Northlands Estates Residential Development City of Port Colborne

Traffic Impact Study Addendum

June 28, 2024

Prepared for:

2600261 Ontario Inc.

Prepared by:

Stantec Consulting Ltd.

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Prepared by 

(signature)

Adam Mildenberger, B.A., C.E.T.

Project Manager, Transportation Planning

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1.0 INTRODUCTION

Stantec Consulting Ltd. has been retained to complete a Traffic Impact Study (TIS) Addendum for the proposed Northland Estates residential development in the City of Port Colborne.

A TIS was prepared in 2022 for a previous iteration of the site plan, which proposed 122 single-family detached units, 50 townhouse units, and a 50-unit mid-rise apartment block with ground floor commercial. Vehicular access to the development is proposed via an extension of Northland Avenue into the development area, and a new connection to Northland Avenue via Street 'A'. The TIS determined that the subject development would not result in any traffic operational concerns on the surrounding road network, and the study intersections are expected to continue operating acceptably up to at least the study's 2034 horizon year.

The site plan has been revised to propose 44 single-family detached units, 4 semi-detached unit, 189 townhouse units, and maintain the previously proposed 50-unit mid-rise apartment block with ground floor commercial. The proposed vehicular access points are unchanged. The site plan is provided in **Appendix A**.

Given the changes to the proposed site statistics, the City and Ontario Ministry of Transportation (MTO) require this TIS Addendum for the proponent's current planning application, to confirm if the findings from the previously completed TIS have changed.

2.0 SITE GENERATED TRAFFIC

The *Institute of Transportation (ITE) Trip Generation Manual* (11th edition) was used to forecast trip generation for the proposed development. Trip generation data sheets are provided in **Appendix B**. **Table 1** below presents the resulting estimated trip generation.

Table 1: Trip Generation Estimates

ITE Land Use	AM Peak Hour			PM Peak Hour		
	In	Out	Total	In	Out	Total
Single-Family Detached	9	26	35	29	17	46
Single-Family Attached	24	71	95	66	46	112
Multi-Family Housing (Mid-Rise)	2	8	10	12	8	20
Retail	23	16	39	56	55	111
TOTAL	**58**	**121**	**179**	**163**	**126**	**289**

The site generated traffic has been assigned to individual turning movements at the study area intersections based on the trip distribution assumptions as described in the comprehensive TIS report, based on Transportation Tomorrow Survey (TTS) data concerning commuter patterns in the area. The resulting assignment of the site generated traffic is shown in **Figure 1**.

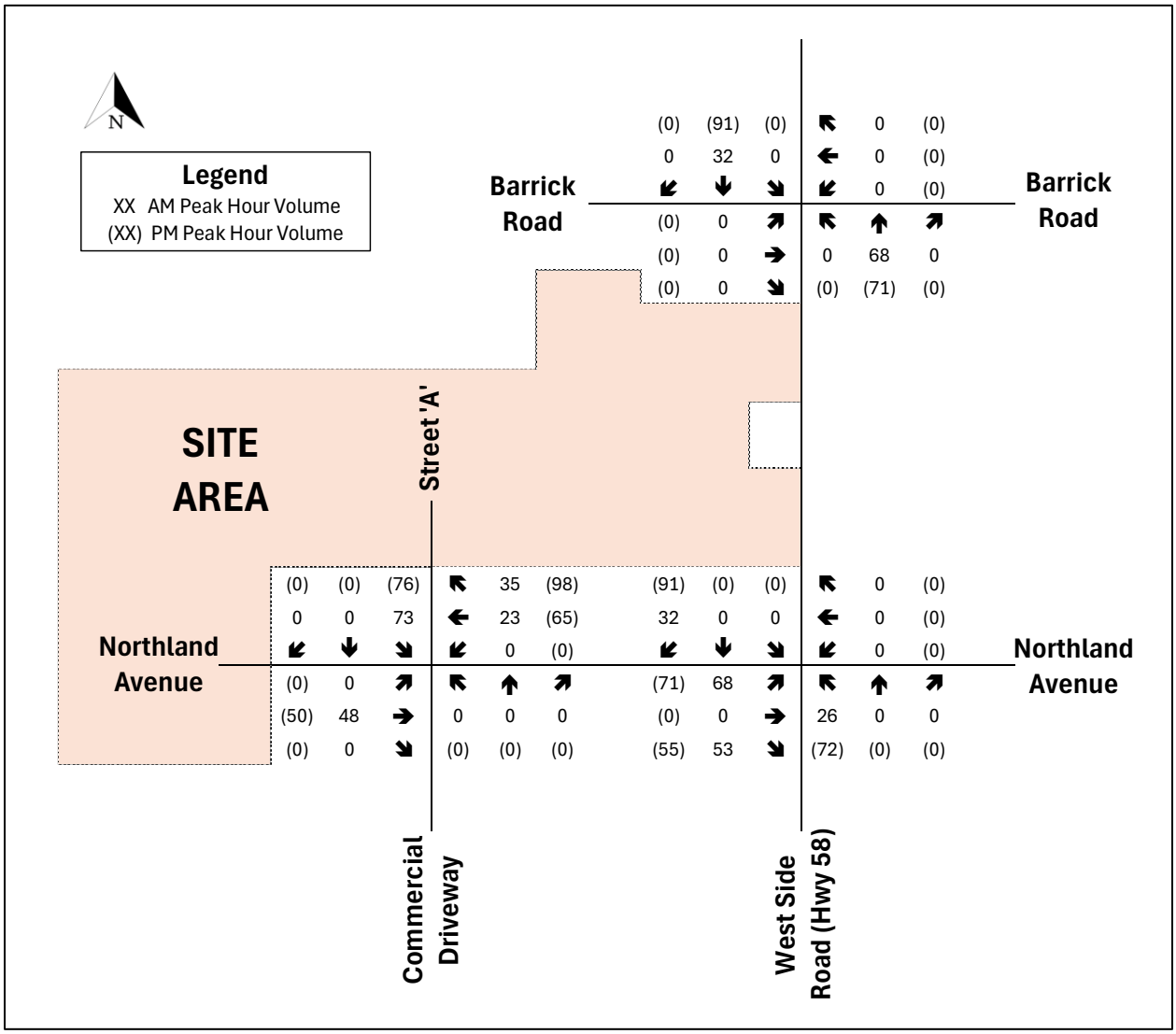


Figure 1: Site Generated Traffic

3.0 FUTURE TOTAL TRAFFIC

The updated 2034 total future traffic volumes were derived by combining the updated site generated trips to the 2034 future background traffic volumes (presented in the comprehensive TIS report). The updated 2034 future total traffic volumes are shown in **Figure 2**.

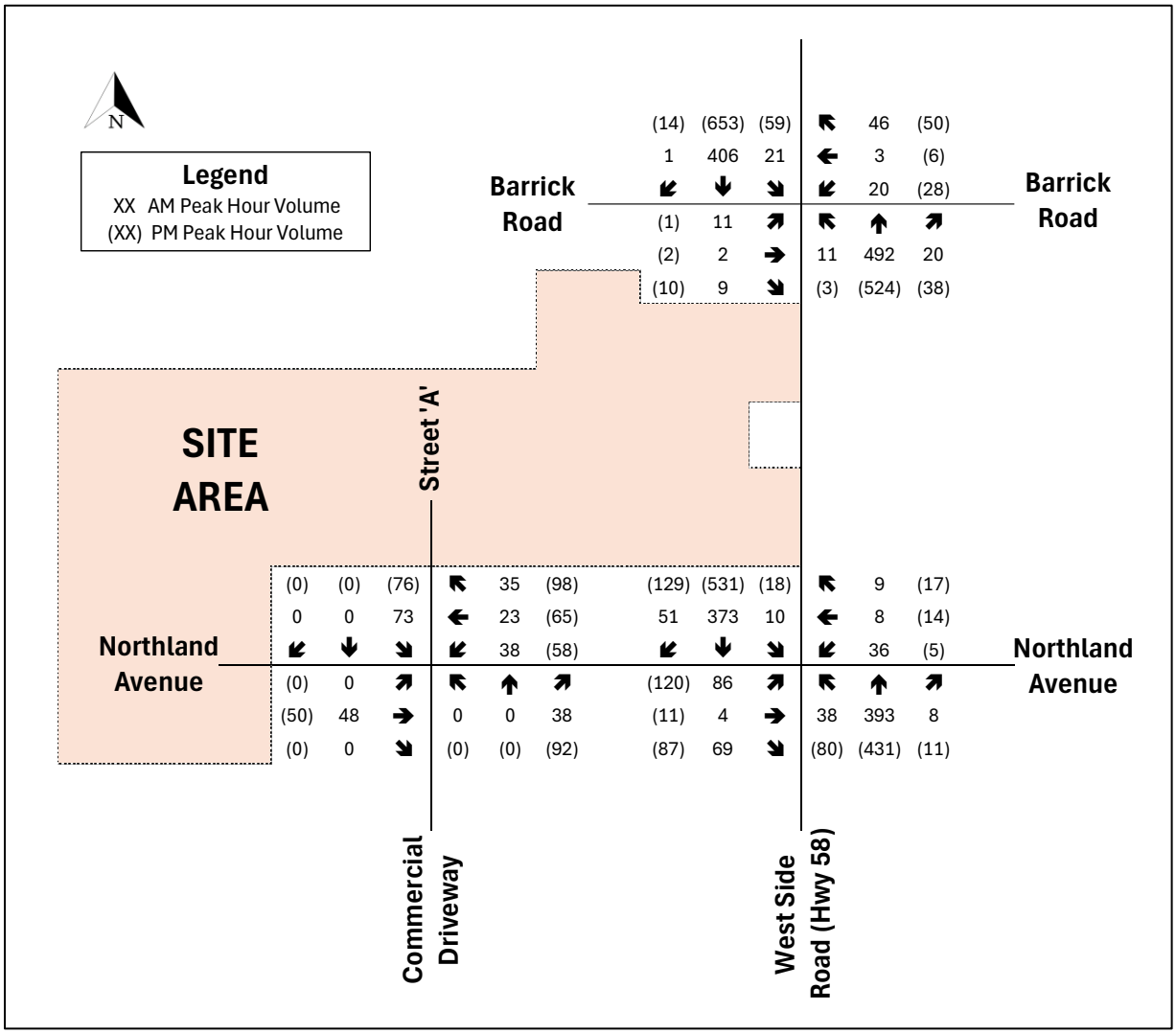


Figure 2: 2034 Future Total Traffic

4.0 INTERSECTION CAPACITY ANALYSIS

The industry standard Synchro macroscopic traffic analysis software was utilized to analyze the study intersections for the updated 2034 future total volumes during the weekday a.m. and p.m. peak hours. Key performance measures such as Level of Service (LOS), volume-to-capacity ratio (v/c ratio), and 95th percentile queuing was reported. **Table 2** presents the updated findings from the capacity analysis for the study area intersections, with detailed output reports from the Synchro software provided in **Appendix C**.

Similar to the findings from the comprehensive TIS report, the results of the analysis indicate the study intersections are currently not experiencing operational concerns and are not expected to experience any new operational concerns with the additional traffic generated by the subject development up to the 2034 horizon year.

Table 2: Capacity Analysis Results – 2034 Future Total

Intersection	Movement	Weekday AM Peak Hour			Weekday PM Peak Hour			Storage Length
		v/c	LOS	95%Q	v/c	LOS	95%Q	
West Side Road at Barrick Road	EBLTR	0.07	C	<1 veh	0.04	C	<1 veh	-
	WBLTR	0.16	B	<1 veh	0.28	C	9m	-
	NBL	0.01	A	<1 veh	0.00	A	<1 veh	100m
	SBL	0.02	A	<1 veh	0.06	A	<1 veh	100m
West Side Road at Northland Avenue	EBLTR	0.33	B	18m	0.43	B	28m	-
	WBL	0.11	B	1 veh	0.01	B	1 veh	30m
	WBTR	0.02	B	<1 veh	0.04	B	<1 veh	-
	NBL	0.08	A	<1 veh	0.22	A	11m	30m
	NBTR	0.24	A	15m	0.26	A	20m	-
	SBL	0.02	A	<1 veh	0.04	A	<1 veh	90m
	SBTR	0.23	A	15m	0.38	A	28m	-
Northland Avenue at Street 'A' / Commercial Driveway	WBLTR	0.03	A	<1 veh	0.04	A	<1 veh	-
	NBLTR	0.04	A	<1 veh	0.10	A	<1 veh	-
	SBLTR	0.11	B	<1 veh	0.17	B	<1 veh	-

5.0 TRAFFIC SIGNAL WARRANTS

MTO traffic signal warrants were completed for the intersections of West Side Road at Barrick Road and Northland Avenue at Street 'A', using the forecasted 2034 future total volumes. The completed warrants are provided in **Appendix D**, which demonstrate that both intersections do not warrants traffic signals to at least the 2034 horizon year due to insufficient traffic volumes.

6.0 LEFT-TURN LANE WARRANTS

An MTO left-turn lane warrant was completed for the westbound left-turn movement on Northland Avenue at the existing commercial driveway (opposite Street 'A'), using the forecasted 2034 future total volumes. The completed warrant is provided in **Appendix E**, which demonstrate that an auxiliary left-turn lane on Northland Avenue at the commercial driveway is not warranted to at least the 2034 horizon year due to insufficient traffic volumes. The left-turn lane warrant is not applicable to stop-controlled approaches (i.e., Barrick Road approaching West Side Road) or signal-controlled

approaches (i.e., Northland Avenue approaching West Side Road). The need for auxiliary left-turn lanes at those intersections is determined based on the results of intersection capacity analysis, the results of which are presented in Section 4 and indicate new auxiliary turn lanes are not required to maintain an acceptable level of service.

7.0 SIGHTLINE ASSESSMENT

An in-field sightline assessment was conducted along West Side Road in the vicinity of the proposed driveways for the proposed semi-attached units which will directly front West Side Road. Photographs of the unobstructed sightlines are provided in **Appendix F**. As shown, visibility looking to the north and south of the proposed driveway location on West Side Road is unobstructed for a significant distance. A driver exiting the driveway can see approaching vehicles from the north to approximately Windsor Terrace (approximately 400 metres away) and approaching vehicles from the south to approximately Northland Avenue (approximately 300 metres away).

As per the Intersection Sight Distance guidelines found in the Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads, a vehicle turning left onto a roadway with an assumed design speed of 90 km/h (based on the posted speed limit of 70 km/h) should have at least 190 metres of unobstructed visibility. Therefore, given existing sightlines at the driveway location have unobstructed sight distances of approximately 300-400 metres, there are no sightline concerns at the driveway location.

8.0 SUMMARY OF FINDINGS

The key findings from this study can be summarized as follows:

- The site is estimated to generate approximately 179 trips during the a.m. peak hour (58 inbound and 121 outbound) and 289 trips during the p.m. peak hour (163 inbound and 126 outbound).
- Similar to the findings from the comprehensive TIS report, the results of the analysis indicate the study intersections are currently not experiencing operational concerns and are not expected to experience any new operational concerns with the additional traffic generated by the subject development up to the 2034 horizon year.
- No new traffic signals or auxiliary turn lanes are required in response to the subject development, as per completed traffic control warrants and the intersection capacity analysis.
- Existing sightlines along West Side Road in the vicinity of the proposed driveways for the proposed semi-attached units have unobstructed sight distances of approximately 300-400 metres, which well exceed the minimum recommended sight distance per applicable guidelines.

9.0 RECOMMENDATIONS

Based on the findings of this TIS Addendum, transportation-related improvements are not recommended at existing study area intersections in response to the subject development.

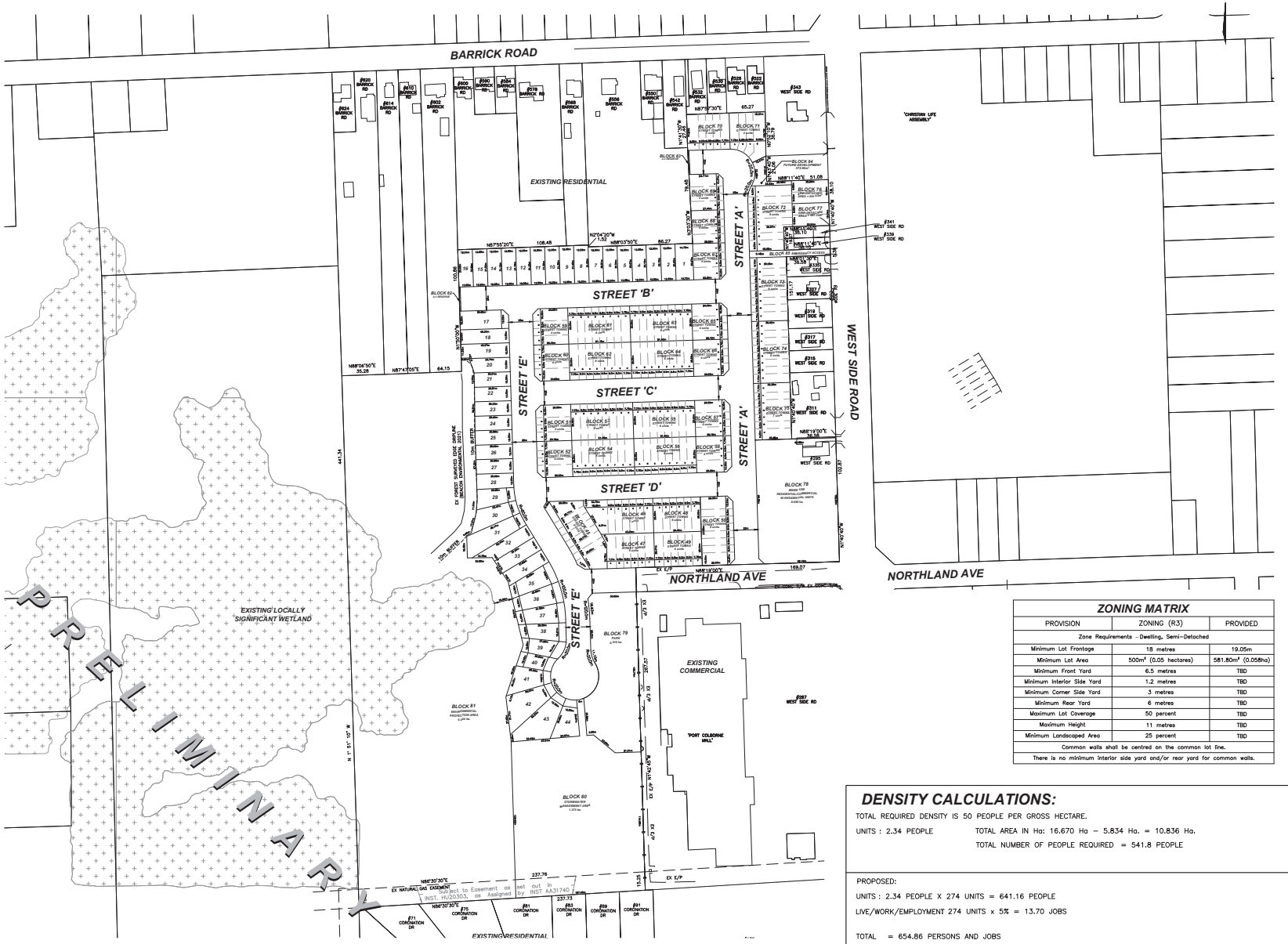
The proposed connection of Street ‘A’ to Northland Avenue is recommended to be stop-controlled, with Northland Avenue remaining free-flow (no stop control).

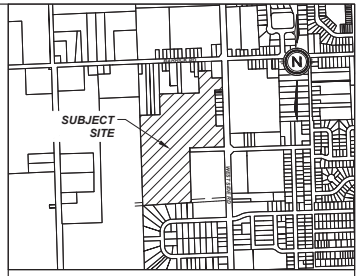
The proposed extension of Northland Avenue westwards into the site is recommended to be stop-controlled at the future intersection with Street ‘E’, with Street ‘E’ being free-flow (no stop control).

APPENDICES

Appendix A SITE PLAN

NORTHLAND ESTATES
CITY OF PORT COLBORNE





KEY PLAN
N.T.S.

LEGAL DESCRIPTION

CON 2 PT LOT 31 RP 59R11866;PARTS 2 TO 5
CITY OF PORT COLBORNE
REGIONAL MUNICIPALITY OF NIAGARA

ZONING MATRIX

PROVISION	ZONING (R3)	PROVIDED
Zone Requirements - Townhouse, Street		
Minimum Lot Frontage per Unit	6 metres	6m
Minimum Lot Area	180m²	183.17m² (0.017ha)
Minimum Front Yard	7.5 metres	TBD
Minimum Interior Side Yard	3 metres	1.5m
Minimum Corner Side Yard	4.5 metres	4.5m
Minimum Rear Yard	6 metres	TBD
Maximum Height	11 metres	TBD
Minimum Landscaped Area	25 percent	TBD
A 3 metre landscape buffer shall be required when a Townhouse development abuts the boundary of the Residential First Density, Residential Second Density or Residential Third Density Zone		
Common walls shall be centred on the common lot line.		
There is no minimum interior side yard and/or rear yard for common walls.		

ZONING MATRIX

PROVISION	ZONING (R3)	PROVIDED
Zone Requirements - Dwelling, Detached		
Minimum Lot Frontage	12 metres	12m
Minimum Lot Frontage - Corner Lot	15 metres	15.50m
Minimum Lot Area	327m²	352.31m²
Minimum Front Yard	6.5 metres	TBD
Minimum Interior Side Yard	1 metre	TBD
Minimum Corner Side Yard	3.5 metres	TBD
Minimum Rear Yard	6 metres	TBD
Maximum Lot Coverage	50 percent	TBD
Maximum Height	11 metres	TBD
Minimum Landscaped Area	25 percent	TBD

ZONING MATRIX

PROVISION	ZONING (R3)	PROVIDED
Zone Requirements - Dwelling, Semi-Detached		
Minimum Lot Frontage	18 metres	19.05m
Minimum Lot Area	500m² (0.05 hectares)	581.80m² (0.058ha)
Minimum Front Yard	6.5 metres	TBD
Minimum Interior Side Yard	1.2 metres	TBD
Minimum Corner Side Yard	3 metres	TBD
Minimum Rear Yard	6 metres	TBD
Maximum Lot Coverage	50 percent	TBD
Maximum Height	11 metres	TBD
Minimum Landscaped Area	25 percent	TBD
Common walls shall be centred on the common lot line.		
There is no minimum interior side yard and/or rear yard for common walls.		

LAND USE SCHEDULE

LAND USE	LOT/BLOCK	UNIT NO.	AREA(ha)	AREA(%)
SINGLE FAMILY RESIDENTIAL	1-44	44	1.993	11.96
STREET TOWN RESIDENTIAL	45-75	189	3.828	22.96
SEMI-DETACHED RESIDENTIAL	76-77	4	0.116	0.70
MIXED-USE RES./COMM.	78	50	0.686	4.12
PARK	79		0.515	3.09
STORMWATER MGMT FACILITY	80		1.373	8.24
ENVIRONMENTAL PROTECTION AREA	81		5.424	32.54
0.3m RESERVE	82-83		0.004	0.02
FUTURE DEVELOPMENT	84		0.037	0.22
EMERGENCY ACCESS	85		0.036	0.22
ROADWAY			2.656	15.93
TOTAL		287	16.670	100.00

DEVELOPABLE AREA (EXCLUDING EPA) = 10.836ha
DEVELOPABLE DENSITY = 26.49 units/ha

DENSITY CALCULATIONS:

TOTAL REQUIRED DENSITY IS 50 PEOPLE PER GROSS HECTARE.

UNITS : 2.34 PEOPLE

TOTAL AREA IN Ha: 16.670 Ha - 5.834 Ha. = 10.836 Ha.

TOTAL NUMBER OF PEOPLE REQUIRED = 541.8 PEOPLE

PROPOSED:

UNITS : 2.34 PEOPLE X 274 UNITS = 641.16 PEOPLE

LIVE/WORK/EMPLOYMENT 274 UNITS x 5% = 13.70 JOBS

TOTAL = 654.86 PERSONS AND JOBS

NO. OF PEOPLE/TOTAL AREA (ha): 654.86/10.836 ha = 60.43 PERSONS & JOBS PER HECTARE

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UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

DRAWING TITLE

CONCEPT PLAN OF SUBDIVISION

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REV	0

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Appendix B TRIP GENERATION SHEETS

Land Use: 210
Single-Family Detached Housing

Description

A single-family detached housing site includes any single-family detached home on an individual lot. A typical site surveyed is a suburban subdivision.

Specialized Land Use

Data have been submitted for several single-family detached housing developments with homes that are commonly referred to as patio homes. A patio home is a detached housing unit that is located on a small lot with little (or no) front or back yard. In some subdivisions, communal maintenance of outside grounds is provided for the patio homes. The three patio home sites total 299 dwelling units with overall weighted average trip generation rates of 5.35 vehicle trips per dwelling unit for weekday, 0.26 for the AM adjacent street peak hour, and 0.47 for the PM adjacent street peak hour. These patio home rates based on a small sample of sites are lower than those for single-family detached housing (Land Use 210), lower than those for single-family attached housing (Land Use 251), and higher than those for senior adult housing -- single-family (Land Use 251). Further analysis of this housing type will be conducted in a future edition of *Trip Generation Manual*.

Additional Data

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/).

For 30 of the study sites, data on the number of residents and number of household vehicles are available. The overall averages for the 30 sites are 3.6 residents per dwelling unit and 1.5 vehicles per dwelling unit.

The sites were surveyed in the 1980s, the 1990s, the 2000s, and the 2010s in Arizona, California, Connecticut, Delaware, Illinois, Indiana, Kentucky, Maryland, Massachusetts, Minnesota, Montana, New Jersey, North Carolina, Ohio, Ontario (CAN), Oregon, Pennsylvania, South Carolina, South Dakota, Tennessee, Vermont, Virginia, and West 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, 869, 903, 925, 936, 1005, 1007, 1008, 1010, 1033, 1066, 1077,1078, 1079

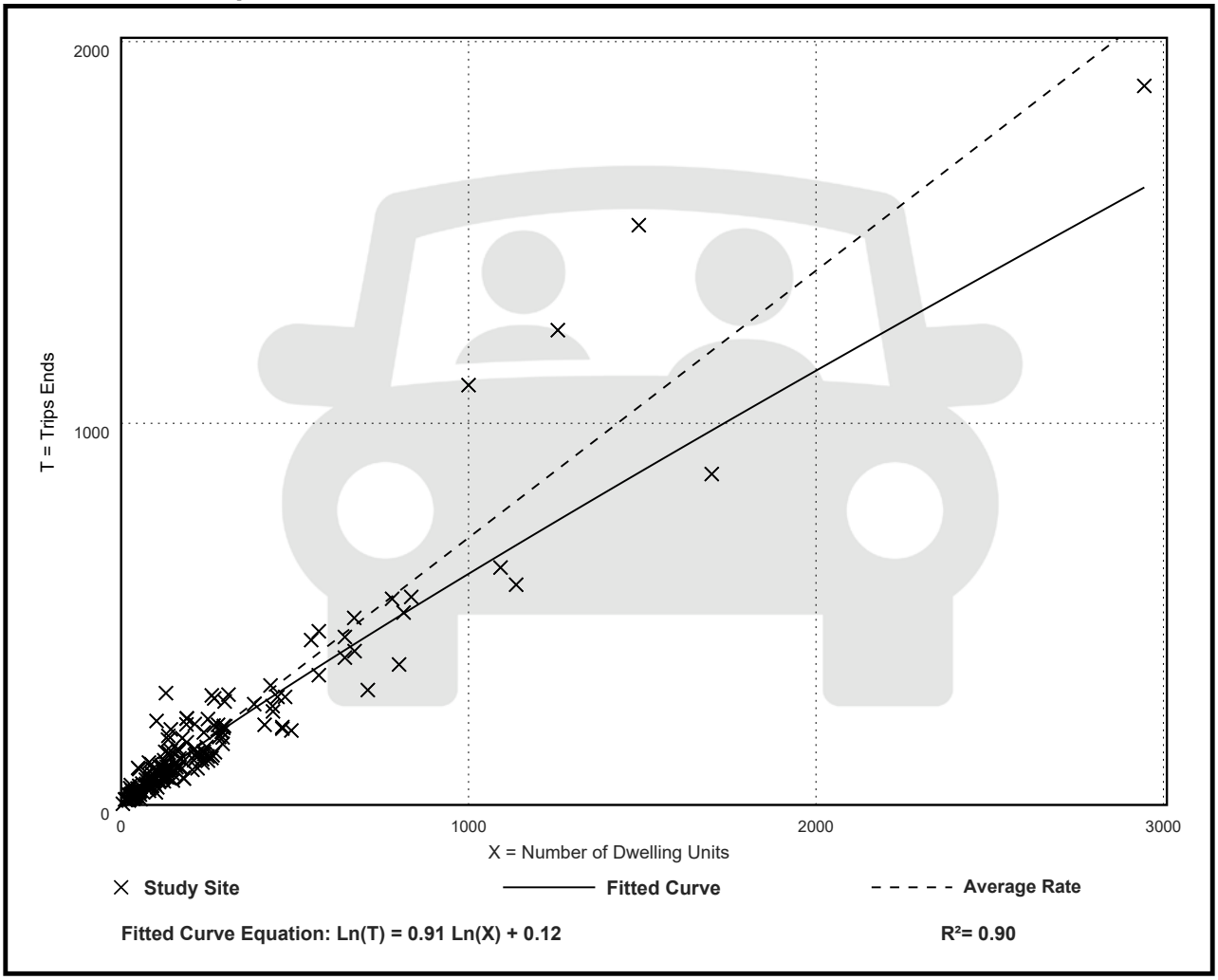
Single-Family Detached Housing
(210)

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



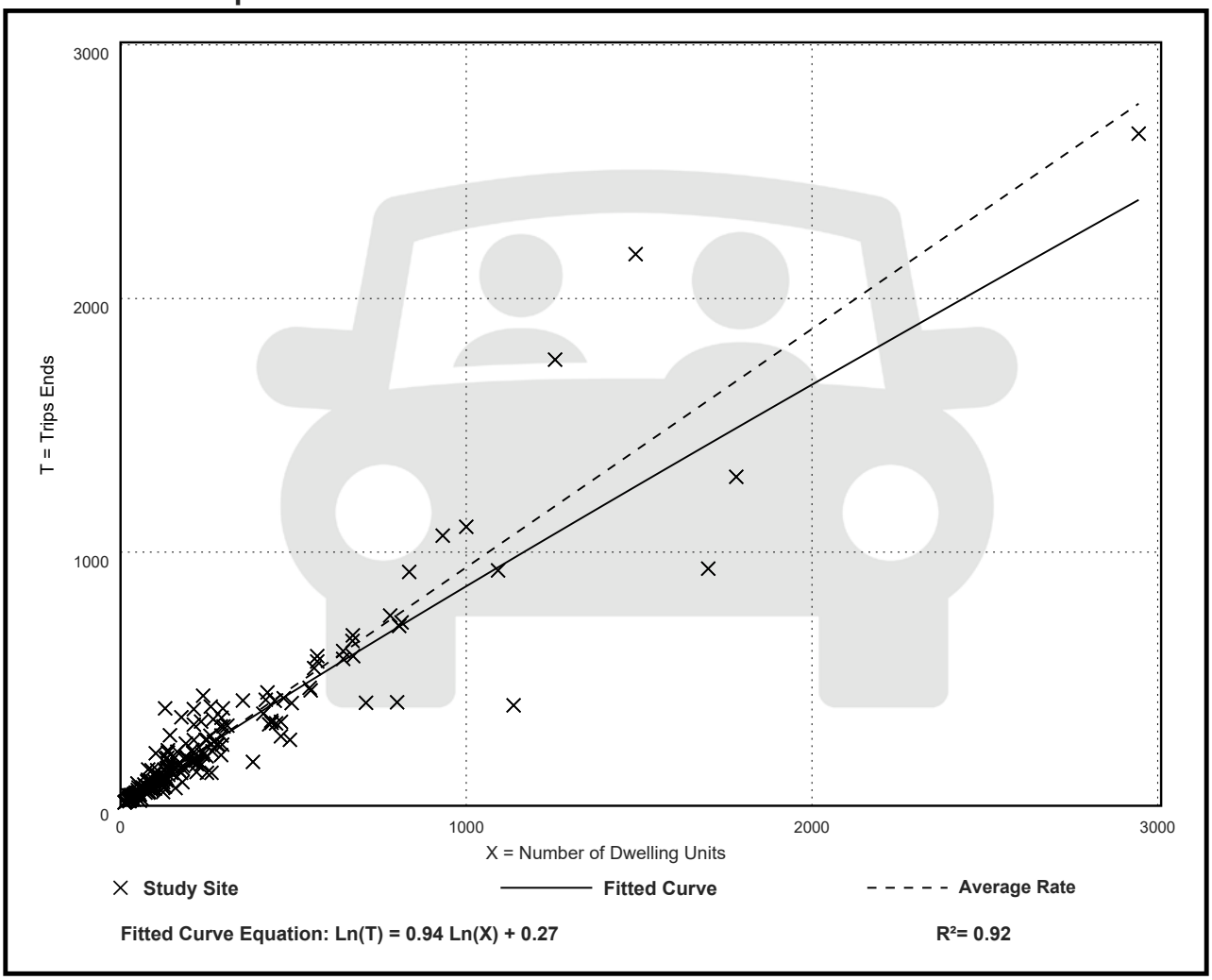
Single-Family Detached Housing
(210)

Vehicle Trip Ends vs: Dwelling Units
On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.
Setting/Location: General Urban/Suburban
Number of Studies: 208
Avg. Num. of Dwelling Units: 248
Directional Distribution: 63% entering, 37% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.94	0.35 - 2.98	0.31

Data Plot and Equation



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

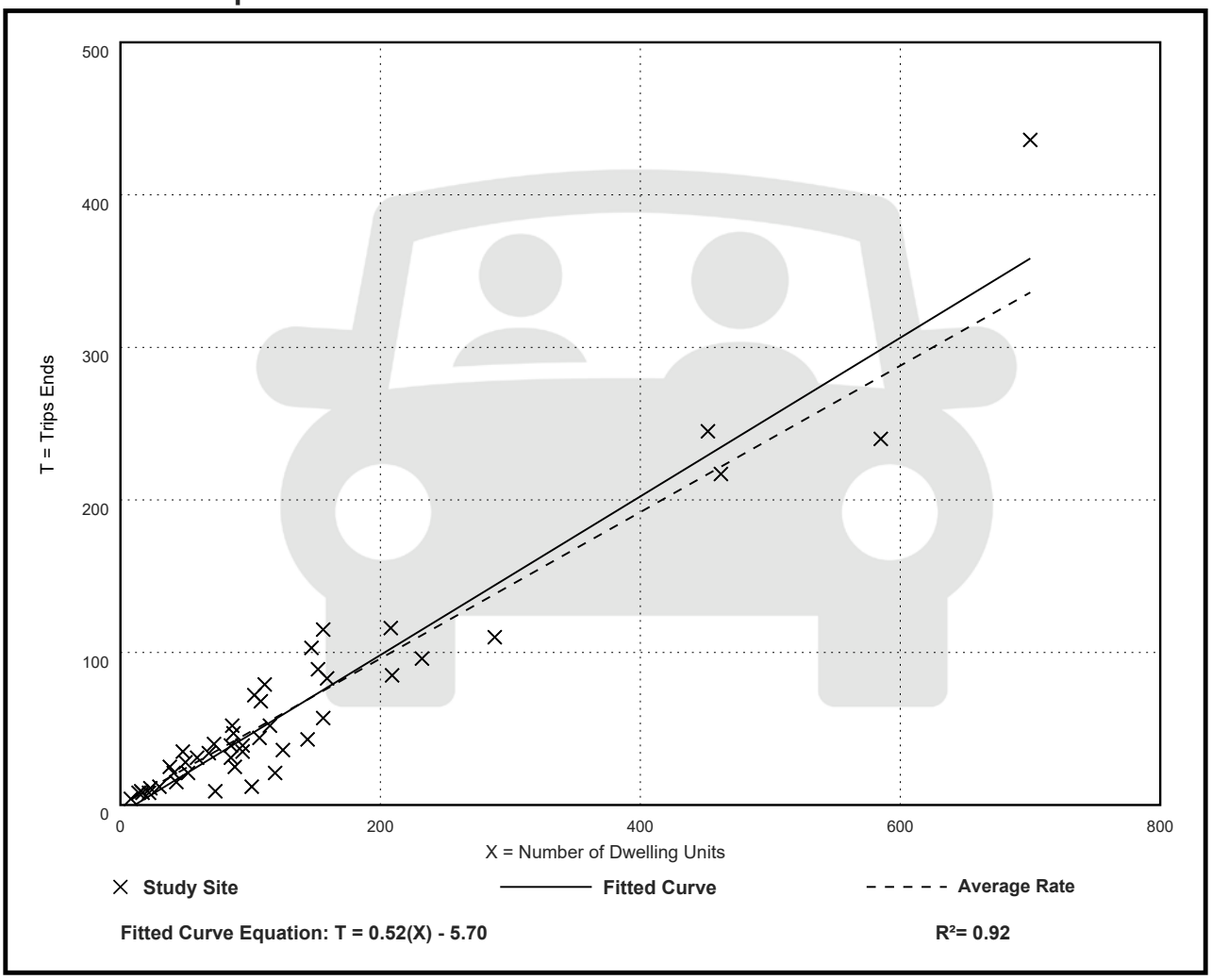
Single-Family Attached Housing
(215)

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: 31% entering, 69% 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



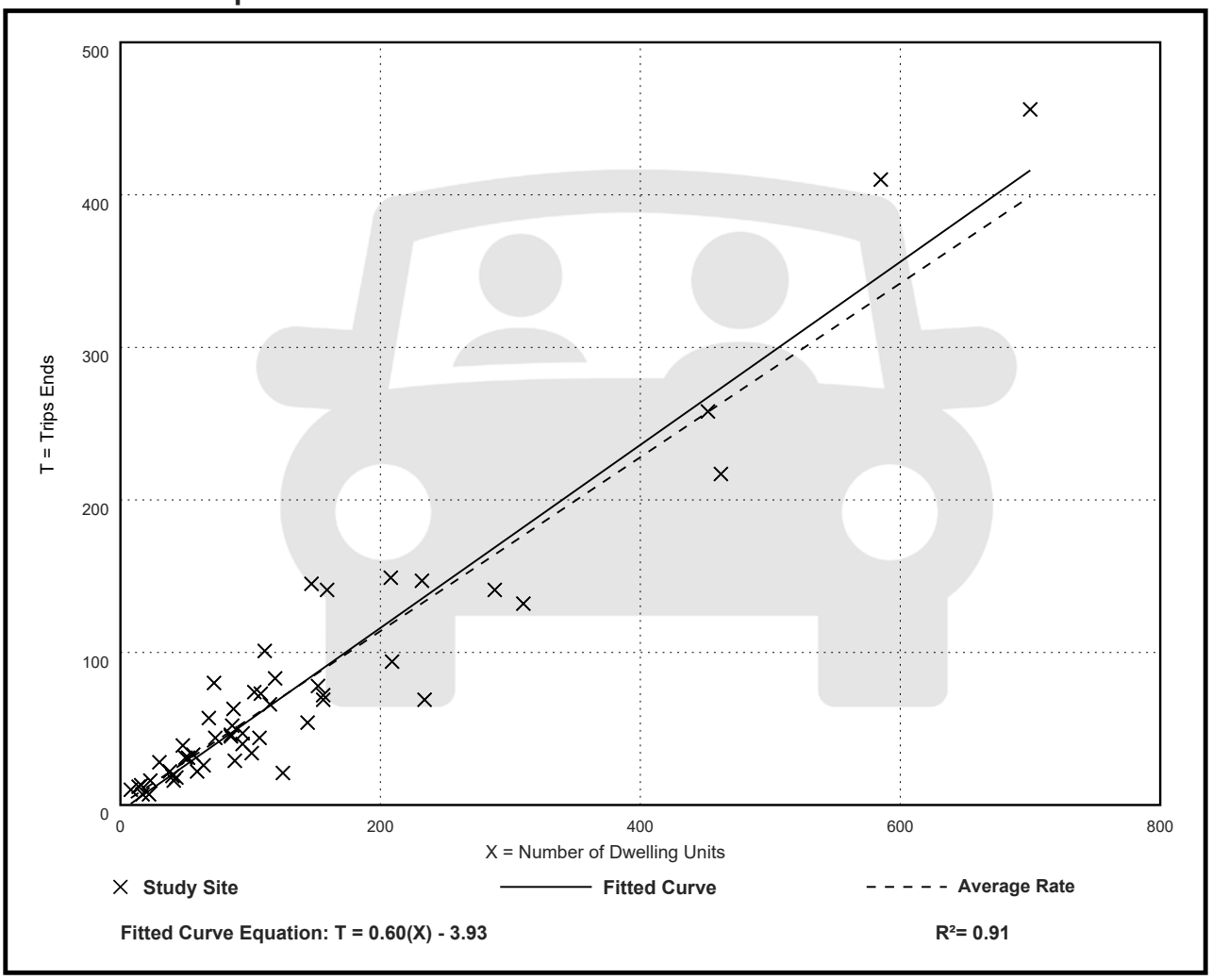
Single-Family Attached Housing
(215)

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: 57% entering, 43% 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



Land Use: 221
Multifamily Housing (Mid-Rise)

Description

Mid-rise multifamily housing includes apartments and condominiums located in a building that has between four and 10 floors of living space. Access to individual dwelling units is through an outside building entrance, a lobby, elevator, and a set of hallways.

Multifamily housing (low-rise) (Land Use 220), multifamily housing (high-rise) (Land Use 222), off-campus student apartment (mid-rise) (Land Use 226), and mid-rise residential with ground-floor commercial (Land Use 231) are related land uses.

Land Use Subcategory

Data are presented for two subcategories for this land use: (1) not close to rail transit and (2) close to rail transit. A site is considered close to rail transit if the walking distance between the residential site entrance and the closest rail transit station entrance is ½ mile or less.

Additional Data

For the six sites for which both the number of residents and the number of occupied dwelling units were available, there were an average of 2.5 residents per occupied dwelling unit.

For the five sites for which the numbers of both total dwelling units and occupied dwelling units were available, an average of 96 percent of the total dwelling units were occupied.

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/).

It is expected that the number of bedrooms and number of residents are likely correlated to the trips generated by a residential site. To assist in future analysis, trip generation studies of all multifamily housing should attempt to obtain information on occupancy rate and on the mix of residential unit sizes (i.e., number of units by number of bedrooms at the site complex).

The sites were surveyed in the 1990s, the 2000s, the 2010s, and the 2020s in Alberta (CAN), California, District of Columbia, Florida, Georgia, Illinois, Maryland, Massachusetts, Minnesota, Montana, New Jersey, New York, Ontario (CAN), Oregon, Utah, and Virginia.

Source Numbers

168, 188, 204, 305, 306, 321, 818, 857, 862, 866, 901, 904, 910, 949, 951, 959, 963, 964, 966, 967, 969, 970, 1004, 1014, 1022, 1023, 1025, 1031, 1032, 1035, 1047, 1056, 1057, 1058, 1071, 1076

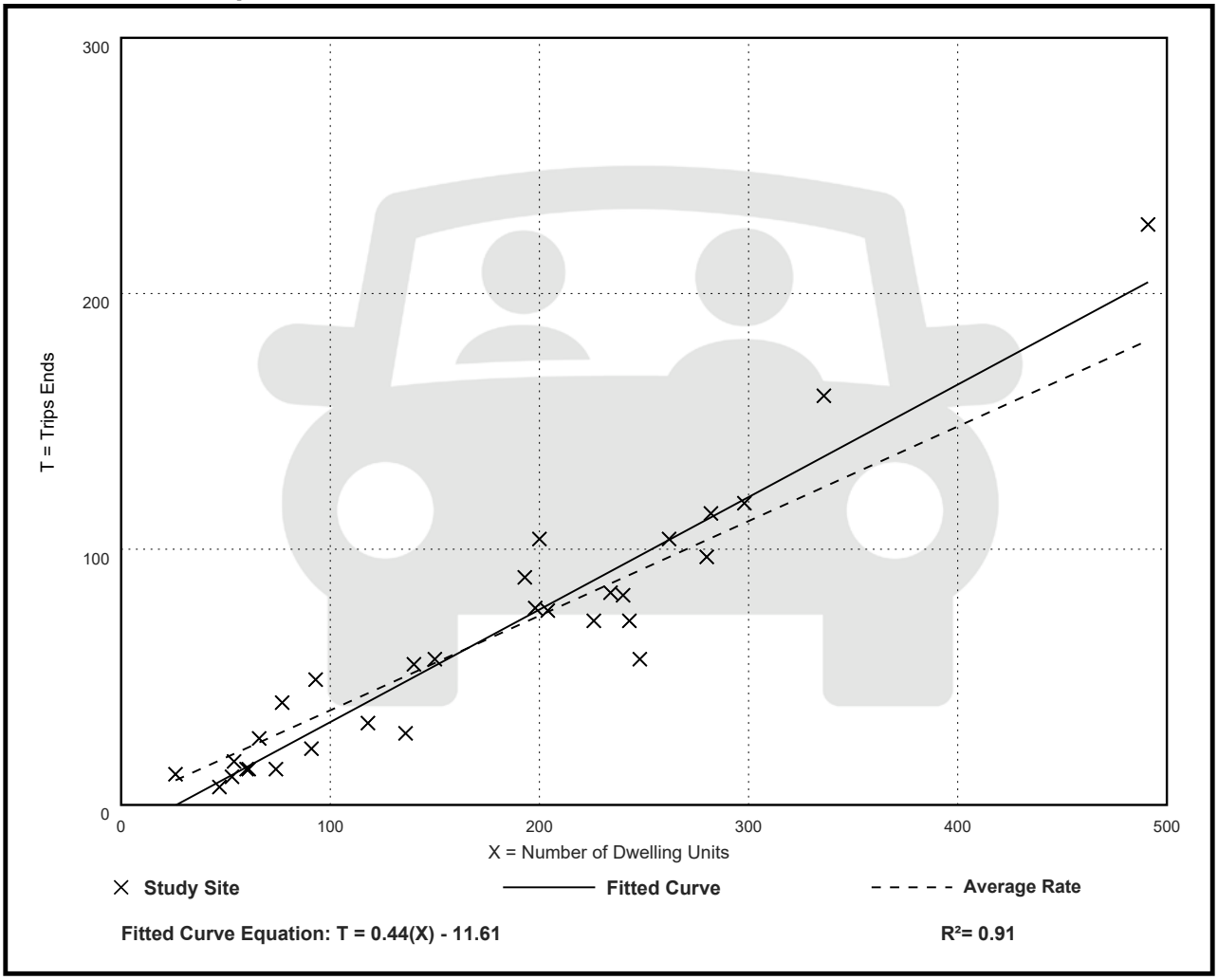
Multifamily Housing (Mid-Rise)
Not Close to Rail Transit (221)

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: 30
Avg. Num. of Dwelling Units: 173
Directional Distribution: 23% entering, 77% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.37	0.15 - 0.53	0.09

Data Plot and Equation



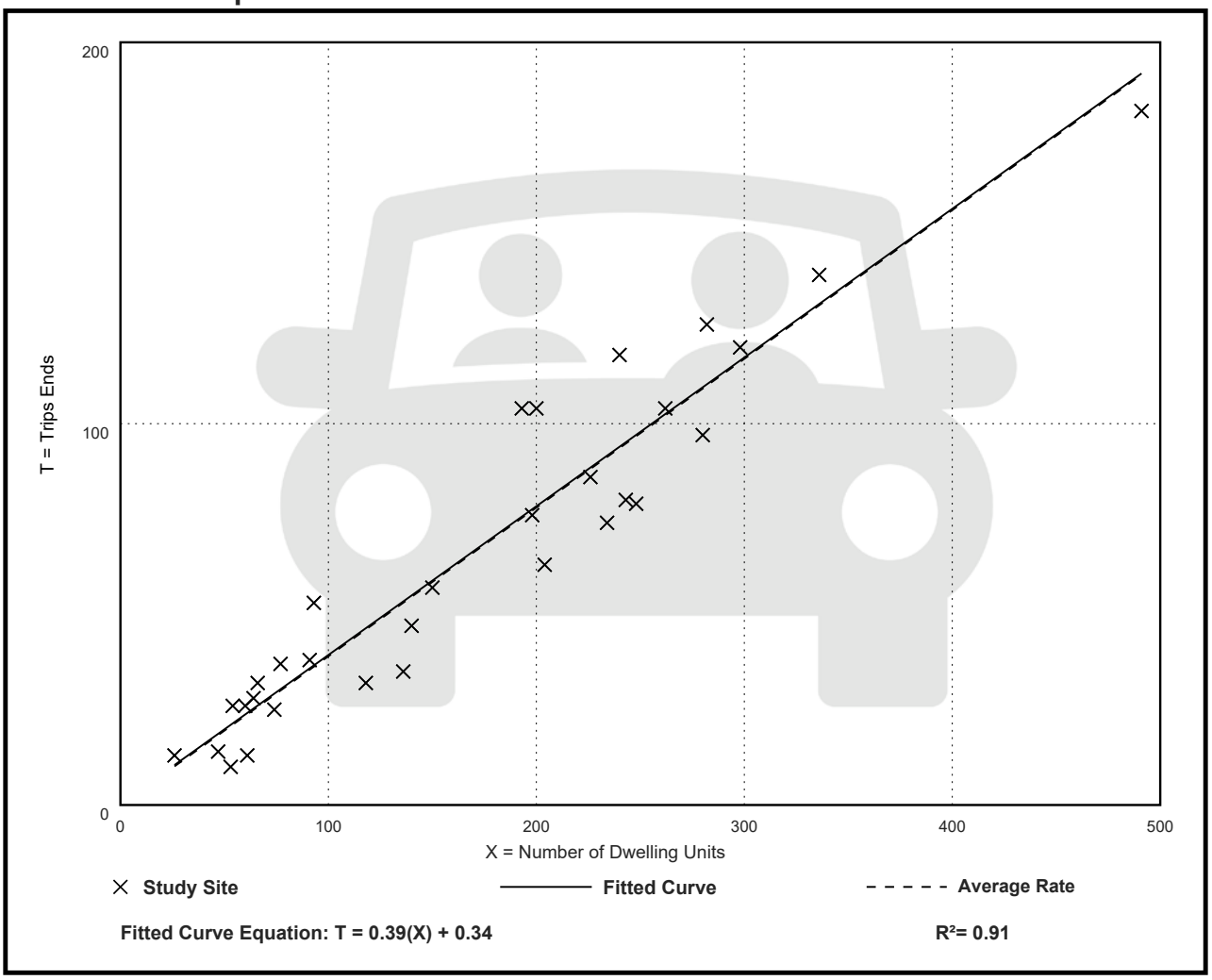
Multifamily Housing (Mid-Rise)
Not Close to Rail Transit (221)

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: 31
Avg. Num. of Dwelling Units: 169
Directional Distribution: 61% entering, 39% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.39	0.19 - 0.57	0.08

Data Plot and Equation



Land Use: 822
Strip Retail Plaza (<40k)

Description

A strip retail plaza is an integrated group of commercial establishments that is planned, developed, owned, and managed as a unit. Each study site in this land use has less than 40,000 square feet of gross leasable area (GLA). Because a strip retail plaza is open-air, the GLA is the same as the gross floor area of the building.

The 40,000 square feet GFA threshold between strip retail plaza and shopping plaza (Land Use 821) was selected based on an examination of the overall shopping center/plaza database. No shopping plaza with a supermarket as its anchor is smaller than 40,000 square feet GLA.

Shopping center (>150k) (Land use 820), shopping plaza (40-150k) (Land Use 821), and factory outlet center (Land Use 823) are related uses.

Additional Data

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 Alberta (CAN), California, Delaware, Florida, New Jersey, Ontario (CAN), South Dakota, Vermont, Washington, and Wisconsin.

Source Numbers

304, 358, 423, 428, 437, 507, 715, 728, 936, 960, 961, 974, 1009

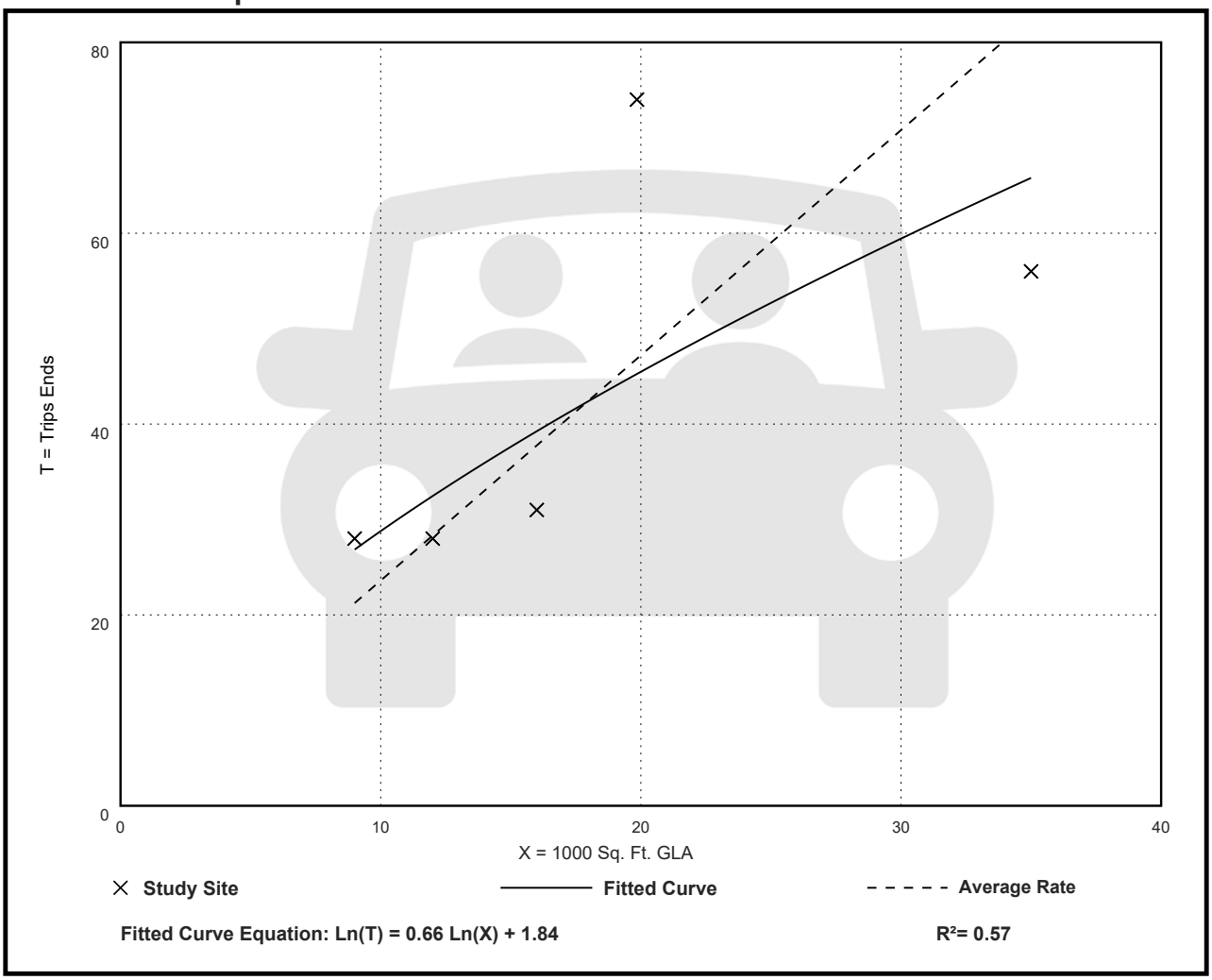
Strip Retail Plaza (<40k)
(822)

Vehicle Trip Ends vs: 1000 Sq. Ft. GLA
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: 5
Avg. 1000 Sq. Ft. GLA: 18
Directional Distribution: 60% entering, 40% exiting

Vehicle Trip Generation per 1000 Sq. Ft. GLA

Average Rate	Range of Rates	Standard Deviation
2.36	1.60 - 3.73	0.94

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.66 Ln(X) + 1.84

R^2= 0.57

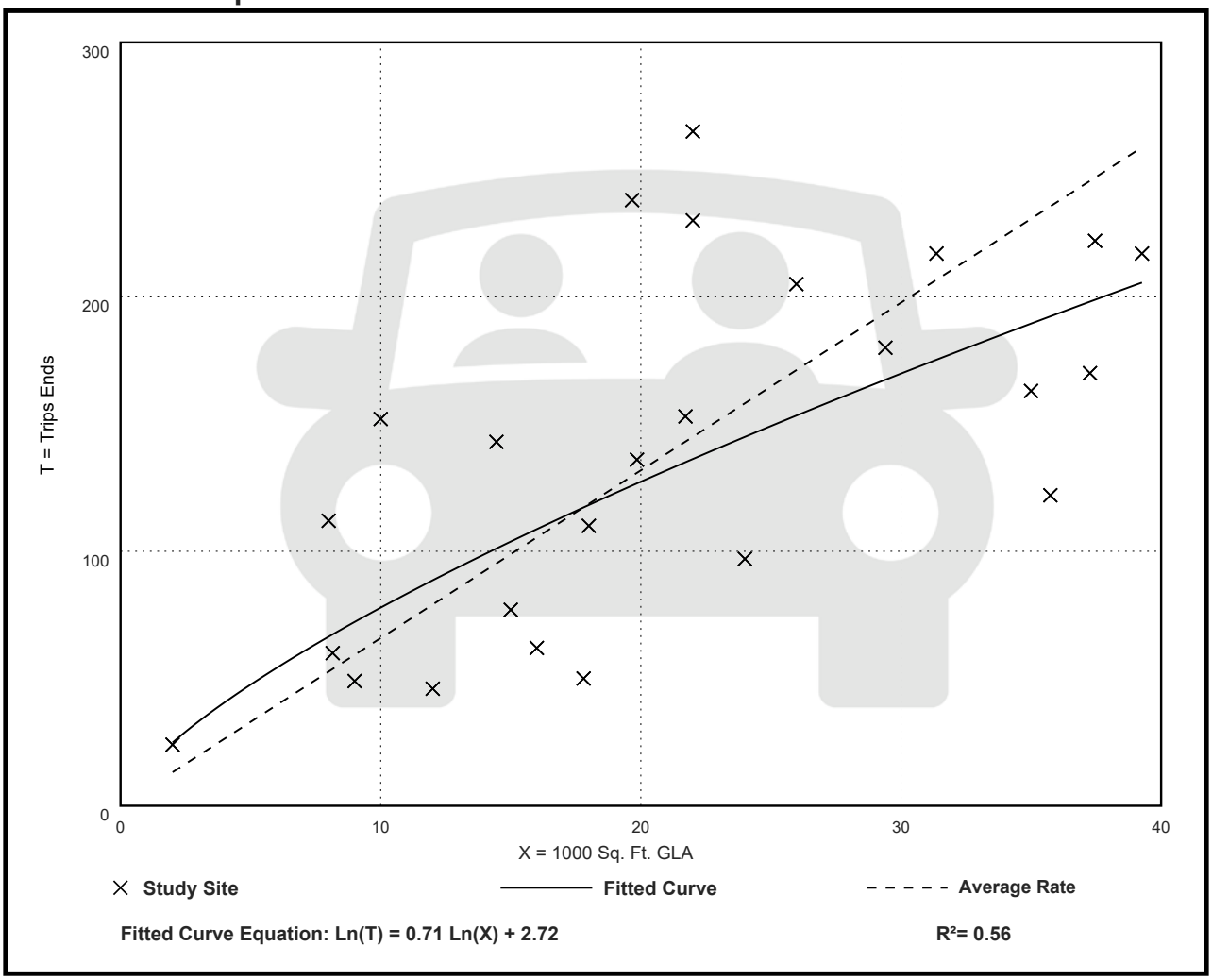
Strip Retail Plaza (<40k)
(822)

Vehicle Trip Ends vs: 1000 Sq. Ft. GLA
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: 25
Avg. 1000 Sq. Ft. GLA: 21
Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per 1000 Sq. Ft. GLA

Average Rate	Range of Rates	Standard Deviation
6.59	2.81 - 15.20	2.94

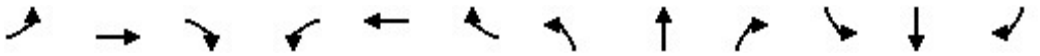
Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.71 Ln(X) + 2.72

R^2= 0.56

Appendix C SYNCHRO REPORTS



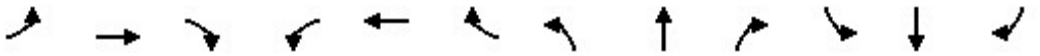
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	11	2	9	20	3	46	11	492	20	21	406	1
Future Volume (Veh/h)	11	2	9	20	3	46	11	492	20	21	406	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	12	2	9	21	3	48	12	518	21	22	427	1
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	804	1034	214	820	1024	270	428			539		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	804	1034	214	820	1024	270	428			539		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	95	99	99	92	99	93	99			98		
cM capacity (veh/h)	251	227	797	259	230	735	1142			1040		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	23	72	12	345	194	22	285	143
Volume Left	12	21	12	0	0	22	0	0
Volume Right	9	48	0	0	21	0	0	1
cSH	338	452	1142	1700	1700	1040	1700	1700
Volume to Capacity	0.07	0.16	0.01	0.20	0.11	0.02	0.17	0.08
Queue Length 95th (m)	1.7	4.3	0.2	0.0	0.0	0.5	0.0	0.0
Control Delay (s)	16.4	14.5	8.2	0.0	0.0	8.5	0.0	0.0
Lane LOS	C	B	A			A		
Approach Delay (s)	16.4	14.5	0.2			0.4		
Approach LOS	C	B						

Intersection Summary				
Average Delay	1.6			
Intersection Capacity Utilization	28.6%	ICU Level of Service		A
Analysis Period (min)	15			

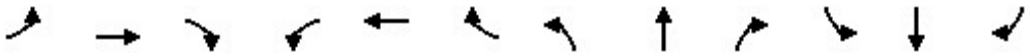
Lane Group	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	170	39	19	41	432	11	456
v/c Ratio	0.39	0.11	0.04	0.08	0.24	0.02	0.25
Control Delay	11.6	12.1	8.6	5.9	6.0	5.5	5.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	11.6	12.1	8.6	5.9	6.0	5.5	5.8
Queue Length 50th (m)	6.7	2.1	0.5	1.3	7.7	0.3	7.7
Queue Length 95th (m)	17.7	6.8	3.6	4.9	14.9	2.0	15.2
Internal Link Dist (m)	64.1		395.5		319.8		420.7
Turn Bay Length (m)		30.0		30.0		90.0	
Base Capacity (vph)	1043	944	1250	894	3157	916	3139
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.16	0.04	0.02	0.05	0.14	0.01	0.15

Intersection Summary



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	86	4	69	36	8	9	38	393	8	10	373	51
Future Volume (vph)	86	4	69	36	8	9	38	393	8	10	373	51
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frt		0.94		1.00	0.92		1.00	1.00		1.00	0.98	
Flt Protected		0.97		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1727		1825	1769		1825	3314		1825	3294	
Flt Permitted		0.82		0.70	1.00		0.49	1.00		0.50	1.00	
Satd. Flow (perm)		1457		1339	1769		940	3314		962	3294	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	92	4	74	39	9	10	41	423	9	11	401	55
RTOR Reduction (vph)	0	38	0	0	7	0	0	2	0	0	12	0
Lane Group Flow (vph)	0	132	0	39	12	0	41	430	0	11	444	0
Heavy Vehicles (%)	2%	0%	2%	0%	0%	0%	0%	10%	0%	0%	10%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		10.5		10.5	10.5		22.2	22.2		22.2	22.2	
Effective Green, g (s)		12.7		12.7	12.7		25.2	25.2		25.2	25.2	
Actuated g/C Ratio		0.28		0.28	0.28		0.55	0.55		0.55	0.55	
Clearance Time (s)		6.2		6.2	6.2		7.0	7.0		7.0	7.0	
Vehicle Extension (s)		3.0		4.5	4.5		3.0	3.0		4.5	4.5	
Lane Grp Cap (vph)		403		370	489		516	1819		528	1808	
v/s Ratio Prot					0.01			0.13			c0.13	
v/s Ratio Perm		c0.09		0.03			0.04			0.01		
v/c Ratio		0.33		0.11	0.02		0.08	0.24		0.02	0.25	
Uniform Delay, d1		13.2		12.4	12.1		4.9	5.4		4.7	5.4	
Progression Factor		1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.5		0.2	0.0		0.1	0.1		0.0	0.1	
Delay (s)		13.7		12.6	12.1		4.9	5.4		4.7	5.5	
Level of Service		B		B	B		A	A		A	A	
Approach Delay (s)		13.7			12.4			5.4			5.5	
Approach LOS		B			B			A			A	

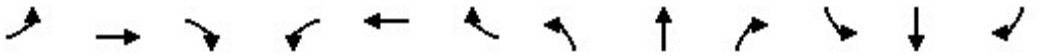
Intersection Summary			
HCM 2000 Control Delay	7.0	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.27		
Actuated Cycle Length (s)	45.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	54.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	48	0	38	23	35	0	0	38	73	0	0
Future Volume (Veh/h)	0	48	0	38	23	35	0	0	38	73	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	52	0	41	25	38	0	0	41	79	0	0
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)					88							
pX, platoon unblocked												
vC, conflicting volume	63			52			178	197	52	219	178	44
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	63			52			178	197	52	219	178	44
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			97			100	100	96	89	100	100
cM capacity (veh/h)	1553			1554			773	684	1016	697	700	1032

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	52	104	41	79
Volume Left	0	41	0	79
Volume Right	0	38	41	0
cSH	1553	1554	1016	697
Volume to Capacity	0.00	0.03	0.04	0.11
Queue Length 95th (m)	0.0	0.6	1.0	2.9
Control Delay (s)	0.0	3.0	8.7	10.8
Lane LOS		A	A	B
Approach Delay (s)	0.0	3.0	8.7	10.8
Approach LOS			A	B

Intersection Summary				
Average Delay	5.5			
Intersection Capacity Utilization	29.5%	ICU Level of Service	A	
Analysis Period (min)	15			



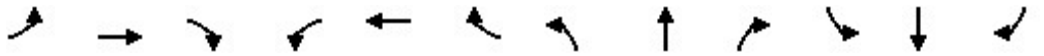
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	1	2	10	28	6	50	3	524	38	59	653	14
Future Volume (Veh/h)	1	2	10	28	6	50	3	524	38	59	653	14
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	1	2	10	29	6	52	3	540	39	61	673	14
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1133	1387	344	1035	1374	290	687			579		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1133	1387	344	1035	1374	290	687			579		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	99	99	98	83	96	93	100			94		
cM capacity (veh/h)	137	135	658	175	137	713	916			1005		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	13	87	3	360	219	61	449	238
Volume Left	1	29	3	0	0	61	0	0
Volume Right	10	52	0	0	39	0	0	14
cSH	348	308	916	1700	1700	1005	1700	1700
Volume to Capacity	0.04	0.28	0.00	0.21	0.13	0.06	0.26	0.14
Queue Length 95th (m)	0.9	8.6	0.1	0.0	0.0	1.5	0.0	0.0
Control Delay (s)	15.7	21.2	8.9	0.0	0.0	8.8	0.0	0.0
Lane LOS	C	C	A			A		
Approach Delay (s)	15.7	21.2	0.0			0.7		
Approach LOS	C	C						

Intersection Summary				
Average Delay	1.8			
Intersection Capacity Utilization	43.4%	ICU Level of Service		A
Analysis Period (min)	15			

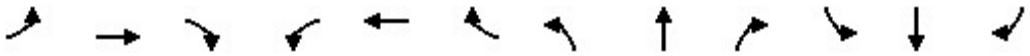
Lane Group	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	222	5	31	82	451	18	674
v/c Ratio	0.47	0.01	0.06	0.22	0.26	0.04	0.39
Control Delay	14.0	11.6	8.3	8.8	7.0	6.7	7.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.0	11.6	8.3	8.8	7.0	6.7	7.3
Queue Length 50th (m)	10.6	0.3	0.8	2.9	8.5	0.6	12.5
Queue Length 95th (m)	28.1	2.1	5.2	11.2	19.6	3.3	28.2
Internal Link Dist (m)	64.1		395.5		319.8		420.7
Turn Bay Length (m)		30.0		30.0		90.0	
Base Capacity (vph)	1025	869	1237	675	3135	892	3107
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.22	0.01	0.03	0.12	0.14	0.02	0.22

Intersection Summary



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	120	11	87	5	14	17	80	431	11	18	531	129
Future Volume (vph)	120	11	87	5	14	17	80	431	11	18	531	129
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frt		0.95		1.00	0.92		1.00	1.00		1.00	0.97	
Flt Protected		0.97		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1736		1825	1763		1825	3313		1825	3279	
Flt Permitted		0.81		0.65	1.00		0.37	1.00		0.49	1.00	
Satd. Flow (perm)		1448		1244	1763		713	3313		944	3279	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	122	11	89	5	14	17	82	440	11	18	542	132
RTOR Reduction (vph)	0	32	0	0	12	0	0	2	0	0	25	0
Lane Group Flow (vph)	0	190	0	5	19	0	82	449	0	18	649	0
Heavy Vehicles (%)	2%	0%	2%	0%	0%	0%	0%	10%	0%	0%	10%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		12.1		12.1	12.1		21.1	21.1		21.1	21.1	
Effective Green, g (s)		14.3		14.3	14.3		24.1	24.1		24.1	24.1	
Actuated g/C Ratio		0.31		0.31	0.31		0.52	0.52		0.52	0.52	
Clearance Time (s)		6.2		6.2	6.2		7.0	7.0		7.0	7.0	
Vehicle Extension (s)		3.0		4.5	4.5		3.0	3.0		4.5	4.5	
Lane Grp Cap (vph)		446		383	543		370	1720		490	1703	
v/s Ratio Prot					0.01			0.14			c0.20	
v/s Ratio Perm		c0.13		0.00			0.11			0.02		
v/c Ratio		0.43		0.01	0.04		0.22	0.26		0.04	0.38	
Uniform Delay, d1		12.8		11.1	11.2		6.1	6.2		5.5	6.7	
Progression Factor		1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.7		0.0	0.0		0.3	0.1		0.1	0.2	
Delay (s)		13.4		11.2	11.3		6.4	6.3		5.5	6.9	
Level of Service		B		B	B		A	A		A	A	
Approach Delay (s)		13.4			11.3			6.3			6.9	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	7.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.40		
Actuated Cycle Length (s)	46.4	Sum of lost time (s)	8.0
Intersection Capacity Utilization	64.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	50	0	58	65	98	0	0	92	76	0	0
Future Volume (Veh/h)	0	50	0	58	65	98	0	0	92	76	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	54	0	63	71	107	0	0	100	83	0	0
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)					88							
pX, platoon unblocked												
vC, conflicting volume	178			54			304	358	54	404	304	124
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	178			54			304	358	54	404	304	124
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			96			100	100	90	83	100	100
cM capacity (veh/h)	1410			1551			632	548	1013	489	587	932

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	54	241	100	83
Volume Left	0	63	0	83
Volume Right	0	107	100	0
cSH	1410	1551	1013	489
Volume to Capacity	0.00	0.04	0.10	0.17
Queue Length 95th (m)	0.0	1.0	2.5	4.6
Control Delay (s)	0.0	2.2	8.9	13.9
Lane LOS		A	A	B
Approach Delay (s)	0.0	2.2	8.9	13.9
Approach LOS			A	B

Intersection Summary				
Average Delay	5.4			
Intersection Capacity Utilization	36.8%	ICU Level of Service	A	
Analysis Period (min)	15			

Appendix D TRAFFIC SIGNAL WARRANTS

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Barrick Road & West Side Road Count Date: 2024

Justification 1: Minimum Vehicle Volumes

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 Lanes		2 or More Lanes		Hour Ending									
Flow Condition	FREE FLOW ☐	RESTR. FLOW ☐	FREE FLOW ☑	RESTR. FLOW ☐	AVG HR VOL	AM HR VOL	AVG HR VOL	AVG HR VOL	AVG HR VOL	PM HR VOL	AVG HR VOL	AVG HR VOL		
1A	480	720	600	900	609	1,042	609	609	609	1,388	609	609		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
1B	120	170	120	170	47	91	47	47	47	97	47	47		
	COMPLIANCE %				39	76	39	39	39	81	39	39	392	49
Free Flow Signal Justification 1:					Both 1A and 1B 100% Fulfilled each of 8 hours — Yes ☐ No ☑									
					Lesser of 1A or 1B at least 80% fulfilled each of 8 hours — Yes ☐ No ☑									

Justification 2: Delay to Cross Traffic

Free Flow Rural Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 lanes		2 or More lanes		Hour Ending									
Flow Condition	FREE FLOW ☐	RESTR. FLOW ☐	FREE FLOW ☑	RESTR. FLOW ☐	AVG HR VOL	AM HR VOL	AVG HR VOL	AVG HR VOL	AVG HR VOL	PM HR VOL	AVG HR VOL	AVG HR VOL		
2A	480	720	600	900	562	951	562	562	562	1,291	562	562		
	COMPLIANCE %				94	100	94	94	94	100	94	94	762	95
2B	50	75	50	75	17	34	17	17	17	35	17	17		
	COMPLIANCE %				34	68	34	34	34	70	34	34	342	43
Free Flow Signal Justification 2:					Both 2A and 2B 100% fulfilled each of 8 hours — Yes ☐ No ☑									
					Lesser of 2A or 2B at least 80% fulfilled each of 8 hours — Yes ☐ No ☑									

Justification 3: Combination

Combination Justification 1 and 2

	Justification Satisfied 80% or More			Two Justifications Satisfied 80% or More	
Justification 1	Minimum Vehicle Volume	YES ☐	NO ☑	YES ☐	NO ☑
Justification 2	Delay Cross Traffic	YES ☐	NO ☑		NOT JUSTIFIED

Justification 4: Four Hour Volume

Justification	Time Period	Total Volume of Both Approaches (Main) X	Heaviest Minor Approach Y (actual)	Required Value Y (warrant threshold)	Average % Compliance	Overall % Compliance
Justification 4	AM HR VOL	951	69	214	32 %	30 %
	AVG HR VOL	562	38	411	9 %	
	AVG HR VOL	562	38	411	9 %	
	PM HR VOL	1,291	84	121	69 %	

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Northland Avenue & Street 'A' Count Date: 2024

Justification 1: Minimum Vehicle Volumes

Restricted Flow Urban Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 Lanes		2 or More Lanes		Hour Ending									
Flow Condition	FREE FLOW ☐	RESTR. FLOW ☑	FREE FLOW ☐	RESTR. FLOW ☐	AVG HR VOL	AM HR VOL	AVG HR VOL	AVG HR VOL	AVG HR VOL	PM HR VOL	AVG HR VOL	AVG HR VOL		
1A	480	720	600	900	174	255	174	174	174	439	174	174		
	COMPLIANCE %				24	35	24	24	24	61	24	24	241	30
1B	120	170	120	170	70	111	70	70	70	168	70	70		
	COMPLIANCE %				41	65	41	41	41	99	41	41	411	51
Restricted Flow Signal Justification 1:					Both 1A and 1B 100% Fulfilled each of 8 hours					Yes ☐		No ☑		
					Lesser of 1A or 1B at least 80% fulfilled each of 8 hours					Yes ☐		No ☑		

Justification 2: Delay to Cross Traffic

Restricted Flow Urban Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 lanes		2 or More lanes		Hour Ending									
Flow Condition	FREE FLOW ☐	RESTR. FLOW ☑	FREE FLOW ☐	RESTR. FLOW ☐	AVG HR VOL	AM HR VOL	AVG HR VOL	AVG HR VOL	AVG HR VOL	PM HR VOL	AVG HR VOL	AVG HR VOL		
2A	480	720	600	900	104	144	104	104	104	271	104	104		
	COMPLIANCE %				14	20	14	14	14	38	14	14	144	18
2B	50	75	50	75	37	73	37	37	37	76	37	37		
	COMPLIANCE %				49	97	49	49	49	100	49	49	493	62
Restricted Flow Signal Justification 2:					Both 2A and 2B 100% fulfilled each of 8 hours					Yes ☐		No ☑		
					Lesser of 2A or 2B at least 80% fulfilled each of 8 hours					Yes ☐		No ☑		

Justification 3: Combination

Combination Justification 1 and 2

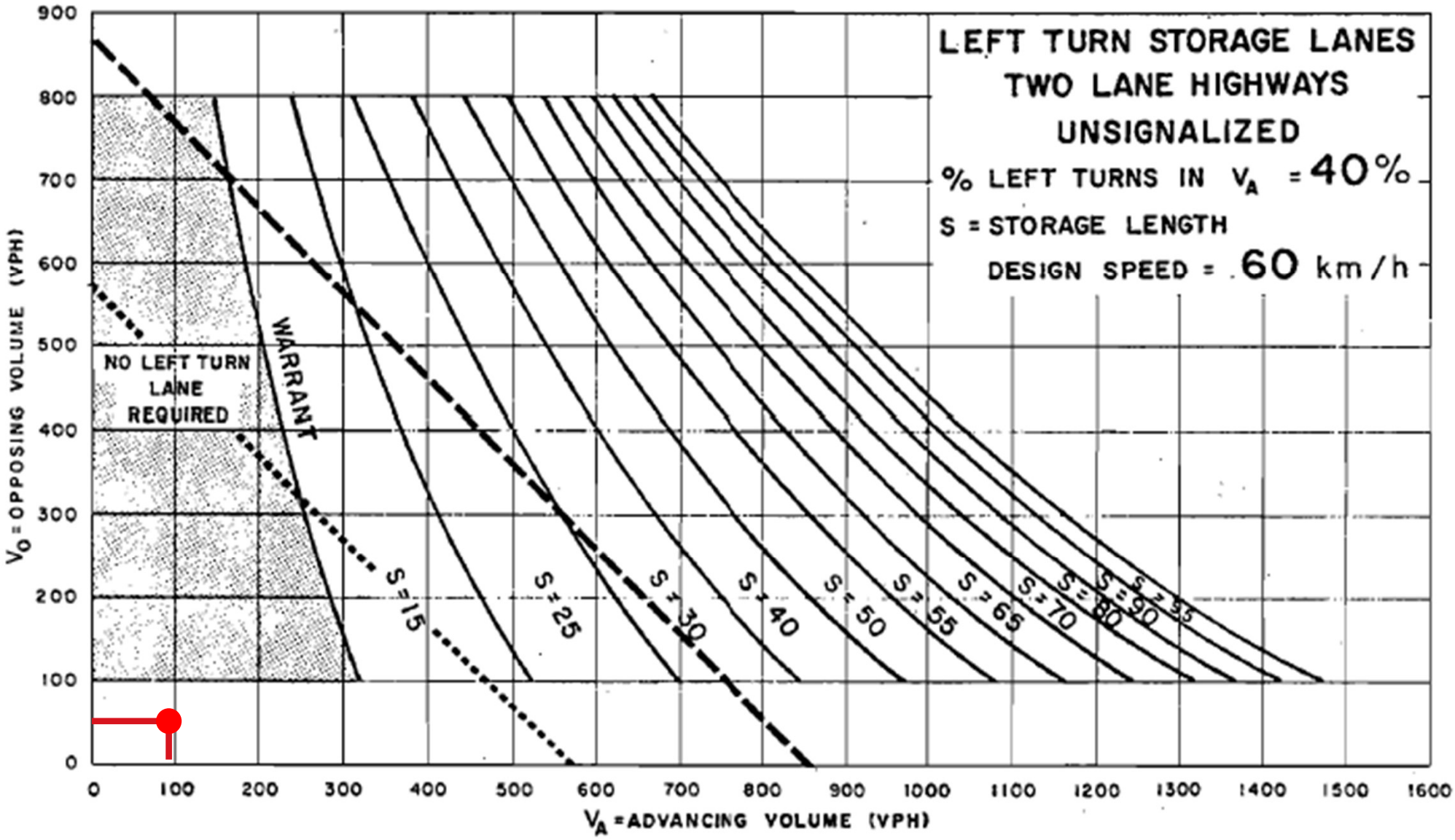
	Justification Satisfied 80% or More			Two Justifications Satisfied 80% or More	
Justification 1	Minimum Vehicle Volume	YES ☐	NO ☑	YES ☐	NO ☑
Justification 2	Delay Cross Traffic	YES ☐	NO ☑		NOT JUSTIFIED

Justification 4: Four Hour Volume

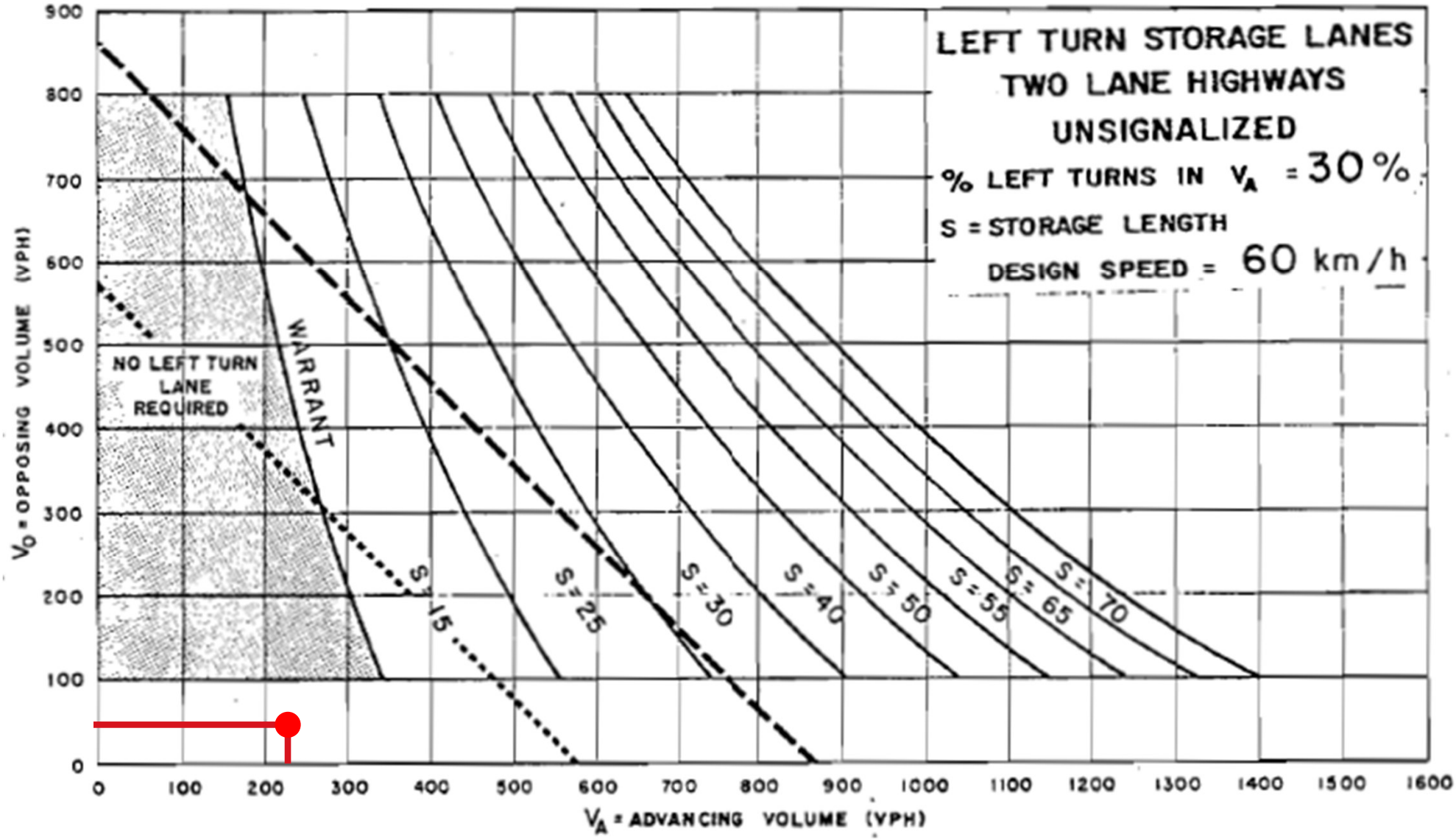
Justification	Time Period	Total Volume of Both Approaches (Main)	Heaviest Minor Approach	Required Value	Average % Compliance	Overall % Compliance
		X	Y (actual)	Y (warrant threshold)		
Justification 4	AM HR VOL	144	73	449	16 %	14 %
	AVG HR VOL	104	37	474	8 %	
	AVG HR VOL	104	37	474	8 %	
	PM HR VOL	271	92	375	25 %	

Appendix E MTO LEFT-TURN LANE WARRANTS

2034FT-AM


LEFT TURN STORAGE LANES
TWO LANE HIGHWAYS
UNSIGNALIZED
% LEFT TURNS IN V_A = 40%
S = STORAGE LENGTH
DESIGN SPEED = 60 km/h
NO LEFT TURN LANE REQUIRED
WARRANT
S=15
S=25
S=30
S=40
S=50
S=55
S=65
S=70
S=80
S=90
S=95
V_O = OPPOSING VOLUME (VPH)
V_A = ADVANCING VOLUME (VPH)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600

2034FT-PM


LEFT TURN STORAGE LANES
TWO LANE HIGHWAYS
UNSIGNALIZED
% LEFT TURNS IN V_A = 30 %
S = STORAGE LENGTH
DESIGN SPEED = 60 km/h
NO LEFT TURN LANE REQUIRED
WARRANT
S=15
S=25
S=30
S=40
S=50
S=55
S=65
S=70
V_O = OPPOSING VOLUME (VPH)
V_A = ADVANCING VOLUME (VPH)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600

Appendix F SIGHTLINE PHOTOGRAPHS