

MEMORANDUM

TO: Mr. Thomas Pappas
Cape Cod Builders
10 Foretop Road
Bourne, MA 02532

FROM: Shaun P. Kelly *SPK*
Associates
Vanasse & Associates, Inc.
35 New England Business Center Drive,
Suite 140
Andover, MA 01810

DATE: September 2, 2022

RE: 8430

SUBJECT: Response to Peer Review Comments
Proposed Chase Estates Residential Development
230 Sandwich Road
Bourne, Massachusetts

INTRODUCTION

Vanasse & Associates, Inc. (VAI) has prepared this memorandum in response to comments issued by the Town of Bourne's transportation peer review consultant, Professional Services Corporation, PC, (PSC) as outlined in their May 9, 2022 peer review memorandum issued on the above referenced project. Specifically, this memorandum serves to update the prior June 9, 2021 Traffic Impact Assessment¹ (TIA) to reflect the reduction in the number of proposed residential units, update the project-generated traffic projections based on current industry data, and to provide an assessment of projected traffic operations during both average and peak summer month conditions.

As documented in this memorandum, the results of the updated analyses, including peak summer month analyses, confirm the findings of the initial TIA, that project-related traffic increases are expected to result in no notable impact to traffic operations along the Sandwich Road corridor.

PROJECT DESCRIPTION

The project entails the development of a 24-unit single family home residential subdivision off the southern side of Sandwich Road. The proposed access to the Project remains unchanged since the preparation of the initial TIA, with access and egress provided via a single driveway onto Sandwich Road, east of the access drive to the Upper Cape Cod Regional Vocational High School, that would operate under STOP-sign control. The location of the project site, relative to the surrounding transportation network is displayed in Figure 1.

¹ *Traffic Impact Assessment – Proposed Chase Estates Residential Development, 230 Sandwich Road, Bourne, Massachusetts; VAI, June 9, 2021.*





Figure 1 – Site Location Map

EXISTING AND FUTURE TRAFFIC VOLUMES

As noted in the initial TIA, an automatic traffic recorder (ATR) count was conducted along Sandwich Road, in the vicinity of the project site in order to identify traffic conditions over an extended period. Based on the collected data, Sandwich Road, in the vicinity of the project site accommodates approximately 24,671 vehicles per day (vpd). Between the weekday morning (7:00 to 9:00 AM) and weekday evening (4:00 to 6:00 PM) commuter peak periods the corridor was found to accommodate 1,870 vehicles per hour (vph) during the weekday morning peak hour and 2,123 vph during the weekday evening peak hour. The weekday morning peak hour generally occurs between 8:00 and 9:00 AM, with the weekday evening peak hour generally occurring between 4:45 and 5:45 PM.

The analysis presented in the TIA reviewed average month conditions, consistent with MassDOT guidelines for preparation of transportation impact assessments. As requested by PSC, these analyses have been supplemented with a review of peak summer month conditions. Specifically, this assessment includes the following analysis time periods:

- 2028 Weekday Morning Peak Hour – Off-Season
- 2028 Weekday Evening Peak Hour – Off Season
- 2028 Weekday Morning Peak Hour – Summer Traffic Volumes
- 2028 Weekday Evening Peak Hour – Summer Traffic Volumes
- 2028 Saturday Peak Hour – Summer Traffic Volumes
- 2028 Sunday Peak Hour – Summer Traffic Volumes

In order to establish peak summer month conditions, traffic volumes collected by the Cape Cod Commission (CCC) and MassDOT were reviewed. Specifically, average annual and summer traffic volumes published by the CCC were reviewed in order to seasonally adjust average month volumes



collected as part of the initial TIA. Additionally, continuous traffic count data published by MassDOT were reviewed to develop hourly factors to adjust peak weekday PM volumes to both Saturday and Sunday peak conditions.

Specifically, in order to adjust the October traffic volumes to peak summer month conditions, both seasonal adjustment factors provided by the CCC and specific traffic count data, proximate to the general study area were reviewed.

The CCC provides average annual and peak summer volumes for a number of locations, including:

- Route 3, north of the Bourn/Plymouth town line
- Route 28 at the Bourne Bridge
- Along the Bourne Bridge

Based on a review of this data, peak summer traffic volumes are approximately 26 to 29 percent higher than average annual conditions for the locations reviewed.

The CCC also provides seasonal adjustment factors for each month. Based on a review of this data, October traffic volumes are typically 1 percent higher than average annual conditions, with peak summer month (July and August) traffic volumes approximately 23 percent higher than average month conditions. Based on these data, the October to peak adjustment factor is 30 percent, which was utilized for the purpose of this assessment to adjust the data collected in the initial TIA to peak summer conditions.

In order to identify the peak Saturday and Sunday traffic volumes, data published by MassDOT for the following count stations were reviewed:

- Station 707 (Continuous) – Bourne Bridge, north of the Bourne Bridge
- Station 7320 – Route 28 Connector East of Bourne Rotary

Station 707 provides continuous count data over a number of months. For the purpose of estimating Saturday midday traffic volumes, specific adjustment factors were developed based on direction of traffic (to or from Cape Cod) and were applied to the weekday evening volumes along Sandwich Road. Data collected in August 2022 on a typical Saturday and weekday were reviewed. In general, weekday evening eastbound traffic volumes were increased by 26 percent, with westbound traffic volumes increased by 17 percent to reflect peak Saturday midday volumes. Additionally, Sunday volumes were also developed by applying a 10 percent reduction to the weekday evening eastbound traffic volumes and a four percent reduction to weekday evening westbound traffic volumes.

Based on the seasonal adjustment factors provided, the following traffic volumes were developed, which were utilized for analysis purposes. The 2021 Existing traffic volume represent current conditions for each analysis scenario, with the 2029 future traffic volumes representing 1 percent growth over a 7-year planning horizon, consistent with the initial TIA.



Table 1
TRAFFIC VOLUME SUMMARY – 2028 FUTURE CONDITION

Scenario	Eastbound Volume (vph)	Westbound Volume (vph)	Total Volume (vph)
Weekday Morning Peak Hour – Off-Season	860	1,010	1,870
Weekday Evening Peak Hour – Off Season	905	1,218	2,123
Weekday Morning Peak Hour – Summer Volumes	1,118	1,313	2,431
Weekday Evening Peak Hour – Summer Volumes	1,176	1,584	2,760
Saturday Peak Hour – Summer Volumes	1,481	1,859	3,340
Sunday Peak Hour – Summer Volumes	1,061	1,523	2,587

Seasonal adjustment calculations are provided as an attachment to this document.

PROJECT-GENERATED TRAFFIC

The proposed development, as currently proposed, will entail the construction of 24 residential homes. As requested by PCS, the trip-generation estimates provided have been revised to reflect the current edition of the Institute of Transportation Engineers (ITE) *Trip Generation* manual², which was published subsequent to the preparation of the initial TIA. The projections reflect the currently proposed 24 units of residential housing, based for Land Use Codes (LUC) 210 – Single-Family Detached Housing, the most appropriate category for this development. Project-related trip generation is summarized in Table 2.

²*Trip Generation*, Eleventh Edition; Institute of Transportation Engineers; Washington, DC; 2021.



Table 2
TRIP GENERATION SUMMARY

Time Period/ Directional Distribution	Vehicle Trips
Weekday Daily	310
<i>Weekday Morning Peak Hour:</i>	
Entering	5
<u>Exiting</u>	<u>15</u>
Total	20
<i>Weekday Evening Peak Hour:</i>	
Entering	16
<u>Exiting</u>	<u>10</u>
Total	26
Saturday Daily	240
<i>Saturday Midday Peak Hour:</i>	
Entering	16
<u>Exiting</u>	<u>14</u>
Total	30
Sunday Daily	204
<i>Sunday Midday Peak Hour:</i>	
Entering	13
<u>Exiting</u>	<u>11</u>
Total	24

^aBased on ITE LUC 210 – Single-Family Detached Housing, 24 units.

As summarized in Table 2, the proposed development is expected to generate 310 vehicle trips (155 entering and 155 exiting) on a typical weekday, including 20 vehicle trips (5 entering and 15 exiting) during the weekday morning peak hour and 26 vehicle trips (16 entering and 10 exiting) during the weekday evening peak hour. On a typical Saturday the project is expected to generate 240 vehicle trips (120 entering and 120 exiting), including 30 vehicle trips (16 entering and 14 exiting) during the Saturday midday peak hour. On a typical Sunday the project is expected to generate 204 vehicle trips (102 entering and 102 exiting), including 24 vehicle trips (13 entering and 11 exiting) during the Sunday peak hour.

TRIP DISTRIBUTION PATTERNS

Consistent with the trip distribution patterns identified in the initial TIA, project-related traffic increases were distributed 55 percent to the west and 45 percent towards the east. Based on these patterns, Project-generated traffic volume are expected to amount to approximately 5 to 9 vehicle trips per hour, in either direction, along segments of Sandwich Road, either east or west of the project.



CAPACITY ANALYSIS RESULTS

Capacity analyses were conducted for each analysis scenario under 2028 Build conditions. The results of the capacity analyses generally confirm the findings of the initial TIA, and indicate:

- During all analysis periods evaluated as part of this assessment, mainline traffic volumes along Sandwich Road are projected to operate at LOS A in both the eastbound and westbound directions;
- Westbound left-turns from Sandwich Road into the project driveway are projected to operate at LOS A or B during all peak periods, with projected delays of approximately 10 to 14 seconds per vehicle, and maximum queues extending one (1) vehicle;
- Vehicles exiting the site driveway are expected to operate at LOS E or F under all analysis scenarios, which is typical for unsignalized driveways along this stretch of Sandwich Road, with maximum queues of approximately 1 vehicle, with the exception of the Saturday midday peak, when maximum queues are predicted to reach three (3) vehicles. It is noted that this level of queuing is expected to occur only during the busiest 3 minutes of the hour, and does not adversely impact traffic operations along Sandwich Road.

Capacity analysis worksheets are provided as an attachment to this document.

CONCLUSION

In conclusion, based on the results of the updated analyses requested by PSC, the findings of the initial TIA remain unchanged, that Project-related traffic increases represent a minor increase to existing traffic flows along the Sandwich Road corridor, and are not expected to result in adverse impacts to traffic operations along Sandwich Road.



APPENDIX

SEASONAL ADJUSTMENT DATA
TRIP GENERATION DATA
CAPACITY ANALYSIS RESULTS

SEASONAL ADJUSTMENT DATA

Traffic Volume Adjustments - Sandwich Road, Bourne, Massachusetts

Base Data (October 2019)

	Eastbound	Westbound	Total Volume
Weekday Morning Peak Hour	802	942	1744
Weekday Evening Peak Hour	844	1136	1980

Peak Summer Month (30% adjustment factor)

Weekday Morning Peak Hour	1043	1225	2268
Weekday Evening Peak Hour	1097	1477	2574

Saturday Peak Hour (PM Volume Adjustment - 1.26 Eastbound/1.17 Westbound)

Sunday Peak Hour	1381	1734	3115
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Sunday Peak Hour (PM Volume Adjustment - 0.90 Eastbound/0.96 Westbound)

Sunday Peak Hour	990	1423	2413
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Future Condition

	Eastbound	Westbound	Total Volume
Weekday Morning Peak Hour	860	1010	1870
Weekday Evening Peak Hour	905	1218	2123

Peak Summer Month (30% adjustment factor)

Weekday Morning Peak Hour	1118	1313	2431
Weekday Evening Peak Hour	1176	1584	2760

Saturday Peak Hour (PM Volume Adjustment - 1.26 Eastbound/1.17 Westbound)

Sunday Peak Hour	1481	1859	3340
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Sunday Peak Hour (PM Volume Adjustment - 0.90 Eastbound/0.96 Westbound)

Sunday Peak Hour	1061	1526	2587
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Seasonal Adjustment Factor Calculations

Station	Year	Year Round	Summer	Ratio
Route 3 North of Bourne/Plymouth town line		39384	49495	1.26
Route 28 at Bourne Bridge		28793	37281	1.29
Bourne Bridge		44562	56890	1.28

CCC October Factor

0.99

CCC Peak (Jul/Aug) Factor

0.76

October to Peak Factor

1.30

Weekday to Saturday Peak Adjustment

Station	Saturday Peak		Weekday PM Peak	
	Northbound	Southbound	Northbound	Southbound
Bourne Bridge north of Bourne Bridge	2065	2235	1759	1775
Saturday to PM Peak Factor	1.17	1.26		

Weekday to Sunday Peak Adjustment

Station	Sunday Peak		Weekday PM Peak	
	Eastbound	Westbound	Eastbound	Westbound
Route 28 Connector East of Bourne Rotary	1254	851	1389	883
Sunday to PM Peak Factor	0.90	0.96		



Table 3: Canal Bridges Permanent Traffic Counting Stations

	#707 Bourne Bridge Yr.Round/Summer		#708 Sagamore Bridge Yr.Round/Summer		Combined (both bridges) Yr.Round/Summer	
2018		58,081		73,502		131,583
2017		56,081		74,736		130,817
2016	44,562	56,890				
2015		58,384		73,041		131,425
2014	44,746	57,980		69,375		127,355
2013	43,909	56,896		71,020		127,916
2012	44,863	58,305	50,448	70,391	95,311	128,696
2011	42,505	58,467	51,489	70,674	93,994	129,141
2010	44,717	59,665	50,272	69,323	94,988	128,988
2009	44,839	58,031	50,052	69,256	94,890	127,287
2008	42,396	55,492	51,019	67,854	93,415	123,346
2007	43,506	57,042	52,559	70,407	96,065	127,449
2006	43,909	57,411	51,916	67,020	95,824	124,431
2005	43,873	58,858	52,282	69,279	96,155	128,137
2004	44,688	59,615	54,143	69,274	98,832	128,889
2003	44,635	60,430	54,114	70,716	98,749	131,146
2002	43,981	60,059	54,905	71,207	98,886	131,266
2001	40,561	54,639	54,309	70,025	94,869	124,664
2000	41,805	56,892	53,832	68,997	95,637	125,889
1999	43,013	59,595	52,434	68,833	95,447	128,428
1998	42,427	58,063	51,490	69,195	93,918	127,258
1997	40,216	56,204	49,716	66,513	89,932	122,717
1996	39,304	54,195	48,071	66,277	87,375	120,472
1995	38,885	52,503	47,994	67,385	86,879	119,888
1994	36,406	52,078				
1993	35,413	49,753				
1992	34,899	49,120				
1991	33,926	48,194	45,667	62,564	79,593	110,758
1990	34,818	49,010	46,571	65,240	81,388	114,250
1989	33,936	49,137	40,814	53,024	74,751	102,161
1988	32,735	46,709	39,822	54,556	72,557	101,265
1987	29,675	39,300	38,078	56,575	67,753	95,875
1986	26,858	35,035	40,870	57,224	67,728	92,259
1985	26,136	36,800	36,877	53,441	63,014	90,241
1984	26,179	41,571	34,244	50,441	60,423	92,012
1983	23,276	29,685	31,695	48,788	54,971	78,473
1982						
1981	15,223	25,427				
1980						
1979	19,480	29,930	30,090	43,792	49,570	73,722
1978	22,256	31,823	28,310	50,557	50,566	82,380
1977	23,113	41,307				
1976	23,173	41,130	26,693	45,260	49,866	86,390
1975	23,484	41,900	24,140	43,095	47,623	84,995

Source: Massachusetts Highway Department / Mass DOT



CAPE COD
COMMISSION

Table 4: Other Cape Cod Permanent Traffic Counting Stations

	#20 Rt 3 N of Bourne TL Yr.Rnd/Summ		#15 Rt 6 E of Rt 149, Exit 5 Yr.Rnd/Summ		#712 Rt 28 E of Main St, Cotuit Yr.Rnd/Summer		#7351 Rt 28 W of Old Post Rd Yr.Rnd/Summ		#709 Rt 28 E of Higgins Crowell Rd Yr.Rnd/Summ		#7322 Rt 28 S of Otis Rotary Yr.Rnd/Summ	
2018		50,268		65,894			27,178	31,505				37,927
2017		49,535						31,138				
2016	39,384	49,495						31,726			28,793	37,281
2015	37,665	49,169					26,163	31,592		23,077		37,266
2014	36,607	47,956					25,937	31,122	17,481	23,075		
2013	36,791	47,810					26,107	31,648	17,600	23,296		
2012		47,958										
2011		45,803		67,799			25,758	31,444		23,780		
2010	34,822	50,178	50,100	72,002			27,025	32,631	18,320	24,054		
2009	34,826	47,308	48,753	70,394			26,906	32,584	18,480	23,959		
2008	35,418	46,031	48,619	67,646			26,607	31,967	18,587	24,090		
2007	36,302	47,486	50,643	70,177			27,512	32,552	19,065	24,337		
2006	34,136	41,840	51,093	69,891			27,003	32,725	20,212	24,995		
2005	33,482	42,123	52,391	72,580			27,845	33,564	20,125	25,961		
2004	34,477	41,669	53,619	73,154			28,130	33,818	20,736	26,180		
2003	54,570	45,570	53,402	74,384			27,373	33,309	20,970	26,662		
2002	38,508	45,921	53,845	73,891					21,597	27,025		
2001	34,186	42,191	51,940	71,798					21,408	26,632		
2000	33,381	41,625	50,128	64,832					21,080	26,747		
1999	32,990	41,797	50,257	71,579					21,369	27,530		
1998	32,873	42,656	48,524	69,195					21,040	27,422		
1997	31,838	41,793	45,961	66,626	20,249	24,570			20,299	27,115		
1996	31,074	41,377	44,530	64,672	19,619	24,697			19,730	26,241		
1995	30,832	42,070	42,689	61,506	19,800	24,649			19,352	24,782		



Table 5: Monthly Adjustment Factors for Cape Cod

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2011*	1.26	1.25	1.20	1.06	0.96	0.89	0.76	0.76	0.92	0.99	1.08	1.14
2010	1.26	1.25	1.19	1.08	0.95	0.88	0.77	0.76	0.93	1.00	1.08	1.15
2009	1.26	1.25	1.19	1.08	0.95	0.88	0.77	0.76	0.93	1.00	1.08	1.15
2008	1.21	1.25	1.19	1.08	0.96	0.89	0.78	0.76	0.93	1.00	1.07	1.14
2007	1.25	1.21	1.17	1.06	0.96	0.86	0.78	0.79	0.93	1.00	1.08	1.14
2006	1.26	1.20	1.18	1.04	0.96	0.86	0.78	0.79	0.93	0.99	1.07	1.12
2005	1.27	1.23	1.18	1.06	0.96	0.85	0.77	0.78	0.93	0.99	1.08	1.15
2004	1.27	1.23	1.18	1.06	0.96	0.85	0.77	0.78	0.93	0.99	1.08	1.15
2003	1.29	1.23	1.16	1.06	0.99	0.87	0.79	0.77	0.95	0.99	1.07	1.14
2002	1.30	1.24	1.16	1.06	0.98	0.86	0.79	0.78	0.93	0.97	1.08	1.14
2001	1.34	1.27	1.18	1.06	0.97	0.86	0.78	0.78	0.94	0.97	1.08	1.13
2000	1.37	1.28	1.20	1.07	0.96	0.87	0.77	0.78	0.93	0.97	1.09	1.14
1999	1.37	1.29	1.23	1.09	0.96	0.87	0.76	0.77	0.94	0.99	1.10	1.15
1998	1.39	1.27	1.23	1.11	0.95	0.87	0.76	0.76	0.93	0.99	1.10	1.16
1997	1.38	1.29	1.22	1.10	0.96	0.86	0.76	0.75	0.92	0.99	1.10	1.19
1996	1.41	1.30	1.22	1.07	0.96	0.86	0.75	0.75	0.91	0.99	1.10	1.19
1995	1.36	1.33	1.24	1.07	0.97	0.86	0.75	0.75	0.90	0.99	1.10	1.19
1994	1.35	1.31	1.25	1.06	0.93	0.86	0.73	0.74	0.89	0.97	1.09	1.15
1993	1.35	1.30	1.24	1.07	0.92	0.85	0.75	0.75	0.90	0.99	1.10	1.17
1992	1.37	1.32	1.29	1.08	0.94	0.87	0.75	0.76	0.90	1.01	1.14	1.21
1991	1.39	1.30	1.22	1.08	0.94	0.87	0.76	0.77	0.95	1.02	1.12	1.20
1990	1.31	1.26	1.16	1.06	0.96	0.85	0.73	0.74	0.94	0.99	1.10	1.22
1989	1.37	1.38	1.25	1.13	0.99	0.89	0.72	0.73	0.94	1.03	1.15	1.17
1988	1.38	1.30	1.21	1.10	0.99	0.83	0.72	0.73	0.91	1.02	1.11	1.15
1987	1.40	1.39	1.23	1.10	0.94	0.85	0.71	0.73	0.96	1.02	1.18	1.25
1986	1.35	1.31	1.21	1.09	1.05	0.84	0.73	0.75	0.96	1.04	1.17	1.22
1985	1.31	1.26	1.17	1.07	0.96	0.92	0.84	0.83	0.97	0.97	1.14	1.16
1984	1.55	1.36	1.46	1.12	1.03	0.85	0.73	0.73	0.94	1.07	1.14	1.24
1983	1.53	1.51	1.30	1.15	0.98	0.82	0.65	0.66	0.87	1.07	1.23	1.30

Source: Massachusetts Highway Department / Mass DOT

*2011 is the last year that MassDOT has supplied monthly adjustment factors

Volume Count Report

LOCATION INFO		INTERVAL:15-MIN					
Location ID	707_NB	Time	15-min Interval				Hourly Count
Type	SPOT		1st	2nd	3rd	4th	
Funct'l Class	2	0:00-1:00	23	22	17	15	77
Located On	BOURNE BRIDGE	1:00-2:00	9	15	14	6	44
Loc On Alias		2:00-3:00	11	11	8	9	39
NORTH OF	BOURNE BRIDGE	3:00-4:00	7	9	12	16	44
Direction	NB	4:00-5:00	17	17	24	16	74
County	Barnstable	5:00-6:00	26	34	45	63	168
Community	Bourne	6:00-7:00	71	77	135	125	408
MPO ID		7:00-8:00	150	198	224	209	781
HPMS ID		8:00-9:00	236	258	266	334	1,094
Agency	MHD	9:00-10:00	307	350	387	389	1,433
		10:00-11:00	448	510	508	445	1,911
		11:00-12:00	483	537	511	534	2,065
		12:00-13:00	529	501	481	468	1,979
		13:00-14:00	491	426	477	473	1,867
		14:00-15:00	363	372	415	368	1,518
		15:00-16:00	472	448	423	412	1,755
		16:00-17:00	447	378	344	341	1,510
		17:00-18:00	330	407	307	298	1,342
		18:00-19:00	257	347	340	314	1,258
		19:00-20:00	275	244	334	375	1,228
		20:00-21:00	306	278	267	275	1,126
		21:00-22:00	227	199	157	179	762
		22:00-23:00	150	127	132	137	546
		23:00-24:00	111	83	63	57	314
		Total					23,343
		AM Peak					11:15-12:15 2,111
		PM Peak					12:00-13:00 1,979

COUNT DATA INFO	
Count Status	Accepted
Holiday	No
Start Date	Sat 8/27/2022
End Date	Sun 8/28/2022
Start Time	12:00:00 AM
End Time	12:00:00 AM
Direction	
Notes	
Station	000000070712
Study	
Speed Limit	
Description	
Sensor Type	
Source	TCDS_COUNT_IMPORT_COMBINE
Latitude,Longitude	

Volume Count Report

LOCATION INFO		INTERVAL:15-MIN					
Location ID	707_SB	Time	15-min Interval				Hourly Count
Type	SPOT		1st	2nd	3rd	4th	
Funct'l Class	2	0:00-1:00	91	102	96	82	371
Located On	BOURNE BRIDGE	1:00-2:00	68	66	57	63	254
Loc On Alias		2:00-3:00	51	44	39	27	161
NORTH OF	BOURNE BRIDGE	3:00-4:00	25	25	30	26	106
Direction	SB	4:00-5:00	40	49	60	72	221
County	Barnstable	5:00-6:00	93	98	150	148	489
Community	Bourne	6:00-7:00	213	297	306	266	1,082
MPO ID		7:00-8:00	243	301	352	339	1,235
HPMS ID		8:00-9:00	358	440	499	459	1,756
Agency	MHD	9:00-10:00	520	568	540	563	2,191
		10:00-11:00	509	527	544	560	2,140
		11:00-12:00	604	519	550	562	2,235
		12:00-13:00	579	540	581	604	2,304
		13:00-14:00	555	518	523	509	2,105
		14:00-15:00	518	571	558	537	2,184
		15:00-16:00	507	566	553	527	2,153
		16:00-17:00	527	452	489	465	1,933
		17:00-18:00	466	410	408	386	1,670
		18:00-19:00	393	340	307	323	1,363
		19:00-20:00	319	333	271	247	1,170
		20:00-21:00	282	228	229	199	938
		21:00-22:00	182	182	191	164	719
		22:00-23:00	154	133	117	115	519
		23:00-24:00	100	77	75	109	361
		Total					29,660
		AM Peak	11:45-12:45				2,262
		PM Peak	12:00-13:00				2,304

COUNT DATA INFO	
Count Status	Accepted
Holiday	No
Start Date	Sat 8/27/2022
End Date	Sun 8/28/2022
Start Time	12:00:00 AM
End Time	12:00:00 AM
Direction	
Notes	
Station	000000070712
Study	
Speed Limit	
Description	
Sensor Type	
Source	TCDS_COUNT_IMPORT_COMBINE
Latitude,Longitude	

Volume Count Report

LOCATION INFO	
Location ID	7320
Type	SPOT
Funct'l Class	3
Located On	ROUTE 28 CONNECTOR
Loc On Alias	
EAST OF	BOURNE ROTARY
Direction	2-WAY
County	BARNSTABLE
Community	BOURNE
MPO ID	
HPMS ID	
Agency	MHD

COUNT DATA INFO	
Count Status	Accepted
Holiday	No
Start Date	Sun 8/12/2018
End Date	Mon 8/13/2018
Start Time	5:00:00 PM
End Time	5:00:00 PM
Direction	2-WAY
Notes	
Station	
Study	
Speed Limit	
Description	
Sensor Type	Tube Class
Source	TcdsBinToVol
Latitude,Longitude	

INTERVAL:15-MIN					
Time	15-min Interval				Hourly Count
	1st	2nd	3rd	4th	
0:00-1:00	37	38	38	29	142
1:00-2:00	27	23	19	15	84
2:00-3:00	21	21	22	40	104
3:00-4:00	20	23	36	38	117
4:00-5:00	50	80	80	118	328
5:00-6:00	116	142	184	214	656
6:00-7:00	244	325	373	416	1,358
7:00-8:00	414	432	438	464	1,748
8:00-9:00	396	450	508	499	1,853
9:00-10:00	425	448	422	496	1,791
10:00-11:00	471	461	471	516	1,919
11:00-12:00	498	514	492	502	2,006
12:00-13:00	525	509	494	519	2,047
13:00-14:00	516	476	477	446	1,915
14:00-15:00	513	527	510	526	2,076
15:00-16:00	487	526	543	532	2,088
16:00-17:00	535	505	541	524	2,105
17:00-18:00	299	396	320	341	1,356
18:00-19:00	335	343	303	301	1,282
19:00-20:00	299	267	239	274	1,079
20:00-21:00	243	236	245	257	981
21:00-22:00	214	196	165	152	727
22:00-23:00	142	125	118	94	479
23:00-24:00	88	70	65	41	264
Total					28,505
AADT					24,034
AM Peak	11:15-12:15 2,033				
PM Peak	15:15-16:15 2,136				

Volume Count Report

LOCATION INFO	
Location ID	7320
Type	SPOT
Funct'l Class	3
Located On	ROUTE 28 CONNECTOR
Loc On Alias	
EAST OF	BOURNE ROTARY
Direction	2-WAY
County	BARNSTABLE
Community	BOURNE
MPO ID	
HPMS ID	
Agency	MHD

COUNT DATA INFO	
Count Status	Accepted
Holiday	No
Start Date	Tue 8/14/2018
End Date	Wed 8/15/2018
Start Time	5:00:00 PM
End Time	5:00:00 PM
Direction	2-WAY
Notes	
Station	
Study	
Speed Limit	
Description	
Sensor Type	Tube Class
Source	TcdsBinToVol
Latitude,Longitude	

INTERVAL:15-MIN					
Time	15-min Interval				Hourly Count
	1st	2nd	3rd	4th	
0:00-1:00	42	27	29	40	138
1:00-2:00	21	21	28	13	83
2:00-3:00	16	21	20	22	79
3:00-4:00	21	17	32	31	101
4:00-5:00	34	61	76	76	247
5:00-6:00	99	142	181	199	621
6:00-7:00	250	346	391	390	1,377
7:00-8:00	423	484	442	501	1,850
8:00-9:00	411	497	495	492	1,895
9:00-10:00	466	521	498	498	1,983
10:00-11:00	473	479	495	534	1,981
11:00-12:00	484	516	485	490	1,975
12:00-13:00	455	577	517	557	2,106
13:00-14:00	418	540	493	458	1,909
14:00-15:00	472	524	528	539	2,063
15:00-16:00	509	599	553	570	2,231
16:00-17:00	565	605	546	556	2,272
17:00-18:00	534	511	514	494	2,053
18:00-19:00	458	429	451	370	1,708
19:00-20:00	337	298	312	264	1,211
20:00-21:00	277	243	264	243	1,027
21:00-22:00	190	154	161	156	661
22:00-23:00	163	120	130	106	519
23:00-24:00	77	58	61	49	245
Total					30,335
AADT					25,782
AM Peak	11:45-12:45 2,039				
PM Peak	15:30-16:30 2,293				

Volume Count Report

LOCATION INFO	
Location ID	7320
Type	SPOT
Funct'l Class	3
Located On	ROUTE 28 CONNECTOR
Loc On Alias	
EAST OF	BOURNE ROTARY
Direction	2-WAY
County	BARNSTABLE
Community	BOURNE
MPO ID	
HPMS ID	
Agency	MHD

COUNT DATA INFO	
Count Status	Accepted
Holiday	No
Start Date	Sun 8/12/2018
End Date	Mon 8/13/2018
Start Time	5:00:00 PM
End Time	5:00:00 PM
Direction	2-WAY
Notes	
Station	
Study	
Speed Limit	
Description	
Sensor Type	Tube Class
Source	TcdsBinToVol
Latitude,Longitude	

INTERVAL:15-MIN					
Time	15-min Interval				Hourly Count
	1st	2nd	3rd	4th	
0:00-1:00	37	38	38	29	142
1:00-2:00	27	23	19	15	84
2:00-3:00	21	21	22	40	104
3:00-4:00	20	23	36	38	117
4:00-5:00	50	80	80	118	328
5:00-6:00	116	142	184	214	656
6:00-7:00	244	325	373	416	1,358
7:00-8:00	414	432	438	464	1,748
8:00-9:00	396	450	508	499	1,853
9:00-10:00	425	448	422	496	1,791
10:00-11:00	471	461	471	516	1,919
11:00-12:00	498	514	492	502	2,006
12:00-13:00	525	509	494	519	2,047
13:00-14:00	516	476	477	446	1,915
14:00-15:00	513	527	510	526	2,076
15:00-16:00	487	526	543	532	2,088
16:00-17:00	535	505	541	524	2,105
17:00-18:00	299	396	320	341	1,356
18:00-19:00	335	343	303	301	1,282
19:00-20:00	299	267	239	274	1,079
20:00-21:00	243	236	245	257	981
21:00-22:00	214	196	165	152	727
22:00-23:00	142	125	118	94	479
23:00-24:00	88	70	65	41	264
Total					28,505
AADT					24,034
AM Peak	11:15-12:15 2,033				
PM Peak	15:15-16:15 2,136				

TRIP GENERATION DATA

Single-Family Detached Housing (210)

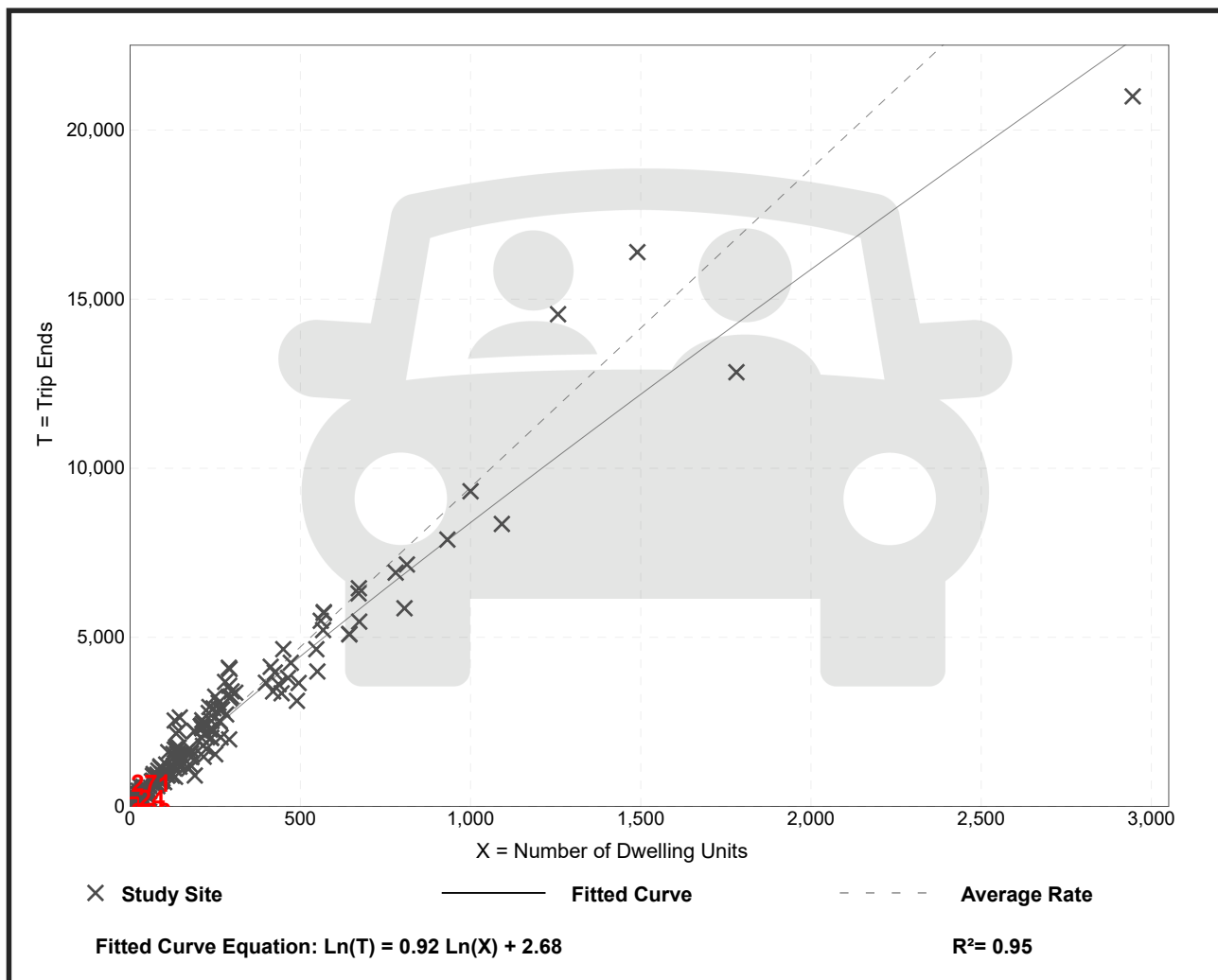
Vehicle Trip Ends vs: Dwelling Units
On a: Weekday

Setting/Location: General Urban/Suburban
Number of Studies: 174
Avg. Num. of Dwelling Units: 246
Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
9.43	4.45 - 22.61	2.13

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: 192

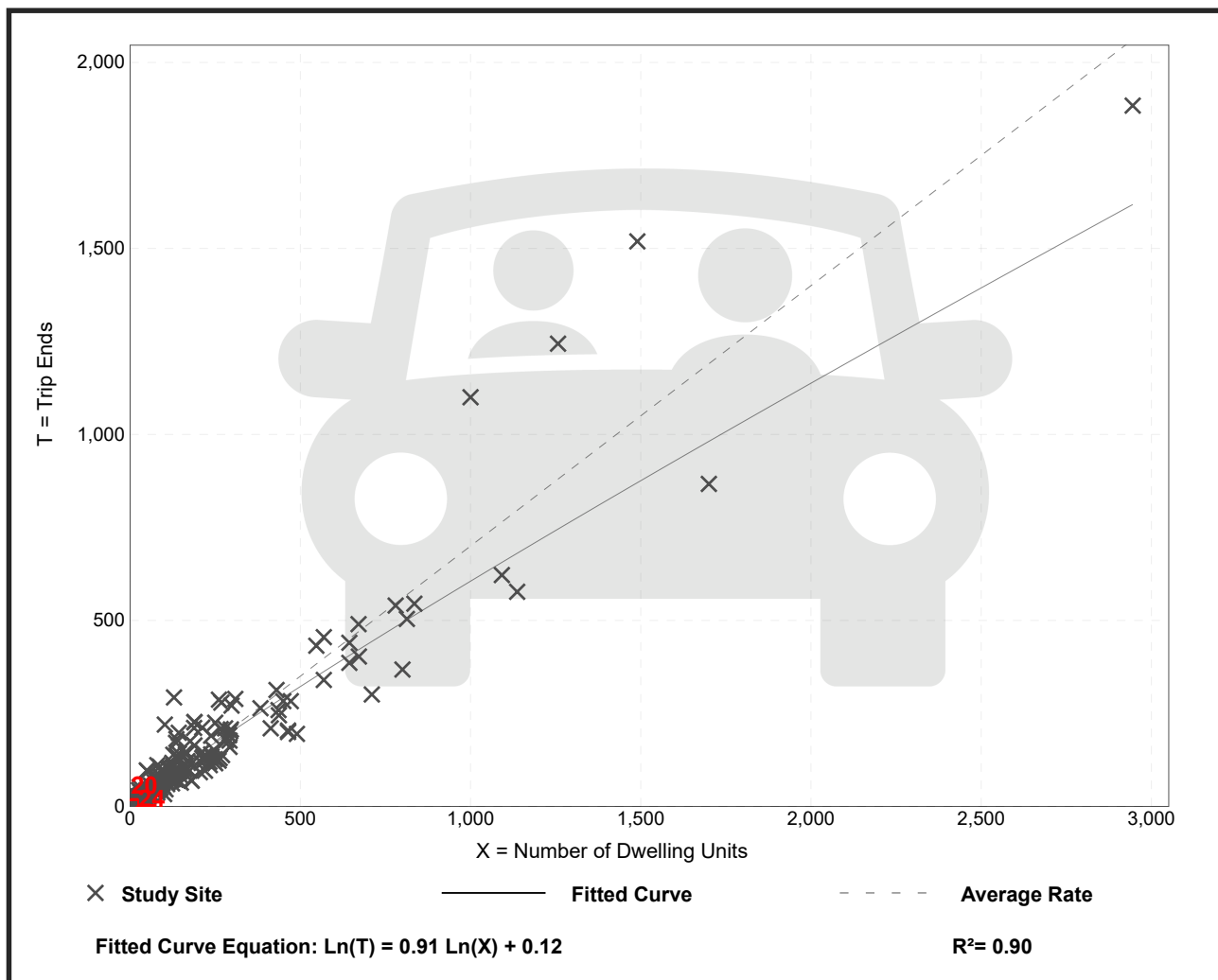
Avg. Num. of Dwelling Units: 226

Directional Distribution: 26% entering, 74% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.70	0.27 - 2.27	0.24

Data Plot and Equation



Single-Family Detached Housing (210)

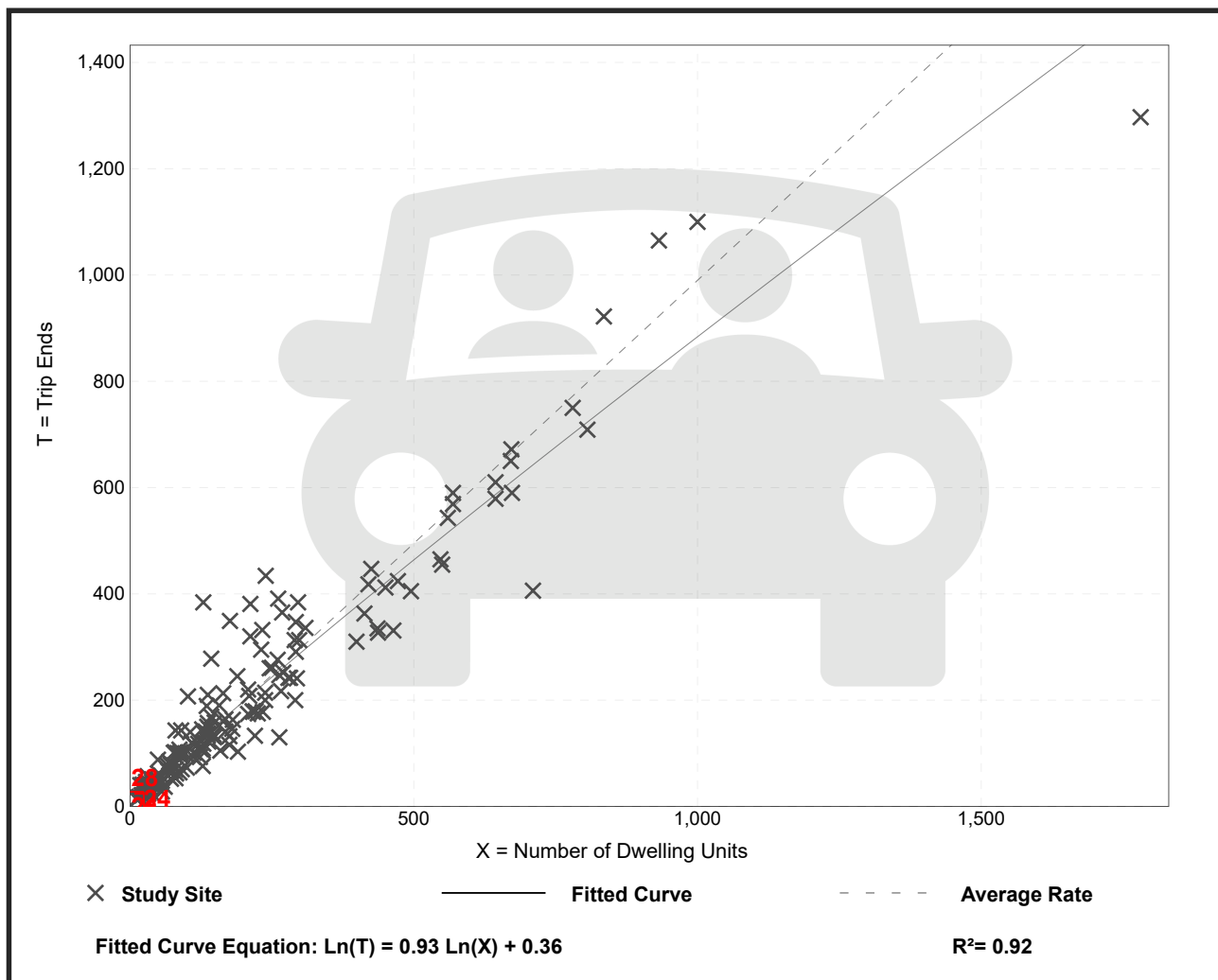
Vehicle Trip Ends vs: Dwelling Units
On a: Weekday,
PM Peak Hour of Generator

Setting/Location: General Urban/Suburban
Number of Studies: 178
Avg. Num. of Dwelling Units: 203
Directional Distribution: 64% entering, 36% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.99	0.49 - 2.98	0.28

Data Plot and Equation



Single-Family Detached Housing (210)

Vehicle Trip Ends vs: Dwelling Units
On a: Saturday

Setting/Location: General Urban/Suburban

Number of Studies: 63

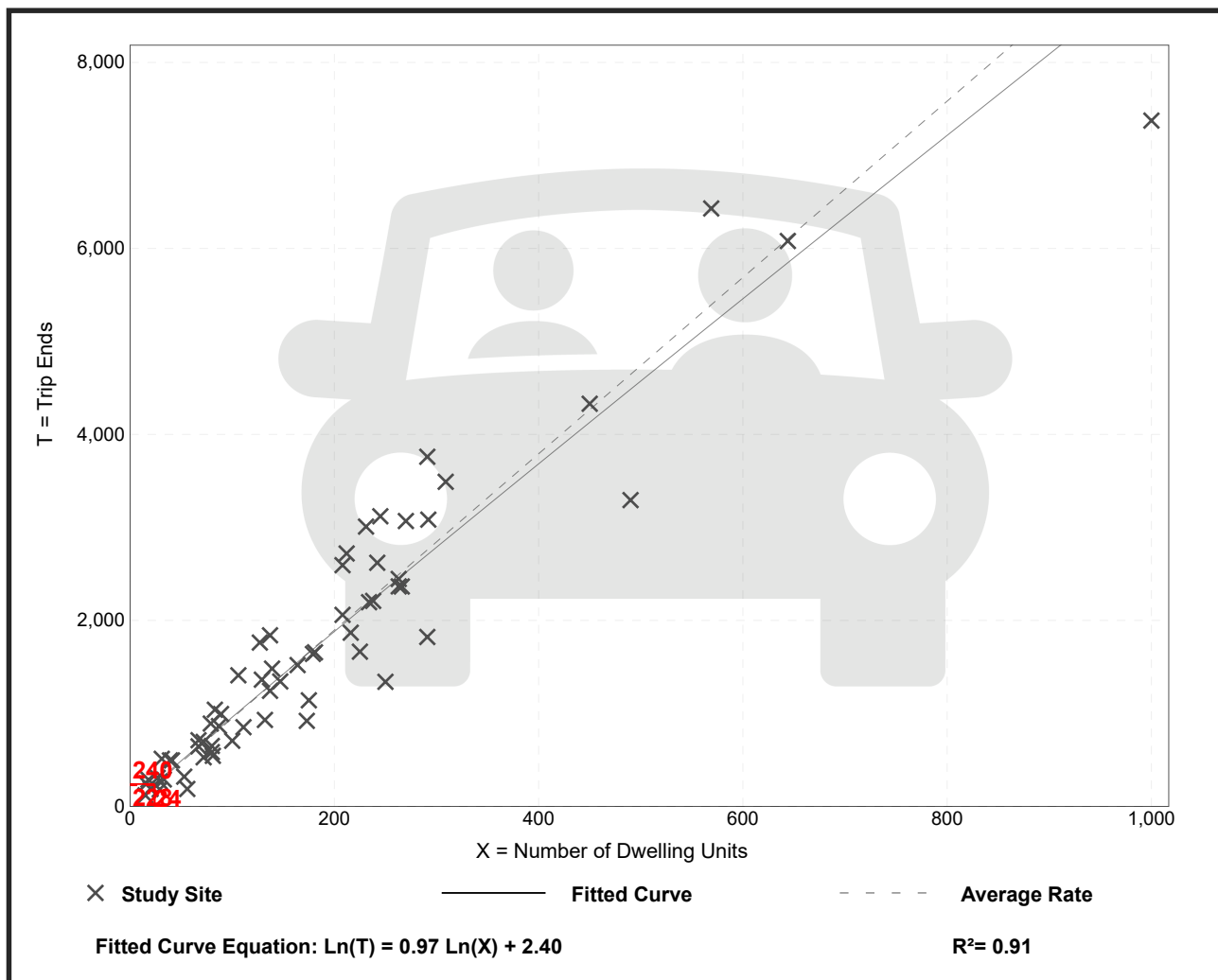
Avg. Num. of Dwelling Units: 179

Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
9.48	3.36 - 16.52	2.26

Data Plot and Equation



Single-Family Detached Housing (210)

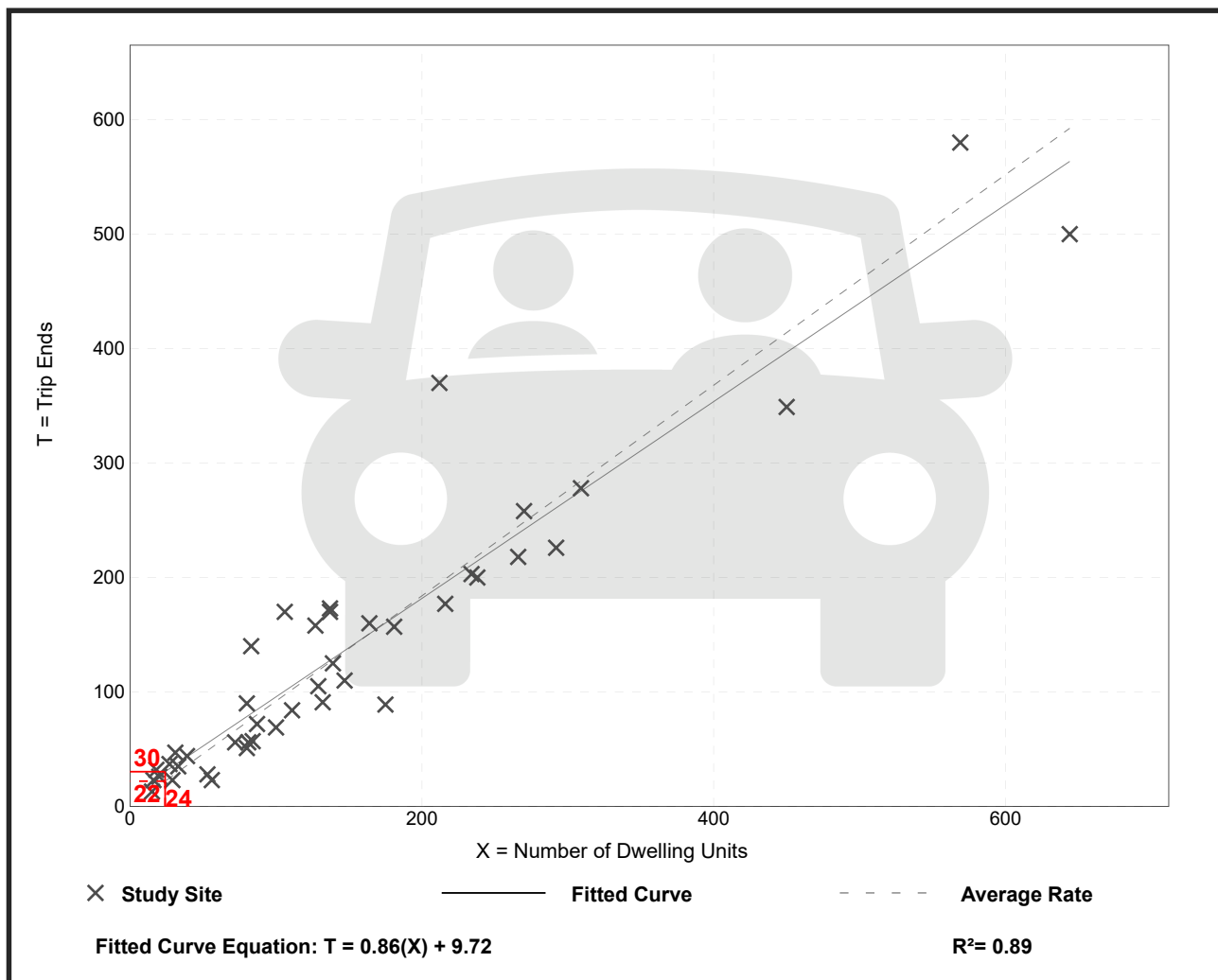
Vehicle Trip Ends vs: Dwelling Units
On a: Saturday, Peak Hour of Generator

Setting/Location: General Urban/Suburban
Number of Studies: 42
Avg. Num. of Dwelling Units: 152
Directional Distribution: 54% entering, 46% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.92	0.41 - 1.78	0.27

Data Plot and Equation



Single-Family Detached Housing (210)

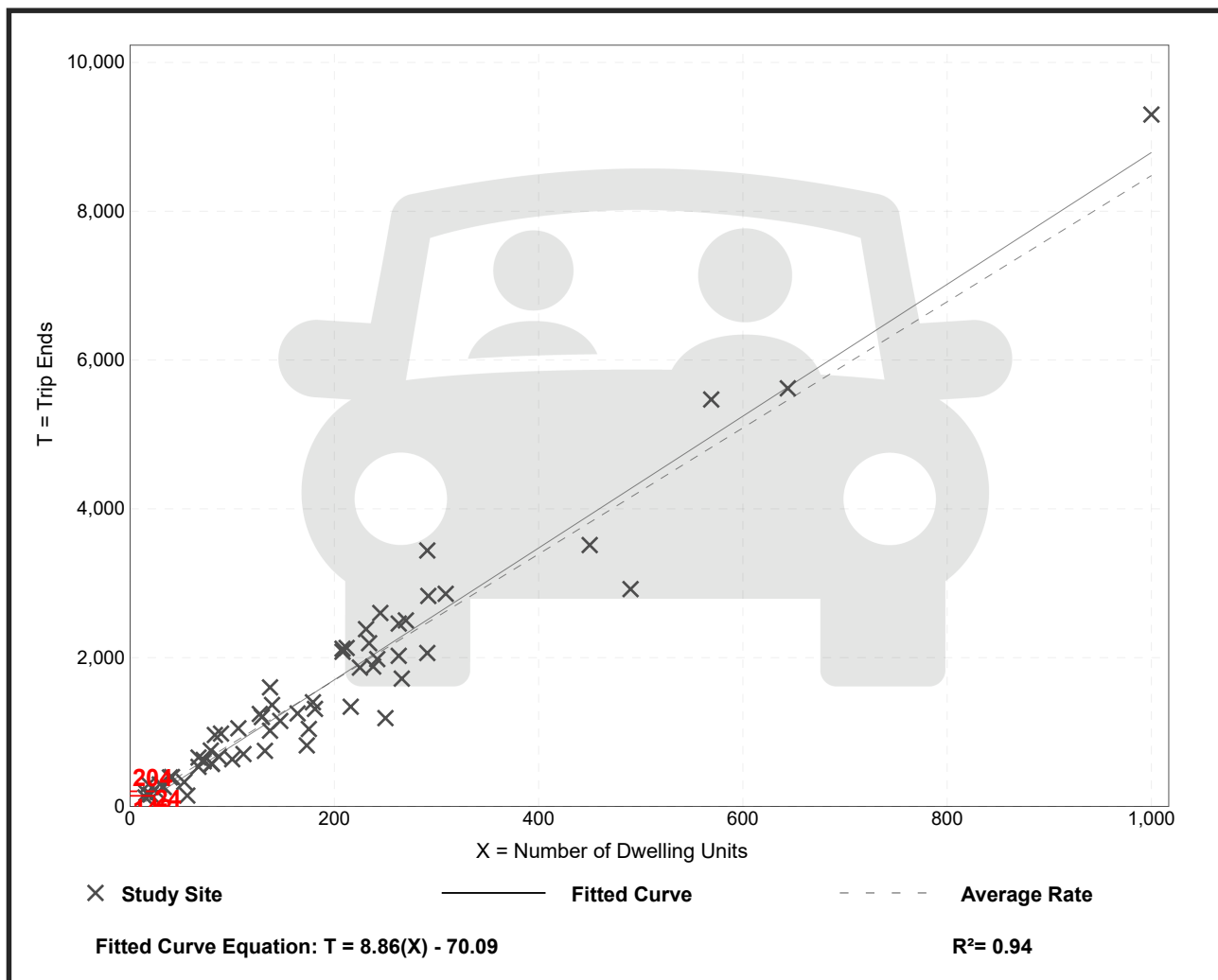
Vehicle Trip Ends vs: Dwelling Units
On a: Sunday

Setting/Location: General Urban/Suburban
Number of Studies: 60
Avg. Num. of Dwelling Units: 186
Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
8.48	2.61 - 16.44	1.74

Data Plot and Equation



Single-Family Detached Housing (210)

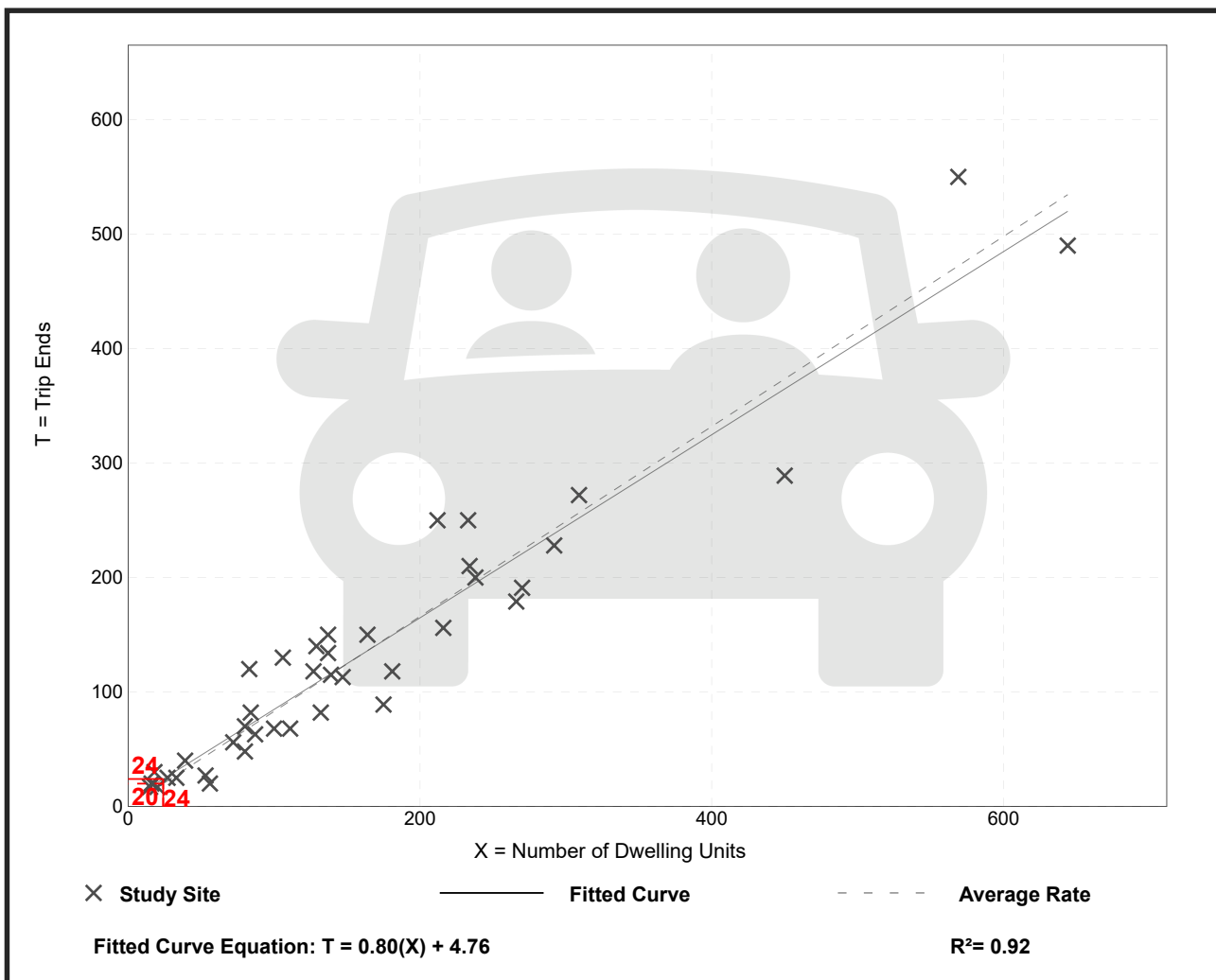
Vehicle Trip Ends vs: Dwelling Units
On a: Sunday, Peak Hour of Generator

Setting/Location: General Urban/Suburban
Number of Studies: 40
Avg. Num. of Dwelling Units: 162
Directional Distribution: 53% entering, 47% exiting






Vehicle Trip Generation per Dwelling Unit






Average Rate	Range of Rates	Standard Deviation
0.83	0.36 - 1.67	0.19






Data Plot and Equation












CAPACITY ANALYSIS RESULTS






Intersection						
Int Delay, s/veh	0.4					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	860	3	2	1010	8	7
Future Vol, veh/h	860	3	2	1010	8	7
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	0	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	0	0	2	0	0
Mvmt Flow	935	3	2	1098	9	8
Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	938	0	2039	937
Stage 1	-	-	-	-	937	-
Stage 2	-	-	-	-	1102	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	739	-	63	324
Stage 1	-	-	-	-	384	-
Stage 2	-	-	-	-	321	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	739	-	63	324
Mov Cap-2 Maneuver	-	-	-	-	63	-
Stage 1	-	-	-	-	384	-
Stage 2	-	-	-	-	320	-
Approach	EB		WB		NB	
HCM Control Delay, s	0		0		47.4	
HCM LOS					E	
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	101	-	-	739	-	
HCM Lane V/C Ratio	0.161	-	-	0.003	-	
HCM Control Delay (s)	47.4	-	-	9.9	-	
HCM Lane LOS	E	-	-	A	-	
HCM 95th %tile Q(veh)	0.5	-	-	0	-	

Intersection						
Int Delay, s/veh	0.8					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	1118	3	2	1313	8	7
Future Vol, veh/h	1118	3	2	1313	8	7
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	0	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	0	0	2	0	0
Mvmt Flow	1215	3	2	1427	9	8
Major/Minor	Major1	Major2		Minor1		
Conflicting Flow All	0	0	1218	0	2648	1217
Stage 1	-	-	-	-	1217	-
Stage 2	-	-	-	-	1431	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	580	-	26	223
Stage 1	-	-	-	-	283	-
Stage 2	-	-	-	-	223	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	580	-	26	223
Mov Cap-2 Maneuver	-	-	-	-	26	-
Stage 1	-	-	-	-	283	-
Stage 2	-	-	-	-	222	-
Approach	EB	WB		NB		
HCM Control Delay, s	0	0		128.8		
HCM LOS	F					
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	44	-	-	580	-	
HCM Lane V/C Ratio	0.371	-	-	0.004	-	
HCM Control Delay (s)	128.8	-	-	11.2	-	
HCM Lane LOS	F	-	-	B	-	
HCM 95th %tile Q(veh)	1.3	-	-	0	-	

Intersection						
Int Delay, s/veh	0.4					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	905	9	7	1218	6	4
Future Vol, veh/h	905	9	7	1218	6	4
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	0	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	0	0	2	0	0
Mvmt Flow	984	10	8	1324	7	4
Major/Minor	Major1	Major2		Minor1		
Conflicting Flow All	0	0	994	0	2329	989
Stage 1	-	-	-	-	989	-
Stage 2	-	-	-	-	1340	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	704	-	41	302
Stage 1	-	-	-	-	363	-
Stage 2	-	-	-	-	247	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	704	-	41	302
Mov Cap-2 Maneuver	-	-	-	-	41	-
Stage 1	-	-	-	-	363	-
Stage 2	-	-	-	-	244	-
Approach	EB	WB		NB		
HCM Control Delay, s	0	0.1		73.7		
HCM LOS	F					
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	63	-	-	704	-	
HCM Lane V/C Ratio	0.173	-	-	0.011	-	
HCM Control Delay (s)	73.7	-	-	10.2	-	
HCM Lane LOS	F	-	-	B	-	
HCM 95th %tile Q(veh)	0.6	-	-	0	-	

Intersection						
Int Delay, s/veh	0.9					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	1176	9	7	1584	6	4
Future Vol, veh/h	1176	9	7	1584	6	4
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	0	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	0	0	2	0	0
Mvmt Flow	1278	10	8	1722	7	4
Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	1288	0	3021	1283
Stage 1	-	-	-	-	1283	-
Stage 2	-	-	-	-	1738	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	545	-	15	204
Stage 1	-	-	-	-	263	-
Stage 2	-	-	-	-	157	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	545	-	15	204
Mov Cap-2 Maneuver	-	-	-	-	15	-
Stage 1	-	-	-	-	263	-
Stage 2	-	-	-	-	155	-
Approach	EB		WB		NB	
HCM Control Delay, s	0		0.1		245.7	
HCM LOS					F	
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	24	-	-	545	-	
HCM Lane V/C Ratio	0.453	-	-	0.014	-	
HCM Control Delay (s)	245.7	-	-	11.7	-	
HCM Lane LOS	F	-	-	B	-	
HCM 95th %tile Q(veh)	1.4	-	-	0	-	

Intersection						
Int Delay, s/veh	4.2					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	1481	9	7	1859	8	6
Future Vol, veh/h	1481	9	7	1859	8	6
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	0	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	0	0	2	0	0
Mvmt Flow	1610	10	8	2021	9	7
Major/Minor	Major1	Major2		Minor1		
Conflicting Flow All	0	0	1620	0	3652	1615
Stage 1	-	-	-	-	1615	-
Stage 2	-	-	-	-	2037	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	407	-	~ 6	130
Stage 1	-	-	-	-	181	-
Stage 2	-	-	-	-	111	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	407	-	~ 6	130
Mov Cap-2 Maneuver	-	-	-	-	~ 6	-
Stage 1	-	-	-	-	181	-
Stage 2	-	-	-	-	109	-
Approach	EB	WB		NB		
HCM Control Delay, s	0	0.1		\$ 992.6		
HCM LOS	F					
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	10	-	-	407	-	
HCM Lane V/C Ratio	1.522	-	-	0.019	-	
HCM Control Delay (s)	\$ 992.6	-	-	14	-	
HCM Lane LOS	F	-	-	B	-	
HCM 95th %tile Q(veh)	2.7	-	-	0.1	-	
Notes						
~: Volume exceeds capacity		\$: Delay exceeds 300s		+: Computation Not Defined		*: All major volume in platoon

Intersection						
Int Delay, s/veh	0.7					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	1061	7	6	1523	6	5
Future Vol, veh/h	1061	7	6	1523	6	5
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	0	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	0	0	2	0	0
Mvmt Flow	1153	8	7	1655	7	5
Major/Minor	Major1	Major2		Minor1		
Conflicting Flow All	0	0	1161	0	2826	1157
Stage 1	-	-	-	-	1157	-
Stage 2	-	-	-	-	1669	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	609	-	20	241
Stage 1	-	-	-	-	302	-
Stage 2	-	-	-	-	170	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	609	-	20	241
Mov Cap-2 Maneuver	-	-	-	-	20	-
Stage 1	-	-	-	-	302	-
Stage 2	-	-	-	-	168	-
Approach	EB		WB		NB	
HCM Control Delay, s	0		0		160	
HCM LOS					F	
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	34	-	-	609	-	
HCM Lane V/C Ratio	0.352	-	-	0.011	-	
HCM Control Delay (s)	160	-	-	11	-	
HCM Lane LOS	F	-	-	B	-	
HCM 95th %tile Q(veh)	1.1	-	-	0	-	