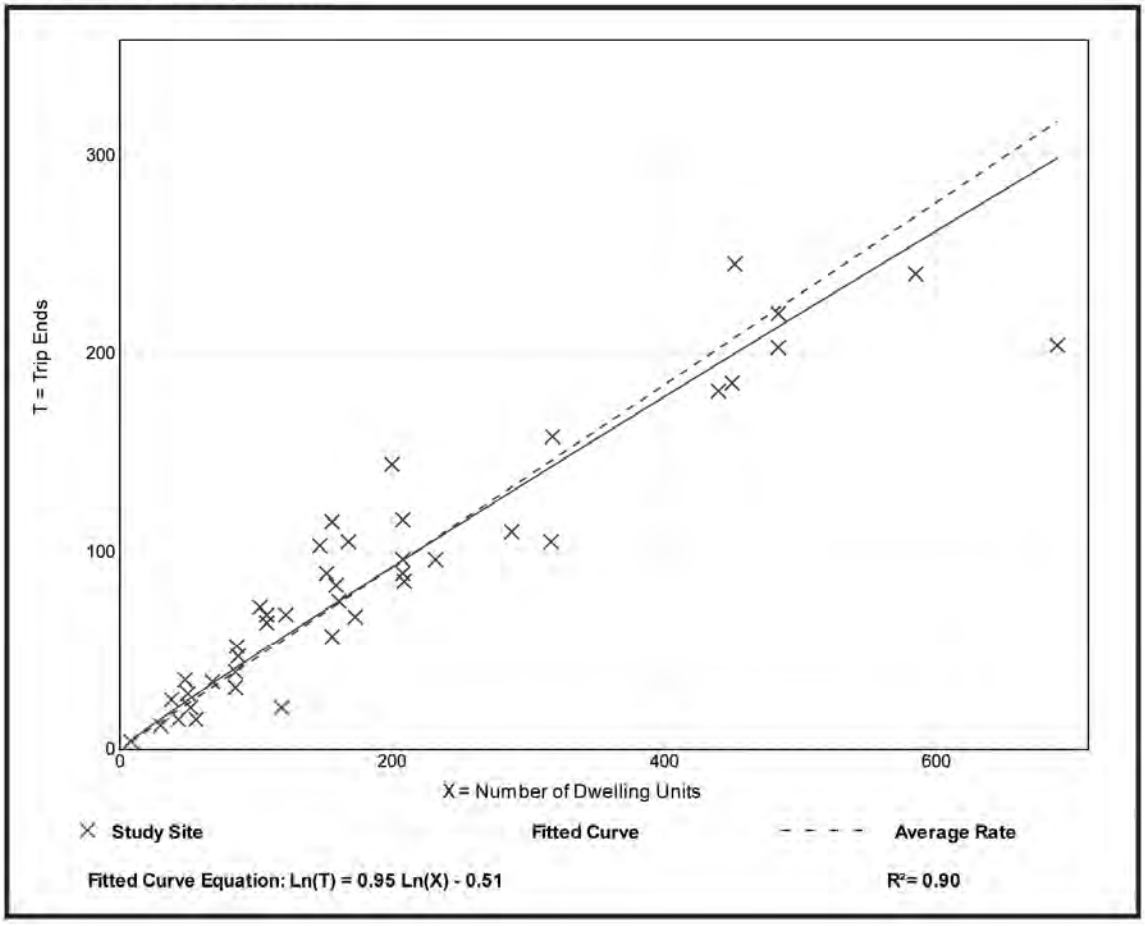
Multifamily Housing (Low-Rise)
(220)

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: 42
Avg. Num. of Dwelling Units: 199
Directional Distribution: 23% entering, 77% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.46	0.18 - 0.74	0.12

Data Plot and Equation



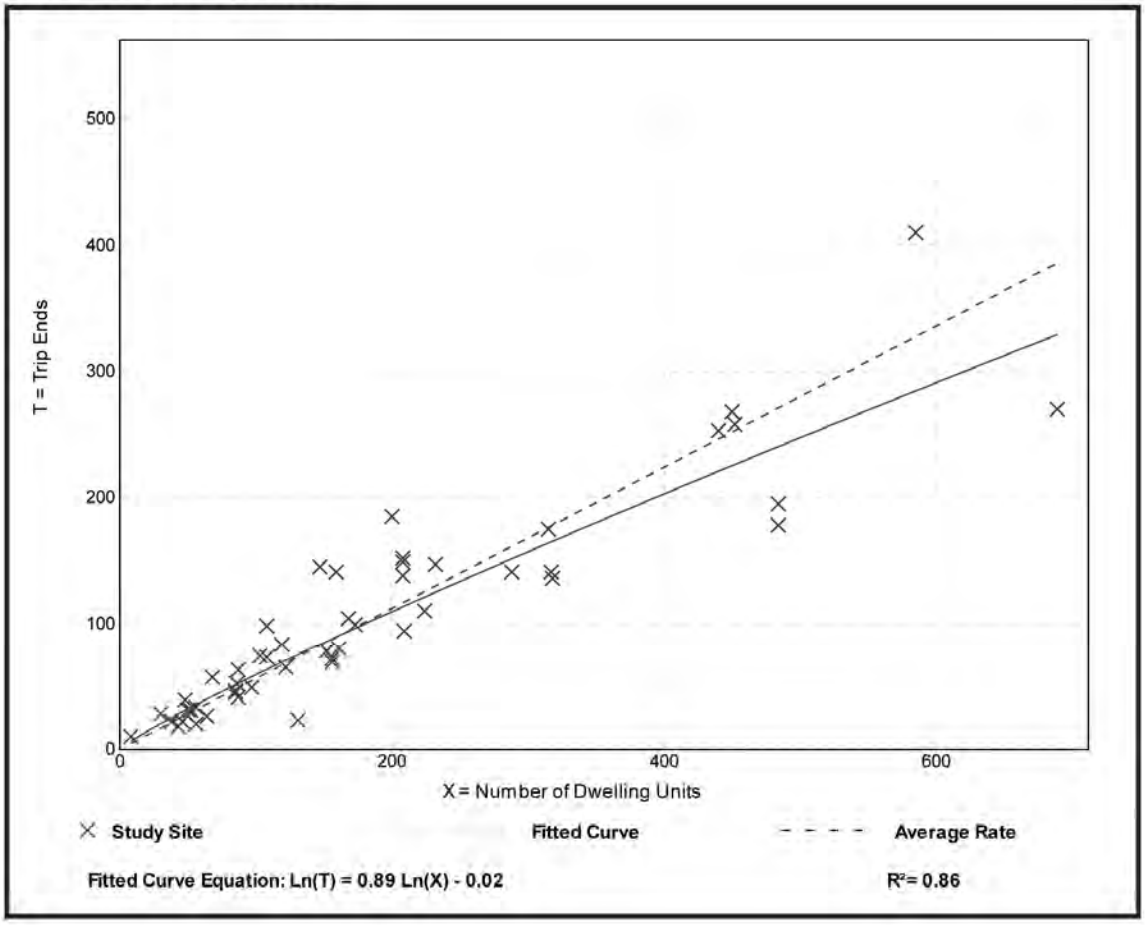
Multifamily Housing (Low-Rise)
(220)

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: 50
Avg. Num. of Dwelling Units: 187
Directional Distribution: 63% entering, 37% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.56	0.18 - 1.25	0.16

Data Plot and Equation



APPENDIX C – Operational Analysis

Future Build Conditions

Curtis Corner Road at Site Access Driveway

C

Future Build Weekday AM / PM Peak Hour

Curtis Corner Road at Site Access Driveway

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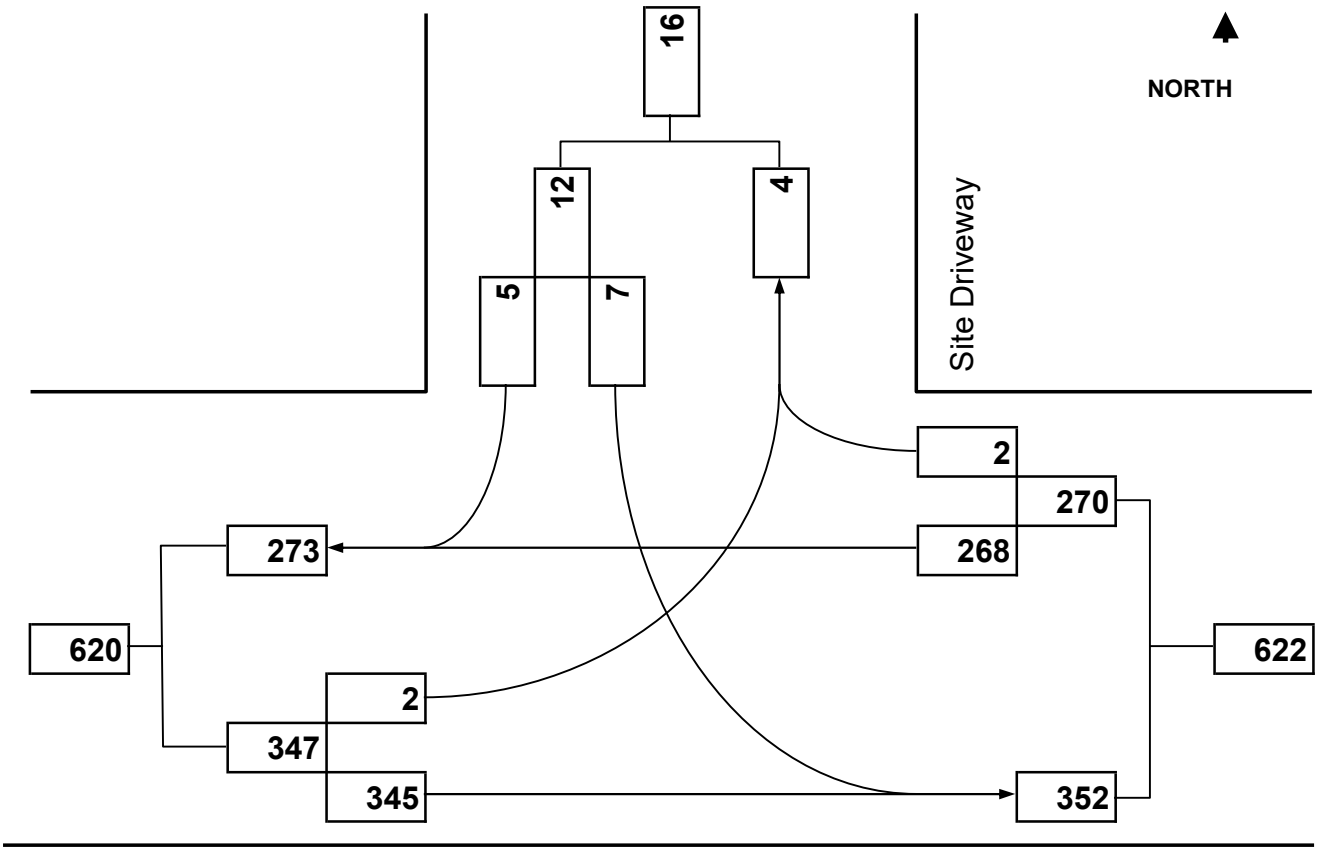
Turning Movement Diagram

Major Street:	Curtis Corner Road	**Minor Street**:	Site Driveway
City/Town:	South Kingstown	**Day of Week**:	Weekday
Reference No.:	7013	**Peak Period**:	7:00 AM - 8:00 AM
Existing:	n/a	**Future**:	Build



HCS7 Two-Way Stop-Control Report

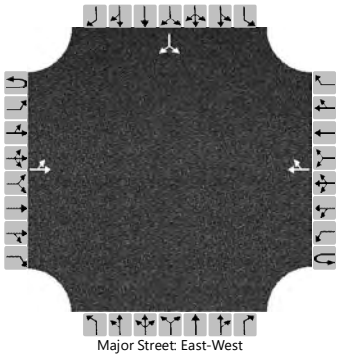
General Information

Analyst	Traffic Department
Agency/Co.	BETA Group, Inc.
Date Performed	2/14/2020
Analysis Year	2020
Time Analyzed	AM Peak Build
Intersection Orientation	East-West
Project Description	The Village at Curtis Corner

Site Information

Intersection	Curtis Corner at Driveway
Jurisdiction	South Kingstown, RI
East/West Street	Curtis Corner Road
North/South Street	Site Driveway
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes


Major Street: East-West

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	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	0	0		0	1	0
Configuration		LT						TR							LR	
Volume (veh/h)		2	345				268	2						7		5
Percent Heavy Vehicles (%)		3												0		0
Proportion Time Blocked																
Percent Grade (%)														0		
Right Turn Channelized																
Median Type | Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1												7.1		6.2
Critical Headway (sec)		4.13												6.40		6.20
Base Follow-Up Headway (sec)		2.2												3.5		3.3
Follow-Up Headway (sec)		2.23												3.50		3.30

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		2													13	
Capacity, c (veh/h)		1262													518	
v/c Ratio		0.00													0.03	
95% Queue Length, Q_{95} (veh)		0.0													0.1	
Control Delay (s/veh)		7.9													12.1	
Level of Service (LOS)		A													B	
Approach Delay (s/veh)	0.1												12.1			
Approach LOS													B			

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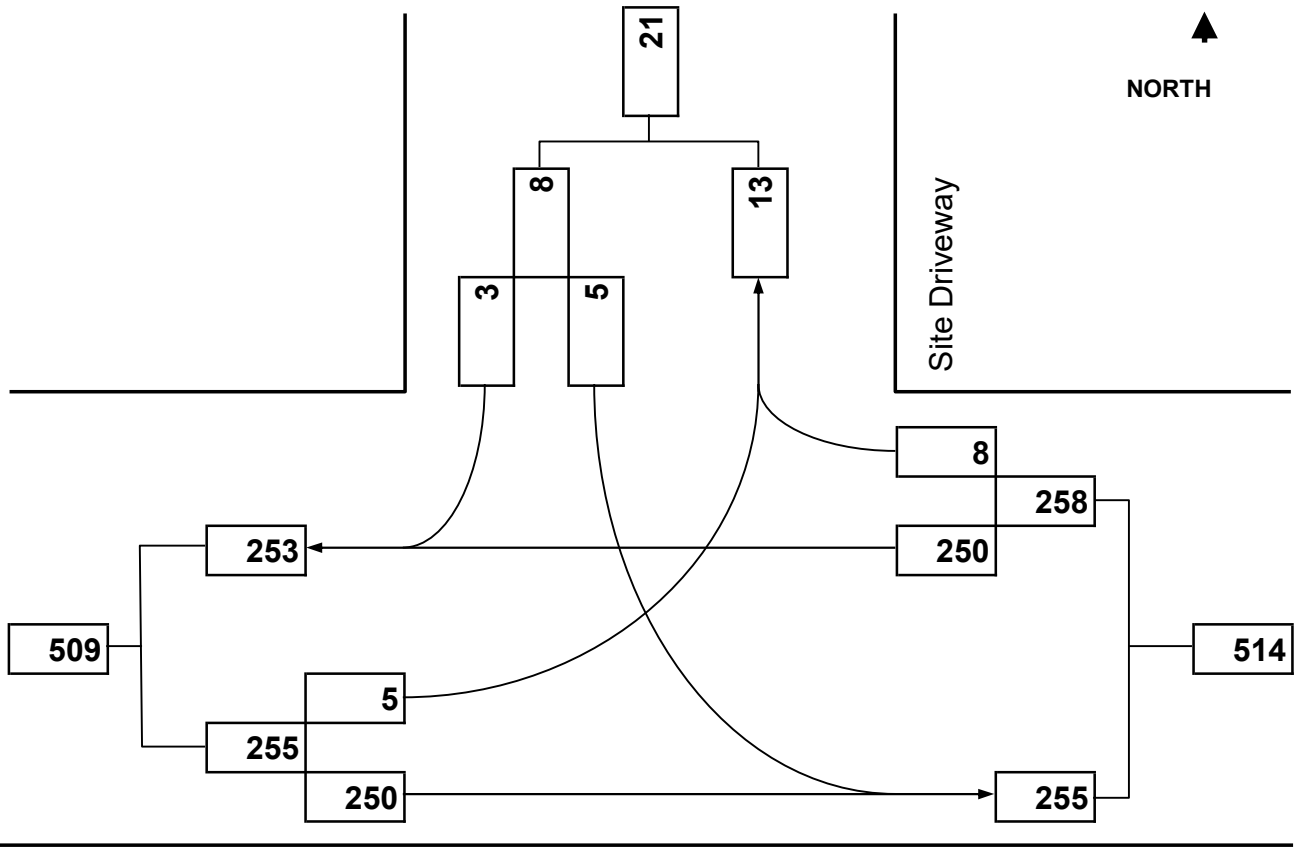
Turning Movement Diagram

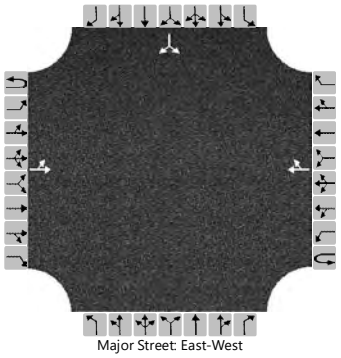
Major Street:	Curtis Corner Road	**Minor Street**:	Site Driveway
City/Town:	South Kingstown	**Day of Week**:	Weekday
Reference No.:	7013	**Peak Period**:	4:00 AM - 5:00 AM
Existing:	n/a	**Future**:	Build



HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	Traffic Department	Intersection	Curtis Corner at Driveway
Agency/Co.	BETA Group, Inc.	Jurisdiction	South Kingstown, RI
Date Performed	2/14/2020	East/West Street	Curtis Corner Road
Analysis Year	2020	North/South Street	Site Driveway
Time Analyzed	PM Peak Build	Peak Hour Factor	0.92
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description	The Village at Curtis Corner		

Lanes


Major Street: East-West

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	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	0	0		0	1	0
Configuration		LT						TR							LR	
Volume (veh/h)		5	250				250	8						5		3
Percent Heavy Vehicles (%)		3												0		0
Proportion Time Blocked																
Percent Grade (%)														0		
Right Turn Channelized																
Median Type | Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1												7.1		6.2
Critical Headway (sec)		4.13												6.40		6.20
Base Follow-Up Headway (sec)		2.2												3.5		3.3
Follow-Up Headway (sec)		2.23												3.50		3.30

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		5													9	
Capacity, c (veh/h)		1276													568	
v/c Ratio		0.00													0.02	
95% Queue Length, Q_{95} (veh)		0.0													0.0	
Control Delay (s/veh)		7.8													11.4	
Level of Service (LOS)		A													B	
Approach Delay (s/veh)	0.2												11.4			
Approach LOS													B			

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