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36 Years

Dutch Meadows Subdivision
Municipality of South Dundas
County of Dundas

Traffic Impact Study

Engineering excellence. Planning precision. Inspired landscapes.

Dutch Meadows Subdivision
Part of Lots 34 and 35, Concession 1
Geographic Township of Williamsburgh,
Municipality of South Dundas,
County of Dundas

TRAFFIC IMPACT STUDY

Prepared By:

NOVATECH
Suite 200, 240 Michael Cowpland Drive
Ottawa, Ontario
K2M 1P6

August 2018

Novatech File: 118063
Ref No. R-2018-105

NOVATECH
Engineers, Planners & Landscape Architects

August 1st, 2018

Swank Construction Ltd.
c/o Mr. Robert (Jack) Sullivan
10781 Highway 2
Iroquois, Ontario K0E 1K0

Attention: **Mr. Ronald Swank**

Dear Sir:

Reference: **Dutch Meadows Draft Plan of Subdivision**
Part of Lots 34 and 35, Concession 1, Municipality of South Dundas
Traffic Impact Study
Our File No. 118063

The following Traffic Impact Study has been prepared in support of a Draft Plan of Subdivision application for the above lands located west of Morrisburg.

If you have any questions as you complete your review, please do not hesitate to contact the undersigned.

Yours truly,

NOVATECH

B. Byvelds

Brad Byvelds, P. Eng.
Project Coordinator | Transportation/Traffic

Suite 200, 240 Michael Cowpland Drive, Ottawa ON K2M 1P6 Tel: 613.254.9643 Fax: 613.254.5867 www.novatech-eng.com

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EXECUTIVE SUMMARY

The following Traffic Impact Study (TIS) has been prepared in support of a Draft Plan of Subdivision application for Part of Lots 34 and 35 of Concession 1 in the Geographic Township of Williamsburgh, Municipality of South Dundas, County of Dundas. The aforementioned lands will henceforth be referred to as the 'Dutch Meadows Subdivision', and are located west of Morrisburg.

The Dutch Meadows Subdivision will contain a total of 58 single detached dwelling units, 23 semi-detached housing units, 24 seniors single detached housing units and 48 condominium units. It is noteworthy that 22 of the single detached dwelling unit lots may become seniors detached housing unit lots, depending on market demands.

The Dutch Meadows Subdivision is anticipated to commence construction in 2019, and is anticipated to be built-out in four phases over a ten year period. The proposed subdivision will ultimately be served by a primary access along County Road 2 and a secondary access along Steward Drive. Phase 1 of the subdivision will temporarily be served by the Steward Drive access exclusively, while construction traffic will use the County Road 2 access. Following the construction of Phase 1, the County Road 2 access is anticipated to be opened to the public and the development will be served by both accesses.

This TIS has been prepared to provide an assessment of the development proposal. The methodologies used to analyze the transportation impacts of the proposed development are described as follows:

- Estimation of trips generated by the proposed subdivision;
- An operational evaluation of the study area intersections under the existing conditions;
- An operational evaluation of the accesses and study area intersections under background and total traffic conditions for the 2022 Phase 1 build-out and 2029 ultimate build-out year;
- A review of turn lane requirements at the accesses and study area intersections; and
- A review of the intersection sight distance at the proposed subdivision accesses.

The study area for this report includes the proposed access intersections as well as the County Road 2/Steward Drive intersection.

The selected time periods for the analysis are the weekday AM and PM peak hours. These peak hours are considered to represent the 'worst case' combination of site generated traffic and adjacent street traffic. Traffic conditions within the study area have been analyzed for the existing, and background and total traffic conditions for the 2022 Phase 1 build-out and 2029 ultimate build-out year.

The main conclusions and recommendations of this report are as follows:

- Phase 1 of the subdivision will temporarily be served by the Steward Drive access exclusively, while construction traffic will use the County Road 2 access. Following the construction of Phase 1, the County Road 2 access is anticipated to be opened to the public and the development will be served by both accesses.

- Phase 1 of the subdivision is anticipated to generate a total of 54 vehicle trips during the weekday AM peak hour and 61 vehicle trips during the weekday PM peak hour. At build-

out, the proposed subdivision is anticipated to generate a total of 95 vehicle trips during the weekday AM peak hour and 124 vehicle trips during the weekday PM peak hour at full build-out.

- Under existing/background traffic conditions, the County Road 2/Steward Drive intersection is anticipated to operate with a LOS A during the weekday AM and PM peak hours. A westbound left turn lane will not be warranted at this intersection.

- Under 2022 total traffic conditions (Phase 1 build-out), the County Road 2/Steward Drive intersection and Steward Drive access are anticipated to operate with a LOS A during the weekday AM and PM peak hours. A westbound left turn lane will not be warranted at the County Road 2/Steward Drive intersection.

- Under the 2029 total traffic conditions (ultimate build-out), the County Road 2/Steward Drive intersection and both accesses are anticipated to operate with a LOS B or better during the weekday AM and PM peak hours. A westbound left turn lane will not be warranted at either the County Road 2/Steward Drive intersection or the County Road 2 access. An eastbound right turn taper is not recommended at the proposed County Road 2 access.

- The required intersection sight distance for a passenger vehicle to exit left or right from the two accesses is achieved.

1.0 INTRODUCTION

The following Traffic Impact Study (TIS) has been prepared in support of a Draft Plan of Subdivision application for Part of Lots 34 and 35 of Concession 1 in the Geographic Township of Williamsburgh, Municipality of South Dundas, County of Dundas. The aforementioned lands will henceforth be referred to as the 'Dutch Meadows Subdivision', and are located west of Morrisburg. An aerial photo of the Dutch Meadows Subdivision is shown in **Figure 1**.

Figure 1: Aerial Photo of Dutch Meadows Subdivision

1.1 Proposed Development

The Dutch Meadows Subdivision will contain a total of 58 single detached dwelling units, 23 semi-detached housing units, 24 seniors single detached housing units and 48 condominium units. It is noteworthy that 22 of the single detached dwelling unit lots may become seniors detached housing unit lots, depending on market demands. A copy of the proposed Draft Plan of Subdivision is included in **Appendix A**.

The Dutch Meadows Subdivision is anticipated to commence construction in 2019, and is anticipated to be built-out in four phases over a ten year period. The proposed subdivision will ultimately be served by a primary access along County Road 2 and a secondary access along Steward Drive. Phase 1 of the subdivision will temporarily be served by the Steward Drive access exclusively, while construction traffic will use the County Road 2 access. Following the construction of Phase 1, the County Road 2 access is anticipated to be opened to the public and the development will be served by both accesses.

1.2 Analysis Methods

Intersection capacity analysis has been completed using the software package Synchro 10. This software uses methodology from the *Highway Capacity Manual 2010* (HCM), published by the Transportation Research Board, to evaluate signalized and unsignalized intersections.

Operating conditions at the accesses and the study area intersections have been evaluated in terms of a delay and a Level of Service (LOS). LOS is a qualitative measure describing the operating conditions within a traffic stream. Letters are assigned to six levels, with a LOS A representing optimal operating conditions and LOS F representing failing operating conditions.

The HCM relates the LOS for individual movements at an unsignalized intersection to average control delay. The HCM criteria are as follows:

Table 1: HCM Criteria for LOS

LOS	Delay (sec/veh)
A	< 10
B	10 to 15
C	15 to 25
D	25 to 35
E	35 to 50
F	**> 50**

This TIS has been prepared to provide an assessment of the development proposal. The methodologies used to analyze the transportation impacts of the proposed development are described as follows:

- Estimation of trips generated by the proposed subdivision;
- An operational evaluation of the study area intersections under the existing conditions;
- An operational evaluation of the accesses and study area intersections under background and total traffic conditions for the 2022 Phase 1 build-out and 2029 ultimate build-out year;
- A review of turn lane requirements at the accesses and study area intersections; and
- A review of the intersection sight distance at the proposed subdivision accesses.

1.3 Analysis Parameters

The study area for this report includes the proposed access intersections as well as the County Road 2/Steward Drive intersection.

The selected time periods for the analysis are the weekday AM and PM peak hours. These peak hours are considered to represent the 'worst case' combination of site generated traffic and adjacent street traffic. Traffic conditions within the study area have been analyzed for the existing, and background and total traffic conditions for the 2022 Phase 1 build-out and 2029 ultimate build-out year.

2.0 EXISTING CONDITIONS

2.1 Roadways and Intersections

County Road 2 generally runs on an east-west alignment and has a two-lane undivided rural cross section with a posted speed limit of 80 km/hr within the study area.

Steward Drive generally runs on a north-south alignment and has a two-lane undivided rural cross section with a posted speed limit of 50km/hr.

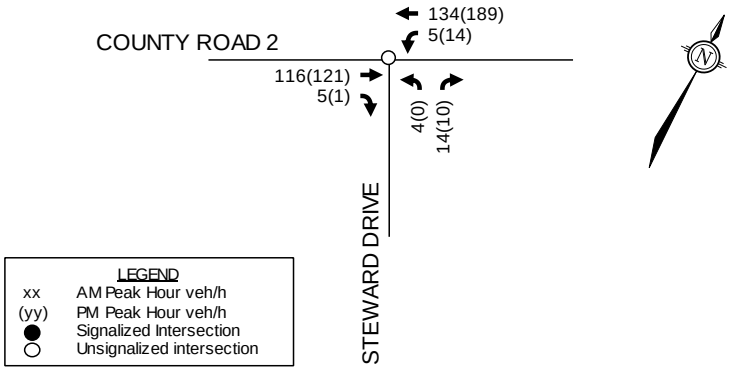
The County Road 2/Steward Drive intersection currently has one lane approaches on all legs. A 40m eastbound right turn taper is provided, however it is painted as a paved shoulder. This intersection currently operates under side street stop control. An aerial photo of this intersection is provided in **Figure 2**.

Figure 2: Aerial Photo of County Road 2/Steward Drive Intersection

2.2 Existing Traffic Volumes

A weekday traffic count was commissioned by Novatech at the County Road 2/Steward Drive intersection and was completed on Wednesday April 18th, 2018. Peak hour summary sheets of the traffic count are included in **Appendix B**. The weekday AM and PM peak hour traffic volumes at the County Road 2/Steward Drive intersection are shown in **Figure 3**.

Figure 3: Existing Traffic Volumes



3.0 TRAVEL DEMAND FORECASTING

3.1 Background Growth

Historical Annual Average Daily Traffic (AADT) counts along County Road 2 between Merkley Drive and County Road 31 were obtained from the Counties of Stormont, Dundas, and Glengarry. Based on the AADT counts, traffic along County Road 2 grew at a rate of 2% per annum between 2012 and 2016.

For the purposes of this analysis, a compound annual growth rate of 2% per annum has been applied to the existing through traffic volumes along County Road 2. Background traffic volumes along the study area roadways for the 2022 Phase 1 build-out and 2029 ultimate build-out year are shown in **Figure 4** and **5** respectively.

Figure 4: 2022 Background Traffic Volumes

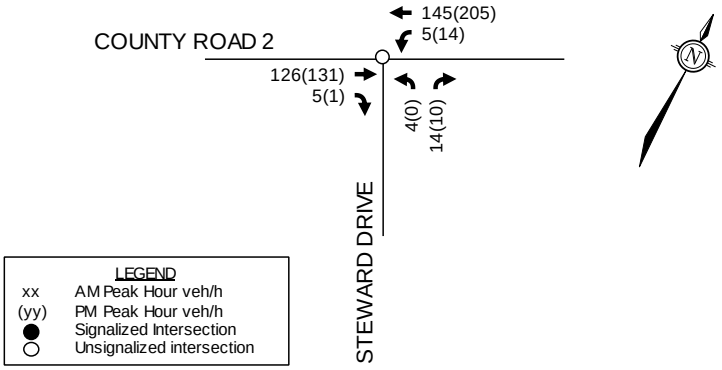
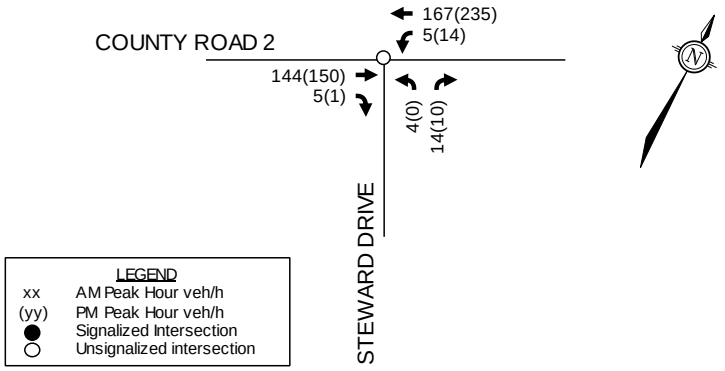


Figure 5: 2029 Background Traffic Volumes



3.2 Trip Generation

The Dutch Meadows Subdivision will contain a total of 58 single detached dwelling units, 23 semi-detached housing units, 24 seniors single detached housing units and 48 condominium units. As identified above, depending on market demand 22 of the single detached dwelling unit lots may become seniors detached housing unit lots. For the purposes of this analysis, it has been conservatively assumed that these lots will contain single detached housing units.

Trips generated by the proposed subdivision have been estimated using relevant rates identified in the Institute of Transportation Engineers (ITE) Trip Generation Manual, 9th Edition. Trips generated by the Dutch Meadows Subdivision are summarized in the following table.

Table 2: ITE Trip Generation

Land Use	ITE Code	Units	AM Peak			PM Peak		
			In	Out	Total	In	Out	Total
Phase 1								
Single Detached Housing Units	210	15	5	15	20	12	7	19
Senior Adult Housing – Detached	251	6	1	1	2	3	2	5
Residential Condominium/ Townhouse	230	55	5	27	32	25	12	37
		Total	**11**	**43**	**54**	**40**	**21**	**61**
Build-out								
Single Detached Housing Units	210	58	13	37	50	40	24	64
Senior Adult Housing – Detached	251	24	2	4	6	9	6	15
Residential Condominium/ Townhouse	230	71	7	32	39	30	15	45
		Total	**22**	**73**	**95**	**79**	**45**	**124**

Based on the foregoing, Phase 1 of the subdivision is anticipated to generate a total of 54 vehicle trips during the weekday AM peak hour and 61 vehicle trips during the weekday PM peak hour. At

build-out, the proposed subdivision is anticipated to generate a total of 95 vehicle trips during the weekday AM peak hour and 124 vehicle trips during the weekday PM peak hour at full build-out.

3.3 Trip Distribution

The distribution of trips generated by the subdivision has been derived based on the existing traffic patterns along County Road 2. The assumed distribution of trips generated by the subdivision is summarized as follows:

- 80% to/from the east via County Road 2; and
- 20% to/from the west via County Road 2.

As described above Phase 1 will temporarily be served by the Steward Drive access exclusively, while construction traffic will use the County Road 2 access. Following the construction of Phase 1, the County Road 2 access is anticipated to be opened to the public and the development will be served by both accesses. At full build-out of the subdivision, approximately 70% of the traffic arriving/departing to/from the east are anticipated to use the County Road 2 access, and the remaining 30% are anticipated to use the Steward Drive access.

Trips generated by Phase 1 of the subdivision are shown in **Figure 6**. This will be an interim condition until the County Road 2 access is constructed as part of future phases. Trips generated at full build-out of the proposed subdivision are shown in the **Figure 7**. Total traffic volumes for the 2022 Phase 1 build-out and 2029 ultimate build-out year are shown in **Figure 8** and **9** respectively.

Figure 6: Phase 1 Interim Site Traffic

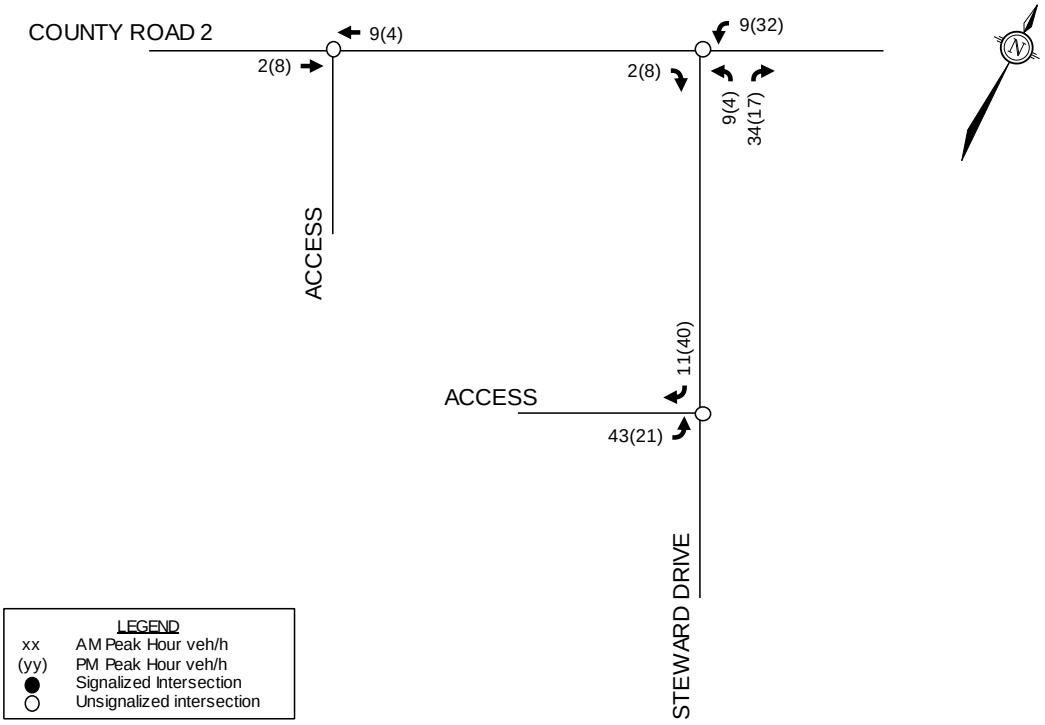


Figure 7: Build-out Site Traffic

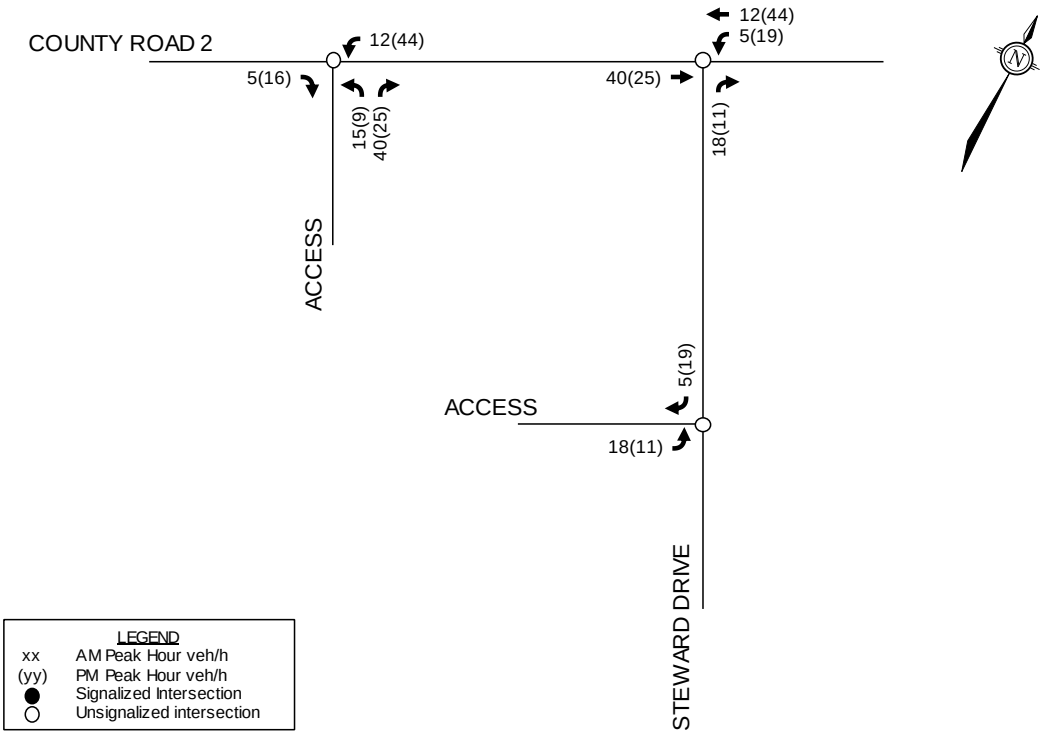


Figure 8: 2022 Total Traffic Volumes

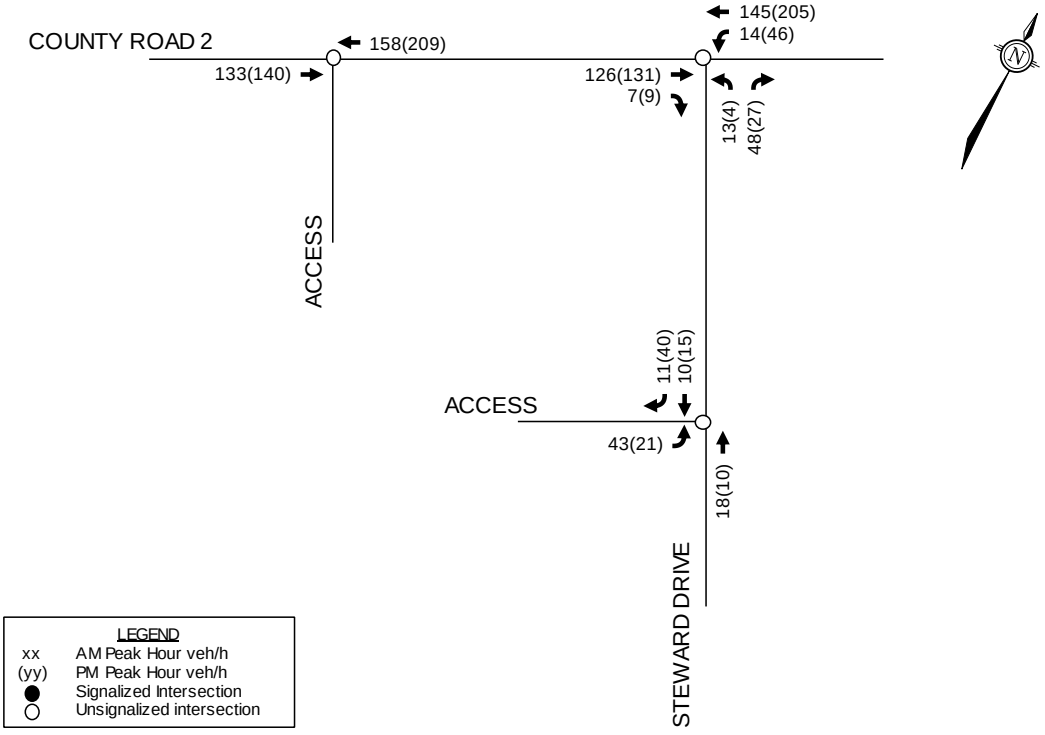
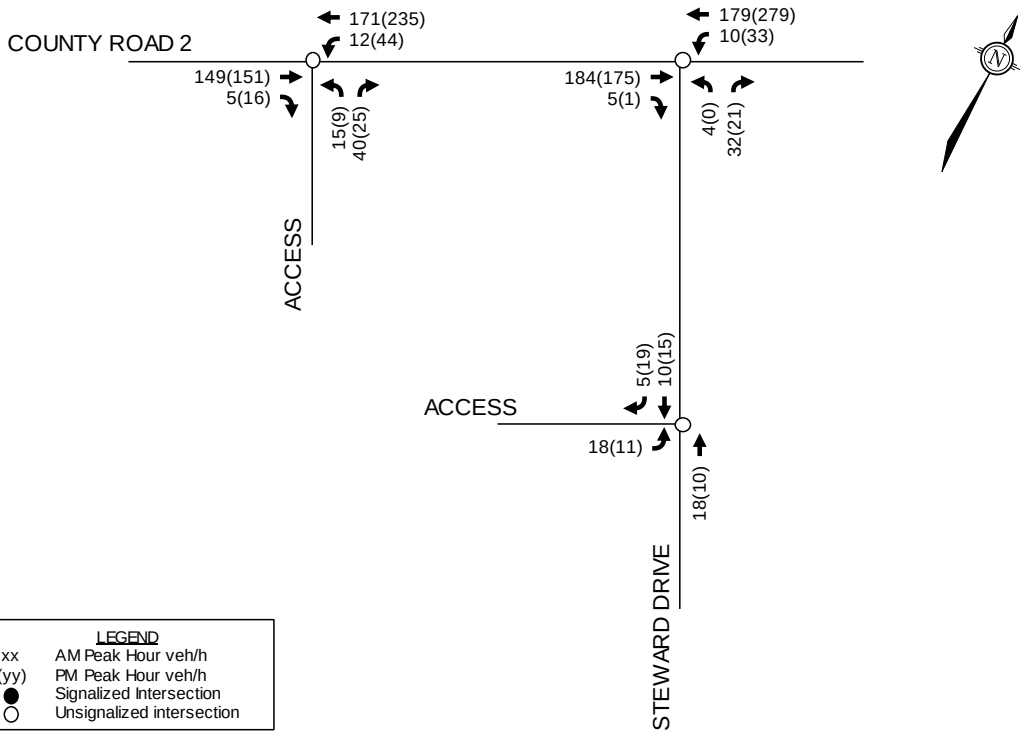


Figure 9: 2029 Total Traffic



4.0 INTERSECTION CAPACITY ANALYSIS

4.1 Existing Intersection Operations

Intersection capacity analysis has been completed for the existing traffic conditions. The lane configurations at the study area intersections are based on the existing geometry, as described in Section 2.1. The results of the Synchro analysis are summarized in the following table for the weekday AM and PM peak hours. Detailed reports are included in **Appendix C**.

Table 3: Existing Intersection Operations

Intersection	AM Peak			PM Peak		
	Critical Delay	LOS	Movement	Critical Delay	LOS	Movement
County Road 2/ Steward Drive	9 sec	A	NB	9 sec	A	NB

Based on the foregoing, the County Road 2/Steward Drive intersection is currently operating with a LOS A during the weekday AM and PM peak hours. A review of Ministry of Transportation of Ontario (MTO) left turn lane graphs have been completed to determine if a westbound left turn lane is warranted along County Road 2 at Steward Drive. Based on the MTO left turn lane graphs, a westbound left turn lane is not warranted at this location. A Copy of the MTO left turn lane graph is included in **Appendix D**.

4.2 2022 Background Traffic Intersection Operations

Intersection capacity analysis has been completed for the 2022 background traffic conditions. The lane configurations at the County Road 2/Steward Drive intersection are based on the existing geometry, as described in Section 2.1. The results of the Synchro analysis are summarized in the following table for the weekday AM and PM peak hours. Detailed reports are included in **Appendix C**.

Table 4: 2022 Background Traffic Intersection Analysis

Intersection	AM Peak			PM Peak		
	Critical Delay	LOS	Movement	Critical Delay	LOS	Movement
County Road 2/ Steward Drive	9 sec	A	NB	9 sec	A	NB

Based on the foregoing, the County Road 2/Steward Drive intersection will continue to operate with a LOS A under the 2022 background traffic conditions. Based on the MTO left turn lane graphs a westbound left turn lane will not be warranted along County Road 2 at Steward Drive. A copy of the MTO left turn lane graph is included in **Appendix D**.

4.3 2029 Background Traffic Intersection Operations

Intersection capacity analysis has been completed for the 2029 background traffic conditions. The lane configurations at the County Road 2/Steward Drive intersection are based on the existing geometry, as described in Section 2.1. The results of the Synchro analysis are summarized in the following table for the weekday AM and PM peak hours. Detailed reports are included in **Appendix C**.

Table 5: 2029 Background Traffic Intersection Analysis

Intersection	AM Peak			PM Peak		
	Critical Delay	LOS	Movement	Critical Delay	LOS	Movement
County Road 2/ Steward Drive	10 sec	A	NB	9 sec	A	NB

Based on the foregoing, the County Road 2/Steward Drive intersection will continue to operate with a LOS A under the 2029 background traffic conditions. Based on the MTO left turn lane graphs a westbound left turn lane will not be warranted along County Road 2 at Steward Drive. A copy of the MTO left turn lane graph is included in **Appendix D**.

4.4 2022 Total Traffic Intersection Operations

Intersection capacity analysis has been completed for the 2022 total traffic conditions. For the purposes of this analysis, it has been assumed that the Steward Drive access will operate under side street stop control.

Based on the MTO left turn lane graphs, a westbound left turn lane will not be warranted along County Road 2 at Steward Drive under the interim condition.

The results of the Synchro analysis are summarized in the following table for the weekday AM and PM peak hours. Detailed reports are included in **Appendix C**.

Table 6: 2022 Total Traffic Intersection Analysis

Intersection	AM Peak			PM Peak		
	Critical Delay	LOS	Movement	Critical Delay	LOS	Movement
County Road 2/ Steward Drive	10 sec	A	NB	10 sec	A	NB
Steward Drive/ Access	9 sec	A	EB	9 sec	A	EB

4.5 2029 Total Traffic Intersection Operations

Intersection capacity analysis has been completed for the 2029 total traffic conditions. For the purposes of this analysis, it has been assumed that the two accesses will operate under side street stop control. Based on the MTO left turn lane graphs, a westbound left turn lane will not be warranted along County Road 2 at either Steward Drive or the proposed access.

Transportation Association of Canada (TAC) Geometric Design Guidelines for Canadian Roads suggest right turn tapers should be considered at unsignalized intersections when the volume of decelerating vehicles compared with the through traffic volumes cause undue hazard. Based on the traffic projections, approximately 15 vehicles are anticipated to perform the eastbound right turn movement at the County Road 2 access during the weekday PM peak hour, equating to approximately one vehicle every four minutes. The eastbound right turning volumes also equate to less than 10% of the approach volumes during the weekday AM and PM peak hours. Based on the foregoing, the eastbound right turning volumes at the County Road 2 access are not anticipated to cause undue hazard and an eastbound right turn taper is not recommended.

The results of the Synchro analysis are summarized in the following table for the weekday AM and PM peak hours. Detailed reports are included in **Appendix C**.

Table 7: 2029 Total Traffic Intersection Analysis

Intersection	AM Peak			PM Peak		
	Critical Delay	LOS	Movement	Critical Delay	LOS	Movement
County Road 2/ Steward Drive	10 sec	A	NB	9 sec	A	NB
County Road 2/ Access	10 sec	B	NB	10 sec	B	NB
Steward Drive/ Access	9 sec	A	EB	9 sec	A	EB

5.0 ACCESS DESIGN

The proposed subdivision will be served by two access roadways, one along County Road 2 opposite a field access to the property to the north, and the other along Steward Drive opposite a pedestrian pathway between Steward Drive and Fairholme Drive.

Intersection sight distance (ISD) at the proposed subdivision accesses has been determined using TAC guidelines. The ISD to turn left or right from a minor road onto a major road is calculated using TAC Equation 9.9.1 ($ISD = 0.278*V_{Major}*t_g$). The ISD at the proposed accesses is summarized in the following table. Relevant excerpts from TAC are included in **Appendix E**.

Table 8: Intersection Sight Distance

Location	Movement	Design Speed[1]	Time Gap[2]	Calculated	Rounded
County Road 2 Access	Left Turn from Minor Road	100 km/hr	7.5 seconds	208.5 metres	210 metres
	Right Turn from Minor Road		6.5 seconds	180.7 metres	185 metres
Steward Drive Access	Left Turn from Minor Road	70 km/hr	7.5 seconds	146 metres	150 metres
	Right Turn from Minor Road		6.5 seconds	126.5 metres	130 metres

1. Design Speed = 10 km/hr above the posted speed limit
2. Time gaps based on TAC Tables 9.9.3 and 9.9.5

County Road 2 does not have significant horizontal or vertical curvature in the vicinity of the access, and the required sight distance is achieved. The required ISD for passenger vehicles to turn left or right from the proposed County Road 2 access is shown in **Figure 7**.

Figure 10: County Road 2 Access Intersection Sight Distance

Steward Drive north of the proposed access does not have significant horizontal or vertical curvature, however there is a horizontal curve to the south. The required ISD for passenger vehicles to turn left or right from the proposed Steward Drive access is shown in **Figure 8**.

Figure 11: Steward Drive Access Intersection Sight Distance

As demonstrated in the above figures, the required ISD for a passenger vehicle to exit left or right from the two accesses is achieved.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the foregoing, the main conclusions and recommendations of this report are as follows:

- Phase 1 of the subdivision will temporarily be served by the Steward Drive access exclusively, while construction traffic will use the County Road 2 access. Following the construction of Phase 1, the County Road 2 access will be opened to the public and the development will be served by both accesses.

- Phase 1 of the subdivision is anticipated to generate a total of 54 vehicle trips during the weekday AM peak hour and 61 vehicle trips during the weekday PM peak hour. At build-out, the proposed subdivision is anticipated to generate a total of 95 vehicle trips during the weekday AM peak hour and 124 vehicle trips during the weekday PM peak hour at full build-out.

- Under existing/background traffic conditions, the County Road 2/Steward Drive intersection is anticipated to operate with a LOS A during the weekday AM and PM peak hours. A westbound left turn lane will not be warranted at this intersection.

- Under 2022 total traffic conditions (Phase 1 build-out), the County Road 2/Steward Drive intersection and Steward Drive access are anticipated to operate with a LOS A during the weekday AM and PM peak hours. A westbound left turn lane will not be warranted at the County Road 2/Steward Drive intersection.

- Under the 2029 total traffic conditions (ultimate build-out), the County Road 2/Steward Drive intersection and both accesses are anticipated to operate with a LOS B or better during the weekday AM and PM peak hours. A westbound left turn lane will not be warranted at either the County Road 2/Steward Drive intersection or the County Road 2 access. An eastbound right turn taper is not recommended at the proposed County Road 2 access.

- The required intersection sight distance for a passenger vehicle to exit left or right from the two accesses is achieved.

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Prepared by:

Brad Byvelds, P. Eng.
Project Coordinator | Transportation/Traffic

Appendix A

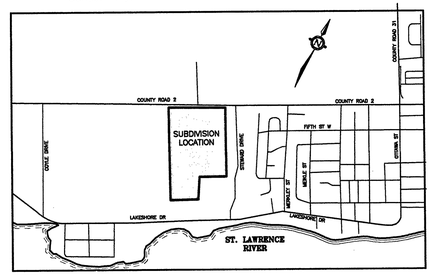
Proposed Draft Plan of Subdivision

DRAFT PLAN OF SUBDIVISION
OF
PART OF LOTS 34 & 35
CONCESSION 1
GEOGRAPHIC TOWNSHIP OF WILLIAMSBURGH
NOW MUNICIPALITY OF SOUTH DUNDAS
COUNTY OF DUNDAS

2018

0 10 20 30m

SCALE: 1:1,000



MORRISBURG KEY PLAN
N.T.S.

STEWARD DRIVE

RESIDENTIAL

PUMP STATION/ STORM MANAGMENT BLOCK 107

AGRICULTURAL

COUNTY ROAD 2

STORM MANAGMENT BLOCK 108

DELFT STREET

ROTTERDAM WAY

CEMETARY

DUTCH MEADOWS DRIVE

ARNHEM AVENUE

AMSTERDAM DRIVE

WALKWAY BLOCK 109

CONDO

CONDO

CONDO

EXISTING FIELD
1
5.20 ha

RESIDENTIAL

LAKESHORE DRIVE

AGRICULTURAL

LOT NO.	USE	LOT NO.	USE	LOT NO.	USE	LOT NO.	USE	LOT NO.	USE
1	CONDOS	24	SINGLE	47	SENIOR	71	SENIOR	94	SEMI
2	SINGLE	25	SINGLE	48	SENIOR	72	SENIOR	95	SEMI
3	SINGLE	26	SINGLE	49	SENIOR	73	SINGLE/SENIOR	96	SINGLE/SENIOR
4	SINGLE	27	SINGLE	50	SENIOR	74	SINGLE/SENIOR	97	SINGLE/SENIOR
5	SINGLE	28	SINGLE	51	SENIOR	75	SINGLE/SENIOR	98	SINGLE/SENIOR
6	SINGLE	29	SINGLE	52	SINGLE	76	SINGLE/SENIOR	99	SINGLE/SENIOR
7	SEMI	30	SINGLE	53	SINGLE	77	SINGLE/SENIOR	100	SINGLE/SENIOR
8	SEMI	31	SINGLE	54	SINGLE	78	SINGLE/SENIOR	101	SENIOR
9	SEMI	32	SEMI	55	SINGLE	79	SINGLE	102	SENIOR
10	SEMI	33	SEMI	56	SINGLE	80	SINGLE	103	SENIOR
11	SEMI	34	SEMI	57	SINGLE	81	SINGLE	104	SENIOR
12	SENIOR	35	SEMI	58	SINGLE	82	SINGLE	105	SENIOR
13	SENIOR	36	SEMI	59	SINGLE	83	SINGLE	106	SENIOR
14	SENIOR	37	SEMI	60	SINGLE	84	SINGLE		
15	SENIOR	38	SEMI	61	SEMI	85	SINGLE		
16	SENIOR	39	SINGLE/SENIOR	62	SEMI	86	SINGLE		
17	SENIOR	40	SINGLE/SENIOR	63	SEMI	87	SINGLE		
18	SINGLE/SENIOR	41	SINGLE/SENIOR	64	SEMI	88	SINGLE		
19	SINGLE/SENIOR	42	SINGLE/SENIOR	65	SEMI	89	SINGLE		
20	SINGLE/SENIOR	43	SINGLE/SENIOR	66	SEMI	90	SINGLE		
21	SINGLE/SENIOR	44	SINGLE/SENIOR	67	SENIOR	91	SEMI		
22	SINGLE/SENIOR	45	SENIOR	68	SENIOR	92	SEMI		
23	SINGLE	46	SENIOR	69	SENIOR	93	SEMI		
				70	SENIOR				

ADDITIONAL INFORMATION

a. – Shown on plan
b. – As Shown on plan
c. – Shown on plan
d. – See table on plan
e. – Shown on plan
f. – Shown on plan
g. – As shown on plan
h. – Publicly owned and operated piped water system
i. – Sandy loam and clay
j. – Storm sewers, sanitary sewers, water and Hydro
k. – None

SURVEYOR'S CERTIFICATE

I certify that the boundaries of the land to be subdivided and their relationship to adjoining lands are accurately and correctly shown.

Signed _____
WILLIAM J. WEBSTER
Ontario Land Surveyor

Dated April 9, 2018

EASTERN ENGINEERING GROUP INC.
CONSULTING ENGINEERS
BROCKVILLE

NOTES:

1. Notes

Appendix B

Traffic Count Information

ACCURATE TRUSTED TRAFFIC DATA

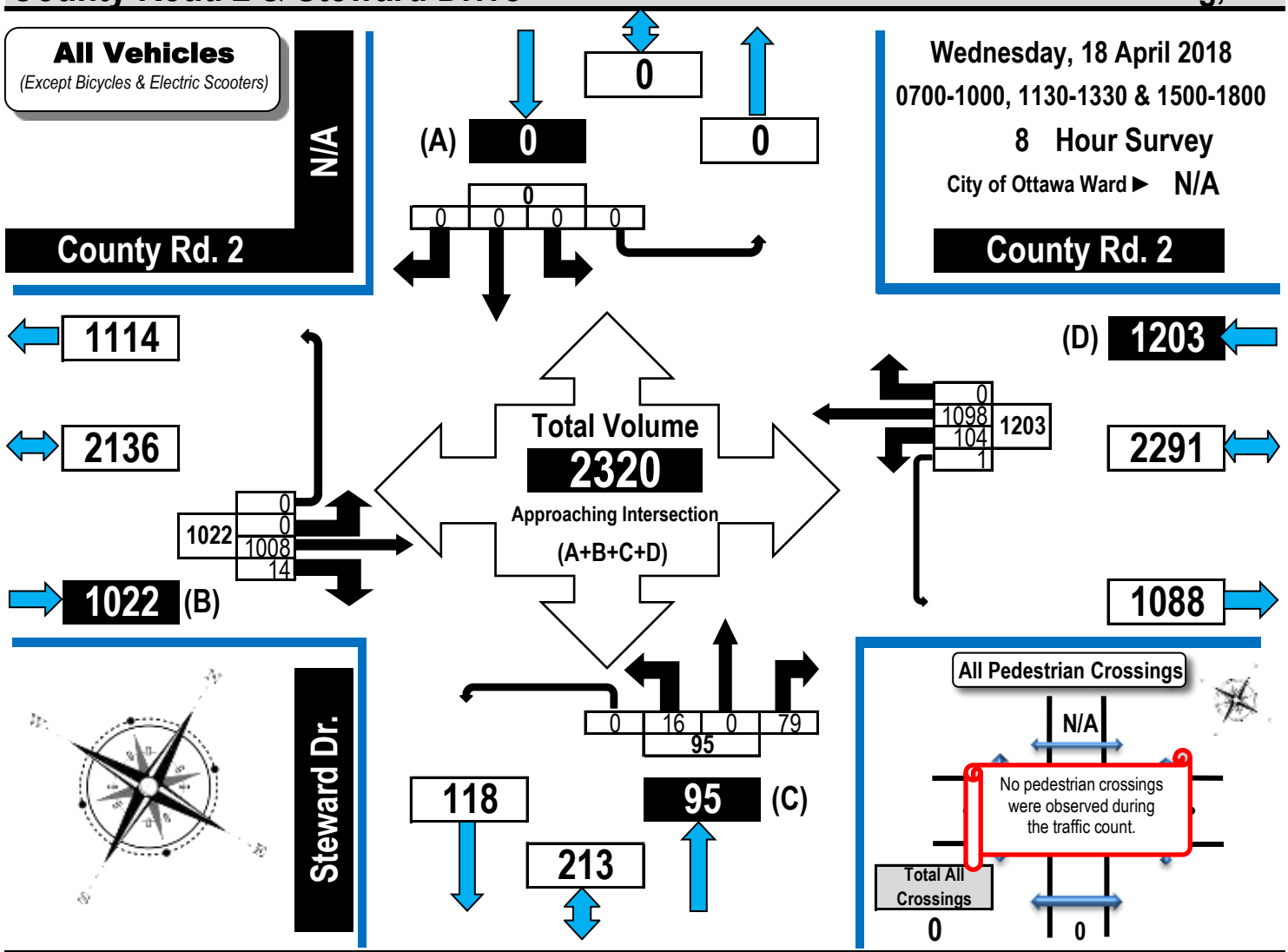
Turning Movement Count
Summary, AM and PM Peak Hour Flow Diagrams

Automobiles, Taxis, Light Trucks, Vans, SUV's, Motorcycles, Heavy Trucks, Buses, and School Buses

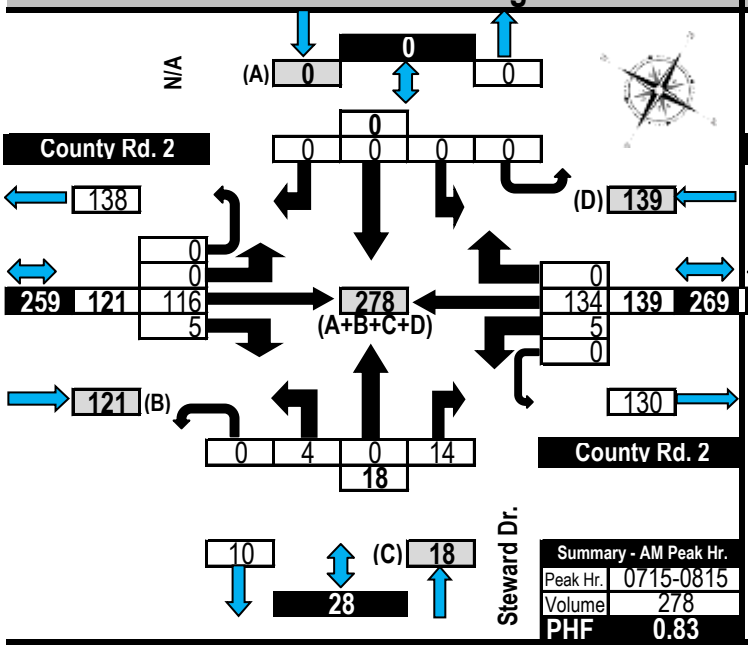
County Road 2 & Steward Drive — Morrisburg, ON

All Vehicles
(Except Bicycles & Electric Scooters)

Wednesday, 18 April 2018
0700-1000, 1130-1330 & 1500-1800
8 Hour Survey
City of Ottawa Ward ► N/A

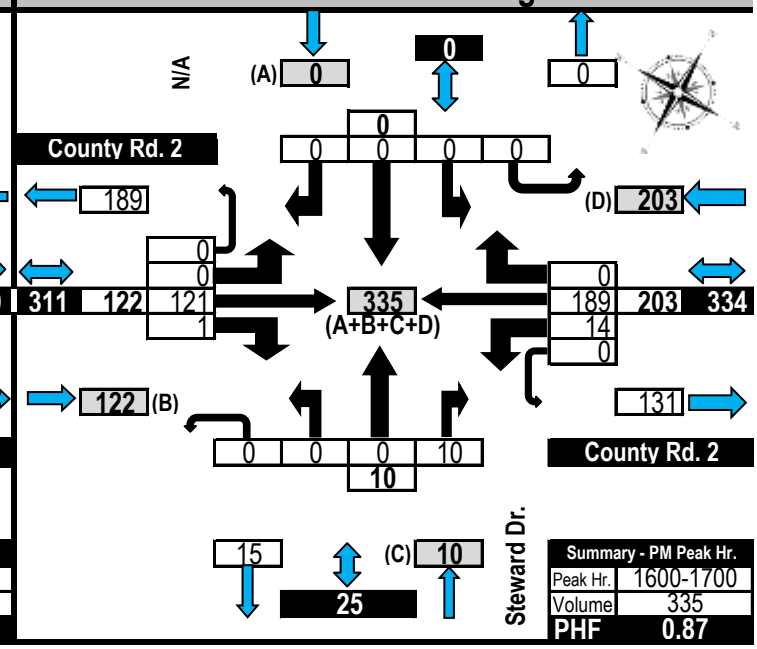


AM Peak Hour Flow Diagram



Summary - AM Peak Hr.	
Peak Hr.	0715-0815
Volume	278
PHF	0.83

PM Peak Hour Flow Diagram



Summary - PM Peak Hr.	
Peak Hr.	1600-1700
Volume	335
PHF	0.87

Appendix C

Synchro Analysis Reports

Intersection	
Int Delay, s/veh	0.8

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	116	5	5	134	4	14
Future Vol, veh/h	116	5	5	134	4	14
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	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	4	0	0	5	0	0
Mvmt Flow	129	6	6	149	4	16

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	135	0	293	132
Stage 1	-	-	-	-	132	-
Stage 2	-	-	-	-	161	-
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	-	-	1462	-	702	923
Stage 1	-	-	-	-	899	-
Stage 2	-	-	-	-	873	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1462	-	699	923
Mov Cap-2 Maneuver	-	-	-	-	699	-
Stage 1	-	-	-	-	895	-
Stage 2	-	-	-	-	873	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.3	9.3
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	862	-	-	1462	-
HCM Lane V/C Ratio	0.023	-	-	0.004	-
HCM Control Delay (s)	9.3	-	-	7.5	0
HCM Lane LOS	A	-	-	A	A
HCM 95th %tile Q(veh)	0.1	-	-	0	-

Intersection	
Int Delay, s/veh	0.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	121	1	14	189	0	10
Future Vol, veh/h	121	1	14	189	0	10
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	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	4	0	0	5	0	0
Mvmt Flow	134	1	16	210	0	11

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	135	0	377	135
Stage 1	-	-	-	-	135	-
Stage 2	-	-	-	-	242	-
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	-	-	1462	-	629	919
Stage 1	-	-	-	-	896	-
Stage 2	-	-	-	-	803	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1462	-	621	919
Mov Cap-2 Maneuver	-	-	-	-	621	-
Stage 1	-	-	-	-	885	-
Stage 2	-	-	-	-	803	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.5	9
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	919	-	-	1462	-
HCM Lane V/C Ratio	0.012	-	-	0.011	-
HCM Control Delay (s)	9	-	-	7.5	0
HCM Lane LOS	A	-	-	A	A
HCM 95th %tile Q(veh)	0	-	-	0	-

Intersection	
Int Delay, s/veh	0.7

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	126	5	5	145	4	14
Future Vol, veh/h	126	5	5	145	4	14
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	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	4	0	0	5	0	0
Mvmt Flow	140	6	6	161	4	16

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	146	0	316	143
Stage 1	-	-	-	-	143	-
Stage 2	-	-	-	-	173	-
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	-	-	1448	-	681	910
Stage 1	-	-	-	-	889	-
Stage 2	-	-	-	-	862	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1448	-	678	910
Mov Cap-2 Maneuver	-	-	-	-	678	-
Stage 1	-	-	-	-	885	-
Stage 2	-	-	-	-	862	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.2	9.4
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	846	-	-	1448	-
HCM Lane V/C Ratio	0.024	-	-	0.004	-
HCM Control Delay (s)	9.4	-	-	7.5	0
HCM Lane LOS	A	-	-	A	A
HCM 95th %tile Q(veh)	0.1	-	-	0	-

Intersection	
Int Delay, s/veh	0.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	131	1	14	205	0	10
Future Vol, veh/h	131	1	14	205	0	10
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	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	4	0	0	5	0	0
Mvmt Flow	146	1	16	228	0	11

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	147	0	407	147
Stage 1	-	-	-	-	147	-
Stage 2	-	-	-	-	260	-
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	-	-	1447	-	604	905
Stage 1	-	-	-	-	885	-
Stage 2	-	-	-	-	788	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1447	-	596	905
Mov Cap-2 Maneuver	-	-	-	-	596	-
Stage 1	-	-	-	-	873	-
Stage 2	-	-	-	-	788	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.5	9
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	905	-	-	1447	-
HCM Lane V/C Ratio	0.012	-	-	0.011	-
HCM Control Delay (s)	9	-	-	7.5	0
HCM Lane LOS	A	-	-	A	A
HCM 95th %tile Q(veh)	0	-	-	0	-

Intersection	
Int Delay, s/veh	0.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	144	5	5	167	4	14
Future Vol, veh/h	144	5	5	167	4	14
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	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	4	0	0	5	0	0
Mvmt Flow	160	6	6	186	4	16

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	166	0	361	163
Stage 1	-	-	-	-	163	-
Stage 2	-	-	-	-	198	-
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	-	-	1424	-	642	887
Stage 1	-	-	-	-	871	-
Stage 2	-	-	-	-	840	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1424	-	639	887
Mov Cap-2 Maneuver	-	-	-	-	639	-
Stage 1	-	-	-	-	867	-
Stage 2	-	-	-	-	840	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.2	9.5
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	817	-	-	1424	-
HCM Lane V/C Ratio	0.024	-	-	0.004	-
HCM Control Delay (s)	9.5	-	-	7.5	0
HCM Lane LOS	A	-	-	A	A
HCM 95th %tile Q(veh)	0.1	-	-	0	-

Intersection	
Int Delay, s/veh	0.5

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	150	1	14	235	0	10
Future Vol, veh/h	150	1	14	235	0	10
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	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	4	0	0	5	0	0
Mvmt Flow	167	1	16	261	0	11

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	168	0	461	168
Stage 1	-	-	-	-	168	-
Stage 2	-	-	-	-	293	-
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	-	-	1422	-	562	881
Stage 1	-	-	-	-	867	-
Stage 2	-	-	-	-	762	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1422	-	555	881
Mov Cap-2 Maneuver	-	-	-	-	555	-
Stage 1	-	-	-	-	856	-
Stage 2	-	-	-	-	762	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.4	9.1
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	881	-	-	1422	-
HCM Lane V/C Ratio	0.013	-	-	0.011	-
HCM Control Delay (s)	9.1	-	-	7.6	0
HCM Lane LOS	A	-	-	A	A
HCM 95th %tile Q(veh)	0	-	-	0	-

Intersection	
Int Delay, s/veh	2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	126	7	14	145	13	48
Future Vol, veh/h	126	7	14	145	13	48
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	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	4	0	0	5	0	0
Mvmt Flow	140	8	16	161	14	53

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	148	0	337	144
Stage 1	-	-	-	-	144	-
Stage 2	-	-	-	-	193	-
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	-	-	1446	-	663	909
Stage 1	-	-	-	-	888	-
Stage 2	-	-	-	-	845	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1446	-	655	909
Mov Cap-2 Maneuver	-	-	-	-	655	-
Stage 1	-	-	-	-	877	-
Stage 2	-	-	-	-	845	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.7	9.7
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	840	-	-	1446	-
HCM Lane V/C Ratio	0.081	-	-	0.011	-
HCM Control Delay (s)	9.7	-	-	7.5	0
HCM Lane LOS	A	-	-	A	A
HCM 95th %tile Q(veh)	0.3	-	-	0	-

Intersection	
Int Delay, s/veh	0

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	133	0	0	158	0	0
Future Vol, veh/h	133	0	0	158	0	0
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	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	148	0	0	176	0	0

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	148	0	324	148
Stage 1	-	-	-	-	148	-
Stage 2	-	-	-	-	176	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1434	-	670	899
Stage 1	-	-	-	-	880	-
Stage 2	-	-	-	-	855	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1434	-	670	899
Mov Cap-2 Maneuver	-	-	-	-	670	-
Stage 1	-	-	-	-	880	-
Stage 2	-	-	-	-	855	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0	0
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	-	-	-	1434	-
HCM Lane V/C Ratio	-	-	-	-	-
HCM Control Delay (s)	0	-	-	0	-
HCM Lane LOS	A	-	-	A	-
HCM 95th %tile Q(veh)	-	-	-	0	-

Intersection	
Int Delay, s/veh	4.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	43	0	0	18	10	11
Future Vol, veh/h	43	0	0	18	10	11
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	48	0	0	20	11	12

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	37	17	23	0	-	0
Stage 1	17	-	-	-	-	-
Stage 2	20	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	975	1062	1592	-	-	-
Stage 1	1006	-	-	-	-	-
Stage 2	1003	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	975	1062	1592	-	-	-
Mov Cap-2 Maneuver	975	-	-	-	-	-
Stage 1	1006	-	-	-	-	-
Stage 2	1003	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	8.9	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1592	-	975	-	-
HCM Lane V/C Ratio	-	-	0.049	-	-
HCM Control Delay (s)	0	-	8.9	-	-
HCM Lane LOS	A	-	A	-	-
HCM 95th %tile Q(veh)	0	-	0.2	-	-

Intersection	
Int Delay, s/veh	1.5

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	131	9	46	205	4	27
Future Vol, veh/h	131	9	46	205	4	27
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	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	4	0	0	5	0	0
Mvmt Flow	146	10	51	228	4	30

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	156	0	481	151
Stage 1	-	-	-	-	151	-
Stage 2	-	-	-	-	330	-
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	-	-	1436	-	548	901
Stage 1	-	-	-	-	882	-
Stage 2	-	-	-	-	733	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1436	-	526	901
Mov Cap-2 Maneuver	-	-	-	-	526	-
Stage 1	-	-	-	-	846	-
Stage 2	-	-	-	-	733	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.4	9.6
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	825	-	-	1436	-
HCM Lane V/C Ratio	0.042	-	-	0.036	-
HCM Control Delay (s)	9.6	-	-	7.6	0
HCM Lane LOS	A	-	-	A	A
HCM 95th %tile Q(veh)	0.1	-	-	0.1	-

Intersection	
Int Delay, s/veh	0

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	140	0	0	209	0	0
Future Vol, veh/h	140	0	0	209	0	0
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	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	156	0	0	232	0	0

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	156	0	388	156
Stage 1	-	-	-	-	156	-
Stage 2	-	-	-	-	232	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1424	-	616	890
Stage 1	-	-	-	-	872	-
Stage 2	-	-	-	-	807	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1424	-	616	890
Mov Cap-2 Maneuver	-	-	-	-	616	-
Stage 1	-	-	-	-	872	-
Stage 2	-	-	-	-	807	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0	0
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	-	-	-	1424	-
HCM Lane V/C Ratio	-	-	-	-	-
HCM Control Delay (s)	0	-	-	0	-
HCM Lane LOS	A	-	-	A	-
HCM 95th %tile Q(veh)	-	-	-	0	-

Intersection	
Int Delay, s/veh	2.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	21	0	0	10	15	40
Future Vol, veh/h	21	0	0	10	15	40
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	23	0	0	11	17	44

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	50	39	61	0	-	0
Stage 1	39	-	-	-	-	-
Stage 2	11	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	959	1033	1542	-	-	-
Stage 1	983	-	-	-	-	-
Stage 2	1012	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	959	1033	1542	-	-	-
Mov Cap-2 Maneuver	959	-	-	-	-	-
Stage 1	983	-	-	-	-	-
Stage 2	1012	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	8.8	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1542	-	959	-	-
HCM Lane V/C Ratio	-	-	0.024	-	-
HCM Control Delay (s)	0	-	8.8	-	-
HCM Lane LOS	A	-	A	-	-
HCM 95th %tile Q(veh)	0	-	0.1	-	-

Intersection	
Int Delay, s/veh	1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	184	5	10	179	4	32
Future Vol, veh/h	184	5	10	179	4	32
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	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	4	0	0	5	0	0
Mvmt Flow	204	6	11	199	4	36

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	210	0	428	207
Stage 1	-	-	-	-	207	-
Stage 2	-	-	-	-	221	-
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	-	-	1373	-	588	839
Stage 1	-	-	-	-	832	-
Stage 2	-	-	-	-	821	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1373	-	583	839
Mov Cap-2 Maneuver	-	-	-	-	583	-
Stage 1	-	-	-	-	825	-
Stage 2	-	-	-	-	821	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.4	9.7
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	800	-	-	1373	-
HCM Lane V/C Ratio	0.05	-	-	0.008	-
HCM Control Delay (s)	9.7	-	-	7.6	0
HCM Lane LOS	A	-	-	A	A
HCM 95th %tile Q(veh)	0.2	-	-	0	-

Intersection	
Int Delay, s/veh	1.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	149	5	12	171	15	40
Future Vol, veh/h	149	5	12	171	15	40
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	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	166	6	13	190	17	44

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	172	0	385	169
Stage 1	-	-	-	-	169	-
Stage 2	-	-	-	-	216	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1405	-	618	875
Stage 1	-	-	-	-	861	-
Stage 2	-	-	-	-	820	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1405	-	612	875
Mov Cap-2 Maneuver	-	-	-	-	612	-
Stage 1	-	-	-	-	852	-
Stage 2	-	-	-	-	820	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.5	10
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	783	-	-	1405	-
HCM Lane V/C Ratio	0.078	-	-	0.009	-
HCM Control Delay (s)	10	-	-	7.6	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.3	-	-	0	-

Intersection	
Int Delay, s/veh	3.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	18	0	0	18	10	5
Future Vol, veh/h	18	0	0	18	10	5
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	20	0	0	20	11	6

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	34	14	17	0	-	0
Stage 1	14	-	-	-	-	-
Stage 2	20	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	979	1066	1600	-	-	-
Stage 1	1009	-	-	-	-	-
Stage 2	1003	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	979	1066	1600	-	-	-
Mov Cap-2 Maneuver	979	-	-	-	-	-
Stage 1	1009	-	-	-	-	-
Stage 2	1003	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	8.8	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1600	-	979	-	-
HCM Lane V/C Ratio	-	-	0.02	-	-
HCM Control Delay (s)	0	-	8.8	-	-
HCM Lane LOS	A	-	A	-	-
HCM 95th %tile Q(veh)	0	-	0.1	-	-

Intersection	
Int Delay, s/veh	0.9

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	175	1	33	279	0	21
Future Vol, veh/h	175	1	33	279	0	21
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	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	4	0	0	5	0	0
Mvmt Flow	194	1	37	310	0	23

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	195	0	579	195
Stage 1	-	-	-	-	195	-
Stage 2	-	-	-	-	384	-
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	-	-	1390	-	481	851
Stage 1	-	-	-	-	843	-
Stage 2	-	-	-	-	693	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1390	-	466	851
Mov Cap-2 Maneuver	-	-	-	-	466	-
Stage 1	-	-	-	-	816	-
Stage 2	-	-	-	-	693	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.8	9.4
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	851	-	-	1390	-
HCM Lane V/C Ratio	0.027	-	-	0.026	-
HCM Control Delay (s)	9.4	-	-	7.7	0
HCM Lane LOS	A	-	-	A	A
HCM 95th %tile Q(veh)	0.1	-	-	0.1	-

Intersection	
Int Delay, s/veh	1.4

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	151	16	44	235	9	25
Future Vol, veh/h	151	16	44	235	9	25
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	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	168	18	49	261	10	28

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	186	0	536	177
Stage 1	-	-	-	-	177	-
Stage 2	-	-	-	-	359	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1388	-	505	866
Stage 1	-	-	-	-	854	-
Stage 2	-	-	-	-	707	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1388	-	484	866
Mov Cap-2 Maneuver	-	-	-	-	484	-
Stage 1	-	-	-	-	819	-
Stage 2	-	-	-	-	707	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.2	10.3
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	716	-	-	1388	-
HCM Lane V/C Ratio	0.053	-	-	0.035	-
HCM Control Delay (s)	10.3	-	-	7.7	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.2	-	-	0.1	-

Intersection	
Int Delay, s/veh	1.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	11	0	0	10	15	19
Future Vol, veh/h	11	0	0	10	15	19
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	12	0	0	11	17	21

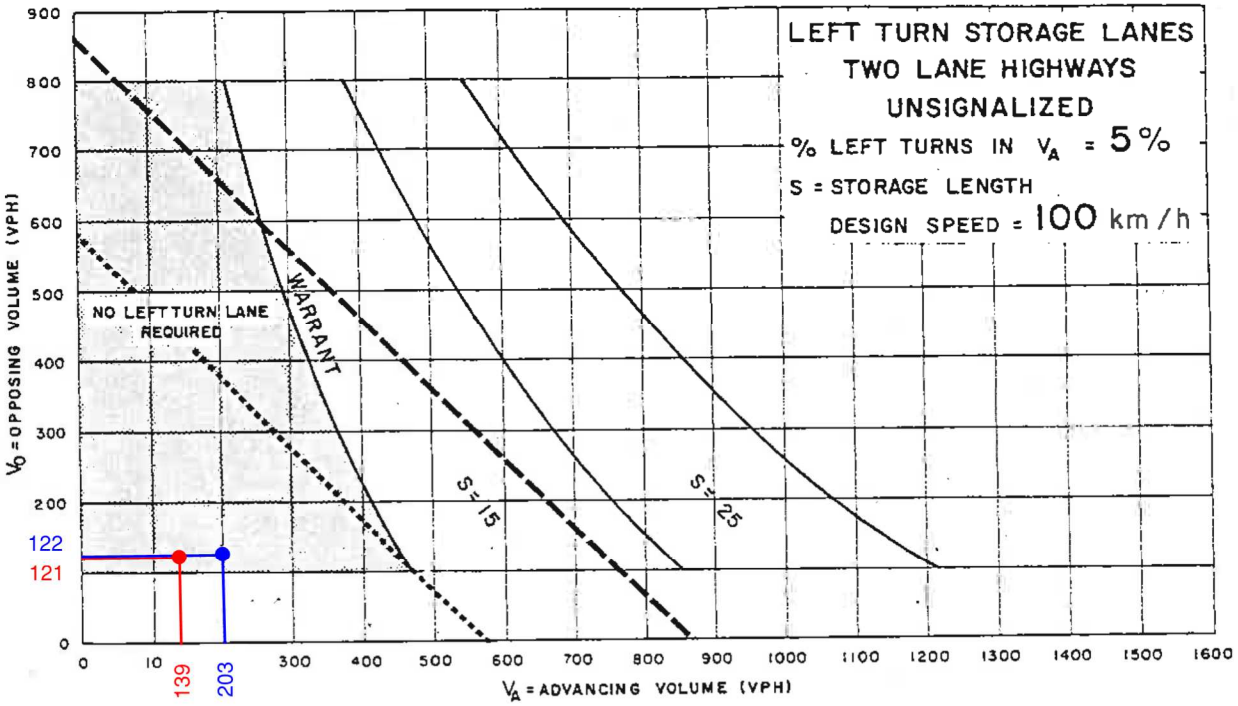
Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	39	28	38	0	-	0
Stage 1	28	-	-	-	-	-
Stage 2	11	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	973	1047	1572	-	-	-
Stage 1	995	-	-	-	-	-
Stage 2	1012	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	973	1047	1572	-	-	-
Mov Cap-2 Maneuver	973	-	-	-	-	-
Stage 1	995	-	-	-	-	-
Stage 2	1012	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	8.7	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1572	-	973	-	-
HCM Lane V/C Ratio	-	-	0.013	-	-
HCM Control Delay (s)	0	-	8.7	-	-
HCM Lane LOS	A	-	A	-	-
HCM 95th %tile Q(veh)	0	-	0	-	-

Appendix D

MTO Left Turn Lane Graphs


LEFT TURN STORAGE LANES
TWO LANE HIGHWAYS
UNSIGNALIZED
% LEFT TURNS IN V_A = 5%
S = STORAGE LENGTH
DESIGN SPEED = 100 km/h
NO LEFT TURN LANE REQUIRED
WARRANT
S=15
S=25
122
121
139
203
V_O = OPPOSING VOLUME (VPH)
V_A = ADVANCING VOLUME (VPH)
TRAFFIC SIGNALS MAY BE WARRANTED IN RURAL AREAS OR URBAN AREAS WITH RESTRICTED FLOW
TRAFFIC SIGNALS MAY BE WARRANTED IN "FREE FLOW" URBAN AREAS
AM Peak
PM Peak

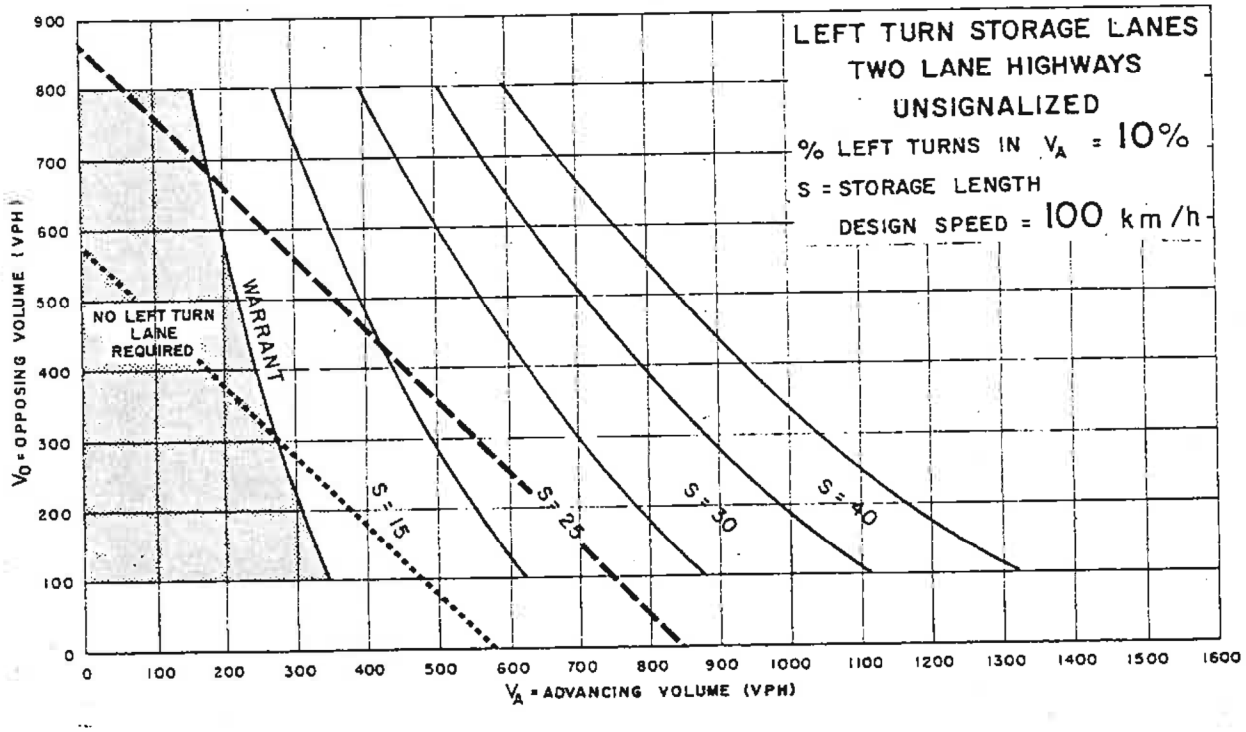
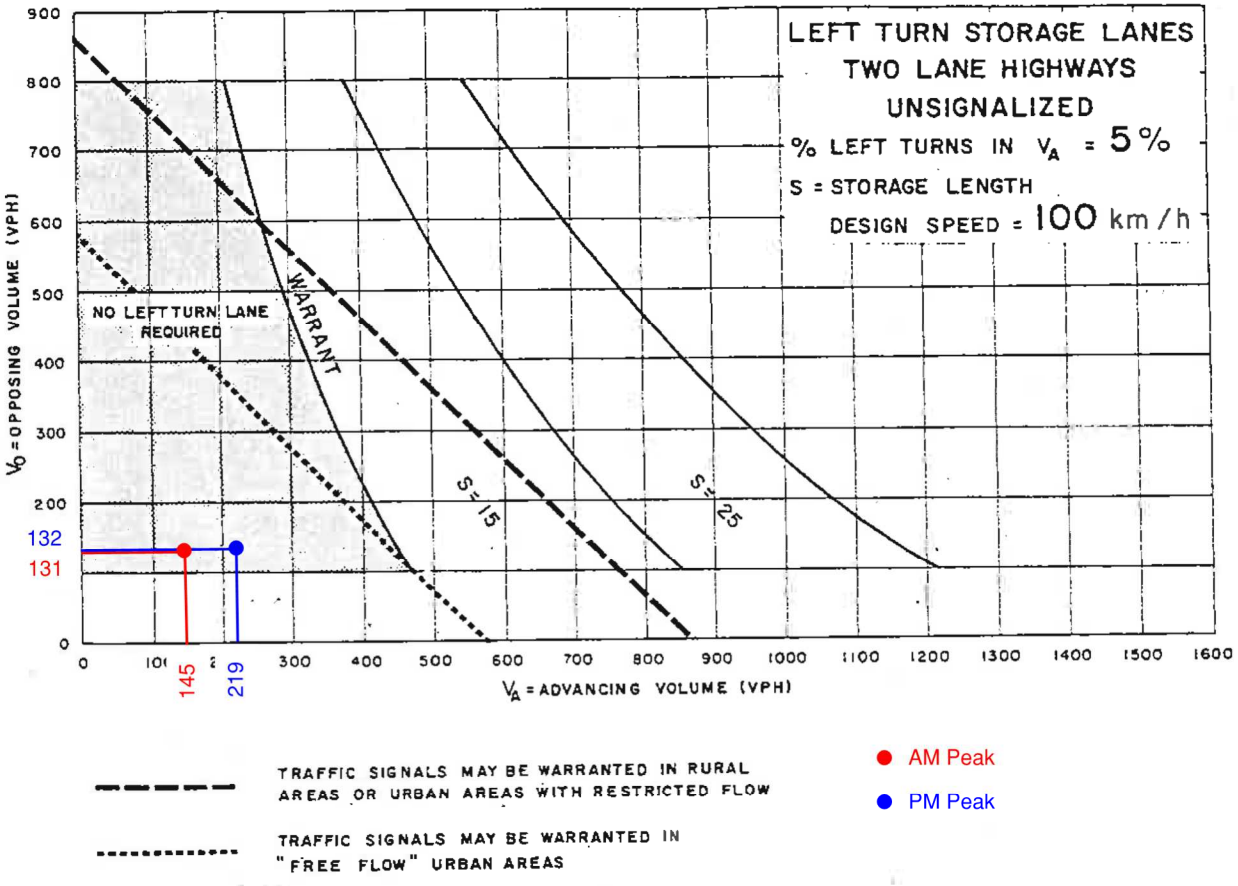

LEFT TURN STORAGE LANES
TWO LANE HIGHWAYS
UNSIGNALIZED
% LEFT TURNS IN V_A = 10%
S = STORAGE LENGTH
DESIGN SPEED = 100 km/h
NO LEFT TURN LANE REQUIRED
WARRANT
S=15
S=25
S=30
S=40
V_O = OPPOSING VOLUME (VPH)
V_A = ADVANCING VOLUME (VPH)

Figure EA-22


LEFT TURN STORAGE LANES
TWO LANE HIGHWAYS
UNSIGNALIZED
% LEFT TURNS IN V_A = 5%
S = STORAGE LENGTH
DESIGN SPEED = 100 km/h
NO LEFT TURN LANE REQUIRED
WARRANT
S=15
S=25
V_O = OPPOSING VOLUME (VPH)
V_A = ADVANCING VOLUME (VPH)
132
131
145
219
TRAFFIC SIGNALS MAY BE WARRANTED IN RURAL AREAS OR URBAN AREAS WITH RESTRICTED FLOW
TRAFFIC SIGNALS MAY BE WARRANTED IN "FREE FLOW" URBAN AREAS
AM Peak
PM Peak

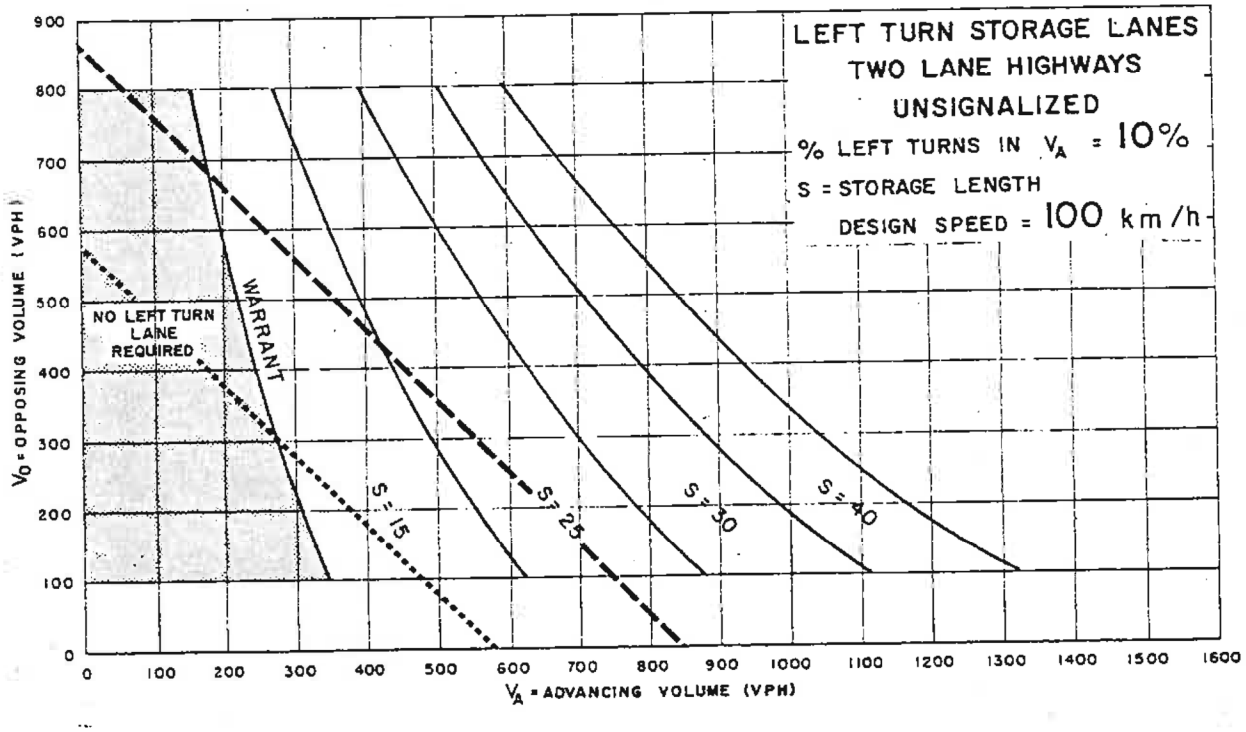
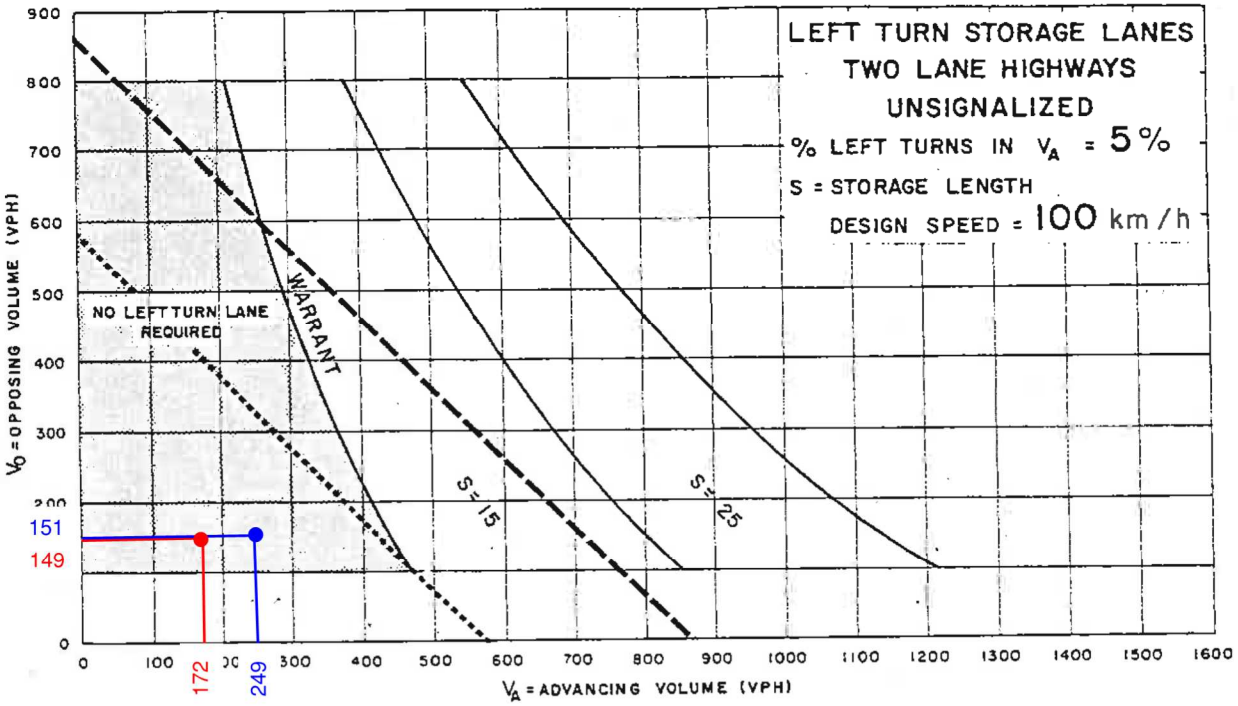

LEFT TURN STORAGE LANES
TWO LANE HIGHWAYS
UNSIGNALIZED
% LEFT TURNS IN V_A = 10%
S = STORAGE LENGTH
DESIGN SPEED = 100 km/h
NO LEFT TURN LANE REQUIRED
WARRANT
S=15
S=25
S=30
S=40
V_O = OPPOSING VOLUME (VPH)
V_A = ADVANCING VOLUME (VPH)

Figure EA-22


LEFT TURN STORAGE LANES
TWO LANE HIGHWAYS
UNSIGNALIZED
% LEFT TURNS IN V_A = 5%
S = STORAGE LENGTH
DESIGN SPEED = 100 km/h
NO LEFT TURN LANE REQUIRED
WARRANT
S=15
S=25
151
149
172
249
V_O = OPPOSING VOLUME (VPH)
V_A = ADVANCING VOLUME (VPH)
TRAFFIC SIGNALS MAY BE WARRANTED IN RURAL AREAS OR URBAN AREAS WITH RESTRICTED FLOW
TRAFFIC SIGNALS MAY BE WARRANTED IN "FREE FLOW" URBAN AREAS
AM Peak
PM Peak

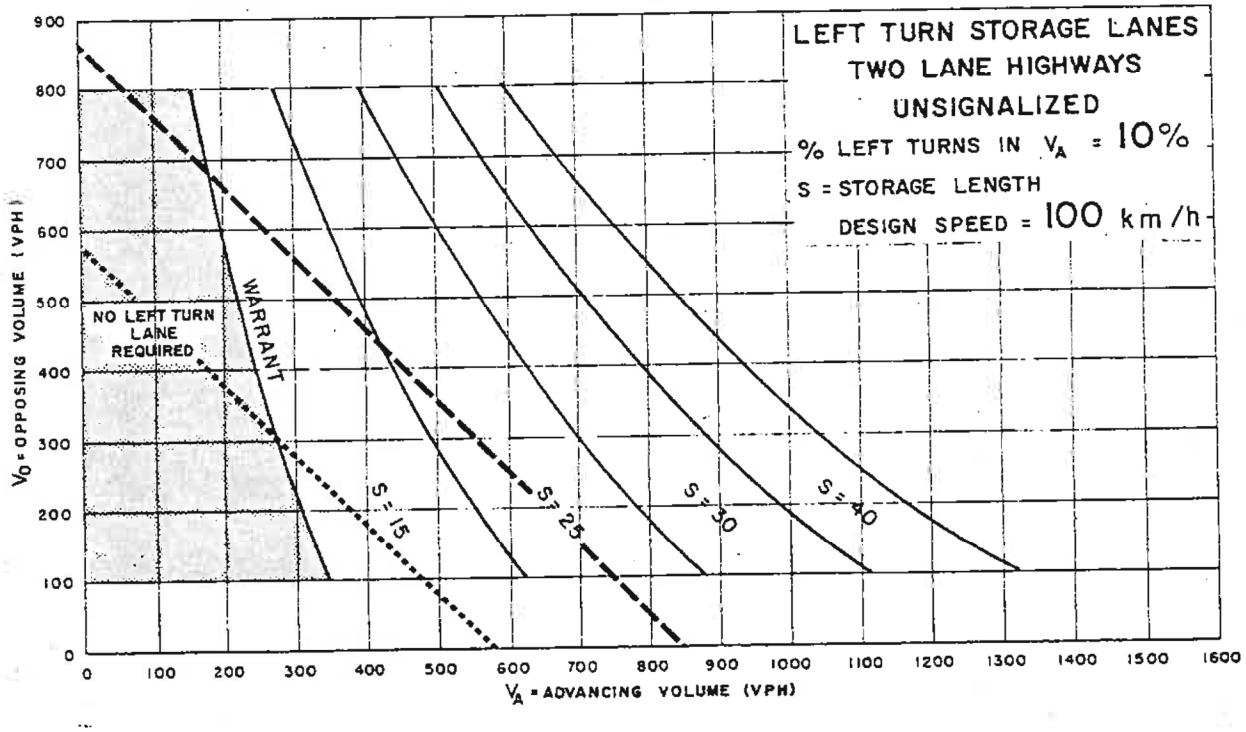
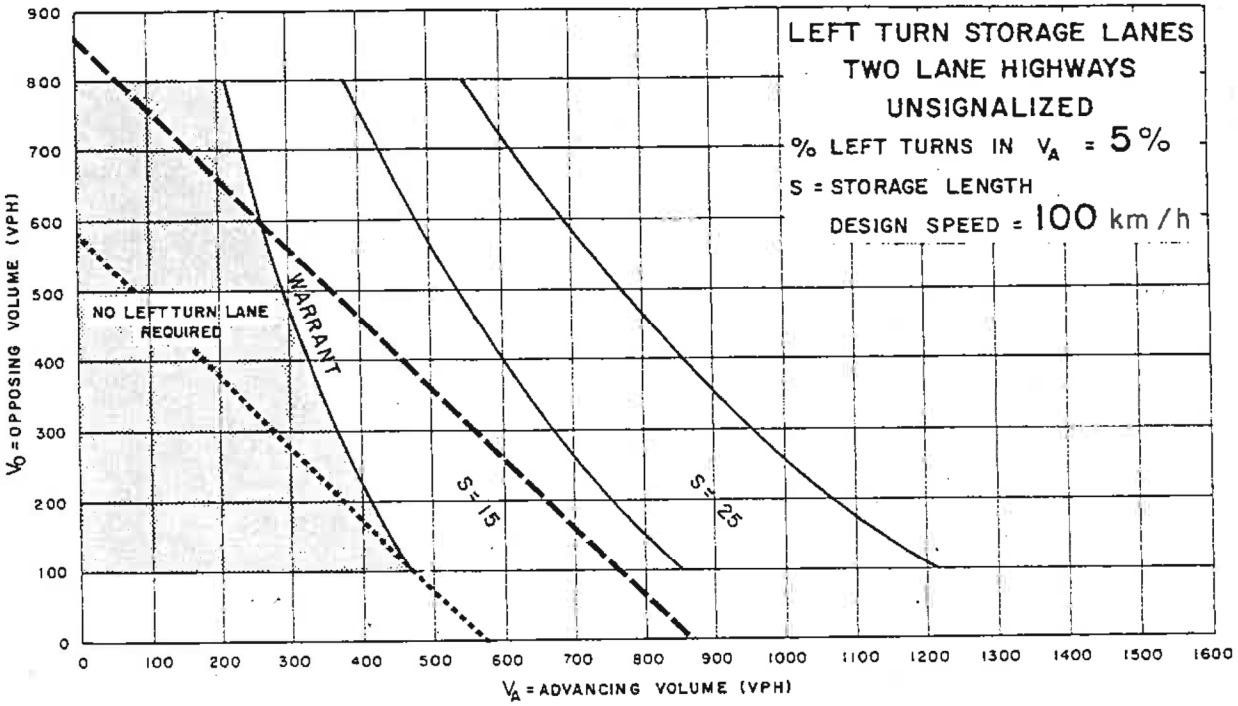

LEFT TURN STORAGE LANES
TWO LANE HIGHWAYS
UNSIGNALIZED
% LEFT TURNS IN V_A = 10%
S = STORAGE LENGTH
DESIGN SPEED = 100 km/h
NO LEFT TURN LANE REQUIRED
WARRANT
S=15
S=25
S=30
S=40
V_O = OPPOSING VOLUME (VPH)
V_A = ADVANCING VOLUME (VPH)

Figure EA-22



TRAFFIC SIGNALS MAY BE WARRANTED IN RURAL AREAS OR URBAN AREAS WITH RESTRICTED FLOW

TRAFFIC SIGNALS MAY BE WARRANTED IN "FREE FLOW" URBAN AREAS

● AM Peak

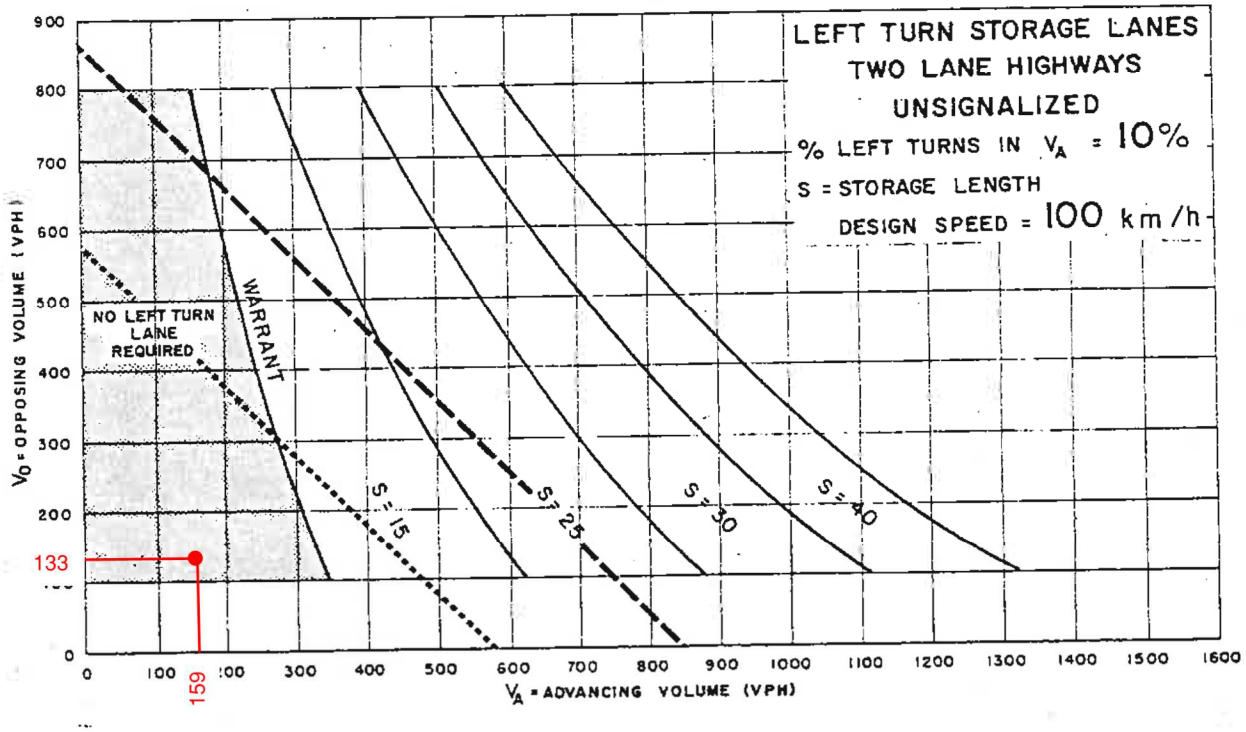
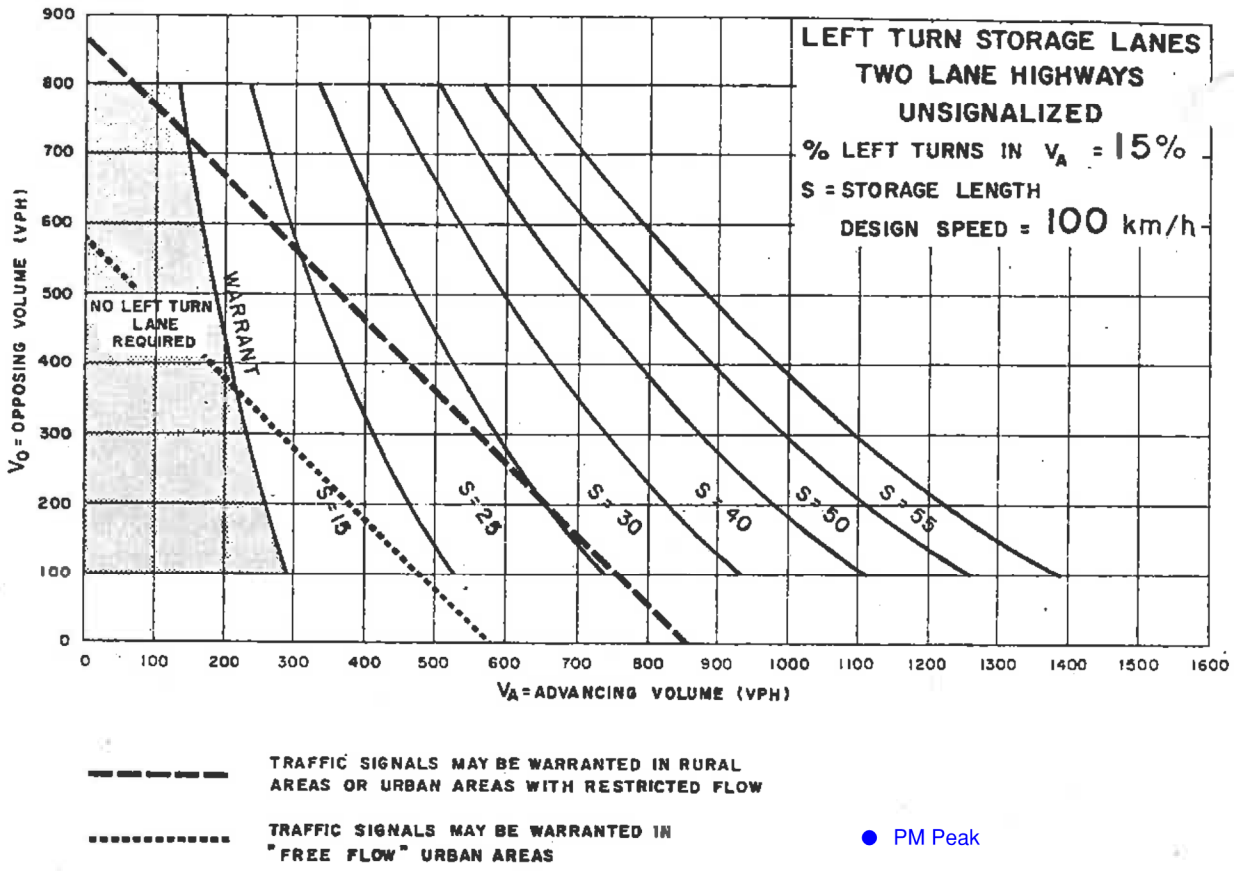


Figure EA-22


LEFT TURN STORAGE LANES
TWO LANE HIGHWAYS
UNSIGNALIZED
% LEFT TURNS IN V_A = 15%
S = STORAGE LENGTH
DESIGN SPEED = 100 km/h
NO LEFT TURN LANE REQUIRED
WARRANT
S=15
S=25
S=30
S=40
S=50
S=55
V_O = OPPOSING VOLUME (VPH)
V_A = ADVANCING VOLUME (VPH)
TRAFFIC SIGNALS MAY BE WARRANTED IN RURAL AREAS OR URBAN AREAS WITH RESTRICTED FLOW
TRAFFIC SIGNALS MAY BE WARRANTED IN "FREE FLOW" URBAN AREAS
PM Peak

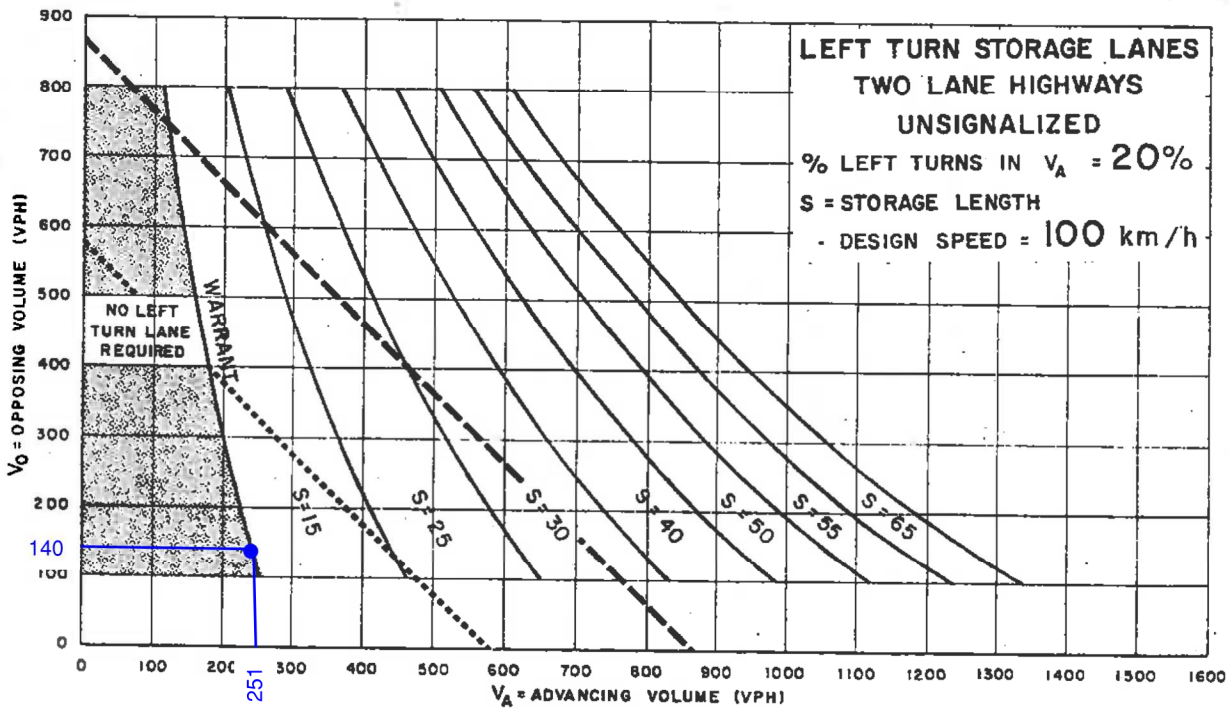
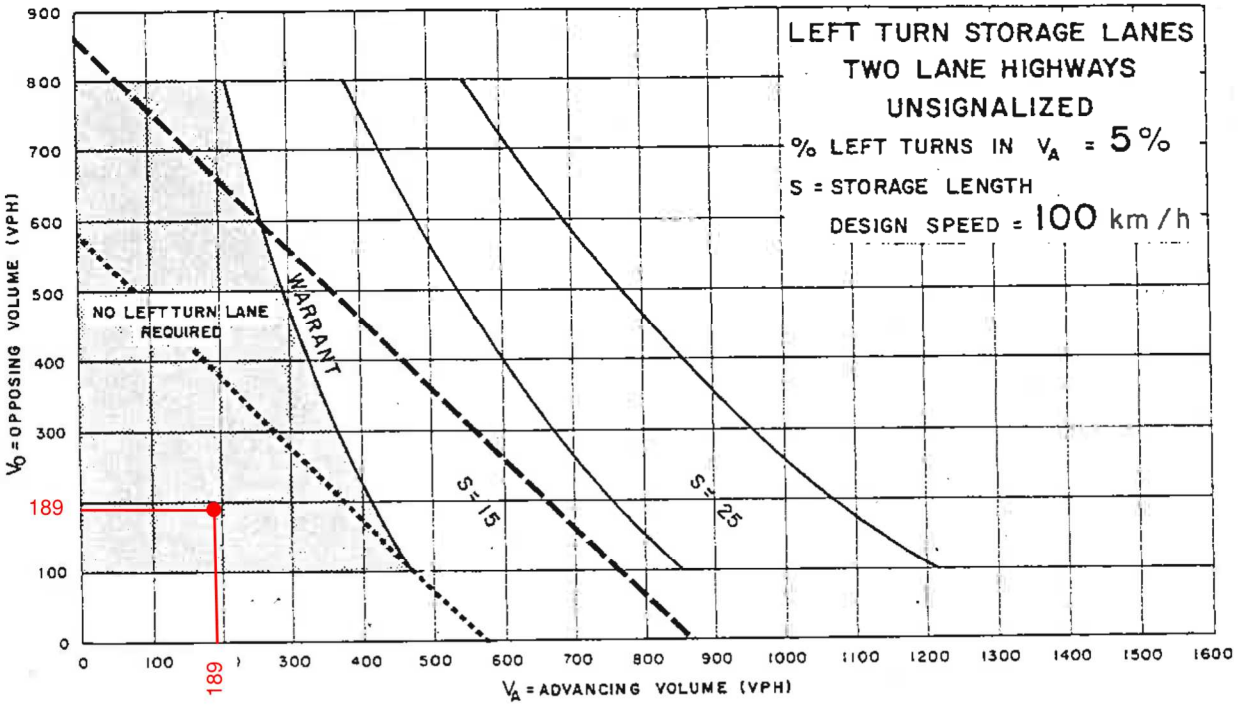

LEFT TURN STORAGE LANES
TWO LANE HIGHWAYS
UNSIGNALIZED
% LEFT TURNS IN V_A = 20%
S = STORAGE LENGTH
DESIGN SPEED = 100 km/h
NO LEFT TURN LANE REQUIRED
WARRANT
S=15
S=25
S=30
S=40
S=50
S=55
S=65
140
251
V_O = OPPOSING VOLUME (VPH)
V_A = ADVANCING VOLUME (VPH)

Figure EA-23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TWO LANE HIGHWAYS
UNSIGNALIZED
% LEFT TURNS IN V_A = 5%
S = STORAGE LENGTH
DESIGN SPEED = 100 km/h
NO LEFT TURN LANE REQUIRED
WARRANT
S=15
S=25
189
V_O = OPPOSING VOLUME (VPH)
V_A = ADVANCING VOLUME (VPH)
TRAFFIC SIGNALS MAY BE WARRANTED IN RURAL AREAS OR URBAN AREAS WITH RESTRICTED FLOW
TRAFFIC SIGNALS MAY BE WARRANTED IN "FREE FLOW" URBAN AREAS
AM Peak
PM Peak

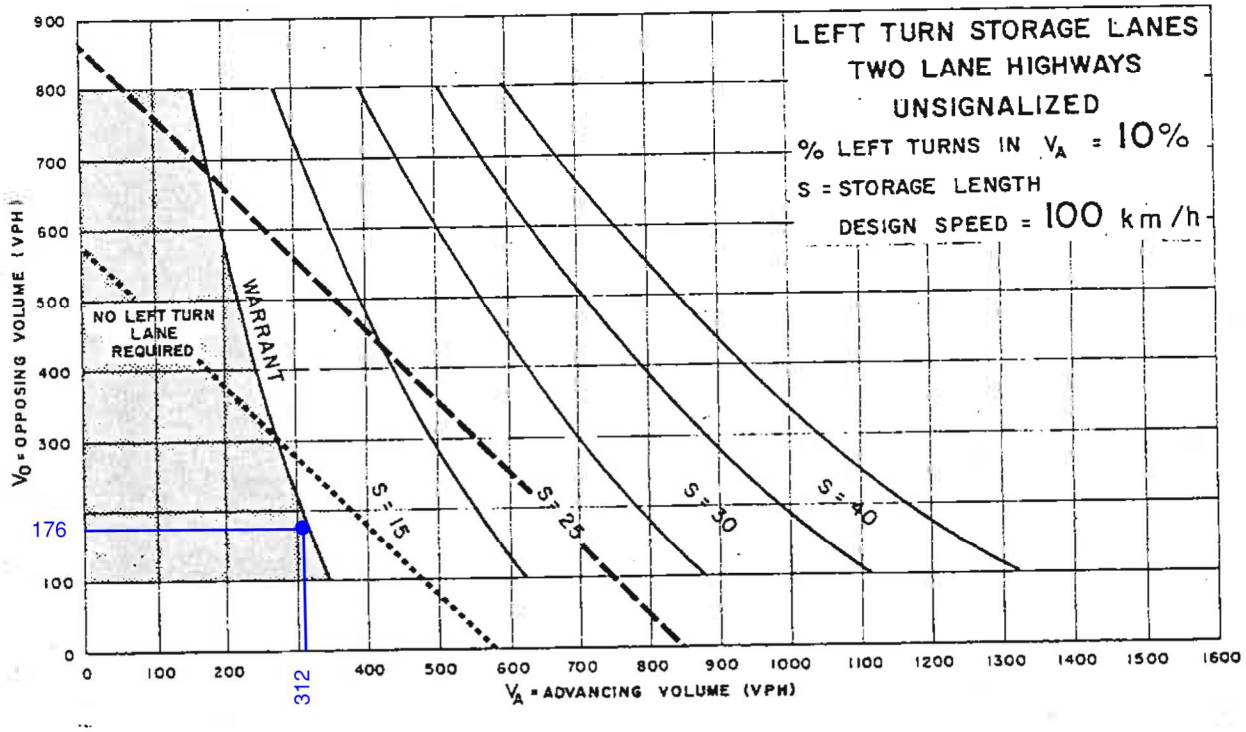
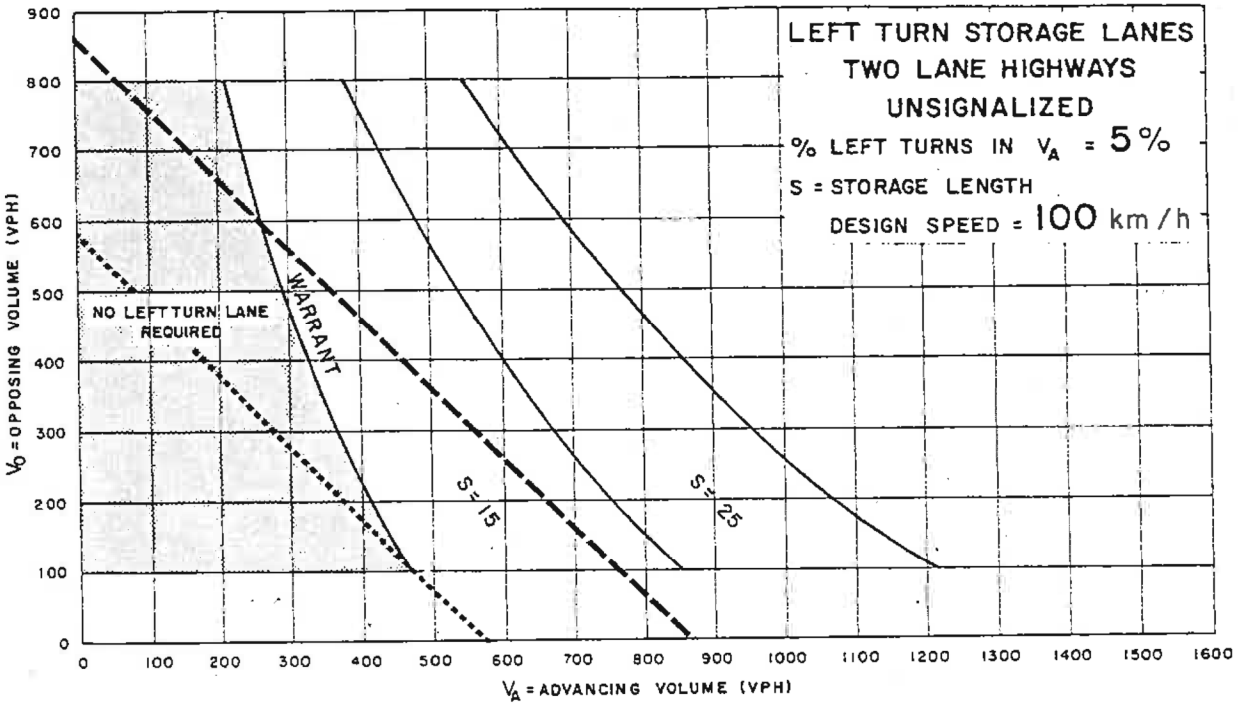

LEFT TURN STORAGE LANES
TWO LANE HIGHWAYS
UNSIGNALIZED
% LEFT TURNS IN V_A = 10%
S = STORAGE LENGTH
DESIGN SPEED = 100 km/h
NO LEFT TURN LANE REQUIRED
WARRANT
S=15
S=25
S=30
S=40
176
312
V_O = OPPOSING VOLUME (VPH)
V_A = ADVANCING VOLUME (VPH)

Figure EA-22



TRAFFIC SIGNALS MAY BE WARRANTED IN RURAL AREAS OR URBAN AREAS WITH RESTRICTED FLOW

TRAFFIC SIGNALS MAY BE WARRANTED IN "FREE FLOW" URBAN AREAS

● AM Peak

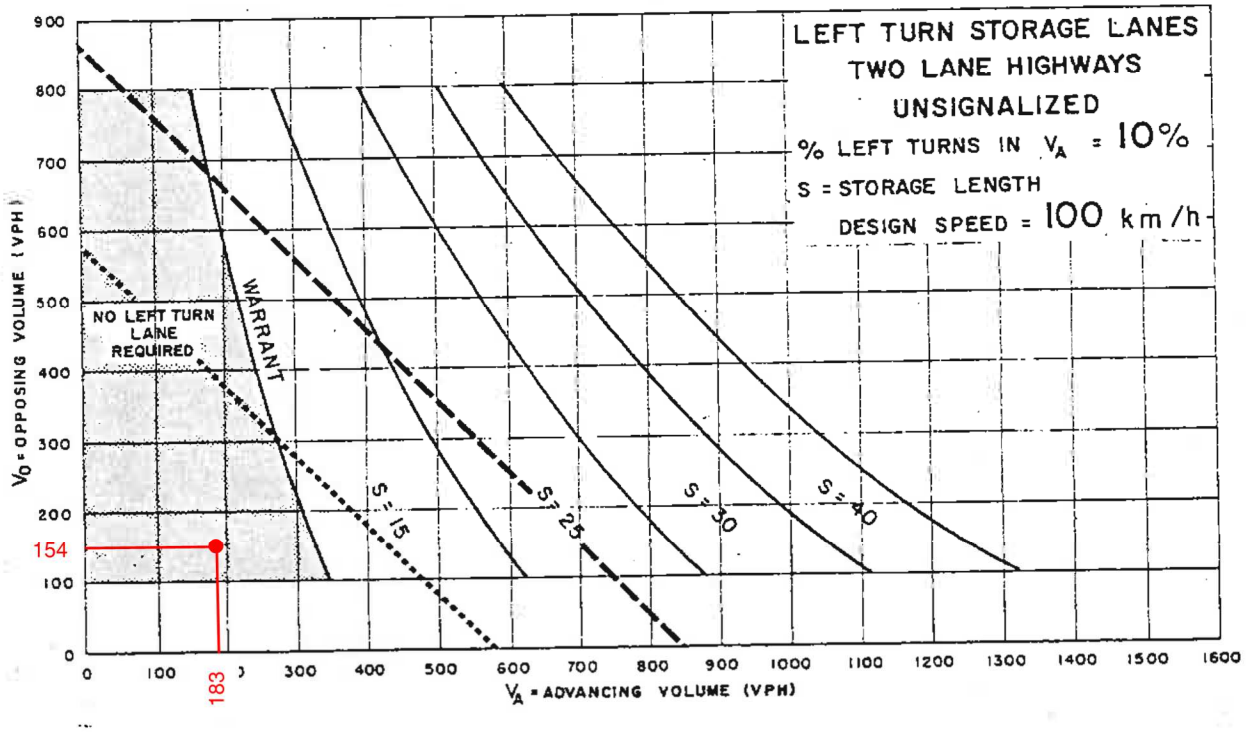
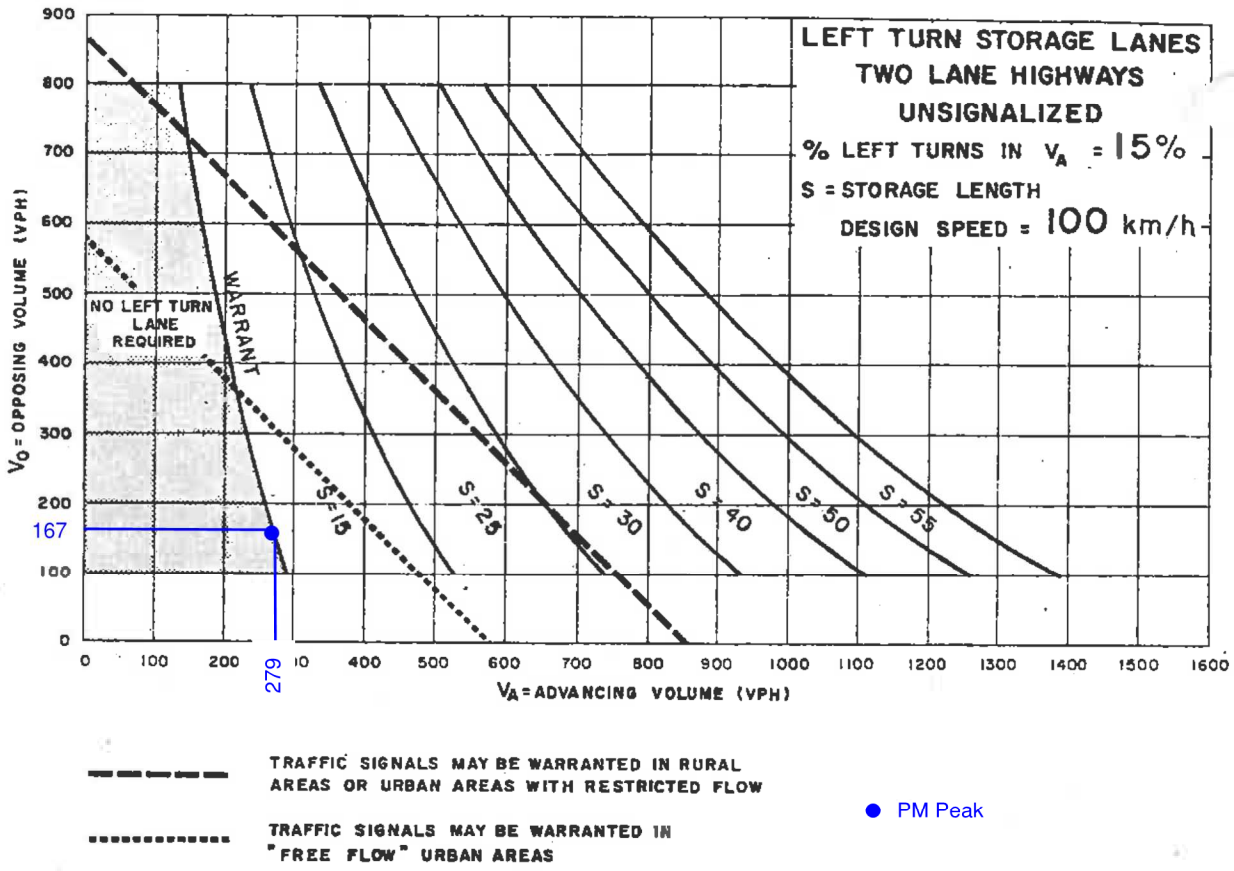


Figure EA-22


LEFT TURN STORAGE LANES
TWO LANE HIGHWAYS
UNSIGNALIZED
% LEFT TURNS IN V_A = 15%
S = STORAGE LENGTH
DESIGN SPEED = 100 km/h
NO LEFT TURN LANE REQUIRED
WARRANT
S=15
S=25
S=30
S=40
S=50
S=55
167
279
V_O = OPPOSING VOLUME (VPH)
V_A = ADVANCING VOLUME (VPH)
TRAFFIC SIGNALS MAY BE WARRANTED IN RURAL AREAS OR URBAN AREAS WITH RESTRICTED FLOW
TRAFFIC SIGNALS MAY BE WARRANTED IN "FREE FLOW" URBAN AREAS
PM Peak

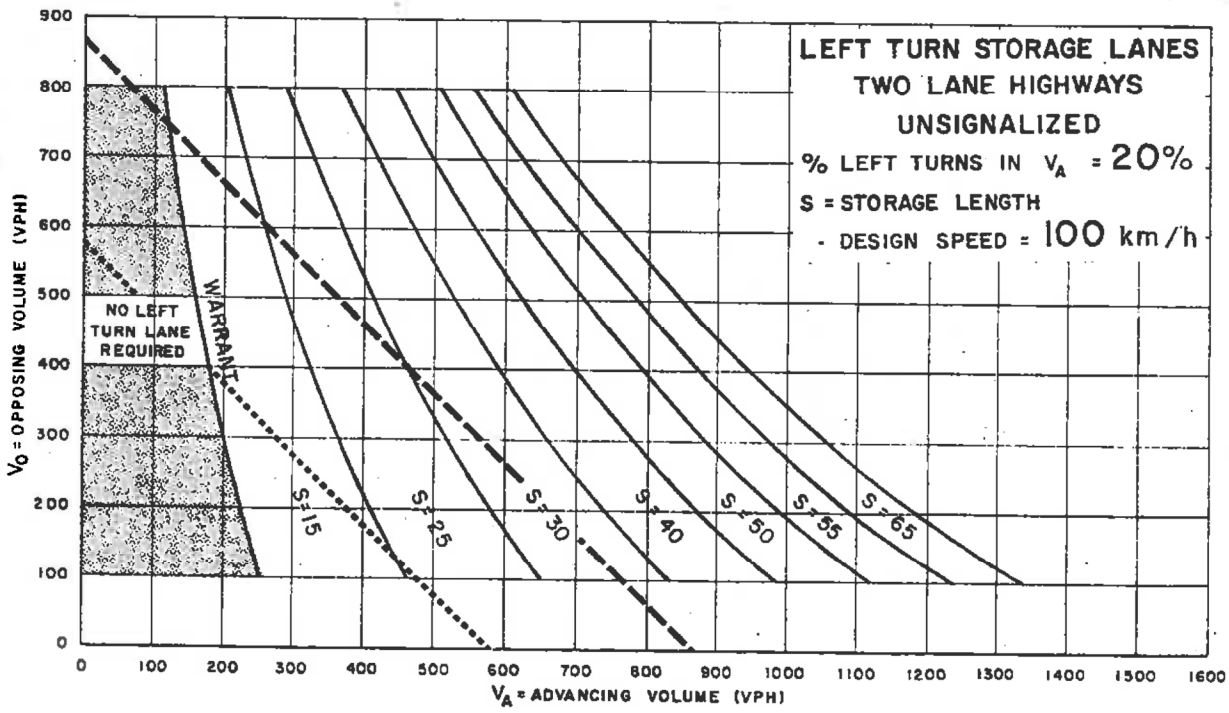

LEFT TURN STORAGE LANES
TWO LANE HIGHWAYS
UNSIGNALIZED
% LEFT TURNS IN V_A = 20%
S = STORAGE LENGTH
DESIGN SPEED = 100 km/h
NO LEFT TURN LANE REQUIRED
WARRANT
S=15
S=25
S=30
S=40
S=50
S=55
S=65
V_O = OPPOSING VOLUME (VPH)
V_A = ADVANCING VOLUME (VPH)

Figure EA-23

Appendix E

Relevant Excerpts from TAC Geometric Design Guidelines

Table 9.9.3: Time Gap for Case B1, Left Turn from Stop

Design Vehicle	Time Gap (t_g)(s) at Design Speed of Major Road
Passenger car	7.5
Single-unit truck	9.5
Combination truck (WB 19 and WB 20)	11.5
Longer truck	To be established by road authority

Notes: Time gaps are for a stopped vehicle to turn left onto a two-lane highway with no median and with grades of 3% or less. The table values should be adjusted as follows:

- For multi-lane highways: For left turns onto two-lane highways with more than two lanes, add 0.5 s for passenger cars and 0.7 s for trucks for each additional lane, from the left, in excess of one, to be crossed by the turning vehicle.
- For minor approach grades: If the approach grade is an upgrade that exceeds 3%, add 0.2 s for each percent grade for left turns.
- Some road authorities use higher values for certain specialized vehicles (e.g., Alberta uses 22 s for very long log trucks).

The intersection sight distance along the major road (distance b in **Figure 9.9.2**) is determined by:

$$ISD = 0.278\, V_{major}\, t_g \qquad (9.9.1)$$

Where:

ISD = intersection sight distance (length of the leg of sight triangle along the major road) (m)
V_{major} = design speed of the major road (km/h)
t_g = time gap for minor road vehicle to enter the major road (s)

For example, a passenger car turning left onto a two-lane major road should be provided sight distance equivalent to a time gap of 7.5 s in major-road traffic. If the design speed of the major road is 100 km/h, this corresponds to a sight distance of 0.278(100)(7.5) = 208.5 or 210 m, rounded for design.

A passenger car turning left onto a four-lane undivided roadway will need to cross two near lanes, rather than one. This increases the recommended gap in major-road traffic from 7.5 to 8.0 s. The corresponding value of sight distance for this example would be 223 m. If the minor-road approach to such an intersection is located on a 4% upgrade, then the time gap selected for intersection sight distance design for left turns should be increased from 8.0 to 8.8 s, equivalent to an increase of 0.2 s for each percent grade.

The design values for intersection sight distance for passenger cars are shown in **Table 9.9.4**. **Figure 9.9.4** includes design values, based on the time gaps for the design vehicles included in **Table 9.9.3**.

No adjustment of the recommended sight distance values for the major-road grade is generally needed because both the major- and minor-road vehicle will be on the same grade when departing from the intersection. However, if the minor-road design vehicle is a heavy truck and the intersection is located near a sag vertical curve with grades over 3%, then an adjustment to extend the recommended sight distance based on the major-road grade should be considered.

Table 9.9.4: Design Intersection Sight Distance – Case B1, Left Turn From Stop

Design Speed (km/h)	Stopping Sight Distance (m)	Intersection Sight Distance for Passenger Cars	
		Calculated (m)	Design (m)
20	20	41.7	45
30	35	62.6	65
40	50	83.4	85
50	65	104.3	105
60	85	125.1	130
70	105	146.0	150
80	130	166.8	170
90	160	187.7	190
100	185	208.5	210
110	220	229.4	230
120	250	250.2	255
130	285	271.1	275

Note: Intersection sight distance shown is for a stopped passenger car to turn left onto a two-lane highway with no median and grades 3% or less. For other conditions, the time gap should be adjusted and the sight distance recalculated.

Sight distance design for left turns at divided-highway intersections should consider multiple design vehicles and median width. If the design vehicle used to determine sight distance for a divided-highway intersection is larger than a passenger car, then sight distance for left turns will need to be checked for that selected design vehicle and for smaller design vehicles as well. If the divided-highway median is wide enough to store the design vehicle with a clearance to the through lanes of approximately 1 m at both ends of the vehicle, no separate analysis for the departure sight triangle for left turns is needed on the minor-road approach for the near roadway to the left. In most cases, the departure sight triangle for right turns (case B2) will provide sufficient sight distance for a passenger car to cross the near roadway to reach the median. Possible exceptions are addressed in the discussion of case B3.

The time gaps in **Table 9.9.3** can be decreased by 1.0 s for right-turn maneuvers without undue interference with major-road traffic. These adjusted time gaps for the right turn from the minor road are shown in **Table 9.9.5**. Design values based on these adjusted time gaps are shown in **Table 9.9.6** for passenger cars. **Figure 9.9.5** includes the design values for the design vehicles for each of the time gaps in **Table 9.9.5**.

Table 9.9.5: Time Gap for Case B2—Right Turn from Stop and Case B3—Crossing Maneuver

Design Vehicle	Time Gap (t_g)(s) at Design Speed of Major Road
Passenger car	6.5
Single-unit truck	8.5
Combination truck (WB 19 and WB 20)	10.5

Note: Time gaps are for a stopped vehicle to turn left onto a two-lane highway with no median and with grades of 3% or less. The table values should be adjusted as follows:

- For multi-lane highways: For left turns onto two-lane highways with more than two lanes, add 0.5 s for passenger cars and 0.7 s for trucks for each additional lane, from the left, in excess of one, to be crossed by the turning vehicle.
- For minor approach grades: If the approach grade is an upgrade that exceeds 3%, add 0.1 s for each percent grade for left turns.

Table 9.9.6: Design Intersection Sight Distance – Case B2, Right Turn from Stop, and Case B3, Crossing Maneuver

Design Speed (km/h)	Stopping Sight Distance (m)	Intersection Sight Distance for Passenger Cars	
		Calculated (m)	Design (m)
20	20	36.1	40
30	35	54.2	55
40	50	72.3	75
50	65	90.4	95
60	85	108.4	110
70	105	126.5	130
80	130	144.6	145
90	160	162.6	165
100	185	180.7	185
110	220	198.8	200
120	250	216.8	220
130	285	234.9	235

Note: Intersection sight distance shown is for a stopped passenger car to turn right onto or to cross a two-lane highway with no median and with grades of 3% or less. For other conditions, the time gap should be adjusted and the sight distance recalculated.

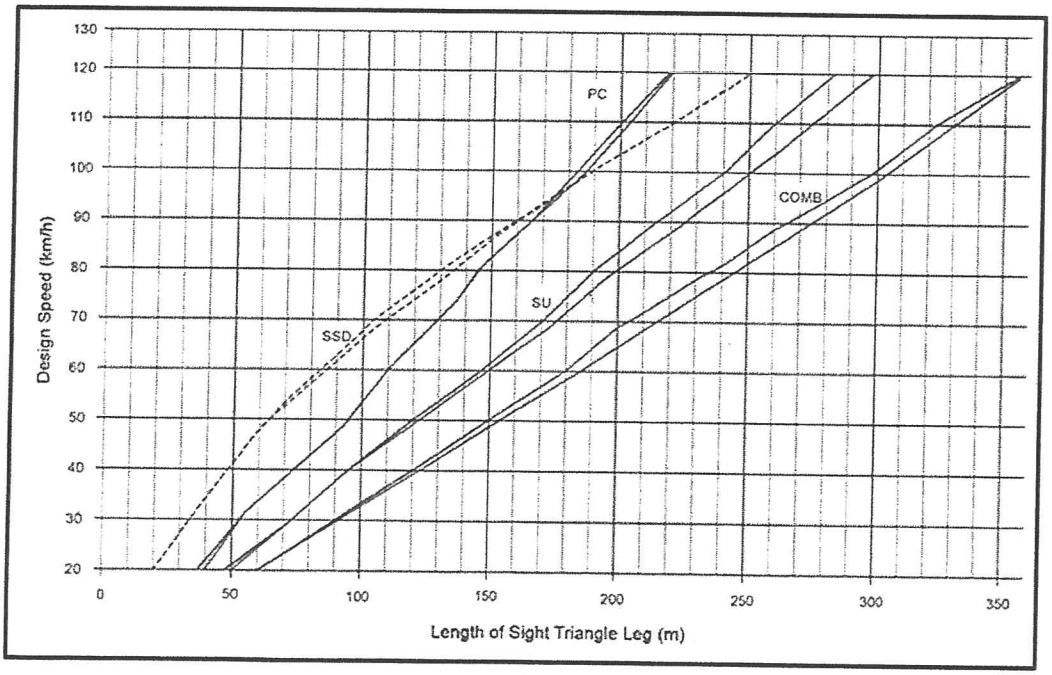


Figure 9.9.5: Intersection Sight Distance – Case B2, Right Turn from Stop, and Case B3, Crossing Maneuver (Calculated and Design Values Plotted)